



The Society
of Thoracic
Surgeons

52ND ANNUAL MEETING

PHOENIX, ARIZONA

JANUARY 23–27, 2016

ABSTRACT BOOK

The Society of Thoracic Surgeons gratefully acknowledges the following companies for providing educational grants for the STS 52nd Annual Meeting.

This list is accurate as of December 15, 2015.

STS Platinum Benefactor

Provided \$50,000 or above

Abbott Vascular

STS Gold Benefactor

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Medtronic

STS Silver Benefactors

Provided \$10,000-\$24,999

Ethicon

HeartWare

St Jude Medical

MISSION STATEMENT

The mission of The Society of Thoracic Surgeons is to enhance the ability of cardiothoracic surgeons to provide the highest quality patient care through education, research, and advocacy.

OVERALL MEETING OBJECTIVE

The overall objective of this meeting is to provide a forum for all cardiothoracic surgeons and their teams to learn the most up-to-date information on research, surgical techniques, patient management, and social, ethical, and political issues in order to maintain the highest level of care for the cardiothoracic patient.

STS CONTINUING MEDICAL EDUCATION (CME) MISSION STATEMENT

The continuing medical education mission of The Society of Thoracic Surgeons is to provide a forum for reporting results of scientific research and for updating information in the disciplines of cardiovascular, general thoracic and congenital heart surgery. The principal continuing education programs conducted by the Society include an annual scientific meeting, self-study programs, and other stand-alone meetings. The Annual Meeting is composed of peer-reviewed scientific abstracts, invited overview presentations, small group presentations, presentations on new technologies and video programs. The broad scope of topics related to cardiothoracic surgery is covered during each Annual Meeting. In addition to and separate from the national meeting, topical meetings are held that focus on relevant information needs of cardiothoracic surgeons. These educational sessions frequently highlight a multidisciplinary approach and include content relevant to cardiothoracic surgeons as well as other physicians and health care providers in related disciplines. STS programs are developed and provided with the intent of confirming existing knowledge base, imparting new knowledge, and promoting competence in the content areas covered for cardiothoracic surgeons, residents, and their allied health care providers.

Amended by the STS Board of Directors: January 25, 2009

FUTURE MEETINGS OF THE SOCIETY OF THORACIC SURGEONS**STS/ELSO ECMO Symposium**

March 11–13, 2016

Tampa, Florida

Advances in Quality & Outcomes

September 28–30, 2016

Baltimore, Maryland

Coding Workshop

November 3–5, 2016

New Orleans, Louisiana

STS 53rd Annual Meeting

January 21–25, 2017

Houston, Texas

The information in this Abstract Book is accurate as of December 9, 2015.

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PROGRAM AT A GLANCE

Friday, January 22, 2016

3:00 PM – 6:00 PM **Registration: STS/AATS Tech-Con and STS Annual Meeting**

Saturday, January 23, 2016

7:00 AM – 6:00 PM **Registration: STS/AATS Tech-Con and STS Annual Meeting**

8:00 AM – 12:30 PM **STS/SCA: Integrating Perioperative Echocardiography Into Cardiac Surgical Clinical Decision Making**

8:00 AM – 3:00 PM **STS/CHEST: Primer on Advanced and Therapeutic Bronchoscopy—Theory and Hands-On Session**

12:00 PM – 6:30 PM **STS/AATS Tech-Con Exhibits**

1:00 PM – 2:30 PM **Cardiopulmonary Bypass Simulation Course**

1:00 PM – 5:00 PM **STS/AATS Tech-Con**

5:00 PM – 6:30 PM **STS/AATS Tech-Con Reception**

Sunday, January 24, 2016

7:00 AM – 6:30 PM **Registration: STS/AATS Tech-Con and STS Annual Meeting**

7:00 AM – 1:15 PM **STS/AATS Tech-Con Exhibits Open**

7:45 AM – 12:00 PM **STS/AATS Tech-Con**

7:50 AM – 12:00 PM **Acquired and Congenital Heart Surgery Symposium: Challenges in Adult Congenital Heart Disease**

Practice Management Summit

STS/AATS Critical Care Symposium: Quality and Value in the CTICU

1:00 PM – 4:00 PM **Residents Symposium: Transitioning From Residency to a Successful Practice ACC @ STS**

1:15 PM – 4:30 PM

How To: Technical Tricks and Pitfalls to Simplify Cardiac Surgery Procedures

Parallel Surgical Symposium: Congenital

Parallel Surgical Symposium: General Thoracic

Resuscitation of Patients Who Arrest After Cardiac Surgery

Scientific Posters

2:00 PM – 6:30 PM

2:30 PM – 4:30 PM

CT Surgery Interprofessional Education Symposium: Multidisciplinary Team Approach to Patient Safety, Quality, Outcomes, and Reimbursement

Opening Reception in STS Exhibit Hall

4:30 PM – 6:30 PM

Monday, January 25, 2016

6:30 AM – 5:00 PM **Registration: STS Annual Meeting**

9:00 AM – 4:30 PM

Exhibit Hall

Scientific Posters

7:00 AM – 7:15 AM

Opening Remarks

7:15 AM – 8:15 AM

J. Maxwell Chamberlain Memorial Papers

8:15 AM – 9:00 AM

Richard E. Clark Memorial Papers

9:00 AM – 9:40 AM

BREAK—Visit Exhibits and Scientific Posters

Complimentary coffee available in the Exhibit Hall

9:40 AM – 9:50 AM

Introduction of the President: Joseph E. Bavaria

9:50 AM – 10:50 AM

Presidential Address: Mark S. Allen

10:50 AM – 11:30 AM

BREAK—Visit Exhibits and Scientific Posters

11:30 AM – 12:30 PM

Adult Cardiac Session: Arrhythmia

(8 parallel sessions)

Basic Science Research: Adult Cardiac

Basic Science Research: General Thoracic

Congenital Session: Adult Congenital

Critical Care

General Thoracic Session: New Technology

Quality Improvement Initiatives in Thoracic Surgery

STS/CATS/CSCS: Adding New Dimensions to Your Surgical Practice—Optimizing

Your Internet Presence and Understanding the Emerging Role of

3-Dimensional Printing in Cardiothoracic Surgery

12:30 PM – 1:30 PM

BREAK—Visit Exhibits and Scientific Posters

Complimentary coffee available in the Exhibit Hall

1:15 PM – 5:15 PM

Redefining Practice Through Quality and Evidence: What's New?

1:30 PM – 3:30 PM
(7 parallel sessions)

Adult Cardiac Session: Aorta I
Adult Cardiac Session: Ischemic
Congenital Session: Pediatric Congenital I
General Thoracic Session: Lung Cancer I
General Thoracic Session: Lung Transplantation
SVS @ STS: Sharing Common Ground for Cardiovascular Problems
30th Anniversary Celebration of Women in Thoracic Surgery:
 Innovations and Contributions of WTS and STS Members

3:30 PM – 4:15 PM



BREAK—Visit Exhibits and Scientific Posters
International Symposium & Reception: The Ethics and Practicality of Using New Technologies to Treat Cardiothoracic Diseases in Different Parts of the World
Surgical Motion Picture Matinees: Adult Cardiac, Congenital, and General Thoracic

3:30 PM – 5:30 PM

4:15 PM – 5:15 PM

5:00 PM – 6:30 PM

5:30 PM – 6:25 PM

6:30 PM – 7:30 PM

7:00 PM – 10:30 PM



Scientific Posters and Wine
Business Meeting (STS Members Only)
STS-PAC Reception
STS Social Event: Corona Ranch

Tuesday, January 26, 2016

6:30 AM – 4:30 PM

Registration: STS Annual Meeting

9:00 AM – 3:30 PM

Exhibit Hall

9:00 AM – 5:00 PM

Scientific Posters

7:30 AM – 8:30 AM

Early Riser Sessions

7:30 AM – 8:30 AM

Early Riser Health Policy Forum: MIPS: The New Medicare Fee-for-Service and What It Means to You

9:00 AM – 10:00 AM

Thomas B. Ferguson Lecture: Scott Parazynski

10:00 AM – 10:45 AM

BREAK—Visit Exhibits and Scientific Posters

Complimentary coffee available in the Exhibit Hall

10:45 AM – 11:00 AM

Award Presentations

11:00 AM – 12:00 PM

C. Walton Lillehei Lecture: Gary Taubes

12:00 PM – 1:00 PM

BREAK—Visit Exhibits and Scientific Posters



Ethics Debate: An Advance Directive Limits Postoperative Care—Should Surgeons Accept Limits on Care?



Residents Luncheon

1:00 PM – 3:00 PM

Adult Cardiac Session: General

(7 parallel sessions)

Adult Cardiac Session: Mitral Valve

Congenital Session: Pediatric Congenital II

General Thoracic Session: Esophageal

General Thoracic Session: Lung Cancer II

Patient Safety Symposium: When Bad Things Happen to Good CT Surgeons—Human Error and the Impact on You, the “Second Victim”

EACTS @ STS: Aortic Valve Repair and Aortic Root Reconstruction for Insufficient Tricuspid and Bicuspid Pathology

1:00 PM – 3:30 PM

JCTSE: Accountable Surgical Education—How Can Cardiothoracic Surgery Move Forward?

1:00 PM – 5:30 PM

Advanced Therapies for End-Stage Heart Disease

3:00 PM – 3:30 PM

BREAK—Visit Exhibits and Scientific Posters

Complimentary coffee available in the Exhibit Hall

3:30 PM – 5:30 PM

Adult Cardiac Session: Aorta II

(7 parallel sessions)

Adult Cardiac Session: Aortic Valve

Cardiothoracic Surgical Education

Congenital Session: Pediatric Congenital III

General Thoracic Session: Mediastinal/Pulmonary

ESTS @ STS: Controversial Issues in General Thoracic Surgery—Perspectives From Europe and North America

SCA @ STS: Perioperative Evaluation and Management of Circulatory Shock

Wednesday, January 27, 2016

6:30 AM – 9:30 AM

Registration: STS University

7:00 AM – 9:00 AM



STS University

9:30 AM – 11:30 AM



STS University (courses repeated)

CONTINUING MEDICAL EDUCATION CREDIT

STS 52nd Annual Meeting

The Society of Thoracic Surgeons is accredited by the Accreditation Council for Continuing Medical Education to provide continuing medical education for physicians.

The Society of Thoracic Surgeons designates this live activity for a maximum of 34.0 *AMA PRA Category 1 Credits*[™]. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

The American Board of Cardiovascular Perfusion designates this activity for 41.9 Category I CEUs.

Learning Objectives for the STS 52nd Annual Meeting

Upon completion of this activity, participants should be able to:

- Review the results of clinical and laboratory investigations designed to reveal new knowledge of cardiothoracic disease or to develop new technology applicable to the management of cardiothoracic disease
- Evaluate the impact of new knowledge and the application of new technology on the treatment of cardiothoracic disease
- Discuss the importance of patient safety issues and how current strategies can be introduced into one's practice or institution
- Discuss surgical techniques in order to improve the standard of care within the specialty
- Examine how public policy can impact the treatment of one's patients
- Share and summarize information provided through small group discussions facilitated by leaders in cardiothoracic surgery

STS EDUCATION DISCLOSURE POLICY

As a sponsor of continuing medical education accredited by the Accreditation Council for Continuing Medical Education (ACCME), The Society of Thoracic Surgeons requires that any individual who is in a position to control the content of an educational activity must disclose all relationships with commercial interests (including known relationships of his or her immediate family, department, and partners). The ACCME defines a commercial interest as "any entity producing, marketing, reselling, or distributing health care goods or services consumed by, or used on, patients. The ACCME does not consider providers of clinical service directly to patients to be commercial interests." The question of whether a disclosed conflict situation could represent undue influence on the educational activity by a commercial interest or whether the disclosed information is sufficient to consider an abstract, presentation, or other educational enduring material to represent potentially biased information must be resolved prior to an individual's involvement in STS educational programming.

Required disclosures include (1) a financial interest of any amount (e.g., through ownership of stock, stock options, or bonds) (2) the receipt of any amount of cash, goods or services within the current 12-month period (e.g., through research grants, employment, consulting fees, royalties, travel, or gifts) or (3) a nonremunerative position of influence (e.g., as officer, director, trustee or public spokesperson). EXCLUDED from this disclosure requirement are blind trusts or other passive investments such as mutual funds. In the case of a financial or other relationship disclosure, the company, product/service, and specific nature of the relationship must be noted. Disclosure is mandatory for any person involved in the planning, management, presentation, and/or evaluation of STS educational activities.

Failure to disclose all relationships with commercial interests disqualifies the individual from being a planning committee member, a teacher, or an author of educational materials, and this individual cannot have any responsibility for the development, management, presentation, or evaluation of STS educational activities. This requirement is intended neither to imply any impropriety of such relationships nor to prejudice any individual planner, presenter or author. It is merely to identify such relationships through full disclosure, and to allow STS to assess and resolve potential influences on the educational activity prior to the planning and implementation of an educational activity. If no relationships with commercial interests exist, the individual must indicate this on the disclosure form.

Additionally, the fact that the presentation, paper, or other educational product describes (a) the use of a device, product, or drug that is not FDA approved or (b) an off-label use of an approved device, product, or drug must also be disclosed. This requirement has been adopted in response to FDA policy and case law involving medical societies, and is not intended to prohibit or inhibit independent presentation or discussion regarding the uses of devices, products, and drugs as described in (a) or (b) above.

For live presentations, all disclosures must be stated orally and on a slide at the beginning of the presentation and will be noted in published material related to the activity. Slides, handouts, and other materials utilized as part of an educational activity cannot contain any advertising, trade names or a product group message. Speakers are required to disclose that they have nothing to disclose if this is the case.

Amended by the STS Executive Committee: April 11, 2012

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

ELECTRONIC CME/CEU EVALUATION

The STS 52nd Annual Meeting utilizes an entirely electronic evaluation and CME/Perfusion CEU credit claim process. Both physicians and perfusionists can use this system to claim credit, complete evaluations, and print CME/Perfusion CEU certificates. Certificates of Attendance also are available for other attendees and international physicians not wishing to claim CME credit. Attendees will not be able to evaluate and claim CME/Perfusion CEU credit for ticketed sessions unless they have registered for those sessions. Please note that CME credit is not available for the Residents Symposium, Residents Luncheon, or STS/AATS Tech-Con 2016.

Attendees can complete the overall meeting evaluations and all individual session evaluations onsite at CME Stations located near Room 120D, Room 121A, and Registration on the Lower Level. Certificate printing is available.

Attendees also can access evaluations and CME/Perfusion CEU credit by visiting the online evaluation site through personal computers or handheld devices at www.sts.org/2016evaluation. You also can access the site through the STS Mobile App. In order to make this process more convenient for attendees, the meeting evaluations will be available online through Thursday, February 11, 2016.

Attendees can log in to the website with the following information:

- **Username:** 6-digit member ID number located at the lower left-hand side of the meeting badge
- **Password:** First initial and last name

PHYSICIAN COMPETENCIES

As an accredited provider of continuing medical education, STS strives to provide the best, most relevant educational experience for those who take part in the Society's educational activities. The Accreditation Council for Continuing Medical Education (ACCME) has stressed the importance of CME program planning and implementation that is focused on quality with the aim of improving health care. In an effort to help clarify how STS programming focuses on the Accreditation Council for Graduate Medical Education (ACGME) / American Board of Medical Specialties (ABMS) competencies, physician competencies are listed prior to STS 52nd Annual Meeting information. Sessions may touch upon other competencies in addition to those identified below.

Practice-Based Learning and Improvement: Show an ability to investigate and evaluate patient care practices, appraise and assimilate scientific evidence, and improve the practice of medicine.

Patient Care and Procedural Skills: Provide care that is compassionate, appropriate, and effective treatment for health problems and to promote health.

Systems-Based Practice: Demonstrate awareness of and responsibility to the larger context and systems of health care. Be able to call on system resources to provide optimal care (eg, coordinating care across sites or serving as the primary case manager when care involves multiple specialties, professions, or sites).

Medical Knowledge: Demonstrate knowledge about established and evolving biomedical, clinical, and cognate sciences and their application in patient care.

Interpersonal and Communication Skills: Demonstrate skills that result in effective information exchange and teaming with patients, their families, and professional associates (eg, fostering a therapeutic relationship that is ethically sound, uses effective listening skills with non-verbal and verbal communication; working as both a team member and at times as a leader).

Professionalism: Demonstrate a commitment to carrying out professional responsibilities, adherence to ethical principles, and sensitivity to diverse patient populations.

ORAL PRESENTATION/POSTER RULES

RULES REGARDING ORAL PRESENTATIONS

1. Each abstract that is presented orally or as a poster during the STS 52nd Annual Meeting **must be submitted before or at the time of the meeting to *The Annals of Thoracic Surgery*** for publication. Manuscripts must be submitted via *The Annals* online manuscript tracking system (www.atseditorialoffice.org). Editorial office staff will be on hand at the meeting in Room 121C to assist you in submitting your paper if you need help. Manuscripts will not be considered for publication if submitted after Wednesday, January 27, 2016, 11:59 PM, Mountain Standard Time. All manuscripts shall become the property of the Society. Publication of manuscripts in *The Annals of Thoracic Surgery* is not assured. If manuscripts are not submitted to *The Annals* prior to or at the time of the STS 52nd Annual Meeting, a 2-year period of ineligibility for participation in the STS Annual Meeting will be imposed upon all authors of the manuscript. The same 2-year sanction applies to all abstracts returned to authors for revisions that are not resubmitted within 1 calendar year of the request for revision.
2. Presenters for scientific sessions are provided with time limits for their presentations and must comply with these limits. Please refer to your confirmation notification for your specific time limit.
3. All visuals accompanying scientific oral presentations must be produced in Microsoft Office PowerPoint. Presenters must report to the Speaker Ready Room (Room 121AB) at least 24 hours prior to their scheduled presentation time to download their PowerPoint into the presentation system.
4. Reserved seating is available for presenters and invited discussants at the front of the room for the General Sessions. In the interest of time, presenters and discussants should sit in this reserved seating.
5. Presenters will remain with discussants on the dais during the oral presentations to respond directly to the discussants' queries.
6. Commercial and regulatory disclosures as defined in the STS Education Disclosure Policy (see page 6) must be disclosed orally to the audience at the beginning of each presentation. This requirement is for moderators, presenters, and invited discussants. The first slide of a presentation must be used to reveal the nature of the disclosure. Disclosure information also will be provided in the text of this *Abstract Book*.

NOTE: The Society of Thoracic Surgeons does not necessarily endorse the opinions expressed by any moderator, presenter, or discussant.

RULES REGARDING SCIENTIFIC POSTERS

1. Each abstract that is presented orally or as a poster during the STS 52nd Annual Meeting **must be submitted before or at the time of the meeting to *The Annals of Thoracic Surgery*** for publication. Manuscripts must be submitted via *The Annals* online manuscript tracking system (www.atseditorialoffice.org). Editorial office staff will be on hand at the meeting in Room 121C to assist you in submitting your paper if you need help. Manuscripts will not be considered for publication if submitted after Wednesday, January 27, 2016, 11:59 PM, Mountain Standard Time. All manuscripts shall become the property of the Society. Publication of manuscripts in *The Annals of Thoracic Surgery* is not assured. If manuscripts are not submitted to *The Annals* prior to or at the time of the STS 52nd Annual Meeting, a 2-year period of ineligibility for participation in the STS Annual Meeting will be imposed upon all authors of the manuscript. The same 2-year sanction applies to all abstracts

returned to authors for revisions that are not resubmitted within 1 calendar year of the request for revision.

2. Scientific posters have been assigned designated poster boards. Each scientific poster must correspond with the assigned poster board number. Scientific poster numbers begin with “P” followed by the corresponding poster board, eg, P12.
3. Scientific posters must be designed to fit the poster board, which is 4 feet high by 8 feet wide. The poster title and author block must be displayed across the top of the poster. This will allow meeting participants to easily find posters. Poster material should be readable from a distance of at least 6 feet.
4. Commercial and regulatory disclosures as defined in the STS Education Disclosure Policy (see page 6) must be included on the poster in the lower right-hand corner. Posters not containing commercial and regulatory disclosures may be removed from the scientific poster area. If you do not have anything to disclose, please print “Nothing to Disclose” in the lower right-hand corner. This requirement is not intended to imply any impropriety of such relationships or to prejudice any individual presenter, author, or discussant. It is merely to identify such relationships through full disclosure and to allow audience members to form their own judgments regarding the poster presentation.
5. Scientific posters may be set up on Saturday, January 23, 2016, from 8:00 AM to 5:00 PM and Sunday, January 24, 2016, from 8:00 AM to 2:00 PM in the foyer outside Room 120. Posters must be hung by a poster representative during these times. STS will move posters chosen for the Scientific Posters and Wine event (see below) between 2:00 PM and 4:00 PM on Monday, January 25, 2016. You will be notified via e-mail by 7:00 PM on Sunday, January 24, 2016, if your poster was selected for the Scientific Posters and Wine event.
6. Scientific posters accepted for the STS 52nd Annual Meeting must be displayed at the meeting for the entire time assigned and in the assigned location. Authors who do not display their posters will be subjected to a 2-year period of ineligibility for participation in the STS Annual Meeting. This sanction applies to all poster authors.
7. The STS 52nd Annual Meeting will feature a unique Scientific Posters and Wine event on Monday, January 25, 2016, from 5:00 PM to 6:30 PM in the foyer outside Room 120. Moderators for each of the three subspecialties will guide participants through a discussion of the selected poster abstracts. If your poster is selected for this event, please arrive at the foyer outside Room 120 no later than 4:45 PM on Monday, January 25, 2016, to prepare.
8. All posters will be graded on the evening of Sunday, January 24, 2016. Therefore, in order to be considered as a poster winner, you will need to have your poster set up by 2:00 PM on Sunday, January 24, 2016. Authors of the top graded posters will present their poster during the Scientific Posters and Wine event and will have their presentations graded by selected reviewers. A winner for each category will be announced shortly thereafter.
9. Scientific poster teardown will occur Tuesday evening, January 26, 2016. If your poster was presented at the Scientific Posters and Wine event, your poster will be moved back after the event ends. Scientific posters must remain on display until 5:00 PM on Tuesday, January 26, 2016. STS is not responsible for any scientific posters remaining after 10:00 AM on Wednesday, January 27, 2016. STS will not ship posters back to authors.

Commercial Relationships of Program Planning Members

The Society would like to thank the following STS leaders for planning the educational content of STS/AATS Tech-Con 2016. Unless otherwise noted, the program planning members have no commercial relationships to disclose:

Govav Ailawadi, Co-Chair, Workforce on Annual Meeting (Tech-Con Task Force)

COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, Edwards Lifesciences Corporation, Abbott Vascular; Speakers Bureau/Honoraria, St Jude Medical; Nonremunerative Position of Influence, AtriCure, Inc

Shanda H. Blackmon, Co-Chair, Workforce on Annual Meeting (Tech-Con Task Force)

Mark F. Berry, Workforce on Annual Meeting (Tech-Con Task Force)

Nimesh Desai, Workforce on Annual Meeting (Tech-Con Task Force)

COMMERCIAL RELATIONSHIPS Speakers Bureau/Honoraria, Medtronic, Inc, W. L. Gore & Associates

Richard Lee, Workforce on Annual Meeting (Tech-Con Task Force)

Himanshu J. Patel, Workforce on Annual Meeting (Tech-Con Task Force)

COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, W. L. Gore & Associates, Vascutek Ltd a Terumo Company

Michael F. Reed, Workforce on Annual Meeting (Tech-Con Task Force)

COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, Spiration, Inc

Joseph D. Schmoker, Workforce on Annual Meeting (Tech-Con Task Force)

COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, Medtronic, Inc, Acelity

Rakesh M. Suri, Workforce on Annual Meeting (Tech-Con Task Force)

COMMERCIAL RELATIONSHIPS Research Grant, Edwards Lifesciences Corporation, St Jude Medical, LivaNova; Consultant/Advisory Board, Abbott Vascular

Wilson Y. Szeto, Workforce on Annual Meeting (Tech-Con Task Force)

COMMERCIAL RELATIONSHIPS Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, LivaNova; Consultant/Advisory Board, Micro Interventional Devices, Inc

The Society would like to thank the following STS leaders for planning the educational content of the STS 52nd Annual Meeting. Unless otherwise noted, the program planning members have no commercial relationships to disclose:

Kevin D. Accola, Workforce on Health Policy, Reform, and Advocacy

COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, Edwards Lifesciences Corporation, CorMatrix; Research Grant, Edwards Lifesciences Corporation, St Jude Medical; Speakers Bureau/Honoraria, Edwards Lifesciences Corporation

Govav Ailawadi, Workforce on Annual Meeting (Program Task Force)

COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, Edwards Lifesciences Corporation, Abbott Vascular; Speakers Bureau/Honoraria, St Jude Medical; Nonremunerative Position of Influence, AtriCure, Inc

Gabriel S. Aldea, Workforce on National Databases

Mark S. Allen, President, Board of Directors; Council on Education and Member Services Operating Board

COMMERCIAL RELATIONSHIPS Nonremunerative Position of Influence, Joint Council on Thoracic Surgery Education

Rakesh C. Arora, Workforce on Critical Care

COMMERCIAL RELATIONSHIPS Research Grant, Pfizer Canada Inc

Giorgio M. Aru, Workforce on Patient Safety

Ashok N. Babu, Workforce on Surgical Treatment of End-Stage Cardiopulmonary Disease

Emile A. Bacha, Director-at-Large, Board of Directors; Council on Education and Member Services Operating Board; Workforce on Surgical Treatment of Adults With Congenital Heart Disease

COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, CorMatrix

Leah M. Backbus, Co-Chair, Workforce on Annual Meeting (Surgical Symposia Task Force)

Faisal G. Bakaeen, Workforce on Clinical Education

COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, JACE Medical, LLC

Craig J. Baker, Workforce on Thoracic Surgery Resident Issues

Michael K. Banbury, Workforce on Health Policy, Reform, and Advocacy

Joseph E. Bavaria, First Vice President, Board of Directors

COMMERCIAL RELATIONSHIPS Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, COOK Medical, Boston Scientific, W.L. Gore & Associates, St Jude Medical

Edo K. Bedzra, Workforce on Thoracic Surgery Resident Issues

Edward M. Bender, Workforce on Clinical Education

Shanda H. Blackmon, Director-at-Large, Board of Directors; Workforce on Annual Meeting (Tech-Con Task Force); Workforce on General Thoracic Surgery

Matthew G. Blum, Workforce on Practice Management

Robert S. Boova, Workforce on Health Policy, Reform, and Advocacy

Greg A. Bowman, Workforce on Practice Management

COMMERCIAL RELATIONSHIPS Employment, Parkview Medical Center

Ayesha S. Bryant, Workforce on Associate Membership

Christopher A. Caldarone, Workforce on Surgical Treatment of Adults With Congenital Heart Disease; Workforce on National Databases

John H. Calhoon, Workforce on Critical Care

Andrea J. Carpenter, Workforce on Clinical Education

COMMERCIAL RELATIONSHIPS Research Grant, Edwards Lifesciences Corporation

Alfred S. Casale, Workforce on Practice Management

COMMERCIAL RELATIONSHIPS Non-Remunerative Position of Influence, American Heart Association

Graciano Castillo-Ortega, Workforce on International Relationships

Robert J. Cerfolio, Workforce on General Thoracic Surgery

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COMMERCIAL RELATIONSHIPS Ownership Interest, Cell Aegis Devices

Julio Vasquez

Christina Vassileva

Jennifer D. Walker

Todd S. Weiser

Benny Weksler

Michael J. Weyant

Glenn J.R. Whitman

Richard I. Whyte

Cameron D. Wright

Saikrishna S. Yendamuri

Marco A. Zenati

NOTES

Unless otherwise noted in this Abstract Book or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Friday, January 22, 2016

3:00 PM – 6:00 PM

Lower Level Foyer

Registration: STS/AATS Tech-Con and STS Annual Meeting

Saturday, January 23, 2016

7:00 AM – 6:00 PM

Lower Level Foyer

Registration: STS/AATS Tech-Con and STS Annual Meeting

12:00 PM – 6:30 PM

Lower Level Foyer

Tech-Con Exhibits

1:00 PM – 3:00 PM

Exhibit Halls 2-3

Adult Cardiac Track I: Mitral Valve Technology

Moderators: Richard Lee, St Louis, MO, and Rakesh M. Suri, Cleveland, OH

COMMERCIAL RELATIONSHIPS R. M. Suri: Consultant/Advisory Board, Abbott Vascular; Research Grant, Edwards Lifesciences Corporation, St Jude Medical, LivaNova

1:00 PM

Welcome and Introduction

Gorav Ailawadi, Charlottesville, VA

COMMERCIAL RELATIONSHIPS G. Ailawadi: Consultant/Advisory Board, Edwards Lifesciences Corporation, Abbott Vascular; Nonremunerative Position of Influence, AtriCure; Speakers Bureau/Honoraria, St Jude Medical

Transcatheter/Novel Repair Approaches

1:05 PM

Update on MitraClip

Gorav Ailawadi, Charlottesville, VA

COMMERCIAL RELATIONSHIPS G. Ailawadi: Consultant/Advisory Board, Edwards Lifesciences Corporation, Abbott Vascular; Nonremunerative Position of Influence, AtriCure; Speakers Bureau/Honoraria, St Jude Medical

1:12 PM

NeoChord

Gino Gerosa, Padova, Italy

REGULATORY DISCLOSURE This presentation will address the NeoChord DS 1000 by NeoChord, Inc, which is not FDA approved.

1:19 PM

Valtech

Francesco Maisano, Milan, Italy

COMMERCIAL RELATIONSHIPS F. Maisano: Ownership Interest, 4Tech Cardio, Edwards Lifesciences Corporation; Research Grant, Abbott Vascular; Speakers Bureau/Honoraria, Abbott Vascular, Valtech Cardio, Medtronic, Edwards Lifesciences Corporation, St Jude Medical, Apica

REGULATORY DISCLOSURE This presentation will address the Cardioband by Valtech Cardio, which is not FDA approved.

1:26 PM

Millipede*Steven F. Bolling, Ann Arbor, MI***COMMERCIAL RELATIONSHIPS** S. F. Bolling: Consultant/Advisory Board, Abbott Vascular, Medtronic, Inc, LivaNova, AtriCure; Ownership Interest, Edwards Lifesciences Corporation, Millipede**REGULATORY DISCLOSURE** This presentation will address a device by Millipede. The FDA status of this device is investigational.

1:33 PM

Mitral Bridge*Valavanur A. Subramanian, New York, NY***COMMERCIAL RELATIONSHIPS** V. A. Subramanian: Ownership Interest, Heart Repair Technologies, Inc**REGULATORY DISCLOSURE** This presentation will address the Mitral Bridge by HRT-Heart Repair Technologies, Inc, which is not FDA approved.

1:40 PM

Basal Annuloplasty of the Cardia Externally*Jai S. Raman, Chicago, IL***COMMERCIAL RELATIONSHIPS** J. S. Raman: Ownership Interest, Phoenix Cardiac Devices; Other, Zimmer-Biomet Microfixation**REGULATORY DISCLOSURE** This presentation will address the BACE device by Phoenix Cardiac Devices, LLC, which has an FDA status of investigational.

1:47 PM

Cardiosolutions Mitra-Spacer*Lars G. Svensson, Cleveland, OH***COMMERCIAL RELATIONSHIPS** L. G. Svensson: Ownership Interest, Cardiosolutions, Inc, Posthorax**REGULATORY DISCLOSURE** This presentation will address the Mitra-Spacer by Cardiosolutions, which is not FDA approved.

1:50 PM

Panel Discussion**Transcatheter Mitral Valve Replacement**

2:10 PM

Fortis Valve*Vinod H. Thourani, Atlanta, GA*

2:17 PM

CardiAQ Valve*Wilson Y. Szeto, Philadelphia, PA***COMMERCIAL RELATIONSHIPS** W. Y. Szeto: Consultant/Advisory Board, Micro Interventional Devices, Inc; Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, LivaNova

2:24 PM

Neovasc Tiara Valve*Anson Cheung, Vancouver, Canada***COMMERCIAL RELATIONSHIPS** A. Cheung: Research Grant, Neovasc, Inc; Speakers Bureau/Honoraria, Neovasc, Inc**REGULATORY DISCLOSURE** This presentation will address the Tiara valve by Neovasc, Inc, which has an FDA status of investigational.

2:31 PM**Tendyne***Robert S. Farviar, Minneapolis, MN***COMMERCIAL RELATIONSHIPS** R. S. Farviar: Consultant/Advisory Board, Edwards Lifesciences Corporation, Abbott Laboratories

2:38 PM**Direct Flow***Robert Bauernschmitt, Munich, Germany***COMMERCIAL RELATIONSHIPS** Consultant/Advisory Board, Medtronic, Direct Flow Medical, Inc**REGULATORY DISCLOSURE** This presentation will address the Direct Flow Medical valve, which is not FDA approved.

2:45 PM**Panel Discussion***Gilbert H. Tang, New York, NY***REGULATORY DISCLOSURE** This presentation will address the CardiAQ and Fortis valves by Edwards Lifesciences Corporation. This presentation describes the off-label use of transcatheter mitral valves made by different companies that are not yet FDA approved and are in feasibility trials. Panel discussion will include these devices.

1:00 PM – 3:00 PM**Room 120D**** General Thoracic Track I: Lung Surgery of the Future***Moderators: Julian Guitron, Loveland, OH, and Michael F. Reed, Hershey, PA***COMMERCIAL RELATIONSHIPS** M. F. Reed: Consultant/Advisory Board, Spiration

1:00 PM**Introduction***Sunil Singhal, Philadelphia, PA*

1:05 PM**Nodule Localization***Sunil Singhal, Philadelphia, PA*

1:20 PM**Energy for Pulmonary Artery Vessel Ligation***Moishe A. Liberman, Montreal, Canada***COMMERCIAL RELATIONSHIPS** M. A. Liberman: Research Grant, Ethicon, Boston Scientific, Baxter

1:35 PM**Lung Cryoablation***Matthew R. Callstrom, Rochester, MN***COMMERCIAL RELATIONSHIPS** M. R. Callstrom: Consultant/Advisory Board, Medtronic, Inc, Perseon; Research Grant, Galil Medical, Inc

1:50 PM**Veran Thoracic Navigation System***Jennifer W. Toth, Hershey, PA*

2:05 PM

Microlectomy: A Novel Form of Video-Assisted Thoracoscopic Lobectomy*Joel Dunning, Middlesbrough, United Kingdom***COMMERCIAL RELATIONSHIPS** J. Dunning: Speakers Bureau/Honoraria, CARDICA, Inc**REGULATORY DISCLOSURE** This presentation will address the Microcutter by Cardica, which is not FDA approved. This presentation will describe vascular thoracic stapling in VATS surgery, which is currently off-label in the USA.

2:20 PM

Minimally Invasive Lung Ablation Using Electromagnetic Navigation Bronchoscopy and Cone Beam Computed Tomography Imaging*Douglas J. Minnich, Birmingham, AL, and William Dickhans, Boulder, CO***COMMERCIAL RELATIONSHIPS** W. Dickhans: Employment, Medtronic, Inc**REGULATORY DISCLOSURE** This presentation will address the Emprint ablation catheter kit with thermosphere technology by Medtronic, Inc, which is not FDA approved.

2:35 PM

Panel Discussion

3:00 PM – 3:30 PM

Lower Level Foyer

BREAK—Visit Tech-Con Exhibits

3:30 PM – 5:00 PM

Exhibit Halls 2-3

**Adult Cardiac Track II: Heart Failure Technology***Moderators: Mark S. Slaughter, Louisville, KY, and Leora T. Yarboro, Charlottesville, VA*

3:30 PM

Update on Novel Left Ventricular Assist Device (LVAD) Trials*Nicholas G. Smedira, Cleveland, OH***REGULATORY DISCLOSURE** This presentation will address the Heartmate 3 by Thoratec, which has an FDA status of investigational.

3:45 PM

Total Artificial Heart: Ready for Primetime at All LVAD Centers?*Francisco A. Arabia, Los Angeles, CA*

4:00 PM

CircuLite Synergy*Pavan Athuri, Philadelphia, PA***REGULATORY DISCLOSURE** This presentation will address the Circulite by HeartWare, which has an FDA status of investigational.

4:07 PM

ReliantHeart HeartAssist*Richard-Tien Ha, Stanford, CA***REGULATORY DISCLOSURE** This presentation will address the HeartAssist by ReliantHeart, which has an FDA status of investigational.

4:14 PM**NuPulse Implantable Counterpulsation***Valluvan Jeevanandam, Chicago, IL***COMMERCIAL RELATIONSHIPS** V. Jeevanandam: Consultant/Advisory Board, Thoratec Corporation, ReliantHeart, Inc, HeartWare, Inc**REGULATORY DISCLOSURE** This presentation will address the NuPulse iVAS by NuPulse, which has an FDA status of investigational. This presentation describes the off-label use of a minimally invasive counterpulsation system for treatment of advanced CHF.**4:21 PM****Self-Regulating, Single-Piece, Pulsatile, Continuous-Flow Total Artificial Heart***Nader Moazami, Cleveland, OH***4:28 PM****Panel Discussion****4:45 PM****Sternal Closure Devices: What's the Skinny on All These Technologies?***Kendra J. Grubb, Louisville, KY***COMMERCIAL RELATIONSHIPS** K. J. Grubb: Speakers Bureau/Honoraria, Edwards Lifesciences Corporation**3:30 PM – 5:00 PM****Room 120D****CME General Thoracic Track II: Advances in Robotic Tools and Technology***Moderators: Mark F. Berry, Stanford, CA, and Jeremiah T. Martin, Lexington, KY***3:30 PM****DaVinci XI Firefly and Staplers***Bernard J. Park, New York, NY***COMMERCIAL RELATIONSHIPS** B. J. Park: Speakers Bureau/Honoraria, Intuitive Surgical, Inc**3:45 PM****Spy/Pinpoint***Min P. Kim, Houston, TX***4:00 PM****Robotic Technology in Development***Mark R. Dylewski, Palmetto Bay, FL***COMMERCIAL RELATIONSHIPS** M. R. Dylewski: Consultant/Advisory Board, Ethicon, Inc; Speakers Bureau/Honoraria, Intuitive Surgical, Inc, Ethicon, Inc, C. R. Bard, Inc**4:15 PM****Emerging Robotic Tools***David C. Rice, Houston, TX***COMMERCIAL RELATIONSHIPS** D. C. Rice: Consultant/Advisory Board, Olympus Corporation**REGULATORY DISCLOSURE** This presentation will address several robotic platforms in development by Titan Medical, which are not FDA approved.**4:30 PM****New Robotic Platforms***Robert J. Cerfolio, Birmingham, AL***COMMERCIAL RELATIONSHIPS** R. J. Cerfolio: Consultant/Advisory Board, Intuitive Surgical, Inc, Ethicon, Covidien, Bovie Medical Corporation

4:45 PM

New Haptic Technology for Robotic Surgery

Mark W. Onaitis, Durham, NC

5:00 PM – 5:30 PM

Lower Level Foyer

STS/AATS Tech-Con Reception

Sunday, January 24, 2016

7:00 AM – 6:30 PM

Lower Level Foyer

Registration: STS/AATS Tech-Con and STS Annual Meeting

7:00 AM – 1:15 PM

Lower Level Foyer

Tech-Con Exhibits

7:45 AM – 9:30 AM

Exhibit Halls 2-3

OME Adult Cardiac Track III: Aortic Valve and Aortic Disease

Moderators: S. Chris Malaisrie, Chicago, IL, and Himanshu J. Patel, Ann Arbor, MI

COMMERCIAL RELATIONSHIPS S. C. Malaisrie: Consultant/Advisory Board, Edwards Lifesciences Corporation, Baxter; Speakers Bureau/Honoraria, Bolton Medical; H. J. Patel: Consultant/Advisory Board, W. L. Gore & Associates, Inc, Vasctek Ltd a Terumo Company

7:45 AM

Update on Transcatheter Aortic Valve Replacement (TAVR) Device Trials in the US and Europe

David R. Holmes, Rochester, MN

8:00 AM

Update on Novel Apical Closure Devices

Thomas Walther, Bad Nauheim, Germany

REGULATORY DISCLOSURE This presentation will address the Cardioclose apical closure system by Entourage, Inc, which has an FDA status of investigational. This presentation will describe the off-label use of an apical access and closure system.

8:10 AM

Novel Suprasternal Aortic Access Device for TAVR

Andy C. Kiser, Chapel Hill, NC

COMMERCIAL RELATIONSHIPS A. C. Kiser: Ownership Interest, Aegis Surgical

8:20 AM

Debate: What the Surgeon's Role in TAVR Really Will Be 5 Years From Now

Let's Get Real, Cardiologists Will Own It

Hersh S. Maniar, St Louis, MO

I Can Do TAVR With My Eyes Closed. I Will Be Doing TAVR

Vinod H. Thourani, Atlanta, GA

8:40 AM

Panel Discussion

8:50 AM

Results of Ascending Aortic Stent Grafting Using the First FDA-Approved Investigational Device Exemption (IDE)

Ali Khoynzhad, Los Angeles, CA

COMMERCIAL RELATIONSHIPS A. Khoynzhad: Consultant/Advisory Board, C. R. Bard, Inc

REGULATORY DISCLOSURE This presentation will address the Valiant Ascending stent graft by Medtronic, Inc, and the Tridyne Vasculart Sealant by C. R. Bard, which both have FDA statuses of investigational. This presentation will describe the off-label use of Tridyne and vascular sealant for proximal aortic surgery.

9:00 AM

Branch Stent Grafting of Arch: IDE Results

Nimesh Desai, Philadelphia, PA

COMMERCIAL RELATIONSHIPS N. Desai: Speakers Bureau/Honoraria, Medtronic, Inc, W. L. Gore & Associates, Inc

REGULATORY DISCLOSURE This presentation will address the TBE Graft by W. L. Gore, which is not FDA approved. This presentation will describe the off-label use of the Gore TBE branched endograft to treat aortic pathologies.

9:10 AM

A Novel Device to Promote Active Remodeling and Cure of Aortic Dissections

Ali Shabriari, Indianapolis, IN

COMMERCIAL RELATIONSHIPS A. Shabriari: Ownership Interest, Ascyrus Medical LLC

REGULATORY DISCLOSURE This presentation will address the Medical Dissection Stent by Ascyrus Medical LLC, which has an FDA status of investigational.

7:45 AM – 9:30 AM

Room 120D

General Thoracic Track III: OR of the Future

Moderators: Reza J. Mebran, Houston, TX, and Allan Pickens, Atlanta, GA

COMMERCIAL RELATIONSHIPS A. Pickens: Speakers Bureau/Honoraria, Ethicon

7:45 AM

Introduction

7:50 AM

Sony Head-Mounted Display

Eric L. Grogan, Nashville, TN

8:05 AM

Apps in Practice

Edward M. Bender, Cape Girardeau, MO

8:20 AM

Google Glass

TBD

8:35 AM

Apps for Education

Shari L. Meyerson, Chicago, IL

8:50 AM

Thoracic Hybrid Room of the Future*Kazuhiro Yasufuku, Toronto, Canada***COMMERCIAL RELATIONSHIPS** K. Yasufuku: Research Grant, Olympus Corporation

9:05 AM

Holographic Projection*Todd L. Demmy, New Brunswick, NJ*

9:20 AM

Panel Discussion

9:30 AM – 10:15 AM

Lower Level Foyer

BREAK—Visit Tech-Con Exhibits

10:15 AM – 12:00 PM

Exhibit Halls 2-3

 **Joint Session: “Shark Tank”—Rapid-Fire Elevator Pitches of Revolutionary Technology***Moderators: Gorav Ailawadi, Charlottesville, VA, and Shanda H. Blackmon, Rochester, MN***COMMERCIAL RELATIONSHIPS** G. Ailawadi: Consultant/Advisory Board, Edwards Lifesciences Corporation, Abbott Vascular; Speakers Bureau/Honoraria, St Jude Medical; Nonremunerative Position of Influence, AtriCure, Inc

10:15 AM

Introduction

10:30 AM

Central Venous Cannulation With a New, Self-Expandable, Polymeric Venous Cannula*Enrico Ferrari, Lugano, Switzerland***COMMERCIAL RELATIONSHIPS** E. Ferrari: Speakers Bureau/Honoraria, Edwards Lifesciences Corporation**REGULATORY DISCLOSURE** This presentation will address the SAFEX by ComEd and Smartcanula by Smartcanula Ltd, which are not FDA approved.

10:40 AM

New Prototype of an Expandable, Catheter-Implantable, Polyurethane Stent Valve for Pediatric Patients*Miguel A. Mahuf, São Paulo, Brazil***REGULATORY DISCLOSURE** This presentation will address an expandable stent valve made of polyurethane by São Paulo Federal University & Bentley InnoMad, which has an FDA status of investigational.

10:50 AM

Spinal Fiber-Optic Monitoring for Ischemia*Thomas Floyd, Stony Brook, NY***COMMERCIAL RELATIONSHIPS** T. Floyd: Ownership Interest, Infosys Limited; Research Grant, Craig H. Neilsen Foundation**REGULATORY DISCLOSURE** This presentation will address a fiber-optic spinal cord flow and oxygenation monitor by NFOYSYS, Inc, which is not FDA approved.

11:00 AM

Cooling Catheter for Spinal Cord Protection*John A. Elefteriades, New Haven, CT***COMMERCIAL RELATIONSHIPS** J. A. Elefteriades: Ownership Interest, Coolspine LLC; Other, Jarvik Heart, Inc, Direct Flow Medical, Inc

11:10 AM

Infrared Coagulator to Treat Atrial Fibrillation, Infectious Endocarditis, and Cardiac Tumors

Hiroshi Kubota, Mitaka, Japan

11:20 AM

Maneuverable Chest Tube

Ian A. Makey, San Antonio, TX

REGULATORY DISCLOSURE This presentation will address a maneuverable chest tube by UTHSCSA, which is not FDA approved.

11:30 AM

Hyperthermic Pleural Lavage for Pleural Metastasis

Daniel L. Miller, Marietta, GA

COMMERCIAL RELATIONSHIPS D. L. Miller: Consultant/Advisory Board, Ethicon, Inc, C. R. Bard, Inc; Research Grant, Medela, Inc; Speakers Bureau/Honoraria, Covidien

11:40 AM

SAFEX Apical Closure Device for Fully Percutaneous Transapical Valve Therapies

Enrico Ferrari, Lugano, Switzerland

COMMERCIAL RELATIONSHIPS E. Ferrari: Speakers Bureau/Honoraria, Edwards Lifesciences Corporation

REGULATORY DISCLOSURE This presentation will address the SAFEX by ComEd and Smartcanula by Smartcanula Ltd, which are not FDA approved.

11:50 AM

Methods of Palliative Treatment for Complicated Forms of Lung Cancer

Vladislav Severgin, Odessa, Ukraine

12:00 PM – 1:15 PM

Lower Level Foyer

Visit Tech-Con Exhibits

Continuing medical education credit will not be offered for STS/AATS Tech-Con 2016 programming.

SATURDAY AT A GLANCE

6AM

7AM

7:00 AM – 6:00 PM
Registration: STS/AATS
Tech-Con and STS
Annual Meeting

8AM

8:00 AM – 12:30 PM
STS/SCA: Integrating
Perioperative
Echocardiography Into Cardiac
Surgical Clinical Decision
Making

8:00 AM – 3:00 PM
STS/CHEST: Primer on
Advanced and Therapeutic
Bronchoscopy—Theory and
Hands-On Session

9AM

10AM

11AM

12PM

1PM

1:00 PM – 2:30 PM
Cardiopulmonary Bypass
Simulation Course

2PM

3PM

4PM

5PM

6PM

7PM

8PM

9PM

- 7:00 AM – 6:00 PM **Registration: STS/AATS Tech-Con and STS Annual Meeting**
- 8:00 AM – 12:30 PM **STS/SCA: Integrating Perioperative Echocardiography Into Cardiac Surgical Clinical Decision Making**
- 8:00 AM – 3:00 PM **STS/CHEST: Primer on Advanced and Therapeutic Bronchoscopy—Theory and Hands-On Session**
- 1:00 PM – 2:30 PM **Cardiopulmonary Bypass Simulation Course**

7:00 AM – 6:00 PM

Lower Level Foyer

Registration: STS/AATS Tech-Con and STS Annual Meeting

8:00 AM – 12:30 PM

Room 122ABC

STS/SCA: Integrating Perioperative Echocardiography Into Cardiac Surgical Clinical Decision Making

In this joint session by STS and the Society of Cardiovascular Anesthesiologists, established and emergent echocardiographic technologies will be discussed, and clinical cases will be presented to demonstrate how qualitative and quantitative tools can facilitate perioperative clinical decision making and an understanding of disease processes. The session primarily will focus on pre-procedure planning, intraoperative clinical decision making, and post-procedure evaluation, with a complementary focus on the utility of echocardiography and its impact in the perioperative period.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Discuss the application of new technologies in the quantitative and qualitative echocardiographic assessment of structural heart disease
- Outline the utility of intraoperative echocardiography in diagnosing complications in the immediate post-cardiopulmonary bypass period
- Describe the utility of intraoperative echocardiography in refining surgical decision making based on intraoperative analysis of the primary indication for surgery and associated lesions

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

The physician competencies addressed in this session are patient care and procedural skills, medical knowledge, and interpersonal and communication skills. These physician competencies will be addressed through a series of collaborative lectures by members of The Society of Thoracic Surgeons and the Society of Cardiovascular Anesthesiologists.

Moderators: Vinay Badhwar, Pittsburgh, PA, John V. Conte, Baltimore, MD, Daniel H. Drake, Traverse City, MI, Gerald M. Lawrie, Houston, TX, and Stanton K. Shernan, Boston, MA

COMMERCIAL RELATIONSHIPS S. K. Shernan: Other, e-echocardiography.com, Philips Healthcare, Inc; J. V. Conte: Consultant/Advisory Board, LivaNova, Medtronic, Inc; Research Grant, Medtronic, Inc, Boston Scientific

Session I

8:00 AM

Transesophageal Echo Simulation

Vinay Badhwar, Pittsburgh, PA, John V. Conte, Baltimore, MD, Daniel H. Drake, Traverse City, MI, Gerald M. Lawrie, Houston, TX, G. Burkhard Mackensen, Seattle, WA, Stanton K. Shernan, Boston, MA, Douglas Shook, Newton Highlands, MA, and Joshua Zimmerman, Salt Lake City, UT

COMMERCIAL RELATIONSHIPS S. K. Shernan: Other, e-echocardiography.com, Philips Healthcare, Inc; J. V. Conte: Consultant/Advisory Board, LivaNova, Medtronic, Inc; Research Grant, Medtronic, Inc, Boston Scientific, D. Shook: Speakers Bureau/Honoraria, Edwards Lifesciences Corporation, St Jude Medical, LivaNova

8:25 AM

Left Ventricle and Mitral Valve Analysis

Stanton K. Shernan, Boston, MA

COMMERCIAL RELATIONSHIPS S. K. Shernan: Other, e-echocardiography.com, Philips Healthcare, Inc

8:50 Right Ventricle and Dynamic Mitral Valve Analysis*G. Burkhard Mackensen, Seattle, WA***9:15 AM Case 1: Patient Prosthetic Mismatch***Joshua Zimmerman, Salt Lake City, UT***10:00 AM Break****Session II****10:30 AM Case 2: Perivalvular Leak After Mitral Valve Replacement***Douglas Shook, Newton Highlands, MA***COMMERCIAL RELATIONSHIPS** D. Shook: Speakers Bureau/Honoraria, Edwards Lifesciences Corporation, St Jude Medical, LivaNova**11:10 AM Case 3: Tricuspid Regurgitation in Mitral Valve Surgery***Stanton K. Shernan, Boston, MA***COMMERCIAL RELATIONSHIPS** S. K. Shernan: Other, e-echocardiography.com, Philips Healthcare, Inc**11:50 AM Case 4: Complex Mitral Valve Repair***G. Burkhard Mackensen, Seattle, WA*

8:00 AM – 3:00 PM

Room 129A

STS/CHEST: Primer on Advanced and Therapeutic Bronchoscopy—Theory and Hands-On Session

This course, offered in conjunction with the American College of Chest Physicians, will introduce participants to the theory and practice of endobronchial ultrasound (EBUS) and interventional bronchoscopy. Practicing cardiothoracic surgeons, who wish to expand their scope of practice, will become familiar with the increasing array of technological solutions to lung cancer staging and management of airway obstruction. A combination of lectures, case presentations, and simulation will be used to teach the basics of EBUS, EBUS-guided biopsy, and the management of airway obstruction by stenting and several modalities of tumor ablation. Hands-on workstations will be available for participants to gain exposure and familiarity with EBUS.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Identify indications, yield, and complications of EBUS
- Discuss the benefits and limitations of airway ablative modalities
- State the benefits and limitations of various airway stents

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

The physician competencies addressed in this session are patient care and procedural skills, medical knowledge, systems-based practice, and interpersonal and communication skills. These physician competencies will be addressed through a series of collaborative lectures and hands-on demonstrations led by members of The Society of Thoracic Surgeons and the American College of Chest Physicians.

Moderators: Momen M. Wahidi, Durham, NC, and Richard I. Whyte, Boston, MA

8:00 AM Introduction

8:10 AM EBUS Mediastinal Anatomy

Kazubiro Yasufuku, Toronto, Canada

COMMERCIAL RELATIONSHIPS K. Yasufuku: Research Grant, Olympus Corporation

8:30 AM EBUS-Transbronchial Needle Aspiration (TBNA)

Momen M. Wahidi, Durham, NC

8:50 AM Navigational Bronchoscopy and Radial EBUS

Alexander C. Chen, St Louis, MO

COMMERCIAL RELATIONSHIPS A. C. Chen: Consultant/Advisory Board, Olympus; Research Grant, Veran Medical Technologies, Inc

9:10 AM Panel Discussion

9:30 AM Break

9:50 AM Rigid Bronchoscopy

Stephen R. Hazelrigg, Springfield, IL

- 10:10 AM Therapeutic Endoscopy: Laser, Cryotherapy, Electrocautery, and Argon Plasma Coagulation (APC)**
Moishe A. Liberman, Montreal, Canada
COMMERCIAL RELATIONSHIPS M. A. Liberman: Research Grant, Ethicon, Boston Scientific, Baxter
- 10:30 AM Airway Stents**
Aaron M. Cheng, Seattle, WA
- 10:50 AM Foreign Body Removal**
Lonny Yarmus, Baltimore, MD
COMMERCIAL RELATIONSHIPS L. Yarmus: Consultant/Advisory Board, Varian Medical Systems
- 11:10 AM Endobronchial Valves for Air Leak**
Christine C. Argento, Chicago, IL
- 11:30 AM Panel Discussion**
- 11:50 AM Lunch and Case Discussion**

12:30 PM

Room 129B

Hands-On Breakout Sessions**Station 1: EBUS-TBNA on Airway Models***Kazuhiro Yasufuku, Toronto, Canada, and Robert E. Merritt, Columbus, OH***COMMERCIAL RELATIONSHIPS** K. Yasufuku: Research Grant, Olympus Corporation**Station 2: Navigational Bronchoscopy***Lonny Yarmus, Baltimore, MD***COMMERCIAL RELATIONSHIPS** L. Yarmus: Consultant/Advisory Board, Varian Medical Systems**Station 3: EBUS Simulator/Endobronchial Valves***Christine C. Argento, Chicago, IL***Station 4: Rigid Bronchoscopy and Airway Stents***Aaron M. Cheng, Seattle, WA, and Momen M. Wabidi, Durham, NC***Station 5: Electrocautery, APC, and Cryotherapy***Alexander C. Chen, St Louis, MO, and Moishe A. Liberman, Montreal, Canada***COMMERCIAL RELATIONSHIPS** A. C. Chen: Consultant/Advisory Board, Olympus; Research Grant, Veran Medical Technologies, Inc; M. A. Liberman: Research Grant, Ethicon, Boston Scientific, Baxter

1:00 PM – 2:30 PM

Room 126ABC

Cardiopulmonary Bypass Simulation Course

The management and mastery of cardiopulmonary bypass is essential for safe and effective cardiac surgery. In this session, a cardiothoracic surgeon and perfusionist will work together to explain a systematic approach for initiating, managing, and separating from cardiopulmonary bypass. A cardiopulmonary bypass simulator and actual patient cases will help participants explore a variety of perfusion crises and emergencies.

This course is open to residents, medical students, and other participants who are part of an interprofessional team within the operating room.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Demonstrate a systematic approach to prepare, initiate, maintain, and separate from cardiopulmonary bypass
- Discuss how to diagnose, stabilize, and manage an array of patient crises and emergencies that can occur while on cardiopulmonary bypass
- Identify the team management skills needed to effectively care for patients experiencing cardiopulmonary bypass emergencies

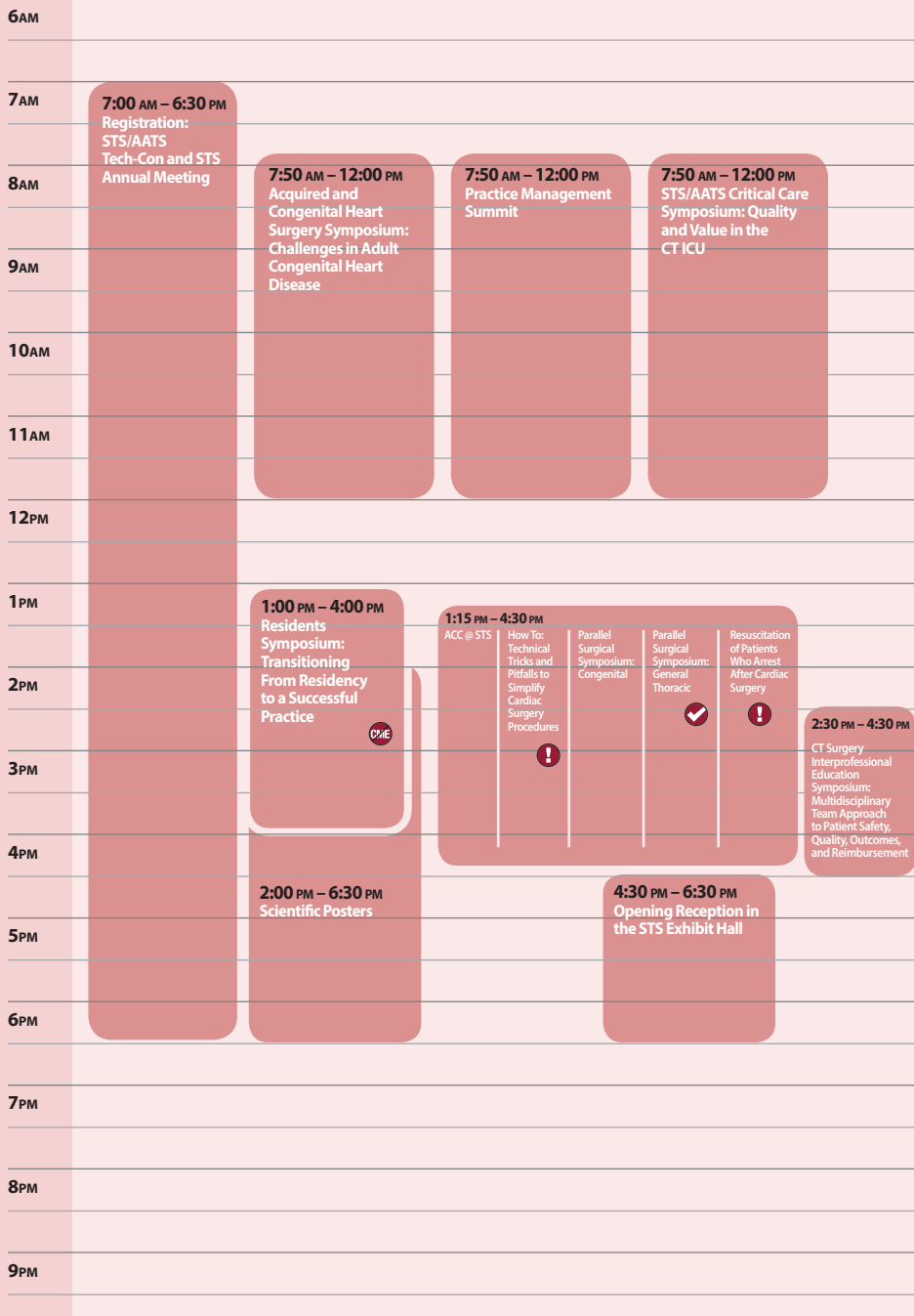
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Course Director: *Thomas E. MacGillivray, Boston, MA*

Faculty: *Uriah Dudgeon, Boston, MA, and Christian DioDato, Boston, MA*

NOTES

SUNDAY AT A GLANCE



- 7:00 AM – 6:30 PM **Registration: STS/AATS Tech-Con and STS Annual Meeting**
- 7:50 AM – 12:00 PM **Acquired and Congenital Heart Surgery Symposium: Challenges in Adult Congenital Heart Disease**
Practice Management Summit
STS/AATS Critical Care Symposium: Quality and Value in the CT ICU
- 1:00 PM – 4:00 PM **ORIE Residents Symposium: Transitioning From Residency to a Successful Practice**
- 1:15 PM – 4:30 PM **ACC @ STS**
! How To: Technical Tricks and Pitfalls to Simplify Cardiac Surgery Procedures
Parallel Surgical Symposium: Congenital
✓ Parallel Surgical Symposium: General Thoracic
! Resuscitation of Patients Who Arrest After Cardiac Surgery
- 2:00 PM – 6:30 PM **Scientific Posters**
- 2:30 PM – 4:30 PM **CT Surgery Interprofessional Education Symposium: Multidisciplinary Team Approach to Patient Safety, Quality, Outcomes, and Reimbursement**
- 4:30 PM – 6:30 PM **Opening Reception in the STS Exhibit Hall**

7:00 AM – 6:30 PM

Lower Level Foyer

Registration: STS/AATS Tech-Con and STS Annual Meeting

7:50 AM – 12:00 PM

Room 122ABC

Acquired and Congenital Heart Surgery Symposium: Challenges in Adult Congenital Heart Disease

High-risk cardiac reoperations are common, and reentry techniques are evolving. In this session, cardiothoracic surgeons, cardiologists, and intensivists, who are experts in pediatric and adult congenital heart surgery, will discuss the varying reentry strategies available. They also will discuss right-sided heart failure, a common pathology in the adult congenital heart patient population for which medical/surgical options are variable and evidence-based decision making is lacking.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Explain the different approaches to high-risk sternal reentry based on which structure is at risk
- Recognize the differences and similarities between pulmonary hypertension and right-sided heart failure in both pediatric and adult congenital heart disease (ACHD)
- Demonstrate an increased awareness of the different surgical and mechanical support options available
- Assess how a surgeon, cardiologist, and intensivist each would approach the treatment of pulmonary hypertension and right-sided heart failure

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The physician competencies addressed in this session are patient care and procedural skills, medical knowledge, professionalism, and interpersonal and communication skills. These physician competencies will be addressed through a series of lectures that will focus on the dilated ascending aorta and the second session will focus on the clinical challenges to treating failing Fontan circulation

Moderators: *Emile A. Bacha, New York, NY, Christopher A. Caldarone, Toronto, Canada, Stephanie M. Fuller, Philadelphia, PA, and Jennifer S. Nelson, Chapel Hill, NC*

COMMERCIAL RELATIONSHIPS E. A. Bacha: Consultant/Advisory Board, CorMatrix

7:50 AM **Welcome and Introduction**

The Hazardous Resternotomy—Pearls and Pitfalls (Personal Technique With Special Attention To...)

8:00 AM **Imaging**
Brian E. Kogon, Atlanta, GA

8:15 AM **Pediatrics**
Charles D. Fraser, Houston, TX
COMMERCIAL RELATIONSHIPS C. D. Fraser: Research Grant, Berlin Heart

8:30 AM **Right-Sided Structures**
Joseph A. Dearani, Rochester, MN

8:45 AM **Patent Coronary Artery Bypass Grafts**
John D. Puskas, Atlanta, GA
COMMERCIAL RELATIONSHIPS J. D. Puskas: Other/Royalties, Scanlan International

9:00 AM **Aorta**
Duke E. Cameron, Baltimore, MD

9:15 AM **Panel Discussion**

9:40 AM **Break**

When the Right Side Fails...

10:00 AM **Differences and Similarities in Pediatric Pulmonary Hypertension vs ACHD**
Nancy S. Ghanayem, Milwaukee, WI

10:15 AM **Postop Care Through the Eyes of a CT Surgeon/Intensivist**
Nevin M. Katz, Baltimore, MD

10:30 AM **Conventional Surgery Options**
Frank L. Hanley, Stanford, CA

10:45 AM **Intraop/Postop Extracorporeal Membrane Oxygenation vs Right Ventricular Assist Devices—Which, When, and Why**
Francis D. Pagani, Ann Arbor, MI

11:00 AM **“Valve-in-Valve” Therapy—The Changing Game**
Doff McElhinney, New York, NY
COMMERCIAL RELATIONSHIPS D. McElhinney: Consultant/Advisory Board, Medtronic, Inc

11:15 AM **Getting the Severely Pulmonary Hypertensive to Be Transplantable**
Richard C. Daly, Rochester, MN
COMMERCIAL RELATIONSHIPS R. C. Daly: Ownership Interest, NeoChord, Inc

11:30 AM **Panel Discussion**

11:55 AM **Closing Comments**

7:50 AM – 12:00 PM

Room 126ABC

Practice Management Summit

This session will provide participants with an opportunity to learn from experienced leaders who are involved in the administration and delivery of cardiothoracic surgical care in our constantly changing health care environment. In addition to presentations from experts, the course will incorporate a panel discussion so that lecturers can interact with attendees. This comprehensive and dynamic learning environment will help ensure that attendees' questions and real-world issues are addressed.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Analyze survey data for use in negotiations
- Describe the relationship between outcomes data and practice patterns
- Illustrate a working knowledge of how to approach compensation negotiations with a health care organization
- Explain how to administrate a co-management relationship with a health care organization
- Identify the role of surgeon entrepreneurs in the device development pathway
- Describe the current reimbursement changes proposed by the Centers for Medicare & Medicaid Services
- Outline how to impact policy discussion on the valuation of cardiothoracic surgery at the federal government level
- Discuss the management of a cardiac service line at a large, nationwide hospital system

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The physician competencies addressed in this session are professionalism, interpersonal skills and communication, and practice-based learning and improvement. These physician competencies will be addressed through a series of individual lectures that are meant to discuss concerns over the changes in health care that have impacted providers and hospitals. The program will have an open discussion forum at the end to encourage questions and participant discussion.

Moderators: Greg A. Bowman, Pueblo, CO, Robert W. Emery, Minneapolis, MN, Frank L. Fazzalari, Rochester, MI, and V. Seenu Reddy, Nashville, TN

COMMERCIAL RELATIONSHIPS R. W. Emery: Ownership Interest, Kips Bay Medical, Inc; Consultant/Advisory Board, Sunshine Heart, Inc; V. S. Reddy: Speakers Bureau/Honoraria, Zoll Life Vest; Consultant/Advisory Board, Acelity

7:50 AM

Introduction

8:00 AM

Data Knows Best—and It Will Bring You to Tiers

Nathan Kaufman, San Diego, CA

8:20 AM

Effective Use of Survey Data in Negotiations

Michael N. Heaton, Indianapolis, IN

- 8:40 AM** **Work Relative Value Unit Employment Models: A Bad Choice for Cardiothoracic Surgeons**
Michael G. Moront, Toledo, OH
COMMERCIAL RELATIONSHIPS M. G. Moront: Consultant/Advisory Board, LSI Solutions, Medtronic, Inc, Edwards Lifesciences Corporation; Speakers Bureau/Honoraria, Medtronic, Inc, Edwards Lifesciences Corporation, LSI Solutions
- 9:00 AM** **Cardiothoracic Surgeon Entrepreneurs and the Device Development Pathway**
Brian W. Duncan, Arvada, CO
COMMERCIAL RELATIONSHIPS B. W. Duncan: Employment, LivaNova
- 9:20 AM** **Retirement Planning**
Roy Smalley, Minneapolis, MN
- 9:40 AM** **Panel Discussion**
- 10:10 AM** **Break**
- 10:20 AM** **Aligning Incentives Through Co-Management**
Suzette Jaskie, Neptune Beach, FL
COMMERCIAL RELATIONSHIPS S. Jaskie: Consultant/Advisory Board, Boston Scientific
- 10:40 AM** **Partnering for Excellence in Today's Health Care Environment: Hospital Corporation of America's Cardiovascular Service Line**
Steven V. Manoukian, Nashville, TN
- 11:00 AM** **Is the Cardiovascular Service Line Really the Best Way to Manage Cardiac Surgery Programs?**
Michael J. Mack, Dallas, TX
COMMERCIAL RELATIONSHIPS M. J. Mack: Consultant/Advisory Board, Edwards Lifesciences Corporation
- 11:20 AM** **Update From the STS/AATS Workforce on Health Policy, Reform, and Advocacy**
Alan M. Speir, Falls Church, VA
COMMERCIAL RELATIONSHIPS A. M. Speir: Consultant/Advisory Board, Medtronic, Inc
- 11:40 AM** **Panel Discussion**

7:50 AM – 12:00 PM

Room 128AB

STS/AATS Critical Care Symposium: Quality and Value in the CT ICU

Cardiothoracic critical care is complex, rapidly evolving, and resource intensive. This session will address the unique issues surrounding postoperative quality and value improvement initiatives with the goal of reducing morbidity and mortality, as well as rationalizing resource utilization. The symposium will address the fundamentals of quality and value, as well as leverage expertise with telehealth solutions, hospital-acquired infections (HAIs), mechanical ventilation, and advanced life support.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Identify the evolving changes in Cardiac Surgery Unit Advanced Life Support (CSU-ALS) following cardiothoracic surgery
- Identify key metrics and drivers of quality and value in cardiothoracic critical care
- List common HAIs in cardiothoracic critical care, their impact on quality and value, and how to mitigate risk
- Discuss the best practice approach (ABCDE) to ventilator management and preventative strategies/management of prolonged ventilation in patients in the CT ICU

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The physician competencies addressed in this session are patient care, medical knowledge, and practice-based learning and improvement. These physician competencies will be addressed through a series of collaborative lectures by members of The Society of Thoracic Surgeons and the American Association for Thoracic Surgery. These lectures are meant to advance knowledge and expertise in the complex field of cardiothoracic critical care. A moderated poster session, panel discussions, and questions from the audience will augment these competencies.

Moderators: Rakesh C. Arora, Winnipeg, Canada, Kevin W. Lobbell, Charlotte, NC, and Vassyl A. Lonchyna, Chicago, IL

COMMERCIAL RELATIONSHIPS R. C. Arora: Research Grant, Pfizer Canada, Inc; K. W. Lobbell: Consultant/Advisory Board, Medtronic, Inc; V. A. Lonchyna: Ownership Interest, Abbott Laboratories, Hospira, AbbVie, Inc

7:50 AM Introduction

Patient-Centered Transformational Redesign

7:55 AM Introduction to Quality and Value in the ICU

Kevin W. Lobbell, Charlotte, NC

COMMERCIAL RELATIONSHIPS K. W. Lobbell: Consultant/Advisory Board, Medtronic, Inc

8:00 AM Importance of Quality and Value in the ICU

Kevin W. Lobbell, Charlotte, NC

COMMERCIAL RELATIONSHIPS K. W. Lobbell: Consultant/Advisory Board, Medtronic, Inc

8:15 AM Tele-ICU: Transforming Critical Care Quality and Value

Scott Lindblom, Charlotte, NC

8:30 AM Discussion

Hospital-Acquired Infections (HAIs)

- 8:45 AM **HAIs: Impact on Quality and Value**
Kevin W. Lobdell, Charlotte, NC
COMMERCIAL RELATIONSHIPS K. W. Lobdell: Consultant/Advisory Board, Medtronic, Inc
- 8:50 AM **Everything You Need to Know About Infection Prevention, HAIs, and Antibiotic Stewardship**
Emily Landon, Chicago, IL
- 9:20 AM **Discussion**
- 9:30 AM **Break and Poster Viewing**

CSU-ALS in the US: The Role and Impact of Physician Assistants

- 9:45 AM **CSU-ALS Overview**
Joel Dunning, Middlesbrough, United Kingdom
COMMERCIAL RELATIONSHIPS J. Dunning: Speakers Bureau/Honoraria, CARDICA, Inc
- 10:00 AM **The ACP/RN Educational Module**
Jill Ley, San Francisco, CA
- 10:15 AM **The Association of Physician Assistants in Cardiovascular Surgery Perspective**
David E. Lizotte, Harrisonburg, VA
- 10:30 AM **Implementation for Your CT ICU Team**
Yoan Lamarche, Montreal, Canada
- 10:45 AM **Discussion**

Prolonged Ventilation

- 11:00 AM **What Is the Ventilator Bundle ABCDE and What Data Support It?**
John P. Kress, Chicago, IL
- 11:10 AM **Tactics to Prevent Prolonged Ventilation and Deal With It When It Happens**
John P. Kress, Chicago, IL
- 11:30 AM **Tracheostomy: Early or Wait?**
Vassyl A. Lonchyna, Chicago, IL
COMMERCIAL RELATIONSHIPS V. A. Lonchyna: Ownership Interest, Hospira, AbbVie, Inc; Other, Abbott Laboratories
- 11:40 AM **When on Extracorporeal Membrane Oxygenation: Awaken, Extubate, and Mobilize**
Darryl C. Abrams, New York, NY
- 11:50 AM **Discussion**

1:00 PM – 4:00 PM

Room 231ABC

Residents Symposium: Transitioning From Residency to a Successful Practice

This symposium will provide cardiothoracic surgery residents with practical information regarding the transition from residency to practice. The first session will include talks related to the job search: how to find the right position, interviewing tips, and negotiating a contract. The second session will include talks related to transitioning into practice: how to be successful in developing a clinical practice, how to find appropriate mentorship, and early career development. Each session will be followed by small group table discussions led by experienced surgeons and a larger group discussion with the speakers.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Plan a successful job search
- List the important elements of a contract
- Discuss the keys to building a successful clinical practice
- Identify the important aspects of early career development

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

The physician competencies addressed in this session are professionalism, practice-based learning and improvement, and interpersonal skills and communication. These physician competencies will be addressed through a series of individual lectures that will address practical early career information.

Moderators: Sidharta P. Gangadharan, Boston, MA, Sandra L. Starnes, Cincinnati, OH, and Ara A. Vaporciyan, Houston, TX

COMMERCIAL RELATIONSHIPS A. A. Vaporciyan: Nonremunerative Position of Influence, American Board of Thoracic Surgery

1:00 PM	Introduction
1:05 PM	How to Find Your First Job <i>Ryan A. Macke, Madison, WI</i>
1:20 PM	Question-and-Answer Session
1:25 PM	Keys to a Successful Interview <i>Ravi K. Ghanta, Houston, TX</i>
1:40 PM	Question-and-Answer Session
1:45 PM	What You Need to Know About Contracts <i>Sandra L. Starnes, Cincinnati, OH</i>
2:00 PM	Question-and-Answer Session
2:05 PM	Breakout Sessions
2:35 PM	Group Discussion / Evaluation Completion
2:45 PM	Building a Successful Clinical Practice <i>Edward P. Chen, Atlanta, GA</i>
3:00 PM	Question-and-Answer Session

- 3:05 PM **Early Career Development**
Elizabeth A. David, Sacramento, CA
- 3:20 PM **Question-and-Answer Session**
- 3:25 PM **Breakout Sessions**
- 3:50 PM **Group Discussion / Evaluation Completion**

1:15 PM – 4:30 PM

Room 120D

ACC @ STS

The focus of this joint session by STS and the American College of Cardiology (ACC) will be the truly collaborative “Heart Team” approach to treating complex issues facing the practicing physician or affiliate provider. Using a unique and innovative format that highlights the spectrum of adult cardiac diseases, speakers will discuss the multidisciplinary approach to aortic valve disease, coronary artery disease, and mitral regurgitation. Course components include technical videos featuring procedural expertise in these disease processes, a critical review of the literature, a lecture regarding research from the STS/ACC TVT Registry™, and presentations describing difficult clinical scenarios.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Discuss the controversies surrounding the management of coronary artery disease
- Describe the indications and contraindications for the treatment of ischemic mitral regurgitation
- Describe the construction and makeup of the multidisciplinary “Heart Team” and its influence in improving patient outcomes and fostering communication among specialties
- Identify and explain the optimal management of patients with aortic valvular disease

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The physician competencies addressed in this session are medical knowledge, patient care, practice-based learning improvement, and systems-based practice. These physician competencies will be addressed through a series of collaborative lectures by members of The Society of Thoracic Surgeons and the American College of Cardiology.

Moderators: David R. Holmes, Rochester, MN, Susheel Kodali, New York, NY, Patrick T. O’Gara, Boston, MA, and Vinod H. Thourani, Atlanta, GA

COMMERCIAL RELATIONSHIPS S. Kodali: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc

1:15 PM Lessons Learned From the STS/ACC TVT Registry™

Frederick L. Grover, Aurora, CO

1:25 PM Ninety Percent of All Transcatheter Aortic Valve Replacements (TAVR) Will Be Done Transfemorally: How Can You Stay in the Game?

Vinod H. Thourani, Atlanta, GA

1:32 PM Debate: TAVR for Low-Risk Patients—The Writing Is On the Wall, But How Will We Evaluate Outcomes?**There Is No Floor**

Michael J. Mack, Dallas, TX

COMMERCIAL RELATIONSHIPS M. J. Mack: Consultant/Advisory Board, Edwards Lifesciences Corporation

Hold Your Horses

David R. Holmes, Rochester, MN

- 1:46 PM Discussion**
- 1:56 PM So Many TAVR Choices: How to Choose the Right Device for the Right Patient**
Susheel Kodali, New York, NY
COMMERCIAL RELATIONSHIPS S. Kodali: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc
- 2:06 PM My Worst Case That I Sent for TAVR: Why Did I Not Send This Patient to Surgery?**
Patrick T. O'Gara, Boston, MA
- 2:14 PM Discussion**
- 2:24 PM Break**
- 2:38 PM Case Presentation and Rationale for When to Use Percutaneous Coronary Intervention in Left Main Coronary Artery Disease (CAD)**
TBD
- 2:46 PM Technical Video and Current Rationale for Hybrid Revascularization: Why You Need to Learn This Procedure to Stay Relevant in the Management of CAD**
Michael E. Halkos, Atlanta, GA
COMMERCIAL RELATIONSHIPS M. E. Halkos: Consultant/Advisory Board, Medtronic, Inc, Intuitive Surgical, Inc, MAQUET Cardiovascular
- 2:54 PM Seriously, Why Are You Not Doing More Multi-Arterial Grafting? My Technique Will Make It Easy for You**
Joseph F. Sabik III, Cleveland, OH
COMMERCIAL RELATIONSHIPS J. F. Sabik: Consultant/Advisory Board, Medtronic, Inc, LivaNova; Research Grant, Abbott Laboratories, Edwards Lifesciences Corporation
- 3:02 PM My Worst Case: Why Did I Ever Take This ST Elevation Myocardial Infarction to Surgery?**
Robert A. Guyton, Atlanta, GA
COMMERCIAL RELATIONSHIPS R. A. Guyton: Consultant/Advisory Board, Medtronic, Inc
- 3:10 PM Discussion**
- 3:20 PM What Surgeons Should Know About the ACC/AHA Valve Guidelines**
Patrick T. O'Gara, Boston, MA
- 3:30 PM Why and How I Decide to Repair vs Replace the Ischemic Mitral Valve**
TBD
- 3:40 PM Follow-Up Report From the National Institutes of Health Cardiothoracic Surgical Trials Network Moderate and Severe Ischemic Mitral Regurgitation Trials**
Michael A. Acker, Philadelphia, PA
COMMERCIAL RELATIONSHIPS M. A. Acker: Consultant/Advisory Board, Thoratec Corporation, HeartWare, Inc
- 3:50 PM Discussion**

- 4:00 PM** **How I Overcame Barriers to Minimally Invasive Mitral Repair and Why You Can Do the Same**
Gorav Ailawadi, Charlottesville, VA
COMMERCIAL RELATIONSHIPS G. Ailawadi: Consultant/Advisory Board, Edwards Lifesciences Corporation, Abbott Vascular; Nonremunerative Position of Influence, AtriCure; Speakers Bureau/Honoraria, St Jude Medical
- 4:08 PM** **My Worst Case: Maybe I Should Have Sent This for Transcatheter Repair**
Vinay Badhwar, Pittsburgh, PA
- 4:16 PM** **Defining the Optimal Patient Population That Benefits From Transcatheter Mitral Valve Repair: A Report From the STS/ACC TVT Registry™**
David R. Holmes, Rochester, MN
- 4:26 PM** **Discussion and Concluding Remarks**

NOTES

1:15 PM – 4:30 PM

Room 131ABC

! How To: Technical Tricks and Pitfalls to Simplify Cardiac Surgery Procedures

Cardiothoracic surgery is a highly technical specialty. Every successful surgeon has useful tips and tricks that can help colleagues improve their techniques, become more efficient, and optimize outcomes. Many educational sessions focus on short- and long-term outcomes, debating optimal approaches, postoperative care, and evaluation of new technologies; however, until now, there has been little focus on how to refine and improve technique.

In this new “how to” session, world-renowned faculty will share high-quality videos that focus on the technical aspects of several common adult cardiac operations. The speakers will share their best tips and methods of avoiding pitfalls. This session will benefit both private practice and academic surgeons and will focus on coronary artery bypass grafting, mitral and aortic valve disease, and aortic surgery.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Recognize the technical aspects of complex operations commonly performed in adult cardiac surgery
- Discuss the potential pitfalls of critical steps in complex cardiac surgery
- Identify novel tricks to make cardiac operations easier, safer, and more reproducible

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The physician competencies addressed in this session are patient care and procedural skills, medical knowledge, professionalism, and interpersonal and communication skills. These physician competencies will be addressed through a series of surgical videos followed by discussion and questions from the audience.

Moderators: Gorav Ailawadi, Charlottesville, VA, and Wilson Y. Szeto, Philadelphia, PA

COMMERCIAL RELATIONSHIPS G. Ailawadi: Consultant/Advisory Board, Edwards Lifesciences Corporation, Abbott Vascular; Nonremunerative Position of Influence, AtriCure, Inc; Speakers Bureau/Honoraria, St Jude Medical; W. Y. Szeto: Consultant/Advisory Board, Micro Interventional Devices, Inc; Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, LivaNova

Coronary Artery Bypass Grafting (CABG)

1:15 PM

Skeletonized Internal Mammmary Artery Harvest

Richard Lee, St Louis, MO

1:23 PM

Total Arterial CABG

Michael E. Halkos, Atlanta, GA

COMMERCIAL RELATIONSHIPS M. E. Halkos: Consultant/Advisory Board, Medtronic, Inc, Intuitive Surgical, Inc, MAQUET Cardiovascular

1:31 PM

Minimally Invasive CABG

Marc Ruel, Ottawa, Canada

Mitral Valve Surgery

1:40 PM

Mitral Exposure in Challenging Patients (Obese, Small Left Atrium, Previous Aortic Valve Replacement [AVR])

Vinay Badhwar, Pittsburgh, PA

- 1:48 PM** **Anterior Leaflet Techniques, Artificial Cord (Measuring Cord Length)**
Michael A. Borger, New York, NY
COMMERCIAL RELATIONSHIPS M. A. Borger: Consultant/Advisory Board, Edwards Lifesciences Corporation, LivaNova; Speakers Bureau/Honoraria, St Jude Medical; Nonremunerative Position of Influence, Medtronic, Inc
- 1:56 PM** **Bileaflet Prolapse Repair Approaches**
Y. Joseph Woo, Stanford, CA
- 2:04 PM** **Sizing Rings Appropriately: Avoiding Systolic Anterior Motion/ Optimizing Coaptation**
Robert L. Smith, Plano, TX
COMMERCIAL RELATIONSHIPS R. L. Smith: Consultant/Advisory Board, Edwards Lifesciences Corporation; Speakers Bureau/Honoraria, Abbott Laboratories, Edwards Lifesciences Corporation
- 2:12 PM** **Total Chordal-Sparing Mitral Valve Replacement**
Michael A. Acker, Philadelphia, PA
COMMERCIAL RELATIONSHIPS M. A. Acker: Consultant/Advisory Board, Thoratec Corporation, HeartWare, Inc
- 2:20 PM** **Septal Myomectomy**
Nicholas G. Smedira, Cleveland, OH
- 2:28 PM** **Tricuspid Valve Repair: Optimizing Coaptation/Avoiding Ring Dehiscence**
James S. Gammie, Baltimore, MD
COMMERCIAL RELATIONSHIPS J. S. Gammie: Ownership Interest, Harpoon Medical, Inc, Correx, Inc
- 2:35 PM** **Break**
- Aortic Valve Surgery**
- 2:55 PM** **Right Thoracotomy Mini-AVR**
John R. Mehall, Colorado Springs, CO
COMMERCIAL RELATIONSHIPS J. R. Mehall: Consultant/Advisory Board, Edwards LifeSciences Corporation, AtriCure
- 3:03 PM** **Aortic Root Enlargement Simplified**
Derek R. Brinster, New York, NY
- 3:11 PM** **Bicuspid Aortic Valve Repair**
Prashanth Vallabhajosyula, Philadelphia, PA
- 3:19 PM** **Sutureless AVR**
David A. Heimansohn, Indianapolis, IN
COMMERCIAL RELATIONSHIPS D. A. Heimansohn: Consultant/Advisory Board, LivaNova
REGULATORY DISCLOSURE This presentation will address Peceval by LivaNova. The FDA status of this device is investigational.
- 3:27 PM** **Stentless AVR/Freedom Solo**
Eric E. Roselli, Cleveland, OH
COMMERCIAL RELATIONSHIPS E. E. Roselli: Consultant/Advisory Board, Medtronic, Inc, Bolton Medical, Apica Ltd; Research Grant, LivaNova, Medtronic, Inc, CorMatrix; Speakers Bureau/Honoraria, Edwards Lifesciences Corporation, St Jude Medical, Vascutek Ltd a Terumo Company, COOK Medical, LivaNova, Medtronic, Inc; Other, Direct Flow Medical, Inc

3:35 PM Transapical Transcatheter AVR (TAVR)

Todd M. Dewey, Dallas, TX

3:43 PM Subclavian TAVR

Michael J. Reardon, Houston, TX

COMMERCIAL RELATIONSHIPS M. J. Reardon: Consultant/Advisory Board, Medtronic, Inc

Aortic Surgery

3:51 PM Type A Dissection Repair

Michael P. Fischbein, Stanford, CA

COMMERCIAL RELATIONSHIPS M. P. Fischbein: Research Grant, National Marfan Society; Speakers Bureau/Honoraria, St Jude Medical

3:59 PM Valve-Sparing Root Replacement

Wilson Y. Szeto, Philadelphia, PA

COMMERCIAL RELATIONSHIPS W. Y. Szeto: Consultant/Advisory Board, Micro Interventional Devices, Inc; Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, LivaNova

4:07 PM Bentall With Stented Bioprosthetic Valve

Anthony L. Estreza, Houston, TX

COMMERCIAL RELATIONSHIPS A. L. Estreza: Consultant/Advisory Board, W. L. Gore & Associates, Inc; Speakers Bureau/Honoraria, MAQUET

4:15 PM Total Arch Replacement/Elephant Trunk

Edward P. Chen, Atlanta, GA

NOTES

1:15 PM – 4:30 PM

Room 126ABC

Parallel Surgical Symposium: Congenital

This symposium will address new findings that challenge historical beliefs regarding common congenital cardiac pathologies. The session will feature video presentations on surgical repair of atrioventricular septal defects (AVSD), the arterial switch operation (ASO), and complete repair of tetralogy of Fallot. The session also will focus on new data regarding the management of hypoplastic left heart syndrome (HLHS), borderline ventricular septal defect (VSD), and aortic valve pathology requiring surgical intervention.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Identify aspects of three separate surgical approaches to AVSD, ASO, and dextro-transposition of the great arteries
- Articulate indications for closure of restrictive VSDs
- Outline differing therapeutic approaches toward the management of children with HLHS, aortic valve disease, and restrictive VSDs

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The physician competencies addressed in this session are patient care and procedural skills, medical knowledge, and systems-based practice. These physician competencies will be addressed through a series of individual lectures and videos that will address issues in congenital heart surgery. Questions from the audience will augment these competencies.

Moderators: Jonathan M. Chen, Seattle, WA, Andrew C. Fiore, St Louis, MO, and Glen S. Van Arsdell, Toronto, Canada

COMMERCIAL RELATIONSHIPS G. S. Van Arsdell: Ownership Interest, Cell Aegis Devices

1:15 PM Welcome and Introduction**Criticize My Operation (Video-Based Session)****1:20 PM Complete AVSD Canal: The Australian Way**

Carl L. Backer, Chicago, IL

1:35 PM Complete AVSD Canal: The Two-Patch Way

David M. McMullan, Seattle, WA

1:50 PM Complete AVSD Canal: The Boston Single-Patch Way

Anees J. Razzouk, Loma Linda, CA

2:05 PM Switch: The Closed Technique

Richard G. Ohye, Ann Arbor, MI

2:20 PM Switch: Open Technique

Tain-Yen Hsia, London, United Kingdom

2:35 PM Tetralogy: Transventricular Septal Defect Closure With Annulus Preservation

Emile A. Bacha, New York, NY

COMMERCIAL RELATIONSHIPS E. A. Bacha: Consultant/Advisory Board, CorMatrix

2:50 PM

Tetralogy: Limited Transannular Incision

Charles D. Fraser, Houston, TX

COMMERCIAL RELATIONSHIPS C. D. Fraser: Research Grant, Berlin Heart

3:05 PM

Tetralogy: Transatrial Repair With Limited Indibular Patch

Osami Honjo, Toronto, Canada

3:15 PM

Break

Old Operations, New Data: Should We Be Managing Patients Differently?

3:30 PM

Hypoplastic Left Heart Syndrome

William M. Decampoli, Orlando, FL

3:41 PM

Discussant for Hypoplastic Left Heart Syndrome

Anne Dipchand, Toronto, Canada

3:46 PM

Borderline VSD

Anne Dipchand, Toronto, Canada

4:01 PM

Discussant for Borderline VSD

Carl L. Backer, Chicago, IL

4:05 PM

Aortic Valve Repair: I Debated Myself and I Decided! Part 1

Zohair Y. Al Halees, Riyadh, Saudi Arabia

4:17 PM

Aortic Valve Repair: I Debated Myself and I Decided! Part 2

James S. Tweddell, Milwaukee, WI

COMMERCIAL RELATIONSHIPS J. S. Tweddell: Consultant/Advisory Board, CorMatrix

REGULATORY DISCLOSURE This presentation will address the CorMatrix patch by CorMatrix, which is FDA approved.

1:15 PM – 4:30 PM

Room 122ABC

✓ Parallel Surgical Symposium: General Thoracic

This symposium will address the optimal minimally invasive approach to thymectomy, with and without myasthenia gravis, advanced surgical techniques for lung resection including bronchoplastic procedures, and localization strategies for small, non-palpable lung nodules. It also will address barriers to participation in national databases and advice for incorporating quality improvement initiatives into cardiothoracic surgical practice.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Outline the available minimally invasive techniques for performing thymectomy in patients with and without thymoma, the advantages and disadvantages of each approach, and the clinical circumstances for their safe use
- Describe the appropriateness of and technical aspects for the use of advanced video-assisted thoracoscopic surgical (VATS) techniques in lung resection, including combined approaches for chest wall and central hilar involvement
- State the technical aspects of performing lung resections requiring bronchoplastic reconstructions and the benefits of parenchymal preservation
- List intraoperative localization techniques for non-palpable lung lesions as an adjunct to performing minimally invasive lung surgery
- Describe the importance of database participation, public reporting, and quality improvement initiatives toward maintenance of certification for the American Board of Thoracic Surgery
- Define the elements of successful quality improvement programs and how to implement them into cardiothoracic surgical practice

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

The physician competencies addressed in this session are patient care and procedural skills, medical knowledge, and systems-based practice. These physician competencies will be addressed through a series of individual lectures that will address issues in thoracic surgery that are commonly encountered in daily practice. Questions from the audience will augment these competencies.

Moderators: Leah M. Backbus, Stanford, CA, Traves D. Crabtree, St Louis, MO, and Joseph B. Shrager, Stanford, CA

COMMERCIAL RELATIONSHIPS J. B. Shrager: Consultant/Advisory Board, CareFusion Corporation, MAQUET

Minimally Invasive Approaches to Thymectomy With and Without Thymoma

1:15 PM

Clinical Vignette/Audience Poll 1

1:20 PM

VATS Thymectomy

Joshua R. Sonett, New York, NY

1:32 PM

Robotic Thymectomy

Richard K. Freeman, Indianapolis, IN

1:44 PM

Transcervical Thymectomy

Marcelo Cypel, Toronto, Canada

1:56 PM

Panel Discussion

Advanced Techniques in Lung Resection2:11 PM **Clinical Vignette/Audience Poll 2**2:16 PM **Bronchoplastic Techniques in Lung Resection***Joseph B. Shrager, Stanford, CA***COMMERCIAL RELATIONSHIPS** J. B. Shrager: Consultant/Advisory Board, CareFusion Corporation, MAQUET2:28 PM **Localization of Sub-Solid Lung Nodules***David R. Jones, New York, NY*2:40 PM **Complex VATS Resections***Todd L. Demmy, Buffalo, NY*2:52 PM **Panel Discussion**3:07 PM **Break****Incorporating Quality Improvement Initiatives Into Thoracic Surgery Practice**3:22 PM **Clinical Vignette/Audience Poll 3**3:27 PM **ProvenCare and the Lung Cancer Clinical Pathway***Douglas E. Wood, Seattle, WA***COMMERCIAL RELATIONSHIPS** D. E. Wood: Research Grant, Spiration, Inc; Consultant/Advisory Board, Spiration, Inc3:39 PM **Using LEAN Principles to Improve System-Level Outcomes Following Esophageal Resection***Farhood Farjab, Seattle, WA*3:51 PM **American Board of Thoracic Surgery Maintenance of Certification Part IV and Quality Improvement***Bryan F. Meyers, St Louis, MO***COMMERCIAL RELATIONSHIPS** B. F. Meyers: Speakers Bureau/Honoraria, Varian Medical Systems, Inc; Consultant/Advisory Board, Ethicon, Inc4:03 PM **Benefits and Barriers to Participation in the STS General Thoracic Surgery Database***Benjamin D. Kozower, Charlottesville, VA*4:15 PM **Panel Discussion**

1:15 PM – 4:30 PM

Room 129AB

1 Resuscitation of Patients Who Arrest After Cardiac Surgery

Speakers in this session will describe and demonstrate the optimal method of resuscitation for postoperative cardiac patients. They will cover evidence-based strategies unique to patients who arrest following cardiac surgery, including conduct of the emergency re sternotomy using a team-based approach, internal massage, pacing, standardized equipment and medications, and training and implementation.

Attendees will have the opportunity to participate in simulated arrest scenarios using re sternotomy manikins. The session will conclude with information on how to become an instructor and implement these resuscitation protocols locally.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Describe the evidence-based protocol for resuscitation of patients who arrest after cardiac surgery
- Identify ways to implement standardized resuscitation protocols locally
- Demonstrate teamwork in emergency simulations using a specialized re sternotomy manikin

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The physician competencies addressed in this hands-on session are patient care and procedural skills, medical knowledge, and practice-based learning and improvement. These physician competencies will be addressed through lectures and hands-on sessions to gain knowledge and practical application experience on resuscitation protocols.

Moderator: Joel Dunning, Middlesbrough, United Kingdom

Faculty: Rakesh C. Arora, Winnipeg, Canada, Richard S. Bell, Baltimore, MD, Adrian Levine, Staffordshire, United Kingdom, Jill Ley, San Francisco, CA, and Aaron Morton, Louisville, KY

COMMERCIAL RELATIONSHIPS R. C. Arora: Research Grant, Pfizer Canada, Inc; J. Dunning: Speakers Bureau/Honoraria, CARDICA, Inc

1:15 PM

Introduction

Joel Dunning, Middlesbrough, United Kingdom

COMMERCIAL RELATIONSHIPS J. Dunning: Speakers Bureau/Honoraria, CARDICA, Inc

1:20 PM

Arrest Practical 1: Group Simulation of Cardiac Arrest After Cardiac Surgery

1:45 PM

The Protocol for the Resuscitation of Patients Who Arrest After Cardiac Surgery

Joel Dunning, Middlesbrough, United Kingdom

COMMERCIAL RELATIONSHIPS J. Dunning: Speakers Bureau/Honoraria, CARDICA, Inc

2:30 PM

Arrest Practical 2: Manikin Simulation of the Arrest Protocol

3:15 PM **Cardiac Arrest Skills Stations**
Station 1: Internal Massage
Station 2: Gowning and Gloving
Station 3: Pacing

4:00 PM **How to Implement Resuscitation Protocols for Arrest After Cardiac Surgery in Your Own Hospital and How to Become a Trainer**
Joel Dunning, Middlesbrough, United Kingdom
COMMERCIAL RELATIONSHIPS J. Dunning: Speakers Bureau/Honoraria, CARDICA, Inc

2:00 PM – 6:30 PM

Room 120 Foyer

Scientific Posters

2:30 PM – 4:30 PM

Room 128AB

CT Surgery Interprofessional Education Symposium: Multidisciplinary Team Approach to Patient Safety, Quality, Outcomes, and Reimbursement

The growing complexity of treating cardiothoracic surgery patients requires comprehensive approaches to achieve safe outcomes, add value, and improve patient satisfaction. Despite outstanding individual clinical expertise and effort, the importance for team-oriented approaches to complex patient care is highlighted by the Centers for Medicare & Medicaid Services' recent move to integrate payments across episodes of care. Thus, the imperative to develop streamlined, multidisciplinary processes within cardiothoracic surgery care teams is paramount. This session will explore key strategies to improve these processes in the preoperative, intraoperative, and postoperative cardiothoracic surgery setting.

Learning Objectives

Upon completion of this activity, participants should be able to:

- List the essential elements of a successful multidisciplinary aortic valve replacement team
- Describe how better preoperative planning leads to better outcomes
- Discuss the operation of the bypass pump and which safety devices and techniques can improve patient safety
- Explain how ICU practices influence patient outcomes
- List the elements of a successful bundled payment system and a successful collaborative care system

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The physician competencies addressed in this session are patient care and procedural skills, medical knowledge, professionalism, and interpersonal and communication skills.

These physician competencies will be addressed through a series of lectures that are meant to enhance understanding of the evolving roles within the interprofessional team.

Moderators: Stefano Schena, St Louis, MO, and Brandon H. Tieu, Portland, OR

2:30 PM

How to Develop a Multidisciplinary Program to Ensure Patient Safety and Good Outcomes: Experience with Transcatheter Aortic Valve Replacement Multidisciplinary Team Development

Elizabeth Perpetua, Seattle, WA

COMMERCIAL RELATIONSHIPS E. Perpetua: Speakers Bureau/Honoraria, Edwards Lifesciences Corporation

2:45 PM

Preoperative Planning Prevents Poor Performance

Baron L. Hamman, Dallas, TX

3:00 PM

Question-and-Answer Session

Brandon H. Tieu, Portland, OR

3:10 PM

Planning and Prevention of Perfusion Accidents: What to Do When the Pump Goes Rogue

Michael Colligan, Houston, TX

- 3:25 PM **Safety in the ICU: Complexity and Normal Accidents—Creating High Reliability in the Perioperative Domain**
Laureen L. Hill, Atlanta, GA
- 3:40 PM **Question-and-Answer Session**
Stefano Schena, St Louis, MO
- 3:50 PM **Heart Team Care Designed for Quality, Value, and Safety**
Kevin W. Lobbell, Charlotte, NC
COMMERCIAL RELATIONSHIPS K. W. Lobbell: Consultant/Advisory Board, Medtronic, Inc
- 4:05 PM **Foundations of Teamwork: Organizing Principles and Care Routines for Safety, Communications, and STS Outcomes**
Paul N. Ublig, Wichita, KS
- 4:20 PM **Question-and-Answer Session**

4:30 PM – 6:30 PM

Exhibit Halls 4-5

Opening Reception in STS Exhibit Hall

MONDAY, JANUARY 25, 2016

6AM
7AM
8AM
9AM
10AM
11AM
12PM
1PM
2PM
3PM
4PM
5PM
6PM
7PM
8PM
9PM

6:30 AM – 5:00 PM
Registration: STS Annual Meeting

7:00 AM – 7:15 AM
Opening Remarks

7:15 AM – 8:15 AM
J. Maxwell Chamberlain Memorial Papers

8:15 AM – 9:00 AM
Richard E. Clark Memorial Papers

9:40 AM – 9:50 AM
Introduction of the President: Joseph E. Bavaria

9:50 AM – 10:50 AM
Presidential Address: Mark S. Allen

9:00 AM – 4:30 PM
Exhibit Hall

Scientific Posters

11:30 AM – 12:30 PM

Adult Cardiac Session: Arrhythmia	Basic Science Research: Adult Cardiac	Basic Science Research: General Thoracic	Congenital Session: Adult Congenital	Critical Care	General Thoracic Session: New Technology	Quality Improvement Initiatives in Thoracic Surgery	STS/CATS/ CSCS
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1:30 PM – 3:30 PM

Adult Cardiac Session: Aorta I	Adult Cardiac Session: Ischemic	Congenital Session: Pediatric Congenital I	General Thoracic Session: Lung Cancer I	General Thoracic Session: Lung Transplantation	SVS @ STS: Sharing Common Ground for Cardiovascular Problems	30th Anniversary Celebration of Women in Thoracic Surgery
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1:15 PM – 5:15 PM
Redefining Practice Through Quality and Evidence: What's New?

3:30 PM – 5:30 PM
International Symposium & Reception: The Ethics and Practicality of Using New Technologies to Treat Cardiothoracic Diseases in Different Parts of the World

4:15 PM – 5:15 PM
Surgical Motion Picture Matinees: Adult Cardiac, Congenital, and General Thoracic

5:00 PM – 6:30 PM
Scientific Posters and Wine

5:30 PM – 6:25 PM
Business Meeting (STS Members Only)

6:30 PM – 7:30 PM
STS-PAC Reception

7:00 PM – 10:30 PM
STS Social Event: Corona Ranch

6:30 AM – 5:00 PM	Registration: STS Annual Meeting
7:00 AM – 7:15 AM	Opening Remarks
7:15 AM – 8:15 AM	J. Maxwell Chamberlain Memorial Papers
8:15 AM – 9:00 AM	Richard E. Clark Memorial Papers
9:00 AM – 4:30 PM	Exhibit Hall Scientific Posters
9:40 AM – 9:50 AM	Introduction of the President: Joseph E. Bavaria
9:50 AM – 10:50 AM	Presidential Address: Mark S. Allen
11:30 AM – 12:30 PM	Adult Cardiac Session: Arrhythmia Basic Science Research: Adult Cardiac Basic Science Research: General Thoracic Congenital Session: Adult Congenital Critical Care General Thoracic Session: New Technology Quality Improvement Initiatives in Thoracic Surgery STS/CATS/CSCS: Adding New Dimensions to Your Surgical Practice— Optimizing Your Internet Presence and Understanding the Emerging Role of 3-Dimensional Printing in Cardiothoracic Surgery
1:15 PM – 5:15 PM	Redefining Practice Through Quality and Evidence: What's New?
1:30 PM – 3:30 PM	Adult Cardiac Session: Aorta I Adult Cardiac Session: Ischemic Congenital Session: Pediatric Congenital I General Thoracic Session: Lung Cancer I—Diagnosis and Staging General Thoracic Session: Lung Transplantation SVS @ STS: Sharing Common Ground for Cardiovascular Problems 30th Anniversary Celebration of Women in Thoracic Surgery: Innovations and Contributions of WTS and STS Members
3:30 PM – 5:30 PM	 International Symposium & Reception: The Ethics and Practicality of Using New Technologies to Treat Cardiothoracic Diseases in Different Parts of the World
4:15 PM – 5:15 PM	Surgical Motion Picture Matinees: Adult Cardiac, Congenital, and General Thoracic
5:00 PM – 6:30 PM	Scientific Posters and Wine
5:30 PM – 6:25 PM	Business Meeting (STS Members Only)
6:30 PM – 7:30 PM	STS-PAC Reception
7:00 PM – 10:30 PM	 STS Social Event: Corona Ranch

6:30 AM – 5:00 PM

Lower Level Foyer

Registration: STS Annual Meeting

9:00 AM – 4:30 PM

Exhibit Halls 4-5

Exhibit Hall

9:00 AM – 4:30 PM

Room 120 Foyer

Scientific Posters

7:00 AM – 10:50 AM

Exhibit Halls 2-3

General Session I

Moderators: Mark S. Allen, Rochester, MN, and Keith S. Naunheim, St Louis, MO

COMMERCIAL RELATIONSHIPS M. S. Allen: Nonremunerative Position of Influence, Joint Council on Thoracic Surgery Education; K. S. Naunheim: Speakers Bureau/Honoraria, Medtronic, Inc

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold**.

The physician competencies addressed in this session are patient care and procedural skills, medical knowledge, and professionalism. These physician competencies will be addressed through a series of individual lectures and focused discussion on key points of presentations.

7:00 AM

Opening Remarks

7:15 AM

Exhibit Halls 2-3

J. Maxwell Chamberlain Memorial Paper for General Thoracic Surgery

Quality Measures in Clinical Stage I Non-Small-Cell Lung Cancer: Improved Performance Is Associated With Improved Survival

P. P. Samson¹, T. D. Crabtree², S. R. Broderick³, A. S. Krupnick², D. Kreisel², G. A. Patterson⁴, B. F. Meyers⁴, V. Puri¹

¹Washington University School of Medicine, St Louis, MO, ²Washington University School of Medicine/Barnes Jewish Hospital, St Louis, MO, ³St Luke's Hospital, Chesterfield, MO,

⁴Washington University, St Louis, MO

COMMERCIAL RELATIONSHIPS B. F. Meyers: Speakers Bureau/Honoraria, Varian Medical Systems, Inc; Consultant/Advisory Board, Ethicon, Inc

Discussant: Felix G. Fernandez, Atlanta, GA

Purpose: National organizations, including The Society of Thoracic Surgeons, the National Comprehensive Cancer Network, and the American College of Surgeons Commission on Cancer, have recommended quality standards for surgery in early stage non-small-cell lung cancer (NSCLC). The determinants and outcomes of adherence to these guidelines are largely unknown.

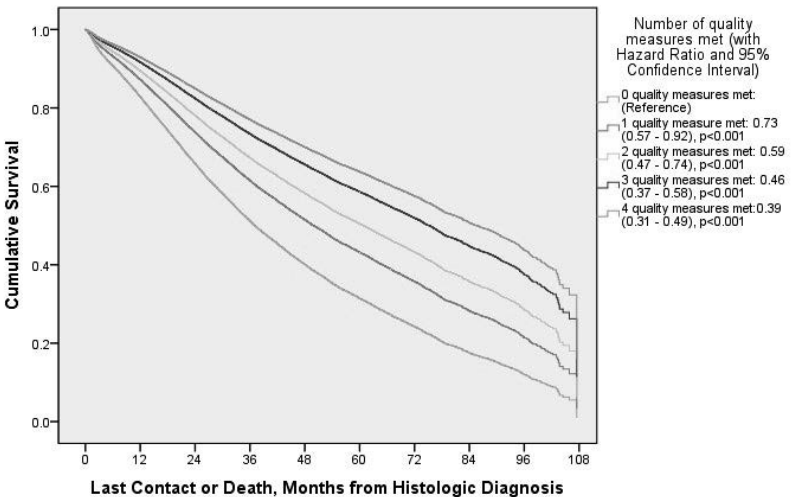
Methods: Patients undergoing surgery for clinical stage I NSCLC were abstracted from the National Cancer Data Base. From a review of literature and guidelines for surgery in stage I lung cancer, the following quality measures were selected for evaluation: performing a lobectomy, surgery within 8 weeks of diagnosis, R0 resection, and evaluation of ≥10 lymph nodes. Univariate and multivariate models were fitted to identify variables independently

associated with adherence to quality measures, and a Cox multivariate model was created to evaluate long-term overall survival.

Results: Between 2003 and 2010, 90,091/90,385 (99.7%), 85,107/90,385 (94.2%), 59,382/90,382 (65.7%), and 17,907/90,385 (19.8%) of patients met at least one, two, three, or all four of the recommended criteria, respectively. Caucasian race (OR 1.21, 1.13–1.28), income \geq \$35,000/year (OR 1.12, 1.07–1.17), and urban population (OR 1.08, 1.04–1.13) were associated with a greater likelihood of receiving all four quality measures. Higher-volume centers (>13 cases per year, OR 1.18, 1.14–1.23), academic institutions (OR 1.51, 1.40–1.62), and designated comprehensive community cancer centers (OR 1.23, 1.15–1.31) were more likely to meet all four parameters; increasing age (OR 0.99, 0.992–0.996) and higher Charlson/Deyo comorbidity score (for 1: OR 0.89, 0.85–0.92, for ≥ 2 : OR 0.84, 0.80–0.89) were associated with lower likelihood of recommended surgical care. Pathologic upstaging (HR 1.90, 1.83–1.97) and meeting all four quality indicators (HR 0.39, 0.31–0.49) were the most powerful determinants of long-term overall survival (Figure).

Conclusions: National adherence to quality indicators for surgery in stage I NSCLC is suboptimal. Compliance with such guidelines is a strong predictor of long-term survival, and vigorous efforts should be instituted at the level of national societies to improve such adherence.

Cox Proportional Hazards Model Showing Survival for Clinical Stage I Non-small Cell Lung Cancer Patients Receiving Surgery, By Number of Quality Measures Obtained



7:35 AM

Exhibit Halls 2-3

J. Maxwell Chamberlain Memorial Paper for Adult Cardiac Surgery
Optimal Timing Between Myocardial Infarction and Coronary Artery Bypass Grafting: Impact on In-Hospital Mortality

E. L. Nichols¹, C. S. Ross², J. R. Brown², R. S. Kramer³, J. N. McCullough⁴, B. M. Westbrook⁵, E. Olmstead⁶, B. J. Leavitt⁶, J. D. Klemperer⁷, G. L. Sardella⁸, F. Hernandez⁷, A. W. Discipio⁹, D. J. Malenka¹

¹The Dartmouth Institute, Lebanon, NH, ²Dartmouth College – Geisel School of Medicine, Lebanon, NH, ³Maine Medical Center, Portland, ⁴Dartmouth-Hitchcock Medical Center, Lebanon, NH, ⁵Catholic Medical Center, Manchester, NH, ⁶University of Vermont Medical Center, Burlington, ⁷Eastern Maine Medical Center, Bangor, ⁸Concord Hospital, NH, ⁹Dartmouth Hitchcock Medical Center, Lebanon, NH

COMMERCIAL RELATIONSHIPS D. J. Malenka: Consultant/Advisory Board, Anthem, Inc

Discussant: Robert A. Guyton, Atlanta, GA

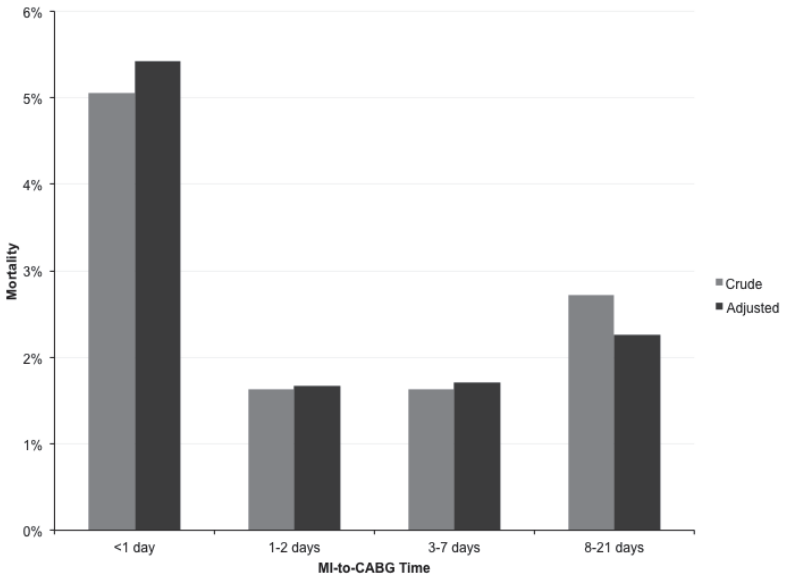
COMMERCIAL RELATIONSHIPS R. A. Guyton: Consultant/Advisory Board, Medtronic, Inc

Purpose: There is debate as to whether increasing the waiting time between myocardial infarction (MI) and coronary artery bypass grafting (CABG) surgery is protective against poor outcomes or is an unnecessary use of health care resources that prolongs hospitalization. This study aimed to determine if timing between MI and CABG impacts in-hospital mortality.

Methods: We analyzed data from 3,060 isolated CABG patients from the Northern New England Cardiovascular Disease Study Group Cardiac Surgery Registry from 2008 to 2014 to compare in-hospital mortality between those with an MI-to-CABG timing of <1 day, 1-2 days, 3-7 days, and 8-21 days. Emergent and shock patients and patients with <=6 hours between MI and CABG were excluded. We used direct standardization to adjust for differences in patient case mix.

Results: Of the patients with prior MI, CABG was performed within <1 day for 99 (3.2%), 1-2 days for 369 (12.1%), 3-7 days for 1,966 (64.3%), and 8-21 days for 626 (20.5%) patients. Patient characteristics and predicted mortality were similar for patients that had CABG within <1 day (1.8%), 1-2 days (1.8%), and 3-7 days (1.9%), but was higher for 8-21 days (2.4%) of MI. However, crude in-hospital mortality was higher for those with an MI-to-CABG time of <1 day (5.1%) compared to 1-2 days (1.6%), 3-7 days (1.6%), and 8-21 days (2.7%, $P = .044$). After adjustment for patient characteristics, in-hospital mortality remained higher in patients with <1 day (5.4%; 95% CI: 1.5, 9.4) and was similar across 1-2 days (1.7%; 95% CI: 0.4, 3.0), 3-7 days (1.7%; 95% CI: 1.1, 2.3), and 8-21 days (2.3%; 95% CI: 1.2, 3.3) between MI and CABG. Results were similar when stratified by ST-segment elevation MI and non-ST-segment elevation MI.

Conclusions: There was similar mortality and patient characteristics for those operated on 1-2 days and 3-7 days after MI. Patients operated on in 8-21 days had more comorbidities and higher mortality, suggesting patient wait times were warranted.



7:55 AM

Exhibit Halls 2-3

J. Maxwell Chamberlain Memorial Paper for Congenital Heart Surgery Clinical Experience With the Bifurcated Y-Graft Fontan Procedure

K. R. Kanter¹, T. Slesnick¹, P. M. Trusty², M. Restrepo², A. P. Yoganathan²

¹Emory University, Atlanta, GA, ²Georgia Institute of Technology, Atlanta

REGULATORY DISCLOSURE This presentation describes the off-label use of an aorto-iliac bifurcated graft by Gore-Tex for a Fontan procedure, which is FDA-approved.

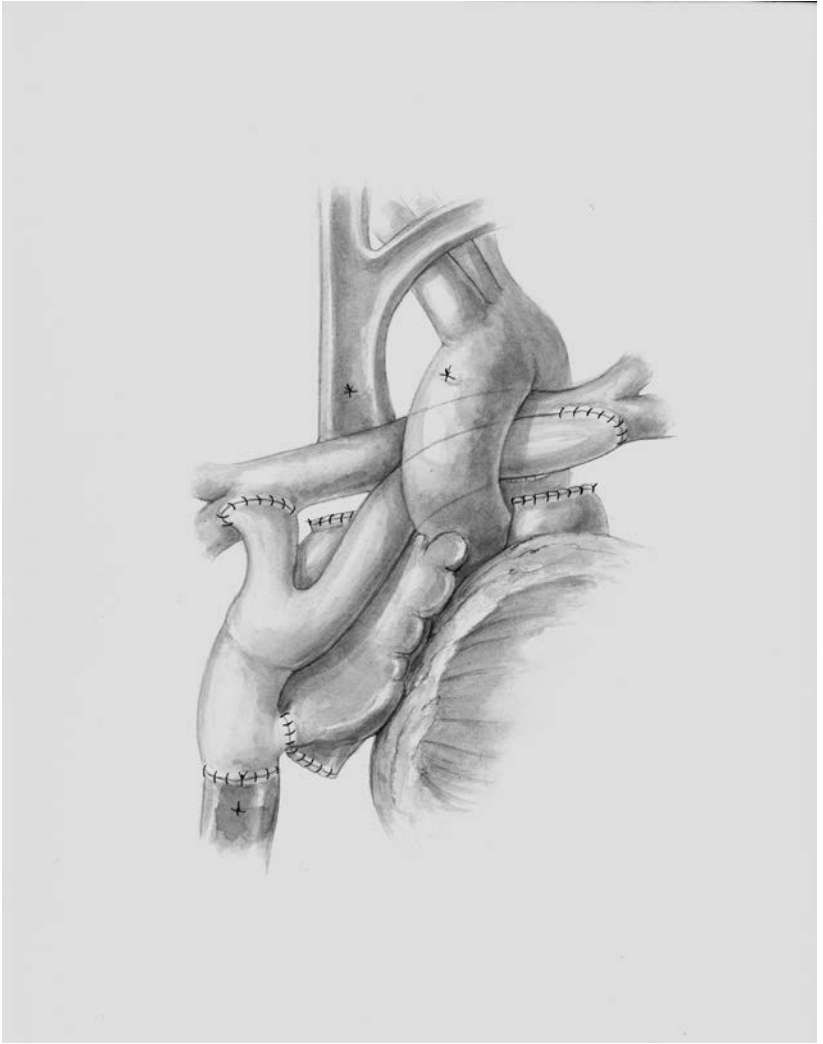
Discussant: Marshall L. Jacobs, Newtown Square, PA

Purpose: Based on improvements in Fontan flow dynamics predicted by computerized modeling, we used a commercially available polytetrafluoroethylene bifurcated Y-graft directing inferior vena caval (IVC) flow with separate graft limbs to the right and left pulmonary arteries (LPA). We present our clinical results with 45 children undergoing a Y-graft Fontan (Figure).

Methods: From August 2010 to May 2015, 45 children aged 1.5-18.9 years (median 3.6 years) weighing 9.8-59.3 kg (median 13.8 kg) had a completion Fontan (n=39) or a Fontan revision (n=6; five for pulmonary arteriovenous malformations) using a bifurcated polytetrafluoroethylene Y-graft (18x9 in five, 20x10 in 30, 22x11 in 10). Sixteen had prior Norwood palliation, nine had heterotaxy, three had interrupted IVC, and seven had bilateral superior vena cavae. All patients had a fenestration. Eight patients had additional procedures besides atrial septectomy or pulmonary arterioplasty. Postoperatively, Fontan baffle imaging was obtained by magnetic resonance imaging (n=38) or chest computed tomography (n=6).

Results: Median hospitalization was 7 days. There were no hospital deaths or Fontan takedowns. There were two early reoperations/reinterventions related to the Y-graft: one IVC anastomosis revision with thrombectomy and one stenting of a kinked left limb of the Y-graft. There were two Y-graft unrelated early reoperations: one LPA augmentation and one pacemaker for sick sinus syndrome (SSS) in a heterotaxy patient. Seventeen patients (38%) had pleural effusion readmissions 8-42 days postoperatively with no long-term recurrence. Early postoperative imaging showed a patent Y-graft Fontan in 39 patients, although native PA narrowing between the two Y-graft limbs was common. After 2-59 months follow-up (mean 2.3 years), there were two late deaths (ongoing liver failure in a patient with preoperative liver dysfunction and one relentless heart failure). One patient developed protein-losing enteropathy 2 years postoperatively and had distal pulmonary artery stents. One patient required a pacemaker for late SSS 1 year postoperatively.

Conclusions: This preliminary surgical experience demonstrates that the bifurcated Y-graft Fontan can be performed safely with good early clinical results in a heterogeneous group despite common early pleural effusions. Longer follow-up is required to determine if improved hemodynamics and flow distribution predicted by computational models will be realized in patients.

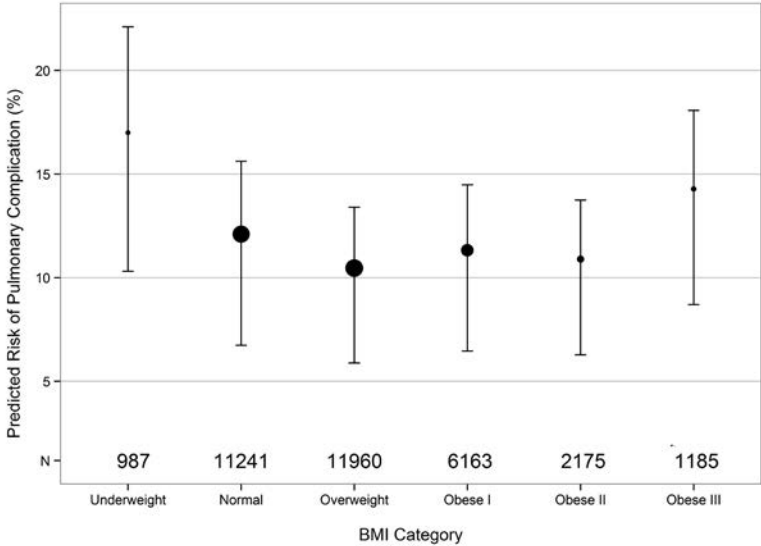


8:15 AM

Exhibit Halls 2-3

Richard E. Clark Memorial Paper for General Thoracic Surgery**Operative Risk for Major Lung Resection Increases at Extremes of Body Mass Index: Analysis of the STS General Thoracic Surgery Database**T. Williams¹, B. Gulack², S. Kim³, F. G. Fernandez⁴, M. K. Ferguson¹¹The University of Chicago, IL, ²Duke University, Durham, NC, ³Duke Clinical Research Institute, Durham, NC, ⁴Emory University, Atlanta, GA**COMMERCIAL RELATIONSHIPS** M. K. Ferguson: Other, The Society of Thoracic Surgeons, Elsevier B.V., Springer; Nonremunerative Position of Influence, CTSNet**Discussant:** Benjamin D. Kozower, Charlottesville, VA**Purpose:** Although body mass index (BMI) has been used in risk stratification for lung resection, many models only take obesity into account. Recent studies have demonstrated that underweight patients also experience increased postoperative complications. We explored the relationship between BMI extremes and outcomes after lung resection.**Methods:** Patients in the STS General Thoracic Surgery Database (2009-2014) undergoing elective anatomic lung resection for cancer were evaluated. Multivariable analysis was performed after adjusting for validated STS risk model covariates, including gender and spirometry.**Results:** We evaluated 41,446 patients (median age 68 years; 53% female) grouped by BMI: underweight (<18.5; 3.0%), normal (18.5-24.9; 33.5%), overweight (25.0-29.9; 35.4%), obese I (30.0-34.9; 18.1%), obese II (35.0-39.9; 6.4%), and obese III (≥ 40.0 ; 3.6%). Women were more often underweight than men (4.1% vs 1.8%, $P < .001$), and underweight patients more often had chronic obstructive pulmonary disease (51.7% vs 35.2%; $P < .001$). Predicted pulmonary complication rates were higher in the underweight and obese III patients after adjusting for covariates ($P < .001$; Figure). Being underweight also was associated with higher rates of infectious and any surgical complications. On multivariable analysis (Table), pulmonary and any postoperative complications were more common among underweight patients, while any major complication was more common among obese III patients. Any postoperative and pulmonary complications were less common among overweight and obese I-II patients compared to patients with a normal BMI.**Conclusions:** BMI is significantly associated with postoperative complications after anatomic lung resection for cancer. Being underweight or severely overweight is associated with an increased risk of complications, whereas being overweight or moderately obese appears to have a protective effect.

Figure: Predicted risk of pulmonary complications by BMI category (mean and interquartile range; the circle diameter indicates the relative number of patients in the cohort; adjusted for STS covariates including gender and spirometry).



Outcome	Operative mortality	Any major complication*	Any complication**	Pulmonary complication**
Underweight	1.12 (0.72,1.76)	1.10 (0.94,1.28)	1.44 (1.26,1.64)	1.41 (1.16,1.70)
Overweight	0.77 (0.64,0.93)	0.90 (0.85,0.97)	0.79 (0.74,0.83)	0.81 (0.74,0.88)
Obese I	0.85 (0.67,1.07)	0.94 (0.87,1.01)	0.77 (0.72,0.82)	0.87 (0.78,0.96)
Obese II	0.91 (0.64,1.29)	0.96 (0.85,1.09)	0.70 (0.63,0.78)	0.80 (0.68,0.93)
Obese III	1.35 (0.83,2.19)	1.18 (1.02,1.36)	0.89 (0.79,1.01)	1.12 (0.95,1.34)

Table: Multivariable analysis of outcomes related to BMI category, adjusted for STS risk model covariates. OR (95% CI); *p=0.003; **p<0.001; **bold** indicates significant difference compared to normal BMI

8:30 AM

Exhibit Halls 2-3

Richard E. Clark Memorial Paper for Adult Cardiac Surgery**Development of a Risk Prediction Model and Clinical Risk Score for Isolated Tricuspid Valve Surgery: Analysis of the STS Adult Cardiac Surgery Database**

D. LaPar¹, D. S. Likosky², M. Zhang², P. F. Theurer², C. E. Fonner³, J. A. Kern⁴, S. F. Bolling², D. H. Drake⁵, A. M. Speir⁶, J. B. Rich⁷, I. L. Kron⁸, R. L. Prager², G. Ailawadi⁴

¹University of Virginia, Charlottesville, ²University of Michigan Health System, Ann Arbor, ³Virginia Cardiac Surgery Quality Initiative, Charlottesville, ⁴University of Virginia Health System, Charlottesville, ⁵Cardiothoracic Surgeons of Grand Traverse, Traverse City, MI, ⁶Cardiac, Vascular & Thoracic Surgery Associates, Falls Church, VA, ⁷Virginia Cardiac Surgery Quality Initiative, Lenexa, KS, ⁸University of Virginia Medical Center, Charlottesville

COMMERCIAL RELATIONSHIPS G. Ailawadi: Consultant/Advisory Board, Edwards Lifesciences Corporation, Abbott Vascular; Nonremunerative Position of Influence, AtriCure, Inc; Speakers Bureau/Honoraria, St Jude Medical; S. F. Bolling: Consultant/Advisory Board, Abbott, Medtronic, Inc, LivaNova, AtriCure, Inc; Ownership Interest, Edwards Lifesciences Corporation, Millipede; D. S. Likosky: Consultant/Advisory Board, AmSECT; Research Grant, Agency for Healthcare Research and Quality, National Institutes of Health; A. M. Speir: Consultant/Advisory Board, Medtronic, Inc

Discussant: Michael A. Acker, Philadelphia, PA

COMMERCIAL RELATIONSHIPS M. A. Acker: Consultant/Advisory Board, Thoratec Corporation, HeartWare, Inc

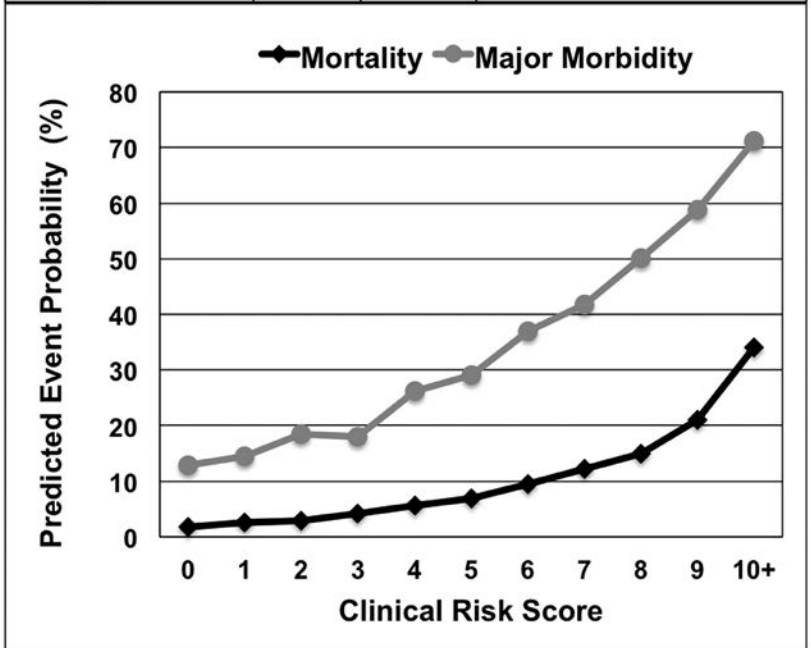
Purpose: While tricuspid valve (TV) operations remain associated with high mortality (~8%-10%), no robust prediction models exist to support clinical decision making. We sought to develop a preoperative clinical risk model with an easily calculable clinical risk score (CRS) to predict mortality and major morbidity after isolated TV surgery.

Methods: Multistate STS Adult Cardiac Surgery Database records were evaluated for 2,050 isolated TV repair and replacement operations for any etiology performed at 49 hospitals (2002-2014). Parsimonious preoperative risk prediction models were developed using multilevel mixed effects regression to estimate mortality and composite major morbidity risk. Model results were utilized to establish a novel CRS for patients undergoing TV operations. Models were evaluated for discrimination and calibration.

Results: Operative mortality and composite major morbidity rates were 9% and 42%, respectively. Final regression models performed well (both $P < .001$, AUC = 0.74 and 0.76) and included preoperative factors of age, gender, stroke, hemodialysis, ejection fraction, lung disease, NYHA class, reoperation, and urgent or emergency status (all $P < .05$). Importantly, a simple CRS from 0-10+ was highly associated ($P < .001$) with incremental increases in predicted mortality and major morbidity. Depending upon calculated total CRS, predicted mortality risk ranged from 2%-34%, and predicted major morbidity risk ranged from 3%-71% (Figure).

Conclusions: Mortality and major morbidity after isolated TV surgery can be predicted using preoperative patient data from the STS Adult Cardiac Surgery Database. A simple clinical risk score predicts mortality and major morbidity after isolated TV surgery. This score may facilitate perioperative counseling and identification of suitable patients for TV surgery.

Patient Factor	Mortality CRS	Major Morbidity CRS	Example Case
Age (years)			73 yo, female, moderate lung disease, NYHA Class III
50-59	0	1	
60-69	2	2	
70+	3	2	Total Mortality CRS: 3 + 1 + 1 + 2 = 7
Sex (Female)	1	1	
Stroke	2	1	Total Major Morbidity CRS: 2 + 1 + 1 + 2 = 6
Hemodialysis	4	1	
Chronic Lung Disease			
Moderate	1	1	Predicted Mortality = 12% (from graph below)
Severe	3	1	
Ejection Fraction < 55%	0	2	Predicted Major Morbidity = 37% (from graph below)
NYHA Class			
Class III	2	2	
Class IV	3	3	
Reoperation Status			
Emergent	4	9	



MONDAY MORNING

Richard E. Clark Memorial Paper for Congenital Heart Surgery
Prevalence of Noncardiac and Genetic Abnormalities in Neonates Undergoing Surgery for Congenital Heart Disease: Analysis of the STS Congenital Heart Surgery Database

A. Patel¹, J. M. Costello¹, C. L. Backer¹, S. K. Pasquali², K. Hilf¹, A. Wallace³, J. P. Jacobs⁴, M. L. Jacobs⁵

¹Ann & Robert H. Lurie Children's Hospital of Chicago, IL, ²University of Michigan, Ann Arbor,

³Duke Clinical Research Institute, Durham, NC, ⁴Johns Hopkins All Children's Heart Institute, St Petersburg, FL, ⁵Johns Hopkins School of Medicine, Newtown Square, PA

Discussant: Peter J. Gruber, Iowa City, IA

Purpose: For patients with congenital heart disease (CHD), the coexistence of noncardiac congenital anatomic abnormalities (NC), genetic abnormalities (GA), and syndromes (S) may influence therapeutic strategies, risk of mortality, and quality of life. The appreciated prevalence of these abnormalities has risen secondary to increased screening and advances in diagnostic precision.

Methods: The Society of Thoracic Surgeons Congenital Heart Surgery Database (CHSD) was queried to identify neonates (≤ 30 days) who underwent an index cardiac operation from January 1, 2010, to December 31, 2013, at North American centers. The patient's fundamental diagnosis, defined by the CHSD as the most complex cardiac anomaly or condition, was used to identify 11 diagnostic groups. This study aims to examine the prevalence and distribution of NC/GA/S across specific diagnostic groups among neonates undergoing cardiac surgery.

Results: The cohort included 15,376 index neonatal operations from 112 centers. Table 1 shows diagnostic groups with prevalence of any NC/GA/S abnormality. Overall 18.8% (2,894/15,376) of neonatal operations were performed on patients with NC/GA/S. As expected, patients with single ventricle/heterotaxy, atrioventricular septal defect, and conotruncal anomalies have a high prevalence of NC/GA/S abnormalities. However, some groups, such as coarctation of the aorta, have a higher prevalence of NC/GA/S than what is generally presumed. Transposition of the great arteries has a much lower prevalence than the other diagnostic groups. Neonates with non-hypoplastic left heart syndrome (HLHS) single ventricles have more abnormalities when compared with HLHS. The most commonly identified NC/GA/S included heterotaxy (3.9%), DiGeorge/22q11 deletion (3.6%), Down syndrome/trisomy 21 (2.1%), intestinal malrotation (1.4%), and Turner syndrome/45XO (1.2%).

Conclusions: In this large, multicenter study, the prevalence of NC/GA/S in neonates undergoing cardiac surgery varies widely (4%-100%) across CHD diagnostic groups. The large variation in prevalence makes this information very important for patient counseling, recommendations for screening for anomalies and genetic disorders, and perioperative management.

Table 1. Prevalence of non-cardiac congenital anatomic abnormalities (NC), genetic abnormalities (GA), and syndromes (S) in neonates who underwent cardiac surgery.

Diagnosis*	N = 15,376 (%)	N = 2,894 (%) with NC/GA/S
Single Ventricle/Biateraxial	281 (1.8)	281 (100)
AVSD	357 (2.3)	212 (59.4)
IAA	567 (3.7)	248 (43.7)
Truncus Arteriosus	554 (3.6)	204 (36.8)
TOF	1383 (9.0)	417 (30.2)
DORV	658 (4.3)	140 (21.3)
Single Ventricle/Non-HLHS	1866 (12.1)	346 (18.5)
COA	3454 (22.5)	538 (15.6)
TAPVC	879 (5.7)	103 (11.7)
HLHS	2599 (16.9)	294 (11.3)
TGA	2778 (18.1)	111 (4.0)

*Diagnosis is based upon the patient's fundamental diagnosis defined as the most complex cardiac anomaly or condition. The groups are therefore mutually exclusive.

AVSD, atrioventricular septal defect; COA, coarctation of the aorta; DORV, double outlet right ventricle; HLHS, hypoplastic left heart syndrome; IAA, interrupted aortic arch; TAPVC, total anomalous pulmonary venous connection; TGA, transposition of the great arteries; TOF, tetralogy of Fallot

9:00 AM

BREAK—Visit Exhibits and Scientific Posters

Complimentary coffee available in the Exhibit Hall

9:40 AM

Exhibit Halls 2-3

Introduction of the President

Joseph E. Bavaria, Philadelphia, PA

COMMERCIAL RELATIONSHIPS J. E. Bavaria: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, COOK Medical, Boston Scientific, W. L. Gore & Associates, St Jude Medical

9:50 AM

Exhibit Halls 2-3

Presidential Address: Innovation for Life

Mark S. Allen, Rochester, MN

COMMERCIAL RELATIONSHIPS M. S. Allen: Nonremunerative Position of Influence, Joint Council on Thoracic Surgery Education

10:50 AM – 11:30 AM

BREAK—Visit Exhibits and Scientific Posters

Complimentary coffee available in the Exhibit Hall

11:30 AM – 12:30 PM

Room 120D

Adult Cardiac Session: Arrhythmia

Moderators: Richard Lee, St Louis, MO, and Jonathan M. Philpott, Norfolk, VA

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold**.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

11:30 AM

Room 120D

Left-Sided Surgical Ablation for Patients With Atrial Fibrillation Undergoing Concomitant Cardiac Surgery

N. Ad, S. Holmes, D. Lamont, D. Shuman

Inova Heart and Vascular Institute, Falls Church, VA

COMMERCIAL RELATIONSHIPS N. Ad: Consultant/Advisory Board, AtriCure, Medtronic, Inc; Ownership Interest, Left Atrial Appendage Occlusion, LLC; Speakers Bureau/Honoraria, AtriCure, Medtronic, Inc

Purpose: There is growing evidence that surgical ablation for atrial fibrillation (AF) confined to the left atrium (LA) can be effective, especially with short AF duration and smaller LA. The purpose of this study was to examine predictors for failure in this interesting group of patients during 2 years after surgery.

Methods: Of 914 patients who underwent surgical ablation (2005–2015), 115 had ablation confined to the LA. Rhythm status was defined per Heart Rhythm Society guidelines as sinus rhythm (SR) off class I/III antiarrhythmic drugs (AAD). Multivariate analyses examined predictors for SR off AAD (n=101). Predictors for failure were stratified as age ≥ 75 , LA size ≥ 5 cm, AF duration ≥ 5 years, and non-PAF type for further descriptive analyses.

Results: Mean age was 69.8 years \pm 10.3 years, mean EuroSCORE II was 4.7% \pm 4.3%, mean LA size was 4.5 cm \pm 1.1 cm, median (IQR) AF duration was 5 (0.4–27) months, 24% female, 57% had coronary artery bypass grafting surgery, 37% had aortic valve, and 27% had mitral valve surgery. Return to SR off AAD at 6/12/24 months was 79% (67/85), 85% (67/79), and 74% (49/66). The only independent predictor for SR off AAD at 6 months was smaller LA size (OR = 0.43, $P = .04$). Each 1-cm increase in LA size reduced odds for SR off AAD by 57%. Return to SR off AAD at 6/12/24 months was respectively 92%/83%/86% for patients with no traditional predictors for failure (n=14), 81%/88%/77% for those with one predictor (n=49), and 71%/81%/68% for those with ≥ 2 predictors (n=38). In pulmonary vein isolation only, SR off AAD for large LA or long AF duration vs neither was 64% vs 85% at 6 months ($P = .19$) and 75% vs 88% at 12 months ($P = .32$).

Conclusions: This study demonstrated that limited LA ablation in patients with shorter AF duration and smaller LA resulted in acceptable success rates. However, a significant reduction in success was demonstrated in patients who had traditional predictors for failure, suggesting that a full Cox-Maze lesion set should be applied to achieve better outcomes.

NOTES

11:45 AM

Room 120D

Biatrial or Left Atrial Lesion Set for Ablation During Mitral Surgery: Risks and Benefits

A. Churyla¹, P. M. McCarthy², J. Kruse¹, A. Andrei¹, S. C. Malaisrie³, Z. Li¹, H. Russell¹, R. Passman¹

¹Northwestern Memorial Hospital, Chicago, IL, ²Northwestern University/Northwestern Memorial Hospital, Chicago, IL, ³Northwestern University, Chicago, IL

COMMERCIAL RELATIONSHIPS S. C. Malaisrie: Consultant/Advisory Board, Edwards Lifesciences Corporation, Baxter; Nonremunerative Position of Influence, ABIOMED; Speakers Bureau/Honoraria, Bolton Medical, Inc; P. M. McCarthy: Consultant/Advisory Board, Edwards Lifesciences Corporation, Abbott Vascular; Ownership Interest, Edwards Lifesciences Corporation; R. Passman: Speakers Bureau/Honoraria, Medtronic, Inc; H. Russell: Speakers Bureau/Honoraria, Edwards Lifesciences Corporation

Purpose: A recent randomized trial in mitral valve (MV) surgery patients questioned the need to create biatrial lesions for atrial fibrillation (AF) ablation during MV surgery, as have prior reports. We hypothesized there would be equivalent results in MV surgery patients receiving biatrial (BA) compared to left atrial (LA) lesions.

Methods: 2,137 patients had MV + other surgeries from 2004 through 2014 in a single center. Of these, 838 (39%) had preoperative AF, and, of these, 724 (86%) had AF ablation surgery. Of these, 257 patients had BA and 359 had LA lesions. No AF surgery was performed at the surgeon's discretion in those with remote isolated AF thought to be unrelated to MV disease, or those judged to be futile (eg, calcified LA with decades of AF). Propensity score matching of BA and LA lesions was performed due to baseline differences.

Results: Several baseline differences were corrected after propensity score matching 34 characteristics (Table 1). Unmatched results indicated more pacemaker use in BA patients (34/257, 13% vs 24/359, 7%; $P = .006$). After propensity score matching, there were no statistically significant differences in perioperative outcomes, freedom from AF off antiarrhythmics (71/92, 77% vs 67/100, 67%; $P = .12$), Coumadin use (71/135, 53% vs 74/133, 56%; $P = .62$), or annualized cerebrovascular accident rate. Subsequent radiofrequency ablation was performed more commonly after BA (11% vs 4.7%; $P = .015$) and recurrent AF arose from the mitral isthmus predominantly. There were no failures mapped to the right atrial appendage (RAA) and there was one pro-arrhythmic area after superior vena cava (SVC) ablation.

Conclusions: Perioperative outcomes of BA and LA lesions are similar. Over time, we abandoned SVC and RAA lesions without failure mapped to these locations. LA lesions were modestly, not statistically, less effective at AF ablation and are an acceptable alternative to more complex lesions.

Table 1 Variable	Unmatched		P	Propensity Score Matched
	BA (N=257)	LA (N=359)		BA vs LA pairs (N=147)
Age, years	69 + 11	68 + 11	0.29	68 vs 68 p=0.81
AF duration in years, median (Q1, Q3)	4.0 (1.0,10.5)	1.0 (0.5,5.0)	<.001	3 vs 2 p=0.23
LA size, cm	4.8	4.6	0.039	4.7 vs 4.9 p=0.12
Tricuspid Valve Surgery	158 (61%)	92 (24%)	<.001	69% vs 67% p=0.82
Persistent/Longstanding Persistent	171 (67%)	136 (38%)	<.001	57% vs 58% p=0.78
Pacemaker pre-discharge	34 (13%)	24 (7%)	0.006	12% vs 10% p=0.57
30 day Mortality	7 (3%)	7 (2%)	0.53	3% vs 3% p=1.00
Freedom from AF off antiarrhythmics	115/166 (69%)	163/220 (74%)	0.30	77% : 67% p=0.12
Coumadin at last follow up	128/236 (54%)	165/320 (52%)	0.53	53% vs 56% p=0.61
Stroke Rate per 10 Person/year	0.11	0.11	0.91	0.08 vs 0.07 p=1.00

12:00 PM

Room 120D

Atrial Fibrillation Ablation Does Not Increase Operative Risk When Added to Coronary Artery Bypass Grafting and Aortic Valve Replacement

*T. Al-Atassi, D. Kimmaliardjuk, C. Dagenais, B. Lam, M. Bourke, F. D. Rubens
University of Ottawa Heart Institute, Canada*

Purpose: Previous studies assessing outcomes after surgical atrial fibrillation (AF) ablation as a concomitant procedure failed to utilize a control cohort of patients with AF who do not undergo ablation during surgery. This study evaluates the safety and efficacy of concomitant AF ablation in patients with AF undergoing coronary artery bypass grafting (CABG) surgery and/or aortic valve replacement (AVR).

Methods: This is a single-center retrospective study of prospectively collected data. All patients with AF presenting for CABG, AVR, or combined CABG and AVR between 2009 and 2013 were included. These patients were divided into a group that underwent concomitant AF ablation (intervention group) and a group that did not (control group). Preoperative, operative, and postoperative data were obtained on all patients. Follow-up data were obtained using telephone interviews with patients or their physicians. The data were 100% complete with a median follow-up time of 30 months.

Results: A total of 375 patients with AF presented for isolated CABG (44%), isolated AVR (27%), or combined CABG and AVR (29%). The intervention (129 patients) and control (246 patients) groups had similar baseline and operative characteristics. The intervention group had significantly longer surgery, cardiopulmonary bypass, and cross clamp times, adding a mean of 32 ± 5 , 31 ± 3 , and 22 ± 3 minutes, respectively. The intervention vs control groups had similar unadjusted rates of hospital mortality (4.7% vs 5.3%, $P = .791$), stroke (3.1% vs 3.3%, $P = .937$), and reopening (4.7% vs 6.9%, $P = .463$). The intensive care and hospital length of stays were similar. The intervention group had significantly lower postoperative AF (27% vs 78%, $P < .0001$). Adjusted operative mortality was not significantly different, but the intervention group had significantly lower odds of postoperative AF (OR 0.07; $P < .001$). Patients undergoing concomitant AF ablation had greater freedom from AF recurrence ($P < .001$) and a non-significant decrease in long-term anticoagulation ($P = .074$). There were no differences in long-term or stroke-free survival.

Conclusions: To date, this represents the largest contemporary data demonstrating that patients undergoing isolated CABG, AVR, or combined CABG/AVR with a history of AF can undergo concomitant AF ablation without increased surgical risk. Moreover, surgical AF ablation in this patient population is effective at reducing postoperative AF burden.

12:15 PM

Room 120D

Panel Discussion: Optimal Lesion Set for Atrial Fibrillation

A. Marc Gillinov, Cleveland, OH

COMMERCIAL RELATIONSHIPS A. M. Gillinov: Consultant/Advisory Board, On-X Life Technologies, Inc, Edwards Lifesciences Corporation, Tendyne Holdings, Inc, Abbott Laboratories; Ownership Interest, ClearFlow, Inc; Speakers Bureau/Honoraria, AtriCure, Inc, Medtronic, Inc, St Jude Medical

NOTES

11:30 AM – 12:30 PM

Room 126ABC

Basic Science Research: Adult Cardiac

Moderators: T. Brett Reece, Aurora, CO, and Y. Joseph Woo, Stanford, CA

COMMERCIAL RELATIONSHIPS T. B. Reece: Research Grant, Bard, Inc, Bolton Medical, Inc

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Presenting authors are listed in **bold**.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

11:30 AM

Room 126ABC

Biodegradable Cardiac Patch Seeded With Human-Induced Pluripotent Stem Cell-Derived Cardiomyocytes Promoted the Regeneration of Host Cardiomyocytes

T. Sugiura¹, T. Yi¹, S. Tara¹, N. Hibino², C. K. Breuer¹, T. Shinoka¹

¹Nationwide Children's Hospital, Columbus, OH, ²The Johns Hopkins Hospital, Baltimore, MD

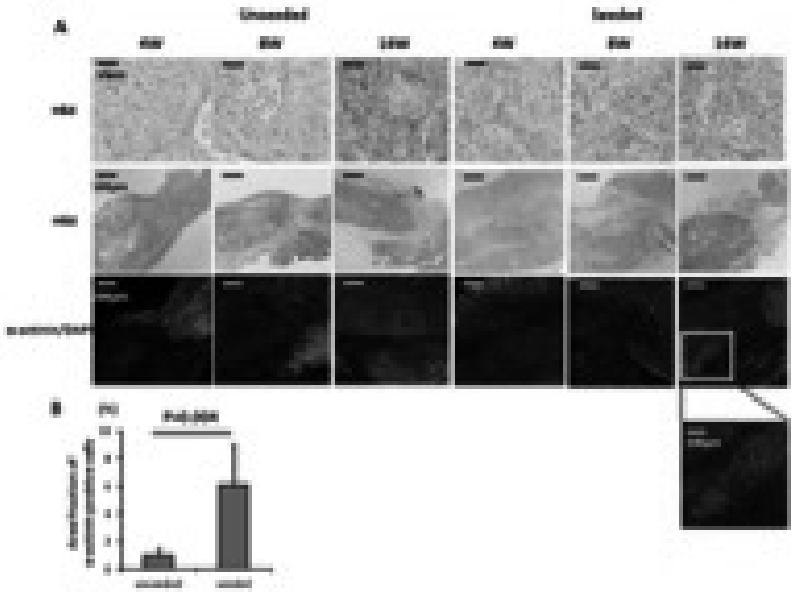
COMMERCIAL RELATIONSHIPS C. K. Breuer: Consultant/Advisory Board, COOK Medical; Ownership Interest, Pall Corporation, Yale University, Nationwide Children's Hospital; Research Grant, Pall Corporation, GUNZE LIMITED; T. Shinoka: Research Grant, GUNZE LIMITED

Purpose: The purpose of the present study was to evaluate the feasibility of seeding terminally differentiated human-induced pluripotent stem cell-derived cardiomyocytes (hiPS-CM) onto a biodegradable cardiac patch composed of polyglycolic acid and ε-caprolactone/L-lactide (PGA-PLCL) for the repair of pediatric right ventricular outflow tract (RVOT) anomalies.

Methods: The hiPS-CMs were cultured on a biodegradable patch (6.0 mm diameter) composed of PGA-PLCL at a density of 2.0×10^5 cells for 1 week. Male athymic rats were divided randomly into two groups of 10 animals each: a hiPS-CM seeded group and an unseeded group. After culture, the cardiac patch was implanted to repair a 2 mm diameter defect created in the RVOT wall. Hearts were explanted at 4 (n=2), 8 (n=2), and 16 (n=6) weeks after patch implantation.

Results: Over the course of 16 weeks, the PGA-PLCL patch gradually degraded and remodeled into vascularized collagenous tissue in both the seeded and unseeded groups. Seeded patch explants did not stain positive for α-actinin at the 4-week time point, suggesting that the cultured hiPS-CMs evacuated the patch in the early phase of tissue remodeling. However, after 16 weeks implantation, the area fraction of positively stained α-actinin cells was significantly higher in the seeded group than in the unseeded group ($6.1\% \pm 2.8\%$ and $0.95\% \pm 0.50\%$, respectively, $P = .004$), suggesting cell seeding promoted regenerative proliferation of host cardiomyocytes. Echocardiography showed no significant dilatation or stenosis of the RVOT in either group.

Conclusions: In conclusion, seeded hiPS-CMs were not present in the patch after 4 weeks. However, we surmise that they influenced the regeneration of host cardiomyocytes via a paracrine mechanism. Bioengineered hiPS-CM seeded PGA-PLCL cardiac patches warrant further investigation for use in the repair of RVOT anomalies in congenital heart disease.



11:40 AM

Room 126ABC

The Impact of Mechanical Properties on Wall Stress in Failed Pulmonary AutograftsY. Xuan¹, A. D. Wisneski¹, A. Mookhoek², P. H. Schoof³, J. Takkenberg², L. Ge⁴, E. E. Tseng¹¹University of California, San Francisco Medical Center and San Francisco VA Medical Center,²Eramus University Medical Center, Rotterdam, The Netherlands, ³University Medical Center Utrecht, The Netherlands, ⁴San Francisco VA Medical Center, CA**COMMERCIAL RELATIONSHIPS** E. E. Tseng: Research Grant, National Institutes of Health, University of California; Ownership Interest, ReValve Med

Purpose: Failed autografts requiring reoperation exhibit remodeling with changes in material properties. We previously investigated autograft biomechanics immediately after Ross procedure prior to remodeling. Our objective in this study was to determine impact of changes in autograft material properties on wall stress in failed autografts explanted during reoperation after Ross procedure.

Methods: We previously created a normal human pulmonary autograft model using micro-computed tomography images for zero-pressure geometry. Failed autograft tissues were obtained from patients requiring reoperation after Ross procedure. In this study, we incorporated patient-specific zero-pressure wall thickness and material properties from failed autografts to develop failed autograft models. An Ogden hyper-elastic model was used to describe failed autograft mechanical properties for adult Ross patients. Autograft dilatation and wall stress distribution were determined at systemic pressures using finite element analyses in LS-DYNA.

Results: The average diameters of failed autografts were $38.98 \text{ mm} \pm 6.99 \text{ mm}$ at systemic pressure. Distensibility, the average change in diameter from diastole to systole, was 2.26 mm (5.88%) for sinuses and 2.47 mm (6.64%) for sinotubular junction. Throughout the cardiac cycle, maximum Von Mises wall stresses occurred at systole. Average maximal wall stresses were $87.77 \text{ kPa} \pm 41.57 \text{ kPa}$ and $149.75 \text{ kPa} \pm 88.83 \text{ kPa}$, respectively, in diastole and systole, in the sinuses and were $114.11 \text{ kPa} \pm 58.95 \text{ kPa}$ and $197.14 \text{ kPa} \pm 127.34 \text{ kPa}$, respectively, in sinotubular junction (Figure). Both wall thickness and compliance at low strain inversely were related to maximum stress, while compliance directly correlated with autograft diameter.

Conclusions: We examined the impact of failed autograft material properties and wall thickness on wall stress. Increased compliance resulted in decreased maximum wall stress and increased dilatation at low strain while the effect of wall thickness was less dominant. Understanding remodeling in autografts will be valuable to assess patient-specific risk of autograft dilatation.

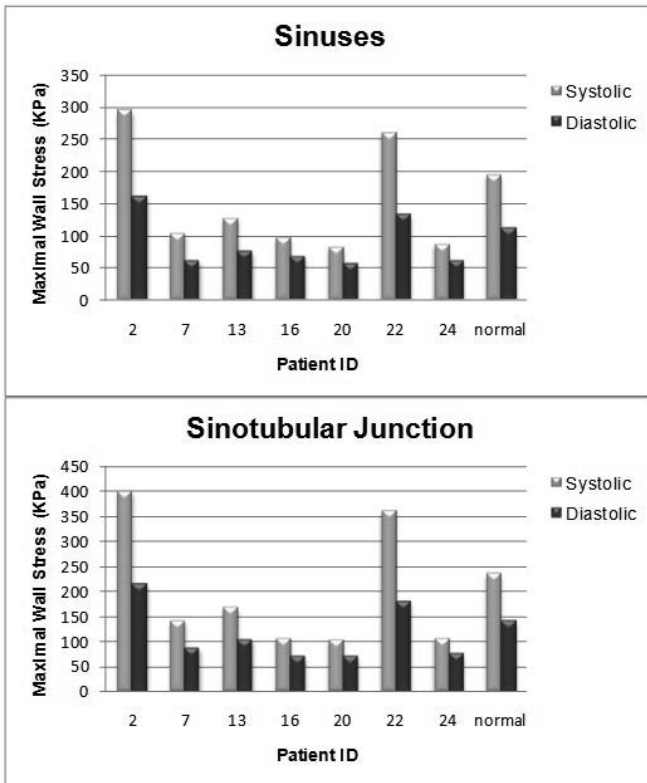


Figure 1. Maximal wall stress in sinuses and sinotubular junction from 7 failed and one normal pulmonary autografts.

11:50 AM

Room 126ABC

Modeling Aortic Valve Insufficiency and Aortic Valve Repair: Applications From Bench to the Operating Room

H. D. Toeg, M. Chamberland, R. Jafar, T. Al-Atassi, M. Labrosse, B. Sobmer, M. Boodhwani
University of Ottawa Heart Institute, Canada

Purpose: Aortic valve repair (AVr) has become an attractive alternative for the correction of aortic insufficiency (AI) as compared to aortic valve replacement. The objective of this study was to measure and compare hemodynamic and echocardiographic properties in a novel, ex vivo model of severe acute AI due to cusp pathology followed by valve repair.

Methods: Porcine aortic roots with intact aortic valves were placed in a left heart simulator mounted with a high-speed camera for baseline hemodynamic assessment. Each porcine root underwent three separate evaluations: 1) a baseline “control” assessment, 2) an AI “lesion” assessment, and 3) AVr “treatment” assessment. Two models of AI followed by respective AVr were studied. All cusp replacements were performed with a pericardial patch. Hemodynamic and echocardiographic data were expressed as medians with interquartile ranges. Finite element modeling (FEM) was performed in both models to understand stress characteristics.

Results: The cusp perforation model (model 1) demonstrated a significant increase in the regurgitant fraction after AI was created (control = 5.2% [5, 5.6] vs AI = 50.1% [49, 53]; $P = .04$) and returned to baseline “control” levels after AVr (AVr = 11.7% [7.1, 11.8]; $P = .14$). As compared to the respective controls, the AI assessment also demonstrated reductions in cardiac output by 39% ($P = .04$), valve opening velocity ($P = .04$), valve closing velocity ($P = .07$), slow closing velocity ($P = .04$), and a significant increase in left ventricular work by 146% ($P = .04$). The cusp excision and repair model (model 2) demonstrated similar results to model 1. Table demonstrates no significant differences in all measured parameters when comparing model 1 vs model 2 after valve repair. Figure 1 summarizes the findings with FEM and leaflet stresses.

Conclusions: We successfully simulated acute AI (RF >50%) and repair in an ex vivo left heart simulator along with 3-dimensional echocardiography (Table). Despite different mechanisms of AI and repair, the final combined leaflet stresses after valve repair were similar (+24%), implicating that residual leaflet stress may account for AVr failure.

Figure 1: Summary of FEM stress changes in both models from baseline/control after inducing AI and AVr. Blue bars represent combined leaflet stresses.

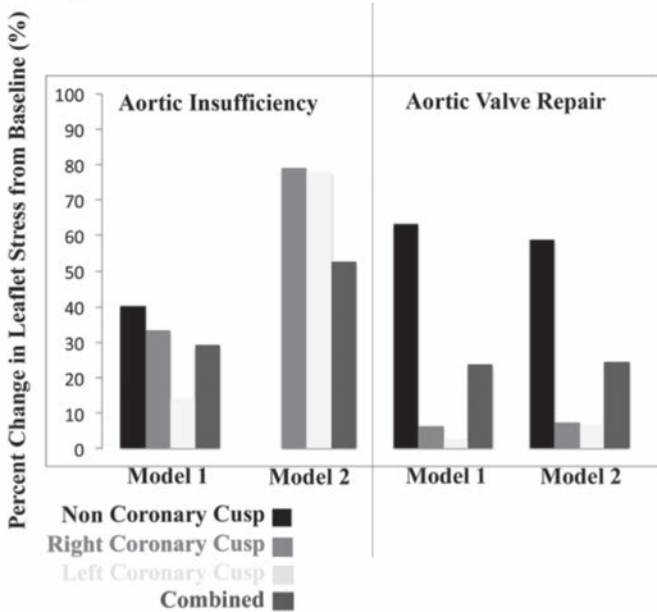


Table 1: Hemodynamic parameters after aortic valve repair comparing both model 1 (cusp perforation) and model 2 (cusp excision and replacement).

	Regurgitant fraction (%)	Coaptation surface area (cm ²)	Regurgitant Orifice Area (mm ²)	Geometric orifice area (cm ²)	Left Ventricular Work (J)	Opening Velocity (cm/s)	Closing Velocity (cm/s)	Slow Closing Velocity (cm/s)
Model 1	11.7 (8,13.6)	1.35 (1.31,1.95)	0.1 (0,0.01)	6.97 (5.41,7.78)	1219 (1173,1321)	139 (84,149)	53 (45,60)	4.1 (2.6,4.4)
Model 2	10.4 (9.7,10.9)	1.59 (1.26,1.59)	0 (0,0.1)	7.16 (6.6,8.9)	1143 (1086,1143)	83 (52,125)	49 (45,65)	5.6 (1.8,9.3)
p-value	0.92	0.75	0.91	0.75	0.09	0.21	0.67	0.92

12:00 PM

Room 126ABC

Accelerated In Situ Constructive Myocardial Remodeling Process of an Extracellular Matrix Cardiac Patch With Sustained Direct Delivery of a Growth Factor

T. Ota¹, A. Tanaka¹, K. Kawaji¹, A. Patel¹, Y. Tabata², M. P. Gupta¹

¹The University of Chicago, IL, ²Kyoto University, Japan

COMMERCIAL RELATIONSHIPS A. Patel: Consultant/Advisory Board, Koninklijke Philips N.V.

Purpose: A unique controlled-release mechanism that provides sustained direct delivery of a basic fibroblast growth factor (bFGF) was incorporated with a tissue-engineered cardiac patch and assessed for whether it expedites the process of in situ myocardial regeneration in a porcine preparation.

Methods: A sustained delivery system of bFGF was embedded in an extracellular matrix (ECM) patch derived from porcine small intestine submucosa. The bFGF incorporated patch was surgically implanted into the porcine right ventricle (Group B, n=5). Untreated ECM (Group U, n=5) served as control. Cardiovascular magnetic resonance was performed after 60 days to evaluate extent of fibrosis/edema with extracellular volume (ECV) fraction, regional contractility with peak longitudinal strain, and tissue perfusion with relative maximum upslope. Extracted tissues were further analyzed with immunohistochemistry and qRT-PCR.

Results: Tissue perfusion was significantly improved in Group B compared to Group U (relative maximum upslope: Group B = 13.7 ± 1.1 , Group U = 10.8 ± 1.3 , $P = .006$), which was also confirmed by a significantly greater degree of vasculogenesis determined by capillary density analysis (Group B = $19.5 \pm 6.2/\text{mm}^3$, Group U = $12.7 \pm 2.5/\text{mm}^3$, $P < .001$). Group B had relatively greater regional contractility compared to Groups U (peak strain: Group B = -16.6 ± 1.8 , Group U = -14.7 ± 1.2 , $P = .087$). ECV in the two groups did not differ (Group B = $45\% \pm 7\%$, Group U = $54\% \pm 10\%$, $P = .126$). Histology in Group B showed homogenous distribution of repopulated host cells including those positive tropomyosin and α -sarcomeric actinin, which implied the presence of maturing cardiomyocytes, while the cell distribution of Group U was scattered and limited to the area around the ECM patch. qRT-PCR demonstrated that the expressions of β -myosin heavy chain, a marker for the early developmental stage of cardiomyocyte, were significantly positive in Group B ($P = .006$) compared to Group U.

Conclusions: The study showed that the reparative pathways of both patches were similar; however, the histological and functional remodeling process was in a more matured phase in the bFGF incorporated patch. The bFGF sustained direct delivery system might contribute to accelerating in situ myocardial regeneration in the ECM patch.

12:10 PM

Room 126ABC

Alternative Therapeutic Strategy for Aortic Aneurysm Using Mesenchymal Stem Cell-Derived Exosomes

M. Kozakai, A. Usui, Y. Narita, H. Oshima, H. Ito, M. Mutsuga, T. Abe, Y. Araki, K. Fujimoto, S. Terazawa, A. Yamawaki-Ogata

Nagoya University Graduate School of Medicine, Japan

Purpose: We have reported that intravenous injection of bone marrow-derived mesenchymal stem cells (MSCs) reduces the incidence of aortic aneurysm (AA). Recently, several studies have demonstrated that MSC-derived exosomes have anti-inflammatory properties like MSCs. Thus, we verified the effects of MSC-derived exosomes for treatment of AA.

Methods: The exosomes were collected by ultracentrifugation and characterized by flow cytometry. In vitro, activated macrophages or aortic smooth muscle cells (SMCs) were incubated with or without exosomes and quantitative RT-PCR was performed to investigate expression of an AA-related gene. In vivo, the AA-induced mice (angiotensin II administrated apolipoprotein E knockout mice, control group, n=10) were intravenously injected with exosomes (n=5, exosome group) or saline as a control (n=5, saline group). Two weeks later, the mice were sacrificed and evaluated for the maximum aortic diameter, incidence of AA, and MMP enzymatic activities.

Results: The exosomes had the specific surface markers CD9 and CD81. In vitro, the gene expressions of IL-1 β (exosome group 0.3 vs control group 3.1, $P < .05$), TNF- α (0.2 vs 0.6, $P < .05$), MMP-2 (1.1 vs 1.9, $P < .05$), and MMP-9 (1.3 vs 2.1, $P < .05$) of the macrophages with exosomes were significantly decreased. The gene expression of TIMP-2 (1.3 vs 0.8, $P < .005$) of SMCs with exosomes was significantly increased. In vivo, the aortic diameter was significantly smaller in the exosome group than in the saline group (1.1 mm vs 2.9 mm, $P < .01$). The incidence of AA was decreased in the exosome group compared with the saline group. Pro- and active-MMP-9 activities were significantly decreased in the exosome group compared with the saline group (pro-MMP-9: 0.46 vs 0.99, $P < .05$, active-MMP-9: 0.24 vs 0.84, $P < .05$).

Conclusions: These results suggest that exosomes from MSCs might be a novel alternative therapeutic tool for treatment of AA. Further investigation is needed to identify the optimal injection dose, frequency, and timing of exosome administration to achieve a sustained effect.

12:20 PM

Room 126ABC

Novel Tissue-Engineered Vascular Graft With Highly Porous Sponge-Type Scaffold as a Small-Diameter Arterial Graft

T. Sugiyama¹, S. Tara¹, H. Nakayama², H. Kurobe³, T. Yi¹, Y. Lee¹, N. Hibino⁴, C. K. Breuer¹, T. Shinoka¹

¹Nationwide Children's Hospital, Columbus, OH, ²Gunze Limited, Kyoto, Japan, ³Tokushima University, Chiba-Nishi General Hospital, Japan, ⁴The Johns Hopkins Hospital, Baltimore, MD

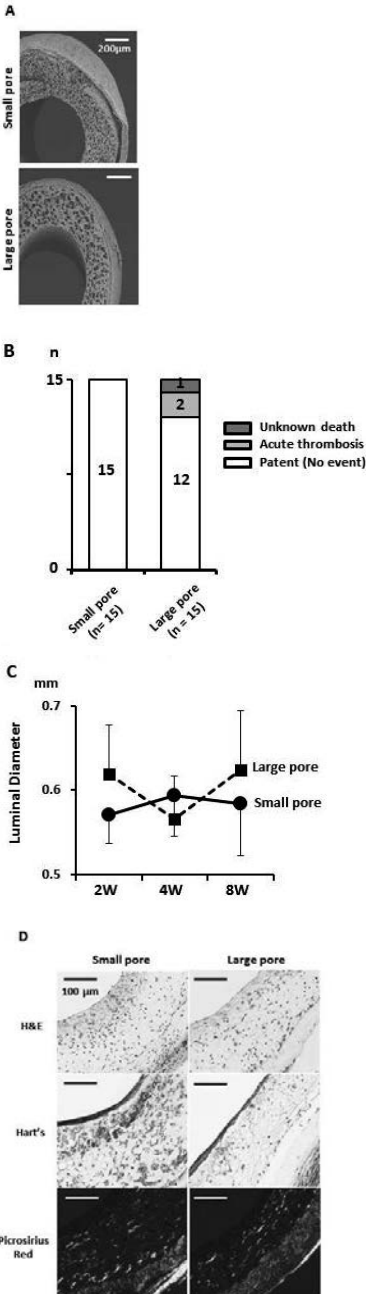
COMMERCIAL RELATIONSHIPS C. K. Breuer: Consultant/Advisory Board, COOK Medical; Research Grant, Pall Corporation, GUNZE LIMITED; Ownership Interest, Pall Corporation, Yale University, Nationwide Children's Hospital; T. Shinoka: Research Grant, GUNZE LIMITED

Purpose: Current commercialized small-diameter arterial grafts have not shown clinical effectiveness due to their poor patency rates. The purpose of the present study was to evaluate the feasibility of a novel tissue-engineered vascular graft (TEVG), with a highly porous sponge-type scaffold, as a small-diameter arterial conduit.

Methods: The TEVGs were constructed by a 50:50 poly (l-lactic-co-ε-caprolactone) copolymer (PLCL) scaffold reinforced by a poly (l-lactic acid) (PLA) nano-fiber. The pore size of the PLCL scaffold was adjusted to a small size (12.8 μm ± 1.85 μm) or a large size (28.5 μm ± 5.25 μm). We compared the difference in cellular infiltration followed by tissue remodeling between the groups. The TEVGs were implanted in 8-10-week-old female mice (n=15 in each group) as infrarenal aortic interposition conduits. Animals were followed for 8 weeks and sacrificed to evaluate neotissue formation.

Results: All mice in the small pore group survived without any complications. In the large pore group, one mouse died of undetermined causes and acute thrombosis occurred in two mice. No aneurysmal change or graft rupture was observed in either group. Histologic assessment demonstrated favorable cell infiltration into scaffolds, neointimal formation with endothelialization, smooth muscle cell proliferation, and elastin deposition in both groups. No significant difference was observed between the groups. Immunohistochemical characterization with anti-F4/80 antibody demonstrated that macrophage infiltration into the TEVG occurred in both groups. Staining for M1 and M2, which are the two major macrophage phenotypes, showed no significant difference between groups (iNOS, small pore group: 1.45 ± 0.32 x10³/mm² vs large pore group: 1.35 ± 0.22 x10³/mm², P = .55; CD206, small pore group: 1.17 ± 0.42 x10³/mm² vs large pore group: 1.08 ± 0.23 x10³/mm², P = .68).

Conclusions: Our novel TEVG showed well-organized neointimal formation in the high-pressure arterial circulation environment; whereas the large-pore-size scaffold did not improve cellular infiltration and neotissue formation when compared to the small-pore-size scaffold. Further study is warranted to evaluate long-term tissue remodeling and graft feasibility.



11:30 AM – 12:30 PM

Room 125AB

Basic Science Research: General Thoracic*Moderators: Jules Lin, Ann Arbor, MI, and Sunil Singhal, Philadelphia, PA*

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Presenting authors are listed in **bold**.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

11:30 AM

Room 125AB

Bioengineering a Partial Tracheal Graft Using 3D-Printed Polymer, Extracellular Matrix, and Mesenchymal Stem Cells

S. Rehmani¹, **A. M. Al-Ayoubi**², **M. Barsky**¹, **C. Forleiter**⁴, **Z. N. Venitelli**³, **C. Sinclair**⁴, **R. Lebovics**⁴, **F. Bhora**⁵

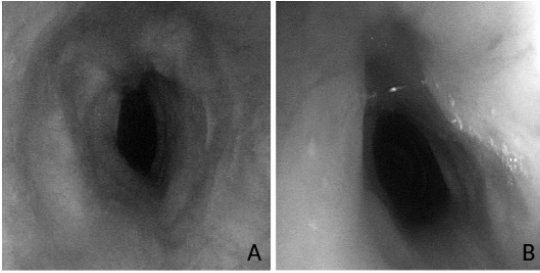
¹Mount Sinai St Luke's Hospital, New York, NY, ²Mount Sinai Health System, New York, NY, ³St Luke's-Roosevelt Hospital Center, New York, NY, ⁴Mount Sinai Roosevelt Hospital, New York, NY, ⁵Mount Sinai Roosevelt and Mount Sinai St Luke's Hospitals, New York, NY

Purpose: Long-segment tracheal stenosis is a devastating condition for which a satisfactory cure is not currently available. The purpose of this study was to design, customize, and create a bioengineered tracheal graft that would repair a partial tracheal defect in a large animal model.

Methods: Three-dimensional images of porcine trachea were obtained using neck computed tomography images. Tracheal rings were designed in computer-aided design software according to the dimensions of the porcine trachea. The customized rings were 3D-printed using a fused-deposition modeling printer. The rings were fabricated using biodegradable polycaprolactone (PCL) polymer. Subsequently, the rings were attached to an extracellular matrix (ECM) membrane and seeded with human mesenchymal stem cells (MSC). The bioengineered graft was implanted in 4-week-old female Yorkshire pigs. Bronchoscopy was performed to monitor graft integration and airway patency.

Results: The bioengineered graft was successfully implanted in seven female pigs to repair an anterior tracheal defect (~40% tracheal length). The animals were divided into two groups: Group I (ECM+PCL) and Group II (ECM+PCL+MSCs). Bronchoscopy at 1 month post-implantation showed graft healing and integration with minimal granulation tissue in all animals. Both groups showed complete mucosal coverage on the luminal aspect. Group I animals, however, showed mild to moderate stenosis (Figure A), while grafts in Group II animals showed minimal stenosis (Figure B).

Conclusions: The bioengineered tracheal graft consisting of 3D-printed PCL rings, ECM membrane, and MSCs successfully can repair long-segment anterior tracheal defects and maintain short-term airway patency. Further experiments are ongoing to ascertain long-term patency, chondrogenesis, and epithelialization of the implanted graft.



Bronchoscopy images one month post-implantation

11:45 AM

Room 125AB

Asbestos Mediates Epigenetic Repression of RASSF1A in Normal Human Mesothelial Cells

D. Straughan¹, S. Xi², E. Reardon¹, S. C. Azoury¹, M. Zhang², J. Hong², R. Ripley³, D. S. Schrumpp¹

¹National Cancer Institute, Bethesda, MD, ²National Institutes of Health, Bethesda, MD, ³Center for Cancer Research, National Cancer Institute, Bethesda, MD

Purpose: Whereas asbestos burden has been linked to cytogenetic alterations in malignant pleural mesothelioma (MPM), the timing and mechanisms of epigenetic aberrations during initiation and progression of MPM have not been fully delineated. In the present study, an in vitro model was utilized to characterize early epigenetic events contributing to MPM.

Methods: Normal human mesothelial cells (LP9 and LP3) and six human pleural mesothelioma cell lines were cultured in normal media with or without crocidolite asbestos fibers (1 µg/cm² or 2 µg/cm²) for up to 10 days. Messenger RNA and protein levels were assessed with quantitative reverse transcription polymerase chain reaction (PCR) and immunoblot techniques, respectively. Methylation-specific PCR, pyrosequencing, and chromatin immunoprecipitation techniques were used to correlate changes in gene expression with epigenetic alterations in the respective promoters.

Results: The tumor suppressor gene RASSF1A was markedly downregulated in MPM lines compared to normal mesothelial cells ($P = .0003$); this phenomenon coincided with significantly increased DNA methyltransferase levels ($P = .0001$) and hypermethylation of the RASSF1A promoter. The DNA demethylating agent, 5-aza-2'-deoxycytidine (DAC; 0-500nM x 72h) mediated dose-dependent derepression of RASSF1A in MPM cells. Asbestos mediated time- and dose-dependent repression of RASSF1A in normal mesothelial cells; this phenomenon coincided with DNA hypermethylation, as well as increased occupancy of the de-novo methyltransferase DNMT3b, but not the maintenance methyltransferase, DNMT1, and decreased H3K9Me2 levels (histone activation mark) within the RASSF1A promoter region.

Conclusions: Asbestos mediates rapid epigenetic repression of RASSF1A in normal human mesothelial cells via DNA methylation. This in vitro model may prove useful for delineating additional epigenetic mechanisms contributing to MPM and the identification of novel targets for treatment of these neoplasms.

12:00 PM

Room 125AB

Role of Stress Proteins in the Carcinogenesis and Maintenance of Esophageal Adenocarcinoma

*K. D. Hazel, S. O. Kalatardi, A. Sjoberg, M. J. Weyant, D. A. Fullerton, X. Meng
University of Colorado School of Medicine, Aurora*

Purpose: Heat-shock proteins (HSPs) are highly conserved proteins, induced in response to stressful stimuli, including contributors to esophageal adenocarcinoma (EAC). HSPs evolved to protect against potentially lethal stimuli and are central to survival. We hypothesized that multiple HSPs are upregulated in EACs and are mediators of cell proliferation and metastasis.

Methods: Baseline levels of HSPs were analyzed using immunoblotting in one immortalized esophageal mucosal cell line (HET-1A) and two EAC cell lines (OE33 and FLO-1). Immunoblotting also was utilized to determine HSP levels in HET-1A cells treated for 30 minutes with deoxycholic acid (DCA) at concentrations of 25 μ M and at acidic pH.

Results: Increased baseline HSP levels are seen in esophageal adenocarcinoma cell lines especially with HSP27 and pHSP27 ($P < .05$). These HSPs also are significantly upregulated in HET-1A cells in response to 25 μ M DCA at pH4 ($P < .028$), as seen in Figure 1.

Conclusions: There is increased expression of specific HSPs in EAC cell lines at baseline and in normal esophageal cell lines in response to in vitro reflux conditions. HSPs are a potential therapeutic target for EAC, and investigation into their role in proliferation, metastasis, and survival is needed.

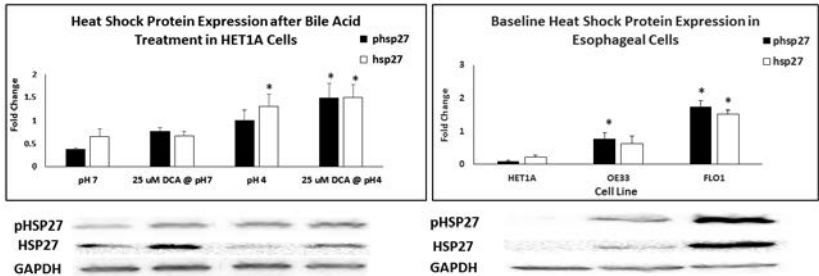


Figure 1. Heat Shock Protein Expression with bile acid treatment and at baseline. * $P < 0.05$ vs untreated control, N=5

MONDAY MORNING

12:15 PM**Room 125AB****Near-Infrared Intraoperative Molecular Imaging Localizes Metastases to the Lung***J.J. Keating¹, S. Nims¹, R. Judy¹, J. Jiang¹, S. Singhal²**¹University of Pennsylvania, Philadelphia, ²Hospital of the University of Pennsylvania, Philadelphia*

Purpose: Pulmonary metastasectomy is widely accepted because it can prolong survival and cure patients with various tumor types. However, intraoperative localization of pulmonary metastases can be technically challenging. We proposed that intraoperative near-infrared (NIR) molecular imaging can improve disease localization.

Methods: We inoculated 50 C57BL/6 mice with LLC flank tumors. Following flank tumor growth, mice were injected via tail vein with indocyanine green (ICG) prior to surgery and intraoperative imaging to detect pulmonary metastases. Based on these experiments, we enrolled eight patients undergoing pulmonary metastasectomy into a pilot and feasibility clinical trial. Each patient received intravenous ICG prior to surgery followed by wedge or segmental resections. Samples were imaged on the back table using a NIR camera to confirm disease presence and margins. All murine and human tumors and margins were confirmed with pathology.

Results: Mice had an average of 4 ± 2 metastatic tumors on both lungs with an average size of $6.5 \text{ mm} \pm 2.0 \text{ mm}$. 200/211 (95%) metastatic deposits were markedly fluorescent with a mean tumor-to-background ratio (TBR) of 3.4 (IQR 3.1-4.1). The remaining tumors had a TBR < 1.5 . Tumor size did not significantly affect fluorescence ($P = .20$). In the human study, intraoperative imaging identified all 12 of the metastatic lesions confirmed with pathology. The average size of the fluorescent tumors in largest dimension was $1.38 \text{ cm} \pm 1.01 \text{ cm}$, and mean TBR was 3.2 (IQR 3.1-3.7). Pathology demonstrated melanoma (four), osteogenic sarcoma (two), renal cell carcinoma (two), chondrosarcoma (two), leiomyosarcoma (one), and germ cell tumor (one).

Conclusions: Systemic ICG localizes to subcentimeter tumor metastases to the lung. Future research will improve depth of penetration into the lung parenchyma and allow for improved in vivo tumor localization.

NOTES

11:30 AM – 12:30 PM

Room 122ABC

Congenital Session: Adult Congenital

Moderators: James Jagers, Aurora, CO, and Kirk R. Kanter, Atlanta, GA

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold**.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

11:30 AM

Room 122ABC

Contemporary Management of Aortic Coarctation in Adults: Mid-Term Results

*P. Noly, V. Legris-Falardeau, I. Boubout, R. Ibrahim, R. Cartier, N. Poirier, P. Demers
Montreal Heart Institute, Canada*

COMMERCIAL RELATIONSHIPS R. Ibrahim: Consultant/Advisory Board, St Jude Medical, W. L. Gore & Associates

Purpose: Despite improvements in endovascular techniques, the management of adult patients with native aortic coarctation or late complications of coarctation repair remains challenging. We aimed to assess perioperative and mid-term results of the management of these patients using contemporary approaches.

Methods: From 2000 to 2014, 63 consecutive adults were treated for native aortic coarctation or complications post-coarctation repair at the Montreal Heart Institute. Preoperative, intraoperative, and mid-term clinical and imaging data were analyzed. Thirty-four patients (54%) had native coarctation (NCoA), 14 patients (22%) had recurrent coarctation (RCoA), and 15 patients (24%) had an aneurysmal complication (AnCoA). The mean age was 42.3 years ± 1.7 years (range: 18–71); 25 patients (40%) underwent coarctation repair in childhood and 45 patients (71%) had associated congenital heart lesions, mainly bicuspid aortic valves (52.4%). Overall mean follow-up was 64.9 months ± 5.4 months and was 95.2% complete.

Results: Overall, 51 patients (81%) underwent transcatheter approaches and 12 patients (19%) underwent surgery. Thirty-three patients with NCoA (97.1%), and 13 patients with RCoA (92.8%) underwent aortic balloon angioplasty. A covered stent was used in 81.8% and 53.8% of the cases, respectively. Among the 15 patients with AnCoA, 10 patients (67%) were treated surgically with resection of the aneurysm using circulatory arrest and five patients (33%) underwent endovascular stent graft repair (TEVAR). No hospital deaths or paraplegia were observed. Four patients (6%) died after a mean of 55.5 months ± 18.3 months (range: 10–84) of a non-related cause (three in the RCoA and one in the AnCoA group). Six patients (10%) needed a second intervention for aneurysmal complications (n=3) and intrastent stenosis (n=3) after a median of 34.5 months (range: 7–138).

Conclusions: Management of aortic coarctation in the adult using transcatheter techniques provides excellent early and mid-term results. Open surgery or endovascular repair remain indicated for coarctation with complex anatomical features as well as for aneurysmal complications.

11:45 AM

Room 122ABC

One Hundred Percent Freedom From Reintervention at 10 Years With a Porcine Valved Conduit for Right Ventricular Outflow Tract Reconstruction

H. Schumehl, M. F. Swartz, G. M. Alfieri

University of Rochester, NY

Purpose: The optimal choice for right ventricular outflow tract (RVOT) reconstruction is uncertain, with varying degrees of longevity associated with homograft and xenograft valves. We hypothesized RVOT reconstruction with a porcine valved conduit would result in superior freedom from valve dysfunction and reintervention.

Methods: All patients >16 years of age who received a Carpentier Edwards model 4300 porcine valved conduit were reviewed from 2000 to 2010. The most recent echocardiogram was used to determine the peak gradient through the prosthesis, as well as the degree of pulmonary insufficiency. Valve dysfunction was defined as greater than mild pulmonary stenosis (peak gradient >40 mm Hg) and/or insufficiency. Freedom from valve dysfunction, reintervention, and survival were determined using Kaplan-Meier analysis.

Results: One hundred patients underwent RVOT reconstruction using a porcine valved conduit. Age at RVOT reconstruction was 27.7 years \pm 10.1 years, with the median conduit size of 25 mm (range: 20-30) (Table). Ninety-nine patients had at least one prior cardiac operation, and the majority had a fundamental diagnosis of tetralogy of Fallot. With 100% follow-up at 6.5 years \pm 3.5 years, the peak gradient was 21.1 mm Hg \pm 10.5 mm Hg, and only one patient had greater than mild pulmonary valve insufficiency. Freedom from valve dysfunction was 100% at 5 years and 92.8% at 10 years (Figure). Freedom from valve reintervention was 100% at 10 years, where one patient required a reoperation for endocarditis at 10.6 years. Survival was 99% at 5 years and 96.1% at 10 years.

Conclusions: RVOT reconstruction using the Carpentier Edwards valve conduit in patients >16 years of age results in sustained freedom from reintervention at an intermediate-term follow-up.

Continued on next page

Figure 1

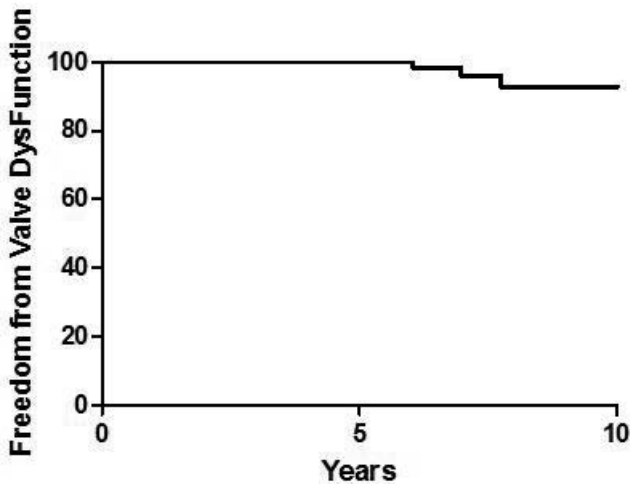


Table 1: Peri-operative Demographics for 100 Patients > 16 Years of Age Requiring a Porcine Valved Conduit

Primary Diagnosis	
Tetralogy of Fallot	78 % (78)
Transposition of the Great Arteries	8 % (8)
Truncus Arteriosus	8 % (8)
Pre-operative Pulmonary Valve Dysfunction	
Insufficiency	55% (55)
Stenosis	30 % (30)
Insufficiency and Stenosis	15% (15)
Porcine Valve Conduit Size	
20 mm	1% (1)
22 mm	17% (17)
25 mm	47% (47)
30 mm	35% (35)

12:00 PM

Room 122ABC

Adult Scimitar Syndrome Repair: Long-Term Results Using an Extracardiac Conduit

N. Carvalho Guerra¹, M. Pernot², M. Al-Yamani², G. Nesseris², X. G. Roques², B. Kreitmann², F. Roubertie²

¹Hopital Cardiologique Haut-Leveque, Bordeaux, France, ²Bordeaux Heart University Hospital, France

Purpose: Scimitar syndrome is an anomalous venous drainage of the right lung to the inferior vena cava (IVC), which may be corrected with different techniques. Repair using an extracardiac conduit rarely has been utilized, but may be suitable in adult complex cases. We assessed long-term outcomes of this technique in adults.

Methods: From January 2000 to June 2011, seven adults with Scimitar syndrome underwent surgical correction by sternotomy, normothermic cardiopulmonary bypass, and aortic cross clamping. In all patients, the scimitar vein drained the entire right lung venous return to the IVC below the diaphragm. A ringed polytetrafluoroethylene conduit was used to connect the scimitar vein to the left atrium, posterior to the IVC. Mean follow-up time was 9.1 years \pm 3.6 years. All patients received long-term antiplatelet drugs and were followed up in regular outpatient appointments with transthoracic echocardiography. Two years postoperatively, transesophageal echocardiography and brain magnetic resonance imaging (MRI) were performed systematically.

Results: Four patients (57%) were females. Mean age at surgery was 32 years (18-50). All were symptomatic (three patients were in NYHA class 3, and four patients suffered recurrent pneumonia), with significant left to right shunt ($Q_p/Q_s > 2$) and without significant pulmonary hypertension. Mean cardiopulmonary bypass and aortic cross clamp time were 108.6 minutes \pm 27.5 minutes and 49.3 minutes \pm 13.4 minutes, respectively. Mean conduit diameter was 14 mm (12-16). Four patients required additional closure of an atrial septal defect. There were no early or late deaths. There were no reoperations. Postoperative morbidity was inexistent. No evidence for subclinical stroke/embolization was found at postoperative brain MRI. No thrombi on the prosthesis or in the left atria were detected at the latest echocardiogram. Scimitar vein and conduit permeability, with a laminar flow from the Scimitar vein to the left atrium, also were confirmed. At last follow-up, all patients were in NYHA class I and free of symptoms.

Conclusions: Scimitar syndrome correction with an extracardiac conduit easily and safely can be performed in adults, with excellent long-term durability and without graft thrombi or stenosis. This technique avoids deep hypothermic circulatory arrest and is an alternative procedure of choice in adults, when scimitar vein anatomy is complex.

12:15 PM

Room 122ABC

Long-Term Outcome of Arterial Switch Operation Conversion After Failed Senning/ Mustard Procedure

T. Maeda, M. Nagashima, T. Hiramatsu, T. Sakamoto, G. Matsumura, K. Agematsu, M. Okura, S. Akiyama, S. Okugi, K. Yamazaki
Tokyo Women's Medical University, Japan

COMMERCIAL RELATIONSHIPS G. Matsumura: Research Grant, Gunze Limited

Purpose: Late complications after Senning/Mustard operation for transposition of the great arteries (d-TGA) include atrial arrhythmias, systemic right ventricular (RV) failure, and baffle complications. We previously reported successful arterial switch operation (ASO) conversion after failed Senning/Mustard operation. The purpose of this study was to evaluate long-term outcomes after ASO conversion.

Methods: Between 1986 and 2006, nine patients with d-TGA underwent ASO conversion at our institution. Indication for conversion was systemic RV failure in nine, baffle leakage in one, and pulmonary venous channel stenosis in one. Six patients revealed supraventricular tachycardia, and eight patients showed moderate or severe tricuspid valve regurgitation (TR), preoperatively. All patients revealed NYHA classification grade III before conversion. Age at conversion was 11.1 years \pm 9.9 years old. All but one had undergone pulmonary artery banding (PAB) for left ventricular training before conversion, and the interval from initial PAB to conversion was 3.6 months \pm 3.2 months.

Results: There was one early death (low output syndrome, 5 days), and one late death (sudden death, 5 months later). Follow-up time was 16.5 years \pm 11.6 years. Actuarial survival rate after conversion was 76.1% at both 10 and 20 years. Long-term survivors revealed good NYHA classification (I: 6, II: 1) with less than mild TR. Cardiac catheterization revealed significant improvement of right ventricular end-diastolic volume (243.2% \pm 124.6% \rightarrow 117.7% \pm 28.1% of normal) and right ventricular ejection fraction (42.0% \pm 5.8% \rightarrow 57.2% \pm 5.1%, $P < .01$). Left ventricular ejection fraction improved to 57.2% \pm 5.3%, although it worsened temporarily after PAB. Brain natriuretic peptide was 40.6 pg/mL \pm 16.2 pg/mL in the long-term period. However, three patients underwent new pacemaker implantation for sick sinus syndrome (SSS), and one patient showed moderate neo-aortic valve regurgitation (AR).

Conclusions: Long-term outcome of ASO conversion for patients who revealed systemic RV failure after Senning/Mustard operation was excellent. However, careful observation for new-onset SSS and AR is mandatory.

NOTES

11:30 AM – 12:30 PM

Room 128AB

Critical Care*Moderators: Rakesh C. Arora, Winnipeg, Canada, and James M. Isbell, Charlottesville, VA***COMMERCIAL RELATIONSHIPS** R. C. Arora: Research Grant, Pfizer Canada, Inc; J. M. Isbell: Ownership Interest, LumaCyte, LLC

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The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

11:30 AM

Room 128AB

Clinical Significance of Spontaneous Echo Contrast on Extracorporeal Membrane Oxygenation*S. Unai, M. Nguyen, D. Tanaka, N. Gorbachuk, H. Hirose, G. D. Marhefka, N. Cavarocchi
Thomas Jefferson University Hospital, Philadelphia, PA*

Purpose: Spontaneous echo contrast (SEC) is known to be a predisposition to thromboembolism and cerebrovascular accident. The aim of this study was to investigate the risk factor and the consequence of SEC in patients who were placed on venoarterial extracorporeal membrane oxygenation (VA-ECMO) due to cardiogenic shock.

Methods: Between January 2011 and December 2014, 98 patients underwent insertion of VA-ECMO due to cardiogenic shock in our institution. Transthoracic and transesophageal echocardiograms were performed and interpreted by cardiologists. Patients were divided into two groups based on the presence and absence of SEC. Clinical data, echocardiographic parameters, and outcome were compared between the two groups.

Results: Of the 98 patients, 68.4% were male with an average age of 50.6 years \pm 14.9 years. Twenty-two patients had SEC on echocardiogram. Patients in the SEC group had lower ejection fraction (EF) (8.0 ± 10.5 vs 29.3 ± 26.5 , $P = .001$), lower pulsatility index (defined by [systolic BP – diastolic BP] / mean BP) while on ECMO (0.13 ± 0.14 vs 0.26 ± 0.21 , $P = .008$), and a lower rate of the aortic valve opening on every beat (20.7% vs 47.4%, $P = .04$). The SEC group had a higher rate of developing intracardiac thrombus (45.5% vs 13.2%, $P = .002$) and stroke (40.9% vs 10.8%, $P = .003$), compared to the non-SEC group. On univariate analysis, intracardiac thrombus ($P = .007$), SEC ($P = .002$), low EF ($P = .09$), and low pulsatility ($P = .005$) was a significant risk factor for developing stroke. On multivariate analysis, SEC was an independent risk factor for stroke. The 30-day mortality of the SEC group and non-SEC group was 77.3% and 55.3% ($P = .08$), respectively.

Conclusions: SEC on VA-ECMO resulted in an increased risk of intracardiac thrombus and stroke. Maintaining pulsatility while on ECMO may help to decrease the chance of developing SEC and stroke.

NOTES

11:45 AM

Room 128AB

Restricted Albumin Utilization Is Safe and Cost Effective in a Cardiac Surgery Intensive Care Unit

J. Rabin, T. Meyenburg, A. V. Lowery, J. S. Gammie, D. Herr
University of Maryland Medical Center, Baltimore

COMMERCIAL RELATIONSHIPS J. S. Gammie: Ownership Interest, Harpoon Medical, Inc, Correx, Inc

Purpose: Volume expansion is often necessary after cardiac surgery, and albumin is often the fluid administered. The high cost of albumin motivated an attempt to reduce its utilization. This study analyzes the impact of implementing guidelines limiting albumin infusion in a cardiac surgery intensive care unit (CS-ICU).

Methods: This retrospective study analyzed albumin use between April 2014 and April 2015 in all patients admitted to a busy CS-ICU at a large tertiary medical center. During the first 9 months, there were no restrictions on albumin use. In January 2015, institutional guidelines were implemented that limited albumin use to patients requiring more than 3 L of crystalloid in the early (first 24 hour) postoperative period, hypoalbuminemic patients (albumin <3.0 g/dL), and patients considered fluid overloaded, based on central venous pressure >15, peripheral artery disease >20, edema on chest x-ray, or physical exam. Albumin utilization was obtained from pharmacy records and compared with outcome quality metrics from the institution's STS National Database report.

Results: During this study, 1,401 patients comprising 7,217 patient days were admitted to the CS-ICU over a 13-month period. Albumin use, mortality, ventilator days, patients receiving packed red blood cell transfusion, ICU days, and average ICU length of stay were compared for 961 patients before and 440 patients after the restrictive guidelines were initiated. After restrictive guidelines were instituted, albumin utilization was significantly reduced from a mean of 280 monthly doses to a mean of 101 monthly doses ($P < .001$). There also was a trend toward reduced ventilator days from a median of 1.5 days to 1.0 days ($P = .06$). Mortality, length of stay, ICU days, and transfusion requirements demonstrated no significant change. Based on an average wholesale price obtained by the pharmacy and an average monthly reduction of 180 albumin doses, the CS-ICU demonstrated more than \$45,000 of wholesale savings per month after restrictions were implemented.

Conclusions: Restriction of albumin use in CS-ICU was feasible and safe. Significant reductions in utilization and cost with no changes in morbidity or mortality were demonstrated. This may provide a strategy for reducing cost while maintaining quality care. Further reductions in cost may be possible with implementation of more restrictive guidelines.

Table 1. Albumin use and outcomes before and after restriction

	Monthly Mean Before Restriction (SD)	Monthly Mean After Restriction (SD)	p-value
Monthly New Patient Admissions	106.66(10.57)	110.00(4.69)	0.57
Patient Days	554.44(32.94)	570.00(49.39)	0.51
Average Patient LOS	5.24(0.73)	5.07(0.25)	0.17
Mortality	6.67(2.96)	5.75(0.96)	0.92
Mortality Percentage	6.34%	5.23%	
Total Vent Days	313.56(67.06)	277.75(20.27)	0.33
Mean Vent Days Per Patient	3.57(0.84)	3.18(0.33)	0.40
Median Vent Days Per Patient	1.56(0.53)	1(0)	0.06
Patients Requiring PRBC Transfusion	43.78(5.04)	40.67(4.16)	0.36
Albumin Doses Administered (in 100mL 25% doses)	280.50(66.84)	100.87(38.06)	0.00

LOS - Length of Stay

SD - Standard Deviation

PRBC - Packed Red Blood Cell

12:00 PM

Room 128AB

Acute Stress Hyperglycemia, Even in Non-Diabetics, Increases the Rate of Atrial Fibrillation in Patients Undergoing Cardiac Surgery

H. A. Jensen¹, E. L. Sarin¹, Y. Ko¹, J. F. Condado¹, M. E. Halkos¹, R. Guyton¹, O. M. Lattouf², J. Miller¹, S. K. Macheers³, D. Murphy⁴, E. P. Chen², B. G. Lesnower², B. Keeling⁴, M. Rajaei¹, G. Umpierrez¹, A. Syed¹, G. Roberts⁴, V. H. Thourani¹

¹Emory University, Atlanta, GA, ²Emory University School of Medicine, Atlanta, GA, ³Emory St Joseph's Hospital, Atlanta, GA, ⁴Flinders Medical Centre, South Australia

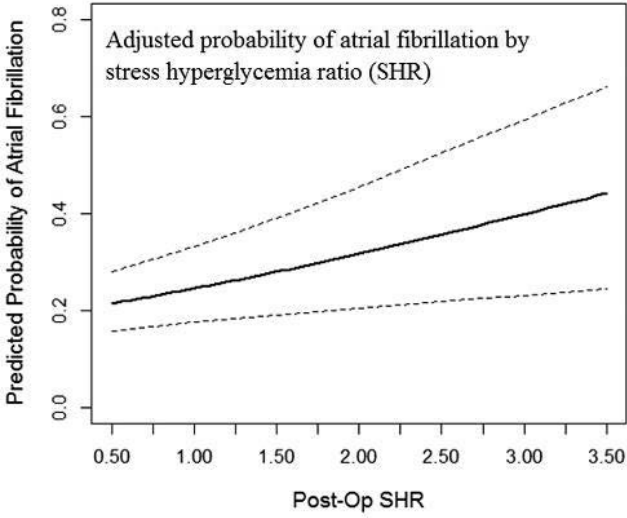
COMMERCIAL RELATIONSHIPS R. Guyton: Consultant/Advisory Board, Medtronic, Inc; M. E. Halkos: Consultant/Advisory Board, Medtronic, Inc, Intuitive Surgical, MAQUET Cardiovascular; O. M. Lattouf: Consultant/Advisory Board, Baxter Healthcare Corporation; Ownership Interest, TransCardiac Therapeutics, LLC, MiMedx Group, Inc; D. Murphy: Speakers Bureau/Honoraria, Medtronic, Inc; E. L. Sarin: Consultant/Advisory Board, Abbott Vascular; G. Umpierrez: Research Grant, Sanofi

Purpose: Acute stress hyperglycemia (SHG) can occur in diabetic and non-diabetic patients when operative blood glucose (BG) considerably exceeds the patient's preoperative BG levels and may be more detrimental than hyperglycemia alone. This study investigated whether SHG was a predictor of mortality or morbidity in patients undergoing cardiac surgery.

Methods: 2,442 patients who underwent coronary artery bypass grafting and/or valve surgery at a single academic institution were retrospectively reviewed. Patients' preoperative BG and HbA1c levels were recorded, as were the highest postoperative BG values. SHG was defined as having a stress hyperglycemia ratio >1, which was calculated by [(Highest BG level in the first two postoperative days) / (1.56 x HbA1c - 2.59)]. Outcomes were adjusted for age, race, body mass index, history of diabetes, diabetes management, The Society of Thoracic Surgeons predicted risk of mortality score, left ventricular ejection fraction, hemoglobin, creatinine, and operative group.

Results: The mean age of all patients was 65 years ± 13 years, and 899 patients (37%) were female. Acute SHG occurred in 1,538 patients (63%) (354 diabetic [23%] and 1,184 non-diabetic [77%] patients). SHG was not associated with increased risk of 30-day mortality (4.2% vs 3.3%, $P = .56$). Similarly, there were no differences in the rates of stroke, sternal wound infection, renal failure, pneumonia, prolonged ventilation, length of ICU or hospital stay, or readmission in patients with or without SHG. However, the risk-adjusted odds of having postoperative atrial fibrillation were estimated to increase by 34% for a one-unit increase in SHG ($P < .01$, Figure) for both diabetic and non-diabetic patients.

Conclusions: In our study, SHG was associated with a higher rate of postoperative atrial fibrillation, supporting the growing evidence that postoperative hyperglycemia can increase susceptibility to arrhythmias. Our findings indicate that not only diabetic patients, but all those with acute SHG, should be carefully monitored for postoperative atrial fibrillation.



12:15 PM

Room 128AB

The Relationship Between Blood Transfusions and Infections Following Cardiac Surgery: Is This Just the Blood?

R. Ohkuma, J. C. Grimm, J. Magruder, E. B. Schneider, J. Canner, G. J. Whitman
The Johns Hopkins Hospital, Baltimore, MD

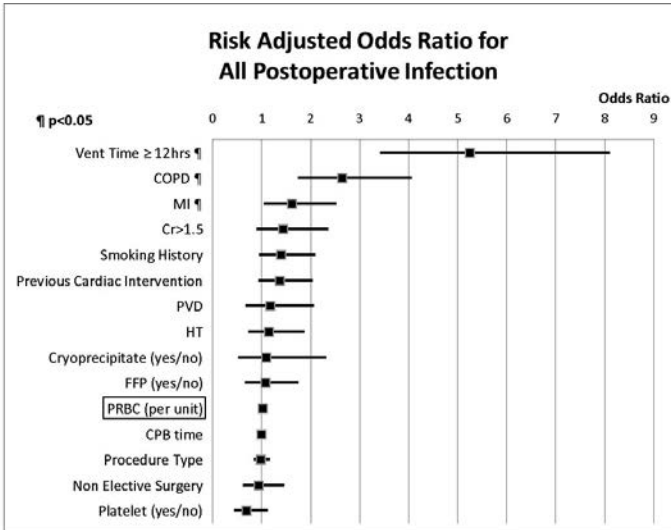
COMMERCIAL RELATIONSHIPS E. B. Schneider: Ownership Interest, Bergeim, LLC

Purpose: Packed red blood cell (PRBC) transfusions have been associated with infections following cardiac surgery, the majority of which are pneumonia. Previous studies failed to control for variability in mechanical ventilation. This study's purpose was to determine whether the relationship between PRBC transfusion and infection persisted after accounting for mechanical ventilation.

Methods: Adult cardiac surgery patients between July 2011 and October 2014 were identified in single institution data. Patients undergoing massive transfusion (>10 units) were excluded. The primary outcome was postoperative infection: pneumonia, surgical site infection (SSI: mediastinitis and superficial surgical site infection), and sepsis, as defined in the STS National Database. Patient, disease, and procedure-related factors were compared between those who were transfused and those who were not. Logistic regression examined the influence of transfusion on the development of postoperative infections, controlling for a variety of factors, including ventilation time.

Results: A total of 3,238 patients met criteria for inclusion, 56.7% of whom underwent PRBC transfusion. Overall, 4.7% of patients developed infection (pneumonia 82.9%, SSI 11.4%, and sepsis 13.3%). Infection was more common in those undergoing PRBC transfusion (4.9% vs 2.7%, $P = .002$), which was driven by the incidence of pneumonia (4.3% vs 2.1%, $P = .001$), as there was no transfusion-related difference in the incidence of SSI or sepsis. Extended ventilation (>12 hours) was 2.6 times more common in transfused patients (36.1% vs 13.6%, $P < .001$). After controlling for ventilation time, PRBC transfusion did not predict overall infection (OR: 1.03, 95% CI: 0.96-1.11), postoperative pneumonia (OR: 1.03, 95% CI: 0.95-1.11), sepsis (OR: 1.02, 95% CI: 0.82-1.26), or SSI (OR: 0.89, 95% CI: 0.70-1.14). Extended ventilation was associated with five times greater odds of infection (OR: 5.26, 95% CI: 3.41-8.11). An interaction between chronic obstructive pulmonary disease and extended ventilation appeared to moderate the effect of extended ventilation on overall infection.

Conclusions: In unadjusted analysis, transfused patients were more likely to develop infection; however, this relationship did not persist after risk adjustment. Extended mechanical ventilation was substantially more common among transfusion recipients. These findings highlight the importance of accounting for duration of mechanical ventilation when examining the relationship between transfusion and postoperative infection.



11:30 AM – 12:30 PM

Room 120A

General Thoracic Session: New Technology*Moderators: Shanda H. Blackmon, Rochester, MN, and Michael Lanuti, Boston, MA*

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold**.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

11:30 AM

Room 120A

Normalization of Exhaled Carbonyl Compounds Following Lung Cancer Resection*E. Schumer, M. Bousamra, J. Trivedi, M. C. Black, V. van Berkel**University of Louisville, KY*

COMMERCIAL RELATIONSHIPS M. Bousamra: Ownership Interest, Breath Diagnostics, Inc; V. van Berkel: Ownership Interest, Breath Diagnostics, Inc

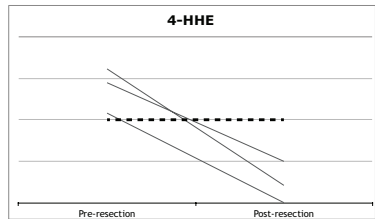
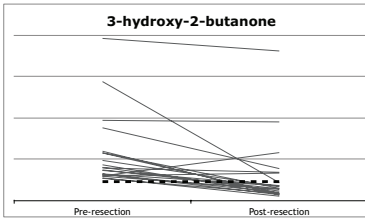
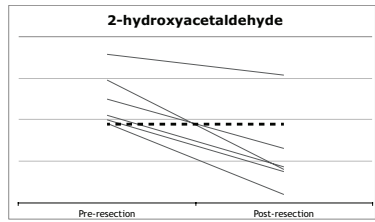
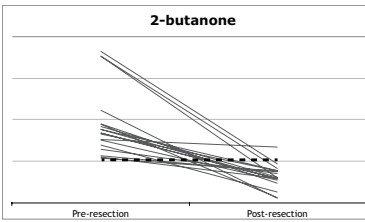
REGULATORY DISCLOSURE This presentation will address a device for noninvasive detection of lung cancer using exhaled breath by Breath Diagnostics, Inc, which has an FDA status of investigational.

Purpose: Quantitative analysis of specific exhaled carbonyl compounds (ECC) has shown promise for the detection of lung cancer. The purpose of this study is to demonstrate the normalization of ECCs in patients following lung cancer resection.

Methods: Patients from a single center were consented and enrolled in the study from 2011 onwards. Breath analysis was performed on lung cancer patients pre- and post-surgical resection of their tumors. One liter of breath was collected from a single exhalation in an inert plastic bag. The contents were evacuated over a silicon microchip, captured by oxidation reaction, and analyzed by mass spectrometry. Concentrations of the ECCs, 2-butanone, 3-hydroxy-2-butanone, 2-hydroxyacetadehyde, and 4-hydroxyhexanal (4-HHE) were measured and compared using the Wilcoxon test. A given cancer marker was considered elevated at ≥ 1.5 standard deviations above the mean of the control population.

Results: There were 27 cancer patients with paired samples and 194 control subjects. The median values of the four ECCs for cancer patients pre-resection and post-resection and control subjects are shown in Table 1. The median post-resection values were significantly lower for all four ECCs and were equivalent to the control patient values for three of the four ECCs. Figure 1 demonstrates the pre- and post-resection values for individual cancer patients for a given pre-resection ECC.

Conclusions: The analysis of ECCs demonstrates reduction to the level of control patients following surgical resection for lung cancer. This technology has the potential to be a useful tool to detect disease following lung cancer resection. Continued follow-up will determine if subsequent elevation of ECCs is indicative of recurrent disease.



Pre-resection versus post-resection values for 2-butanone, 3-hydroxy-2-butanone, 2-hydroxyacetaldehyde, and 4-hydroxyhexanal (4-HHE) when the pre-resection value is elevated. The dashed line is the threshold for an elevated carbonyl compound.

Compound	Pre-Resection	Post-Resection	P-value
2-butanone	3.39 (2.22, 4.13)	1.39 (1.21, 1.82)	<0.001
3-hydroxy-2-butanone	0.29 (0.24, 0.52)	0.14 (0.08, 0.31)	<0.001
2-hydroxyacetaldehyde	0.26 (0.13, 0.36)	0.14 (0.08, 0.23)	0.027
4-HHE	0.004 (0.001, 0.011)	0.002 (0.001, 0.003)	0.001
Compound	Control	Post-resection	P-value
2-butanone	1.36 (0.87, 1.92)	1.39 (1.21, 1.82)	0.616
3-hydroxy-2-butanone	0.07 (0.04, 0.12)	0.14 (0.08, 0.31)	<0.001
2-hydroxyacetaldehyde	0.18 (0.09, 0.26)	0.14 (0.08, 0.23)	0.436
4-HHE	0.001 (0.001, 0.004)	0.002 (0.001, 0.003)	0.602

Comparison of pre- versus post-resection carbonyl values and control versus post-resection values. Results reported in mean (interquartile range). A p-value <0.05 is considered significant.

11:42 AM

Room 120A

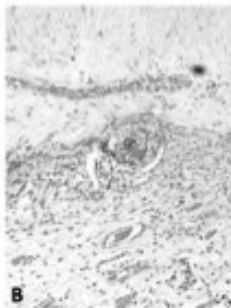
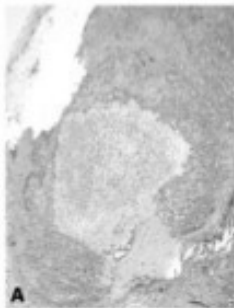
Pulmonary Artery Sealing Using an Ultrasonic Energy Vessel-Sealing Device in Video-Assisted Thoracoscopic Lobectomy: Survival Study in a Canine ModelE. Goudie¹, M. Khereba¹, M. Tahiri¹, P. Hegde¹, V. Thiffault¹, R. Hadjeres², J. Berdugo², P. Ferraro¹, M. Liberman¹¹CHUM Endoscopic Tracheobronchial and Oesophageal Center, University of Montreal, Canada,²University of Montreal, Canada**COMMERCIAL RELATIONSHIPS** M. Liberman: Research Grant, Ethicon Endosurgery, Boston Scientific, Baxter**REGULATORY DISCLOSURE** This presentation describes the off-label use of the HARMONIC ACE+7 by Ethicon Endosurgery, which is FDA-approved.

Purpose: Pulmonary artery (PA) sealing in video-assisted thoracoscopic (VATS) lobectomy is typically accomplished using vascular endostaplers. Endostaplers may be associated with iatrogenic PA branch injury, especially in short, small PA branches. We evaluated PA branch sealing with an ultrasonic energy vessel-sealing device in VATS lobectomy in a canine survival model.

Methods: Ten adult dogs underwent VATS lobectomy. Standard VATS lobectomy operative technique was utilized for the entire operation, except for PA branch sealing. A 5 mm, thoracoscopic, ultrasonic energy vessel-sealing device was used for all PA branch sealing. Dogs were kept alive for 30 days and followed for any hemorrhagic complications.

Results: Five adult dogs underwent VATS right upper lobectomy and five underwent VATS right lower lobectomy. Mean animal weight was 33.5 kg. A total of 21 PA branches were sealed with the ultrasonic energy vessel-sealing device. No PA branch was divided with an endostapler. There were no intraoperative complications or conversions to thoracotomy. Mean in vivo PA diameter was 5.6 mm (range: 2-12). Mean ex-vivo PA diameter was 5.5 mm (range: 2-14). One PA branch with a diameter of 10 mm had a partial seal failure immediately at the time of sealing. The device was reapplied on the stump, and the PA branch was successfully sealed. All dogs survived 30 days without hemothorax. Necropsy at 30 days did not reveal any signs of postoperative bleeding. Pathology of the sealed PA branches at 30 days revealed fibrosis, giant cell reaction, neovascularization, and thermal changes of the vessel wall (Figure; HE stain, 1A - Low Power, 1B - High Power).

Conclusions: The use of an ultrasonic energy vessel-sealing device for PA branch sealing in VATS lobectomy is safe and effective in an animal survival model. Human studies are needed to determine the clinical safety of ultrasonic PA branch sealing prior to widespread clinical utilization.



11:54 AM

Room 120A

Safety and Effectiveness of Cadaveric Allograft Sternochondral Replacement After Sternectomy: A New Tool for Reconstruction of the Anterior Chest Wall

G. Marulli¹, A. Dell'amore², F. Calabrese¹, M. Schiavon³, N. Daddi², F. Stella², F. Rea³, G. Dolci⁴
¹University of Padova, Italy, ²S. Orsola-Malpighi Hospital, Bologna, Italy, ³University of Padua, Italy, ⁴University of Bologna, Italy

Purpose: Surgical excision with safety margins, prevention of respiratory impairment, and protection of surrounding organs are primary goals in the resection and reconstruction of the chest wall. Various techniques and materials have been used for sternal replacement. We describe our experience with the use of a sternal allograft to reconstruct the anterior chest wall.

Methods: Between January 2009 and January 2015, 18 patients underwent surgery. Indications for sternectomy were: sternal metastases from various primary tumors (n=10), primary chondrosarcoma (n=4), sternal dehiscence after cardiac surgery (n=2), soft tissue sarcoma (n=1), and malignant solitary fibrous tumor (n=1). The defect was reconstructed by using a cadaveric allograft sternum with costal cartilages harvested aseptically, treated with antibiotic solution, and cryopreserved at -80°C. This process guarantees the sterility of the graft and the absence of immunogenic capacity. The graft was tailored to fit the defect perfectly and fixed with titanium plates and screws.

Results: Four patients underwent a total sternectomy, nine underwent a partial sternectomy with preservation of manubrium, and five underwent a partial sternectomy involving the manubrium, clavicles, and part of the body. In 14 patients, muscle flaps were positioned to cover the graft. Postoperatively, one patient had systemic Candida infection and one patient underwent surgical revision for bleeding at the site of muscle flap without redo-surgery on the sterno-chondral allograft. Furthermore, one patient required removal of a screw on the clavicle 4 months after operation because of partial dislocation, without consequences for the stability of graft. At a median follow-up of 32 months (range: 8-88), neither infection nor rejection of the graft occurred, 13 patients are alive without disease, five patients died (three for metastatic spread of primary tumor and two for unrelated causes), and none had local relapse of the tumor.

Conclusions: Sternal replacement with cadaveric allograft is safe and effective, providing optimal stability of the chest wall and protection of surrounding organs, even after extensive chest wall resections. The allograft was well tolerated biologically, allowing a perfect integration into the host. Further studies are needed to assess the outcome of this method.

12:06 PM

Room 120A

Peroral Endoscopic Myotomy: Early Experience With a Multispecialty ApproachR. J. Marchigiani¹, E. V. Arshava², J. C. Keech³, K. R. Parekh³, H. Gerke², R. El Abiad²¹University of Iowa, North Liberty, ²University of Iowa, Iowa City, ³University of Iowa Hospital & Clinics, Iowa City

Purpose: Peroral endoscopic myotomy (POEM) for the treatment of esophageal motility disorders has gained increasing popularity, with several short-term studies reporting excellent results. Our POEM procedures were performed with one interventional gastroenterologist and one thoracic surgeon. We retrospectively looked at our institution's initial consecutive 28 cases and report on the outcomes.

Methods: We performed a retrospective chart review of our initial 28 POEM cases from November 2013 through May 2015. We analyzed demographics, comorbidities, type of achalasia, Eckardt score, length of hospital stay (LOS), duration of surgery (DOS), morbidity, and length of myotomy (LOM). The mean was calculated for Eckardt score, LOS, DOS, and LOM.

Results: Average body mass index was 34 (range: 23-41). Sixteen patients (57%) had prior interventions (nine pneumatic dilations [32%] and seven Botox injections [25%]). Ten patients (36%) had chronic obstructive pulmonary disease. Sixteen patients (57%) had type II achalasia (type I=7 [25%], III=6 [21%]). Mean Eckardt score was 6.67 (range: 3-12). Average LOS was 1.25 days (range: 1-5; one person stayed > 2 days, 25 patients (89%) LOS=1 day). Mean DOS for all patients was 107.5 minutes (range: 60-148). For the initial 20 cases, the average DOS was 117.9 minutes; for cases 21-26, the mean DOS was 96.5 minutes. Mean LOM was 12.8 cm (range: 10-15). We experienced no morbidity; however, we did experience one 30-day mortality after discharge due to cardiac arrhythmia. Two out of 28 (7%) had prior Heller myotomy and underwent a posterior myotomy during POEM; otherwise, all myotomies were anterior. Twenty-six of 28 patients (93%) reported good to excellent relief of symptoms at short-term follow-up.

Conclusions: The POEM procedure has demonstrated its success in the treatment of achalasia with our collaborative multispecialty approach with decreased duration of surgery over time, low morbidity even in higher risk and obese patients, a long myotomy, and allowing options for posterior myotomy in patients with prior Heller myotomy.

NOTES

12:18 PM

Room 120A

Temporary Esophageal Stenting for the Treatment of Benign Dilation-Refractory Esophageal Stenosis

J. Jacob-Brassard¹, V. Thiffault², P. Ferraro³, M. Liberman³, P. Hegde³

¹University of Montreal, Canada, ²CHUM- Notre Dame Hospital, Montreal, Canada, ³CHUM Endoscopic Tracheobronchial and Oesophageal Center, University of Montreal, Canada

COMMERCIAL RELATIONSHIPS M. Liberman: Research Grant, Ethicon Endosurgery, Boston Scientific, Baxter

Purpose: In cases of dilation-refractory benign esophageal strictures, a temporary esophageal stent may be inserted as a short-term dilator and subsequently removed. The purpose of this study was to evaluate the short- and long-term outcomes and procedural and periprocedural morbidity in patients undergoing temporary esophageal stent insertion for dilation-refractory benign esophageal stenoses.

Methods: The study consisted of a retrospective case series. Eligible patients were identified from a prospectively accrued interventional thoracic endoscopy database. All benign strictures treated using an esophageal stent were included. Specific outcomes of interest included number of attempts at pre-stenting dilation, success of previous dilation, days between dilation attempts and days of successful dilation, tolerance of stenting, success with stenting, days stent left in place, success/failure with stenting, duration of success, morbidity, and complications related to stenting.

Results: Thirty-eight patients fulfilled initial selection criteria. Complications of stent insertion occurred in 16 patients (18 complications), Table. Complications included: stent migration (n=8, 22%), severe granulation tissue formation (n=3, 8%), refractory dysphagia (n=3, 8%), tracheoesophageal fistula (n=2, 5%), and (n=1, 3%) for each of the following: food impaction, aorto-digestive fistula, esophageal perforation, bleeding, and aspiration pneumonia. Thirty-five patients had complete short-term outcome reported: 28 patients (80%) showed improvement of dysphagia, five patients (14%) did not have improvement, and two patients (6%) had worsened dysphagia. Twenty-two patients had available long-term outcomes: eleven patients (50%) had improvement of dysphagia, six patients (50%) were stable, and none had worsened dysphagia. Eighteen patients (36%) required further interventions (total of 74), including: 35 esophagoscopies (15 rigid, 20 flexible), 13 dilations, 14 stent removals (four for success of treatment, nine for stent migration, and one for worsening dysphagia), and 10 additional stenting.

Conclusions: The treatment of dilation-refractory benign esophageal stenoses and strictures is challenging, and new methods of treatment are necessary to help this complex patient population. Temporary stenting is feasible and associated with acceptable short- and long-term outcomes in the majority of patients; however, complications and reintervention rates are high.

Table 1: Complications in Patients who Underwent Stent Insertion for Benign Dilatation-Refractory Esophageal Stenosis

Time of appearance	Type	Number of patients (N)	% (all patients)	% (patients with complications)
Early (<24h)	Migration	1	2.7	6.3
	Bleeding	1	2.7	6.3
	Recurrent dysphagia	1	2.7	6.3
Mid (24h-14d)	Granulation tissue formation	1	2.7	6.3
	Tracheo-esophageal fistula	1	2.7	6.3
	Aspiration pneumonia	1	2.7	6.3
Late (>14d)	Migration	7	18.9	33.3
	Granulation tissue formation	2	5.4	12.5
	Food obstruction	1	2.7	6.3
	Recurrent dysphagia	1	2.7	6.3
	Aorto-digestive fistula	1	2.7	6.3
	Esophageal perforation	1	2.7	6.3
	Recurrent dysphagia	2	5.4	12.5

11:30 AM – 12:30 PM

Room 127ABC

Quality Improvement Initiatives in Thoracic Surgery

Moderators: K. Robert Shen, Rochester, MN, and Sudish C. Murthy, Cleveland, OH

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold**.

The physician competencies addressed in this session are patient care and procedural skills, medical knowledge, and professionalism. These physician competencies will be addressed through a series of individual lectures and focused discussion on key points of presentations.

11:30 AM

Room 127ABC

Longitudinal Follow-Up of Lung Cancer Resection From The Society of Thoracic Surgeons General Thoracic Surgery Database

F. G. Fernandez¹, A. P. Furnary², A. S. Kosinski³, M. W. Onaitis³, D. Boffa⁴, P. Cowper³, S. Kim³, J. P. Jacobs⁵, C. D. Wright⁶, J. B. Putnam⁷

¹Emory University, Atlanta, GA, ²Starr-Wood Cardiac Group, Portland, OR, ³Duke University, Durham, NC, ⁴Yale University, New Haven, CT, ⁵Johns Hopkins All Children's Heart Institute, St Petersburg, FL, ⁶Massachusetts General Hospital, Boston, ⁷Baptist MD Anderson Cancer Center, Jacksonville, FL

Discussant: Benjamin D. Kozower, Charlottesville, VA

COMMERCIAL RELATIONSHIPS A. P. Furnary: Consultant/Advisory Board, Edwards Lifesciences Corporation, Glysurre Ltd; Nonremunerative Position of Influence, Johnson & Johnson, LifeScan, Inc; Speakers Bureau/Honoraria, Edwards Lifesciences Corporation

Purpose: The Society of Thoracic Surgeons (STS) General Thoracic Surgery Database (GTSD) currently does not capture long-term survival following lung cancer surgery. Our objective was to provide the first longitudinal follow-up to the STS-GTSD through linkage to Centers for Medicare & Medicaid Services (CMS) data for patients 65 years of age or older.

Methods: STS-GTSD lung cancer operations from 2002 to 2012 were linked to CMS data for patients >65 years of age using variables common to both the STS and CMS databases with a deterministic matching algorithm. Survival data were abstracted for each linked patient from the CMS data for a retrospective cohort analysis. The Kaplan-Meier method was used to estimate long-term survival for lung cancer surgery patients based on tumor stage.

Results: From 2002 to 2012, 60,089 lung cancer resections were identified in the GTSD; 37,009 (61.7%) were in patients >65 years. 26,055/37,099 (70%) of lung cancer resections in patients >65 years were successfully linked to CMS data. Failure to link most commonly was related to having a health maintenance organization (HMO) and/or commercial insurance as the primary payer. 40.5% (5,290/13,065) of patients with HMO and/or commercial insurance were not linked from 2009 to 2012 (years payer data available). Descriptive characteristics of patient cohorts are shown (Table). Long-term survival following lung cancer resection in patients >65 years is shown based on American Joint Committee on Cancer 7th edition pathologic stage (Figure). Median survival was 6.6 years for stage I, 3.5 years for stage II, 2.5 years for stage III, and 2.3 years for stage IV.

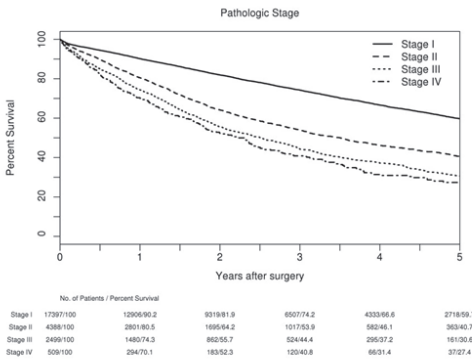
Conclusions: CMS data complements STS-GTSD data by enabling examination of long-

term survival and resource utilization in patients >65 years. STS-GTSD data linked with CMS data also facilitates longitudinal comparative effectiveness analyses between different surgical approaches for the treatment of lung cancer.

Table. Descriptive statistics of STS-GTSD lung cancer resection patients 2002-2012

Effects	Overall N=60,089	Age ≥ 65 years old matched with CMS N=26,055	Age > 65 years old NOT matched with CMS N=11,044	Age < 65 years old N=22,990
Age (years)	Median (IQR)	68.0 (60.0, 74.0)	73.0 (69.0, 78.0)	72.0 (68.0, 77.0)
Gender	Male	28,451 (47.4%)	12,636 (48.5%)	5,614 (50.9%)
	Female	31,601 (52.6%)	13,427 (51.5%)	5,418 (49.1%)
Race	White/Caucasian	62,069 (91.0%)	23,344 (89.3%)	9,483 (80.6%)
	Black/African American	4,895 (8.0%)	1,494 (5.7%)	937 (8.0%)
	Other	225 (0.4%)	68 (0.3%)	59 (0.5%)
FEV1 Test Performed	Yes	53,651 (89.3%)	23,491 (90.2%)	9,896 (89.6%)
FEV1 % Predicted	Median (IQR)	79.0 (65.0, 93.0)	79.0 (64.0, 94.0)	78.0 (63.0, 93.0)
Induction Therapy	Chemotherapy Only	2,283 (3.8%)	848 (3.3%)	360 (3.3%)
	Radiation Therapy Only	499 (0.8%)	238 (0.9%)	87 (0.8%)
	Chemotherapy and Radiation	3,262 (5.4%)	933 (3.6%)	368 (3.3%)
Clinical Stage	Stage I	38,873 (72.8%)	17,687 (70.0%)	7,256 (79.8%)
	Stage II	7,758 (14.5%)	3,111 (13.4%)	1,412 (14.4%)
	Stage III	6,642 (10.4%)	2,020 (8.7%)	940 (9.8%)
	Stage IV	1,360 (2.5%)	460 (2.0%)	227 (2.3%)
Pathologic Stage	Stage I	38,172 (66.9%)	17,367 (70.2%)	7,139 (67.6%)
	Stage II	10,758 (18.9%)	4,369 (17.7%)	2,002 (19.0%)
	Stage III	6,599 (11.6%)	2,499 (10.1%)	1,140 (10.9%)
	Stage IV	1,528 (2.7%)	508 (2.1%)	280 (2.7%)
Primary Procedure	Wedge Resection	9,913 (16.5%)	4,604 (17.7%)	2,179 (19.7%)
	Segmentectomy	2,428 (4.0%)	1,270 (4.9%)	464 (4.2%)
	Lobectomy	41,088 (68.4%)	18,081 (69.4%)	7,427 (67.2%)
	Sleeve Lobectomy	893 (1.5%)	243 (0.9%)	113 (1.0%)
	Bilobectomy	1,508 (2.3%)	710 (2.7%)	360 (3.2%)
	Pneumonectomy	2,725 (4.5%)	799 (3.1%)	340 (3.1%)
Operative Mortality	Yes	1,166 (1.9%)	582 (2.2%)	296 (2.7%)

Figure. Survival for surgically managed primary lung cancer according to pathologic stage in patients ≥65 years with STS-GTSD records linked to CMS data



MONDAY MORNING

Spectrum of Congenital Heart Surgery Case Mix Across US Centers and Impact on Performance Assessment

S. K. Pasquali¹, A. S. Wallace², J. W. Gaynor³, M. L. Jacobs⁴, S. M. O'Brien², K. D. Hill⁵, M. G. Gaies¹, J. C. Romano¹, D. M. Shabian⁵, J. E. Mayer⁶, J. P. Jacobs⁷

¹University of Michigan, Ann Arbor, ²Duke Clinical Research Institute, Durham, NC, ³The Children's Hospital of Philadelphia, PA, ⁴Johns Hopkins School of Medicine, Newtown Square, PA, ⁵Massachusetts General Hospital, Sudbury, ⁶Boston Children's Hospital, MA, ⁷Johns Hopkins All Children's Heart Institute, St Petersburg, FL

Discussant: Joseph A. Dearani, Rochester, MN

COMMERCIAL RELATIONSHIPS J. W. Gaynor: Other/Provided slides for a presentation, SynCardia Systems; J. E. Mayer: Consultant/Advisory Board, Medtronic, Inc

Purpose: Assessment of center performance in congenital heart surgery, while important to multiple stakeholders, is challenging due to the wide heterogeneity of disease and case mix. We describe the current spectrum of case mix across US centers and impact of including all operations vs the subset of current STS benchmark operations in assessing performance.

Methods: Centers (n=119) participating in the STS Congenital Heart Surgery Database (2010–2014) were included. The distribution of operation type and frequency (as assessed by the primary procedure of the index cardiac operation) was described. In 95 centers with adequate data quality, performance was compared when including all operations vs the 10 benchmark operations (repair of ventricular septal defect [VSD], coarctation, tetralogy of Fallot, atrioventricular canal and truncus arteriosus, arterial switch operation [+/- VSD repair], bidirectional Glenn/hemi-Fontan, Fontan, and Norwood). Risk-adjusted operative mortality was the performance metric evaluated, and centers were characterized as having higher, lower, or same as expected mortality based on their observed:expected ratio and 95% confidence interval from standard STS models.

Results: Overall, 207 types of operations were performed during the 5-year study period (112,140 total cases). There was a wide range across operations in the number of cases performed (range: 1–8,633 cases/operation). Many operations were performed infrequently, with 92/207 (44%) performed <100 times in 5 years. On a center level, only 52/207 operations (25%) were performed at least once by ≥75% centers. The benchmark operations comprise 36% of total cases (40,545/112,140), and all but one were performed by ≥90% of centers. The Table further describes the number of operations capturing specified proportions of centers, total cases, and mortalities. When evaluating center performance based on benchmark vs all operations, 81/95 centers (85%) did not change performance classification, and 14/95 (15%) changed by one category. Ten of the 14 (71%) who changed moved to a higher performance (lower mortality) category. Basing performance estimates on benchmark vs all operations was associated with lower statistical power (35% vs 78% of centers met the volume threshold needed to detect a doubling of mortality).

Conclusions: The current practice of congenital heart surgery consists of a wide spectrum of operations with many performed infrequently. Performance metrics based on benchmark vs all operations are associated with both strengths (less heterogeneity) and weaknesses (lower power), and lead to differing characterization of performance for some centers, while the majority remain unchanged. Performance metrics based on benchmark and/or other common operations may provide a useful adjunct to metrics based on all operations.

Table. Operations capturing specified proportions of centers, total cases, and mortalities

N (%) of 207 total operations performed by:		
≥50% of centers 95 (45.9%)	≥75% of centers 52 (25.1%)	≥90% of centers 22 (10.6%)
N (%) of 207 total operations capturing:		
≥50% of all cases 19 (9.2%)	≥75% of all cases 42 (20.3%)	≥90% of all cases 74 (35.7%)
N (%) of 207 total operations capturing:		
≥50% of all mortalities 12 (5.8%)	≥75% of all mortalities 33 (15.9%)	≥90% of all mortalities 63 (30.4%)
<p>For reference, the 10 current STS benchmark operations (which include 26 unique procedure codes) are all performed by ≥90% of centers (except truncus arteriosus repair), capture 36.2% of all cases, and 33.5% of mortalities</p>		

12:10 PM

Room 127ABC

Simulation-Based Training in Cardiac Surgery for Improved Patient Safety

R. H. Feins¹, H. M. Burkhardt², J. V. Conte³, D. N. Coore⁴, J. I. Fann⁵, G. L. Hicks⁶, N. A. Mokadam⁷, J. C. Nesbitt⁸, P. S. Ramphal⁹, S. E. Schiro¹, K. R. Shen¹⁰, A. Sridhar¹, P. Stewart¹¹, J. D. Walker¹²

¹University of North Carolina, Durham, ²University of Oklahoma Health Sciences Center, Oklahoma City, ³John Hopkins Hospital, Baltimore, MD, ⁴University of West Indies, Mona Campus, Jamaica, ⁵Stanford University, CA, ⁶University of Rochester Medical School, NY, ⁷University of Washington, Seattle, ⁸Vanderbilt University Medical Center, Nashville, TN, ⁹University of the West Indies, Nassau, Bahamas, ¹⁰Mayo Clinic, Rochester, MN, ¹¹University of North Carolina Gillings School of Global Public Health, Chapel Hill, ¹²UMass Memorial Medical Center—University Campus, Worcester

Discussant: Stephen C. Yang, Baltimore, MD

COMMERCIAL RELATIONSHIPS J. V. Conte: Consultant/Advisory Board, LivaNova, Medtronic, Inc; Research Grant, Medtronic, Inc, Boston Scientific; D. N. Coore: Consultant/Advisory Board, KindHeart, Inc; Ownership Interest, KindHeart, Inc; J. I. Fann: Consultant/Advisory Board, Twelve, Inc; R. H. Feins: Nonremunerative Position of Influence, KindHeart, Inc; Ownership Interest, KindHeart, Inc; N. A. Mokadam: Consultant/Advisory Board, Thoratec Corporation, HeartWare, Inc, SynCardia Systems, Inc, St Jude Medical; P. S. Ramphal: Ownership Interest, KindHeart, Inc, University of the West Indies

Purpose: This study postulated that a structured simulation-based skills curriculum employing component task training and deliberate practice improves surgical skill acquisition for cardiothoracic surgery residents and allows acquisition of skills necessary for cognitive and technical mastery of rare adverse events.

Methods: Funded by the Agency for Healthcare Research and Quality, eight cardiothoracic residency programs produced a structured simulation-based curriculum of component task skills training in three standard cardiac operations (cardiopulmonary bypass [CPB], coronary artery bypass grafting [CABG], and aortic valve replacement [AVR]) and three potential adverse events (massive air embolism [MAE], acute intraoperative aortic dissection [AIAD], and sudden deterioration of cardiac function [SDCF]). The curriculum specified comprehensive training protocols, assessment tools, and novel component task simulations for each of 42 training sessions. Over a 2-year period, 30 first-year traditional or Integrated-6 residents from the eight institutions participated. Each trainee was coached and evaluated on component tasks for each module and ultimately on the full cardiac operations on the cardiac surgery simulator. Evaluations were recorded on a 1-to-5 Likert scale using study-developed assessment tools. Analysis relied on simple tabulations and generalized linear mixed-effect models. Outcomes were indexed by module, session, assessment tool, tasks within each assessment tool, and number of repetitions.

Results: 36,354 data points were analyzed for a total of more than 3,000 total hours of simulation training. By the final session of each module, at least 95% of the residents received near-perfect or perfect scores (4 or 5 on the Likert scale): CPB 4.84 ± 0.12 , CABG 4.55 ± 0.17 , AVR 4.46 ± 0.20 , MAE 4.70 ± 0.17 , AIAD 4.53 ± 0.18 , and SDCF 4.36 ± 0.64 . Improvement with repetitions of practice was evident in the data (eg, in the CPB module, the first and last repetitions in each of sessions 5, 6, and 7 demonstrated substantial temporal improvement in mean scores: [first] 3.83 ± 0.16 , 4.33 ± 0.18 , 4.26 ± 0.21 , 4.49 ± 0.19 , 4.55 ± 0.18 , and [final] 4.80 ± 0.120). The detrimental effect of elapsed time off from training also was evident. Compliance with the curriculum was good across all modules.

Conclusions: Overall performance in the component tasks and in the complete procedures improved with simulation-based training. Coaching, deliberate practice, repetition, and

progressive simulation complexity improved resident performance using validated assessment tools. Importantly, simulation imparted skillsets unique to the management of rare adverse events (MAE, AIAD, and SDCF). Use of the curriculum has the potential to produce safer surgeons.

11:30 AM – 12:30 PM

Room 123

STS/CATS/CSCS: Adding New Dimensions to Your Surgical Practice—Optimizing Your Internet Presence and Understanding the Emerging Role of 3-Dimensional Printing in Cardiothoracic Surgery

This collaborative educational session with STS, the Canadian Association of Thoracic Surgeons, and the Canadian Society of Cardiac Surgeons will provide dynamic talks on the emerging topics of online physician marketing, “physician review” websites, and the application of 3-dimensional printing in cardiothoracic surgery. Attendees will learn how to utilize these emerging technologies.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Describe key components to a user-friendly, high-quality website
- Identify ways to optimize their internet/public profile through online marketing
- Discuss how “physician review” websites function to serve the public and how physicians can manage their reputations related to these websites
- Describe the fundamentals of 3-dimensional printing
- Explain how 3-dimensional printing may apply to their practices and patients

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

The physician competencies addressed in this session are professionalism, medical knowledge, interpersonal skills and communication, and systems-based practice. These physician competencies will be addressed through a series of lectures and a panel discussion that is meant to enhance the understanding of the different workforce issues in cardiothoracic surgery.

Moderators: Sean C. Grondin, Calgary, Canada, and Colin Schieman, Hamilton, Canada

11:30 AM **How to Improve Your Internet Profile: Building a Winning Website for You and Your Team**

Christopher W. Seder, River Forest, IL

11:40 AM **Social Media in Cardiothoracic Surgery and the Thoracic Surgery Social Media Network: Understanding How Social Media Can Benefit You and Your Patients**

Mara B. Antonoff, Houston, TX

11:50 AM **Panel Discussion**

12:00 PM **3-Dimensional Printing Applications in Cardiovascular Surgery**

Mackenzie Quantz, London, Canada

COMMERCIAL RELATIONSHIPS M. Quantz: Consultant/Advisory Board, SurgiSim; Speakers Bureau/Honoraria, Kinetic Concepts, Les Laboratoires Servier

12:10 PM **3-Dimensional Printing in General Thoracic Surgery**

Stephen D. Cassivi, Rochester, MN

12:20 PM **Panel Discussion**

12:30 PM – 1:30 PM

BREAK—Visit Exhibits and Scientific Posters

Complimentary coffee available in the Exhibit Hall

1:15 PM – 5:15 PM

Room 127ABC

Redefining Practice Through Quality and Evidence: What's New?

The STS National Database is the most valuable tool in cardiothoracic surgery for outcomes assessment, evidence-based practice, and clinical practice guideline development. Founded in 1989, the Database has evolved to meet the changing needs of physicians in a complex health care delivery system. This session will address Database initiatives including the latest updates in clinical practice guideline development, risk modeling, public reporting, and quality measurement.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Describe the methodology for risk adjustment
- Outline the rationale for use of composite measures and the new mitral measures
- Discuss implications of and strategies for physician-level reporting
- Identify strategies for long-term follow-up of patient outcomes
- Discuss the importance of cost and resource utilization in care delivery
- Define data transparency and describe its importance in improving quality
- Apply strategies for using the feedback report for quality improvement
- Explain the rationale for a multidisciplinary approach in quality improvement
- Describe the process to obtain region-specific reports from the STS National Database

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Presenting authors are listed in **bold**.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures that will focus on the STS National Database and how it is evolving to meet the changing needs of physicians in a complex health care delivery system. Panel discussions and questions from the audience will augment these competencies.

Moderators: Vinay Badhwar, Pittsburgh, PA, and Jeffrey P. Jacobs, St Petersburg, FL

1:15 PM Introduction

1:20 PM STS Clinical Practice Guidelines: What's New?

John D. Mitchell, Aurora, CO

COMMERCIAL RELATIONSHIPS J. D. Mitchell: Consultant/Advisory Board, Covidien, MAQUET

1:50 PM Question-and-Answer Session

2:05 PM Local and Regional Quality Collaboratives: What's New?

John V. Conte, Baltimore, MD, Donald S. Likosky, Ann Arbor, MI, and Alan M. Speir, Falls Church, VA

COMMERCIAL RELATIONSHIPS J. V. Conte: Consultant/Advisory Board, LivaNova, Medtronic, Inc; Research Grant, Medtronic, Inc, Boston Scientific Corporation; D. S. Likosky: Consultant/Advisory Board, AmSECT; Research Grant, Agency for Healthcare Research and Quality, National Institutes of Health; A. M. Speir: Consultant/Advisory Board, Medtronic, Inc

2:35 PM Question-and-Answer Session

2:50 PM

Room 127ABC

Development and Validation of a Reliable Score to Predict the Risk of Readmission Following Adult Cardiac Surgery

A. Kiliç¹, J. Magruder², J. C. Grimm², S. Dungan², T. C. Crawford², G. J. Whitman², J. V. Conte²
¹The Johns Hopkins University, Baltimore, MD, ²The Johns Hopkins Hospital, Baltimore, MD

COMMERCIAL RELATIONSHIPS J. V. Conte: Consultant/Advisory Board, LivaNova, Medtronic, Inc; Research Grant, Medtronic, Inc, Boston Scientific

Purpose: Readmissions after cardiac surgery are increasingly being scrutinized. Although risk factors have been identified previously, a widely employed risk stratification model for estimating odds of readmission currently does not exist. The purpose of this study was to develop and validate a risk score for readmissions after cardiac surgery.

Methods: Adults surviving to discharge following cardiac surgery at a single institution from 2008 to 2013 were randomly divided 3:1 into training and validation cohorts. The primary outcome was readmission within 30 days of discharge. A multivariable model was constructed in the training cohort incorporating variables associated with 30-day readmission in univariate logistic regression. Points were assigned to predictors in the multivariable model proportional to their odds ratios, and the risk score was generated by summing these points. Predicted rates of readmission based on the score in the training cohort were compared with the actual rates in the validation cohort using weighted regression.

Results: 5,360 patients were divided into training (75%; n=4,020) and validation cohorts (25%; n=1,340). The 30-day readmission rate was 10.9% (n=585). The most common reason for readmission was related to volume overload (21%; n=122). The risk score incorporated five multivariable predictors and was out of 19 possible points (Table). The predicted rate of 30-day readmission based on the training cohort ranged from 5.5% (score=0) to 51.2% (score=19). Patients were categorized as low (score <5; readmission 8.3%), moderate (score 5-9; readmission 13.6%), and high risk (score ≥10; readmission 23.4%) ($P < .001$). Thirty-day readmission rates based on these score categories were similar in the validation cohort (low 8.9%, moderate 12.5%, high 24.5%; $P < .001$). There was a robust correlation between predicted rates of readmission in the training cohort based on the composite risk score and actual rates of readmission in the validation cohort ($r=0.94$, $P < .001$).

Conclusions: This study developed and validated a risk score for 30-day readmission after cardiac surgery in more than 5,300 patients. The risk score has quality improvement implications, as it may be used in identifying populations at high risk for readmission and for which targeted interventions and risk factor modification can be emphasized.

RISK FACTOR	POINTS
African American Race	3
Type of Cardiac Operation	
CABG	0
Valve	0
CABG + Valve	0
Other	3
Length of Hospitalization >7 days	4
Severe Chronic Lung Disease	6
Postoperative Acute Renal Failure	3
TOTAL POINTS POSSIBLE	19

3:00 PM**Room 127ABC****Cost Analysis of a Physician Assistant Home Visit Program to Reduce Readmissions Following Cardiac Surgery***J. P. Nabagiez, M. A. Shariff, W. J. Molloy, J. T. McGinn**Staten Island University Hospital, North Shore-LIJ Health System, NY***COMMERCIAL RELATIONSHIPS** J. T. McGinn: Speakers Bureau/Honoraria, Medtronic, Inc

Purpose: A physician assistant home care (PAHC) program providing house calls was initiated to reduce hospital readmissions following adult cardiac surgery. The purpose of our study was to analyze 30-day PAHC and pre-PAHC readmission rates and costs.

Methods: Patients who underwent adult cardiac surgery from September 2008 through August 2012 were reviewed retrospectively using pre-PAHC patients as the control group. Readmission rates, diagnoses, and health care costs were compared between the two groups with propensity score matching.

Results: Of the 1,185 patients who were discharged directly home, 155 (13%) were readmitted. Total readmissions for the control group (n=648) was 101 patients (16%), compared to the PAHC group total (n=537) of 54 (10%), for a 38% reduction in the rate of readmission ($P = .0049$). Propensity score-matched groups showed a reduction of 41%, with 17% (62/363) for the control compared to 10% (37/363) for the PAHC group, $P = .0061$. The average hospital bill per readmission was \$39,100 in the control group and \$56,600 in the PAHC group ($P = .0547$). The cost of providing home visits was \$12,500 per year.

Conclusions: The PAHC program reduced the 30-day readmission rate by 41% in propensity score-matched patients. The cost analysis demonstrated \$39 in health care savings for every \$1 spent. Therefore, a home visit by a cardiac surgical physician assistant is a cost-effective strategy to reduce readmissions following cardiac surgery.

3:10 PM

Room 127ABC

Unplanned Readmission Following Lung Resection: Complete Follow-Up in a 1-Year Cohort With Identification of Associated Risk Factors

K. J. Dickinson, J. B. Taswell, M. S. Allen, S. H. Blackmon, F. C. Nichols, K. Shen, D. A. Wigle, S. D. Cassivi

Mayo Clinic, Rochester, MN

COMMERCIAL RELATIONSHIPS M. S. Allen: Nonremunerative Position of Influence, Joint Council on Thoracic Surgery Education

Purpose: Unplanned readmissions are adverse events, which negatively impact patients and health care resources. Identifying risk factors predicting readmissions might permit improved patient management. We compiled a complete account of readmissions following lung resection to identify potentially modifiable risk factors.

Methods: All patients undergoing elective lung resection between August 2013 and July 2014 were contacted directly to ascertain whether they had required readmission to any institution within 30 days of hospital dismissal following their index admission for lung resection at our institution. Demographic data was supplemented from our prospectively maintained database. Follow-up was complete in 100% of patients.

Results: 526 patients underwent lung resections. Median age was 64 years (range: 16-88). Male:female ratio was 276:250. Fifteen patients (3.0%) underwent pneumonectomy, 227 (43.3%) underwent lesser anatomical resections, 270 (51.3%) underwent non-anatomical (wedge) resections. There was no 30-day or in-hospital mortality. Unplanned readmission occurred in 42 patients (8.0%): 28 (66.7%) at our institution and 14 (33.3%) at other institutions. Median interval to readmission was 14.5 days (range: 1-30). Readmissions occurred in 7.3% of patients dismissed to home, whereas 17.1% of patients dismissed to a nursing home or other facility required readmission ($P = .032$). The most common reason for readmission was respiratory complications (50.0%). Significant factors ($P < .05$) associated with readmission were: lower %-predicted FEV1, perioperative furosemide administration, pain score ≥ 6 between 12-24 hours after surgery, prolonged air leak (>5 days), ventilator support >48 hours, cardiovascular complications, blood transfusion, and dismissal to a nursing home. Length of stay was not associated with unplanned readmission.

Conclusions: The unplanned readmission rate following lung resection was 8.0%, with half being due to respiratory issues. Risk factors in the preoperative, perioperative, and postoperative setting were identified that may provide opportunities for improving readmission rates.

3:20 PM

Break

3:35 PM

Room 127ABC

Adhering to Quality Measures in Esophagectomy Improves Overall Survival in All Stages of Esophageal Cancer

P. P. Samson¹, V. Puri¹, S. R. Broderick², D. Kreisel³, A. S. Krupnick³, G. A. Patterson⁴, B. F. Meyers¹, T. D. Crabtree^{3,1} *Washington University School of Medicine, St Louis, MO, ²St Luke's Hospital, Chesterfield, MO, ³Washington University School of Medicine/Barnes Jewish Hospital, St Louis, MO, ⁴Washington University, St Louis, MO*

COMMERCIAL RELATIONSHIPS B. F. Meyers: Speakers Bureau/Honoraria, Varian Medical Systems, Inc; Consultant/Advisory Board, Ethicon, Inc

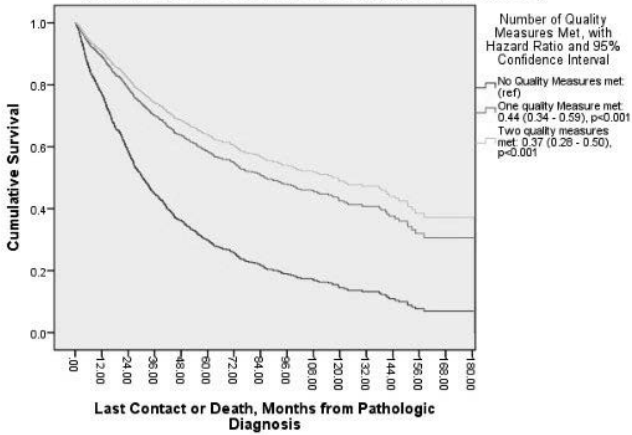
Purpose: Organizations such as the National Comprehensive Cancer Network (NCCN) and the American College of Surgeons Commission on Cancer (CoC) recommend specific quality measures in the treatment of early and locally advanced esophageal cancer. Our purpose was to identify variables associated with achieving quality measures and determine their effect on overall survival.

Methods: Patient, tumor, and treatment characteristics were abstracted from the National Cancer Database Participant User File for esophageal cancer. From a review of NCCN and CoC guidelines, the quality measures for evaluation included: esophagectomy with R0 resection, evaluation of ≥ 15 lymph nodes, adjuvant therapy for upstaged early stage tumors, and induction therapy for locally advanced tumors. A univariate analysis and multivariate models were done to identify variables associated with achieving quality measures. Finally, a Cox proportional hazards model was created to evaluate factors associated with increased mortality.

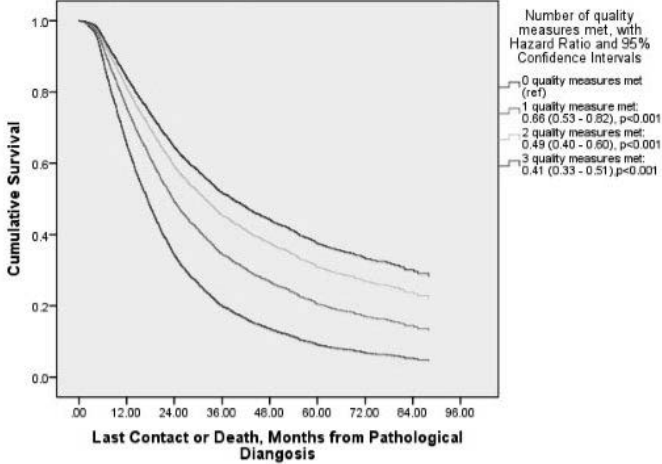
Results: Of the 5,035/16,153 (31.3%) early stage esophageal cancer patients (T1A-T2N0) receiving esophagectomy from 1998 to 2012, 4,603/5,035 had an R0 resection and 1,417 (29.6%) had ≥ 15 lymph nodes sampled. Variables independently associated with increased likelihood of having an R0 resection and ≥ 15 lymph nodes sampled included receiving surgery at an academic center (1.43, OR 1.21-1.68) and the number of esophagectomies done per year (OR 1.02, 1.02-1.03), all $P < .001$. Meeting both quality measures was independently associated with decreased overall mortality (0.79, HR 0.69-0.92, $P = .002$). For the 8,700/39,245 (22.2%) of locally advanced patients (N+ or T3-4N0) that received esophagectomy, 7,325/8,700 (84.2%) received induction therapy, 7,968 (91.6%) had R0 resection, and 3,492 (40.1%) had ≥ 15 lymph nodes obtained. Number of esophagectomies performed per year was again associated with increased likelihood of meeting all three quality measures (1.03, OR 1.02-1.03, $P < .001$). Overall survival was improved with each quality measure obtained for both early and locally advanced patients (Figure).

Conclusions: The ability to adhere to nationally recommended quality measures is independently associated with improved overall survival in both early and locally advanced stages of esophageal cancer. Despite these recommendations, only a minority of patients nationally are receiving care in accordance with these quality measures.

Cox Proportional Hazard Regression, With Survival Curves, for Early Stage (T1A-low gradeT2N0) Esophagectomy Patients Receiving Zero, One, or Two Quality Measures (R0 Resection and >1 15 Lymph Nodes Sampled)



Cox Proportional Hazard Regression, With Survival Curves for for Locally Advanced (N+ or T3-4N0) Esophagectomy Patients Receiving Zero, One, Two, or Three Quality Measures (Induction Therapy, R0 Resection, and >1 15 Lymph Nodes Sampled)



MONDAY AFTERNOON

Perfusion Strategies for Neonatal and Infant Aortic Arch Repair: Review of Contemporary Practice Patterns in the STS Congenital Heart Surgery Database

D. B. Meyer¹, A. Wallace², K. HilP, J. P. Jacobs³, M. L. Jacobs⁴, B. Bateson¹

¹Cohen Children’s Medical Center, New Hyde Park, NY, ²Duke Clinical Research Institute, Durham, NC, ³Johns Hopkins All Children’s Heart Institute, St Petersburg, FL, ⁴Johns Hopkins School of Medicine, Newtown Square, PA

Purpose: Regional cerebral perfusion (RCP) is used as an alternative or adjunct perfusion strategy to deep hypothermic circulatory arrest (DHCA) for neonates and infants undergoing aortic arch repair. Clinical studies have yet to provide evidence of clear superiority of either strategy with respect to survival or neurodevelopmental outcomes.

Methods: The STS Congenital Heart Surgery Database (2010–2013) was queried to identify neonates and infants whose index operation involved aortic arch repair with cardiopulmonary bypass. Operations missing data on perfusion strategy were excluded. Three distinct perfusion strategies were identified: isolated DHCA, RCP (with ≤10 min of DHCA), or mixed (RCP with >10 min of DHCA). Data were analyzed for the entire cohort and stratified by operation subtypes.

Results: Table 1 summarizes the cohort demographics and prevalence of the various perfusion strategies. Overall, 4,523 patients (105 centers) were identified, with a male predominance (58%) and a median age of 7 days (IQR: 5.0, 13.0). The dominant perfusion strategy was RCP (43%), with DHCA and mixed perfusion accounting for 32% and 16% of cases, respectively. In all, 59% of operations included some period of RCP, and RCP remained the dominant perfusion strategy regardless of operation subtype. Neither age nor weight was associated with perfusion strategy, but reoperations were less likely to use RCP (31% vs 45%, $P < .001$). The combined duration of RCP and DHCA in the RCP group was longer than the DHCA time in the DHCA group (45 minutes vs 36 minutes, $P < .001$). There was no significant correlation between center volume and proportion of DHCA or RCP use in the overall cohort (Pearson $\rho=0.07$, $P = .50$ and $\rho=0.13$, $P = .17$, respectively).

Conclusions: In contemporary practice, RCP has emerged as the more prevalent perfusion strategy relative to DHCA for aortic arch repair in children 1 year of age or less. Further investigation is warranted to determine the relative merits of these techniques.

	Overall N=4523	DHCA N=1431	RCP N=1946	Mixed N=717	P
Age at Surgery (days)	7.0 (5.0, 13.0)	7.0 (4.0, 13.0)	7.0 (5.0, 12.0)	7.0 (5.0, 11.0)	0.1088
Male	2,603 (57.6%)	821 (57.4%)	1,117 (57.4%)	416 (58.0%)	0.3289
DHCA time (min)	7.0 (0.0, 32.0)	36.0 (25.0, 47.0)	0.0 (0.0, 3.0)	26.0 (17.0, 42.0)	<.0001
RCP time (min)	45.0 (30.0, 63.0)	0 (0, 0)	45.0 (31.0, 62.0)	44.0 (27.0, 68.0)	0.8037
RCP+DHCA (min)	41.0 (25.0, 60.0)	36.0 (25.0, 47.0)	45.0 (31.0, 64.0)	73.0 (49.0, 100.0)	<.0001
Previous CT Operations					
No (n)	3,906 (86.4%)	1,124 (28.8%)	1,769 (45.3%)	634 (16.2%)	<.0001
Yes (n)	290 (6.4%)	118 (40.7%)	90 (31.0%)	47 (16.2%)	
Group					
Nonwood (n)	2,437 (53.9%)	724 (29.7%)	1,051 (43.1%)	485 (19.9%)	<.0001
Interrupted Aortic Arch ± VSD (n)	459 (10.1%)	149 (32.5%)	205 (44.7%)	63 (13.7%)	
Arch + VSD (n)	614 (13.6%)	195 (31.8%)	256 (41.7%)	69 (11.2%)	
Isolated Arch (n)	1,013 (22.4%)	363 (35.8%)	434 (42.3%)	100 (9.9%)	

Data represent median (interquartile range) or n (%). * In 9% of operations (n=429) neither RCP nor DHCA could be assigned

- 3:55 PM **Quality Measurement: What's New?**
David M. Shabian, Sudbury, MA
- 4:10 PM **Public Reporting: What's New?**
Vinay Badhwar, Pittsburgh, PA
- 4:20 PM **Public Reporting With the STS General Thoracic Surgery Database**
Benjamin D. Kozower, Charlottesville, VA
- 4:30 PM **STS Congenital Heart Surgery Database Risk Models**
Marshall L. Jacobs, Newtown Square, PA
- 4:40 PM **National Quality Initiatives (National Quality Forum, AMA-convened Physician Consortium for Performance Improvement, and CMS Physician Compare Website): What's New?**
Jeffrey P. Jacobs, St Petersburg, FL
- 4:55 PM **Physician Reimbursement (CPT and RUC): What's New?**
Peter K. Smith, Durham, NC
- 5:05 PM **Question-and-Answer Session/Discussion**

1:30 PM – 3:30 PM

Room 120D

Adult Cardiac Session: Aorta I

Moderators: Derek R. Brinster, New York, NY, and Wilson Y. Szeto, Philadelphia, PA

COMMERCIAL RELATIONSHIPS W. Y. Szeto: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, LivaNova; Consultant/Advisory Board, Micro Interventional Devices, Inc

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Presenting authors are listed in **bold**.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

1:30 PM

Room 120D

Open Repair of Thoracoabdominal Aortic Aneurysm in Patients ≤50 Years of Age

J. S. Coselli¹, O. A. Preventza², K. I. de la Cruz², S. Green², M. D. Price², S. A. LeMaire¹

¹Baylor College of Medicine, Houston, TX, ²Baylor College of Medicine/Texas Heart Institute, Houston

COMMERCIAL RELATIONSHIPS J. S. Coselli: Consultant/Advisory Board, Vascutek Ltd a Terumo Company; Research Grant, Medtronic, Inc, W. L. Gore & Associates; Speakers Bureau/Honoraria, Vascutek Ltd a Terumo Company; S. A. LeMaire: Consultant/Advisory Board, Baxter Healthcare Corporation, Medtronic, Inc; Research Grant, Vascutek Ltd a Terumo Company, Medtronic, Inc, GlaxoSmithKline, W. L. Gore & Associates, COOK Medical, Edwards Lifesciences Corporation; O. A. Preventza: Consultant/Advisory Board, Medtronic, Inc; Speakers Bureau/Honoraria, W. L. Gore & Associates, COOK Medical

Purpose: Evolving endovascular approaches to thoracoabdominal aortic aneurysm (TAAA) repair are attractive alternatives to the “gold standard” of conventional open TAAA repair. However, younger patients (≤50 years) may be better served by traditional repair techniques. To better understand operative risk, we evaluated open TAAA repair in younger (≤50 years) and older (>50 years) patients.

Methods: We reviewed retrospective and prospective data from 3,330 cases of open TAAA repair performed between 1986 and 2015. 443 patients (13.3%) were ≤50 years of age (median age, 41.0 [IQR 34.0-46.0]), and of these, 249 (56.2%) had a connective tissue disorder. Aortic dissection was common in younger patients (n=357, 80.6%). Thirty-three patients (7.4%) had an acute/subacute aortic dissection. Rupture was relatively uncommon (n=12, 2.7%). Thirty patients (6.8%) previously had an open or endovascular repair failure. Adverse event was defined as operative death or permanent (present at discharge) stroke, paraplegia, paraparesis, or renal failure necessitating dialysis.

Results: Significant differences were found between younger and older patients. Peripheral vascular disease occurred less often in younger vs older patients, as did coronary artery disease. Extent II and urgent/emergent repair were more common in younger vs older patients. Aortic clamp time was increased in younger patients than in older patients. Bypass grafts to visceral arteries were increasingly used in younger patients than in older patients. Younger patients often had better early outcomes than older patients (Table), including operative death, 30-day death, permanent paraplegia, permanent renal failure necessitating dialysis, and cardiac complications, but both groups had similar rates of permanent or temporary stroke.

Conclusions: Early outcomes of open TAAA repair were excellent for patients ≤ 50 years old, compared to those for older patients; risk was typically reduced by half or greater. Patient age is easily assessed. In general, one should consider reserving evolving endovascular approaches to TAAA repair for patients > 50 years old.

Table. TAAA Repair Stratified by Patient Age: ≤ 50 years vs > 50 years

	All (n=3330)	≤ 50 years (n=443)	> 50 years (n=2887)	P-value
<i>Preoperative factors</i>				
Aortic dissection	1196 (35.9)	357 (80.6)	839 (29.1)	<.0001
Coronary artery disease	1241 (37.3)	60 (13.5)	1181 (40.9)	<.0001
Peripheral vascular disease	858 (25.8)	34 (7.7)	824 (28.5)	<.0001
<i>Operative details</i>				
Extent II repair	1075 (32.3)	194 (43.8)	881 (30.5)	<.0001
Urgent or emergent repair	729 (21.9)	117 (26.4)	612 (21.2)	.02
Aortic clamp time, median	48.0 [36.0-62.0]	58.0 [43.5-75.0]	47.0 [36.0-60.0]	<.0001
Bypass graft to any visceral artery	842 (25.3)	135 (30.5)	707 (24.5)	.008
<i>Early outcomes</i>				
Adverse event ¹	482 (14.5)	24 (5.4)	458 (15.9)	<.0001
Operative death	252 (7.6)	15 (3.4)	237 (8.2)	<.0001
30-day death	162 (4.9)	11 (2.5)	151 (5.2)	.01
Early survival with life-altering complication ²	230 (6.9)	9 (2.0)	221 (7.7)	<.0001
Permanent/temporary stroke	100 (3.0)	7 (1.6)	93 (3.2)	<.0001
Cardiac complications	866 (26.0)	48 (10.8)	818 (28.3)	<.0001
Permanent ³ stroke	75 (2.3)	5 (1.1)	70 (2.4)	.1
Permanent ³ renal failure	190 (5.7)	7 (1.6)	183 (6.3)	<.0001
Permanent ³ paraplegia	98 (2.9)	5 (1.1)	93 (3.2)	.02
Permanent ³ paraparesis	81 (2.4)	4 (0.9)	77 (2.7)	.02

¹Adverse event was defined as operative death or permanent (present at hospital discharge) stroke, paraplegia, paraparesis, or renal failure on dialysis.

²Discharged with stroke, paraplegia, paraparesis, or renal failure necessitating dialysis.

³Present at the time of hospital discharge or early death.

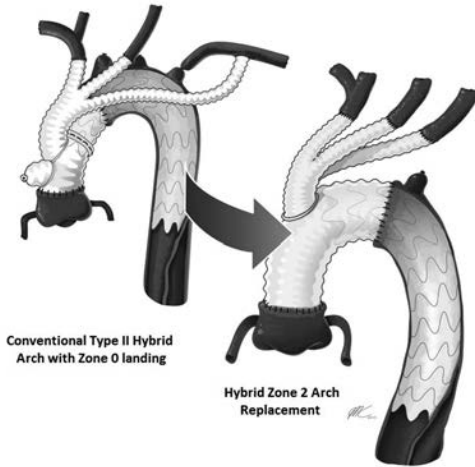
1:45 PM**Room 120D****Imaging Experience of Type II Hybrid Aortic Arch Repair: Lessons Learned From 6 Years of Zone 0 Landing and Evolution to Zone 2 Arch Repair****J.J. Appoo¹, V. Kotba², E. Herget³**¹*Libin Cardiovascular Institute, University of Calgary, Canada,* ²*Foothills Medical Centre, University of Calgary, Canada,* ³*University of Calgary, Canada*

Purpose: Endovascular therapy changed the paradigm of descending thoracic aortic surgery. The proximal arch and ascending aorta are current frontiers being investigated. However, stability of stent grafts deployed across the arch and into ascending aorta (Zone 0) is unknown. This study examines our completed experience with type II hybrid arch replacement.

Methods: Baseline characteristics, intraoperative variables, and postoperative complications were reviewed for all patients at a single center undergoing type II hybrid arch replacement utilizing a four-branch Bavaria graft and Zone 0 endovascular stent graft placement. Dedicated imaging follow-up protocol was followed. Imaging was reviewed by dedicated cardiovascular imagers to assess stent graft complications related to landing in Zone 0.

Results: Twenty-three consecutive patients underwent type II hybrid arch replacement from November 2008 to July 2014. Indications included dissection (n=13), aneurysm (n=9), and penetrating atherosclerotic ulcer (n=1), all involving the ascending aorta, arch, and descending thoracic aorta. There was one intraoperative death. One patient was lost to follow-up after 12 months. Mean imaging follow-up was 33 months (range: 4-72). One third of patients had mean follow-up greater than 4.5 years. Three patients required four reinterventions for proximal landing zone complications: stent graft buckling (n=1), graft migration (n=1), and persistent type 1a endoleak (n=2). There was no stent graft fracture. Proximal stent graft bird beaking within Zone 0 was seen along the lesser curve of the Dacron graft in 15 patients, four of which caused greater than 2 cm non-apposition. At 6-year clinical follow-up, there was no aortic rupture or late mortality.

Conclusions: Ability of endografts to treat diffuse thoracic aortic disease may be limited by issues with conforming to the double curve formed by ascending, arch, and descending aorta. We have changed our technique of hybrid arch to extend surgical resection into Zone 2 of the arch, creating an idealized landing zone.



Conventional Type II Hybrid Arch with Zone 0 landing

Hybrid Zone 2 Arch Replacement

<u>Tertiles based on follow up</u>	<u>Average duration of f/u (months)</u>	<u>Total type 1A Endoleak</u>	<u>Re-intervention</u>	<u>Bird beaking</u>
<u>Tertile 1 (n=7)</u>	57	2	2	6
<u>Tertile 2 (n=8)</u>	32	1	2	5
<u>Tertile 3 (n=7)</u>	11	1	0	4
Total	Average = 33	4	4	15

2:00 PM

Room 120D

Endovascular Arch Repair in Zone 0 and Zone Z Arch Disease

Joseph E. Bavaria, Philadelphia, PA

COMMERCIAL RELATIONSHIPS J. E. Bavaria: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, COOK Medical, Boston Scientific, W. L. Gore & Associates, St Jude Medical

REGULATORY DISCLOSURE This presentation will address the TBE Graft by W. L. Gore, which has an FDA status of investigational. This presentation describes the off-label use in a trial as an adjunct to the Zone 2 arch procedure.

MONDAY AFTERNOON

2:15 PM

Room 120D

Clinical Outcomes of the David V Valve-Sparing Root Replacement Compared to Bioprosthetic Valve Conduits for Aortic Root Aneurysms

J. Esaki¹, B. G. Lesbnower², J. Binongo³, Y. Lasanajak³, M. E. Halkos³, R. Guyton³, E. P. Chen³
¹Otsu Red Cross Hospital, Japan, ²Emory University School of Medicine, Atlanta, GA, ³Emory University, Atlanta, GA

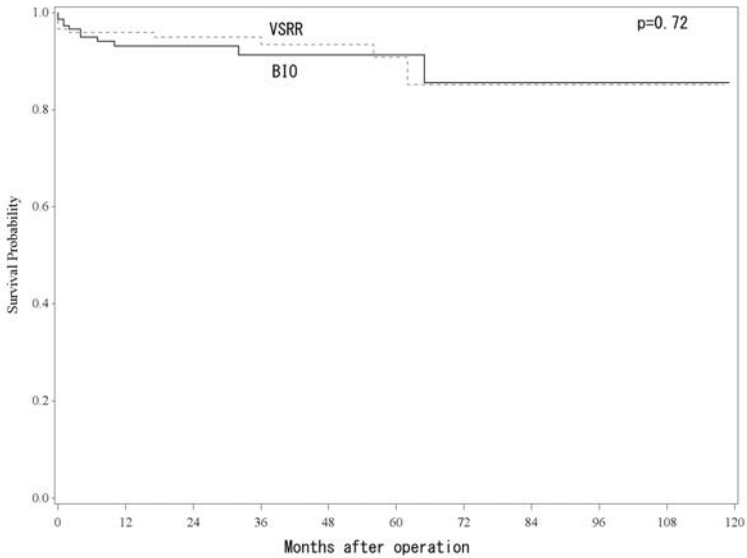
COMMERCIAL RELATIONSHIPS R. Guyton: Consultant/Advisory Board, Medtronic, Inc; M. E. Halkos: Consultant/Advisory Board, Medtronic, Inc, Intuitive Surgical, MAQUET Cardiovascular

Purpose: Valve-sparing root replacement (VSRR) is an established therapy for aortic root pathology. Limited insight exists, however, when comparing results of VSRR with conventional root replacement using a bioprosthetic composite conduit (BIO). The study evaluates and compares clinical outcomes of patients undergoing VSRR and BIO.

Methods: A retrospective review from 2002 to 2015 at a US academic center identified 618 patients who underwent a VSRR (262 patients) or BIO (356 patients). Propensity score matching was performed for each patient using 17 preoperative characteristics and resulted in 149 matched pairs.

Results: The mean age was 49 years in both groups ($P = .97$). Left ventricular ejection fraction was 58% in both groups ($P = .41$). The incidence of bicuspid valves (VSRR 29.5%, BIO 30.2%; $P = .90$), Marfan syndrome (VSRR 10.7%, BIO 5.4%; $P = .09$), type A dissection (VSRR 13.4%, BIO 13.4%; $P = 1.00$), and arch replacement (VSRR 60.4%, BIO 54.4%; $P = .29$) were similar between the groups. The reoperation rate was higher in BIO than VSRR (VSRR 11.4%, BIO 37.6%; $P < .01$). Cardiopulmonary bypass (VSRR 230 minutes, BIO 203 minutes; $P < .01$) and cross clamp times (VSRR 202 minutes, BIO 171 minutes; $P < .01$) were longer in VSRR patients. Operative mortality was 3.4% in both VSRR and BIO ($P = 1.00$). There were no significant differences in renal failure or stroke between the groups (Table). VSRR patients had less prolonged ventilation as well as shorter ICU and hospital LOS compared with BIO. Five-year survival was equivalent between groups (VSRR 90.8%, BIO 91.3%; $P = .72$).

Conclusions: Despite being a more complex procedure, VSRR, in comparison to BIO, results in similar operative mortality and morbidity, but with shorter overall ICU and hospital stays and similar mid-term survival. In appropriately selected patients, VSRR provides an attractive alternative to BIO.



	VSRR (n=149)	BIO (n=149)	GMR/OR [95%CI]	p-value
Reoperation for bleeding	7 [4.7%]	8 [5.4%]	0.88 [0.32,2.41]	0.80
Prolonged ventilation (>24h)	22 [14.8%]	39 [26.2%]	0.49 [0.27,0.87]	0.02
ICU stay (hours) (Median [q1,q3] (mean))	42.8 [24.0,72.8] (48.5)	49.0 [34.0,110.0] (60.6)	0.80 [0.66,0.97]	0.03
LOS (days) (Median [q1,q3] (mean))	6.0 [5.0,8.0] (7.4)	6.0 [5.0,9.0] (8.4)	0.87 [0.77,0.98]	0.02
IABP	6 [4.0%]	17 [11.4%]	0.33 [0.12,0.85]	0.02
New dialysis required	1 [0.7%]	3 [2.0%]	0.42 [0.06,2.92]	0.38
Transient Neurological Dysfunction	4 [2.7%]	6 [4.0%]	0.68 [0.20,2.33]	0.54
Permanent Neurological Dysfunction	3 [2.0%]	4 [2.7%]	0.77 [0.19,3.20]	0.72
Pacemaker implantation	1 [0.7%]	4 [2.7%]	0.33 [0.05,2.12]	0.24
Deep sternal infection	0 [0.0%]	2 [1.3%]	0.20 [0.01,4.19]	0.30
Operative mortality	5 [3.4%]	5 [3.4%]	1.00 [0.30,3.35]	1.00

2:30 PM

Room 120D

The Concept of Selective Antegrade Cerebral Perfusion During Mild (28 °C) Systemic Hypothermia Safely and Reproducibly Can Be Applied to All Aspects of Aortic Arch Surgery: Single-Center Experience Over a 15-Year Period in 587 Consecutive Patients*A. El-Sayed Ahmad, N. Papadopoulos, A. Moritz, A. Zierer**University Hospital Frankfurt, Germany*

Purpose: Whether selective antegrade cerebral perfusion (ACP) during mild systemic hypothermia ($\geq 28^{\circ}\text{C}$) is applicable to aortic arch surgery without restrictions, including the emergency setting of an acute type A aortic dissection or extensive total arch procedures like elephant and frozen elephant trunk techniques, is a subject of ongoing controversy.

Methods: Between January 2000 and January 2015, 587 consecutive all-comers underwent aortic arch surgery at our institution, uniformly applying selective ACP (unilateral: $n=393$, 67%; bilateral: $n=194$, 37%) during mild systemic hypothermia ($28.7^{\circ}\text{C} \pm 0.6^{\circ}\text{C}$). Patient mean age was 68 years ± 16 years; 405 patients (69%) were men. 219 patients (37%) had acute type A aortic dissection. Hemiarch replacement was performed in 386 patients (66%), while the remaining 201 patients (34%) underwent total arch replacement, including elephant trunk ($n=74$, 13%) and frozen elephant trunk ($n=37$, 6%) procedures. Fifty-six patients (10%) have had previous aortic arch surgery. Clinical data were prospectively entered into our institutional database.

Results: Cardiopulmonary bypass time accounted for 183 minutes ± 67 minutes and myocardial ischemic time reached 110 minutes ± 45 minutes. Mean duration of selective ACP was 48 minutes ± 21 minutes (range: 12-96). Chest tube drainage during the first 24 hours accounted for 597 mL ± 438 mL. Mean ventilation time was 31 hours ± 18 hours. Re-exploration for bleeding and new postoperative renal replacement therapy was necessary in 74 patients (13%) and 65 patients (11%), respectively. Mean intensive care unit stay was 4 days ± 5 days. We observed new postoperative permanent neurologic deficits in 34 patients (6%; stroke: $n=33$, 6%; paraplegia $n=1$, 0.02%) and transient neurologic deficits in 29 patients (5%). Thirty-day mortality was 6% ($n=36$).

Conclusions: Current data suggest that selective ACP in combination with mild systemic hypothermia offers sufficient neurologic and visceral organ protection to all-comers requiring aortic arch surgery without pathological or procedural limitations.

2:45 PM

Room 120D

Morphologic and Functional Markers of Aortopathy in Patients With Bicuspid Aortic Valve Insufficiency vs Stenosis

E. Girdauskas¹, M. Rouman¹, M. A. Borger², T. M. Kuntze³, B. Fey¹, K. Dish¹

¹Central Hospital Bad Berka, Germany, ²Columbia University Medical Center, New York, NY,

³Zentralklinik Bad Berka, Germany

COMMERCIAL RELATIONSHIPS M. A. Borger: Consultant/Advisory Board, Edwards Lifesciences Corporation, LivaNova; Nonremunerative Position of Influence, Medtronic, Inc; Speakers Bureau/Honoraria, St Jude Medical

Purpose: Bicuspid aortic valve (BAV) associated aortopathy is heterogeneous and still insufficiently defined. We aimed to prospectively analyze the morphologic and functional parameters of aortopathy in patients undergoing surgery for bicuspid aortic valve insufficiency vs stenosis.

Methods: A total of 172 consecutive patients (59 years \pm 10 years, 71% male) underwent aortic valve replacement with or without proximal aortic surgery for BAV stenosis (n=137, AS group) and BAV insufficiency (n=35, AI group) from January 2012 through December 2014. All patients underwent preoperative cardiac magnetic resonance imaging (MRI) to evaluate morphological/functional parameters of the aortic root. MRI data were used to guide sampling of aortic tissue intraoperatively (from the area where flow-jet impacts on the aortic wall [jet-sample] and the opposite aortic wall [control-sample]). Aortic wall lesions were graded based on histological sum-score (0-21). Expression/severity of aortopathy was quantified by means of proximal aortic phenotype, indexed aortic diameters, and a sum-score.

Results: There was a significant difference in maximal aortic diameters between Group AS vs Group AI (41 mm \pm 8 mm vs 47 mm \pm 8 mm, $P < .001$). Although mid-ascending aortic phenotype (type II) was the most prevalent aortopathy in both study subgroups, there was a significantly higher prevalence of root dilatation phenotype (type I) in the Group AI (27% vs 6%, $P = .01$). Moreover, aortic annulus diameter was significantly larger in Group AI vs Group AS (32 mm \pm 3 mm vs 27 mm \pm 3 mm, $P < .001$). Histological sum-score was significantly different between Group AI vs Group AS (3.2 \pm 2.6 vs 2.5 \pm 1.4, $P = .03$). The angle left ventricle/aorta did not differ significantly between Group AS vs Group AI (49.8° \pm 10.5° vs 45.7° \pm 9.2°, $P = .08$). Logistic regression identified the BAV functional form (Group AI vs Group AS) as independent predictor of indexed aortic diameter >22 mm/m² (OR 4.7, $P = .007$).

Conclusions: Our study demonstrates that BAV functional phenotype (insufficiency vs stenosis) has a significant impact on the expression and severity of bicuspid aortopathy.

3:00 PM

Room 120D

Bicuspid Aortic Valve Insufficiency With Root Aneurysm: Repair With Root Reimplantation

Edward P. Chen, Atlanta, GA

3:15 PM

Room 120D

Redo Thoracoabdominal Aortic Aneurysm Repair: A Single-Center Experience Over 25 YearsR. Afifi¹, A. E. Trott¹, H. K. Sandhu², C. C. Miller¹, A. L. Estrera¹, H. J. Safi¹¹The University of Texas Health Science Center, Houston, ²The University of Texas Medical School, Houston**COMMERCIAL RELATIONSHIPS** A. L. Estrera: Consultant/Advisory Board, W. L. Gore & Associates; Speakers Bureau/Honoraria, MAQUET

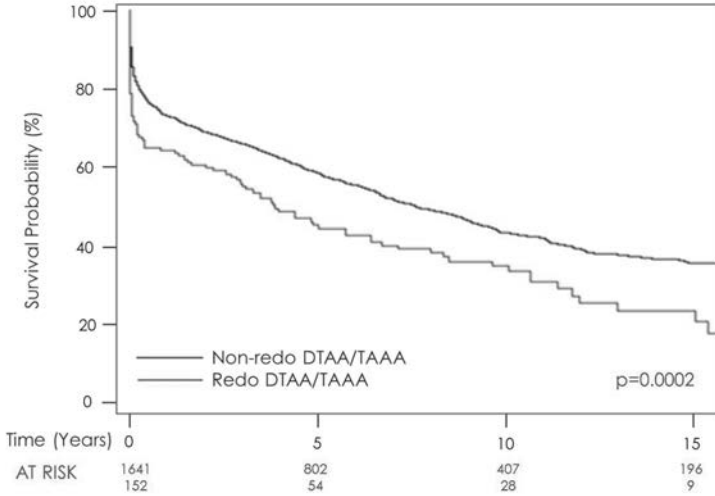
Purpose: Aortic disease is a lifelong progressive illness that may require repeated intervention over time. We reviewed our 25-year experience with thoracoabdominal (TAAA) and descending thoracic (DTAA) aortic repair. We attempted to identify risk factor profiles of patients with durable repairs and those requiring subsequent reoperation.

Methods: We reviewed all cases of open TAAA and DTAA repair in our practice between 1991 and 2014. Patient characteristics, operative variables, and reasons for redo requirement were evaluated. Data were analyzed by contingency table and by multiple logistic regression.

Results: We performed 1,897 open DTAA/TAAA repairs and 254 (13%) were redos. Redos were associated with age (61 years \pm 16 years vs 65 years \pm 13 years, $P < .02$), Marfan syndrome (33, 13% redo vs 74, 5% non-redo, $P < .001$), and chronic obstructive pulmonary disease (COPD) (122, 48% redo vs 592, 36% non-redo, $P < .002$). Reasons for redo DTAA/TAAA were extension of disease (85%), intercostal patch expansion (5%), visceral patch expansion (4%), infection (3%), anastomotic pseudoaneurysm (2%), and thoracic endovascular aortic repair complications (1%). Previously repaired aortic extents evenly involved DTAA, TAAA, and abdominal aneurysm, and 15% had multiple segment involvement. Extent IV TAAA was predominantly involved in redos (40% redo vs 14% non-redo, $P < .001$). Thirty-day mortality was significantly higher (61, 24% redo vs 241, 15% non-redo, $P < .002$). Long-term survival was significantly lower among redos compared to non-redo DTAA/TAAAs (Figure). Redo was an independent predictor of overall mortality (HR 1.6, $P < .001$) after adjustment for age, aneurysm extent, preoperative glomerular filtration rate, cerebrovascular disease, rupture, and smoking.

Conclusions: Need for redo surgery of DTAA/TAAA is common. It most often presents as extension of disease into an adjacent segment and is independently related to younger age, Marfan syndrome, and COPD. Long-term surveillance is indicated in patients following TAAA/DTAA repair.

Long-term Survival Comparing Redo to Non-redo DTAA/TAAA Repairs



1:30 PM – 3:30 PM

Room 126ABC

Adult Cardiac Session: Ischemic

Moderators: Frank W. Sellke, Providence, RI, and Brett C. Sheridan, Chapel Hill, NC

COMMERCIAL RELATIONSHIPS F. W. Sellke: Consultant/Advisory Board, Boehringer Ingelheim, The Medicines Company

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold**.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

1:30 PM

Room 126ABC

Failure-to-Rescue Rates After Coronary Artery Bypass Grafting: An Analysis From the STS Adult Cardiac Surgery Database

F. H. Edwards¹, V. A. Ferraris², P. A. Kurlansky³, K. W. Lobbell⁴, X. He⁵, S. O'Brien⁶, A. P. Furnary⁷, J. Rankin⁸, C. M. Vassileva⁹, F. L. Fazzalari¹⁰, M. J. Magee¹¹, V. Badhwar¹², Y. Xian⁶, J. P. Jacobs¹³, M. C. Wyler von Ballmoos¹⁴, D. Shabian¹⁵

¹University of Florida, Jacksonville, ²University of Kentucky Chandler Medical Center, Lexington, ³Columbia University, New York, NY, ⁴Sanger Heart & Vascular Institute/Carolinas HealthCare System, Charlotte, NC, ⁵Duke Clinical Research Institute, Durham, NC, ⁶Duke University, Durham, NC, ⁷Starr-Wood Cardiac Group of Portland, OR, ⁸Cardiothoracic Surgery Associates, Nashville, TN, ⁹Southern Illinois University School of Medicine, Springfield, ¹⁰University of Michigan Medical School, Rochester, ¹¹HCA North Texas Division, Dallas, ¹²University of Pittsburgh, PA, ¹³Johns Hopkins All Children's Heart Institute, St Petersburg, FL, ¹⁴Medical College of Wisconsin, Milwaukee, ¹⁵Massachusetts General Hospital, Sudbury

COMMERCIAL RELATIONSHIPS V. A. Ferraris: Consultant/Advisory Board, Acelyt; A. P. Furnary: Consultant/Advisory Board, Edwards Lifesciences Corporation, Glysure Ltd; Nonremunerative Position of Influence, Johnson & Johnson, LifeScan, Inc; Speakers Bureau/Honoraria, Edwards Lifesciences Corporation; K. W. Lobbell: Consultant/Advisory Board, Medtronic, Inc; J. Rankin: Consultant/Advisory Board, BioStable Science and Engineering, Admedus

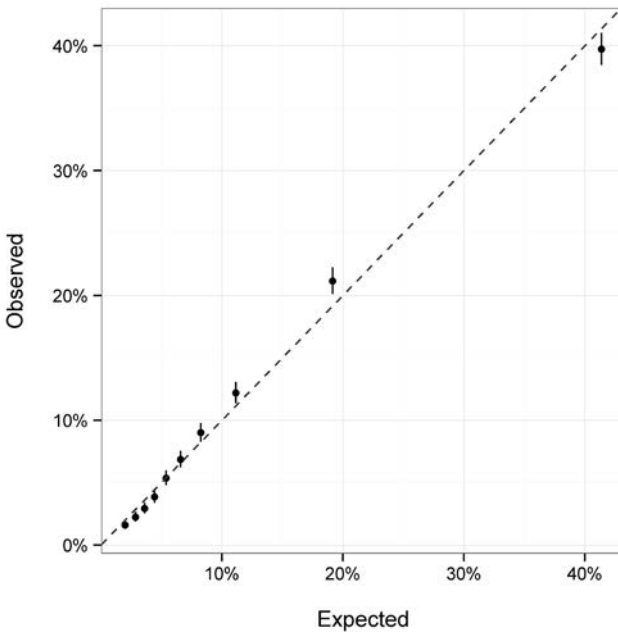
Purpose: Failure to rescue (FTR) increasingly is recognized as an important quality indicator in surgery. We used the STS National Database to develop an FTR measure for coronary artery bypass grafting (CABG) surgery. Factors influencing FTR were explored, and a model was developed to predict FTR based on patient risk factors.

Methods: The study population consisted of patients undergoing isolated CABG from January 2010 through December 2013. We defined FTR as death following complications included in the STS CABG composite morbidity measure: stroke, renal failure, reoperation, and prolonged ventilation. We determined FTR for a composite of the four complications and for each individual complication. A statistical model to predict FTR was developed from these data and the STS CABG risk model. Validation was based on both a “training set/test set” approach and internal validation.

Results: 604,154 CABG records from 1,105 centers met study criteria. FTR rates were: stroke 16.4%, renal failure 22.3%, reoperation 12.4%, and prolonged ventilation 12.1%. FTR was 10.5% for the composite of any of these complications. Numbers of complications and combinations of complications were strongly associated with outcome. The FTR prediction model demonstrated a c-index of 0.79. The model was well calibrated, with a 0.8%

average difference between observed and predicted mortality rates across 10 risk categories. With centers grouped into mortality terciles, complication rates increased modestly (11.4% to 15.7%) from lowest to highest terciles, but FTR more than doubled (6.8% to 13.9%). When centers were grouped into terciles based on complication rate, annualized CABG volumes from lowest to highest complication terciles were 151, 133, and 107. Using the FTR prediction model, centers with low complication rates had an FTR O/E=1.14 while the group with the highest complication rates had 0.91 O/E.

Conclusions: Overall mortality rates and FTR are directly related, but the latter varies more across hospitals than the former. Lower FTR suggests greater capability to effectively manage serious complications. Predicted FTR rates for various combinations of complications may assist in patient counseling, and FTR O/E ratios have promise as valuable quality metrics.



1:45 PM

Room 126ABC

Total Arterial Coronary Revascularization: A Superior Strategy for Diabetic Patients Who Require Coronary Surgery*J. Tatoulis¹, R. Wynne², B. F. Buxton², P. Skillington³**¹Royal Melbourne Hospital, University of Melbourne, Australia, ²University of Melbourne, Australia, ³Royal Melbourne Hospital, Parkville, Australia*

Purpose: The Future Revascularization Evaluation in Patients with Diabetes Mellitus (FREEDOM) randomized trial showed that for patients with diabetes and advanced coronary artery disease, coronary artery bypass grafting (CABG) surgery was superior to percutaneous intervention. We investigated whether total arterial revascularization (TAR) conferred an additional survival advantage for diabetic patients having CABG.

Methods: We reviewed 63,592 cases from an audited, collaborative Australian cardiac surgical database. A total of 34,181 patients undergoing first-time isolated CABG from 2001 to 2012 were identified. There were 11,642 diabetic patients (34.1%). TAR was performed in 12,271 patients (35.9%); 3,795 (30.9%) with diabetes vs 8,476 (69.1%) without diabetes. Propensity score matching resulted in 6,232 matched pairs of patients who did or did not have TAR. Data were linked to the National Death Index.

Results: In the total matched sample (n=12,464), there were 3,984 patients (32.0%) with diabetes. Mean follow-up was 4.9 years. Analysis of diabetic patients (n=3,984) from the propensity score-matched TAR cohort showed that similar proportions of diabetic patients did have TAR (n=2,017, 50.6%) and did not have TAR (n=1,967, 49.4%); $P = .337$. Perioperative, including 30-day mortality, was similar: 1.2% (24/2,017) for TAR and 1.4% (28/1,967) for no TAR; $P = .506$. Late mortality was less in diabetic patients who underwent TAR, 10.2% (205/2,017) vs no TAR, 12.2% (240/1,967); $P = .041$. Kaplan-Meier survival at 1, 5, and 10 years was 96.2%, 88.9%, and 82.2% for the diabetic TAR group vs 95.4%, 87.5%, and 78.3% for diabetic non-TAR (log rank, $P = .036$).

Conclusions: In a large, propensity score-matched cohort of patients having CABG, TAR demonstrated further long-term prognostic benefit for diabetic patients, in the context of equivalent perioperative mortality.

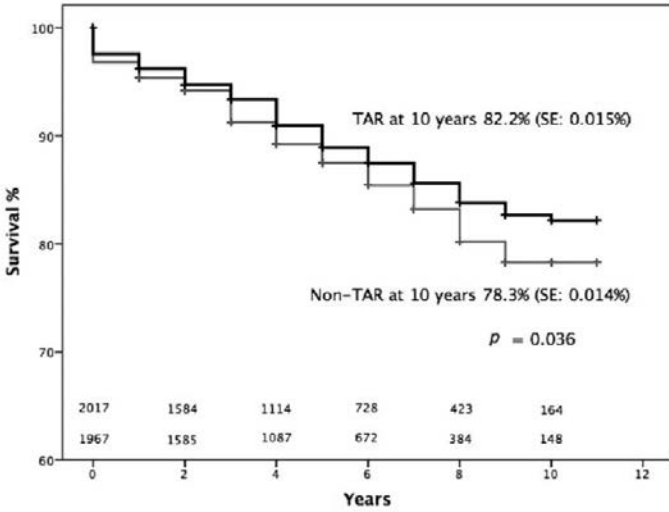


Figure 1. Comparison of Kaplan-Meier survival for diabetic TAR versus diabetic non-TAR propensity matched patients. (log-rank, $p = 0.036$). TAR: Total Arterial Revascularization.

2:00 PM

Room 126ABC

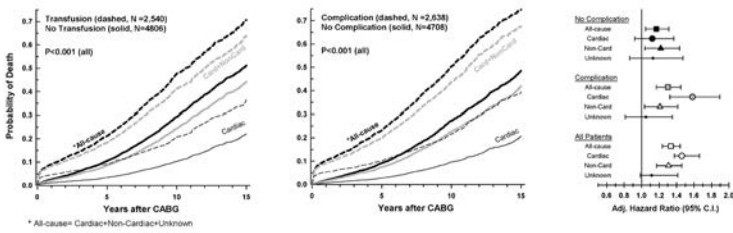
Effects of Blood Transfusion on Late Cardiac and Noncardiac Mortality After Coronary Artery Bypass Grafting*T. A. Schwann¹, J. R. Habib², V. Nauffal³, J. M. Khalifeh², M. R. Bonnell¹, M. Engoren⁴, R. H. Habib²**¹University of Toledo Medical Center, OH, ²American University of Beirut, Lebanon, ³The Johns Hopkins Hospital, Baltimore, MD, ⁴University of Michigan, Ann Arbor*

Purpose: Perioperative transfusion has been associated with increased late death after coronary artery bypass grafting (CABG) surgery. Transfusions also are increasingly more frequent in patients suffering serious post-CABG complications, which independently are linked to poorer long-term survival. We aimed to ascertain the transfusion effect on late, after-CABG death independent of complications.

Methods: We analyzed the CABG experience from two Ohio hospitals (n=7,346; 1994–2007). Salvage and preoperative renal failure patients were excluded. Long-term outcomes and leading cause of death (cardiac, noncardiac, all-cause) were derived from the Social Security Death Index and Ohio death data. Kaplan-Meier 15-year mortality was compared for transfusion groups (Yes/No: n=2,540/4,806) overall and stratified based on perioperative complications sub-cohorts (Yes/No: 2,638/4,708). Comprehensively risk-adjusted transfusion effects were estimated by multivariate proportional-hazard Cox regression analysis with forced adjustment using 32 covariates, including demographic and risk factors, completeness of revascularization, and use of arterial grafting. Results were confirmed by propensity score-adjusted analysis.

Results: Perioperative transfusions and complications occurred in 35.6% and 35.9% of the overall study CABG population, respectively. Transfusion rates were about twice as frequent in patients with perioperative complications compared to uncomplicated patients (26.1% vs 49.7%; $P < .001$). A total of 3,347 deaths (45.6%) were observed for the overall cohort at a median time-to-death of 7.43 years after surgery. Death was substantially more frequent in the case of complications (58.2% vs 38.5%; $P < .001$) or transfusion (41.6% vs 53.1%; $P < .001$). Subsequently, 15-year cardiac mortality, known cause mortality (cardiac or noncardiac), and all-cause mortality all showed large late effects of both perioperative transfusions [Figure, right] and complications [Figure, middle]. The risk-adjusted transfusion effects [Figure, left] after stratification showed: 1) similarly increased risk of noncardiac death irrespective of perioperative complication status (No/Yes: adjusted HR=1.22 [1.04–1.43] / 1.21 [1.03–1.41]); and 2) risk of cardiac death was increased substantially in complicated patients only (Complicated [Yes/No]: adjusted HR=1.58 [1.32–1.89] and 1.12 [0.92–1.37], respectively).

Conclusions: Perioperative transfusion is associated with significant adverse late death effects in both complicated and uncomplicated patients. Our analysis suggests an interaction of this transfusion effect with perioperative complications—specifically, late cardiac death. Further studies are needed to confirm and elucidate this finding, including its potential dose dependence.



2:15 PM

Room 126ABC

The Optimal Composite Graft Strategy for Multiple Sequential Radial Artery Grafting to the Non-Left Anterior Descending Artery Territories in Aortic No-Touch Total Arterial Off-Pump Coronary Artery Bypass Grafting

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Purpose: We retrospectively reviewed the patients who underwent aortic no-touch total arterial off-pump coronary artery bypass grafting (OPCAB) with an arterial composite graft technique and evaluated a reliable composite graft strategy derived from the relationship between the severity of target vessel stenosis and late graft patency.

Methods: The composite graft consisted of an in situ internal thoracic artery (ITA), which had a distal end anastomosed to the proximal radial artery that applied to the non-left anterior descending territories using sequential anastomotic technique. Between 2002 and 2013, 1,456 patients underwent aortic no-touch total arterial OPCAB in our center, and of these, 610 patients received this type of composite graft procedure. Of those, 145 patients (437 grafts) with two, three, and four sequential anastomoses had late graft examination 4.2 years ± 2.0 years after OPCAB; these patients were enrolled in our study. A graft with most distal anastomosis was defined as a last graft.

Results: The overall late graft patency with two, three, and four sequential anastomoses was 67.5%, 79.4%, and 80.4%, respectively. When the last graft was anastomosed to the severely stenotic vessel (≥75%), late graft patency of each composite graft became higher than that with the last graft that was anastomosed to the moderately stenotic vessel (<50%): 79.5%, 86.5%, and 83.6% vs 52.8%, 65.1%, and 73.1%, $P < .05$. Furthermore, in the composite graft with two sequential anastomoses, late graft patency increased as high as 91.7% when all sequential grafts were anastomosed to the severely stenotic vessels. In the composite graft with four sequential anastomoses with the last graft anastomosed to the severely stenotic vessel, if the number of moderately stenotic target vessels except the last graft was set at ≤1, late graft patency increased to a high value compared with the number of these set at >1 (91.7% vs 75.0%, $P < .05$).

Conclusions: In sequential multivessel radial artery grafting of the composite grafts including in situ ITA, severely stenotic lesion of the most distal target causes a favorable late graft patency. Furthermore, a good late graft patency can be obtained by minimizing the number of moderately stenotic targets.

MONDAY AFTERNOON

2:30 PM

Room 126ABC

Coronary Artery Bypass Surgery With Hypothermic Ventricular Fibrillation Without Aortic Occlusion: A Contemporary Study on Early Results and Long-Term Survival

P. E. Antunes, C. F. Branco, F. Soares, M. J. Antunes

Center of Cardiothoracic Surgery, Coimbra, Portugal

Purpose: There is little information in the recent literature on the results of patients undergoing coronary artery bypass grafting (CABG) surgery with hypothermic ventricular fibrillation without aortic occlusion. We analyzed early results and long-term survival in a contemporary series of patients who underwent CABG surgery with this technique.

Methods: Patients were identified and the preoperative, operative, and postoperative data retrieved from our institutional prospective CABG registry. From this database, the records of 4,912 consecutive patients who underwent isolated CABG with hypothermic ventricular fibrillation without aortic occlusion from January 2000 to December 2013 were retrieved for analysis. Mean age was 63.2 years \pm 9.5 years, 13% (638) were women, 29.9% (1,467) were diabetic, 10.3% (508) had peripheral vascular disease, 8.8% (431) had cerebrovascular disease, and 50.4% (2,475) had previous acute myocardial infarction (AMI). Three-vessel disease was present in 76.3% (3,747) of the cases, and 8.5% (414) had left ventricle ejection fraction <40%. Patient survival was calculated by actuarial analysis according to the Kaplan-Meier method.

Results: The mean cardiopulmonary bypass time was 53.6 minutes \pm 16.7 minutes. The mean number of grafts per patient was 2.7 \pm 0.7 (arterial: 1.2 \pm 0.5). The left internal thoracic artery (ITA) was used in 99.6% (4,893) of patients and both ITAs in 21.8% (1,071). The in-hospital and 30-day mortality rate was 0.5% (24) and 0.6% (27), respectively. Inotropic support was required in 6.1% (299) and mechanical support in 0.6% (31), and 1.5% (74) were re-explored for bleeding and 0.6% (31) for sternal complications (mediastinitis, 0.3%). Acute kidney injury occurred in 962 patients (19.7%). The incidence rates of stroke/transient ischemic attack and AMI were 2.4 and 1.5%, respectively. The mean hospital stay was 7.0 days \pm 4.4 days. Follow-up was 36,498 patient-years (median 7.8 years) and was complete for 95.9% of patients. Late survival rates at 1, 5, and 10 years were 97.1% \pm 0.2%, 92.2% \pm 0.4%, and 80.1% \pm 0.7%, respectively.

Conclusions: In this contemporary series, we demonstrate that hypothermic ventricular fibrillation without aortic occlusion affords good early and long-term survival results in patients undergoing isolated CABG. This method is simple and expeditious and remains a very useful alternative technique of myocardial protection, which should be known to every surgeon who performs CABG.

2:45 PM

Room 126ABC

A Comparison of Graft Stenosis and Occlusion Between Radial Artery and Saphenous Veins 5 Years After Coronary Artery Bypass Grafting: A Secondary Analysis of the Radial Artery Patency Study

M. Yamasaki¹, S. E. Fremes¹, S. Deb¹, H. Tsubota¹, F. Moussa², E. Cohen¹, S. Radhakrishnan¹, J. Dubbin¹, D. Ko¹, A. Kiss³, L. Schwartz⁴

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COMMERCIAL RELATIONSHIPS S. E. Fremes: Research Grant, Canadian Institutes of Health Research; S. Radhakrishnan: Consultant/Advisory Board, Medtronic, Inc

Purpose: Coronary graft stenosis may be associated with future graft failure. This investigation was to compare the prevalence, severity, and location of angiographic graft stenosis between the radial artery (RA) and saphenous vein grafts (SVG) at least 5 years postoperatively using the late Radial Artery Patency Study (RAPS) data.

Methods: Graft stenosis, assessed for patients with Thrombolysis in Myocardial Infarction (TIMI) 3 flow of both grafts, was defined as grade 0 = 0%-24%, 1 = 25%-49%, 2 = 50%-74%, or 3 = 75%-99% stenosis; significant stenosis was defined as >50%. The primary outcome was the prevalence of significant graft stenosis involving either the proximal anastomosis, graft body, or distal anastomosis. Secondary outcomes were significant stenosis in the individual regions of the graft considered separately and the overall burden of graft disease using the full grading scale. The tertiary outcome was major adverse cardiac events (MACE) of study patients.

Results: Of 234 patients who underwent late invasive angiography, 163 patients had TIMI 3 flow in both the RA and study SVG. The presence of significant stenosis anywhere along these grafts were similar between radials and SVGs (RA: 14/163 [8.6%], SVG: 19/163 [11.7%], $P = .30$); this also was true for the proximal anastomosis (RA: 5/163 [3.1%], SVG: 5/163 [3.1%], $P = 1.00$), graft body (RA: 6/163 [3.7%], SVG: 13/163 [8.0%], $P = .09$), or the distal anastomosis (RA: 4/163 [2.5%], SVG: 5/163 [3.1%], $P = .71$) considered separately. However, the overall burden of graft body disease was higher in SVGs ($P = .03$), predominantly driven by a greater number of SVG grafts with lesions less than 50%. MACE were substantially higher in patients with significant graft stenosis than patients without (patients with significant graft stenosis: 10 [35.7%], patients without significant graft stenosis: seven [5.2%], $P < .0001$).

Conclusions: There was no difference in the rates of significant stenosis of patent RA grafts and SVGs more than 5 years postoperatively. However, the burden of graft body stenosis was less in RAs compared with SVGs, suggesting that the RA grafts will continue to outperform the SVG late after surgery.

3:00 PM

Room 126ABC

The Racial Paradox in Multiarterial Conduit Utilization for Coronary Artery Bypass Grafting

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COMMERCIAL RELATIONSHIPS R. Guyton: Consultant/Advisory Board, Medtronic, Inc; M. E. Halkos: Consultant/Advisory Board, Medtronic, Inc., Intuitive Surgical, MAQUET Cardiovascular; O. M. Lattouf: Consultant/Advisory Board, Baxter Healthcare Corporation; Ownership Interest, TransCardiac Therapeutics, LLC, MiMedx Group, Inc; E. L. Sarin: Consultant/Advisory Board, Abbott Vascular

Purpose: It has been established that outcomes for black patients undergoing coronary artery bypass grafting (CABG) surgery are inferior to those of their white counterparts. The purpose of this study was to determine if a racial bias exists in patients who undergo multiarterial CABG, which may lead to differences in postoperative outcomes.

Methods: A retrospective review of black (n=2,808) and white (n=13,570) patients who underwent isolated, primary CABG from January 2002 to June 2014 at a US academic institution was performed. Multivariable logistic regression analysis was used to assess the difference in 30-day and long-term outcomes between racial groups following CABG.

Results: Overall, 16,378 patients underwent CABG, and 2,441 (14.9%) received >1 arterial graft. Black men received the highest percentage of multiarterial CABGs (317/1,639, 19.3%) followed by white men (1,715/10,246, 16.8%), black women (126/1,169, 10.8%), and white women (283/3,324, 8.5%). Blacks were 30% more likely to receive multiarterial grafts than whites (OR 1.3, 95% CI 1.2, 1.5), yet had significantly higher odds of stroke (OR 2.1, 95% CI 1.6, 2.9), Table. Among whites, women experienced higher odds of in-hospital mortality (OR 1.5, 95% CI 1.1, 2.2); among blacks, female gender was associated with lower in-hospital mortality (OR 0.5, 95% CI 0.2, 0.9). Despite having the highest rates of multiarterial grafting, black men continued to demonstrate the worst in-hospital survival compared to all other groups. Furthermore, blacks had a higher mortality than whites at 5 years (HR 1.5, [1.3, 1.7], $P < .0001$).

Conclusions: Whites were less likely than blacks to receive multiarterial CABG in this large, single-center cohort. Despite higher rates of arterial grafting, blacks continued to have significantly worse early and late survival when compared to whites. Increased evaluation of the causes of this disparity is warranted.

OUTCOME	Black vs White	
	OR (95% CI)	p-value
Myocardial infarction	1.4 (0.8, 2.6)	0.23
Stroke	2.1 (1.6, 2.9)	<0.0001
Mediastinitis	2.7 (0.7,10.3)	0.14
Septicemia	1.7 (1.2, 2.5)	0.01
Heart block requiring pacemaker	0.7 (0.3, 1.4)	0.25
MSOF	1.5 (0.9, 2.5)	0.15
Re-exploration for hemorrhage	1.2 (0.9, 1.6)	0.16
Postoperative Pneumonia	1.3 (1.1, 1.8)	0.001
Postoperative IABP insertion	2.4 (1.5, 3.9)	0.0004

3:15 PM

Room 126ABC

What Are the Barriers to Multiple Arterial Grafting?

Joseph F. Sabik III, Cleveland, OH

COMMERCIAL RELATIONSHIPS J. F. Sabik: Consultant/Advisory Board, Medtronic, Inc, LivaNova; Research Grant, Abbott Laboratories, Edwards Lifesciences Corporation

1:30 PM – 3:30 PM

Room 122ABC

Congenital Session: Pediatric Congenital I*Moderators: Andrew C. Fiore, St Louis, MO, and Mark D. Rodefeld, Indianapolis, IN*

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold**.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

1:30 PM

Room 122ABC

Selection Schemes and Technical Diversities of Extra-Anatomic Bypass in Complex and Recurrent Aortic Coarctation and Hypoplastic Arch**E. B. Delmo Walter¹, B. Hartmann¹, A. Ekkernkamp¹, R. Hetzer²**¹Trauma Center Berlin, Germany, ²Herzzentrum Cottbus, Germany

Purpose: Even with all the interventions presently available for native coarctation of aorta (CoA) and hypoplastic arch, repeat surgeries still may be required due to restenosis and/or aneurysm formation. We report the selection schemes, technical variations, and long-term outcome of extra-anatomic bypass to correct complex and recurrent CoA and hypoplastic aortic arch.

Methods: From 1989 to 2012, 60 patients (mean age 29 years \pm 6.7 years) with complex aortic coarctation (n=33; long-segment hypoplastic aortic arch in 15), recurrent coarctation (n=27; anastomosis pseudoaneurysm in 10), underwent correction using extra-anatomic bypass, either with (n=18; femoral bypass=13, left heart bypass=5) or without (n=42) extracorporeal circulation via left lateral thoracotomy (n=52), combined median sternotomy and abdominal laparotomy (n=5), and supraclavicular (n=3) approach. The decision to use extracorporeal circulation was based on the anatomical location of the coarctation, length of hypoplasia, and history of previous repair. Preoperatively, mean systolic blood pressure was 130 mm Hg \pm 30 mm Hg at rest and 180 mm Hg \pm 40 mm Hg during exercise, with mean pressure gradient of 80 mm Hg \pm 11.6 mm Hg (range: 40-120).

Results: Various extra-anatomic bypass strategies included left subclavian artery (LSCA) to descending aorta (DA) (n= 38), right subclavian artery to left carotid artery (LCA) (n=2), LCA to LSCA (n=3), LCA to DA (n=2), ascending aorta (AA) to LSCA (n=3), AA to DA (n=4), aortic arch to DA (n=3), and AA to abdominal aorta (n=5). Graft size (median 18 mm, range: 6-26) was chosen according to the diameter of the ascending aorta. No operative mortality, incidence of paraplegia and signs of neurological complications, or abdominal malperfusion occurred. Mean reduction in systolic blood pressure was 60 mm Hg \pm 25 mm Hg without any pressure gradient ($P < .001$). During a mean follow-up of 18.3 years \pm 3.7 years, there were no reoperations or graft complications and pseudoaneurysm formation on the anastomotic sites. Seven patients (11.6%) had mild/moderate hypertension and are on anti-hypertensive medications. No patients presented with claudication nor did any patient experience orthostatic problems due to steal phenomenon.

Conclusions: The strategy of using various extra-anatomic bypass techniques to correct coarctation and its recurrence was based on the complexity of coarctation sites of stenosis and length of the hypoplastic segment. Extra-anatomic bypass is a safe, effective solution and achieves satisfactory long-term results.

1:45 PM

Room 122ABC

Association of 24/7 In-House Attending Coverage With Outcomes in Children Undergoing Heart Operations: An Analysis of the Virtual Pediatric Systems Database

P. Gupta¹, M. Rettigant², H. E. Jeffries³, N. Brundage⁴, B. P. Markovitz⁵, M. C. Scanlon⁶, J. M. Simsic⁷

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COMMERCIAL RELATIONSHIPS M. C. Scanlon; Other, Virtual PICU Systems, LLC, Provide clinical design guidance to the database development

Purpose: Multicenter data are limited regarding around-the-clock (24/7) presence of an in-house critical care attending physician and outcomes in children undergoing heart surgery. To address these knowledge gaps, this study evaluated this association using the Virtual Pediatric Systems Database.

Methods: Children <18 years undergoing heart surgery in the Virtual Pediatric Systems Database (2009–2014) were included. The study population was divided in two groups: 24/7 group (15,209 patients, 33 hospitals) and No 24/7 group (10,717 patients, 23 hospitals). Hospitals with changing staffing patterns for the presence of an in-house ICU attending during the study period were excluded (2,477 patients, nine hospitals). Propensity score matching was performed to 1-1 match patients in the 24/7 group and No 24/7 group (Figure). The patients were matched for patient characteristics, preoperative risk factors, severity of illness, complexity and number of operations performed, and center volume.

Results: Overall, 25,926 patients (56 hospitals) qualified for inclusion. By propensity score matching, 9,344 patients matched 1-1 between the two groups (4,672 in each group). Prior to matching, the patients in the No 24/7 group were younger, smaller, more likely to have preoperative risk factors, and underwent more than one cardiac surgery. After matching, patients in the two groups were similar with respect to patient and center characteristics. In the matched sample, mortality and duration of mechanical ventilation were lower in the 24/7 group vs the No 24/7 group. Other outcomes (such as use of extracorporeal membrane oxygenation, incidence of cardiac arrest, extubation within 48 hours after surgery, rate of reintubation, and duration of arterial line after surgery) also were significantly improved in the 24/7 group (Table). In analysis stratified by surgical complexity, the majority of the study outcomes remained significantly better in the 24/7 group for patients undergoing both low complexity and high complexity operations.

Conclusions: The presence of 24-hour in-ICU attending coverage for children undergoing heart surgery is associated with better outcomes, including mortality. It is possible that 24-hour in-ICU attending coverage may be a surrogate for other factors that may bias the results. Further study is warranted.

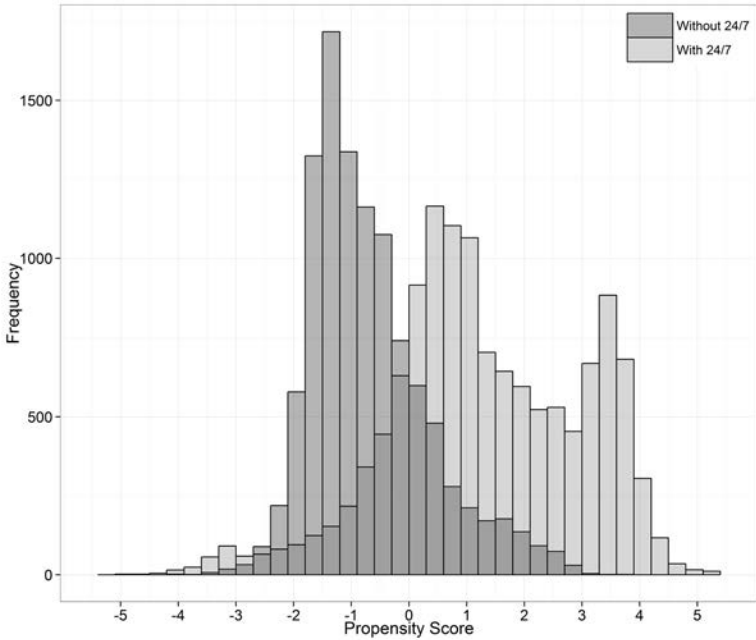


Table. Study Outcomes Among the Matched Patients

	Without 24/7 Coverage (N=4,672)	With 24/7 Coverage (N=4,672)	P-value
Major Outcomes			
Mortality	164 (3.5%)	119 (2.6%)	0.007
Length of ICU Stay	11.03 (0.3)	10.76 (0.2)	0.46
Length of Mechanical Ventilation	7.85 (0.3)	7 (0.2)	0.02
Minor Outcomes			
Use of ECMO	209 (4.5%)	159 (3.4%)	0.008
Cardiac Arrest	165 (3.5%)	103 (2.2%)	0.0001
Extubation ≤ 24 hours	2,064 (57.7%)	2,169 (59.3%)	0.17
Extubation < 48 hours	2,382 (66.6%)	2,558 (69.9%)	0.003
Reintubation	568 (15.9%)	478 (13.1%)	0.0007
Days of Arterial line	6.68 (0.2)	6.03 (0.2)	0.007
Days of Central line	7.53 (0.2)	7.05 (0.2)	0.08

Continuous variables are summarized by mean ± standard deviation. Categorical variables are summarized as N (%).

2:00 PM**Room 122ABC****A Structured Blood Conservation Program in Pediatric Cardiac Surgery: More Is Better****S. Gunaydin¹, K. McCusker²**¹*Adatip Hospital, Ankara, Turkey*, ²*Portsmouth Regional Hospital, NH*

Purpose: The limitation of alternative transfusion practices in infants increases the benefits of blood conservation. We analyzed the efficacy of a structured program to reduce transfusions and transfusion-associated complications in cardiac surgery.

Methods: Our pediatric cardiac surgery database was reviewed retrospectively, comparing outcomes before and after the March 2014 implementation of an effective two-way blood conservation program (significantly less prime volume, condensed circuit, cerebral saturation-rSO₂, retrograde priming, cell salvage, and pole-mounted vents). Group 1-Blood Conservation consisted of 214 infants (8.1 months ± 3.4 months) who underwent biventricular repair utilizing cardiopulmonary bypass (CPB) during the 12-month period after implementation of the new program (March 2014-February 2015). They were compared with Group B-Control/No Blood Conservation, 250 infants (7.91 months ± 3.2 months) from the previous 12-month period (March 2013-February 2014).

Results: In Group 1, there were no statistical differences in age, sex, weight, CPB and cross clamp times, preoperative and postoperative hemoglobin levels, and red blood cell transfusions, despite lower intraoperative hemoglobin levels ($P < .001$) and blood transfusion ($P < .05$) requirements. There were significantly lower inotropic scores ($P < .01$) and a trend toward a shorter duration of time on the ventilator ($P < .067$) in the blood conservation group. Logistic regression analysis demonstrated a significant correlation between intraoperative blood transfusion and increased inotropic score, longer duration on the ventilator, and increased length of hospitalization.

Conclusions: These findings, in addition to attendant risks and side effects of blood transfusion and the rising cost of safer blood products, justify blood conservation in pediatric cardiac operations. Circuit miniaturization, ultrafiltration, and reduced postoperative bleeding, presumably secondary to higher fibrinogen and other coagulation factor levels, contributed to this outcome.

2:15 PM

Room 122ABC

Evaluation of Explanted CorMatrix™ Intra-Cardiac Patches in Children With Congenital Heart Disease

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Purpose: Animal data demonstrate that intra-cardiac patches of decellularized porcine small intestine submucosa (CorMatrix) become repopulated with native cells, suggesting the possibility of a substrate for regenerative tissue in humans. We report the only prospective series to date of these explanted CorMatrix patches placed in infants with congenital heart disease.

Methods: CorMatrix patches were implanted as the hemi-Fontan baffle in patients during their second stage of palliation. The patch material was explanted as part of the standard Fontan operation. Specimens were analyzed using hematoxylin and eosin, Movat pentachrome, and trichrome stains.

Results: Of the 12 implantations, 10 specimens were explanted. Two subjects did not undergo Fontan due to unfavorable hemodynamics. Explanted patches revealed acellular material, chronic inflammation, fibrosis, and foreign body giant cell reaction in all cases. In addition, calcification was seen in two specimens and eosinophils in two specimens (Table). No explanted CorMatrix material showed evidence of ingrowth of native cells or transformation into cardiac tissue at a median of 21 months after implantation.

Conclusions: While the CorMatrix remained pliable and most did not exhibit calcification, these intra-cardiac patches did not show evidence of native heart tissue ingrowth at a median of 21 months *in vivo*.

Table. Patient characteristics (N=12) and histopathology (N=10)*

Characteristics	
Male sex	9 (75.0)
Diagnosis	
HLHS	7 (58.3)
DILV	1 (8.3)
DORV, HRV, PS	1 (8.3)
Unbalanced AVSD, HLV, DORV, heterotaxy, dextrocardia, interrupted IVC	1 (8.3)
DIRV, DORV	1 (8.3)
DORV, unbalanced AVSD, HLV	1 (8.3)
Median age at implant (months)	6
Median age at explant (months)	27
Median time <i>in vivo</i> (months)	21
Histopathology	
Fibrosis, acellular material, chronic inflammation, foreign body giant cell reaction	6 (60.0)
Membranous fibroconnective tissue with chronic inflammation + dystrophic calcification	2 (20.0)
Fibrosis, acellular material, chronic inflammation, foreign body giant cell reaction + eosinophils	2 (20.0)
Abbreviations: HLHS, hypoplastic left heart syndrome; DILV, double inlet left ventricle; DORV, double outlet right ventricle; HRV, hypoplastic right ventricle; PS, pulmonary stenosis; AVSD, atrioventricular septal defect; HLV, hypoplastic left ventricle; IVC, inferior vena cava; DIRV, double inlet right ventricle. * Data are presented as N (%) unless otherwise noted.	

2:30 PM

Room 122ABC

Symptoms Do Not Correlate With Coronary Artery Intramural Length or Ostial Diameter in Patients With Anomalous Aortic Origin of Coronary Artery

S. Balasubramanya, M. C. Monge, O. Eltayeb, A. E. Sarwark, J. M. Costello, C. K. Rigsby, A. R. Popescu, C. L. Backer

Ann & Robert H. Lurie Children's Hospital of Chicago, IL

Purpose: Anomalous aortic origin of coronary artery (AAOCA) from the contralateral aortic sinus of Valsalva with an intramural course is a rare congenital anomaly. Sudden death is the most devastating complication. We hypothesized that longer intramural lengths and smaller ostial diameters in these patients would correlate with preoperative symptoms.

Methods: Retrospective analysis of data from all patients who underwent AAOCA unroofing from 2006 to 2014 was performed. All patients underwent preoperative imaging with either computed tomography (CT) or magnetic resonance imaging (MRI) or both, and the intramural lengths were measured. Intramural lengths and ostial diameters also were directly measured intraoperatively. Patients were grouped into those who had preoperative symptoms and those who did not. The intramural lengths measured both preoperatively by imaging and intraoperatively were compared between the two groups. Similarly, the ostial diameters between the groups also were compared.

Results: Sixty-six patients underwent AAOCA unroofing. Mean age was 12.4 years \pm 4 years (range: 4.6-27.9). The gender distribution was 41 male (62.1%) and 25 female (37.9%). Fourteen patients were asymptomatic. Of the 52 patients who were symptomatic, 38 had chest pain (24 typical anginal chest pain and 14 atypical chest pain), 11 had syncope, 11 had dizziness, nine had arrhythmia/palpitations, eight had shortness of breath, three had exercise intolerance, and two had left arm pain. There was no significant difference in intramural lengths measured by CT/MRI (symptoms 8.6 mm \pm 3.5 mm, no symptoms 8.9 mm \pm 2.8 mm, $P = .77$) and measured intraoperatively (symptoms 7.3 mm \pm 2.5 mm, no symptoms 6.9 mm \pm 2.8 mm, $P = .62$). There was no significant difference in the ostial diameters between the two groups (symptoms 1.9 mm \pm 0.49 mm, no symptoms 1.6 mm \pm 0.49 mm, $P = .09$). Mean hospital length of stay was 4.5 days \pm 1 day. There was no mortality.

Conclusions: Coronary unroofing for AAOCA is a safe method of eliminating the intramural course. There was no demonstrable correlation between preoperative symptoms and intramural AAOCA length or AAOCA ostial diameter. Further investigation of AAOCA morphology is needed to help clarify indications for surgery.

2:45 PM

Room 122ABC

Long-Term Outcomes of Complete Vascular Ring Division in Children: 36-Year Experience From a Single Institution

P. S. Naimo¹, E. Sawan², J. S. Donald², T. A. Fricke², Y. d'Udekem¹, C. P. Brizard², I. E. Konstantinov¹

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COMMERCIAL RELATIONSHIPS C. P. Brizard: Consultant/Advisory Board, Admedus; Ownership Interest, Admedus; Y. d'Udekem: Consultant/Advisory Board, Medical Specialties Distributors

Purpose: Complete vascular rings are rare and may cause tracheoesophageal compression. Following surgical division, some patients have persisting tracheomalacia. Recently, it was suggested that simultaneous tracheal reconstruction and resection of Kommerell's diverticulum is beneficial. Long-term outcome studies are limited. We aimed to analyze the long-term outcomes of complete vascular ring division.

Methods: We conducted a retrospective review of all children (n=132) who underwent surgical division of a complete vascular ring between 1978 and 2014 at our institution. Surgery was performed via a median sternotomy (n=15), left thoracotomy (n=114), or right thoracotomy (n=12). Cardiopulmonary bypass was used in 14 patients. Concomitant repair of cardiovascular anomalies was undertaken in 16 patients. Tracheal reconstruction was not performed in any patients. Kommerell diverticulum was not resected in any patients.

Results: Patient characteristics are summarized in Table 1. Hospital mortality was 1.5% (2/132). Two patients with Noonan's syndrome died in 1987 and 2009 of progressive hypertrophic cardiomyopathy. There were no late deaths. Overall survival was $98.3\% \pm 1.2\%$ (95% CI: 93.4, 99.6) at 20 years. Postoperatively, bronchoscopy or bronchogram identified tracheal stenosis in three patients (two early, one late) and tracheomalacia in 15 patients (five early, 10 late). There were nine reoperations in eight patients. Freedom from reoperation was $89.9\% \pm 3.8\%$ (95% CI: 79.4, 95.2) at 20 years. Of these reoperations, two were due to residual tracheal compression and one was a tracheostomy for tracheomalacia, while six were related to concomitant cardiac anomalies. Follow-up was 92% complete (121/132), with median follow-up of 10.4 years (range: 14 days-36 years). At last follow-up, bronchoscopy identified mild tracheomalacia in four patients and moderate tracheomalacia in one patient.

Conclusions: Survival beyond hospital discharge is associated with excellent outcomes. No patient required resection of Kommerell diverticulum or tracheal reconstruction. Respiratory symptoms following complete vascular ring division are uncommon.

Continued on next page

Congenital Session: Pediatric Congenital I – Continued
Abstract continued from previous page

Table 1. Patient Characteristics

Variable	Total (n=132)
Median age at repair	1 year (range, 5 days to 15.7 years)
Median weight at repair	8.7kg (range, 0.9kg to 76kg)
Type of Complete Vascular Ring	
DAA	60.6% (80/132)
RAA with aberrant left subclavian artery, and left ligamentous arteriosus	37.8% (50/132)
Kommerell's diverticulum	20% (10/50)
RAA with mirror-image branching, and left ligamentous arteriosus	0.8% (1/132)
LAA with right-sided descending aorta, and right ligamentous arteriosus	0.8% (1/132)
Concomitant Cardiovascular Anomalies	
Tetralogy of Fallot	6.8% (9/132)
Atrial septal defect	4.5% (6/132)
Patent ductus arteriosus	3.0% (4/132)
Ventricular septal defect	3.0% (4/132)
Double-outlet right ventricle	1.5% (2/132)
Hypertrophic obstructive cardiomyopathy	1.5% (2/132)
Single coronary artery (right coronary artery from the left coronary artery)	0.8% (1/132)

DAA, double aortic arch; LAA, left aortic arch; RAA, right aortic arch

3:00 PM

Room 122ABC

Post-Fontan Follow-Up Outcomes in Patients With a Pulsatile Glenn ShuntS. Ferns¹, C. F. Elzein², S. Subramanian², M. N. Ilbarwi²¹University of North Carolina, Chapel Hill, ²Advocate Children's Hospital, Oak Lawn, IL**Purpose:** To evaluate and compare continued pulmonary artery growth in patients with and without a prior pulsatile Glenn during mid-term follow-up after the Fontan.**Methods:** Records of 212 patients undergoing staged single ventricle palliation during a 10-year period were reviewed. Of those, 103 (33 in pulsatile group A and 70 in non-pulsatile group B) were selected. Demographic data, previous surgical or interventional procedures, and intra, postoperative, and mid-term follow-up course on this cohort of patients after the Fontan was noted. Echo data was collected at pre-Fontan catheterization and regular intervals thereafter. Pulmonary artery sizes were documented on cardiac catheterization and echo. To determine if there was measuring system bias, a comparison between Nakata indexes calculated with catheterization and echocardiographic data at similar time points was made.**Results:** Demographic details were comparable in both groups. Average age and weight at time of Fontan was 2.3 years and 12 kg. Perioperative details, such as prior surgeries, fenestration at Fontan, bypass time, inotropic support, duration of ventilation, postop saturations, central venous pressure, chest tube drainage, ICU days, and hospital days, were comparable in both groups. Mean pulmonary artery pressure and systemic saturations were higher in group A than B. There was a higher incidence of veno-venous collaterals in group A. There was a significant difference in Nakata index in the pre-Fontan and follow-up period between group A vs B. There was a significant increase in the Nakata index in group A between pre-Glenn and pre-Fontan assessments (154.3, 186.7, $P < .005$), as well as the Nakata index between the pre-Fontan and long-term follow-up in this group (186.7, 195.1, $P < .05$). There was no significant change in the Nakata index in group B between assessments (Table).**Conclusions:** Pulsatile bidirectional Glenn is associated with better pulmonary artery growth, which continues long after the additional pulsatile flow is disrupted after the Fontan procedure.**Table: Nakata Index at various time points**

Time of measurement	Group A	Group B	P value
Pre Glenn (cath)	154.3(149.9-158.8)	163(150.9-175.1)	0.34
Pre Fontan (cath)	186.7(168.8-204.6)	160.1(150.4-169.9)	0.005
Follow up (echo)	195.1(176.1-195.1)	167.3(157.9-176.7)	0.004

3:15 PM

Room 122ABC

Mid-Term Results of a Total Cavopulmonary Connection With an Extracardiac Conduit Performed in the Second Decade of Life

A. Metras¹, V. Fouilloux², M. Al-Yamani³, N. Tafer³, X. G. Roques³, D. R. Metras⁴, B. Kreitmann³, F. Roubertie³

¹Bordeaux Hospital University, Pessac, France, ²Children's Hospital La Timone Marseille, France,

³Bordeaux Heart University Hospital, France, ⁴Centre Hospitalier La Timone, Marseille, France

Purpose: Completion of a total cavopulmonary connection (TCPC) with an extracardiac conduit is usually performed in early childhood. Completion in the second decade of life (10–20 years old) rarely has been studied. This bicentric study assessed early and late morbidity/mortality outcomes after completing a TCPC in the second decade.

Methods: Between January 1999 and June 2014, 63 patients (36 males; mean age: 14.5 years + 2.9 years) underwent Fontan completion in the second decade of life. Palliation before completion was an isolated bidirectional cavopulmonary shunt (BCPS) in three patients or BCPS associated with additional pulmonary blood flow (APBF), which was antegrade (Group 1) in 38 (60%) or retrograde (Group 2) in 22 (35%). Preoperative data and perioperative courses were reviewed retrospectively. Data from a primary Fontan or a Fontan conversion were excluded from this study. Mean follow-up time was 4.57 years (range: 0.8–15), with no patients lost to follow-up.

Results: Mean pulmonary arterial and ventricular end-diastolic pressures were 12.2 mm Hg and 9.5 mm Hg, respectively, with no statistical difference between the groups. Mean Nakata index was $284 \text{ mm}^2/\text{m}^2 \pm 123 \text{ mm}^2/\text{m}^2$ and $228 \text{ mm}^2/\text{m}^2 \pm 92 \text{ mm}^2/\text{m}^2$ for groups 1 and 2, respectively ($P = .01$). Aortic cross clamps were performed in 24 (group 1) and eight (group 2), $P = .03$. Forty TCPCs were fenestrated. There was one early death. Nine patients had a prolonged ICU length of stay (>6 days). Mean time of pleural drainage was $10.6 \text{ days} \pm 5.2 \text{ days}$. There were two late deaths. Actuarial survival was 98% and 96% at 1 and 4 years, respectively. At the last follow-up, single-ventricle function remained similar or improved in all group 2 patients, compared to 80% in group 1 ($P = .01$). NYHA significantly improved in both groups: preoperatively, 47 patients were NYHA class II and 16 were NYHA class III, compared to 50 NYHA class I and 10 NYHA class II postoperatively ($P < .001$).

Conclusions: Single-ventricle palliation with BCPS and APBF allowed completion of TCPC in the second decade of life, with satisfactory early and mid-term results and good functional outcomes. However, BCPS and antegrade APBF were associated with moderate single-ventricle dysfunction, so they need to be used cautiously as long-lasting palliation before Fontan completion.

NOTES

1:30 PM – 3:30 PM

Room 120A

General Thoracic Session: Lung Cancer I—Diagnosis and Staging

Moderators: Leah M. Backbus, Stanford, CA, and Subroto Paul, New York, NY

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold**.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

1:30 PM

Room 120A

Thoracic Surgery-Driven Free Lung Cancer Screening in an Underserved Region Demonstrated Triple the Incidence of Lung Cancer Compared to the National Lung Screening Trial

E. L. Simmerman¹, N. B. Thomson III¹, C. Schroeder²

¹Georgia Regents Medical Center, Augusta, ²Georgia Regents University, Augusta

COMMERCIAL RELATIONSHIPS N. B. Thomson III: Ownership Interest, Nuance Communications, Inc

Purpose: The National Lung Screening Trial (NLST) confirmed that screening high-risk individuals for lung cancer with low-dose computed tomography (LDCT) of the chest saves lives. To increase screening accessibility to patients, our division of thoracic surgical oncology developed a program offering free LDCT lung screening to individuals who met National Comprehensive Cancer Network (NCCN) high-risk criteria.

Methods: This is a retrospective chart review from the first year of a free LDCT lung screening program that started June 14, 2014. Advertising for the program, promoted by our thoracic oncology surgeon, was by word of mouth, flyers, and a television news interview. Within 1 year, 398 patients enrolled in the program, of which 255 qualified for free screening based on NCCN high-risk criteria. Patients traveled as far as 151 miles for free screening. Patients were divided into categories based on Lung-RADS Categories. Data were collected on Lung-RADS Categories 3 and 4, and appropriate workups were performed.

Results: Of 255 patients screened, 23 patients (9%) were Lung-RADS Category 4, 23 patients (9%) were Category 3, 64 patients (25%) were Category 2, and 145 patients (57%) were Category 1. Patients in Category 3 demonstrated stable follow-ups and/or have follow-ups pending. With regard to Lung-RADS Category 4 patients, preliminary data demonstrated cancer in eight patients (34.8% of Category 4 patients and a 3.1% overall incidence). To date, four patients (1.6%) had pathologically proven malignancies, four patients (1.6%) had a clinical diagnosis of cancer, seven patients (2.7%) had equivocal findings with workup pending, four patients (1.6%) had false positives, and four patients (1.6%) chose to avoid intervention and undergo serial imaging surveillance instead. Pathologic staging results for subjects with cancer demonstrated three pT1aN0M0 adenocarcinomas and one metastatic colon cancer. Of note, referral basis has increased significantly for the thoracic surgical oncology department as a result of this program.

Conclusions: This study demonstrated an overall cancer incidence of one in 32 high-risk patients in our region, triple the number reported in the NLST. We report pathologically proven cancers at early and treatable stages, confirming the importance of free lung cancer screening programs in high-risk regions, such as ours.

1:45 PM

Room 120A

Operating on a Smoking Patient: A Survey Among US Thoracic Surgeons*B. Weksler, K. A. Marino, R. Klesges, Z. Bursac, M. A. Little, J. L. Sullivan**University of Tennessee Health Science Center, Memphis*

Purpose: Current smoking has been associated with increased postoperative complications in patients undergoing major thoracic surgical procedures. However, there are no guidelines addressing the smoking patient. This study was designed to understand current management of the smoking thoracic surgical patient in the preoperative period.

Methods: An anonymous survey was sent to thoracic and cardiac surgeons in the United States. The survey included questions on strategies used to assist patients to quit smoking prior to surgery and assessed the likelihood of a surgeon offering surgery to a smoking patient.

Results: 158 surgeons responded to the survey. The majority (69%, 109/158) were general thoracic surgeons in an academic practice (57%, 90/158) and with more than 15 years in practice (51%, 81/158). The overwhelming majority of respondents (99%, 157/158) considered current smoking a risk factor for postoperative complications. The most common cessation strategy used in smoking patients was pharmacologic intervention with or without behavioral support (77%, 122/158). About half of surgeons (47%, 74/158) reported that they would not operate on a smoking patient, and 14% (10/74) tested patients preoperatively for smoking. The ideal wait time from smoking cessation to surgery was 2-4 weeks, according to two out of three respondents (66%, 48/74). Logistic regression showed that thoracic surgeons (OR 2.1, 95% CI 1.04-4.34, $P = .05$) in academic practice (OR 1.9, 95% CI 0.98-3.5, $P = .07$) were more likely not to offer surgery to currently smoking patients.

Conclusions: Despite a consensus that current smoking is a risk factor for postoperative complications, there are a variety of therapeutic interventions used in the smoking patient. Prospective studies and guidelines are needed to address preoperative care in the smoking patient.

2:00 PM**Room 120A****BRAF Mutation in Resected Stage I Lung Adenocarcinoma Is a Marker of Worse Outcome***N. S. Lui, L. F. Tapias, D. J. Mathisen, M. Lanuti**Massachusetts General Hospital, Boston*

Purpose: Despite complete surgical resection, patients with stage I non-small-cell lung cancer (NSCLC) are at risk for disease recurrence. The impact of oncogenic driver mutations on prognosis in stage I NSCLC are limited. The pure prognostic value of BRAF mutational status was explored in resected stage I lung adenocarcinoma.

Methods: Mutation status was tested in patients who had complete resection of stage I lung adenocarcinoma (T1-2aN0) without any adjuvant therapy from 2008 to 2011, using a multiplex PCR-based assay. Disease-free survival (DFS) and overall survival (OS) were compared between patients with BRAF mutant and BRAF wild-type tumors

Results: 312 patients were included in this analysis; 127 (41%) harbored KRAS mutations, 59 (19%) EGFR mutations, and 126 (40%) were KRAS-wildtype and EGFR-wildtype tumors. Among the infrequent driver mutations were BRAF in seven patients (2.2%). There were 59 recurrences in the entire cohort with a median follow-up time of 36 months. Patients who harbored a BRAF mutation had a 28.6% recurrence rate compared to BRAF wildtype 18.9% ($P < .0001$). BRAF-mutant patients had similar tobacco use compared to BRAF wildtype patients (median pack-years 27.5 vs 30, respectively). All BRAF-mutants underwent lobectomy but were associated with more synchronous tumors at the time of surgery. There were no deaths in the BRAF-mutant cohort despite recurrences. BRAF inhibitors have been employed in patients with recurrent BRAF-mutant disease. Two patients harbored both a BRAF and KRAS mutation, suggesting collision of tumors.

Conclusions: BRAF mutation is associated with increased risk of recurrence in resected stage I lung adenocarcinoma. Genotyping early stage resected lung adenocarcinoma can identify high-risk patients who may be eligible for adjuvant therapy.

2:15 PM

Room 120A

Lung Adenocarcinomas Presenting as Multiple Lesions With Ground-Glass Opacities Should Be Treated as Independent EventsY. Zhang¹, H. Chen²¹Fudan University Shanghai Cancer Center, China, ²Fudan University Shanghai Cancer Center/ Shanghai Chest Hospital, Shanghai Jiaotong University, China

Purpose: The diagnostic criteria for multiple primary lung cancers mainly rely on pathological examination of resected specimens. How to identify multiple primaries before surgery in order to develop an appropriate treatment plan is a clinical dilemma. We hypothesized that multiple ground-glass opacities (GGOs) at computed tomography might be one of the signs suggesting primary lesions.

Methods: Prospectively collected data of consecutive patients with resected lung adenocarcinomas were investigated retrospectively for clinicopathologic features, spectrum of well-identified driver mutations, and survival. Outcomes were compared between patients with multiple GGOs and sole tumor.

Results: A total of 1,205 patients with resected lung adenocarcinomas were included in this study, of which 163 patients (13.5%) presented with multiple GGOs. Compared to single-tumor patients, the multiple-GGO individuals were more likely to be female ($P < .001$) and non-smokers ($P < .001$). Also, they were inclined to have a history of malignancy other than pulmonary cancers ($P = .001$) and family history of malignancy ($P = .001$). The driver mutations were detected more often in multiple-GGO cases than in single-cancer patients (95.8% vs 75.4%, $P < .001$). For the paired lesions of the multiple GGOs, the discordant rate of the mutational distribution was 84.5%. The multiple-GGO patients shared similar recurrence-free survival with those having stage-IA single adenocarcinoma ($P = .618$), but significantly better than that of patients with stage-IB sole cancer ($P = .004$). As for overall survival, multiple-GGO individuals were about the same with IA patients ($P = .627$), while seeming to be superior to stage-IB cases, although it did not reach statistical significance ($P = .127$).

Conclusions: Lung adenocarcinomas presented as multiple GGOs harbored a high discrepancy of driver mutations and a favorable prognosis after resection, which supports treating multiple lesions as independent events.

2:30 PM

Room 120A

A Risk Score to Assist in Selecting Lobectomy vs Sublobar Resection for Early Stage Non-Small-Cell Lung Cancer

B. Gulack¹, C. Yang², B. Yerokun¹, B. C. Tong², M. Onaitis², T. A. D'Amico², D. Harpole¹, M. G. Hartwig², M. F. Berry³

¹Duke University, Durham, NC, ²Duke University Medical Center, Durham, NC, ³Stanford University, CA

COMMERCIAL RELATIONSHIPS T. A. D'Amico: Consultant/Advisory Board, Scanlan International; B. C. Tong: Consultant/Advisory Board, W. L. Gore & Associates

Purpose: The potential long-term survival benefit of lobectomy over sublobar resection for early stage non-small-cell lung cancer must be weighed against a potentially increased risk of perioperative mortality. A risk score was developed to aid in identifying patients whose lobectomy risk is significantly higher than their sublobar resection risk.

Methods: The 2005-2012 American College of Surgeons National Surgical Quality Improvement Program database was queried for patients undergoing a lobectomy or sublobar resection (including segmentectomy or wedge resection) for lung cancer. A multivariable logistic regression model using backwards stepwise variable selection was utilized to determine factors associated with 30-day mortality among the lobectomy group. The coefficients of the factors remaining in the model were then divided by the lowest coefficient to determine an associated score to predict perioperative mortality. Perioperative mortality and other postoperative complications were compared among patients receiving lobectomy vs sublobar resection by risk score.

Results: 5,749 patients met study criteria, of which 4,424 (77%) underwent lobectomy. Among those who underwent sublobar resection, 1,098 (83%) underwent wedge resection, while 227 (17%) underwent segmentectomy. Age, chronic obstructive pulmonary disease, previous cerebrovascular event, functional status, smoking status in the past year, and surgical approach (minimally invasive vs open) were associated with perioperative mortality among patients receiving lobectomy (Figure). Among the entire cohort, patients with a risk score of five or less had no significant difference in perioperative mortality by surgical approach (Table). However, the perioperative mortality among patients with a risk score greater than five was significantly higher for lobectomy as compared to segmentectomy or wedge resection, respectively (4.9% vs 3.6% vs 0.8%, $P < .01$). The risk score also was useful for delineating patients at significantly increased risk for prolonged ventilation (>48 hours) when undergoing lobectomy as compared to sublobar resection.

Conclusions: In this study, we have developed a risk model that predicts which patients will have increased perioperative risk when receiving a lobectomy for lung cancer as compared to a sublobar resection. Among patients with a risk score ≤ 5 , lobectomy should be strongly considered to optimize long-term survival.

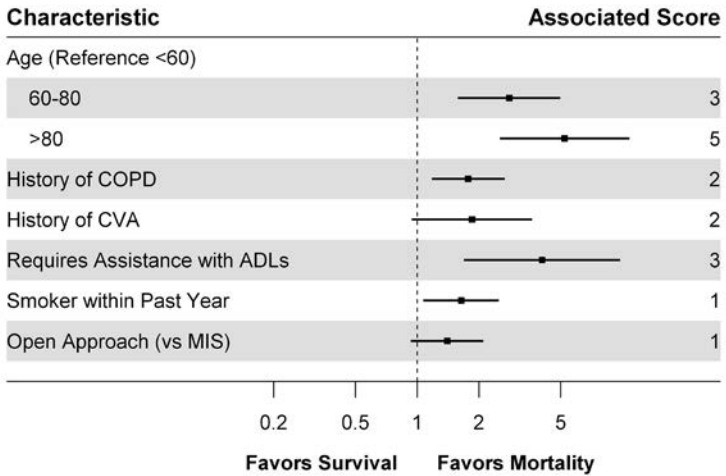


Table: Association of perioperative outcomes by risk score among patients undergoing sublobar resection or lobectomy for lung cancer.

Group	Wedge Resection	Segmentectomy	Lobectomy	p-value
<i>Number of Patients</i>				
Score ≤5	835	172	3502	
Score >5	263	55	922	
<i>Mortality</i>				
Score ≤5	1.2%	1.2%	1.2%	0.99
Score >5	0.8%	3.6%	4.9%	<0.01
<i>Pneumonia</i>				
Score ≤5	3.0%	5.2%	5.1%	0.03
Score >5	5.7%	7.3%	12.6%	<0.01
<i>Failure to Wean from Ventilator >48 Hours</i>				
Score ≤5	1.6%	2.3%	1.9%	0.67
Score >5	2.7%	3.6%	6.4%	0.04
<i>Reintubation</i>				
Score ≤5	2.8%	4.1%	2.8%	0.75
Score >5	3.8%	3.6%	7.5%	0.07

2:45 PM

Room 120A

Induction Chemotherapy for cN1 Non–Small-Cell Lung Cancer Is Not Associated With Improved Survival

P. J. Speicher¹, B. Gulack¹, C. Yang², D. Harpole¹, T. A. D'Amico², M. F. Berry³, M. G. Hartwig²
¹Duke University, Durham, NC, ²Duke University Medical Center, Durham, NC, ³Stanford University, CA

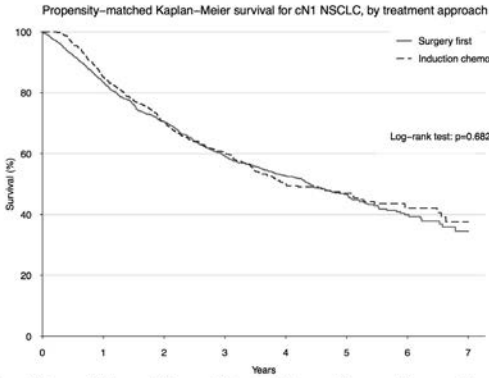
COMMERCIAL RELATIONSHIPS T. A. D'Amico: Consultant/Advisory Board, Scanlan International

Purpose: Current treatment guidelines recommend primary surgery for resectable non–small-cell lung cancer (NSCLC) patients with clinical N1 disease, and adjuvant chemotherapy if nodal disease is confirmed after resection. Because induction chemotherapy is recommended for mediastinal nodal disease (cN2), we tested the hypothesis that induction chemotherapy for cN1 disease improves survival.

Methods: Patients diagnosed with cT1-3N1M0 NSCLC from 2006 to 2011 in the National Cancer Data Base and who were treated with either lobectomy or pneumonectomy were stratified by treatment strategy: surgery first vs induction chemotherapy. Baseline characteristics were compared with standard statistical tests. Propensity scores were developed and matched with a 2:1 nearest neighbor algorithm. Short-term outcomes included margin status, 30- and 90-day mortality, readmission, and length of stay. Clinical nodal staging accuracy was estimated using pathologic nodal status data for the patients treated with a surgery–first approach. Survival analyses using Kaplan–Meier methods were performed on both the unadjusted and propensity score-matched cohorts.

Results: A total of 6,772 cN1 patients were identified for inclusion, of which 735 (10.9%) were treated with induction chemotherapy. Among patients treated with surgery first, clinical nodal staging was accurate in roughly two-thirds of cases (pN1: 68.8%, pN0: 16.6%, pN2-3: 10.9%, pNX: 3.6%), and of the patients found to be pN1-3, 60.1% went on to receive adjuvant chemotherapy. Prior to adjustment, patients treated with induction chemotherapy were younger, had lower comorbidity burden, and were more likely to be treated at an academic center and to have private insurance (all $P < .001$) but were significantly more likely to have T3 tumors (30.1% vs 9.8%, $P < .001$) and to require pneumonectomy (22.9% vs 17.9%, $P = .001$). Following propensity score matching, there were no significant differences in any patient characteristics (all $P > .6$), as well as clinical T-stage ($P = .64$) and need for pneumonectomy ($P = .43$). There were no differences in short-term outcomes (Table) or survival (Figure) between groups.

Conclusions: Preoperative clinical evaluation commonly overstages N1 disease. Induction chemotherapy for cN1 NSCLC is not associated with improved survival and should not be considered routinely. This analysis supports the currently recommended treatment paradigm for cN1 NSCLC.



Treatment Approach	0	1	2	3	4	5	6	7
Surgery first (n=1470)	1470	1172	856	541	330	184	72	15
Induction chemo (n=735)	735	601	439	291	169	94	56	13

Outcome measure	Overall (n = 2205)	Surgery (n = 1470)	Induction (n = 735)	p-value
Extent of resection				0.43
Lobectomy	1,677 (76.1%)	1,110 (75.5%)	567 (77.1%)	
Pneumonectomy	528 (23.9%)	360 (24.5%)	168 (22.9%)	
Surgical approach (2010-2012)				0.58
VATS	97 (13%)	62 (12.2%)	35 (14.7%)	
Converted	49 (6.6%)	35 (6.9%)	14 (5.9%)	
Open	601 (80.5%)	412 (80.9%)	189 (79.4%)	
Nodes removed (IQR)	12 (7, 19)	12 (7, 19)	11 (6, 20)	0.85
Positive margins	221 (10.2%)	154 (10.6%)	67 (9.3%)	0.39
Surgical margins				0.80
R0	1,950 (89.8%)	1,298 (89.4%)	652 (90.7%)	
R1	113 (5.2%)	79 (5.4%)	34 (4.7%)	
R2	8 (0.4%)	6 (0.4%)	2 (0.3%)	
Positive NOS	100 (4.6%)	69 (4.8%)	31 (4.3%)	
Short-term outcomes				
30-day mortality	60 (2.7%)	40 (2.7%)	20 (2.8%)	0.99
90-day mortality	117 (5.4%)	74 (5.1%)	43 (6%)	0.47
30-day readmission	90 (4.2%)	53 (3.7%)	37 (5.2%)	0.12
Hospital LOS (IQR)	6 (4, 8)	6 (4, 8)	6 (4, 8)	0.50

3:00 PM

Room 120A

Lung Cancer Breath Detection

Michael Bousamra, Louisville, KY

COMMERCIAL RELATIONSHIPS M. Bousamra: Ownership Interest, Breath Diagnostics

MONDAY AFTERNOON

1:30 PM – 3:30 PM

Room 125AB

General Thoracic Session: Lung Transplantation

Moderators: Pablo Sanchez, Baltimore, MD, and Matthew Thomas, Jacksonville, FL

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold**.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

1:30 PM

Room 125AB

Lung Transplant Outcomes in Patients With Coronary Artery Bypass Grafts

T. Songdechakrai¹, **T. J. Richards**¹, **M. N. Crespo**¹, **N. Shigemura**¹, **J. Pilewski**², **J. D’Cunha**¹, **C. A. Bermudez**³

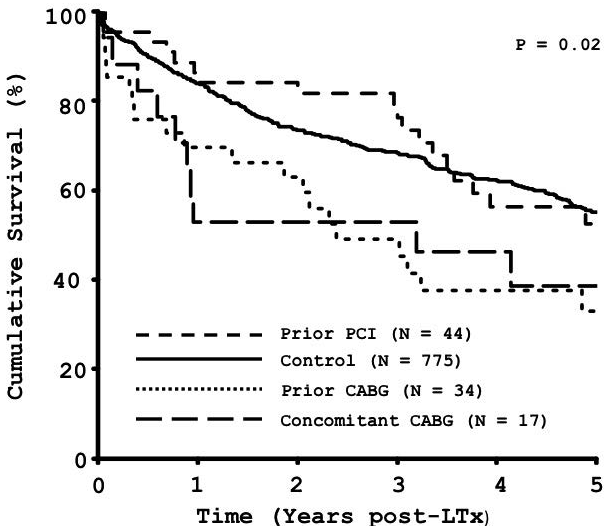
¹University of Pittsburgh Medical Center, PA, ²University of Pittsburgh, PA, ³University of Pennsylvania, Philadelphia

Purpose: The presence of coronary artery disease (CAD) impacts candidacy of patients referred for lung transplantation. The impact of prior and concomitant coronary artery bypass grafting (CABG) surgery on lung transplant (LT) outcomes has not been elucidated.

Methods: We performed a retrospective review of 870 consecutive LTs performed at the University of Pittsburgh Medical Center for restrictive or obstructive end-stage lung disease between January 2005 and December 2014 and analyzed demographics, operative details, and postoperative outcomes. We considered four groups: previous CABG, 34 patients (3.9%); previous percutaneous interventions (PCI), 44 patients (5%); concomitant CABG, 17 patients (2%); and control. Redo LTs were excluded. The Kruskal-Wallis test was used for categorical and ANOVA for quantitative group comparisons. Kaplan-Meier and Cox proportional hazards analyses were used to test group differences in time-to-event outcomes.

Results: Demographic data were comparable among groups, except for obstructive lung disease that was less frequent ($P < .0001$) and coronary artery disease burden that was significantly more extensive in the previous CABG group ($P < .0001$). Single lung transplant was significantly more frequent ($P < .0001$), as the use of intraoperative extracorporeal support via cardiopulmonary bypass or extracorporeal membrane oxygenation was more likely required ($P < .0001$) in previous CABG group. Previous CABG was significantly more likely to lead to complications: respiratory failure ($P < .0001$), acute renal insufficiency ($P = .0002$), multiorgan failure ($P = .0002$), and atrial fibrillation ($P = .001$). Concomitant CABG had the longest length of ICU stay with mean 25.6 days ($P = .025$). In-hospital and long-term survival were significantly lower in the previous CABG and concomitant CABG group ($P = .01$) compared to previous PCI and control group ($P = .01$). Average follow-up was 5 years post-transplant. There was no difference between the groups in post-transplant quality of life as assessed by Karnofsky score.

Conclusions: LT patients with advanced CAD (previous CABG/concomitant CABG) present an increased risk of mortality (early and late) and perioperative complications. These patients should be selected carefully.



Continued on next page

* significant	pre cabg	pre pci	conc cabg	control
number of patients	34	44	17	775
donor age (year)	36 ±13	35 ±15	34 ±14	36 ±15
recipient age (year)	66 ±6	65 ±7	61 ±8	60 ±9
sex, male	32 (94)	40 (91)	15 (88)	425 (45)
LAS score	45	39	39	41
bmi (kg/m ²)	29 ± 4	29 ± 4	26 ±4	27 ± 5
race, white	32 (94)	43 (97)	16 (94)	698 (90)
diabetes	32 (24)	62 (14)	46 (27)	132 (17)
hypertension	5 (15)	8 (19)	6 (33)	209 (27)
hyperlipidemia	9 (27)	9 (21)	3 (20)	147 (19)
diagnosis: obstructive disease	6 (18)	16 (36)	7 (41)	327 (42)
double lung transplant *	10 (29)	28 (63)	14 (82)	603 (78)
use of cardiopulmonary bypass/ECMO*	10 (29)	2 (4.5)	7 (41)	84 (10.8)
triple vessel disease*	23 (32)	5 (11)	2 (12)	n/a
postop hospital stay (d)	40 (22,69)	26 (18,36)	32 (25,51)	26 (16,44)
postop ICU stay (d)	12	9	13	11
complication				
Afib*	16 (47)	7 (16)	1 (6)	164 (21)
MI	0	0	2 (12)	16 (2)
Cardiac arrest	1 (3)	2 (5)	0	20 (3)
CVA	0	1 (2)	1 (6)	15 (2)
Encephalopathy	4 (12)	1 (2)	0	33 (4)
Respiratory failure*	19 (56)	18 (41)	7 (41)	227 (29)
diaphragm paralysis	0	2 (5)	2 (12)	25 (3)
vocal cord dysfunction	2 (6)	1 (2)	0	49 (6)
Airway dehiscence	2 (6)	0	1 (6)	18 (2)
Acute renal insufficiency*	20 (59)	20 (45)	6 (35)	219 (28)
Dialysis	9 (26)	3 (7)	2 (12)	90 (12)
GI problem	1 (3)	0	0	14 (2)
reexploration for bleeding	6 (18)	4 (9)	2 (12)	81 (10)
Wound dehiscence	2 (6)	2 (5)	1 (6)	28 (4)
infection	13 (38)	23 (52)	5 (29)	254 (33)
Acute rejection	18 (53)	32 (73)	10 (59)	509 (66)
MOFS*	6 (18)	0	0	28 (4)
Karnofsky >= 70% (dependence)	17 (50)	29(66)	11 (65)	496 (64)
30 day mortality*	4 (11)	2 (4)	1 (5)	21 (2)
in hospital mortality*	4 (11)	2 (4)	1 (5)	42 (5)
cause of death	24	25	11	321
cardiovascular*	3 (13)	2 (8)	1 (9)	10 (3)
infection	5 (21)	6 (24)	2 (18)	82 (26)
malignant*	2 (8)	6 (24)	3 (27.3)	42 (13)
graft failure*	1 (4)	8 (32)	2 (18)	45 (14)
unknown	6 (25)	1 (4)	2 (18)	6 (2)

NOTES

1:45 PM**Room 125AB****Can Donor Lungs With Prolonged Storage Be Reconditioned by Ex Vivo Lung Perfusion?***T. Okamoto, D. Wheeler, C. Farver, K. R. McCurry
Cleveland Clinic, OH***REGULATORY DISCLOSURE** This presentation will address the Vivoline LS1 by Vivoline Medical, which is not FDA-approved.

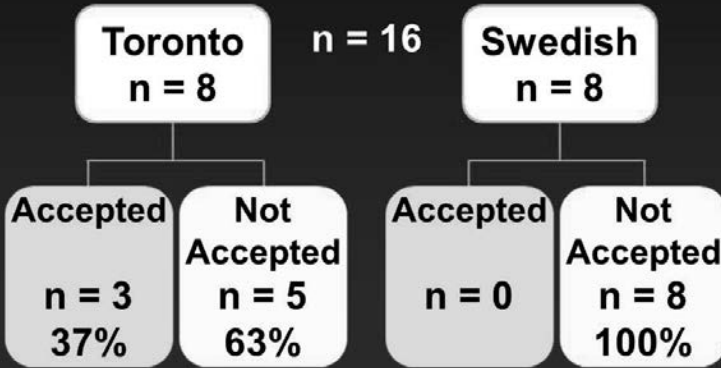
Purpose: Ex vivo lung perfusion (EVLP) of unacceptable donor lungs has the potential to increase the number of lungs available for transplantation. Cold ischemic time (procurement to EVLP) might be critical in ischemic reperfusion injury. The purpose of this study was to identify an acceptable range of cold ischemic time before EVLP.

Methods: Rejected human donor lungs were obtained from a local organ procurement organization once research consent was given. Rejected donor lungs were perfused using either the Toronto (n=11; perfusion: 40% of cardiac output) or Swedish (n=11; perfusion: 100% of cardiac output) EVLP system. Three cases of short (<8 hours) and eight cases of long (≥8 hours) cold ischemic time were evaluated with each system. Suitability of lungs for transplantation at the conclusion of EVLP was based on blood gas, airway/vascular variables, and visual inspection. Blood gas analysis data, physiologic parameters, and inflammatory cytokines in perfusate were measured.

Results: In donor lungs with long cold ischemic times, five of eight (62%) were not acceptable for transplantation in the Toronto system, and eight of eight (100%) were not acceptable in the Swedish system. In contrast, five of six lungs (83%, 2/3 in the Toronto, 3/3 in the Swedish) with short cold ischemic times were deemed acceptable for transplantation. In both systems, inflammatory cytokines (IL-1beta, IL-6, IL-8, IL-10, and TNF-alpha) in perfusate were increased in a time-dependent fashion. In the Toronto system, there was no difference in inflammatory cytokines between the short cold ischemic time group and the long cold ischemic time group. In the Swedish system, inflammatory cytokines were significantly increased in the long cold ischemic time group, compared to the short cold ischemic time group.

Conclusions: The potential for reconditioning lungs with a cold ischemic time >8 hours is diminished compared with lungs having a shorter cold ischemic time due to severe ischemic reperfusion injury. Furthermore, the data suggest that high perfusion flow may be necessary to detect ischemic reperfusion injury in EVLP.

Suitability of Rejected Donor Lungs Long Cold Ischemic Time



2:00 PM

Room 125AB

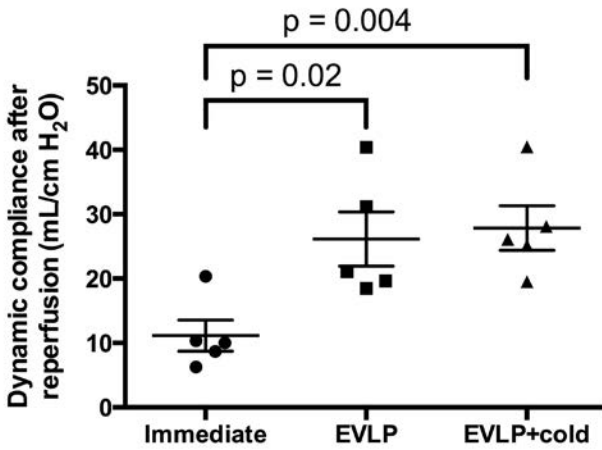
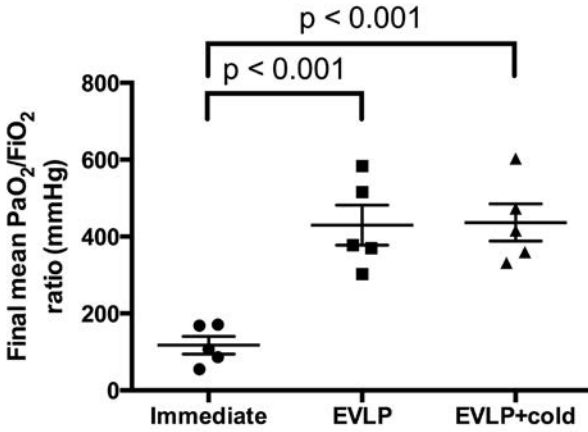
Cold Preservation of Donation-After-Cardiac Death Lungs Following Ex Vivo Lung Perfusion Allows Transport From Lung Rehabilitation Centers to Suitable RecipientsE. J. Charles¹, M. E. Huerter², C. E. Wagner³, A. K. Sharma⁴, Y. Zhao¹, J. M. Isbell¹, C. L. Lau³, C. Tribble³, V. E. Laubach³, I. L. Kron⁴¹University of Virginia Health System, Charlottesville, ²University of Illinois at Chicago Health Sciences Center, ³University of Virginia, Charlottesville, ⁴University of Virginia Medical Center, Charlottesville**COMMERCIAL RELATIONSHIPS** C. L. Lau: Consultant/Advisory Board, XVIVO

Purpose: Despite the critical need for donor lungs, logistical barriers often hinder lung utilization. We hypothesized that donation-after-cardiac death (DCD) lungs could be used more routinely with extended cold preservation following ex vivo lung perfusion (EVLP), allowing for preparation of a local recipient or transport of rehabilitated lungs to another center.

Methods: Donor porcine lungs were procured after cardiac death and a 15-minute period of warm ischemia time. Three groups (n=5/group) were randomized: immediate left lung transplantation (Immediate), normothermic EVLP with preservation solution for 4 hours followed by transplantation (EVLP), or normothermic EVLP for 4 hours followed by 6 hours of cold preservation followed by transplantation (EVLP+cold). Lungs were reperfused for 2 hours prior to obtaining left superior and inferior pulmonary vein samples for PaO₂/FiO₂ calculations. Dynamic compliance was measured 2 hours after reperfusion, and lung wet-to-dry weight ratios were measured in fresh tissue obtained from upper and lower lobes.

Results: As illustrated in Figure 1, PaO₂/FiO₂ ratios in both EVLP and EVLP+cold groups were significantly improved compared with the Immediate group (429.7 mm Hg ± 51.8 mm Hg and 436.7 mm Hg ± 48.2 mm Hg vs 117.4 ± 22.9 mm Hg, respectively). The improved oxygenation observed with EVLP rehabilitation was maintained in the EVLP+cold group, as these two groups were not significantly different. Additionally, dynamic compliance was significantly improved in the EVLP and EVLP+cold groups compared to the Immediate group (26.2 mL/cm H₂O ± 4.2 mL/cm H₂O and 27.9 mL/cm H₂O ± 3.5 mL/cm H₂O vs 11.1 mL/cm H₂O ± 2.4 mL/cm H₂O, respectively). Dynamic compliance was not significantly different between the EVLP and EVLP+cold groups. Pulmonary edema, measured as mean wet-to-dry weight ratios, was not significantly different among all three groups.

Conclusions: Cold preservation of DCD lungs for up to 6 hours following 4 hours of EVLP allows for lung assessment and rehabilitation prior to identification of a suitable recipient. Lung rehabilitation centers could increase the donor pool through procurement, EVLP-mediated rehabilitation, and allocation, even to distant recipients, without compromising allograft function.



2:15 PM

Room 125AB

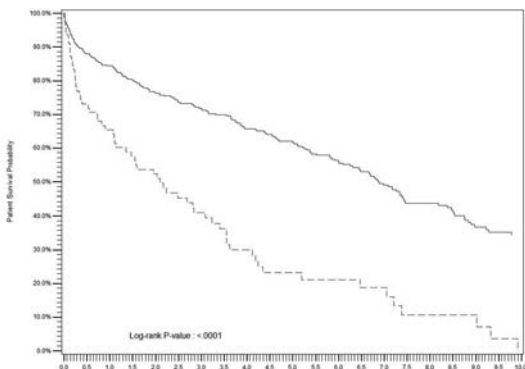
Two Decades of Lung Retransplantation: A Single-Center ExperienceD. J. Hall¹, E. V. Bell², T. M. Beaver³, T. N. Machuca¹¹University of Florida College of Medicine, Gainesville, ²Mayo Clinic Florida, Gainesville,³University of Florida, Gainesville

Purpose: Pulmonary retransplantation composes an increasing share of lung transplants and in recent years has shown improved outcomes. The aim of this study was to identify preoperative risk factors affecting overall survival after pulmonary retransplantation (ReTX) at our institution before and after implementation of the Lung Allocation Score (LAS).

Methods: The United Network for Organ Sharing database was used to identify patients undergoing lung transplantation at our institution over a 20-year period from 1994 to 2014. Of the total 533 lung transplants performed, 78 (14.6%) were retransplants. The primary outcome investigated was overall survival. Kaplan-Meier analysis compared survival between primary and retransplant groups. Preoperative recipient and donor characteristics were subjected to multivariate Cox regression models to assess impact on survival.

Results: Of the 78 patients who underwent ReTX, median survival was 2 years. Estimated survival at 1, 3, and 5 years was 64% (95% CI: 52%-74%), 39% (95% CI: 28%-50%), and 21% (95% CI: 12%-32%), respectively. Predictors of overall survival on multivariate analysis include: recipient age between 50 and 60 years (RR: 4.3, $P = .03$); less than 2 years between previous and current transplant (RR: 3.8, $P = .01$); and indication for ReTX as bronchiolitis obliterans or chronic lung allograft dysfunction (RR: 1.23, $P = .02$). Indication for ReTX as primary graft dysfunction or acute rejection (RR: 0.97, $P = .003$), as well as recipient diabetes (RR: 0.2, $P = .001$) were associated with poor outcomes. Single lung ReTX compared to bilateral lung ReTX trended toward decreased survival, but did not reach significance ($P = .06$). Overall survival of ReTX occurring after the initiation of the LAS in 2005 was not significantly different.

Conclusions: Lung ReTX is a complex therapy that should be considered only for well-selected patients. Outcomes are worse than for primary transplants. The indication of lung ReTX for primary graft dysfunction and acute rejection should be viewed with caution. Notably, ReTX after the implementation of LAS did not affect survival.



Multivariable analysis		
Variable	RR (95% CI)	P-value
18 ≤ Recip Age < 30	2.24 (0.46, 10.84)	0.06
30 ≤ Recip Age < 40	2.53 (0.52, 12.36)	0.38
40 ≤ Recip Age < 50	1.00 (reference)	N/A
50 ≤ Recip Age < 60	4.26 (1.27, 14.26)	0.034
Recip Age ≥ 60	10.26 (2.73, 38.63)	0.123
Gender (female)	1.05 (0.41, 2.68)	0.93
Transplant Era (>2005)	1.92 (0.68, 5.39)	0.21
Transplant Type		
Bilateral	1.00 (reference)	N/A
Single	0.15 (0.02, 1.06)	0.06
Pulmonary wedge > 12 mmHg	0.45 (0.096, 2.08)	0.305
Years between TXs		
Test of overall difference	P = 0.011	
More than 2 years	1.00 (reference)	N/A
Less than or = 2 years	3.76 (1.37, 10.2)	0.010
Reason for ReTX		
Acute Rej/Primary GF	0.97 (0.35, 2.70)	0.003
Bronchiolitis Obliterans /Chronic Rej	1.23 (0.52, 2.90)	0.023
IPF/Pulm HTN	4.09 (0.48, 35.1)	0.063
Cause of death		
Cardiac	17.5 (2.90, 105.8)	0.002
Infection	1.04 (0.37, 2.89)	0.94
Malignancy	0.03 (0.002, 0.28)	0.003
Pulmonary		
Drug Treated HTN	1.87 (0.73, 4.78)	0.193
Diabetes	0.22 (0.09, 0.55)	0.001
Inhale NO therapy	3.60 (0.16, 81.2)	0.42
Ventilator dependence	1.50 (0.41, 5.51)	0.54
Donor gender (female)	1.05 (0.41, 2.69)	0.93
Donor pulmonary infection	0.95 (0.32, 2.83)	0.93

Relative risks, 95% confidence intervals, and p-values result from Cox proportional hazards regression models. Relative risks correspond to presence of the given characteristic (categorical variables) or the increase given in parenthesis (continuous variables). All variables with p-value ≤ 0.05 in a single variable analysis were included in multivariable analysis (# used= 33). RR=relative risk. CI=confidence interval. N/A= not applicable. HTN=hypertension. Rej=rejection. NO=nitric oxide

2:30 PM

Room 125AB

Antireflux Surgery Is Safe and Effective Following Lung TransplantationD. D. Odell¹, J. D. Luketich¹, E. G. Chan², N. Shigemura¹, M. N. Crespo¹, M. Morrell¹, J. Pilewski³, J. D'Cunha³¹University of Pittsburgh Medical Center, PA, ²University of Pittsburgh Medical Center, Squirrel Hill, PA, ³University of Pittsburgh, PA**COMMERCIAL RELATIONSHIPS** J. D. Luketich: Research Grant, Accuray

Purpose: Gastroesophageal reflux disease (GERD) has been associated with the development of allograft dysfunction and increased episodes of rejection in patients undergoing lung transplantation. Antireflux surgery has been shown to limit these events after transplantation. We present the largest reported series of antireflux surgery in the lung transplant population.

Methods: We reviewed medical records for all patients who underwent lung transplantation at our institution from January 2007 to January 2015 (n=895) to identify patients who also underwent surgical treatment for GERD. Patient demographic information, operative approach, perioperative outcomes, and long-term surgical results are reported. The surgical approach was influenced by preoperative evaluation of esophageal function. Nissen fundoplication was favored when motility was preserved, and partial fundoplication or esophagojejunostomy was favored in cases of motor impairment. Outcomes also were compared to those patients who underwent antireflux surgery prior to transplantation.

Results: A total of 86 operations were performed in 82 patients (9.2% of transplant patients); 73 were post-transplant and 13 were pre-transplant. Nissen fundoplication was the most common operation performed (n=52) with seven patients requiring Collis gastroplasty. The remaining patients underwent Dor (n=15) and Toupet (n=9) funduplications, Roux-en-Y esophagojejunostomy (n=9), and esophagectomy (n=1). There was no observed 30- or 90-day mortality, though perioperative complications were observed in 24% (n=21) of patients. Only two of these resulted in reoperation: one patient with an early recurrence from retching and one patient with a perforation after dilation on postoperative day 32. Clinical response to surgery was good with 94% of patients having an improvement in reflux symptoms and 78% an improvement in respiratory symptoms. Complications were minimal dumping and gas bloat in 7% and dysphagia in 22% (with 14% requiring dilation). Mean number of rejection episodes decreased from 2.2 before surgery to 1.4 after surgery ($P = .0367$).

Conclusions: Surgical treatment of GERD is effective and can be accomplished safely in the period surrounding lung transplantation. The surgical approach should be individualized based on esophageal motility and symptom severity. Long-term results are favorable both in terms of symptom control and preservation of recipient allograft function.

	Nissen Fundoplication (n=52)	Toupet Fundoplication (n=9)	Dor Fundoplication (n=17)	Roux-en-Y Esophagojejunostomy (n=9)
Preoperative				
<i>Esophageal motility (%)</i>	80.1	20	58.3	14.3
<i>Aperistalsis (%)</i>	8.7	68	25	55
<i>DeMeester Score</i>	33.9	35.1	37.4	54
<i># Rejection Episodes (mean)</i>	2.4	1.9	1.9	1.9
Postoperative				
<i>Reflux Sx Improvement (%)</i>	97.9	83.3	90.9	100
<i>Respiratory Sx Improvement (%)</i>	76.6	66.7	90.9	85.7
<i>PPI Free (%)</i>	48.1	37.5	25	44.5
<i># Rejection Episodes (mean)</i>	1.3	1.5	1.8	1.2

2:45 PM

Room 125AB

Bridging Strategies to Lung Transplantation Do Not Have an Impact on 1-Year Survival

M. J. Mulligan¹, A. T. Iacono¹, B. P. Griffith¹, S. Phan², J. S. Gammie², G. J. Bittle¹, Z. N. Kon¹, P. Sanchez²

¹University of Maryland School of Medicine, Baltimore, ²University of Maryland, Baltimore

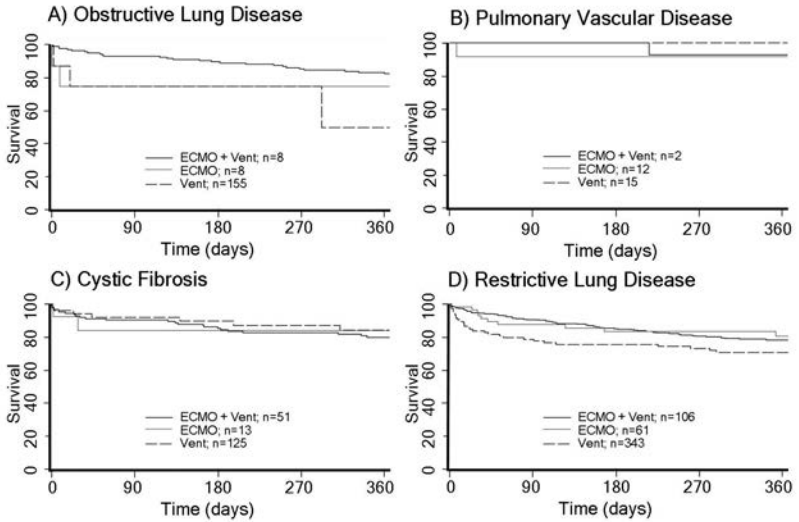
COMMERCIAL RELATIONSHIPS J. S. Gammie: Ownership Interest, Harpoon Medical Inc, Correx, Inc

Purpose: The use of mechanical ventilation and extracorporeal membrane oxygenation (ECMO) for respiratory support in transplant candidates initially was considered exclusion criteria for lung transplantation. Recently, these bridging strategies have been shown to have acceptable transplant outcomes. However, there is still conflicting evidence of the best bridging strategy.

Methods: Using the United Network of Organ Sharing database, we analyzed outcomes for candidates bridged to lung transplantation with ventilation, ECMO+ventilation, awake ECMO, and those transplanted without bridging from 2008 to 2014. We excluded retransplants, donation-after-cardiac-death donors, and recipients <18 years old. Outcomes also were evaluated by recipient diagnosis to the following groups: Group A: obstructive disease, Group B: vascular disease, Group C: cystic fibrosis, and Group D: restrictive disease. Survival was evaluated with Kaplan-Meier curves and log-rank tests. Our primary outcome was 1-year transplant survival.

Results: We identified 10,811 lung recipients, of which 899 (8.3%) were bridged to transplantation: 638 via ventilation, 167 via ECMO+ventilation, and 94 via awake ECMO. One-year survival after transplant was 80%, 74%, and 82%, respectively, $P = .15$. The majority of the recipients bridged to transplant were in Group D (505). Patients in group D were bridged via ventilation $n=343$, ECMO+ventilation $n=101$, and awake ECMO $n=61$. Recipients more commonly bridged to transplant via ventilation were in Group A (155/171, 86%), via ECMO+ventilation were Group C (51/189, 27%), and via awake ECMO were in Group B (12/29, 41%). We observed no differences in 1-year survival across bridging strategies by diagnosis group: Group A (83%, 50%, 75%; $P = .06$), Group B (93%, 100%, 92%; $P = .87$), Group C (80%, 84%, 84%; $P = .81$), and Group D (78%, 81%, 71%; $P = .10$) for ventilation, ECMO+ventilation, and awake ECMO, respectively.

Conclusions: Bridging patients to lung transplantation remains an uncommon strategy. Nevertheless, 1-year survival in this population has improved in recent years. In this analysis of a current lung transplant series, there was no survival advantage for any bridging strategy.



3:00 PM

Room 125AB

Debate: Is Lung Retransplantation Justified From an Ethical and Economical Perspective?

PRO: Steven M. Karwut, Philadelphia, PA

CON: Kenneth R. McCurry, Cleveland, OH

MONDAY AFTERNOON

1:30 PM – 3:30 PM

Room 128AB

SVS @ STS: Sharing Common Ground for Cardiovascular Problems

In this session from STS and the Society for Vascular Surgery, cardiothoracic and vascular surgeons will provide perspectives on the contemporary management of type B aortic dissection, as well as the management of patients with thoracoabdominal aortic aneurysms and thoracic outlet syndrome.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Formulate a plan based on experience and published data for management of patients with type B thoracic aortic dissection
- Identify treatment options (open or endovascular) for patients with thoracoabdominal aortic aneurysms
- Describe the best medical management practices for treatment of symptomatic thoracic outlet syndrome

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

The physician competencies addressed in this session are patient care and procedural skills, medical knowledge, and practice-based learning and improvement. These physician competencies will be addressed through a series of collaborative lectures by members of The Society of Thoracic Surgeons and the Society for Vascular Surgery.

Moderators: A. Michael Borkon, Kansas City, MO, and Jason T. Lee, Stanford, CA

1:30 PM

Introduction

1:35 PM

Conservative Management of Acute Type B Dissections: “To Treat Now or Later”

Michael P. Fischbein, Stanford, CA

COMMERCIAL RELATIONSHIPS M. P. Fischbein: Research Grant, National Marfan Society; Speakers Bureau/Honoraria, St Jude Medical

1:50 PM

Aggressive Stent Grafting

Joseph V. Lombardi, Camden, NJ

COMMERCIAL RELATIONSHIPS J. V. Lombardi: Research Grant, COOK Medical

2:05 PM

Discussion

2:15 PM

Thoracic Aortic Aneurysm: Why Open Treatment?

Joseph S. Coselli, Houston, TX

COMMERCIAL RELATIONSHIPS J. S. Coselli: Speakers Bureau/Honoraria, Vascutek Ltd a Terumo Company; Consultant/Advisory Board, Vascutek Ltd a Terumo Company; Research Grant, Medtronic, Inc, W. L. Gore & Associates

REGULATORY DISCLOSURE This presentation will address various stent grafts by W. L. Gore & Associates, Inc, Medtronic, Inc, COOK Medical, and Bolton Medical. The FDA statuses of these devices are investigational.

2:30 PM

Thoracic Aortic Aneurysm: Why Endovascular Repair?

Gustavo S. Oderich, Rochester, MN

COMMERCIAL RELATIONSHIPS G. S. Oderich: Consultant/Advisory Board, W. L. Gore & Associates, Inc; Research Grant, COOK Medical, MAQUET, W. L. Gore & Associates, Inc; Speakers Bureau/Honoraria, Endologix, Inc

- 2:45 PM** **Discussion**
- 2:55 PM** **Arterial/Venous Thoracic Outlet Syndrome: How I Do It—
STS Perspective**
John A. Kern, Charlottesville, VA
- 3:10 PM** **Arterial/Venous Thoracic Outlet Syndrome: How I Do It—
SVS Perspective**
Julie A. Freischlag, Sacramento, CA
- 3:25 PM** **Discussion**

1:30 PM – 3:30 PM

Room 123

30th Anniversary Celebration of Women in Thoracic Surgery: Innovations and Contributions of WTS and STS Members

This session will highlight significant professional contributions by STS members who also are WTS members. The changing face of cardiothoracic surgery, as well as strategies for mentoring female and minority surgeons, also will be discussed.

Learning Objectives

Upon completion of this activity, participants should be able to:

- State the barriers to mentoring female and minority surgeons
- Demonstrate knowledge of significant contributions by women in each cardiothoracic surgery discipline
- Describe how cardiothoracic surgery will look in the future
- Describe the strengths that women possess as leaders
- Explain the importance and need for men to mentor and sponsor female and minority surgeons due to the lack of large numbers of female and minority mentors in leadership positions

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

The physician competencies addressed in this session are medical knowledge, interpersonal skills and communication, and professionalism. These physician competencies will be addressed through a series of collaborative lectures by members of The Society of Thoracic Surgeons and Women in Thoracic Surgery.

Moderators: Jessica S. Donington, New York, NY, Leslie J. Kohman, Syracuse, NY, and Jennifer S. Lawton, St Louis, MO

COMMERCIAL RELATIONSHIPS J. S. Donington: Consultant/Advisory Board, KCI; L. J. Kohman: Research Grant, CareFusion Corporation

1:30 PM Introduction

1:32 PM The Untapped Potential of Women as Leaders

Douglas E. Wood, Seattle, WA

COMMERCIAL RELATIONSHIPS D. E. Wood: Research Grant, Spiration, Inc; Consultant/Advisory Board, Spiration, Inc

1:47 PM Pioneers and Significant Contributions in Congenital Heart Surgery

Kristine J. Guleserian, Dallas, TX

2:02 PM Pioneers and Significant Contributions in Adult Cardiac Surgery

Andrea J. Carpenter, San Antonio, TX

COMMERCIAL RELATIONSHIPS A. J. Carpenter: Research Grant, Edwards Lifesciences Corporation

2:17 PM Pioneers and Significant Contributions in General Thoracic Surgery

Yolonda L. Colson, Boston, MA

2:32 PM Changes in the Demographics of American Board of Thoracic Surgery Diplomates Since 1961

William A. Baumgartner, Baltimore, MD

2:47 PM **Mentoring Female and Minority Surgeons**

G. Alexander Patterson, St Louis, MO

3:02 PM **Diversity in Cardiothoracic Surgery and the Future: What Will the Face of CT Surgery Be?**

Valerie W. Rusch, New York, NY

3:17 PM **Panel Discussion**

3:30 PM – 4:15 PM

BREAK—Visit Exhibits and Scientific Posters

Complimentary coffee available in the Exhibit Hall

3:30 PM – 5:30 PM

Room 129AB

International Symposium & Reception: The Ethics and Practicality of Using New Technologies to Treat Cardiothoracic Diseases in Different Parts of the World

This symposium will focus on the viability of employing new technologies to treat cardiothoracic diseases in certain parts of the world, specifically, evolving treatment approaches for rheumatic heart disease, endocarditis, and mitral valve disease. The session also will address the ethics of testing new technologies in developing countries that could never afford the widespread dispersal of the technology in question.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Identify different approaches and emerging trends in the treatment of rheumatic heart disease, endocarditis, and mitral valve disease in different parts of the world
- Describe the ethical concerns regarding the testing of new cardiothoracic medical devices in developing countries
- List the challenges of introducing new technologies for the treatment of cardiothoracic diseases into developing countries in view of cost considerations
- Elucidate different perspectives on the health policy, corporate, institutional, economic, and ethical factors that affect the international development, testing, and dispersal of new technologies for the treatment of cardiothoracic diseases

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

The physician competencies addressed in this session are professionalism, medical knowledge, and patient care. These physician competencies will be addressed through a series of lectures followed by in-depth discussion.

Moderator: A. Pieter Kappetein, Rotterdam, The Netherlands

COMMERCIAL RELATIONSHIPS A. P. Kappetein: Research Grant, Medtronic, Inc

3:30 PM Introduction

Rheumatic Heart Disease

3:35 PM Rheumatic Heart Disease: Between a Rock and a Heart Place

Tarveesak Chotivatanapong, Nonthaburi, Thailand

3:42 PM Question-and-Answer Session

The Modern Era of Endocarditis Treatment

3:50 PM Emerging Trends in Infective Endocarditis

Adnan Cobanoglu, Beachwood, OH

3:57 PM Different Treatment Approaches in Japan

Yutaka Okita, Kobe, Japan

4:01 PM Different Treatment Approaches in South Korea

Jae Won Lee, Seoul, South Korea

The Future of Transcatheter Mitral Valve Disease Treatment in Different Parts of the World

4:05 PM **New Technologies Available and On the Horizon**

Joseph E. Bavaria, Philadelphia, PA

COMMERCIAL RELATIONSHIPS J. E. Bavaria: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, COOK Medical, Boston Scientific, W. L. Gore & Associates, St Jude Medical

4:12 PM **Varieties of Mitral Valve Disease: Is the Developing World Ready for New Devices?**

Arkalud Sampath Kumar, Delhi, India

COMMERCIAL RELATIONSHIPS A. Sampath Kumar: Consultant/Advisory Board, Edwards Lifesciences Corporation

The Ethics of Testing New Devices in Developing Countries

4:20 PM **Panel Discussion: Where Are Devices Being Tested? The Ethics of Testing Devices in Countries Where the Technology Likely Will Not Be Dispersed**

Joseph E. Bavaria, Philadelphia, PA, Steven F. Bolling, Ann Arbor, MI, William E. Cohn, Houston, TX, A. Pieter Kappetein, Rotterdam, The Netherlands, John C. Laschinger, Silver Spring, MD, Robert M. Sade, Charleston, SC, and Moritz C. Wyler von Ballmoos, Milwaukee, WI

COMMERCIAL RELATIONSHIPS J. E. Bavaria: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, COOK Medical, Boston Scientific, W. L. Gore & Associates, St Jude Medical; S. F. Bolling: Ownership Interest, Edwards, Millipede; Consultant/Advisory Board, Abbott, Medtronic, Inc, LivaNova, Atricure; W. E. Cohn: Employment, Texas Heart Institute, Baylor College of Medicine; Nonremunerative Position of Influence, Reliant Heart, BiVACOR; A. P. Kappetein: Research Grant, Medtronic, Inc

4:45 PM **Reception**

4:15 PM – 5:15 PM

Room 120D

Surgical Motion Picture Matinee: Adult Cardiac*Moderators: Edward P. Chen, Atlanta, GA, and Leora T. Yarboro, Charlottesville, VA*

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold**.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of surgical videos followed by discussion and questions from the audience.

4:15 PM

Room 120D

Endovascular Repair of Thoracoabdominal Aortic Aneurysm With Custom-Manufactured, Fenestrated-Branched Stent Grafts**L. E. Greiten, G. S. Oderich***Mayo Clinic, Rochester, MN*

COMMERCIAL RELATIONSHIPS G. S. Oderich: Consultant/Advisory Board, W. L. Gore & Associates; Speakers Bureau/Honoraria, Endologix, Inc; Research Grant, COOK Medical, MAQUET, W. L. Gore & Associates, Inc

Purpose: Endovascular repair of thoracoabdominal aortic aneurysms (TAAA) using fenestrated and branched stent grafts has been increasingly utilized. Custom-manufactured designs with fenestrations and/or branches are based on anatomical features of the aorta and target vessels.

Methods: This illustrated video summarizes the technique of endovascular repair of an enlarging type III TAAA using a custom-manufactured thoracoabdominal stent graft with combination two-directional branches for the celiac axis and superior mesenteric artery (SMA) and two fenestrations for the renal arteries (Figure). Device design based centerline of flow measurements consisted of a custom-manufactured stent-graft with two branches and two fenestrations. The device also included two preloaded catheters to facilitate catheterization of the celiac and SMA branches via the left brachial approach.

Results: Spinal cord injury prevention was done using cerebrospinal fluid drainage, permissive hypertension, and intraoperative neuro-monitoring. The procedure was performed under general anesthesia in a hybrid endovascular room. After bilateral percutaneous femoral and left open brachial artery access was established, the device was oriented extracorporeally and introduced via the left femoral approach. Using the preloaded catheters, the celiac axis and SMA branches were accessed via the left brachial approach, and both renal arteries were accessed via the right femoral approach. Sequential visceral stenting was performed using balloon-expandable covered stents for the renal arteries and self-expandable stent grafts for the mesenteric arteries. A distal bifurcated component and iliac limbs were used to extend the repair into the iliac arteries. There were no complications. Follow-up completion computed tomography angiography revealed no endoleak and patent side branches.

Conclusions: This illustrated video demonstrates the technique of implantation of custom-manufactured thoracoabdominal stent grafts for type III TAAA, emphasizing the important technical aspects of the procedure to minimize risk of complications. High technical success, low mortality, high target vessel patency, and low conversion rates can be achieved in properly selected patients.



4:27 PM

Room 120D

An Overlooked Tool to Address Mitral Regurgitation at the Time of Septal Myectomy for Hypertrophic Obstructive CardiomyopathyA. A. Shab¹, D. Glower², J. G. Gaca¹¹Duke University Medical Center, Durham, NC, ²Duke University, Durham, NC**Purpose:** To address mitral valve disease and avoid the need for left atrial mitral exposure at the time of septal myectomy for hypertrophic obstructive cardiomyopathy.**Methods:** We have adopted a technique where we place an Alfeiri stitch in the mitral valve through the aortotomy while performing septal myectomy. This technique avoids the need for bicaval cannulation for left atrial mitral valve exposure. Our video is of a 60-year-old male patient who presented with 6 months of worsening dyspnea and exercise intolerance, despite optimal medical management of his hypertrophic obstructive cardiomyopathy. He had a peak resting left ventricular outflow tract gradient of 66, systolic anterior motion (SAM) of the anterior leaflet of his mitral valve, and moderate mitral regurgitation (MR).**Results:** After median sternotomy, the distal ascending aorta and right atrium were cannulated for cardiopulmonary bypass. Antegrade and retrograde cardioplegia catheters were placed, as well as a left ventricular vent. After aortic cross clamping, an aortotomy was made 1 cm above the sinotubular junction, and a septal myectomy was performed in the standard fashion. Next, through the aortotomy, two 4-0 polyester sutures were placed in a figure-of-eight fashion through P2 and A2. The heart was deaired, and the patient was weaned from cardiopulmonary bypass. Post-bypass transesophageal echo demonstrated a mean left ventricular outflow tract gradient of 2, a mean mitral gradient of 5, and trace mitral regurgitation. This technique has been used in 19 total patients, with no patients having postoperative SAM or requiring a second aortic cross clamping for mitral repair, and all but one having improvement in MR.**Conclusions:** Transaortic Alfeiri stitch placement for mitral repair during septal myectomy is feasible as an additional tool to improve MR and minimize SAM. This technique may have a role in addressing mitral disease at the time of septal myectomy without the need for left atriotomy for mitral exposure.

4:39 PM

Room 120D

Minimally Invasive Replacement of the Hemi Arch, Ascending Aorta, and Aortic Root With Reimplantation of the Coronary Arteries Utilizing Circulatory Arrest and Retrograde Cerebral Perfusion**J. Lamelas***Mount Sinai Medical Center, Miami Beach, FL***COMMERCIAL RELATIONSHIPS** J. Lamelas: Ownership Interest, Miami Instruments; Speakers Bureau/Honoraria, Medtronic, Inc, St Jude Medical, On-Q

Purpose: Replacement of the hemi arch, ascending aorta, and aortic root with coronary reimplantation historically has been performed via a median sternotomy. Recently, this procedure also has been performed safely via an upper hemi sternotomy. In this video, another minimally invasive, non-sternotomy-based approach to this pathology is demonstrated.

Methods: The patient was placed in the supine position and femoral cannulation was employed. A 6 cm right mini-thoracotomy incision was performed in the second intercostal space. The distal hemi arch anastomosis was performed utilizing circulatory arrest and retrograde cerebral perfusion with a venous cannula placed through the chest tube incision and then the superior vena cava. Exposure of the hemi arch was facilitated with additional pericardial stay sutures. A Bentall technique was utilized for root replacement. Careful measurement of the distal graft to the root was required. Long-shafted instruments were mandatory to perform an accurate anastomosis.

Results: Minimally invasive mini-thoracotomy operations are more technically challenging compared to those performed via a median sternotomy. Procedures involving the ascending aorta and aortic valve have been demonstrated to be feasible via a limited access approach. At our institution, 75 patients have been operated upon by this approach. When compared to the same procedure performed via a sternotomy, this group demonstrated slightly longer circulatory arrest, cross clamp, and cardiopulmonary bypass times, although there was less bleeding, as well as a faster recovery. The composite complication rate also has been low.

Conclusions: A minimally invasive, mini-thoracotomy approach to the ascending aortic and aortic valve pathology is feasible and can provide a safe and effective alternative despite limited access. This video demonstrates the technical details in performing the procedure.

4:51 PM**Room 120D****Minimally Invasive Left Ventricular Assist Device Implantation***Y. Lin, L. D. Joyce, J. M. Stulak, R. C. Daly, D. L. Joyce**Mayo Clinic, Rochester, MN***COMMERCIAL RELATIONSHIPS** R. C. Daly: Ownership Interest, NeoChord, Inc

Purpose: Left ventricular assist devices (LVADs) typically are implanted through a full sternotomy on cardiopulmonary bypass. Minimally invasive techniques are desirable to minimize surgical trauma, blood loss, and re-entry risk of subsequent heart transplantation. We present here the operative techniques that have been adapted in our institution.

Methods: We offer minimally invasive LVAD implantation to patients who are approved for use of the HeartWare device and have mild or less tricuspid regurgitation on preoperative imaging. Obesity, aortic regurgitation, and redo sternotomy represent additional challenges to the procedure, although the approach can be used in each of these scenarios. Incisions include left anterior lateral thoracotomy combined with either right anterior thoracotomy or upper sternotomy. Both central and peripheral cannulation strategies can be used for cardiopulmonary bypass.

Results: With the combination of two small incisions, the left ventricular apex and ascending aorta can be well exposed without difficulty. The cardiopulmonary bypass time is comparable to standard implantation procedure. In general, blood product usage and ICU length of stay is less when compared to open procedures.

Conclusions: Minimally invasive LVADs implantation is feasible in select patients by using multiple smaller incisions and modified cannulation strategy. Avoiding full sternotomy may be advantageous in reducing adhesions and surgical trauma, minimizing perioperative blood loss, favoring mediastinal re-entry, and increasing thoracic compliance.

5:03 PM

Room 120D

Repair of Bicuspid Aortic Valve Insufficiency and Ascending Aortic Aneurysm Associated With Coronary Anomalies

Y. Choi¹, D. Mazzitelli², J. Rankin³, K. Ferdinand⁴, A. Deppe⁴, T. C. Wahlers¹

¹University of Cologne, Germany, ²German Heart Center Munich, ³Cardiothoracic Surgery Associates PLLC, Nashville, TN, ⁴University Hospital Cologne, Germany

COMMERCIAL RELATIONSHIPS Y. Choi: Consultant/Advisory Board, Biostable Science and Engineering; J. Rankin: Consultant/Advisory Board, BioStable Science and Engineering, Admedus

REGULATORY DISCLOSURE This presentation will address the HAART 200 Annuloplasty Ring by BioStable Science and Engineering, Inc. The FDA status of this device is investigational.

Purpose: Annular stabilization during bicuspid valve repair frequently is accomplished with root reimplantation. Bicuspid reimplantation, however, can be difficult in the presence of coronary anomalies. An internal bicuspid annuloplasty ring could be useful in this setting.

Methods: A 49-year-old man presented with severe bicuspid valve insufficiency and a 6-cm ascending aortic aneurysm associated with anomalous right coronary artery. Aortic valve annuloplasty was accomplished with a bicuspid ring, along with leaflet repair and ascending aortic replacement. The ring mounted the bicuspid valve commissures on 15-degree outwardly flaring posts, positioned at 180 degrees along the circular base geometry. Leaflet repair then was performed with plication and bicuspid cleft closure to achieve adequate effective height and coaptation. The ascending aortic aneurysm was replaced with a simple supra-coronary Dacron graft, without the need for implantation of the anomalous coronary.

Results: In the patient shown, the bicuspid ring acutely corrected the bicuspid annular dilatation and also stabilized the annulus long-term. Major annular remodeling produced by the geometric ring moved the sinuses toward the midline and facilitated leaflet coaptation. No need existed for placing a reimplantation graft because the annulus was stabilized by the ring. The right coronary artery arising very close to the commissure could be avoided and the 6-cm ascending aneurysm replaced in a standard fashion. After valve repair and aortic replacement, aortic insufficiency grade fell to zero, with good leaflet mobility and a low gradient. The patient experienced an uncomplicated postoperative course and is asymptomatic over 1 year postoperatively.

Conclusions: Geometric bicuspid ring annuloplasty provides a simple method of bicuspid annular stabilization, allowing valve sparing even in the presence of coronary anomalies. This technique also could be useful for other forms of bicuspid aortic valve repair.

4:15 PM – 5:15 PM

Room 122ABC

Surgical Motion Picture Matinee: Congenital

Moderators: Bahaaldin Alsoufi, Atlanta, GA, and Aditya K. Kaza, Boston, MA

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Presenting authors are listed in **bold**.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of surgical videos followed by discussion and questions from the audience.

4:15 PM

Room 122ABC

The Senning/Rastelli Operation for Congenitally Corrected Transposition of the Great Arteries With Pulmonary Stenosis: A Technique to Prevent Pulmonary Vein Stenosis

J. S. Nelson¹, E. L. Bove²

¹University of North Carolina, Chapel Hill, ²University of Michigan, Ann Arbor

Purpose: Anatomic repair of congenitally corrected transposition of the great arteries is associated with better long-term outcomes than biventricular repair with the right ventricle as systemic ventricle. However, late obstruction of the pulmonary veins and/or pulmonary venous pathway is a described complication of the Senning component. The technical modifications demonstrated in this video attempt to address this quality gap.

Methods: Specific modifications to the operation are shown, including extension of right pulmonary venous incisions out to the pericardial reflection and use of an autologous pericardial pedicle flap for reconstruction of the pulmonary venous pathway.

Results: These modifications are designed to minimize the risks of late pulmonary venous stenosis and obstruction within the pulmonary venous pathway.

Conclusions: Key steps in this operation are shown. A review of the long-term results of patients who have undergone this operation using this modification at our institution is ongoing.

4:27 PM

Room 122ABC

Double Switch Operation With Combined Nikaidoh and Senning Procedures for Congenitally Corrected Transposition of the Great Arteries/Ventricular Septal Defect/Pulmonary Stenosis*R. Aeba**Keio University, Tokyo, Japan*

Purpose: In congenitally corrected transposition of the great arteries, ventricular septal defect, and pulmonary stenosis (ccTGA/VSD/PS), several surgical options have been proposed. We herein present a video of a double switch operation with combined Nikaidoh and Senning procedures in a ccTGA/VSD/PS patient.

Methods: A 12-year-old girl with ccTGA/VSD/PS was referred for surgery due to progressive cyanosis. VSD was a remote type and restrictive. On bypass, both coronary arteries were mobilized, and the aortic root was harvested from the right ventricle. On cross clamp, a Senning procedure was performed using an in situ autologous pericardial sac for pulmonary venous route. The right-sided coronary artery was temporarily detached, and the aortic root was pivot-rotated 120 degrees and reimplanted into the opened pulmonary annulus. The detached coronary was then reattached. The VSD was closed with a patch. After the Le Compte maneuver, the right ventricular outflow was reconstructed with a PTFE valved conduit.

Results: After bypass and cross clamp times of 395 minutes and 241 minutes, respectively, the patient was weaned from bypass, and the chest was closed without any mechanical circulatory supports. The patient remained uneventful until 7 months after the surgery.

Conclusions: Although technically demanding and time consuming, the double switch operation with combined Nikaidoh and Senning procedures offers straight and non-obstructed both the ventricular outflows and therefore may be an excellent option in select ccTGA/VSD/PS patients.

4:39 PM**Room 129AB****Truncal Half Turn and Senning Operation: Anatomical Correction of Congenitally Corrected Transposition of Great Arteries (IDD) With Pulmonary Stenosis, Ventricular Septal Defect, Situs Inversus, and Levocardia***P. Murin, M. Cho, J. Photiadis**German Heart Institute Berlin*

Purpose: The first successful anatomical correction of congenitally corrected transposition of great arteries (ccTGA) with pulmonary stenosis (PS), malalignment ventricular septal defect (VSD) in situs inversus and levocardia was performed using arterial trunk rotation in combination with the Senning operation, preventing recurrent outflow tract obstruction often seen after the Senning-Rastelli operation.

Methods: A 5-year-old boy with complex ccTGA, progressing cyanosis, and exercise intolerance underwent anatomical correction with truncal half turn and modified Senning operation. Bicaval cannulation of both left-sided caval veins, full flow bypass, and mild hypothermia (32 °C) were used. First, the Senning atrial switch was accomplished from the left side due to situs inversus and levocardia. After explantation of the coronary arteries, the arterial trunk was harvested en bloc and rotated by 180 degrees. The coronary arteries were reimplanted, and the Lecompte maneuver was performed. A pericardial patch was used for VSD closure and reconstruction of the left and right ventricular outflow tract.

Results: The patient was weaned from ventilator 3 days later and discharged home on the 8th postoperative day with excellent postoperative results and without residual problems.

Conclusions: Truncal half turn as a part of the anatomical correction of ccTGA is a feasible option even in situs inversus with levocardia. The translocated aortic root above the left ventricle and the avoidance of conduit insertion for the right ventricular outflow minimizes the risk of frequent recurrent outflow tract obstructions.

4:51 PM

Room 122ABC

A Novel Technique for Aortic Arch Reconstruction With Pulmonary Autograft Tube for Right-Sided Interrupted Aortic ArchN. Kato¹, M. Yamagishi²¹Children's Medical Center, Kyoto Prefectural University of Medicine, Japan, ²Kyoto Prefectural University of Medicine, Japan

Purpose: Right-sided interrupted aortic arch (IAA) is extremely rare in congenital heart disease and more risky for bronchus compression because the right bronchus sits higher than the left. We show a novel technique of aortic arch reconstruction with a pulmonary autograft (PA) tube, which can prevent airway compression without aortic arch stenosis.

Methods: A 23-day-old, 2.5 kg female neonate underwent definitive repair for type B right-sided IAA with aberrant left subclavian artery (LScA) through a standard median sternotomy. After establishing cardiopulmonary bypass and aortic cross clamp, PA tissue was harvested from the pulmonary artery trunk, and was rolled up and sutured to form a PA tube with a diameter of 7 mm and length of 10 mm. Ductal tissue was removed from the descending aorta, and the PA tube was interposed between the ascending and descending aorta for aortic arch reconstruction. The pulmonary artery was reconstructed with direct anastomosis and the surplus pulmonary wall.

Results: Postoperative hemodynamic recovery was quick and excellent. There was no pressure gradient between upper rims and lower rims. Follow-up cardiac 3-dimensional multidetector computed tomography showed the reconstructed aortic arch without obstruction, the spared and non-stretched aberrant LScA, and the widely opened airway without compression from aortic arch. During the 11-month follow-up, the patient has been free from any cardiac symptoms.

Conclusions: A PA tube is a simple and useful technique for aortic arch reconstruction to permit complete relief of anatomic afterload and diminish the anastomotic tension, thus reducing the risk of airway compression. A PA tube may provide an advantage for growth potential of aortic arch and is feasible for infants and children.

5:03 PM

Room 122ABC

From Right Arch to Left Arch: Modified Norwood Procedure for a Newborn Infant With Tricuspid Atresia, Transposition of Great Arteries, and Right Arch With Complete Vascular Ring

C. Hsu, Y. Chen, S. Huang

National Taiwan University Hospital, Taipei

Purpose: We here report a modified Norwood operation in a newborn patient with tricuspid atresia, transposition of great arteries, right arch with coarctation, and an aberrant left subclavian artery with complete vascular ring. The cardiopulmonary bypass strategy and management of vascular ring are described.

Methods: The surgical procedure entailed cardiopulmonary bypass by dual arterial cannulation to ascending aorta and patent ductal arteriosus, and the patient was cooled down to 20° C. The right distal arch was divided and anastomosed with a 3.5 mm Gore-Tex graft, serving as the conduit for subsequent selective cerebral perfusion. The patent ductal arteriosus was divided. The neo-aorta reconstruction was performed by incorporation of Kommerell diverticulum up to the left subclavian artery, aortic arch, and the transected main pulmonary. After atrial septectomy and full systemic perfusion via ascending aorta, the Gore-Tex graft was anastomosed to the right pulmonary artery as the Blalock-Taussig (BT) shunt.

Results: Postoperative course was smooth and uneventful. Postoperative computed tomography revealed the patent neo-aorta and the BT shunt; the vascular ring was relieved with patent tracheobronchial tree.

Conclusions: This extremely rare condition of combined vascular ring and hypoplastic right arch requires a Norwood procedure as initial palliation. We report our Norwood modification with a one-stage correction of both hypoplastic and abnormal aortic arch laterality. The dual cannulation technique could provide cardiopulmonary bypass with avoidance of circulatory arrest.

NOTES

4:15 PM – 5:15 PM

Room 120A

Surgical Motion Picture Matinee: General Thoracic*Moderators: K. Robert Shen, Rochester, MN, and Sandra L. Starnes, Cincinnati, OH*

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4:15 PM

Room 120A

Tracheal Resection and Carinal Reconstruction for Squamous Cell Carcinoma**T. S. Lancaster¹, S. B. Krantz¹, G. A. Patterson²**¹Washington University School of Medicine, St Louis, MO, ²Washington University, St Louis, MO

Purpose: Surgical resection is the treatment of choice for primary squamous cell carcinoma of the trachea and is associated with superior long-term survival. We present the rare case of a life-long nonsmoker with primary squamous cell carcinoma of the trachea, requiring tracheal resection and carinal reconstruction.

Methods: The patient is a 61-year-old female nonsmoker presenting with a 5-year history of chronic cough. Computed tomography of the chest showed a 2 cm mass in the anterior tracheal wall at the level of the aortic arch. A positron emission tomography scan showed no other hypermetabolic lesions. Preoperative bronchoscopy revealed a fungating mass in the anterior wall of the distal trachea, extending to the origin of the right main bronchus. Bronchoscopic biopsy demonstrated poorly differentiated squamous cell carcinoma. Cervical mediastinoscopy revealed no invasion into neighboring mediastinal structures and negative peritracheal lymph node examination by frozen section.

Results: After median sternotomy and mobilization of the ascending aorta, superior vena cava, and right pulmonary artery, the trachea was exposed by division of the posterior pericardium. Cross-field ventilation was employed during resection of the tracheal mass. The resected specimen included 2.5 cm of distal airway, extending from the distal trachea to the right and left main bronchi origins. Focal microscopic disease was present at the resection margins on frozen pathology, and this was accepted in favor of ensuring adequate tracheal length for a tension-free anastomosis. The proximal trachea was mobilized fully. The anterior carina was reconstructed, and the tracheal anastomosis was then completed with running suture of the posterior membranous airway and interrupted suture of the anterior airway. The patient was extubated at the conclusion of the procedure. Postoperative bronchoscopy after 1 week showed healing of the anastomosis without compromise. She will undergo adjuvant radiation therapy to encompass the positive microscopic margins.

Conclusions: Primary tracheal malignancies are rare, and complete resection is associated with improved long-term survival. Key factors in management include thorough preoperative evaluation to determine tumor resectability and attention to techniques for reducing anastomotic complications, such as avoidance of tracheal devascularization and anastomotic tension.

4:27 PM

Room 120A

Is Single Anatomical Segmentectomy of the Mediobasal Segment (S7) Possible?

K. Shimizu¹, T. Nagashima¹, Y. Ohtaki¹, K. Obayashi², S. Nakazawa¹, T. Yazawa¹, H. Iga³, M. Kamiyoshihara³, T. Yajima¹, R. Onozato¹, A. Mogi¹, H. Kurwano¹

¹Gunma University Hospital, Maebashi, Japan, ²Gunma University, Maebashi, Japan, ³Maebashi Red Cross Hospital, Japan

Purpose: The mediobasal segment (S7) has an anatomical feature that is complex because it is adjacent to multiple segments and has many variations in vessels and bronchi. The aim of this study was to clarify the anatomical variations relating to the S7 and to develop a technique for single S7 segmentectomy.

Methods: We reviewed the anatomical variations present in the S7 pulmonary bronchus and vessels of 218 patients using images obtained by 3-dimensional computed tomography angiography and bronchography (3DCTAB) with a 64-channel multidetector. We also performed a total thoroscopic single S7 segmentectomy on a 64-year-old male patient with a pulmonary metastasis arising from renal cancer.

Results: The B7 bronchus has two rami: B7a and B7b, which run the ventral and dorsal side of the lower pulmonary vein, respectively. Therefore, B7 can be classified into three types. The “B7a-type” B7, comprising only the B7a ramus, was evident in 168 instances (77%), whereas the “B7b-type” B7, comprising only the B7b ramus, was evident in 15 instances (7%). The “B7ab-type” B7, comprising both B7a and B7b, was evident in 25 instances (12%). Our patient had a “B7a-type.” The details of the procedure are as follows. The A7 artery was ligated and cut, exposing the B7a. The S7 was then inflated using jet ventilation to create an inflation-deflation line, and the B7a was incised. The intersegmental plane was dissected from the proximal. The V7a vein was cut. Thereafter, the lung was cut along the inflation-deflation line, and the cut line was connected to the plane already dissected from the proximal.

Conclusions: Based on our data regarding anatomical variations, as well as preoperative simulation and intraoperative navigation using 3DCTAB, it was determined that a total thoroscopic single S7 segmental resection can be performed on patients with a “B7a-type.”

4:39 PM**Room 120A****Minimally Invasive Nerve Root-Sparing Resection of a Thoracic Schwannoma: A Case Report**

*E. A. Gillaspie, S. H. Blackmon
Mayo Clinic, Rochester, MN*

Purpose: Schwannomas are benign, encapsulated, peripheral nerve sheath tumors, affecting men and women equally, in the third to fifth decade of life. Schwannomas manifest with nerve dysfunction and rarely exhibit malignant degeneration. We share a novel technique for thoracoscopic, intracapsular excision of T1 nerve root tumor with preservation of posterior fibers.

Methods: A 20-year-old female presented with postural orthostatic tachycardia syndrome, migrating arthritis, and a rash. Chest computed tomography revealed a well-circumscribed, low-density, extra-pulmonary mass in the apex of the chest, approaching the T1 or T2 neural foramen. Magnetic resonance imaging confirmed T1 nerve root origin and was consistent with a Schwannoma.

Results: Video-assisted thoracoscopic exploration of the chest with three ports identified the mass to be emerging from the T1 nerve root as expected. Circumferential dissection was performed with electrocautery. Tumor sheath was incised anteriorly to deliver the mass. An intracapsular enucleation was accomplished with visible preservation and continuity of the posterior nerve. Our patient had an uneventful recovery and was discharged on postoperative day 2. Neurologic examinations were performed beginning the evening of the surgery. She demonstrated no neuromuscular deficits and only mild sensory deficits in the medial forearm. Follow-up imaging demonstrated no residual lesion. Subsequent electromyography and neurologic exam revealed no muscular deficits and only a mild sensory deficit.

Conclusions: For intrathoracic Schwannomas, video-assisted thoracoscopic surgery provides excellent exposure to perform an intracapsular enucleation while maintaining continuity of posterior nerve fibers. As established in neurosurgery literature, an intracapsular dissection relieves nerve compression and maintains nerve function without compromising margins or resection. This procedure should be in the armamentarium of thoracic surgeons.

4:51 PM

Room 120A

Thoracoscope-Assisted Minimally Invasive Multiple-Level Rib Fixation and Lung Repair in Traumatic Chest Wall Injury*K. Han¹, H. Kim¹, H. Lee¹, Y. Choi²**¹Korea University Guro Hospital, Seoul, ²Korea University Medical Center, Seoul*

Purpose: Usually, a rib fixation in multiple level rib fractures requires relatively long and multiple thoracic incisions. We performed thoracoscope-assisted multiple rib fixation using a small chest tube site and additional camera port.

Methods: A 58-year-old male with 4th, 5th, 6th, and 7th rib fractures by trauma was referred to our hospital for surgical correction of herniated lung between fractured rib segments and continuous air leak. We performed lung repair and thoracoscope-assisted multiple-level rib fixations using multi-hole titanium plates and previous chest drain incision.

Results: Through a 4-cm incision and one 5-mm camera port, herniated lung was pushed back to chest cavity after periosteal dissection of fractured ribs, and we repaired the lacerated lung parenchyma through the port. The fractured ribs were repositioned and fixed with multi-hole titanium rib plates. For the fixation of the 4th rib, which was unable to screw through the incision, we made an additional 5-mm incision at anterior chest and successfully fixed the high-level rib fracture guided by thoracoscope. The wound retractor at muscle layer often helped minimize the wound during the procedure, and the thoracoscope showed invisible area of high level rib fixation. The patient was discharged after 5 postoperative days without complication.

Conclusions: Minimally invasive rib fixation guided by thoracoscope is a safe and feasible option for multiple level fixation with small incision and detection of hidden intrathoracic organ injury.

5:03 PM

Room 120A

Total Endoscopic First Rib Resection for Thoracic Outlet Syndrome

R. George, R. Milton, N. Chaudhuri, K. Papagiannopoulos
St James's University Hospital, Leeds, United Kingdom

Purpose: Thoracic outlet syndrome (TOS) causes neurological symptoms in 93% of cases and vascular symptoms in 7% of cases. Surgical resection is curative. Endoscopic transaxillary assisted first rib resection has been previously reported. In this study, we report a novel, complete intrapleural approach using tailored endoscopic tools.

Methods: Endoscopic first rib resection was performed following failure of symptom improvement with physiotherapy. Intraoperatively, patients were managed in the decubitus position with double-lumen intubation. Three standard video-assisted thoracoscopic surgical ports were placed after lung isolation. The parietal pleura and periosteum overlying the first rib were stripped, avoiding injury to the neurovascular bundle. The rib was transected with an endoscopic rib cutter and resected completely in a piecemeal fashion using endoscopic bone nibblers.

Results: Nine patients (seven females, average age 32.4 years \pm 5.9 years) presented with TOS: neurogenic (n=8) and bilateral arterial compression (n=1). Predominant symptoms included presence of muscle wasting/weakness (n=3), paresthesia (n=2), numbness (n=1), pain (n=2), and bilateral vascular compression related symptoms (n=1). All patients underwent physiotherapy treatment for at least 6 weeks with no symptomatic relief. Following surgery, patients were discharged within 48 hours. At follow-up, eight patients had complete resolution of their main symptoms. One patient with neurogenic TOS developed mild functional and sensational loss of the non-dominant hand, which is improving with physiotherapy.

Conclusions: Unlike the classic approaches, video-assisted thoracoscopic first rib resection for TOS provides a superior, magnified, and well-illuminated view of the thoracic inlet. It allows good posterior trimming of the first rib, release of brachial plexus, and an aesthetically pleasing result, especially in female patients.

5:00 PM – 6:30 PM

Room 120D Foyer

Scientific Posters and Wine

5:30 PM – 6:25 PM

Room 125AB

Business Meeting (STS Members Only)

6:30 PM – 7:30 PM

Camelback B, Sheraton Grand Phoenix

STS-PAC Reception



7:00 PM – 10:30 PM

 **STS Social Event: Corona Ranch**

Join your colleagues for an evening of mariachi music, delicious food, and ice-cold margaritas at Corona Ranch, nestled in the shadows of nearby mountains. You can compete against fellow attendees in “cowboy games” and get a front-row seat for an exciting rodeo that will incorporate bronco and bull riding, high-speed horse maneuvers, and trick roping. Don't miss this opportunity to relax and have fun in an Old Mexico environment. (Please note that this is an outdoor event and the desert can get chilly at night, so please dress accordingly.)

TUESDAY AT A GLANCE

6AM	6:30 AM – 4:30 PM Registration: STS Annual Meeting							
7AM								
8AM	7:30 AM – 8:30 AM Early Riser Sessions				7:30 AM – 8:30 AM Early Riser Health Policy Forum: MIPS: The New Medicare Fee-for-Service and What It Means to You			
9AM	9:00 AM – 3:30 PM Exhibit Hall		9:00 AM – 5:00 PM Scientific Posters		9:00 AM – 10:00 AM Thomas B. Ferguson Lecture: Scott Parazynski			
10AM								
11AM	10:45 AM – 11:00 AM Award Presentations							
	11:00 AM – 12:00 PM C. Walton Lillehei Lecture: Gary Taubes							
12PM	12:00 PM – 1:00 PM Ethics Debate: An Advance Directive Limits Postoperative Care—Should Surgeons Accept Limits on Care?						12:00 PM – 1:00 PM Residents Luncheon	
1PM	1:00 PM – 3:00 PM						1:00 PM – 3:30 PM JCTSE: Accountable Surgical Education—How Can Cardiothoracic Surgery Move Forward?	
2PM	Adult Cardiac Session: General	Adult Cardiac Session: Mitral Valve	Congenital Session: Pediatric Congenital II	General Thoracic Session: Esophageal	General Thoracic Session: Lung Cancer II—Treatment	Patient Safety Symposium: When Bad Things Happen to Good CT Surgeons—Human Error and the Impact on You, the “Second Victim”	EACTS @ STS	1:00 PM – 5:30 PM Advanced Therapies for End-Stage Heart Disease
3PM								
4PM	3:30 PM – 5:30 PM							
5PM	Adult Cardiac Session: Aorta II	Adult Cardiac Session: Aortic Valve	Cardiothoracic Surgical Education	Congenital Session: Pediatric Congenital III	General Thoracic Session: Mediastinal/Pulmonary	ESTS @ STS: Controversial Issues in General Thoracic Surgery—Perspectives From Europe and North America	SCA @ STS: Perioperative Evaluation and Management of Circulatory Shock	
6PM								
7PM								
8PM								
9PM								

- 6:30 AM – 4:30 PM **Registration: STS Annual Meeting**
- 7:30 AM – 8:30 AM **Early Riser Sessions**
Early Riser Health Policy Forum: MIPS: The New Medicare Fee-for-Service and What It Means to You
- 9:00 AM – 10:00 AM **Thomas B. Ferguson Lecture: Scott Parazyński**
- 9:00 AM – 3:30 PM **Exhibit Hall**
- 9:00 AM – 5:00 PM **Scientific Posters**
- 10:45 AM – 11:00 AM **Award Presentations**
- 11:00 AM – 12:00 PM **C. Walton Lillehei Lecture: Gary Taubes**
- 12:00 PM – 1:00 PM  **Ethics Debate: An Advance Directive Limits Postoperative Care—Should Surgeons Accept Limits on Care?**
-  **Residents Luncheon**
- 1:00 PM – 3:00 PM **Adult Cardiac Session: General**
Adult Cardiac Session: Mitral Valve
Congenital Session: Pediatric Congenital II
General Thoracic Session: Esophageal
General Thoracic Session: Lung Cancer II—Treatment
Patient Safety Symposium: When Bad Things Happen to Good CT Surgeons—Human Error and the Impact on You, the “Second Victim”
EACTS @ STS: Aortic Valve Repair and Aortic Root Reconstruction for Insufficient Tricuspid and Bicuspid Pathology
- 1:00 PM – 3:30 PM **JCTSE: Accountable Surgical Education—How Can Cardiothoracic Surgery Move Forward?**
- 1:00 PM – 5:30 PM **Advanced Therapies for End-Stage Heart Disease**
- 3:30 PM – 5:30 PM **Adult Cardiac Session: Aorta II**
Adult Cardiac Session: Aortic Valve
Cardiothoracic Surgical Education
Congenital Session: Pediatric Congenital III
General Thoracic Session: Mediastinal/Pulmonary
ESTS @ STS: Controversial Issues in General Thoracic Surgery—Perspectives From Europe and North America
SCA @ STS: Perioperative Evaluation and Management of Circulatory Shock

6:30 AM – 4:30 PM

Lower Level Foyer

Registration: STS Annual Meeting

7:30 AM – 8:30 AM

Various locations; see below

Early Riser Sessions

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

The physician competencies addressed in these sessions are patient care and procedural skills, medical knowledge, practice-based learning and improvement, professionalism, and systems-based practice. These physician competencies will be addressed through conversational lectures on the specific course topics.

Early Riser Session 1

Room 123

Women in Thoracic Surgery: Patient-Centered Care and Research

Patient-centered medicine recently has attracted renewed attention. The approach focuses on patient participation in clinical decision making by taking into account a patient's perspective and individualizing medical care based on his or her needs and preferences. More than ever, patients have a desire to take an active role in pre- and post-treatment care plans. Attention to a patient's needs and circumstances when planning care is associated with improved health care outcomes. Patient-centered research allows patients and physicians to identify and discuss the medical information that is most relevant to a patient's individual case. Surgeons must understand and recognize the importance of this approach and identify ways to incorporate it into their practices.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Identify ways to incorporate patient-centered care into clinical practice (ie, disease surveillance, survivorship)
- Describe important factors to include when developing patient-centered care strategies
- Identify ways research is being incorporated to optimize patient care
- Explain funding opportunities for patient-centered research

7:30 AM

Introduction

Valerie A. Williams, Cincinnati, OH

7:35 AM

Patient-Centered Care: Survivorship

Stephen C. Yang, Baltimore, MD

7:50 AM

Patient-Centered Care: Surveillance

Leah M. Backhus, Stanford, CA

8:05 AM

Patient-Centered Research and Funding

Benjamin D. Kozower, Charlottesville, VA

Early Riser Session 2

Room 221A

Task Force on Military Affairs: Disaster Preparedness and Mass Casualty—The Role of a Cardiothoracic Surgeon

Natural disasters and terrorist threats are, unfortunately, becoming increasingly common. Cardiothoracic surgeons have an intimate knowledge of traumatic thoracic vascular injury, which carries an extremely high mortality rate. Additionally, as team leaders, CT surgeons can play a vital role in organizing a response when unexpected disasters occur. However, many CT surgeons have not been fully trained in disaster preparedness and response.

This session will focus on the role of the cardiothoracic surgeon in coordinating disaster preparedness protocols and managing mass casualty situations in an urban setting. Expert panelists include world-renowned cardiothoracic/trauma surgeon Kenneth Mattox, MD, who will share his personal experience in the wake of Hurricane Ike, and Emily Farkas, MD, who will share her experiences in Nepal as a surgical volunteer following the recent earthquake.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Describe what constitutes a mass casualty event
- Identify the relationship between mass casualty events and disaster preparedness
- Describe the role of cardiothoracic surgeons in disaster preparedness and dealing with a mass casualty situation
- Identify barriers to appropriate disaster preparedness and review potential solutions to these barriers

Moderators: Danny Cbu, Pittsburgh, PA, and Elizabeth A. David, Davis, CA

7:00 AM The Surgeon During Disaster Medical Response

Kenneth L. Mattox, Houston, TX

7:30 AM Nepal Disaster Relief: Moral Obligation or Mismatched Motivation?

Emily A. Farkas, Los Angeles, CA

7:50 AM Panel Discussion/Question-and-Answer Session

Early Riser Session 3**Room 221B****Transitioning to Retirement**

This session will provide advice on how to prepare for and plan retirement from clinical practice, as well as offer alternative activities in which to participate after leaving practice. Attendees will learn about the psychological and financial requirements necessary for a successful transition from clinical practice to retirement.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Explain methods of saving for retirement and avoiding debt
- Describe the concept of retiring at the correct time
- Discuss potential activities in which to participate after retirement
- Describe the psychological aspects of leaving a rewarding, high-profile, ego-fulfilling profession
- Describe how to maintain educational opportunities and licensure

Moderators: James R. Edgerton, Dallas, TX, and Robert W. Emery, Minneapolis, MN

7:30 AM**Welcome and Introduction****7:32 AM****Financially Preparing for Retirement**

Robert W. Emery, Minneapolis, MN

7:39 AM**Psychologically Preparing for Retirement**

James R. Edgerton, Dallas, TX

7:46 AM**Opportunities After Retirement: Professional and Other**

John W. Hammon, Winston-Salem, NC

7:53 AM**Physically Preparing for Retirement**

Sidney Levitsky, Boston, MA

8:00 AM**Panel Discussion/Question-and-Answer Session****Early Riser Session 4****Room 221C****How to Acquire and Use Data From the STS National Database for Research**

This session will provide attendees with actionable advice on how to conduct research utilizing data from the STS National Database. Faculty members include STS members who have directed multiple successful research projects using the STS National Database.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Describe the process for creating a Data Request to access STS National Database data for research
- Discuss the differences between Major Data Requests and Minor Data Requests
- Explain the process of developing a hypothesis, specific aims, and a research plan

7:30 AM**Research With the STS National Database: Major Requests and Minor Requests**

Jeffrey P. Jacobs, St Petersburg, FL

- 7:40 AM** **The A&P Review Process**
Jane Han, Chicago, IL
- 7:50 AM** **Research With the STS Adult Cardiac Surgery Database**
Vinay Badhwar, Pittsburgh, PA
- 8:00 AM** **Research With the STS Congenital Heart Surgery Database**
Marshall L. Jacobs, Newtown Square, PA
- 8:10 AM** **Research With the STS General Thoracic Surgery Database**
Henning A. Gaissert, Boston, MA

Early Riser Session 5

Room 222A

The Annals Academy

This session is the perfect venue for young investigators and those interested in improving their scholarly research abilities to interact with *Annals* editors and senior investigators. *The Annals Academy* seeks to endow potential authors with the necessary tools to turn their data into interesting and potentially practice-improving scholarly articles. Attendees will be exposed to all aspects of the article preparation process, from hypothesis generation to final formatting of manuscripts in preparation for online submission.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Generate a definitive and interesting purpose to their study
- Declare the limitations of their study and describe the importance of not overstating their findings
- Prepare/format their manuscripts and figure files correctly to conform with journal standards
- Describe how to enhance their study with engaging and instructive video/other media content
- Locate the correct venue for their work and properly identify its priority for publication

- 7:30 AM** **Introduction, *The Annals of Thoracic Surgery* Background and History**
G. Alexander Patterson, St Louis, MO
- 7:35 AM** **Generating a Hypothesis/Purpose to Your Study**
Jennifer C. Hirsh-Romano, Ann Arbor, MI
- 7:45 AM** **From Gathering Data to Manuscript Writing: Knowing Your Limits**
Mark K. Ferguson, Chicago, IL
COMMERCIAL RELATIONSHIPS M. K. Ferguson: Other, The Society of Thoracic Surgeons, Elsevier, Springer; Nonremunerative Position of Influence, CTSNet
- 8:00 AM** **Preparing Your Manuscript for Submission and Finding the Proper Journal**
Jennifer S. Lawton, St Louis, MO
- 8:10 AM** **Enhancing Your Paper With Multimedia Content**
Shanda H. Blackmon, Rochester, MN
- 8:20 AM** **Question-and-Answer Session**

Early Riser Session 6**Room 128AB****New Technologies and Controversies in Esophageal Disease**

This session will provide an in-depth review of three esophageal surgery areas, including less invasive antireflux surgeries (LINX, transoral incisionless fundoplication, and MUSE), flexible endoscopic procedures (peroral endoscopic myotomy, cricopharyngeal myotomy, and submucosal tumors), and techniques to reduce axial and radial diaphragmatic tension during paraesophageal hernia repair. In each area, experts will share their experiences and review current results.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Identify new treatment options for gastroesophageal reflux disease (GERD) and their role in the management along the GERD spectrum
- Describe techniques for natural orifice or endoscopic treatments for achalasia, submucosal tumors, and esophageal diverticula
- Identify options for reducing axial tension and radial diaphragm tension during paraesophageal hernia repair
- Describe the role of mesh in hiatal hernia repair

7:35 AM**Less Invasive Options for Gastroesophageal Reflux Disease***Hiran C. Fernando, Boston, MA***COMMERCIAL RELATIONSHIPS** H. C. Fernando: Consultant/Advisory Board, Galil Medical, Inc, CSA Medical, Inc**7:42 AM****Discussion****7:50 AM****Endoscopic Surgery for Achalasia***Brian E. Louie, Seattle, WA***7:57 AM****Discussion****8:05 AM****Reducing Tension and Recurrence During Hiatal Hernia Repair***Alexander S. Farivar, Seattle, WA***8:12 AM****Discussion****Early Riser Session 7****Room 126ABC****Lung Cancer Screening: Policy, Program Development, and Patient Management**

Although lung cancer is the leading cause of cancer death in the United States and in most of the world, early detection through lung cancer screening has not been a part of public policy, in contrast to other common cancers. The National Lung Screening Trial demonstrated a 20% reduction in lung cancer mortality in people at high risk for lung cancer through screening with low-dose computed tomography. The finding helped lead to a major US policy change in support of lung cancer screening for both privately insured and Medicare patients. This session will help attendees learn the background, rationale, and controversies of lung cancer screening policies, provide indications for screening and the management of screen-detected nodules, and provide fundamentals and regulatory requirements important in developing a new lung cancer screening program.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Outline the policy steps of lung cancer screening, the role of thoracic surgeons, and the impact on patient access and equity
- Articulate the rationale for and limitations of current eligibility criteria for lung cancer screening
- List the algorithms and tools for responsible management of screen-detected lung nodules
- Explain the basic components of setting up a successful screening program

Moderators: *Gaetano Rocco, Naples, Italy, and Douglas E. Wood, Seattle, WA*

COMMERCIAL RELATIONSHIPS D. E. Wood: Research Grant, Spiration, Inc; Consultant/Advisory Board, Spiration, Inc

7:30 AM Development of Guidelines and Policy in Lung Cancer Screening

Douglas E. Wood, Seattle, WA

COMMERCIAL RELATIONSHIPS D. E. Wood: Research Grant, Spiration, Inc; Consultant/Advisory Board, Spiration, Inc

7:50 AM LungRADS and Management of Screen-Detected Nodules

Ella Kazerooni, Ann Arbor, MI

8:10 AM Essential Elements for a Successful and Compliant Screening Program

Brady McKee, Burlington, MA

COMMERCIAL RELATIONSHIPS B. McKee: Speakers Bureau/Honoraria, Covidien, Medtronic, Inc

Early Riser Session 8

Room 224A

Coding and Billing in the ICU

Julie Painter, Thornton, CO, and Jay G. Shake, Temple, TX

This session will provide attendees with information about the physician and hospital sides of billing and coding. It also will highlight the importance of appropriate medical record documentation to support a given level of billing.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Explain current coding systems and outline the appropriate documentation for coding
- Discuss critical care coding
- Explain coding for physicians in training and non-physician providers
- Identify non-critical care codes
- Identify the utility of extracorporeal membrane oxygenation and ventricular assist device notes

Early Riser Session 9**Room 122ABC****LVAD Thrombosis: Diagnosis and Management**

This session will provide a detailed review of current knowledge related to pump thrombosis. The prevalence of pump thrombosis and a comparison between HeartMate II and HeartWare devices will be offered, as will a review of the latest diagnosis, treatment, and surgical therapy options. A panel discussion will complete the session.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Explain how to quickly diagnose pump thrombosis
- List the options available for treatment
- Discuss surgical approaches for pump exchange

7:30 AM **Overview of Pump Thrombosis**
Nicholas G. Smedira, Cleveland, OH

7:40 AM **Diagnosis of Pump Thrombosis**
Robert L. Kormos, Pittsburgh, PA

7:50 AM **Principles to Reduce Pump Thrombosis**
Francis D. Pagani, Ann Arbor, MI

8:00 AM **Surgical Treatment of Pump Thrombosis**
Abmet Kilic, Columbus, OH
COMMERCIAL RELATIONSHIPS A. Kilic: Speakers Bureau/Honoraria, Thoratec Corporation, Baxter International

8:10 AM **Question-and-Answer Session**

Early Riser Session 10**Room 131ABC****Tough Calls in Mitral Valve Disease**

Michael A. Borger, New York, NY, Anson Cheung, Vancouver, Canada, and Vinod H. Thourani, Atlanta, GA

In this interactive session, experienced surgeons will discuss the spectrum of treatment approaches for complex mitral valve disease.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Discuss the range of available approaches for mitral valve disease
- Describe the decision-making process for and against surgical intervention

Early Riser Session 11

Room 127ABC

Safe Reoperative Surgery

Due to the high risk of problems associated with reoperative surgeries, few surgeons perform these types of procedures regularly. However, studies suggest an increasing need for reoperative procedures. Studies also show that the status of reoperation is no longer an independent risk factor for mortality. This session seeks to close the gap in physician understanding of postoperative outcomes and improve the ability to carry out proper perioperative strategies in order to perform safe reoperative procedures.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Identify operative options for performing safe reoperative surgeries
- Describe various approaches to assessing appropriate candidates for reoperations
- Propose protocols to reduce intraoperative injuries

7:30 AM	Introduction/Safe Sternal Re-Entry <i>John A. Kern, Charlottesville, VA</i>
7:37 AM	Question-and-Answer Session
7:40 AM	Redo Aortic Valve Replacement <i>Joel S. Corvera, Indianapolis, IN</i>
7:47 AM	Question-and-Answer Session
7:50 AM	Redo Coronary Artery Bypass Grafting Surgery <i>Jack Boyd, Stanford, CA</i>
7:57 AM	Question-and-Answer Session
8:00 AM	Redo Mitral Valve Replacement <i>Pavan Athuri, Philadelphia, PA</i>
8:07 AM	Question-and-Answer Session
8:10 AM	Redo Aortic Surgery <i>Wilson Y. Szeto, Philadelphia, PA</i> COMMERCIAL RELATIONSHIPS W. Y. Szeto: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, LivaNova; Consultant/Advisory Board, Micro Interventional Devices, Inc
8:17 AM	Question-and-Answer Session
8:20 AM	Panel Discussion

Early Riser Session 12**Room 125AB****Three Cases I Wish I Could Get Back**

Have you ever had a case where, after it was over, you thought, “What was I thinking?!” or “I’d like to start that one over again.”? In this session, three experienced, high-volume surgeons will describe cases where they felt they could have performed differently to improve morbidity or the ultimate outcomes of their patients. The surgeons will highlight key areas of decision making, information gathering, and technical performance that might have been improved or would be improved in the future based on what they’ve learned from these cases.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Delineate that all surgeons face intellectual and technical challenges
- Articulate the algorithms required to work through a problem
- Describe the importance of post-hoc event evaluation
- Explain the importance of implementing structural improvements to prevent future similar difficulties

7:30 AM**Case 1***Emile A. Bacha, New York, NY***COMMERCIAL RELATIONSHIPS** E. A. Bacha: Consultant/Advisory Board, CorMatrix**7:42 AM****Case 1: Discussion****7:47 AM****Case 2***Jonathan M. Chen, Seattle, WA***7:59 AM****Case 2: Discussion****8:04 AM****Case 3***Glen S. Van Arsdell, Toronto, Canada***COMMERCIAL RELATIONSHIPS** G. S. Van Arsdell: Ownership Interest, Cell Aegis Devices**8:16 AM****Case 3: Discussion****8:21 AM****Panel Discussion****Early Riser Session 13****Room 129AB****Mechanical Circulatory Support of the Single Ventricle**

Many single ventricle patients require mechanical circulatory support, and physicians must choose from several options. Speakers in this session will describe the indications, implantation techniques, and outcomes data for extracorporeal membrane oxygenation (ECMO), ventricular assist devices (VADs), and artificial hearts.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Explain the indications, implantation techniques, and outcomes data for ECMO support of the single ventricle patient
- Identify the indications, implantation techniques, and outcomes data for VAD support of the single ventricle patient

- Describe the indications, implantation techniques, and outcomes data for artificial heart support of the single ventricle patient

7:30 AM

Welcome and Introduction

7:35 AM

Indications, Techniques for Implementation, and Outcome Data for Extracorporeal Membrane Oxygenation Support of the Single Ventricle Patient*David L. Morales, Cincinnati, OH*

COMMERCIAL RELATIONSHIPS D. L. Morales: Ownership Interest, CorMatrix; Consultant/Advisory Board, CorMatrix, Berlin Heart, SynCardia Systems, Inc; Other, CorMatrix, Berlin Heart, SynCardia Systems, Inc

REGULATORY DISCLOSURE This presentation will address the SynCardia 50/50cc TAH, the HeartWare MVAD, and the HeartMate II by Thoratec. The FDA statuses of these devices are investigational.

7:50 AM

Indications, Techniques for Implementation, and Outcome Data for Ventricular Assist Device Support of the Single Ventricle Patient*Ronald K. Woods, Milwaukee, WI*

COMMERCIAL RELATIONSHIPS R. K. Woods: Consultant/Advisory Board, St Jude Medical; Research Grant, SynCardia Systems, Inc, HeartWare

8:05 AM

Indications, Techniques for Implantation, and Outcome Data for Artificial Heart Support of the Single Ventricle Patient*J. William Gaynor, Philadelphia, PA*

COMMERCIAL RELATIONSHIPS J. W. Gaynor: Other/Provided slides for a presentation, SynCardia Systems

8:20 AM

Panel Discussion/Question-and-Answer Session**Early Riser Session 14**

Room 226C

Clinical Trials in Thoracic Surgical Oncology*Gail E. Darling, Toronto, Canada, and Linda W. Martin, Baltimore, MD*

Clinical research is essential to improving patient outcomes. Many surgeons are unaware of clinical trials that may be relevant to their patients and their practices; thoracic surgeon engagement, participation, and patient enrollment are critical elements to successful studies. This session will inform surgeons practicing general thoracic surgery about clinical trials available through cooperative oncology groups, as well as other mechanisms. There also will be education regarding how to get involved in the cooperative groups and how to open a trial at a surgeon's home institution.

Learning Objectives

Upon completion of this activity, participants should be able to:

- List the available clinical trials in general thoracic surgery
- List upcoming trials/trials in development
- State how to become involved in clinical research locally (in their own practice settings) and in the cooperative groups nationally
- State barriers to performing clinical research
- Discuss knowledge gaps in clinical trial evidence

Early Riser Session 15**Room 224B****Update on Maintenance of Certification for the American Board of Thoracic Surgery***Bryan F. Meyers, St Louis, MO, and Cameron D. Wright, Boston, MA*

This activity will feature presentations on the recently changed requirements for ABTS Diplomates to remain compliant with maintenance of certification (MOC) activities. It will include a review of MOC goals, changes in specific MOC practices and requirements in surgery and cardiothoracic surgery, and the responsibilities for board-certified cardiothoracic surgeons. All cardiothoracic surgeons are welcome, but those approaching the fifth or 10th year of their ABTS cycle will find the session particularly valuable. Practical solutions will be offered for MOC.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Recognize the reasons for and importance of board certification and MOC programs
- List the recent changes to MOC that have impacted all American Board of Medical Specialties boards
- State their personal MOC requirements in the next 1-5 years
- Demonstrate an understanding of the MOC expectations

7:30 AM – 8:30 AM**Room 226A****Early Riser Health Policy Forum****MIPS: The New Medicare Fee-for-Service and What It Means to You**

Beginning in 2019, all cardiothoracic surgeons who treat Medicare patients will be paid according to the Merit-Based Incentive Payment System (MIPS), which is designed to drive Medicare payment away from traditional fee-for-service and toward a pay-for-quality model. MIPS combines requirements from the Physician Quality Reporting System, Electronic Health Records Meaningful Use Final Rule, Value-Based Payment Modifier, and new clinical practice improvement activity regulations. This session will outline these programs and provide instruction on how participants can prepare their practices for the future Medicare payment system. A preview also will be offered of specialty-specific Alternative Payment Models and new documentation requirements related to global surgical payments.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Identify ways to help their hospitals and practices prepare for MIPS
- List the requirements of the revised Medicare fee-for-service payment system
- Identify ways to participate in ongoing STS advocacy

The physician competencies addressed in this session are patient care and procedural skills and systems-based practice. These competencies will be addressed through a lecture followed by an open forum on Medicare payment issues.

- 7:30 AM **Introduction and Overview of the Changing Health Policy Environment**
Alan M. Speir, Falls Church, VA
COMMERCIAL RELATIONSHIPS A. M. Speir: Consultant/Advisory Board, Medtronic, Inc
- 7:50 AM **In-Depth Overview of the MIPS Program**
Courtney Yohe, Washington, DC
- 8:10 AM **Question-and-Answer Session**

9:00 AM – 3:30 PM

Exhibit Halls 4-5

Exhibit Hall

9:00 AM – 5:00 PM

Room 120 Foyer

Scientific Posters

9:00 AM – 12:00 PM

Exhibit Halls 2-3

General Session II

Moderators: Mark S. Allen, Rochester, MN, and Keith S. Naunheim, St Louis, MO

COMMERCIAL RELATIONSHIPS M. S. Allen: Nonremunerative Position of Influence, Joint Council on Thoracic Surgery Education; K. S. Naunheim: Speakers Bureau/Honoraria, Medtronic, Inc

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The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and focused discussion on key points of presentations.

9:00 AM

Exhibit Halls 2-3

Thomas B. Ferguson Lecture

The Requisite Innovator's Mindset: Open-Mindedness and the Relentless Hunt for Problems in Need of Fixing

Scott Parazynski, Houston, TX

COMMERCIAL RELATIONSHIPS S. Parazynski: Consultant/Advisory Board, Helius Medical Technologies, BioDirection



Health care systems must create an environment wherein every provider not only is allowed to contribute to the advancement of the mission, but also one where he/she feels a deep-seated obligation to innovate. That's the kind of environment and work ethic Dr. Parazynski has spent a lifetime advancing: from developing tools and techniques to recover from the Space Shuttle Columbia accident, to developing innovative medical devices and enhancing safety on the slopes of the world's highest mountains, he draws on his background working in extreme environments as a catalyst for innovation in daily life. He will share this mindset with powerful examples from aerospace, medicine, mountaineering, and

everyday life with engaging, relatable stories and good humor.

10:00 AM

BREAK—Visit Exhibits and Scientific Posters

Complimentary coffee available in the Exhibit Hall

10:45 AM

Exhibit Halls 2-3

Award Presentations

11:00 AM

Exhibit Halls 2-3

C. Walton Lillehei Lecture
Why We Get Fat



*Gary Taubes, New York, NY**

***For more information on this speaker, please visit www.prhspeakers.com.**

12:00 PM – 1:00 PM

BREAK—Visit Exhibits and Scientific Posters

Complimentary coffee available in the Exhibit Hall

12:00 PM – 1:00 PM

Room 229AB

Ethics Debate: An Advance Directive Limits Postoperative Care—Should Surgeons Accept Limits on Care?

A patient's advance directive sometimes places limitations on care and is particularly problematic when it limits postoperative care, a time when some instability is likely. Some surgeons believe that limitations on life-sustaining technologies are acceptable because caring for patients is paramount, while others think that such limitations are unjustified and should not be accepted. How should a surgeon respond to such a situation?

The Ethics Debate will feature a case in which a patient with multiple comorbidities had a surrogate decision-maker who limited postoperative care by restricting life support to 1 week after a complex operation. The case will be discussed by two experts with differing views of the proper response. Substantial time is planned for questions and comments from the audience.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Discuss the factors to be considered when faced with an advance directive that limits postoperative care
- Decide whether to accept limitations on care

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The physician competencies addressed in this session are patient care and procedural skills, practice-based learning and improvement, and professionalism. These physician competencies will be addressed through lectures, a debate, and questions from the audience.

Facilitator: Robert M. Sade, Charleston, SC

PRO: Constantine D. Mavroudis, Philadelphia, PA

CON: Jeffrey G. Gaca, Durham, NC

12:00 PM – 1:00 PM

Room 231ABC

Residents Luncheon

This luncheon, which is open to all residents, facilitates mentorship and discussion between experienced cardiothoracic surgery leaders and resident attendees. Each attendee will be provided with discussion topics to encourage engagement. Discussion topics will address the various types of cardiothoracic surgery training programs, identification of gaps in training, and how STS can continue to support residents as they prepare to enter the workforce. Participants consistently rate the discussions and interaction with leaders as the most valued and appreciated aspect of the luncheon.

NOTES

1:00 PM – 3:00 PM

Room 131ABC

Adult Cardiac Session: General*Moderators: Kevin L. Greason, Rochester, MN, and Christina M. Vassileva, Springfield, IL*

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Presenting authors are listed in **bold**.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

1:00 PM

Room 131ABC

Amiodarone Protocol Reduces Atrial Fibrillation and Decreases Mortality in Cardiac Surgery Patients

W. Elkbali¹, M. D. Grinn², W. Elzomor¹, R. Cosenza¹, V. DeBari¹, A. Hamdan¹, C. Badami¹, K. Asgarian¹, M. Connolly¹

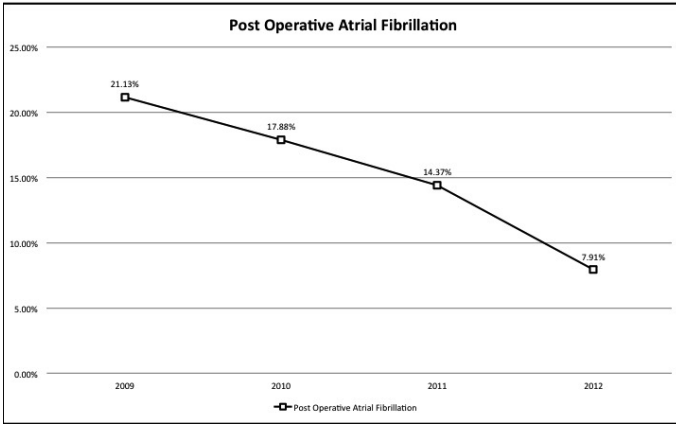
¹St Joseph's Healthcare System, Paterson, NJ, ² St Joseph's Regional Medical Center, Paterson, NJ

Purpose: The most commonly occurring arrhythmia following cardiac surgery is atrial fibrillation. Nationally, the percentage of patients with postoperative atrial fibrillation (POAF) can be as high as 50%. At our institution, an amiodarone protocol was instituted in 2011 for all patients undergoing coronary artery bypass grafting (CABG) surgery to reduce POAF rates substantially.

Methods: This is a retrospective cohort study of a prospectively maintained cardiac surgery database consisting of 1,439 patients from January 2009 to December 2012. After including only patients undergoing CABG and excluding those who had prior cardiac surgery and with preexisting atrial fibrillation, a total of 727 patients were analyzed. The incidence of POAF and its complications in the pre-amiodarone protocol (2009-2010) group were compared to the post-amiodarone protocol group (2011-2012). This analysis will assess the efficacy of our amiodarone protocol, which includes intraoperative IV loading to reduce postoperative atrial fibrillation in the CABG patient population.

Results: The amiodarone protocol provided a relative risk reduction (RRR) of 0.455 (CI: 0.220-0.620) and an OR of 0.489 (CI: 0.322-0.744). The number needed to treat was calculated to be 11 (CI: 27-7), and the absolute risk reduction was 0.090 (CI: 0.038-0.143). The final year of the study resulted in a POAF average decrease to 7.91%. Patients older than 65 years of age had a higher rate of POAF (RRR: 0.586, CI: 0.214-0.782). Patients with a worsening NYHA Class had an increased incidence of POAF as well; however, there was a reduction after the amiodarone protocol. Preoperational comorbidities were consistent throughout all groups, and postoperative complications showed no statistically significant differences based on chi-square analysis between both study groups.

Conclusions: The incidence of POAF, complications, and mortality can be reduced by strict adherence to an amiodarone protocol in CABG patients. The clinical significance has many implications. A multicenter institutional trial is warranted to determine widespread applicability of an amiodarone protocol in CABG patients.



Protocol Group	CABG Cases	Incidence of POAF
Pre-Protocol 2009-10	172.5 Cases per Year	19.73%
Post-Protocol 2011-12	191 Cases per Year	10.73%
Relative Risk Reduction	0.455	Confidence Interval: 0.220 to 0.620
Number Needed to Treat	11	Confidence Interval: 27 to 7
Absolute Risk Reduction	0.09	Confidence Interval: 0.038 to 0.143

1:15 PM

Room 131ABC

Valve Repair Is Superior to Replacement in Patients With Coexisting Degenerative Mitral Valve and Ischemic Heart Disease

H. Javadikasgari, A. M. Gillinov, R. M. Suri, L. G. Svensson, J. L. Navia, P. L. Houghtaling, J. J. Idrees, J. F. Sabik, E. Blackstone

Cleveland Clinic, OH

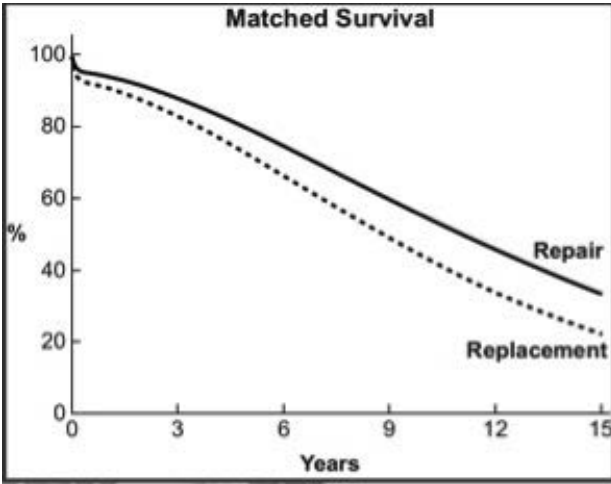
COMMERCIAL RELATIONSHIPS E. Blackstone: Other, Edwards Lifesciences Corporation; A. M. Gillinov: Consultant/Advisory Board, On-X Life Technologies, Inc, Edwards Lifesciences Corporation, Tendyne Holdings, Inc, Abbott Laboratories; Ownership Interest, ClearFlow, Inc; Speakers Bureau/Honoraria, AtriCure, Inc, Medtronic, Inc, St Jude Medical; J. F. Sabik: Consultant/Advisory Board, Medtronic, Inc, LivaNova; Research Grant, Abbott Laboratories, Edwards Lifesciences Corporation; R. M. Suri: Consultant/Advisory Board, Abbott Vascular; Research Grant, Edwards Lifesciences Corporation, St Jude Medical, LivaNova; L. G. Svensson: Ownership Interest, Cardiosolutions, Inc, Posthorax

Purpose: Recent data suggest that mitral valve replacement is the preferred option for patients with severe ischemic mitral regurgitation. However, appropriate valvular surgical strategy (mitral valve repair vs replacement) is controversial for degenerative mitral valve disease in patients with coexisting ischemic heart disease.

Methods: From 1985 to 2011, 1,071 adults (mean age 70 years \pm 9.3 years, n=829 [77%] men) with both degenerative mitral valve and ischemic heart disease underwent combined coronary artery bypass grafting and either mitral valve repair (n=872, 81%) or replacement (n=199, 19%). Factors associated with repair and replacement were used for multivariable propensity score matching to compare outcomes of the two procedures. Risk factors for death were identified by means of multivariable, multiphase hazard-function analysis.

Results: Patients who underwent mitral valve replacement were more likely to be older and female, with more valve calcification and a higher prevalence of preoperative atrial fibrillation and heart failure (all $P < .0001$). Unadjusted comparisons showed that patients who had replacement vs repair experienced higher hospital mortality (n=10 [5.0%] vs n=9 [1.0%], $P = .0001$) and more postoperative renal failure (n=14 [7.0%] vs n=28 [3.2%], $P = .01$), re-exploration for bleeding (n=12 [6.0%] vs n=27 [3.1%], $P = .05$), and respiratory failure (n=24 [14%] vs n=36 [4.7%], $P < .0001$). Unadjusted survival at 1, 5, 10, and 15 years was 89%, 69%, 46%, and 18%, respectively, after replacement vs 96%, 88%, 71%, and 52%, respectively, after repair ($P < .0001$). Using propensity score matching, the survival benefit of repair became evident after 1 year ($P = .05$; Figure). Nearly all patients were predicted to benefit from repair.

Conclusions: In patients with coexisting degenerative mitral valve and ischemic heart disease, mitral valve repair confers a survival advantage over replacement, with fewer hospital complications. When feasible, it is the procedure of choice for these patients.



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Room 131ABC

Pericardiectomy After Previous Coronary Bypass Grafting: Analyzing Risk and Effectiveness in this Rare Clinical Entity

E. A. Gillaspie, K. L. Greason, R. C. Daly, H. V. Schaff, J. A. Dearani, L. D. Joyce, J. M. Stulak
Mayo Clinic, Rochester, MN

COMMERCIAL RELATIONSHIPS R. C. Daly: Ownership Interest, NeoChord, Inc

Purpose: Iatrogenic pericardial constriction is being diagnosed with increasing frequency with most cases occurring after coronary artery bypass grafting. To date, there has been no large series evaluating the incidence, presentation, and effectiveness of surgical intervention. We review our 20-year experience managing this special subset of patients.

Methods: From January 1993 to December 2013, 938 patients underwent pericardiectomy at our institution. We identified 98 patients who underwent pericardiectomy after previous coronary artery bypass grafting. Median age at operation was 68 years (range: 38-81) and 91 (93%) were male. The indication for pericardiectomy was constriction in all patients. Median preoperative left ventricular ejection fraction was 60% (range: 30-71) and median New York Heart Association (NYHA) Functional Class was III (91% class III/IV).

Results: Surgical approach was median sternotomy in 81 patients (83%), left thoracotomy in 16 (16%), and clamshell in one (1%). Extent of pericardial resection was radical in 61 patients (62%), subtotal in 27 (28%), and completion in 10 (10%). Cardiopulmonary bypass was utilized in 63 patients (64%) and aortic cross clamping in five (5%). Concomitant coronary artery bypass grafting was performed in 10 patients (10%). Early mortality was 3/98 (3%). Median duration of late follow-up was 3.2 years (max: 17.5 years) and overall 5- and 10-year survival was 62% and 41%, respectively. There were no multivariate predictors of worse outcome. The sole univariate predictor of lower overall survival was use of cardiopulmonary bypass (HR: 1.96 [1.03, 3.7], $P = .04$). At last follow-up, median NYHA Functional class was II (84% class I/II) ($P < .001$ vs preop).

Conclusions: Early mortality for pericardiectomy after previous coronary artery bypass grafting is low. Late survival is adversely impacted only when cardiopulmonary bypass is required. Importantly, during late follow-up, including some extending to 17 years, the vast majority of patients demonstrate significant improvement in NYHA Functional Class.

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Room 131ABC

Improved Outcomes of Total Arterial Myocardial Revascularization in Elderly Patients at Long-Term Follow-Up: A Propensity-Matched Analysis

G. Bisleri, L. Di Bacco, D. Turturiello, A. Mazzeletti, L. Giroletti, A. Repossini, C. Muneretto
University of Brescia Medical School, Italy

COMMERCIAL RELATIONSHIPS G. Bisleri: Speakers Bureau/Honoraria, AtriCure, Inc, KARL STORZ, Covidien; A. Repossini: Consultant/Advisory Board, LivaNova

Purpose: Despite the proven advantages of total arterial grafting in patients undergoing coronary artery bypass grafting (CABG) surgery, its benefits in the elderly population at long-term follow-up have been widely debated to date.

Methods: Among 988 consecutive patients scheduled to undergo isolated CABG surgery, we performed a propensity score-matched analysis in a population with double and triple vessel disease who were older than 70 years of age and compared patients receiving total arterial grafting (Group 1/G1, 315 patients) with conventional myocardial revascularization (left internal mammary artery on left anterior descending artery plus saphenous vein grafts, Group 2/G2, 201 patients). Two groups of 175 patients each were obtained after 1:1 matching. Primary endpoint was cardiac-related mortality while secondary endpoint was overall mortality and survival free from major adverse cardiovascular and cerebrovascular events (MACCEs), defined as cardiac death, myocardial infarction, need for repeated revascularization on grafted vessels, or stroke.

Results: Preoperative and intraoperative patient characteristics were similar between groups (mean number of grafted vessels: G1 = 2.53 ± 0.46 vs G2 = 2.6 ± 0.57 ; $P = .41$), as was incidence of hospital mortality (0% in both groups) and early postoperative complications. At a median follow-up of 89 months, total arterial grafting was associated with significantly improved actuarial overall survival (G1 = $67.5\% \pm 4.6\%$ vs G2 = $57.0\% \pm 4.4\%$; $P = .029$) and survival free from cardiac death (G1 = $86.9\% \pm 3.4\%$ vs G2 = $75.9\% \pm 4.0\%$; $P = .02$) and survival free from MACCEs (G1 = $78.8\% \pm 3.9\%$ vs G2 = $65.5\% \pm 4.4\%$; $P = .017$). Multivariate Cox regression analysis depicted conventional myocardial revascularization (with saphenous vein grafts) as an independent predictor for all-cause mortality (OR 1.8, 95% CI 1.1-2.65; $P = .006$) and occurrence of MACCEs (OR 1.9, 95% CI 1.2-3.2; $P = .008$).

Conclusions: The use of complete arterial myocardial revascularization in elderly patients is associated with a reduced late incidence of cardiac-related mortality and major cerebral and cardiovascular events compared with the use of saphenous vein grafts, thereby providing improved long-term benefits in this specific subset of patients.

2:00 PM

Room 131ABC

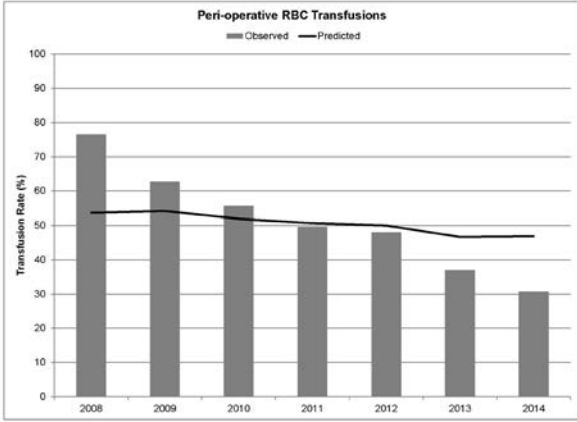
Effective Strategies for Reducing Blood Transfusions in Adult Cardiac SurgeryJ. W. Haft¹, R. L. Prager², A. Geltz¹, J. J. Wolvertson¹, T. Paugh², D. S. Likosky²¹University of Michigan, Ann Arbor, ²University of Michigan Health System, Ann Arbor**COMMERCIAL RELATIONSHIPS** D. S. Likosky: Consultant/Advisory Board, AmSECT; Research Grant, Agency for Healthcare Research and Quality, National Institutes of Health

Purpose: Blood transfusions are associated with complications and are costly. To date, evidence supporting effective blood management practices has been lacking. We evaluated the effectiveness of two intraoperative blood management techniques in reducing perioperative blood transfusions among adult patients undergoing noncatheter-based cardiac surgery.

Methods: We leveraged our institutional cardiac surgery database to evaluate the effectiveness of retrograde autologous priming/venous antegrade priming (RAP/VAP) and autologous normovolemic hemodilution (ANH) in reducing perioperative blood transfusions. We used logistic regression analysis to estimate the independent effect of RAP/VAP and ANH after accounting for preoperative factors (preoperative hematocrit, age, gender, body surface area, reoperation, creatinine, ejection fraction, peripheral vascular disease, and lung disease) and procedure type. Intraoperative nadir hematocrit also was trended over the study period.

Results: From 2008 through 2014, 6,061 adult patients underwent cardiac surgery at our institution. There was a significant and progressive decline in the requirement for blood transfusions prior to hospital discharge, Figure. Our regression model performed well (ROC 0.83) and suggested a small reduction in transfusion estimates over time (Figure). The application of RAP increased from 0% in 2008 to 59.8% in 2014. After adjusting for baseline characteristics and year, RAP/VAP use was not associated with reduced transfusions (ORadj 0.91, $P = .16$). Average nadir intraoperative hematocrit rose slightly over time (23.5% to 24.3%, $P < .001$). This qualitatively small difference suggests that lower transfusion triggers were not responsible for improvements in transfusion rate. ANH use increased from 0% in 2008 to 76.1% in 2014. After adjusting for preoperative variables and year, ANH was associated with reduced perioperative transfusions (ORadj 0.62, $P < .001$). Operative mortality trended down over the time interval from 4.6% to 2.5%, $P = .049$.

Conclusions: Over a 6-year period, we have successfully reduced the frequency of perioperative blood transfusions from 76.5% to 30.7%. After accounting for changes in patient variables and case mix, we found the use of ANH had a profound impact on reducing requirements for blood transfusions.



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Room 131ABC

The Unintended Consequences of Over Reducing Cardiopulmonary Bypass Circuit Prime Volume

B. C. Sun¹, T. A. Dickinson², D. S. Likosky³, D. Wells³, S. Weinstein²

¹Minneapolis Heart Institute, MN, ²SpecialtyCare, Nashville, TN, ³University of Michigan Health System, Ann Arbor

COMMERCIAL RELATIONSHIPS D. S. Likosky: Consultant/Advisory Board, AmSECT; Research Grant, Agency for Healthcare Research and Quality, National Institutes of Health; S. Weinstein: Employment, SpecialtyCare; D. Wells: Consultant/Advisory Board, SpecialtyCare; Employment, SpecialtyCare; Ownership Interest, SpecialtyCare

Purpose: The Society of Thoracic Surgeons blood conservation guidelines recommend minimizing cardiopulmonary bypass (CPB) circuit prime volume (PV) as an integral, evidence-based (Class I, Level A) blood conservation strategy. We used a large, multiinstitutional database to evaluate the effectiveness of restricting CPB prime volume on intraoperative red blood cell (RBC) transfusion.

Methods: We reviewed 51,100 isolated coronary artery bypass grafting (CABG) procedures performed among 190 institutions between April 2012 and May 2015. We categorized net prime volume (NPV) as total prime volume minus autologous priming and evaluated three groups: <500 mL, 500-999 mL, and ≥ 1 L. The primary outcome was transfusion of at least one unit of intraoperative RBCs. Logistic regression was used to model the odds of transfusion. We report odds ratios for transfusion after adjusting for age, gender, acuity, reoperation, estimated blood volume (EBV), first hematocrit in the operating room, nadir hematocrit on CPB, and year. We tested for an interaction by gender.

Results: Nearly one-quarter of patients ($n=11,351$, 22.2%) received an intraoperative RBC transfusion. Relative to an NPV between 500-999 mL, patients exposed to NPV <500 mL had a 1.26-fold increased adjusted odds of transfusion, while those exposed to a net prime ≥ 1 L had a 1.61-fold increased odds of transfusion. Women had similar average CPB NPV to men (864 mL vs 858 mL, $P = .12$), although a higher odds of transfusion (OR 5.26, $P < .001$). There was a statistical interaction by gender, $P = .037$. Relative to patients with NPV between 500-999 mL, men exposed to an NPV ≥ 1 L had a 1.52-fold increased adjusted odds of transfusion and a 1.36-fold increase when exposed to net prime of <500 mL (both $P < .001$). Women had a 1.72-fold increased adjusted odds of transfusion when exposed to net prime of ≥ 1 L ($P < .001$), but a nonsignificant 1.11-fold increase when exposed to net prime <500 mL ($P = .12$).

Conclusions: Efforts to minimize CPB NPV below 500 mL do not protect patients from intraoperative RBC transfusion and may actually increase exposure. Perfusion net prime volume can impact both patient morbidity and the economic impact associated with blood utilization. Further studies on the influence of gender on blood transfusion are warranted.

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Room 131ABC

Insights From Longitudinal Echocardiographic Follow-Up After Surgical Correction of Mitral Prolapse: Modes of Mitral Repair Failure

V. Chan, E. Elmistekawy, M. Ruel, T. G. Mesana

University of Ottawa Heart Institute, Canada

Purpose: Repair of mitral regurgitation (MR) due to prolapse has been well validated. Although favorable early and late results following repair have been reported, few data are available that mechanistically describe how a mitral repair fails, beyond the mere need for mitral valve reoperation. We therefore sought to determine the modes.

Methods: Between 2001 and 2015, 855 patients underwent repair of mitral regurgitation due to prolapse. Mean patient age was 63.7 years \pm 12.7 years and 380 (44%) had bileaflet prolapse. Overall repair rate was 97.2%. These patients were followed as part of a cohort initiative and underwent serial clinical and echocardiographic assessments 1, 3-6, and 12 months after surgery. Beyond the first year of surgery, patients were assessed via echocardiography every 1-2 years or when clinically indicated. Clinical and echocardiographic follow-up averaged 4.3 years \pm 3.5 years.

Results: Five- and 10-year freedom from recurrent MR ($\geq 2+$) was 92.4% \pm 1.3% and 86.6% \pm 2.4%, respectively. Overall, 49 patients developed recurrent MR $\geq 2+$ at a mean of 3.1 years \pm 2.5 years after surgery, of whom 14 had recurrent MR 3+ or 4+. Among patients with bileaflet prolapse, recurrent MR $\geq 2+$ was observed in 24, of whom nine had 3+ or 4+ MR. The development of recurrent MR $\geq 2+$ was associated with prolapse progression or failure of a previously repaired portion of the valve ($P < .03$), but also included endocarditis and prolapse of a previously unrepaired valve segment. Severe mitral stenosis occurred in three patients 8.2 years after surgery. Mitral reoperation was ultimately performed in 15 patients. Patients who had recurrent MR $\geq 2+$ within the first year after surgery were more likely to undergo subsequent mitral valve reoperation (incident rate ratio [IRR] 5.2 \pm 2.9, $P = .003$) independent of the extent of prolapse (IRR for bileaflet prolapsed 0.7 \pm 0.3, $P = .5$).

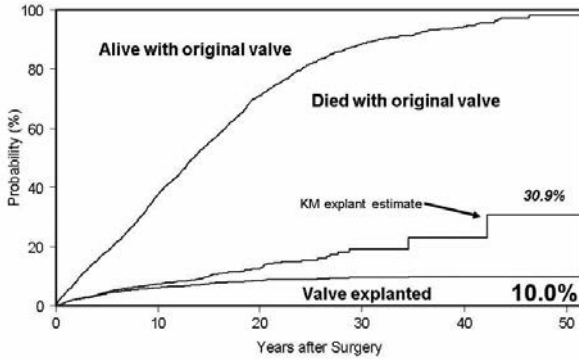
Conclusions: Severe MR after repair is rare, although some may have recurrent moderate MR. Patients who require subsequent mitral valve reoperation were most likely to have recurrent MR $\geq 2+$ within the first year after surgery, suggesting that valve surveillance beyond a year may not be needed in asymptomatic patients.

2:45 PM

Room 131ABC

50-Year Follow-Up of Mechanical Aortic Valve Replacement: Patient Survival and Prosthesis DurabilityA. P. Furnary¹, M. Wang², G. L. Grunkemeier², A. Starr³¹Starr-Wood Cardiac Group of Portland, OR, ²Providence Health & Services, Portland, OR, ³Oregon Health & Science University, Portland**COMMERCIAL RELATIONSHIPS** A. P. Furnary: Consultant/Advisory Board, Edwards Lifesciences Corporation, Glysure Ltd; Nonremunerative Position of Influence, Johnson & Johnson, LifeScan, Inc; Speakers Bureau/Honoraria, Edwards Lifesciences Corporation**Purpose:** To examine the long-term survival and explant rates of mechanical aortic valve replacement (AVR) with and without coronary artery bypass grafting (CABG) surgery and compare observed survival to expected survival.**Methods:** All valve replacement patients operated on at our institution since 1960 have been prospectively followed for survival and explant on an annual basis. This included 3,037 mechanical AVR patients (1961-2014) followed for 32,800 patient-years. Expected survival was calculated for each patient from age-gender-operative year-matched US life tables and compared to observed survival using Mortality Risk Ratio (MRR = total observed deaths/total expected deaths) and Standardized Mortality Ratios (SMR = observed/expected death ratio) calculated at the median expected survival timepoint. Cumulative incidence of valve explant was compared to Kaplan-Meier estimates of explant.**Results:** MRR and SMR were calculated in 2,868 operative survivors: 2,158 isolated AVR (26,141 follow-up years) and 710 AVR/CABG (6,656 follow-up years). Median survival was 13.5 years. Mechanical AVR was unable to restore expected survival (SMR=1.45, 95% CI 1.36-1.53; MRR=1.59, 95% CI 1.52-1.66). There were no significant differences in SMR or MRR between the isolated AVR and AVR/CABG populations, even though median survival was significantly longer for the younger, less male-dominated isolated AVR population (Table). Cox regression revealed that later operative year ($P = .0001$), increasing age ($P = .0001$), concomitant CABG ($P = .0001$), caged-ball valve type ($P = .0001$), and male gender ($P = .032$) significantly increased the probability of late death. Mechanical AVR after 1974 had better survival outcomes than earlier AVR: SMR 1.34 (95% CI 1.25-1.42) vs 1.94 (95% CI 1.68-2.23); MRR 1.37 (95% CI 1.30-1.44) vs 2.42 (95% CI 2.24-2.61) respectively, but still did not restore expected survival. Even in the best survival subset—isolated bileaflet AVR after 1986—MRR and SMR were still significantly greater than 1.0 (SMR=1.42, 95% CI 1.11-1.81; MRR=1.16, 95% CI 1.00-1.32).**Conclusions:** Fifty-year survival without valve explantation can be achieved with a mechanical AVR. However, mechanical AVR does not restore expected lifespan. Kaplan-Meier estimates significantly overestimate the actual incidence of valve explantation.

Probability of Mechanical AVR Explant:
Cumulative Incidence vs. KM Estimate



	All AVR (N=2868)	Iso AVR (N=2158)	AVR+CAB G (N=710)	All AVR after 1974 (N=2209)
Mean Age	58.0	55.8 ^	64.8	59.6
% Male	71.8	69.1 ^	80.1	70.9
Observed Median Survival	13.5	15.2 ^	10.3	13.6
Expected Median Survival	18.3	20.5 ^	13.1	17.0
SMR @ median Survival	1.45*	1.51*	1.41*	1.34*
Total Observed deaths	2038	1485	553	1402
Total Expected deaths	1284	906	379	1022
Mortality Risk Ratio	1.59*	1.64*	1.46*	1.37*
25-yr Explant Rate,%	9.2#	11.1#	3.6	6.1#
25-yr KM est. explant, %	15.5	17.0	12.6	11.4
50-yr Explant Rate, %	10.0#	12.2#	NA	NA
50-yr KM est. explant, %	30.9	33.4	NA	NA

^ P <0.05 versus AVR CABG

*P<0.05 versus expected survival

P<0.05 versus Kaplan-Meier estimate

1:00 PM – 3:00 PM

Room 120D

Adult Cardiac Session: Mitral Valve*Moderators: Juan A. Crestanello, Columbus, OH, and Richard Lee, St Louis, MO***COMMERCIAL RELATIONSHIPS** J. A. Crestanello: Research Grant, Medtronic, Inc, Abbott Vascular

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold**.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

1:00 PM

Room 120D

Off-Pump Mitral Valve Repair With NeoChord Implantation: 1-Year Follow-Up

A. Colli¹, L. Besola¹, E. Manzan¹, E. Bizzotto², F. Zucchetta¹, R. Bellu², L. Bagozzi¹, D. Pittarello¹, G. Gerosa¹

¹University of Padova, Italy, ²University of Padua, Italy

COMMERCIAL RELATIONSHIPS A. Colli: Ownership Interest, NeoChord, Inc

REGULATORY DISCLOSURE This presentation will address the NeoChord DS 1000 device, which is not FDA-approved.

Purpose: Transapical off-pump mitral valve repair with NeoChord implantation (TOP-MINI) is a new microinvasive procedure to treat degenerative mitral valve regurgitation due to flail/prolapse without adjunctive annuloplasty. This prospective, single-center study sought to assess the safety and effectiveness of the TOP-MINI procedure at 1-year follow-up.

Methods: Outcomes were evaluated at 1, 3, and 6 months and 1 year for all patients who underwent the TOP-MINI procedure from November 2013 to March 2015. Procedural success was defined as residual mitral regurgitation (MR) $\leq 2+$ at any time.

Results: Sixty-one patients were treated. One-year survival was $96.7\% \pm 2.3\%$. Freedom from MR $>2+$ is shown in Figure 1A. Freedom from MR $>2+$ according to valve anatomy (Type A isolated P2 disease, Type B posterior multisegment disease, Type C anterior or bileaflet and/or calcified disease) is shown in Figure 1B. Left ventricle (LV) ejection fraction increased from $57.2\% \pm 7.2\%$ to $59.9\% \pm 5.1\%$ ($P = .08$), LV end diastolic volume index reduced from $62.7 \text{ mL/m}^2 \pm 17.0 \text{ mL/m}^2$ to $71.8 \text{ mL/m}^2 \pm 12.9 \text{ mL/m}^2$ ($P = .013$), LV end systolic volume index reduced from $30.4 \text{ mL/m}^2 \pm 15.9 \text{ mL/m}^2$ to $28.8 \text{ mL/m}^2 \pm 7.2 \text{ mL/m}^2$ ($P = .61$), left atrium diameter reduced from $57.4 \text{ mm} \pm 10.9 \text{ mm}$ to $50.3 \text{ mm} \pm 10.2 \text{ mm}$ ($P = .001$), and pulmonary artery pressure reduced from $37.5 \text{ mm Hg} \pm 13.1 \text{ mm Hg}$ to $28.4 \text{ mm Hg} \pm 11.1 \text{ mm Hg}$ ($P = .032$).

Conclusions: TOP-MINI is a safe and effective procedure at 1-year follow-up. Residual MR is influenced by valve anatomy. The lack of annuloplasty does not negatively influence the residual MR and left ventricle reverse remodeling.

Figure 1A

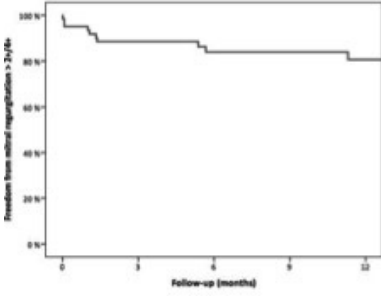
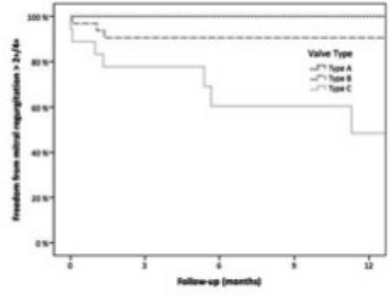


Figure 1B



1:15 PM

Room 120D

Ischemic Mitral Regurgitation: In Whom Should Mitral Valve Repair Be Performed?V. Chan¹, O. Levac-Martinho², E. Elmistekawy¹, M. Ruel¹, T. G. Mesana¹¹University of Ottawa Heart Institute, Canada, ²University of Ottawa, Canada**COMMERCIAL RELATIONSHIPS** O. Levac-Martinho: Other Research Support, University of Ottawa Heart Institute

Purpose: Data comparing outcomes following repair vs replacement of chronic ischemic mitral regurgitation (MR) are evolving. Recent data suggest that repair is associated with recurrent MR, but not survival when compared with replacement. However, it remains unclear as to when either surgical strategy should be applied based on preoperative mitral valve

Methods: Between 2001 and 2013, 161 patients underwent repair or replacement of chronic ischemic MR. The mean patient age was 68.2 years \pm 9.0 years, 44 (27%) were female, and concomitant coronary artery bypass grafting (CABG) surgery was performed in 126 (78%). The mean preoperative posterior leaflet angle was 27.7° \pm 14.2° and left ventricle (LV) ejection fraction was 41.2% \pm 12.4%. Detailed preoperative assessments of mitral valve anatomy were determined via transesophageal echocardiography. Clinical and echocardiographic follow-up was for 4.6 years \pm 3.2 years and extended to 11.7 years.

Results: Overall, perioperative mortality occurred in six patients (3.3%), two after repair and four after replacement. Five-year survival and freedom from recurrent MR ($\geq 2+$) were 74.0% \pm 5.6% and 54.0% \pm 7.5%, respectively, following repair and 69.4% \pm 6.2% and 85.2% \pm 7.0%, respectively, following replacement. Repair was associated with recurrent MR ($\geq 2+$) (HR 4.57 \pm 2.44, $P = .005$), but not survival (HR 0.92 \pm 0.29, $P = .8$). Notably, preoperative posterior leaflet tethering angle was associated with recurrent MR ($\geq 2+$) (HR 1.03 \pm 0.01, $P = .03$) and survival (HR 1.07 \pm 0.03, $P = .01$) following repair. Based on a receiver operator curve describing the relationship between recurrent MR ($\geq 2+$) and posterior leaflet tethering angle, a threshold of 22° was determined. Notably, a preoperative posterior leaflet tethering angle $> 22^\circ$ was associated with recurrent MR ($\geq 2+$) independent of preoperative LV size, preoperative LV function, or mitral annular dimension ($P < .01$).

Conclusions: Surgical correction of chronic ischemic MR can be performed with favorable early and late results, although recurrent MR occurred more often following repair. Among patients who underwent repair of ischemic MR, a preoperative posterior leaflet tethering angle $> 22^\circ$ was associated with worse late outcomes. d ratio (HR) 4.57 \pm 2.44, $P = .005$), but not

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Room 120D

Evolution of Secondary Tricuspid Regurgitation After Mitral Valve Surgery for Ischemic Mitral Regurgitation

J. L. Navia, H. Elgharably, A. Ibrahim, H. Javadikasgari, A. M. Gillinov, E. E. Roselli, E. Blackstone, L. G. Svensson

Cleveland Clinic, OH

COMMERCIAL RELATIONSHIPS E. Blackstone: Other, Edwards Lifesciences Corporation; A. M. Gillinov: Consultant/Advisory Board, On-X Life Technologies, Inc, Edwards Lifesciences Corporation, Tendyne Holdings, Inc, Abbott Laboratories; Ownership Interest, ClearFlow, Inc; Speakers Bureau/Honoraria, AtriCure, Inc, Medtronic, Inc, St Jude Medical; E. E. Roselli: Consultant/Advisory Board, Medtronic, Inc, Bolton Medical, Apica Ltd; Research Grant, LivaNova, Medtronic, Inc, CorMatrix; Speakers Bureau/Honoraria, Edwards Lifesciences Corporation, St Jude Medical, Vascutek Ltd a Terumo Company, COOK Medical, LivaNova, Medtronic, Inc; Other, Direct Flow Medical, Inc ; L. G. Svensson: Ownership Interest, Cardiosolutions, Inc, Posthorax

Purpose: Secondary tricuspid regurgitation (TR) associated with mitral valve disease has been shown to persist or even progress after surgical correction of the mitral valve alone. The study aims to analyze the evolution of secondary TR after surgical treatment of ischemic mitral regurgitation (IMR) with or without tricuspid valve repair.

Methods: From 2001 to 2011, 568 patients with IMR and varying degrees of secondary TR underwent mitral valve repair or replacement: TR 0+ (n=178, 31%), 1+ (n=139, 24%), 2+ (n=136, 24%), 3+ (n=79, 14%), or 4+ (n=36, 6.3%); 131 underwent tricuspid valve repair (four with 1+, 31 with 2+, 62 with 3+, and 34 with 4+ preoperative TR). Mean age was 68 years \pm 9.4 years, and 62% were men. A total of 1,474 echocardiograms of postoperative TR and functional assessment of right ventricle were available for longitudinal nonlinear mixed-model analysis, with grades 0+, 1+, 3+, and 4+ collapsed into single categories.

Results: In patients without tricuspid repair, the degree of preoperative TR was significantly associated with early postoperative TR severity ($P = .011$). Within 5 years of surgery, TR evolution in the whole cohort showed a constant decrease of mild TR (0, 1+) prevalence, with a constant increase of moderate (2+, 33%) and severe TR (3, 4+, 16%). Prevalence at 5 years of moderate TR among patients with preoperative mild TR who did not undergo tricuspid repair was 38%. On the other hand, if the tricuspid valve was repaired, the prevalence of moderate TR by 5 years was 57%. Surgical treatment of IMR (repair or replacement) had no impact on degree of postop TR.

Conclusions: This study shows that evolution of mild to moderate TR secondary to IMR is a progressive process that was not ameliorated by surgical treatment of MR. Tricuspid valve repair for moderate TR concomitant with IMR surgery is reasonable to prevent its progression and right ventricular dysfunction and avoid later reoperation.

1:45 PM

Room 120D

Twenty-Year Experience With Tricuspid Annuloplasty for Functional Tricuspid Regurgitation: Is Ring Annuloplasty Superior to Suture Annuloplasty?*H. Hata, T. Fujita, Y. Shimahara, Y. Kume, J. Kobayashi**National Cerebral and Cardiovascular Center, Osaka, Japan*

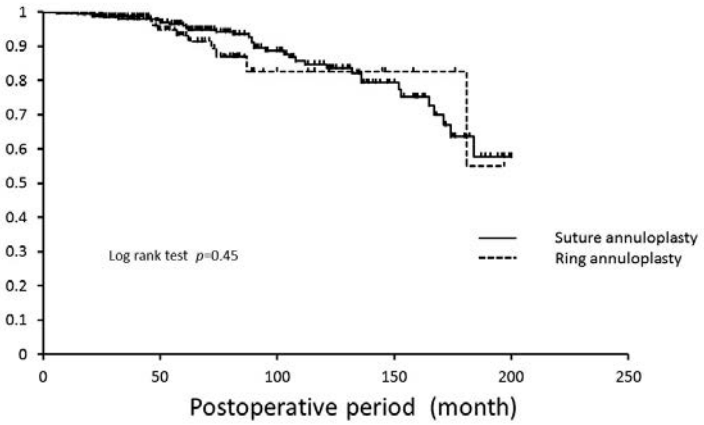
Purpose: Although some evidence supporting ring annuloplasty over suture annuloplasty for treating functional tricuspid regurgitation (TR) has been reported, it is still controversial whether there is a significant difference in surgical outcomes between the two procedures. We aimed to compare the mid-term outcomes of tricuspid annuloplasty (TAP) with or without an annuloplasty ring.

Methods: From January 1996 to December 2014, 638 patients (mean age, 65 years, 60% women) underwent TAP for functional TR at our institution, of whom 324 underwent conventional suture annuloplasty with De Vega or Kay technique and the other 314 underwent ring annuloplasty (flexible ring, 71; rigid ring, 243). Transthoracic echocardiography was performed before and 1 week after operation and in the follow-up period. The severity of TR was graded from 0 to 4. The clinical data were retrospectively collected and statistically analyzed.

Results: The mean follow-up period was 69 months (range: 6–210). Suture annuloplasty patients were younger (62.9 years vs 67.6 years). Other preoperative characteristics and operative parameters were similar between the two groups. There was no significant difference in the overall survival (suture 96.4% vs ring 97.4% at 1 year and 81.1% vs 88.9% at 10 years, respectively) and freedom from recurrent moderate to severe TR (99.6% vs 99.8% at 1 year and 85.1% vs 83.6% at 10 years, respectively) between the groups; however, TR grade was significantly better in the ring group at discharge (1.2 vs 0.8) and follow-up (1.6 vs 1.0). Multivariate analysis revealed that suture annuloplasty, prior cardiac surgery, and preoperative severe TR were the predictors of recurrent TR. Although 3-dimensional echocardiogram revealed that anteroposterior diameter of tricuspid annulus significantly decreased in the rigid ring group, there was no significant difference in mid-term outcomes between the flexible and rigid ring.

Conclusions: In conclusion, both suture and ring annuloplasty provided acceptable mid-term outcomes. Suture annuloplasty, prior cardiac surgery, and preoperative severe TR were risk factors of recurrent TR. There was no significant difference in clinical outcomes between the rigid and flexible ring groups.

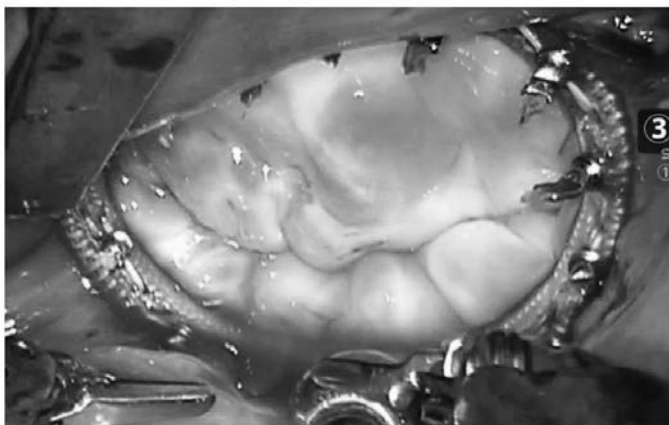
Freedom from recurrent moderate to severe TR



2:00 PM

Room 120D

Robotic vs Non-Robotic Mitral Valve Surgery for Degenerative Mitral Valve DiseaseM. E. Halkos¹, E. Moss², J. Binongo¹, R. Guyton¹, V. H. Thourani¹, A. M. Herzog³, A. Atherton¹, E. L. Sarin¹, J. Miller¹, D. Murphy¹¹Emory University, Atlanta, GA, ²McGill University, Montreal, Canada, ³Emory St Joseph's Hospital, Atlanta, GA**COMMERCIAL RELATIONSHIPS** R. Guyton: Consultant/Advisory Board, Medtronic, Inc; M. E. Halkos: Consultant/Advisory Board, Medtronic, Inc, Intuitive Surgical, MAQUET Cardiovascular; D. Murphy: Speakers Bureau/Honoraria, Medtronic, Inc; E. L. Sarin: Consultant/Advisory Board, Abbott Vascular**Purpose:** The purpose of this study was to compare patients with severe mitral regurgitation secondary to leaflet prolapse undergoing robotic mitral valve surgery (MVS) with patients undergoing non-robotic MVS within a single academic health care system.**Methods:** From 2010 to 2013, 621 patients underwent primary MVS for leaflet prolapse (type II) at a US academic institution. Concomitant aortic ablation and tricuspid operations were included. A database was created that utilized existing fields within the STS National Database supplemented with disease-specific and operative variables. Thirty-day outcomes were compared between patients who had robotic vs non-robotic MVS using odds ratios or geometric mean ratios (GMR) estimated from logistic and linear regression models, respectively, adjusted for the propensity score (calculated on 21 variables).**Results:** Of 621 patients, 430 (69%) underwent robotic MVS and 191 (31%) underwent non-robotic MVS (107 sternotomy, 84 mini-thoracotomy). The STS predicted risk of mortality was higher in non-robotic (0.9%, Q1-Q3 0.4%-2.1%) compared to robotic MVS (0.5%, Q1-Q3 0.3%-0.9%, $P < .001$). Mitral repair was performed more often in robotic compared to non-robotic patients (429 [99.8%] vs 146 [76.4%], $P < .0001$), Table. After multivariable adjustment, the risk of mortality (OR 0.16, 95% CI 0.01-4.10) and stroke (OR 0.68, 95% CI 0.05-8.61) were similar between groups. However, robotic MVS was associated with a lower risk of transfusion (0.43, 95% CI 0.20-0.92, $P = .03$) and atrial fibrillation (OR 0.35, 95% CI 0.17-0.74, $P = .006$). Units of blood transfused (0 vs 2, GMR 0.67, 95% CI 0.57-0.80, $P < .0001$), ICU hours (24 vs 48, GMR 0.69, 95% CI 0.57-0.85, $P = .0004$), and hospital stay (4 vs 6, GMR 0.09, 95% CI 0.02-0.45, $P = .004$) were less with robotic vs non-robotic MVS. Post-repair regurgitation $\leq 1+$ was $>97\%$ for both groups.**Conclusions:** Compared to non-robotic MVS, robotic MVS results in similar perioperative outcomes, lower rates of transfusion and atrial fibrillation, shorter hospital stay, and higher rates of successful repair for patients with leaflet prolapse. In an experienced mitral center, robotic MVS represents a safe and effective alternative to conventional approaches for MVS.



VARIABLES	Robotic (n=430)	Non-Robotic (n=191)	p-value
Operative mortality (%)	1 (0.2)	4 (2.1)	0.01
Postoperative stroke (%)	3 (0.7)	3 (1.6)	0.38
Mitral repair vs. replacement (%)	429 (99.8)	146 (76.4)	<0.0001
Concomitant tricuspid valve repair (%)	44 (10.0)	12 (6.3)	0.14
Concomitant atrial ablation (%)	65 (15.1)	27 (14.1)	0.76
Ischemic time, min, median (Q1, Q3)	78 (68, 93)	93 (75, 122)	<0.0001
Perfusion time, min, median (Q1, Q3)	105 (91, 123)	127 (106, 158)	<0.0001
Leaflet resection (%)	98 (22.8)	112 (58.6)	<0.0001
Chordal reconstruction (%)	354 (82.3)	26 (13.6)	<0.0001
Closure of left atrial appendage (%)	430 (100.0)	188 (98.4)	0.03

2:15 PM

Room 120D

Mechanical vs Bioprosthetic Valve Replacement in Young Women: Does Type of Valve Affect Survival?*J. Hughes, H. V. Schaff, J. A. Dearani, R. C. Daly, H. Connolly**Mayo Clinic, Rochester, MN***COMMERCIAL RELATIONSHIPS** R. C. Daly: Ownership Interest, NeoChord, Inc

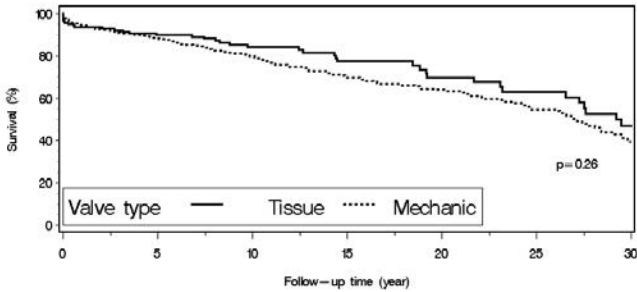
Purpose: Young women undergoing cardiac valve replacement may choose bioprosthetic rather than mechanical valves in anticipation of pregnancy and desire to avoid anticoagulation. The impact of valve choice on late survival of women is unsettled. We compared long-term survival and valve durability after bioprosthetic and mechanical valve replacement in young women.

Methods: From January 1967 to December 2012, 606 women between 12-45 years underwent cardiac valve replacement. Late survival was compared to an age-matched population of women without valve replacement, and analyses were stratified for patients undergoing isolated mitral (MVR) or aortic (AVR) valve replacement. Cumulative risk of having a reoperation also was analyzed for the groups.

Results: Mean age was 33 years. Ninety-five patients had complex congenital heart disease (CHD); nine patients had prior valve replacements at other institutions. 318 patients underwent AVR; 97 bioprosthetic, 221 mechanical. 261 patients underwent MVR; 55 bioprosthetic, 206 mechanical. Follow-up averaged 15 years. Survival for all patients at 10, 20, and 30 years was 81%, 66%, and 41% (expected 98%, 95%, and 87%). Survival was adversely affected by CHD, preoperative renal failure, index ejection fraction (EF) <50%, and Marfan syndrome. Valve type did not influence survival. Reoperation at 10, 20, and 30 years for all valves was 8%, 43%, and 56%. Probability of reoperation increased in younger patients, valve replacement after year 2000, EF <50%, and with bioprosthetic valves. Sixty-five patients initially underwent valve replacement with bioprosthesis and subsequently had mechanical valves implanted during reoperation (82%); survival for these patients was excellent: 98%, 88%, and 62% at 10, 20, and 30 years.

Conclusions: In young women undergoing valve replacement, survival is reduced compared with the general population, largely due to the influence of coexisting CHD and Marfan syndrome. Initial selection of a bioprosthesis did not increase late mortality, and survival of patients with bioprosthetic valves replaced with mechanical valves was excellent.

Overall survival by valve types



Tissue	159	116	79	54	35	26	13
Mechanic	447	303	212	145	110	73	43

	10 year survival	20 year survival	30 year survival	P value
AVR, Tissue	83.60% (75.62, 92.42)	73.15% (60.43, 88.55)	57.60% (39.22, 84.61)	0.2535
AVR, Mechanical	84.80% (79.47, 90.48)	64.53% (55.87, 74.53)	45.67% (35.13, 59.38)	0.352
MVR, Tissue	84.94% (75.11, 96.07)	69.50% (56.04, 86.18)	42.52% (27.65, 65.38)	0.277
MVR, Mechanical	76.05% (69.67, 83.02)	62.35% (54.53, 71.28)	35.65% (26.78, 47.45)	0.066

2:30 PM

Room 120D

Debate: The Future of Mitral Valve Regurgitation Treatment

Open Surgery: TBD

Transcatheter Repair: Gorav Ailawadi, Charlottesville, VA

Transcatheter Replacement: Michael J. Mack, Dallas, TX

COMMERCIAL RELATIONSHIPS G. Ailawadi: Consultant/Advisory Board, Edwards Lifesciences Corporation, Abbott Vascular; Nonremunerative Position of Influence, AtriCure, Inc; Speakers Bureau/Honoraria, St Jude Medical; M. J. Mack: Consultant/Advisory Board, Edwards Lifesciences Corporation

REGULATORY DISCLOSURE This presentation will address CardiAQ by Edwards Lifesciences Corporation, Tendyne by Abbott Laboratories, and Tiara by Neovasc. The FDA status of all three devices is investigational.

1:00 PM – 3:00 PM

Room 122ABC

Congenital Session: Pediatric Congenital II*Moderators: Richard W. Kim, Los Angeles, CA, and Glen S. Van Arsdell, Toronto, Canada***COMMERCIAL RELATIONSHIPS** G. S. Van Arsdell: Ownership Interest, Cell Aegis Devices

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold**.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

1:00 PM

Room 122ABC

Aortic Valve Annulus Is the Best Predictor of Left Ventricular Outflow Tract Reintervention Following Biventricular Repair of Interrupted Arch/Ventricular Septal Defect
R. Subramanian¹, S. Ramachandran², A. Cheng², P. Wong², W. J. Wells², V. A. Starnes³
¹University of Southern California, Los Angeles, ²Children's Hospital Los Angeles, CA, ³University of Southern California Keck School of Medicine, Los Angeles

COMMERCIAL RELATIONSHIPS R. Subramanian: Consultant/Advisory Board, IKARIA, Inc

Purpose: Following primary biventricular repair of aortic arch interruption and ventricular septal defect (IAA/VSD), there continues to be a need for reintervention due to left ventricular outflow tract (LVOT) obstruction. We hypothesized that preoperative aortic valve annulus is the best predictor of need for LVOT reintervention.

Methods: We retrospectively reviewed the charts of 59 infants who underwent primary neonatal biventricular repair of IAA/VSD between 2000 and 2013 at a single institution. Echocardiographic parameters were obtained by independent review of all studies by a single blinded cardiologist. Primary endpoint was reintervention in LVOT. Reintervention rates were calculated by Kaplan-Meier analyses and receiver-operating characteristic (ROC) curves were used to determine the inflection point of significance.

Results: Mean age at surgery was 11 days (range: 2-106), mean weight 2.9 kg (range: 1-4). Forty-six (78%) had type B interruption. During a mean follow-up of 7.2 years, 10 patients (17%) required reintervention in LVOT at a mean of 2 years after initial repair. There were seven subaortic resections, two Konno, and one Ross, aortic valvotomy, and aortic augmentation each. Among the different echocardiographic parameters analyzed by multiple regression, preoperative aortic valve annulus was the best predictor of LVOT reintervention. ROC curves identified 4.5 mm as the inflection point. Among 19 infants with annular diameter less than 4.5 mm, seven required LVOT reintervention with a 1, 5, and 8-year freedom from reintervention of 86%, 48%, and 48%, respectively. In contrast, of the 40 infants with aortic annulus over 4.5 mm, only three required reintervention for a freedom of 100%, 85%, and 85% at 1, 5, and 8 years, respectively ($P < .001$).

Conclusions: Preoperative aortic valve annulus of less than 4.5 mm continues to be the best predictor of LVOT reintervention following primary biventricular repair of IAA/VSD in infants.

NOTES

1:15 PM

Room 122ABC

Cardiopulmonary Bypass Management Strategies Have Minimal Impact on Early Neurodevelopmental Outcomes After Cardiac Surgery in Infants

J. Gaynor¹, D. Wypij², C. Stopp², D. B. Andropoulos³, J. Atallah⁴, A. M. Atz⁵, J. Beca⁶, M. Donofrio⁷, K. F. Duncan⁸, N. S. Ghanayem⁹, C. S. Goldberg¹⁰, H. Hovels-Gurich¹¹, F. Ichida¹², J. P. Jacobs¹³, R. Justo¹⁴, B. Latal¹⁵, J. S. Li¹⁶, W. Mable¹⁷, P. S. McQuillen¹⁸, S. C. Menon¹⁹, V. L. Pemberton²⁰, N. A. Pike²¹, C. Pizarro²², L. S. Shekerdemian³, A. Synnes²³, I. Williams²⁴, D. C. Bellinger², J. W. Newburger²

¹The Children's Hospital of Philadelphia, PA, ²Boston Children's Hospital, MA, ³Texas Children's Hospital, Houston, TX, ⁴Alberta Health Services, Canada, ⁵Medical University of South Carolina, Charleston, SC, ⁶Starship Children's Health, Auckland, New Zealand, ⁷Children's National Medical Center, Washington, DC, ⁸University of Nebraska Medical Center, Omaha, ⁹Children's Hospital and Medical College of Wisconsin, Milwaukee, ¹⁰Mott Children's Hospital, Ann Arbor, MI, ¹¹University Hospital, Aachen, Germany, ¹²Toyama University Hospital, Japan, ¹³Johns Hopkins All Children's Heart Institute, St Petersburg, FL, ¹⁴University of Queensland, Australia, ¹⁵University Children's Hospital Zurich, Switzerland, ¹⁶Duke University Medical Center, Durham, NC, ¹⁷Emory University, Atlanta, GA, ¹⁸University of California, San Francisco, ¹⁹University of Utah, Salt Lake City, ²⁰National Heart, Lung, and Blood Institute, Bethesda, MD, ²¹University of California, Los Angeles School of Nursing, ²²A. I. duPont Hospital for Children, Wilmington, DE, ²³University of British Columbia, Vancouver, Canada, ²⁴Morgan Stanley Children's Hospital, New York

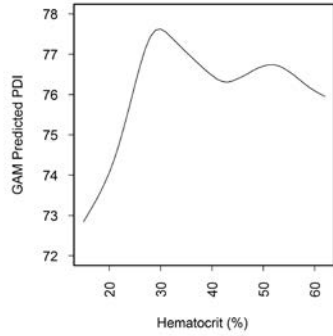
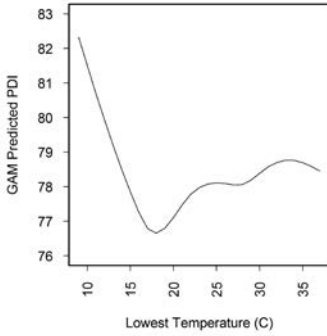
COMMERCIAL RELATIONSHIPS J. Gaynor: Other/ Provided slides for a presentation, SynCardia Systems

Purpose: Neurodevelopmental (ND) disability is common after surgery for congenital heart disease (CHD). Previously, we analyzed the contributions of patient/preoperative factors to ND outcomes, which explained 24.3% and 27.7% of variance (adjusted R2) for the Psychomotor Development Index (PDI) and Mental Development Index (MDI) of the Bayley Scales of Infant Development-II.

Methods: We now investigate how much cardiopulmonary bypass (CPB) management factors add to the prediction of PDI and MDI. We analyzed ND outcomes after surgery with CPB at age ≤ 9 months between 1996 and 2009. The primary outcome was PDI, and the secondary outcome was MDI.

Results: Linear regression and generalized additive models were used to investigate the impact of operative factors of age, weight, and CPB management (lowest temperature, lowest hematocrit, α -stat vs pH-stat blood gas management, and duration of cooling, total support, CPB, deep hypothermic circulatory arrest [DHCA], and regional cerebral perfusion [RCP]) on ND outcomes, adjusting for center, type of CHD, year of birth, and preoperative factors. Data on preoperative brain magnetic resonance imaging and intraoperative anesthetic techniques were not available. Among 1,770 subjects from 22 institutions assessed at age 14.5 months \pm 3.7 months, longer total support time (but not DHCA or RCP times) and older age (>30 days) were associated with lower PDI and MDI in some models ($P < .05$). Other models suggested significant nonlinear relationships of lowest temperature and hematocrit with PDI (Figure). However, CPB management factors explained only trivial additional variance ($\sim 1\%$) in PDI and MDI in models based on identical samples and adjusted for patient and preoperative factors.

Conclusions: In this sample, CPB management factors are less important than innate patient and preoperative factors in predicting early ND outcomes after cardiac surgery in infants.



1:30 PM

Room 122ABC

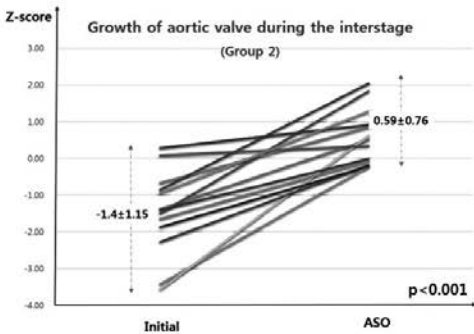
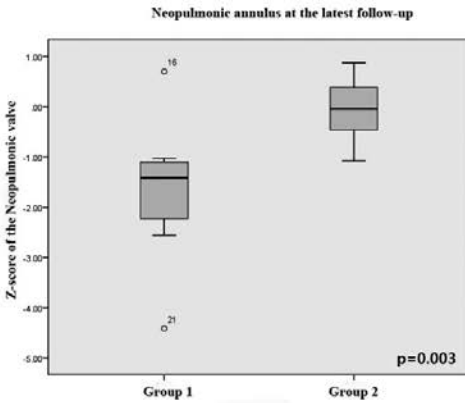
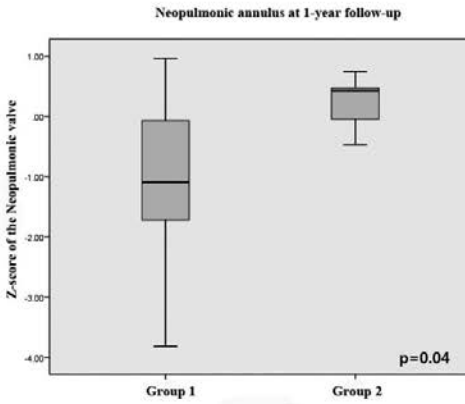
Growth of the Neopulmonic Valve After the Arterial Switch Operation in Patients With Aortic Arch ObstructionJ. Park¹, W. Kim¹, S. Cho², K. Hyun¹, Y. Kim¹¹Seoul National University Children's Hospital, South Korea, ²Seoul National University Hospital, South Korea

Purpose: One-stage repair currently is advocated for transposition of the great arteries (TGA) or Taussig-Bing anomaly (TBA) with aortic arch obstruction (AAO), but a small neopulmonic valve often can cause right ventricular outflow tract obstruction (RVOTO). We evaluated the growth of neopulmonic valve and significance of right-sided obstruction according to the different surgical strategies.

Methods: Between January 2001 and January 2015, 23 patients with TGA/AAO or TBA/AAO (11, 47.8%) underwent surgical repair. Aortic arch obstruction included coarctation of aorta (n=17) and interrupted aortic arch (n=6). One-stage repair was performed in 10 patients (Group 1), and two-staged repair was performed in 13 patients (Group 2). The arterial switch operation (ASO) was performed 6.4 months \pm 2.9 months after the repair of aortic arch obstruction and pulmonary artery banding. In Group 2, we checked the growth of aortic valve (ie, neopulmonic) during the interstage period by echocardiography.

Results: The initial Z-score of aortic annulus was comparable in the two groups (-1.74 ± 0.62 , -1.46 ± 1.15 , $P = .51$). In Group 2, during the interstage period, the Z-score of aortic annulus increased from -1.46 ± 1.15 (range: -3.57 to 0.29) to 0.59 ± 0.76 (range: -0.22 to 2.05), $P < .001$. The Z-score of neopulmonic valve of Group 2 at 1-year follow-up and at the latest follow-up were significantly larger than those of Group 1 (1 year: -1.1 ± 1.6 , 0.2 ± 0.39 , $P = .04$, latest follow-up: -1.6 ± 1.5 , -0.7 ± 0.56 , $P = .003$). Four patients had a significant pressure gradient (>30 mm Hg) across the right ventricular outflow tract in Group 1, whereas no patients in Group 2 did. There was one hospital death and one late death, all in Group 1. There have been three reoperations for RVOTO (two in Group 1, 20%; one in Group 2, 7.6%).

Conclusions: The growth of neopulmonic valve through short interstage period in two-staged repair was significant. This could lead to improvement for right-sided obstruction and reduce the reoperation rate associated with RVOTO. The two-staged repair would be a reasonable option, especially in patients who have a small aortic valve.



1:45 PM

Room 122ABC

Coronary Anatomical Patterns and Clinical Outcome in the Surgical Treatment of Transposition of the Great Arteries*M. Trezzi, A. Albano, S. B. Albanese, E. Cetrano, A. Carotti**Bambino Gesù' Children's Hospital, Rome, Italy*

Purpose: To determine differences in baseline characteristics and clinical outcomes in a consecutive series of patients undergoing arterial switch operation (ASO), assessing the effect of coronary anatomy on post-ASO mortality, both overall and adjusted for time.

Methods: From January 2000 to May 2015, 283 consecutive patients presenting with transposition of the great arteries (TGA) with associated anomalies underwent ASO. Complete data and follow-up were available for 262 of them (92.6%): of those, 99 patients (37.7%) had an associated ventricular septal defect and 106 patients (40%) had an abnormal coronary artery pattern. Kaplan-Meier survival curves were constructed based on the type of coronary anatomy, and for the early (2000-2007, n=137) and late (2008-onwards, n=125) experience. Leiden classification was used to define coronary patterns. Hazard ratios corresponding to coronary anatomy were calculated.

Results: Distribution of coronary patterns is shown in Figure 1A and Table. Overall hospital mortality was 2.29% (six events), with five deaths occurring in the early surgical era (2000-2007). Median follow-up was 6.5 years (range: 0-15). Subgroup analysis of mortality associated with variant coronary artery patterns over time suggested decreased mortality rates for infants who underwent surgery during 2008 or later compared with before 2008 (log-rank test $P = .1$, HR 4.5, 95% CI 0.9-22.6; Figure 1B). In the whole cohort of patients, the presence of an intramural coronary artery was associated with the highest mortality of any coronary pattern, with a more than 13-fold increase compared with other arrangements (OR 13.2, 95% CI 2.4-70.2; $P = .0025$). Since 2008, we observed only one death (1/125, 0.8%; pattern 1L2RCx) with no significant difference in mortality between "usual" and variant patterns ($\chi^2 = 0.6$, $P = .4$).

Conclusions: Mortality rates decreased in both the usual and variant anatomy groups in the recent years. In the most recent series of patients, intramural and looping coronaries do not seem to affect early and late outcomes following ASO. However, despite surgical advances, unusual coronary patterns in TGA patients still require special consideration at the time of reimplantation. Careful intraoperative determination of coronary artery entrance and exit points remains crucial.

Figure 1A

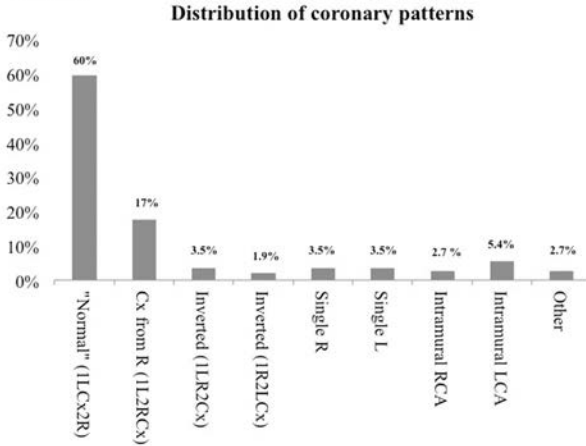
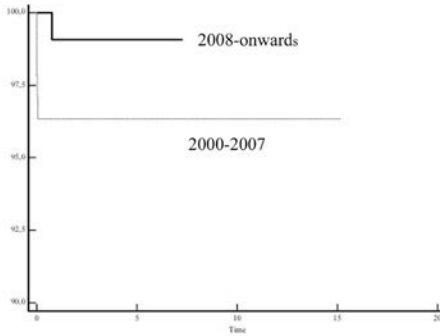


Figure 1B



Coronary Pattern	Surgical Era		p
	2000-2007 (n = 137)	2008-onwards (n = 125)	
"Normal"	87	69	0.21
Cx from Right	20	26	0.23
Inverted	11	3	0.08
Single	8	10	0.21
Intramural	10	11	0.05
Other	1	6	0.01

2:00 PM

Room 122ABC

Optimal Timing for Elective Early Primary Repair of Tetralogy of FallotM. Cunningham¹, M. Donofrio², S. Peer², D. Zurakowski³, R. A. Jonas², P. Sinba⁴¹Children's National Medical Center, Kensington, MD, ²Children's National Medical Center, Washington, DC, ³Harvard Medical School, Boston, MA, ⁴Children's National Health System, Washington, DC

Purpose: Early primary repair of tetralogy of Fallot can be performed with low mortality and no increase in resource utilization, but has not been accepted universally due to concerns for increased morbidity, mortality, and higher risk of reintervention. We sought to identify the optimal timing for early primary repair.

Methods: Retrospective review of all patients with tetralogy of Fallot with pulmonary stenosis (TOF/PS) undergoing elective early primary between September 2004 and December 2013 was performed. Patients with prior palliation, non-elective repair, and discontinuous branch pulmonary arteries were excluded. Preoperative and postoperative variables were assessed, as was the initial discharge echocardiogram-based Technical Performance Score (TPS). Kaplan-Meier curves were compared using the log-rank test. Univariate Fisher's exact test and multivariable Cox regression analysis were used to identify independent predictors of future reintervention. Youden's J-index in ROC analysis identified the optimal age cut-off predictive of future reintervention.

Results: 129 patients with TOF/PS, with median (IQR) age and weight of 78 days (56-111) and 5 kg (4.1-5.7), respectively, underwent early primary repair. After a median (IQR) follow-up of 5.9 years (0.1-11.8), there were no deaths. Eighteen patients (14%) required a total of 22 reinterventions (seven surgical, 15 percutaneous). Youden's J-index revealed that the risk of reintervention significantly decreased with repair performed after 55 days of age. Multivariable Cox regression identified age ≤ 55 days at repair (HR 4.5, $P = .003$), valve-sparing repair (HR 13.4, $P = .001$), and inadequate TPS (HR 23.4, $P < .001$) as independent predictors of overall reintervention (Table). Lower body weight did not increase likelihood of reintervention ($P = .505$). Freedom from reintervention was significantly better for TPS-1 (optimal repair) vs TPS-2 (adequate repair) (log-rank 9.4, $P = .002$) and TPS-3 (inadequate repair) (log-rank 64.5, $P < .001$) and for TPS-2 vs TPS-3 (log-rank 25.8, $P < .001$) (Figure).

Conclusions: Early primary repair of TOF/PS can be performed safely with low reintervention rates after 2 months of age, irrespective of the patient's size. TPS is an effective tool in identifying patients at risk of reintervention.

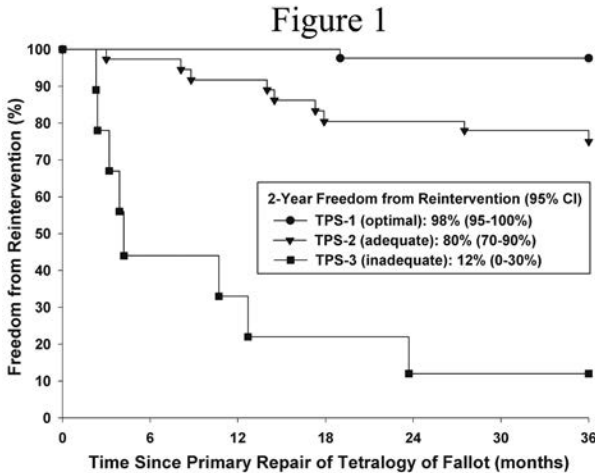


Figure 1: Freedom from reintervention for the patients who underwent elective primary repair of tetralogy of Fallot. TPS-1: optimal technical performance. TPS-2: adequate technical performance. TPS-3: inadequate technical performance.

Table 1: Predictors of Overall Reintervention (Surgical or Percutaneous) Related to TOF Repair

Variable	No Reintervention (n = 111)	Reintervention (n = 18)	Univariate p-value	Multivariable Cox Regression HR (95% CI)	p-value
Age at surgery, days	84 (61-116)	45 (33-78)	0.002*		
Age group					
≤ 55 days	22 (69%)	10 (31%)	0.003*	4.5 (1.7-12.1)	0.003†
> 55 days	89 (92%)	8 (8%)			
Gender			0.594		
Male	69 (87%)	10 (13%)			
Female	42 (84%)	8 (16%)			
Gestational age, wks	39 (37-40)	40 (37-40)	0.438		
Birth weight, grams	3000 (2592-3500)	3050 (2627-3225)	0.997		
Height, cm	58 (54-62)	57 (51-59)	0.150		
Weight, kg	5.1 (4.3-5.8)	4.2 (3.5-4.8)	0.004*		
Weight category			0.007*		0.505
≤ 4 kg	21 (70%)	9 (30%)			
> 4 kg	90 (91%)	9 (9%)			
BSA, m ²	0.29 (0.25-0.32)	0.25 (0.23-0.28)	0.005*		0.457
Di George syndrome	3 (7%)	1 (2%)	1.000		
Extracardiac malform.	13 (87%)	2 (13%)	1.000		
Chromosome anomaly	8 (89%)	1 (11%)	1.000		
Coronary variations	16 (84%)	3 (16%)	0.730		
Pre-op PV Z-score	-1.7 (-2.5, -0.7)	-2.2 (-3.1, -1.2)	0.255		
CPB time, min	77 (69-90)	80 (70-98)	0.430		
CCT, min	43 (38-51)	47 (41-57)	0.164		
Transannular patch					
No	72 (81%)	17 (19%)	0.012*	13.4 (1.6-108.6)	0.001†
Yes	39 (98%)	1 (2%)			
TPS					
1 or 2 (optimal or adequate)	109 (92%)	10 (8%)			
3 (inadequate)	2 (20%)	8 (80%)	<0.001*	24.4 (8.5-70.1)	<0.001†
Follow-up, yrs	5.9 (0.1-10.9)	10.1 (4.6-14.0)	0.027*		0.636

Continuous data are expressed as median (interquartile range). HR = hazard ratio; CI = confidence interval; BSA = body surface area; PV = pulmonary valve annulus; CPB = Cardiopulmonary Bypass; CCT = aortic Cross-Clamp Time; TPS = Technical Performance Score.

* Significant association by univariate analysis. † Significant independent predictor of reintervention.

2:15 PM

Room 122ABC

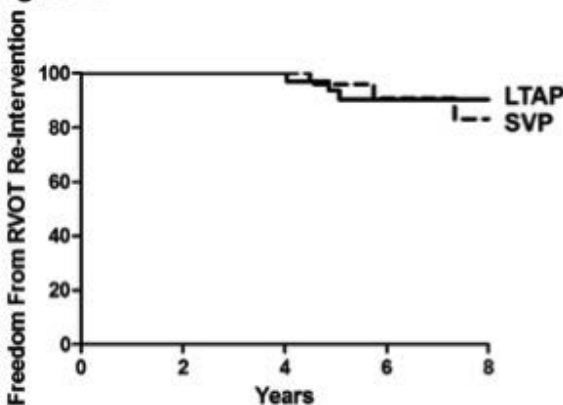
Limited Transannular vs Subvalvar Patch in Infants With Tetralogy of FallotB. V. Simon¹, M. F. Swartz², G. M. Alfieris¹¹University of Rochester, NY, ²University of Rochester – Strong Memorial Hospital, NY

Purpose: Repair of tetralogy of Fallot (TOF) using a transannular patch can result in progressive severe pulmonary insufficiency (PI). A limited transannular patch (LTAP) attempts to restrict obligatory PI and the extent of right ventricular outflow tract disruption. We hypothesized that an LTAP may compare favorably to a subvalvar patch (SVP).

Methods: From 2000 to 2010, infants <1 year of age with TOF were reviewed and divided into two groups: TOF repair using an LTAP and TOF repair using an SVP. Both perioperative and most recent echocardiographic data were obtained and used to determine Z-values based upon body surface area. Freedom from >moderate PI and freedom from right ventricular outflow tract reintervention were assessed using Kaplan-Meier analysis.

Results: Of 80 infants, 42 were repaired using an LTAP and 38 using an SVP. Those infants requiring an LTAP were younger and had a smaller pulmonary valve annulus Z-value (Table). At a follow-up of 6.7 years \pm 2.6 years, freedom from >moderate PI at 5 and 8 years was 93.9% vs 100% and 82.5% vs 100% ($P = .04$) within the LTAP vs SVP groups, respectively. However, despite the differences in surgical approach, there were no significant differences in right ventricular end diastolic diameter Z values (LTAP: 1.5 ± 1.1 vs SVP: 0.9 ± 1.5 , $P = .1$). Freedom from reintervention at 5 and 8 years also was not significant between the LTAP and SVP groups, respectively (5 years: 90.2% vs 95.8%; 8 years: 90.2% vs 83.2%; $P = .7$) (Figure).

Conclusions: When necessary, TOF repair in early infancy using an LTAP results in acceptable reintervention and right ventricular dilatation at an intermediate-term follow-up.

Figure 1

Abbreviations: LTAP-Limited Trans-Annular Patch, SVP-Sub-Valvar Patch

Table 1: Peri-operative Demographics

	LTAP	AS RVOT	p value
Age (days)	104.9 ± 70.2	164.6 ± 85.4	0.001
Male gender	28	20	0.26
Weight (kg)	5.31 ± 1.66	6.01 ± 1.50	0.05
Pre-operative pulmonary annulus Z value	-2.69 ± 1.15	-0.73 ± 1.13	1.31x10 ⁻⁶
Immediate post-operative pulmonary annulus Z value	-1.39 ± 1.25	-0.49 ± 1.38	0.03
Immediate post-operative PI > moderate	1/42	0/38	1.00
Immediate post-operative PS > moderate	0/42	0/38	1.00

Abbreviations: PI = pulmonary insufficiency, PS= pulmonary stenosis

2:30 PM

Room 122ABC

Systemic Pulmonary Shunt Facilitates the Growth of the Pulmonary Valve Annulus in Patients With Tetralogy of Fallot**B. Chong***Asan Medical Center, Seoul, South Korea*

Purpose: Surgical strategies for tetralogy of Fallot (TOF) with a marginally small pulmonary valve annulus (PVA) have moved toward PVA preservation instead of placing transannular patch (TAP). If a systemic pulmonary shunt (SPS) facilitates growth of the PVA, patients with a marginally small PVA could benefit from staged repair in terms of lowering the risk of TAP.

Methods: A total of 347 infants with TOF underwent surgical correction between January 2004 and December 2013 in a tertiary referral hospital, and patients with serial echocardiographic data prior to TOP repair (n=216) were analyzed. Twenty-nine infants underwent placement of an SPS with a subsequent repair (SPS-group), while 187 infants received primary repair (PR-group). SPS was performed at the median age of 32 days (range: 5-315). Repair was performed at the median age of 256 days (range: 157-382) in the SPS-group and 118 days (range: 77-163) in the PR-group. Mixed linear regression analysis was used to compare the pre-repair growth of the PVA between the two groups.

Results: There was no early mortality but two late deaths in the SPS group, while one early death and one late death occurred in the PR-group. TAP was placed in 62/216 patients (29%), and the risk of TAP was higher as the initial PVA (Z) decreased (RR 0.629, $P < .001$). Although the initial PVA (Z) of the SPS-group (-3.69 ± 1.5) was significantly smaller than that of the PR-group (-1.98 ± 1.2) ($P < .001$), there was no significant difference in the placing of TAP at the time of repair between the two groups (11/29, 38% in the SPS-group, 51/187, 27% in the PR-group, $P = .195$). PVA (Z) increased significantly from -3.69 to -2.73 after the placement of SPS ($P < .001$) in the SPS-group, while the pre-repair changes in PVA (Z) were not statistically significant in the PR-group (-1.98 to -2.09 , $P = .752$), with a significant inter-group difference ($P < .001$).

Conclusions: SPS facilitates the growth of PVA in patients with TOF. Therefore, there might be a subset of patients with a marginally small PVA who would have TAP with a primary repair strategy, rather than preserve PVA with a staged repair strategy. SPS could be considered as a better option in some cases.

Figure 1. Changes of PVA (Z) in SPS-group and PR-group

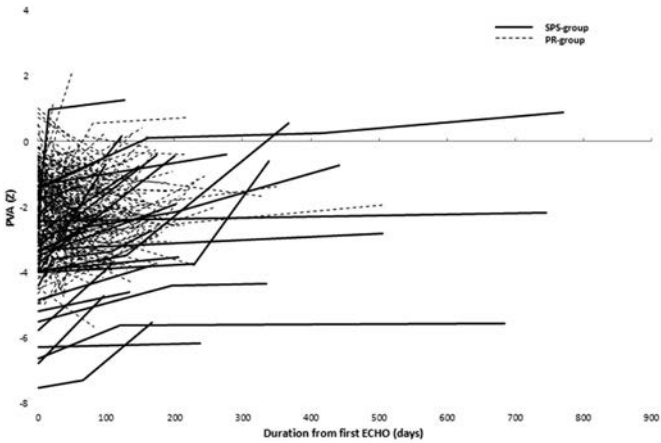


Table 1. Characteristics and clinical data of subjects

	SPS (n=29)	Primary repair (n=187)	p-value
Sex (female)	16 (55%)	80 (43%)	0.21
BW (Kg)	3.91 ± 1.54	3.34 ± 1.05	0.015
Age at shunt (days)	59.52 ± 7.71		
Age at repair (days)	377.89 ± 325.83	188.30 ± 76.71	<0.001
TAP	11 (38%)	51 (28%)	0.195
First ECHO	41.93 ± 73.51	12.84 ± 30.29	<0.001
PVA	4.44 ± 0.96	5.77 ± 1.16	<0.001
PVA (Z)	-3.69 ± 1.5	-1.98 ± 1.2	<0.001
Last ECHO	351 ± 322.17	122 ± 64.98	<0.001
PVA	7.56 ± 2.16	7.02 ± 1.50	0.204
PVA (Z)	-2.73 ± 2.15	-2.09 ± 1.23	0.024

2:45 PM

Room 122ABC

Global Tetralogy of Fallot Surgical Practice Patterns

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¹The Hospital for Sick Children, Toronto, Canada, ²Asan Medical Center, Seoul, South Korea, ³National Cardiovascular Center Harapan Kita, Jakarta, Indonesia, ⁴King Abdulaziz University, Jeddah, Saudi Arabia, ⁵Kokilaben Dburrybbai Ambani Hospital, Mumbai, India ⁶West China Hospital, Sichuan University, Chengdu, ⁷Texas Children's Heart Institute, Houston, ⁸The Royal Children's Hospital, Melbourne, Australia, ⁹Population Health Research Institute, Hamilton, Canada

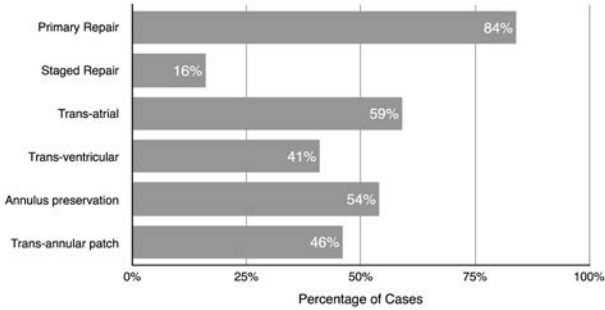
COMMERCIAL RELATIONSHIPS Y. d'Udekem: Consultant/Advisory Board, Medical Specialties Distributors; G. S. Van Arsdell: Ownership Interest, Cell Aegis Devices; C. D. Fraser: Research Grant, Berlin Heart

Purpose: Multiple surgical strategies are employed in tetralogy of Fallot (TOF) repair. Depending on anatomy, strategy, and bias, surgeons leave varying degrees of residual obstruction, which has long-term consequences on ventricular health. We sought to establish global practice patterns for the surgical management of TOF.

Methods: Surgeons from 15 international pediatric cardiac surgery centers (representing 1,700 TOF cases/year) completed a REDCap-based survey. The participating countries included: China (3), India (2), Nepal (1), Korea (1), Indonesia (1), Saudi Arabia (3), Japan (1), Australia (1), United States (1), and Canada (1). Summary measures were reported as means and counts (percentages). Responses were weighted based on case volume per center.

Results: Primary repair was the prevalent strategy (84%) with variation in age at elective repair (3 months to >1 year). Nearly 50% (7/15) used patient age as a factor in determining the strategy, with age <3 months being the common cut-off for a staged repair. Weight less than 3 kg was an indication for staged repair for 80% of institutions. Transatrial ventricular septal defect closure was the preferred approach in 61% of sites. Nearly 70% (12/15) of responders reported using pulmonary valve z-score to guide right ventricular outflow tract management technique with the most prevalent cutoff of annulus preservation being a z value of -3. Estimated incidence of annulus preservation was 54%. Of those performing a transannular patch, 90% were considered "minimal" type incisions. Questions on follow-up practices revealed that 4/15 sites used cardiac MRI routinely and would usually commence at 6-7 years of age.

Conclusions: There is variation in TOF surgical management with no consensus on standard of practice globally. An even split exists between a bias toward leaving "little" and "some" outflow stenosis. A large international prospective cohort study would allow analysis of impact of repair strategy on early and late patient outcomes.



Variable	Practices
Average number of surgeons/center	3.86 (2-10)
Number of TOF repairs annually	15-450
Estimated case volume/surgeon	28.9 (6.3-75)
% primary repair	84.2% (28-95%)
Age at elective repair	6 - <9 months
Approach to VSD closure	Trans-atrial (61.3%)
Bias towards management of the pulmonary valve	53.4 % bias towards leaving some obstruction 46.6% bias toward little/no obstruction
RVOT management	AP (53.8%), TAP (46.2%): Minimal patching (91.2%) and standard/large (8.8%)
Method to dilate pulmonary valve in annulus preservation technique	Valvotomy only (17.6%) Valvotomy and Hegar dilation (83.9%) Valvotomy and balloon dilation (1.2%)

1:00 PM – 3:00 PM

Room 125AB

General Thoracic Session: Esophageal*Moderators: Ross M. Bremner, Phoenix, AZ, and Christopher R. Morse, Boston, MA***COMMERCIAL RELATIONSHIPS** R. M. Bremner: Research Grant, Ethicon; Consultant/Advisory Board, EndoStim

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold**.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

1:00 PM

Room 125AB

Quality of Lymphadenectomy Is Associated With Improved Overall Survival in Esophageal Cancer Patients

P. P. Samson¹, V. Puri¹, S. R. Broderick², D. Kreisel³, A. S. Krupnick³, G. A. Patterson⁴, B. F. Meyers⁴, T. D. Crabtree³

¹Washington University School of Medicine, St Louis, MO, ²St Luke's Hospital, Chesterfield, MO,

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COMMERCIAL RELATIONSHIPS B. F. Meyers: Consultant/Advisory Board, Ethicon, Inc; Speakers Bureau/Honoraria, Varian Medical Systems, Inc

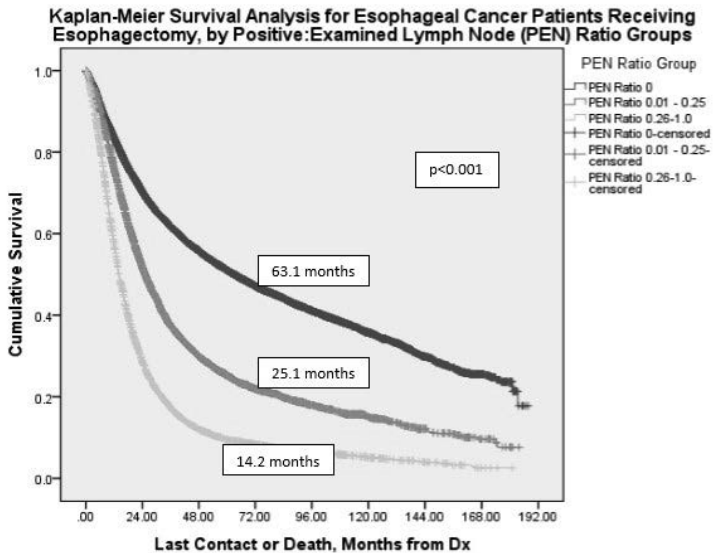
Purpose: The American College of Surgeons Commission on Cancer (CoC) guidelines currently recommend that esophagectomy patients receive a lymphadenectomy with ≥ 15 lymph nodes for pathologic examination. The purpose of this study was to evaluate practice patterns of lymphadenectomy and determine how the number of lymph nodes examined impacts survival.

Methods: Patients undergoing esophagectomy for esophageal cancer in the National Cancer Data Base were identified. Univariate analysis and logistic regression were performed to identify variables associated with ≥ 15 lymph nodes. A positive:examined lymph node (PEN) ratio was calculated for each patient, and cutpoint analysis (X-tile Bioinformatics Software) was used to determine ratio values to identify maximal survival differences. 1:1 propensity score matching was performed on patient, tumor, and treatment characteristics to compare overall survival in a Kaplan-Meier analysis. A Cox-proportional hazard model was done to identify variables associated with improved survival.

Results: From 1998 to 2012, there were 38,553 esophagectomies. 22,468 (67.5%) had 1-14 lymph nodes sampled, while 10,834 (32.5%) had ≥ 15 lymph nodes. 5,090 patients (13.2%) had no lymph nodes examined. Variables associated with having ≥ 15 lymph nodes sampled included income $\geq \$35,000$ (OR 1.17, 1.06-1.31), private insurance (OR 1.36, 1.04-1.77), receiving esophagectomy at an academic facility (OR 1.49, 1.38-1.60), increasing tumor size (OR 1.002, 1.001-1.003), and increasing clinical N stage (N1: OR 1.16, 1.05-1.28; N2: OR 1.41, 1.14-1.75; N3: OR 1.98, 1.25-3.14), while induction therapy was associated with a decreased likelihood (OR 0.74, 0.67-0.81), all $P < .05$. On propensity score matching, patients with ≥ 15 lymph nodes examined had improved overall survival (44.1 months vs 27.8 months, $P < .001$). Results of PEN ratio cutpoint survival analysis are shown in the Figure. Increasing PEN ratio was independently associated with increased mortality

(PEN ratio 0.01-0.25: HR 1.72, 1.63-1.82; PEN ratio 0.26-1.0: HR 2.86, 2.69-3.04; reference PEN ratio=0, $P < .001$).

Conclusions: Utilizing a large national database of esophageal cancer resections, we have demonstrated the impact of lymphadenectomy on survival and the prognostic role of a PEN ratio. Furthermore, dissection of at least 15 lymph nodes should be an essential measure when assessing the quality of esophageal cancer management.



1:15 PM

Room 125AB

Assessing the Importance of Age on Outcomes Associated With Repair of Giant Paraesophageal Hernias

K. Mobiuiddin, M. El Lakis, M. Hubka, J. Speicher, D. E. Low

Virginia Mason Medical Center, Seattle, WA

Purpose: Paraesophageal hernias (PEH) produce a variety of chronic and acute symptoms. Proceeding with elective repair involves assessment of the symptomatic impact of the hernia and operative risk. PEH typically presents in older populations, and advanced age is often regarded as a contraindication for elective repair.

Methods: All patients undergoing PEH repair at a high-volume center between January 2000 and October 2014 were prospectively entered into an IRB-approved database. Patients were assessed in three age-related demographic groups, those <70, 70-80, and >80 years of age, and were analyzed according to presenting characteristics and perioperative outcomes. Over the study period, 504 patients underwent PEH repair; 279 were <70 years (55.4%), 147 were 70-80 years (29.2%), 78 were >80 years (15.5%).

Results: Body mass index was significantly higher in younger patients. The >80 years group had a higher percentage of ASA class 3 and mean age-adjusted Charlson comorbidity index. Comparisons included percentage of patients with 90%-100% intrathoracic stomach (<70: 59.1%, 70-80: 31.9%, >80: 55.1%, *P* = ns). Older patients had a higher percentage of type 4 hernias (8.2% vs 19.7% vs 34.6%, *P* < .001). There was no statistical difference in presenting symptoms. Older patients had a higher incidence of overall complications (20.8% vs 34.7% vs 37.4%, *P* < .001) and longer mean length of hospital stay (LOS) (4 days vs 4.7 days vs 5.9 days, *P* < .001). Patients >80 years were more likely to have acute presentations requiring emergency operations (6.5% vs 5.4% vs 16.6%, *P* < .001). There was only one operative mortality in the entire study group. Patient satisfaction scores over the last 5 years of the study showed no significant difference between groups. Only two readmissions were required, both patients <70 years.

Conclusions: Patients >80 years will present with higher comorbidity scores, higher levels of perioperative complications and longer LOS. However, overall outcomes in patients >80 years are excellent, with patient satisfaction scores, readmission rates, and mortality similar to younger patients. Symptomatic patients should be given the opportunity to be assessed for elective repair.

Table 1: Study Groups

	Age (years)			
	<70	70-80	>80	
Age Mean	59.6	75.6	85.3	
Female	68.80%	68%	73.10%	ND
BMI Mean	31.9	28.5	25.9	<i>p</i> < .0001
ASA 3	15.40%	27.20%	43.60%	<i>p</i> < .0001
CCI Standard Mean	1.02	1.28	1.37	ND
CCI Age Mean	2.98	4.06	4.73	<i>p</i> < .0001
Operative Time Mean (Min)	160.9	153.1	147.9	ND

1:30 PM

Room 125AB

Influence of Specialty Training and Trainee Involvement in the Perioperative Outcomes of Esophagectomy

Z. Khoubbal¹, B. Mungo¹, J. Canner², M. Stem¹, A. Lidor¹, E. B. Schneider², D. Molena¹

¹The Johns Hopkins University, Baltimore, MD, ²The Johns Hopkins Hospital, Baltimore, MD

COMMERCIAL RELATIONSHIPS D. Molena: Speakers Bureau/Honoraria, Novadaq Technologies, Inc; E. B. Schneider: Ownership Interest, Bergeim, LLC

Purpose: Hospital and surgeons volume-outcome relationships have been reported in several esophagectomy studies with an inverse association of mortality and volume. The purpose of our study was to evaluate the outcomes of esophagectomy in the United States relative to the surgeon's training and the involvement of trainees performing the procedure.

Methods: This was a retrospective analysis using the American College of Surgeons National Surgical Quality Improvement Program database (2005-2013). All patients (18 years and older) who underwent esophagectomy were divided into two groups according to whether the operation was performed by a general or a cardiothoracic surgeon. A comparison of intraoperative and postoperative outcomes between the groups was conducted. The primary outcome was 30-day mortality. Secondary outcomes included overall and serious morbidity, discharge destination, and length of hospital stay.

Results: Of the 15,128 esophagectomies identified, 69.8% were performed by general surgeons and 30.2% by cardiothoracic surgeons. Overall, cardiothoracic surgeons' patients had significantly higher comorbidities, cancer rates (61% vs 54%, $P < .001$), and trainee involvement with their surgery (86% vs 81%, $P < .001$). There was no significant difference in mortality. Multivariable regression analysis showed a 1.34-fold increase in serious morbidity (OR 1.34, 95% CI 1.17-1.53, $P < .001$), longer hospital stay, and decreased odds for home discharge (OR 0.18, 95% CI 0.10-0.14, $P < .001$) when the esophagectomy was performed by a general surgeon. When involvement of trainees was evaluated as an independent variable, no significant differences were seen in the outcomes of patients undergoing esophagectomy with or without the presence of trainees.

Conclusions: Our study showed that while specialty training might be an important factor affecting the outcome of esophagectomy, trainee involvement during the procedure does not impair the results of the operation.

1:45 PM

Room 125AB

Accelerated Recovery Within Standardized Pathways Following Esophagectomy: A Prospective Cohort Study Assessing Outcomes, Readmissions, Patient Satisfaction, and Costs*H. M. Schmidt, M. El Lakis, S. Markar, D. E. Low**Virginia Mason Medical Center, Seattle, WA*

Purpose: Standardized clinical pathways (SCP) provide an infrastructure for improving outcomes associated with esophagectomy. Length of stay (LOS) is commonly reported as a quality metric that can impact costs. This study analyzed the subgroup of patients with “accelerated recovery” (AR) who exceeded a targeted discharge goal of postoperative day 7.

Methods: Between 2010 and 2013, all 137 consecutive patients undergoing esophagectomy were entered into an IRB-approved prospective database. All patients were managed according to the SCP. The AR group included 32 patients (26%) who were discharged on day 5 or 6. The comparison groups were made up of 62 patients (45%) discharged within the SCP targeted recovery (TR) goal of LOS 7-8 days and 40 patients (29%) who failed to meet the discharge goal of 8 days (delayed recovery [DR]). Patient characteristics, surgical factors, postoperative complications, readmission rates, patient satisfaction, and overall costs were compared among groups.

Results: The percentage of AR patients increased during the 4-year study period from 3% to 46%. All groups were comparable regarding severity of comorbidities, cancer stages, and treatment approach. AR patients were more likely to have neoadjuvant therapy, shorter operations, and less operative blood loss. DR patients were more likely to have complications (40% [AR] vs 45% [TR] vs 90% [DR], $P < .001$). Overall in-hospital and 90-day mortality was 1.5%. All AR patients were discharged home (100% [AR] vs 87% [TR] vs 63% [DR], $P < .001$), and 30-day readmission rates were comparable among the groups (14% [AR] vs 19% [TR] vs 5% [DR], $P = .122$). Overall average costs (\$38,385 [AR] vs \$41,607 [TR] vs \$61,199 [DR], $P < .001$), as well as readmission costs (\$7,470 [AR] vs \$27,695 [TR] vs \$33,398 [DR], $P = .202$), were lower in the AR group. Overall EORTC patient satisfaction scores were comparable among the groups.

Conclusions: There is an increasing cohort of patients who can move quickly through SCP. Age and comorbidities are not the defining issues in these overachievers, but avoiding complications are crucial factors. Enhanced recovery after surgery protocols and SCP should be designed to accommodate these patients to improve patient satisfaction and treatment cost.

2:00 PM

Room 125AB

Risk Factors for Local Recurrence and Optimal Length of Esophagectomy in Esophageal Cancer

C. Kang, Y. Hwang, H. Lee, I. Park, Y. Kim

Seoul National University Hospital, South Korea

Purpose: The risk factors for local recurrence (LR) and how much of the esophagus should be resected have not yet been established in esophageal cancer. This study aimed to identify risk factors for LR and optimal length of esophageal resection in esophageal cancer.

Methods: Patients who underwent curative esophagectomy with more than 2 years of follow-up were included. Patients who received preoperative chemoradiation or in whom the proximal margin distance (pmD) from resected tumor was not documented in the pathologic report were excluded. A total of 582 patients from January 1995 to December 2012 were included. There were 552 male patients (95%). Mean age was 62.7 years \pm 8.4 years. Squamous cell carcinoma was the most common cell type (n=552, 95%). Locations of tumor were upper thoracic in 48 (8%), mid-thoracic in 171 (29%), and lower thoracic in 363 (62%).

Results: Negative proximal resection margin was achieved in 541 patients (93%), and mean pmD was 3.5 cm \pm 2.5 cm. Cervical and thoracic anastomosis was performed in 167 patients (29%) and 415 patients (71%), respectively, and the mean pmD was 3.8 cm \pm 3.0 cm and 3.3 cm \pm 2.3 cm, respectively ($P = .094$). Gender, age, location of tumor, location of anastomosis, minimally invasive esophagectomy, three-field lymphadenectomy, cell type, differentiation, proximal resection margin status, tumor size, number of dissected lymph nodes, and T stages were not risk factors of LR. N stage was a risk factor for LR. Five-year freedom from LR was 95% in N0, 84% in N1, 84% in N2, and 78% in N3 ($P = .002$). pmD was not related to LR in N0, but 5-year freedom from LR was higher in pmD >5 cm in N+ esophageal cancer (79% in pmD \leq 5 cm vs 95% in pmD >5 cm, $P = .049$).

Conclusions: LR after esophagectomy in esophageal cancer is related to nodal metastasis rather than proximal margin status, which raises the possibility that the main mechanism of local recurrence is submucosal lymphatic metastasis. Esophagectomy with pmD more than 5 cm is recommended in esophageal cancer with nodal metastasis.

2:15 PM

Room 125AB

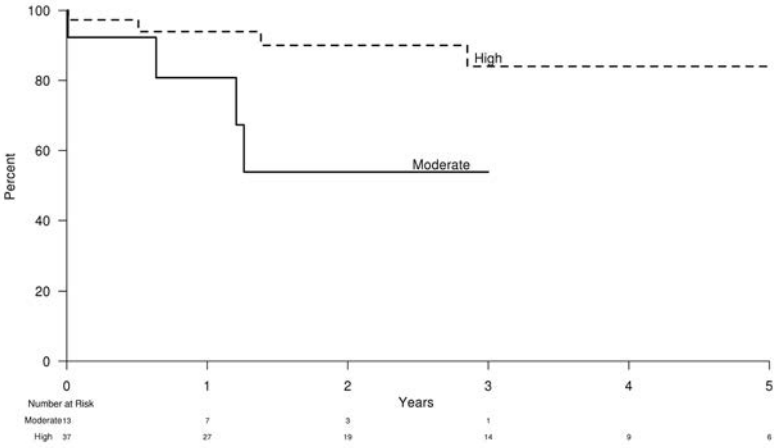
Esophagectomy Outcomes in the Endoscopic Mucosal Resection Era*K. J. Dickinson, K. Wang, L. Zhang, M. S. Allen, S. D. Cassivi, F. C. Nichols, K. Shen, D. A. Wigle, S. H. Blackmon**Mayo Clinic, Rochester, MN***COMMERCIAL RELATIONSHIPS** M. S. Allen: Nonremunerative Position of Influence, Joint Council on Thoracic Surgery Education (JCTSE)

Purpose: Endoscopic mucosal resection (EMR) and esophagectomy are both treatment options for cT1-esophageal adenocarcinoma (EA). Individualized management should be based on patient risk to enhance survival and allow esophageal preservation, when appropriate. Patients with cT1 EA undergoing EMR and subsequent esophagectomy represent an understudied cohort, and measuring patient outcomes is important.

Methods: We performed a retrospective analysis of a prospectively collected database of patients undergoing EMR for cT1 EA and subsequent esophagectomy between November 2004 and November 2014. EMR histology was reviewed and patients were risk stratified according to a modified established scoring system (based on tumor size, differentiation, depth, and lymphovascular invasion). Patient demographics, surgical techniques, pathology reports, postoperative outcomes, and survival were recorded.

Results: Fifty-one patients underwent EMR for cT1 EA with subsequent esophagectomy. Multiple EMRs occurred in 13/51 patients (25%). Median time between EMR and esophagectomy was 1 month (range: 0.5-50). Median age at esophagectomy was 66 years (range: 50-89). One patient was low risk, 13 patients (25%) were moderate risk, and 37 patients (73%) were high risk. No neoadjuvant therapy was used. Operative approach was Ivor Lewis esophagogastrectomy in 34 (67%), McKeown in 5 (10%) and transhiatal in 11 (22%). Operative mortality was 4%. Complications occurred in 43%: pneumonia in 3/51 (6%), atrial fibrillation in 4/51 (8%), and clinical anastomotic leak in 6/51 (12%). Surgical pathologic stage was pT0N0M0 in 14/51 (28%) and pT1N0M0 in 21 (41%). 16/51 patients (31%) were upstaged on final pathology (T/N stage or both). 3/13 moderate-risk patients (23%) and 9/37 high-risk patients (24%) had positive lymph nodes. Median follow-up was 18 months (range: 1-72), and three patients had recurrence/metastatic disease (one moderate risk, two high risk). Five-year survival was 54% in moderate-risk patients and 84% in high-risk patients ($P = .04$).

Conclusions: Studying cT1 EA patients treated with EMR and esophagectomy is important, as these patients are traditionally considered a low-risk cancer group. Our data suggest that moderate-risk cT1 EAs established by EMR and esophagogastroduodenoscopy criteria are at high risk of lymph node metastases and greatest risk of death.



2:30 PM

Room 125AB

Impact of Postoperative Infection on Overall Survival and Recurrence After Minimally Invasive Esophagectomy: A Propensity Score-Matched AnalysisV. Tam¹, J. D. Luketich¹, D. G. Winger², I. Sarkaria¹, R. M. Levy¹, N. A. Christie², O. Awais¹, M. R. Shende³, K. S. Nason²¹University of Pittsburgh Medical Center, PA, ²University of Pittsburgh, PA, ³University of Pittsburgh, Erie, PA**COMMERCIAL RELATIONSHIPS** O. Awais: Speakers Bureau/Honoraria, Covidien; Speakers Bureau/Honoraria, PinnacleHealth System; J. D. Luketich: Research Grant, Accuray

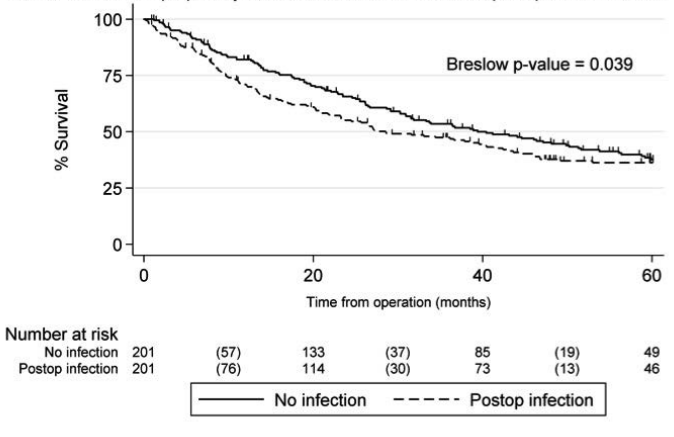
Purpose: Evidence suggests that postoperative infections compromise patient immunity and promote tumor recurrence in colorectal cancer, leading to worse survival. Our study aimed to determine whether postoperative infection was associated with differential tumor recurrence rates and overall survival following minimally invasive esophagectomy for esophageal adenocarcinoma in propensity score-matched cohorts.

Methods: We abstracted data for 812 patients who underwent elective minimally invasive esophagectomy for esophageal adenocarcinoma (1997-2011). Propensity scores were generated using 30 pretreatment/intraoperative variables (Table); exposure was defined as at least one infectious event within 30 days postoperatively (sepsis, anastomotic or conduit leak, pneumonia, empyema, *Clostridium difficile* colitis, pancreatitis, urinary tract infection, or wound infection/cellulitis). A total of 278 patients (34%) with postoperative infection were identified. Overall survival and time to recurrence were compared using Kaplan-Meier curves and differences assessed using the Breslow test. Factors associated with time to recurrence and overall survival were analyzed using Cox regression with shared frailty.

Results: Pretreatment and intraoperative factors were assessed for association with infectious complications (Table). Sixteen of 17 patients with prolonged initial ventilation suffered infectious complications and were dropped from analysis due to near perfect separation between groups prior to propensity score generation. After propensity score matching, 201 matched pairs were obtained (median bias across all variables reduced from 12.9% to 3.7%; maximum absolute standardized difference=0.111). Median follow-up time was 29.5 months. Recurrence (median 33.6 months) was found in 39% of propensity score-matched patients (157/401); rate of recurrence ($P = .378$) and time to recurrence (Breslow test $P = .299$) were not associated with postoperative infection. Overall survival was significantly shorter in the propensity score-matched cohort with infection (29 vs 39 months, Breslow test $P = .039$), but was not an independent predictor of increased hazard for death when adjusted for age, neoadjuvant therapy, comorbidity score, sex, body mass index, positive resection margins, and pathologic stage (HR 1.22, 95% CI 0.95-1.57).

Conclusions: In contrast to surgically resected colorectal cancer patients, post-esophagectomy complications were not associated with increased recurrence rates or earlier time to recurrence in patients with esophageal adenocarcinoma in propensity score-matched patient cohorts. While overall survival was shorter, infectious complications were not an independent survival predictor when adjusted for other important survival predictors.

Figure. Overall survival after minimally-invasive esophagectomy for esophageal adenocarcinoma in propensity-matched cohorts with & without postoperative infection



	Infection n (%)	No infection n (%)	p-value
Age (median; IQR)	66 (58-75)	64 (56-71)	0.008
Age-adjusted Charlson comorbidity index score (median; IQR)	3 (0-5)	2 (0-4)	<0.001
History of:			
Gastroesophageal reflux	189 (69)	403 (76)	0.028
Myocardial infarction/coronary artery disease	96 (35)	102 (19)	<0.001
Peripheral vascular disease	36 (13)	24 (4.5)	<0.001
Diabetes requiring medical therapy	62 (22)	84 (16)	0.026
Pulmonary disease	75 (27)	103 (19)	0.016
Any neurologic event or disorder	26 (9.3)	23 (4.3)	0.008
Any prior malignancy in last 5 years	35 (13)	45 (8.4)	0.063
Renal insufficiency or Cerebral vascular accident (composite)	33 (12)	30 (5.6)	0.002
Surgeon (JDL vs all others)	185 (67)	399 (75)	0.014
Intraoperative blood transfusion	73 (27)	79 (15)	<0.001
Conversion to thoracotomy	11 (3.9)	4 (0.75)	0.004
Prior esophageal surgery	33 (12)	31 (5.8)	0.004
Coronary revascularization	60 (22)	80 (15)	0.024

Additional variables included in propensity score generation but not significantly associated with infectious complications in the overall dataset: nonwhite race, history of cigarette smoking, body mass index, neoadjuvant therapy, high-grade dysplasia versus invasive adenocarcinoma, hospital, number of lymph nodes resected, conversion to laparotomy, tumor grade, histologic confirmation of Barrett's metaplasia, history of peptic ulcer disease, daily alcohol use.

2:45 PM

Room 125AB

Race Is Associated With Reduced Overall Survival Following Esophagectomy for Esophageal Cancer Only Among Patients From Lower Socioeconomic BackgroundsL. Erhunmwunsee¹, B. Gulack², C. Rushing¹, D. Niedzwiecki¹, M. F. Berry³, M. G. Hartwig¹¹Duke University Medical Center, Durham, NC, ²Duke University, Durham, NC, ³Stanford University, CA

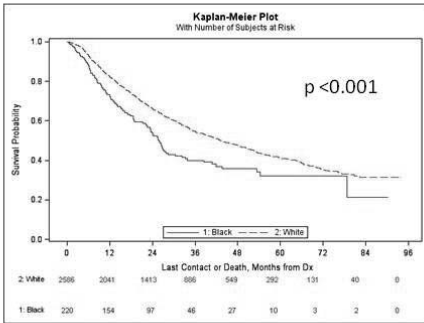
Purpose: Black patients with esophageal cancer (EC) have worse survival than white patients. Our institutional experience has suggested that this racial disparity may vary with socioeconomic status (SES). We performed this study to determine if this relationship exists on a national level.

Methods: The associations between race and SES with overall survival (OS) of patients treated with esophagectomy for stages I-III EC between 2003 and 2011 in the National Cancer Data Base were evaluated with Kaplan-Meier and Cox proportional hazard analyses. The following variables were adjusted against: sex, age, Charlson score, stage, facility type, histology, and tumor location. Median income by zip code was grouped into income quartiles (IQ) and used as a surrogate for SES (4th quartile equaling the highest SES group). Subgroup analyses were performed to determine how the association of race and overall survival varied by SES.

Results: Of 16,807 EC patients who met study criteria, 1,792 patients (10.6%) were black. The majority of patients (n=9,208, 54.8%) were in the lowest two IQs. Before adjustment, black patients had worse OS than white patients (median survival: 33 vs 51 months, $P < .001$), and each lower income quartile was associated with progressively worsening OS ($P < .001$). After adjustment, both black race (adjusted HR 1.206, 95% CI 1.027-1.416) and lower IQ (adjusted HR 1.241, 95% CI 1.113-1.384) remained significantly associated with OS. However, there was no significant difference in OS between white and black patients in the two highest IQs before or after adjustment (median survival: 57 vs 61 months, $P = .993$, adjusted HR 0.877, 95% CI 0.638-1.205), while a significant difference remained between white and black patients in the bottom quartiles (median survival: 43 vs 26 months, $P < .001$, adjusted HR 1.360, 95% CI 1.120-1.650) (Figure).

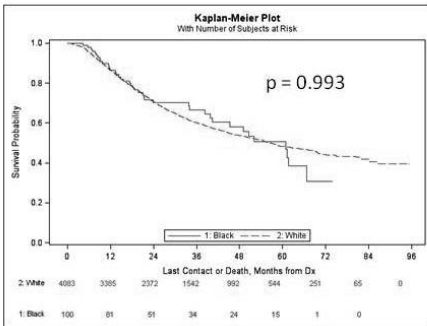
Conclusions: Racial disparities in outcomes after esophagectomy for esophageal cancer exist in patients with lower SES, but are not present among patients with higher SES. Future racial disparity studies must focus on low SES patients in order to eliminate health care disparities.

Survival of patients in the *lower 2* income quartiles by race



- Black patients in lower SES quartiles (Q1-Q2) – 26 months
- White patients in lower SES quartiles (Q1-Q2) – 43 months

Survival of patients in the *upper 2* income quartiles by race



- Black patients in higher SES quartiles (Q3-Q4) – 61 months
- White patients in higher SES quartiles (Q3-Q4) – 56 months

1:00 PM – 3:00 PM

Room 120A

General Thoracic Session: Lung Cancer II—Treatment*Moderators: David T. Cooke, Sacramento, CA, and Eric L. Grogan, Nashville, TN*

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold**.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and answer-session after each topic.

1:00 PM

Room 120A

Successful Linkage of the STS General Thoracic Surgery Database and a Hospital Cancer Registry to Obtain Long-Term Survival Data in Patients Undergoing Lobectomy for Lung Cancer
M. J. Magee¹, S. L. Prince², M. A. Herbert³
¹HCA North Texas Division, Dallas, ²Cardiopulmonary Research Science and Technology Institute, Dallas, TX, ³Medical City Dallas Hospital, TX

Purpose: The STS General Thoracic Surgery Database (GTSD) provides robust perioperative clinical data but is currently lacking information on long-term survival. Cancer Registries (CR) provide administrative data and utilize rigorous methods to determine survival status. We hypothesized that the GTSD and CR could be linked to add value to both registries.

Methods: All patients diagnosed with cancer were entered into the CR, maintained under the auspices of the National Cancer Data Base. Survival status was updated annually through correspondence with patients, their physicians, searches of the Social Security Death Index, and obituaries. Participation in the GTSD began in our hospital in October 2007 with the recruitment of a general thoracic surgeon. Patients undergoing lobectomy for lung cancer in the GTSD were identified, and a matching field was created based on concatenating patient names. Using an SQL query, patients were then matched between the GTSD and the CR datasets.

Results: From October 1, 2007, through December 31, 2013, 152 patients who had lobectomy for lung cancer were identified in the GTSD. All were successfully linked (100% match) to the hospital cancer registry. Patients also were matched for TNM stage with a high correlation between the two registries. Five patients (3.3%) were lost to follow-up at the time of analysis. Thirty-day survival, obtained from the GTSD was 98.7%. One- and 3-year survival obtained from the CR was 86.2% and 70.4%, respectively.

Conclusions: The CR and the GTSD can be precisely linked within a hospital to allow more robust analyses, incorporating the detailed clinical data in the STS General Thoracic Surgery Database with long-term follow-up available in the Cancer Registry.

NOTES

1:15 PM

Room 120A

Nationwide Utilization of Robotic Lobectomy and Postoperative Outcomes*R. Rajaram¹, S. Mohanty², D. Bentrem¹, E. Pavey¹, D. D. Odell¹, A. Bharat³, K. Y. Bilimoria¹, M. M. DeCamp³**¹Northwestern University, Chicago, IL, ²American College of Surgeons, Chicago, IL, ³Northwestern Memorial Hospital, Chicago, IL***COMMERCIAL RELATIONSHIPS** M. M. DeCamp: Consultant/Advisory Board, PneumRx, Pulmonx, Holaira, Inc, Soffio Medical, Inc; E. Pavey: Other, Mayo Foundation for Medical Education and Research

Purpose: Robotic lobectomy has increasingly been described for the treatment of non–small-cell lung cancer (NSCLC). Our objectives were to evaluate utilization of robotic lobectomy over time, identify hospital factors associated with its use, and assess postoperative outcomes after robotic lobectomy in comparison to other surgical approaches.

Methods: Patients with stage I-IIIa NSCLC were identified from the National Cancer Data Base between 2010 and 2012. Trends in the use of robotic lobectomy were assessed over time. Multivariable logistic regression models were developed to identify hospital factors associated with the use of robotic lobectomy. Propensity score-matched cohorts were constructed to compare length of stay (LOS), lymph node counts, surgical margin status, 30-day readmission, 30-day mortality, and 90-day mortality rates after robotic lobectomy with video-assisted thoracoscopic surgery (VATS) and open lobectomy.

Results: 62,206 patients underwent either open (n=45,527), VATS (n=12,990), or robotic (n=3,689) lobectomy at 1,215 hospitals. Use of robotic lobectomy significantly increased from 3.0% to 9.1% ($P < .001$) between 2010 and 2012. Hospitals performing robotic lobectomy also increased from 153 (12.6%) in 2010 to 255 (21.0%) in 2012 ($P < .001$). On multivariable analysis, academic hospitals (OR 1.55, 95% CI 1.04-2.33) and hospitals in the highest-volume quartile (OR 1.49, 95% CI 1.04-2.14) were significantly associated with use of robotic lobectomy. Matched analyses of postoperative outcomes (Table) demonstrate that the mean LOS was shortest in VATS patients (5.9 days), followed by robotic (6.1 days), then open (6.9 days) patients. Compared to VATS, robotic patients had fewer mean lymph nodes (9.9 vs 10.9, $P < .001$) and were less likely to have ≥ 12 nodes examined (32.0% vs 35.6%, $P = .005$). There was no difference between robotic and open or robotic and VATS patients in margin positivity, 30-day readmission, or 30- and 90-day mortality rates.

Conclusions: In patients with operable NSCLC, use of robotic surgery has increased significantly in recent years with postoperative outcomes similar to other surgical approaches. Additional studies are needed to determine whether the known increased costs and learning curve associated with robotic surgery justify its use.

Table: Comparison of Outcomes in Propensity-Matched Open, VATS, and Robotic Lobectomy Patients.

Outcome	Open	VATS	Robotic	P value ^a	P value ^b
Hospital LOS (days), mean (SD)	6.9 (5.7)	5.9 (6.1)	6.1 (5.5)	< 0.001	0.019
Prolonged LOS (> 14 days)	238/3514 (6.8)	165/3588 (4.6)	210/3570 (5.9)	0.123	0.013
Lymph nodes examined, mean (SD)	9.9 (7.5)	10.9 (8.8)	9.9 (7.3)	0.746	< 0.001
≥ 12 lymph nodes examined	1074/3432 (31.3)	1205/3381 (35.6)	1096/3423 (32.0)	0.699	0.005
No lymph nodes examined	81/3432 (2.4)	64/3381 (1.9)	49/3423 (1.4)	0.002	0.166
Positive surgical margin	132/3689 (3.6)	126/3689 (3.4)	125/3689 (3.4)	0.656	0.948
30-day unplanned readmission	146/3674 (4.0)	170/3682 (4.6)	150/3680 (4.1)	0.810	0.258
30-day mortality	64/3530 (1.8)	51/3553 (1.4)	58/3429 (1.7)	0.389	0.545
90-day mortality	117/3405 (3.4)	95/3401 (2.8)	97/3238 (3.0)	0.091	0.877

^aAbbreviations: VATS, video-assisted thoracic surgery; LOS, length of stay; SD, standard deviation.

^bBetween open and robotic resection.

^cBetween VATS and robotic resection.

1:30 PM

Room 120A

Does the Use of Cardiopulmonary Bypass During En Bloc Resection of T4 Non-Small-Cell Lung Cancer Affect Early or Late Outcomes?

N. B. Langer, O. Mercier, S. Mussot, P. G. Dartevielle, E. Fadel

Marie Lannelongue Hospital, Le Plessis Robinson, France

Purpose: A complete, en bloc resection offers the greatest chance of long-term survival in T4 non-small-cell lung cancer (NSCLC). Using cardiopulmonary bypass (CPB) to achieve an en bloc resection is controversial due to potentially increased bleeding, pulmonary edema, and tumor dissemination. We reviewed our institutional experience to assess the effect of CPB on survival.

Methods: We retrospectively reviewed all patients who underwent resection for T4 NSCLC at our institution between 1980 and 2013. Survival analysis was performed using the Kaplan-Meier method, with the log-rank test used to compare groups. Continuous variables were compared with the Student's t-test and discrete variables with Pearson's chi-square test.

Results: 377 consecutive patients underwent en bloc resection with curative intent for T4 NSCLC; 22 required CPB. Mean age was 57 years (range: 30-82). 205 patients had squamous carcinoma, and 172 had non-squamous carcinoma. 104 (28%) received neoadjuvant therapy, and 215 (57%) underwent adjuvant therapy. The use of CPB was planned in 15 of 22 cases (68%) and instituted emergently in seven (32%). There were no statistically significant differences in baseline patient characteristics or medical treatments between the CPB and non-CPB groups. Operative mortality (9% with CPB vs 4.5% without, $P = .37$) and completeness of resection (87% R0 without CPB vs 95% with CPB, $P = .62$) were similar, and the planned vs emergent use of CPB did not affect survival ($P = .56$). Overall and disease-free survival at 1, 3, and 5 years were 48%, 40%, and 27% and 40%, 34%, and 22%, respectively, with no statistically significant difference between the two groups ($P = .75$ and $P = .68$).

Conclusions: The use of CPB allows for complete, en bloc resection in otherwise inoperable patients with T4 NSCLC and offers similar overall and disease-free survival to patients resected without CPB. All thoracic surgeons managing T4 NSCLC should consider using CPB if necessary to achieve a complete, en bloc resection.

NOTES

1:45 PM

Room 120A

Quality Metrics for Minimally Invasive Lobectomy: A Comparison Between Video-Assisted and Robotic Approaches for Clinical Stage I and II Non–Small-Cell Lung Cancer Using the STS National Database

B. E. Louie¹, J. L. Wilson², S. Kim³, R. J. Cerfolio⁴, B. J. Park⁵, A. S. Farivar⁶, E. Vallieres¹, R. W. Aye⁶, W. R. Burfeind⁷, M. I. Block⁸

¹Swedish Cancer Institute, Seattle, WA, ²Beth Israel Deaconess Medical Center, Boston, MA, ³Duke Clinical Research Institute, Durham, NC, ⁴University of Alabama at Birmingham, ⁵Memorial Sloan Kettering Cancer Center, New York, NY, ⁶Swedish Medical Center, Seattle, WA, ⁷St Luke's University Health Network, Bethlehem, PA, ⁸Memorial Healthcare System, Hollywood, FL

COMMERCIAL RELATIONSHIPS R. J. Cerfolio: Consultant/Advisory Board, Intuitive Surgical, Ethicon, Covidien, Bovie Medical Corporation; B. J. Park: Speakers Bureau/Honoraria, Intuitive Surgical; E. Vallieres: Consultant/Advisory Board, Uptake Medical; Speakers Bureau/Honoraria, Genentech, Inc, Myriad Genetics, Inc

Purpose: Data from selected centers show that robot-assisted lobectomy (RAL) is safe, effective, and has comparable 30-day mortality to video-assisted lobectomy (VAL). However, widespread adoption of RAL is controversial. We used the STS General Thoracic Surgery Database to compare and validate quality metrics for these two techniques of minimally invasive lobectomy (MIL).

Methods: A query of the database for instances of primary RAL or VAL for clinical stage I or II NSCLC from 2009 to 2013 identified 1,220 RALs and 12,378 VALs. At least 20 cases per center were required for inclusion of that center. Cases were excluded if preoperative chemotherapy or radiation therapy was received. Quality metrics evaluated included operative, morbidity, 30-day mortality, and nodal upstaging (NU), defined as cN0 to pN1. Multivariable logistic regression was used to evaluate NU.

Results: RALs increased each year and made up 14% of MIL in 2013. RAL patients were older, heavier, less active, and less likely to be an ever smoker (all $P < .05$), and also were more likely to have coronary heart disease or hypertension (all $P < .001$) and have had preoperative mediastinal staging ($P < .0001$). RAL operative times were longer (median 186 minutes vs 173 minutes, $P < .001$); all other operative parameters were similar. All postoperative outcomes were similar, including complications and 30-day mortality (0.6% vs 0.8%, $P = .4$) (RAL vs VAL respectively). Median length of stay was 4 days for both, but a higher proportion of RALs stayed <4 days: 48% vs 39%, $P < .001$. NU overall was similar ($P = .4$). Analysis of NU by cT stage and approach showed a significant interaction ($P = .003$), but strata-specific results were mixed, with trends favoring VAL in the cT1b group and RAL in the cT2a group (Table).

Conclusions: Use of RAL increased during the study period and now represents 14% of MILs. RAL patients had more comorbidities and RAL operative times were longer, but quality outcome measures, including complications, hospital stay, 30-day mortality, and NU, suggest RAL and VAL are equivalent.

Table 1: Association between operative approach and nodal upstaging (cN0 to pN1) stratified by clinical T stage

Strata	Proportion Upstaged		Risk of Upstaging RAL vs. VAL	
	RAL (n=1055)	VAL (n=10 218)	Adjusted OR (95% CI)	Adjusted P
T1a	29/471 (6.2%)	293/4941 (5.9%)	1.01 (0.69, 1.48)	0.9652
T1b	19/293 (6.5%)	238/2715 (8.8%)	0.69 (0.48, 1.01)	0.0536
T2a	34/244 (13.9%)	220/2063 (10.7%)	1.30 (0.95, 1.78)	0.0973
T2b	7/47 (14.9%)	62/499 (12.4%)	1.16 (0.46, 2.92)	0.7592

2:00 PM

Room 120A

Recurrence Patterns After Wedge Resection for Early Stage Lung Cancer: How to Rationally Follow Up to Detect Early Local FailuresA. Bille¹, U. Ahmad³, K. Suzuki¹, K. Woo¹, P. S. Adusumilli¹, J. Huang¹, D. R. Jones¹, N. P. Rizk²¹Memorial Sloan Kettering Cancer Center, New York, NY, ²Memorial Sloan Kettering Cancer Center, Rye, NY, ³Cleveland Clinic, OH

Purpose: A wedge resection for selected patients with early stage non-small cell lung cancer (NSCLC) is a valid option, albeit data suggests a high local and locoregional recurrence rate. The aim of this study was to evaluate recurrence patterns after wedge resection and to recommend a follow-up regimen.

Methods: We conducted a retrospective analysis of 447 consecutive patients who underwent a wedge resection for clinical stage I NSCLC between March 2000 and December 2012. Exclusion criteria included recurrent lung cancers (n=49), receiving adjuvant treatment (n=31), and having a completion lobectomy (n=15). All patients were regularly followed up with a computed tomography (CT) scan with or without contrast (by physician choice). The recurrence was recorded as local (involving the same lobe of the wedge resection), locoregional (involving the mediastinal or hilar lymph node or an ipsilateral lobe), or distant (including distant metastasis and diffuse pleural disease).

Results: Median follow-up for survivors (n=283) was 44.6 months. 164 patients died, with a median overall survival of 82.6 months. Most follow-up CT scans were performed without contrast (n=319, 71%). During follow-up, 36 patients were diagnosed with new primary NSCLC and 152 with recurrence (79 local, 47 locoregional, and 26 distant). The cumulative incidence of recurrence at 1, 2, and 3 years was 11.2%, 22.4%, and 30.9%, respectively. There was no difference in the recurrence detection rate between CT scans with or without contrast ($P=.18$). The cumulative incidence of local recurrences at 1, 2, and 3 years was higher than the cumulative incidence for locoregional and distant recurrences: 5.2%, 11.1%, and 14.9% vs 3.7%, 6.8%, and 10.1% vs 2.3%, 4.5%, and 5.9%, respectively. The recurrence risk reached the plateau after 5 years. At multivariate analysis, the primary tumor diameter was the only independent prognostic factor for local recurrence.

Conclusions: A wedge resection for early stage lung cancer is associated with a significant risk for local and locoregional recurrence. A long-term follow-up regimen is appropriate to monitor for these recurrences, using non-contrast CT scans at consistent intervals for at least 5 years due to the ongoing risk.

NOTES

2:15 PM

Room 120A

Is the T3 Designation Valid in Patients With Centrally Located Non-Small-Cell Lung Cancer?

J. Jeon, M. Kim, J. Lee, H. Yang

Center for Lung Cancer, National Cancer Center, Goyang, South Korea

Purpose: T3 non-small-cell lung cancers (NSCLC) are a heterogeneous group of tumors in terms of T3 descriptors and prognosis. The purpose of this study was to determine the characteristics and prognosis of each descriptor of T3 NSCLC.

Methods: Of 3,241 patients who were operated on for NSCLC between 2001 and 2013, this study included 431 patients who had complete anatomic resection of T3 NSCLC without neoadjuvant treatment. The following potential prognostic factors for disease-free survival (DFS) were investigated: age, sex, operation type, histology type, T3 descriptor, N status, lymphatic invasion, venous invasion, perineural invasion, and adjuvant chemotherapy. The T3 descriptors were coded as follows: tumor invading main bronchus within 2 cm of the carina (T3-cent), tumor invading beyond visceral pleura (T3-inv), tumor larger than 7 cm (T3-size), separate tumor nodules (T3-sep), or tumor with combined T3 descriptors (T3-comb).

Results: There were 375 male patients and 56 female patients with a mean age of 63.6 years ± 8.7 years. In-hospital mortality was 5.8% and the DFS at 5 years was 41.0%. The T3 distribution was as follows: T3-cent, 70 patients (16.2%); T3-inv, 145 patients (33.6%); T3-size, 127 patients (29.4%); T3-sep, 34 patients (7.9%); T3-comb, 55 patients (12.8%). In subgroup analysis, there was significant survival benefit in the T3-cent group compared with other groups (all $P < .05$). The 5-year DFS rates were 53.5%, 38.4%, 41.2%, 34.2%, and 34.1% in the T3-cent, T3-inv, T3-size, T3-sep, and T3-comb subgroups, respectively. On multivariate analysis, age ($P = .042$), N status ($P = .007$), adjuvant chemotherapy ($P = .001$), and T3 descriptors (T3-cent, $P = .007$) were the most important independent prognostic factors for DFS.

Conclusions: The current T3 designation represents a heterogeneous population. Survival for T3 NSCLC located centrally is better than other type T3 NSCLC, and the T3 descriptor may unduly upstage these cases.

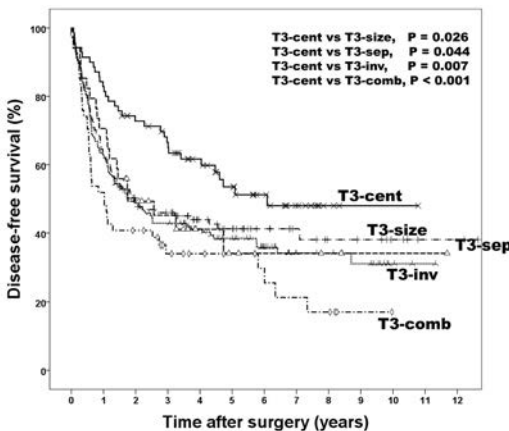


Table 1. Prognostic Factors for Disease-Free Survival in T3 Non-Small Cell Lung Cancer

Variables	Univariate Analysis	Multivariate analysis	
	P	HR (95% CI)	P
Age, years	0.006	1.016 (1.016-1.001)	0.042
Sex (female)	0.458		
Op type (lobectomy)	0.831		
Lymphatic invasion (yes)	0.077		
Venous invasion (yes)	0.454		
Perineural invasion (yes)	0.699		
N status (N0)	0.058		0.007
N1		1.353 (1.017-1.800)	0.038
N2		1.683 (1.194-2.374)	0.003
T3 subgroup (T3-cent)	0.008		0.007
T3-inv		1.887 (1.246-2.858)	0.003
T3-size		1.807 (1.181-2.763)	0.006
T3-sep		1.735 (0.984-3.057)	0.057
T3-comb		2.388 (1.491-3.823)	<0.001
Adjuvant chemotherapy (yes)	<0.001	0.611 (0.463-0.808)	<0.001

2:30 PM

Room 120A

Debate: Post-Resection Surveillance: Does It Make Sense?*PRO: Douglas E. Wood, Seattle, WA***COMMERCIAL RELATIONSHIPS** D. E. Wood: Consultant/Advisory Board, Spiration, Inc; Research Grant, Spiration, Inc*CON: James Jett, Denver, CO*

1:00 PM – 3:00 PM

Room 127ABC

Patient Safety Symposium: When Bad Things Happen to Good CT Surgeons—Human Error and the Impact on You, the “Second Victim”

Within the framework of patient safety is recognizing the importance of human factors. A human factors approach acknowledges that medical errors can result from a combination of individual factors and work system factors. After a medical error or adverse event, involved health care providers are considered “second victims” (subsequent patients who are harmed are “third victims”). The impact of adverse events on second victims is becoming better defined, and what kind of support these individuals need is better understood. The impact of errors or adverse events on the health care provider will be addressed through a series of lectures, panel discussion, and audience interaction.

Learning Objectives

Upon completion of this activity, participants should be able to:

- List human factors in the context of patient safety
- Describe the impact that an adverse event or error may have on a health care provider
- Identify ways to respond and recover after an error or adverse event
- Illustrate the importance of disclosure and legal issues after an adverse event

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of lectures and a panel discussion.

Moderator: James I. Fann, Stanford, CA

COMMERCIAL RELATIONSHIPS J. I. Fann: Consultant/Advisory Board, Twelve, Inc

1:00 PM **Welcome and Introduction**

1:05 PM **Human Factors and System Error: Impact on the Provider**

James Jagers, Aurora, CO

1:35 PM **When Bad Things Happen: Reactions to Recovery From Adverse Events**

Carol-Anne Moulton, Toronto, Canada

2:05 PM **What Is Disclosure and Risk Management?**

Timothy McDonald, Chicago, IL

2:35 PM **Panel Discussion**

Michal Hubka, Seattle, WA, and Kevin W. Lobdell, Charlotte, NC

COMMERCIAL RELATIONSHIPS K. W. Lobdell: Consultant/Advisory Board, Medtronic, Inc

NOTES

1:00 PM – 3:00 PM

Room 126ABC

EACTS @ STS: Aortic Valve Repair and Aortic Root Reconstruction for Insufficient Tricuspid and Bicuspid Pathology

In this session, presented by STS and the European Association for Cardio-Thoracic Surgery, international experts will discuss the various aortic valve repair procedures for both tricuspid and bicuspid valves. Valve repairs utilizing the reimplantation procedure and the remodeling procedure with subannular ring stabilization will be highlighted. Additionally, the session will include discussion of isolated aortic valve repair in the setting of normal aortic root geometry. Emphasis also will be placed on the alternative treatment paradigm of aortic root surgery for aortic valve insufficiency.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Distinguish between various aortic root morphologies and subsequent respective reconstruction techniques for aortic valve repair, such as reimplantation, remodeling, and subannular ring stabilization
- Discuss the results of aortic valve repair in both tricuspid and bicuspid valve diseases, as well as the gold-standard results of aortic root reconstruction with classic Bentall for aortic valve insufficiency
- Recognize the nuanced anatomy of the various valvular characteristics that contribute to aortic valve insufficiency and can be repaired

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold**.

The physician competencies addressed in this session are patient care and procedural skills, medical knowledge, and interpersonal and communication skills. These physician competencies will be addressed through a series of collaborative lectures by members of The Society of Thoracic Surgeons and the European Association for Cardio-Thoracic Surgery.

Moderators: *Joseph E. Bavaria, Philadelphia, PA, and Ruggero de Paulis, Rome, Italy*

COMMERCIAL RELATIONSHIPS J. E. Bavaria: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, COOK Medical, Boston Scientific, W. L. Gore & Associates, St Jude Medical; R. de Paulis: Ownership Interest, Vascutek Ltd a Terumo Company

1:00 PM

Room 126ABC

Introduction

1:05 PM

Room 126ABC

Suture Annuloplasty Significantly Improves the Durability of Bicuspid Aortic Valve Repair

U. Schneider, C. Hofmann, D. Aicher, H. Takahashi, Y. Miura, H. Schäfers

Saarland University Medical Center, Homburg, Germany

Purpose: Isolated repair of the regurgitant bicuspid aortic valve (BAV) with preserved root dimensions has yielded suboptimal durability with annular dilatation as an important risk factor for recurrent aortic regurgitation (AR). We hypothesized that adding a suture annuloplasty (SA) should lead to improved repair stability.

Methods: Between July 1999 and September 2014, 268 patients underwent isolated BAV repair. Mean age was 41 years \pm 13 years; 249 were male. All patients underwent repair for relevant AR; concomitant surgery was performed in 31. All patients underwent repair of cusp prolapse using standard techniques. From January 2009 to September 2014, 164 consecutive patients underwent repair including SA (study) using either braided polyester (n=37) or polytetrafluoroethylene (PTFE) (n=127) placed around the basal ring. The SA was placed internally (n=69) or externally (n=95). Patients who underwent surgery prior to January 2009 served as controls (n=104). All patients were followed (98.9% [n=265] complete, 1 week to 181 months).

Results: Annular size was larger in the study group ($P < .001$), and age was lower ($P < .001$). There were no differences between the groups in other clinical data. Hospital mortality was 0.7% (n=2). Pacemaker implantation was necessary in two patients of the study group. Seven patients died long-term (controls); 10-year survival was 94.2%. Thirty-six patients required valve-related reoperations (8 days to 94 months postoperatively; controls=32, study=4). Complications related to SA (ventricular septal defect, interference with coronary artery) occurred in n=6 (3.7%); in four (10.8%) occurred with polyester SA and in two with PTFE (1.6%). Of these, four occurred after internal and two after external placement of SA. In the controls, freedom from reoperation at 5 and 10 years was 74.2% and 63.4%. With SA, 5-year stability was significantly improved to 92.6% ($P = .0013$); it was 96.7% for PTFE vs 83.5% for polyester SA ($P = .0132$). Five-year freedom from AR \geq II was improved with SA (controls: 68.2%, study: 79.5%, $P = .0092$).

Conclusions: Annular dilatation is a risk factor for failure after repair of regurgitant BAV. Its elimination through the use of SA significantly improves repair stability. With PTFE as material and external placement for SA, optimal repair stability and minimal local complications are achieved.

1:20 PM

Room 126ABC

From Knowledge of Root Geometry to a Step-by-Step Surgical Reimplantation of a 3-Cusp Aortic Valve

Ruggiero de Paulis, Rome, Italy

COMMERCIAL RELATIONSHIPS R. de Paulis: Ownership Interest, Vascutek Ltd a Terumo Company

1:35 PM

Room 126ABC

At the Root of the Repair Debate: Outcomes Following Elective Root Replacements for Ascending Aneurysms and Aortic Insufficiency

F. H. McCarthy¹, J. E. Bavaria², K. M. McDermott¹, P. Moeller³, D. Spragan², M. L. Williams², P. Vallabhajosyula², W. Y. Szeto², N. Desai²

¹Hospital of the University of Pennsylvania, Philadelphia, ²University of Pennsylvania, Philadelphia, ³University of Pennsylvania School of Medicine, Philadelphia

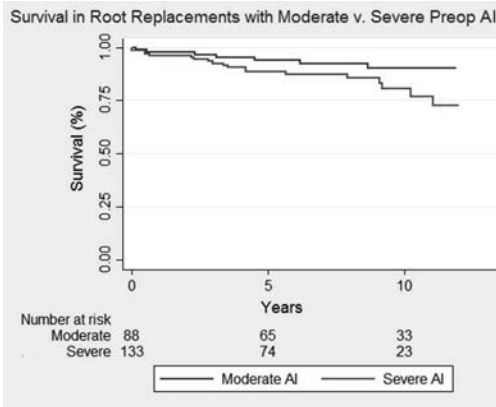
COMMERCIAL RELATIONSHIPS J. E. Bavaria: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, COOK Medical, Boston Scientific, W. L. Gore & Associates, St Jude Medical; N. Desai: Speakers Bureau/Honoraria, Medtronic, Inc, W. L. Gore & Associates; W. Y. Szeto: Consultant/Advisory Board, Micro Interventional Devices, Inc; Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, LivaNova

Purpose: Growing appreciation of bicuspid aortic valve disease and ascending aortopathies has generated increased interest in aortic valve-sparing and valve repair operations. The ideal operation in this generally younger and healthier cohort of patients is controversial because the outcomes of root replacements in these patients has yet to be thoroughly examined.

Methods: A retrospective review was performed of all root replacements at a single institution from 2002 to 2014. Inclusion criteria were age less than 70 years and presence of moderate or greater aortic insufficiency (AI). Exclusion criteria included previous aortic valve replacement (AVR), moderate or greater aortic stenosis (AS), endocarditis, and aortic dissection. Out of an original cohort of 1,425 patients, 221 patients (15%) were considered in the final analysis. Patients were further stratified by degree of presenting AI.

Results: Of the 221 patients, 88 patients presented with moderate AI and 133 patients presented with severe AI. There were no significant differences in baseline demographics or comorbidities, but decreased ejection fractions and increased ventricular diameters in severe AI patients (Table). There were no significant differences in the postoperative complications of stroke, prolonged ventilation, renal failure, or atrial fibrillation. Thirty-day mortality was 0% in moderate AI patients and 2% (three) in severe AI ($P = .3$). Freedom from reoperation was 95% at 10 years. Survival at 10 years was 84%. Severe preoperative AI was associated with worse long-term survival compared to moderate AI in univariate analysis (logrank $P = .03$, Figure) and a multivariable analysis (HR 2.6, $P = .04$). Biologic vs mechanical prosthesis was not associated with increased mortality (logrank $P = .6$). Other multivariable predictors of increased long-term mortality were age (HR 1.1, $P = .01$) and preoperative renal failure (HR 6.9, $P < .01$).

Conclusions: Outcomes following Bentall root replacement operations were excellent and should be considered as the benchmark for aortic valve-sparing or repair operations. Increased mortality was associated with severe aortic insufficiency and increased age, providing some supporting evidence for earlier intervention in this cohort.



	Moderate AI (n=88)	Severe AI (n=133)	p
PREOP			
Age (mean ±SD)	51.5 ±12.8	52.0 ±11.0	0.7
Male	80% (70)	85% (113)	0.2
NYHA III/IV	18% (13)	31% (37)	0.0
Renal Failure	2.3% (2)	4.5% (6)	0.5
PREOP ECHO			
EF (mean ±SD)	58% ±10.2	52% ±12.7	<0.01
Aortic Insufficiency	2	3	n/a
LVEDD cm (mean ±SD)	3.7 ±0.9	4.2 ±1.0	<0.01
LVEDD cm (mean ±SD)	5.7 ±0.9	6.2 ±1.1	0.001
Mitral Regurgitation (median, IQR)	0 (0-1)	0 (0-1)	0.3
Tricuspid Regurgitation (median, IQR)	0 (0-1)	0 (0-1)	0.1
POSTOP			
Reoperation - Bleeding	3.4% (3)	2.2% (3)	0.6
Stroke	0	1.5% (2)	0.5
Renal Failure	0	2.2% (3)	0.2
Dialysis	0	1.5% (2)	0.5
Prolonged Ventilation	5.6% (5)	7.5% (10)	0.7
Pneumonia	2.2% (2)	1.5% (2)	0.6
Atrial Fibrillation	27% (24)	22% (30)	0.2
Multisystem Organ Failure	1.1% (1)	0	0.3
30 Day Mortality	0	2% (3)	0.9

1:50 PM

Room 126ABC

Valve-Sparing Root Replacement in Bicuspid Valves: Managing the Annulus and Cusps

Munir H. Boodhwani, Ottawa, Canada

TUESDAY AFTERNOON

2:05 PM

Room 126ABC

Impact of Cusp Repair on Reoperation Risk Following the David Procedure: Subgroup Analysis of Patients With Bicuspid and Tricuspid Aortic Valves

F. Settepani, A. Cappai, A. Basciu, M. Moz, A. Barbone, E. Citterio, D. Ornaghi, G. Tarelli

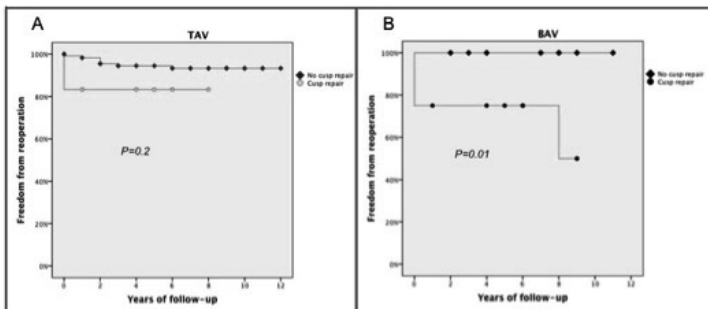
Humanitas Clinical and Research Center, Rozzano, Italy

Purpose: Valve-sparing aortic root replacement has been performed progressively widely; however, evidence of durability following adjunctive cusp repair is limited in literature. We assessed whether adjunctive cusp repair affects the echocardiographic mid-term results; a subgroup analysis among patients with bicuspid aortic valve (BAV) and tricuspid aortic valve (TAV) was performed.

Methods: Between June 2002 and May 2015, 157 consecutive patients underwent valve-sparing aortic root replacement with the David technique. The mean age was 61 years \pm 12 years. Thirty patients (19%) had BAV. Preoperative aortic regurgitation was grade III or IV in 96 patients (61%). In 19 cases (12%), cusp motion or anatomical abnormalities concurred in determining aortic regurgitation requiring an adjunctive cusp repair. Mean cardiopulmonary bypass time was 138 minutes \pm 32 minutes, and the mean duration of aortic cross clamping time was 118 minutes \pm 25 minutes. Follow-up ranged from 1 to 12 years (mean 7 years \pm 3.4 years) and was 99% complete.

Results: The mortality pre-discharge was 1.2% (two patients). The cumulative 1-, 5-, and 12-year survival rates were 98%, 94%, and 90%, respectively. Fourteen patients developed severe aortic regurgitation during follow-up requiring aortic valve replacement. In two cases (1.2%), the underlying cause was bacterial endocarditis. Freedom from reoperation due to structural valve deterioration and severe aortic regurgitation was 96% at 1 year, 93% at 5 years, and 91% at 12 years. The rate of aortic valve reoperation was significantly higher ($P < .001$) in patients who received leaflet repair when compared with patients who did not, with a freedom from reoperation at 8 years of 58% vs 94%. Interestingly, among patients with BAV, those who didn't require cusp repair had a freedom from reoperation at 8 years of 100%, with a significant difference when compared with patients who received cusp repair ($P = .01$). Conversely, cusp repair didn't affect reoperation risk in patients with TAV (Figure).

Conclusions: Adjunctive cusp repair seems to affect the mid-term reoperation risk in patients with BAV and not in patients with TAV. A careful evaluation of the valve in the setting of BAV is mandatory, and we recommend caution in using this technique in case of asymmetric BAV requiring cusp repair.



2:20 PM

Room 126ABC

Reimplantation for Type A Dissection: Technique and Result

Himanshu J. Patel, Ann Arbor, MI

COMMERCIAL RELATIONSHIPS H. J. Patel: Consultant/Advisory Board, W. L. Gore & Associates, Inc, Vascutek Ltd a Terumo Company

2:35 PM

Room 126ABC

Severity of Preoperative Aortic Regurgitation Does Not Impact Valve Durability of Aortic Valve Repair Following the David V Valve-Sparing Aortic Root ReplacementW. B. Keeling¹, B. G. Lesnower², J. Binongo¹, L. McPherson¹, E. P. Chen¹¹Emory University, Atlanta, GA, ²Emory University School of Medicine, Atlanta, GA

Purpose: The David V valve-sparing aortic root replacement (VSRR) is an established therapy for aortic root pathology. However, the severity of preoperative aortic regurgitation (AR) and its impact on valve function remains unclear. The study investigated the impact of preoperative AR on mid-term durability following VSRR.

Methods: A retrospective review of the adult cardiac surgical database at a single academic center was undertaken from 2005 to 2015 for 223 adult patients who underwent VSRR. Among them, 107 patients had preoperative AR <2 and 116 patients had preoperative AR ≥2. Patients were followed prospectively and had annual echocardiograms. Follow-up was 96.3% complete, and the mean echocardiographic follow-up period was 20.3 months (range: 1-116). Comparisons were then made between survivors who had preoperative AR <2 and preoperative AR ≥2 to determine the impact of preoperative AR on durability.

Results: There were five in-hospital deaths (2.2%) in the series, leaving 218 patients (97.8%) available for long-term follow-up. Forty-six patients had a bicuspid valve (20 AR <2, 26 AR ≥2, $P = ns$). Use of hypothermic circulatory arrest for arch reconstruction was similar between groups (preoperative AR <2 47.66% vs preoperative AR ≥2 53.45%, $P = .39$). More patients with preoperative AR ≥2 required cusp repair (37.1%) than those with preoperative AR <2 (18.69%, $P = .00$). At mid-term follow-up, the freedom from >2+ AR was not significantly different between groups (preoperative AR <2 94.4% vs preoperative AR ≥2 88.86%, $P = .27$) (Figure). Freedom from aortic valve replacement (AVR) also was similar between groups and not impacted by degree of preoperative AR (preoperative AR <2 96.64% vs preoperative AR ≥2 98.04%, $P = .74$). Patients with preoperative AR ≥2 experienced greater reverse left ventricular (LV) remodeling and increases in left ventricular ejection fraction than patients with preoperative AR <2 (Table). Preoperative AR ≥2 did not represent an adverse risk factor for recurrent AR ≥2 (OR 0.26, $P = .09$) or AVR (OR 1.09, $P = .94$).

Conclusions: VSRR can be safely and effectively performed in the setting of preoperative AR. Patients with worse preoperative AR had better improvement in LV remodeling. Worsening severity of preoperative AR does not impact freedom from moderate to severe AR or freedom from AVR at mid-term follow-up.

Figure 1 – Mid-Term Freedom from Recurrent 2+ AR (p=0.27)

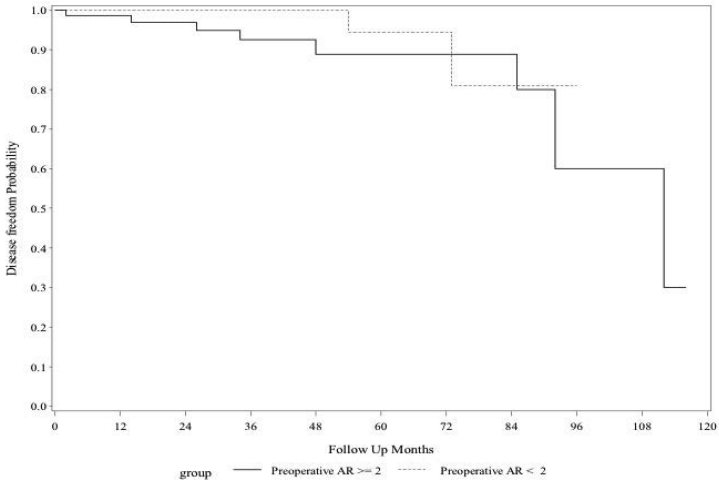


Table 1 – Mid-Term Echocardiographic Data

	Pre-op AR<2	Pre-op AR 2+	p-value
Change in EF (%)	0.62 +/- 8.26	4.76 +/- 10.22	0.02
Change in LVESD (cm)	-0.11 +/- 0.81	-0.63 +/- 0.80	<0.01
Change in LVEDD (cm)	-0.12 +/- 0.63	-0.84 +/- 0.72	<0.01

2:50 PM

Room 126ABC

Panel Discussion

TUESDAY AFTERNOON

1:00 PM – 3:30 PM

Room 123

JCTSE: Accountable Surgical Education—How Can Cardiothoracic Surgery Move Forward?

New technology and science are changing the landscape of both resident and continuing education in cardiothoracic surgery. Simply showing up at an annual scientific meeting or completing a surgical fellowship may not be enough in the future to ensure either cognitive or technical competency. This session will show how advances in surgical education through curriculum implementation, faculty development, and the introduction of learning management systems (LMS) may improve accountability in the specialty's educational efforts.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Describe the potential of e-learning and the use of an LMS
- Explain the joint efforts of STS and JCTSE in developing a thoracic surgery curriculum and LMS
- Create an electronic learner portfolio
- Apply improved competency in resident and continuing surgical education

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

The physician competencies addressed in this session are systems-based practice, professionalism, and interpersonal and communication skills. These physician competencies will be addressed through a series of lectures followed by in-depth discussion.

Moderator: Edward D. Verrier, Seattle, WA

1:00 PM Welcome and Introductory Remarks

1:15 PM Introducing the New Thoracic Surgical Curriculum

Craig J. Baker, Los Angeles, CA

1:30 PM Discussion

1:40 PM Accountability in Surgical Curriculum Development Using an Electronic Platform

Ara A. Vaporciyan, Houston, TX

COMMERCIAL RELATIONSHIPS A. A. Vaporciyan: Nonremunerative Position of Influence, American Board of Thoracic Surgery

1:55 PM Discussion

2:05 PM Progress in Adopting a Global Curriculum

Rafael Sadaba, Pamplona, Spain

2:20 PM Discussion

2:30 PM Gamification of Surgical Education

Nabush A. Mokadam, Seattle, WA

COMMERCIAL RELATIONSHIPS N. A. Mokadam: Consultant/Advisory Board, Thoratec Corporation, HeartWare, Inc, SynCardia Systems, Inc, St Jude Medical

2:45 PM

Discussion

2:55 PM

EACTS Portfolio Tool to Monitor Surgical Training

A. Pieter Kappetein, Rotterdam, The Netherlands

COMMERCIAL RELATIONSHIPS A. P. Kappetein: Research Grant, Medtronic, Inc

3:10 PM

Panel Discussion

1:00 PM – 5:30 PM

Room 128AB

Advanced Therapies for End-Stage Heart Disease

In this interactive session, leading experts will discuss practice recommendations for patients receiving mechanical circulatory support, heart transplantation, and alternative treatment options for end-stage heart disease. They also will review results from recent related major trials, explain new data on risk factors for adverse events, and present strategies to improve efficiency and quality of care.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Identify current and appropriate indications for treatment of end-stage heart disease, including mechanical circulatory support, heart transplantation, and newer alternative treatment options
- Identify alternative non-mechanical or non-transplant treatment strategies that can lead to improved patient outcomes
- Discuss the results from recent major studies in the field that have had a significant impact on patient selection and patient care practices
- Describe new trials and technology that will be or have been recently introduced into the field

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold**.

The physician competencies addressed in this session are patient care, medical knowledge, and practice-based learning and improvement. These physician competencies will be addressed through a series of lectures meant to enhance the understanding of patient selection, new technologies and devices, and how to tailor devices to patients.

Moderators: Robert L. Kormos, Pittsburgh, PA, Nahush A. Mokadam, Seattle, WA, Francis D. Pagani, Ann Arbor, MI, and Craig H. Selzman, Salt Lake City, UT

COMMERCIAL RELATIONSHIPS N. A. Mokadam: Consultant/Advisory Board, Thoratec Corporation, HeartWare, Inc, SynCardia Systems, Inc, St Jude Medical

1:00 PM

Room 128AB

Has ENDURANCE or ROADMAP Changed the Practice of Ventricular Assist Device (VAD) Therapy in the US?

Michael A. Acker, Philadelphia, PA

COMMERCIAL RELATIONSHIPS M. A. Acker: Consultant/Advisory Board, Thoratec Corporation, HeartWare, Inc

1:15 PM

Room 128AB

New VAD Trials and Technology: Better or Just New?

Daniel J. Goldstein, Bronx, NY

COMMERCIAL RELATIONSHIPS D. J. Goldstein: Consultant/Advisory Board, Medtronic, Inc, Sunshine Heart, Inc, Thoratec, St Jude Medical; HeartWare

REGULATORY DISCLOSURE This presentation will address the HeartMate 3, which is not FDA approved.

1:30 PM

Room 128AB

Percutaneous Non-Extracorporeal Membrane Oxygenation Mechanical Circulatory Support: Developing a Rational Approach to Treatment of Shock*Carmelo A. Milano, Durham, NC*

COMMERCIAL RELATIONSHIPS C. A. Milano: Consultant/Advisory Board, HeartWare, Inc

1:45 PM

Room 128AB

If Not a Heart Transplant or VAD, Then What? High-Risk Alternative Strategies in the Era of STS National Database Reporting*Nicholas G. Smedira, Cleveland, OH*

2:00 PM

Room 128AB

Non-Sternotomy Approaches to VAD Implantation: Is Less Better?*Jay D. Pal, Seattle, WA*

2:15 PM

Room 128AB

Panel Discussion

2:30 PM

Room 128AB

The Safety and Utility of Nurse-Managed Extracorporeal Life Support in an Adult Cardiothoracic Intensive Care Unit

A. E. Hackmann¹, L. M. Wiggins¹, G. Grimes², F. Schenke², M. Barr¹, M. E. Bowdish³, M. Cunningham¹, V. A. Starnes³, R. Fogel²

¹University of Southern California, Los Angeles, ²Keck Hospital, University of Southern California, Los Angeles, ³University of Southern California Keck School of Medicine, Los Angeles

COMMERCIAL RELATIONSHIPS M. E. Bowdish: Research Grant, Medtronic, Inc, HeartWare, Inc, Sunshine Heart, Inc, Thoratec Corporation; M. Cunningham: Speakers Bureau/Honoraria, Medtronic, Inc

Purpose: The use of extracorporeal life support (ECLS) worldwide has increased exponentially since 2009. The critically ill patient requiring ECLS demands a significant investment of hospital resources, including personnel. Educating bedside nurses to manage ECLS circuits broadens the availability of trained providers, which can accommodate this growing patient population.

Methods: Experienced cardiothoracic intensive care unit (CT ICU) nurses underwent extensive training regarding bedside management of ECLS circuits, including volume assessment, analysis and treatment of arterial blood gas (ABG) values, the physiology of various ECLS configurations, and recognition of common emergencies. In addition to lectures and written exams, hands-on simulation using water circuits and a virtual ICU model allowed assessment of skills and understanding of concepts in a variety of settings. Performance assessments were completed regularly at the bedside, and skills revalidation occurred every 6 months and as needed. A sequential cohort of 40 patients was tracked over 1 year.

Results: Despite doubling the census of ECLS patients in 1 year, management by specially trained CT ICU nurses has positively impacted patient care and outcomes. At a single institution, 40 patients had a median of 6 days (range: 2-226) of support in 2014 leading to 767 patient-days of support (Table). Indications for support included: postcardiotomy shock, massive pulmonary embolus, post-cardiac arrest, myocardial infarction, pre-heart or lung transplant, posttransplant graft dysfunction, post-left ventricular assist device (LVAD) right ventricular failure, H1N1 influenza, and acute respiratory distress syndrome. Overall survival to hospital discharge increased from 20% in 2013 to 45% in 2014, which exceeds the internationally reported average of 41%. Of those patients surviving, two underwent lung transplantation and two received implanted LVADs. The remaining survivors weaned from support. Neurological injury was the most common cause of death, followed by failure to qualify for long-term advanced therapies (transplant or LVAD).

Conclusions: With intensive, ongoing education and assessment, including crisis training, physiology, and cannulation strategies, CT ICU nurses can safely operate ECLS circuits. Nurse-managed ECLS models allow increased availability of appropriately trained providers to accommodate the exponential increase in ECLS cases without negatively impacting outcomes and generally at a lower cost.

Modality	Number of Patients	Time on Support (days)	Median Days on support	Survival to Discharge (%)
VV	7	185	15	57
VA/VAV	22	128	3.5	50
LVAD	3	60	13	33
RVAD	3	54	23	67
BiVAD	5	340	41	0
Total	40	767	6	45

2:45 PM

Room 128AB

Posttransplant Outcomes Among Septuagenarians Bridged to Heart Transplantation With Continuous-Flow Left Ventricular Assist DevicesS. Fukubara¹, K. Takeda², P. A. Kurlansky³, A. R. Polanco², H. Takayama², Y. Naka⁴¹Columbia University Medical Center, Fort Lee, NJ, ²Columbia University Medical Center, New York, NY, ³Columbia University, New York, NY, ⁴Columbia University College of Physicians and Surgeons, New York, NY**COMMERCIAL RELATIONSHIPS** Y. Naka: Consultant/Advisory Board, Thoratec Corporation

Purpose: Bridge to transplant (BTT) strategy with continuous-flow left ventricular assist devices (CF-LVADs) is increasingly being offered to older patients. However, the upper patient age limit for this therapy has not been defined, and few studies have evaluated outcomes in CF-LVAD-supported BTT patients aged 70 years or older.

Methods: The United Network of Organ Sharing Database was used to identify 21,258 heart transplant recipients from 2004 to 2014. Of these, 4,850 (22.8%) were bridged with CF-LVAD. Recipients were stratified by age: Group 1 (70 years or older, n=115, 2.4%) and Group 2 (18–69 years, n=4,735, 97.6%). Clinical characteristics and outcomes were compared between groups. Patients in Group 1 more likely had ischemic etiology (69.6% vs 41.0%; $P < .001$), more often received a heart from an older (35.8 years vs 31.3 years, $P < .001$) and expanded criteria donor (8.7% vs 2.4%; $P < .001$) than did patients in Group 2.

Results: Patients in Group 1 had decreased 90-day (88.8% vs 93.2%, $P = .021$) and 3-year posttransplant survival (80.9% vs 85.7%; $P = .073$) compared with recipients in Group 2. However, analysis of a propensity score-matched cohort, adjusting recipient MELD-XI score, donor-recipient weight ratio, inotropic and mechanical ventilator support, gender mismatch, organ ischemic time, and donor age, did not demonstrate survival difference at 90 days and 3 years between groups (Figure 1A). Multivariable Cox regression analyses among subjects aged ≥ 70 years revealed MELD-XI score ≥ 15 to be an independent predictor for 90-day (HR 6.11, 95% CI 1.93–19.37; $P = .002$) and 3-year mortality (HR 5.24, 95% CI 2.11–13.03; $P < .001$), whereas functional independency at time of transplant was an independent protective factor for 3-year mortality (HR 0.10, 95% CI 0.13–0.83; $P = .033$). Functionally independent individuals at time of transplant demonstrated an excellent early and mid-term posttransplant survival (Figure 1B).

Conclusions: Despite controversy, CF-LVAD-supported septuagenarians were not associated with increased posttransplant mortality. Functional outcomes during device support, rather than an absolute age cutoff, may have important implications in organ allocation in the device-supported elderly population.

Figure 1A
Three-year Kaplan-Meier curve of the propensity-matched cohort

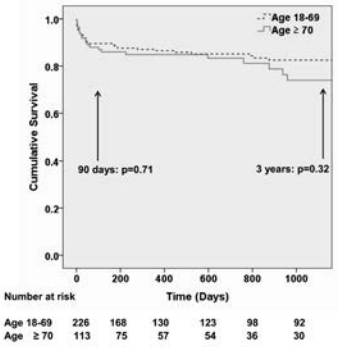
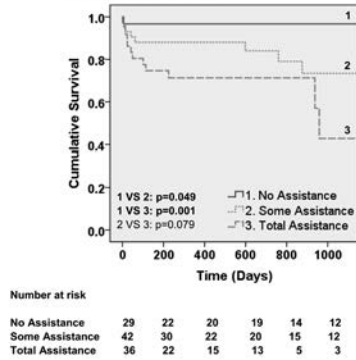


Figure 1B
Three-year Kaplan-Meier curve among septuagenarians stratified by functional status



3:00 PM

Break

3:30 PM

Room 128AB

VAD Therapy or Transplant for Adult Congenital Heart Disease: Unique Challenges and Solutions

Gonzalo V. Gonzalez-Stawinski, Dallas, TX

3:45 PM

Room 128AB

An Update on the STICH Trial Results: Is There Evidence to Change our Approach to Ischemic Heart Disease?

Eric J. Velazquez, Durham, NC

COMMERCIAL RELATIONSHIPS E. J. Velazquez: Research Grant, NHLBI

4:00 PM

Room 128AB

Consideration of Percutaneous Options for Structural Heart Disease in the Setting of Severe Left Ventricle Dysfunction

Stephanie L. Mick, Cleveland, OH

4:15 PM

Room 128AB

Evolution of Surgical Management of Functional Mitral Insufficiency

Donald D. Glower, Durham, NC

4:30 PM

Room 128AB

Panel Discussion

TUESDAY AFTERNOON

Duration of Left Ventricular Assist Device Support Does Not Impact Survival Following Heart Transplantation in the US

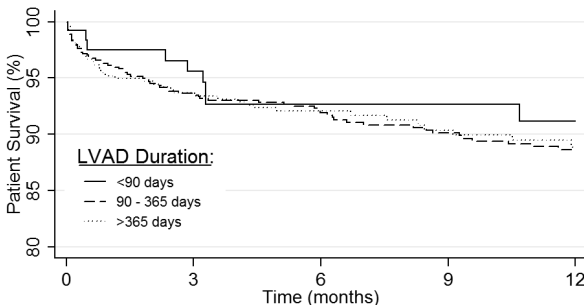
J. C. Grimm, J. Magruder, T. C. Crawford, W. G. Plum, C. Sciortino, A. S. Shah, G. J. Whitman
The Johns Hopkins Hospital, Baltimore, MD

Purpose: The aim of this study was to determine whether the duration of left ventricular assist device (LVAD) support influenced outcomes following orthotopic heart transplantation (OHT) in a modern, bridge to transplant (BTT) national cohort.

Methods: The United Network for Organ Sharing database, which recently has made pre-transplant LVAD duration available, was queried for all adult BTT patients between January 2011 and December 2012. Three LVAD duration cohorts were generated as follows: Cohort 1 (<90 days), Cohort 2 (90-365 days), and Cohort 3 (>365 days). Recipient, donor, and transplant-specific characteristics were compared among the duration cohorts. Unadjusted short- and long-term survival was estimated with the Kaplan-Meier method. Risk-adjusted models also were constructed to determine the independent impact of device duration on mortality.

Results: Of the 1,332 patients that met criteria for inclusion, 9.8% (n=130), 54.7% (n=729), and 35.5% (n=473) were classified as Cohort 1, Cohort 2, and Cohort 3, respectively. While the performance status across each cohort was similar at listing (P = .38), more patients in Cohorts 2 and 3 were considered functionally independent prior to OHT (2: 32% and 3: 37% vs 1: 18%, P < .001). Additionally, despite worse baseline renal function in Cohorts 2 and 3 relative to Cohort 1 (glomerular filtration rate – 2: 57 and 3: 57 vs 1: 69, P < .001), there was no difference in the incidence of new onset posttransplant renal failure (1: 7% vs 2: 10% vs 3: 9%, P = .41). There also was no difference in 30-day (98% vs 96% vs 95%, P = .51), 6-month (93% vs 92% vs 92%, P = .93), or 1-year (91% vs 89% vs 89%, P = .78) survival across the cohorts (Figure). After risk adjustment, duration did not independently predict mortality at any time point.

Conclusions: In the largest, non-industry sponsored study of a modern BTT cohort, we demonstrated that duration of LVAD support prior to OHT does not influence posttransplant morbidity or mortality. In subanalysis, support ≥90 days is associated with improvements in pre-transplant functional performance.



Number at risk	0	3	6	9	12
<90 days	127	99	81	62	43
90 - 365 days	714	559	474	379	249
>365 days	459	355	274	207	133

5:00 PM

Room 128AB

Correlation of Pre-Explant Lactate Dehydrogenase Levels and Findings During Post-Explant Pump Analysis of the HeartMate II Left Ventricular Assist Device

V. Sood¹, F. D. Pagani¹, D. L. Joyce², L. D. Joyce², R. C. Daly², J. M. Stulak²

¹University of Michigan Health System, Ann Arbor, ²Mayo Clinic, Rochester, MN

COMMERCIAL RELATIONSHIPS R. C. Daly: Ownership Interest, NeoChord, Inc

Purpose: Detailed analyses of HeartMate II left ventricular assist device (LVAD) are routinely performed after explant if returned to the manufacturer. Pumps may be explanted under a variety of clinical situations for varying reasons, but findings from inside the pump have not been correlated to pre-explant lactate dehydrogenase (LDH) values.

Methods: Between May 2004 and December 2014, 502 patients underwent HeartMate II implantation at our centers. During this time, 84 pumps were explanted; 53/84 (63%) for suspected thrombosis and 31/84 (37%) for infection or lead fracture. Median time from implant to explant was 14 months (range: 1 month to 5.2 years) and median time to first hemolysis event in those with suspected pump thrombus was 9 months (range: 1-57). Median LDH level 1 month prior to first hemolysis event was 470 (max: 963) in those with pump thrombus and 344 (max: 523) in those without during the same timeframe ($P = .012$).

Results: On pump analysis, thrombus was noted on the inlet portion of the pump in 32 patients (60%), outlet portion in 25 (47%), and impeller in 16 (30%). During the month between first hemolysis event and pump explant, median LDH level in thrombus patients was 937 (max: 3153) and 377 (max: 1325) in non-thrombus patients ($P < .001$). Adverse events in the month preceding device explants were similar between thrombus and non-thrombus patients, respectively, and included gastrointestinal bleeding (5/53 vs 4/31, $P = .62$), ischemic stroke (2/53 vs 2/31, $P = .58$), and hemorrhagic stroke (1/53 vs 0/31, $P = .45$).

Conclusions: Thrombus can be present on all portions of the pump, and pre-explant LDH levels were significantly higher in these patients. Despite differing indications for pump explant, adverse event rates were similar between groups. These data can help establish confidence intervals to aid in interpreting LDH levels with suspected thrombus.

5:15 PM

Room 128AB

Uncorrected Significant Mitral Valve Regurgitation Is Associated With Decreased Survival and Increased Readmissions After Left Ventricular Assist Device Implantation

A. Tanaka¹, D. Onsager¹, D. Cozadd¹, G. Kim², S. Adatya¹, N. Sarswat¹, G. Sayer², S. Fedson², V. Jeevanandam¹, N. Uriel², T. Ota¹

¹The University of Chicago, IL, ²The University of Chicago Medical Center, IL

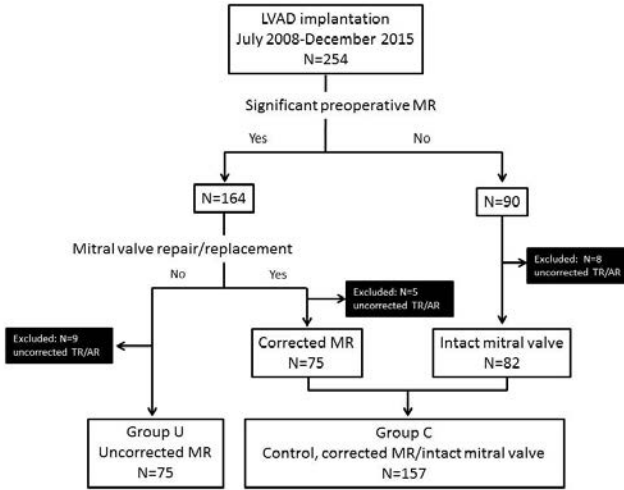
COMMERCIAL RELATIONSHIPS V. Jeevanandam: Consultant/Advisory Board, Thoratec Corporation, ReliantHeart, Inc, HeartWare, Inc; N. Uriel: Consultant/Advisory Board, Thoratec Corporation, HeartWare, Inc; Research Grant, HeartWare, Inc

Purpose: This is a retrospective, single-institutional study to investigate the impact of significant preoperative mitral regurgitation (MR) in patients undergoing left ventricular assist device (LVAD) implantation.

Methods: From July 2008 to December 2014, 254 patients underwent HeartMate II LVAD implantation. A total of 186 patients presented with preoperative significant MR defined as more than moderate MR, and 80 patients received concomitant mitral valve procedure. Patients with uncorrected significant tricuspid/aortic regurgitation were excluded from the study (n=22, Figure). The cohort was divided into two groups: Group U with uncorrected MR (n=75) and Group C without significant MR (n=157, 75 patients with surgically corrected MR and 82 patients with preoperatively intact mitral valve). Pre- and postoperative data were retrospectively reviewed.

Results: Preoperative patient demographics were similar in the two groups except for significantly higher median pulmonary wedge pressure (PWP) in Group U (Group U=26 [IQR: 21-33], Group C=24 [IQR: 18-28], $P = .017$). Concomitant valve procedures were performed in 71% (111/157) of patients in Group C (mitral=23, mitral+aortic=3, mitral+tricuspid=45, mitral+aortic+tricuspid=9) and 57% (43/75) of patients in Group U (aortic=1, tricuspid=35, aortic+tricuspid=7). In-hospital mortality was 18.7% in Group U and 11.5% in Group C ($P = .145$). Mean pulmonary artery pressure (mPA) and PWP during follow-up were significantly lower in Group C compared to Group U (mPA: Group C=22 [IQR: 15-30], Group U=27 [IQR: 22-33], $P = .036$; PWP: Group C=12 [IQR: 7-18], Group U=16 [IQR: 11-22], $P = .023$). Kaplan-Meier analysis demonstrated that Group C had significantly higher survival rate and improved freedom from heart failure readmission compared to Group U (survival at 1 year: Group C=72.4% \pm 3.7%, Group U=57.3% \pm 5.9%, $P = .041$ [log-rank]; heart failure readmission free at 1 year: Group C=89.3% \pm 2.8%, Group U=80.8% \pm 5.9%, $P = .063$ [log-rank]).

Conclusions: Concomitant mitral valve procedures did not increase in-hospital mortality and morbidity. Uncorrected MR during follow-up was associated with decreased survival and increased readmissions due to heart failure. Aggressive mitral valve intervention during LVAD implantation may contribute to improved mid-term hemodynamics and survival.



3:00 PM – 3:30 PM

BREAK—Visit Exhibits and Scientific Posters

Complimentary coffee available in the Exhibit Hall

3:30 PM – 5:30 PM

Room 120D

Adult Cardiac Session: Aorta II*Moderators: Thomas E. MacGillivray, Boston, MA, and Eric E. Roselli, Cleveland, OH***COMMERCIAL RELATIONSHIPS** E. E. Roselli: Speakers Bureau/Honoraria, Edwards Lifesciences Corporation; Consultant/Advisory Board, Medtronic, Inc, Bolton Medical, Apica Ltd; Research Grant, LivaNova, Medtronic, Inc, CorMatrix; Other, Direct Flow Medical, Inc

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold**.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

3:30 PM

Room 120D

Moderate vs Deep Hypothermic Circulatory Arrest Is Associated With Similar Postoperative Kidney Function in Elective Aortic Hemiarch Reconstruction**G. J. Arnaoutakis¹, P. Vallabajosyula², I. Sultan³, M. Siki², S. Naidu², N. Desai², R. Milewsk², M. L. Williams², W. C. Hargrove⁴, J. E. Bavaria², W. Y. Szeto²**

¹University of Pennsylvania Health System, Philadelphia, ²University of Pennsylvania, Philadelphia, ³Hospital of the University of Pennsylvania, Philadelphia, ⁴Penn/Presbyterian Medical Center, Philadelphia, PA

COMMERCIAL RELATIONSHIPS J. E. Bavaria: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, COOK Medical, Boston Scientific, W. L. Gore & Associates, St Jude Medical; N. Desai: Speakers Bureau/Honoraria, Medtronic, Inc, W. L. Gore & Associates; W. C. Hargrove: Consultant/Advisory Board, Edwards Lifesciences Corporation, LivaNova, AtriCure, Inc; W. Y. Szeto: Consultant/Advisory Board, Micro Interventional Devices, Inc; Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, LivaNova

Purpose: Although moderate hypothermic circulatory arrest (MHCA) with antegrade cerebral perfusion (ACP) has similar stroke and mortality outcomes to deep hypothermic circulatory arrest (DHCA) with retrograde cerebral perfusion (RCP), criticism remains that MHCA may lead to worse distal organ malperfusion. We compared postoperative acute kidney injury (AKI) in elective hemiarch repair with either DHCA/RCP or MHCA/ACP.

Methods: This was a retrospective review of all patients undergoing elective hemiarch reconstruction for aneurysmal disease between 2009 and 2014. Patients were stratified according to use of DHCA/RCP vs MHCA/ACP. The primary outcome measure was the occurrence of AKI at 48 hours, as defined by the novel Risk, Injury, Failure, Loss, End Stage (RIFLE) criteria. Glomerular filtration rate (GFR) was determined according to the Modification of Diet in Renal Disease (MDRD) formula. ACP was performed via axillary artery or direct innominate artery cannulation. After testing for univariate associations, a multivariable logistic regression was performed to identify risk factors for AKI.

Results: There were 118 ACP and 471 RCP patients included. Mean lowest temperature was 26.5°C in ACP patients and 18.1°C in RCP patients. Baseline demographics were similar except RCP patients were more likely to have peripheral arterial disease or bicuspid aortic valves. Cardiopulmonary bypass and aortic cross clamp times were shorter in the ACP group. AKI as defined by RIFLE-R, I, or F occurred in 15 ACP patients (14.7%) and 66 RCP patients (14.2%), $P = .3$. Four RCP patients (0.8%) required postoperative dialysis.

In-hospital mortality tended to increase with increasing RIFLE classification (RIFLE class 0 = 0.83%, R = 1.35%, and I = 8.3%, $P = .2$). On multivariable analysis, lowest temperature and cerebral perfusion method were not significant predictors of AKI. Lower baseline GFR and longer cardiopulmonary bypass time were independently associated with higher AKI.

Conclusions: We applied the sensitive RIFLE criteria to examine AKI in patients undergoing elective hemiarach replacement for aneurysmal disease. Baseline renal dysfunction and longer cardiopulmonary bypass time are independent predictors of AKI. Neither DHCA/RCP nor MHCA/ACP cerebral protection strategy is associated with worse postoperative renal outcomes.

Table 4: Multivariable logistic regression for Predictors of AKI



Variable	Odds Ratio	95% CI	P-value*
RCP	0.93	0.33-2.63	0.9
Age, years	0.99	0.97-1.02	0.6
Female gender	0.78	0.40-1.56	0.5
CPB time	1.01	1.00-1.01	0.03
Ejection fraction	0.98	0.95-1.01	0.1
Cerebral perfusion / distal organ ischemia time	0.99	0.95-1.03	0.5
Lowest body temperature	0.99	0.90-1.08	0.8
Baseline GFR > 60	0.34	0.14-0.77	0.01



3:45 PM

Room 120D

The Differential Impact of Anemia on Outcomes in Transcatheter vs Surgical Aortic Valve Replacement

F. H. McCarthy¹, K. M. McDermott¹, A. C. Hoedt¹, D. Spragan², P. Vallabhajosyula², W. Y. Szeto², M. L. Williams², J. E. Bavaria², N. Desai²

¹Hospital of the University of Pennsylvania, Philadelphia, ²University of Pennsylvania, Philadelphia

COMMERCIAL RELATIONSHIPS J. E. Bavaria: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, COOK Medical, Boston Scientific, W. L. Gore & Associates, St Jude Medical; N. Desai: Speakers Bureau/Honoraria, Medtronic, Inc, W. L. Gore & Associates; W. Y. Szeto: Consultant/Advisory Board, Micro Interventional Devices, Inc; Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, LivaNova

Purpose: To investigate the differential impact of preoperative anemia in patients with severe aortic stenosis undergoing surgical aortic valve replacement (SAVR) or transcatheter aortic valve replacement (TAVR).

Methods: Preoperative hemoglobin values were collected from the STS National Database for 1,032 TAVR and 3,244 SAVR patients who underwent valve replacement at a single institution between January 2008 and March 2015. Mean follow-up time was 31 months \pm 19 months. Anemia was defined using World Health Organization criteria (hemoglobin <13.0 g/dL in males and <12.0 g/dL in females). In patients for whom only preoperative hematocrit values were available, hemoglobin was estimated to be 1/3 of hematocrit. Kaplan-Meier and Cox proportional hazard modeling were used to examine survival; all other analyses were conducted using Pearson's chi-square or independent-sample t tests.

Results: Preoperative anemia presented in 66% (n=675) of TAVR patients and 47% (n=1,524) of SAVR patients ($P < .001$). Compared to SAVR patients with anemia, TAVR patients were older and had higher rates of many common comorbidities (Table). Overall 30-day mortality was similar following TAVR and SAVR (4.5% [n=46] and 5.3% [n=174], respectively, $P = .414$); among patients with anemia, 30-day mortality was lower following TAVR (4.7% vs 7.6%, $P = .014$, Table). Kaplan-Meier survival for anemic patients was not significantly different between TAVR and SAVR through 1 year (log rank $P = .11$, Figure). In a multivariate survival model, anemia was associated with worse survival following SAVR (HR 1.93 [1.56-2.38], $P < .001$) but not TAVR (HR 1.18 [0.88-1.61], $P = .282$); the interaction effect between anemia and SAVR vs TAVR was significant at $P = .0045$. Receiving intraoperative blood products was the factor associated with the greatest increase in mortality risk (HR 2.56 [2.06-3.18]).

Conclusions: Preoperative anemia is associated with increased mortality following aortic valve replacement. This association is stronger among anemic SAVR patients than anemic TAVR patients. The strong association between intraoperative transfusion and worse survival underscores the importance of optimizing low preoperative hemoglobin in both groups.

Figure 1. Kaplan-Meier Survival in Patients with and without Anemia Undergoing TAVR or SAVR

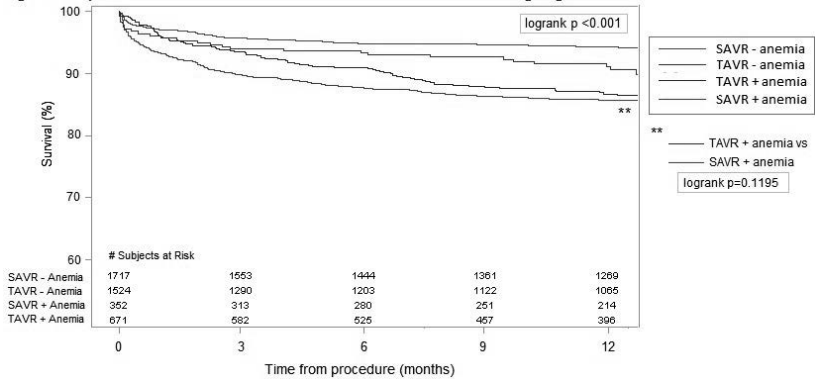


Table 1. Sample characteristics and outcomes in aortic valve replacement patients with preoperative anemia

	All	SAVR	TAVR	p
	Anemic	Anemic	Anemic	
	n=2199	n=1524	n=675	
Age (mean ± SD)	75.8 ± 11.6	72.5 ± 11.6	83.1 ± 7.4	<0.001
Male	61% (1336)	63% (960)	56% (376)	0.0015
White	87% (1922)	86% (1318)	89% (604)	0.0513
Black	8% (178)	10% (145)	5% (33)	0.0002
Diabetes	31% (683)	32% (489)	29% (194)	0.1216
Renal Failure	13% (283)	12% (185)	15% (98)	0.129
Chronic Lung Disease	15% (331)	12% (184)	22% (147)	<0.001
Liver Disease	2% (44)	1% (12)	5% (32)	<0.001
Heart Failure within two weeks	84% (1855)	81% (1237)	92% (618)	<0.001
Metastatic Tumor	5% (115)	3% (52)	9% (63)	<0.001
Peripheral Vascular Disease	24% (538)	20% (298)	36% (240)	<0.001
Cerebral Vascular Disease	22% (477)	21% (313)	24% (164)	0.0498
Obesity	33% (736)	37% (564)	25% (172)	<0.001
Operative Mortality	7% (145)	8% (115)	5% (30)	0.0142
Post-Op LOS days (mean ± SD)	10.5 ± 10.7	12.7 ± 11.0	8.5 ± 7.7	<0.001
ICU hours (mean ± SD)	111 ± 199	124 ± 212	81 ± 160	<0.001
Intraop Blood Transfusion	70% (1545)	82% (1254)	43% (291)	<0.001
Acute Kidney Injury	2% (54)	3% (48)	1% (6)	0.0009
Stroke	3% (62)	3% (46)	2% (16)	0.4852
Reoperation for Bleed	3% (58)	4% (54)	1% (4)	<0.001

4:00 PM

Room 120D

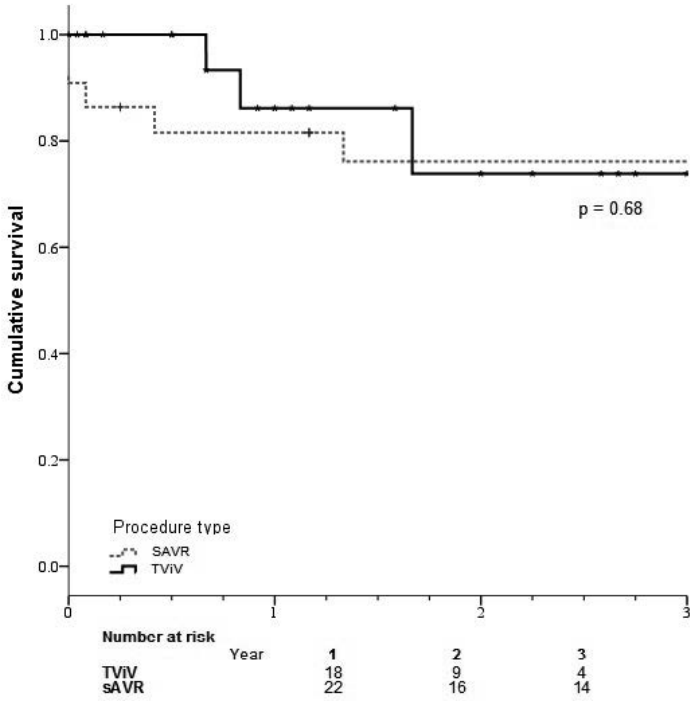
Reoperative Surgical Aortic Valve Replacement vs Transcatheter Valve-in-Valve Replacement for Degenerated Bioprosthetic Aortic Valves*J. I. Ejjofor, M. Yammine, S. McGurk, L. H. Cohn, J. D. Muebschlegel, P. S. Shekar, P. Shah, T. Kaneko**Brigham and Women's Hospital, Boston, MA*

Purpose: Recent data from The Society of Thoracic Surgeons (STS) show that bioprosthetic aortic valve use has increased steadily. One factor influencing this trend is the potential for future utilization of transcatheter valve-in-valve (TViV) when bioprosthetic valves fail. We compared the results of reoperative TViV to surgical aortic valve replacement (SAVR) for degenerated bioprosthetic valves.

Methods: We identified 91 patients with degenerated bioprosthetic valves who underwent isolated AVR between January 2002 and January 2015; 69 had SAVR and 22 had TViV. Patients with prior homografts, active endocarditis, and those undergoing concomitant coronary, other valvular, or aortic interventions were excluded. To adjust for significant differences in baseline characteristics between the cohorts, STS risk scores were used to create 22 matched pairs of SAVR and TViV patients. Outcomes of interest included operative mortality, postoperative complications, postoperative valvular gradients, and mid-term survival.

Results: At baseline, the mean STS risk score was 4.4 ± 3.1 for SAVR vs 7.5 ± 3.0 for TViV ($P = .001$); the matched SAVR cohort score was 7.7 ± 3.4 ($P = .36$ vs TViV). Among matched patients, mean age was 74.5 years \pm 10.4 years for SAVR and 75.0 years \pm 9.6 years for TViV ($P = .75$). There was one operative mortality in the SAVR group vs 0/22 for TViV, ($P = 1.0$). Postoperatively, mean AV gradient was 13.5 mm Hg \pm 13.2 mm Hg for SAVR and 12.4 mm Hg \pm 6.2 mm Hg for TViV ($P = .58$). Neither cohort had coronary obstruction, but 5/22 TViV patients had mild paravalvular leak vs 0/22 SAVR patients ($P = .048$). There were no postoperative strokes in the TAVR group and 2/22 in the SAVR group ($P = .49$). TViV patients had shorter lengths of stay (5 days vs 11 days, $P \leq .001$), but more 30-day readmissions (8/22 vs 3/22, $P = .095$) than SAVR. Median follow-up time was 33 months. SAVR and TAVR 3-year survival was 76.3% (95% CI 58.1%–94.5%) vs 78.7% (95% CI 56.2%–100%, $P = .68$), respectively (Figure).

Conclusions: TViV for degenerated bioprosthetic aortic valves had similar operative mortality, stroke rates, and survival to SAVR. Neither group had coronary obstruction, and postoperative AV gradients in both groups were comparable. TViV is a viable alternative for this indication. Studies using registry data are needed to establish non-inferiority to SAVR.



4:15 PM

Room 120D

Open Surgical Repair Remains the Gold Standard for Treating Aortic Arch Pathology

V. Khullar, H. V. Schaff, J. Dearani, R. C. Daly, K. L. Greason, A. Pochettino

Mayo Clinic, Rochester, MN

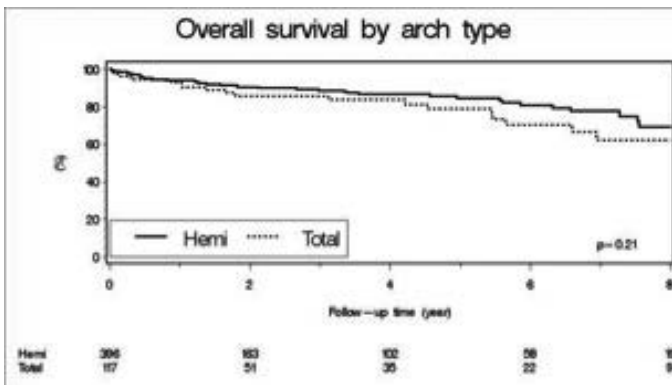
COMMERCIAL RELATIONSHIPS R. C. Daly: Ownership Interest, NeoChord, Inc

Purpose: The primary driving force pushing endovascular arch repair technology is the assumption that open arch repair is a high-risk procedure. The purpose of this study was to evaluate clinical results of open arch reconstruction achieved in the modern era in a large group practice.

Methods: From October 2003 to June 2014, 570 patients underwent aortic arch surgery. 429 patients (75%) underwent hemiarch repair (group A), while 132 patients (23%) had a total aortic arch repair (group B); the remaining nine patients (2%) had patch arch repairs. The procedure was emergent in 88 patients (20.6%) in group A and 41 patients (31.1%) in group B. Redo sternotomy after previous aortic arch surgery was done in 35 patients (8.2%) in group A and 29 patients (22.3%) in group B.

Results: Postoperative stroke was diagnosed in 23 patients (5.4%) in group A and 8 patients (6%) in group B. No patient suffered spinal cord injury. Thirty-day mortality was 4% (17 patients) in the hemiarch group and 5.3% (7 patients) in the total arch group. Patients in the hemiarch group were younger than in the total arch group (mean age 61.3 years vs 63.8 years, $P = .04$). Mean maximum aortic diameter was 53.8 mm in group A vs 56.4 mm in group B ($P = .0032$). Older age (OR 1.05, 95% CI 1.02-1.09; $P = .0037$) and extracorporeal circulation time (OR 1.01, 95% CI 1.01-1.02; $P < .001$) were predictors of perioperative 30-day mortality. Age (OR 1.05, 95% CI 1.01-1.08; $P = .005$) was the only predictor for neurological dysfunction. Survival at 2, 6, and 8 years was 90%, 80%, and 69% for group A and 85%, 70%, and 62% for group B.

Conclusions: Modern open surgical techniques for aortic arch repair result in very good outcomes. These results set a high standard for new endovascular technology that is being applied to arch pathology.



4:30 PM

Room 120D

Surgical Outcomes in the Treatment of Type A Aortic Dissection Are Superior at High-Volume Centers

M. Arsalan¹, J. J. Squiers², M. A. Herbert³, S. L. Prince⁴, D. O. Moore⁵, K. B. Harrington⁵, J. DiMairo⁶, M. J. Mack¹, W. T. Brinkman⁵

¹Baylor Scott & White Health, Plano, TX, ²Baylor Scott & White Health, Dallas, TX, ³Medical City Dallas Hospital, TX, ⁴Cardiopulmonary Research Science and Technology Institute, Dallas, TX, ⁵The Heart Hospital Baylor Plano, TX, ⁶Baylor College of Medicine, Dallas, TX

COMMERCIAL RELATIONSHIPS W. T. Brinkman: Speakers Bureau/Honoraria, Medtronic, Inc, W. L. Gore & Associates; M. J. Mack: Consultant/Advisory Board, Edwards Lifesciences Corporation; Other, Abbott Vascular

Purpose: Immediate surgery is standard therapy for acute type A aortic dissections. Due to the low incidence, many smaller cardiac surgery programs do not routinely perform this procedure. In this study, we compared the surgical outcomes for type A aortic dissections in high- (HV) and low-volume (LV) centers.

Methods: Data from the Texas Quality Initiative regional certified cardiovascular registry (STS data collected from a North Texas cooperative of 29 hospitals) were evaluated. Patient characteristics and operative mortality were analyzed using STS definitions. Programs performing at least 100 operations during the study period were considered high-volume centers.

Results: Between January 1, 2008, and December 31, 2014, 612 patients underwent surgery for type A aortic dissection in the participating hospitals. Only three of the 29 participating hospitals performed at least 100 operations during this period. High-volume centers performed 431 operations, and low-volume centers performed 181. The preoperative characteristics of the patients were very similar. While circulatory arrest with cerebral perfusion was more often performed in HV centers (79.7% vs 63.0%, $P = .004$), perfusion, cross clamp, and circulatory arrest times did not differ significantly between groups. There was no significant difference in postoperative paralysis rate (HV 2.8% vs LV 5.1%, $P = .219$) or stroke rate (HV 10.7% vs LV 9.4%, $P = .649$). Operative mortality was significantly lower in HV vs LV centers (14.4% vs 24.3%, $P = .003$), without significant difference in 30-day readmission rates (HV 11.9% vs LV 16.7%, $P = .157$).

Conclusions: More than two-thirds of all surgeries for type A aortic dissections in North Texas were performed in high-volume centers. Surgery in these centers with extensive experience resulted in significantly lower operative mortality. These data support preferred treatment of type A aortic dissections in high-volume centers.

4:45 PM

Room 120D

Open Distal Fenestration of Chronic Dissection Facilitates Endovascular Elephant Trunk Completion: Late Outcomes*M. Aftab, J. J. Idrees, J. L. Navia, E. E. Roselli**Cleveland Clinic, OH*

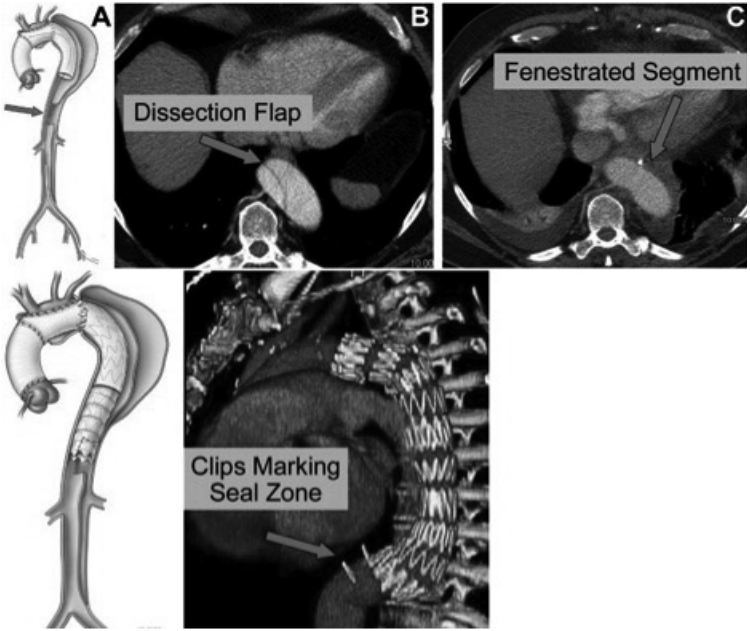
COMMERCIAL RELATIONSHIPS E. E. Roselli: Consultant/Advisory Board, Medtronic, Inc, Bolton Medical, Apica Ltd; Research Grant, LivaNova, Medtronic, Inc, CorMatrix; Speakers Bureau/Honoraria, Edwards Lifesciences Corporation, St Jude Medical, Vascutek Ltd a Terumo Company, COOK Medical, LivaNova, Medtronic, Inc; Other, Direct Flow Medical, Inc

Purpose: Persistent retrograde false lumen (FL) perfusion is a common mode of failure after stent grafting for complicated chronic dissection. We developed a novel technique consisting of open fenestration during first-stage elephant trunk (ET) to create a landing zone for endovascular ET completion (EEC). Objectives were to assess long-term safety and durability of this technique.

Methods: From 2007 to 2014, 54 patients with thoracoabdominal dissection and aneurysm underwent ET and descending open fenestration. Fifteen patients (28%) had DeBakey type III dissection, three (5%) had chronic type I, and 36 (67%) presented with residual dissection after a previous type I repair. Mean maximum descending diameter was $5.7 \text{ cm} \pm 1 \text{ cm}$. Repair was performed urgently in 12 patients (22%) and 39 cases (72%) were reoperations. Imaging follow-up was complete in 96% (mean 27 months \pm 21 months, >5 years in 13%).

Results: Forty-five patients (83%) completed EEC at a mean interval of 12 weeks \pm 11 weeks. EEC was completed during the same hospitalization in nine patients (17%) for urgent indications: rupture in two, impending rupture in seven. Operative mortality after ET was 1.9%; one patient died of pulmonary embolism. In eight patients who did not complete EEC, open fenestration was performed prophylactically due to moderate dilatation and are under surveillance. Complications after first stage included transient ischemic attack in one patient (1.8%), subdural hemorrhage in one patient (1.8%), and re-operation for bleeding in eight patients (15%). None of the patients experienced renal dialysis, tracheostomy, or permanent spinal cord deficit. All 45 patients had thoracic FL thrombosis. Aneurysm sac shrunk in 71% with no retrograde FL flow and a mean size reduction of $1 \text{ cm} \pm 0.8 \text{ cm}$. There were four late noncardiac deaths. Late reintervention was required in seven patients (13%): thoracic endovascular aortic repair extension for type 1 endoleak in three patients (7%), thoracoabdominal repair in three patients (5.4%), and FL embolization in one patient (1.8%) for progressive growth. Actual survival at mean follow-up of 28 months \pm 22 months was 91%.

Conclusions: Open aortic fenestration to create distal landing zone during stage 1 ET facilitates EEC for aneurysms associated with chronic distal dissection. Mid- to long-term results show that this technique is safe, effective, and durable. It promotes false lumen thrombosis and reverse remodeling of aorta by eliminating retrograde false lumen filling.



5:00 PM

Room 120D

Preoperative Renal Dysfunction and Its Impact on Acute Kidney Injury After Conventional and Transcatheter Aortic Valve Replacement: A Statewide, Population-Based Analysis

H. J. Patel¹, M. Herbert², P. F. Theurer¹, E. T. Murphy³, G. Paone⁴, A. Pruitt⁵, F. L. Shannon⁶, R. Prager⁷

¹University of Michigan Health System, Ann Arbor, ²Southwest Data Consultants, Dallas, TX, ³Spectrum Health, Grand Rapids, MI, ⁴Henry Ford Hospital, Detroit, MI, ⁵St Joseph Mercy Hospital Ann Arbor, Ypsilanti, MI, ⁶William Beaumont Hospital, Royal Oak, MI, ⁷University of Michigan, Ann Arbor

COMMERCIAL RELATIONSHIPS H. J. Patel: Consultant/Advisory Board, W. L. Gore & Associates, Vascutek Ltd a Terumo Company; F. L. Shannon: Ownership Interest, Domain Surgical, Inc, BioStar Ventures; Speakers Bureau/Honoraria, AtriCure, Inc, Medtronic, Inc

Purpose: Preoperative chronic renal disease (CKD) frequently is present in patients undergoing conventional aortic valve replacement (SAVR). Acute kidney injury (AKI) is associated with increased risk for postoperative adverse events after SAVR. We sought to analyze the relationship between these two conditions in the current era of transcatheter (TAVR) options.

Methods: Using a statewide quality collaborative database (2011–2014), 8,897 patients were identified who underwent TAVR (1,495) or SAVR (7,402). Preoperative CKD was defined by stepwise reduction in estimated glomerular filtration rates. AKI was defined using the Acute Kidney Injury Network classification. Demographics are listed in the Table. As expected, CKD was more prevalent in the TAVR group (87.5% vs 60.5%, $P < .001$).

Results: Preoperative CKD stage predicted occurrence of 30-day mortality, stroke, and prolonged ventilation after SAVR (all $P < .01$) but not TAVR. AKI occurred in 2,694 patients (stage 1=5.5%, stage 2=22.3%, stage 3=2.4%) and was higher after SAVR vs TAVR at each stage ($P < .001$). In the SAVR group, occurrence of AKI was independently predicted by moderate (OR 1.72) or severe (OR 2.01) preoperative CKD ($P < .001$). In contrast, only severe preoperative CKD independently predicted AKI occurrence after TAVR (OR 1.79, $P = .001$). Understanding baseline differences in treatment groups, we analyzed AKI occurrence across tertiles of STS-PROM (low 1.1% ± 0.3%, medium 2.5% ± 0.6%, and high 7.2% ± 2.2%). AKI occurred more frequently after SAVR particularly in the medium (30.7% vs TAVR 21.7%, $P = .03$) and high (31.7% vs TAVR 23.4%, $P < .001$) STS-PROM tertiles, and this effect was independent of preoperative CKD status.

Conclusions: In this population-based analysis and in the setting of a higher prevalence of preoperative CKD, TAVR is associated with a lower incidence of AKI when compared to conventional AVR. These data support consideration of a transcatheter approach particularly in those patients with moderate or severe pre-existing renal dysfunction.

TAVR-SAVR Preoperative Risk Factors			
Variable	SAVR	TAVR	p-Value
Overall Number of Patients in Group	7402	1495	
Age (yr)	70.2 (69.94, 70.46)	81.47 (81.02, 81.92)	< 0.001
STS Predicted Risk of Mortality (%)	3.38 (3.31, 3.45)	6.74 (6.42, 7.05)	< 0.001
Mild GFR Impairment	35.13% (34.04, 36.21)	24.88% (22.69, 27.07)	< 0.001
Moderate GFR Impairment	23.70% (22.73, 24.67)	51.44% (48.9, 53.97)	< 0.001
Severe GFR Impairment	1.72% (1.42, 2.01)	11.51% (9.89, 13.12)	< 0.001
Postoperative Outcomes			
Operative Mortality	2.61% (2.25, 2.97)	5.62% (4.45, 6.79)	< 0.001
Postoperative Stage 1 AKI	5.90% (5.37, 6.44)	3.81% (2.84, 4.78)	< 0.001
Postoperative Stage 2 AKI	23.28% (22.31, 24.24)	17.66% (15.73, 19.59)	< 0.001
Postoperative Stage 3 AKI	2.46% (2.11, 2.81)	2.07% (1.35, 2.8)	< 0.001
Postoperative Permanent Stroke	1.69% (1.4, 1.98)	2.74% (1.91, 3.57)	0.006
Prolonged Ventilation	11.80% (11.06, 12.53)	6.35% (5.12, 7.59)	< 0.001

AKI = Acute Kidney Injury
GFR = Glomerular Filtration Rate

5:15 PM

Room 120D

Twenty-Five-Year Outcome of Composite Graft Aortic Root Replacement: Near “Curative” Impact on Aortic Root Disease

S. Mok¹, W. Ma², M. Ahmed¹, P. Charilaou³, S. Peters³, A. S. Chow³, B. Ziganshin³, M. Tranquilli³, J. A. Elefteriades³

¹Yale New Haven Hospital, CT, ²Yale University School of Medicine and Beijing Anzhen Hospital, Capital Medical University, New Haven, CT, ³Yale University School of Medicine, New Haven, CT

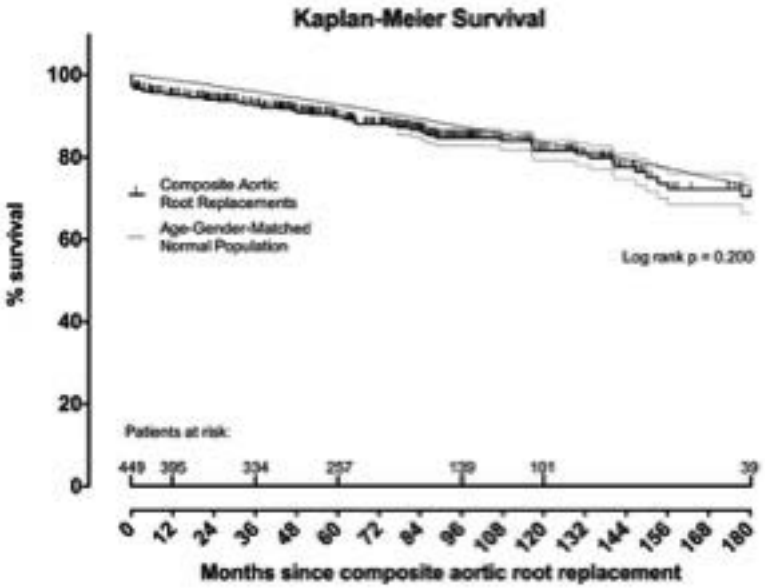
COMMERCIAL RELATIONSHIPS J. A. Elefteriades: Ownership Interest, Coolspring LLC; Other, Jarvik Heart, Inc (Data Safety Monitoring Board), Direct Flow Medical, Inc (Salus Valve - Data Safety Monitoring Board)

Purpose: Operative choices for aortic root disease abound. We report our results with traditional composite graft replacement in 449 patients between 1990 and 2015 to evaluate the early and late survival, freedom from reoperation, and late adverse events.

Methods: Operations were done with coronary button reimplantation (by a single surgeon). Mean age was 56.1 years \pm 14.0 years (range: 14-87) with 83% (373/449) males. Valve prosthesis was mechanical in 343 (76%) and bioprosthetic in 106 (24%). Modified Cabrol procedure (Dacron coronary graft) was done in 10% (45/449) and concomitant coronary artery bypass grafting surgery in 11.1% (50/449). There were 15.8% (71/449) urgent/emergent and 37 (8.2%) redo procedures. Mean cross clamp and cardiopulmonary bypass times were 113 minutes \pm 29 minutes and 160 minutes \pm 81 minutes. Deep hypothermic circulatory arrest used in 37.6% (169/449) averaged 27 minutes \pm 6 minutes. Long-term follow-up (100%) averaged 7.0 years \pm 5.1 years (range: 0.1-24.8).

Results: Hospital mortality occurred in 14 patients (3.1%), eight of which were in acute type A dissections. Mortality in patients without acute dissection was 6/419 (1.4%). Mortality in elective first-time operations was 7/361 (1.9%). Stroke and reexploration for bleeding occurred in 1.8% (8/449) and 4.2% (19/449), respectively. Major late events included bleeding in 2.5% (11/435) and thromboembolism in 1.1% (5/435). Freedom from major late events was 98.2%, 89.0%, and 89.0% at 5, 10, and 20 years, respectively. Freedom from reoperations on the aortic root was 99.0%, 99.0%, and 97.9% and on other aortic segments 98.9%, 96.7%, and 86.5% at 5, 10, and 20 years, respectively. Survival in patients aged <60 years was 91.9%, 90.1%, and 79.7% at 5, 10, and 20 years vs 88.4%, 67.9%, and 42.6% in patients aged \geq 60 years. Comparing age- and gender-matched controls, survival was not significantly different ($P = .20$, Figure).

Conclusions: Composite graft root replacement is associated with low operative risk, excellent long-term survival, and low incidence of reoperation and late events. The low operative risk is very relevant to decisions regarding prophylactic operations in asymptomatic individuals. The favorable long-term results indicate an almost “curative” impact on aortic root disease.



3:30 PM – 5:30 PM

Room 131ABC

Adult Cardiac Session: Aortic Valve*Moderators: Juan A. Crestanello, Columbus, OH, and Bradley G. Leshnower, Atlanta, GA***COMMERCIAL RELATIONSHIPS** J. A. Crestanello: Research Grant, Medtronic, Inc, Abbott Vascular

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold**.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

3:30 PM

Room 131ABC

The Year in Review: What's New in the Management of Aortic Valve Disease?*Thomas G. Gleason, Pittsburgh, PA***COMMERCIAL RELATIONSHIPS** T. G. Gleason: Research Grant, Medtronic, Inc**REGULATORY DISCLOSURE** This presentation will address the Lotus Valve by Boston Scientific, which has an FDA status of investigational.

3:45 PM

Room 131ABC

Early and Mid-Term Clinical and Hemodynamic Outcomes of Transcatheter Valve-in-Valve Implantation: Results From a Multicenter Experience*A. D'Onofrio¹, E. Tarja¹, M. Agrifoglio², G. Luzi³, M. Aiello⁴, D. Gabbieri⁵, G. Tarantini¹, G. Rizzoli¹, F. Musumeci¹, G. Gerosa¹**¹University of Padova, Italy, ²Centro Cardiologico Monzino, Milan, Italy, ³San Camillo Hospital, Rome, Italy, ⁴Polichinico San Matteo, Pavia, Italy, ⁵Hesperia Hospital, Modena, Italy***COMMERCIAL RELATIONSHIPS** M. Aiello: Other, Edwards Lifesciences Corporation (Proctor); A. D'Onofrio: Consultant/Advisory Board, Edwards Lifesciences Corporation; D. Gabbieri: Consultant/Advisory Board, Edwards Lifesciences Corporation**REGULATORY DISCLOSURE** This presentation describes the off-label use of the Sapien valve by Edwards Lifesciences Corporation and the CoreValve device by Medtronic, Inc in the valve-in-valve procedure. Both of these devices are FDA-approved.

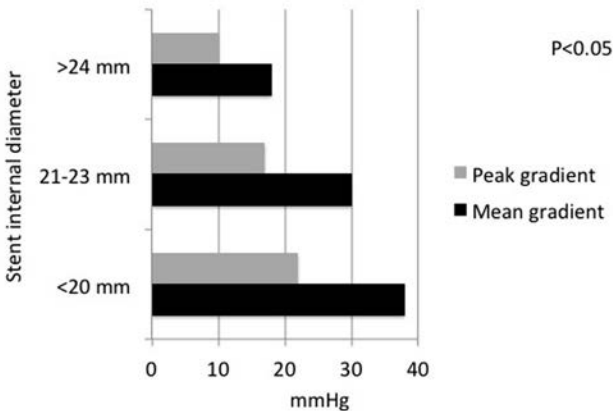
Purpose: Transcatheter valve-in-valve (VIV) implantation is an alternative option in inoperable or high-risk patients with prosthetic valve dysfunction. The aim of this retrospective multicenter study was to evaluate early and mid-term clinical and hemodynamic outcomes of patients undergoing aortic and mitral VIV.

Methods: We analyzed data from 66 procedures performed in 65 patients who underwent VIV procedures in the aortic (VIV-A) and mitral (VIV-M) position at five national institutions from January 2008 to May 2015. VIV-A and VIV-M were 44 (68%) and 22 (32%), respectively; one patient underwent combined mitro-aortic VIV. All VIV-M were done through a transapical access, while VIV-A were performed through transapical and transfemoral approach in 16 (38%) and 28 (62%) cases, respectively. Study devices were both balloon-expandable and self-expandable. Outcomes were defined according to the updated Valve Academic Research Consortium definitions.

Results: Mean logistic EuroSCORE and STS score were $29.4\% \pm 14.4\%$ and $12\% \pm 16.9\%$, respectively. Overall all-cause 30-day mortality was 6% (four patients), and it was 4.5% and 9% in VIV-A and VIV-M, respectively (two patients in each group).

Mean follow-up of the entire cohort was 14 months \pm 14 months. Total cumulative follow-up was 77 patient-years. The linearized incidence of late mortality was 9.1% patient-year. Kaplan-Meier survival of the entire cohort at 1, 2, 3, and 4 years was 84.4% \pm 4.9%, 80.5% \pm 6%, 74.3% \pm 8.1%, and 62% \pm 13.2%, respectively. Age (HR 1.1, 95% CI 1.0-1.3, $P = .035$) and diabetes (HR 7.2, 95% CI 2.1-23.7, $P = .001$) were identified as independent predictors of mortality. Degenerated surgical aortic prostheses with an internal diameter (ID) <20 mm had significantly higher peak and mean transaortic gradients if compared to prostheses with ID 21-23 mm and >23 mm (Figure). After VIV-A, a severe stenosis (mean gradient >35 mm Hg) was detected in three cases (6.8%), all with ID <20 mm.

Conclusions: According to our data, VIV provides good early and mid-term results in high-risk or inoperable patients with mitral or aortic bioprosthesis dysfunction requiring reoperation. Age and diabetes are independently associated with mortality. Size of bioprosthesis ID has a significant impact on postoperative transaortic gradients.



4:00 PM

Room 131ABC

Recovery of Left Ventricular Size and Function After Surgical Correction of Aortic Valve Regurgitation: Implications for Timing of Surgical Intervention

T. Murashita, R. M. Suri, H. V. Schaff, R. C. Daly, J. Dearani, K. L. Greason

Mayo Clinic, Rochester, MN

COMMERCIAL RELATIONSHIPS R. C. Daly: Ownership Interest, NeoChord, Inc; R. M. Suri: Consultant/Advisory Board, Abbott Vascular; Research Grant, Edwards Lifesciences Corporation, St Jude Medical, LivaNova

Purpose: Current consensus statements recommend surgical correction of aortic valve regurgitation (AR) in the setting of left ventricular (LV) dysfunction or severe LV enlargement. The clinical and echocardiographic predictors of long-term recovery of LV function (EF) after surgical correction of aortic valve regurgitation are unknown.

Methods: We studied the records of 530 consecutive patients undergoing aortic valve repair or replacement for severe AR between January 1, 2004, and June 30, 2014. We excluded patients with moderate or less AR, aortic valve stenosis, acute AR, periprosthetic valve regurgitation, and concomitant mitral valve procedures. Mean clinical follow-up was 3.8 years \pm 3.2 years, and a total of 1,129 follow-up echocardiograms were analyzed at a mean of 2.0 years \pm 2.8 years postoperatively. A Cox proportional hazards test was utilized to determine predictors of EF recovery and late death during long-term follow-up.

Results: Mean age was 57.1 years \pm 17.0 years, there were 425 men, and mean EF was 0.56 \pm 0.10. There were four early deaths (0.75%). As seen in the Table, after an initial decline from preoperative to dismissal ($P < .01$), EF improved steadily and significantly to last follow-up echocardiogram. Regression in LV dimensions occurred early postoperatively and continued thereafter ($P < .01$). Multivariate analysis demonstrated risk factors for persistently abnormal EF (<60%) 1 year after surgery were lower preoperative EF ($P < .001$, OR 0.37), previous myocardial infarction ($P = .03$, OR 4.02), and larger preoperative LV end-diastolic diameter ($P < .001$, OR 1.07). The 5-year and 10-year survival rates were 85.4% and 69.5%, respectively. In multivariate analysis, variables associated with late death were older age ($P = .01$, OR 1.02), lower preoperative EF ($P = .03$, OR 0.51), and previous myocardial infarction ($P = .02$, OR 2.55).

Conclusions: LVEF declines in the early postoperative period after correction of AR and improves with time. Because LV function is more likely to normalize in those with greater EF and smaller dimensions, surgical intervention should be considered promptly in those with severe AR and deterioration of these parameters during echocardiographic surveillance.

	Preop (n=525)	Dismissal (n=505)	1 yr (n=235)	1-3 yr (n=174)	3-5 yr (n=121)	>5 yr (n=89)
EF	0.56 \pm 0.10	0.51 \pm 0.12*	0.57 \pm 0.10	0.59 \pm 0.10	0.57 \pm 0.11	0.58 \pm 0.10
EDD (mm)	61.8 \pm 7.9	55.0 \pm 7.3*	51.8 \pm 6.6	51.9 \pm 6.4	52.8 \pm 7.5	52.6 \pm 7.1
ESD (mm)	42.1 \pm 8.3	39.6 \pm 8.3*	35.1 \pm 7.2	34.5 \pm 6.5	36.1 \pm 8.2	35.1 \pm 6.4

* $p < 0.01$, EDD; end-diastolic diameter, ESD; end-systolic diameter

4:15 PM

Room 131ABC

Aortic Valve Repair Is Not Associated With Greater Valve-Related Morbidity than Replacement in Isolated Valve Insufficiency: A 12-Year Prospective, Controlled Study

G. B. Luciani¹, S. Torre¹, A. Rungtatscher¹, G. Lucchese², G. Faggiani³

¹University of Verona, Italy, ²St Thomas' Hospital, London, United Kingdom, ³University of Verona Medical School, Italy

Purpose: Valve repair for pure aortic insufficiency (AI) is increasingly performed. Long-term outcome in terms of freedom from valve-related morbidity, however, remains controversial.

Methods: All consecutive patients (n=429, aged 0.2-88 years) with pure AI having valve repair (Group 1) or replacement (Group 2) between January 2002 and December 2013 were prospectively studied. Patients having root replacement were excluded. Treatment choice was non-random. Group 1 (n=109) and Group 2 (n=320) patients had similar gender distribution, but Group 1 had younger mean age (53 ± 23 vs 62 ± 15 , $P = .001$), greater prevalence of congenital lesion ($50/109$ vs $81/320$, $P = .001$), ascending aortic graft replacement ($66/109$ vs $81/320$, $P = .002$), and urgent procedure ($16/109$ vs $3/109$, $P = .01$), but lower prevalence of prior cardiac operations ($3/109$ vs $38/320$, $P = .002$) and endocarditis ($3/109$ vs $19/320$, $P = .01$).

Results: There were no hospital deaths and 32 late deaths ($6/109$ vs $26/320$, $P = .4$), with greater prevalence of cardiac cause in Group 2 ($0/6$ vs $12/26$, $P = .03$) during a mean follow-up of $6.2 \text{ years} \pm 4.1 \text{ years}$ (range: 1-13). Actuarial 12-year survival ($86\% \pm 8\%$ vs $87\% \pm 3\%$, $P = .9$), freedom from major cardiovascular and cerebral events ($85\% \pm 4\%$ vs $77\% \pm 4\%$, $P = .8$), and valve reoperation ($92\% \pm 3\%$ vs $82\% \pm 6\%$, $P = .1$) were comparable. Ross procedure emerged as a risk factor for reoperation at univariate analysis, but not at multivariate. Functional status at follow-up was comparable ($100/106$ vs $274/294$ patients in NYHA I, $P = .8$), but prevalence of oral anticoagulation was significantly higher in Group 2 ($2/106$ vs $59/294$, $P = .002$).

Conclusions: An institutional policy of valve repair allows sparing of up to a quarter of aortic valves in all-comers with pure AI of any age, without reflecting into increased valve-related morbidity, particularly reoperation, in the first postoperative decade. Aortic valve repair seems rational in younger, active patients with congenital valve disease.

4:30 PM

Room 131ABC

Impact of Preoperative Chronic Kidney Disease in 2,531 Patients Undergoing Transcatheter Aortic Valve Replacement

H. A. Jensen¹, N. Beohar², D. Dosbr³, G. M. Ayele⁴, A. Kirtane⁵, V. Babaliaros¹, S. Kodali⁵, L. G. Svensson⁶, E. Tuzcu⁶, W. Y. Szeto⁷, H. C. Herrmann⁸, R. Makkar⁹, M. Alu¹, R. M. Suri⁶, G. Ailawadi¹⁰, H. S. Maniar¹¹, A. Zajarias¹¹, J. F. Condado¹, L. L. Tsai¹, M. J. Mack¹², M. B. Leon¹³, V. H. Thourani¹

¹Emory University, Atlanta, GA, ²Columbia University Division of Cardiology at Mount Sinai Medical Center, Miami Beach, FL, ³Columbia University Medical Center, New York, NY, ⁴Cardiovascular Research Foundation, New York, NY, ⁵Columbia University, New York, NY, ⁶Cleveland Clinic, OH, ⁷University of Pennsylvania, Philadelphia, ⁸Hospital of the University of Pennsylvania, Philadelphia, ⁹Cedars-Sinai Medical Center, Los Angeles, CA, ¹⁰University of Virginia Health System, Charlottesville, ¹¹Washington University School of Medicine, St Louis, MO, ¹²Baylor Scott & White Health, Plano, TX, ¹³Columbia University, New York, NY

COMMERCIAL RELATIONSHIPS G. Ailawadi: Consultant/Advisory Board, Edwards Lifesciences Corporation, Abbott Vascular; Nonremunerative Position of Influence, AtriCure, Inc; Speakers Bureau/Honoraria, St Jude Medical; V. Babaliaros: Research Grant, Edwards Lifesciences Corporation, Abbott Vascular; H. C. Herrmann: Consultant/Advisory Board, Siemens Corporation, Edwards Lifesciences Corporation; Nonremunerative Position of Influence, PinnacleHealth System, Society for Cardiovascular Angiography and Interventions, Mayo Foundation for Medical Education and Research, Cardiovascular Institute of Philadelphia, Rhode Island Hospital of Brown University, Northwestern Medical Center, Yale University, Washington Hospital St Louis, Westchester Medical Center, Beaumont Hospital; Ownership Interest, Micro Interventional Devices, Inc; Research Grant, Abbott Vascular, Boston Scientific, Edwards Lifesciences Corporation, St Jude Medical, Medtronic, Inc, W. L. Gore & Associates, Siemens Corporation, CardioKinetic, Inc, Laval University, MitraSpan, Inc; A. Kirtane: Research Grant, Boston Scientific, Medtronic, Inc, Abbott Vascular, Abiomed, St Jude Medical, Eli Lilly and Company, GlaxoSmithKline, Inc, Vascular Dynamics, Inc; S. Kodali: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc; M. J. Mack: Consultant/Advisory Board, Edwards Lifesciences Corporation; Other, Abbott Vascular; R. Makkar: Consultant/Advisory Board, Edwards Lifesciences Corporation; Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, St Jude Medical; R. M. Suri: Consultant/Advisory Board, Abbott Vascular; Research Grant, Edwards Lifesciences Corporation, St Jude Medical, LivaNova; W. Y. Szeto: Consultant/Advisory Board, Micro Interventional Devices, Inc; Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, LivaNova; A. Zajarias: Consultant/Advisory Board, Edwards Lifesciences Corporation, Boston Scientific

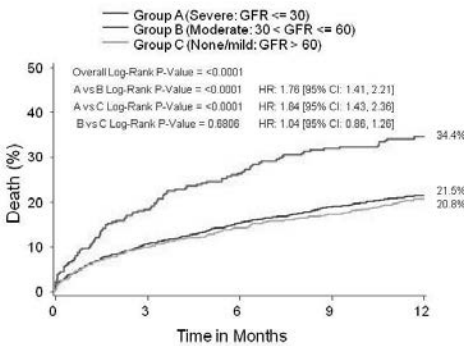
Purpose: Renal dysfunction (RD) is associated with increased mortality and resource utilization after surgical aortic valve replacement (SAVR), but its impact on outcomes after transcatheter aortic valve replacement (TAVR) is less defined. This study explored the effect of preoperative renal function on 30-day and 1-year outcomes in the PARTNER-I TAVR trial.

Methods: Preoperative glomerular filtration rate (GFR) was calculated utilizing the Modification of Diet in Renal Disease equation in 2,531 TAVR patients in a multi-institution trial. Based on the exclusion criteria of the trial, patients with preoperative creatinine greater than 3 mg/dL were not included in the study. Patients were divided into three groups: GFR >60 mL/min (normal function or mild RD), GFR 31 to 60 mL/min (moderate RD), and GFR ≤30 mL/min (severe RD). Operative characteristics and clinical outcomes were analyzed. Cox regression models were used to determine the independent association of RD with 1-year all-cause mortality.

Results: Of the study population, 767 (30%) had no or mild RD, 1,473 (58%) had moderate RD, and 291 (12%) had severe RD. The mean STS predicted risk of mortality (PROM) score for the entire cohort was 11.5% and was highest in the severe RD group (13.8%, $P < .01$, Table). Patients with severe RD were older, more often female, had higher body mass index, and had a greater incidence of diabetes and pulmonary disease. There was a stepwise increase in early and 1-year mortality, re-hospitalization, and need for new postoperative renal replacement with worsening RD. Overall hospital length of stay, as well as stroke at 30

days and 1 year, was similar among groups. While there were no differences in mortality for those with none/mild RD and moderate RD ($P = .68$), severe RD was associated with an increased 1-year mortality (Figure); this difference remained significant in a multivariable model ($P < .01$).

Conclusions: There remains no difference in short- or 1-year outcomes following TAVR between those with preoperative none/mild or moderate RD. However, severe RD is associated with increased mortality, re-hospitalization, and need for new dialysis through 1 year after TAVR. Careful patient selection and rigorous follow-up is necessitated in this challenging patient cohort.



Number at risk:					
Group A	291	236	210	193	169
Group B	1,473	1,312	1,228	1,164	1,032
Group C	767	684	643	614	534

Table 1. Preoperative, operative and postoperative characteristics of the study cohort based on degree of renal dysfunction

	None/mild renal dysfunction (GFR > 60) (n=767)	Moderate renal dysfunction (30 < GFR ≤ 60) (n=1473)	Severe renal dysfunction (GFR ≤ 30) (n=291)	P-value
Baseline:				
Mean age	83.90 ± 7.84	84.89 ± 6.75	84.4 ± 7.0	<0.01
Male gender	57.2% (437)	51.1% (755)	46.7% (136)	<0.01
BMI	28.09 ± 5.36	26.95 ± 6.44	27.47 ± 6.32	<0.01
STS Score	10.27 ± 3.60	11.60 ± 4.07	13.81 ± 4.26	<0.01
Diabetes	34.2% (262)	36.0% (530)	44.5% (129)	<0.01
Prior CABG	42.0% (322)	43.3% (637)	40.7% (118)	0.65
Cerebrovascular disease	26.7% (197)	27.1% (395)	22.4% (64)	0.26
COPD	48.7% (370)	45.9% (646)	39.7% (114)	0.02
HbA1c (g/dL) mean	17.02 ± 1.89	12.48 ± 2.61	11.14 ± 1.55	<0.01
Creatinine mean	0.87 ± 0.17	1.37 ± 0.28	2.22 ± 0.99	<0.01
Operative characteristics:				
Mean volume of contrast	131.98 ± 142.28	126.77 ± 117.33	88.43 ± 58.87	<0.01
Mean fluoroscopy time	21.35 ± 13.34	20.71 ± 15.97	19.00 ± 13.21	0.61
30 day outcomes:				
Hospital length of stay	6.17 ± 2.61	6.27 ± 2.78	6.56 ± 2.96	0.18
Mortality	5.6% (43)	5.8% (86)	9.4% (28)	0.01
Stroke	5.8% (45)	3.0% (43)	4.9% (14)	0.19
Re-hospitalization	6.0% (46)	5.7% (81)	10.0% (27)	0.03
New Dialysis	1.7% (13)	2.5% (36)	9.3% (28)	<0.01
1 year outcomes:				
Mortality	20.8% (157)	21.5% (313)	34.4% (99)	<0.01
Stroke	5.3% (37)	5.0% (68)	6.2% (17)	0.54
Re-hospitalization	16.4% (114)	19.8% (249)	25.1% (61)	0.01
New Dialysis	2.3% (17)	3.7% (51)	16.3% (42)	<0.01

Continuous variables are expressed as mean ± standard deviation, categorical variables are expressed as % (n).

4:45 PM

Room 131ABC

Aortic Valve Replacement via Ministernotomy vs Transcatheter Aortic Valve Implantation: Which Approach Is the Gold Standard in a Moderate Risk Group?

N. Furukawa¹, O. Kuss², S. Scholtz¹, W. Scholtz¹, T. Becker¹, S. Ensminger¹, J. Gummer¹, J. Boergermann¹

¹Heart and Diabetes Center, Bad Oeynhausen, Germany, ²Institute for Biometry and Epidemiology, German Diabetes Center, Leibniz Institute for Diabetes Research at Heinrich Heine University, Düsseldorf, Germany

COMMERCIAL RELATIONSHIPS S. Ensminger: Consultant/Advisory Board, Edwards Lifesciences Corporation, JenaValve Technology; Speakers Bureau/Honoraria, SYMETIS

Purpose: We investigated periprocedural outcome in accordance with the Valve Academic Research Consortium-2 criteria, as well as mid-term survival in all patients who underwent aortic valve replacement (AVR) via ministernotomy, transapical, or transfemoral transcatheter aortic valve implantation (TAVI) at our hospital.

Methods: A prospective register was taken from a single center recording all aortic valve replacements via ministernotomy (MIC, n=1,177), transapical (TA, n=363), and transfemoral (TF, n=507) aortic valve implantations during the period from July 2009 to October 2014. Propensity score matching was performed based on 24 preoperative risk factors, including the EuroSCORE II, STS, and German Aortic Valve Disease Score, to correct for selection bias between the three groups.

Results: We were able to find 92 triplets (n=276) MIC vs TA vs TF at moderate risk (EuroSCORE II 3.5 vs 3.5 vs 3.2; STS 4.4 vs 4.7 vs 4.6). In the comparison, there were no significant periprocedural differences regarding 30-day mortality (2.2% MIC vs 6.5% TA vs 1.1% TF), stroke (1.1% MIC vs 2.2% TA vs 1.1% TF), or myocardial infarction (0.0% MIC vs 1.1% TA vs 0.0% TF). Both intensive care and hospitalization times were significantly longer in the TA group. Regarding mid-term survival, the TA procedure showed a tendency toward a less favorable outcome (HR for TA [95% CI] 1.82 [0.94- 3.54], $P = .08$; HR for TF [95% CI] 0.68 [0.31-1.48], $P = .33$; reference: MIC).

Conclusions: The periprocedural results between MIC, TA, and TF are comparable in patients at moderate surgical risk. Long-term data from randomized studies are required in order to exclude a tendency toward a less favorable survival outcome for TAVI compared to the reference procedure MIC in patients at moderate surgical risk.

NOTES

5:00 PM

Room 131ABC

Long-Term Durability of Aortic Valve Repair for Aortic Regurgitation

A. Zeesban, J. J. Idrees, E. Blackstone, J. Rajeswaran, A. M. Gillinov, B. Griffin, G. Richard, D. F. Hammer, D. R. Johnston, G. B. Pettersson, E. E. Roselli, J. F. Sabik, E. G. Soltesz, L. G. Svensson
Cleveland Clinic, OH

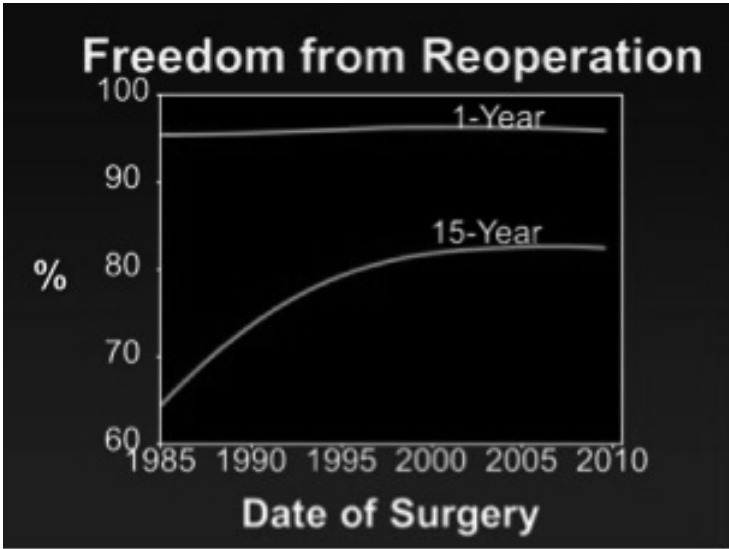
COMMERCIAL RELATIONSHIPS E. Blackstone: Other, Edwards Lifesciences Corporation; A. M. Gillinov: Consultant/Advisory Board, On-X Life Technologies, Inc, Edwards Lifesciences Corporation, Tendyne Holdings, Inc, Abbott Laboratories; Ownership Interest, ClearFlow, Inc; Speakers Bureau/Honoraria, AtriCure, Inc, Medtronic, Inc, St Jude Medical; D. R. Johnston: Consultant/Advisory Board, Edwards Lifesciences Corporation, St Jude Medical; Ownership Interest, JACE Medical, LLC; E. E. Roselli: Consultant/Advisory Board, Medtronic, Inc, Bolton Medical, Apica Ltd; Research Grant, LivaNova, Medtronic, Inc, CorMatrix; Speakers Bureau/Honoraria, Edwards Lifesciences Corporation, St Jude Medical, Vascutek Ltd a Terumo Company, COOK Medical, LivaNova, Medtronic, Inc; Other, Direct Flow Medical, Inc; J. F. Sabik: Consultant/Advisory Board, Medtronic, Inc, LivaNova; Research Grant, Abbott Laboratories, Edwards Lifesciences Corporation; E. G. Soltesz: Nonremunerative Position of Influence, JACE Medical; Speakers Bureau/Honoraria, St Jude Medical, Edwards Lifesciences Corporation, AtriCure, Inc; L. G. Svensson: Ownership Interest, Cardiosolutions, Inc, Posthorax

Purpose: Aortic valve (AV) repair is a reliable technique for treating aortic regurgitation. It offers long-lasting repair; however, long-term data is sparse. The purpose of this study is to identify risk factors for failure and assess the durability of various repair techniques.

Methods: From June 1985 to January 2011, aortic valve repair was planned in 2,567 patients and performed in 2,334 (91%) using commissuroplasty (n=1,099, 47%), figure-of-eight sutures (n=67, 2.9%), debridement (n=691, 33%), resuspension (n=619, 27%), free-margin plication (n=453, 19%), resection (n=266, 11%), root remodeling (n=71, 3.0%), or reimplantation (n=275, 12%). A multivariable logistic regression analysis to identify the variables associated with immediate repair failure was performed.

Results: A total of 233 patients (9.0%) received valve replacement instead of planned repair; risk factors included greater severity of AR ($P = .0002$). Hospital outcomes in the remaining 2,334 patients included mortality (2.8%), stroke (2.9%), dialysis (2.6%), and respiratory failure (17%). Freedom from aortic valve reoperation at 5, 10, 15, and 20 years was 90%, 81%, 69%, and 54%, respectively, but for repairs since 2000, it was 82% at 15 years (Figure). Valve resuspension and figure-of-eight sutures were least likely to require reoperation and commissuroplasty most likely. Other early risk factors included higher preoperative AR. Survival at 5, 10, 15, and 20 years was 85%, 73%, 61%, and 49%, respectively. At 15 years, AR grade was 0+ in 14%, 1+ in 28%, 2+ in 30%, and 3+/4+ in 28%.

Conclusions: Aortic valve repair is an effective, long-lasting technique for treating AR. Higher grade of preoperative AR was associated with higher risk of repair failure. Aortic valve resuspension and figure-of-eight sutures are more durable than commissuroplasty or debridement.



5:15 PM

Room 131ABC

Pericardial Stentless Valve for Aortic Valve Replacement: Long-Term Durability and Hemodynamic Performance—A European Multicenter Experience

A. Repossini¹, B. Passaretti², L. Di Bacco¹, C. Muneretto¹, G. Bisleri¹, L. Giroletti¹, C. Schäfer³, B. Claus³, G. Santarpino⁴, T. J. Fischlein⁴, H. Grubitzsch³

¹University of Brescia Medical School, Italy, ²Cliniche Humanitas Gavazzeni, Cardiology Unit, Bergamo, Italy, ³Charité Universitätsmedizin Berlin, Germany, ⁴Klinikum Nürnberg – Paracelsus Medical University, Nuremberg, Germany

COMMERCIAL RELATIONSHIPS G. Bisleri: Speakers Bureau/Honoraria, AtriCure, Inc; Speakers Bureau/Honoraria, Karl Storz; Speakers Bureau/Honoraria, Covidien; T. J. Fischlein: Consultant/Advisory Board, LivaNova; A. Repossini: Consultant/Advisory Board, LivaNova

Purpose: The Freedom Solo (FS) bovine pericardial valve is a stentless bioprosthesis introduced in 2004 and FDA-approved in 2014. No long-term follow-up series are available to date. We report a multi-institutional experience by the four European centers that started implanting FS extensively from its introduction, providing the largest series with long-term follow-up.

Methods: From 2004 to 2009, 565 patients (mean age 74.6 years \pm 8.3 years, 242 females [42.8%]) underwent isolated (n=350) or combined (n=215) aortic valve replacement (AVR) with the FS. Follow-up, including clinical and strict echocardiographic evaluation, was 97.7% complete with an average follow-up time of 6.9 years \pm 3.7 years (maximum 11.8 years) and cumulative follow-up was 2,965 patient/years. Primary endpoint was freedom from structural valve deterioration (SVD) while secondary endpoints were freedom from reoperation and overall survival.

Results: Mean logistic EuroSCORE I was 10.3% \pm 6.7%. Overall 30-day mortality was 3.7% (2% for isolated and 6.5% for combined AVR), and none was valve-related. Preoperative peak (mean) gradients were 75.1 mm Hg \pm 32.6 mm Hg (45.1 mm Hg \pm 17.7 mm Hg) decreased to 17.3 mm Hg \pm 8.1 mm Hg (8.9 mm Hg \pm 6.2 mm Hg), stable over the follow-up period. Postoperative effective orifice area was 1.84 cm² \pm 0.7 cm², 1.96 cm² \pm 0.52 cm², 2.15 cm² \pm 0.45 cm², and 2.23 cm² \pm 0.51 cm² for valve size 21, 23, 25, and 27, respectively. There was no severe prostheses-patient mismatch (Ppm), and moderate Ppm occurred only in one patient (0.17%). Twenty-eight (5.2%) underwent reoperation (20 surgical replacement, eight TAVR) due to endocarditis (nine), blunt trauma (one), and SVD (18). SVD was reported in five other patients alive at time of censor. Freedom from SVD and reoperation were 90.6% (89.1%–92.1%) and 87.8% (85.6%–90%) respectively at 10 years follow-up, while overall actuarial survival was 56.4% (53.3%–59.5%).

Conclusions: The FS valve provided excellent long-term durability and hemodynamic performance in this large, multi-institutional European experience. Moreover, the FS, given the low rate of structural valve deterioration along with a simple implantability, proved to be a reliable bioprosthesis in aortic position, as a valid alternative to stented bioprostheses.

NOTES

3:30 PM – 5:30 PM

Room 127ABC

Cardiothoracic Surgical Education*Moderators: Ara A. Vaporciyan, Houston, TX, and Jennifer D. Walker, Worcester, MA***COMMERCIAL RELATIONSHIPS** A. A. Vaporciyan: Nonremunerative Position of Influence, American Board of Thoracic Surgery

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold**.

The physician competencies addressed in this session are professionalism and interpersonal and communication skills. These physician competencies will be addressed through a series of lectures and a brief question-and-answer session after each topic.

3:30 PM

Room 127ABC

Outcomes of Trainees Performing Coronary Artery Bypass Grafting: Does Resident Experience Matter?**K. W. Yount¹, L. T. Yarboro², A. K. Narahari¹, R. K. Ghanta³, C. Tribble¹, I. L. Kron², J. A. Kern³, G. Ailawadi³**¹University of Virginia, Charlottesville, ²University of Virginia Medical Center, Charlottesville,³University of Virginia Health System, Charlottesville**COMMERCIAL RELATIONSHIPS** G. Ailawadi: Consultant/Advisory Board, Edwards Lifesciences Corporation, Abbott Vascular; Nonremunerative Position of Influence, AtriCure, Inc; Speakers Bureau/Honoraria, St Jude Medical

Purpose: Outcomes following coronary artery bypass grafting (CABG) surgery are known to be dependent upon surgeon volume. However, the influence of resident case experience on outcomes is unknown. Our objective was to assess the influence of resident experience to understand the learning curve during CABG.

Methods: From 2008 to 2014, all isolated on-pump CABGs (n=1,668) in which a trainee performed the entire operation (including sternotomy, mammary harvest, bypass anastomosis, and closure) were reviewed at a tertiary care academic medical center with an accredited thoracic surgery training program. Operations were ordered by the operative volume of the trainee to date and further stratified by academic quarter. Primary outcomes included total operative duration, separated by “opening times” (skin incision to initiation of cardiopulmonary bypass), cross clamp times, cardiopulmonary bypass times, and “closing times” (bypass termination to skin closure). Secondary outcomes included 30-day mortality, complications, and resource utilization.

Results: Opening time was 9.5 minutes longer during the first academic quarter compared to the remainder of the year (91.5 minutes vs 82.0 minutes, $P < .001$). Multivariable regression controlling for resident, attending, time of year, STS PROM, number of grafts, and redo status revealed that each progressive case took 20 seconds less until reversion to the median ($P < .001$). Overall reversion to the median required 31 operations (range: 15–43). Similarly, closing time was 7 minutes longer (62.8 minutes vs 55.8 minutes, $P = .045$) with each progressive case taking 14 seconds less until reversion to the median ($P = .041$). Despite these differences, cross clamp time (70.6 minutes vs 68.1 minutes, $P = .10$) and cardiopulmonary bypass time (95.2 minutes vs 91.5 minutes, $P = .12$) were not significantly different. Importantly, there were no differences in major complications or 30-day mortality with respect to resident experience.

Conclusions: Operative duration and opening time during CABG is dependent upon resident experience with significant improvement by roughly the 30th case. Importantly, these differences do not translate into worse outcomes or longer cross clamp times. These data support trainees performing all components of CABG—even early in the residency experience.

3:45 PM

Room 127ABC

A System for Real-Time Evaluation of Thoracic Resident Operative Autonomy and Formative Feedback

J. M. Sternbach¹, E. M. Bender², J. B. Zwischenberger³, S. L. Meyerson¹

¹Northwestern University, Chicago, IL, ²St Francis Medical Center, Cape Girardeau, MO,

³University of Kentucky, Lexington

COMMERCIAL RELATIONSHIPS J. B. Zwischenberger: Ownership Interest, MAQUET; Research Grant, National Institutes of Health

Purpose: Concerns have been raised about whether graduating thoracic residents are able to operate independently. This is difficult to quantify since there is currently no method for measuring resident autonomy in training. This study describes a smartphone-based system for evaluating resident autonomy on a daily basis and providing formative feedback.

Methods: A free smartphone application called “Zwisch Me!!” was developed, which uses a four-step scale to evaluate operative autonomy (Zwisch scale). After frame of reference training, residents accessed the application at the end of each case and entered procedure information, including operation, date, and faculty surgeon. They then rated their perception of autonomy achieved, as well as the difficulty of the case. Faculty members were subsequently alerted by automated text message to complete their evaluation of resident autonomy and case difficulty, blinded to resident ratings. Faculty also had the option to provide brief formative feedback.

Results: Over a 3-month period, 124 thoracic operations were performed by three faculty members at an academic, tertiary care hospital. A dedicated thoracic resident was involved in 97 operations (78%) with the remainder performed with general surgery residents. Sixty-two of the thoracic resident cases (66%) were evaluated by trainees using the mobile application. The faculty responded to 55 of the entered cases (87%) with a median response time of 41 minutes and gave detailed formative feedback in 40 cases (73%). Resident and faculty perceptions of operative autonomy were similar with an intraclass correlation of 0.64. Both chose the same Zwisch level in 41 cases (75%). Residents perceived less autonomy in 11 cases (20%) and more autonomy in three cases (5%). Evaluation of case difficulty was less consistent with both agreeing on only 31 cases (56%). As expected, level of training was strongly associated with Zwisch level ($P < .001$).

Conclusions: The “Zwisch Me!!” free, resident-driven smartphone application is a simple, feasible system for evaluating resident autonomy. It allows real-time formative feedback for trainees and provides programs with evidence to support Accreditation Council for Graduate Medical Education milestone evaluations. Broader adoption will create benchmarks for resident performance and inform faculty development related to operative autonomy.

4:00 PM

Room 127ABC

Coronary Artery Bypass Grafting Outcomes in a Resident Training Program Using Real-Time Intraoperative Indocyanine Green Imaging: 3,257 Anastomoses

A. N. Patel¹, C. H. Selzman², G. S. Kumpati², S. H. McKellar², D. A. Bull¹

¹University of Utah School of Medicine, Salt Lake City, ²University of Utah, Salt Lake City

Purpose: As the comorbidity of cardiac patients and the use of drug-eluting stents increases, the quality of coronary artery targets decreases for surgical revascularization and resident training. The role of intraoperative indocyanine green imaging (IGI) for real-time evaluation of coronary anastomoses may improve the ability to train residents.

Methods: Patients undergoing primary, reoperative, or combined valve and coronary revascularization were included at a university-based teaching institution over a 4-year period. Pre/intra/postoperative demographics and outcomes were evaluated. Multiple surgeons and residents were involved in performing the anastomoses. Patients underwent IGI after each anastomosis. Analysis and revisions were made on a real-time basis.

Results: There were 704 cases: 524 coronary artery bypass grafting (CABG) surgery, 163 CABG+other, and 17 RedoCABG. There were 3,257 anastomoses that were performed in the study evaluated by IGI. There were 52 anastomoses that were revised based on IGI analyses: left internal mammary artery to left anterior descending artery, nine; saphenous vein graft (SVG) to obtuse marginal artery, 23; SVG to posterior descending artery (PDA), 18; and right internal mammary artery to PDA, two. The mean STS score was 4.4 for all patients. The 30-day mortality was 2.8% with a readmission rate of 8.1%. Predicted renal failure was 14.5% by STS; actual renal failure was 7.1%. The resident compared to attending surgeon outcomes are in the Table. There were significantly more operations involving residents. Resident operations had higher revisions and readmissions but with no increased reintervention or mortality.

Conclusions: As the complexity of patients referred for coronary revascularization increases, many advocate the use of intraoperative angiography, which has risk. Our program's use of IGI in a resident teaching program has led to successful patient outcomes with acceptable risks. The use of IGI should be evaluated in a larger randomized trial.

Anastomoses	Resident	Attending	p
N*	2541	716	0.0012
Revision (%)*	1.7	1.3	0.042
30 Day Reintervention (%)	1.2	0.9	0.27
30 Day Readmission (%)*	8.4	7.9	0.035
30 Day Mortality (%)	2.9	2.6	0.57

4:15 PM

Room 127ABC

Application of a 3-Dimensional Video System in Training Surgical Skills for Uniportal Thoracoscopic Surgery

K. Han¹, H. Kim¹, H. Lee¹, Y. Choi²

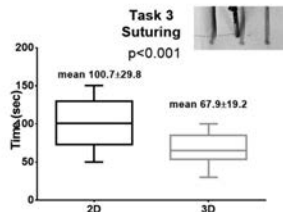
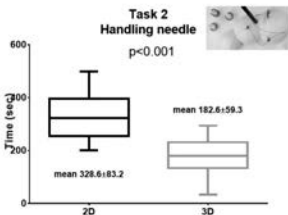
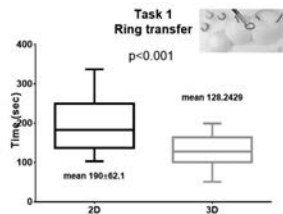
¹Korea University Guro Hospital, Seoul, South Korea, ²Korea University Medical Center, Seoul, South Korea

Purpose: To compare a three-dimensional (3D) video system with a two-dimensional (2D) simulation program for uniportal surgery.

Methods: We launched an endoscopic simulation program for uniportal thoracoscopic surgery using a 3D high-definition video system for the surgeon in training and medical students. This program included three basic surgical skills: ring transfer, passing needle through 3-mm hole, and suturing on the tailor-made skin model. We evaluated the impact of 3D vision in simulation for uniportal surgery in each tasks.

Results: 113 trainees (85 surgeons in training and 28 medical students) who had not yet experienced the 3D video system registered for the program. Three surgical simulation skills were evaluated under the 2D and 3D systems (92 trainees [81.4%] participated in task 1, 102 [95.6%] in task 2, and 88 [87.6%] in task 3). The 3D video system showed less time for procedures and improved performance (an improvement of 65 seconds in task 1, 145 seconds in task 2, and 32 seconds in task 3). On post-simulation survey, trainees reported improved depth perception (n=71, 62.8%) and instrument handling on the uniportal surgical module (n=39, 34.5%) as advantages of the 3D video system during simulation. Sixty trainees (53.1%) were not disturbed by 3D glasses; however, 53 (46.9%) reported mild eye discomfort during the simulation.

Conclusions: A 3D video system has potential advantages, such as improved procedure time and handling of instruments, especially for uniportal thoracoscopic surgery.



4:30 PM**Room 127ABC****Measuring Error Identification and Recovery Skills in Surgical Residents***J. M. Sternbach, K. Wang, R. El Khoury, E. N. Teitelbaum, S. L. Meyerson**Northwestern University, Chicago, IL*

Purpose: Although error identification and recovery skills are essential for the safe practice of surgery, they traditionally have not been taught or evaluated in residency training. This study aims to develop and validate a method for assessing error identification and recovery skills in surgical residents using a thoracoscopic lobectomy simulator.

Methods: A five station, simulator-based exam was developed, containing the most common cognitive and technical errors occurring during division of the superior pulmonary vein for left upper lobectomy. Successful completion of each station required identification and correction of these errors. Exams were videorecorded and scored in a blinded fashion using an exam-specific rating instrument evaluating task performance, as well as error identification and recovery skills. Evidence of validity was collected in the categories of content, response process, internal structure, and relationship to other variables.

Results: Fifteen general surgical residents (nine interns, six third-year residents) completed the exam. Content validity was ensured by basing the exam on prior work demonstrating the most common significant errors created by residents in this simulated procedure. Inter-rater reliability was high with an intraclass correlation coefficient of 0.78 between four trained raters. Station difficulty ranged from 0.64–0.84. All stations adequately discriminated between high and low performing residents with discrimination ranging from 0.35–0.65. The overall exam score was significantly higher for intermediate residents than interns (mean score 74 vs 64, $P = .03$).

Conclusions: The described simulator-based exam with embedded errors and its accompanying assessment tool can be used to measure error identification and recovery skills in surgical residents. This exam provides a valid method for comparing teaching strategies designed to improve error prevention, recognition, and recovery in residents to improve patient safety.

Correlation Between Training Patterns and Lifetime Academic Achievement of US Academic Cardiac Surgeons: Does Investing in Designated Research Time During Training Improve Career Metrics?

C. Rosati¹, N. Valsangkar¹, M. W. Turrentine², J. W. Brown³, L. G. Koniaris¹

¹Indiana University School of Medicine, Indianapolis, ²Indiana University, Indianapolis, ³Indiana University Health, Indianapolis

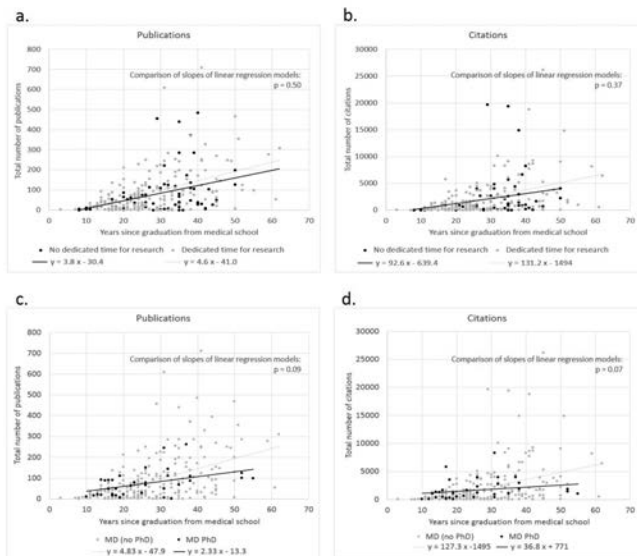
Purpose: We have previously shown that cardiac surgeons are among the most academically productive surgical subspecialists. Herein, we sought to investigate the relationship between dedicated time for research (DTR) during training and subsequent academic achievements (career, publications, citations, and National Institutes of Health [NIH] funding).

Methods: Online resources (SCOPUS, NIH Reporter, institutional websites, CTSNet) were queried to collect academic metrics (publications, citations, research funding) for 284 academic cardiac surgeons practicing at 35 premier institutions in the US. Information regarding individual training, including timing of graduation from medical school, residency, and fellowship, DTR, training duration for general and cardiothoracic surgery, and attainment of a PhD also was collected.

Results: Overall, 187 surgeons (65.8%) took DTR during their training years, while 71 (25.0%) did not, with incomplete data for 26 individuals (9.2%); 248 surgeons (87.3%) were MD only and 36 (12.7%) also had a PhD. There was no statistically significant difference in either ongoing publications or annual accrual of citations (correcting for time since medical school graduation) between those with vs without DTR (Figure a-b). Training experience abroad (88 yes, 196 no) was not correlated with ongoing academic productivity. No overall increase in publications/citations was observed among those with a PhD (Figure c-d). A history of DTR was more prevalent (83.9%) among surgeons with vs without current NIH funding (69.3%; $P = .045$; Table). No statistically significant difference in funding rate or speed of academic rank advancement was observed for those with a PhD. Rates of leadership roles (division/department head) were no different between those with vs without DTR during their training.

Conclusions: Academic success can be achieved through diverse pathways. Our data suggest that, in cardiac surgery, devoting time during the training years exclusively to research or attaining a doctorate degree might not correlate with higher ongoing academic productivity and career achievements (either in terms of academic metrics, titles, or leadership roles).

Continued on next page



	Dedicated time for research during training		PhD	
	Yes	No	Yes	No
Academic title				
Professor – n (%)	71 (70)	31 (30)	14 (13)	97 (87)
Associate Professor – n (%)	45 (75)	15 (25)	8 (13)	53 (87)
Assistant Professor – n (%)	45 (74)	16 (26)	10 (14)	59 (86)
Instructor – n (%)	15 (75)	5 (25)	3 (11)	24 (89)
	$p = 0.73$		$p = 0.97$	
NIH funding				
Yes – n (%)	47 (84)	9 (16)	7 (12)	52 (88)
No – n (%)	140 (69)	62 (31)	29 (13)	196 (87)
	$p = 0.045$		$p = 0.84$	
Division/Department Chief				
Yes – n (%)	32 (68)	15 (32)	4 (8)	45 (92)
No – n (%)	155 (73)	56 (27)	32 (14)	203 (86)
	$p = 0.46$		$p = 0.35$	

Note: Missing data points were excluded.

NOTES

5:00 PM

Room 127ABC

Gender and Cardiothoracic Surgery Training: Specialty Interests, Satisfaction, and Career Pathways

E. H. Stephens¹, M. P. Robich², D. Walters³, W. F. DeNino⁴, M. Aftab², V. Tchanchaleisbvil⁵, A. L. Eilers⁶, R. Rice⁷, A. B. Goldstone⁸, R. Shelstead⁹, T. Malas¹⁰, M. Cevasco¹¹, E. A. Gillaspie¹², D. LaPar¹³, A. A. Shah¹⁴

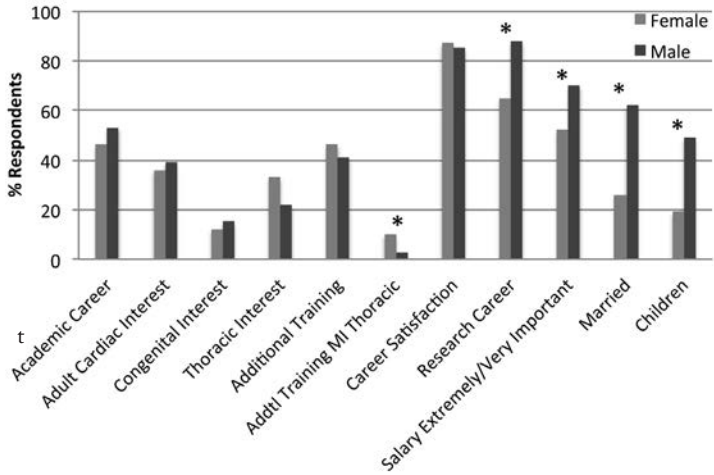
¹Columbia University, New York, NY, ²Cleveland Clinic, OH, ³University of Washington, Seattle, ⁴Medical University of South Carolina, Charleston, ⁵University of Rochester Medical Center, NY, ⁶University of Texas Health Science Center, San Antonio, ⁷Dwight D. Eisenhower Army Medical Center, Fort Gordon, GA, ⁸University of Pennsylvania, Philadelphia, ⁹University of Colorado, Aurora, ¹⁰University of Ottawa Heart Institute, Canada, ¹¹Brigham and Women's Hospital, Boston, MA, ¹²Mayo Clinic, Rochester, MN, ¹³University of Virginia, Charlottesville, ¹⁴Duke University Medical Center, Durham, NC

Purpose: The cardiothoracic surgical workforce is changing. While approximately 5% of practicing surgeons are female, almost 20% of current cardiothoracic surgery residents are female. The purpose of this study was to evaluate the influence of gender on specialty interest, satisfaction, and career pathways of current US cardiothoracic surgery residents.

Methods: Responses to the 2015 TSDA/TSRA in-training exam (ITE) survey taken by current cardiothoracic surgery residents were analyzed. Results from a total of 354 residents (100% response rate) were evaluated. The influence of gender on outcomes was assessed using standard univariate analyses.

Results: Women accounted for 19% of residents, and the percentage did not vary with postgraduate year or program type (traditional vs integrated program). While there were no differences between genders related to specialty interest, academic vs private practice career, or pursuit of additional training (Figure), women were more likely to pursue additional training in minimally invasive thoracic surgery (10% vs 2.5%, $P = .001$) and less likely to perform research in their careers (65% vs 88%, $P = .043$). No differences were noted between genders in career satisfaction, perception of adequate technical training, and preparation for the boards. Among graduating residents, there were no gender differences related to number of interviews or job offers; however, women were less likely to consider money as “extremely” or “very” important (52% vs 70%, $P = .007$). Female residents were less likely to be married (26% vs 62%, $P < .001$) and have children (19% vs 49%, $P < .001$).

Conclusions: Select gender differences exist among cardiothoracic surgery residents. While career satisfaction and specialty interest were similar between genders, females were less likely to intend to perform research during their careers, despite similar previous research experience. Women also demonstrated lower rates of marriage and child-rearing as compared to their male counterparts.



Addtl=additional; MI Thoracic=minimally-invasive thoracic; *= $P < 0.05$ between genders.

5:15 PM

Room 127ABC

Impact of a Moodle-Based Online Curriculum on Thoracic Surgery In-Training Exam Scores

M. B. Antonoff, E. D. Verrier², M. S. Allen³, L. Aloia⁴, C. Baker⁵, J. I. Fann⁶, M. D. Iannettoni⁷, S. C. Yang⁸, A. A. Vaporciyan¹

¹University of Texas MD Anderson Cancer Center, Houston, ²University of Washington, Seattle,

³Mayo Clinic, Rochester, MN, ⁴Joint Council on Thoracic Surgery Education, Inc, Chicago, IL,

⁵University of Southern California Keck School of Medicine, Los Angeles, ⁶Stanford University Medical Center, CA, ⁷East Carolina Heart Institute at East Carolina University, Greenville, NC,

⁸The Johns Hopkins University School of Medicine, Baltimore, MD

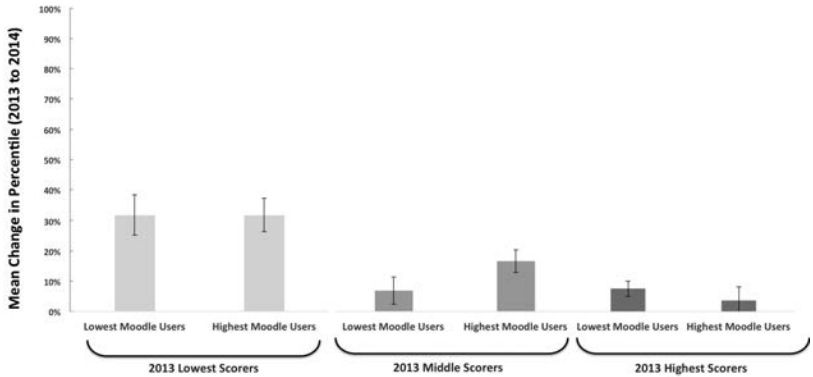
COMMERCIAL RELATIONSHIPS M. S. Allen: Nonremunerative Position of Influence, Joint Council on Thoracic Surgery Education (JCTSE); J. I. Fann: Consultant/Advisory Board, Twelve, Inc; A. A. Vaporciyan: Nonremunerative Position of Influence, American Board of Thoracic Surgery

Purpose: The feasibility and efficacy of a web-based curriculum in supplementing thoracic surgical training previously has been shown. However, the impact of curricular participation upon validated knowledge tests remains unknown. We aimed to compare in-service training examination (ITE) results among trainees stratified by use of the updated, nationally implemented curriculum.

Methods: The national online curriculum was implemented at the beginning of the 2013-2014 academic year. We conducted a retrospective review of trainees who participated in thoracic surgery training programs in both the 2012-2013 and 2013-2014 years. Standardized scores from the 2013 and 2014 ITE exams were obtained, and curricular usage data were collected from site analytics. Trainees were separated into three groups based on their 2013 ITE score, and, within each group, changes in score for high- vs low-volume users were compared.

Results: 187 trainees took the ITE in both 2013 and 2014, comprising a unique cohort of individuals who took the exam for two consecutive years, with exposure to the online curriculum during only the second year. As expected, mean percentile scores of all trainees improved with time. High-volume user scores trended toward greater improvement than those of low-volume users (+18.2% vs +13.0%, $P = .199$) (Table). Although this finite, distinctive population limited the study's ability to achieve statistical significance, important trends were observed. When stratified by 2013 score, the lowest scoring quartile improved substantially and the highest scoring quartile improved modestly, regardless of curricular use. However, for those individuals who achieved mid-range scores in 2013, there was a trend toward much greater improvement in score with heavier use of the curriculum (+17.0% vs +7.0%, $P = .094$) (Figure).

Conclusions: Among trainees who had access to the novel online curriculum during the second of two consecutive years, we evaluated the impact of curricular participation on ITE scores. The effect appears to be most pronounced in individuals with mid-range scores, in whom high curricular utilization led to the greatest improvement.



	All users	High-volume users	Low-volume users	High vs Low, P-value
Number of logins	13.4 (0-89)	36.5	0.4	<0.0001
2013 percentile (baseline)	42.4	43.2	46.9	0.701
2014 percentile (after curricular exposure)	58.1	61.4	59.9	0.766
Improvement in percentile	+15.7	+18.2	+13.0	0.199

3:30 PM – 5:30 PM

Room 122ABC

Congenital Session: Pediatric Congenital III*Moderators: Jeffrey P. Jacobs, St Petersburg, FL, and James D. St. Louis, Minneapolis, MN*

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Presenting authors are listed in **bold**.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

3:30 PM

Room 122ABC

Palliation Outcomes of Neonates Born With Single Ventricle Anomalies Associated With Aortic Arch Obstruction

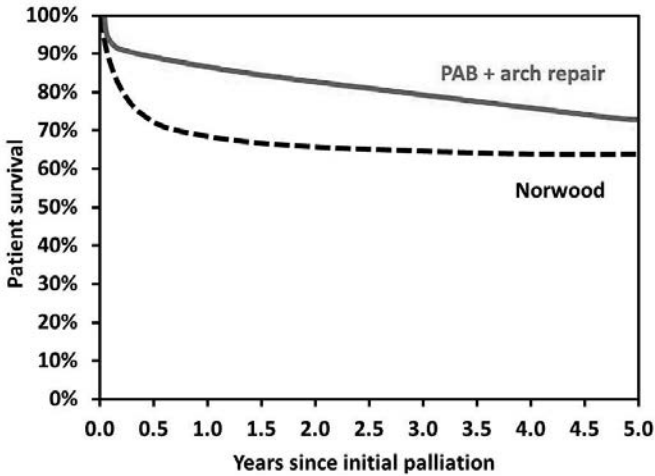
B. Alsoufi, B. Schlosser, T. Slesnick, B. E. Kogon, K. R. Kanter
Emory University, Atlanta, GA

Purpose: The management of single ventricle anomalies associated with arch obstruction is challenging due to the development of subaortic obstruction and ventricular hypertrophy. Norwood operation and pulmonary artery band plus arch repair (PAB+arch) are the most common palliation strategies in those patients, with each strategy associated with specific advantages and shortcomings.

Methods: Between 2002 and 2012, 94 neonates with single ventricle and arch obstruction underwent Norwood (n=65) or PAB+arch (n=29) at our institution. Underlying cardiac anomaly was tricuspid atresia (n=20), double outlet right ventricle (n=16), unbalanced atrioventricular septal defect (n=16), atrial isomerism (n=14), double inlet left ventricle (n=13), mitral atresia (n=9), and other (n=6). Patients with hypoplastic left heart syndrome were excluded. Outcomes were parametrically modeled, comparison of early and late outcomes between the two surgical strategies was performed, and risk factors associated with mortality were analyzed.

Results: Following first stage palliation, Norwood operation was associated with more extracorporeal membrane oxygenation requirement (14% vs 3%, OR 4.5 [0.5-37.0], $P = .163$) and fewer unplanned reoperations (20% vs 31%, OR 0.6 [0.2-1.5], $P = .247$) than PAB+arch. Unplanned reoperations following Norwood were mainly shunt revisions or pacemaker implantations, while reoperations following PAB+arch were mainly band adjustments, shunt additions, or conversions to Norwood (n=5 conversions). Norwood operation was associated with higher hospital mortality (15% vs 3%, OR 5.1 [0.6-41.8], $P = .130$) than PAB+arch. Following hospital discharge, Norwood operation was associated with similar interstage mortality (12% vs 10%, $P = .674$) and progression to subsequent Glenn (84% vs 89%, $P = .612$) compared to PAB+arch. Overall, 8-year survival was 70% (Norwood 66%, PAB+arch 79%, $P = .354$). On multivariable analysis, factors associated with mortality were weight <2.5 kg (OR 2.6 [1.1-5.9], $P = .026$), genetic syndromes (OR 2.3 [1.0-5.3], $P = .049$), and underlying diagnosis other than tricuspid atresia or double inlet left ventricle (OR 2.4 [0.9-5.8], $P = .067$).

Conclusions: Both management strategies are associated with acceptable outcomes. Norwood has higher operative mortality but similar progression to subsequent palliation stages and comparable late attrition among hospital survivors. Despite higher reoperation risk, the PAB+arch strategy is a valid alternative in well-selected patients. Underlying cardiac anatomy and patient characteristics affect outcomes.



	PAB + arch N=29	Norwood N=65	P-value
Unplanned reoperation	9 (31%)	13 (20%)	0.247
ECMO	1 (3%)	9 (14%)	0.163
Hospital mortality	1 (3%)	10 (15%)	0.130
Interstage mortality	3 (10%)	8 (12%)	0.674
Progression to Glenn for hospital survivors	25 (89%)	46 (84%)	0.612
Survival at 8 years	79%	66%	0.354

3:45 PM

Room 122ABC

Aortic Arch Reconstruction in Comprehensive Stage II Compared With Norwood Reconstruction in Hypoplastic Left Heart Syndrome and Variants

C. Haller, D. Chetan, A. Saedi, R. Parker, G. S. Van Arsdell, C. A. Caldarone, O. Honjo

The Hospital for Sick Children, Toronto, Canada

COMMERCIAL RELATIONSHIPS G. S. Van Arsdell: Ownership Interest, Cell Aegis Devices

Purpose: Growth of the aortic arch after the Norwood procedure in patients with hypoplastic left heart syndrome and variants (HLHS) is influenced by multiple factors. The techniques used for reconstruction in comprehensive stage II can differ significantly from conventional repairs. Aortic arch dimensions after conventional and hybrid palliation remain unclear.

Methods: Between 2007 and 2014, 139 patients with HLHS underwent either stage I Norwood (n=72) or hybrid (n=67) palliation. Pre-stage II (P1, n=75) and pre-Fontan (P2, n=32) angiograms were analyzed with regard to ascending aorta (AA), transverse arch (TA), isthmus (IA), and descending aorta (DA) dimensions. In hybrid patients, P1 measurements covered DA dimensions only. Arch reconstruction was performed with an interdigitating technique in both groups (n=88) or with stent inclusion in 13 hybrid patients.

Results: Prior to P1, hybrid patients had significantly larger DA z-score than controls ($P < .0005$). P2 measurements did not show differences in z-scores ($P = .558/.827/.689/.160$) at AA, TA, IA, or DA. A statistically significant increase of DA z-scores was found in the Norwood ($P = .039$), but not the hybrid group ($P = .801$). The change in z-score calculated by the difference between P2 and P1 z-score was comparable in Norwood and hybrid patients ($P = .215$). Within the hybrid group, reconstruction of the aortic arch with incorporation of the ductal stent did not lead to significantly restricted growth (z-scores; $P = .549/.934/.875/.082$), but DA z-score showed a trend toward larger dimensions with a retained stent. Altered geometry assessed by calculation of AA/TA, TA/IA, and IA/DA ratios ($P = .628/.905/.083$) showed a trend towards smaller IA/DA ratio. Reintervention for arch obstruction was performed in four conventionally treated (5.6%) and three hybrid patients (4.5%) ($P = .815$).

Conclusions: Aortic arch growth does not differ between groups. The increase in DA in Norwood patients may reflect physiologic changes. Inclusion of the stent does not impair growth restriction or geometry. The trend toward smaller IA/DA ratio with the stent retained may result from increased DA diameters, rather than isthmic narrowing.

4:00 PM

Room 122ABC

Mid-Term Survival Following Resuscitative Bilateral Pulmonary Artery Banding in High-Risk Single Ventricle Neonates and Infants: How Do They Fare?K. J. Guleserian¹, A. W. Nugent², J. M. Forbess²¹Children's Medical Center of Dallas/University of Texas Southwestern Medical Center, ²Children's Medical Center of Dallas, TX

Purpose: Bilateral pulmonary artery banding (bPAB) with or without ductal stenting (DS) has been performed at our institution as a resuscitative intervention for patients considered too high risk (profound metabolic acidosis, ventricular dysfunction, significant atrioventricular valve regurgitation [AVVR], and/or end-organ dysfunction) for conventional single ventricle (SV) palliation. The purpose of this study was to determine mid-term survival of this particularly high-risk group using this resuscitative strategy.

Methods: Retrospective review of all SV patients <3 months of age who underwent bPAB and DS or maintenance of ductal patency by PGE1 infusion between January 2007 and October 2011 and survived to discharge. Echocardiographic, angiographic, operative, and clinical data were reviewed. Follow-up was complete in 100%.

Results: Fifteen of 24 patients (62.5%) who underwent bPAB at a median age of 9 days (range: 2-39), gestational age of 38 weeks (range: 36-41), and weight of 3.2 kg (range: 2.7-4.1) survived to hospital discharge. In this group, maintenance of ductal patency was either by DS (n=8) or PGE1 infusion (n=7). Median follow-up for the entire cohort was 62 months. Cardiac diagnoses included hypoplastic left heart syndrome (HLHS) or variant HLHS in 12 and unbalanced atrioventricular canal in three. In the HLHS group, seven of 12 (58.3%) had an intact or highly restrictive atrial septum requiring either open (n=1) or transcatheter atrial septostomy (n=6) with or without atrial stent placement (n=3). Conventional Norwood (n=7) or comprehensive stage 2 (n=1) was performed in patients suitable for surgical palliation (recovery of ventricular function), while primary transplant (TXPLT) was undertaken in seven deemed unsuitable (persistent ventricular dysfunction with or without severe AVVR). Pulmonary artery intervention was performed in 10 patients (66.6%)—four at TXPLT, one s/p TXPLT, one at NW, and four s/p subsequent surgical palliation. All survived to hospital discharge. Six of seven (85.7%) s/p NW underwent bidirectional Glenn shunt, three have undergone Fontan completion, and two await further surgical palliation. Late deaths occurred in one patient s/p TXPLT and three s/p surgical palliation (one s/p NW, one s/p bidirectional Glenn shunt, one s/p CS2). Six of seven (85.7%) transplanted patients are alive at median follow-up of 66 months.

Conclusions: Mid-term survival following initial resuscitative bPAB in high-risk single ventricle neonates and infants is excellent. Pulmonary artery intervention either at the time of or after surgical palliation or TXPLT is necessary in the majority.

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Room 122ABC

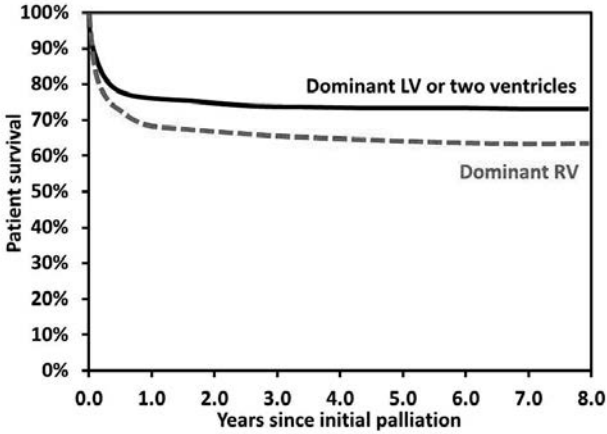
The Impact of Dominant Ventricle Morphology on Palliation Outcomes of Single Ventricle Anomalies*B. Aloufi, K. R. Kanter, W. Mable, B. E. Kogon**Emory University, Atlanta, GA*

Purpose: Differences in the structure of the right ventricle and tricuspid valve compared to the left ventricle and mitral valve make them less equipped to support the systemic circulation in the long term, leading to late systemic right ventricle failure. We examined the effect of dominant ventricle morphology on palliation outcomes of single-ventricle anomalies.

Methods: Between 2002 and 2012, 530 neonates underwent first stage palliation at our institution, including: Norwood (n=284, 54%), modified Blalock-Taussig shunt (n=173, 33%), and pulmonary artery band (n=73, 14%). Patients were divided into two groups: neonates with dominant right ventricle morphology (RV group, n=302, 57%) and a control group (LV group, n=228, 43%) that included neonates with dominant left ventricle morphology (n=199, 38%) and those with functional single-ventricle anomalies and two well-formed ventricles (n=29, 5%). Comparisons of hospital outcomes, interstage mortality, progression to subsequent palliation stages, and late survival was performed between the two study groups, and factors associated with outcomes were examined.

Results: The differences between the two study groups are shown in the Table. Following first stage palliation, RV group had comparable extracorporeal membrane oxygenation requirement (12% vs 11%, $P = .648$), unplanned reoperation (12% vs 13%, $P = .586$), and hospital mortality (16% vs 13%, $P = .437$) to the control LV group. Among hospital survivors, RV group had comparable interstage mortality (11% vs 9%, $P = .509$), progression to subsequent Glenn (89% vs 84%, $P = .529$), and higher death following Glenn (10% vs 4%, $P = .020$) with trend for lower 8-year survival (66% vs 74%, $P = .077$) than the control LV group. On multivariable analysis, dominant RV morphology was not associated with mortality (OR 1.2 [0.7-2.0], $P = .522$), while other factors, such as genetic syndromes (OR 2.9 [2.0-4.4], $P < .001$), low weight ≤ 2.5 kg (OR 1.6 [1.0-2.4], $P = .05$), and underlying high-risk cardiac anomalies, such as pulmonary atresia/intact ventricular septum and heterotaxy syndrome (OR 2.6 [1.4-4.5], $P = .001$), were associated with diminished survival.

Conclusions: At mid-term follow-up following first stage single-ventricle palliation, underlying cardiac anomaly and patient characteristics affect mortality more than dominant ventricular morphology. As failure of the right ventricle and associated tricuspid valve might occur at late stages, the impact of dominant ventricular morphology on long-term outcomes requires further assessment.



	RV group N=302	LV group N=228	p-value
Weight \leq 2.5 Kg	15%	15%	0.975
Premature \leq 36 weeks	14%	15%	0.827
Genetic syndromes	9%	13%	0.156
Palliation type			
Norwood	81%	16%	<0.001
Modified BT shunt	8%	66%	
PA band	11%	18%	
Cardiopulmonary bypass use	88%	30%	<0.001
TAPVC repair	4%	4%	0.988

4:30 PM

Room 122ABC

Periventricular Device Closure of Perimembranous Ventricular Septal Defect: Safety and Efficiency With Symmetric and Asymmetric Occluders

X. Pan, W. Ouyang, K. Pang, S. Wang, F. Zhang, Y. Liu, D. Zhang, S. Hu, S. Li

National Center for Cardiovascular Diseases, Fuwai Hospital, Chinese Academy of Medical Sciences, and Peking Union Medical College, Beijing, China

Purpose: Periventricular device closure of perimembranous ventricular septal defects (pmVSDs) without cardiopulmonary bypass is a treatment for pmVSDs. This report is to describe the safety and efficiency of symmetric and asymmetric occluders applied in this technique.

Methods: From May 2011 to April 2015, 334 patients with pmVSDs were enrolled for periventricular device closure of their defects. According to the distance from aortic valve to upper rim of pmVSDs, they were divided into symmetric group (n=236, distance ≥ 2 mm) and asymmetric group (n=98, distance < 2 mm). Patients were followed up at an outpatient clinic at 1 month, 6 months, 1 year, and every year after the operation with echocardiography and electrocardiogram at each visit.

Results: There were no significant differences between the two groups in terms of age, weight, and defect diameter (4.1 mm \pm 1.3 mm symmetric group vs 4.0 mm \pm 1.1 mm asymmetric group, $P = .701$). The procedure success rate was similar between two groups (94.5% [223/236, symmetric group] vs 91.8% [90/98, asymmetric group], $P = .363$). However, the asymmetric group had higher trivial residual shunt rate (16.7% [15/90] vs 7.6% [17/223], $P = .017$) and bundle branch block rate (8.9% [8/90] vs 1.3% [3/223], $P = .003$) than the symmetric group immediately post-procedure. Most of the patients were discharged within 4 to 5 days after procedure. Follow-up in all patients ranged from 1 to 48 months (29.4 months \pm 11.3 months) and revealed no severe complications, such as aortic regurgitation, malignant arrhythmias, or device dislocation. However, the asymmetric group had higher trivial residual shunt rate (7.8% [7/90] vs 2.2%, $P = .021$) and bundle branch block rate (6.7% [6/90] vs 1.3% [3/223], $P = .010$) than the symmetric group in follow-up.

Conclusions: Minimally invasive periventricular device closure of pmVSDs is safe and effective with symmetric and asymmetric occluders. However, patients with asymmetric occluders need closer long-term follow-up because of higher incidence of residual shunt and bundle branch block.

4:45 PM

Room 122ABC

Small-sized Expanded Polytetrafluoroethylene Valved Conduit for Right Ventricular Outflow Reconstruction in Patients With Congenital Heart Disease*E. Yamashita¹, M. Yamagishi¹, T. Miyazaki¹, S. Asada¹, H. Yaku¹, N. Kato²**¹Kyoto Prefectural University of Medicine, Japan, ²Children's Medical Center, Kyoto Prefectural University of Medicine, Japan*

Purpose: Homografts and xenografts are widely used for reconstruction of right ventricular outflow tract (RVOT), but their limited availability and durability has been concerning. In Japan, fan-shaped expanded polytetrafluoroethylene (ePTFE) valved conduits with bulging sinus mainly are used instead. The purpose of our study was to evaluate their durability and performance.

Methods: This is a retrospective review of 302 patients who underwent reconstruction of RVOT using fan-shaped ePTFE valved conduits with bulging sinus at 63 Japanese hospitals from 2003 to 2014. Inclusion criteria were conduit size ≤ 16 mm and surgery as a primary correction for the underlying heart diseases, with palliative surgery being excluded. The conduit performance were evaluated in terms of mortality, conduit exchange for any reason, and valve dysfunction, defined as a peak pressure gradient ≥ 40 mm Hg or at least moderate pulmonary regurgitation (PR) on the latest cardiac catheterization and echocardiography.

Results: Patient age was 24.8 months ± 23.7 months and body weight was 8.8 kg ± 4.2 kg at the operation. Follow-up period was 2.0 years ± 1.6 years. Diagnoses (patient number) were pulmonary atresia/pulmonary stenosis (PS) + ventricular septal defect (VSD) (113), tetralogy of Fallot/double-outlet right ventricle (96), persistent truncus arteriosus (41), aortic stenosis/regurgitation (16), transposition of the great arteries + PS + VSD (16), interrupted aortic arch/coarctation of the aorta + left ventricular outflow tract obstruction (13), and other diseases (seven). The early mortality rate within 30 days after the conduit implantation was $6/302$ (2.0%). The late mortality rate beyond 30 days was $9/302$ (3.0%). A total of eight patients (2.6%) required a conduit exchange at a median time of 2.4 years. The rate of freedom from conduit exchange was $91.4\% \pm 4.7\%$ at 5 years. A total of 21 patients (7.0%) developed at least moderate pulmonary regurgitation at 3.2 years ± 1.8 years. A total of 29 patients (9.6%) developed conduit stenosis with the pressure gradient ≥ 40 mm Hg at 2.3 years ± 1.8 years.

Conclusions: Fan-shaped ePTFE valved conduits with bulging sinus have excellent mid-term outcomes, compared with reported outcomes of homograft or xenograft conduits. In order to evaluate long-term results, further follow-up is required.

5:00 PM

Room 122ABC

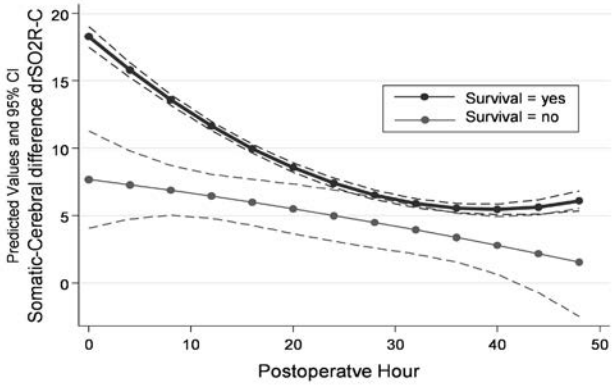
Postoperative Trajectories of Cerebral and Somatic Near Infrared Spectroscopy Saturations and Outcomes After Stage I Palliation of Hypoplastic Left Heart SyndromeG. Hoffman¹, N. S. Ghanayem¹, J. P. Scott¹, J. S. Tweddell², M. E. Mitchell², K. A. Mussatto²¹Children's Hospital and Medical College of Wisconsin, Milwaukee, ²Children's Hospital of Wisconsin, Milwaukee**COMMERCIAL RELATIONSHIPS** J. S. Tweddell: Consultant/Advisory Board, CorMatrix

Purpose: Low systemic venous oxygen saturation (SvO₂) following surgical palliation of hypoplastic left heart syndrome predicts adverse neurologic outcome and reduced survival. We herein test the hypothesis that systemic oxygen status as assessed by noninvasive continuous cerebral and somatic near-infrared spectroscopy (NIRS) predicts survival.

Methods: A registry of 48-hour hemodynamic measures following stage 1 palliation for HLHS has been maintained for 15 years with IRB approval. Monitoring cerebral (rSO₂C) and somatic (rSO₂R) saturations with NIRS has been standard of care at our hospital for the past decade. We used logistic and multivariable mixed regression methods to analyze the relationship between standard hemodynamic measures and NIRS-derived measures of regional venous saturation and outcome. The arterial-cerebral (darSO₂C), arterial-somatic (darSO₂R), and somatic-cerebral rSO₂ difference (drSO₂R-C) were calculated by temporally synchronous subtraction. The primary outcome measure was survival at hospital discharge or 30 days. For regressions with $P < .05$, the area under the receiver operating characteristic curve (ROCA) was used to summarize the predictive power.

Results: Complete data were available from 209 patients. The early (hospital or 30-day) survival rate was 189/209 or 90.4%. Extracorporeal membrane oxygenation (ECMO) was used in 20 patients (9.6%), with survival in 9/20 (45%). The changes in rSO₂R, rSO₂C, and SvO₂ over time were significantly different for survivors vs non-survivors (Figure). Measures over the first 6 hours predicted survival better than measures over 48 hours. Of hemodynamic measures at 6 hours, survival was best predicted by the average somatic-cerebral rSO₂ difference drSO₂R-C ($P < .001$, ROCA=0.73) or by average rSO₂R ($P = .047$, ROCA=0.73), followed by arterial-somatic difference darSO₂R ($P = .050$, ROCA=0.69) and SvO₂ ($P = .012$, ROCA=0.67). Neither average arterial blood pressure nor cerebral rSO₂C predicted survival. The number of hours with rSO₂R < 65 was predictive of survival ($P < .001$, ROCA=0.68). ECMO use was best predicted by cerebral rSO₂C ($P < .001$, ROCA=0.89), somatic rSO₂R ($P = .003$, ROCA=0.86), and SvO₂ ($P < .001$, ROCA=0.79).

Conclusions: The predictive power of two-site NIRS is superior to that of SvO₂, and thus, a monitoring strategy that includes cerebral and somatic NIRS could supplant invasive measures. Since outcomes were strongly determined by NIRS measures at 6 hours, early postoperative NIRS measures may be a rational target for goal-directed interventions.



5:15 PM

Room 122ABC

Report of the 2015 STS Congenital Heart Surgery Practice Survey

D. L. Morales¹, M. Khan¹, J. W. Turek², R. M. Biniwale³, C. I. Tchervenkov⁴, M. Chao⁵, J. P. Jacobs⁶, J. S. Tweddell⁷, M. L. Jacobs⁸

¹Cincinnati Children's Hospital Medical Center, OH, ²University of Iowa Hospital & Clinics, Iowa City, ³University of California, Los Angeles, ⁴The Montreal Children's Hospital of McGill University Health Center, Montreal, Canada, ⁵The Society of Thoracic Surgeons, Chicago, IL, ⁶Johns Hopkins All Children's Heart Institute, St Petersburg, FL, ⁷Children's Hospital of Wisconsin, Milwaukee, ⁸Johns Hopkins School of Medicine, Newtown Square, PA

COMMERCIAL RELATIONSHIPS D. L. Morales: Consultant/Advisory Board, CorMatrix, Berlin Heart, SynCardia Systems, Inc; Other, CorMatrix, Berlin Heart, SynCardia Systems, Inc; J. S. Tweddell: Consultant/Advisory Board, CorMatrix

Purpose: The Society of Thoracic Surgeons (STS) Workforce on Congenital Heart Surgery (CHS) undertook a third subspecialty practice survey (2005, 2010, and 2015) to obtain contemporary data.

Methods: A search for potential participants was conducted using four directories (Cardiothoracic Surgery Network, Congenital Cardiology Today, STS reports, and Congenital Heart Surgeons' Society). All surgeons listing congenital and/or pediatric cardiac surgery among their interests were sent an invitation to a web-based survey. In total, there were 213 respondents, of which 177 (83%) were practicing congenital heart surgeons (age, mean \pm SD: 51 years \pm 9 years, males 93%). Additional respondents included nine (4%) CHS trainees (age: 39 years \pm 6 years, males 100%), 17 (8%) retired congenital heart surgeons (age: 71 years \pm 6 years, males 100%), and 10 (5%) others (age: 57 years \pm 10 years, males 70%).

Results: All trainees (9/9) planned to pursue CHS as career focus, six (67%) wanted to pursue a faculty position in US/Canada, and five (56%) were somewhat concerned/pessimistic about a future appointment. For retired surgeons, retirement age was 63 years \pm 7 years, 14 (82%) felt financially secure, and 13 (76%) considered "family" as the most important personal compromise. For practicing surgeons, 141 (80%) were extremely/very satisfied and 22 (12%) were satisfied in their career. American medical graduates included 130 of the respondents (73%). Mean postgraduate training duration was 10 years \pm 2 years, 148 (84%) were American Board of Thoracic Surgery certified, and 24 (14%) received CHS training outside US/Canada. Satisfaction with current salary was 54%, and 156 (88%) performed exclusively CHS. Caseload for 47 practicing surgeons (27%) was <100 CHS/year, and 42 (24%) performed >200 CHS/year; 72 (41%) considered their caseload too low. For practicing surgeons, anticipated mean retirement age was 67 years \pm 4 years, and 31 (18%) estimated \leq 5 years to retirement (Table).

Conclusions: These data provide insight into the current practice of congenital heart surgery in North America and should help facilitate rational plans to meet workforce needs for an expanding patient population.

Table – Most frequent responses from the practicing congenital heart surgeons to the 2015 STS CHS Practice Survey questions.

Questions	Responses
Median duration in current practice situation (min-max)	7y (0-37y)
Median number of jobs as CHS (min-max)	2 (1-5)
Practicing at a free-standing children's hospital	103 (58%)
Full-time academic appointment	118 (67%)
Average weekly work hours of 61-70	64 (36%)
Yearly vacation days of 15-28	92 (52%)
Too many individuals practicing CHS in geographic area	91 (51%)
Majority of adult CHS in institution is performed by a dedicated surgeon, majority of whose patients are pediatric	133 (75%)
The environment for surgical and postoperative care of adult CHS patients does not matter as long as the physicians and staff are familiar and competent	73 (41%)
Adult CHS should be performed by dedicated congenital heart surgeons even though majority of their caseload is pediatric	112 (63%)

3:30 PM – 5:30 PM

Room 120A

General Thoracic Session: Mediastinal/Pulmonary*Moderators: Chadrick E. Denlinger, Charleston, SC, and Jessica S. Donington, New York, NY***COMMERCIAL RELATIONSHIPS** J. S. Donington: Consultant/Advisory Board, KCI

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold**.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

3:30 PM

Room 120A

An Extended-Pleurectomy, Decortication-Based Treatment for Advanced Stage, Large Tumor Volume Epithelial Mesothelioma Yielding a Median Survival of Greater than 3 Years**J. Friedberg¹, C. B. Simone², M. Culligan¹, K. Cengel¹, A. Barsky², E. Alley²**¹University of Maryland, Baltimore, ²University of Pennsylvania, Philadelphia**REGULATORY DISCLOSURE** This presentation describes the off-label use of the drug Photofrin by Pinnacle Biologics, which is FDA-approved.

Purpose: The purpose of this study was to assess survival and compare outcomes by histology for patients with malignant pleural mesothelioma utilizing extended pleurectomy-decortication. In this series, lung-sparing surgery was the only approach considered, and it was the intention to treat all patients with intraoperative photodynamic therapy and adjuvant pemetrexed-based chemotherapy.

Methods: Seventy-eight consecutive patients with greater than 90% stage III-IV disease underwent definitive lung-sparing surgery on two prospective clinical trials from 2007 to 2013. Patients were a median of 64 years (range: 37-81) and predominantly male (83%). A consistent lung-sparing surgical strategy-technique was employed for all patients. Despite large tumor volumes, no patient underwent pneumonectomy or any other lung resection. All patients had a thorough lymphadenectomy. All patients received intraoperative photodynamic therapy, and 65 (83%) received adjuvant pemetrexed-based chemotherapy. The volume of each tumor specimen was measured directly by displacement, submerging the tumor in saline after its removal.

Results: There were two (2.6%) 30-day postoperative deaths. Sixty-four patients (82%) had pure epithelial subtype, and 14 (18%) had sarcomatous subtypes (pure sarcomatous or mixed epithelial/sarcomatous). Macroscopic complete resection was achieved in all 64 epithelial patients (100%) and 12 sarcomatous patients (86%). Tumor volumes ranged from 150 to 2,300 mL, with a median of 600 mL. At a median follow-up of 3.5 years among living patients, median overall survival (OS) was significantly longer for patients with epithelial (40.1 months) compared to sarcomatous subtypes (5.1 months), $P < .001$. Twenty-four epithelial patients (37%) had N0-1 disease, and 40 (63%) had N2 disease. Subanalyses for the epithelial patients revealed a median OS of 23.2 months if the patients had N2 disease and 57.1 months if they had N0-1 disease. Progression-free survival (PFS) for the same epithelial subgroups was 11.8 months for N2 and 23.8 months for N0-1.

Conclusions: In light of the advanced stage and large tumor volumes, these results are, arguably, superior to any other reported results for this cancer. The employed surgical technique is reliable and reproducible. Surgery should be limited to epithelial patients. The reasons for the unusually long PFS-OS intervals are under investigation and are perhaps photodynamic therapy-related.

3:45 PM

Room 120A

Robot-Assisted Thymectomy in Anterior Mediastinal Tumor: Propensity Score-Matching Study With Transsternal Thymectomy

C. Kang, Y. Hwang, H. Lee, I. Park, Y. Kim

Seoul National University Hospital, South Korea

Purpose: Robot-assisted thymectomy (RT) increasingly has been performed for the treatment of anterior mediastinal tumors. However, there have been only a few papers addressing the benefits of RT compared to conventional transsternal thymectomy (TT). This study aimed to compare early and long-term outcomes between RT and TT.

Methods: A total of 529 patients who underwent surgical resection of anterior mediastinal tumors from January 2006 to June 2015 were included in the study, and RT was performed in 117 patients (22%). Propensity score matching was performed between RT and TT with variables of gender, age, tumor size, clinical stage, Charlson comorbidity index, cell types, and concomitant operations. After propensity score matching, 105 patients in each group were selected. Early postoperative outcomes and long-term oncological outcomes were compared between RT and TT.

Results: Thymic epithelial tumor (TET) was the most common type of tumor in the study group (53 patients, 51% in RT; vs 58 patients, 55% in TT; $P = .791$), and thymic carcinoma was identified in 13 patients in RT (12%) and 12 patients in TT (11%). Distribution of pathologic stages in TET was not different between RT and TT (44% vs 36% in stage I, 43% vs 52% in stage II, 7% vs 3% in stage III, and 7% vs 9% in stage IV; $P = .408$). RT showed less intraoperative blood loss ($103.6 \text{ mL} \pm 105.5 \text{ mL}$ vs $380.0 \text{ mL} \pm 533.9 \text{ mL}$, $P < .001$), lower incidence of postoperative complication (1 patient, 1% vs 13 patients, 12%; $P < .001$), and shorter length of hospital stay ($2.7 \text{ days} \pm 1.5 \text{ days}$ vs $6.7 \text{ days} \pm 7.2 \text{ days}$, $P < .001$). Three-year overall survival and freedom from recurrence of TET were 100% and 88% in RT and 98% and 92% in TT ($P = .668$ and $.568$, respectively).

Conclusions: RT demonstrated excellent early outcomes compared to TT by reducing blood loss, decreasing postoperative complications, and shortening length of hospital stay. RT also could achieve comparable long-term oncologic outcomes compared to TT in TET. RT should be considered as an alternative surgical option for the treatment of anterior mediastinal tumors.

Variables	RT (n=105)	TT (n=105)	p-value
Cell types (% TET)	53 (52%)	58 (55%)	0.791
Size (cm)	4.6 ± 3.1	4.4 ± 2.5	0.483
Charlson comorbidity index ≥ 2	14 (13%)	18 (17%)	0.565
Myasthenia gravis	10 (10%)	12 (11%)	0.822
Total thymectomy	105 (100%)	102 (97%)	0.246
Operation time (min)	163.3 ± 93.4	167.1 ± 78.0	0.758
Blood loss (ml)	103.6 ± 105.5	380.0 ± 533.9	<0.001
Postoperative complications	1 (1%)	13 (12%)	<0.001
Length of hospital stay (days)	2.7 ± 1.5	6.7 ± 7.2	<0.001
Incomplete resection	0 (0%)	3 (3%)	0.246
3-year overall survival in TET	100%	98%	0.668
3-year freedom from recurrence in TET	88%	92%	0.568

4:00 PM

Room 120A

Do Systemic Corticosteroids Have a Role in the Management of Post-Intubation Tracheal Stenosis? A Randomized Clinical Trial

M. B. Shadmehr¹, M. Zangi¹, A. Abbasidezfouli², R. Farzanegan¹, S. Pejhan¹, A. Daneshvar¹, K. Sheikhy¹, S. R. Saghebi¹, F. Sadeghbeige¹, A. Gharedaghi¹, N. Jabanshahi¹

¹National Research Institute of Tuberculosis and Lung Disease, Shahid Beheshti University of Medical Sciences, Tehran, Iran, ²Massih Daneshvari Hospital, Tehran, Iran

Purpose: While most patients with post-intubation tracheal stenosis (PITS) require repeated bronchoscopic dilatations (RBD) before airway resection (AR), some of them eventually recover by RBD. Our hypothesis was whether systemic corticosteroids could decrease the number of patients ultimately requiring AR, shorten the length of AR, and increase the time intervals between RBD.

Methods: Between February 2009 and November 2012, a randomized double-blind clinical trial with a 1:1 ratio (group C: prednisolone 15 mg/day and group P: Placebo) was conducted on 120 (out of 522) eligible adult PITS patients, who were not ideal candidates for AR at presentation. All underwent RBD until they became asymptomatic or were prepared for AR. Those who became asymptomatic received the capsules (prednisolone/placebo) for 6 months; the others were taken off the capsules before surgery. Those who required RBD at short intervals underwent tracheostomy/T-tube placement and were then excluded. Follow-ups were continued for 6 months after AR or capsule discontinuation.

Results: There were 105 patients (72 males) in the range of 15 to 64 years (50 in group C) who completed their follow-ups. There was no significant difference between the two groups in terms of the age, sex, history of tracheostomy, duration of intubation, time interval between intubation and first bronchoscopy, length of stenosis, and subglottic involvement. Our study showed that the group C patients underwent preliminary bronchoscopic procedures with longer time intervals (22 days) and required fewer surgeries (17%, 28/50 vs 40/55) than the group P patients, although statistically insignificant. However, it was demonstrated that the required length of airway resection became significantly shorter (5.3 mm) in the group C patients. There was no important drug side effects in the group C patients.

Conclusions: Most PITS patients are not ideal candidates for AR at presentation, and their airways temporarily must be kept open by RBD while the coexisting problems are managed. Considering this and the inflammatory nature of PITS, early, low-dose systemic corticosteroids could have a beneficial role in the management of PITS.

	Corticosteroid (50 patients)	Placebo (55 patients)	P value
Number of patients who finally underwent airway surgery	28 (56%)	40 (72.7%)	0.102
Time interval between bronchoscopies (days)	52.3	30.6	0.115
Length of resected airway (mm)	38.3 (9.5)	43.6 (11.3)	0.044

4:15 PM

Room 122ABC

Optimal Timing of Urinary Catheter Removal After Thoracic Surgery: A Randomized, Controlled Study

K. Shen, S. H. Blackmon, F. C. Nichols, S. D. Cassivi, W. S. Harmsen, B. Lechtenberg, K. E. Pierson, D. A. Wigle, M. S. Allen

Mayo Clinic, Rochester, MN

COMMERCIAL RELATIONSHIPS M. S. Allen: Nonremunerative Position of Influence, Joint Council on Thoracic Surgery Education (JCTSE)

Purpose: The aim of this randomized trial was to determine if removal of the urinary catheter within 48 hours after thoracic surgery, as required by Surgical Care Improvement Project measure #9, would lead to an increase in urinary tract reintervention and lower rate of urinary tract infections.

Methods: From February 2012 to August 2014, patients undergoing a general thoracic surgical procedure that had an epidural catheter placed for analgesia were eligible for inclusion in the trial. Patients were randomized to either have the urinary catheter removed within 48 hours of the completion of surgery or 6 hours after the epidural catheter was removed on postoperative day four.

Results: There were 374 patients (217 men) enrolled in the study. The median age of the 247 eligible and evaluated patients was 61.5 years (range: 21-87). Median length of stay was 5 days (range: 2-42) for all patients, and there was no difference between the two groups ($P = .0962$). There were a significantly greater number of patients in the early removal group who had to have the urinary catheter reinserted (15 [12.4%] vs four [3.2%], $P = .0065$). Patients who had the urinary catheter removed within 48 hours of the operation had a much higher rate of bladder scans postoperatively (59.5%, $n=72$) compared to those who had the urinary catheter removed 6 hours after the epidural was discontinued (31.0%, $n=39$), $P < .0001$. There was only one documented urinary tract infection in the entire cohort, and this occurred in a patient who had the urinary catheter removed within 24-48 hours after surgery.

Conclusions: In a randomized control trial, patients with an epidural catheter in place after a general thoracic surgical operation have a higher rate of urinary problems when their urinary catheter is removed early, while the epidural is still in place, compared to patients that have the urinary catheter removed after

4:30 PM

Room 120A

Surgical Treatment of Benign Tracheoesophageal Fistulas: A 10-Year Experience*B. J. Bibas¹, L. P. Eloy-Pereira¹, M. F. Tamagno¹, P. F. Cardoso¹, H. Minamoto¹, R. M. Terra², P. Pego-Fernandes¹**¹Heart Institute (InCor), Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo, Brazil, ²University of São Paulo Medical School, Brazil***COMMERCIAL RELATIONSHIPS** R. M. Terra: Consultant/Advisory Board, Johnson & Johnson; Speakers Bureau/Honoraria, Covidien

Purpose: Benign tracheoesophageal fistulas (TEF) are rare conditions, and primary surgical correction is the ideal method of treatment. The objective of this study was to evaluate the results of surgical treatment of benign TEF in patients from a tertiary institution.

Methods: Retrospective study of patients with benign TEF who were diagnosed, treated, and followed-up between January 2005 and December 2014. Preoperative evaluation included computed tomography of the chest, flexible bronchoscopy, rigid bronchoscopy, endoscopy, and esophageal contrast radiology. Preoperative treatment included nutritional support via gastrostomy or nasogastric tube and treatment of lung infections. Surgical repair was done with resection and reconstruction, laryngotracheal resection, or membranous tracheal repair without resection. Esophageal closure consisted of two-layer closure.

Results: Twenty patients (11 males) with mean age of 48 years + 17 years were treated. The most frequent causes of TEF were postintubation injury (n=16, 80%), trauma (n=2, 10%), and infections (n=2, 10%). Fifteen patients had previous tracheostomy (75%). Three were initially treated with T tubes and two with tracheal stents. The mean length of TEF was 1.29 cm + 0.8 cm. The most commonly used surgical approach was cervicotomy and cervicosternotomy (n=15, 75%); the remainder were treated by right thoracotomy. Ten patients required tracheal resection, with a mean length of 2.6 cm + 1.8 cm. Seven patients (35%) required intraoperative tracheostomy and four (20%) required a T-tube. Complications included subcutaneous emphysema (n=4, 20%) and pneumonia (n=3, 15%). There was one dehiscence of the tracheal anastomosis and two surgical site infections. One patient died 60 days after surgery due to pulmonary sepsis. Ninety-five percent of patients had complete resolution of the TEF. Late complications included three cases of tracheal restenosis.

Conclusions: Surgical treatment of TEF is effective in the majority of patients. Nonetheless, complications and mortality-related procedures are not negligible, even when performed at a referral center and after appropriate preoperative evaluation.

NOTES

4:45 PM

Room 120A

A Multicenter Study of Volumetric Computed Tomography for Staging Malignant Pleural Mesothelioma

V. W. Rusch¹, R. Gill², A. Mitchell³, D. Naidich⁴, D. C. Rice⁵, H. I. Pass⁶, H. Kindler⁷, M. De Perrot⁸, J. Friedberg⁹

¹Memorial Sloan Kettering Cancer Center, New York, NY, ²Brigham and Women's Hospital, Boston, MA, ³Cancer Research and Biostatistics, Seattle, WA, ⁴New York University, NY, ⁵University of Texas MD Anderson Cancer Center, Houston, TX, ⁶New York University School of Medicine & Comprehensive Cancer Center, NY, ⁷The University of Chicago, IL, ⁸Toronto General Hospital and Princess Margaret Hospital, Toronto, Canada, ⁹University of Maryland, Baltimore

COMMERCIAL RELATIONSHIPS D. C. Rice: Consultant/Advisory Board, Olympus Corporation

Purpose: Standard imaging modalities are inaccurate in clinically staging malignant pleural mesothelioma (Mpm). Small, single-institution studies suggest that volumetric computed tomography (VolCT) is prognostic and, if found practical and reproducible, could improve clinical TN classification. We established a multicenter network to test the interobserver variability, accuracy (relative to pathologic stage), and prognostic significance of semi-automated VolCT.

Methods: Six North American institutions electronically submitted clinical, pathologic, and imaging data to an established multicenter database and biostatistical center (BC) on patients with stages I-III Mpm who had surgery. Institutional radiologists submitted preoperative CT scans of optimal image resolution via electronic network to BC. Two reference radiologists, blinded to clinical data, independently reviewed scans, performed semi-automated tumor volume calculations using commercially available software, and then submitted readings to BC. Study endpoints included feasibility of multicenter network, interobserver variability for volumetric assessment, correlation of average tumor volume measurements to pT and pN stages, and overall survival (OS).

Results: Of 164 submitted cases, 129 were considered analyzable (100 pathologic stages II or III) and were read by both reference radiologists. The majority of tumors were confirmed <500 cm³ (84 by both readers, 103 by at least one reader). A small measurement bias was observed between the readers, as one reader tended to provide consistently larger measurements than the other (mean=47.9, paired t-test for no difference $P = .0027$). However, for 80% of the cases, the absolute difference between readers was ≤ 200 cm³. The correlation between the two readers was 0.84. Volume correlated with pT stage (range of median volumes=23.8 cm³ for pT1 to 387.9 cm³ for pT4) and with pN stage. Tumor volume also correlated with OS, best defined by three groups with volumes of 91.2, 245.3, and 511.3 cm³ associated with median OS of 37, 18, and 8 months, respectively (Figure).

Conclusions: We successfully established a multicenter network and showed correlations of Mpm tumor volume to pTN stage and OS. Based on this experience, we plan a larger, multicenter, international prospective study to confirm standards for tumor volume measurement and refine correlations between volume, stage, and OS.



5:00 PM

Room 120A

Impact of Pectus Excavatum on Cardiac Function: A Cardiovascular Magnetic Resonance Imaging StudyB. Hokschi¹, P. Fabien², R. A. Schmid¹, W. Andreas²¹University Hospital, Bern, Switzerland, ²University Clinic of Cardiology, Bern, Switzerland

Purpose: Patients with pectus excavatum (PE) frequently report exercise intolerance, shortness of breath, and atypical chest pain. It is commonly believed that this thoracic deformity may compress the cardiac chambers between the sternum and the spine. However, the degree of cardiac dysfunction caused by PE, if any, remains controversial.

Methods: Ninety-one patients referred for surgical correction of PE (Nuss procedure) were prospectively examined using cardiovascular magnetic resonance (CMR). Both ventricles were imaged from the base toward the apex during short end-expiratory breath-holds using contiguous short axis slices (cine steady state free precession technique with retrospective gating, at 1.5 and 3T). End-diastolic and end-systolic borders were manually traced for each slice. Left and right ventricular volumes, systolic function, and cardiac output were obtained and correlated with PE severity, as assessed by the Haller index, and exercise capacity. In 67 patients (74%), the preoperative work-up included an additional spirometry.

Results: Despite modified anatomy due to PE, all patients had normal left and right ventricular normalized volumes, systolic function, and cardiac output. PE severity as quantified by the Haller index was found to inversely correlate with left ventricular mass measured by CMR ($r=0.4$, $P < .001$) and exercise capacity (in Watts; $r=0.6$, $P < .001$ / VO_2 max $r=0.5$, $P < .001$). In contrast, higher left ventricular mass was directly associated with higher exercise capacity and VO_2 max ($r=0.6$, $P < .001$ and $r=0.5$, $P < .001$, respectively). As previously described, a higher Haller index was associated with lower lung function indices (FEV1: $r=0.44$, $P < .001$; FVC: $r=0.3$; $P < .037$).

Conclusions: Patients with PE had normal left and right ventricular volumes, systolic function, and cardiac output. The Haller index inversely correlated with left ventricular mass and exercise capacity. Thus, besides the previously described impaired pulmonary function, physical deconditioning, reflected by lower left ventricular mass, may contribute to exercise intolerance in PE.

NOTES

5:15 PM

Room 120A

Preoperative Mediastinal Staging With Mediastinoscopy Causes a Significantly Higher Rate of Unsuspected Mediastinal Lymph Node Metastases than Endobronchial Ultrasound-Guided Transbronchial Needle Aspiration

J. Eckardt, E. Jakobsen

Odense University Hospital, Denmark

Purpose: Invasive mediastinal staging is crucial for planning the treatment of non-small-cell lung cancer (NSCLC). Mediastinoscopy is the gold standard, but endobronchial ultrasound-guided transbronchial needle aspiration (EBUS-TBNA) has now been introduced in some hospitals. In a national setting, we investigated the frequency of unsuspected mediastinal lymph node metastases related to the invasive staging procedure.

Methods: During a 9-year period (2003–2011), all patients in the country treated with lobectomy for NSCLC (3,953 patients) were investigated for unsuspected mediastinal lymph node metastases at surgery. We extracted information from a national registry about preoperative invasive mediastinal staging procedure. The use of positron emission tomography-computed tomography (PET-CT) also was retrieved together with information about tumor location, histopathology, and clinical and pathological TNM-stage. All patients with preoperative diagnosed mediastinal lymph node metastases were excluded. Endoscopic ultrasound (EUS) and PET-CT were used in combination with mediastinoscopy or EBUS-TBNA, and for selected patients with T1 tumors, PET-CT was the only preoperative mediastinal staging procedure.

Results: Mediastinal lymph node sampling was performed in all patients during surgery, and unsuspected mediastinal lymph node metastases (N2-disease) were found in 9.8% (426/3,953). Mediastinal lymph node metastases were significantly more common in patients with mediastinoscopy as invasive mediastinal staging procedure (16.0%, 250/1,558) compared with EBUS-TBNA (5.2%, 46/886, $P < .01$). Unsuspected subcarinal metastasis was significantly more frequent in patients with mediastinoscopy as invasive mediastinal staging procedure (5.2%, 99/1,558) compared with EBUS-TBNA as invasive mediastinal staging procedure (1.7%, 15/886, $P < .01$). Preoperative invasive mediastinal staging was performed in 57% of all patients (2,253/3,953) but significantly more frequently in patients with N2-disease (69.5%, 296/426, $P < .01$) and in patients with subcarinal N2-disease (68.7%, 114/166, $P < .01$).

Conclusions: Mediastinoscopy is the gold standard for invasive mediastinal staging, but the rate of unsuspected mediastinal lymph node metastases diagnosed at surgery is significantly higher than EBUS-TBNA.

Procedure	All patients	N 2 disease	Station 7 metastasis
PET-CT	1953	17 (0.8 % = 17/1953)	7 (0.3 % = 7/1953)
Mediastinoscopy	1558*	250(16.0%=250/1558)	99 (5.2 % = 99/1558)
EBUS-TBNA	886*	46 (5.2 % = 46/886)	15 (1.7 % = 15/886)
EUS	236	5 (2.1 % = 5/236)	2 (0.8 % = 2/236)
Total	3953	426	166

* Some patients underwent both procedures but 2253 patients had exclusively EBUS-TBNA or mediastinoscopy.

3:30 PM – 5:30 PM

Room 125AB

ESTS @ STS: Controversial Issues in General Thoracic Surgery—Perspectives From Europe and North America

This collaborative session by STS and the European Society of Thoracic Surgeons will provide European and North American perspectives on a variety of controversial issues in general thoracic surgery. Expert thoracic surgeons will discuss controversies in the management of high-risk patients diagnosed with early stage lung cancer, the management of solitary pulmonary nodules/ground glass opacities, the management of patients diagnosed with achalasia, and the management of paraesophageal hernias (PEH).

Learning Objectives

Upon completion of this activity, participants should be able to:

- Describe the optimal work-up and treatment for high-risk patients diagnosed with early stage lung cancer
- Explain the role of limited resection and lobectomy in the management of solitary pulmonary nodules, as well as ground glass opacities
- Describe the role of new technologies in the optimal management for achalasia
- Identify the surgical controversies in the management of paraesophageal hernias

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

The physician competencies addressed in this session are patient care and procedural skills, medical knowledge, and interpersonal and communication skills. These physician competencies will be addressed through a series of collaborative lectures by members of The Society of Thoracic Surgeons and the European Society of Thoracic Surgeons.

Moderators: Sean C. Grondin, Calgary, Canada, and Gaetano Rocco, Naples, Italy

COMMERCIAL RELATIONSHIPS G. Rocco: Research Grant, Baxter, Covidien; Speakers Bureau/Honoraria, Covidien

3:30 PM

Optimal Work-Up and Limits of Surgery

Alessandro Brunelli, Leeds, United Kingdom

COMMERCIAL RELATIONSHIPS A. Brunelli: Consultant/Advisory Board, Medela, Inc

3:40 PM

Stereotactic Body Radiation Therapy vs Surgery

Gail E. Darling, Toronto, Canada

3:50 PM

Discussion

4:00 PM

Indications for Sublobar Resection

Raja M. Flores, New York, NY

4:10 PM

Indications for Lobectomy

Gonzalo Varela, Salamanca, Spain

COMMERCIAL RELATIONSHIPS G. Varela: Research Grant, Baxter, Covidien; Speakers Bureau/Honoraria, Bard; Consultant/Advisory Board, Ethicon

4:20 PM

Discussion

- 4:30 PM **Indications for Peroral Endoscopic Myotomy vs Heller Myotomy vs Balloon**
Shanda H. Blackmon, Rochester, MN
- 4:40 PM **Heller Myotomy With or Without Fundoplication**
Philippe Nafteux, Leuven, Belgium
- 4:50 PM **Discussion**
- 5:00 PM **Open vs Minimally Invasive PEH Repair**
Donald E. Low, Seattle, WA
- 5:10 PM **Mesh vs No-Mesh Repair of PEH**
Xavier Benoit D'Journo, Marseille, France
COMMERCIAL RELATIONSHIPS X. D'Journo: Speakers Bureau/Honoraria, Ethicon
- 5:20 PM **Discussion**

3:30 PM – 5:30 PM

Room 126ABC

SCA @ STS: Perioperative Evaluation and Management of Circulatory Shock

Nearly a third of patients are admitted to the ICU with circulatory shock, and early recognition and intervention of this clinical state is required to avoid subsequent multi-organ injury. Various types of shock commonly present in critically ill cardiac surgical patients, and each have implications for therapeutic management. Through lectures given by experts in the field, this joint STS-Society of Cardiovascular Anesthesiologists session explores different strategies for identifying various shock etiologies and the role of hemodynamic tools for monitoring fluid responsiveness and cardiac output in the perioperative setting. Faculty also will review current evidence-based guidelines and practices for managing circulatory failure, which will include presentations on evidence-based pharmacological management of different shock etiologies and the optimal choice and timing of intervention for mechanical support in circulatory shock.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Identify the various types of circulatory failure (shock types) and their presentation in cardiac surgical patients in the perioperative period
- List the pros and cons of different hemodynamic monitoring devices currently available for use in shock management
- Describe the optimal strategy for managing different types of shock and ideal targeted goals
- Outline the best available evidence for choosing pharmacological agents to treat circulatory failure (septic, cardiogenic, distributive/vasoplegia)
- Identify the indications, options, and outcomes for using mechanical circulatory support devices in patients who present with acute circulatory failure

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of collaborative lectures by members of The Society of Thoracic Surgeons and the Society of Cardiovascular Anesthesiologists.

Moderators: Aaron M. Cheng, Seattle, WA, and Jay G. Shake, Temple, TX

3:30 PM

Introduction

3:35 PM

Identifying Different Types of Shock in the Challenging Postoperative Cardiac Patient

Jerrold H. Levy, Durham, NC

3:55 PM

Perioperative Hemodynamic Monitoring

Robert Sladen, New York, NY

4:15 PM

Pharmacologic Management of Shock: What Strategies Have Proven Outcomes?

David Ciceri, Temple, TX

4:35 PM

The Role of Mechanical Support for Shock and Choosing the Optimal Device

Asbish Shah, Baltimore, MD

4:55 PM

Question-and-Answer Session/Panel Discussion

WEDNESDAY AT A GLANCE

6AM

6:30 AM – 9:30 AM
Registration: STS University

7AM

7:00 AM – 9:00 AM
STS University

8AM



9AM

9:30 AM – 11:30 AM
STS University
(courses repeated)

10AM

11AM



12PM

1PM

2PM

3PM

4PM

5PM

6PM

7PM

8PM

9PM

- 6:30 AM – 9:30 AM **Registration: STS University**
- 7:00 AM – 9:00 AM  **STS University**
- 9:30 AM – 11:30 AM  **STS University (courses repeated)**

6:30 AM – 9:30 AM**Lower Level Foyer****Registration: STS University****7:00 AM – 9:00 AM and repeated 9:30 AM – 11:30 AM****Exhibit Hall 6** **STS University**

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

The physician competencies addressed in each STS University course are medical knowledge and practice-based learning and improvement. These physician competencies will be addressed through hands-on sessions to gain knowledge and practical application experience.

Course 1: Essentials of TAVR

Course Directors: *Basel Ramlawi, Houston, TX, and Eric L. Sarin, Atlanta, GA*

COMMERCIAL RELATIONSHIPS B. Ramlawi: Consultant/Advisory Board, Medtronic, Inc, LivaNova, AtriCure, Inc; E. L. Sarin: Consultant/Advisory Board, Abbott Vascular

Proficiency in transcatheter aortic valve replacement (TAVR) requires knowledge of multiple endovascular principles and techniques. In this course, attendees will get hands-on experience with the latest TAVR technology, including balloon-expandable and self-expanding TAVR platforms. Attendees will receive an introduction to the various sheaths, guidewires, and catheters relevant to TAVR. Basics of alternative TAVR access will be discussed, and all participants will gain operational knowledge of the various delivery systems.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Describe the decision-making process for choosing a TAVR access point (transfemoral, direct aortic, subclavian artery, and transapical)
- State the salient differences in the deployment of balloon-expanded versus self-expanded devices
- Describe the various types of sheaths and guidewires used during the TAVR procedure and understand reasons for their use

Course 2: TEVAR and Aortic Arch Debranching Procedures

Course Directors: *Ali Khojnejzad, Los Angeles, CA, and Ourania A. Preventza, Houston, TX*

COMMERCIAL RELATIONSHIPS A. Khojnejzad: Research Grant, Medtronic, Inc, Vascutek Ltd a Terumo Company; O. A. Preventza: Consultant/Advisory Board, Medtronic, Inc; Speakers Bureau/Honoraria, W. L. Gore & Associates, Inc, COOK Medical

This course will review basic catheter and wire skills for TEVAR. Participants will have hands-on experience with thoracic stent grafts and intravascular ultrasound, as well as using vascular plugs from the brachial or femoral approach. Furthermore, surgical techniques for zone 0-2 aortic arch debranching procedures will be discussed in detail.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Identify the most common catheters and wires for TEVAR
- Describe the deployment of commercially available stent grafts
- Explain the use of intravascular ultrasound and the use of the Amplatz plug for subclavian artery occlusion
- Describe the surgical techniques used in aortic arch debranching

Course 3: Mitral Valve Repair

Course Directors: *Evelio Rodriguez, Nashville, TN, and Robert L. Smith, Plano, TX*

COMMERCIAL RELATIONSHIPS E. Rodriguez: Consultant/Advisory Board, St Jude Medical, Edwards Lifesciences Corporation, Abbott Vascular; R. L. Smith: Speakers Bureau/Honoraria, Abbott Vascular, Edwards Lifesciences Corporation; Consultant/Advisory Board, Edwards Lifesciences Corporation

In this course, participants will interact with experts in mitral valve repair. Hands-on stations will cover the role of 3D transesophageal echo (TEE), posterior leaflet resection, anterior leaflet and commissural repair techniques, non-resection techniques, and different chordal approaches. There will be a dedicated station for secondary mitral repair techniques, including ring selection, leaflet extension, and papillary techniques. Finally, participants will receive hands-on experience with percutaneous mitral valve repair technology.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Discuss the importance of 3D TEE and mitral valve repair planning
- Describe different leaflet resection and non-resection approaches, in addition to different chordal techniques required for successful mitral valve repair
- Identify advance repair techniques for both primary and secondary mitral valve regurgitation
- List the procedural steps for percutaneous mitral valve repair technology deployment

Course 4: Valve-Sparing Aortic Root Replacement

Course Directors: *Duke E. Cameron, Baltimore, MD, and Edward P. Chen, Atlanta, GA*

This course will provide interactive, hands-on instruction of the surgical techniques and critical steps necessary for performing a successful valve-sparing aortic root replacement (VSRR).

Learning Objectives

Upon completion of this activity, participants should be able to:

- Describe the anatomy of the aortic root
- Summarize the technical steps necessary for a successful VSRR
- List different methods in choosing a graft size
- Discuss leaflet repair and annuloplasty methods

Course 5: Aortic Root Enlarging Procedures

Course Directors: *David A. Fullerton, Aurora, CO, and S. Adil Husain, San Antonio, TX*

This course will review the anatomic approaches and surgical techniques employed in performing aortic root enlarging procedures. Surgical strategies addressed will include Nicks, Manouagian, Mavroudis, Ross Konno, upsizing the aortic root-Bentall type procedure, and myectomy/myotomy techniques.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Identify the anatomy and appropriate surgical landmarks in the left ventricular outflow tract and aortic valve apparatus
- Describe the incision sites and overall surgical techniques for a variety of root enlargement strategies
- Discuss surgical pitfalls associated with each strategy and mechanisms by which to delineate options based upon patient and anatomic substrate

Course 6: ICU/ECHO

Course Directors: *Haney Mallemat, Baltimore, MD, and Glenn J. R. Whitman, Baltimore, MD*

This course will review the utilization of a focused ultrasound examination of the heart, pleural space, and central veins. Attendees will gain hands-on experience with ultrasound simulators and live models. Topics will include basic cardiac anatomy and physiology as visualized by three common transthoracic views: inferior vena cava evaluation to determine intravascular volume, pleural space pathology (eg, pneumothorax and pleural effusions), and ultrasound techniques for central vein visualization and cannulation.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Perform an echocardiographic parasternal, apical, and subcostal view of the heart
- Evaluate the inferior vena cava to help determine volume status
- Identify the pleura and sliding lungs
- Demonstrate how ultrasound can be used to safely accomplish subclavian and internal jugular venous cannulation

Course 7: VATS Lobectomy

Course Directors: *Robert J. McKenna, Los Angeles, CA, and Shari L. Meyerson, Chicago, IL*

COMMERCIAL RELATIONSHIPS R. J. McKenna: Speakers Bureau/Honoraria, Ethicon, Inc

This course will review the indications, patient selection, technical steps, and recent advances for performance of lobectomy using video-assisted thoracic surgery (VATS). Participants will be able to perform VATS left upper lobectomies on porcine heart-lung blocks.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Describe the indications and steps to perform VATS
- Discuss potential pitfalls and strategies for intraoperative troubleshooting to successfully achieve minimally invasive lobectomy
- Identify instruments and other technologies available for performance of minimally invasive lobectomy

Course 8: Advanced Open Esophageal and Tracheal Procedures

Course Directors: Sidharta P. Gangadharan, Boston, MA, and Thomas K. Varghese Jr, Salt Lake City, UT

This course will provide hands-on training for several esophageal anastomosis techniques, as well as airway anastomosis and repair. These advanced operative techniques are not frequently utilized in most general thoracic surgery practices, but competence in these techniques is important.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Describe and perform the appropriate esophageal anastomosis technique depending on anatomic or other considerations
- Perform airway anastomoses and recognize technical pitfalls associated with the various techniques
- Identify the key steps of tracheobronchoplasty

Course 9: Chest Wall Resection and Adult Pectus Surgery

Course Directors: James M. Donahue, Baltimore, MD, and Mathew Thomas, Jacksonville, FL

In this hands-on course, participants will learn the various techniques for reconstruction of large chest wall defects after resection. Other highlights of the course will include stabilization of rib and sternal fractures using the most current reconstruction systems and minimally invasive repair of adult pectus excavatum defects.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Perform rigid and semi-rigid reconstruction of chest wall defects after resection, including the ribs and sternum
- Demonstrate how to stabilize single and multiple rib fractures using rib fixation devices
- Use sternal fixation devices to stabilize the sternum
- Perform minimally invasive repair of adult pectus excavatum defects

Course 10: Atrial Fibrillation (Maze Procedure)

Course Directors: *Matthew A. Romano, Ann Arbor, MI, and Edward G. Soltesz, Cleveland, OH*

COMMERCIAL RELATIONSHIPS M. A. Romano: Consultant/Advisory Board, Edwards Lifesciences Corporation; E. G. Soltesz: Speakers Bureau/Honoraria, St Jude Medical, Edwards Lifesciences Corporation, AtriCure, Inc

Cardiac surgeons often encounter atrial fibrillation in patients referred for other cardiac surgical procedures. However, surgical ablation of atrial fibrillation continues to be undertreated at the time of cardiac surgery. Recent data have supported high rates of sinus rhythm restoration and a survival advantage for concomitant treatment of atrial fibrillation during cardiac surgery. Unfamiliarity with recommended lesion sets, energy sources, available devices, and techniques has resulted in an underutilization of the Maze procedure.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Explain the different energy sources for performing the Maze procedure
- Discuss the available devices for surgical ablation and left atrial appendage ligation
- Perform the Maze IV procedure lesions based on different operative scenarios (mitral valve surgery, coronary artery bypass grafting, aortic valve replacement)
- Describe the Cut and Sew Maze procedure

Course 11: Aortic Valve Leaflet Reconstruction

Course Directors: *Gebrine El-Khoury, Brussels, Belgium, and J. Scott Rankin, Nashville, TN*

COMMERCIAL RELATIONSHIPS J. S. Rankin: Consultant/Advisory Board, BioStable Science and Engineering, Admedus

Leaflet reconstruction is very important for aortic valve repair: 80% of aortic valves with moderate-to-severe insufficiency have leaflet defects requiring reconstruction. Additionally, most patients with aortic stenosis, rheumatic disease, and endocarditis have irreparable leaflets. Repairable leaflet defects include leaflet prolapse, nodular retraction, holes, commissural ruptures, and extensive lateral fenestrations. Current techniques for leaflet reconstruction are evolving, but include central plication for prolapse, nodular release, pericardial patches and strips for holes and ruptures, and complete pericardial leaflet replacement for irreparable leaflets. In this course, each of these methods will be illustrated and practiced on porcine hearts.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Assess leaflet pathology to select proper reconstructive techniques
- Perform aortic valve leaflet plication
- Demonstrate how to suture pericardial strips and patches into leaflets
- Perform complete pericardial leaflet replacement

Course 12: Advanced Aerodigestive Endoscopy

Course Director: *Daniel L. Miller, Marietta, GA*

COMMERCIAL RELATIONSHIPS D. L. Miller: Consultant/Advisory Board, Ethicon, Inc, Bard, Inc

This course will provide hands-on experience with established and new endoscopic procedures for benign and malignant aerodigestive diseases. Endobronchial ultrasound (EBUS) and endoscopic ultrasound (EUS) have attained firm places in the endoscopic diagnostic and staging armamentarium of mediastinal lymph nodes and esophageal cancer, respectively. Electromagnetic navigation bronchoscopy (ENB) is an interesting technology aimed at facilitating the endoscopic biopsy of peripheral lung lesions. Airway and esophageal stenting are important tools for the palliation of malignant disease and the treatment of benign disease in general thoracic surgical practice. New peroral endoscopic procedures (POEM) are increasing in popularity for achalasia, as are ablation techniques for Barrett's esophagus. Endoscopic mucosal resection (EMR) combined with ablation techniques is becoming the procedure of choice for small, localized esophageal tumors.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Discuss how EBUS and EUS are used in mediastinal and esophageal staging, respectively
- Describe potential indications and limitations of ENB
- Identify potential pitfalls and ways to avoid complications during airway and esophageal stent insertion
- Discuss the role of EMR for locally advanced esophageal cancers
- Describe the indications of endoscopic ablative techniques for Barrett's esophagus
- State the technical aspects and potential complications of the POEM procedure

Course 13: Adult Congenital Pulmonary Valve Replacement

Course Director: *Patrick I. McConnell, Columbus, OH*

COMMERCIAL RELATIONSHIPS P. I. McConnell: Other Research Support, Thoratec Corporation; Speakers Bureau/Honoraria, CorMatrix; Consultant/Advisory Board, Clear Catheter, Inc

Pulmonary valve replacement (PVR) is commonly required in adolescent and adult patients after earlier transannular repair of tetralogy of Fallot (TOF). The reconstructed right ventricular outflow tract (RVOT) is anatomically diverse, commonly presenting with mixed pulmonary insufficiency and stenosis. There are key concepts and strategies at the time of PVR to deal with potentially unrecognized RVOT obstruction, augment typically distorted main and branch pulmonary arteries, and allow for the optimal size and position of the valve prosthesis—all in an effort to minimize the future need for surgical PVR in these young adults and adolescents.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Identify and recognize the complex anatomic relationships that can produce residual RVOT obstruction in adolescent and adult patients after transannular patch repair of TOF
- Demonstrate the surgical approaches and materials to augmenting the RVOT, main pulmonary, and branch pulmonary arteries prior to PVR
- Discuss the important anatomic characteristics and sizing of various stented valve prostheses and the potential impact on later percutaneous interventions and valve-in-valve PVR in adolescents and young adults
- Demonstrate the correct positioning of the valve prosthesis within the RVOT, avoiding residual main and branch pulmonary artery obstruction and optimizing the potential for percutaneous valve-in-valve PVR in the future

Course 14: TSDA Cardiac Surgery Simulation Curriculum* Room 122ABC and Exhibit Hall 6

Course Directors: *Richard H. Feins, Chapel Hill, NC, and Nahush A. Mokadam, Seattle, WA*

COMMERCIAL RELATIONSHIPS R. H. Feins: Ownership Interest, KindHeart, Inc; N. A. Mokadam: Consultant/Advisory Board, Thoratec Corporation, HeartWare, Inc, SynCardia Systems, Inc, St Jude Medical

This course is intended for thoracic residency faculty who are interested in adopting the TSDA Cardiac Surgery Simulation Curriculum. Attendees will use Component Task Simulators to learn how to conduct the simulation for each of the six modules (cardiopulmonary bypass, coronary artery bypass grafting, aortic valve replacement, massive air embolism, acute intraoperative aortic dissection, and sudden deterioration of cardiac function) that make up the curriculum. The program is not intended to provide training in how to do the procedures identified, but rather how to teach them using the curriculum.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Perform simulation-based education in each of the six modules
- Assess performance of a trainee using the developed assessment tools
- Design and use the Component Task Simulators for each module

**This course runs once from 7:00 AM to 10:30 AM.*

NOTES

ADULT CARDIAC

P1

Increased Plasma Magnesium and Potassium Levels Are Associated With Postoperative Atrial Fibrillation After Cardiac Surgery: A Time-Matched Analysis

T. S. Lancaster¹, R. B. Schuessler¹, T. J. Zhang¹, K. R. Balsara¹, A. Itob², J. S. Lawton¹, H. S. Maniar¹, M. F. Masood¹, M. K. Pasque², M. R. Moon², R. Damiano¹, S. J. Melby¹

¹Washington University School of Medicine, St Louis, MO, ²Washington University School of Medicine/Barnes Jewish Hospital, St Louis, MO

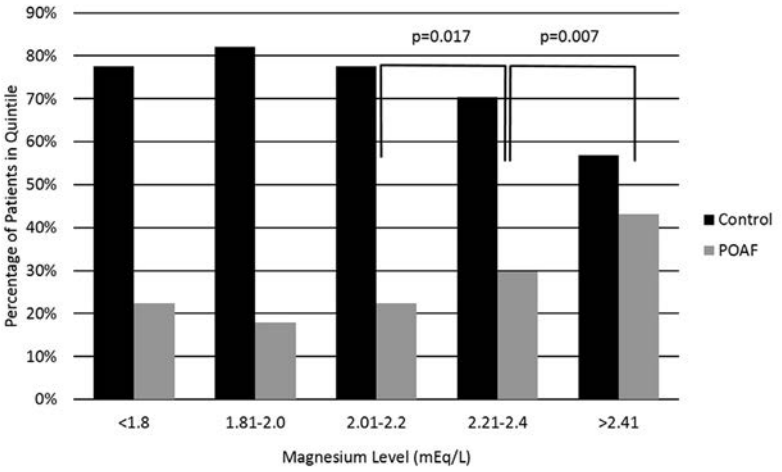
COMMERCIAL RELATIONSHIPS R. Damiano: Speakers Bureau/Honoraria, AtriCure, Inc, Edwards Lifesciences Corporation; M. Pasque: Ownership Interest, Cardio Wise, Inc

Purpose: Hypomagnesemia and hypokalemia commonly are thought to increase risk for postoperative atrial fibrillation (AF) after cardiac surgery; however, no trials have directly evaluated the relationship between postoperative AF and plasma magnesium (Mg) and potassium levels. A time-matched analysis of electrolyte levels in patients with and without postoperative AF was performed.

Methods: 1,900 consecutive adult patients who underwent coronary artery bypass grafting and/or valve surgery between 2009 and 2013 were reviewed retrospectively. Patients with a preoperative history of AF were excluded. For patients with new postoperative AF, plasma magnesium and potassium results falling within a window of ± 6 hours around the time of AF onset were selected for analysis. Laboratory results were excluded if magnesium had been administered between the time of AF onset and the time of lab draw. A time-matched control group of laboratory results was selected from the remaining patients who did not have postoperative AF.

Results: Postoperative AF occurred in 32% of patients (611/1,900). The median time to AF onset was 58 hours (interquartile range: 41-96). At the time of AF onset, patients with postoperative AF had higher mean plasma magnesium (2.30 mEq/L vs 2.18 mEq/L, $P < .001$) and potassium (4.29 mEq/L vs 4.17 mEq/L, $P < .001$) levels than time-matched controls. By logistic regression analysis, increased plasma magnesium and potassium levels were each associated with increased risk for postoperative AF occurrence (OR 3.00, $P < .001$ for magnesium; OR 1.81, $P < .001$ for potassium). Magnesium levels were further analyzed by stratifying into quintiles across the test reference range (quintile 1=Mg < 1.8 mEq/L, 2=Mg 1.81-2.0 mEq/L, 3=Mg 2.01-2.2 mEq/L, 4=Mg 2.21-2.4 mEq/L, 5=Mg > 2.41 mEq/L). The proportion of patients with postoperative AF was increased in the higher magnesium level quintiles (43.2% in quintile 5 vs 29.7% in quintile 4, $P = .007$, vs 17.95%-22.4% in quintiles 1-3, $P = .017$; see Figure).

Conclusions: Contrary to prevailing wisdom, higher magnesium and potassium levels were associated with increased occurrence of postoperative AF after cardiac surgery. These findings may help explain the inconsistent efficacy of magnesium for AF prophylaxis and warrant further investigation into treatment strategies for postoperative electrolyte management.



P2

Moderate Hypothermia at Warmer Temperatures Is Safe and Shortens Hospital Stay in Elective Proximal and Total Arch Surgery: Results in 664 Patients

O. A. Preventza¹, A. Garcia², S. Kashyap³, S. Akvan³, D. A. Cooley⁴, K. Simpson⁵, M. Price³, F. G. Bakaen⁶, L. Cornwell⁷, S. Omer⁶, K. I. de la Cruz⁸, J. S. Coselli³

¹Baylor College of Medicine/Texas Heart Institute, Houston, ²Baylor College of Medicine, San Antonio, TX, ³Baylor College of Medicine, Houston, TX, ⁴Texas Heart Institute, Houston, ⁵Michael E. DeBakey VA Medical Center, Niceville, FL, ⁶Baylor College of Medicine and Michael E. DeBakey VA Medical Center, Houston, TX, ⁷Michael E. DeBakey VA Medical Center, Houston, TX, ⁸Baylor College of Medicine/Texas Heart Institute, Bellaire

COMMERCIAL RELATIONSHIPS F. G. Bakaen: Consultant/Advisory Board, JACE Medical, LLC; J. S. Coselli: Consultant/Advisory Board, Vascutek Ltd, a Terumo Company; Research Grant, Medtronic, Inc, W. L. Gore & Associates; Speakers Bureau/Honoraria, Vascutek Ltd, a Terumo Company; O. A. Preventza: Consultant/Advisory Board, Medtronic, Inc; Speakers Bureau/Honoraria, W.L. Gore & Associates, COOK Medical

Purpose: Elective aortic arch surgery can be performed with adjunctive antegrade selective perfusion (ACP) and moderate hypothermia within a wide temperature range (20.1°C-28°C). We evaluated the effect of using higher or lower temperatures within this range ($\geq 24.0^\circ\text{C}$ vs $\leq 23.9^\circ\text{C}$) on adverse outcome and length of hospital stay.

Methods: Over a 9-year period, 664 patients underwent elective proximal (n=478, 72%) or total (n=186, 28%) arch replacement with moderate hypothermia and ACP. Circulatory arrest was initiated at 20.1°C-23.9°C in Group A (n=332 [50.0%]; 221 [66.6%] proximal, 111 [33.4%] total) and at 24°C-28°C in Group B (n=332 [50.0%]; 257 [77.4%] proximal, 75 [22.6%] total). Composite adverse outcome was defined as operative mortality, permanent neurologic event, or permanent hemodialysis at discharge. Multivariate logistic regression analysis of 22 predictor variables was used to model adverse outcome, and the standard least squares model was used to identify predictors of length of hospital stay.

Results: The composite adverse outcome occurred in 7.2% of patients. Operative mortality was 5.1% (n=34) overall; it was 4.5% in Group A and 5.7% in Group B ($P = .48$). The rate of postoperative permanent neurologic deficit was 2.4% (1.8% Group A, 3.0% Group B, $P = .31$). Group B had lower rates of ventilator support >48 hours ($P = .047$) and shorter intensive care unit (ICU) and hospital lengths of stay ($P = .063$ and $.0014$). Group A had longer cardiopulmonary bypass times and received more intraoperative red blood cell (RBC) transfusions, but these differences were not significant ($P = .25$, $P = .49$). Multivariate analysis identified age as an independent predictor of composite adverse outcome ($P = .0046$), prolonged hospital stay ($P < .0001$), ICU stay ($P < .0001$), and ventilator support ($P < .0001$). RBC transfusion independently predicted the composite outcome ($P = .0090$) and length of stay ($P = .0002$), whereas higher temperature independently predicted shorter length of stay ($P = .0047$).

Conclusions: In patients undergoing elective proximal and total arch surgery, higher temperatures ($\geq 24^\circ\text{C}$) within the wide range of moderate hypothermia (20.1°C-28°C) are safe and, compared with the colder temperatures, are not associated with significantly different composite adverse outcome. Higher temperature is an independent predictor of shorter length of stay.

P3

Outcomes of 7,883 Isolated Coronary Artery Bypass Grafting Surgeries for Acute Coronary Syndrome Based on Japanese Adult Cardiovascular Surgery Database*S. Kawamoto, Y. Saiki**Tohoku University, Sendai, Japan*

Purpose: Acute coronary syndrome (ACS) involves various situations from unstable angina (uAP) to acute myocardial infarction (AMI), and an optimal surgical strategy should be selected depending on the patient's condition. The aim of this study was to evaluate surgical outcomes of off-pump coronary artery bypass grafting (CABG) surgery and on-pump CABG in stratified risk categories based on a preoperative risk estimation.

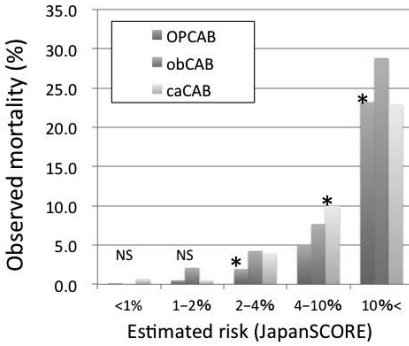
Methods: A total of 7,883 isolated CABG cases for ACS excluding AMI-related mechanical complication cases were identified in the Japan Adult Cardiovascular Surgery Database from 2008 to 2012. Patients were stratified into five subgroups depending on a preoperative risk estimation calculated based on this database (JapanSCORE): <1% group; 1%-2% group; 2%-4% group; 4%-10% group; >10% group. Surgical outcomes of off-pump CABG (OPCAB), on-pump beating CABG (obCAB), and cardiac-arrested CABG (caCAB) in each stratified subgroup were evaluated. Incidence of major operative complications was compared among surgical strategies.

Results: uAP patients were more dominant in groups with estimated risk score under 10%, whereas AMI patients were dominant in the high-risk group with estimated risk score over 10%. Regarding surgical strategies performed in each stratified group, OPCAB predominantly was performed in all groups, while the proportion of obCAB increased in higher risk groups. Average observed mortality rate was compatible with preoperative estimated risk in all stratified subgroups. There was no difference in observed mortality among surgical strategies in the low-risk groups (-2%). The mortality rate of caCAB in the 4%-10% risk group was significantly higher compared to OPCAB and obCAB. The mortality rate of OPCAB was significantly lower compared to obCAB and caCAB in the 2%-4% risk group and the >10% risk group. The incidence of major complications (reoperation 2.8%, stroke 2.0%, dialysis 3.4%) was significantly lower in OPCAB.

Conclusions: JapanSCORE, a preoperative surgical risk estimation system, is reliable even for ACS patients. OPCAB was the main procedure performed in all groups, especially for those patients with estimated risk under 10%, with lower incidence of major complications, whereas the ratio of obCAB increased in higher risk groups.

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Observed operative mortality rate in each stratified group. Asterisk indicate statistically difference comparing to other surgical strategies with Pearson’s chi-square test.

P4

Do Familial Aortic Dissections Tend to Occur at the Same Age?

A. S. Chou¹, W. Ma², B. Ziganshin¹, S. Mok³, S. Peters⁴, M. Tranquilli⁴, J. A. Elefteriades¹

¹Yale University School of Medicine, New Haven, CT, ²Yale University School of Medicine and Beijing Anzhen Hospital, Capital Medical University, New Haven, CT, ³Yale New Haven Hospital, CT, ⁴Aortic Institute at Yale New Haven Hospital, Yale University School of Medicine, CT

COMMERCIAL RELATIONSHIPS J. A. Elefteriades: Ownership Interest, Coolspline LLC; Other, Jarvik Heart, Inc (Data Safety Monitoring Board), Direct Flow Medical, Inc (Salus Valve - Data Safety Monitoring Board)

Purpose: When an individual suffers an aortic dissection, it would be helpful for family members to know if they are likely to experience a dissection at a similar age. If the age at dissection for one family member can predict the age of other familial dissectors, surgical decision making will be enhanced.

Methods: Through an institutional registry of dissection patients, we examined patterns of aortic dissection in 90 patients whose complete first order family trees were available. There were 51 sporadic dissectors (only one dissection in family) and 39 familial dissectors (two or more dissections in family) from 16 families. Differences in age at dissection were computed for sporadic dissectors and for familial dissectors of the same family. Relationships between age of onset of dissection in family members were analyzed by linear regression and clustering analysis.

Results: Mean age of familial dissectors was significantly younger (53.9 years \pm 15.2 years) than sporadic dissectors (63.1 years \pm 12.4 years) ($P = .002$). Regression analysis found a moderately close linear fit between proband and family member ages at onset of dissection ($R^2=0.33$, ie, 33% of the variation was predicted) (Figure 1A). Cluster analysis indicated that age of onset of family dissectors increases as age of proband dissector increases (Table, Figure 1B). Over 50% of familial dissections occurred within 10 years of the median onset age for any given age decade. For “young” familial dissectors, with age of onset 30 to 49 years, 69% of other family member dissections occurred between ages 30 and 49, and no dissections occurred above the age of 63. For “older” familial dissectors, with age of onset 60 to 79 years, 79% of other family member dissections occurred over the age of 50.

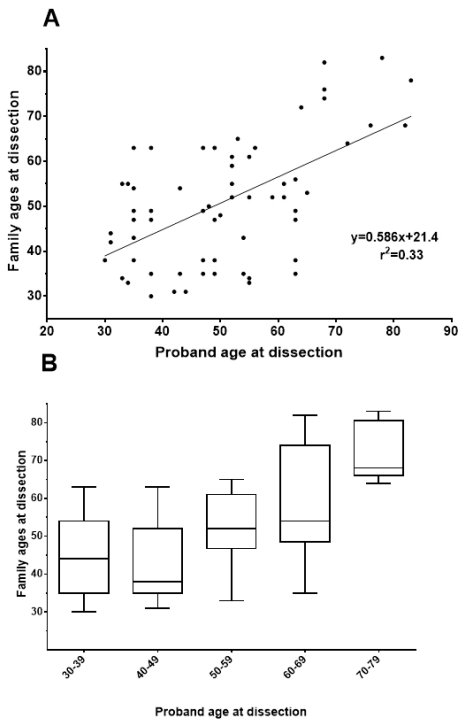
Conclusions: Familial dissections occur earlier than sporadic dissections. Dissections cluster by age in families: the age of one dissector can predict the approximate age of other dissectors. This information argues for prophylactic resection of an aneurysm in a family member approaching the age of a prior family dissector.

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Table 1: Cluster Statistics for Familial Age of Onset of Dissection

	Age of onset of proband dissection				
	30-39	40-49	50-59	60-69	70-79
Number of familial dissectors	19	13	18	14	5
Familial ages at dissection (years)					
Minimum	30	31	33	35	64
25% Percentile	35	35	46.75	48.5	66
Median	44	38	52	54	68
75% Percentile	54	52	61	74	80.5
Maximum	63	63	65	82	83



P5

Which Is the Better Procedure: Using the Frozen Elephant Trunk Technique or the Classical Elephant Trunk Technique Followed With Second-Stage Thoracic Endovascular Aortic Repair for Extensive Aortic Arch Repair?*M. Mutsuga, K. Fujimoto, T. Abe, Y. Narita, H. Oshima, A. Usui**Nagoya University Graduate School of Medicine, Japan*

Purpose: Paraplegia is one of the most devastating complications during extensive aortic arch repair. We retrospectively analyzed our results comparing primary repair using the frozen elephant trunk technique (FET) with the classical elephant trunk technique (CET) followed by second-stage thoracic endovascular aortic repair (TEVAR). The CET technique followed with the second stage

Methods: Between March 1997 and December 2014, 69 patients (mean age: 71 years \pm 8.6 years, 57 male and 12 female) underwent total aortic arch replacement with either FET (42 cases) or CET (27 cases). The mean follow-up time was 60 months in FET and 29 months in CET. The major indication for surgery was 76% true aneurysm in FET and 96% in CET. The other indication was aortic dissection. CET had second-stage TEVAR with median duration of 36 days.

Results: In-hospital death was two (4.8%) in FET and none in CET. Late death occurred in 17 of FET (40%) and 4 of CET (15%). Overall survival was 69% in FET and 80% in CET at 5 years. Kaplan-Meier survival regression showed no significant difference between two groups ($P = .97$). Aortic events occurred in 10 of FET (24%) and three of CET (11%). Freedom from aortic events was 80% in FET and 88% in CET at 5 years. Freedom from aortic events between two groups had no significant difference ($P = .97$). Five neurologic events (12%) occurred in FET and three events (11%) in CET ($P = .99$). The occurrence of paraplegia was significantly higher in FET compared to CET (19% vs 0%, $P = .016$).

Conclusions: The FET technique with primary repair for extensive aortic arch repair had acceptable hospital mortality and aortic event rates, but had high incidence of paraplegia. The CET followed with the second-stage TEVAR with two-staged repair may produce a favorable mid-term surgical outcome with low risk of paraplegia.

P6

Subclavian vs Direct Aortic Approach for Transcatheter Aortic Valve Implantation With CoreValve Revalving System: Insights From the Italian National Registry

C. Fiorina¹, G. Bruschi², L. Testa³, F. De Marco², M. De Carlo⁶, G. Coletti⁵, S. Bonardelli¹, G. Sciotti⁴, P. Panisi³, F. Bedogni³, A. Petronio⁴, F. Ettori¹

¹Spedali Civili Brescia, Brescia, Italy, ²Niguarda Ca' Granda Hospital, Milan, Italy, ³Clinical Institute S. Ambrogio, Milan, Italy, ⁴Azienda Ospedaliero Universitaria Pisana, Pisa, Italy,

⁵Cardiac Surgery-Spedali Civili, Collebeato, Italy

COMMERCIAL RELATIONSHIPS F. Bedogni: Consultant/Advisory Board, Medtronic, Inc, St Jude Medical, Boston Scientific; G. Bruschi: Consultant/Advisory Board, Medtronic, Inc, Direct Flow Medical, Inc; G. Coletti: Consultant/Advisory Board, Medtronic, Inc; M. De Carlo: Consultant/Advisory Board, Medical Specialties Distributors; Speakers Bureau/Honoraria, Abbott Vascular, Volcano Corporation; F. Ettori: Other, Medtronic, Inc; A. Petronio: Consultant/Advisory Board, Medtronic, Inc, Boston Scientific, Abbott Laboratories

Purpose: In patients with contraindication to the femoral approach for transcatheter aortic valve replacement (TAVR), the alternatives are transaxillary (TAX), transapical (TA), and direct-aortic (DA). Our purpose was to evaluate the impact on procedural and clinical outcomes of the TAX compared to DA access with Medtronic CoreValve Revalving System (CRS).

Methods: All consecutive patients who underwent TAVR with CRS treated through TAX and DA approaches in four Italian centers were analyzed. The device success, safety, and efficacy endpoints according to VARC-2 criteria were evaluated.

Results: Among 1,049 patients undergoing CRS implantation between September 2007 and February 2014, 242 (23%) were treated through the TAX (61%) and DA (39%) route because of peripheral artery disease. Demographic features were similar, except for a higher clinical risk profile (STS-PROM: 10% vs 6%, $P = .005$) and previous coronary artery bypass grafting (20% vs 9%, $P = .011$) in DA group. The device success was similar ($P = .16$) with a trend to a lower incidence of significant paravalvular leak (6% vs 14%, $P = .07$) and a significant reduction of permanent pacemaker implantation (PPM) (13% vs 34%, $P = .001$) in the DA. The independent predictors of PPM were the onset of complete heart block after TAVR (OR 6.07) and the TAX approach (OR 2.80). Conversely, the DA group showed a higher incidence of acute kidney injury ($P = 0.016$) and a longer hospital stay. The Kaplan Meier survival was similar at 30 days ($P = .2$) and at 1 year ($P = .7$).

Conclusions: Although direct-aorta patients had a higher clinical risk profile, the DA approach showed equally high device success with similar safety and efficacy compared to TAX route. The interaction among different specialists is crucial to optimize the results of TAVR, particularly in very high-risk patients.

P7

Effects of False Lumen Procedures on Aorta Remodeling of Chronic DeBakey IIIb Aneurysm*S. Song, T. Kim, K. Lee**Gangnam Severance Hospital, Yonsei University College of Medicine, Seoul, South Korea*

Purpose: Although thoracic endovascular aortic repair (TEVAR) is widely used in chronic DeBakey IIIb aneurysm (CDIIIb), persistent retrograde flow to the false lumen (FL) through distal reentry tears is a main cause of failure. We sought to determine the effects of false lumen procedures (FLP) on aorta remodeling in these patients.

Methods: From 2012 to 2015, 25 patients (mean age, 55.2 years \pm 11.2 years) with CDIIIb underwent FLP using vascular plugs, stent grafts, coils, or glues. Thirteen patients had CDIIIb, and 12 patients had residual CDIIIb after prior type A repair. FLPs were performed as adjunctive after previous TEVAR in 10 patients, concomitant with TEVAR in 12 patients, and isolated procedure in three patients. The outcomes were measured as degree of thrombosis and diameter change of the true and false lumen (TL and FL). The diameters were measured at the three levels (left subclavian artery, pulmonary artery bifurcation, and celiac artery).

Results: There was no postoperative morbidity or and 30-day mortality. All patients were followed up with the mean duration of 15 months. One patient died at 7 months postoperatively due to intraventricular hemorrhage. There were no aorta-related complications or death. Complete FL thrombosis was observed in 20 patients (80%) after FLP. Incomplete thrombosis was observed in five patients (20%), including two patients who had short follow-up duration, two patients targeting primary proximal tear, and one patient with visceral procedure. After FLP, the diameter of the FL (from 22.23 mm \pm 10.18 mm to 17.56 mm \pm 10.84 mm) was decreased, and the diameter of the TL (from 20.45 mm \pm 5.33 mm to 25.12 mm \pm 5.60 mm) was increased (Figure). In patients with adjunctive FLP after previous TEVAR, the regression rate of FL after FLP was more prominent than the rate after TEVAR (-0.57 mm/month \pm 1.10 mm/month vs -0.25 mm/month \pm 1.31 mm/month) at the pulmonary artery bifurcation level (Table).

Conclusions: False lumen procedures with various thrombogenic materials were safe and promoted complete thrombosis and favorable aorta remodeling in patients with CDIIIb. Further large studies of this strategy are warranted.

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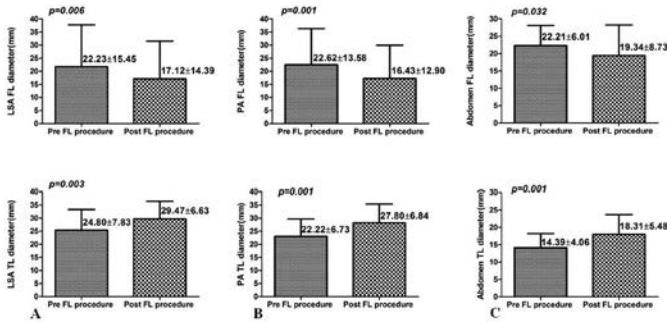


Figure 1. The mean diameter of each level of aorta in pre and post treatment. Comparison of pre and post treatment in LSA level(A), PA level(B) and Abdomen level(C).
 FL, false lumen, TL, true lumen, LSA, left subclavian artery level, PA, Pulmonary artery bifurcation level, Abd, Celiac artery level

	Pre-FLP	Post-FLP
LSA FL(mm/month)	-1.07 ± 2.00	-0.17 ± 0.50
PA FL (mm/month)	-0.25 ± 1.31	-0.57 ± 1.10
Abd FL(mm/month)	-0.18 ± 1.10	-0.18 ± 1.00

Table 1. Comparison of remodeling rate between pre and post FL procedure.
 FLP, false lumen procedure, LSA, left subclavian artery level, PA, Pulmonary artery bifurcation level, Abd, Celiac artery level

P8

Late Open Conversion After Abdominal Endovascular Aortic Repair*H. Joo¹, B. Chang², Y. Youn¹*¹*Severance Cardiovascular Hospital, Yonsei University College of Medicine, Seoul, South Korea,*²*Yonsei University College of Medicine, Seoul, South Korea*

Purpose: With the increasing use of endovascular aortic repair (EVAR), open repair after aortic stent grafting has attracted greater interest. We retrospectively reviewed open repair cases with complications following aortic endovascular repair.

Methods: Endovascular aortic repair due to aortic aneurysm and dissection was performed in 566 patients between 1994 and 2015. A retrospective review of EVAR requiring late open conversion (>1 month after implant) was conducted. Patient demographics, reason of conversion, operative technique, operative outcomes, and late survival were reviewed.

Results: Thirty patients (5.3%) required late conversion to open repair. The mean interval to open conversion after EVAR was 48.6 months (range: 1-195). Indications of open conversion included type I endoleak (n=10), stent distal obstruction (n=3), stent graft infection (n=4), type V endoleak (n=4), stent fracture (n=4), stent migration (n=3), and type II endoleak (n=2). Twenty-four operations were elective and six (20%) were emergent due to aneurysm rupture. Compete endograft removal was performed in 14/30 patients (46.6%), and 16 endografts was partially left in situ. Hospital mortality was 10% (3/30); two of them were emergency cases. Overall survival at mean follow-up of 84 months was 70.7%.

Conclusions: Late open conversion after failed EVAR will remain an important issue in the future. Open conversion due to late complication after EVAR can be performed successfully with encouraging results. Lifelong surveillance is justified, and early decision for open conversion, if indicated, is necessary to achieve better outcomes.

P9

Mid-Term Prognosis of Reduction Ascending Aortoplasty for Dilatation of the Ascending Aorta in Patients With Aortic Valve Disease*S. Liu, J. Xu, Y. Shi**National Center for Cardiovascular Diseases, Furwai Hospital, Chinese Academy of Medical Sciences, and Peking Union Medical College, Beijing*

Purpose: Reduction ascending aortoplasty is an alternative procedure for the replacement of the ascending aorta in the case of ascending aortic aneurysm without aortic root involvement. This study was designed to identify the mid-term prognosis of aortoplasty for dilatation of the ascending aorta in patients with aortic valve disease.

Methods: From January 1, 2010, to December 31, 2013, 102 patients with aortic valve disease and dilatation of the ascending aorta who had undergone aortic valve replacement in combination with unsupported reduction aortoplasty were enrolled. Fifty-seven patients (58.9%) were diagnosed with bicuspid aortic valve. Patients' mean age was 52.7 years \pm 12.9 years. Measurement of the ascending aorta was obtained at three points: before surgery, during the early postoperative period, and during the follow-up. The mean preoperative aortic diameter was 45.6 mm \pm 4.9 mm. Follow-up data were obtained in all patients, and mean follow-up time was 38.8 months \pm 13.0 months.

Results: There were only two mortalities (2.0%) due to heart failure and stroke. No reoperations and major adverse aortic complications were found in the early postoperative period and follow-up. The actual freedom from cardiac-related death at 3 years was 98.0%. When compared with preoperative data, postoperative left ventricular end-diastolic diameter, left atrium diameter, and diameter of ascending aorta had decreased significantly ($P < .001$). The mean expansion degree of ascending aorta was 0.39 cm \pm 0.26 cm, and the mean ascending aorta expansion rate was 1.3 mm/y \pm 0.8 mm/y in patients with aortic redilatation. Significant difference was found in patients with bicuspid aortic valve disease when comparing the ascending aorta diameter in the early postoperative period and at follow-up (37.0 mm \pm 5.0 mm vs 35.5 mm \pm 4.6 mm, $P = .009$), while no significant change was found in patients without bicuspid aortic valve diseases (36.1 mm \pm 4.7 mm vs 35.5 mm \pm 4.6 mm, $P = .188$).

Conclusions: Reduction ascending aortoplasty is a safe and effective procedure. It shows good mid-term results with low mortality and low morbidity in patients with aortic valve disease and dilatation of the ascending aorta. Redilatation tends to happen in patients with bicuspid valve disease, and long-term follow-up is necessary.

P10

Assessing Clinical Outcomes Among 13,906 Transfused Patients After Coronary Artery Bypass Surgery: Is It the Patient or Is It the Transfusion?

G. Paone¹, M. A. Herbert², P. F. Theurer³, R. Prager³, D. S. Likosky³

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COMMERCIAL RELATIONSHIPS D. S. Likosky: Consultant/Advisory Board, AmSECT; Research Grant, Agency for Healthcare Research and Quality, National Institutes of Health

Purpose: The independent effect of red blood cell (RBC) transfusion on morbidity and mortality after coronary artery bypass grafting (CABG) surgery remains controversial. To enhance our understanding of this relationship, this study examined perioperative outcomes specifically among the subset of patients who received RBC transfusions related to CABG.

Methods: Using our statewide collaborative registry, we analyzed data from 13,906 patients who received RBC transfusions following isolated primary CABG between January 2009 and December 2014. Univariate analysis compared pre- and intraoperative variables and postoperative outcomes between those who survived and those who died following surgery. In addition, a greedy match algorithm compared 632 surviving patients with 332 patients who died based solely upon preoperative risk factors.

Results: Operative mortality was 3.7% for this cohort of transfused patients (514/13,906). By univariate analysis, those who died had more baseline comorbidities, including higher preoperative PROM (7.8% died vs 2.9% alive; $P < .001$). Postoperatively, they underwent more reoperations, were ventilated and in the intensive care unit longer, and had a higher rate of stroke, renal, and multisystem organ failure ($P < .001$ for all). Among those patients matched by preoperative risk, baseline demographics including PROM (4.7% alive vs 5.0% died; $P = .327$) were well balanced between the two groups. In addition, intraoperative characteristics were similar for both groups, except that those dying received greater intraoperative RBC volume (Table). Postoperatively, a greater percentage of those who died received RBC, fresh frozen plasma (FFP), and platelet transfusions and received greater volumes of RBCs and FFP than did survivors. They also suffered significantly higher rates of essentially all postoperative complications than did those who survived (Table).

Conclusions: Relative to those who survived, patients who died were exposed to greater blood volume and experienced more postoperative complications. Our findings suggest that the association between transfusion and outcome after CABG may be more dependent upon the postoperative events that lead to transfusion than on the transfusion itself.

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POSTER ABSTRACTS

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Patients Matched By Preoperative Risk Factors			
Variable	Alive	Dead	p-Value
Number of Patients	632	332	
STS Predicted Risk of Mortality	4.7	5	0.33
Intraoperative Transfusion			
RBC (% Transfused)	56.3%	57.5%	0.72
RBC (mean # units)	2.0	2.5	< 0.001
FFP (% Transfused)	14.4%	17.5%	0.21
FFP (mean # units)	0.5	0.7	0.08
Platelets (% Transfused)	20.6%	23.8%	0.3
Platelet (mean # units)	0.64	0.65	0.94
Postoperative Transfusion			
RBC (% Transfused)	78.2%	88.6%	< 0.001
RBC (mean # units)	2.6	5.2	< 0.001
FFP (% Transfused)	12.8%	26.8%	< 0.001
FFP (mean # units)	0.5	1.7	< 0.001
Platelets (% Transfused)	16.5%	28.3%	< 0.001
Platelet (mean # units)	0.6	0.8	0.25
Any Reoperation	5.1%	14.2%	< 0.001
Prolonged Ventilation	26.0%	65.6%	< 0.001
Re-intubated	8.4%	50.0%	< 0.001
Total Intensive Care Unit Hours	124.1	229.8	< 0.001
Permanent Stroke	1.6%	10.9%	< 0.001
Postoperative Renal Failure	6.0%	28.6%	< 0.001
Postoperative Dialysis Required	3.0%	15.4%	< 0.001
Multi-System Organ Failure	0.3%	15.7%	< 0.001

P11

Aortic Dissection in Pregnancy: Etiology, Management, and Outcomes in 24 Patients*L. Wang¹, J. Zhu¹, W. Ma², S. Peterss³, J. Zheng¹, Z. Qiao¹, Y. Liu¹, L. Sun¹**¹Beijing Anzhen Hospital, Capital Medical University, and Beijing Institute of Heart, Lung and Blood Vessel Diseases, China, ²Yale University School of Medicine and Beijing Anzhen Hospital, Capital Medical University, New Haven, CT, ³Yale University School of Medicine, New Haven, CT*

Purpose: Aortic dissection (AoD) in pregnancy is a rare catastrophe threatening the lives of the mother and the fetus. Clinical experience is limited to case reports or short series. We seek to report our clinical experience in 24 patients over a 17-year period, with emphasis on etiology, management strategy, and outcomes.

Methods: Between 1998 and 2015, we treated 24 pregnant women who developed AoD at 28 weeks \pm 10 weeks of gestation (range: 6 weeks to 6 weeks postpartum). Mean age was 31.5 years \pm 4.8 years (range: 24-40). There were 19 type A (79%) and five type B dissections (21%). Marfan syndrome was seen in 17 patients (71%) and hypertension in six (25%). Aortic regurgitation was present in 87.5% (21/24). During the first, second, and third trimester and postpartum, type A AoD (TAAD) occurred in two, six, seven, and four patients, and type B AoD (TBAD) in zero, three, two, and zero, respectively.

Results: Eighteen TAADs (94.7%) were managed surgically. Among these, 36.8% (7/19) underwent a Cesarean delivery at 37 weeks \pm 3 weeks of gestation (range: 31-39), followed by surgical repair after mean 41 days (median 7; range: 1-149); 31.6% (6/19) had aortic repair initially at mean 17 weeks \pm 7 weeks of gestation, followed by delivery after mean 40 days (median 20; range: 3-101); 26.3% (5/19) underwent single-stage Cesarean delivery followed by aortic repair. Maternal and fetal mortality was zero and zero in the delivery first group, and 16.7% (1/6) and 66.7% (4/6) in the surgery first group, respectively. Of five TBADs, three were managed surgically, one endovascularly, and one medically. Overall maternal mortality was zero regardless of the treatment. Fetal mortality was 100% in the surgical patients and zero in others (Table). Follow-up extending to 8 years was available in 23 (95.8%). Maternal survival was 82.9% and 69.1% at 3 and 5 years, respectively.

Conclusions: Marfan syndrome is the leading cause of aortic dissection in pregnancy. In type A dissection, fetal operative mortality remains high. Maternal survival should be prioritized based on weeks of gestation and the family's decision. In type B dissection, no management strategy is preferred due to the small number of patients.

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Table 1. Management and Outcomes of Aortic Dissection in Pregnancy

Variable	Type A dissection (n = 19, 79.2%)	Type B dissection (n = 5, 20.8 %)
Patient age (years)	32 ± 5	31 ± 4
Marfan syndrome	14 (73.7%)	3 (60.0%)
Weeks of gestation (median)	28 ± 10 (31)	27 ± 10 (22)
<i>Management</i>		
Surgical	18 (94.7%)	3 (60%)
Endovascular	0 (0)	1 (20%)
Medical	1 (5.3%)	1 (20%)
<i>Timing of aortic repair and delivery</i>		
Delivery before aortic repair in 2 stages	7 (36.8%)	3 (60%)
Delivery before aortic repair in 1 stage	5 (26.3%)	0 (0)
Delivery after aortic repair in 2 stages	6 (31.6%)	1 (20%)
<i>Early Mortality</i>		
<i>Maternal</i>		
Delivery first	0 (0)	0 (0)
Aortic repair first	1 (6.7%)	0 (0)
<i>Fetal/Neonatal</i>		
Delivery first	0 (0)	3 (100%)
Aortic repair first	4 (66.7%)	0 (0)

P12

Long-Term Outcomes After Reoperation on the Aortic Arch: Our Experience in 154 Patients

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REGULATORY DISCLOSURE This presentation will address the E-vita Open by Jotec and the Thoraflex hybrid graft by Vascutek Ltd a Terumo Company, which are not FDA-approved.

Purpose: Very few data are available regarding long-term outcomes after reoperative arch surgery. The aim of this study was to assess early and long-term results in a large cohort of patients undergoing reoperations on the aortic arch.

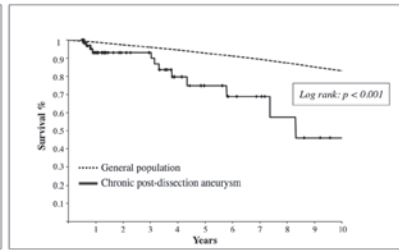
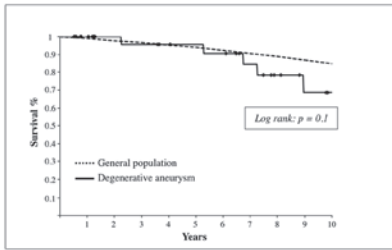
Methods: From 1987 to 2014, 154 consecutive patients (mean age: 59.7 years) underwent reoperations on the aortic arch after previous aortic surgery in our institution. Antegrade selective cerebral perfusion was used in all cases. An urgent/emergent operation was performed in 17 patients (11%). Chronic post-dissection arch aneurysm (CPDA) (n=87; 56.5%) and degenerative aneurysm (DA) (n=43; 27.9%) represented the most common indications for surgery. A complete arch replacement was performed in 77.3% of cases (n=119), and an associated root repair in 45.5% (n=70). The frozen elephant trunk technique was used in 70 patients (45.5%).

Results: Hospital mortality was 11.7% (n=18). Postoperative permanent neurological dysfunction occurred in 10 patients (6.4%). On multivariate analysis, cardiopulmonary bypass time (OR 1.02/min, $P = .005$) emerged as the only independent predictor of hospital mortality. Follow-up was 100% complete. The estimated 1, 5, and 10-year survival was 79.6%, 69.9%, and 46.8%, respectively. Freedom from reoperation at 5 and 10 years was 75.6% and 54.6%, respectively. Cox regression identified CPDA (OR 4.2, $P = .006$) as the only independent predictor of aortic reintervention. Late survival was comparable between DA patients and an age- and sex-matched Italian population (standardized mortality ratio [SMR] 1.9, $P = .1$), whereas patients operated on for CPDA showed reduced longevity (SMR 6.3; $P < .001$).

Conclusions: Reoperative arch surgery can be performed with acceptable mortality and good long-term outcomes. CPB time remains associated with increased early mortality and CPDA with a reduced freedom from reintervention at follow-up. Compared with general population, DA patients showed similar longevity, while CPDA patients continued to have a poorer long-term outlook.

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Kaplan-Meier estimate of late survival for patients with degenerative aneurysm (left), chronic dissection (right), and age- and sex- matched Italian population.

Table 1. Patients' demographics ($n = 154$).

	Frequency	%
Male	122	79.2
Age	59.7 ± 12.1	
NYHA class III-IV ($n = 115$)	17	11
Hypertension	113	73.4
Diabetes	8	5.2
Obesity	4	2.6
Smoking	52	33.8
COPD	11	7.1
Renal insufficiency	9	5.8
Peripheral vascular disease	10	6.5
Cerebral vascular disease	5	3.2
CAD	16	10.4
Marfan	13	8.4
Chronic post-dissection aneurysm	87	56.5
Degenerative aneurysm	43	27.9
False aneurysm	19	12.3
Acute aortic dissection	4	2.6
Endocarditis	2	1.3
Urgent / emergent status	17	11
Redo > 2	18	11.7
Years from last operation	9.2 ± 7.6	

COPD: chronic obstructive pulmonary disease; CAD: coronary artery disease. NYHA: New York Heart Association.

P13

Outcomes of a Less Invasive Approach in Proximal Aortic Surgery

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COMMERCIAL RELATIONSHIPS E. Blackstone: Other, Edwards Lifesciences Corporation; A. M. Gillinov: Consultant/Advisory Board, On-X Life Technologies, Inc, Edwards Lifesciences Corporation, Tendyne Holdings, Inc, Abbott Laboratories; Ownership Interest, ClearFlow, Inc; Speakers Bureau/Honoraria, AtriCure, Inc, Medtronic, Inc, St Jude Medical; D. R. Johnston: Consultant/Advisory Board, Edwards Lifesciences Corporation, St Jude Medical; Ownership Interest, JACE Medical, LLC; E. E. Roselli: Consultant/Advisory Board, Medtronic, Inc, Bolton Medical, Apica Ltd; Research Grant, LivaNova, Medtronic, Inc, CorMatrix; Speakers Bureau/Honoraria, Edwards Lifesciences Corporation, St Jude Medical, Vascutek Ltd a Terumo Company, COOK Medical, LivaNova, Medtronic, Inc; Other, Direct Flow Medical, Inc; E. G. Soltesz: Nonremunerative Position of Influence, JACE Medical; Speakers Bureau/Honoraria, St Jude Medical, Edwards Lifesciences Corporation, AtriCure, Inc; L. G. Svensson: Ownership Interest, Cardiosolutions, Inc, Posthorax

Purpose: Less invasive techniques previously have been described for mitral and aortic valve surgery; however, few studies have examined their benefit for aortic root and ascending aorta reconstruction. We compared outcomes of patients undergoing proximal aortic surgery via full sternotomy vs mini-sternotomy using propensity score matching.

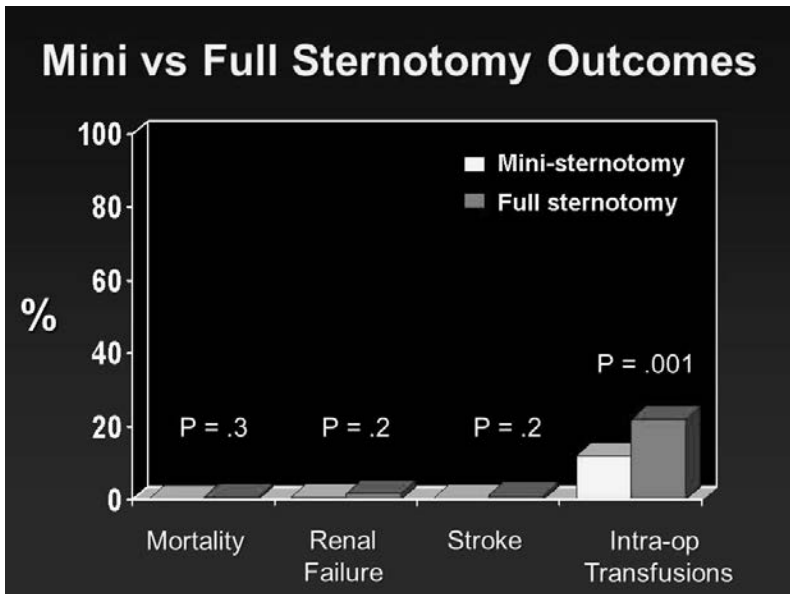
Methods: From January 1995 to July 2014, 8,533 patients underwent proximal aortic surgery at Cleveland Clinic. The study population comprised 1,476 patients after those with prior cardiac surgery, emergency procedures, endocarditis, or circulatory arrest were excluded; 422 (29%) underwent mini-sternotomy. A propensity score based on 45 variables was generated to account for differences in characteristics of full sternotomy and mini-sternotomy patients, producing 398 matched patient pairs (94% of possible).

Results: In-hospital mortality (one [0.25%] mini-sternotomy vs three [0.75%] full sternotomy; $P = .3$), renal failure (three [0.75%] vs seven [1.8%]; $P = .2$), stroke (two [0.5%] vs five [1.3%]; $P = .2$), perioperative myocardial infarction (31 [7.8%] vs 22 [5.3%]; $P = .2$), and reoperation for bleeding (18 [4.5%] vs 13 [3.3%]; $P = .4$) were similar among matched pairs. Fewer intraoperative blood products were used in patients having a mini-sternotomy (37 [12%] vs 58 [22%]; $P = .001$), although postoperative transfusions were similar (70 [20%] vs 91 [24%]; $P = .2$). ICU (median 24 hours vs 27 hours) and hospital (median 5 days vs 6 days) stays were shorter ($P < .0001$).

Conclusions: Mini-sternotomy is a feasible technique for proximal aortic surgery, with complications similar to those of full sternotomy, but with the advantages of fewer blood product transfusions, shorter ICU and hospital stays, and better cosmesis.

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P14

A Preoperative Prediction Model for Perioperative Transfusions After Isolated Coronary Artery Bypass Grafting Surgery

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COMMERCIAL RELATIONSHIPS D. S. Likosky: Consultant/Advisory Board, AmSECT; Research Grant, Agency for Healthcare Research and Quality, National Institutes of Health

Purpose: A number of prior studies have focused on identifying perioperative factors associated with transfusion following isolated coronary artery bypass grafting (CABG) surgery. However, few contemporaneous risk prediction tools exist to estimate an individual patient’s preoperative risk for receiving a transfusion in this setting.

Methods: We performed a regional observational study of consecutive patients undergoing isolated CABG among patients at 33 hospitals in the state of Michigan between 2011 and 2014. The transfusion rate was 31.1% (4,553/14,629). We developed a preoperative risk prediction model using logistic regression analysis and assessed the model’s fit and discrimination.

Results: The final regression model included 13 preoperative variables, Table. The model significantly predicted ($P < .0001$) the transfusion of RBC units. The correlation between the observed and expected transfusions was 1.0. The risk prediction model discriminated well (ROC: 0.74) and had satisfactory calibration ($P > .05$).

Conclusions: We developed a robust risk prediction model for transfusions using 13 readily obtainable preoperative variables. This well-performing model, which provides a patient-specific estimate of the need for transfusion, offers clinicians a guide for decision making and evaluating the effectiveness of blood management strategies.

Table: Multivariable Model

Variable	Odds Ratio	CI 95%
Patient Age		
<60	Ref	
60-69	1.27	(1.14, 1.41)
70+	1.66	(1.47, 1.88)
Female sex	1.30	(1.17, 1.46)
Body Surface Area		
<1.8	1.58	(1.37, 1.82)
1.8-1.99	1.40	(1.20, 1.62)
>=2.00	Ref	
Albumin (with each unit increase, g/dL)	0.85	(0.72, 0.99)
Chronic Lung Disease, Moderate-Severe	1.39	(1.21, 1.59)
Creatinine (with each unit increase, mg/dL)	1.25	(1.17, 1.33)
Peripheral Arterial Disease	1.29	(1.17, 1.44)
Last Preoperative Hematocrit		
<36	4.86	(4.04, 5.86)
36-39	2.75	(2.39, 3.16)
40-42	1.55	(1.34, 1.79)
43+	Ref	
Previous operation	2.12	(1.71, 2.63)
Ejection Fraction<40%	1.34	(1.19, 1.50)
Emergent/Salvage	2.40	(1.82, 3.18)
Thrombocytopenia (<=150K)	1.13	(1.03, 1.23)
Myocardial Infarction>1week	1.28	(1.17, 1.40)

P15

Assessment of the Association of Bilateral Internal Thoracic Artery Skeletonization and Sternal Wound Infection After Coronary Artery Bypass Grafting Surgery

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Purpose: Skeletonization is a technique of bilateral internal thoracic artery (BITA) harvest that preserves sternal blood flow. We sought to identify the relationship of skeletonization and sternal wound infection in a population undergoing BITA harvest.

Methods: Demographics and outcomes were recorded for patients undergoing CABG with BITA using either skeletonized (n=531) or non-skeletonized (n=970) techniques. The primary outcome was total infection. Propensity score (PS) analysis, as well as univariable and multivariable analyses, was performed to determine the effect of skeletonization in the total cohort and in each gender.

Results: Although patients undergoing skeletonized BITA had a lower body mass index, they were significantly older with a higher proportion of women, diabetes, urgent/emergent surgery, renal failure, vascular and lung disease, and lower preoperative hemoglobin. There was a significant effect of skeletonization in decreasing total infection incidence (OR 0.606, 95% CI 0.383-0.959, $P = .032$). The effect of skeletonization on total infection in men was more prominent (OR

Conclusions: Skeletonization is associated with a significant protective effect with regard to sternal infection after CABG with BITA. Female gender is a major risk factor for infection, and risk is not modified significantly with a strategy of skeletonization in women.

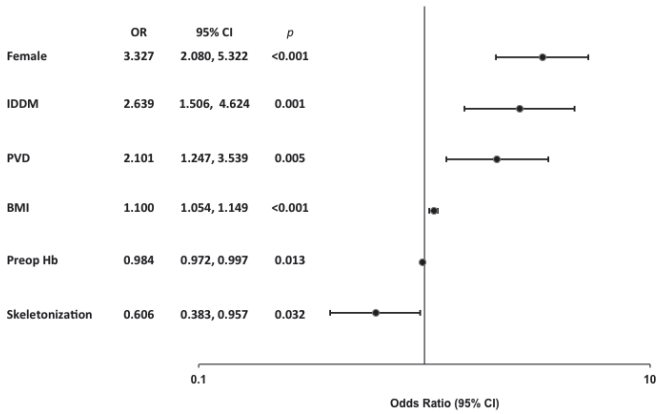


Table – Wound Infections

	Non-skeletonized	Skeletonized	<i>P</i> *
Superficial (%)	37(3.8)	18(3.4)	0.214
Deep (%)	23(2.4)	13(2.5)	0.277
Organ (%)	13(1.3)	2(0.4)	0.069
Total Infection (%)	73(7.5)	33(6.2)	0.021
Debridement (%)	15(1.6)	4(0.8)	0.138

*Significance (*p*) post-correction using propensity score.

P16

Mild Acute Kidney Injury After Transcatheter Aortic Valve Replacement Is Associated With Poor Outcome: A Study Considering Valve Academic Research Consortium-I (VARC-I) and VARC-II

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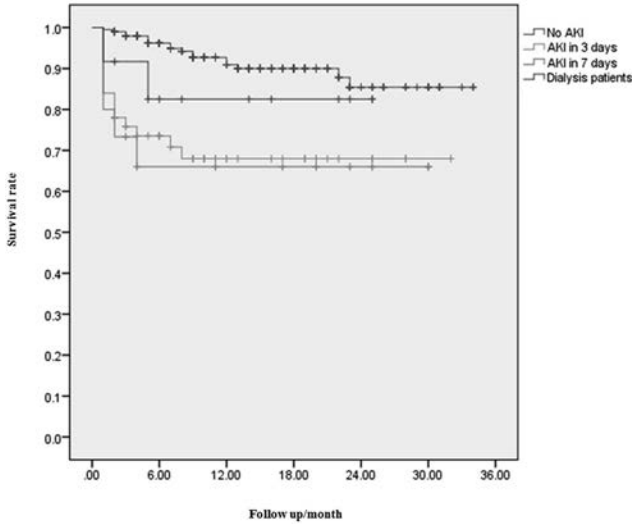
COMMERCIAL RELATIONSHIPS R. Anderson: Consultant/Advisory Board, Biosense Webster, Inc

Purpose: Acute kidney injury (AKI) during transcatheter aortic valve replacement (TAVR) from preoperative and procedural contrast and periprocedural injury can hinder outcomes. We assessed the trend of creatinine from preoperative work-up through 7 days post-procedure, compared accuracy of Valve Academic Research Consortium (VARC)-I and VARC-II criteria in determining the incidence of AKI, and evaluated the effects of AKI on patients' outcomes.

Methods: 290 consecutive patients (March 2012-December 2014) underwent TAVR. VARC-I criteria for AKI diagnosis at 72 hours and VARC-II criteria at 7 days were used. Twelve hemodialysis (HD) patients were analyzed separately, and 14 patients were excluded.

Results: Overall AKI incidence was 24.62% (65/264, stage I=59, stage II=2, stage III=4); 50 patients at 72 hours and 15 patients at 7 days. Multivariate logistic regression determined transapical (TA) approach (OR 4.46, 95% CI 1.37-7.63, $P = .007$) and pre-procedural GFR less than 45 (stage 3B CKD) (OR 3.47, 95% CI 1.35-14.70, $P = .008$) as determinants for AKI at 72 hours, and prior coronary artery bypass grafting (CABG) (OR 3.02, 95% CI 1.007-9.09, $P = .048$) and peripheral artery disease (PAD) [OR 3.53, 95% CI 1.06-11.62, $P = .045$] for AKI at 7 days. In-hospital and 30-day mortality was higher in AKI patients (Table). Non-AKI patient survival was 93% at 6 months, 89% at 12 months, and 86% at 24 months, whereas with survival in AKI at 72 hours was 66% at 6, 12, and 24 months (HR AKI vs no AKI 3.9, 95% CI 2.0-7.6, $P < .001$) and for AKI at 7 days 64% at 6, 12, and 24 months (HR 3.13, 95% CI 1.42-6.92, $P = .002$). For the 12 HD patients, survival was 82% at 6, 12, and 24 months (Figure).

Conclusions: Mild AKI is associated with poor outcome. Patients with CKD, PAD, prior CABG, and TA approach require close surveillance, as they are at risk for AKI up to 7 days after TAVR. TAVR was beneficial for HD patients in this series.



Variable	All patients (n=264)	Acute kidney injury (n=65) ^a	Non-acute kidney injury (n=199)	P value
Age, year, mean ±SD	80.19±8.02	80.18±7.99	80.19±8.05	0.99
STS score, mean ±SD	7.74±7.4	9.56±4.7	7.15±3.95	0.03
Female, n (%)	121(45.83)	30(46.15)	91(45.72)	1.00
BMI, kg/m ² , ±SD	29.91±22.18	28.05±5.93	30.51±25.28	0.20
Procedure approach, n (%)				
Transapical	93 (35.22)	34 (52.31)	59 (29.64)	0.001
Transfemoral	168 (63.63)	31(47.69)	137 (68.84)	
Transaortic	3 (1.13)	-	3 (1.50)	-
Contrast material volume ml, mean ±SD	84.92±40.09	77.3±30.74	87.28±42.40	0.107
Baseline Cr, mg/dl, mean ±SD	1.13±0.38	1.20±0.36	1.10±0.38	0.12
Baseline GFR, mL/min, mean ±SD	61.25±1976	56.33±17.56	63.10±20.29	0.038
Preoperative Cr, mg/dl, mean ±SD	1.09±0.38	1.19±0.67	1.04±0.38	0.096
Preoperative GFR, mL/min, mean ±SD	63.29±25.07	59.13±22.43	67.16±23.73	0.015
Diabetes, n (%)	88(33.33)	23(35.38)	65(32.66)	0.76
HTN, n (%)	213(80.68)	34(83.07)	159(79.89)	0.71
Hyperlipidemia, n (%)	152(57.57)	39(60)	113(56.78)	0.77
Coronary artery bypasses graft, n (%)	84(31.18)	28 (43.07)	56 (28.14)	0.067
Peripheral artery disease, n (%)	37(14.01)	17(26.15)	23(11.55)	0.063
Congestive heart failure, n (%)	125(47.37)	34(52.3)	91(45.72)	0.39
Preoperative hematocrit, %, mean ±SD	37.02±5.40	35.93±5.44	37.38±5.35	0.063
Preoperative EF, %, mean ±SD	52.13±14.97	50.77±15.78	52.58±14.71	0.42
Valve gradient, mmHg, mean ±SD	43.76±17.04	43.38±17.21	43.89±17.03	0.83
Valve area, cm ² , mean ±SD	0.66±0.25	0.66±0.23	0.66±0.25	0.97
Patients' post-operative outcomes				
Post-operative Cr in 3 days, mg/dl, mean ±SD	1.23±0.62	1.79±0.88	1.05±0.36	<0.001
Post-operative Cr in 7 days, mg/dl, mean ±SD	1.24±0.68	1.81±0.79	0.96±0.39	<0.001
ICU admission hours, mean ±SD	85.33±90.27	129.62±96.21	71.02±83.62	<0.001
Ventilation hours, mean ±SD	9.64±21.96	19.60±37.68	6.08±10.28	0.028
Dialysis/Hemofiltration n (%)	4 (1.51)	4 (6.15)	-	-
Stroke n (%)	9 (3.4)	4 (6.15)	5 (2.51)	0.069
Length of Stay (day)	6.87±5.71	10.47±7.99	5.70±4.13	<0.001
Death before discharge n (%)	4 (1.51)	4 (6.15)	0 (0)	0.003
Death at 30 days after procedure	11 (4.1)	10 (15.3)	1 (0.5)	<0.001

^a Based on VARC-1 criteria: Change in serum creatinine (≥72 h) compared to baseline; stage 1: 1.5-2.0 times or >0.3mg/dl Cr increase, stage 2: 2.0-3.0 times or increase, and stage 3: >3 times or >4mg/dl Cr increase compared to baseline or renal replacement therapy)

P17

Optimal Preoperative Left Atrial Diameter for Atrial Fibrillation Surgery in Patients With Mitral Valve Disease and Atrial Fibrillation

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Purpose: Although it has been described that the preoperative left atrial size is a predictor of the effectiveness of atrial fibrillation (AF) surgery, it is still unclear. The purpose of this study was to determine the optimal preoperative left atrial diameter (LAD) for AF surgery in our 20-year experience.

Methods: Between November 1993 and April 2015, 244 consecutive patients underwent AF surgery concomitant with a mitral valve surgery in our institution (full Maze in 230 patients and pulmonary vein isolation in 14). The mode of preoperative AF was paroxysmal in 50 patients and longstanding persistent in 194. Complete medical records, postoperative electrocardiograms, and Holter records were examined for all episodes of AF. The AF cure and stroke rates over 20 years were verified between a preoperative LAD <60 mm (n=195), 60-70 mm (n=38), and ≥70 mm (n=11). The preoperative fibrillatory wave amplitudes in lead V1 were 0.19 mV ± 0.09 mV, 0.19 mV ± 0.09 mV, and 0.22 mV ± 0.08 mV, respectively (NS).

Results: The AF cure rate at 1 month after the AF surgery was 99%, and the operative mortality was 1.0%. The AF cure rates at 5, 10, and 20 years after AF surgery were 85%, 65%, and 65% for an LAD <60 mm. However, the AF cure rates at 5 and 10 years were 80% and 60% for the 60-70 mm group (log-rank $P = .124$), and 26% and 0% for the LAD ≥70 mm group (log-rank $P < .001$). A multivariate Cox proportional hazard model revealed that the preoperative LAD and cardiothoracic ratio were significant predictors of recurrence of AF (HR 1.067, $P = .010$ and HR 1.074, $P = .017$, respectively). One patient (LAD <70 mm) had a stroke postoperatively due to the recurrence of AF ($P = .8$ vs LAD ≥70 mm).

Conclusions: The AF cure rate was over 60% for 20 years after AF surgery and the operative mortality was very low in patients with mitral valve disease and AF who had a LAD <70 mm. For patients who had a LAD ≥70 mm, however, AF surgery was ineffective, even though preoperative fibrillatory waves were prominent.

P18

Fibrous Reconstruction With Commando Operation: Newer Indications in Non-Endocarditis Patients

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COMMERCIAL RELATIONSHIPS D. R. Johnston: Consultant/Advisory Board, Edwards Lifesciences Corporation, St Jude Medical; Ownership Interest, JACE Medical, LLC; E. E. Roselli: Consultant/Advisory Board, Medtronic, Inc, Bolton Medical, Apica Ltd; Research Grant, LivaNova, Medtronic, Inc, CorMatrix; Speakers Bureau/Honoraria, Edwards Lifesciences Corporation, St Jude Medical, Vascutek Ltd a Terumo Company, COOK Medical, LivaNova, Medtronic, Inc; Other, Direct Flow Medical, Inc

Purpose: Reconstruction of the aortomitral curtain as part of combined aortic and mitral valve replacement (Commando operation) has been well described for endocarditis. Recently, this technique has been applied for non-infectious indications such as medial artery calcification (MAC), small annuli, and radiation heart disease. The objectives of this study are to characterize patients, describe non-infectious indications, and assess outcomes.

Methods: From 2011 to 2015, 446 patients underwent combined aortic and mitral valve replacement. Commando operation was performed in 30 (7%) for non-endocarditis indications, including calcification and small mitral and/or aortic annulus (Table). Mean age was 62 years \pm 10 years. Both valves were replaced using bioprostheses in 19 (64%), mechanical valves in 10 (33%), or a combination in one (3%). Sixty percent were reoperations. Fibrous skeleton reconstruction was performed using pericardium in 20 (67%) and extracellular matrix in 10 (34%). Mean follow-up was 10 months \pm 9 months. Postoperative imaging was available in 87% with a follow-up of more than 1 year in 27%.

Results: Operative mortality was 6.7% (2/30). Postoperative mean gradient across bioprosthetic valve was 12 mm Hg \pm 8 mm Hg for aortic and 7 mm Hg \pm 2 mm Hg for mitral. Other complications included two strokes (6.7%), two reoperations for bleeding (6.7%), and two tracheostomies (6.7%). One patient had elevated outflow tract gradients post-surgery; however, no patients had aortic insufficiency, mitral stenosis, or regurgitation. There was no evidence of perivalvular leak or dehiscence of reconstruction material.

Conclusions: The Commando operation can be performed safely in selected patients undergoing double valve replacement for non-infectious etiology. It allows safe debridement of aortomitral curtain calcification and provides excellent exposure to the posterior annulus, so a larger sized mitral prosthesis can be implanted in patients with small annulus or severe MAC.

Continued on next page

POSTER ABSTRACTS

Continued from previous page

	Indications for Commando operation	N=30 (%)
1	Severe mitral annular calcification (MAC)	9 (33%)
2	Radiation heart disease with calcified aortic/mitral annulus and aorto-mitral curtain	n=10 (26%)
3	Recurrence from previous prosthesis mismatch due to a small or calcified annulus	n=4 (15%)
4	Miscellaneous <ul style="list-style-type: none"> - Obstruction of left ventricular outflow tract from a previous mitral mechanical valve - Recurrent periprosthetic leak after mitral replacement and failed attempt with amplatzer plugs requiring open replacement - Mitral and aortic valve dysfunction due to atrioventricular congenital defect - Annular sclerosis due to scleroderma - Pannus formation and undermined fibrosa after previous failed mitral valve repair for rheumatic disease - Re-do commando operation for recurrent prosthetic leak from previous commando operation for endocarditis 	n=6 (22%)

P19

Outcomes of Patients Who Undergo Cardiac Surgery After Liver Transplantation*P. Harrington, A. S. Bryant, M. Kukreja, J. K. Kirklin, S. H. Gray, J. E. Davies**University of Alabama at Birmingham*

Purpose: There is a paucity of information available regarding the impact of cardiac surgery on patients who have undergone prior liver transplantation. The primary purpose of this study was to ascertain the outcomes and predictors of mortality in this cohort.

Methods: A retrospective cohort study consisting of a consecutive series of patients with a functioning liver allograft who subsequently underwent cardiac surgery between January 1991 and December 2012. The optimal MELD score cut-point for predicting late mortality was identified using ROC curve analysis. Risk of death following surgery was determined by parametric hazard analysis.

Results: Between January 1991 and December 2012, 43 patients (median age 60 years) underwent cardiac surgery after liver transplantation. Median interval between liver transplant and cardiac surgery was 42 months (range: 1.1-217). There were three hospital mortalities and 24 late mortalities. ROC curve analysis identified the optimal pre- and postoperative MELD score cut-points for predicting late mortality as >13.8 (AUC=0.674) and >17 (AUC=0.633), respectively. Patients with a preoperative MELD score ≤ 13.8 had a significantly greater survival than those with MELD score >13.8 ($P = .028$); patients with postoperative MELD score ≤ 17 had a significantly greater survival than those with MELD score >17 ($P < .001$). Multivariate parametric hazard analysis identified postoperative peak creatinine as a statistically significant predictor of mortality (RR 1.8; $P = .01$). The 1, 5, and 10-year Kaplan-Meier survival rates were 90%, 51%, and 35%, respectively; postoperative mortality followed a constant phase model with a hazard of death of 10% per year.

Conclusions: Cardiac surgery can be performed with acceptable short- and long-term outcomes in liver transplant recipients. Elevated pre- and postoperative MELD scores and postoperative peak creatinine level may portend mortality in this cohort. There is a constant hazard of death of 10% per year.

P20

Trends in Surgical Intervention for Endocarditis: A Single-Center Experience in 1,404 Patients

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COMMERCIAL RELATIONSHIPS J. E. Bavaria: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, COOK Medical, Boston Scientific, W. L. Gore & Associates, St Jude Medical; N. Desai: Speakers Bureau/Honoraria, Medtronic, Inc, W. L. Gore & Associates; W. Y. Szeto: Consultant/Advisory Board, Micro Interventional Devices, Inc; Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, LivaNova

Purpose: The current study aims to describe patient characteristics and outcomes in a large, 14-year, single-center series of cardiac surgery in patients with endocarditis.

Methods: A total of 1,404 patients with a preoperative diagnosis of endocarditis underwent cardiac surgery at a single institution between January 2002 and March 2015. Estimated mean follow-up was 54 months ± 46 months. The study period was divided into an early era (2002-2008) and a current era (2009-2015) to facilitate time-related comparisons. For the purpose of survival analysis, cases were classified as either simple or complex: double valve procedures, aortic root procedures, non-root aortic repairs, reconstruction with patching, transplants, and procedures involving a redo sternotomy were considered complex; all other procedures were considered simple.

Results: Mean annual case volume was not significantly different between the early and current eras, and patients in both eras were demographically similar (Table). Cases in the current era were more likely to be non-elective admissions (53% early vs 59% current, $P = .02$) and to be complex (54% early vs 62% current, $P = .02$). Current-era patients had longer ICU stays (184 hours ± 313 hours vs 132 hours ± 258 hours, $P < .01$). Thirty-day mortality over the entire study period was 11.6%; the difference between 30-day mortality in the early era (12.7%) compared to the current era (10.3%) was not statistically significant ($P = .17$). Rate of early readmission was lower in the current era (3% vs 6%, $P < .01$). Survival analysis showed improved 5-year survival in the current era for all cases (log-rank $P = .0001$, Figure 1a) and among complex cases (log-rank $P < .0001$, Figure 1b). Rates of postoperative complications, including stroke, new hemodialysis, and sepsis, were not different between eras (Table).

Conclusions: In a single-center series of cardiac surgery patients with endocarditis, an increased proportion of complex cases in recent years has not led to higher rates of major complications. In the context of longer ICU stays, stable complication rates and improved survival may reflect changes in ICU management of complex cases.

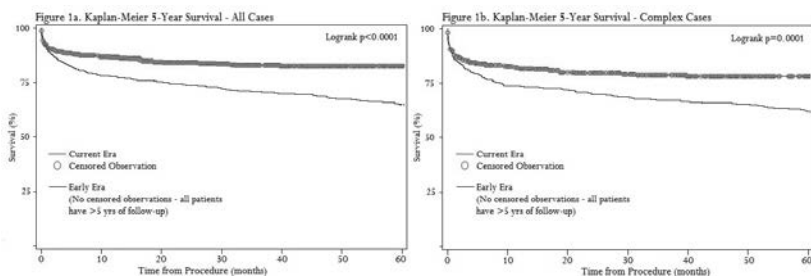


Table 1. Sample Characteristics and Major Outcomes

	All n=1404	Early Era (2002-2008) n=740	Current Era (2009-2015) n=664	p
Annual Cases (mean ± SD)	106 ± 20	106 ± 25	107 ± 16	0.98
Age (mean ± SD)	57 ± 16	57 ± 16	56 ± 16	0.10
Male	67% (943)	66% (489)	68% (454)	0.36
White	78% (1088)	80% (586)	77% (502)	0.22
Elective Admission	44% (614)	47% (342)	41% (272)	0.02
Transfer from another facility	50% (650)	48% (314)	52% (336)	0.16
Complex Case	57% (799)	54% (393)	62% (406)	<0.01
Length of Stay	19.9 ± 18.5	20.0 ± 18.9	19.8 ± 18.0	0.90
Total ICU Hours	160 ± 290	132 ± 258	184 ± 313	<0.01
Operative (30-day) Mortality	12% (156)	13% (92)	10% (64)	0.17
30-Day Readmission	5% (66)	6% (47)	3% (19)	<0.01
Sepsis	12% (70)	12% (51)	11% (19)	0.88
Stroke	5% (46)	4% (19)	6% (27)	0.29
New Hemodialysis	5% (77)	5% (35)	6% (42)	0.20

P21

Outcomes Following Surgical Pulmonary Embolectomy for Acute Pulmonary Embolus: A Multi-institutional Study

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COMMERCIAL RELATIONSHIPS L. Aklog: Consultant/Advisory Board, AngioDynamics; O. M. Lattouf: Consultant/Advisory Board, Baxter Healthcare Corporation; Ownership Interest, TransCardiac Therapeutics, LLC, MiMedx Group, Inc; M. Leacche: Speakers Bureau/Honoraria, ConvaTec; T. M. Sundt: Consultant/Advisory Board, Thrason Therapeutics; Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc

Purpose: Surgical pulmonary embolectomy (SPE) has been utilized sparingly for successful treatment of massive and submassive pulmonary emboli. To date, all data regarding SPE have been limited to single-center experiences. The purpose of this study is to document short-term outcomes following SPE for acute pulmonary emboli (PE) at multiple high-volume centers.

Methods: A retrospective review of data from multiple local STS National Database reports of adults undergoing SPE from 1998 to 2014 for acute PE was performed (n=214). Demographic, operative, and outcomes data were collected and analyzed. Patients were summarily categorized as having either massive or submassive PEs based on the presence or absence of preoperative vasopressors.

Results: There were a total of 214 patients treated by SPE with acute pulmonary emboli. Mean age was 56.0 years ± 14.5 years, and 92 patients (43.6%) were female. Of those, 176 (82.2%) were submassive and 38 (17.8%) were massive. Fifteen patients (7.0%) underwent concomitant cardiac procedures, with 10 (4.7%) having simultaneous valvular interventions and five (2.4%) undergoing concomitant bypass grafting. Cardiopulmonary bypass (CPB) was used for all cases. Cardioplegic arrest was utilized for 64 patients (29.9%). Median CPB and aortic cross clamp times were 71.5 minutes (IQR: 47.0-109.5) and 46.0 minutes (IQR: 26.0-74.5), respectively. The differences in postoperative outcomes shown in Table 1 are site-adjusted. Notably, only 25 patients (11.7%) suffered in-hospital mortality. Mortality was highest among the 32 patients who suffered preoperative cardiac arrest (nine, 32.1%).

Conclusions: These data represent the first multi-center experience with SPE for acute pulmonary emboli. SPE for acute massive and submassive PE is safe and can be performed with acceptable in-hospital outcomes. SPE should be included in the multimodality treatment of life-threatening pulmonary emboli.

Table 1 – Postoperative outcomes

Outcome	All (n=215)	Massive (n=38)	Submassive (n=176)	p-value
Postoperative Transfusion	93 (43.5)	29 (76.3)	64 (36.4)	<0.01
Septicemia	8 (3.7)	3 (7.9)	5 (2.8)	0.12
TIA	0	0	0	
Myocardial Infarction	5 (7.2)	2 (8.7)	3 (6.5)	0.68
Permanent Stroke	10 (4.7)	3 (7.9)	7 (4.0)	0.24
Atrial fibrillation	26 (12.1)	7 (18.4)	19 (10.8)	0.20
Multi-system organ failure	5 (15.6)	2 (16.7)	3 (15.0)	0.85
Pneumonia	14 (6.5)	4 (10.5)	10 (5.7)	0.23
Prolonged Ventilation	60 (28.0)	16 (42.1)	44 (25.0)	0.036
Postoperative dialysis	3 (1.4)	0 (0.0)	3 (1.7)	0.78
Renal Failure	24 (11.2)	5 (13.2)	19 (10.8)	0.59
Re-exploration for hemorrhage	18 (8.4)	6 (15.8)	12 (6.8)	0.079
In-hospital Mortality	25 (11.7)	9 (23.7)	16 (9.1)	0.014

P22

Aortic Remodeling Following Thoracic Endovascular Aortic Repair for Complicated Acute DeBakey 3 Aortic Dissection

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COMMERCIAL RELATIONSHIPS Y. Duwayri: Consultant/Advisory Board, COOK Medical; Research Grant, COOK Medical, TriVascula, Inc; R. Veeraswamy: Consultant/Advisory Board, COOK Medical; Research Grant, Medtronic, Inc

Purpose: The objective of this study was to examine the impact of thoracic endovascular aortic repair (TEVAR) on clinical outcomes and aortic remodeling in acute DeBakey 3 aortic dissections.

Methods: Between January 2012 and June 2015, 182 patients underwent TEVAR at a US academic institution. Forty-five patients underwent TEVAR for acute complicated DeBakey 3a (n=9) and 3b (n=36) aortic dissections. Volumetric aortic measurements of the true (TL) and false lumens (FL) of the dissected thoracoabdominal aorta were performed using 3-dimensional reconstructions of pre- and postoperative triple-phase computed tomography angiograms using TeraRecon Software.

Results: The mean age was 54 years ± 12 years. Indications for TEVAR were rupture in three (7%), malperfusion in 22 (49%), and intractable back pain in 20 (44%). The length of aortic coverage was 203 mm ± 36 mm, and left subclavian coverage was required in 19 patients (42%). 43/45 patients survived to hospital discharge. There were two deaths secondary to abdominal aortic rupture and acute respiratory distress syndrome. The incidence of stroke and paraparesis were 4.7%. Eleven patients (26%) required reintervention (open n=7, endovascular n=4). The mean follow-up was 10 months ± 10 months (range: 1-37). During the follow-up period, 100% of 3a and 50% of 3b patients had complete FL thrombosis along the length of the stent. The abdominal FL remained patent in 100% of 3b patients distal to the stent. Volumetric analysis following TEVAR demonstrated significant TL expansion, FL reduction, and an increase in total aortic size. Maximum total aortic diameters were stable in the thoracic aorta and increased in the abdominal aorta (Table).

Conclusions: TEVAR is the definitive therapy for acute complicated DeBakey 3 aortic dissection. Aortic remodeling is observed by evidence of TL expansion, FL reduction, and FL thrombus formation along the length of the stent. Although the total aortic size increases, thoracic aortic dimensions are stabilized by TEVAR.

Aortic Remodeling following TEVAR

	Pre-TEVAR	Post-TEVAR	P
True Lumen Volume (cm ³)	84±43	179±66	<0.001*
False Lumen Volume (cm ³)	203±66	189±86	0.04*
Total Aortic Volume (cm ³)	287±95	370±115	<0.001*
Max Thoracic Diameter (mm)	41±8	43±9	0.17
Max Abdominal Diameter (mm)	31±4	35±5	<0.001*

P23

Thoracic Endovascular Aortic Repair Using the Percutaneous Technique or Open Exposure: A Comparison of Early OutcomesL. S. Foley¹, T. B. Reece¹, M. T. Bell²¹University of Colorado, Aurora, ²University of Colorado, Denver**COMMERCIAL RELATIONSHIPS** T. B. Reece: Research Grant, Bard, Bolton Medical, Inc

Purpose: Percutaneous approach for endovascular aortic repair reduces morbidity and is well described; however, this technique is underreported in thoracic endovascular aortic repair (TEVAR) with larger devices. The purpose of this study was to compare early outcomes of percutaneous and open access techniques for large thoracic devices. We hypothesized that percutaneous access can be performed safely for TEVAR cases.

Methods: From February 2006 to April 2015, 114 thoracic endovascular aortic interventions were performed. Data were collected prospectively. Computed tomographic angiography was performed on all patients, and access vessel anatomy was evaluated for vessel diameter, anterior wall calcifications, and depth of vessel. All percutaneous access was obtained under ultrasound guidance, and closure was performed using two percutaneous suture devices (n=64). Data were retrospectively analyzed for initial access approach, technical success, hospital course, and access-related complications, including wound infection, clinically significant hematomas (requiring blood transfusion or delaying discharge), and arterial stenosis or dissection requiring vessel repair.

Results: Of the 114 TEVAR cases performed, 106 were included in this study. Alternative access sites (aorta and iliac sites) and patients with a prior arterial cutdown were excluded. Access-related complications occurred in 19.0% of open femoral exposures, compared to only 4.7% of percutaneous approaches ($P = .0475$). The success rate for percutaneous approach was 92.2%. Failures requiring conversion to open arterial repair occurred in five cases: failure of device (n=2), dissection (n=2), and occlusion (n=1). Complications following cutdowns included hematoma (n=3), infection (n=3), dissection (n=1), and vessel narrowing (n=1). Of note, wound infections were only present in open access cases (7.9% open vs 0% percutaneous, $P = .0595$). In cases of failed percutaneous access, conversion to open surgical repair was facilitated by following the access tract down to the arterial puncture site, limiting dissection required for exposure.

Conclusions: Percutaneous approach for thoracic aortic endografting can be safely performed with few access-related complications. Our programmatic practice has shifted to widespread use of percutaneous access, even in cases where failure rates are expected to be high due to anatomic factors, as these failures are infrequent and readily repairable.

P24

Is Surgery the Optimal Therapy for the Treatment of Aortic Valve Stenosis for Patients With an Intermediate STS Risk Score?

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COMMERCIAL RELATIONSHIPS M. A. Groh: Consultant/Advisory Board, St Jude Medical, AtriCure, Inc, Edwards Lifesciences Corporation

Purpose: In low-risk (LR) patients with aortic stenosis, surgical aortic valve replacement (SAVR) routinely is selected instead of transcatheter aortic valve replacement (TAVR). However, patients in intermediate risk (IR) frequently are oriented toward the TAVR option, against guidelines. Our goal is to evaluate best treatment strategies for IR patients with severe aortic stenosis.

Methods: Out of a consecutive series of 1,144 SAVRs performed in our institution between 2008 and 2014 and entered prospectively in the STS National Database, we reviewed the early and late outcomes of two different groups: a LR group of 470 patients (STS score <3.0) and an IR group of 620 patients (STS score >3 and <8). We eliminated from analysis 54 high-risk patients who are currently candidates for TAVR. All patients underwent SAVR with (44.22%) or without concomitant coronary artery bypass grafting. Baseline variables are depicted in Table 1, and Social Security Death Master File interrogation provided long-term information.

Results: There were no between-group differences in early morbidity except for late onset atrial fibrillation, more common in the IR group. Early mortality between LR and IR patients was not different (1.70% vs 2.74%, $P = .25$) and both had lower than predicted mortality rates. However, cumulative 5-year survival (Figure) was significantly higher in LR patients (86.3% vs 75.4% for IR cases, log-rank test, $P = .0007$), although still excellent in the IR group. There were 72 late deaths in the IR group compared to 26 in LR patients. When looking more precisely at IR patients and comparing survivors and non-survivors, age at surgery was 69.5 years \pm 12.7 years for survivors vs 75.4 years \pm 9.6 years for those experiencing late deaths ($P = .002$). Other risk factors with same levels of significance in survivors were lower preoperative creatinine level, lower incidence of diabetes, hemodialysis, chronic lung disease, and smaller number of diseased coronary vessels.

Conclusions: The majority of IR patients should undergo SAVR due to excellent late survival combined with still unavailable late structural deterioration rates in TAVR valves. Patients in the IR group with higher STS scores and advanced age may be better served with TAVR as data regarding late percutaneous valve function accrue.

Fig.1. Cumulative Survival Comparison Between Intermediate and Low Risk STS Score after Isolated Aortic Valve Replacement

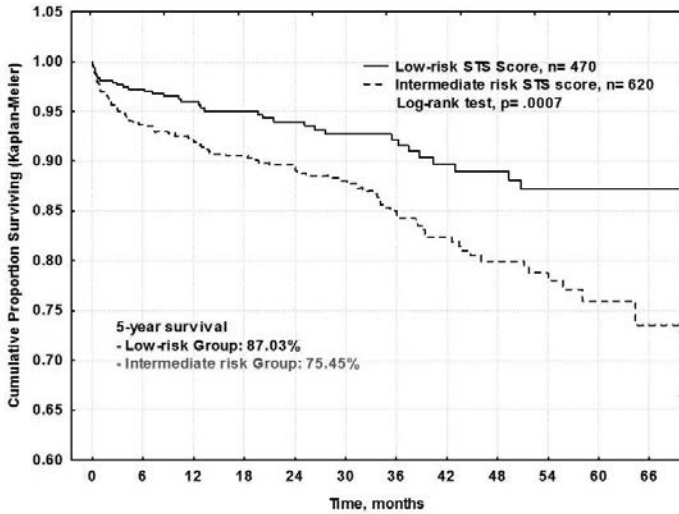


Table 1. Comparison of Perioperative Variables in Low and Intermediate STS Score Groups

Variable	LR Group, n= 470	IR Group, n= 620	p value
Age, years	67.3 ± 10.7	70.3 ± 12.4	<0.001
Diabetes	132 (28)	218 (35.16)	0.0132
Pre-Op Creatinine, mg/dL	0.95 ± 0.3	1.13 ± 0.6	<0.001
Hemodialysis	0	8 (1.29)	0.0134
Chronic lung disease	37 (7.9)	77 (12.42)	0.0056
Associated CABG	174 (37.0)	308 (49.68)	<0.001
LOS, days	6.9 ± 4.4	9.0 ± 6.5	<0.001
EF, %	53.1 ± 8.50	50.5 ± 10.8	<0.001
Perfusion. Time, min	103.0 ± 45.5	130.41 ± 56.3	<0.001
Aortic clamping Time, min	78.66 ± 37.7	97.82 ± 44.1	<0.001

Values expressed as Mean ± SD, or Frequency, (%)
 LR=Low Risk. IR= Intermediate Risk. CABG= Coronary bypass graft

P25

Previous Percutaneous Coronary Intervention Does Not Increase Postoperative Adverse Outcomes After Subsequent Coronary Artery Bypass Grafting

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Purpose: The adverse effect of previous percutaneous coronary intervention (PCI) on early mortality and morbidity after coronary artery bypass grafting (CABG) is still under discussion. This study aimed to evaluate the impact of previous PCI on early mortality and morbidity after subsequent CABG using data from the Japanese national database.

Methods: We analyzed 48,051 consecutive patients retrieved from the Japan Adult Cardiovascular Surgery Database (JACVSD) who underwent primary, isolated, elective CABG between January 2008 and December 2013. Patients with acute myocardial infarction were excluded. Early mortality and morbidity in patients with previous PCI (n=12,457, 25.9%) were compared with those outcomes in patients with no PCI (n=35,594, 74.1%). Multivariate logistic regression analysis and propensity score analyses were performed. Propensity scores were created based on 31 preoperative variables. Composite operative mortality or major morbidity (stroke, reoperation for bleeding, prolonged ventilation, newly required dialysis, or deep sternum infection) was considered a postoperative morbidity.

Results: Operative mortality (no PCI, 1.2%; previous PCI, 1.2%; $P = .970$) and morbidity (no PCI, 7.4%; previous PCI, 7.2%; $P = .436$) was similar between two groups. In the risk-adjusted multivariate logistic regression analysis, previous PCI was not a significant risk factor of operative mortality (OR 0.987, 95% CI 0.811-1.203, $P = .900$) nor morbidity (OR 0.951, 95% CI 0.877-1.032, $P = .231$). A regression adjustment for propensity score also confirmed that previous PCI was not associated with operative mortality (OR 0.953, 95% CI 0.783-1.160, $P = .630$) and morbidity (OR 0.969, 95% CI 0.893-1.053, $P = .462$). Further, in the analysis of 11,972 propensity score matched pairs, there still was no significant difference in operative mortality (OR 1.198, 95% CI 0.942-1.523, $P = .142$) and morbidity (OR 0.937, 95% CI 0.851-1.032, $P = .193$).

Conclusions: The present study using large data from JACVSD revealed that the previous PCI procedure does not increase operative mortality and morbidity after subsequent CABG. In patients needing repeat revascularization, the most appropriate method of revascularization should be selected by the heart team without being affected by the history of previous PCI procedure.

	No PCI group (n=35,594)	Prior PCI group (n=12,457)	Risk-adjusted OR* [95% CI]	PSM-adjusted OR* [95% CI]
Operative mortality	433 (1.2%)	151 (1.2%)	0.987 [0.811-1.203]	1.198 [0.942-1.523]
Composite outcome**	2,650 (7.4%)	901 (7.2%)	0.951 [0.877-1.032]	0.937 [0.851-1.032]
Stroke	460 (1.3%)	152 (1.2%)	1.005 [0.828-1.219]	1.089 [0.863-1.374]
Newly required dialysis	491 (1.4%)	133 (1.1%)	0.705 [0.576-0.864]	0.857 [0.675-1.087]
Deep sternum infection	513 (1.4%)	149 (1.2%)	0.810 [0.668-0.981]	0.835 [0.666-1.048]
Prolonged ventilation	1,248 (3.5%)	451 (3.6%)	1.011 [0.900-1.136]	0.897 [0.787-1.024]
Reoperation for bleeding	443 (1.2%)	164 (1.3%)	1.113 [0.921-1.345]	1.105 [0.882-1.385]

*OR(Odds ratio): Prior PCI group versus No PCI group

**Composite operative mortality or major morbidity

(stroke, reoperation for bleeding, prolonged ventilation, newly required dialysis or deep sternum infection)

P26

Does Femoral Cannulation Increase Cerebral Embolic Events During Minimally Invasive Cardiac Surgery? A Diffusion-Weighted Magnetic Resonance Imaging Study

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Purpose: Compared to conventional antegrade perfusion, retrograde arterial perfusion through femoral artery cannulation for minimally invasive cardiac surgery has been known to increase incidence of clinical stroke. However, data on the true incidence of cerebral embolism for the two perfusion strategies, as detected by diffusion-weighted magnetic resonance imaging (DW-MRI), are still limited.

Methods: Between November 2010 and May 2015, a total of 315 adult patients who underwent cardiac surgery had postoperative brain MRI as a routine evaluation. Of these patients, 103 patients had anterograde perfusion (group A), and 212 patients were perfused in the retrograde fashion (group R). Preoperative computed tomography angiography was evaluated in every patient, and cerebral DW-MRI was performed within 14 days after operation. Logistic regression was used to identify whether retrograde perfusion was the risk factor for the embolic event. A propensity score-matching analysis was applied to adjust for preoperative risk factors.

Results: Before matching, operative mortality (group A: 2.2%, group R: 1.5%, $P = 1.0$), incidence of clinical stroke (group A: 0%, group R: 0.5%, $P = .77$), and cerebral embolism (group A: 35.9%, group R: 26.4%, $P = .08$) were comparable. Multiple logistic regression identified that age (OR 1.02, $P = .049$), hypertension (OR 1.80, $P = .046$), emergency (OR 2.92, $P = .01$), and cardiopulmonary bypass time (OR 1.01, $P = .004$) were independent risk factors for brain DW-MRI lesion, but group R was not the risk factor. Following propensity score matching, 56 pairs of patients matched successfully. In propensity score-matching analysis, incidence of the brain DW-MRI lesion (group A: 39.3%, group R: 35.7%, $P = .70$), median number of lesions per patient, longest diameter of the lesion, and distribution of the lesion was comparable between groups (Table).

Conclusions: In this brain DW-MRI-based study, retrograde perfusion with femoral cannulation itself does not increase prevalence of postoperative cerebral embolic events in a properly selected patient population.

After PSM	Group R (n=56)	Group A (n=56)	p Value
New infarct	20 (35.7%)	22 (39.3%)	0.696
Number	2 (1-3)	2 (2-3)	0.640
Size	7 (6-9)	7 (4-8)	0.751
Posterior / Anterior	65% / 80%	68.2% / 81.8%	0.827
Left / Right	75% / 65%	77.3% / 77%	0.863

P27

Outcomes in Patients Undergoing Combined Heart-Kidney Transplants: The Impact of Mechanical Circulatory Support

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Purpose: A small proportion of patients undergoing simultaneous heart-kidney transplantation (HKT) require mechanical circulatory support (MCS) prior to transplantation. We sought to examine outcomes, such as patient survival and graft function, after transplantation.

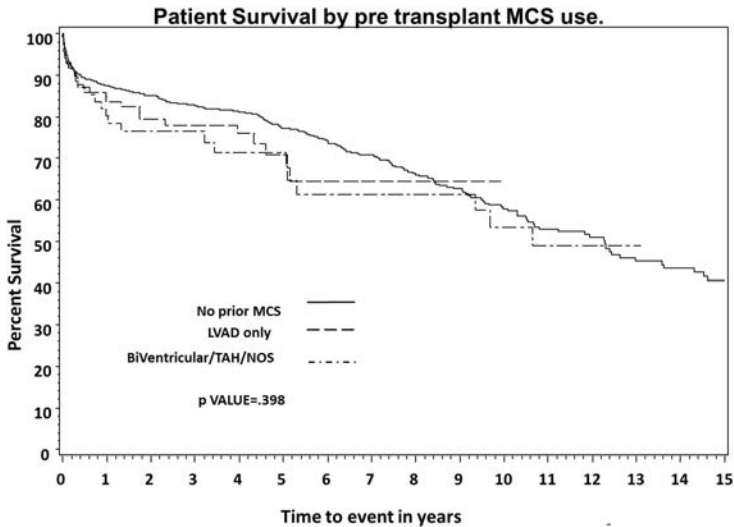
Methods: The United Network for Organ Sharing database was reviewed for patients undergoing HKT from 1994 to 2014. Patients were stratified by whether they required MCS prior to transplantation. Demographic data, recipient comorbidities, and kidney-specific variables were collected. Outcomes, including cardiac and renal allograft failure as well as 1-year and 10-year survival, were compared. Categorical variables were compared using χ^2 analysis and time-to-event data by Kaplan-Meier analysis.

Results: 965 patients underwent HKT from 1994 to 2014. Of these, 799 (81%) required no MCS prior to transplant, 113 (11.4%) required left ventricular assist device, and 73 (7.4%) required biventricular support or MCS not otherwise specified (Table). Recipients requiring hemodialysis did not differ between the three groups ($P < .15$). Sixty-three (37%) with MCS required pre-transplant hemodialysis (PTH); at 1 year, 64% of recipients who had prior MCS and no PTH were alive, compared to 63% who required PTH and MCS. Rates of treated rejection episodes for both heart ($P < .21$) and kidney ($P < .18$) did not differ between the three groups. There was no difference in overall patient survival seen in recipients requiring pre-transplant MCS and those who did not receive MCS, ($P < .75$). We also noted no difference in overall cardiac allograft failure among patients requiring pre-transplant MCS and those who did not receive MCS ($P < .8$). Subgroup analysis of recipients who had either LVAD or biventricular support prior to transplant demonstrated similar survival (Figure).

Conclusions: Patients who require MCS prior to HKT have comparable outcomes in patient and allograft survival as those without MCS. Thus, MCS should be considered a viable strategy for end-stage heart disease with renal insufficiency/failure if the patient is eligible for a heart-kidney transplant.

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	No VAD (n= 799)	LVAD (n=113)	biVAD/TAH/NOS (n=73)	p value
Age (years)	50.6±13.7	53.2±12.5	50.2±12.0	0.09
No. male (%)	585 (75.1)	96 (85)	62 (84.9)	0.02
BMI	25.6±5.0	27.0±5.4	25.8±5.1	0.05
Ethnicity (Non-Hispanic)	92%	88.5%	94.5%	0.3
No. requiring pre transplant dialysis (%)	242 (30.2)	32 (28.3)	31 (42.4)	0.18
Ischemic time (hours)	3.1±1.0	3.4±1.4	3.4±1.4	0.04
Length of stay after transplant (days)	25.2±24.4	30.7±32.8	30.2±29.4	0.04
No. with renal graft failure				
Renal re-transplant (%)	58 (7.4)	7 (6.2)	5 (6.8)	0.88
Dialysis after transplant (%)	204 (26.2)	35 (31.0)	26 (35.6)	0.15
No. treated for rejection at 1 year				
Cardiac allograft rejection	78 (10)	6 (5.3)	5 (6.8)	0.21
Renal allograft rejection	54 (6.9)	7 (6.2)	1 (1.4)	0.18

P28

Effect of Status 1A on Heart Transplant Outcomes in the Continuous-Flow Left Ventricular Assist Device Era

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Purpose: Heart transplant remains the gold standard for end-stage heart failure but is limited due to donor organ shortage. The emergence of continuous-flow left ventricular assist devices (CFLVAD) has changed waiting list times and donor allocation. We reviewed the Status 1A indications at transplant and its impact on post-transplant survival in CFLVAD patients.

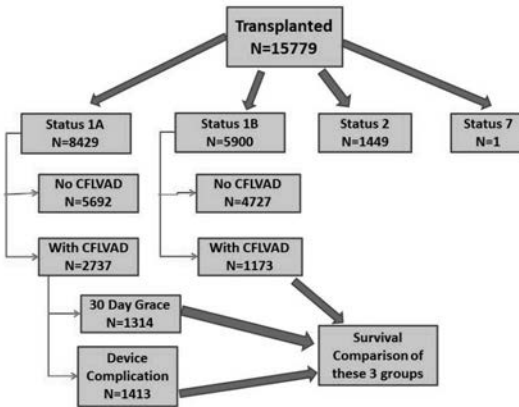
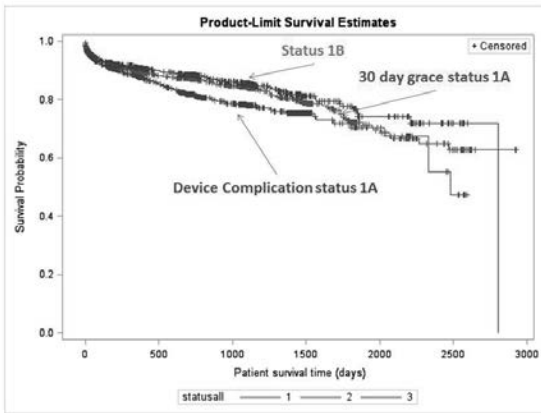
Methods: The United Network for Organ Sharing thoracic organ transplant database was queried between 2006 and 2013 to identify patients ≥ 18 years old who underwent heart transplant as UNOS Status 1A or 1B. In patients supported with a CFLVAD, the indication for Status 1A was divided into groups: device complication vs “free 30 days.” Analysis was performed to determine if the indication for listing as Status 1A had an effect on post-transplant survival.

Results: A total of 8,429 patients underwent heart transplant as Status 1A during the study period, of which 2,737 (32%) had CFLVAD at time of transplant. Of all Status 1A patients with a CFLVAD at time of transplant, 1,413 (52%) had device complications (thrombosis, infection, malfunction, and other), and 1,314 (48%) were on the 30-day grace period. There was no difference in 1-year survival between the groups. Post-transplant survival at 3 years of CFLVAD patients transplanted on 30-day grace period was similar to patients transplanted as Status 1B (84% vs 85%, $P = .5$). Transplant survival, either as Status 1A grace period or Status 1B, were significantly better compared to Status 1A patients due to device complications (84% and 85% vs 78%, $P = .01$) (Figure). Post-transplant survival in non-device Status 1A (82%) and 1B (83%) patients was similar to CFLVAD Status 1B (85%) and 30-day grace period Status 1A (84%).

Conclusions: CFLVAD patients transplanted as Status 1B or on the 30-day grace period Status 1A have similar post-transplant survival, which is significantly better than Status 1A patients with device complications. These data suggest that there needs to be an organ allocation score for heart transplant recipients.

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P29

Frailty Testing Can Identify Patients at Risk for Aspiration

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Purpose: Dysphagia is a common complication among hospitalized patients, and patients undergoing cardiac surgery are at increased risk. Traditional comorbidities are not predictive of dysphagia, and these patients are at increased risk of aspiration. Our aim was to determine if screening for frailty could identify patients at risk.

Methods: A prospective cohort study of patients 65 years and older undergoing nonemergent heart surgery at a single community hospital for 1 year was performed. All patients were screened for frailty before surgery using the 5-meter walk test. Patients were stratified into two groups based on the results of the 5-meter walk test (Frail, Not Frail). All patients were screened for dysphagia pre- and postoperatively by experienced acute care speech-language pathologists (SLP) using a 90 mL water swallow challenge protocol. Patients who failed the dysphagia screen were formally evaluated and treated by SLP. Preoperative risk factors and postoperative outcomes were analyzed.

Results: Thirty-eight of 176 patients (21.6%) failed the postoperative swallow screen and were subsequently treated by SLP. Univariate analysis showed that frail patients were 4.5 times more likely to have dysphagia than their non-frail counterparts (OR 4.5; 95% CI 1.5-13.0; *P* = .006). After adjusting for age, comorbidities, type and duration of surgery, ventilation time, and the use of intraoperative transesophageal echocardiography, the likelihood of dysphagia was still almost four times higher in frail patients (OR 3.9; 95% CI 1.1-13.9; *P* = .03). Frail patients were 4.5 times more likely to require a skilled nursing facility on discharge (OR 4.5; 95% CI 1.4-14.7; *P* = .012). Dysphagia, not frailty, was predictive of higher ICU length of stay (LOS), hospital LOS, and higher costs (Table). Only one aspiration-related complication occurred in the study group, and this happened before postoperative SLP evaluation.

Conclusions: Frailty is a predictor of dysphagia and should be included in the assessment of perioperative risk of elderly patients undergoing cardiac surgery. Dysphagia is a better predictor of utilization of care than frailty. Frailty assessment may help identify those at risk and reduce complications of dysphagia.

Table 1. Dysphagia predicts utilization of care

	Frailty			Dysphagia		
	Yes	No	P Value	Yes	No	P Value
	(Mean ± Std.)	(Mean ± Std.)		(Mean ± Std.)	(Mean ± Std.)	
ICU LOS (hrs.)	35.4 ± 28.1	33.4 ± 64.6	0.816	65.8 ± 126.3	24.4 ± 10.5	< 0.001
Hospital LOS (days)	8.8 ± 3.8	7.5 ± 3.3	0.126	9.8 ± 5.1	7.1 ± 2.3	< 0.001
Total Costs	\$45,499 ± \$11,038	\$39,687 ± \$17,433	0.194	\$50,588 ± \$26,607	\$36,391 ± \$8,376	< 0.001

P30

Acute Kidney Injury Severity and Long-Term Readmission and Mortality Following Cardiac Surgery

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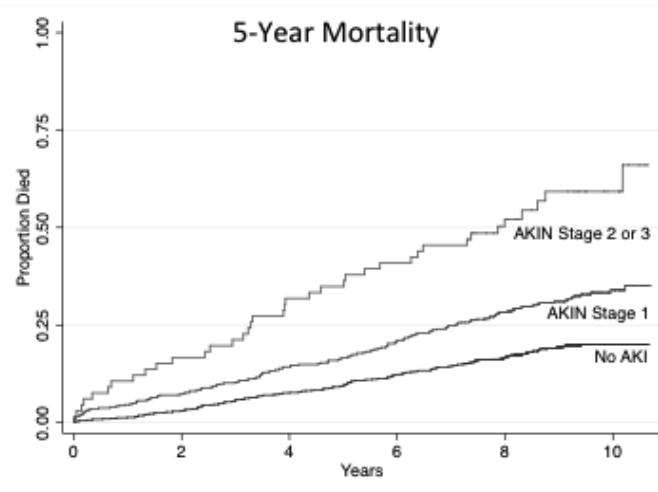
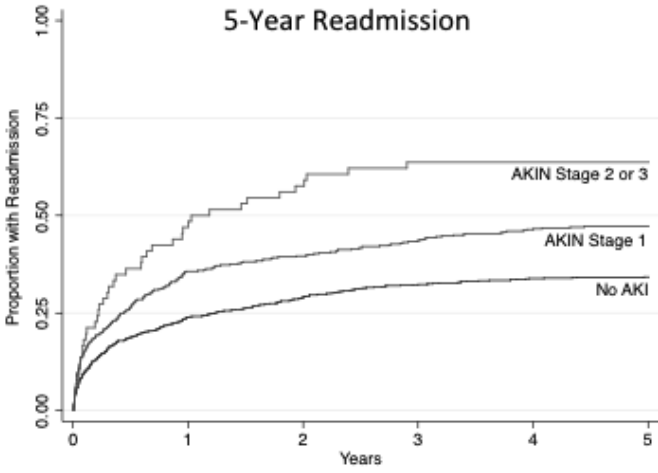
COMMERCIAL RELATIONSHIPS A. Everett: Ownership Interest, ImmunArray Pvt Ltd; D. S. Likosky: Consultant/Advisory Board, AmSECT; Research Grant, Agency for Healthcare Research and Quality, National Institutes of Health

Purpose: Acute kidney injury (AKI) is a common injury following cardiac surgery. While severity of AKI is associated with increased risk of short-term outcomes (such as 30-day mortality and readmissions), its long-term impact is less well understood.

Methods: 1,690 patients undergoing adult cardiac surgery at any of eight centers in Maine, Vermont, and New Hampshire between 2004 and 2007 were enrolled into the Northern New England biomarker study. Patients were excluded if they presented with dialysis (n=15) or died during the index admission (n=39). AKI severity was defined using the AKI Network. Our database was linked to national Medicare and state all-payer claims to ascertain readmissions and to the National Death Index to ascertain survival status. Kaplan-Meier and Cox proportional hazard modeling were conducted for time to readmission and death over 5 years, adjusting for age, sex, cardiovascular comorbidities, and baseline renal

Results: 551 patients (33.7%) developed AKI with AKIN Stage 1 (29.7%) and Stage 2-3 (4.0%). There were 651 readmissions (39.8%) and 406 deaths (24.6%). The overall incidence of readmission was 11.8 per 100 person years, while highest among those with Stage 2-3 AKI (no AKI: 9.7 per 100 person years, Stage 1: 15.6 per 100 person years, Stage 2-3: 28.3 per 100 person years, $P < .001$). After adjustment, patients in Stage 1 AKI had a 30% increased risk of readmission (1.10, 1.54), while those in Stage 2-3 had an 81% increased risk (1.30, 2.52). While the incidence of mortality was 3.0 per 100 person years, the rate increased across AKI severity (no AKI: 2.2 per 100 person years, Stage 1: 4.1 per 100 person years, Stage 2-3: 9.3 per 100 person years, $P < .001$). After adjustment, relative to those without AKI, patients in Stage 1 had a 37% increased risk of mortality (1.10, 1.70), while those in Stage 2 or 3 had a 2.40-fold higher risk (1.66, 3.46).

Conclusions: AKI severity using the AKIN stage criteria is associated with a significant increased risk of 5-year readmission and mortality. Our findings suggest that efforts to reduce even small increases in postoperative creatinine values may have significant long-term impact for patients and payers.



P31

The Impact of Liver Stiffness on Predicting Right Ventricular Failure Following Left Ventricular Assist Device Implantation

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Purpose: Although right ventricular failure (RVF) is associated with poor outcome following left ventricular assist device (LVAD) implantation, predictive factors of RVF have not been fully established. The liver stiffness (LS) closely related to RV filling pressure potentially presents the severity of RVF. We herein hypothesized that increased LS would be

Methods: This study enrolled 44 patients who were diagnosed as having dilated cardiomyopathy (DCM) and underwent LVAD implantation for bridge to transplantation between 2011 and 2015. The LS (standard value <5.5 kPa) was obtained by transient elastography before LVAD implantation. RVF was defined as need for inotropic support for 30 days or more, nitric oxygen inhalation for 5 days or more, and/or exchange to bi-VAD support.

Results: Sixteen patients (36%) presented with RVF following LVAD implantation. Survival of the patients with and without RVF was 64% and 95%, respectively, at 2 years post-LVAD implantation (log-rank <0.01). LV ejection fraction ($P = .2$), right atrial pressure (RAP, $P = .1$), or Michigan RVF score ($P = .3$) was not different in the patients with and without RVF, whereas LV end-diastolic dimension (LVDd) ($67 \text{ mm} \pm 10 \text{ mm}$ vs $78 \text{ mm} \pm 11 \text{ mm}$, $P < .01$) and RV stroke work index (SWI) ($5.3 \text{ g-m/m}^2/\text{beat} \pm 2.2 \text{ g-m/m}^2/\text{beat}$ vs $8.1 \text{ g-m/m}^2/\text{beat} \pm 3.2 \text{ g-m/m}^2/\text{beat}$, $P < .01$) were significantly lower, and the preoperative LS was significantly higher ($21.2 \text{ kPa} \pm 21.3 \text{ kPa}$ vs $8.9 \text{ kPa} \pm 6.8 \text{ kPa}$, $P < .06$) in the patients with RVF, as compared to those without RVF. In the multivariate logistic regression analysis, RVF after LVAD implantation was significantly predicted by the preoperative LS, LVDd, and RVSWI ($P = .017$, $P < .01$, and $P < .01$, respectively) and more accurately predicted by the combination of these parameters in ROC analysis (AUC=0.89, $P < .01$).

Conclusions: In addition to low RVSWI or small LV dimension, liver stiffness was a predictive factor of RVF post-LVAD implantation, indicating usefulness of transient elastography for this purpose.

P32

Oversizing Decreases Performance in Commercially Available Aortic Valve Bioprostheses

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COMMERCIAL RELATIONSHIPS M. E. Bowdish: Research Grant, Medtronic, Inc, HeartWare, Inc, Sunshine Heart, Inc, Thoratec Corporation; R. G. Cohen: Consultant/Advisory Board, Medtronic, Inc; Research Grant, Medtronic, Inc; Y. A. Darekar: Employment, Medtronic, Inc; C. A. Eberhardt: Employment, Medtronic, Inc; A. M. Speir: Consultant/Advisory Board, Medtronic, Inc; T. A. Vassiliades: Employment, Medtronic, Inc

Purpose: Poor outcomes associated with patient prosthesis mismatch drive surgical dogma to select the largest valve possible during aortic valve replacement (AVR). Interactions between the native aortic annulus and valve prosthesis remain poorly defined. We examined the hemodynamic and functional consequences of oversizing contemporary bioprostheses in an in vitro model.

Methods: Five contemporary aortic bioprostheses (Edwards Magna, St Jude Trifecta and Epic, Medtronic Mosaic and Hancock) were selected. Three commonly used sizes (21 mm, 23 mm, and 25 mm) of each were tested on a mock annulus in a pulsatile aortic simulator. Initially, the annulus was sized to match each valve. It subsequently was decreased by 3 mm, then 6 mm to simulate oversizing. We measured effective orifice area (EOA) and mean pressure gradient. Changes in prosthetic leaflet behavior and geometric orifice area (GOA) were assessed with slow-motion video. Statistical analysis allowed comparison within and between valve models.

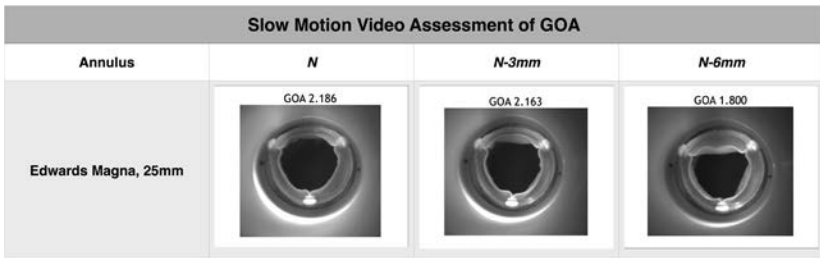
Results: For each valve model and size, simulated oversizing resulted in decreased EOAs and increased pressure gradients. This effect was more pronounced with smaller valve sizes, as well as higher flow rates. Its magnitude varied between valve type (Table). For some valve models, the effect was so pronounced that larger valve prostheses demonstrated worse performance than those of one size smaller when placed on the same sized annulus. Other valves appeared more resistant to the effects of oversizing. The observed decreases in EOA with valve/annular mismatch were corroborated by decreases in measured GOA. Slow-motion imaging revealed this change in GOA to be a result of an inward shift of the valve leaflet hinge point (Image).

Conclusions: In this in vitro model, bioprosthetic oversizing impairs hemodynamic performance of commonly used contemporary aortic valves. The magnitude of this effect varies by valve model and size. Clinically, these data suggest that oversizing should be of concern during AVR, as valve bioprostheses perform optimally when sized identically to the annulus.

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POSTER ABSTRACTS

Continued from previous page



Measured Mean EOA (cm ²) in Relation to Reductions in Annular Size					
	Edwards Magna	St. Jude Triecta	St. Jude Epic	Medtronic Mosaic	Medtronic Hancock
Valve Size= 21mm					
<i>N</i>	1.64	1.85	1.28	1.29	1.24
<i>N-3mm</i>	1.51	1.38	1.23	1.23	1.23
<i>N-6mm</i>	1.08	0.87	1.07	0.87	0.90
Valve Size=23mm					
<i>N</i>	1.95	2.20	1.58	1.51	1.42
<i>N-3mm</i>	1.81	1.75	1.55	1.46	1.45
<i>N-6mm</i>	1.41	1.16	1.45	1.19	1.24

P33

The Efficacy and Complications of Cerebrospinal Fluid Drainage for Thoracoabdominal Aortic Aneurysm Repair

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Purpose: We reviewed our experiences of thoracoabdominal aortic aneurysm repair to assess efficacy of cerebrospinal fluid drainage (CSFD) for protection of neurological deficits and complications associated with CSFD.

Methods: Between 2002 and 2015, 116 patients underwent surgery for thoracoabdominal aortic aneurysms. Crawford classification was type I in 51, type II in 31, type III in 13, type IV in 12, and type V in nine cases. Seventy-seven patients underwent CSFD for 2.7 days ± 1.1 days after surgery, while the other 39 patients did not undergo CSFD because of urgent situation, chronic disseminated intravascular coagulation, or anatomical difficulties. Cardiopulmonary bypass was applied in 113 cases, and the other three cases used extra-anatomical bypass. Hypothermia was applied moderately in 18 and deeply in 32 cases. Intercostal artery reconstruction was used in 58 cases.

Results: There were five hospital deaths (4.3%). Neurological complications included paraplegia (n=14, 12.1%), paraparesis (n=4, 3.4%), cerebral infarction (n=12, 10.3%), and cerebral hemorrhage (n=1, 0.9%), which were not related to CSFD. Complications related to CSFD included the following: headaches due to intracranial hypotension (n=13, 17%); subdural hematoma, which was treated conservatively (n=1, 1.3%); a neurological symptom of bilateral thighs (n=1, 1.3%); pale hemorrhagic discharge (n=2, 2.6%); and residual catheter fragment (n=1, 1.3%). There were seven cases of paraplegia and two cases of paraparesis in 77 patients who underwent CSFD (9/77, 12%) and seven cases of paraplegia and two cases of paraparesis in the other 39 patients without CSFD (9/39, 23%). A multivariate analysis determined that a longer cardiopulmonary bypass time was a significant risk factor of spinal cord dysfunction (OR 1.0, *P* = .009) and that CSFD showed a significant protective effect for the spinal cord (OR 0.17, *P* = .012, Table).

Conclusions: CSFD often associates with minor complications, such as headache; however, CSFD effectively protects against spinal cord dysfunction during surgery for thoracoabdominal aortic aneurysms.

		Univariate		Multivariate	
		Odds ratio	P value	Odds ratio	P value
Age		1.0	0.45		
Crawford classification	Type II	3.1	0.074	3.2	0.12
	Type III	3.9	0.074	5.4	0.057
Operation time		1.0	0.007	0.99	0.57
Cardiopulmonary bypass time		1.0	0.002	1.0	0.009
Deep hypothermia during cardiopulmonary bypass		1.1	0.82		
Urgent operation		1	> 0.99		
Intercostal artery reconstruction		0.70	0.50		
Cerebrospinal fluid drainage		0.46	0.13	0.17	0.012

P34

Whole Body Perfusion in Patients Undergoing Frozen Elephant Trunk for Type A Acute Aortic Dissections: Early Experience

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Purpose: Frozen elephant trunk (FET) can be adopted in type A acute aortic dissections (TAAAD) with distal intimal tears, but despite antegrade cerebral perfusion (ACP), the length of circulatory arrest is concerning. We describe our experience with whole body perfusion including ACP + distal antegrade lower body perfusion (DALBP) in TAAAD.

Methods: DALBP use in TAAAD is controversial, since placing a balloon-tipped cannula in a dissected descending aorta can cause aortic rupture. We instead used the stent deployed during FET to land the cannula and safely perform DALBP. From 2012 to 2014, 21 patients with type A acute aortic dissections underwent the implant of a short-stented FET (130 mm) with whole body perfusion (ACP + DALBP). DALBP pressures were kept between 50-60 mm Hg, perfusion flow between 20-30 ml/kg/min. Brain and lower calf near-infrared spectroscopy was used to monitor the effectiveness of this perfusion strategy.

Results: Cardiopulmonary bypass time was 167 minutes ± 20 minutes, cross clamp time was 101 minutes ± 18 minutes, ACP time was 51 ± 15 minutes, and using DALBP the actual distal circulatory arrest was reduced to 10 minutes ± 3 minutes. To perform DALBP, a Pruitt catheter was used for the first five patients, and in the remaining 16 patients, a size 24 three-way Foley catheter was adopted instead. Mortality was 0%. No patient had DALPB-induced complications. No patients had neurological complications or visceral ischemia. Type I, II, and III acute kidney injury rates were respectively 33% (seven patients), 4.7% (one patient), and 0%. Four patients had an additional endovascular stent deployed to complete the closure of the residual false lumen.

Conclusions: These preliminary results show that in patients with TAAAD, the adoption of whole body perfusion while performing FET is feasible, safe, and effective. If these data are confirmed on a larger scale, they could support a shift toward warmer perfusion temperatures during complex aortic surgery with whole body perfusion.

P35

News to the World: Intermediate Results With the Use of the New Generation Multilayer Flow Modulator Grafts in the Endovascular Treatment of Aortic Dissections and Aneurysms

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REGULATORY DISCLOSURE This presentation will address the Multilayer Flow Modulator by Cardiatis, which is not FDA-approved.

Purpose: Complex thoracoabdominal aneurysms and type B dissections involving spinal and visceral branches of the aorta are pathological entities with high-risk prognosis and actual treatment options. Multilayer flow modulator (MFM) technology may be a well-tolerated, safe, and effective solution.

Methods: Between October 2013 and June 2015, we treated 25 consecutive patients with abdominal or thoracoabdominal aortic aneurysms involving spinal and visceral aortic branches, as well as two cases of residual type B aortic dissection (after a type A dissection treated surgically 3 months before). In all cases, the new generation MFM endograft was implanted on the abdominal aorta, +/- thoracic aorta, and +/- common iliac arteries when necessary. All patients had a femoral surgical approach.

Results: The rate of technical success was 100%. The mean age of patients was 66.8 years (range: 28-78). Mean procedural time was 119.9 minutes, with a mean contrast loading of 91 mL. The mean air karna was 1,965.53 mGy and a mean fluoroscopy time of 21.7 minutes. The early results were excellent, with significant or total exclusion of the aneurysm from circulation, and the emergent branches from the aorta remaining widely patent. The mean duration of hospitalization was 4.8 days. During follow-up, reintervention was necessary in one case due to a type IB endoleak. There were no cases of early/late infection, impairment of renal function, or spinal/mesenteric ischemia.

Conclusions: The MFM technology may be the solution in the treatment of complex aortic aneurysmal pathology and type B dissection—not only in elderly patients with heavy comorbidities, but also for younger cases, as the technology at this stage has shown low mortality, low morbidity, and low costs compared to other known

CARDIOTHORACIC SURGICAL EDUCATION

P36

The Joint Council on Thoracic Surgery Education “Educate the Educator” Faculty Development Course: Analysis of the First 5 Years

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COMMERCIAL RELATIONSHIPS A. A. Vaporciyan: Nonremunerative Position of Influence, American Board of Thoracic Surgery

Purpose: Since 2010, the Joint Council on Thoracic Surgery Education (JCTSE) has sponsored an annual “Educate the Educator” (EtE) course. The goal is to provide US academic cardiothoracic (CT) surgeons with the fundamentals of teaching skills, developing an educational curriculum, and using education for academic advancement. This abstract describes the attendee course evaluation and assessment of skills development.

Methods: JCTSE tries to engage CT surgeons in every cardiothoracic surgical residency program in the US. The content of the 2.5-day EtE course was based on several needs assessment surveys of CT surgeons and residents conducted at the 2009 annual meetings of The Society of Thoracic Surgeons, Thoracic Surgery Directors Association, and Thoracic Surgery Residents Association. From 2010 to 2014, the EtE program was offered to all CT surgeons at Accreditation Council for Graduate Medical Education-approved training programs. The quality of the course content, presentations, and meeting logistics were evaluated by using end-of-course evaluation forms. Debriefing feedback critique was provided by an external reviewer. Annual course modifications were implemented following these summative and formative evaluations.

Results: Of the 72 training programs, 68 institutions (94%) have sent faculty to EtE. With 963 known academic CT surgeons in the US, 156 (16.3%) have attended; there was one international surgeon. Recently, seven institutions also sent their program coordinators. Using a five-point Likert scale, composite assessment mean scores on course parameters, session presentations, and self-assessments from all 164 respondents are listed in the Table. Generally, ratings of all course contents were excellent, ranging from 4.4 to 4.8, and accompanied with highly complementary comments. Specifically, topics on developing an educator’s portfolio, using educational activity for promotion, and understanding adult learning principles consistently receive the highest ratings (4.7, 4.6, and 4.6, respectively). Through self-assessment, the learners felt that their skills and knowledge in all content areas improved, mostly with these same three topics. Workshops focusing on educational leadership, milestones implementation, and eLearning concepts received the highest ratings (5.0, 4.8, and 4.5, respectively).

Conclusions: The EtE program offers an excellent opportunity for academic CT surgeons to enhance their teaching skills, develop educational activities, and provide avenues for academic promotion. It also has provided a unique environment for networking and mentorship and plays an important role in the evolution of cardiothoracic surgical training in the US.

	Average Rating (Likert Scale 1-5, 1=poor, 5=excellent)
<i>Table 1: Summary Evaluation Data for "Educate the Educators" Course 2010-2014 (n=164)</i>	
<i>Overall Course Evaluation Parameters</i>	
The learning objectives for this course were clearly stated	4.5
The selection of topics was appropriate to meet stated objectives	4.4
This course was relevant to my learning needs	4.6
The course was organized and flowed well	4.5
The facility was conducive to learning	4.7
Networking with fellow participants/faculty contributed to my learning	4.5
The course instructors were enthusiastic about the topics	4.8
This course instructors were knowledgeable about the topics	4.8
This course was a valuable learning experience	4.7
I would recommend this course to my colleagues/peers	4.7
I plan to implement what I have learned in this course into my teaching practice	4.7
I would be interested in attending an advanced EtE course at a future national meeting (e.g. STS, AATS)	4.6
<i>Session Titles</i>	
Assessment of Surgical Skills	4.5
Cashing-in On Your Educational Portfolio	4.7
Converting Educational Effort Into Promotional Currency	4.6
Curriculum Design	4.5
End of Course Evaluation	4.6
Formative Feedback	4.5
How People Learn	4.6
Teaching in the OR	4.5
Teaching Psychomotor Skills	4.5
<i>Attendee Self-Assessment: Knowledge Pre- and Post-Course</i>	
	Mean Pre/Post Course
Designing a Curriculum	2.4/3.7
Teaching in the OR	3.3/4.1
Simulation Lab Development and Implementation	3.1/3.8
Building a Curriculum to Address Existing Educational Need	3.0/3.9
Understanding How People Learn	2.9/4.4
Implementing the Milestones and the New Online Curriculum	2.7/3.8
Providing Constructive Feedback	3.0/4.3
Teaching Psychomotor Skills	3.2/4.1
Implementing Change in Your Setting	2.9/3.8
Leading a Team	3.5/4.0
Creating an Educational Portfolio	2.6/4.1
Converting Educational Activity into Promotional Currency	2.6/4.2

P37

Experience with the Cardiac Surgery Simulation Curriculum: Results of Resident and Faculty Survey

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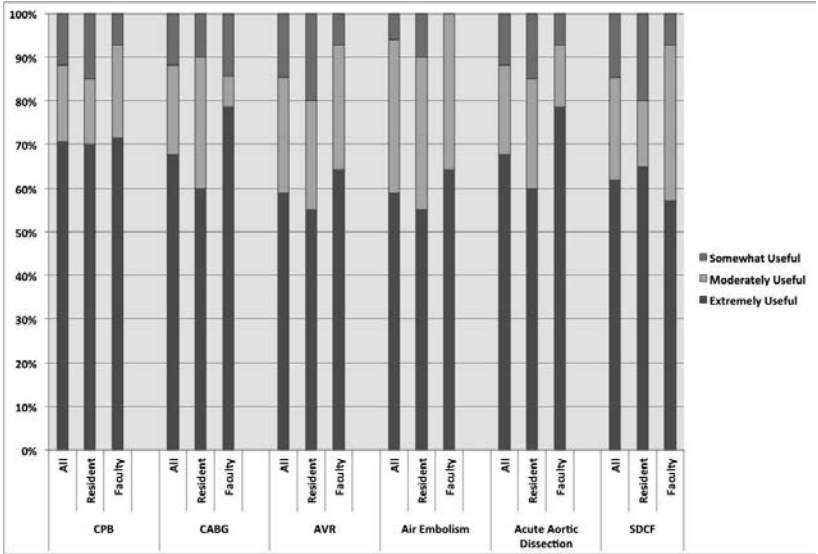
COMMERCIAL RELATIONSHIPS J. V. Conte: Consultant/Advisory Board, LivaNova, Medtronic, Inc; Research Grant, Medtronic, Inc, Boston Scientific; D. N. Coore: Consultant/Advisory Board, KindHeart, Inc; Ownership Interest, KindHeart, Inc; J. I. Fann: Consultant/Advisory Board, Twelve, Inc; R. H. Feins: Nonremunerative Position of Influence, KindHeart, Inc; Ownership Interest, KindHeart, Inc; N. A. Mokadam: Consultant/Advisory Board, Thoratec Corporation, HeartWare, Inc, SynCardia Systems, Inc, St Jude Medical; P. S. Ramphal: Ownership Interest, KindHeart, Inc, University of the West Indies

Purpose: The Cardiac Surgery Simulation Curriculum was developed at eight institutions as an iterative document from 2010 to 2013, sponsored by the Agency for Healthcare Research and Quality. A total of 27 residents were taught by 18 faculty members using the curriculum. A survey was conducted to document and gain insight into the initial experience.

Methods: Residents and faculty were sent 72- and 69-question surveys, respectively. In addition to demographic information, participants reported their overall impressions of the curriculum. Focused investigation (including session-to-session assessments) into each of the six modules (cardiopulmonary bypass, coronary artery bypass, aortic valve replacement, air embolism, aortic dissection, and sudden deterioration in cardiac function) was obtained. Participants also evaluated the specific simulators used. Institutional biases regarding implementation of the curriculum were evaluated.

Results: Twenty residents (74%) and 14 faculty (78%) responded to the questionnaire. The majority of residents (70%) completed this training in their first and second year of a traditional track program. The modules were well regarded (see Figure), with no respondents having an unfavorable view. Both residents and faculty found low, moderate, and high-fidelity simulators to be extremely useful, with particular emphasis on utility of high-fidelity components. Importantly, the vast majority of residents (85%) felt more comfortable in their skillset and in the operating room. Faculty members were universally reassured of resident technical skills. Simulation of rare adverse events increased confidence and allowed for the development of multidisciplinary teams to address them. Sessions always were conducted in a dedicated space, and the majority (71%) were performed at set days and times every week. At most institutions, the conduct of this curriculum took precedence over clinical obligations (64%).

Conclusions: The Cardiac Surgery Simulation Curriculum was implemented with excellent adoption among the investigating centers. Both residents and faculty viewed the modules favorably. Using this curriculum, participants indicated an improvement in resident technical skills and were enthusiastic about adverse events training.



P38

Resident Identification of Significant Learning Experiences: A Qualitative Analysis*E. Michel, S. L. Meyerson**Northwestern University, Chicago, IL*

Purpose: Practice-based learning is a core competency that is required of all residency training programs. An initial step is identification of areas for improvement. This study explores what types of experiences residents identify as significant for learning and investigates the feasibility of a simple written system for tracking practice-based learning.

Methods: After an introductory lecture on the science of learning, thoracic residents were asked to submit a brief monthly written reflection highlighting something they learned from a clinical experience. Qualitative analysis of these reflections was performed using grounded theory. This generated categories of learning topics, which were then combined into themes and used to develop theories about how residents learn from their experiences. The frequency of categories was compared between senior and junior residents with the Pearson chi-square test to determine if they approach learning differently.

Results: Seven residents submitted a total of 56 cases (19 by senior residents, 37 by junior residents) over a 1-year period. Open coding revealed 113 learning points in 12 unique categories (Table) with procedure choice as the most common. Saturation was reached with no further unique codes identified. Senior residents (PGY4-8) were more likely to report learning points involving procedure choice (15 [31%] vs 12 [18%], $P = .01$) and procedure timing (four [8%] vs one [2%], $P = .04$) than junior residents (PGY1-3). The 12 categories were combined into four themes: preoperative phase, technical skills, complication identification and management, and teamwork. Senior residents were more likely to report learning points in the preoperative phase (22 [46%] vs 21 [32%], $P = .01$).

Conclusions: Brief written reflection is a feasible approach to explore and document practice-based learning. Faculty members should explicitly help residents improve their practice using individualized guidance and can influence what residents take away from each situation by asking targeted questions, clarifying decisions, and modeling behavior.

Category	Theme	Number (%)
Procedure Choice	Preoperative phase	27 (23.9%)
Technical tips	Technical skills	19 (16.8%)
Complication management	Complications	15 (13.3%)
Complication prevention	Complications	14 (12.4%)
Patient evaluation (testing)	Preoperative phase	10 (8.8%)
Complication diagnosis	Complications	8 (7.1%)
Procedure Timing	Preoperative phase	5 (4.4%)
Communication	Teamwork	4 (3.5%)
Professionalism	Teamwork	4 (3.5%)
Error recognition	Complications	3 (2.7%)
Systems	Teamwork	3 (2.7%)
History/physical exam	Preoperative phase	1 (0.9%)
Total		113

Table 1 – Learning points identified by Thoracic Surgery residents

CONGENITAL

P39

Current Outcomes and Trends of Ventricular Assist Device Selection in Children With End-Stage Heart Failure

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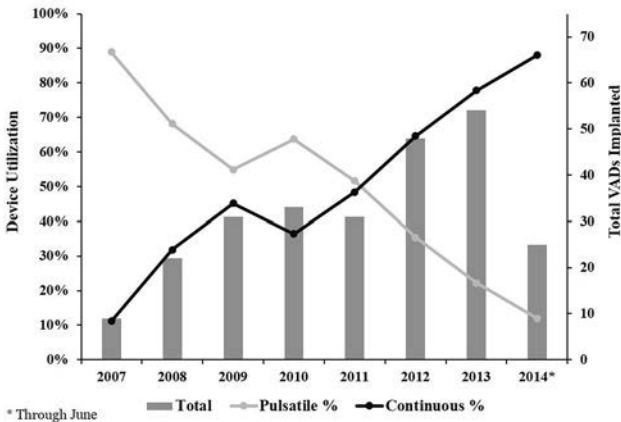
REGULATORY DISCLOSURE This presentation will address some adult durable continuous-flow ventricular assist devices by Thoratec (HeartMate) and HeartWare (HVAD). The FDA status of these devices is investigational.

Purpose: Older pediatric patients with end-stage heart failure increasingly are being bridged to heart transplant (HT) with a ventricular assist device (VAD). Multiple devices currently are available, including continuous-flow (CFD) and pulsatile-flow devices (PFD). We aimed to examine the contemporary trends in VAD selection and their associated outcomes in older children.

Methods: The United Network for Organ Sharing database was reviewed for pediatric patients (age ≤18 years) listed for HT from January 2007 through June 2014. Inclusion criteria were patients with a VAD at the time of initial wait listing or when removed from the waiting list. Children were subdivided based on size eligibility for a durable CFD (body surface area [BSA] >1.0 m²). Devices were categorized into CFD or PFD and durable or non-durable. Patients with an unclear device were excluded. Survival to transplant or recovery was based on patients achieving a definitive outcome.

Results: In total, 634 pediatric patients underwent VAD implantation while awaiting HT, 206 (32%) received a CFD and 428 (68%) a PFD. Of these, 253 patients (40%) with a BSA >1.0 m² received a durable device, 144 (57%) CFD and 109 (43%) PFD. Device type varied significantly based on year implanted, with CFD increasing from 11% (1/9) in 2007 to 78% (42/54) in 2013 and 88% (22/25) in 2014 ($P < 0.01$) (Figure). Overall, 83% of patients were diagnosed with dilated cardiomyopathy. Notably, the PFD patients were younger, had a lower BSA, a decreased rate of dilated cardiomyopathy, an increased rate of prior graft failure, and an increased rate of ventilator, extracorporeal membrane oxygenation, and biventricular assist device support at listing (Table). Survival to transplant or recovery was similar for durable CFD devices (96%, 131/137) and durable PFD devices (94%, 101/108) ($P = .57$), as was the post-HT survival ($P = .44$), 95% at 1 year for both.

Conclusions: There is no difference in survival for older pediatric patients supported with a durable CFD or PFD, despite those receiving a PFD having more risk factors for a poor outcome. Even so, there is a dramatic trend toward increased utilization of CFD devices, likely because of other advantages provided.



	Continuous N (%) N= 144	Pulsatile N (%) N= 109	p-value
<u>Characteristics at listing</u>			
Age (y), mean ± SD	14.0 ± 2.5	12.8 ± 3.0	<0.01
BSA (m ²), mean ± SD	1.8 ± 0.4	1.5 ± 0.4	<0.01
<u>Diagnosis</u>			
Dilated cardiomyopathy	128 (89)	82 (75)	<0.01
Congenital heart disease	7 (5)	13 (12)	0.06
Re-transplant	1 (1)	8 (7)	<0.01
Restrictive cardiomyopathy	2 (1)	1 (1)	1.00
Other	6 (4)	5 (5)	1.00
Inotropes	67 (47)	55 (50)	0.61
Ventilator	15 (10)	29 (27)	<0.01
ECMO	2 (1)	14 (13)	<0.01
BiVAD	8 (6)	31 (28)	<0.01
Dialysis	1 (1)	4 (4)	0.17
Creatinine (mg/dl), mean ± SD	0.9 ± 0.5	0.9 ± 0.6	1.00
Albumin (g/dl), mean ± SD	3.4 ± 0.7	3.4 ± 0.8	1.00
<u>Outcomes</u>			
Transplant	131 (91)	100 (92)	1.00
Condition improved	0	1 (1)	0.43
Death	3 (2)	3 (3)	1.00
Condition deteriorated	3 (2)	3 (3)	1.00
Death at transplant	0	1 (1)	0.43
Still waiting on list	3 (2)	1 (1)	0.64
Other	4 (3)	0	0.14

P40

Outcomes of Functional Single Ventricle and Total Anomalous Pulmonary Venous Connection

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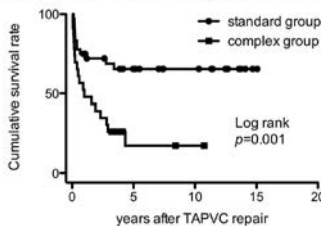
Purpose: Surgical results of functional single ventricle and total anomalous pulmonary venous connection (TAPVC) have been associated with high rates of mortality and morbidity. This group of patients often includes more complex anatomical features. We retrospectively reviewed our surgical experience and long-term outcomes after surgery.

Methods: Between 1998 and 2015, 59 patients with functional single ventricle and TAPVC underwent repair of TAPVC. The pulmonary venous connection was supracardiac in 37 patients, cardiac in six, infracardiac in 12, and mixed type in four. Heterotaxy was present in 43 patients. Major aortopulmonary collateral artery (MAPCA) was present in four patients, hypoplastic left heart syndrome (HLHS) or variant in seven, moderate or severe atrioventricular valve (AVVR) in 10, and non-confluent pulmonary artery in two. Patients with MAPCA, HLHS (variant), moderate or severe AVVR, or non-confluent pulmonary artery were defined as the complex group. The complex group was compared with other standard group.

Results: The median age and body weight at surgery were 39 days and 3.4 kg. Concomitant procedures included systemic-to-pulmonary artery shunt in 20, pulmonary artery banding in 13, bidirectional Glenn in nine, Norwood operation in five, repair of atrioventricular valve in nine, and other in five. Overall, 1-year and 5-year survival was 64% and 47%. Nine patients required reoperation for pulmonary vein stenosis. Twenty-three patients were included in complex group and 36 in standard group. Standard group and complex group survival curves were significantly different ($P = .001$). One-year and 5-year survival in standard group was 75% and 65%, respectively, and in complex group, it was 48% and 17%. In standard group, 20 patients (56%) completed Fontan, and in complex group, only two (9%). After Fontan, catheter study revealed central venous pressure 11 mm Hg \pm 3 mm Hg, oxygen saturation 94% \pm 2%, and two patients died, but all others were in New York Heart Association class II or less.

Conclusions: Without complex anatomy, functional single ventricle and TAPVC could reach good Fontan circulation. Association of MAPCA, HLHS (variant), moderate or severe AVVR, or non-confluent pulmonary artery was common, and this led to poor outcomes.

Comparison between standard group and complex group



P41

Mechanical Circulatory Support as Bridge to Transplantation for the Failing Single Ventricle Circulation

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COMMERCIAL RELATIONSHIPS J. Gaynor: Other/Provided slides for a presentation, SynCardia Systems

Purpose: Many patients with functional single ventricle physiology ultimately will develop circulatory failure necessitating cardiac transplantation. There is a growing interest in the use of mechanical circulatory support (MCS) in this population.

Methods: This is a retrospective case series of patients with functional single ventricle who underwent MCS with a ventricular assist device (VAD) or a total artificial heart (TAH) as a bridge to cardiac transplantation at a quaternary care pediatric hospital between January 2006 and December 2014. Baseline demographics, intraoperative data, and postoperative complications and outcome data were collected from the medical record.

Results: MCS was utilized in five patients. The mean age at MCS was 12 years ± 8 years and all patients were male (Table). Devices used were: HeartWare VAD (n=1), Syncardia TAH (n=1), Thoratec Paracorporeal VAD (n=1), and the Berlin Heart EXCOR (n=2). No patients were supported with extracorporeal membrane oxygenation preoperatively. There were two early deaths at 12 and 28 days after MCS, one due to multiorgan system failure and one due to neurologic injury. Overall, three patients (60%) suffered neurologic complications, and one patient (20%) required renal replacement therapy. Three patients (60%) underwent successful cardiac transplantation. The wait list time was 59 days and median duration of MCS prior to transplantation was 93 days. At the time of transplant, all three patients were ambulatory without need for mechanical ventilation and had complete resolution of end-organ dysfunction. All three transplanted patients were discharged from the hospital and are alive at an average follow-up of 9 months ± 14 months.

Conclusions: MCS can be successfully used as a bridge to transplantation in critically ill patients with a failing single ventricle circulation. Use of MCS can allow for resolution of end-organ dysfunction and rehabilitation prior to transplantation and may lead to improved outcomes in this difficult population.

Patient	Diagnosis	Reconstruction Stage	Age	Device	Pre-op ventilation (Y/N)	Pre-op Inotropes (Y/N)	End-organ dysfunction
1	Single ventricle	Fontan	18	HeartWare	Y	Y	Yes (renal)
2	PA/IVS	Fontan	5	Syncardia	Y	Y	Yes (renal, plastic bronchitis)
3	HLHS	Bidirectional Glenn	14	Berlin Heart	N	Y	No
4	Single Ventricle	Fontan	3	Berlin Heart	Y	Y	Yes (renal)
5	Single Ventricle	Fontan	23	Thoratec	N	Y	Yes (renal)

P42

Echocardiography Is Not a Consistent Predictor of Candidacy for Biventricular Repair in Patients With Borderline Left Heart Structures

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COMMERCIAL RELATIONSHIPS C. D. Fraser, Research Grant, Berlin Heart

Purpose: Surgical management of patients with borderline left heart structures remains controversial. Predictors of single ventricle palliation (SVP) or biventricular repair (BVR) have not been well defined. The purpose of this study was to evaluate echocardiographic measurements used to determine the feasibility of BVR in patients with borderline left heart structures.

Methods: Preoperative echocardiographic reports of all neonates surgically treated from 1995 to 2015 were reviewed to obtain mitral valve, aortic valve, and left ventricle end diastolic dimension (LVEDD) z-scores. Clinical consultation and multidisciplinary conference notes for patients who had at least two of the three measurements with z-score ≤ -2 were reviewed to include only patients in whom a decision between SVP and BVR was controversial. The ultimate decision was made by the surgeon after reviewing all the data or after performing an intracardiac exploration. Data were analyzed using chi square/Fisher's exact, Kruskal-Wallis, and Kaplan-Meier methods.

Results: The cohort included 47 patients: 10 (21%) underwent SVP and 37 (79%) BVR. Median follow-up time was 5 years (range: 5 months-18 years). Thirty-seven patients (79%) had a median sternotomy with intracardiac exploration; 10 patients with BVR had a coarctation repair via left thoracotomy as the initial procedure. Echocardiographic measurements are shown in the Table. There was no significant difference between patients with SVP and BVR, although mitral z-scores tended to be smaller on patients with SVP. There was one perioperative death in the BVR group after failure to wean from bypass and unsuccessful conversion to SVP a few days later. One patient from the SVP group was converted to BVR 4 months later. Four patients have died during follow-up, all in the first year. There was no significant difference in long-term survival between both groups (10-year survival: 100% for SVP, 89% for BVR, $P = .3$).

Conclusions: The feasibility of BVR in patients with borderline left heart structures should not rely strictly on echocardiographic measurements. Patients with low z-scores may undergo BVR with good outcomes. Intracardiac exploration can help guide the decision-making process in this patient population.

Table 1. Echocardiographic measurements at initial procedure.

Variable expressed in median (range)	Overall n=47	Single Ventricle n=10	Biventricular n=37	p-value
Mitral valve diameter (mm)	6.9 (4.6 – 9.6)	6.5 (4.6 – 7.8)	6.9 (5.4 – 9.6)	0.26
Mitral valve z-score	-2.8 (-4.3 – -0.4)	-3.0 (-4.3 – -2.4)	-2.6 (-4.3 – -0.4)	0.06
Aortic valve annulus diameter (mm)	4.9 (3.6 – 6.0)	4.8 (4.4 – 5.8)	4.9 (3.6 – 6.0)	0.87
Aortic valve annulus z-score	-2.4 (-4.7 – -0.6)	-2.5 (-3.9 – -1.5)	-2.4 (-4.7 – -0.6)	0.62
LVEDD* (mm)	14.1 (6.1 – 25.9)	14.1 (7.5 – 16.5)	14.1 (6.1 – 25.9)	0.46
LVEDD z-score	-2.4 (-8.5 – -0.4)	-4.3 (-8.5 – -2.4)	-3.7 (-8.2 – -0.4)	0.70

*LVEDD= Left ventricle end diastolic dimension

P43

Comparable Cerebral Blood Flow Velocities in Both Hemispheres With Regional Cerebral Perfusion During Infant Aortic Arch Surgery

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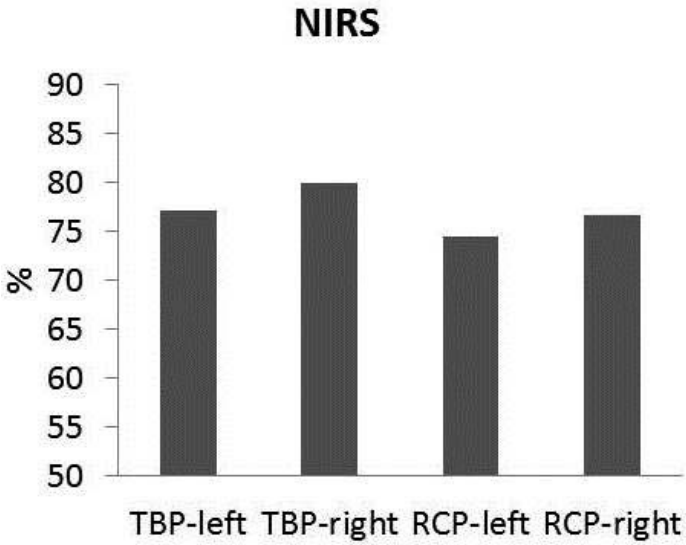
University Hospital Erlangen, Germany

Purpose: Cerebral protection during aortic arch surgery can be provided by regional cerebral perfusion (RCP) via the innominate artery. A homogenous distribution of cerebral perfusion during RCP is matter of discussion. This study hopes to determine whether blood flow velocities measured in intracranial vessels during RCP are comparable between both hemispheres.

Methods: Twelve infants underwent aortic arch repair from an anterior approach with RCP. Median age and weight were 10 days (range: 9-78) and 3.5 kg (range: 2.8-3.7), respectively. Intraoperatively, bilateral near infrared spectroscopy (NIRS) of both frontal lobes were assessed, and mean time average velocities (TAV) were measured with transfontanelar and transtemporal Pw-Doppler ultrasound in basilar artery (BA), left and right anterior cerebral artery (ACA), left and right medial cerebral artery (MCA), and left and right internal carotid artery (ICA). Measurements were performed at target temperature (28°C) during full-flow total body perfusion (TBF) and during RCP with a flow rate of 60 ml/kg/min.

Results: Comparison of TAV between left and right vessels within and between both groups showed no significant differences (Table). In both groups, mean NIRS levels between both hemispheres were comparable (TBP: 77% ± 10% vs 80% ± 7%, $P = .49$; RCP: 75% ± 6% vs 76% ± 7%, $P = .72$) (Figure).

Conclusions: There is no significant side-dependent difference between TAV in individual vessels of both hemispheres, regardless the type of selected perfusion method. Predisposing a constant vessel diameter at target temperature, RCP seems to enable a homogenous perfusion of both hemispheres.



		TBP (cm/s)	RCP (cm/s)	p
ACA	left	7.1 ± 5.6	6.2 ± 3.4	0.53
	right	6.9 ± 4.5	6.6 ± 3.4	0.32
	p	0.93	0.73	
MCA	left	6.8 ± 2.5	7.3 ± 6	0.9
	right	6.6 ± 1.9	8.0 ± 4.7	0.62
	p	0.82	0.75	
ICA	left	7.3 ± 8.5	9.6 ± 5.1	0.76
	right	13.7 ± 8	16.4 ± 13,8	0.68
	p	0.07	0.16	
BA		11.6 ± 9.8	11.5 ± 6.1	0.98

P44

Primary Cardiac Tumors in Infants and Children: Surgical Strategy and Long-Term Outcome

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Purpose: Primary cardiac tumors in infants and children are extremely rare; hence, there is very little literature available, and most knowledge is based on collections of case reports. This report is a comprehensive review of our 26-year experience with primary cardiac tumors in children with emphasis on surgical indications, strategies and

Methods: Between 1986 and 2012, 46 children (mean age 6.6 months ± 2.4 months, range: 1 day-17 years) underwent either subtotal or total resection of cardiac tumors (rhabdomyoma=13, fibroma=10, teratoma=9, myxoma=8, hemangioma=2, rhabdomyosarcoma=1, non-Hodgkin lymphoma=1, lymphangioma=1). The majority were diagnosed with echocardiography (n=33). Clinical patterns were varied: 40 had an atypical heart murmur and six were asymptomatic. Outflow tract obstruction of >30 mm Hg was present in 11 children. Three patients had abnormal coronary arteries secondary to pressure from tumor bulk. Indications of resection were hemodynamic/respiratory compromise, severe arrhythmia, and a significant embolization risk. Strategy of resection varied according to location and hemodynamic status without damage to adjacent structures.

Results: Morbidity included bleeding in one patient and a transient low output state in another. A 5-month-old with left ventricular fibroma underwent left ventricular assist device (LVAD) implantation secondary to failure from weaning off cardiopulmonary bypass, and she eventually underwent heart transplantation 17 days later. Early mortality included a 5-month-old who underwent complete resection of rhabdomyoma located in the left ventricle with concomitant pulmonary valve replacement; unfortunately, he underwent LVAD implantation for postoperative heart failure and died on the 13th postoperative day. An 8-month-old with 3x4 cm fibroma obstructing the right ventricular outflow tract compressing the right coronary artery died of severe right heart failure on the 13th postoperative day. A 16-year-old with non-Hodgkin lymphoma died 7 months after the surgery. Mean duration of follow-up is 11.6 years ± 3.5 years. All survivors (93.4%) are well, free of tumor-related symptoms and tumor recurrence/progression, even when resection was incomplete.

Conclusions: This study illustrates that although primary cardiac tumors in infants and children have a wide and unusual spectrum of clinical presentation, an individualized approach to tumor resection allows restoration of an adequate hemodynamic function and satisfactory long-term tumor-free outcome.

P45

Association of Nadir Oxygen Delivery on Cardiopulmonary Bypass With Glial Fibrillary Acid Protein in Pediatric Heart Surgery Patients

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COMMERCIAL RELATIONSHIPS A. D. Everett: Ownership Interest, ImmunArray Pvt Ltd

Purpose: Recent studies show that nadir oxygen delivery (DO₂) during cardiopulmonary bypass (CPB) may be associated with adverse outcomes after cardiac surgery, including acute kidney injury. We evaluated potential associations between nadir DO₂ during pediatric cardiac surgery and biomarker indices of inflammation (cytokines) or brain injury (glial fibrillary acidic protein [GFAP]).

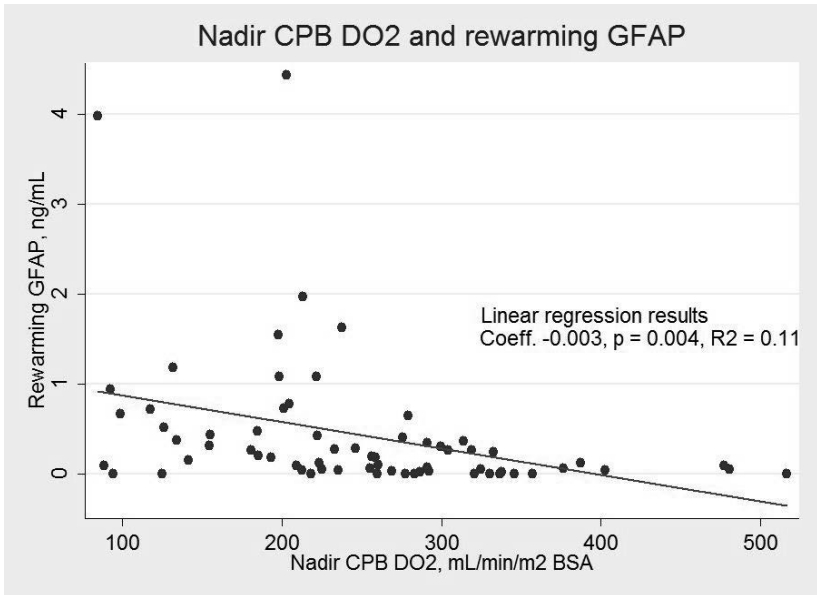
Methods: Blood samples were obtained during a prospective, single-center observational study of children undergoing congenital heart surgery with cardiopulmonary bypass (2010-2011). Remnant blood samples, collected serially prior to cannulation for bypass and until incision closure, were analyzed for cytokine and GFAP levels. Perfusion records were reviewed to calculate nadir DO₂ from pump flow, hemoglobin, arterial oxygen tension, and body surface area. Linear regression analysis was used to assess the association between nadir DO₂ and GFAP levels.

Results: Seventy-five consecutive children were included, with a median age of 0.75 years (IQR 0.42-8) and median weight of 8.3 kg (5.8-20). Single-ventricle anatomy was present in 19 patients (25.3%). Nadir DO₂ was significantly associated with GFAP values measured during both rewarming on CPB (coefficient -0.003, 95% CI -0.005 to -0.001, *P* = .004) and after decannulation (coefficient -0.0008, 95% CI -0.001 to -0.0001, *P* = .01). The cytokines IL-1, IL-6, IL-10, IL-12, interferon gamma, and tumor necrosis factor alpha were not associated with nadir DO₂ at any time point.

Conclusions: Lower nadir DO₂ is associated with increased GFAP levels, suggesting that diminished DO₂ during pediatric heart surgery may be a determinant of neurological injury. The DO₂-GFAP relationship may provide a useful measure for implementation and evaluation of strategies to optimize neuroprotection in pediatric heart surgery, including goal-directed perfusion.

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P46

Anatomical Predictor of Postoperative Compression of Pulmonary Artery After the Norwood Procedure Without Supplementary Material

S. Asada¹, M. Yamagishi¹, T. Miyazaki¹, Y. Maeda¹, N. Kato², H. Yaku¹

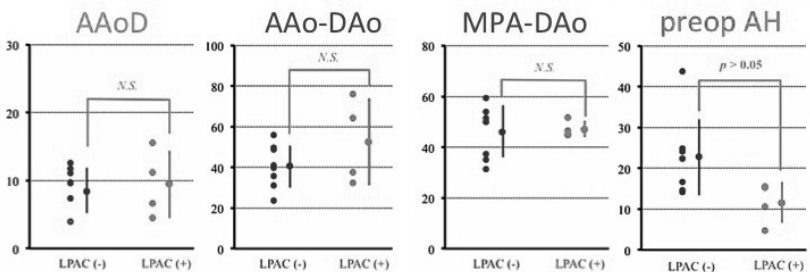
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Purpose: Because of the scarcity of homografts in Japan, we have reconstructed the aortic arch without supplementary materials to permit its growth. Narrowing of the aortopulmonary space and subsequent left pulmonary artery compression (LPAC) is a possible complication; therefore, we analyzed its relationship with the pre- and postoperative aortic arch configuration.

Methods: Pre- and postoperative computed tomography data were available in 12 patients (five hypoplastic left heart syndrome [HLHS] and seven HLHS variants, age: 7 days to 4 months, mean body weight: 3.4 kg) out of 20 patients who underwent the Norwood procedure from May 2004 to December 2012. Six patients underwent previous bilateral PA banding. The distance between ascending and descending aorta (AAo-DAo), distance between main PA and descending aorta (MPA-DAo), height from the carina to the inferior side of the aortic arch top (arch height; AH), and AAo diameter were measured and corrected for the square root of their body surface area [mm/ $\sqrt{m^2}$].

Results: Four patients had postoperative LPAC, and eight did not. The AAo diameter, AAo-DAo, and MPA-DAo in the two groups were not significantly different. The only statistically significant difference found between the group with LPAC and without LPAC was preoperative AH. Both pre- and postoperative AH were significantly smaller in the group with LPAC. Postoperative AH was smaller compared to the preoperative AH in both groups.

Conclusions: Anatomical characteristics of the aortic arch of HLHS considerably affect postoperative LPAC. The preoperative AH is a possible predictor of postoperative LPAC. Norwood procedure without supplementary material is valid for patients with large AH, whereas the use of patch supplementation or alternative surgical innovation should be considered for patients with short AH.



P47

Looks Do Matter! Aortic Arch Shape Following Hypoplastic Left Heart Syndrome Palliation Correlates With Cavopulmonary Physiology and Outcomes

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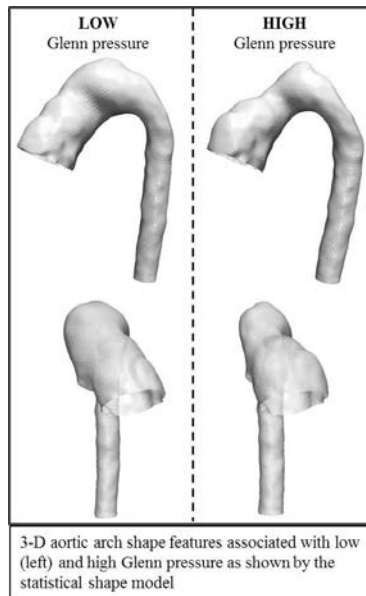
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Purpose: Aortic arch reconstruction required in hypoplastic left heart syndrome (HLHS) palliation can vary widely in shape and dimensions from patient to patient. Arch morphology alone may impact outcome. We sought to uncover the relationship of arch 3D shape features with functional and outcome data following cavopulmonary connection.

Methods: Aortic arch shape models of 40 patients with HLHS (age 3.05 years ± 1.02 years) were reconstructed from magnetic resonance data prior to Fontan procedure. A novel, validated statistical shape analysis method computed a 3D mean anatomic shape from the cohort and calculated the deformations (vectors) of this mean shape toward each patient's specific anatomy. From these deformations, 3D shape features most related to ventricular ejection fraction (EF) and indexed end-diastolic volume (iEDV) were extracted by partial least square regression analysis. Moreover, shape patterns relating to Glenn pressure and length of ICU stay following Fontan completion were assessed.

Results: See Table. There was no significant correlation between aortic arch shape features and EF. However, distinct deformations from the mean shape correlated with increased iEDV. In addition, high aortic arch dysmorphia correlated with higher Glenn pressure at the time of Fontan procedure (Figure) and longer stay in the ICU following Fontan completion.

Conclusions: Independent of hemodynamics and obstruction, aortic arch morphology in HLHS patients appears to have important associations with outcome markers of cavopulmonary circulation. This novel statistical shape analysis not only sheds light on a previously unknown aortic morphology/outcome relationship, but also can be an adjunct to risk assessment in HLHS palliation.



<i>Correlations</i>	3D shape features	
EF [%]	$\tau = 0.13$	$p = .286$
iEDV [ml/m²]	$r = 0.44$	$p = .009$
pGlenn [mmHg]	$r = 0.51$	$p = .005$
LICU [days]	$\tau = 0.37$	$p = .028$

EF = ejection fraction; iEDV = indexed end diastolic volume; pGlenn = Glenn pressure; LICU = length of stay in ICU post Fontan; r = Pearson's correlation coefficient; τ = Kendall's rank correlation coefficient; p = level of significance

P48

Tracheostomy Following Surgery for Congenital Heart Disease: Epidemiological Analysis Based on the STS Congenital Heart Surgery Database

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Purpose: Information concerning tracheostomy as a complication of surgery for congenital heart disease (CHD) has come primarily from single-center reports. We aimed to describe the epidemiology and outcomes associated with tracheostomy in a multi-institutional CHD registry.

Methods: The STS Congenital Heart Surgery Database (2000-2014) was queried for all index operations with the complication "postoperative tracheostomy" or "respiratory failure, requiring tracheostomy." Patients with preoperative tracheostomy or less than 2.5 kg undergoing isolated closure of patent ductus arteriosus were excluded. Trends in tracheostomy incidence over time were analyzed using a Cochran-Armitage test. Patient characteristics associated with operative mortality were analyzed from January 2010 to June 2014, which includes deaths occurring up to 6 months after transfer to other institutions.

Results: From 2000 to 2014, incidence of tracheostomy following surgery for CHD increased from 0.11% in 2000 to a high of 0.76% in 2012, $P < .0001$ (Figure). From 2010 to 2014, 648 patients underwent tracheostomy. Median age at CHD surgery was 2.5 months (25th, 75th percentile: 0.4-7). Prematurity (n=165, 26%), genetic abnormalities (n=298, 46%), and preoperative mechanical ventilation (n=275, 43%) were common. Additional postoperative complications also were common, including cardiac arrest (n=131, 20%), extracorporeal support (n=87, 13%), phrenic or laryngeal nerve injury (n=114, 18%), and neurological deficit (n=51, 8%). Operative mortality was 25% (n=153). Mortality among the 606 patients for whom operative mortality data were available at the time of query is outlined in the Table.

Conclusions: Tracheostomy as a complication of surgery for CHD remains rare but increasingly has been utilized over the past 15 years. This trend and the considerable mortality risk among patients requiring postoperative tracheostomy support the need for further research in this complex population.

Figure: Trend in Tracheostomy over Time, 2000-2014

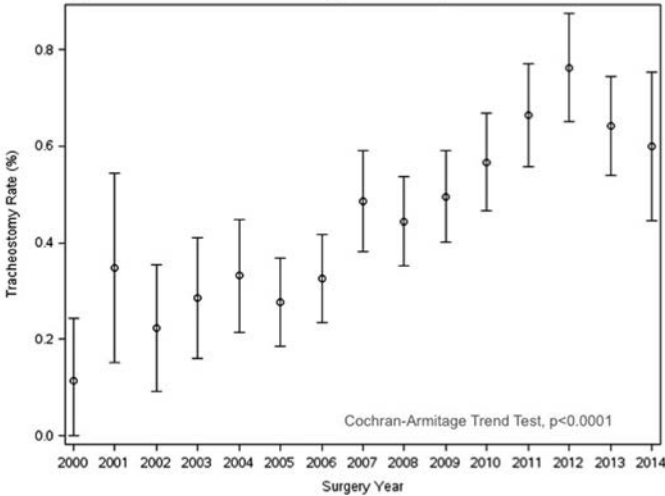


Table 1. Operative mortality for the 10 most common primary diagnoses & procedures

All Patients	Survived (n=453)	Died (n=153)
Primary Diagnosis		
Hypoplastic left heart syndrome	32 (56.1%)	25 (43.9%)
Other Single Ventricle Lesions	36 (73.5%)	13 (26.5%)
Atrioventricular septal defect, complete	34 (81.0%)	8 (19.0%)
Ventricular septal defect, Type 2	26 (92.9%)	2 (7.1%)
Patent ductus arteriosus	19 (76.0%)	6 (24.0%)
Pulmonary atresia, ventricular septal defect	13 (68.4%)	6 (31.6%)
Tetralogy of Fallot, absent pulmonary valve	12 (66.7%)	6 (33.3%)
Truncus arteriosus	15 (83.3%)	3 (16.7%)
Coarctation of aorta	14 (93.3%)	1 (6.7%)
Tetralogy of Fallot	12 (85.7%)	2 (14.3%)
Primary Procedure		
Norwood procedure	31 (67.4%)	15 (32.6%)
Pulmonary artery banding	23 (76.7%)	7 (23.3%)
Atrioventricular septal defect repair, complete	24 (82.8%)	5 (17.2%)
Atrial septal defect creation / enlargement	19 (67.9%)	9 (32.1%)
Ventricular septal defect repair, patch	24 (85.7%)	4 (14.3%)
Patent ductus arteriosus closure, surgical	19 (79.2%)	5 (20.8%)
Aortic arch repair	16 (84.2%)	3 (15.8%)
Transplant, Heart	14 (77.8%)	4 (22.2%)
Pulmonary atresia, reconstruction	13 (76.5%)	4 (23.5%)
Modified Blalock-Taussig Shunt	14 (82.4%)	3 (17.6%)

P49

Completeness and Reliability of Perioperative Variables in Local Clinical Registry Data vs Research Coordinator Chart Review for Children Undergoing Heart Surgery

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COMMERCIAL RELATIONSHIPS J. Gaynor: Other/Provided slides for a presentation, SynCardia Systems; O. J. White: Employment, CardioAccess, Inc

Purpose: Leveraging data captured in existing clinical registries may enhance research efficiency. However, the utility of registry data remains unclear. We evaluated completeness and reliability of perioperative data within congenital heart centers' local clinical registry data vs chart review by research coordinators.

Methods: Within 12 Pediatric Heart Network (PHN) centers, we evaluated 113 perioperative variables (demographics, preoperative data, diagnoses, procedures, operative data, and outcomes) collected via sites' local clinical registries for planned submission to the STS Congenital Heart Surgery Database using STS Harvest Compliant software vs chart review by sites' trained PHN research coordinators. Both used standard STS definitions. Data were collected on 10 consecutive subjects for two to five procedures/site, including the Norwood operation, arterial switch operation, tetralogy of Fallot repair, atrioventricular septal defect repair, and arch/ventricular septal defect repair. Analyses included comparison of missing data, agreement, and mismatches between the two data sources.

Results: We collected 56,500 data points on 500 subjects. Overall, 3.1% of data points were missing from the registry only, 0.6% from coordinator-collected data only, with 0.4% missing from both. The overall agreement between sources for non-missing data was 98% (Table). Mismatches were adjudicated by the study team, with coordinator-collected data correct in 53.7% and registry data correct in 46.3% of instances. Overall, 94.7% of data points were both available and reliable in the registry data; 94.8% in coordinator-collected data. There was some variation across variables with overall 97% of variables having <10% missing data in the registry and 81% with agreement of >97%. There also was variation across centers, with missing registry data ranging from 0.1% to 14.5% and agreement between data sources ranging from 96.8% to 99.1%.

Conclusions: We found 94.7% of perioperative data points were available and reliable in clinical registry data, with 98% agreement with coordinator-collected data. This suggests that registry data represent a readily available and reliable information source for congenital heart surgery studies, while indicating areas for improved data collection across variables and centers.

Measurement	Proportion (denominator includes all variables)	Proportion (denominator includes only non-missing pairs)
Agreement		
Agreement between coordinator and registry data	93.9% (53054/56500)	98.0% (53054/54161)
Mismatch		
Coordinator data correct	0.9% (521/56500)	1.0% (521/54161)
Registry data correct	0.8% (450/56500)	0.8% (450/54161)
Unable to adjudicate	0.2% (136/56500)	0.3% (136/54161)
Missing data		
Missing in coordinator data	0.6% (365/56500)	NA
Missing in registry data	3.1% (1729/56500)	NA
Missing in both	0.4% (245/56500)	NA

P50

The Impact of Frequency and Severity of Rejection Episodes After Heart Transplantation on Cardiac Growth in Children*E. B. Delmo Walter¹, B. Hartmann¹, A. Ekkernkamp¹, R. Hetzer²**¹Trauma Center Berlin, Germany, ²Herzzentrum Cottbus, Germany*

Purpose: Data addressing the adaptive growth and remodeling of transplanted hearts, as well as influence of size disparity of transplanted hearts on cardiac growth over time, in children have been published. This study evaluated the impact of frequency and severity of rejection episodes on growth of transplanted hearts in children.

Methods: Extensive review of medical and echocardiographic records of 179 children (mean age 8.65 years \pm 5.98 years, median 9, range 0-15) who underwent heart transplantation was performed. All patients had complete follow-up with echocardiographic series at different set time points. To demonstrate growth of the transplanted heart over time, only those \leq 13 years old at the time of transplantation were included with at least 5-year follow-up. Noninvasive rejection monitoring techniques, particularly the intramyocardial echocardiograph, were employed. Cardiac growth was measured by comparing donor cardiac dimensions (right and left ventricular end-diastolic dimensions, volumes, and mass) during transplantation to the recipient cardiac dimensions over time.

Results: The mean duration of follow-up was 13 years \pm 0.8 years (range: 5-22). 197 episodes of rejections (<1 year old=18; 1-2 years old=33; <2-5 years old=28; <5-10 years=36; and >10-13 years=39) occurred in 47 children. Rejection episodes occurred less frequently in infants and frequently in >10-13 years old. Severity of rejection was variable among the different age groups. Seventeen patients were three standard deviations below normal at early follow-up but were close to the normal range at late follow-up. These patients included seven infants who have shown delayed linear growth while still receiving steroids and nine children on high-dose immunosuppressants because of rejection episodes. Over time, the mean range in body surface area was 0.17 m² \pm 0.03 m² (range: 0.12-0.50). There was no significant difference ($P = .078$) in cardiac growth (z score 0.9-2-0) between those with rejection episodes, regardless of severity and frequency, and those who had not ($P = .035$).

Conclusions: This study indicates that despite frequency and severity of rejection episodes, the transplanted heart undergoes normal growth in diastolic dimensions, volume, and myocardial mass over time appropriate for somatic growth in children.

P51

In-Hospital Cardiac Arrest Following Pediatric Heart Operations of Varying Complexity: An Analysis of the Virtual Pediatric Systems Database

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COMMERCIAL RELATIONSHIPS T. B. Rice: Employment, VPS, LLC; M. C. Scanlon: Other, VPS, LLC

Purpose: Multicenter data regarding cardiac arrest in children undergoing heart operations of varying complexity are limited. We described epidemiology and outcomes associated with postoperative cardiac arrest after pediatric cardiac surgery among operations of varying complexity using the Virtual Pediatric Systems Database.

Methods: Children <18 years undergoing heart surgery (with or without cardiopulmonary bypass) in the Virtual Pediatric Systems Database (2009-2014) were included. Patients were grouped into two levels of complexity based on STS-EACTS Mortality Categories (Categories 1, 2, and 3 were classified as "low" complexity and Categories 4 and 5 classified as "high" complexity). The outcomes evaluated included odds of cardiac arrest, mortality after cardiac arrest, and good neurological outcomes after cardiac arrest. Multivariable mixed logistic regression models were adjusted for patient characteristics, preoperative risk factors, severity of illness, complexity and number of operations performed, and center volume.

Results: Overall, 27,756 patients (64 centers) were included, and 3% (n=689) had one or more postoperative cardiac arrests. By univariate analysis, cardiac arrest rate was higher with younger age, lower weight, presence of preoperative morbidities, higher severity of illness, and patients with single ventricle anatomy. The prevalence of cardiac arrest was lower among patients undergoing low complexity operations (low complexity vs high complexity: 2% vs 5%). Unadjusted mortality and good neurological outcomes after cardiac arrest were significantly better among patients undergoing low complexity operations (20% vs 37% and 75% vs 68%, respectively). After adjusting for patient and center characteristics, odds of cardiac arrest was significantly lower among patients undergoing low complexity operations (OR 0.75, 95% CI 0.62-0.92). Regardless of the complexity of operations performed, there was no difference in mortality or good neurological outcomes after cardiac arrest (OR 0.85, 95% CI 0.51-1.43 and OR 3.46, 95% CI 0.77-15.5, respectively).

Conclusions: This multicenter study demonstrates that prevalence of postoperative cardiac arrest increases with increasing case complexity. However, the risk of mortality and good neurological outcomes after cardiac arrest remain similar, regardless of level of complexity of operation performed. Further study to evaluate this relationship is needed.

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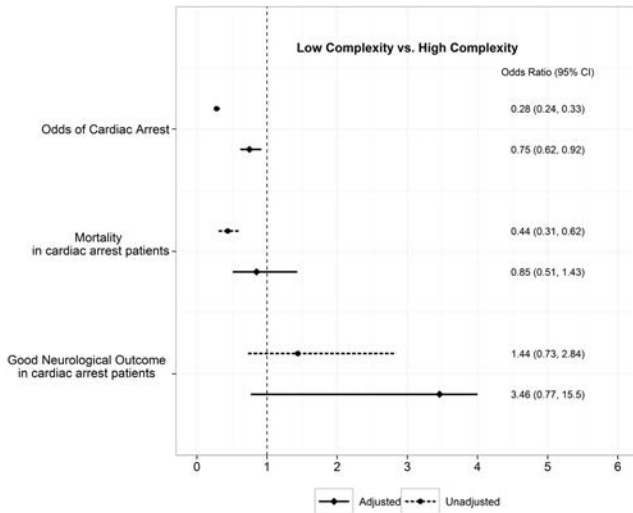


Table. Characteristics of Study Patients across Operations of Varying Complexity

	All Patients	Low Complexity Operations	High Complexity Operations
Number of operations	27,756	20,726	7,030
Number of centers	64	62	58
Range of center-specific sample size	1-713	1-1481	1-561
Overall mortality	756 (2.7%)	246 (1.2%)	500 (7.1%)
Range of center-specific mortality in all patients	0%-100%	0%-11.1%	0%-100%
Overall good neurological outcomes	10,665/10,919 (97.7%)	8,072/8,167 (98.8%)	2,593/2,752 (94.2%)
Range of center-specific good neurological outcomes in all patients	0%-100%	96%-100%	0%-100%
Number of cardiac arrest	689 (2.4%)	318 (1.5%)	371 (5.3%)
Range of center-specific rate of cardiac arrest	0%-50%	0%-25%	0%-15.9%
Mortality in those with cardiac arrest	202 (29.3%)	65 (20.4%)	137 (36.9%)
Range of center-specific mortality in those with cardiac arrest	0%-100%	0%-100%	0%-100%
Good neurological outcomes in those with cardiac arrest	119/166 (71.9%)	64/85 (75.3%)	55/81 (67.9%)
Range of center-specific good neurological outcomes in those with cardiac arrest	0%-100%	44%-100%	0%-100%
Unadjusted		OR (95% CI)	
Cardiac arrest rate	N/A	0.28 (0.24-0.33)	Reference
Mortality after cardiac arrest	N/A	0.44 (0.31-0.62)	Reference
Good neurological outcomes after cardiac arrest	N/A	1.44 (0.73-2.84)	Reference
Adjusted		OR (95% CI)	
Cardiac arrest rate	N/A	0.75 (0.62-0.92)	Reference
Mortality after cardiac arrest	N/A	0.85 (0.51-1.43)	Reference
Good neurological outcomes after cardiac arrest	N/A	3.46 (0.77-15.5)	Reference

P52

Achievements and Limitations of a Strategy of Rehabilitation of the Native Pulmonary Vessels in Pulmonary Atresia, Ventricular Septal Defect, and Major Aortopulmonary Collateral Arteries

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COMMERCIAL RELATIONSHIPS C. P. Brizard: Consultant/Advisory Board, Admedus; Ownership Interest, Admedus; Y. d'Udekem: Consultant/Advisory Board, Medical Specialties Distributors

Purpose: A strategy of rehabilitation for pulmonary atresia (PA), ventricular septal defect (VSD), and major aortopulmonary collateral arteries (MAPCAs) comprises repetitive shunting and patching procedures of the central pulmonary arteries. We wanted to determine the feasibility and limitations of a strategy of rehabilitation in terms of mortality, repair and failure rates, and right ventricular pressures late after repair.

Methods: The records of 39 consecutive patients operated for PA-VSD-MAPCAs from June 2003 to December 2014 were reviewed. Four patients underwent a single-stage repair with unifocalization. The study focused on the 35 patients who entered a rehabilitation strategy. The median age was 3.8 weeks (range: 0.4-526) at the first procedure. The outcomes (mortality and repair rate) were reviewed, as well as the number and types of rehabilitation procedures before repair (shunts, right ventricle-PA conduit, other) and additional procedures associated to a strategy of rehabilitation (pulmonary arteries reconstruction, MAPCAs ligation, connection of intrapulmonary vessels dependent of MAPCAs).

Results: Thirty-five patients in the rehabilitation strategy had 2.03 ± 0.87 procedures before complete repair. Median age at the time of last follow-up was 6.6 years (range: 0.3-18.7). Overall repair rate was 83%. Repair rate in the 35 patients who underwent a rehabilitation strategy was 75% (24 patients). Failure occurred in two patients (6%) who underwent unifocalization later, and death occurred in three patients (9%). Three patients (9%) were left palliated, and three are still awaiting repair. Additional procedures to the rehabilitation strategy consisted in pulmonary arteries reconstruction in 27 patients (77%), MAPCAs ligation in seven (20%), connection of intrapulmonary branch artery in four (11%), and pulmonary balloon angioplasty in 13 (37%). Post-repair catheter in rehabilitation patients at 30.4 months showed median right ventricle/left ventricle (LV) pressures of 0.65 (range: 0.48-1.05) and median main PA/LV pressures of 0.54 (range: 0.46-0.81).

Conclusions: A strategy of rehabilitation of the native pulmonary vessels can be implemented in 90% of the cases with low mortality. Following a strategy of rehabilitation, three-quarters of the patients can be repaired successfully. Unifocalization strategy remains useful in some patients born with large intrapulmonary vessels and heart failure.

P53

Regionalization of Pediatric Cardiac Surgery Lowers 5-Year Mortality and Freedom From Reoperation Following the Arterial Switch Operation

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Purpose: The mortality of neonates requiring the arterial switch operation has been linked to center and surgeon volume. We hypothesized that the regionalization of pediatric cardiac surgical care from three medical centers would lower the operative mortality, as well as 5-year mortality and freedom from reoperation.

Methods: Neonates requiring the arterial switch operation from 1994 to 2008 were collected from the state department of health database. Patients were divided into two groups: pre-regionalization, when the arterial switch operation was performed in three separate hospitals from three separate cities (1994-2000), and post-regionalization, when operations were transitioned from two hospitals to one regional center (2001-2008). Operative survival, 5-year mortality, and reoperation were compared between the groups.

Results: Of 141 neonates, 64 were repaired at three separate hospitals in the pre-regionalization group. Seventy-seven underwent repair in the post-regionalization era. There were no significant differences in preoperative age, weight, or gender between groups (Table). Pre-regionalization operative survival was lower than the state average. Post-regionalization operative survival was significantly greater than pre-regionalization and higher than the state average (Figure). Five-year survival (96.9% vs 77.2%; OR 4.6, $P = .01$) and freedom from reoperation (90.0% vs 77.2%; OR 2.8, $P = .04$), remained significantly greater in the post-regionalization vs pre-regionalization group.

Conclusions: This demonstrates that regionalization of pediatric cardiac surgical care lowers the operative and 5-year mortality, as well as rate of reoperation, following the arterial switch procedure.

Figure 1

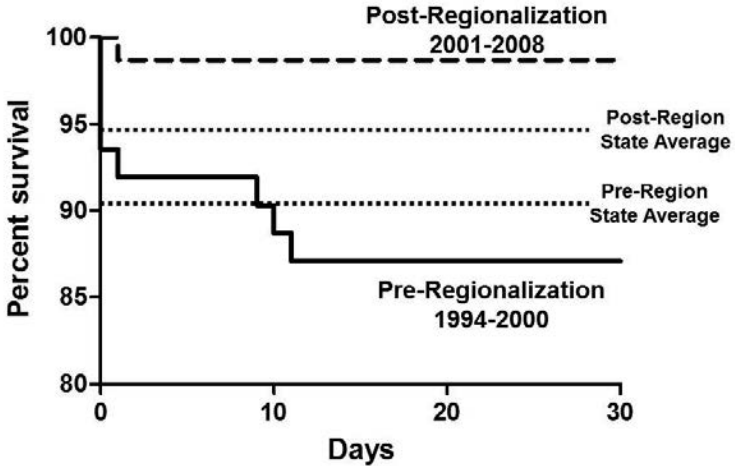


Table 1. Peri-operative Demographics

	Pre-Regionalization (n=64)	Post-Regionalization (n=77)	p value
Age (Days)	12.2 ± 17.8	12.3 ± 25.5	0.9
Male Gender	54.6% (35)	63.1 (48)	
Weight (kg)	3.4 ± 0.8	3.3 ± 1.1	0.7
Diagnosis			
Simple TGA	53.1% (34)	61.0% (47)	0.4
TGA + VSD	34.4% (22)	23.4% (18)	0.2
TGA + CoA	0	5.3% (4)	0.1
TGA +VSD+COA	12.5% (8)	10.3% (8)	0.8
Hospital LOS	16.8 ± 17.2	18.3 ± 22.3	0.7

Abbreviations: TGA-Transposition of the Great Arteries, VSD-Ventricular Septal Defect, CoA-Coarctation of the Aorta, LOS-Length of Stay.

P54

Long-Term Surgical and Non-Surgical Outcomes of Patients With Ebstein's Anomaly: A Single-Institution Clinical Series

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Purpose: The objective of this study was to review the long-term surgical (S-EA) and non-surgical (NS-EA) outcomes of patients with Ebstein's anomaly (EA) followed at our center.

Methods: The medical records of 145 patients with a diagnosis of EA admitted to our institution between 1980 and 2014 were reviewed. Carpentier and Glasgow Outcome Scale (GOSE) scores were used to classify the severity of the Ebstein's anomaly prior to S-EA and at the last follow-up. Outcomes included survival, need for surgical intervention, degree of tricuspid valve regurgitation (TVR), and patient functional status as measured by the New York Heart Association classification.

Results: No S-EA was required in 91 patients. Fifty-four patients had S-EA. Age at initial S-EA was <1 month, 1-12 months, and >1 year in 12, four, and 38 patients, respectively. Tricuspid repair or replacement occurred in 24 and 18 patients, respectively. Twenty-one (39%) required intervention for pulmonary stenosis or atresia. Twelve had palliative procedures. Early and late mortality (all neonates and infants) for the S-EA was seven and five, respectively. The mean follow-up for the 54 S-EA patients was 8 years (range: 1 month–27 years). In 33/54 S-EA patients for whom pre-surgical echocardiograms (ECHOs) were available, two, 11, nine, and 11 patients had Carpentier grades A, B, C, and D, respectively. The mean pre- and post-surgical GOSE score was 1.26 and 0.62. In 42/54 patients with good postoperative ECHOs, 29, 10, three, and 0 had Carpentier grades A, B, C, and D, respectively. The 5-year survival was 99%, 71%, and 80% in the NS-EA, palliated group, and S-EA groups, respectively. Seventeen S-EA patients (36%) have required reintervention, with only 10 (21%) requiring tricuspid valve reintervention.

Conclusions: Milder forms of EA can be managed medically. Symptomatic infants may require neonatal palliation and/or S-EA. Tricuspid valve repair/replacement has been necessary in only 37% of 145 patients. Mortality is highest among neonates and patients with concurrent pulmonary stenosis/atresia. Life-long follow-up is required for this unusual cardiac anomaly.

P55

Antibody-Mediated Rejection After Pediatric Heart Transplant Is Associated With Differential Endothelial Cell Activation and Matrix Metalloproteinase Expression

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Purpose: Antibody-mediated rejection (AMR) is associated with decreased allograft survival. AMR is a consequence of B cell activation, which subsequently results in vascular endothelial cell activation and perturbation of the extracellular matrix. Identification of associated biomarkers could provide an earlier, less invasive diagnosis of AMR.

Methods: A retrospective analysis was performed of pediatric heart transplant recipients between February 2007 and April 2013. Posttransplant endomyocardial biopsies were analyzed for the presence of AMR. AMR was defined as ISHLT pAMR ≥2. Serum was analyzed for matrix metalloproteinases (MMPs), tissue inhibitors of matrix metalloproteinases (TIMPs), epidermal growth factor (EGF), granulocyte colony-stimulating factor (GCSF), interferons, interleukins 1, 2, 6, 8, 10, and TNF α. Nonparametric statistics were used to compare the two groups. Repeated measures ANOVA was performed for patients with both pre- and posttransplant samples. Data are presented as median and interquartile range.

Results: There were 23 serum samples in 12 recipients who had both serum and biopsies available for analysis. AMR occurred in four patients. There were significant differences in serum biomarker levels between AMR and No AMR patients both pre- and posttransplant (Table). Seven patients had both pre- and posttransplant (paired) serum samples (AMR=3). Among the patients with paired samples, the AMR group demonstrated an increased posttransplant expression of MMP-7 (3,522 [2,315-5,981] vs 12,410 [7,782-17,037], *P* = .04) and EGF (444 [328-551] vs 979 [951-1,008], *P* < .01), while the No AMR group showed no significant differences.

Conclusions: Pediatric heart transplant recipients with AMR had a characteristic biomarker profile pretransplant and demonstrated a significantly increased postoperative expression of EGF and MMP 7. Early identification of a cohort susceptible to AMR could aid in the early diagnosis and treatment of AMR, which would help develop targeted therapy for cardiac allograft failure.

Table 1: Biomarker expression in AMR

Analytes (pg/ml)	No AMR	AMR	p-value
Pre-Transplant			
MMP-8	32978 (20536-53268)	3725 (2608-11796)	0.01
MMP-9	375819 (189683-657556)	93794 (68215-167227)	0.03
EGF	610 (396-674)	84 (57-159)	<0.01
GCSF	192 (95-271)	46 (26-68)	0.02
IL-8	754 (290-1712)	23 (13-68)	0.03
Post-Transplant			
MMP-2	170149 (23856-248423)	632354 (444426-829745)	0.05

P56

Mid-Term Outcomes of Patients With 16 mm Polytetrafluoroethylene Conduit After an Extracardiac Fontan Procedure*W. Kim¹, S. Cho², K. Hyun¹, J. Park¹, E. Choi³**¹Seoul National University Children's Hospital, South Korea, ²Seoul National University Hospital, South Korea, ³Sejong General Hospital, Bucheon, Gyeonggi-Do, South Korea*

Purpose: Selection of an optimally sized conduit for extracardiac Fontan procedure is an important issue. The large conduit is difficult to use technically in small patients and also is hemodynamically undesirable. The purpose of this study was to evaluate the outcome of patients with 16 mm polytetrafluoroethylene (PTFE) conduits after Fontan procedure.

Methods: We have implanted 16 mm PTFE conduits to indicated patients who had low body weight and not enough pericardial space to implant large conduits. We considered 16 mm PTFE conduit implantation when pulmonary artery size was small, regarding hemodynamics. Between June 1997 and May 2015, 66 patients (mean age 2.9 years \pm 1.2 years) underwent extracardiac Fontan procedure with 16 mm PTFE graft. The mean body weight at operation was 12.9 kg \pm 2.3 kg. Twenty-two patients (33.3%) showed heterotaxy, and fenestration was created in 25 patients (37.5%).

Results: Mean follow-up duration was 7.1 years \pm 6.1 years. There was no mortality. Other late-occurring morbidities included protein-losing enteropathy in two, liver cirrhosis in three, and thromboembolism in three patients. One patient underwent atrioventricular valve repair at 16 years postoperatively, and conduit change was performed simultaneously. There was no conduit-related reoperation or reintervention. The Kaplan-Meier estimate for freedom from reoperation was 93.5% \pm 3.7% at 10 years. The freedom from catheter-based intervention was 92.1% \pm 3.8% at 10 years.

Conclusions: The mid-term outcomes of patients with 16 mm PTFE conduits after Fontan procedure were excellent, with no mortality and low morbidity rates. The 16 mm PTFE conduit is feasible and useful in indicated patients at Fontan procedure.

P57

Impact of Prematurity on Clinical Outcomes in Infants With Hypoplastic Left Heart Syndrome

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COMMERCIAL RELATIONSHIPS G. S. Van Arsdell: Ownership Interest, Cell Aegis Devices

Purpose: Prematurity remains a significant risk factor for patients with hypoplastic left heart syndrome (HLHS). We hypothesized that our current strategy can achieve equal results in preterm compared to term neonates.

Methods: Patients (n=110) with HLHS undergoing staged repair between 2007 and 2014 were analyzed. Those with hybrid palliation for primary transplant were excluded. Eighteen patients (17.8%) were born prematurely (median 36 weeks, IQR 35-37) and 83 (82.2%) at term. Median follow-up was 1.48 years (IQR 0.44–3.64). Fifty-two patients (51.5%) underwent Norwood palliation at stage I, 49 patients (48.5%) were palliated with a hybrid approach (nine [18.4%] as a salvage procedure). Mean age at operation was 7.61 days \pm 8.02 days for term and 8.86 days \pm 6.08 days for preterm patients ($P = .527$). Operative and clinical data, as well as Pediatric Cerebral Performance Category (PCPC), were collected and analyzed.

Results: Corrected age (pppp=.441/.808;p=.123/.079). The rate of patients proceeding to subsequent palliation was equal for stage II (47 [56.6%] vs 10 [55.6%]; $P = .934$) and Fontan completion (21 [44.7%] vs four [40.0%]; $P = .786$). Term patients had worse atrioventricular valve regurgitation prior to stage I ($P = .031$), but not during follow-up. One-year survival was comparable between the groups (preterm, 55.2% vs term, 66.7%, $P = .7$). Survival was equal between groups with Norwood palliation ($P = .336$), but there was a trend toward worse survival in preterm infants after hybrid palliation ($P = .095$). Within the preterm group, hybrid palliation showed a trend to worse survival as compared to Norwood palliation ($P = .076$). Exclusion of patients with salvage hybrid revealed worse survival in preterms with hybrid palliation compared to terms ($P = .014$) and worse survival of preterm hybrids compared to preterm Norwoods ($P = .035$). There were 15 in-hospital deaths (14.9%) following stage I. Interstage (I to II) mortality after discharge was 16 (18.6%). There was no difference in PCPC.

Conclusions: Prematurity in general does not impact survival, progression to subsequent palliation, and mid-term PCPC in HLHS. The worse outcomes of preterm patients undergoing hybrid palliation partly could be due to patient selection, and the result should be interpreted carefully.

P58

Early Extubation Within 6 Hours Should Be Standard Practice Following Primary Repair For Tetralogy of Fallot

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Purpose: It has been postulated that early extubation (EE) of children undergoing tetralogy of Fallot repair (TOF) reduces intensive care unit (ICUs) and hospital stay (HS). Our aim is to prove that EE following TOF repair is safe, feasible, and associated with reduced morbidity and mortality.

Methods: This is a retrospective review of all children who underwent TOF repair in our institute between January 2012 and December 2014 as compared to a historical group operated on between January 2006 and December 2009. Data for each group regarding demographics, time to extubation, complications including need for reintubation, chest drain insertion, or renal support, and time of discharge from PICU and hospital were collected by reviewing case notes, ICU charts, and surgical and PICAnet databases. Results are presented in the Table.

Results: Over the years, the practice of EE increased (58.9% vs 28.8%), extubation in theater in particular. In Group A, in those extubated early fewer patients required reintubation (9/85, 10.65%) or chest drain reinsertion (5/85, 5.9%) compared with Group B (reintubation 15/80, 18.8%; chest drain reinsertion 27/80, 33.8%). Comparison between the two groups shows that we are operating on younger patients: Group A: 8.4 months (5.9-11.7), Group B: 13.2 months (10-22.4). Modification of surgical technique reduced the bypass and cross clamp time. In Group A, the normothermic strategy to run the cardiopulmonary bypass was adopted, and in addition, there was a higher threshold for blood transfusion. In both groups, patients who underwent EE had fewer complications compared with patients who underwent late extubation (>6-24 hours) or a delayed extubation (>24 hours). Patients who were extubated early have reduced ICUs and HS. This would suggest that EE does not adversely impact morbidity and mortality following surgery.

Conclusions: Early extubation is safe and feasible following TOF repair. The rate of early extubation has increased over the years, in particular the extubation in theater. There are fewer complications in patients undergoing early extubation. The length of stay in ICU and hospital is less following early extubation.

Groups: (Total number of patients)	PICU stay days median, range (-), and interquartile range (-)	Hospital stay days median, range (-), and interquartile range (-)	Re intubation episode (%)	Chest drain insertion episode (%)
Early extubated (<=6hrs) (68)	1 (1-9){1-2.5}	7 (4-24){6-10}	6 (8.8%)	4 (5.9%)
Late extubated (>6 -24 hrs) (49)	2 (1-39){1-4}	9 (5-132){7-13}	12 (24.5%)	11 (22.4%)
Delayed extubated (>24hrs) (48)	4 (1-82){2.25-9}	12.5 (4-311){9-23.25}	6 (12.5%)	17 (35.4%)

Table n°1

P59

Novel Modifications of a Ventricular Assist Device for Infants and Children

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Purpose: We modified a continuous-flow "adult" ventricular assist device (VAD) to support infants and children waiting for heart transplantation and report our outcomes. Components for VAD setup (cannulas, grafts, and connectors) are readily available in any cardiac operating room.

Methods: A commercially available centrifugal VAD was used to bridge pediatric patients to heart transplantation. The device is designed to flow from 1.5 to 8 L/min. In smaller children and infants, a modified recirculation shunt was added to permit lower flow ranges (down to 700 cc/min). In hypoxic patients, an oxygenator was spliced into the circuit.

Results: From 2010 to 2014, the VAD was placed in 11 consecutive patients. Age ranged from 0.9 to 16 years (median 7 years). Body surface area ranged from 0.4 to 2.1 m² (median 0.9 m²). Seven patients were less than 1.0 m². Four patients were on extracorporeal membrane oxygenation prior to VAD and two had single ventricle/Glenn physiology. Three patients had a recirculation shunt, and three had use of an oxygenator. Median time on the VAD was 11 days (range: 2-79). In patients with a recirculation shunt, mean patient flow was 1.3 L/min and mean shunt flow was 2.0 L/min. All patients were transplanted, survived, and discharged at a median of 26 days (range: 17-83) posttransplantation. There were no infections. There was one cerebrovascular accident. Wait list mortality dropped from 10% (5/52) in 2007-2010 to 3% (2/68) in 2011-2014 ($P = .24$). VAD mortality dropped from 33% (3/9) to 0% (0/11) ($P = .07$).

Conclusions: The centrifugal VAD successfully supported pediatric patients awaiting heart transplantation. The modified recirculation shunt allows patient flows as low as 700 mL/min. The design facilitates placement of an in-line oxygenator. Compared to traditional pulsatile devices, use of this VAD was associated with a trend toward decreased waitlist and VAD mortality.

CRITICAL CARE

P60

Temperature Management After Aortic Arch Surgery With Deep Hypothermic Circulatory Arrest Affects Survival and Neurologic Outcome*A. Rungtatscher¹, G. B. Luciani², D. Linardi¹, E. Milani¹, L. Gottin¹, B. H. Walpoth², G. Faggian³**¹University of Verona, Italy, ²Geneva University Hospital, Switzerland, ³University of Verona Medical School, Italy*

Purpose: International guidelines recommend therapeutic hypothermia after cardiocirculatory arrest. However, the effects of different temperature management during the first 24 hours after deep hypothermic circulatory arrest (DHCA) for aortic arch surgery on survival and neurologic outcome are undefined.

Methods: From 2010 to 2014, a total of 210 consecutive patients undergoing aortic arch surgery with DHCA were included. They were divided retrospectively into three groups by median peak nasopharyngeal temperature within 24 hours after rewarming: hypothermia (<36°C; n=65), normothermia (36°C-37°C; n=110), and hyperpyrexia (>37°C; n=35). Multivariate stepwise logistic and linear regressions were performed to determine whether different temperature independently predicted 30-day mortality, stroke incidence, and neurologic outcome assessed by Cerebral Performance Category (CPC) at hospital discharge.

Results: Compared with hypothermia and normothermia, fever was associated independently with a higher risk of 30-day mortality (35.7% vs 6.5%; OR 9.4; 95% CI 1.1-81.6; $P = .005$), stroke incidence (64.3% vs 13.3%; OR 9.3; 95% CI 2.9-92.3; $P = .002$), and poor neurologic outcome (CPC 3-5) (85.7% vs 36.9%; OR 4.5; 95% CI 0.9-87.6; $P = .01$). No significant difference was demonstrated between hypothermia and normothermia.

Conclusions: Postoperative hypothermia is not associated with better outcome after aortic arch surgery with DHCA. However, postoperative fever (>37°C) is associated with high stroke incidence, poor neurologic outcome, and increased 30-day mortality. Target temperature management in the first 24 hours after surgery should be evaluated in prospective randomized trials.

P61

Rescue Therapy With High Frequency Percussive Ventilation in Patients With Hypoxemia Refractory to Conventional Ventilation After Cardiac Surgery

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Purpose: Respiratory failure after cardiac surgery significantly reduces survival. In patients who fail conventional ventilation, prognosis is dismal, with extracorporeal membrane oxygenation (ECMO) frequently utilized as a salvage therapy. We describe our experience with high-frequency percussive ventilation (HFPV) as a rescue therapy for hypoxemia refractory to conventional ventilation after cardiac surgery.

Methods: In a 5-year retrospective analysis, we identified 16 subjects who required HFPV postoperatively after cardiac surgery. Primary endpoint data collected included pre- and post-HFPV partial pressures of oxygen (pO₂). Secondary endpoints collected were age, type of cardiac surgery, length of time on HFPV, and postoperative outcomes.

Results: Sixteen patients undergoing cardiac surgery required HFPV postoperatively due to hypoxemic respiratory failure refractory to conventional mechanical ventilation. Surgical procedures included coronary artery bypass grafting (n=8), valve repair/replacement (n=2), aortic aneurysm/dissection repair (n= 5), and atrial septal defect closure (n=1). Mean pO₂ increased 3.5-fold 2 hours after initiation of HFPV (55 mm Hg vs 234 mm Hg; P < .01). The improvement was durable at 24 hours whether or not the patient was returned back to conventional ventilation or remained on HFPV (55 mm Hg vs 112 mm Hg; P < .01). The mean age of subjects was 65 and mean time on HFPV was 4 days. Survival was 75%.

Conclusions: The literature is limited with regard to the utilization of HFPV after cardiac surgery. We achieved a 75% survival rate in a cohort of critically ill patients and obviated the need for ECMO. Although further studies are warranted, HFPV should be considered in cardiac surgical patients failing conventional ventilation.

Operation	Pre-HFPV pO2	2 Hours Post-HFPV pO2	24 Hours post HFPV pO2	Expired?
Aortic valve repair	-	566	102	no
Aortic aneurym repair	58	152	83	no
CABG	64	354	92	no
CABG	-	227	85	yes
ASD closure, pericardial patch and maze procedure	-	414	163	no
CABG	63	432	137	no
Aortic aneurym repair	60	441	88	no
CABG	33	77	104	yes
MVR tissue valve with TV repair	-	249	144	no
LM dissection/CABG	28	158	55	yes
Aortic aneurym repair	70	112	113	no
CABG	60	64	121	no
Aortic dissection repair	56	195	107	no
CABG	70	108	96	no
Aortic dissection repair	34	112	102	yes
CABG	61	85	195	no

Abbreviations: CABG: coronary artery bypass graft; ASD: atrial septal defect; MVR: mitral valve replacement; TV: tricuspid valve; LM: left main; ECMO: extracorporeal membrane oxygenation; HFPV: high frequency percussive ventilation; pO2: partial pressure of oxygen

P62

Postoperative Hypoglycemia Is Associated With Worse Outcomes After Cardiac Surgery

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COMMERCIAL RELATIONSHIPS G. Ailawadi: Consultant/Advisory Board, Edwards Lifesciences Corporation, Abbott Vascular; Nonremunerative Position of Influence, AtriCure, Inc; Speakers Bureau/Honoraria, St Jude Medical; A. McCall: Consultant/Advisory Board, Pfizer, Inc, Sanofi; Research Grant, Sanofi, Eli Lilly and Company

Purpose: Hypoglycemia is a known risk of intensive postoperative glucose control in cardiac surgery patients. However, neither the consequences of hypoglycemia relative to hyperglycemia, nor the possible interaction effects, have been well described. We examined the effects of postoperative hypoglycemia, hyperglycemia, and their interaction on short-term morbidity and mortality.

Methods: Single-institution STS National Database patient records from 2010 to 2014 were merged with clinical data, including blood glucose values measured in the intensive care unit (ICU). Exclusion criteria included fewer than three glucose measurements and absence of an STS predicted risk of morbidity or mortality score. Primary outcomes were operative mortality and composite major morbidity (permanent stroke, renal failure, prolonged ventilation, pneumonia, or myocardial infarction). Secondary outcomes included ICU and postoperative length of stay. Hypoglycemia was defined as <70 mg/dL and hyperglycemia as >180 mg/dL. Simple and multivariable regression models were used to evaluate outcomes.

Results: A total of 2,265 patient records met selection criteria for analysis. The mean postoperative glucose was 140.8 mg/dL ± 18.8 mg/dL. Overall, 24% of patients experienced a hypoglycemic episode (n=546), and 1.24% (n=28) had a severe hypoglycemic episode (<40 mg/dL). The unadjusted odds ratio (UOR) for operative mortality for patients with any hypoglycemic episode compared to those without was 4.64 (95% CI 2.66-8.09), and the UOR for major morbidity was 4.20 (95% CI 3.20-5.51). After adjustment for age, gender, diabetes, mean glucose, predicted risk of morbidity or mortality, dialysis, operative urgency, procedure type, and year, the adjusted odds (AOR) of operative mortality are significant for patients with any hypoglycemia (AOR 3.68, 95% CI 2.00-6.76) and patients with both events (AOR 9.80, 95% CI 1.23-77.8), but not hyperglycemia alone (AOR 2.25, 95% CI 0.51-10.0). The AOR of major morbidity for patients with both events is 16.9 (95% CI 5.89-48.3). Secondary outcomes are presented in the Table.

Conclusions: Postoperative hypoglycemia is associated with both mortality and major morbidity after cardiac surgery. The combination of both hyperglycemia and hypoglycemia may represent a substantial increase in risk. It remains unclear whether hypoglycemia is a cause or a result of poor outcomes, but this is a promising area for future research.

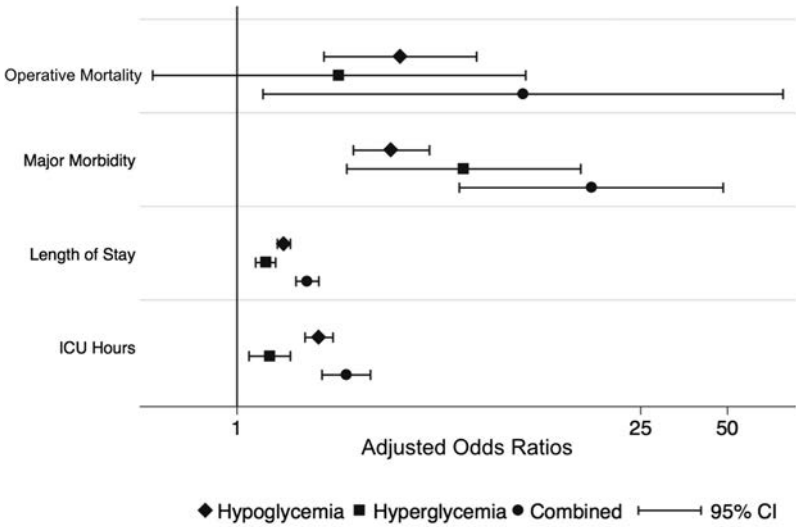


Table 1: Logistic & Negative Binomial Regression

	Unadjusted Odds Ratio (95% CI)	p-value	Adjusted Odds Ratio (95% CI)	p-value
Operative Death				
Hypoglycemia only	4.64 (2.66-8.09)	p<0.001	3.68 (2.00-6.76)	p<0.001
Hyperglycemia only	3.83 (0.93-15.8)	p=0.063	2.25 (0.51-10.0)	p=0.29
Hypo- and hyperglycemia	16.1 (2.18-119)	p=0.006	9.80 (1.23-77.8)	p<0.031
Major Morbidity				
Hypoglycemia only	4.20 (3.20-5.51)	p<0.001	3.42 (2.53-4.64)	p<0.001
Hyperglycemia only	7.99 (3.27-19.5)	p<0.001	6.10 (2.40-15.5)	p<0.001
Hypo- and hyperglycemia	21.2 (7.75-58.1)	p<0.001	16.9 (5.89-48.3)	p=0.002
Post-Operative Length of Stay				
Hypoglycemia only	1.64 (1.55-1.72)	p<0.001	1.45 (1.38-1.53)	p<0.001
Hyperglycemia only	1.44 (1.33-1.55)	p<0.001	1.26 (1.16-1.36)	p<0.001
Hypo- and hyperglycemia	2.05 (1.88-2.24)	p<0.001	1.75 (1.60-1.92)	p<0.001
Total ICU Hours				
Hypoglycemia only	2.46 (2.19-2.76)	p<0.001	1.92 (1.72-2.15)	p<0.001
Hyperglycemia only	1.66 (1.40-1.97)	p<0.001	1.30 (1.10-1.53)	p=0.003
Hypo- and hyperglycemia	3.18 (2.64-3.83)	p<0.001	2.39 (1.97-2.90)	p<0.001

GENERAL THORACIC

P63

Single vs Double Lung Replantation Does Not Affect Survival Based on Previous Transplant Type

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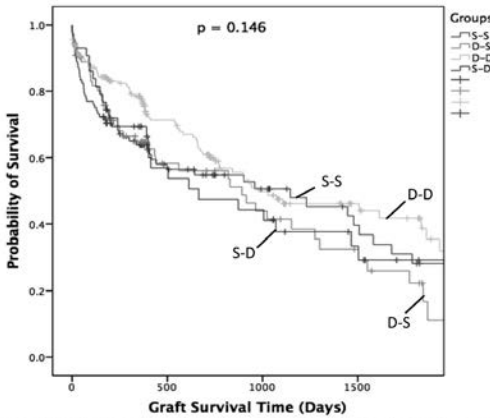
COMMERCIAL RELATIONSHIPS M. Bousamra: Ownership Interest, Breath Diagnostics; V. van Berkel: Ownership Interest, Breath Diagnostics

Purpose: Survival following retransplantation with a single lung is worse than with double lungs. We sought to characterize survival of patients who underwent lung retransplantation based on prior transplant type of single or double lungs.

Methods: The United Network for Organ Sharing database was queried for adult patients who underwent lung retransplantation from 2005 onwards. Patients were excluded if they underwent more than one retransplantation. The patient population was divided into four groups based on first followed by second transplant type, respectively: single then single, double then single, double then double, and single then double. Descriptive analysis and Kaplan-Meier survival analysis were performed. A *P*-value < .05 was considered significant.

Results: A total of 410 patients underwent retransplantation in the study time period. Patient characteristics at the time of retransplantation are shown in the Table. Overall mean survival for all patients who underwent retransplantation was 1,213 days. Kaplan-Meier survival analysis demonstrated no difference in 5-year survival between the four study groups (*P* = .146, Figure).

Conclusions: There was no significant difference in 5-year survival between recipients of retransplant with single or double lungs when stratified by previous transplant type. These results suggest that when retransplantation is performed, single lung retransplantation should be considered, regardless of previous transplant type, in an effort to maximize organ resources.



Comparison of survival following re-transplant for single following by single (S-S), double followed by single (D-S), double followed by double (D-D), and single followed by double (S-D) lung transplantation.

	Single-Single (N=110)	Double-Single (N=73)	Double-Double (N=184)	Single-Double (N=43)	p-value
Gender (male)	67 (60.9)	42 (57.5)	97 (52.7)	27 (62.8)	0.448
Age (years)	60.1±9.6	48.6±14.0	36.8±15.8	60.9±5.9	<0.001
BMI	25.1±4.2	24.1±5.1	20.2±5.9	25.2±3.9	<0.001
Creatinine	1.3±0.7	1.1±0.7	1.0±0.7	1.0±0.4	0.018
Waitlist time (days)	66.9±101.8	70.3±104.3	79.7±134.3	74.8±99.3	0.825
Time to retransplant (days)	564.5±581.7	655.0±521.0	933.6±682.5	506.4±596.2	<0.001
LAS	57.9±20.9	53.6±21.7	63.5±21.5	65.3±21.3	0.002
O₂	5.4±6.0	5.7±5.8	6.6±5.8	8.2±7.1	0.050
Requirement (L/min)					
Diagnosis					<0.001
COPD	30 (27.3)	9 (12.3)	11 (6.0)	11 (25.6)	
CF	0 (0)	11 (15.1)	83 (45.1)	0 (0)	
IPF	67 (60.9)	29 (39.7)	38 (20.7)	28 (65.1)	
Other	13 (11.8)	24 (32.9)	52 (28.3)	4 (9.3)	

Characteristics of study groups. Reported in n (%) or mean ± standard deviation.

P64

Single Center Experience in Urgent Lung Transplantation Program: Early and Mid-Term Outcomes and Risk Factor Analysis

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Purpose: In rapidly deteriorating patients awaiting lung transplantation (LTx), supportive strategies for lung function are only temporary with a high wait list mortality, and urgent lung transplantation remains the definitive therapy. The few publications on this topic report conflicting results, putting a word of caution about these urgent transplant programs.

Methods: Since November 2010, an urgent transplant program was introduced in Italy to allow LTx in these patients. Patients on the waiting list dependent on mechanical ventilation and/or extracorporeal lung support could be included in this urgent transplant program and transplanted on an emergency basis with the first available graft in the country. We reviewed our experience from January 2012 to December 2014, including 17 patients (15 females, median age 24 years; IQR 21-30 years), focusing on perioperative outcomes. The analysis of risk factors for in-hospital mortality was performed using Forest Tree analysis and GLMM models.

Results: Rapidly deteriorating lung function was supported by mechanical ventilation (MV) in one patient (5.9%), veno-venous extracorporeal membrane oxygenation (ECMO) in four patients (23.5%), and MV plus ECMO (nine veno-venous and three arteriovenous) in the remaining 12 patients (70.6%). The main indications for LTx was cystic fibrosis (58.8%). Median recipient lung allocation score was 52.5 (IQR 44.5-71.8). One patient died awaiting transplantation with a waiting list mortality of 5.8%, while 16 patients underwent bilateral LTx with a median waiting list time of 6 days (IQR 3-14 days). In the postoperative period, ECMO weaning was possible in 14 patients (87.5%) with ECMO median duration of 3 days (IQR 0-4 days). The in-hospital mortality and morbidity rates were 37.5% and 50%, respectively. The 1-year survival rate was 54%. According to our analysis, the high-impact risk factors for in-hospital mortality were pretransplant plasma transfusion, recipient *P. Aeruginosa* colonization, C-reactive protein, and lactic acid level.

Conclusions: The urgent lung transplant program allows transplantation in a significant percentage of prioritized patients, but an accurate selection of recipients is necessary to improve clinical outcome for high-risk patients. Larger studies are needed to validate the real value of observed risk factors and the impact of this transplant program.

P65

Surgical Management of Advanced Stage Non-Small-Cell Lung Cancer Is Decreasing But Remains Associated With Improved Survival*E. A. David¹, R. J. Canter¹, Y. Chen², D. Cooke¹, R. D. Cress²**¹University of California, Davis Medical Center, Sacramento, ²University of California, Davis*

Purpose: For patients with advanced stage non-small-cell lung cancer (NSCLC), chemotherapy and chemoradiation are the principal treatment modalities, and the role of surgical resection remains unclear. Our objective was to evaluate current trends and oncologic outcomes following surgical resection in advanced NSCLC in California.

Methods: The California Cancer Registry was queried from 2004 to 2012 for cases of stage 3A, 3B, and 4 NSCLC, and 34,016 cases were identified. We hypothesized that surgery has increased over time for these patients. Poisson regression with logarithm of the annual number of patients as offset was used to determine the trends in use of treatment. Kaplan-Meier and Cox regression model were used to determine its influence on overall (OS) and cancer-specific survival (CSS). We focused on patients treated with chemotherapy and chemoradiation (CR); chemotherapy, radiation, and surgical intervention in any sequence (CRS); surgery alone (SURG); and radiation alone (RAD).

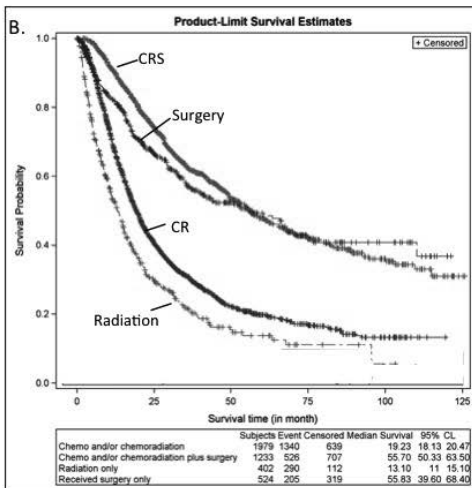
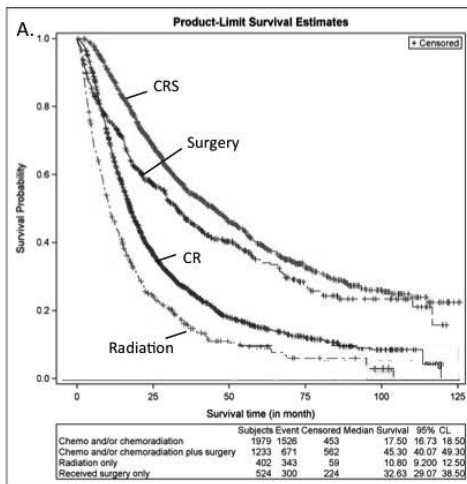
Results: The treatment groups differed significantly with respect to age, gender, socioeconomic status, race, and stage ($P < .0001$). Over the study period, for all stages, treatment with SURG, CRS, or RAD decreased ($P < .0001$, $P = .0349$, $P = .0080$), and treatment with CR increased ($P < .0001$). For stage 3B and 4, there was a decrease in treatment with SURG ($P < .0001$, $P < .0001$). For patients treated with CRS, there was an increase in use of lobectomy ($P = .0242$). For all stages, median OS and CSS were greater in patients who received surgery (CRS and SURG) ($P < .0001$) (Figure 1 for Stage 3A, data not shown for 3B or 4). On multivariate analysis, when compared with CRS, treatment with CR, RAD, or SURG was associated with worse OS (HR 1.816, 95% CI 1.698-1.942, $P < .0001$, HR 3.817, 95% CI 3.544-4.110, $P < .0001$, and HR 1.203, 95% CI 1.100-1.316, $P < .0001$). When compared to CRS, CSS was shorter in patients treated with CR or RAD (HR 1.980, 95% CI 1.840-2.131, $P < .0001$ and HR 4.109, 95% CI 3.790-4.454, $P < .0001$).

Conclusions: For patients with advanced stage NSCLC, treatment with CR is increasing, and the use of multimodality regimens that include surgery are decreasing, despite longer OS and CSS. Future studies need to identify the demographics and clinical characteristics of patients with advanced-stage NSCLC that benefit the most from surgery.

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Figure 1. A. Kaplan-Meier survival plot for OS for Stage 3A patients. B. Kaplan-Meier survival plot for CSS for Stage 3A patients. Data not shown for Stage 3B or 4. The log-rank test was highly significant (p -value <0.0001) for all stages for OS and CSS.



P66

Open Repair Remains the Gold Standard for Type III/IV Paraesophageal Hernias: A Modern Series of 94 Consecutive Patients*W. M. Burrows¹, J. M. Donabue², M. K. Wilson¹, L. W. Martin², S. R. Carr¹**¹University of Maryland School of Medicine, Baltimore, ²University of Maryland, Baltimore*

Purpose: The purpose of this study was to review our current results of Belsey-Mark IV for repair of type 3 and 4 paraesophageal hernias in the modern era of laparoscopic repair.

Methods: Between 2011 and 2015, there were 94 consecutive patients from a single institution who underwent transthoracic paraesophageal hernia repair via a Belsey-Mark IV operation. Charlson comorbidity index scores were calculated for each patient. We assessed length of stay, recurrence rates, and complications.

Results: There were 94 patients between age 26 to 94 years who underwent transthoracic repair for 91.5% type 3 and 8.5% type 4 paraesophageal hernias. 80.6% were female. A single mortality (1.1%) occurred within 30 days of surgery. Median length of stay was 9 days (range: 5-54). Complications occurred in 29.7% of patients. While there were four readmissions within 90 days (4.3%), all were overnight admissions for nausea and dehydration. The clinical recurrence rate when primary surgery was done by an experienced thoracic surgeon was 1.1%. This patient also is the only one to require reoperation at our institution. Charlson comorbidity index scores were not associated with readmission or need for reoperation.

Conclusions: These results indicate transthoracic repair remains the gold standard. While length of stay is shorter for minimally invasive surgery, recurrence rates are 15%-59%. Our approach provides optimal results with only a single patient having clinical recurrence. These results are of potentially greater significance in the current reimbursement.

P67

Outcomes After Esophagectomy for the Treatment of Failed Prior Antireflux Surgery

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COMMERCIAL RELATIONSHIPS O. Awais: Speakers Bureau/Honoraria, Covidien Ltd, PinnacleHealth System; J. D. Luketich: Research Grant, Accuray; A. Pennathur: Research Grant, Accuray

Purpose: Intractable gastroesophageal reflux disease (GERD) after prior antireflux operations presents a challenging clinical problem for surgeons. Some patients have had multiple prior antireflux surgeries, and esophagectomy may be the only viable option. Our objective was to evaluate the results of esophagectomy for intractable symptoms despite prior antireflux surgery

Methods: We conducted a retrospective review of patients who underwent an esophagectomy for refractory symptoms following prior antireflux operations. We evaluated perioperative outcomes, dysphagia (scored 1 [best] to 5 [worst]), and quality of life (QOL), assessed by administering the Gastroesophageal Reflux Disease–Health-Related Quality of Life (GERD-HRQOL) questionnaire (range 1 [best] to 50 [worst]) and the Short Form 36-Item Health Survey (SF-36), measuring physical (PCS) and mental (MCS) component scores.

Results: A total of 39 patients (median age 56 years; 20 men, 19 women) underwent an esophagectomy for refractory symptoms of GERD, despite one or more prior antireflux surgeries. The median number of prior antireflux surgeries in these patients was two. A total of 54% (21/39) had documentation of dysmotility on manometry. The primary surgical approach was a transthoracic esophagectomy (n=36; 92%) and was accomplished in a minimally invasive fashion in 27 patients (69%). The perioperative mortality was 0%. Two patients (5%) developed anastomotic leaks, which required operative intervention. The median hospital stay was 10 days (range: 4-45). The median follow-up was 31 months. Following resection, the median dysphagia score decreased from 3 to 2 ($P = .057$). The median postoperative PCS and MCS were 39 and 42, respectively. The median postoperative GERD-HRQOL score was 9 (categorized as excellent).

Conclusions: Esophagectomy for the treatment of intractable GERD after prior antireflux surgery can be performed safely in centers experienced in esophageal surgery. The QOL as determined by the GERD-HRQOL score was excellent after esophagectomy. Esophagectomy should be considered an important option for the treatment of refractory symptoms despite prior antireflux surgeries.

P68

Defining the Ideal Time Interval Between Planned Induction Therapy and Surgery for Stage IIIA Non-Small-Cell Lung Cancer

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COMMERCIAL RELATIONSHIPS B. F. Meyers: Consultant/Advisory Board, Ethicon, Inc; Speakers Bureau/Honoraria, Varian Medical Systems, Inc; D. Morgensztern: Consultant/Advisory Board, Celgene Corporation, Genentech, Inc; Speakers Bureau/Honoraria, Boehringer Ingelheim; C. Robinson: Consultant/Advisory Board, Radialogica; Employment, Washington University in St Louis; Research Grant, Varian Medical Systems, Inc; Speakers Bureau/Honoraria, Varian Medical Systems, Inc

Purpose: Surgical resection leads to significant improvement in survival for selected patients with stage IIIA non-small-cell lung cancer (NSCLC). Generally, these patients receive induction chemotherapy (\pm radiation) followed by surgery; however, the ideal time interval between induction therapy and surgery remains unknown.

Methods: Clinical stage IIIA NSCLC patients receiving induction chemotherapy or chemoradiation therapy followed by surgery were identified in the National Cancer Data Base (NCDB). Delayed surgery was defined as ≥ 3 months after starting induction therapy based on cutpoint survival analysis (X-Tile Software). Patient, tumor, and treatment characteristics were abstracted and compared between 'early' and 'delayed' surgery groups. Patients with an interval > 200 days were excluded for presumed salvage surgery. A logistic regression model was fitted to identify variables associated with delayed surgery. Cox proportional hazards model and Kaplan-Meier analysis were performed to study overall survival.

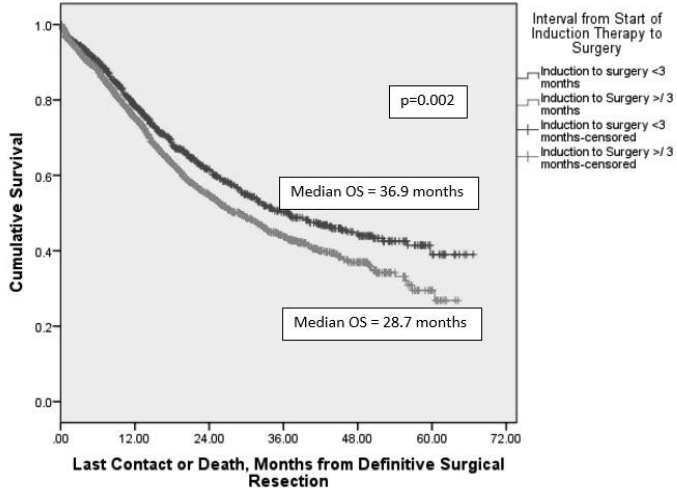
Results: From 2006 to 2010, 851/2,380 of clinical stage IIIA NSCLC patients (35.8%) received surgery < 3 months from the start of induction therapy (early), while 1,529/2,380 (64.2%) experienced a delayed induction therapy interval. Delayed surgery patients were older (61.2 years \pm 10.0 years vs 60.3 years \pm 9.2 years, $P = .03$), more likely to be non-Caucasian (189/1,521, 12.4% vs 82/845, 9.7%, $P = .046$), and less likely to have private insurance (755/1,511, 50% vs 493/847, 58.2%, $P = .002$). Delayed surgery patients were more likely to have a sublobar resection (96/1,529, 6.3% vs 25/821, 2.9%) and less likely to undergo a pneumonectomy (186/1,529, 12.2% vs 151/821, 17.7%, $P < .001$). On multivariable analysis, age > 68 years (OR 1.37, 95% CI 1.1-1.7) was associated with delayed surgery, while Caucasian race (OR 0.75, 95% CI 0.57-0.99) and private insurance status (OR 0.82, 95% CI 0.68-0.99) were associated with early surgery. Delayed surgery was independently associated with higher risk of long-term mortality (HR 1.25, 95% CI 1.07-1.47), $P = .005$.

Conclusions: Delayed surgery after induction therapy for stage IIIA lung cancer is independently associated with shorter survival and is influenced by both socioeconomic and physiologic factors. Close coordination between oncologists and thoracic surgeons is mandatory to provide timely care to these patients.

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Kaplan-Meier Curve for Clinical Stage IIIA Non-Small Cell Lung Cancer Patients, By Induction Therapy to Surgery Time Interval (<3 months versus >/3 months)



P69

Barriers and Facilitators to Accessing Optimal Esophageal Cancer Care for Socioeconomically Disadvantaged PatientsC. Lineback¹, C. Mervak², R. M. Reddy¹¹University of Michigan, Ann Arbor, ²University of Michigan Medical School, Ann Arbor**COMMERCIAL RELATIONSHIPS** R. M. Reddy: Consultant/Advisory Board, Intuitive Surgical; Research Grant, GlaxoSmithKline; Speakers Bureau/Honoraria, Covidien

Purpose: Survivorship of lower socioeconomic status (SES) patients with esophageal cancer is greatly diminished for unclear reasons. We aimed to define the specific barriers that prevent patients from effectively utilizing health care resources and better understand how to improve outcomes in low SES populations.

Methods: Esophageal cancer patients participated in 1-hour semi-structured interviews and were asked to provide a detailed description of their experience with esophageal cancer and the barriers they encountered while receiving care. Participants were separated into either high or low SES groupings based on household income.

Results: Our study included 80 participants, stratified into high (38) and low (42) SES groupings. No differences were noted in comorbidities or primary staging between groups. However, a significantly smaller proportion of the low SES population was offered surgery, either alone or with adjunct chemotherapy/radiation (17/38, 44.7%), compared to high SES (29/38, 76.3%) ($P = .0048$). Regarding disease and treatment understanding, the majority of high SES participants reported good understanding of their treatment options (31/37, 83.8%) vs the low SES group (26/42, 61.9%) ($P = .031$). Additionally, low SES participants were significantly less likely to pursue second options following their initial diagnosis (10/42, 23.8%) compared to high SES (25/38, 65.8%) ($P = .0002$). Finally, more low SES participants reported losing trust in one physician over the course of their treatment (9/18, 50%) compared to the high SES group (2/13, 15.4%) ($P = .046$). In addition to reported financial differences, the proportion of individuals who lost their employment was significantly higher in the low SES (14/42, 33.3%) compared to high (1/38, 2.6%) ($P = .0004$).

Conclusions: Reduced understanding of treatment options, financial difficulties, including loss of employment, and decreased surgical options all were barriers encountered by patients demonstrating lower socioeconomic status. Overcoming these difficulties is essential to improving cancer care for this population.

P70

Triangular vs Circular Stapled Anastomosis for Minimally Invasive Esophagectomy: Results From a Randomized, Controlled Study

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Purpose: In this prospective study (NCT 01696682), we aimed to compare the triangular and circular stapled gastroesophageal anastomosis for three-stage minimally invasive esophagectomy (MIE).

Methods: From December 2013 to May 2015, esophageal cancer patients were randomly assigned to circular stapled (CS) or triangular stapled (TS) gastroesophageal anastomosis during the three-stage MIE. Following the surgery, the incidence of anastomotic leakage and stricture were recorded and statistically compared to determine the efficacy of the two anastomotic methods.

Results: There were 133 patients in CS and 148 patients in TS. Patient demographics and clinical characteristics were comparable between the two groups. Postoperatively, a total of 23 cases (8.18%) of anastomotic leakage and 18 cases (6.41%) of anastomotic stricture were observed. The incidence of anastomotic leakage was close in TS and CS (7.52% vs 8.78%, $P = .699$), and less anastomotic stricture was recorded in TS compared with CS (3.38% vs 6.08%, $P = .029$).

Conclusions: Compared with circular stapled anastomosis, triangular stapled anastomosis resulted in close anastomotic leakage but lower anastomotic stricture following minimally invasive esophagectomy. Further study based on a larger population and its long-term effects is required to confirm the advantages of this technique.

P71

Lung Cancer as a Second Primary Among Patients With Previous Malignancy: Who Is at Risk?

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COMMERCIAL RELATIONSHIPS D. J. Raz: Ownership Interest, Cireca Theranostics, LLC

Purpose: Patients with personal history of cancer may be at increased risk for developing lung cancer (LC). National Comprehensive Cancer Network guidelines for lung cancer screening incorporate personal history of cancer into screening criteria; however, the extent of this risk for many cancer types is not well defined.

Methods: The Surveillance, Epidemiology, and End Results 1992-2012 dataset was used to identify patients with a prior malignancy that subsequently developed primary LC ≥ 6 months after their initial cancer. Standardized incidence ratios (SIRs) for LC were calculated as a ratio of observed to expected LC cases adjusted by person-years at risk, age, sex, race, and time of diagnosis. Cancers with SIRs >1.0 have higher rates of LC than expected. Confidence intervals (CI) were used to test for significance and ranges that exclude 1.0 correspond to $P < .01$. Analyses were stratified by sex and receipt of radiation for the first cancer.

Results: We identified 41,675 primary LC patients with prior malignancies and found the highest SIRs in those with history of lung (SIR 4.13, CI 3.99-4.28), head and neck (3.69, 3.54-3.85), and bladder (1.85, 1.77-1.93) cancers ($P < .01$). All patients who had leukemia or non-Hodgkin's lymphoma, as well as women who had breast, pancreatic, or renal cancer, demonstrated elevated SIRs for LC ($P < .01$, Table). When considering radiation, we found that women with irradiated breast and pancreatic cancers had increased SIRs of 1.06 (1.01-1.11) and 2.86 (1.71-4.46), respectively ($P < .01$), while those without radiation history had insignificant SIRs of 0.97 (0.93-1.02) and 1.06 (0.63-1.67), respectively. Among men with colorectal cancer, only those treated with radiation had increased SIR for LC (1.28, 1.11-1.46, $P < .01$). Lower SIRs for LC were identified in patients who had prior melanoma, prostate, uterine, or endometrial cancers ($P < .01$). Women had consistently higher SIRs for LC than men across all previous malignancies.

Conclusions: Smoking-related cancers had the highest SIRs for subsequent LC. Without radiation, certain cancers did not confer an increased risk of LC. Women had higher SIRs for LC than men. These data may be useful in determining lung cancer screening guidelines for the growing population of cancer survivors.

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Table 1. Standard incidence ratios (SIRs) of primary lung cancer in men and women with previous malignancy by initial primary site.

Initial Primary Site	Observed/ Expected Lung Cancer Cases	All Patients SIR (99% CI)	Men SIR (99% CI)	Women SIR (99% CI)
Lung and bronchus	5,542/1,341	4.13 (3.99-4.28)	3.47 (3.30-3.65)	5.07 (4.82-5.32)
Head and neck	3,943/1,068	3.69 (3.54-3.85)	3.58 (3.41-3.75)	4.09 (3.76-4.44)
Bladder	3,831/2,070	1.85 (1.77-1.93)	1.74 (1.66-1.82)	2.39 (2.18-2.61)
Leukemia	781/596	1.31 (1.19-1.44)	1.24 (1.10-1.40)	1.44 (1.23-1.67)
Non-Hodgkin's Lymphoma	1,492/1,180	1.26 (1.18-1.35)	1.17 (1.07-1.28)	1.40 (1.26-1.54)
Colorectal	4,492/4,191	1.07 (1.03-1.11)	1.05 (1.00-1.10)	1.10 (1.04-1.17)
Pancreas	119/95	1.25 (0.98-1.58)	1.04 (0.72-1.45)	1.54 (1.09-2.12)
Renal	828/741	1.12 (1.02-1.22)	1.07 (0.96-1.20)	1.22 (1.04-1.42)
Breast	6,739/6,645	1.01 (0.98-1.05)	0.93 (0.64-1.29)	1.01 (0.98-1.05)
Uterine/Endometrial	957/1,126	0.85 (0.78-0.92)	--	0.85 (0.78-0.92)
Prostate	10,780/13,344	0.81 (0.79-0.83)	0.81 (0.79-0.83)	--
Thyroid	399/402	0.99 (0.87-1.13)	0.90 (0.70-1.12)	1.04 (0.89-1.22)
Melanoma	1,829/2,323	0.79 (0.74-0.84)	0.74 (0.69-0.80)	0.88 (0.79-0.97)

SIR = standard incidence ratio (observed/expected) adjusted by person-years at risk, age, sex, race/ethnicity and time of diagnosis

SIR > 1.0 indicates higher than expected rate of lung cancer.

SIR < 1.0 indicates lower than expected rate of lung cancer.

Bolded results are significant with $p < 0.01$.

P72

Predictors of Pleural Implants in Patients With Thymic Tumors

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Purpose: Recurrence after surgical resection of thymic tumors often occurs in the pleural space. We sought to identify factors predicting pleural dissemination, which would perhaps allow for tailored surgical, adjuvant, or surveillance strategies.

Methods: A retrospective review of a prospective database (2000-2014) was performed to identify patients with thymic tumors (excluding neuroendocrine). Demographic, clinical, and pathological data were reviewed. Multivariable logistic regression analysis was performed to determine independent predictors of pleural implants (either synchronous or metachronous). Univariate predictors ($P < .20$) were selected for inclusion in a multivariate model. ROC curve was used to assess the effect and cutoff value of tumor size on the incidence of pleural metastasis.

Results: 162 patients with thymic tumors were identified. Pleural deposits were incidentally identified intraoperatively in four patients (2.5%) and developed during follow-up in 15 patients (10%), with a median follow-up of 34 months (IQ range: 12-71). The incidence of pleural implants in relation to clinicopathological variables is listed in the Table. Independent predictors of pleural metastasis development by univariate analysis were: organ invasion, preoperative core biopsy, pathological tumor size, R1 resection, as well as WHO type B1/B2 and type B3/C. In the multivariate model, only R1 resection (OR 6.58, $P = .003$) and tumor size (OR 1.19, $P = .030$) were found to be independent factors predicting pleural metastasis (Table). The relationship between the pathological tumor size and development of pleural metastasis was further investigated using the ROC curve (area under the curve 0.78, $P < .001$), and the cutoff tumor size that gave the best combined sensitivity and specificity was 6.5 cm (Figure). Overall survival of patients with pleural implants was 88% and 50% at 5 and 10 years, respectively.

Conclusions: Development of pleural metastasis is predictable. Pathological tumor size, an independent predictor of pleural implants, easily can be extrapolated from computed tomography scanning. Pleural exploration at the index operation should be considered in high-risk patients. Further studies are needed to assess the role of prophylactic adjuvant modalities to reduce metachronous pleural disease.

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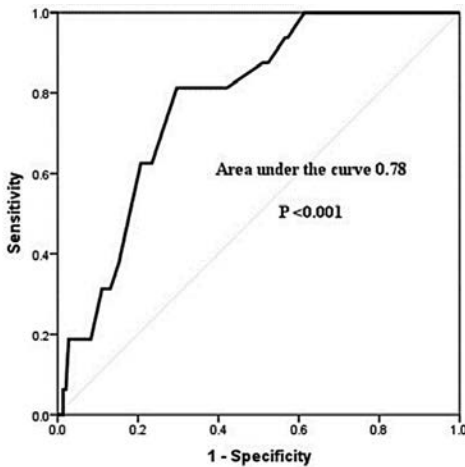


Fig.1 ROC curve showing the effect of increased tumor size on pleural metastasis development

Table 1: Clinico-pathological Characteristics and Predictors of Pleural Implants in Thymoma Patients			
Clinical/Pathological Variables	Incidence of pleural implants (19/162)	Logistic regression analysis of predictors of pleural implants	
		Univariate OR (95% CI, P value)	Multivariate OR (95% CI, P value)
Gender			
Female	7/66 (10.6%)	Reference	
Male	12/96 (12.5%)	1.20 (0.45-3.24, p=0.71)	
Biopsy			
Not done	6/84 (7%)	Reference	
FNA	5/43 (11.5%)	1.71 (0.49-5.96, p=0.399)	
Core biopsy	6/29 (21%)	3.39 (0.99-11.53, p=0.050)	3.74 (0.87-16.01, p=0.075)
Surgical	2/6 (33%)	6.50 (0.98-43.01, p=0.052)	2.42 (0.24-24.54, p=0.456)
WHO Thymoma Classification			
A/AB	3/65 (4.6%)	Reference	
B1/B2	9/63 (14.3%)	3.44 (0.89-13.37, p=0.074)	1.77 (0.34-9.08, p=0.496)
B3/C	7/33 (21.2%)	5.56 (1.33-23.20, p=0.018)	0.63 (0.09-4.44, p=0.644)
Induction Chemotherapy			
No	11/137 (8%)	Reference	
Yes	8/25 (32%)	5.39 (1.90-15.26, p=0.002)	1.93 (0.43-8.79, p=0.393)
Tumor Size (cm)			
continuous		1.19 (1.06-1.34, p=0.003)	1.19 (1.02-1.36, p=0.030)
Less than 6.5 cm	1/64 (1.6%)		
6.5 cm or more	18/97 (18.6%)		
Tumor Invasion			
Capsulated/Microscopic invasion	1/97 (1%)	Reference	
Macroscopic invasion	5/21 (23.8%)		
Organ invasion	13/44 (11.7%)	7.83 (2.75-22.26, p=0.001)	2.76 (0.64-11.89, p=0.173)
Resection Status			
R0	10/138 (7.2%)	Reference	
R1	9/24 (37.5%)	7.68 (2.69-21.89, p=0.001)	6.58 (1.87-23.16, p=0.003)
Adjuvant Radiotherapy			
Yes	18/64 (28%)	Was not included in the analysis as nearly all patients who developed pleural implants received adjuvant radiotherapy	
No	1/98 (1%)		

P73

Hyperthermic Pleural Lavage for Pleural Metastasis*D. L. Miller, J. Wetstone, G. Helms**WellStar Health System, Marietta, GA***COMMERCIAL RELATIONSHIPS** D. L. Miller: Consultant/Advisory Board, Ethicon, Inc, Bard, Inc; Research Grant, Medela, Inc; Speakers Bureau/Honoraria, Covidien

Purpose: To evaluate the safety and efficacy of hyperthermic pleural lavage (HTPL) with cisplatin in patients who had undergone cytoreductive surgery (pleurectomy/decortication [PD]) for isolated chemo-resistant pleural metastasis (PM). This treatment may be an alternative for patients with isolated pleural metastasis and controlled primary disease.

Methods: After IRB and Cancer Committee approval, 10 patients who had unilateral chemo-resistant pleural metastasis were registered prospectively. The patients' primary sites of malignancy were under control for a median of 40 months (range: 32-61) prior to developing PM. Median time of systemic chemotherapy for PM was 29 months (range: 28-76). All 10 patients underwent a unilateral radical pleurectomy/decortication and lymph node dissection, 60 minutes pleural lavage (1,500 cc/min) with 225 mg/m² of cisplatin at 42°C. Cisplatin levels were drawn at time zero, 1 hour, 4 hours, and 24 hours after completion of HTPL.

Results: Median age was 53 years (range: 38-64); seven patients (70%) were women. Primary tumor was breast in five, colon in two, and thymic, renal cell, and anal cancer in one each. Surgical approach was a thoracotomy in nine patients (90%). Morbidity included atrial fibrillation in three patients (30%), prolonged air leak in three (30%), and acute respiratory distress syndrome in one (10%). Median hospital stay was 7 days (range: 4-14). Serum cisplatin levels peaked at 4 hours after lavage; no cisplatin levels were in the toxic range. Median dose of cisplatin was 386 mg (range: 299-450); no patient developed renal insufficiency. Median follow-up was 10 months (range: 1-15). No patient has developed recurrence of their malignant disease at last follow-up. All 10 patients experienced improved quality of life and respiratory function, as well as reduced pleuritic pain after cytoreduction and HTPL.

Conclusions: Surgical cytoreduction of chemo-resistant PM followed by HTPL with cisplatin was well tolerated. No patient developed cisplatin-related toxicities. Early results are promising. This novel treatment (P/D and HTPL) of these patients with isolated pleural metastasis represents the only American series. Longer follow-up is warranted to determine a survival advantage.

P74

Impact of Surgery for Stage I Non-Small-Cell Lung Cancer on Quality of Life

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Purpose: The literature is mixed regarding the impact of lung cancer surgery on physical and mental health quality of life (QoL). The current study aims to assess the impact of surgery on both physical and mental health QoL in screening-diagnosed patients with early stage lung cancer, an under-studied population.

Methods: SF-12 QoL indicators were collected from 86 participants (40 women, 46 men) at baseline computed tomography screening and 1-year follow-up post-surgery for clinical stage IA non-small-cell lung cancer. A total of 69 patients had lobectomy and 17 had sublobar resection. Average time of follow-up was 12 months since surgery (SD: 1.5 months; range: 9-15 months post-surgery). Univariate and multivariate analyses were performed to examine the difference in physical (PHC) and mental (MHC) health component scores of the SF-12 before and after surgery using the Wilcoxon signed rank and Mann Whitney tests.

Results: There was no significant change in PHC post-surgery (Wilcoxon signed rank test, $S=-216, P=.32$), but MHC significantly improved from baseline to post-surgery ($S=527, P=.01$). Mean MHC was significantly higher among men as compared to women at both baseline (Chi-square=3.95, $P=.047$) and post-surgery (Chi-square=4.23, $P=.039$) and after controlling for age, ethnicity, and education, while no differences in PHC was observed. Further, there was an improvement in PCS score post-surgery among participants who underwent limited resection, while a decrease in PCS score was observed among those who underwent lobectomy. The change in PCS score was significantly different between type of surgery ($t=-2.01, P=.048$). After controlling for demographics, the difference was borderline significant ($F=3.62, P=.06$).

Conclusions: Early stage lung cancer surgery was associated with an increase in mental (not physical) health QoL 1 year after surgery. Physical health QoL marginally improved among participants who underwent limited resection as compared to lobectomy. Findings can guide the discussion of the impact of surgery on QoL with these patients.

P75

Iterative Surgery for Re-Recurrence After Complete Resection of Thymic Tumors

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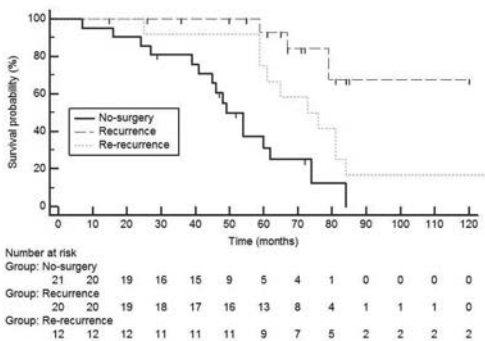
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Purpose: To evaluate the role of iterative surgery in patients with re-recurrence after complete resection of thymic tumors.

Methods: This is a retrospective, multicenter study including 53 patients with recurrence and/or re-recurrences after complete resection of thymic tumors (46 thymoma and 7 thymic carcinoma). Data including demographics, stage, type of treatment, pathology, and survival were statistically analyzed.

Results: 32/53 patients (60%) underwent surgery with curative intent for recurrence. Twelve (37%) had a second recurrence (median time 59 months) and were reoperated; nine (28%) were reoperated for a third recurrence (median time 20 months) and three (9%) for a fourth recurrence (median time 29 months). Histology of primary tumor was AB (three), B1 (six), B2 (15), B3 (six), and C (two); at the time of recurrence, it changed from AB to B3 (three), B1 to B2 (two), B1 to B3 (two), and B2 to B3 (five). The changes were more frequent in patients with re-recurrences compared to those with one recurrence only (9/12, 75% vs 3/20, 15%; $P = .0006$). Patients undergoing surgery for a single recurrence had a better survival than those operated for multiple recurrences (Figure) (HR 3.7, 95% CI 1.21-11.1, $P = .02$). Patients undergoing chemo/radiotherapy alone (21) showed worse survival rates than those receiving surgery for single (HR 0.11, 95% CI 0.04-0.28, $P < .0001$) and for multiple recurrences (HR 0.44, 95% CI 0.20-0.97, $P = .02$).

Conclusions: Iterative surgery achieves better survival rates compared to chemo/radiotherapy alone in patients with recurrence and re-recurrences after complete resection; it always should be performed when technically feasible.



P76

CHADS2 Score Predicts Postoperative Atrial Fibrillation in Patients Undergoing Elective Pulmonary Lobectomy

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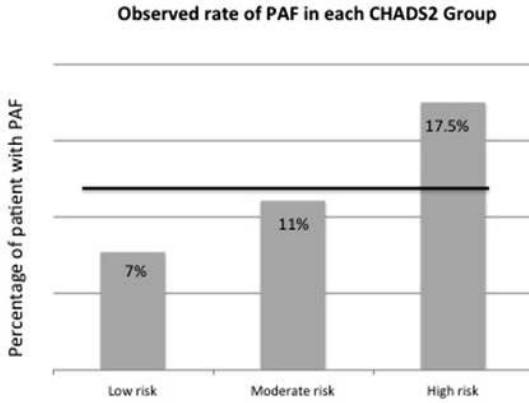
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Purpose: Postoperative atrial fibrillation (PAF) affects 12.5% of patients undergoing lobectomy and is associated with prolonged hospital stay and decreased survival. CHADS2 predicts PAF in patients undergoing heart surgery. Our purpose was to determine whether CHADS2 score can predict PAF in patients undergoing elective lobectomy.

Methods: A prospective thoracic surgery clinical database was reviewed, identifying all patients undergoing elective lobectomy between January 1, 2005, and June 30, 2014. Exclusion criteria included patients under 18 years old, non-elective operation, concurrent or secondary operations (cardiac, esophageal, abdominal, spine), and pre-existing AF. Two groups (PAF and No PAF) were analyzed. CHADS2 was calculated for each patient. Patients' characteristics and mean CHADS2 scores were compared. Rate of PAF was calculated in low (CHAD2 score 0), moderate (CHAD2 score 1), and high risk (CHADS2 score 2 or greater) groups. P value < .05 was significant.

Results: PAF developed in 113 patients of 943 undergoing lobectomy with incidence of 12%. Age (and age >75) was the only significantly different preoperative characteristic between PAF and No PAF groups. New neurologic events and hospital mortality were significantly higher in PAF group. Mean CHADS2 score was significantly higher in patients with PAF (1.6 vs 1.24, $P = .0035$). Logistic regression identified CHADS2 score as the only significant variable predictive of PAF. 33% of patients were low risk (score 0) with 7.7% incidence of PAF. 34% of patients had score of 1, with 11% of those developing PAF, similar to overall incidence for the entire cohort (12%). The remaining 33% were at high risk, and 17.5% of patients developed PAF. The difference among these groups (Figure) was statistically significant ($P = .0002$).

Conclusions: Preoperatively calculated CHADS2 predicts PAF in patients undergoing elective lobectomy. CHADS2 scoring could be used to direct PAF prophylaxis in elective lobectomy patients at the greatest risk. Further validation of this model is warranted to optimize prophylactic measures and improve patient outcomes.



Line represents 12.5% rate of PAF noted in the entire cohort and reported in literature.
 All show statistically significant difference ($p < 0.0002$).

Table 1: Patient characteristics and CHADS2 scores

	PAF N=113 (%)	No PAF N=830 (%)	p-value
Age	72.0±8	65.2±11.1	<0.001
Age>75	46 (40%)	173 (20%)	<0.001
New neuro events	3 (2.7%)	4 (0.5%)	<0.05
Hospital mortality	7 (6.2%)	14 (1.7%)	<0.05
CHADS2 score (mean)	1.46 ±0.21	1.1 ±0.08	<0.01
CHADS 0	24 (21.2%)	287 (34.6%)	<0.001
CHADS 1	37 (32.7%)	298 (35.9%)	
CHADS 2>	52 (46.0%)	245 (29.5%)	

P77

Significance of Epidermal Growth Factor Receptor Mutation Status in pN1-pN2 Pulmonary Adenocarcinoma: The Implication for the Prognosis

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Purpose: Patients with stage IV pulmonary adenocarcinoma harboring EGFR exon 21 point mutation (Ex21) have poorer prognosis than EGFR exon 19 deletion adenocarcinoma (Ex19). In this study, we examined whether the prognosis of highly aggressive pN1-pN2 pulmonary adenocarcinoma differed by EGFR mutation status.

Methods: Among 277 patients with pN1-pN2 pulmonary adenocarcinoma who underwent curative resection of the lung and lymph node dissection from January 2002 to February 2015, we identified 41, 55, and 102 cases of Ex21, Ex19 and EGFR mutation wild (WT), respectively. Five-year disease-free survival (DFS)/disease-free interval (DFI) and overall survival (OS) of each EGFR gene status were analyzed by the Kaplan-Meier method and compared among the three groups using the log-rank test.

Results: The mean observation period was 47.1 months, and the DFS and the OS was 25.2% and 59.7%, respectively. Patients with Ex19 had longer DFS (38.8%) compared with WT (24.6%) and Ex21 (11.8%) ($P = .022$ and $P = .001$, respectively). Furthermore, patients with Ex19 tended to have longer OS (78.3%) than WT (54.2%) and Ex21 (48.3%) ($P = .235$ and $P = .123$, respectively). Among pN1 lung cancer, patients with Ex19 and WT had longer DFI (54.0 and 58.1 months) than Ex21 (22.3 months) ($P = .003$ and $P = .118$, respectively). Among pN2 lung cancer, patients with Ex19 had longer DFI (43.6 months) than WT (31.2 months) and Ex21 (30.1 months) ($P = .034$ and $P = .109$, respectively).

Conclusions: Among pN1-pN2 pulmonary adenocarcinoma, patients with Ex19 had the longer DFS and OS than WT and Ex21, whereas Ex21 had the poorest prognosis, especially in pN1. EGFR mutation testing should be considered for all patients with pN1-pN2 pulmonary adenocarcinoma because it gives important information on their prognosis.

Fig 1. Disease free survival curve for each EGFR status

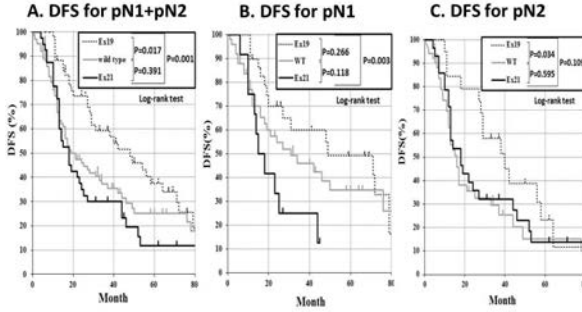


Table 1. DFS and OS for each EGFR status

	Ex19 (n=55)	WT (n=102)	Ex21 (n=41)	p-value
DFS (%)	38.8	24.6	11.8	Ex19 vs WT: p=0.022 Ex19 vs Ex21: p=0.001
OS (%)	78.3	54.2	49.3	N.S.

	Ex19 (n=35)	WT (n=50)	Ex21 (n=12)	p-value
pN1 DFI (month)	54.0	58.1	22.3	Ex19 vs Ex21: p=0.003
pN1 mean survival (month)	81.0	82.9	50.6	Ex19 vs Ex21: p=0.022

	Ex19 (n=25)	WT (n=52)	Ex21 (n=29)	p-value
pN2 DFI (month)	43.6	31.2	30.1	Ex19 vs WT: p=0.034
pN2 mean survival (month)	78.8	75.0	76.9	N.S.

P78

Does Repeat Lung Resection Provide a Chance of Cure for Recurrent Pulmonary Metastases of Colorectal Cancer? Results of a Retrospective Japanese Multicenter Study

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Purpose: The survival benefit of repeat lung resection (RLR) for recurrent pulmonary metastases (PM) from colorectal cancer (CRC) (CRC-PM) has not been well defined. The purpose of this study was to clarify the long-term survival outcomes and prognostic factors after RLR for recurrent CRC-PM using a nationwide Japanese database.

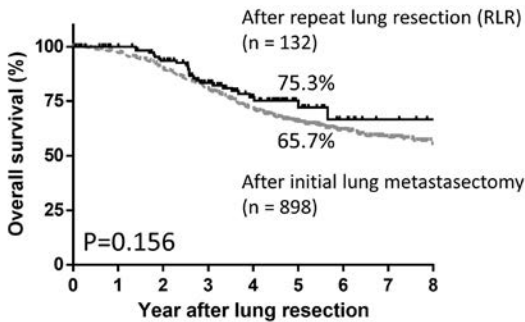
Methods: We constructed a nationwide database in 2012 to analyze surgical outcomes of metastasectomy for CRC-PM between 2004 and 2008. Among 898 patients who underwent R0 resection, 132 patients who underwent RLR up to three times for recurrent CRC-PM were enrolled in this retrospective study. Survival after RLR was compared to that after no surgical treatments for recurrent CRC-PM (non-RLR: n=84) and after initial lung metastasectomy (n=898). Various clinical parameters also were investigated to identify prognostic factors after RLR for recurrent CRC-PM.

Results: Compared with non-RLR, RLR more frequently received adjuvant chemotherapy after initial CRC-PM resection (61% vs 39%, P = .002) and had cut-end recurrence rather than

newly developed PM (21% vs 7%, $P = .006$). RLR showed significantly better overall survival (OS) than non-RLR after recurrent CRC-PM detection (5-year OS: 76.6% vs 23.3%, $P < .001$). OS after RLR was almost equivalent to that after initial lung metastasectomy (5-year OS: 75.3% after RLR, 65.7% after initial lung metastasectomy, $P = .156$). For 22 patients who underwent a second RLR, 5-year OS was 55.1% after the last lung resection. In a multivariate analysis, significant adverse prognostic factors after RLR were primary rectal tumor (HR 3.30, 95% CI 1.24-9.62) and the coexistence of liver metastasis before the initial pulmonary metastasectomy (HR 4.69, 95% CI 1.49-13.7). OS after RLR for cut-end recurrence tended to be superior to that for newly developed PM, although this difference was not significant (HR 0.29, 95% CI 0.05-1.14).

Conclusions: These results suggest that RLR for recurrent CRC-PM can provide survival equivalent to that with initial lung metastasectomy. The origin of the primary tumor and liver status at initial lung metastasectomy were associated with OS after RLR. Recurrence location (cut-end or metachronous new PM) also potentially affected OS after RLR.

Figure



P79

Barriers to Video-Assisted Thoracic Surgery Adoption: A Premier Prospective™ Analysis of Lobectomy for Primary Lung Cancer*J. Blasberg¹, J. D. Maloney², R. A. Macke²**¹University of Wisconsin, Madison, ²University of Wisconsin Hospital and Clinics, Madison*

Purpose: Video-assisted thoracoscopic lobectomy slowly has become an accepted surgical approach for lung cancer treatment. However, recent reports indicate less than half of lobectomies are performed by VATS, despite evidence supporting oncologic efficacy, shorter hospital stays, and decreased morbidity. We examined nationwide lobectomy trends to identify potential barriers to VATS adoption.

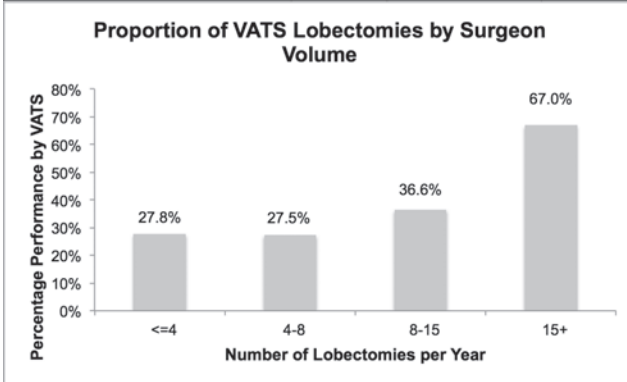
Methods: Premier hospital data (2010 to 2014) was used to identify principal procedures for lobectomy (ICD-9 codes 32.41-VATS and 32.49-open and MS-DRG codes 163, 164, 165) for primary lung cancer. Propensity score methodology was used to match VATS and open cases (1:1) based on patient demographics, hospital characteristics, physician specialty, and payer type. A Generalized Estimating Equation model adjusted for differences between groups using providers as the cluster variable. Variables associated with the primary outcome of VATS utilization were assessed by multivariate logistic regression to evaluate independent predictors. Secondary outcomes included length of stay, postoperative complications, readmission, and hospital costs.

Results: A total of 14,756 patients with primary lung cancer and a procedure code for VATS (n=5,811, 39.4%) or Open (n=8,945, 60.6%) lobectomy were identified during the study period. After matching for patient and provider characteristics, 4,224 patients were available in each group for analysis. During the study period, VATS utilization increased significantly (39.6% in 2010 vs 43.8% in 2014; $P < .0001$). Variables independently associated with VATS utilization included Charlson Comorbidity Index, age, gender, region of practice, hospital type (teaching vs non-teaching and urban vs rural), hospital size, payer type, surgeon specialty, and surgeon annual lobectomy volume (Figure). VATS lobectomy was associated with shorter average hospital LOS compared to open lobectomy (6.0 days vs 7.4 days, $P < .0001$). Operative costs for VATS were on average \$426 higher than open, offset by reduced costs in the postoperative period, with an average savings of \$1,112 per VATS procedure (mean summary cost: \$22,435 vs 23,547; $P < .001$).

Conclusions: The slow pace of VATS adoption correlates with specific patient, provider, and geographical characteristics. Variability in VATS utilization for lobectomy was greatest when comparing surgeon volume, hospital setting, and region. Increased efforts are needed to enhance minimally invasive training in rural and non-teaching hospitals if increased VATS adoption is expected.

Figure 1. Variables associated with VATS Utilization for Lobectomy

	OR	95% CI	p-value
VATS Utilization by Year			
2011 vs 2010	0.885	0.792-0.988	0.0301
2012 vs 2010	1.086	0.969-1.217	0.1562
2013 vs 2010	1.107	0.986-1.242	0.086
2014 vs 2010	1.398	1.243-1.572	<0.0001
Patient Characteristics			
Charlson Comorbidity Index	0.919	0.905-0.933	<0.0001
Age	1.011	1.006-1.016	<0.0001
Male vs Female	0.818	0.76-0.88	<0.0001
Obesity	0.969	0.859-1.093	0.5656
Black vs. White	1.156	1.006-1.328	0.0404
Latin vs. White	0.689	0.375-1.268	0.2318
Other vs. White	0.712	0.639-0.795	<0.0001
Region			
Midwest vs. South	0.584	0.527-0.648	<0.0001
Northeast vs. South	2.441	2.192-2.72	<0.0001
West vs. South	1.082	0.971-1.207	0.1532
Hospital Characteristics			
Teaching vs. Non-Teaching	1.288	1.183-1.403	<0.0001
Urban vs. Rural	1.715	1.488-1.976	<0.0001
<250 vs. 250-500 Beds	0.655	0.585-0.734	<0.0001
<250 vs. 500 Beds	0.745	0.655-0.848	<0.0001
Payer Type			
Managed Care vs. Medicare	1.135	1.022-1.261	0.0178
Medicaid vs Medicare	1.104	0.922-1.323	0.2813
Other vs. Medicare	1.197	0.988-1.451	0.0658
Surgeon Speciality			
Thoracic vs. Other Speciality	1.155	1.063-1.255	0.0007
Surgeon Volume (Lobectomies/year)			
4-8 vs <=4	0.917	0.823-1.022	0.1178
8-15 vs <=4	1.249	1.128-1.383	<0.0001
15+ vs <=4	4.882	4.372-5.45	<0.0001



P80

Evaluation of Emphysema Severity Calculated Using High-Quality 3-Dimensional Computed Tomography Images Predicts Postoperative Complications in Lung Cancer Patients

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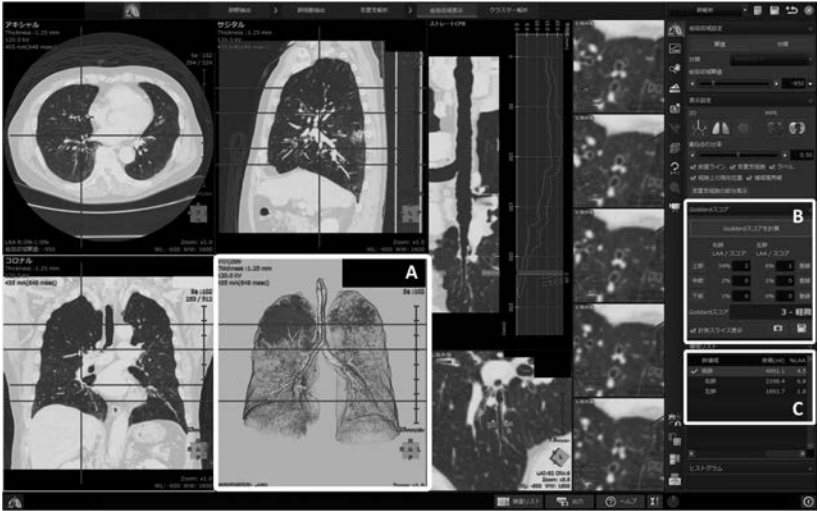
COMMERCIAL RELATIONSHIPS N. Ikeda: Research Grant, Chugai Pharmaceutical Co, Ltd, Eli Lilly and Company, Taiho Pharmaceutical Co, Ltd; Speakers Bureau/Honoraria, Chugai Pharmaceutical Co, Ltd, Eli Lilly and Company, Taiho Pharmaceutical Co, Ltd, Olympus Corporation

Purpose: Emphysema is the main predictor of respiratory morbidity in lung cancer patients. Three-dimensional (3D) computed tomography (CT) is excellent for demonstrating emphysema as a low attenuation area (LAA) and visual scores based on Goddard classification. The aim of this study was to evaluate the effectiveness of 3D-CT in predicting respiratory complications.

Methods: The study included 504 patients who underwent preoperative 3D-CT for surgical simulation followed by resection of lung cancer from October 2010 to March 2015. From the 3D-CT data, Goddard score and %LAA (LAA/lung field area) were measured retrospectively. A surgeon can construct 3D images completed within approximately 2-3 minutes for accurate analysis. We studied the relationship between the development of postoperative respiratory complications and independent variables including age, sex, forced expiratory volume in 1 second as percent forced vital capacity (FEV1%), histology, smoking status, surgical procedure, Goddard score, and %LAA.

Results: Postoperative pulmonary complications were observed in 71 patients (14.0%). These included prolonged air leakage >7 days (n=26), pneumonia (n=14), bronchial fistula (n=4), atelectasis (n=6), acute respiratory distress syndrome/interstitial pneumonia (n=2), empyema (n=8), and others (n=17). On multivariate analysis, gender (female vs male, $P = .049$), Goddard score ($P < .001$), %LAA ($P = .009$), and surgical procedure (bilobectomy and pneumonectomy vs others, $P = .001$) were statistically associated with postoperative pulmonary complications. At the cut-off levels that would indicate postoperative complications set by the ROC curves, the suitable cut-off value of Goddard score and %LAA were estimated to be 1 and 0.7%, respectively. Postoperative respiratory complications were observed in 32% of the patients who demonstrated Goddard score ≥ 1 and in 25% of the patients who showed %LAA ≥ 0.7 .

Conclusions: Goddard score and %LAA measured using 3D-CT were more powerful predictors of postoperative pulmonary complications than FEV1% or any other factors. High-quality 3D-CT enables surgeons to construct the model of respiratory function analysis and plays important roles in not only surgical simulations but also in the prediction of short-term surgical outcomes.



A. 3D image of emphysema B. Goddard score C. %LAA

A surgeon can construct 3D images completed within approximately 2-3 minutes for accurate analysis.

P81

The Diminishing Thoracic Surgery Experience During General Surgery Residency*W. Ragalie¹, P. Termuhlen², J. Patel³, A. G. Little⁴**¹Medical College of Wisconsin, Milwaukee, ²University of Minnesota Duluth, ³University of Kentucky, Lexington, ⁴University of Arizona, Tucson*

Purpose: Possible changes in the operative exposure to general thoracic surgery during general surgery residency have not been described recently. Our study aims to quantify and trend the operative experience among general surgery residents and to stratify cases according to level of complexity and resident participation.

Methods: A retrospective review of the prospectively maintained Accreditation Council for Graduate Medical Education resident case log database was performed. Cases were categorized by year and level of resident participation. Cases were further classified by level of complexity, designating esophagectomy, pneumonectomy, and lobectomy (video-assisted thoracoscopic surgery [VATS] or open) as "major general thoracic." Cases that did not involve hilar dissection (exploratory thoracotomy, wedge resection, pleurodesis, and "other thoracic") were classified as "other thoracic." A linear regression model was used to determine if there was a significant trend in case volumes over time.

Results: The most recent 11 years of case log data were analyzed. The 90th percentile of first assist thoracic cases decreased significantly over the study period by an average of 1.46 cases per year ($P = .0012$). There were statistically significant trends of decreased case volume in pneumonectomy at the surgeon junior (-0.012 case/year, $P < .0001$) and chief resident (-0.31 case/year, $P < .001$) level. This also was true of open lobectomy (surgeon junior -0.14 case/year, $P < .001$, chief -3.41 case/year, $P < .0001$). For VATS lobectomy, there was an increase in average case volume at the surgeon junior level (0.13 case/year, $P < .001$) but a decrease at chief resident level (-1.00 case/year, $P < .001$). For the remainder of analyzed thoracic cases, at the chief level, there was a decrease in open exploratory thoracotomy (-3.17 cases/year, $P < .001$), VATS exploratory thoracoscopy (-2.95 cases/year, $P < .0001$), open wedge resection (-1.52 cases/year, $P < .0227$), VATS wedge resection (-2.72 cases/year, $P = .0002$), "other thoracic" (-6.3 cases/year, $P = .0001$), and thoracoscopic pleurodesis (-2.09 cases/year, $P < .0001$).

Conclusions: There has been a small but statistically significant trend of less resident participation in general thoracic surgical cases. These findings may be a result of the work hours reduction causing less exposure to thoracic surgery and/or a reluctance to allow general surgery residents to perform the increasingly common minimally invasive procedures.

P82

Serial Improvement of Quality Indicators in Pediatric Thoracoscopic Pulmonary Resection: 10-Year Experience of 195 Consecutive Cases*C. Kang, Y. Hwang, H. Lee, I. Park, Y. Kim, S. Park**Seoul National University Hospital, South Korea*

Purpose: Video-assisted thoracoscopic (VATS) pulmonary resection in children is a technically demanding procedure that requires a relatively long learning period. This study aimed to evaluate the serial improvement of quality indicators according to case volume experience in pediatric VATS pulmonary resection of congenital lung disease.

Methods: VATS pulmonary resection in congenital lung disease was attempted in 207 patients and was completed successfully in 195 patients (5.8% conversion rate). Median age and body weight were 2.2 years and 12.9 kg. Congenital cystic adenomatoid malformation (n=149, 72%) and pulmonary sequestration (n=53, 25.6%) were the most common diagnoses. Conversion rate, operation time, complication rate, and length of hospital stay were evaluated according to the accumulated case volume (first period, 1-50 cases; second period, 51-100 cases; third period, over 100 cases).

Results: Lobectomy or bilobectomy was performed in 183 patients, and segmentectomy was performed in 12 patients. Median operative time was 95 minutes. Median length of hospital stay and median chest tube indwelling duration were 4 days and 2 days, respectively. After 50 cases, although operations were performed in younger and smaller patients, the quality indicators were improved continuously. A significant learning curve was identified in operation time, which was proportional to case volume (Figure). Conversion to open thoracotomy was occurred in 11 patients (91.7%) during the first 40 cases. Conversion rate and length of hospital stay were improved until 50 cases ($P < .001$), then maintained in steady status. However, postoperative complications continuously decreased over the three learning periods, even after 100 cases ($P < .001$) (Table).

Conclusions: Quality indicators in pediatric VATS pulmonary resection, including conversion rate, operation time, and length of hospital stay, were stabilized in relatively short learning periods. However, further improvement of reducing postoperative complications could be achieved after longer learning periods.

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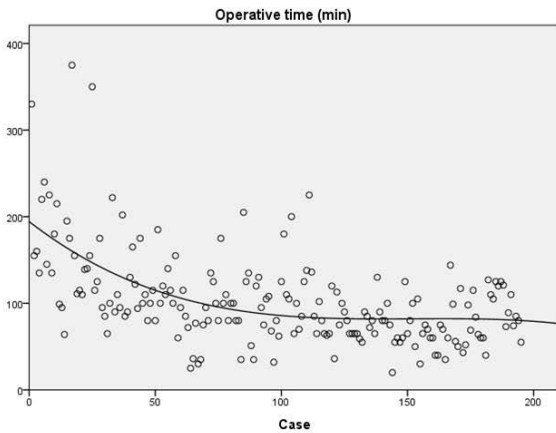


Figure. Learning curve of pediatric VATS lobectomy ($Y = 194 - 2.250X + 0.015X^2 - 3.275E-005X^3$; X = cumulative case, Y = operation time, $P < 0.001$)

	1st period	2nd period	3rd period	P value
Operation time (mean, minute)	146.9 ± 69.0	95.1 ± 39.8	84.3 ± 34.6	<0.001 ^a
Length of hospital stay (mean, day)	6.7 ± 5.4	4.5 ± 3.6	3.7 ± 2.2	<0.001 ^b
Chest tube duration (mean, day)	4.9 ± 5.1	3.3 ± 3.6	2.4 ± 1.9	<0.001 ^c
Age (mean, month)	61.1 ± 58.0	35.1 ± 27.7	34.0 ± 30.8	<0.001 ^d
Weight (mean, kg)	22.2 ± 18.8	14.5 ± 6.4	14.1 ± 7.8	<0.001 ^e
Complication rate (n, %)	7 (14.0%)	3 (6.0%)	2 (2.1%)	0.005

Continuous variables by ANOVA, Categorical variable by linear by linear association

- a. 1st period vs 2nd period, $P < 0.001$; 2nd period vs 3rd period, $P = 0.383$
- b. 1st period vs 2nd period, $P = 0.006$; 2nd period vs 3rd period, $P = 0.466$
- c. 1st period vs 2nd period, $P = 0.053$; 1st period vs 3rd period, $P < 0.001$; 2nd period vs 3rd period, $P = 0.245$
- d. 1st period vs 2nd period, $P = 0.003$; 2nd period vs 3rd period, $P = 0.987$
- e. 1st period vs 2nd period, $P = 0.003$; 2nd period vs 3rd period, $P = 0.972$

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Outcomes of Major Lung Resection for Lung Cancer in Patients With Cardiac Artery Diseases Taking Antithrombotic Agents

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Purpose: There is variability in previous research findings about the management and outcomes of lung resection in patients with cardiovascular diseases. The aim of this study was to clarify the outcomes of lung resection for lung cancer in patients with cardiovascular diseases, especially cardiac artery disease (CAD) in a large-scale multi-institutional cohort.

Methods: We retrospectively collected data on 1,254 patients who underwent major lung resection for lung cancer and had been diagnosed with coronary stenosis and/or atrial fibrillation in 58 institutions in Japan between January 2009 and December 2011. The primary outcome was 90-day postoperative mortality and in-hospital death. We also investigated 30-day postoperative mortality and 90-day postoperative morbidity. Postoperative mortality was evaluated according to National Cancer Institute Common Toxicity Criteria (version 4.0).

Results: Among the 1,254 patients, 886 (70.7%) and 452 (36.0%) were preoperatively diagnosed with coronary artery disease and atrial fibrillation, respectively, and 951 patients (75.8%) received antiplatelet therapy. Among the patients with history of coronary stents (n=532, 42.4%), drug-eluting stents were used in 204 (16.3%). Thirty-day mortality and 90-day mortality, including in-hospital death, were 12 (1.0%) and 32 (2.6%), respectively. The grade 5 complications included stent thrombosis (n=1), thromboembolic events without stent thrombosis (n=2), and bleeding (n=2). On multivariable regression, perioperative blood transfusions (OR 9.400, 95% CI 3.933-22.468), history of cerebrovascular disease (OR 3.574, 95% CI 1.612-7.923), intraoperative blood loss (100 mL or more) (OR 3.574, 95% CI 1.612-7.923), and history of heart failure (OR 2.827, 95% CI 1.175-6.802) were associated with a higher independent risk of 90-day postoperative mortality and in-hospital death, but cessation of antiplatelet therapy was not associated.

Conclusions: Major lung resection for lung cancer in patients with cardiac artery disease is feasible. Our study suggests that cessation of antiplatelet therapy may not increase postoperative complications, including stent thrombosis, in patients with history of coronary stents.

P84

Patient Preferences in Treatment Choices for Early Stage Lung Cancer

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COMMERCIAL RELATIONSHIPS T. A. D'Amico: Consultant/Advisory Board, Scanlan International; B. C. Tong: Consultant/Advisory Board, W. L. Gore & Associates

Purpose: Decision making for lung cancer treatment can be complex, as it involves both provider recommendation based on the patient's clinical condition, as well as patient preferences. This study describes the relative importance of several considerations in lung cancer treatment, from the patient's perspective.

Methods: A discrete choice experiment was conducted. Survey respondents were presented with a scenario that would make them eligible for the treatment of stage I lung cancer. Respondents chose among procedures that differed in terms of treatment modalities, potential for treatment-related complications, likelihood of recurrence, provider case volume, and distance needed to travel for treatment. Conjoint analysis derived relative weights for these attributes.

Results: A total of 225 responses were analyzed. Respondents were most willing to accept minimally invasive surgery for treatment of their hypothetical lung cancer, followed by stereotactic body radiation therapy (SBRT); they were least willing to accept thoracotomy and lobectomy. Treatment type and risk of recurrence were the most important attributes from the conjoint (each with relative weight 0.23), followed by provider volume (0.21), risk of major complications (0.18), and distance needed to travel for treatment (0.15). Procedural and treatment preferences did not vary with demographics, self-reported health status, or familiarity with the procedures.

Conclusions: Survey respondents preferred minimally invasive surgery over SBRT or thoracotomy for treatment of early stage non-small-cell lung cancer. Treatment modality and risk of cancer recurrence were the most important factors associated with treatment choices. Provider experience outweighs the potential need to travel for lung cancer treatment.

Table 1. Relative weights of attributes determining respondent choices

Attribute	Relative weight
Type of treatment	0.23
Risk of recurrence	0.23
Provider volume	0.21
Risk of complications	0.18
Travel distance for treatment	0.15

P85

Travel Distance to Treatment Center and Likelihood of Undergoing Surgery for Lung Cancer*T. Grenda, M. A. Healy, J. Lin, S. L. Wong**University of Michigan, Ann Arbor***COMMERCIAL RELATIONSHIPS** S. L. Wong: Research Grant, Agency for Healthcare Research and Quality, American Cancer Society

Purpose: There may be significant variation in use of surgery for potentially curable early stage lung cancer that may be influenced by patient travel distance to treatment centers. In this context, we examined associations between patient distance to treatment center and the likelihood of undergoing surgery for early stage lung cancer.

Methods: Using the National Cancer Data Base Participant User File, we identified patients (n=75,170) diagnosed with non-small-cell lung cancer (stage I-II) in 2010-2012 across 1,305 Commission on Cancer hospitals. We determined distance from patient residence to the treatment center and stratified by whether a patient received care at more than one center. We then used logistic regression models, adjusting for patient, tumor, and hospital characteristics, to examine the effect of patient distance to treatment center on the likelihood of undergoing surgery.

Results: Overall, 18% of all patients (n=75,170) did not undergo resection of early stage lung cancer, with only 2.5% of all patients determined to have risk factors contraindicating surgery. A total of 11% of all patients traveled ≥ 50 miles to a treatment center, with 13% receiving care at more than one center. Patients who received care at more than one institution and traveled a greater distance to a treatment center had increased odds of undergoing surgery (distance 50-99 miles: OR 2.39, 95% CI 1.83-3.13; ≥ 100 miles: OR 2.52, 95% CI 1.82-3.48) when compared to those with shorter travel distance (< 12.5 miles). Similar results, but to a lesser magnitude, were observed for patients who received care at one center (50-99 miles: OR 1.44, 95% CI 1.18-1.75; ≥ 100 miles: OR 1.34, 95% CI 1.02-1.76) when compared to those with a shorter travel distance (< 12.5 miles) to treatment center.

Conclusions: Patients with early stage lung cancer who traveled longer distances to treatment centers were more likely to undergo potentially curative resection. These findings suggest that patients' ability to travel longer distances to providers may affect access to surgical care for early stage lung cancer.

P86

Surgery and Surgical Consult Rates for Early Stage Lung Cancer in Ontario: A Population-Based Study

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COMMERCIAL RELATIONSHIPS T. K. Waddell: Consultant/Advisory Board, United Therapeutics Corporation; Ownership Interest, XOR Laboratories Toronto

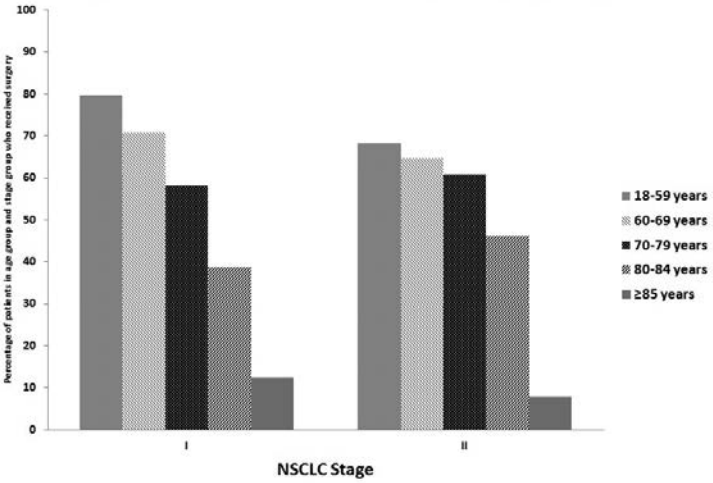
Purpose: Surgery offers the best chance for non-small-cell lung cancer (NSCLC), but resection rates are only approximately 20%. We investigated whether this is due to advanced stage at presentation or whether more modifiable factors might play a role by determining surgery and surgical consult rates by stage in Ontario, Canada.

Methods: Administrative, physician billing, and health registry information were linked retrospectively. All new diagnoses of NSCLC, surgical consultations, and surgical resections of all or part of a lung in Ontario between 2010 and 2012 were captured. The lung cancer resection rate for the study period was calculated. NSCLC stage distribution, surgical resection rates by stage, and surgical consult rates by stage were tabulated. Rates by age groups also were determined.

Results: Between 2010 and 2012, 17,752 persons were newly diagnosed with lung cancer in Ontario. The overall resection rate was 18.1%. 4,309 cases (24%) were stage I or II at diagnosis; 3,361 (78%) of these patients were under 80 years of age. Overall, only 62.5% (2,169/3,469) of stage I and 69.3% (582/840) of stage II patients received a surgical consult for NSCLC. For stage I and II, 77.5% (1,406/1,815) of patients under 70 years of age and 71.1% (2,391/3,361) of patients under 80 years of age received a consult for surgery. Only 58.7% (2,038/3,469) stage I and 59.6% (501/840) stage II patients received a resection. 75.9% (1,377/1,815) under 70 years of age and 68.0% (2,285/3,361) of patients under 80 years of age received a lung resection.

Conclusions: Only 58.9% of stage I and II NSCLC cases received surgery. For those receiving surgical consultation, a high proportion underwent resection. Decisions for potentially curable disease are being made without surgical consultation. Further research needs to determine whether those without surgery receive treatment and the reasons for low consultation rates.

Figure 1. Resection Rates For Non-Small Cell Lung Cancer by Stage and Age



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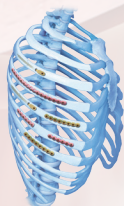
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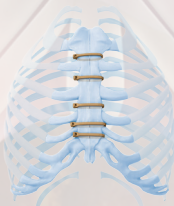
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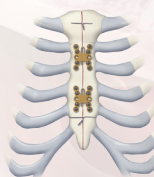
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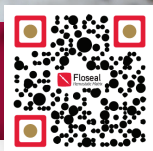
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Do not use FLOSEAL Matrix in patients with known allergies to materials of bovine origin. Do not use FLOSEAL Matrix in the closure of skin incisions because it may interfere with the healing of the skin edges. FLOSEAL Matrix contains Thrombin made from human plasma. It may carry a risk of transmitting infectious agents, e.g., viruses, and theoretically, the Creutzfeldt-Jakob disease (CJD) agent.

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Do not use FLOSEAL Matrix on bone surfaces where adhesives, such as methylmethacrylate or other acrylic adhesives, will be required to attach a prosthetic device.

Rx Only. For safe and proper use of this device, refer to the full Instructions for Use.

References: 1. Nasso G, Piancone F, Bonifazi R, et al. Prospective, randomized clinical trial of the FloSeal matrix sealant in cardiac surgery. *Ann Thorac Surg.* 2009;88:1520-1526. 2. SURGIFLO Hemostatic Matrix Kit Instructions for Use. Somerville, NJ: J&J Wound Management. 2014. 3. VITAGEL Surgical Hemostat Instructions for Use. Malvern, PA: Orthovita, Inc. 2012. 4. D-STAT Clamp Accessory Topical Hemostat Instructions for Use. Minneapolis, MN: Vascular Solutions, Inc. 2013. 5. FLOSEAL Hemostatic Matrix Instructions for Use. Hayward, CA: Baxter Healthcare Corporation.

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