Welcome

Bill Burfeind, Jr., MD
St. Luke’s Health Network
General Thoracic Surgery
Presented by the STS Task Force on Quality Initiatives

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Iman Aziz
Thomas Beaver
Tad Boeve
Bill Burfeind Jr.
Bill Caine
Joe Cleveland
Kathy Cornelius
Michael Culig
Chris Feindel
Tony Furnary
Kris George
Fred Grover
Baron Hamman
Chasity Harness
Jeff Jacobs
Cathy Knoff
Donny Likosky
Kevin Lobdell
John Mayer
James McClurken
Rich Prager
Syma Prince
Dan Raymond
Jeffrey Rich
Juan Sanchez
Dave Shahian
Frank Shannon
Alan Speir
Judy Tingley
Paul Uhlig
Robert Welsh
Michael Weyant
Jaelene Williams
Dave Wormuth
Presenters

Thomas D’Amico, MD
Todd Demmy, MD
Mark Onaitis, MD
Shari Meyerson, MD
Thoracoscopic Lobectomy: Why?

Thomas A. D’Amico MD

Gary Hock Professor of Surgery
Section Chief, Thoracic Surgery, Duke University Medical Center
Medical Director, Duke Cancer Institute
Disclosures

• None
Paradigm for surgical innovation against resistance, which would apply across surgical disciplines

• Common problem: Lung Cancer

• Established treatment: Thoracotomy

• Established treatment: Low mortality
Advantages of Thoracoscopic Lobectomy: 1995-2005

- Less postoperative pain
- Shorter chest tube duration
- Shorter length of stay
- Faster return to full activity
- Preservation of pulmonary function
- Lower inflammatory cytokine response
- Lower cost
Subjective QOL Favoring VATS Lobectomy

- Paradigm for surgical innovation against resistance, which would apply across surgical disciplines
- Pain: 8 Studies
- Functional Health: 3 Studies
- Symptom Control: 3 Studies
Operative Approach for Lobectomy and Postop Pain Measured by 11-Point Pain Scale

Objective Studies Favoring VATS Lobectomy

- Functional: 13 Studies
- Respiratory: 7 Studies
- Socioeconomic: 5 Studies
- Mediators: 10 Studies
36 patients with clinical stage I NSCLC

Randomized to VATS or thoracotomy for lobectomy

Inflammatory cytokines IL-6 and IL-8 levels significantly lower in VATS group

Preserved humoral immunity
Pulmonary Function, Postoperative Pain, Serum Cytokine Level after Lobectomy: A Comparison of VATS and Conventional Procedure

- 22 patients with clinical stage I NSCLC
- 13 VATS, 9 Thoracotomy (non-randomized)
- VATS associated
  - Less postoperative pain
  - Preserved pulmonary function
  - Less inflammatory cytokine production
Minimally Invasive Lobectomy Directed Towards Frail and High-Risk Patients

• 19 VATS cases compared to matched thoracotomy cases for anatomic lobectomy
• Age, sex, side, pulmonary function matched
• VATS associated with
  • Shorter LOS
  • Fewer chest tube days
  • Earlier return to full activity
  • Lower analgesic requirement
Advantages of Thoracoscopic Lobectomy: 1995-2005

1. Less postoperative pain
2. Shorter chest tube duration
3. Shorter length of stay
4. Faster return to full activity
5. Preservation of pulmonary function
6. Lower inflammatory cytokine response
7. Lower cost

Despite these proved advantages, only 30% of lobectomies were performed thoracoscopically by 2007
Lobectomy in STS Database

- Thoracoscopy
- Thoracotomy

Year

2002
2003
2004
2005
2006
2007

Patients (Number)

(10%)
(10%)
(13%)
(16%)
(22%)
(29%)

(200)
(601)
(723)
(882)
(1290)
(1346)
Feasibility and quality of life advantages were insufficient to improve adoption against concerns regarding:

- Safety (case reports of bleeding)
- Oncologic Efficacy (local and regional recurrence)
Thoracoscopic Lobectomy is Associated with Lower Morbidity Compared to Thoracotomy


<table>
<thead>
<tr>
<th>Feature</th>
<th>Thoracotomy (n=284)</th>
<th>VATS (n=284)</th>
<th>P</th>
</tr>
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<tbody>
<tr>
<td>At least 1 Cx</td>
<td>49%</td>
<td>31%</td>
<td>0.0001</td>
</tr>
<tr>
<td>Atrial Fibrillation</td>
<td>21%</td>
<td>13%</td>
<td>0.01</td>
</tr>
<tr>
<td>Atelectasis</td>
<td>12%</td>
<td>5%</td>
<td>0.006</td>
</tr>
<tr>
<td>Prolonged air leak</td>
<td>19%</td>
<td>13%</td>
<td>0.05</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>10%</td>
<td>5%</td>
<td>0.05</td>
</tr>
<tr>
<td>Transfusion</td>
<td>13%</td>
<td>4%</td>
<td>0.02</td>
</tr>
<tr>
<td>Renal Failure</td>
<td>5%</td>
<td>1%</td>
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Cx = complication
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Thoracoscopic Lobectomy is Associated with Lower Morbidity than Open Lobectomy: A Propensity-matched Analysis from the STS Database

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<td>25%</td>
<td>&lt;0.0001*</td>
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<tr>
<td>All Cardiovascular</td>
<td>13%</td>
<td>8%</td>
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<td>All Pulmonary</td>
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<td>Reintubation</td>
<td>3%</td>
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Thoracoscopic lobectomy is safer and superior to thoracotomy: should be considered the standard for all patients with early stage lung cancer.

Is there an incremental advantage in high-risk patients?
- ↑ Age
- ↓ Pulmonary function
- ↑ Extent of procedure
High Risk

- Under 70 Poor PFT: n=207 (22%)
- Over 70 Poor PFT: n=135 (14%)
- Over 70 Good PFT: n=203 (22%)
- Low Risk: n=398 (42%)
Risk Factors for Morbidity after Lobectomy for Lung Cancer in Elderly Patients

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<tr>
<th>Morbidity</th>
<th>HR</th>
<th>P Value</th>
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<td>Age</td>
<td>1.09</td>
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<td>A-fib</td>
<td>28%</td>
<td>18%</td>
<td>0.04</td>
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<td>Respiratory Cx</td>
<td>12%</td>
<td>5%</td>
<td>0.03</td>
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<tr>
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<td>16%</td>
<td>7%</td>
<td>0.01</td>
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Cx = complication; A-fib = atrial fibrillation
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The use of VATS is twice as important as age in predicting complications.

VATS is associated with fewer overall and specific complications in the elderly.

Cx = complication; A-fib = atrial fibrillation
High Risk

- Under 70 Poor PFT: n=207 (22%)
- Over 70 Poor PFT: n=135 (14%)
- Over 70 Good PFT: n=203 (22%)
- Low Risk: n=398 (42%)
Thoracoscopic Lobectomy Has Increasing Benefit in Patients with Pulmonary Function: A STS Database Analysis

Pulmonary Complications by FEV1

FEV1 <60, p=0.02

Thoracotomy n=8439
Thoracoscopy n=4531

Percent Pulmonary Complications

FEV1 predicted (range)

20-40 40-50 50-60 60-70 70-80 80-90 90-100

*
Pulmonary Complications by FEV1

VATS is associated with fewer overall and specific pulmonary complications.

The use of VATS is even more important in those with compromised pulmonary function.
Thoracoscopic Lobectomy Facilitates the Delivery of Chemotherapy after Resection for Lung Cancer

<table>
<thead>
<tr>
<th>100 Patients: Lobectomy + Adjuvant Chemo</th>
<th>Thoracotomy N=43</th>
<th>Thoracoscopic N=57</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any delayed chemo doses</td>
<td>58%</td>
<td>18%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Any reduced chemo doses</td>
<td>49%</td>
<td>26%</td>
<td>0.02</td>
</tr>
<tr>
<td>75% of planned regimen</td>
<td>40%</td>
<td>61%</td>
<td>0.03</td>
</tr>
</tbody>
</table>
• 21 comparative studies: 2 randomized
• Morbidity, mortality, recurrence, 5-year mortality
Systematic Review and Meta-Analysis of Randomized and Nonrandomized Trials on Safety and Efficacy of VATS Lobectomy

- VATS Lobectomy
  - Reduced systemic recurrence rate ($P=0.03$)
  
- Improved 5-year mortality rate ($P =0.04$)
## All-Cause Mortality

![All-Cause Mortality Graph](image)

<table>
<thead>
<tr>
<th>Study or subcategory</th>
<th>RR (random)</th>
<th>95% CI</th>
<th>Weight</th>
<th>RR (random)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugi et al²</td>
<td>0.90</td>
<td>(0.29 to 2.77)</td>
<td>11.70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Koizumi et al¹⁰</td>
<td>0.75</td>
<td>(0.30 to 1.89)</td>
<td>17.32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tashima et al¹²</td>
<td>0.25</td>
<td>(0.06 to 1.02)</td>
<td>7.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shigemura et al¹⁴</td>
<td>2.72</td>
<td>(0.31 to 23.65)</td>
<td>3.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shiraishi et al¹⁶</td>
<td>0.62</td>
<td>(0.25 to 1.52)</td>
<td>18.30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sawada et al¹⁶</td>
<td>0.43</td>
<td>(0.13 to 1.42)</td>
<td>10.09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sakuraba et al¹⁷</td>
<td>0.72</td>
<td>(0.37 to 1.41)</td>
<td>32.21</td>
<td></td>
<td></td>
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**Total (95% CI)**

- Total events: 44 (VATS), 65 (Open)
- Test for heterogeneity: $\chi^2_6 = 4.51$, $P = .61$, $I^2 = 0$
- Test for overall effect: $z = 2.11$, $P = .04$

**Favors VATS** Favors Open
A Meta-analysis of Unmatched and Matched Patients Comparing Video-assisted Thoracoscopic Lobectomy and Conventional Open Lobectomy

- Meta-analysis of 3 studies with propensity matching
Relative Risk of Perioperative Morbidity

A. Un-matched

<table>
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<tr>
<th>Study or Subgroup</th>
<th>VATS Events</th>
<th>VATS Total</th>
<th>Thoracotomy Events</th>
<th>Thoracotomy Total</th>
<th>Weight</th>
<th>Risk Ratio M-H, Random, 95% CI</th>
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<tr>
<td>Ilonen 2011</td>
<td>12</td>
<td>116</td>
<td>55</td>
<td>212</td>
<td>10.8%</td>
<td>0.40 [0.22, 0.71]</td>
</tr>
<tr>
<td>Paul 2010</td>
<td>336</td>
<td>1281</td>
<td>1788</td>
<td>5042</td>
<td>47.4%</td>
<td>0.74 [0.67, 0.82]</td>
</tr>
<tr>
<td>Villamizar 2009</td>
<td>212</td>
<td>697</td>
<td>190</td>
<td>382</td>
<td>41.8%</td>
<td>0.61 [0.53, 0.71]</td>
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Total (95% CI)

Total events: 2094
Total events: 5636
Heterogeneity: $\tau^2 = 0.02; \chi^2 = 7.78, df = 2 (P = 0.02); I^2 = 74$
Test for overall effect: $Z = 4.09 (P < 0.0001)$

B. Matched

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<td>1281</td>
<td>444</td>
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<td>284</td>
<td>140</td>
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<td>39.0%</td>
<td>0.63 [0.51, 0.78]</td>
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Total (95% CI)

Total events: 1681
Total events: 1681
Heterogeneity: $\tau^2 = 0.03; \chi^2 = 5.71, df = 2 (P = 0.06); I^2 = 65$
Test for overall effect: $Z = 3.55 (P = 0.0004)$
Thoracoscopic Approach to Lobectomy for Lung Cancer Does Not Compromise Oncologic Efficacy

• 1087 patients: 610 VATS, 477 thoracotomy
• Multivariable analysis, worse survival associated:
  1. Increasing age (HR 1.02 per year, p<0.0001)
  2. Pathologic stage (HR 1.45/stage, p<0.0001)
  3. Thoracotomy approach (HR 1.22, p=0.01)
Survival of All Patients by Operative Approach

Log-rank test: \( p < 0.001 \)
Survival of Propensity Matched Patients by Operative Approach

Log-rank test: p=0.328
STS Database: % Thoracoscopic Lobectomy

Despite these proved advantages, only 46% of lobectomies were performed thoracoscopically by 2010.
Video-assisted Thoracoscopic Surgery versus Open Lobectomy for Non-small-cell Lung Cancer: A Propensity-matched Analysis of Outcome from the ESTS Database

Thoracoscopic Lobectomy

- Advantages in safety (Cx) and quality of life
- Equal or superior oncologic outcomes and survival
- Superior compliance with adjuvant chemotherapy
- More differentially beneficial than any other minimally invasive procedure vs open alternative
- Even more advantageous for complex patients (high-risk) and complex resections (locally advanced disease)
- Underutilized worldwide
Oncologic Validity of Minimally Invasive Pulmonary Lobectomy

Todd L. Demmy, MD

Professor of Oncology
Department of Thoracic Surgery
Roswell Park Cancer Institute
Disclosures

• Consultant for Medtronic
Objectives

- Randomized Trials
- Retrospective/Large Database
- Correlative Mechanistic (TNM) Considerations
Randomized Trial of Lobectomy Versus Limited Resection for T1 N0 Non–Small Cell Lung Cancer

Lung Cancer Study Group (Prepared by Robert J. Ginsberg, MD, and Lawrence V. Rubinstein, PhD)

- No Analysis type of approach
Video-assisted Thoracoscopic Lobectomy Achieves a Satisfactory Long-term Prognosis in Patients with Clinical Stage IA Lung Cancer

Kazuro Sugi, M.D.,1 Yoshikazu Kaneda, M.D.,2 Kensuke Esato, M.D.2
1Department of Clinical Research, National Sanjo Hospital, Higashikiwa 685, Ube, Yamaguchi, 755-0241 Japan
2First Department of Surgery, Yamaguchi University School of Medicine, Kogushi 1144, Ube, Yamaguchi, 755-8505 Japan

100 Randomized, Ages 62-72, Same One Year Stage Specific Survival

- Significantly fewer complications for VATS

![Graph showing survival rates for VATS and Open procedures at stages 1A, 2A, and 3A. At 1 year, 4 VATS vs. 8 Open Deaths, p=ns.]

Phase 2, in 10 centres (24 months recruitment)

n=1312

All patients referred for lobectomy for lung cancer (100%)

n=787

Eligible for VIOLET (60%)

Not eligible, 40%, n=525

Not recruited, 50% in phase 1 centers', 70% phase 2 centers' in first 6 months, 50% thereafter, n=411

Potential n=376
Required n=336

336 randomised to:

168 VATS
168 Open surgery

Phase 1 & 2 patients (162+336) followed up after surgery, n=498

>95% followed to primary outcome (5 weeks), 80% followed to 1 year
VATS vs. Axillary Thoracotomy N=481
Randomized - China

• Multicenter trial – 5 sites, Guangzhou, Chongqing, Shanghai (2), Shenzhen
• 3.72% Conversion
• 16 min faster and less blood loss in VATS (both p=0.001)
• Positive margins 1 VATS and 5 Open
• Lymph nodes 10 vs 12, p=0.389
• Long-term survival pending

• Proceedings of STS Annual Meeting 2017, Houston, TX
High Volume - 1100 VATS Lobes

• MSK Data, Stage 1, 2002-2012
• Long-term Lobectomy Survival by Approach for Clinical Stage I NSCLC (516 Matched Cases)
• Minimally invasive shorter LOS
• Robotic (8% of cases), more nodes
• No difference in LT Survival

Meta-Analyses

2009

Yan, et al, J Clin Oncol 27:2553-2562

2011


All Cause Mortality

FAVOR VATS

FAVOR VATS
CALGB 31001, an Ancillary Analysis of CALGB 140202 (Alliance)

- Patients from Lung Cancer Tumor Bank Stage I+2
- Open (n = 175) vs. VATS (n = 175); matched

ACOSOG Z0030 Trial Propensity Matched, VATS N=59 vs. Open N=549

VATS in 29,899 Medicare Patients STS Database Analysis

January 23, 2017
J. Maxwell Chamberlain
Paper

Kaplan–Meier unadjusted survival curves
Multivariable Cox model adjusted survival curves

No. of Patients / Percent Survival

VATS 14182 10005/90.1 6662/80.1 4259/71.7 2578/63.9 1476/57.3 745/51.6 318/46.5 137/41.5 51/34.6 25/33.8 11/25.4
Open 15717 11756/83.8 8924/72.5 6885/64.1 4853/56.5 3367/50.2 2307/45.0 1431/40.1 903/35.2 405/29.9 143/25.7 39/22.4
France – National Registry EPITHOR 24,811
Open and 1,278 VATS
European (ESTS) Registry N=28,771
5,442 Propensity Matched

- Fewer VATS complications
- Less VATS perioperative mortality 1.0 vs. 1.9%, p=0.02

23% VATS
Commentary

Re: Video-assisted thoracoscopic surgery versus open lobectomy for primary non-small-cell lung cancer: a propensity-matched analysis of outcome from the European Society of Thoracic Surgeon database

Douglas J. Mathisen

- Selection bias
  - “Procedure done only 10% of time”
- Upstaging Differences (Nodes)
- “Cure remains the goal of surgical therapy and must not be compromised”
ACOSOG Z0030 Trial Sampling vs. Dissection N=1023

Overall Survival by Arm - Eligible patients

MGH Early-stage NSCLC Formal VATS Lobes/Segs N=550

- Sampling > 3 LNS
  - 10 RNs increased nodal upstaging
  - Only LNS > 3 independently predicted lower mortality in VATS lobectomy and segmentectomy

Less Nodal Upstaging VATS STS Database

Node Concerns, Danish Registry

Cornell VATS Reliability

A. Individual

B. Institutional

62,206 Lobectomies Performed 2010 - 2012
NCDB Data - Stage I-IIIA, 1215 Hospitals

- More nodes for VATS than Open at academic centers in early stage


Between 1998 and 2001, 128 patients with peripheral lung nodules ≤ 3 cm

- 4-8 cm Access
- Pure Video Guidance
- Hilar Dissection
- No Rib Spreading
European Registry Data Nodal Upstaging

Summary – Node Question

- Plausible mechanisms of VATS oncologic failure
  - Inadequate Nodal Dissection
  - Incomplete Resection of Primary
  - Tumor Dissemination
  - Missing local spread
  - Systemic Effects

- Centrality bias seems to be a more plausible for difference in upstaging seen by VATS in large series

- No strong signal in low or high nodal failure risk populations that inadequate nodal assessment would be a mechanism of VATS survival inferiority
Central Tumors

- Bronchial
- Direct tumor invasion
- cN1,N2
- 19% Conversion
- 88 Propensity
  Matched pairs

After Induction Therapy: Duke

Advanced VATS Resections: Survival N = 125

- Tumors ≥ 4cm
- Any T3 or T4 tumor
- Neoadjuvant chemotherapy

---

Advanced VATS Resections: Survival N = 125

* Significant

Cornell Induction cases, propensity matched

Disease-free Survival

Summary – Tumor

- Plausible mechanisms of VATS oncologic failure
  - Inadequate Nodal Dissection
  - Incomplete Resection of Primary
  - Tumor Dissemination
  - Missing local spread
  - Systemic Effects

- Despite taking on higher stage (T and N) tumors, centers are not reporting increased local recurrences or worse survivals by VATS

- This combined with lack of signal of impaired local control for early stage tumors reduces the plausibility of this mechanism
Systemic Effect Mechanisms

- **Negative mechanisms Open compared to VATS**
  - Pain
  - Bleeding
  - Cytokines
  - Accentuated in frail populations

- **Negative mechanisms VATS compared to Open**
  - Prolonged time under anesthesia
Special Populations Amplifying Salutary Effects of VATS

- Pulmonary Compromise
- Cardiac Dysfunction
- Extrathoracic Malignancy
- Poor Physical Performance
- Rheumatologic / Orthopaedic
- Advanced Age
- Vascular Problems
- Recent or Impending Major Operations
- Psychologic / Neurologic
- Immunosuppression / Impaired Wound Healing
Cause-Specific Mortality and Morbidity in Stage I Lung Cancer by Age

NSQIP Analysis 2005-2012: Mortality by Age Favoring VATS

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Odds Ratio</th>
<th>95% CI</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>65–69 years</td>
<td>2.72</td>
<td>1.00–9.46</td>
<td>0.039</td>
</tr>
<tr>
<td>70–74 years</td>
<td>4.41</td>
<td>1.28–23.42</td>
<td>0.008</td>
</tr>
<tr>
<td>75–80 years</td>
<td>1.60</td>
<td>0.50–5.95</td>
<td>0.450</td>
</tr>
</tbody>
</table>
Better Outcome for Poor PFTs – STS

“Excisional surgery for cancer cure: therapy at a cost,”

- Circulating tumor cells
- LPS
- Inflammatory cytokines
- Immunosuppression
- Opioids
- Transfusion

\[ \text{Minimal Residual Disease} \]

\[ \text{Accelerated systemic/local recurrence} \]
Recurrence Dynamics

“Air Got to the Tumor”

Demicheli, J Thorac Oncol. 2012;7: 723–730
Opioid and Cancer


μ Opioid Receptor
EBL 250cc (HR: 1.65, 95%CI: 1.04-2.61) independently predicted poor DFS

EBL was the only modifiable predictor of poor DFS

Circulating Tumor Cells

Delay of Adjuvant Chemotherapy *Path Stage II or IIIA NSCLC*

- **VATS group** (N=193)
  - ≤ 8 weeks: • p = 0.276
  - > 8 weeks: • p = 0.030

- **Open group** (N=169)
  - ≤ 8 weeks: • p = 0.276
  - > 8 weeks: • p = 0.030

• No difference in time to initiation.

DFS curves similar

Jing, et al. JBUON 2016; 21(6): 1524-1529
Conclusions - 1

• VATS lobectomy has accrued more evidence of oncologic safety than previous approach enhancements accepted by our profession, e.g. Axillary thoracotomy

• Evidence for adoption for this “new” technology is on par used by related specialties such radiation oncology to adopt similar enhancements to their therapies
Conclusions - 2

- Greatest oncologic concern has been in VATS nodal assessment, although this is attributable to early central tumor avoidance the signal has been weak as it pertains to survival
- “Stress testing” plausible mechanisms in patients high risk for failures have not yet generated concerns
Conclusions - 3

- A large proportion of the lung cancer population is older or otherwise frail and it is this group that has higher risk of non-oncologic mortality.
- For this group there is a strong signal that VATS is superior largely due to the reduction in complications and mortality.
Conclusions - 4

• Reductions in blood loss, long-term pain, and mediators known to affect tumor dynamics and host immune function are plausible mechanisms that favor less invasive operations

• It is reasonable to accept VATS lobectomy as a generally equivalent oncologic operation and preferable for frail patients until there is evidence to the contrary
Disclosures

• None
VATS/Minimally-invasive Definition

- Absence of rib spreading
- Visualization by camera
Importance of Minimally-invasive Resection

• Less pain
• Decreased LOS
• Earlier return to work
• Better tolerance of adjuvant therapy
Thoracoscopic (VATS) Lobectomy

• Adoption is less than 50% nationally
  • SEER Database: 8%
  • STS Database: 30-40%
  • Surveys: 50% of recent trainees

• Reasons are multiple
  • Discomfort with bleeding risk
  • Dissatisfaction with lymph node harvest
  • Learning curve, time to complete operation
VATS Pro/Con

• VATS strengths
  • Flexibility
  • Proximity of surgeon to patient
  • Possibly (probably) cheaper

• VATS weaknesses
  • Reliance on help
  • 2D camera/monitors
  • Difficulty of LN dissection?
Robot Pro/Con

- Robotic strengths
  - 3D camera with 10x magnification
  - Wristed instruments

- Robotic weaknesses
  - Inflexibility
  - No haptic feedback
  - Reliance on help

- 200 consecutive lobectomies
- Median operative times 90 minutes
- 3 conversions
- Median LOS 3d
- 325 lobectomies at three institutions with eight conversions
- Median chest tube duration 3d [1,23]
- 1 perioperative mortality (0.3%)
• 168 consecutive attempted robotic cases (106 successful 4-arm lobectomies)
• Median chest tube duration 1.5d [1,6]
• Median hospital stay 2d [1,7]
• Median no. of N1 nodes resected [5 (4 in 3:1 matched thoracotomy group)]
• 13 conversions (1 in last 106)
Comparison of Video-Assisted Thoracoscopic Surgery and Robotic Approaches for Clinical Stage I and Stage II Non-Small Cell Lung Cancer Using The Society of Thoracic Surgeons Database

Brian E. Louie, MD, Jennifer L. Wilson, MD, Sunghee Kim, PhD, Robert J. Cerfolio, MD, Bernard J. Park, MD, Alexander S. Farivar, MD, Eric Vallières, MD, Ralph W. Aye, MD, William R. Burfeind, Jr, MD, and Mark I. Block, MD


**Table 4. Pathologic Nodal Upstaging Overall and Stratified by Clinical Staging**

<table>
<thead>
<tr>
<th>Clinical Stage</th>
<th>Overall</th>
<th>Robotic Treatment</th>
<th>VATS</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>cT1aN0</td>
<td>322/5,412 (5.95)</td>
<td>29/471 (6.16)</td>
<td>293/4,941 (5.93)</td>
<td>0.8422</td>
</tr>
<tr>
<td>cT1bN0</td>
<td>257/3,008 (8.54)</td>
<td>19/293 (6.48)</td>
<td>238/2,715 (8.77)</td>
<td>0.1844</td>
</tr>
<tr>
<td>cT2aN0</td>
<td>254/2,307 (11.01)</td>
<td>34/244 (13.93)</td>
<td>220/2,063 (10.66)</td>
<td>0.1228</td>
</tr>
<tr>
<td>cT2bN0</td>
<td>69/546 (12.64)</td>
<td>7/47 (14.89)</td>
<td>62/499 (12.42)</td>
<td>0.6263</td>
</tr>
<tr>
<td>Total</td>
<td>902/11,273 (8.00)</td>
<td>89/7,055 (8.44)</td>
<td>813/10,218 (7.96)</td>
<td>0.5847</td>
</tr>
</tbody>
</table>

VATS = video-assisted thoracoscopic surgery.

- 13,598 patients: No differences in morbidity/mortality
- Robotic lobes had significantly longer OR time
Incisions

3 arms: 5th, 9th, 9th spaces
Camera: 8th space
Accessory: 10th space
Cost, Effectiveness, Cost-effectiveness?

• Calculating cost of robotic lobectomy is difficult
  • There is no way that the robot is cheaper than VATS
  • If robotic technique can bring a surgeon from open to minimally-invasive lobectomy, there will be cost savings
  • Marketing is intimately related to cost

• Potential effectiveness benefits
  • Better lymph node dissection?
  • Less pain?
  • Fewer conversions?
  • Better teaching (dual console, simulation)
Learning Minimally Invasive Lobectomy

Shari L. Meyerson, M.D.

Associate Professor of Surgery
Northwestern University
Disclosures

• None
"Nurse, get on the internet, go to SURGERY.COM, scroll down and click on the 'Are you totally lost?' icon."
Procedures Developed/Popularized Since I Graduated

• VATS Lobectomy
• Robotic Thymectomy
• Per-Oral Endoscopic Myotomy (POEM)
• Endobronchial Ultrasound
Incorporating New Technology Into Practice

http://www.gartner.com/technology/research/methodologies/hype-cycle.jsp
So, What if I Want to learn:

- VATS Lobectomy
Learning Framework

• What background information do I need to learn?
• What components of this procedure are new skills for me?
• What simulators exist to help me learn?
• Should I take a formal course?
Step 1 - Homework

• What background information do I need to learn?

• What components of this procedure are new skills for me?
YouTube
• Different view of the anatomy
• Unfamiliar instruments
• Done from the hilum up rather than the fissure down

Write out the steps of the operation

List instruments used (do you know/have them)

Next time you’re doing a VATS wedge or decort, try to reproduce the retraction, look at the hilum
Choosing a Simulator

Low Fidelity → High Fidelity

Component Task → Full Operation

Tissue-Based → Inanimate or VR

One Shot → Reusable
Step 2 - Practice

- What simulators exist to help me learn?

Trehan K, Kemp CD, Yang SC. JTCVS 2014; 147
Learning in Practice

Can I build it?
Can I buy it?
Can I borrow/visit it?

Cost
Re-usability
Specific needs
Access
Special requirements
• Must be bought (cost?)
• Good for learning anatomy/steps
• Not reusable (need more inserts)
• Just put it in a lap trainer

Obuchi T, et al. Surg Today 2012; 42

• Can be built (instructions in paper)
• Good for tissue feel/dissection
• Not reusable (need more inserts)
• Just put it in a lap trainer
• Animal tissue (may need facility)


• Requires VR platform (cost/access?)
• Good for learning anatomy/steps
• Reusable, multiple practices

Step 3 – Try It in a Patient

• Should I take a formal course?
  • If you are not familiar with the equipment - YES
  • If you can’t get access to simulation - YES

• If you have a friend/local surgeon who can help/proctor – maybe/maybe not
Translation of Skills

- Tissue quality
- Angles of access/incisions
- Time
- Variations in anatomy
- Force required
- Effects of pathology/tumor size

WELCOME TO THE REAL WORLD
Start with Angle of Approach

- Anterior to posterior rather than down through fissure
Get Used To the Thoracoscopic View
Get Used To New Instruments

Conventional Scissors

VATS / MICS Scissors

Pivot Point 1

Sliding Shaft

Pivot Point 2

Working Length
Shrink Incision and Move Anteriorly
Phone a Friend

KEEP CALM
AND
CALL YOUR PRECEPTOR
So, What If instead I Want to Learn:

- Robotic Lobectomy
Step 1 - Homework

• What background information do I need to learn?
  • Same as VATS lobectomy

• What components of this procedure are new skills for me?
  • Totally new platform/instruments
Step 2 - Practice

• What simulators exist to help me learn?

• Due to technology there are limited simulator options

• Find an academic center or talk to your rep. If hospital purchasing a robot make sure simulator module included
Step 2 - Practice

• What simulators exist to help me learn?

• Limited options – You can’t build this at home

Liss ML, McDougall EM. Cancer J 2013; 19
Step 3 – Try It in a Patient

• Should I take a formal course?
  • Absolutely!!!!

• Unfamiliar platform = need help learning
• Utilize company to identify training options and proctor
Tips for Success

• Be honest about your abilities
• Start slowly, one component at a time
• Converting to open means intelligence not failure
• Retake a course if you are struggling
Learning through Simulation

Homework

Reflection

Try It

Practice
Questions

Please direct questions, comments and feedback to Sydney Clinton, STS Quality Metrics & Initiatives Coordinator, at sclinton@sts.org.
Thank you for viewing the Lobectomy for Lung Cancer Webinar

Please note that webinar slides and other materials are posted on the STS website.