STS/EACTS Latin America Cardiovascular Surgery Conference

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Hilton Cartagena | Cartagena, Colombia

The Society of Thoracic Surgeons

EACTS

Children's National

New Strategies in Cardia Intensive Care

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Disclosures

I have no real or perceived conflicts of interest related to this talk

I will not be discussing off-label use of drugs or devices

Outline

I will not be discussing:

- New Medicines
- New Operations
- New Ventilator Strategies

1. Reducing the Frequency of Cardiac Arrest
   - And increasing the critical examination of those that do occur
2. Improving Monitoring
   - At the Bedside
   - Telemedicine
3. Re-thinking Single Ventricle Physiology
4. Neuroprotection and Neurodevelopment – (16:28)

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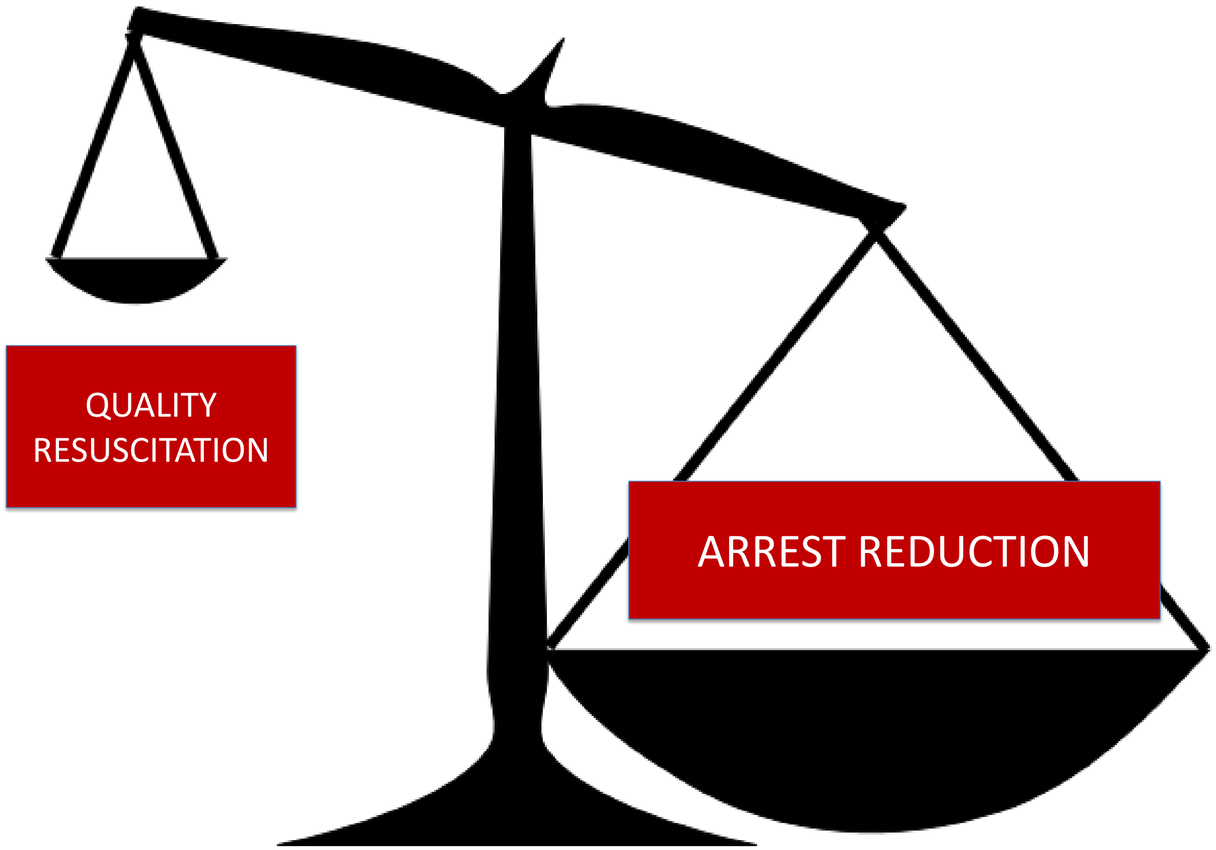
Reducing the Frequency of Cardiac Arrest

Emphasis Tipping From Quality of CPR towards Reduction of Cardiac Arrests



Darren Klugman, MD

Wes Diddle, MD

Justine Fortkiewicz-Mize, MSN

Reducing the Frequency of Cardiac Arrest

Strategies

1. Daily Identification of High-Risk Patients (“HRP”)
2. Full Team Rounds Four Times per Day
3. Shared Communication & “Mental Model”
4. Escalation Algorithm

CICU High Risk Cardiac Arrest Reduction Clinical Pathway Overview

	Day 1	Day 2-3	Day 4-5	Day 5-7
Overarching Goal	☑ Hemostasis ☑ Hemodynamic Stability	☑ Hemodynamic Stability ☑ Diuresis ☑ Chest closure (as applicable)	☑ Diuresis ☑ Wean to extubate	☑ Nutrition ☑ Weaning
CARP Initiatives	☑ HRP ☑ HFR ☐ Case Scenario	☑ HRP ☑ HFR ☐ Case Scenario	☑ HRP ☑ HFR ☐ Case Scenario	☑ HRP ☑ HFR ☐ Case Scenario
If not, why not?	☐ Massive Transfusion ☐ Elective ECMO ☐ TEG ☐ CV surgery consult ☐ Attending Peer Check	☐ Repeat echo ☐ Cardiac cath ☐ Stress dose steroids ☐ PD cath placement ☐ Attending Peer Check	☐ Attending Peer check	☐ Attending Peer check
HAC/QI Reminders		Remove LA Remove foley		Remove RA Place PICC?

Inclusion Criteria & Guidance for Use

Please check one of the following HRP indications:

Surgical Patient Criteria

All neonates (<30 days) after cardiac surgery requiring CPB

Any patients undergoing a Stage 1 palliation (e.g. PAB, hybrid, shunt, etc)

Duration of bundle activation: from postoperative admission until 24 hours after extubation to maximum of 7 days postoperative

Medical Patient Criteria

Any medical patients requiring intubation/mechanical ventilation within first 4 hours

Duration of bundle activation: from intubation until 24 hours after extubation to maximum of 72 hours from intubation

Other Indication

Any patients the care team feels is high risk. Details:_____

***Pathway should be automatically discontinued if patient is placed on ECMO**

***CICU attending: Return completed tools w/ patient label attached to CARP Box @ Welcome 2**

PATIENT LABEL

Date/Time initiated_____ LIP Initials_____

GOAL: Hemostasis & Hemodynamic Stability (Day 1)

I know what is wrong:

I know what to worry about:

Preventative Measures

- ☑ PRE-SEDATE with all noxious stimuli (e.g IV sticks, gastric tube placement, etc)
- ☑ 24 hour EEG
- ☑ No Bath, including CHG
- ☑ No Weights
- ☑ No linen changes
- ☑ Pacemaker cables attached to patient wires, box at bedside
  - Settings:
    - Mode: _____
    - Lower Rate: _____
- ☑ Initial suctioning ETT with LIP present
- ☑ Subsequent suction plan:
  - ☐ Pre-sedate & paralyze
  - ☐ Pre-sedate only
  - ☐ LIP present
  - ☐ LIP notified
  - ☑ Standard (2-person present)

LIP: Goal/Alarm Parameters

	AM	PM
HR		
SBP		
MAP		
Sats		
pH		
RAP		
LAP		
Temp		

RN1: Post-Op Bleeding (cc/ kg/hr)

Hour 1:	Hour 2:	Hour 3-6:

Resuscitation Readiness

- ☑ 1 code dose epi (0.1mg/mL) drawn up & ready to administer at the bedside
- ☑ Blood on hold for ECMO (1 unit for pts<10kg, 2 units for pts >/= 10kg)
- Vials at bedside:
  - ☑ Epi (0.1mg/mL)
  - ☐ Calcium Chloride
  - ☐ Sodium Bicarbonate
  - ☐ Rocuronium
  - ☐ Other _____

Notify LIP

- For VS outside of alarm parameters
- Prior to ETT manipulation (re-taping etc)
- When changing lines containing vasoactives
- Chest tube output >10mL/kg/hr x 1 hr OR >5mL/kg/hr x 2 hours
- *Attending notification (by RN or LIP/Fellow) for sustained HR>200, pH <7.25, new PaO2 <30, addition of new vasoactive, impending arrest*

Time (in minutes, circle one)	< 5	5-10	>10	ATTENDANCE	
iAware Open & Reviewed		Y / N		Bedside RN	Y / N
T3 Open & Reviewed		Y / N		Charge RN	Y / N
Goals addressed from rounds		Y / N		Attending MD	Y / N
Overall Trajectory				Fellow MD/NP	Y / N
Improving	Same	Worse		RT	Y / N

New Concerns:

Interventions Made:

If rounds were not able to be conducted/participants were absent, why?

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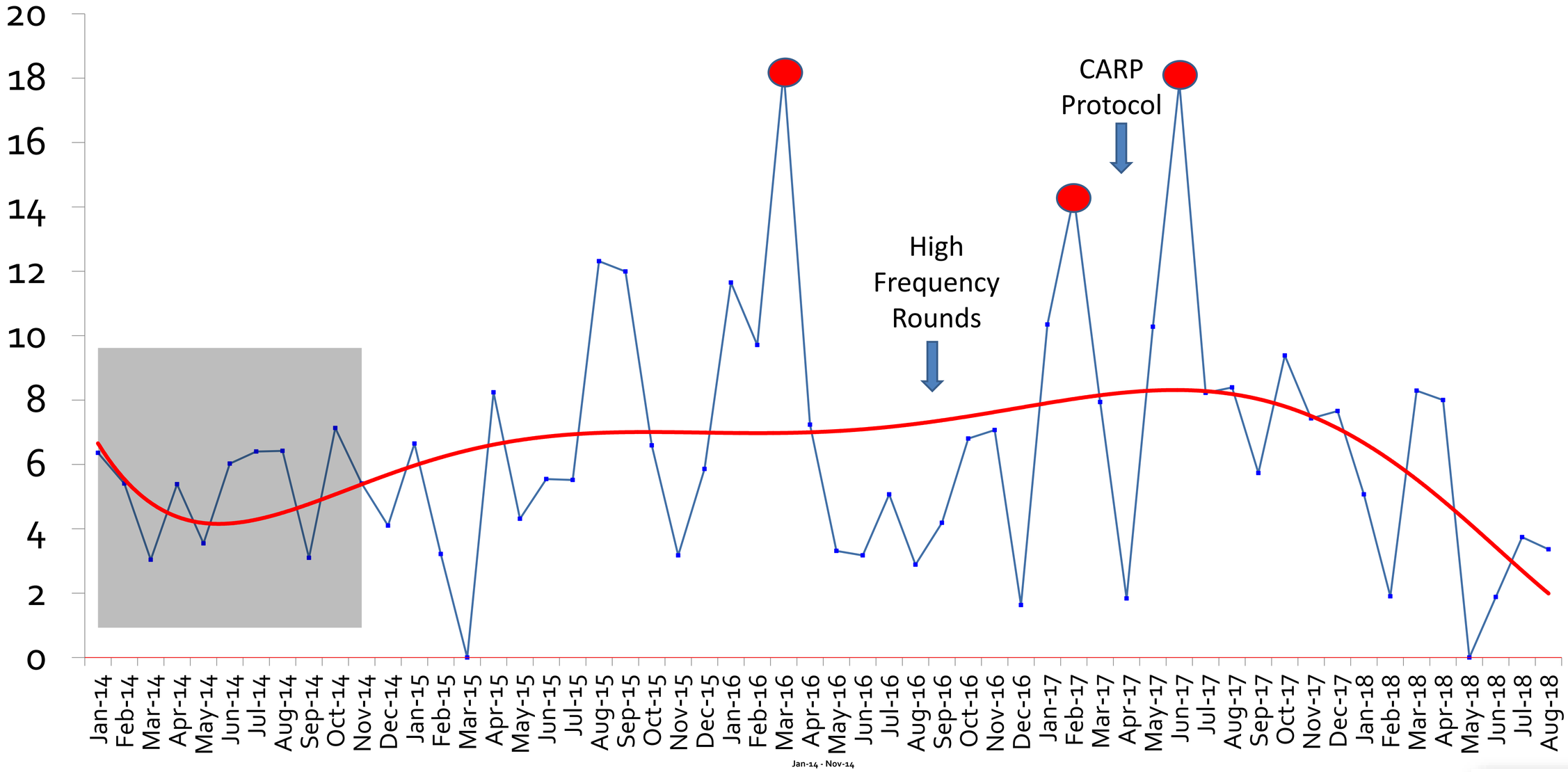
CICU Adjusted Arrests per 1,000 Patient Days



Critical Event Review

The Use of Video and "Debriefing" in the Cardiac ICU

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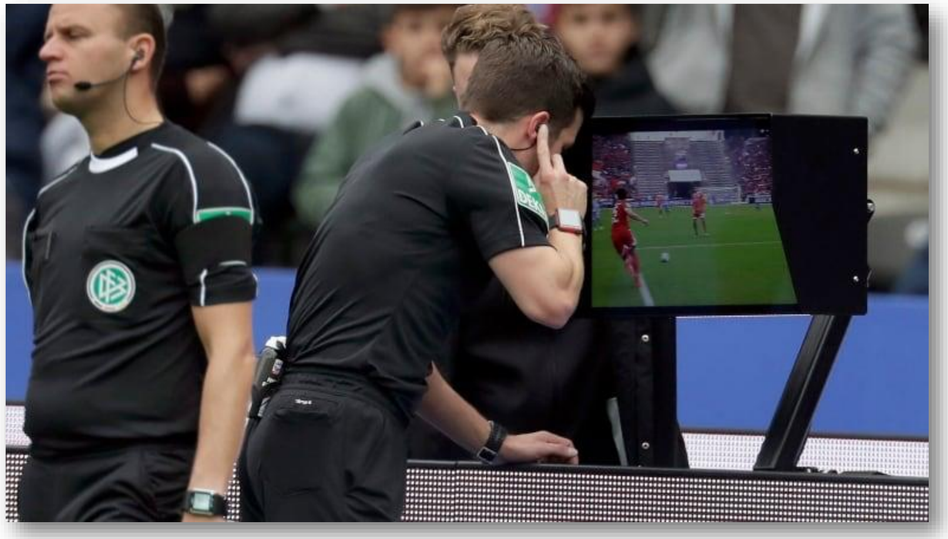
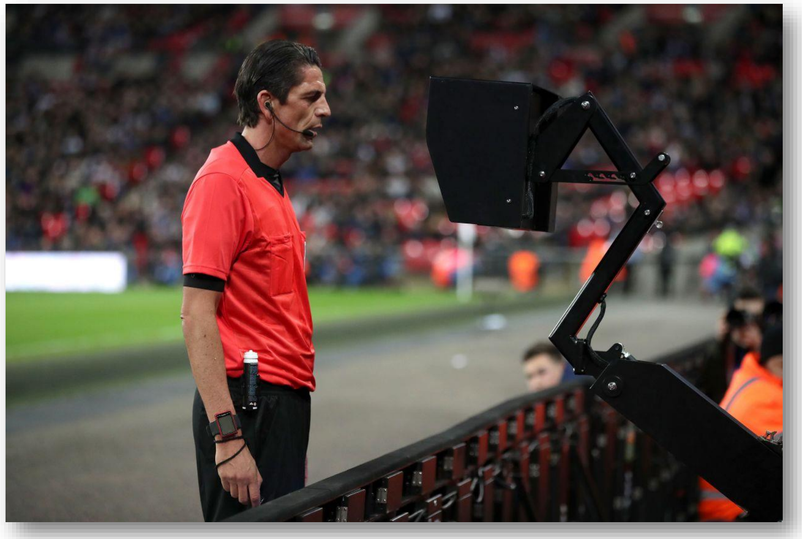
“Instant Replay”

The World Cup and
National Football League
“Gets It Right”





Healthcare: The Next Group for Body Cameras?

Video Debriefing in the Cardiac ICU

John T. Berger, MD

- 24 hour Video Recording of Each Room
- Stored for 24 hours
- More accurate and reliable understanding of the events
  - "Everything was fine until the patient arrested"
- Better learning and performance improvement
- Learning theory – Reflection on Action

Performance during PICU CPR Events (n=40)

CPR Target	Monitor / Defibrillator Data	Code Leader Recall
Inadequate Chest Compression (CC) Rate	7.5%	0%
Inadequate CC Depth	10%	0%
CPR interruption > 10 sec	80%	47%
Over-ventilation during CPR	71%	67%

You cannot correct what you cannot see

McInnes et al. Resuscitation 2012

8 year old with Severe Pulmonary Hypertension after Cardiac Catheterization

Nurse Called Physician: “Patient Unresponsive”

"INSTANT REPLAY"

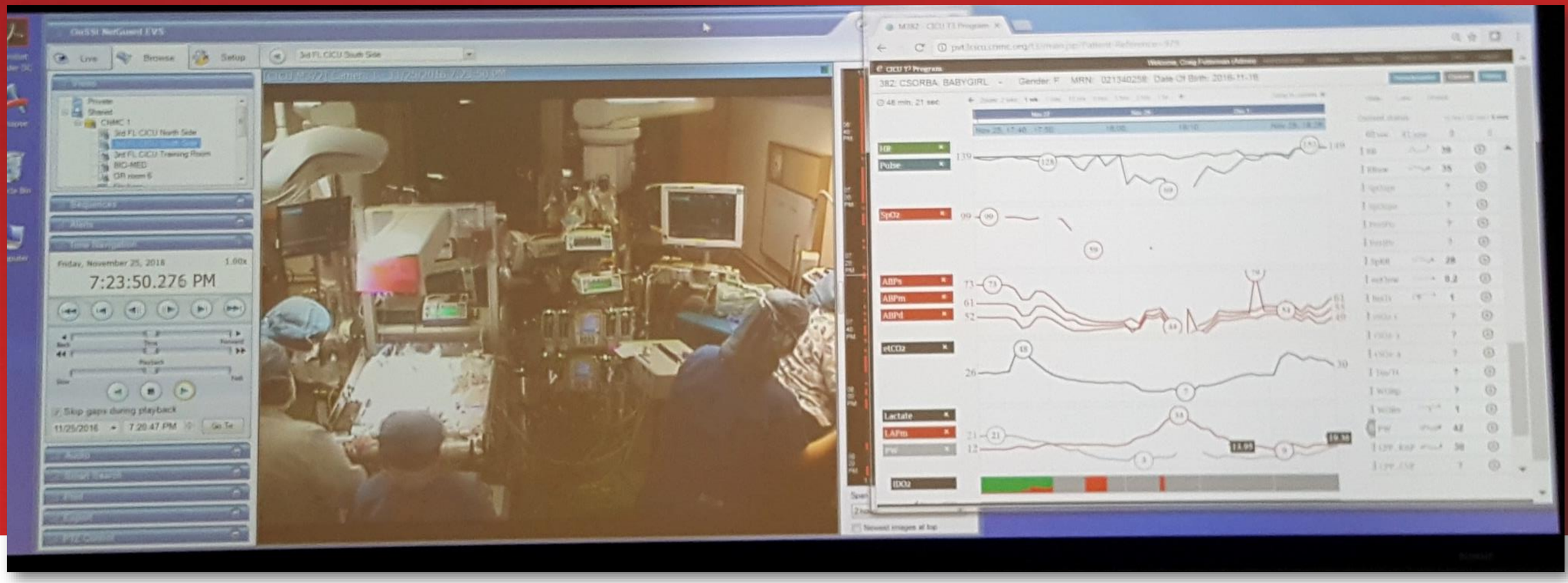
IMMEDIATELY AFTER PATIENT STABILIZATION:

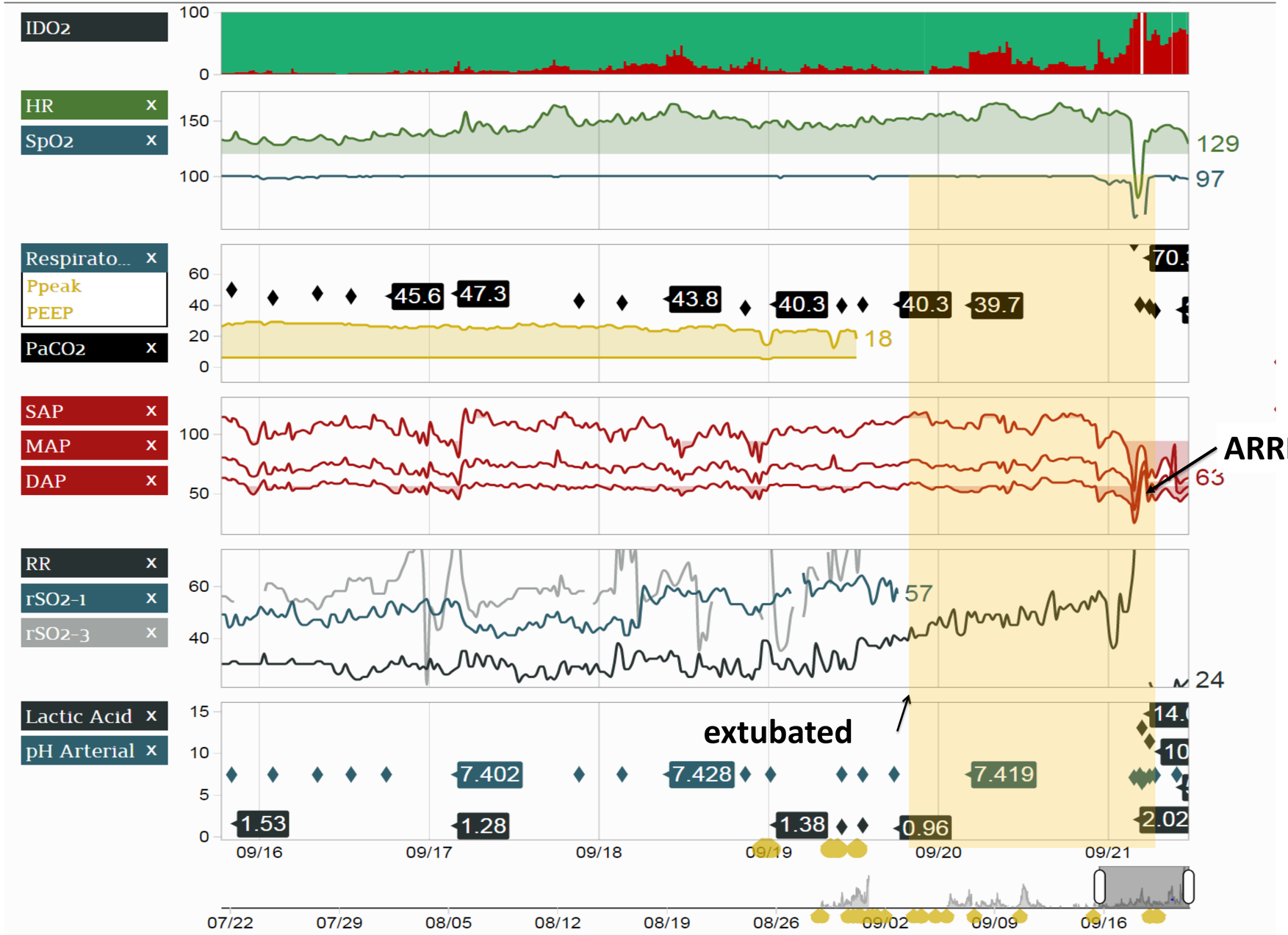
- Physician In Charge of "Code"
- All Other Personnel
    - Physicians, Nurses, Respiratory Therapy, Support Staff

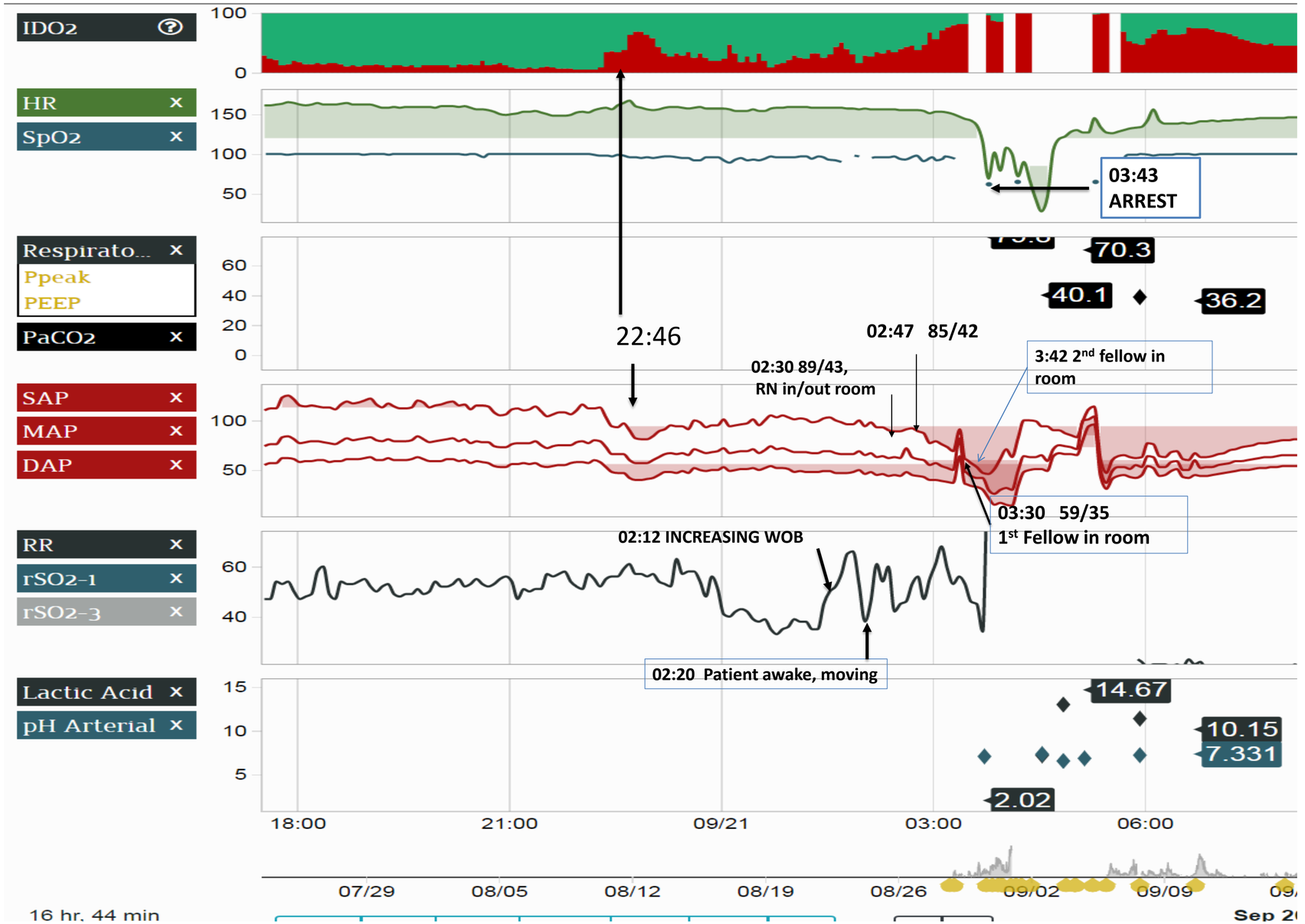
1. Each team member first fills out **standardized form:**
    - **What went well? What did not go as well as it could/should have? *How did I perform?***
2. **Discussion**
    - Individuals **– self criticism**
    - Individuals – feedback to others – **not blaming.** "Constructive Criticism"
    - Team – Noise, assigned roles, etc.
    - "Systems" – Availability of medications, beepers, etc.

3. Final Opinions Shared with *Entire Staff* by Physician in Charge

Monitor Integration







CICU - Remote Monitoring

CICU - Remote Monitoring

Alejandro Jose Lopez Magallon, MD
Ricardo Muñoz, MD

→ →

Paper → Electronic

Intermittent Monitoring → Continuous Monitoring

Isolated Monitoring → Integrated Monitoring

Memory of Events → Video Documentation of Events

New Thinking in Single Ventricle

Terminology

Management Philosophy

I Suspect This Will Be Controversial

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Concepts and Terminology That I Suggest We Eliminate:

Parallel Circulation

"Overcirculation"

Balancing the Circulation

Optimal Qp:Qs Ratio

Simplistic

Outdated

Non-Specific

Inaccurate

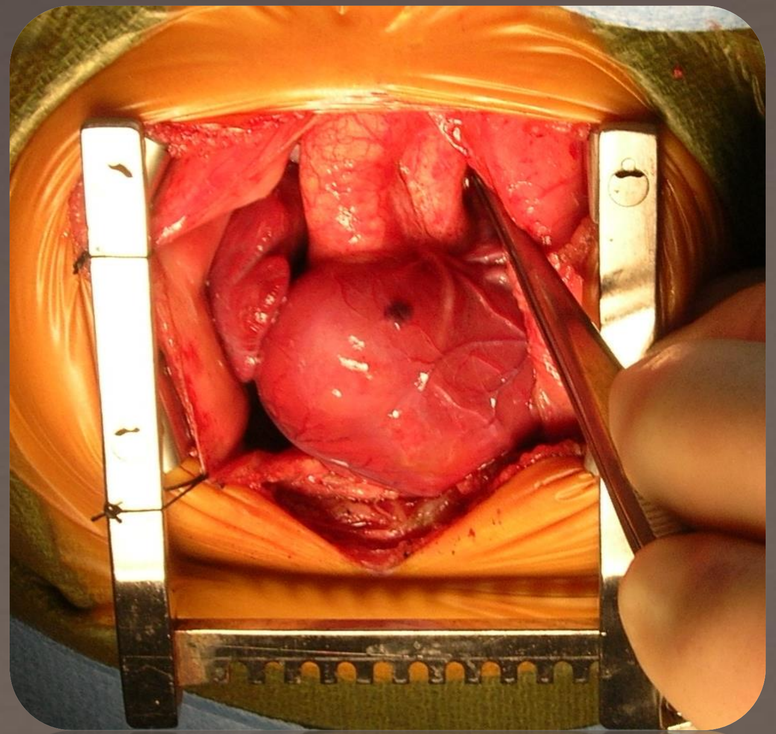
In Patients with a Single Ventricle

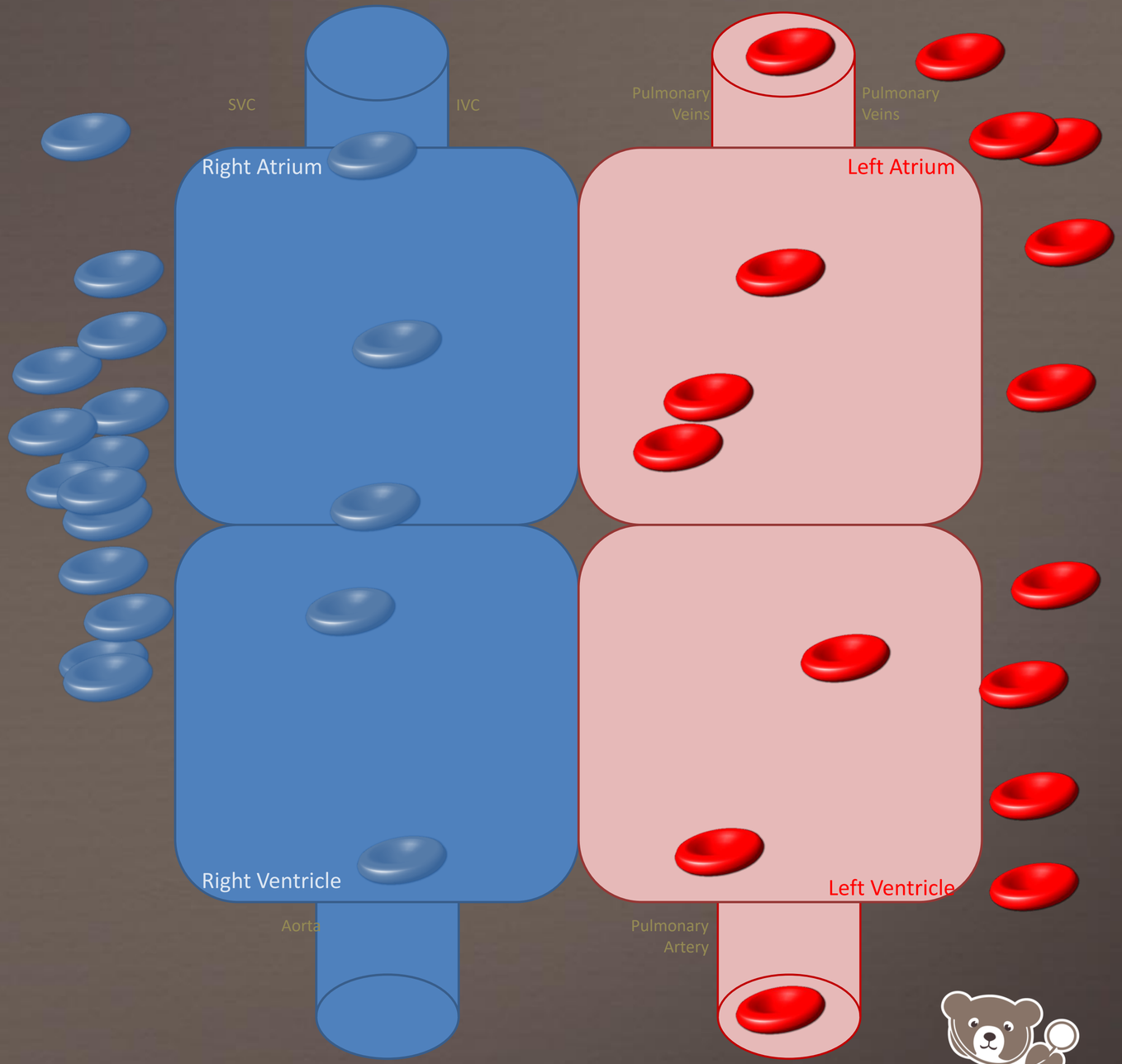
Concepts That I Suggest We Eliminate:

Parallel Circulation

"Parallel Circulation"

Should Be Reserved for Transposition of the Great Arteries





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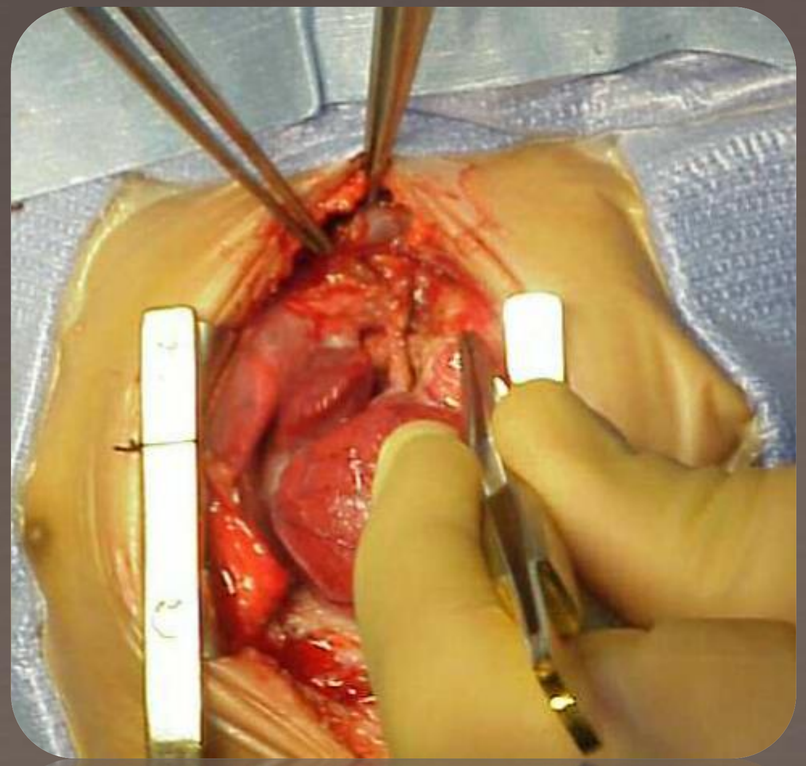
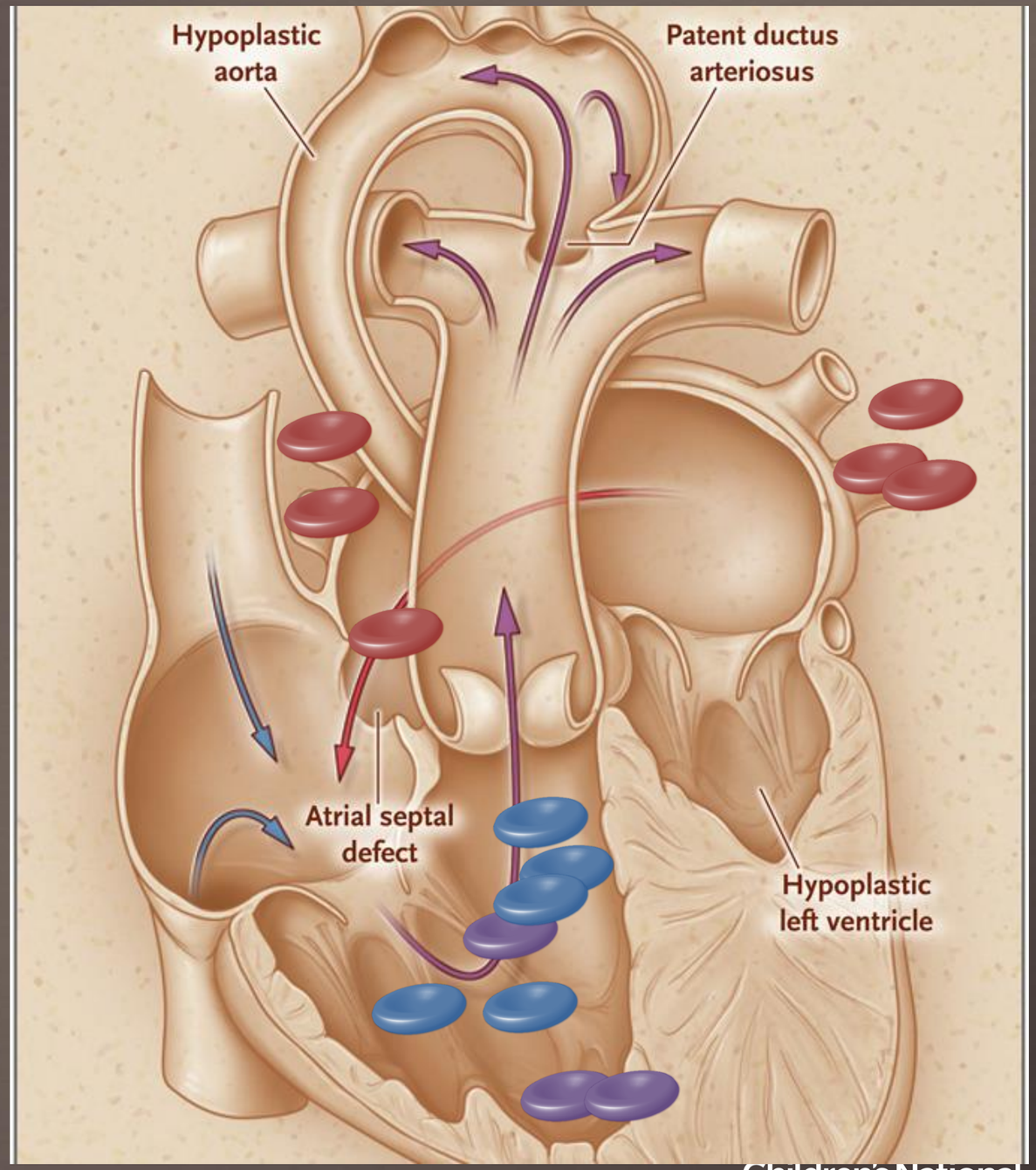
Single Ventricle Results in a *"Multi-Distribution Circulation"*



Qp

+Qs

+Qr



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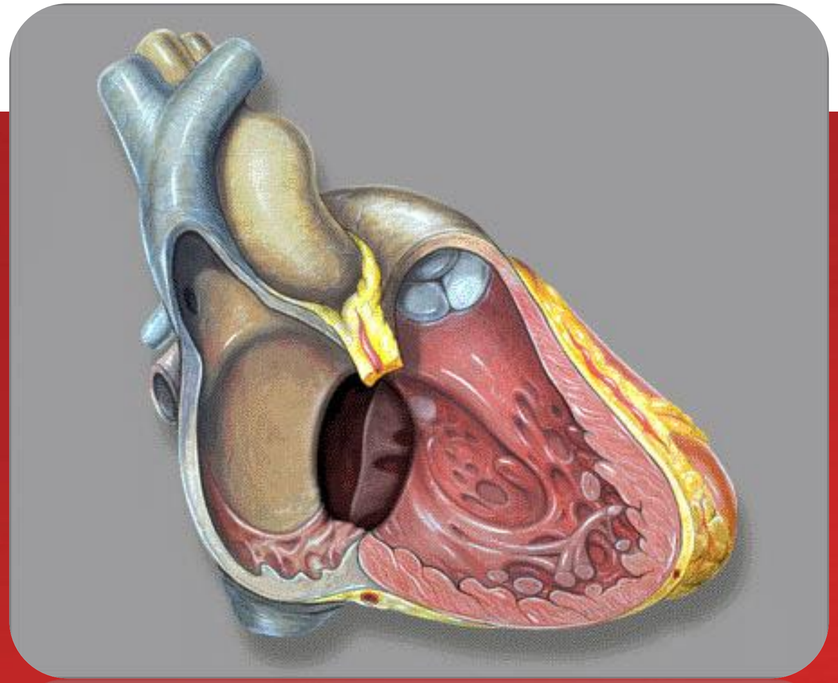
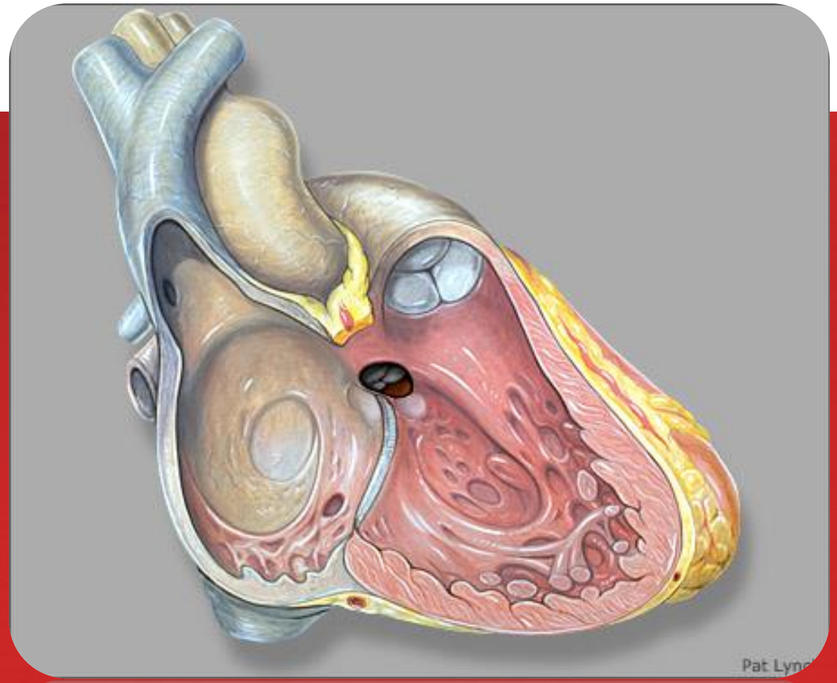
In Patients with a Single Ventricle

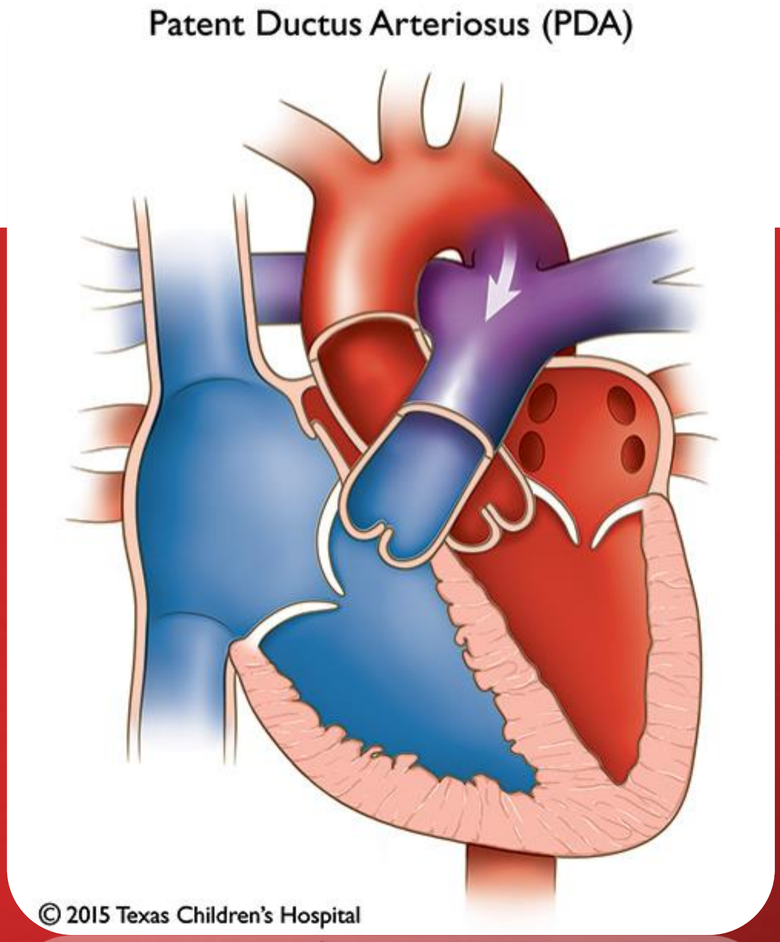
Concepts That I Suggest We Eliminate:

"Overcirculation"

Examples of "Overcirculation" or "High Qp:Qs"







Rethinking Single Ventricle Management

- *In isolation,* pulmonary over-circulation DOESN'T matter
- Systemic under-circulation DOES matter
- Pulmonary under-circulation DOES matter

Preferred Terminology and Thinking

Hypoxemia and/or Low Systemic Oxygen Delivery ("Undercirculation")

May Be Caused By:

1. **Ventricular Dysfunction** and/or
2. **Circulatory Maldistribution** due to:
   - Anatomic Obstruction
     - Preoperative – PDA, Atrial Septum, Ventricular to Systemic or Pulmonary Circuit
     - Postoperative – Arch, Atrial Septum, Shunt, Bands
   - Fluctuations in Pulmonary and Systemic Vascular Resistance
   - Atrio-Ventricular Valve Regurgitation
   - Anatomically Large Shunt *(in isolation-**RARE**)*

In Patients with a Single Ventricle

Concepts That I Suggest We Eliminate:

"BALANCING THE CIRCULATION"

"Optimal Qp:Qs Ratio"

"Ideal" Oxygen Saturation

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HLHS: Pulse Oximetry Value of 90%

Pulse Oximetry Value of 90%

Pulmonary Vein	100
Pulse Oximetry	90

?? High Qp:Qs

Pulse Oximetry Value of 90%

Pulmonary Vein	100
Pulse Oximetry	90
Mixed Venous Saturation	70

Normal Oxygen Delivery!

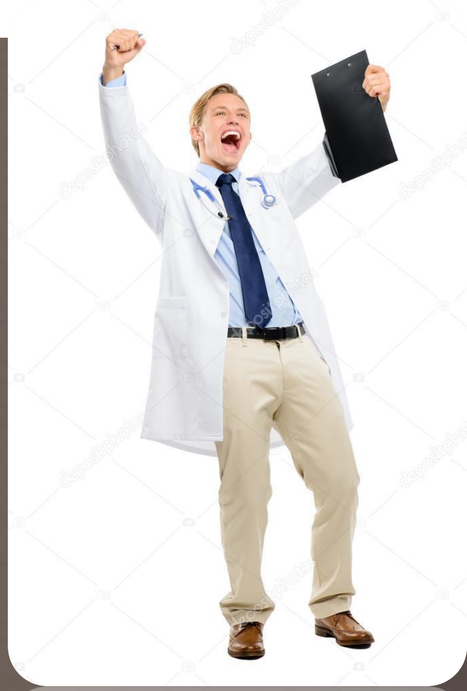
No Medical Management Needed

Qp:Qs 2:1

(Needs Surgery)

“Balanced Circulation”

Qp:Qs 1:1



Pulmonary Vein	100
Pulse Oximetry	75
Mixed Venous Saturation	50

"Balanced Circulation"

Qp:Qs 1:1

Pulmonary Vein	100
Pulse Oximetry	75
Mixed Venous Saturation	50

Borderline Oxygen Delivery!

Medical Management Needed

(Needs Surgery)

“Ideal” Oxygen Saturation of 80%

Pulmonary Vein	100
Pulse Oximetry	80

"Ideal" Oxygen Saturation of 80%

(Needs Surgery)

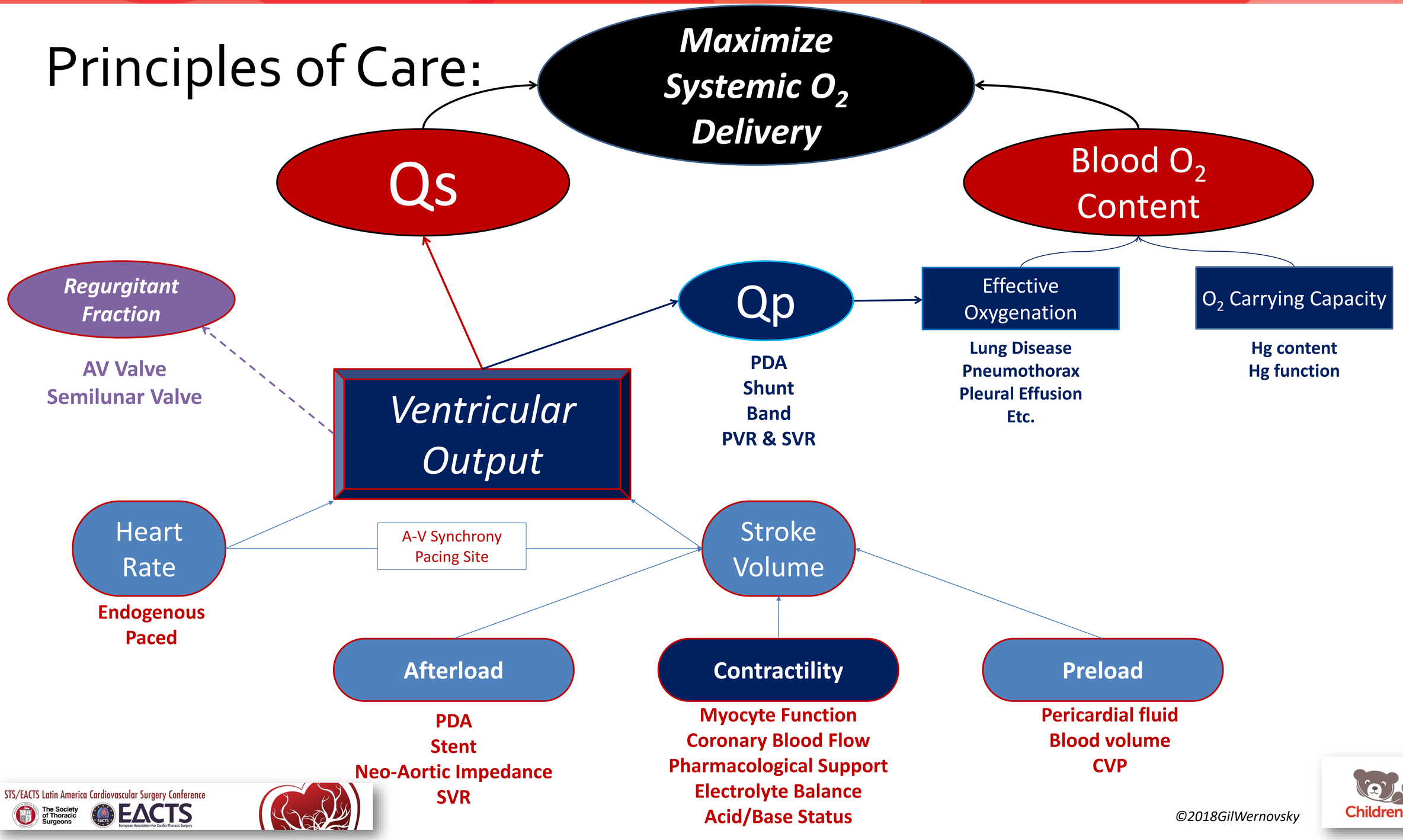
Pulmonary Vein	100
Pulse Oximetry	80
Mixed Venous Saturation	**30**

Qp:Qs 2 ½:1

Very Low Oxygen Delivery!

Medical Management Needed Quickly!

Principles of Care:



Principles of Care:

Maximize Systemic O_2 Delivery

Qs = Qp

Does it Really Make Sense to use a Ratio Here????

Blood O_2 Content

Effective Oxygenation

Lung Disease
Pneumothorax
Pleural Effusion
Etc.

O_2 Carrying Capacity

Hg content
Hg function

PDA
Shunt
Band
PVR & SVR

Heart Rate

Endogenous
Paced

A-V Synchrony
Pacing Site

Stroke Volume

Afterload

PDA
Stent
Neo-Aortic Impedance
SVR

Contractility

Myocyte Function
Coronary Blood Flow
Pharmacological Support
Electrolyte Balance
Acid/Base Status

Preload

Pericardial fluid
Blood volume
CVP

New Thinking

- Target Oxygen Delivery, not Oxygen Saturation
  - A Patient with a “High” Oxygen Saturation (“Overcirculation”) May Not Be Sick
  - A Patient with a “Balanced Circulation” May Be Sick
  - A Patient with the “Ideal” Oxygen Saturation of 80% May Be Sick

- Don’t Treat Surgical Heart Disease with “Medical” Therapy

Summary

- What's New in Cardiac Intensive Care?
    - Not Much in New Medications or Procedures
        - *(Exception: Lymphatic Interventions)*
- Cardiac Arrest Reduction and Protocolized Management
- Critical Evaluations of Team Performance
- Integrated Monitoring & Remote Monitoring
- Revised Concepts in the Terminology, Assessment and Management of Single Ventricle

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THANK YOU

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