

Anesthesia for Non-Cardiac Cases in Patients with Congenital Heart Disease: Pediatric Anesthesiologists Are Capable

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Objectives

- Review the anesthetic implications of the theoretical case
 - Congenital heart disease related
 - Developmental aspects
- Discuss the practical implications of case requirements and necessary training
- **Convince you that my learned opponent is sadly mistaken**

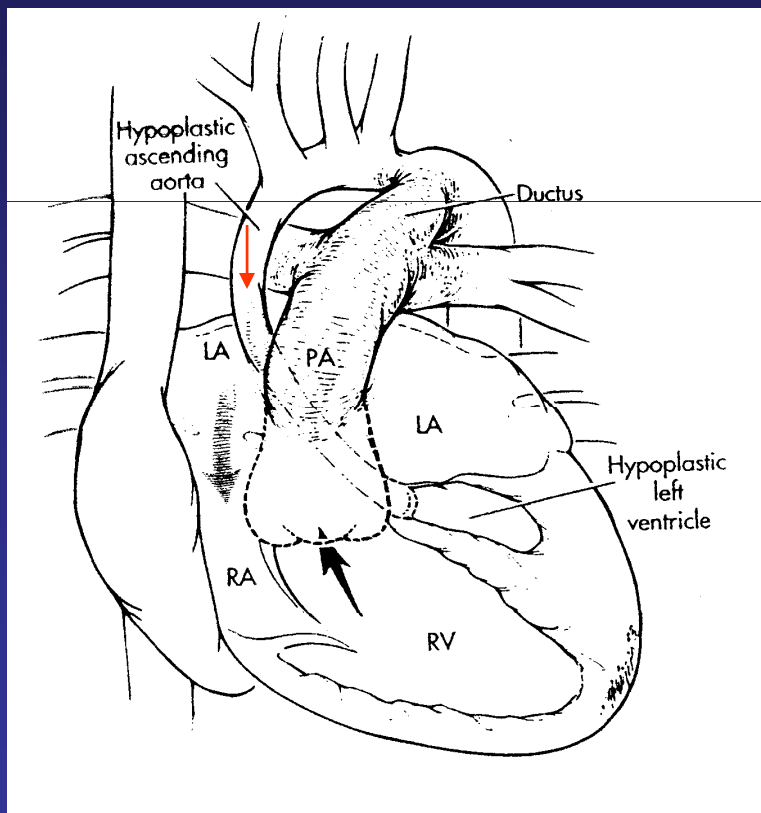
Our Case

- 1 month with hypoplastic left heart syndrome (HLHS)
- Undergone Norwood procedure with modified Blalock-Taussig shunt (BTS) at age 1 week
- 2 week post-op ICU course
- Transferred to community hospital for recovery
- Feeding difficulties noted
- Scheduled for laparoscopic Nissen + GT/button

Anesthesia Implications: Cardiac Related

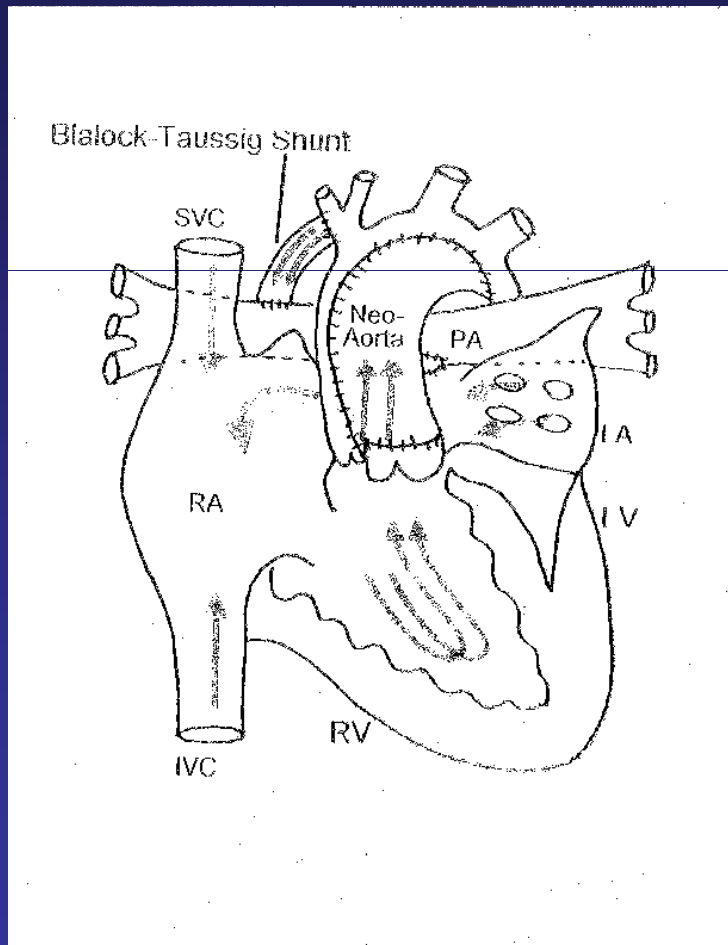
- 1 mo with hypoplastic left heart syndrome (HLHS) s/p Norwood with modified BTS
- Single ventricle provides pulmonary flow (Q_p) + systemic flow (Q_s) = **volume load**
- Balanced (SVR & PVR) circulation
 - $Q_p/Q_s = 1$ ($SpO_2 = 70-85\%$, $SvO_2 = 45-55\%$)
 - Systemic output influenced by PVR

Hypoplastic left heart syndrome (HLHS)



- Flow:
 - Pulmonary:
RA-RV-PA-lungs-LA
 - Systemic:
RA-RV-PA-PDA- desc Aorta
 - Coronary: retrograde
- Q_p/Q_s depends on PVR/SVR
 - increased PA pressure
 - increased RV (pressure/volume) work

Norwood Stage 1



- Flow:
 - Pulmonary: RA-RV-SCA-BTS-PA-lungs-LA
 - Systemic: RA-RV-neoAo- desc Aorta
 - Coronary: antegrade with diastolic runoff via BTS
- Qp/Qs depends on
 - PVR (BTS flow)
 - SVR (low CO)
 - increased RV (pressure/volume) work

Norwood Hemodynamic Management

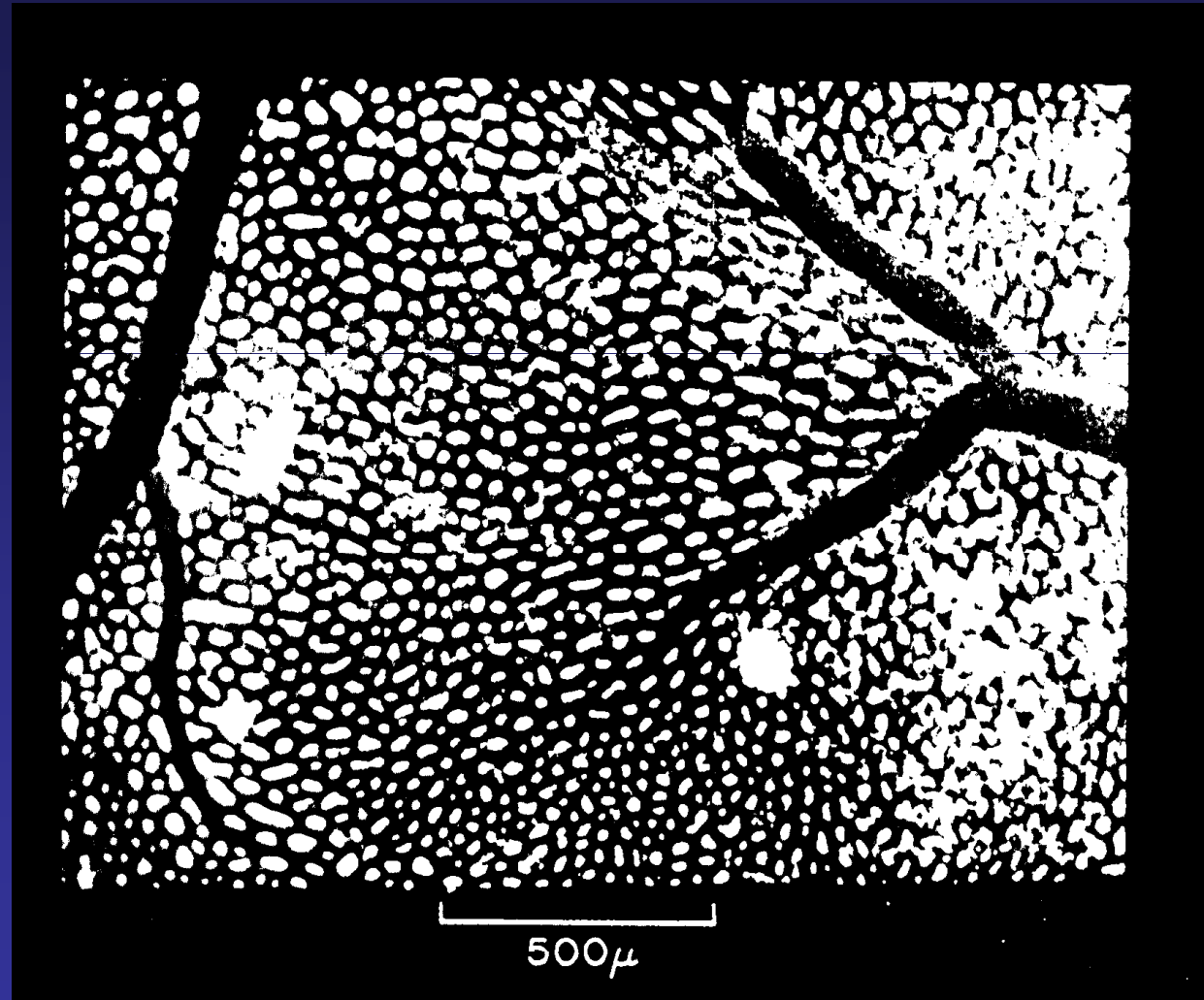
- Interaction between SVR & PVR
 - Excess pulmonary blood flow
 - Low PVR (oxygen, hyperventilation)
 - High SVR (inadequate anesthesia, catecholamines, hypovolemia)
 - Low pulmonary blood flow (cyanosis)
 - High PVR (atelectasis, lung over distention)
 - Low SVR (vasodilators)

Stage 1 Norwood Complications

Presenting Sign	Pathophysiology	Treatment
Congestive heart failure	AV valve regurgitation	AV valve repair
	Distal arch obstruction	Balloon or surgical aortoplasty
RV hypertrophy	Arch obstruction	Balloon or surgical aortoplasty
Hypoxemia	Shunt obstruction	Stunt repair ± pulm arterioplasty
	Anemia	Red blood cell transfusion
	Restrictive IAC	Balloon or surgical septectomy
	Pulmonary vein stenosis	Sutureless pulm vein repair or heart transplantation
	Congestive heart failure	See CHF therapy above

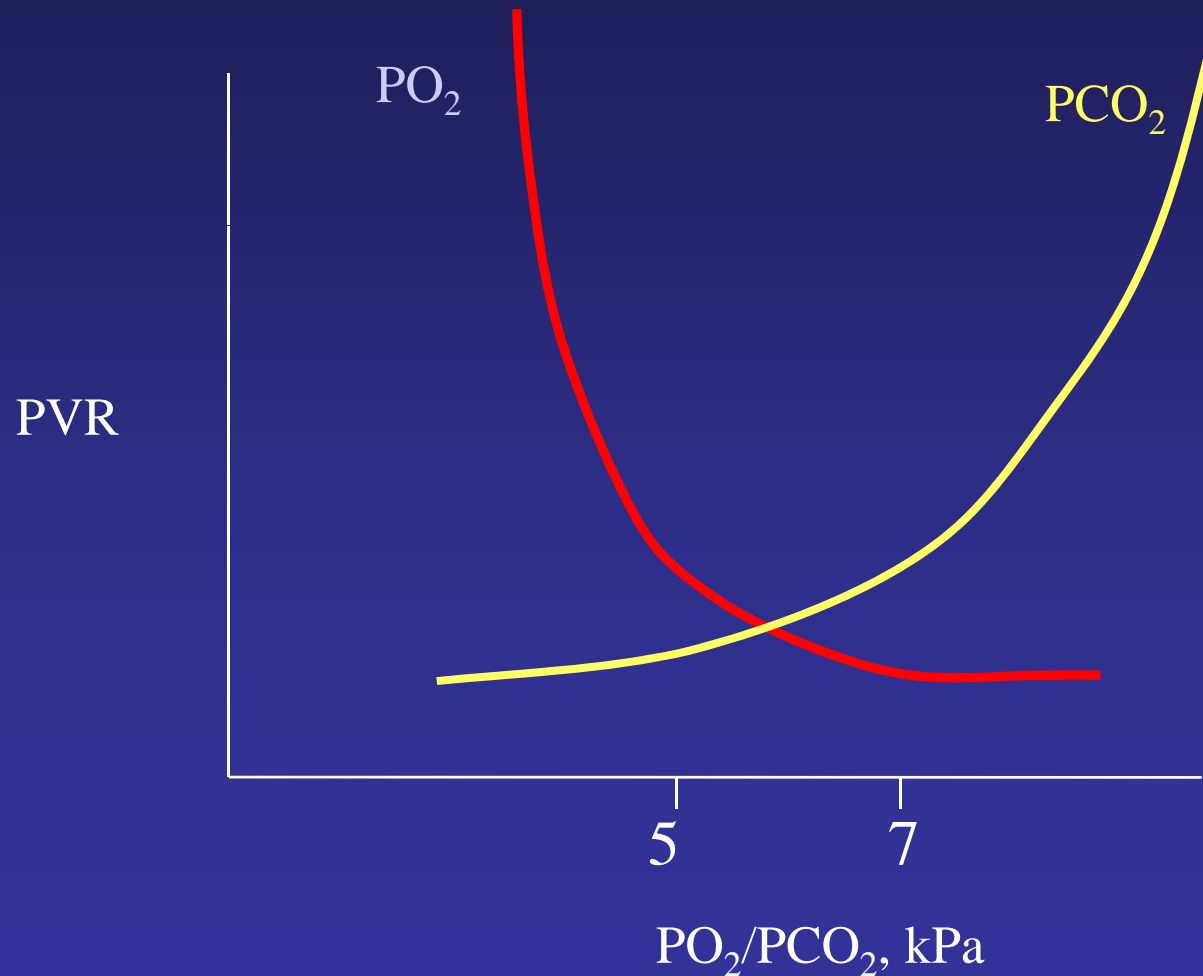
The pulmonary vasculature

The lung is a
"target organ".
PVR can be
decreased or
increased with
ventilation



PVR increases when:

PO_2 decreases and PCO_2 increases (pH decrease)



Anesthesia Implications: Age Related

- Developmental aspects of care for a 1-month old
 - Airway
 - Vascular access
 - Fluid management
 - Organ physiology (cardiovascular, pulmonary, neuro)
 - Pharmacology (kinetics/dynamics)

ACGME Requirements: Pediatric Anesthesia

- Clinical components
 - Placement arterial and venous catheters
 - Pharmacologic support of the circulation
 - Management of children for elective/emergent surgery **INCLUDING** CPB & congenital disorders
 - Diagnosis & perioperative management congenital disorders
 - Care of critically ill **INFANTS**

ACGME Requirements: Pediatric Anesthesia

- Didactic components (emphasis on development)
 - Pharmacokinetic/pharmacodynamics and drug delivery
 - Physiology, pathophysiology, and therapy
 - **CARDIOVASCULAR**, respiratory, renal, hepatic, & CNS
 - Congenital anomalies
 - Medical/Surgical problems common in children
 - Airway problems

Pediatric Anesthesia Programs

(as of 01/15/2008)

- 45 ACGME-certified U.S. fellowship programs
- 171 positions currently filled

http://www.acgme.org/adspublic/reports/accredited_programs.asp

Summary

Pediatric Anesthesiologists

- Receive necessary training
 - Developmental physiology & pharmacology
 - Congenital disorders **INCLUDING CHD**
- Are in sufficient supply to meet the needs

Rebuttal

ACGME Requirements: Cardiac Anesthesia

- Didactic Curriculum
 - Embryological development of cardiothoracic structures
 - Pathophysiology, pharmacology and management of patients with cardiac disease, including.... CHD,.....

http://www.acgme.org/acWebsite/downloads/RRC_progReq/041pr206.pdf

ACGME Requirements: Cardiac Anesthesia

- Clinical components
 - Experience with pediatric cardiothoracic anesthesia is **ENCOURAGED**

http://www.acgme.org/acWebsite/downloads/RRC_progReq/041pr206.pdf

Cardiac Anesthesia Programs

(as of 01/15/2008)

- 32 ACGME-certified U.S. fellowship programs
- 88 positions currently filled

http://www.acgme.org/adspublic/reports/accredited_programs.asp

Mythical Creature

PEDIATRIC Cardiac Anesthesiologist

- Pediatric Anesthesia + Cardiac Anesthesia
- Pediatric Anesthesia + Pediatric Cardiology
- Pediatric Cardiology + Anesthesia
- ACGME fellowships = 0
- Graduates non-ACGME fellowships = 10-12/yr

Baum and de Souza: *Pediatr Anesth* 2007; 17: 407-9

Society for Pediatric Anesthesia: Phoenix, Arizona - March 2007

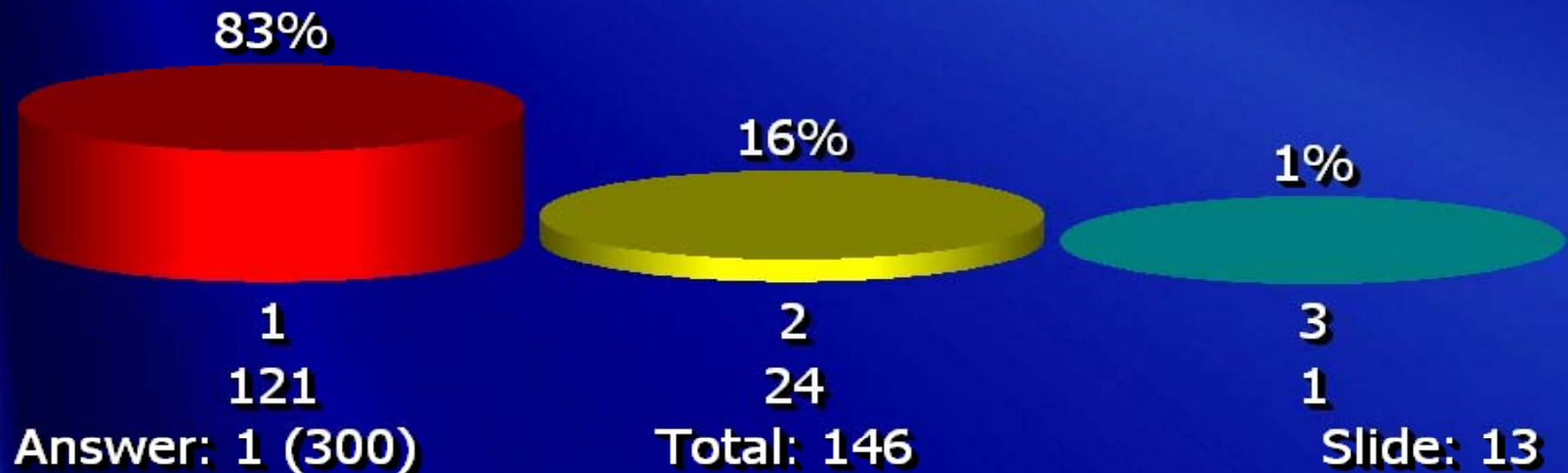
- Audience response (500+ anesthesiologists)
 - Predominately pediatric anesthesiologists
- Survey list of specific questions

[CHD 300 (1 of 2)]

A J 45

When a child with CHD presents for non cardiac surgery, e.g., a tonsillectomy, the child is anesthetized by:

1. Any pediatric anesthesiologist in the group
2. Only pediatric cardiac anesthesiologists
3. Cardiac anesthesiologists (either adult or pediatric anesthesiologists)



Summary

Pediatric Anesthesiologist

- Is appropriately trained
- Is readily available
- Is the right individual for this case