CARDIOLOGY 2025

Time to Rethink Congenital Heart Surgery: Minimally Invasive vs Minimal Impact with Maximum Benefit

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Phoenix Children's

Phoenix Children's

Disclosures

- No financial relationships
- Second TED-like talk
- From PR (Latino)
  - May move a lot
  - Will try not to do so
- Complimentary Dramamine

DeBÍ TiRAR MáS FOTOS

I
SHOULD
HAVE
PRACTICED
MORE

“How can I know how many lives my cat has left to live?”

“How come Tarzan was a wa shaven if he lived in the ju

Wh

Phoenix Children's

Confessions, and getting to know each other….


MSP

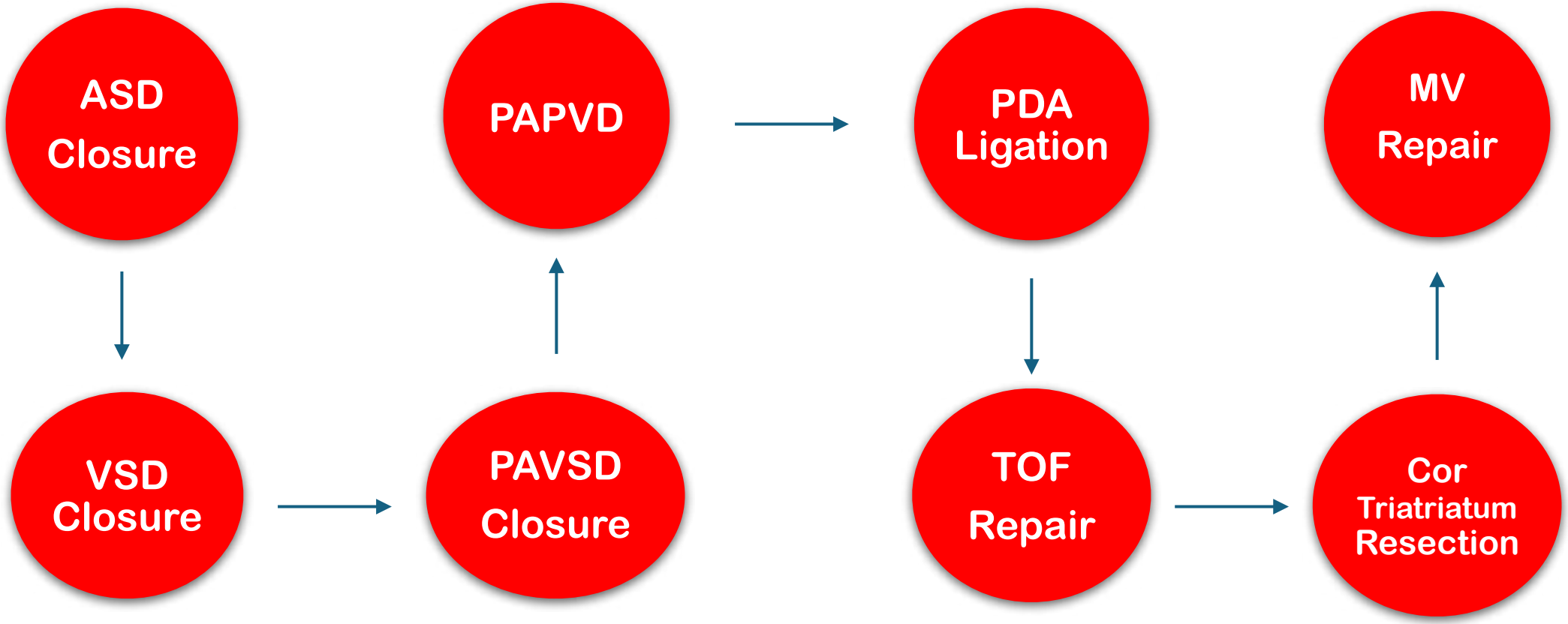
Confessions, and getting to know each other….

- Background
- Large experience in adults early on
  - 300 cases/yr
  - 20-30 isolated valve cases/yr
- Repairs
  - Visualization and mobilization is key
- Took on MIS for Mitral valve Surgery
- Liked it a lot!

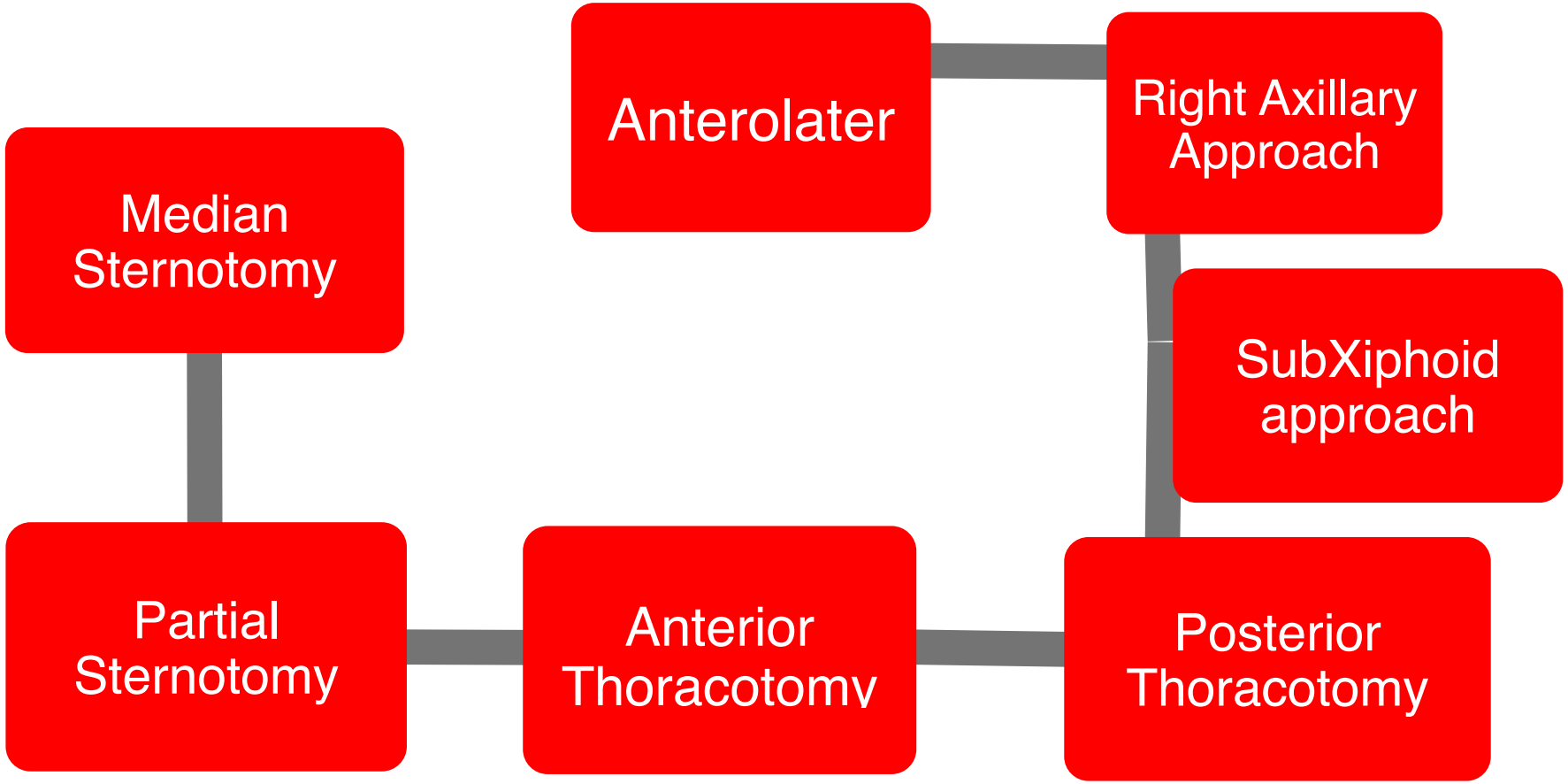
Confessions, and getting to know each other….

- For Peds, Not a fan
- Seizures
  - Open more the retractor!
  - Beg for a longer incision
- Will do my best to present the data objectively
- I try…..

Minimal Invasive Surgery: Where do we stand in 2025



Types of Incisions



What is out there?

- Not much…
- Two thirds of the manuscripts are case reports
- Not even 600 manuscripts
- Expanding the search to terminology that fits, 27K
- Perhaps limiting to those with a specific number of pts may have significance

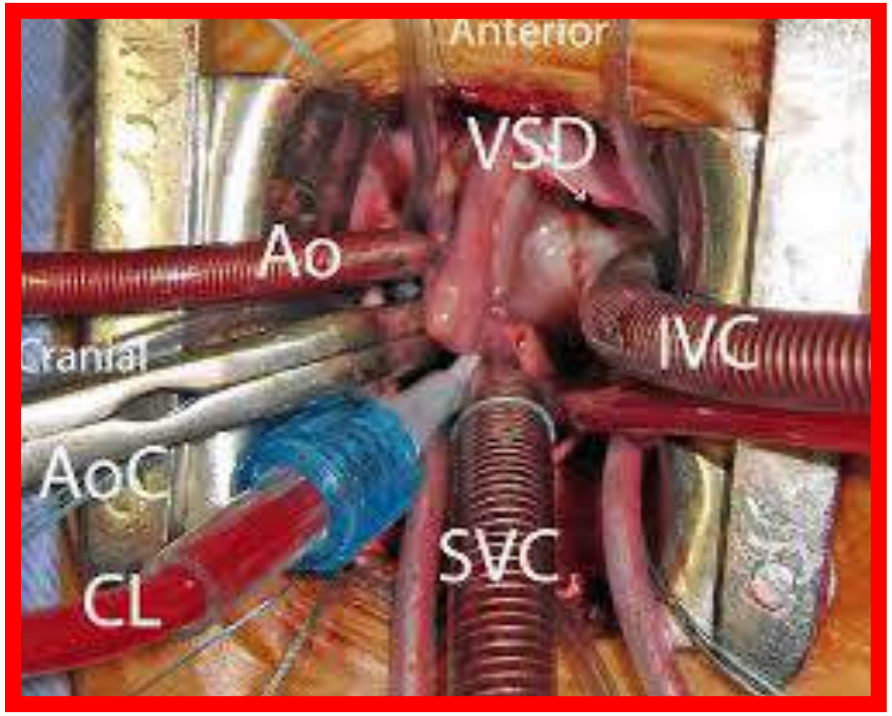

A
B
C
D

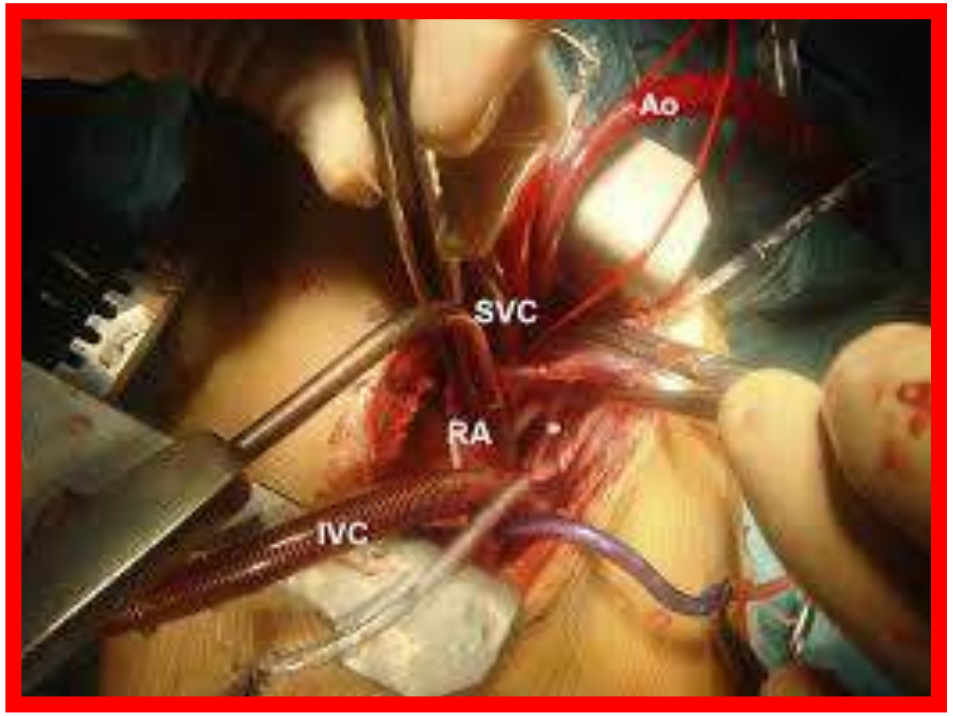

cm
inch

Minimal Access

- Minimally invasiveness is not clearly defined
- Limited skin incisions with complete or near-complete median sternotomies have been reported as one way to improve cosmesis after cardiac surgery but can hardly be considered minimally invasive
- Partial sternotomies, sternal splits, and lateral thoracotomies have been used increasingly approaches
- Gradually moved away from the midline with larger series now reporting midaxillary access as their preferred approach
- Totally endoscopic repairs with or without robotic assistance have been reported in pediatric patients as well

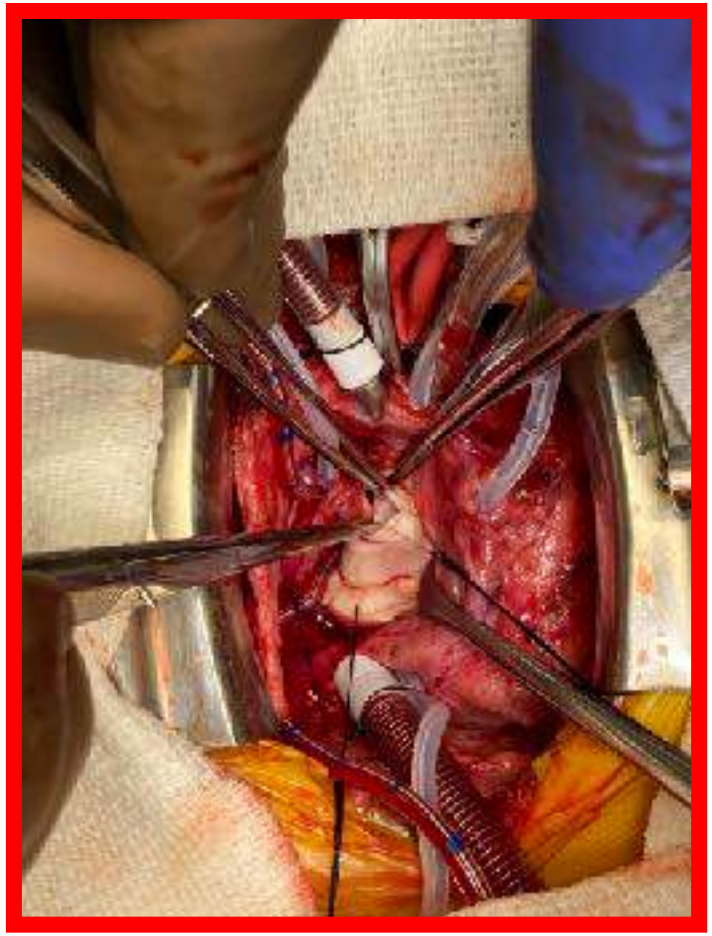
The Playing Field…..





Partial Sternotomy, Sternal Split, and Parasternal Incisions

- Proponents state that many procedures that are routinely performed via a complete median sternotomy do not need tensive exposure
- Shorter skin incisions
- Partial Sternotomies



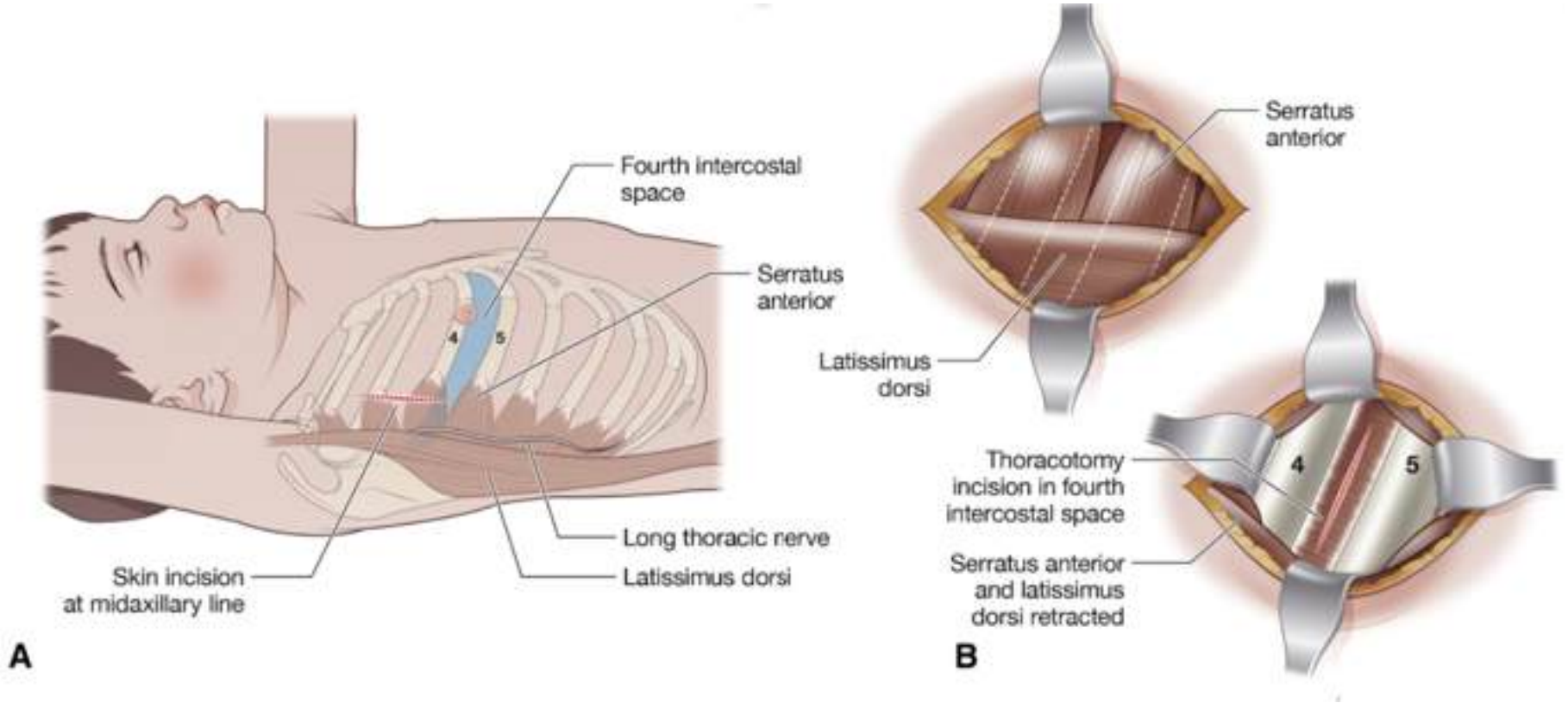
Anterolateral Thoracotomies

- Claims that shifting the incision from the midline laterally, can not only
  - Improve the aesthetic result of the procedure
  - Enhance exposure
  - Avoid complications associated with the division of sternum or ribs
  - Skin incisions are commonly performed following the submammary fold
  - Periareolar incisions have been described as well
- Length and exact position
  - Highly dependent on surgeon's preference
- May depend on the cardiac structure to be accessed
  - The 4th ICS is adequate to access most cardiac lesions
- Limitation of this approach especially in young female patients is the risk of abnormal breast development

Posterolateral and Vertical Infra-axillary Thoracotomy

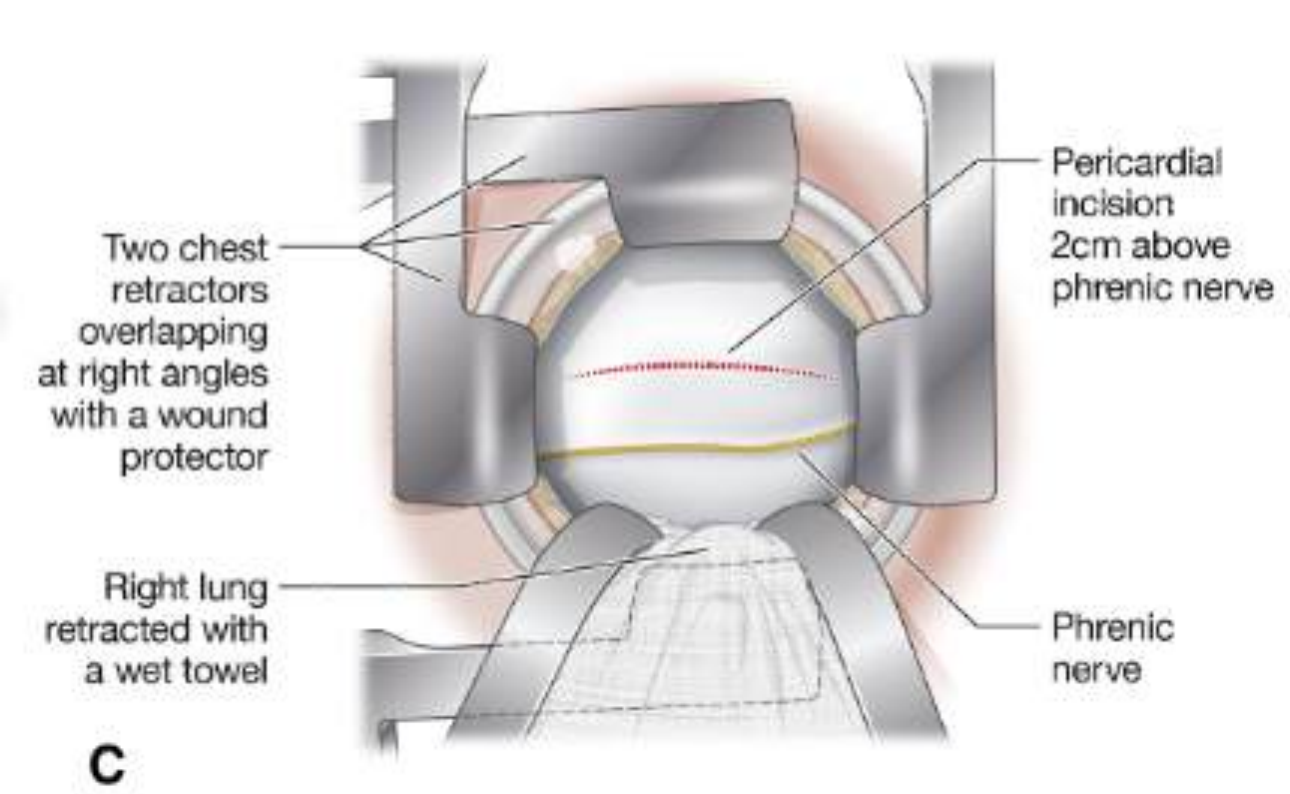
- More recently, incisions are performed posterior to the anterior axillary line
- Incisions can follow a horizontal, diagonal, or vertical course.
- Alert: "***The scar is less exposed for improved cosmesis".*** Vertical incisions parallel to the axillary line can hide the scar quite effectively underneath the arm.
    - Further away from breast tissue
    - Acceptance of this approach has increased as surgeons have become more familiar with minimally invasive approaches (Europe)
- Brush off concerns of limited exposure due to the lateralized visual angle have been settled with large studies proving feasibility of repairs of many different cardiac lesions
- Same intercostal approach only skin incision is different
- Alert: Excellent results can be achieved even in patients smaller than 4kg
- In older patients access to the inguinal vessels can be maintained by rotating the chest by approximately

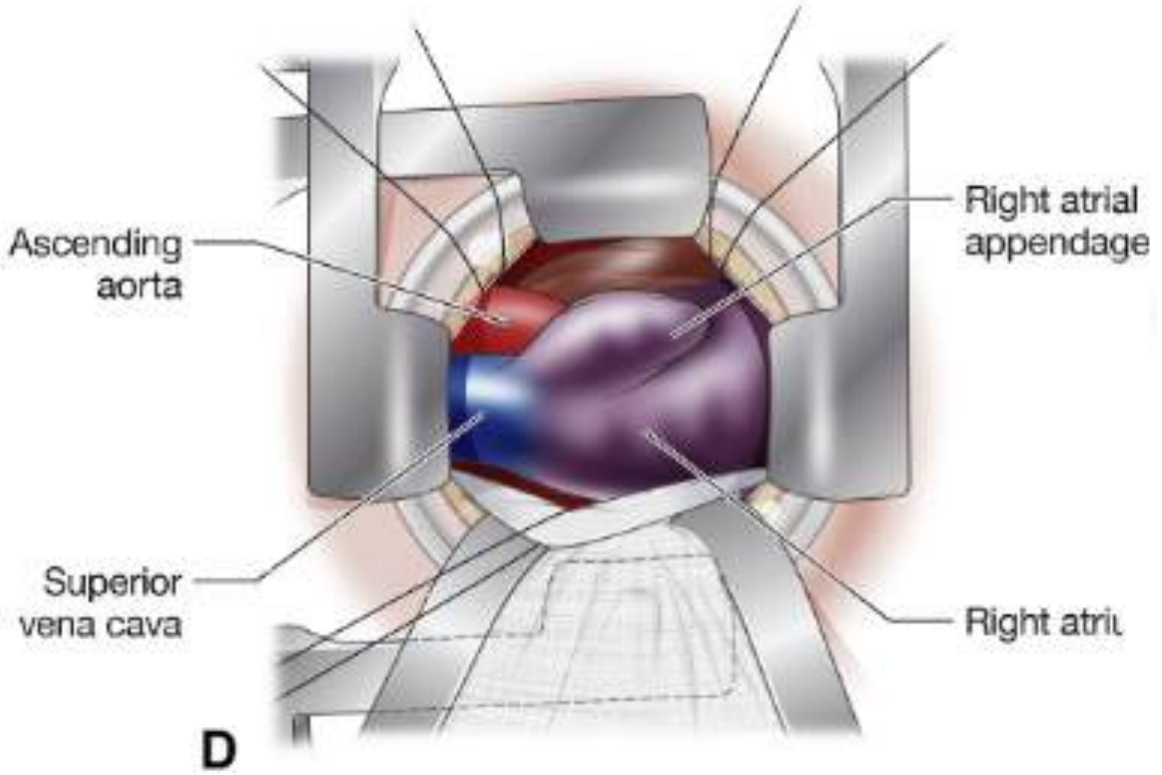
Right Axillary Approach



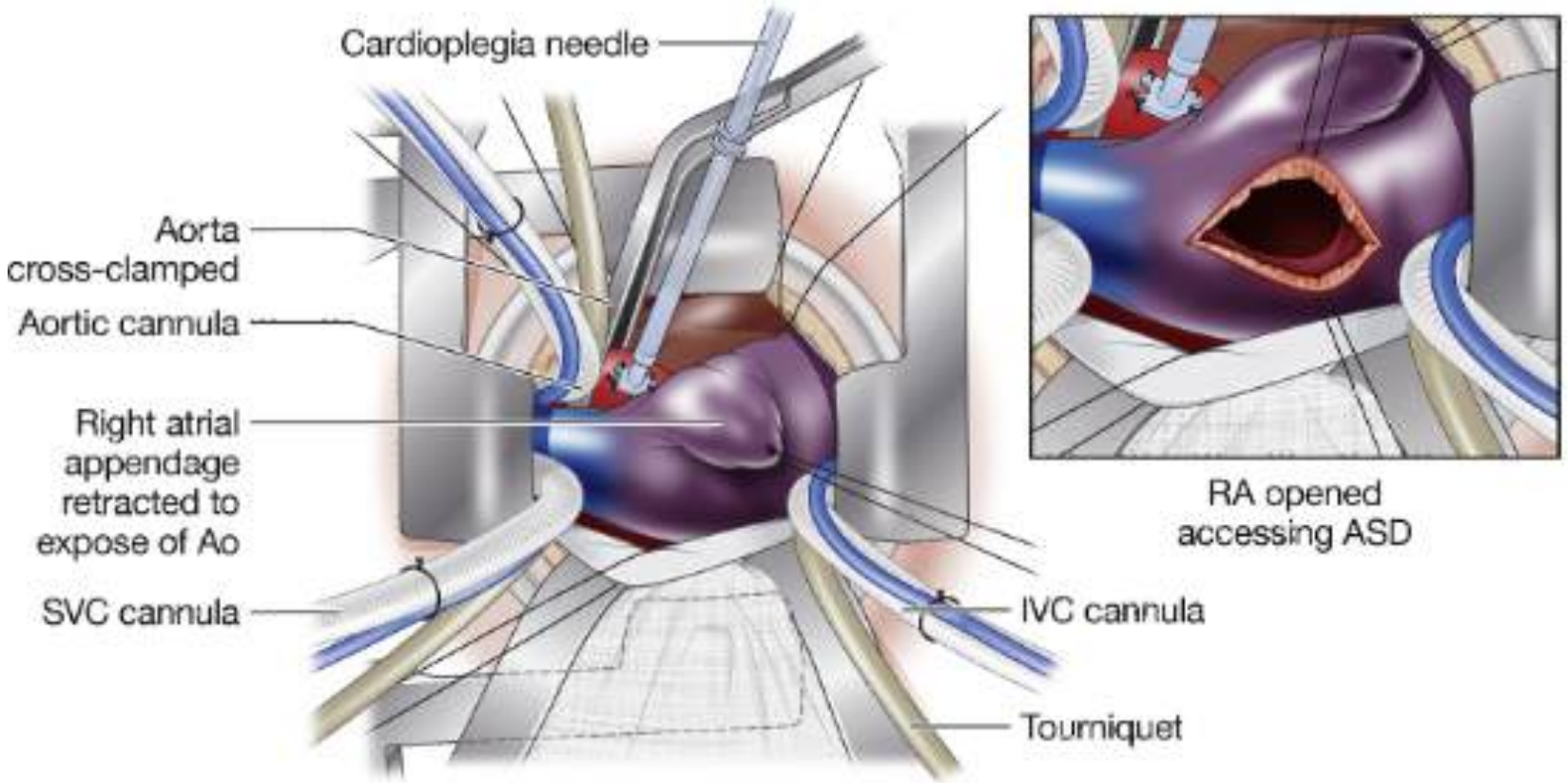
Minimally invasive closure of atrial septal defects can be safely achieved with a range of techniques. Currently, partial sternotomy and right axillary thoracotomy are the most widely used approaches.

Right Axillary Approach





Right Axillary Approach



RA opened accessing ASD

E

F Postoperative appearance

Seminars
IN THORACIC AND
CARDIOVASCULAR SURGERY

The Right Axillary Incision: A Potential New Standard of Care for Selected Congenital Heart Surgery

Timothy Lee, BS * · Aaron J. Weiss, MD * · Elbert E. Williams, MD * · Fuad Kiblawi, MD † · Joanna Dong, BA * · Khanh H. Nguyen, MD ‡ ✉

CONGENITAL – ORIGINAL SUBMISSION · Volume 30, Issue 3, P310-316, Autumn 2018

Right Axillary Approach

- Lee et.al. (2018): Right transverse axillary incision was performed in 358 patients for 24 unique procedures
  - Ages 1-66
  - Most common lesions: ASDs 68% followed by VSDs 20%
  - Other Surgeries included: Sub-aortic membrane resection, TOF repair, DCRV resection + RVOT patch, and Mitral Valve Repair
  - No reported intraoperative deaths or conversions to, 5 reoperations for re-bleeding, intrahospital mortality, 6 cases of pneumothorax or pleural effusion, and 4 patients requiring permanent pacemakers.
  - Surgeons reported longer bypass times
  - Limitations: retrospective, no control group, poor patient follow-up, no long-term outcomes
  - Brave Statement: ***"New Standard of Care"***

Mini right axillary thoracotomy for congenital heart defect repair can become a safe surgical routine

Part of: Surgery

Published online by Cambridge University Press: **18 February 2022**

Jannika Dodge-Khatami, Rabia Noor, Kyle W. Riggs and Ali Dodge-Khatami

Show author details

Mini Right Axillary Approach

- Dodge Khatami et al (2022): 116 patients underwent repairs via right mini thoracotomy.
  - 97 patients achieved on table extubation
  - No mortality or need for approach conversion (mean age 4.3 years, range 0.17–17, mean weight 18.6 kg, range 4.8–74.4) in 118 repairs for atrial septal defect, ventricular septal defect, partial anomalous pulmonary venous return, partial atrioventricular canal with mitral cleft, scimitar syndrome, double-chambered right ventricle, cor triatriatum, and tricuspid valve repair

Not Everything That Shines……

Pros and Cons: Open vs Minimally Invasive

	Open	Minimally Invasive
Advantage	• Best visualization and access • Easier learning curve • Broader patient selection • Easier Central Cannulation • Proven procedures and data	• Improved physical appearance perception • Potential decreased LOS, postoperative, and hospital cost
Disadvantage	• 35% of patients and families find median sternotomy cosmetically unappealing • Longer ICU and Hospital LOS • Increased pain and discomfort	• Proper patient selection • Limited space and access • Unfamiliar vantage points • Obstruction of surgeon's view (cannulas) • Reproducibility, learning curve, trainee teachability • Requires alternative sites for cannulation (i.e. femoral artery)

Minimally invasive cardiac surgery: A systematic review and meta-analysis

Gudrun Dieberg [a 1], Neil A. Smart [a 1], Nicola King [b 2]

In 596 participants analyzed:
-Increased operative time and perioperative complications
-Increased short term pain due to involvement of intercostal nerve and excessive rib retraction
-MICS is more technically demanding
-One study demonstrated increased ventilation time

J Clin Med. 2020 Dec 10;9(12):3999. doi: 10.3390/jcm9123999

Advances and Trends in Pediatric Minimally Invasive Surgery

Andreas Meinzer [1], Ibrahim Alkatout [2], Thomas Franz Krebs [3], Jonas Baastrup [1], Katja Reischig [1], Roberts Meiksans [1], Robert Bergholz [1,*]

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PMCID: PMC7764454 PMID: 33321836

A Minimally Invasive Problem: Maybe Not So Minimal

- For patients and families, MIS implies that they expect the surgery to be truly minimally invasive
- Therefore they begin earlier oral diets, start mobilizing or perceive pain less pain because they have been told to be operated on by minimally invasive surgeries
- Any true study comparing MIS vs Open Surgery in Pediatric Patients should be randomized, prospective, and if possible double blinded, at least during the short term of the hospitals stay

› Ann Thorac Surg. 2021 Dec;112(6):2020-2027. doi: 10.1016/j.athoracsur.2020.10.028. Epub 2020 Nov 21.

Early Results of Robotically Assisted Congenital Cardiac Surgery: Analysis of 242 Patients

Burak Onan [1], Ismihan Selen Onan [2]

Affiliations + expand

PMID: 33232727 DOI: 10.1016/j.athoracsur.2020.10.028

Patient Selection and Surgical Considerations

- Cannulation:
  - Some centers require patients to weigh ≥15 kg to facilitate peripheral cannulation
  - Gupta et al: prefers central cannulation in all patients <50 kg or if the femoral artery is <5 mm in diameter
  - No robust data to choose peripheral vs central cannulation
- CPB Time:
  - Luo and coworkers reported that cardiopulmonary bypass and aortic clamping times was significantly longer with the totally endoscopic and minimally invasive thoracotomy techniques compared with median sternotomy
- Robotic Surgery:
  - In a small single study (N=242), 12.3% were less than 18, with a 12-year-old child underwent successful ASD closure
  - Major issue: distance between 2 ribs for trocar insertion, thoracic cavity size, requires training of multiple specialists

- Reported mortality among papers with at least 100 cases: 0-2.9%
  - Deaths associated with complex lesions or redo procedures
- Conversion to median sternotomy or extension of a limited sternotomy to full sternotomy is very rare
  - Related to poor exposure, complications while cannulating, or upon removal of aortic cross clamp

- According to Gupta et al, manuscripts involving at least 100 patients report an average complication rate of 5.8%.
  - Downside: great study variability, single centered, lack of RCTs
- While mortality is relatively consistently reported, complication rates are inconsistently reported with some manuscript only mentioning major complications, while others include even very small complications that do not necessitate intervention.
- Due to the lack of granularity of data on complications it is not possible to separate specific types of complications.

Pain

- Operations that are more painful for the surgeon than the patient need to be reconsidered….
- PTPS can be severely debilitating and painful
- There is inconclusive evidence to state that a smaller incision or even totally endoscopic approaches clearly reduce the incidence of PTPS
- It is important to note that many studies on PTPS are derived from the thoracic surgery population and therefore includes patients with larger thoracotomies than commonly used in MICS, more aggressive resections of the chest wall or lung, and patients with pre-existing chronic pain

The Case for Changing The Mindset

- Residual Lesions?
  - How is it possible in the era of "***No pixel goes undetected"*** and ***"There is no such thnig as single descriptor classification of Insufficiency"***
- Not so sure…
- Rescue after conversion, is it the same approach?
- Pain Free, Really?
- Adults Mitral: Plane of Visualization is perpendicular to the access
- Equipment Vs Size
- Exposure is different, every VSD is different
- Training

Comparative Study > Pediatr Cardiol. 2005 Jul-Aug;26(4):315-22.
doi: 10.1007/s00246-005-8648-0.

Hybrid pediatric cardiac surgery

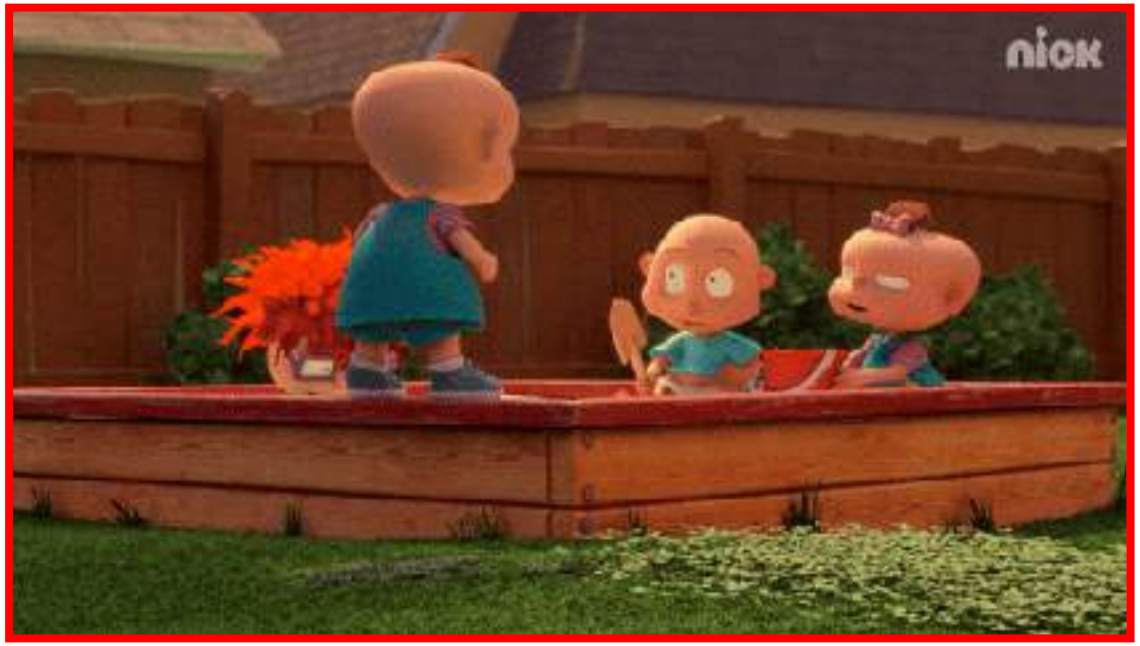
E A Bacha [1], Z M Hijazi, Q-L Cao, R Abdulla, J P Starr, J Quinones, P Koenig, B Agarwala

Affiliations + expand

PMID: 16374678 DOI: 10.1007/s00246-005-8648-0

Playing Nice in the Sandbox

- Hybrid Procedures: combining interventional and surgical techniques has been shown to reduce complexity of procedures, reduce bypass time and risk, and improving outcomes.
- Early studies, Bacha et.al, demonstrated the safety of Amplatzer device closure in the catheterization laboratory followed by surgical completion or one-stage intraoperative off-pump device closure.
    - Eight patients with branch pulmonary artery (PA) stenoses underwent intraoperative PA stenting or stent balloon dilatation along with concomitant surgical procedures. All patients survived hospitalization

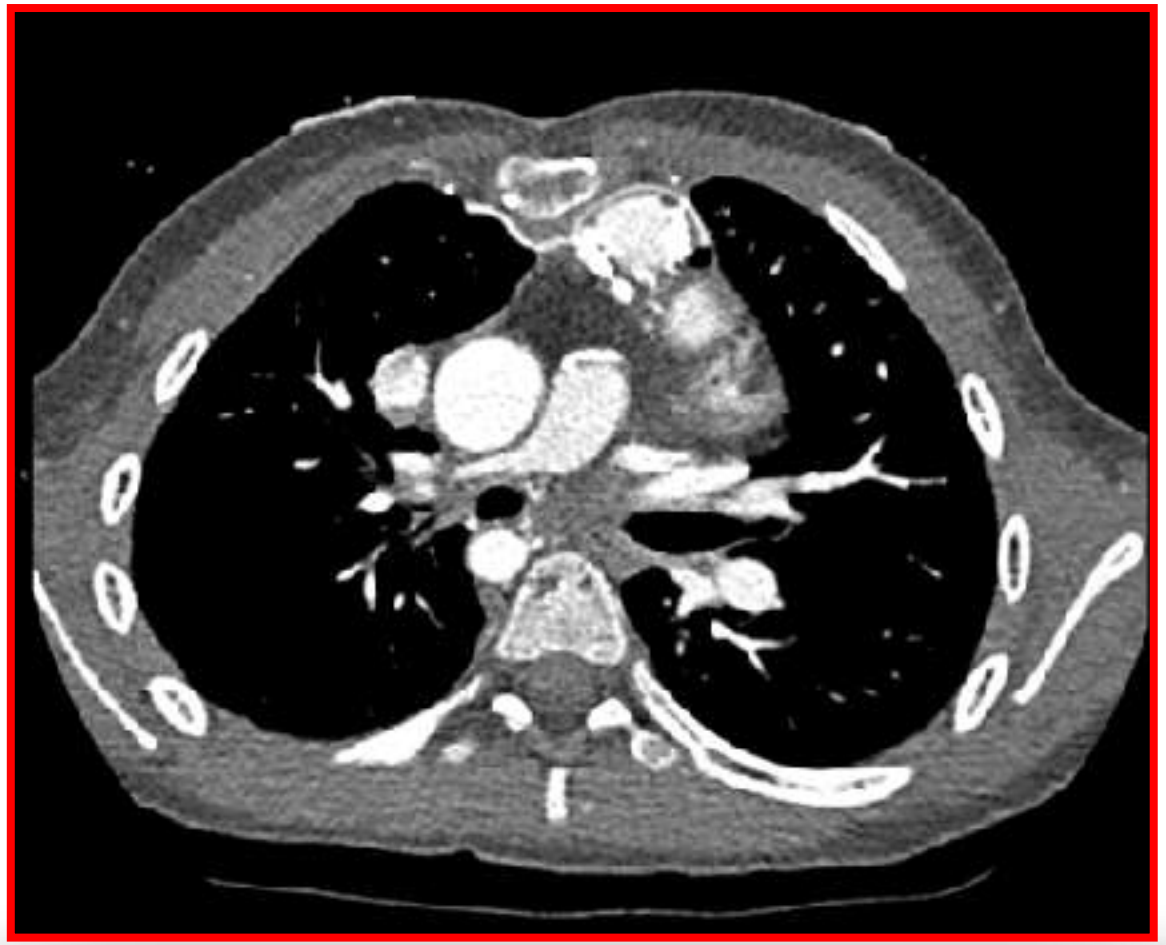


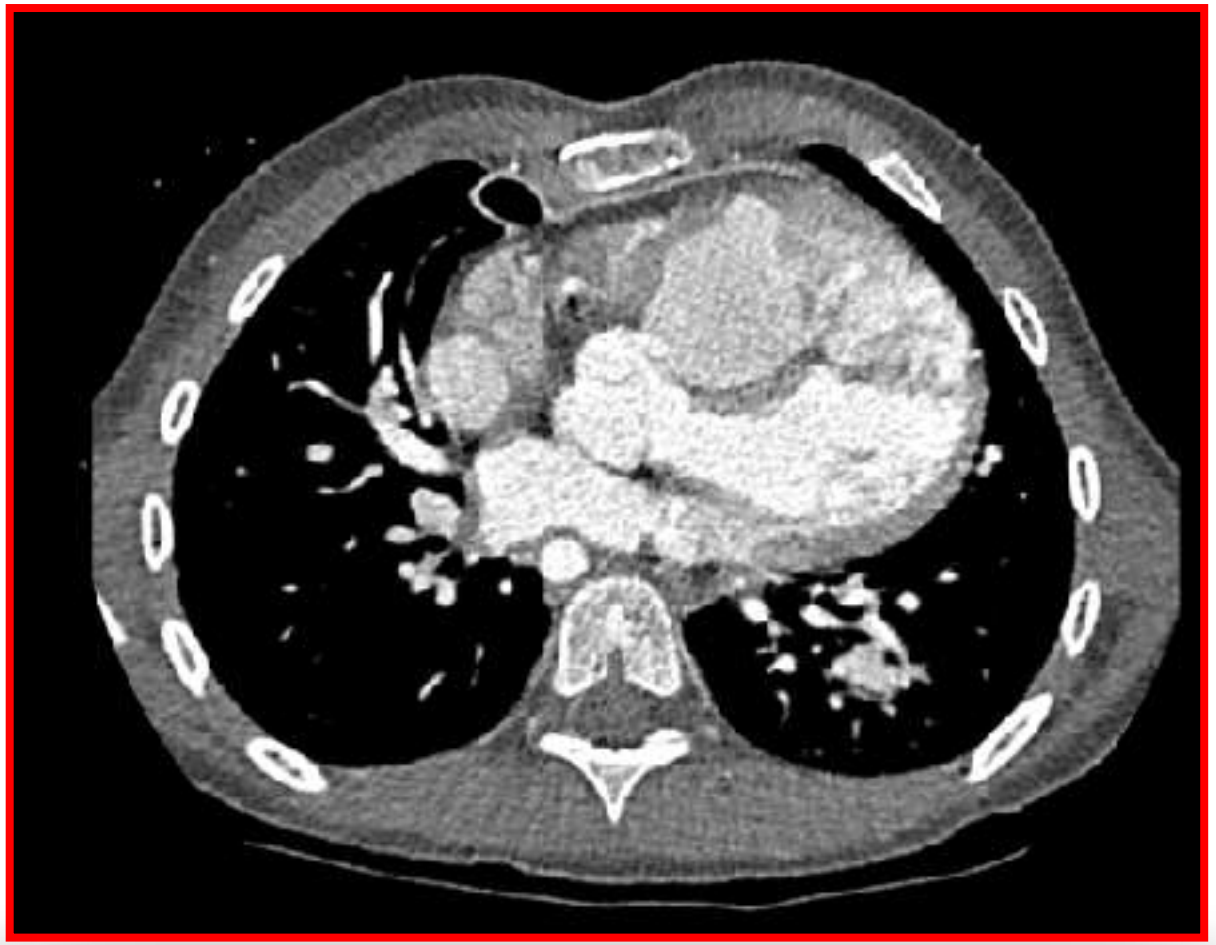
The Case for Minimal Impact/Maximum Benefit Surgery According To D. Velez

- Improved cosmesis **SHOULD NEVER** be the goal of an CHD operation
- Much less above patient safety
  - Full Repair or Adequate palliation should be
- Consider reducing the use of blood products
- Operative times,
- Set yourself and the patient up for winning,
  - Use of materials to minimize adhesions during re-operations to reduce operative time, structural injuries
- Use of trans-catheter valves placed surgically, reducing anticoagulation use, and use ballon dilation as the patient outgrows them to then replace

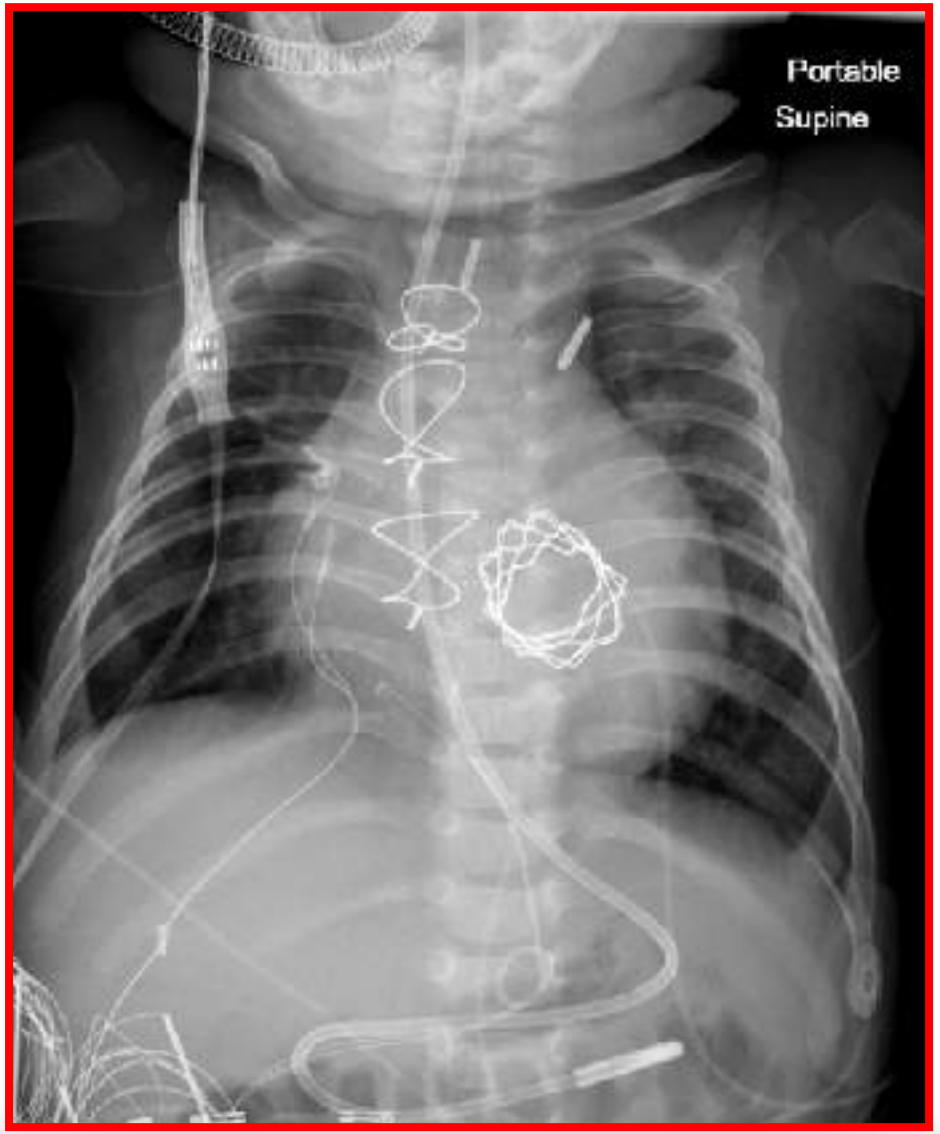
The Case for Minimal Impact/Maximum Benefit Surgery According To D. Velez

- Pediatric cardiac surgery is a highly specialized field, and decisions about the most appropriate surgical approach for a child should be made by a multidisciplinary team:
  - Cardiologists
  - Cardiac surgeons
  - Anesthesiologists
  - Perfusion






R
Portable
Supine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Timothy Lee, Aaron J. Weiss, Elbert E. Williams, Fuad Kiblawi, Joanna Dong, Khanh H. Nguyen, The Right Axillary Incision: a Potential New Standard of Care for Selected Congenital Heart Surgery, Seminars in Thoracic and