DU Reanimation Cardiopathie Congenitale et Pediatrique
Bordeaux, Dec 2023

Imaging of coarctation and interrupted aortic arches

Olivier Villemain, MD, PhD
Staff Pediatric Cardiology - CHU Haut-Leveque
University of Bordeaux

No disclosures

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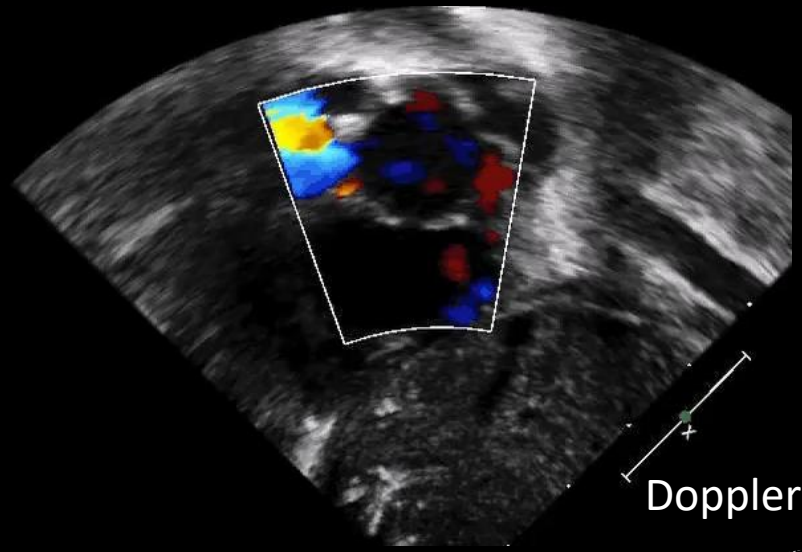
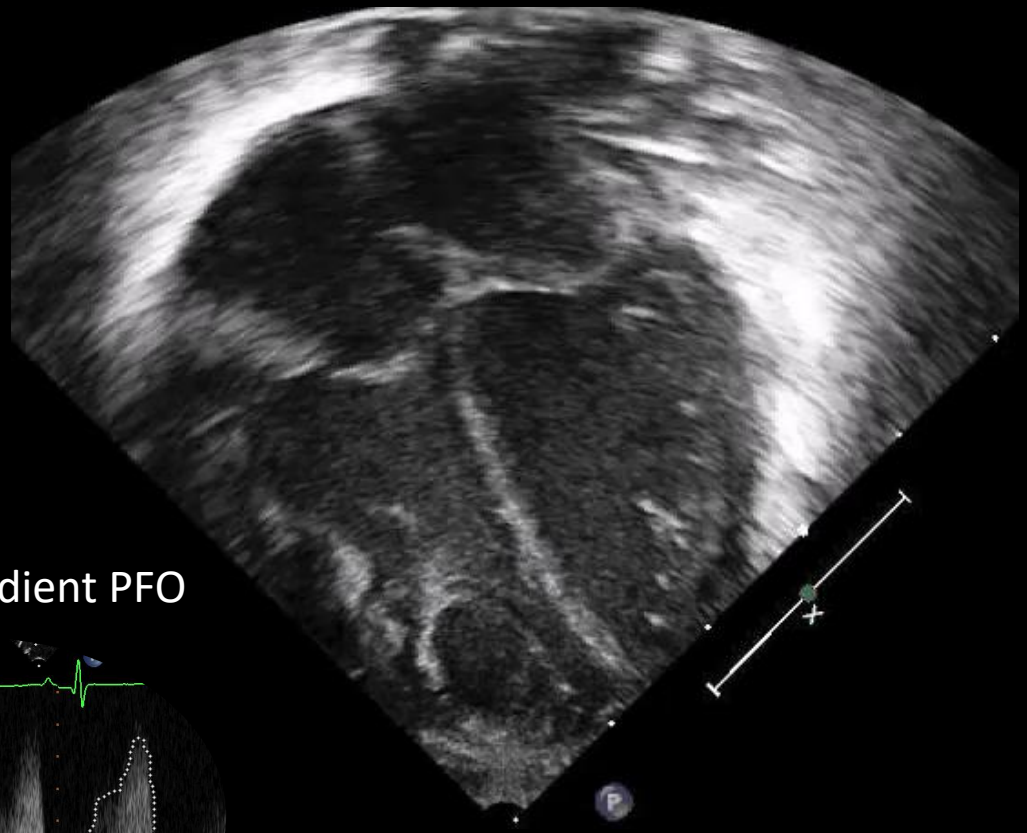
No disclosures

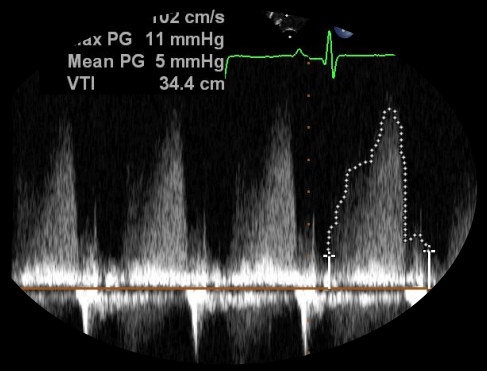
Case 1

2 days, poor perfusion, upper-lower BP 30 mmhg and pre and post ductal Sat difference of 10-15%... PGE started





Doppler gradient PFO



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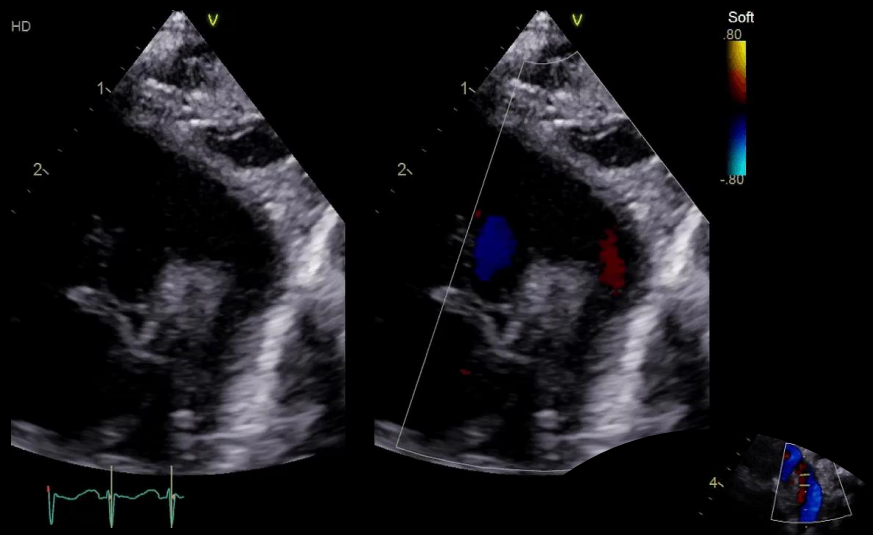
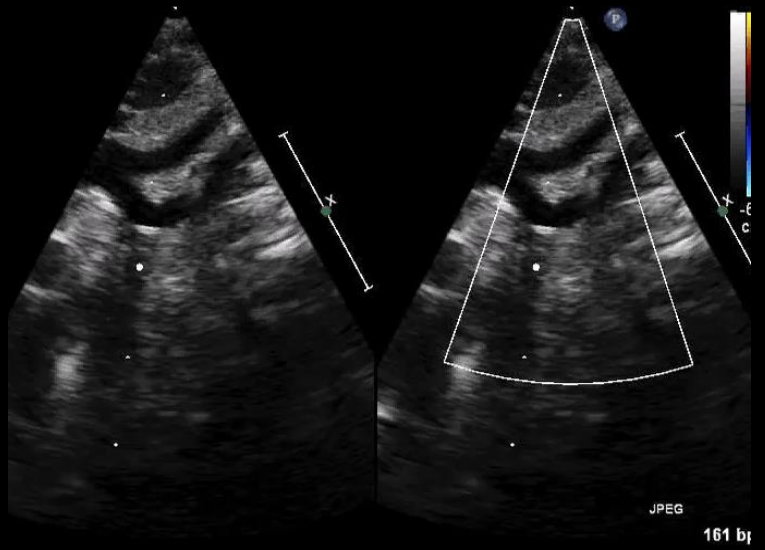
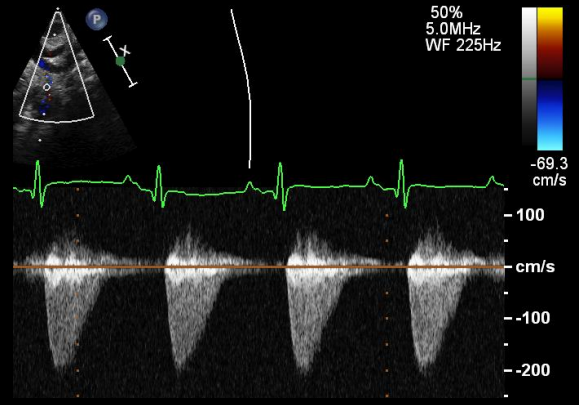
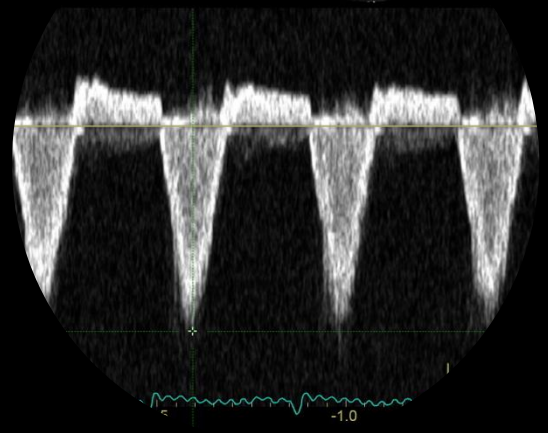
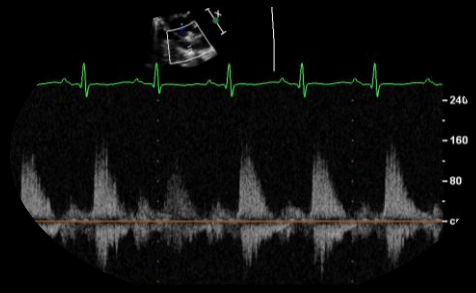








Abdominal aorta



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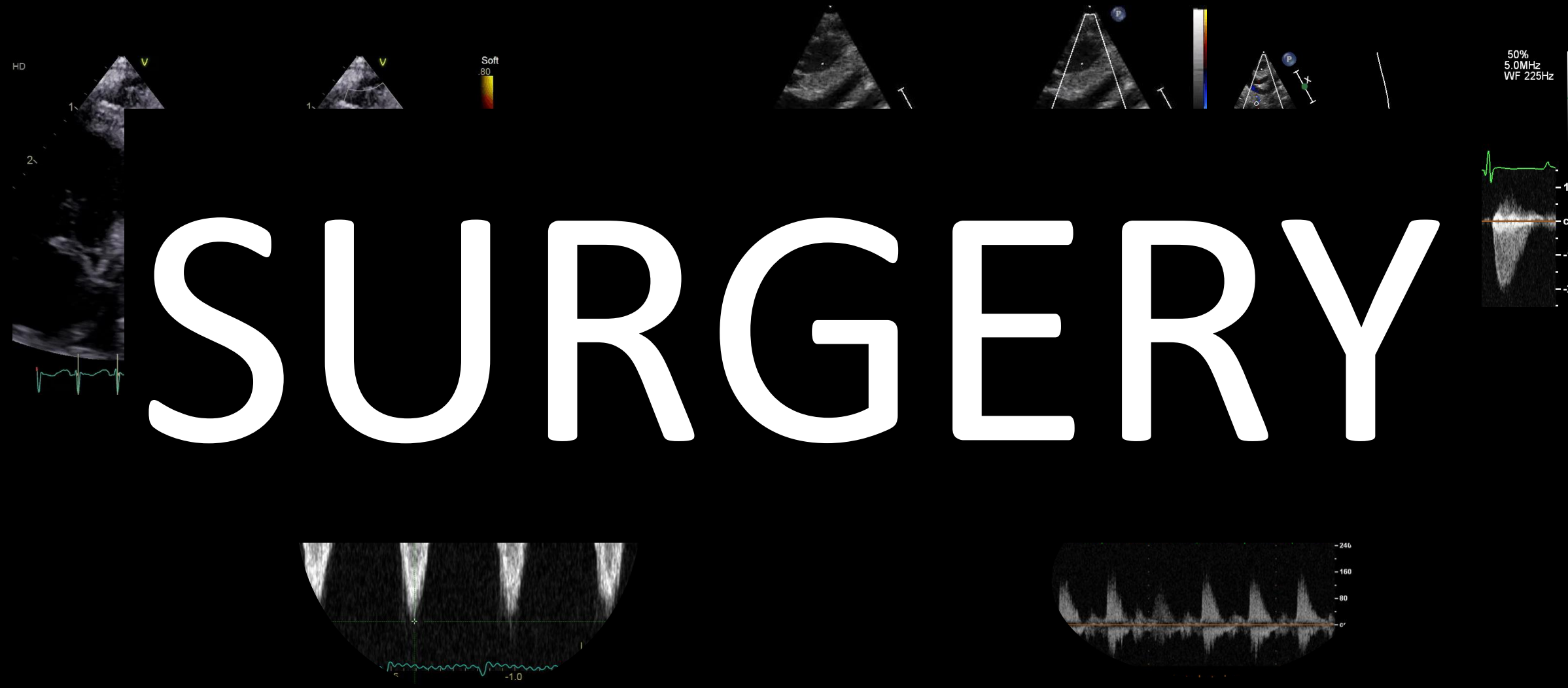
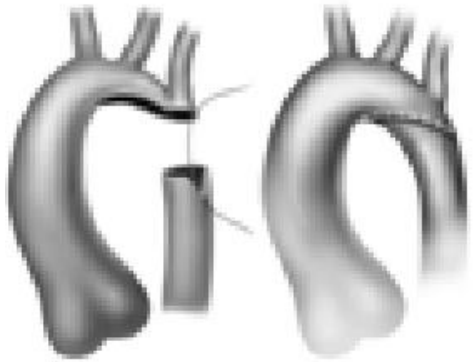


SURGERY

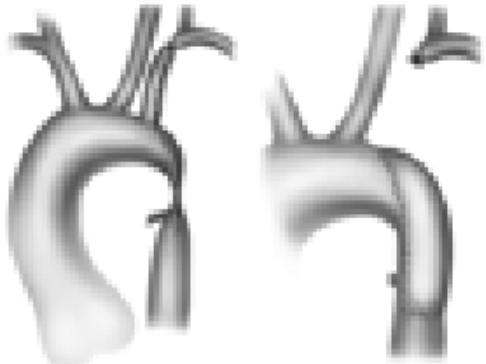
CoA management – surgical options

End to end anastomosis



Extended End to end anastomosis

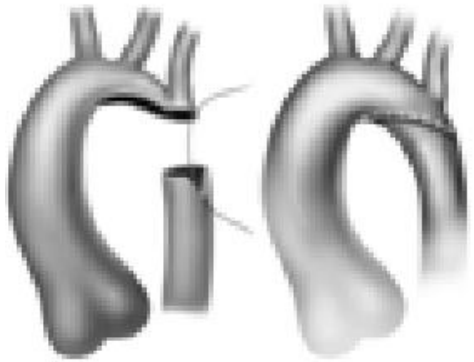
Prosthetic patch aortoplasty



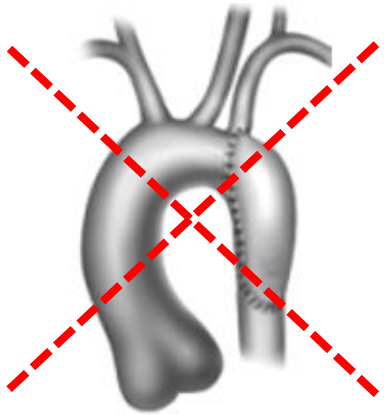
Flap of left subclavian artery

CoA management – surgical options

End to end anastomosis



Extended End to end anastomosis



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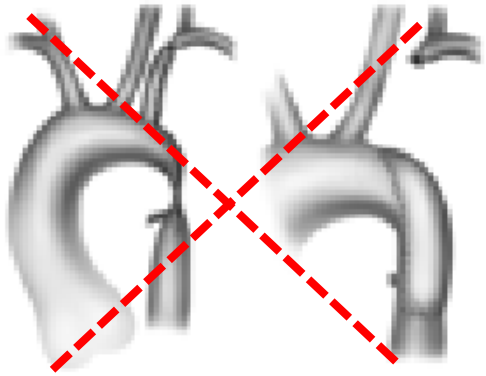

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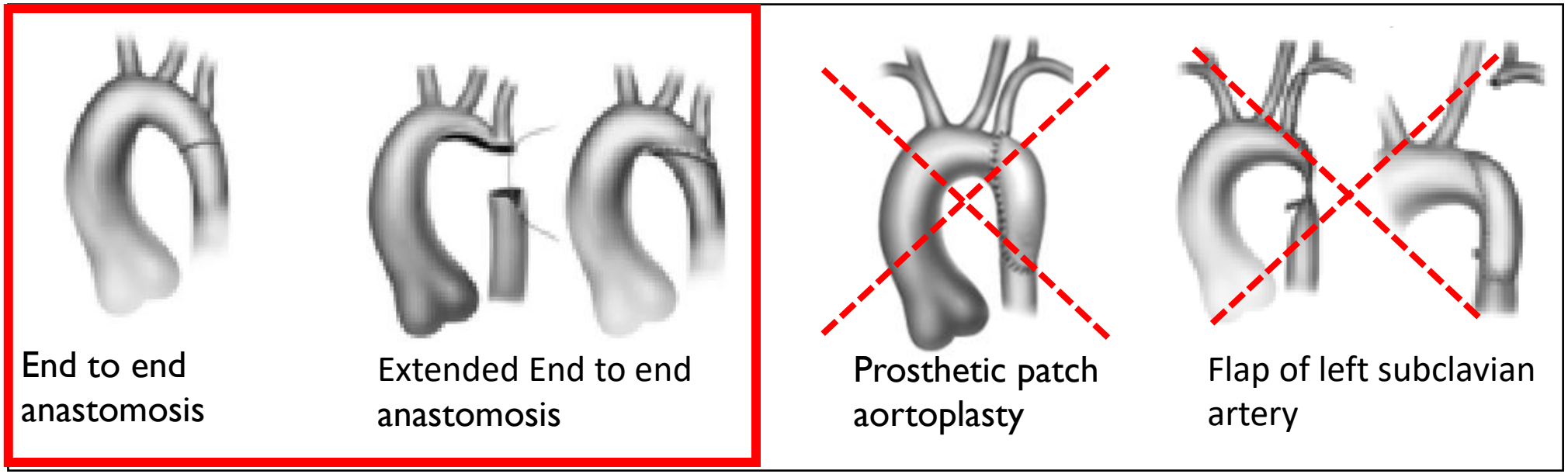
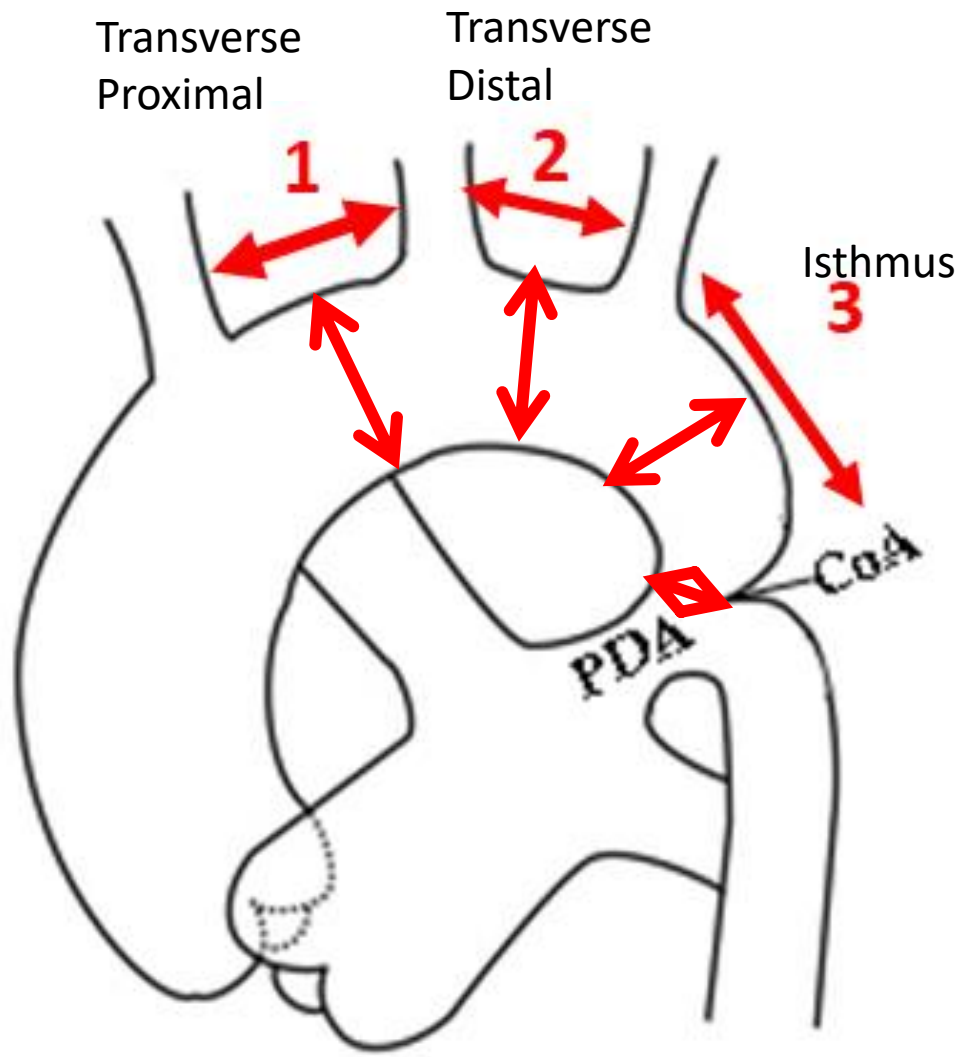
CoA management – surgical options



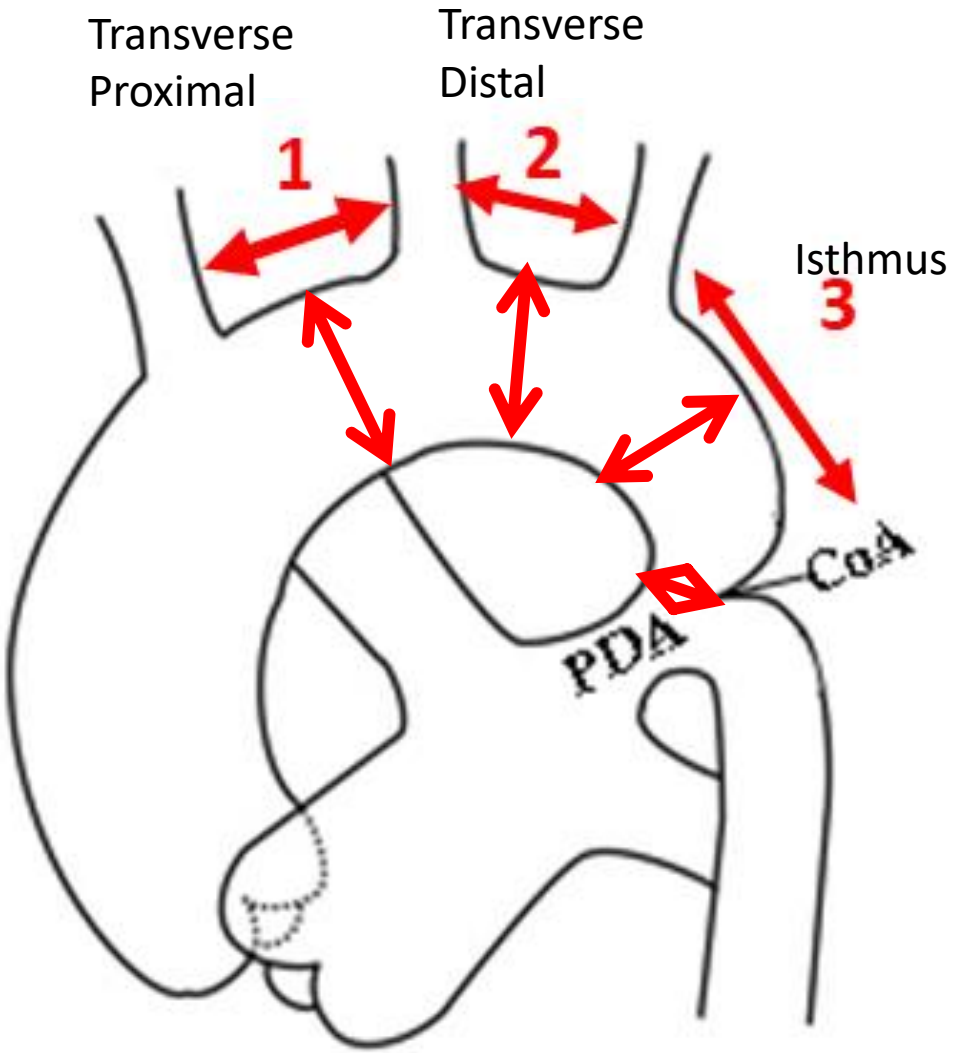
Sternotomy or thoracotomy?

Identify the location and severity of obstruction(s)

- ✓ Measure and calculate z-scores for each segment of the aortic arch in the sagittal view.
- ✓ Locate and measure the diameter of the narrowest part of the aorta



Aortic Arch Hypoplasia



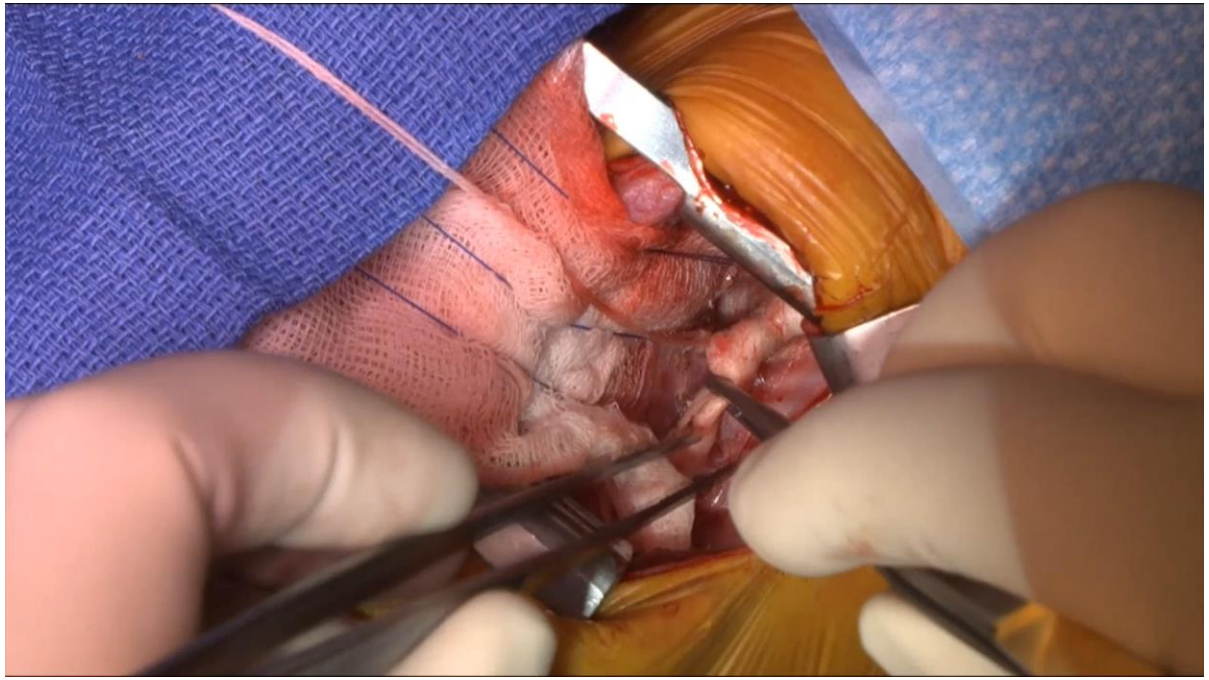
Definition

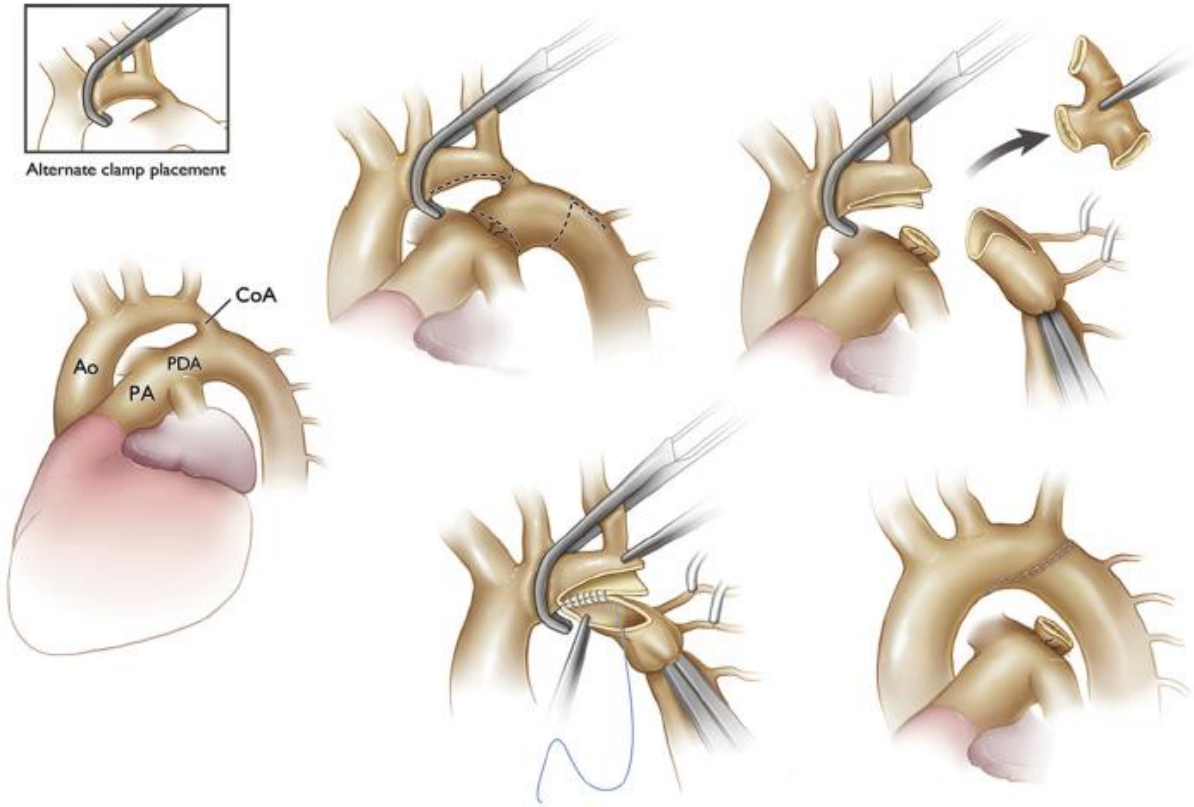
- Transverse arch diameter mm < weight in Kg + 1
- Score z < -2
- Ratio between transverse arch diameter/ descending < 50%

Implications

- Key point for decision making & surgical approach

Left posteriolateral thoracotomy

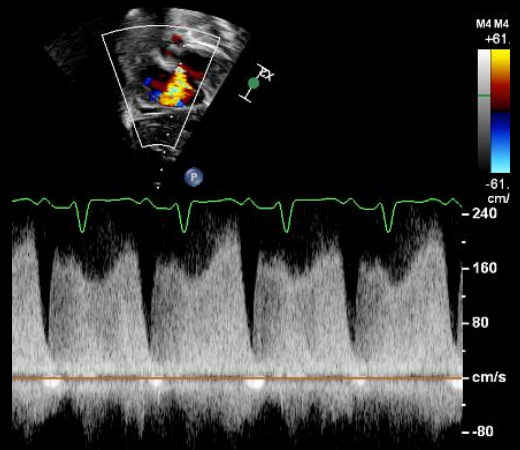


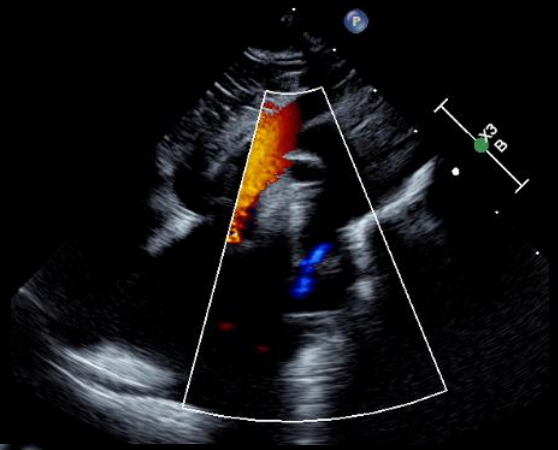


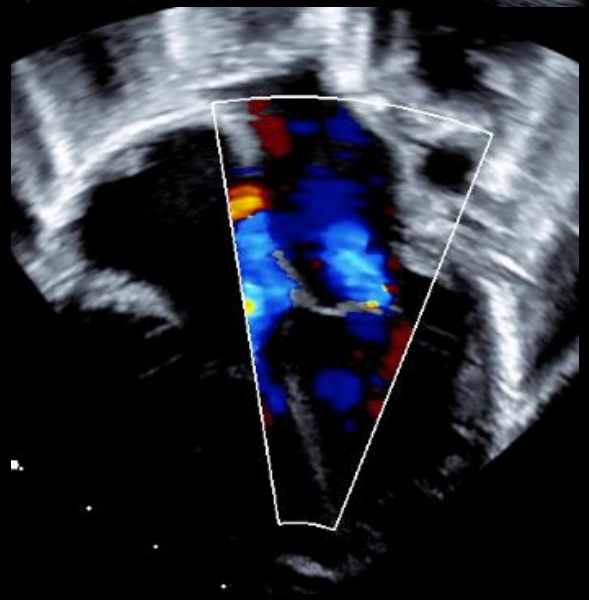
Courtersy of Dr Olivier Raisky (Paris)

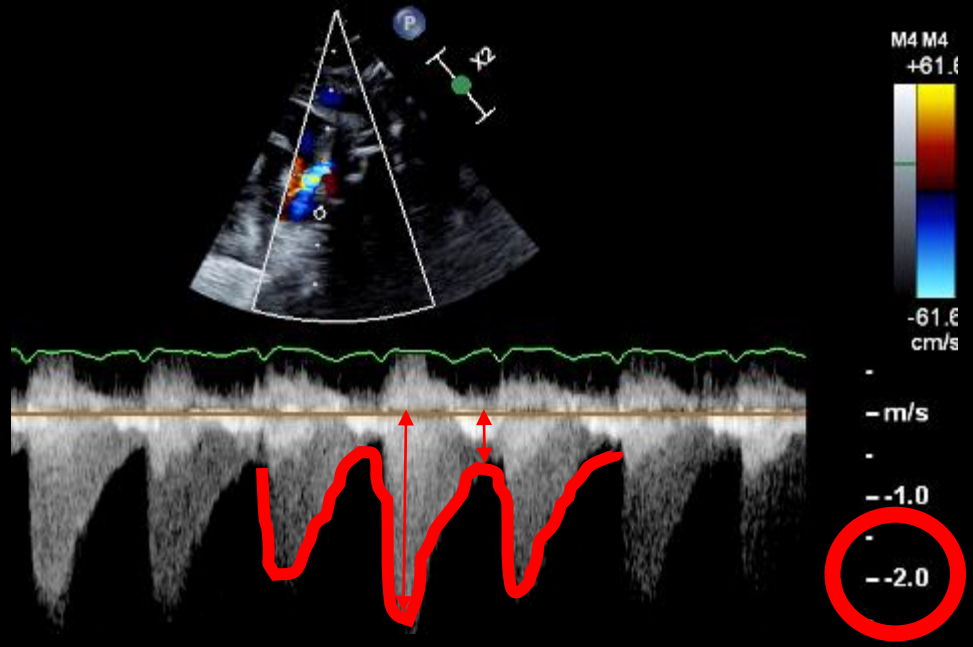
Case 2

HX: 14 days old – Cardiogenic shock, lactate=16 – CoA with severe LV dysfunction









- Low velocity systolic-diastolic
- Systolic and diastolic gradient
- Antegrade flow and gradient during diastole: severity

Case 2

HX: 14 days old – Cardiogenic shock, lactate=16 – CoA with severe LV dysfunction

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ent during diastole: severity

Case 2

HX: 14 days old – Cardiogenic shock, lactate=16 – CoA with severe LV dysfunction

If PGE are not working…

Case 2

HX: 14 days old – Cardiogenic shock, lactate=16 – CoA with severe LV dysfunction

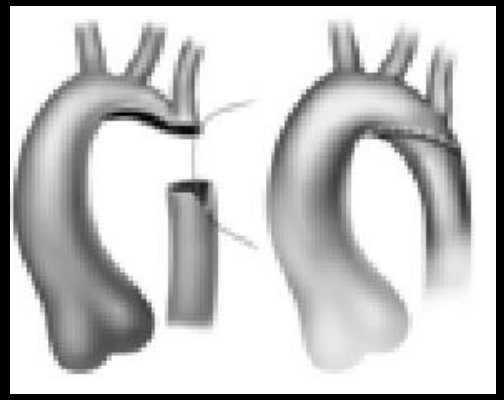
If PGE are not working… tricky (and high risk) situation…

Case 2

HX: 14 days old – Cardiogenic shock, lactate=16 – CoA with severe LV dysfunction

If PGE are not working… Two options:

Surgery



Extended end to end anastomosis
By sternotomy
+/- ECMO after

Balloon angioplasty

"Bridge to surgical repair"

Case 2

HX: 14 days old – Cardiogenic shock, lactate=16 – CoA with severe LV dysfunction

Cardiol Young 2009; 19: 244–251
© Cambridge University Press
ISSN 1047-9511
doi:10.1017/S1047951109003837
First published online 3 April 2009

Original Article

Percutaneous treatment of neonatal aortic coarctation presenting with severe left ventricular dysfunction as a bridge to surgery

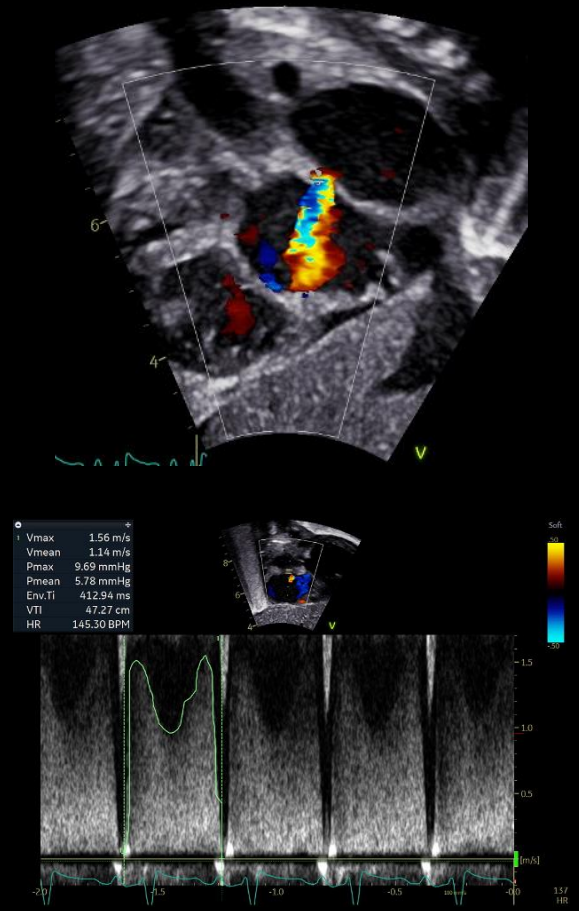
Ivan Bouzguenda, Davide Marini, Phalla Ou, Younes Boudjemline, Damien Bonnet, Gabriella Agnoletti

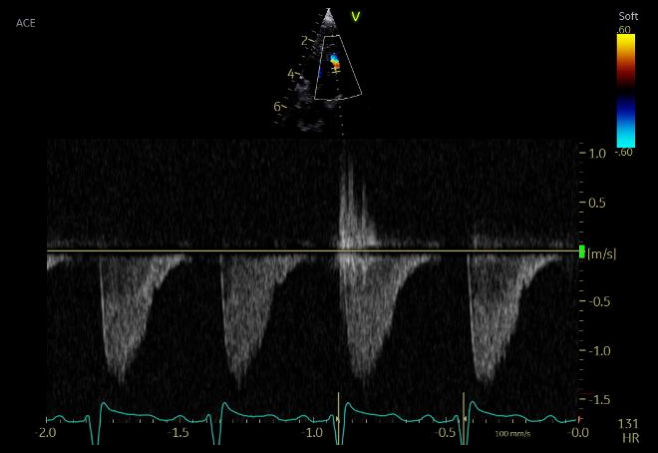
Conclusions: To the best of our knowledge, this is the first series of neonates with aortic coarctation and multiorgan failure receiving a palliative treatment by balloon dilation. Although the prognosis of this condition remains severe, emergency balloon dilation can diminish mortality, providing a bridge to surgery in severely ill patients.

Case 2

HX: 14 days old – Cardiogenic shock, lactate=16 – CoA with severe LV dysfunction

PGE are "working"… after 12 hours: lactate=1.3 and better LV function





But no DA…

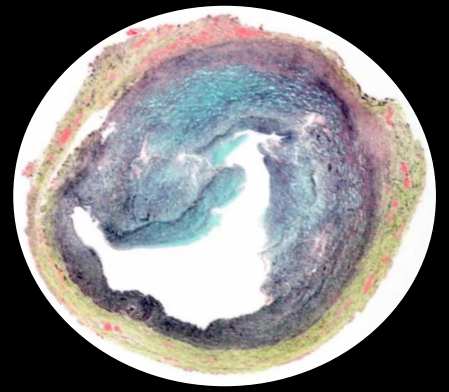
Case 2

PGE and CoA

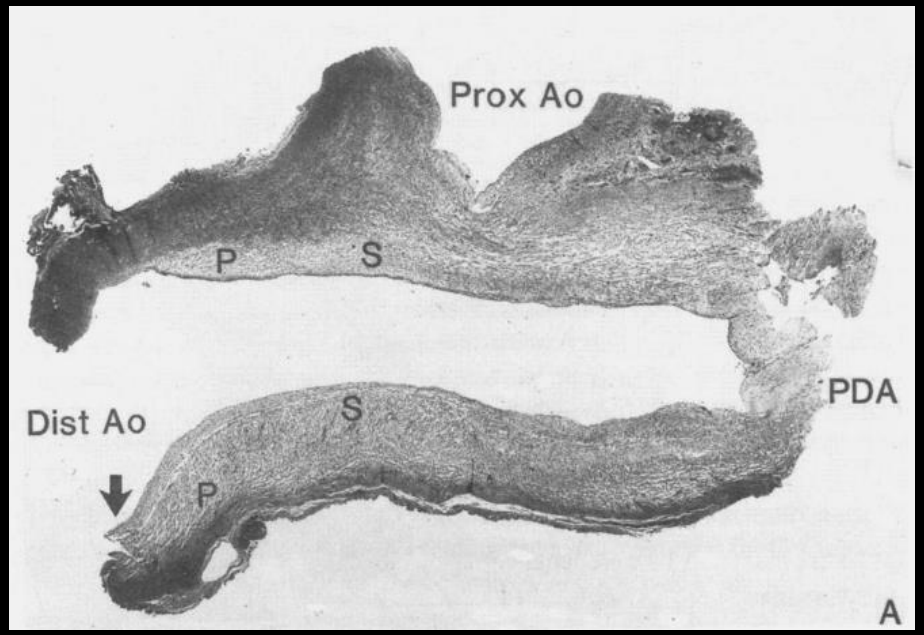
J THORAC CARDIOVASC SURG 1991;102:596-601

Patterns of ductal tissue in coarctation of the aorta in the first three months of life

G. A. Russell, BSc, MRCPath,[a] P. J. Berry, MA, MRCP, MRCPath,[a] K. Watterson, FRACS,[b] J. P. Dhasmana, FRCS,[b] and J. D. Wisheart, MCh, FRCS,[b] *Bristol, United Kingdom*



Courtesy Dr David Chiasson
Sickkids



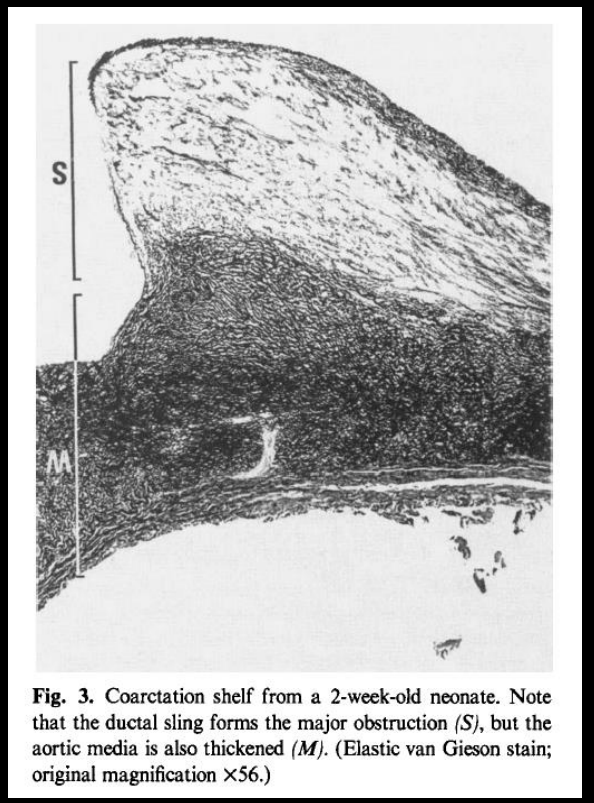


Fig. 3. Coarctation shelf from a 2-week-old neonate. Note that the ductal sling forms the major obstruction *(S)*, but the aortic media is also thickened *(M)*. (Elastic van Gieson stain; original magnification ×56.)

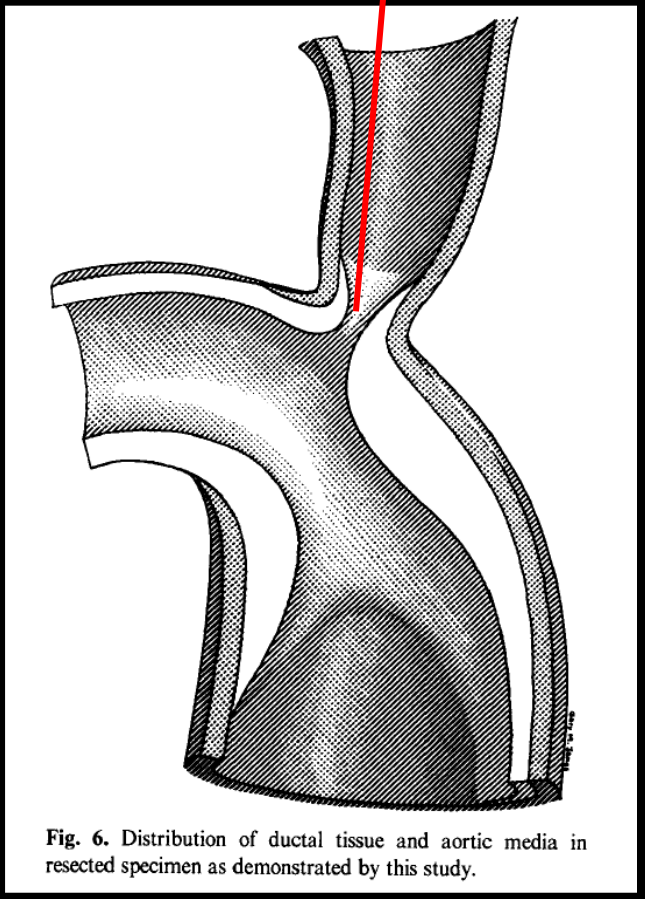


Fig. 6. Distribution of ductal tissue and aortic media in resected specimen as demonstrated by this study.

Case 2

PGE and CoA

Interactive CardioVascular and Thoracic Surgery 29 (2019) 469–475
doi:10.1093/icvts/ivz117 Advance Access publication 14 May 2019

ORIGINAL ARTICLE

Cite this article as: Lehnert A, Villemain O, Gaudin R, Méot M, Raisky O, Bonnet D. Risk factors of mortality and recoarctation after coarctation repair in infancy. Interact CardioVasc Thorac Surg 2019;29:469–75.

Risk factors of mortality and recoarctation after coarctation repair in infancy

Amélia Lehnert [a,†], Olivier Villemain [a,b,*,†], Régis Gaudin [a], Mathilde Méot [a,b], Olivier Raisky [a,b] and Damien Bonnet [a,b,c]

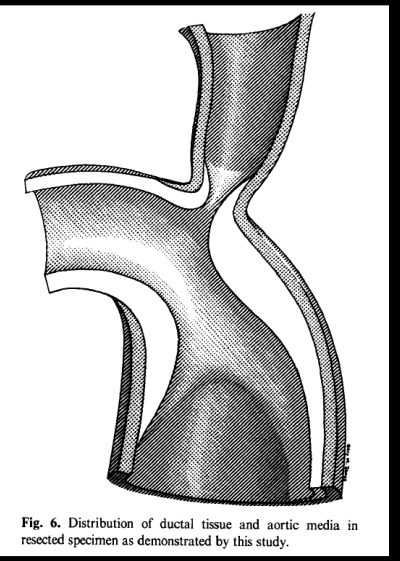


Fig. 6. Distribution of ductal tissue and aortic media in resected specimen as demonstrated by this study.

Key question

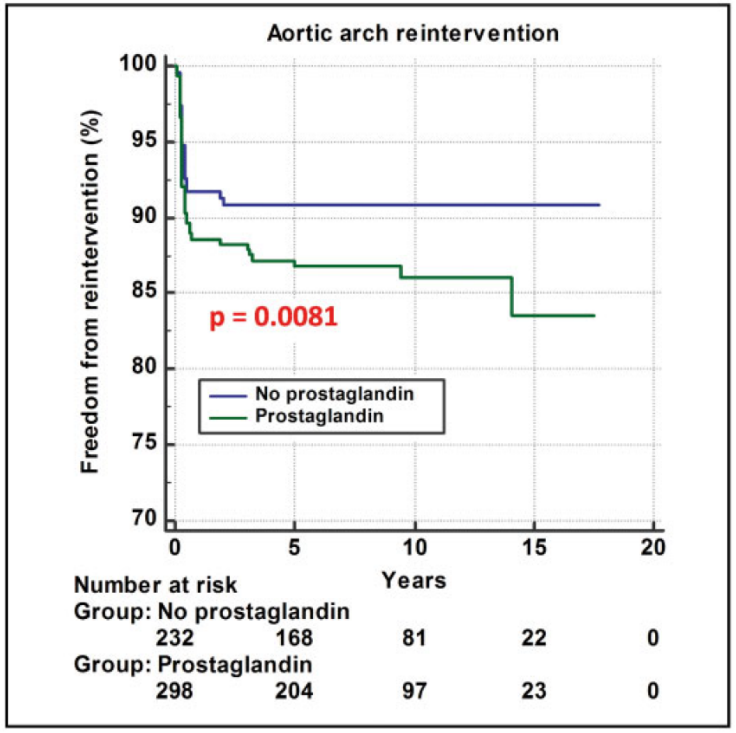
Are there any predictors of aortic arch reintervention after aortic coarctation repair?

Key finding(s)

Both very young age and the need for prostaglandin infusion are risk factors for recoarctation.

Take-home message

In cases of neonatal coarctation, indications of prostaglandin must be clarified and respected.



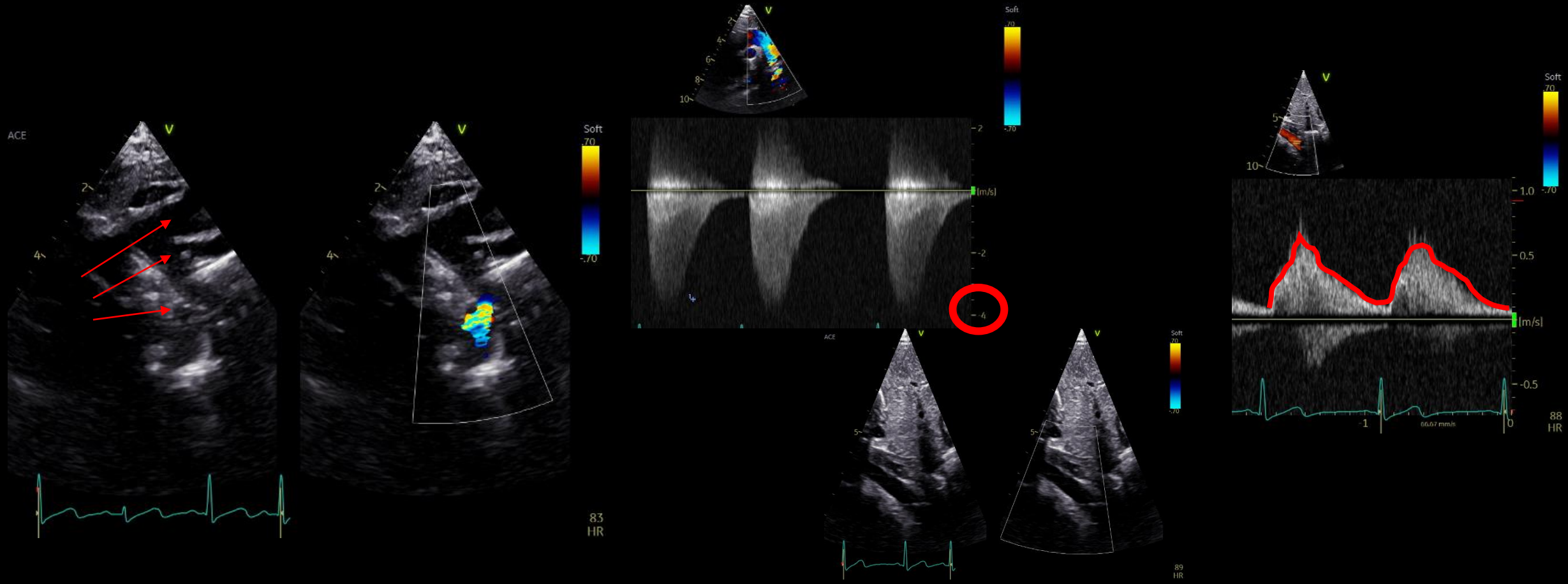
Case 3

11 month old, hypertension and diminished femoral pulses…

BP Right Arm 125/64/88 mmhg & Left leg 76/35/57 mmhg

Case 3

11 month old, hypertension and diminished femoral pulses…



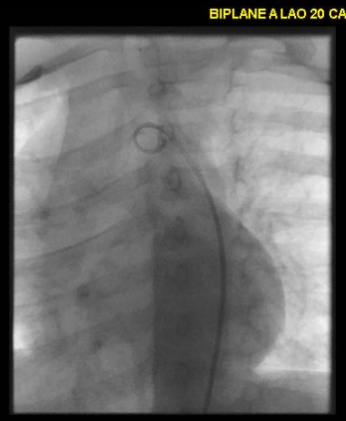
BP Right Arm 125/64/88 mmhg & Left leg 76/35/57 mmhg

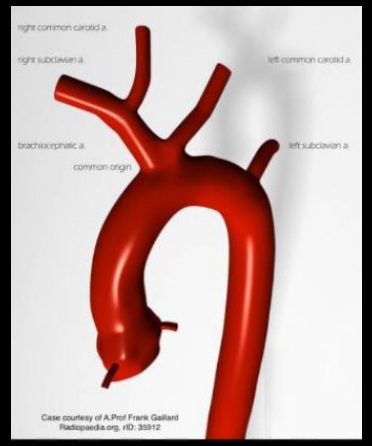
Arch Sidedness + Neck Vessel Sweep

Case 3

11 month old, hypertension and diminished femoral pulses…

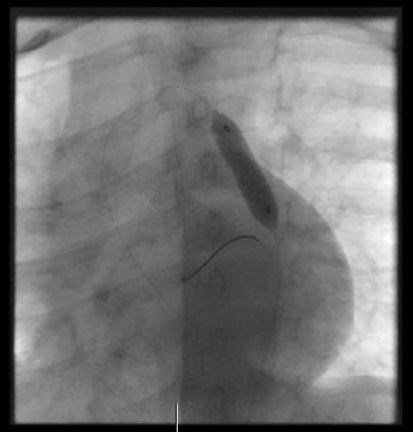
BEFORE



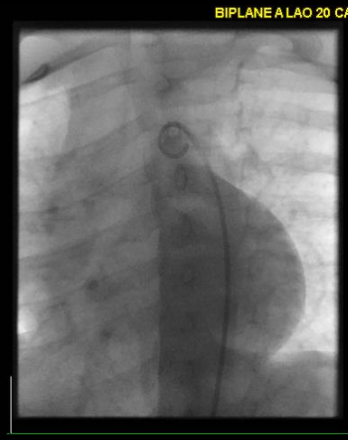


'Bovine arch'

DURING



AFTER



Case 3

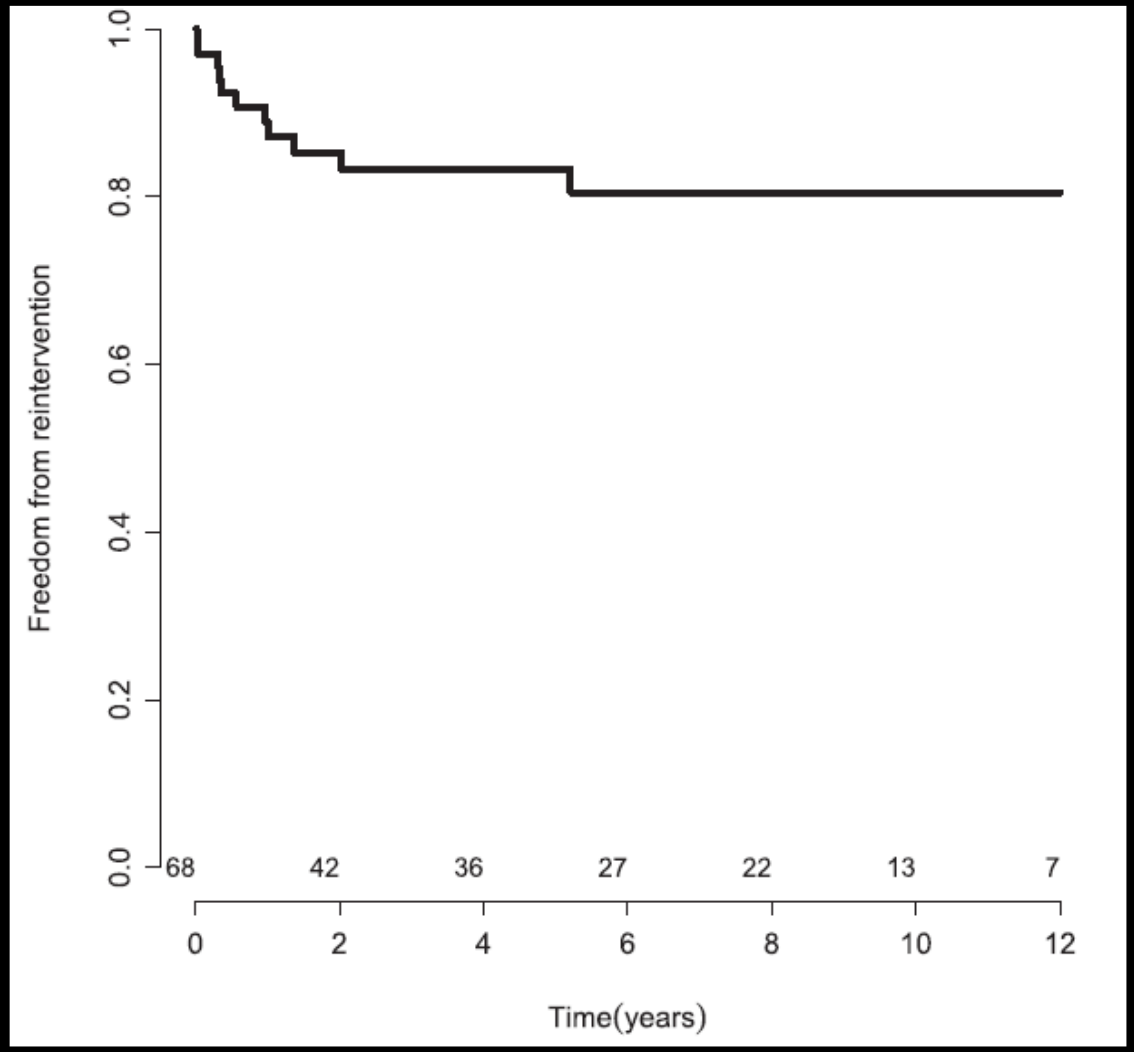
Circulation: Cardiovascular Interventions

ORIGINAL ARTICLE

Balloon Angioplasty for Native Aortic Coarctation in 3- to 12-Month-Old Infants

Juan Pablo Sandoval, MD*; Sok-Leng Kang, MBBS, MSc*; Kyong-Jin Lee, MD; Lee Benson, MD; Kentaro Asoh, MD; Rajiv R. Chaturvedi, MB BChir, MD, PhD

2021



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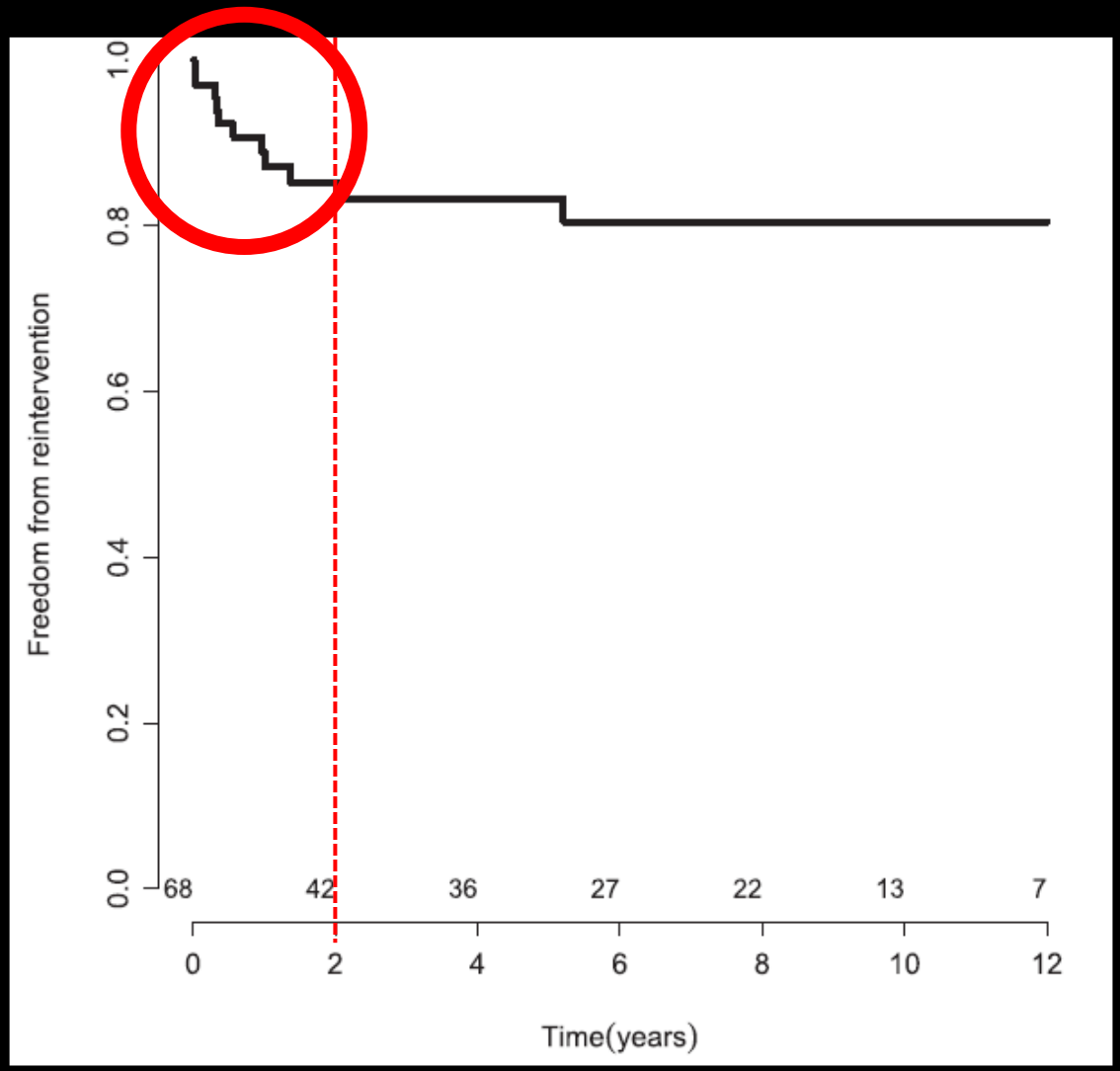
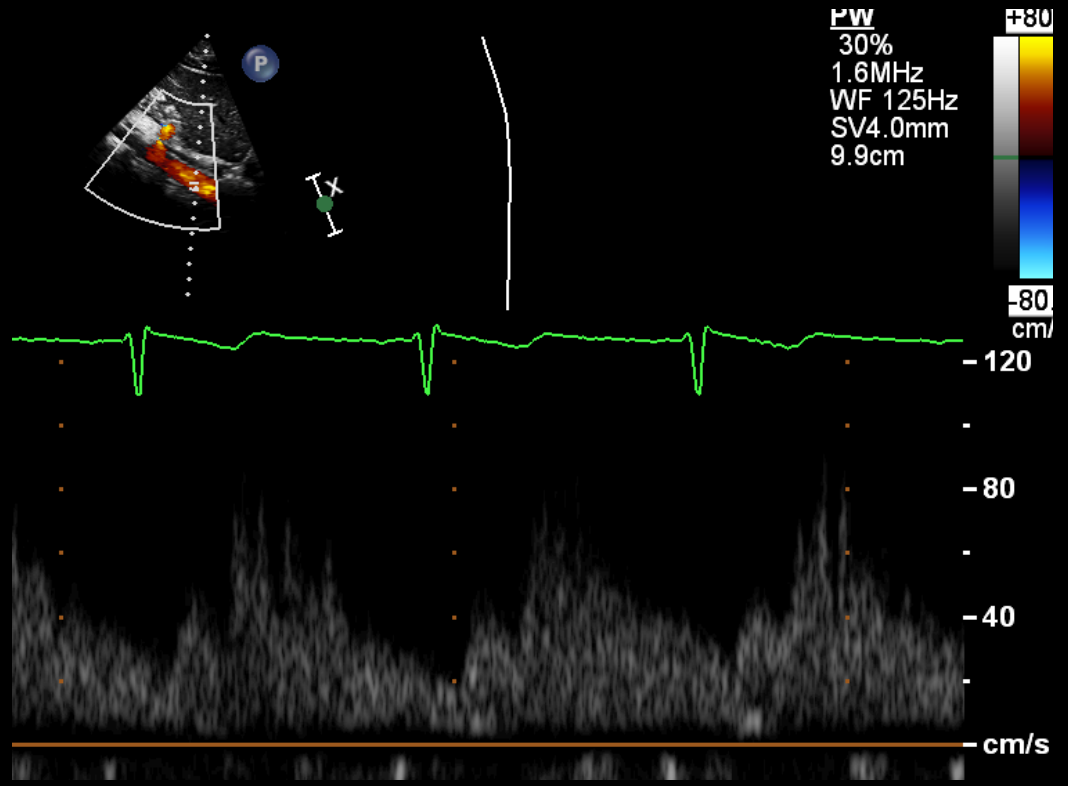


Case 4

8 y old, headaches and hypertension
Right Arm BP 123/83/96
Left Leg 91 mmhg



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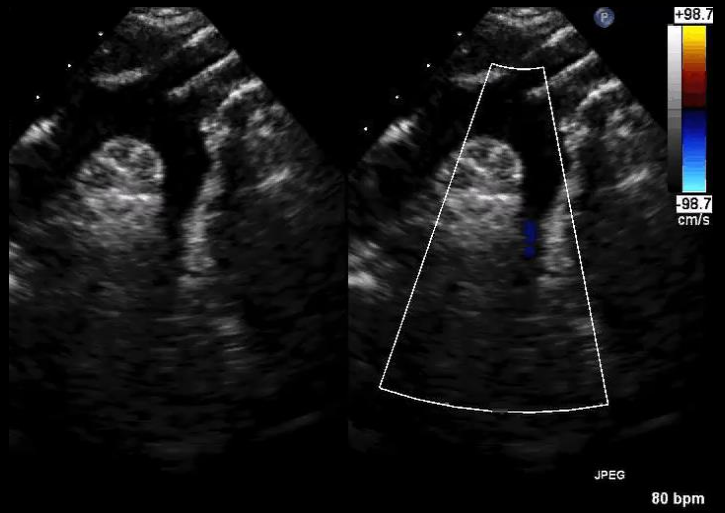
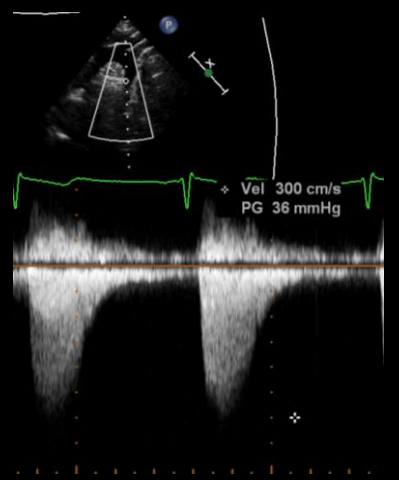
Right Arm BP 123/83/96
Left Leg 91 mmhg

Supra sternal view : from short axis to long axis

Initial view
Not good!





After optimization
Better!

Case 4

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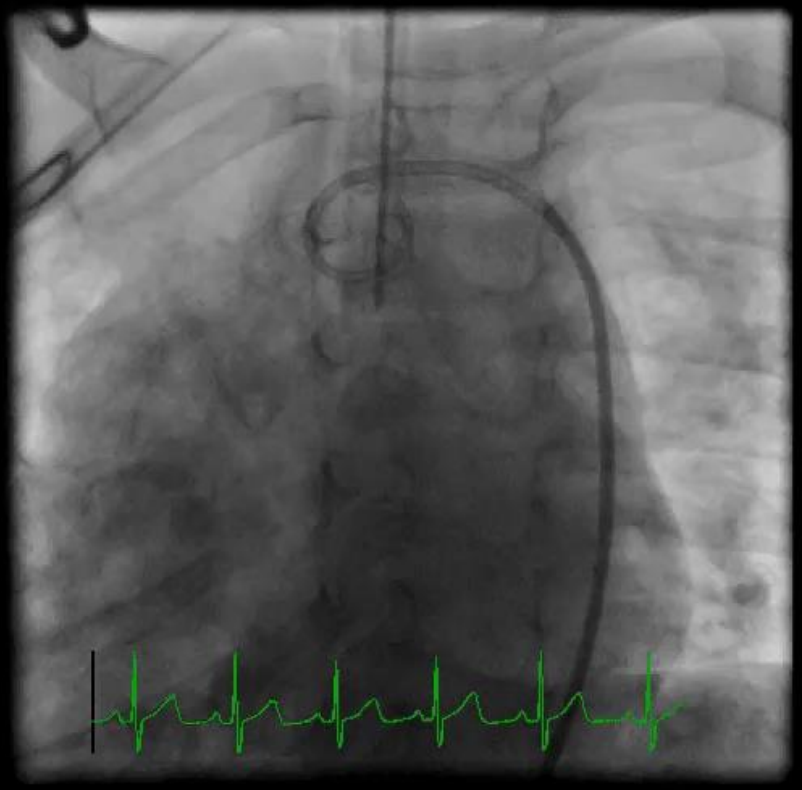
Right Arm BP 123/83/96
Left Leg 91 mmhg

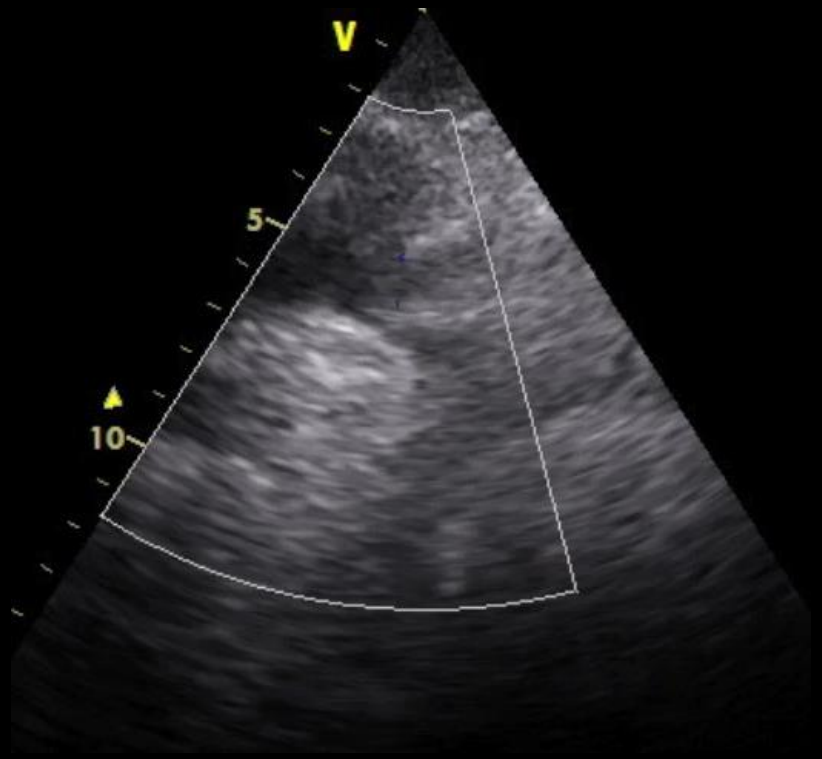


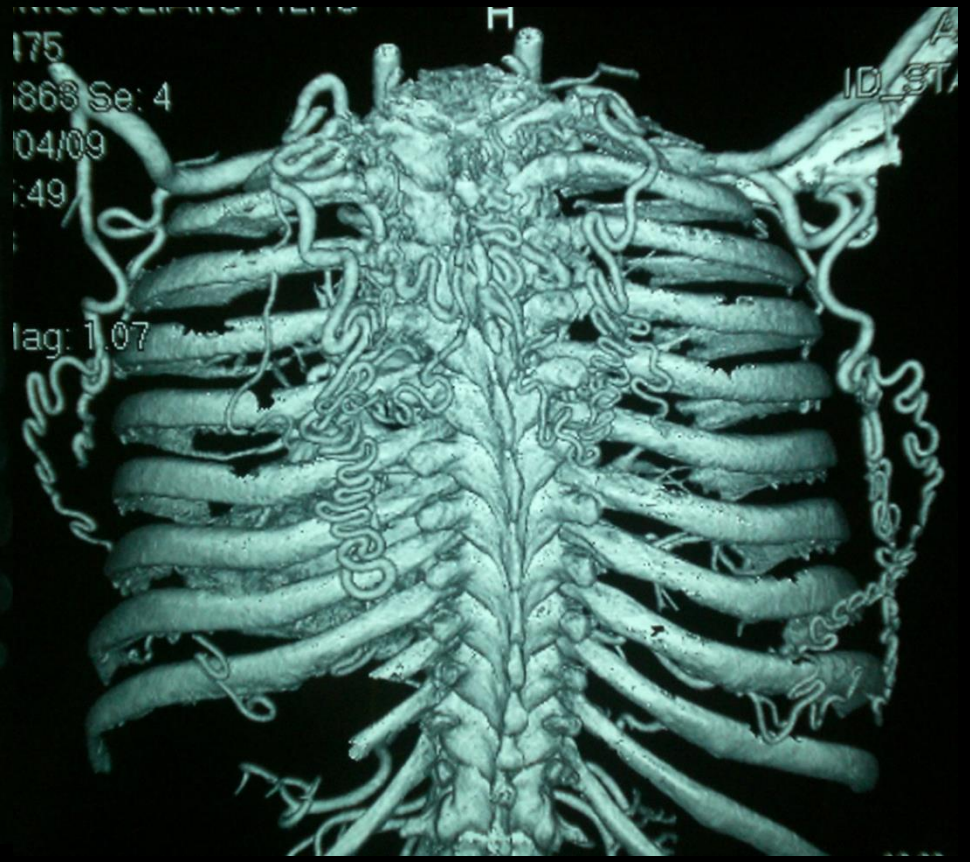
Discrete coarctation

Stenting

Case 5

47 years old, Systemic hypertension untreatable





Sometimes, echocardiography is not your best friend…!

Take home messages

Coarctation of Aorta : Echo imaging goals pre-operatively

- ✓ Segmental cardiac anatomy
- ✓ Function and morphology, size of LV, inflow , outflow
- ✓ Arch anatomy: sidedness, origin and course of brachiocephalic vessels, aortic isthmus, and proximal descending aorta
- ✓ Identify the location and severity of obstruction of the aortic arch
- ✓ Flow gradient in the transverse arch and at obstruction site
- ✓ Flow in the arterial ductus
- ✓ Doppler evaluation / profile descending aorta
- ✓ Atrial communication (direction of flow)
- ✓ Degree of pulmonary hypertension

Take home messages

Coarctation of Aorta : Echo imaging goals pre-operatively

- ✓ Segmental cardiac anatomy
- ✓ Function and morphology, size of LV, inflow , outflow
- ✓ Arch anatomy: sidedness, origin and course of brachiocephalic vessels, aortic isthmus, and proximal descending aorta
- ✓ Identify the location and severity of obstruction of the aortic arch
- ✓ Flow gradient in the transverse arch and at obstruction site
- ✓ Flow in the arterial ductus
- ✓ Doppler evaluation / profile descending aorta
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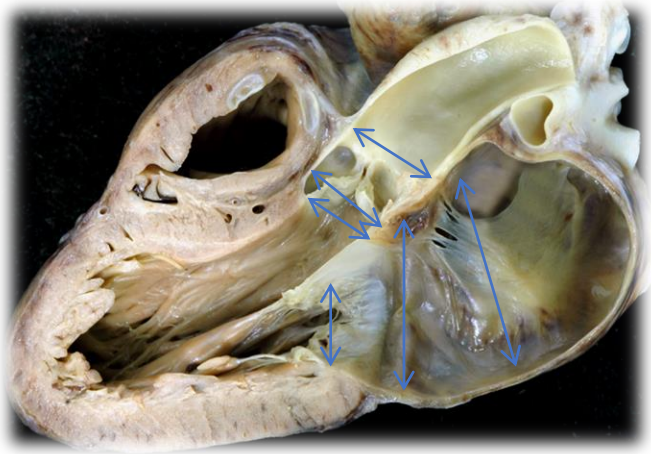
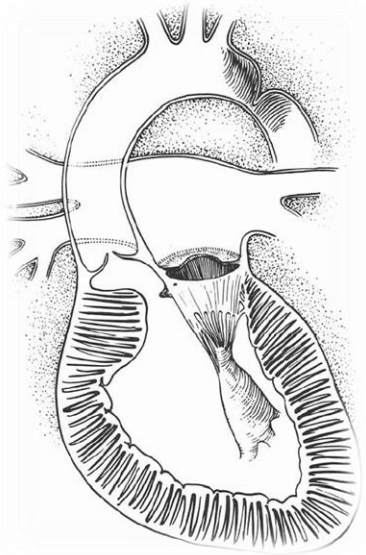
Isolated CoA?





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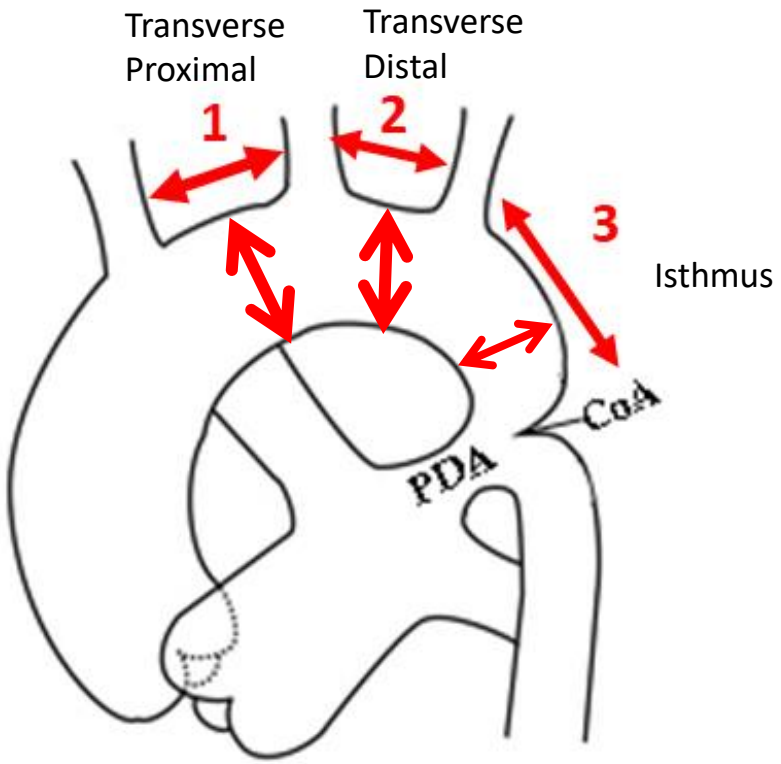

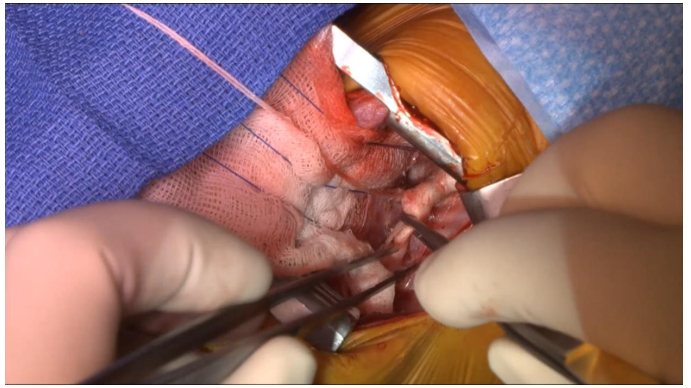

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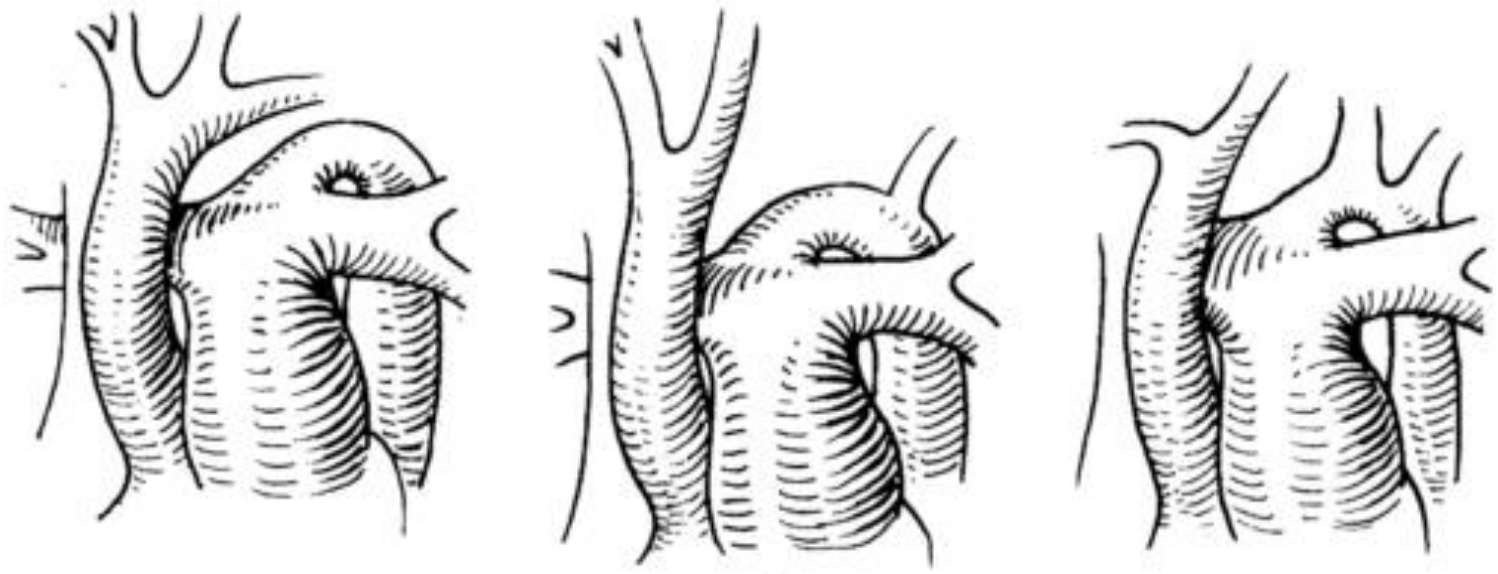
"For neonates"
Additional elements for the pre-interventional medical management

- **PGE?**
- **ICU management?**
- **Timing for intervention?**

Imaging of coarctation and interrupted aortic arch

- Introduction and pathophysiology
- imaging of coarctation
- Imaging of interrupted aortic arch

Celoria and Patton classification



a

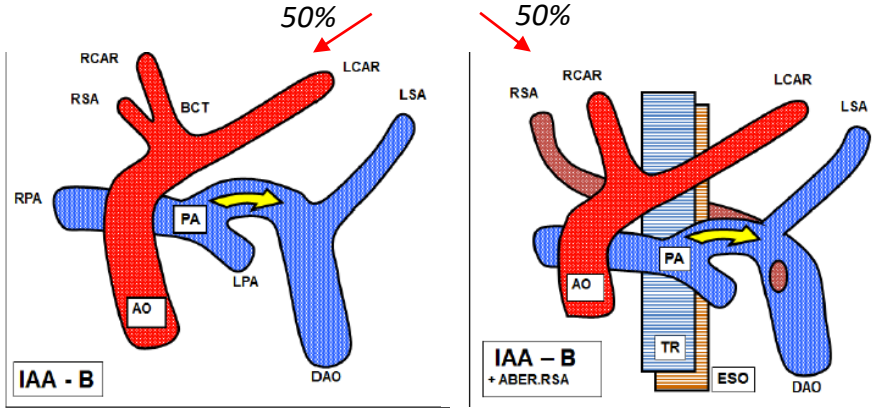
33%

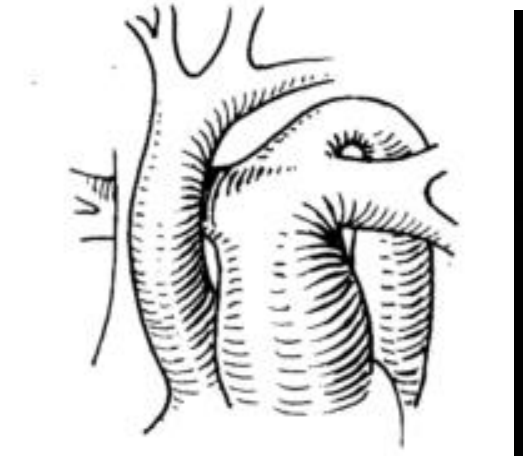
b

66%

c

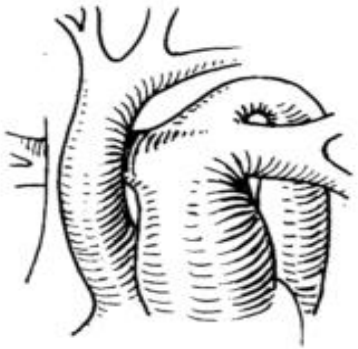
1%





Type A IAA

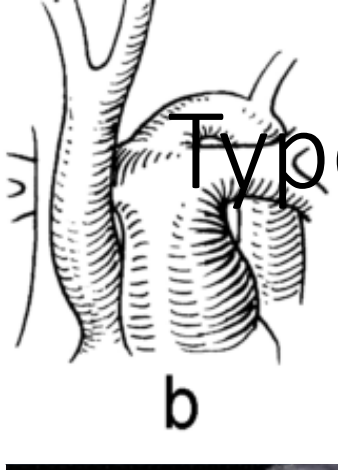
-site of interruption
-Ao arch diameter
-Distance IAA-DescAo



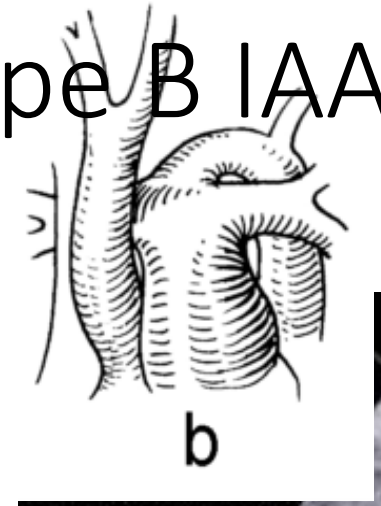
a

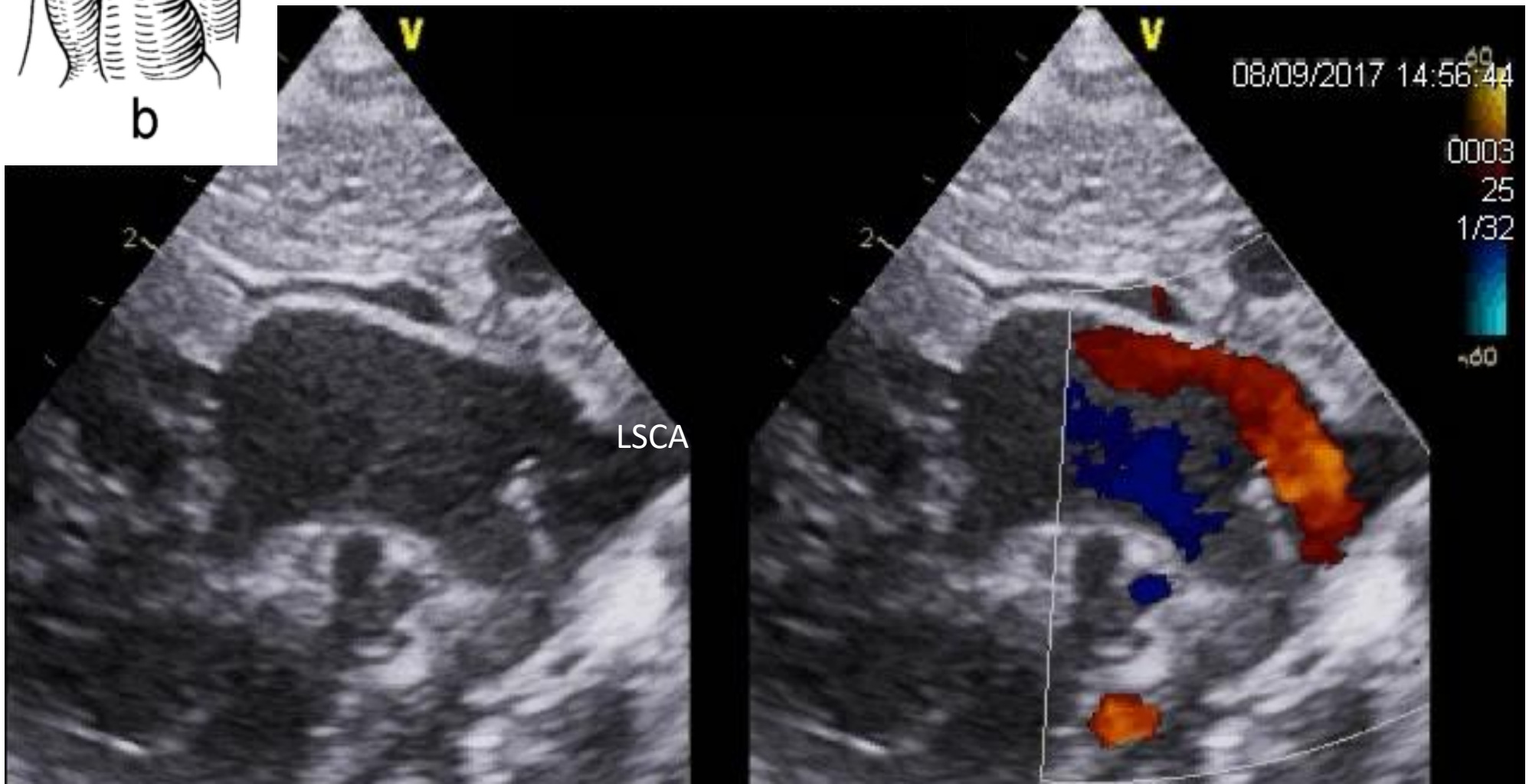
Type A IAA

Type B IAA



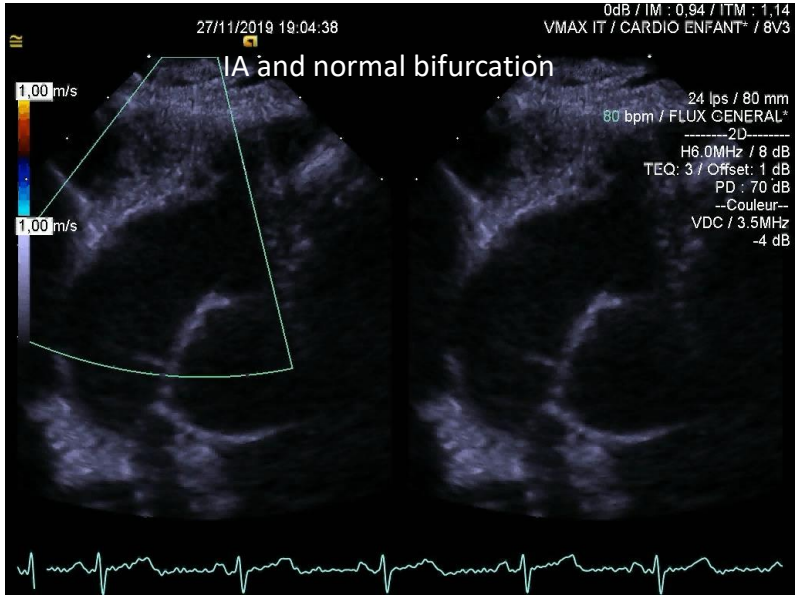
Type B IAA

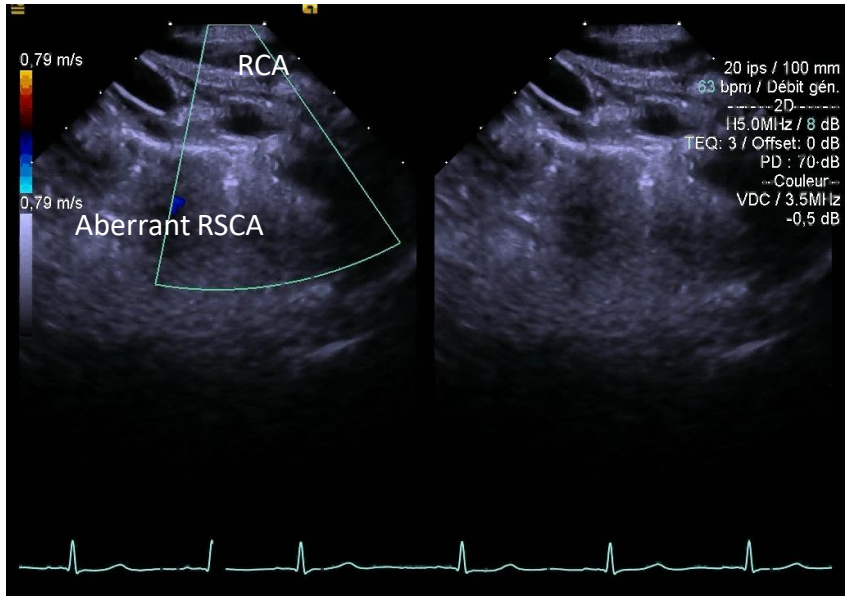




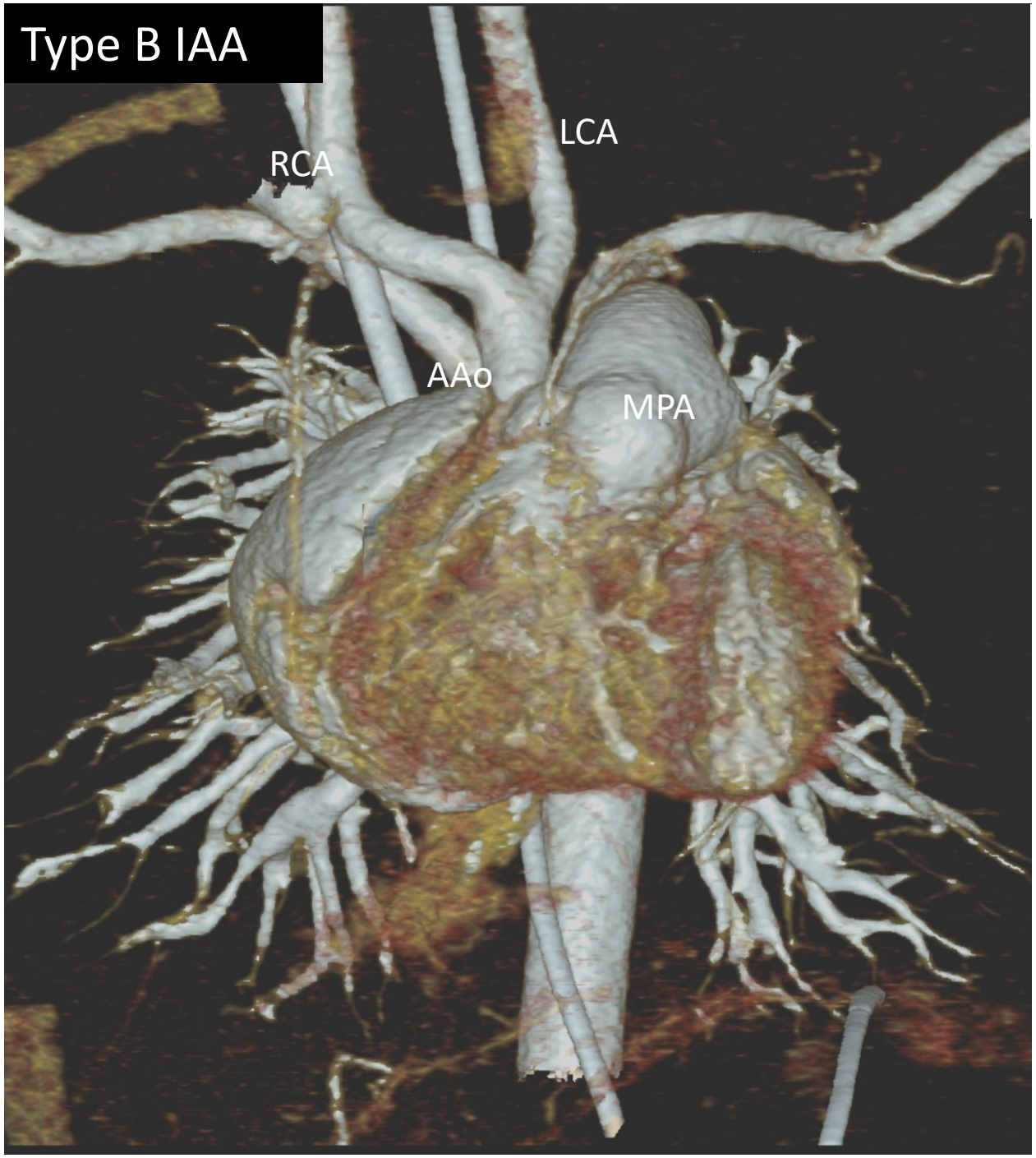
Aberrant origin of the subclavian artery

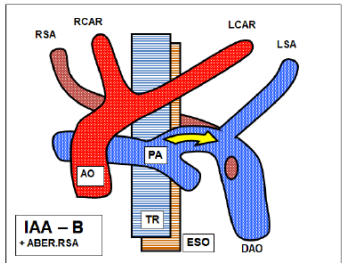
- Identify the 1st brachiocephalic vessel (opposite to the arch side) and IA bifurcation (RCA +RSCA)
- Lower and posterior course of aberrant RSCA relative to RCA
- Can aslo be identified arising from Desc Ao (suprasternal coronal view/ subcostal view)



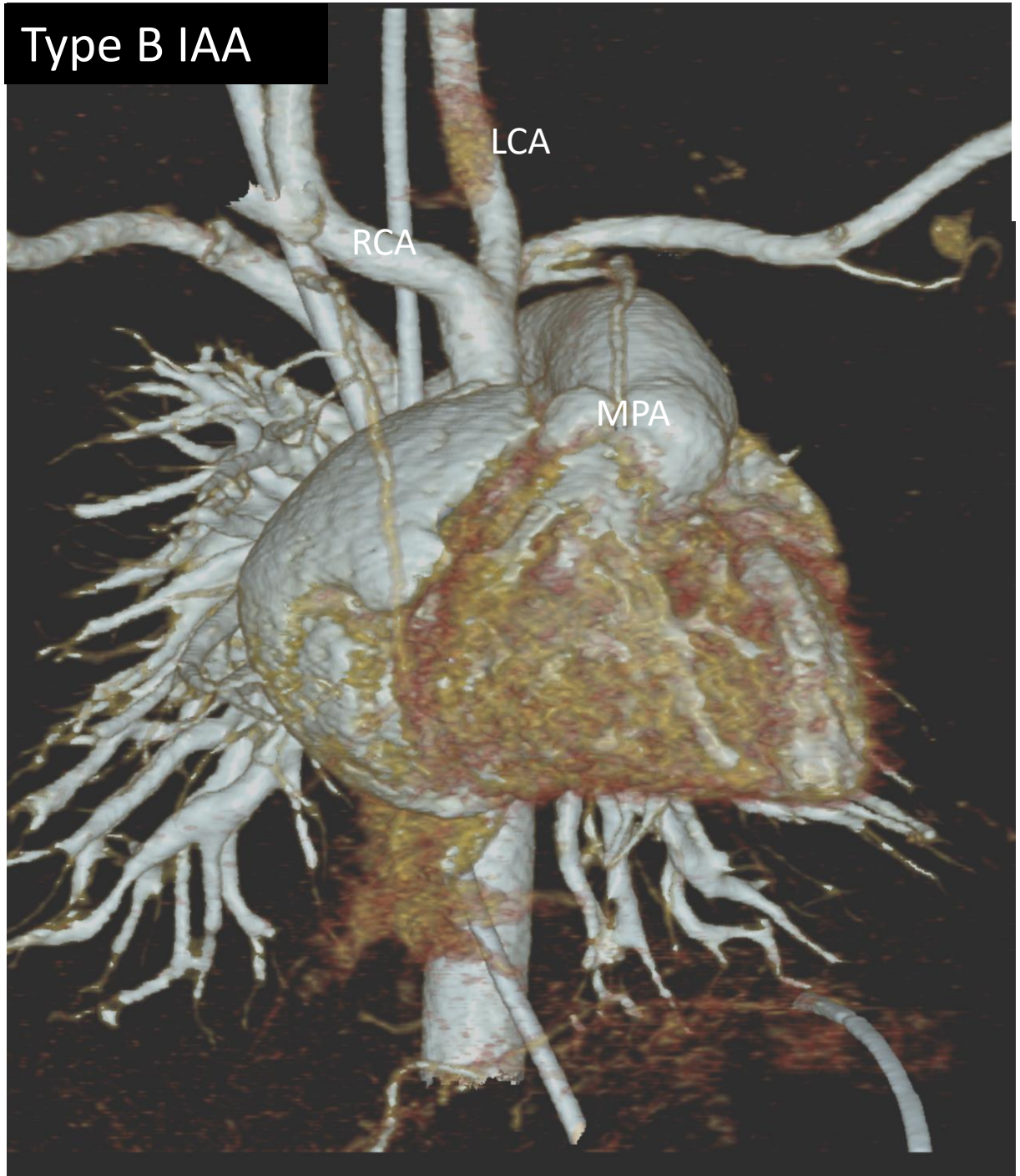


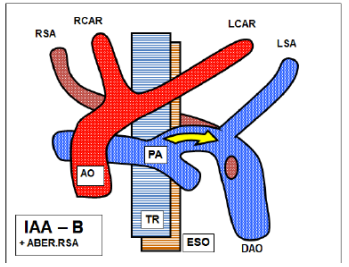
Type B IAA





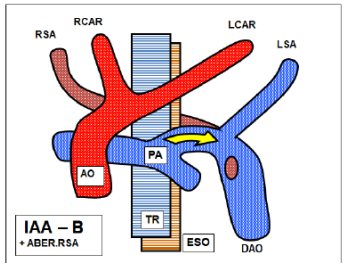
Type B IAA



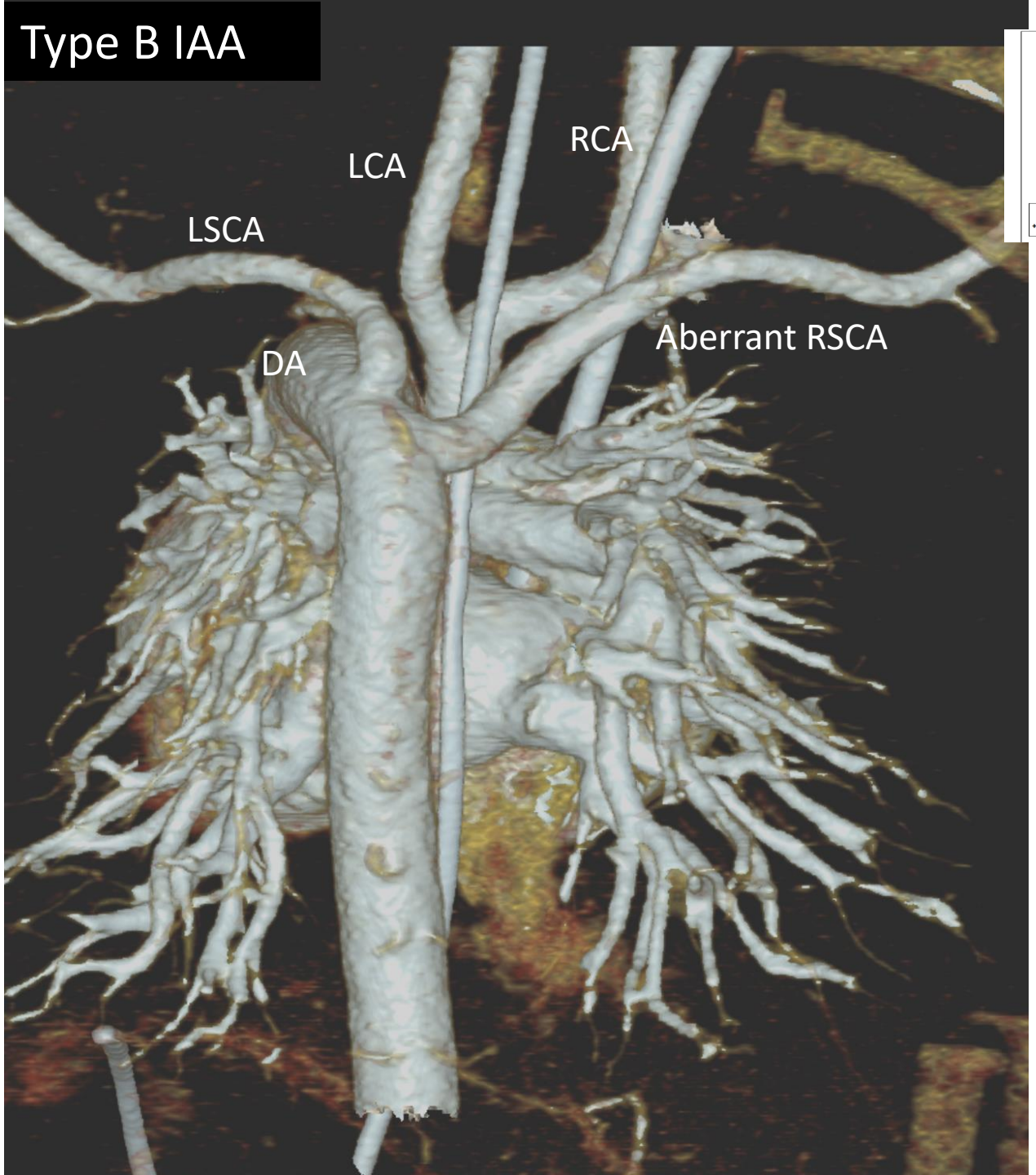


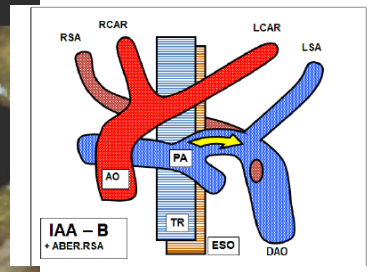
Type B IAA


LCA
RCA
Aberrant RSCA
MPA
DA


RSA
RCAR
LCAR
LSA
PA
AO
TR
ESO
DAO
IAA – B
+ ABER.RSA

Type B IAA


RCA
LCA
LSCA
DA
Aberrant RSCA


RSA
RCAR
LCAR
LSA
PA
AO
TR
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DAO
IAA – B
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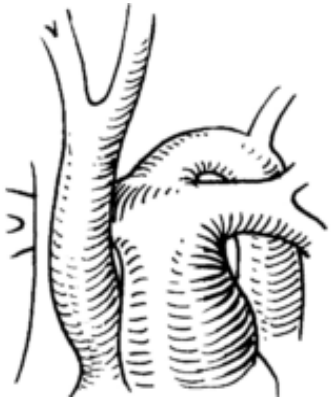
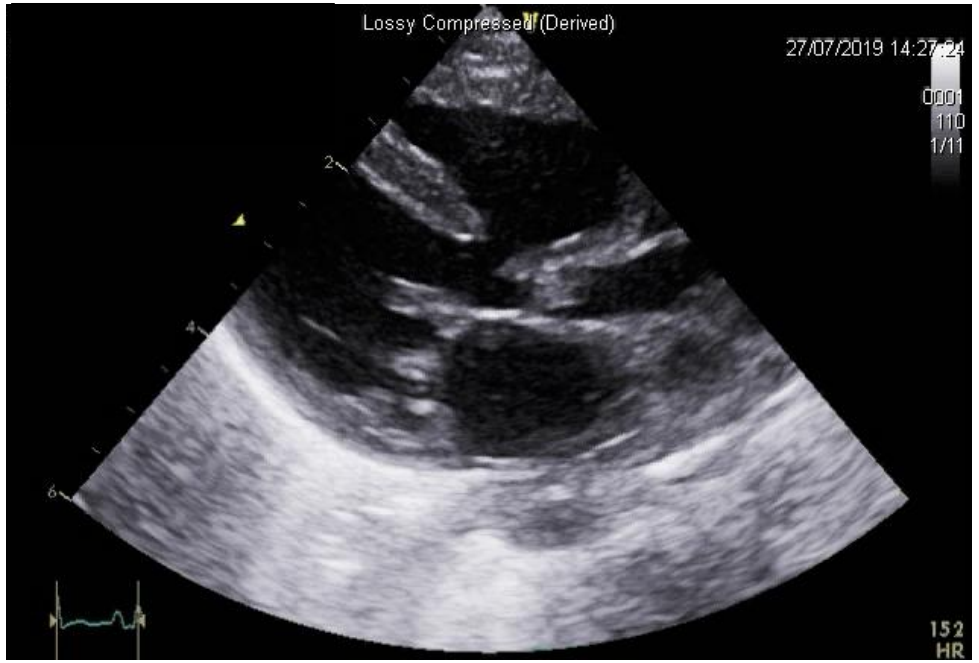


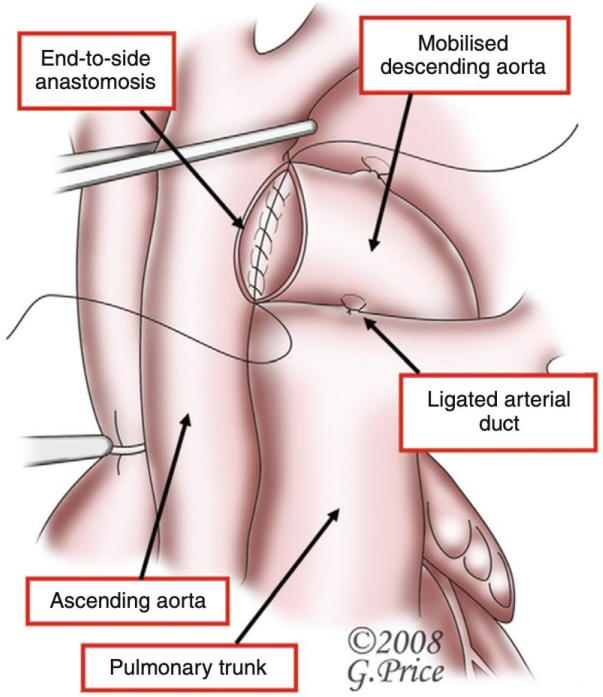
Associated lesions: Conoventricular VSD

- Integral part of the type B IAA
- Posterior malalignment of conal septum
- Various degree of Subaortic stenosis
  - LVOT area < 0,7vm^2/m^2: predictive factor of post-op LVOTO

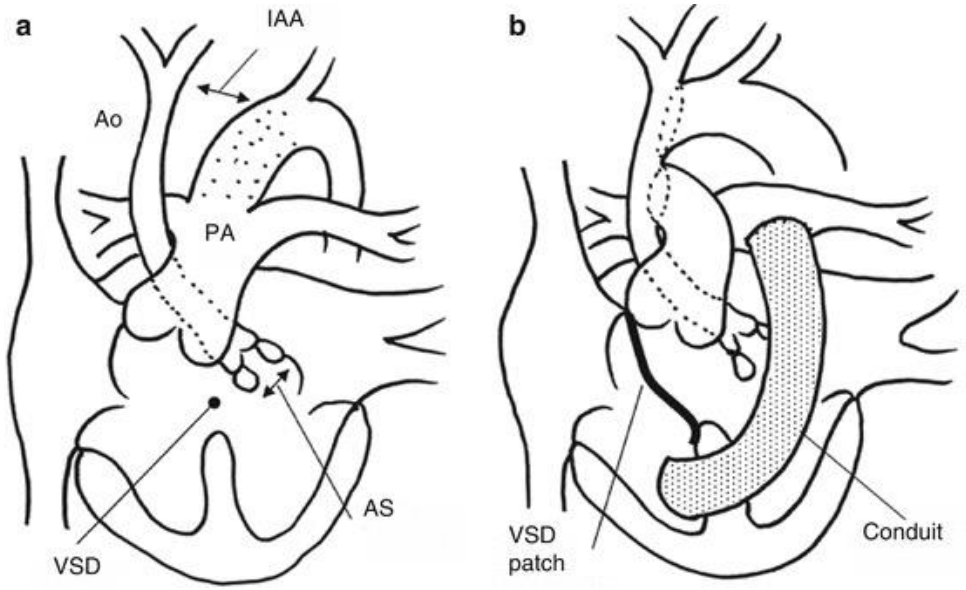


Surgical repair

- Conventional technique includes
  - VSD closure
  - End to side anastomosis

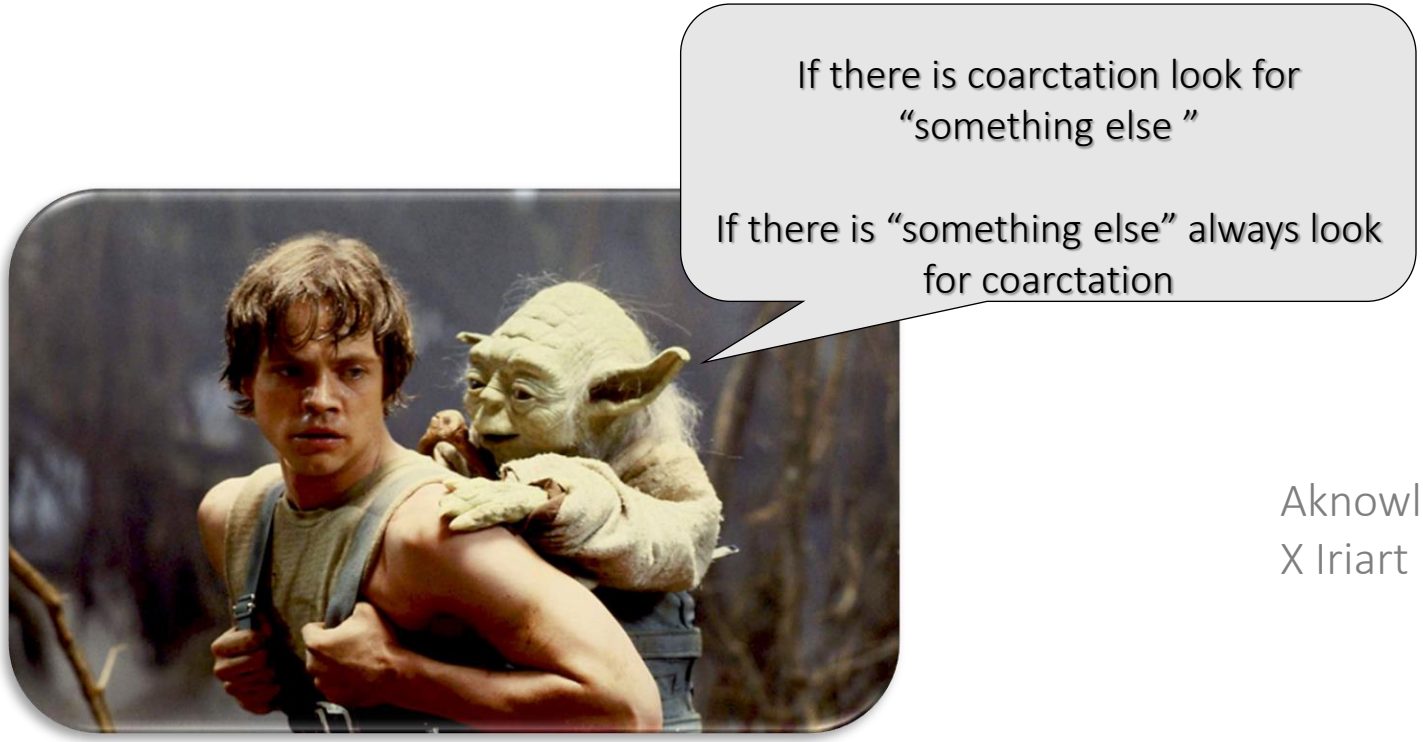


- The Yasui procedure includes:
  - modified DKS procedure to bypass the LVOTO (connecting the aortic and pulmonary roots)
  - Rastelli operation (RV to PA conduit)



Conclusion - IAA

- Comprehensive assessment of Ao arch anatomy, origins of brachiocephalic vessels, isthmus, and prox desc Ao
- Assessment of flow gradients in transverse arch, arterial duct and at the coarctation site
- LV size and function – **LVOT and VSD**
- **Associated malformations; examples**
  - Truncus arteriosus type IV
  - TGA – malalignment VSD - IAA



Aknowledgements
X Iriart


Thank you for your attention

Echocardiographic assessment of coarctation of the aorta –
What is important for surgical/interventional decision-making?

Thank you

olivier.villemain@sickkids.ca