



Non invasive anatomy/physiology of coarctation and neonatal management

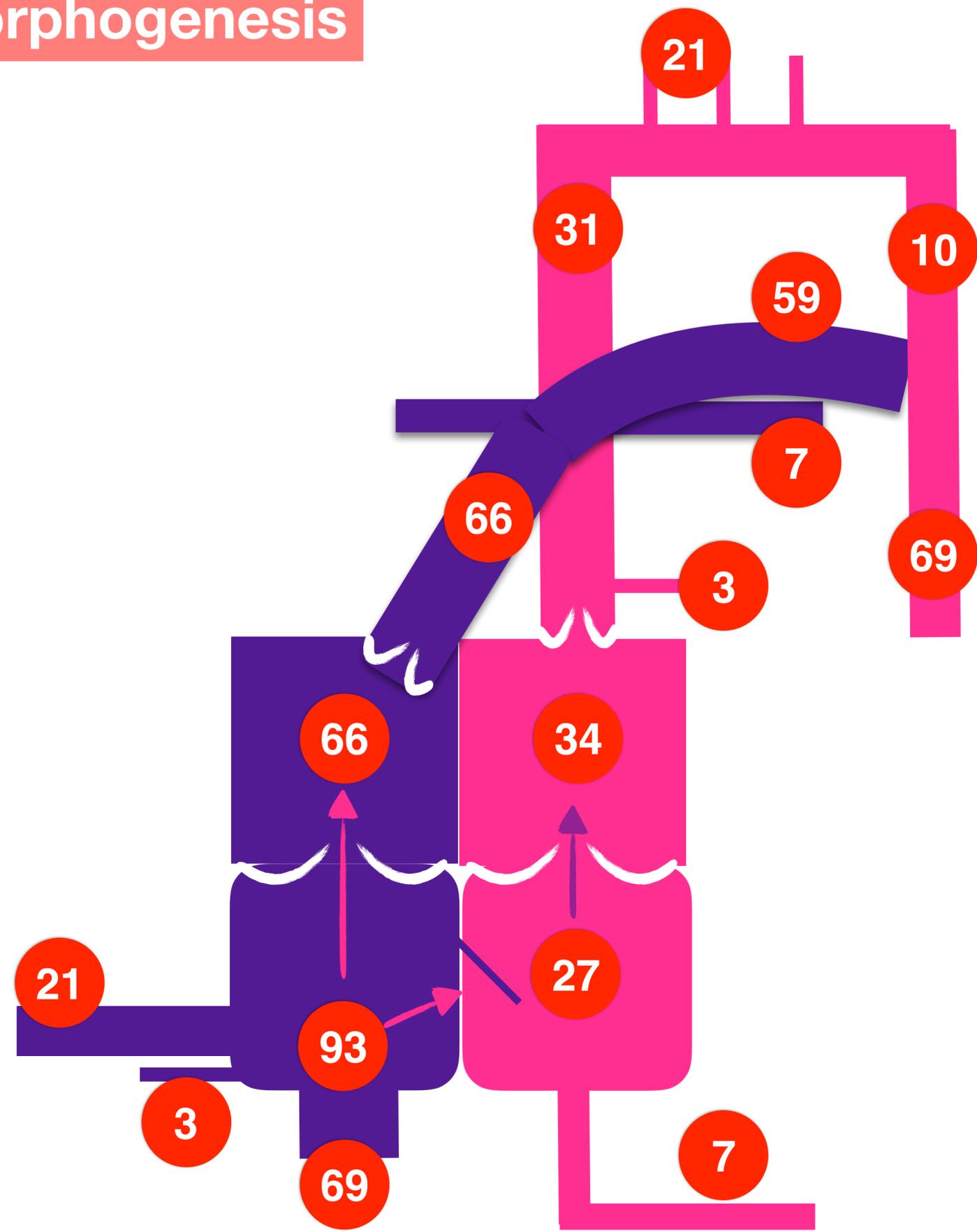
Damien Bonnet

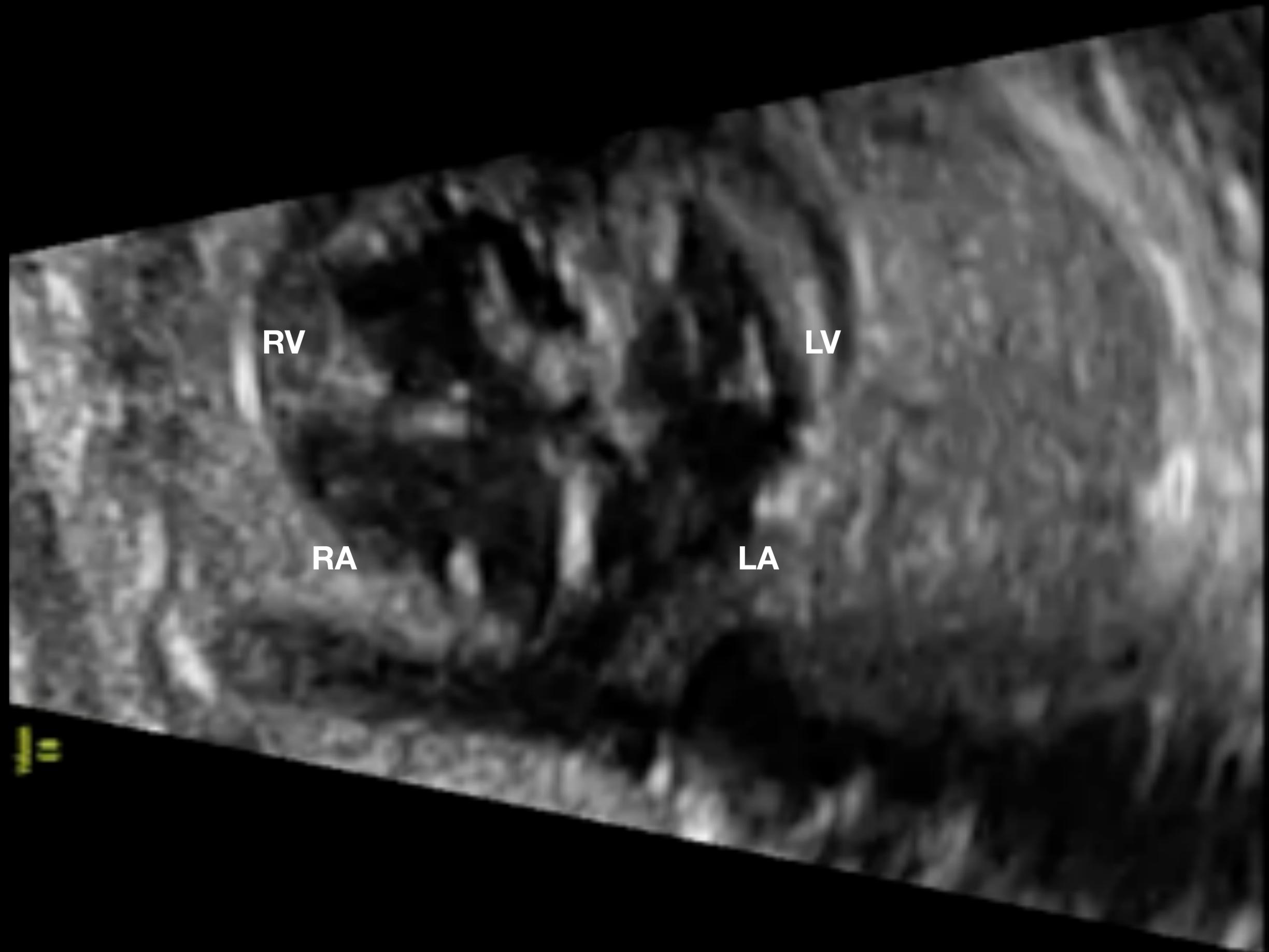
Unité médico-chirurgicale de Cardiologie Congénitale et Pédiatrique
Hôpital Universitaire Necker Enfants malades – AHP, Université de Paris
Institut Hospitalo-Universitaire IMAGINE

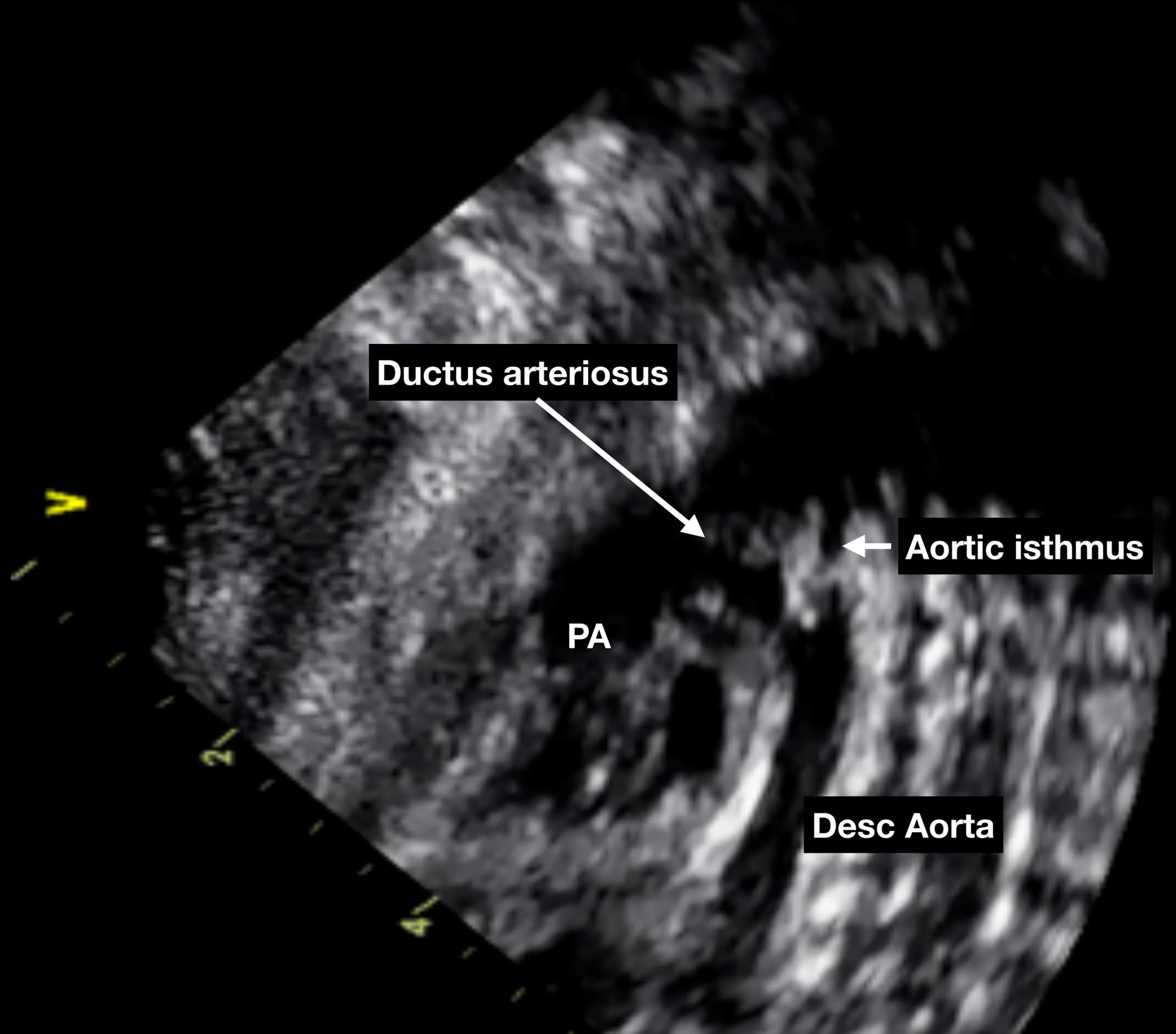
Centre de Référence Maladies Rares
Malformations Cardiaques Congénitales Complexes-M3C
Centre de Référence Maladies Rares
Maladies Cardiaques Héritaires- CARDIOGEN



Fetal circulation and morphogenesis







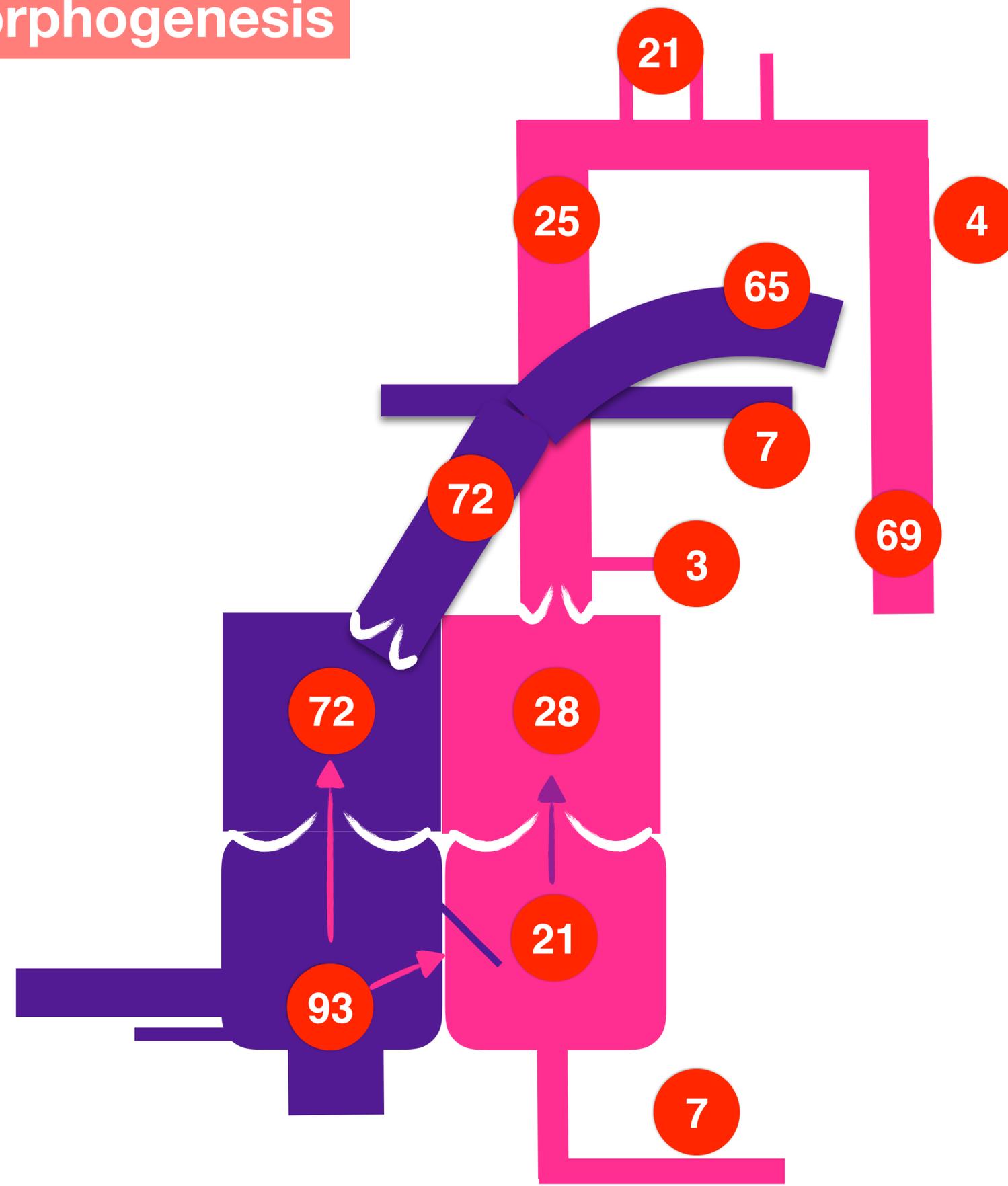
Ductus arteriosus

Aortic isthmus

PA

Desc Aorta

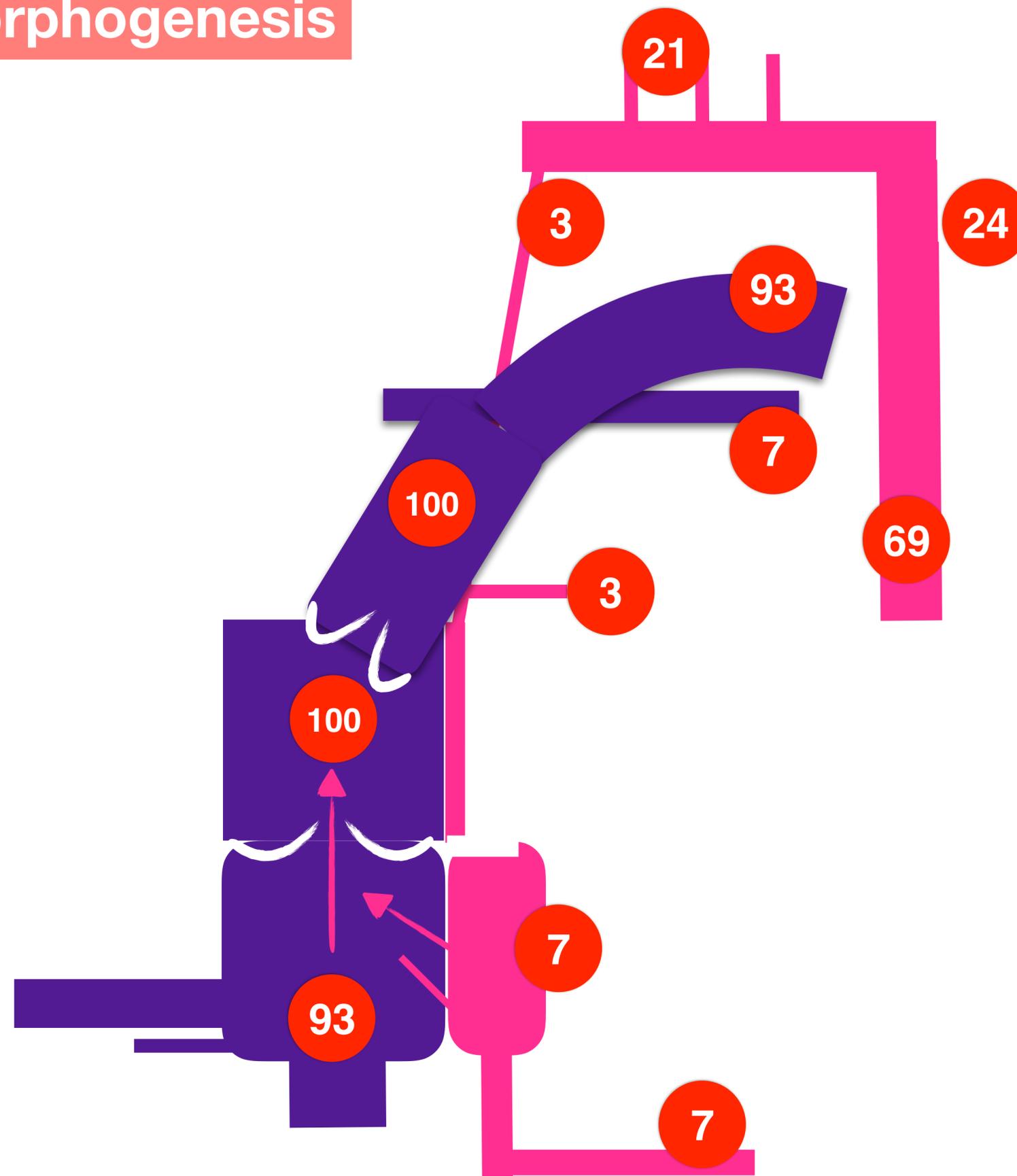
Fetal circulation and morphogenesis



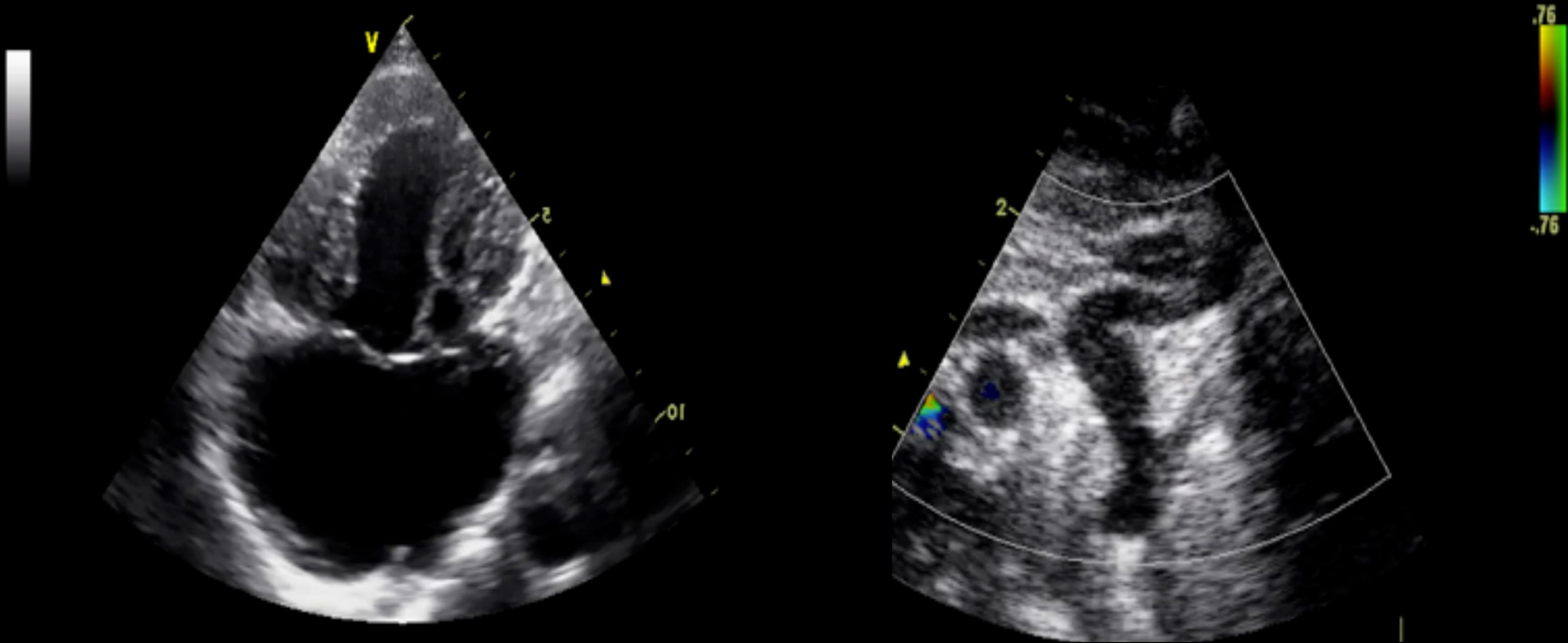
Fetal circulation and morphogenesis



Fetal circulation and morphogenesis



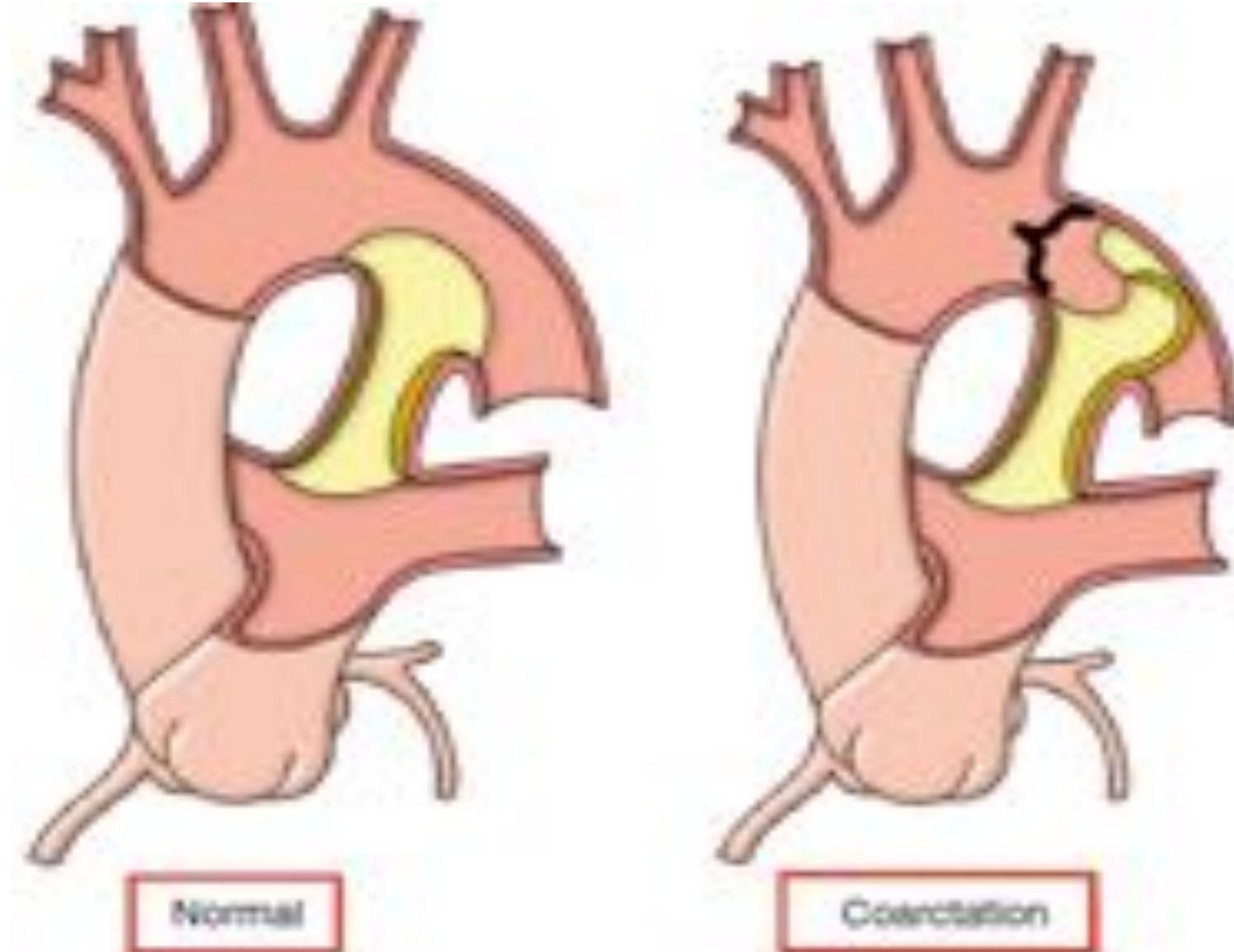
Fetal circulation and morphogenesis





**Hypoplastic left heart syndrome
Aortic atresia**

Extension of ductal tissue into the isthmus



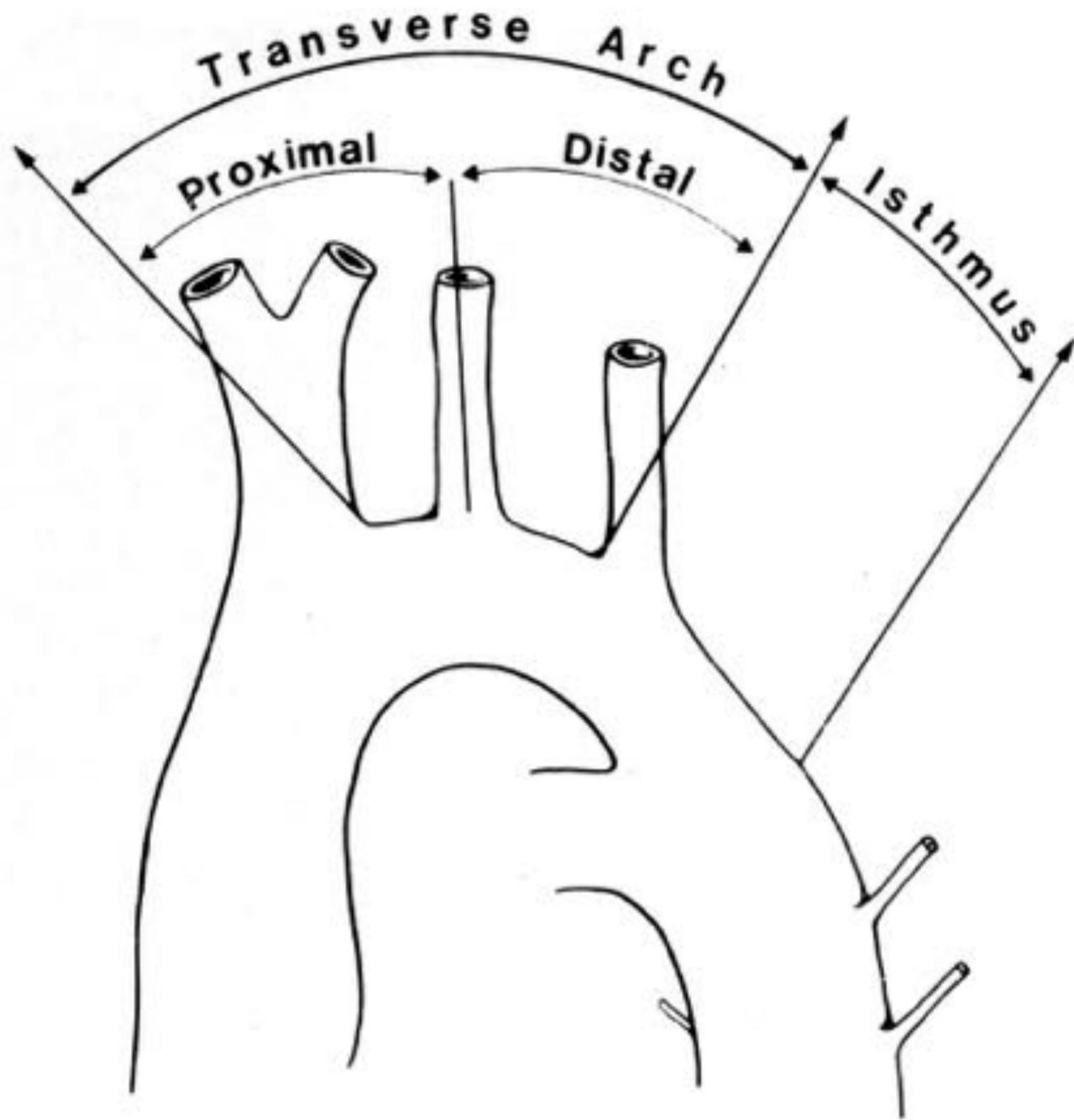


Fig. 1. Aortic arch anatomy in neonates.

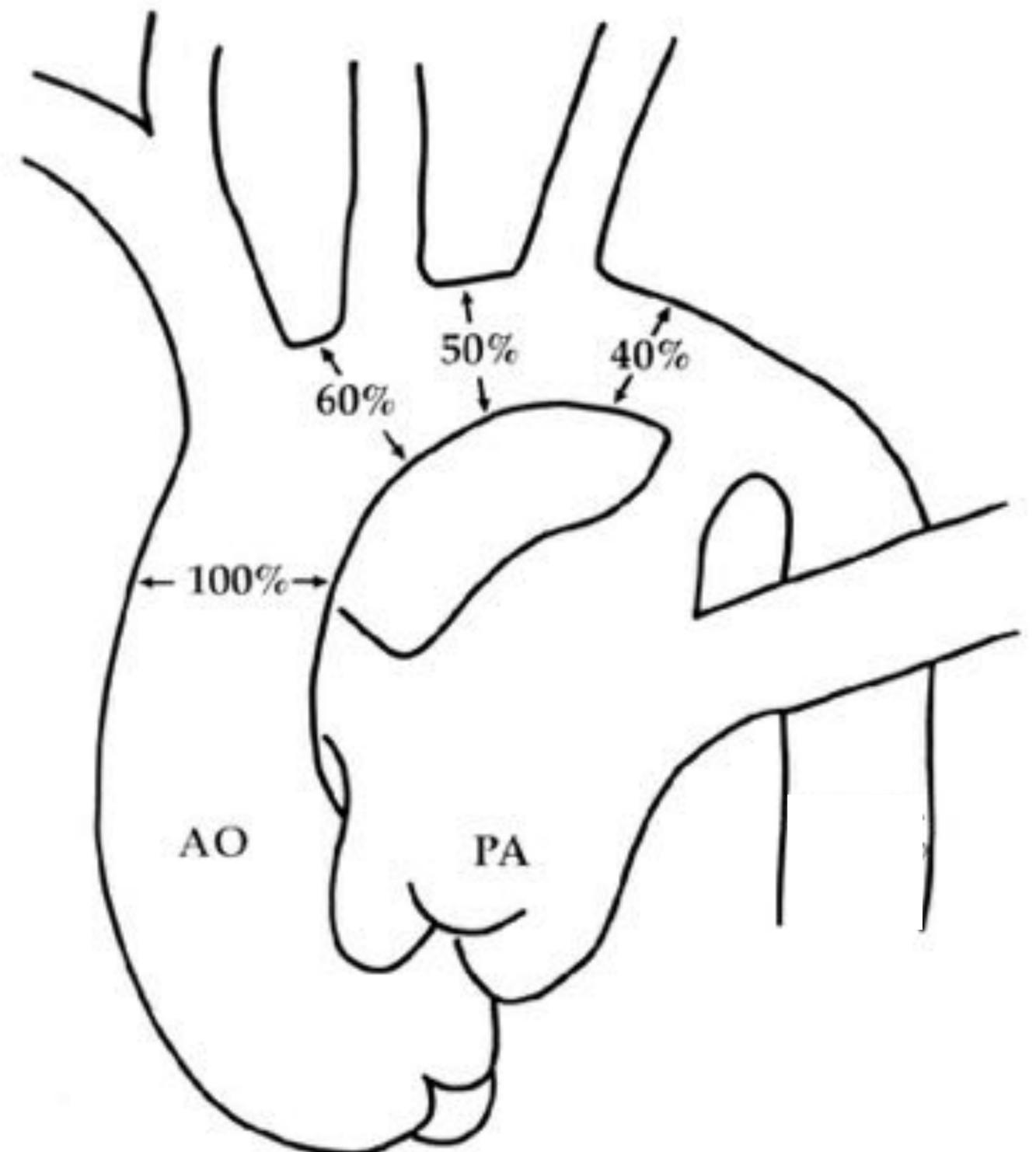


Fig 1. Minimal relative diameters of the normal thoracic aorta (AO) in infancy. (PA = pulmonary artery.) (Adapted from Moulaert AJ, Bruins CC, Oppenheimer-Dekker A. Anomalies of the aortic arch and ventricular septal defects. Circulation 1976;53:1101-5, by permission.)

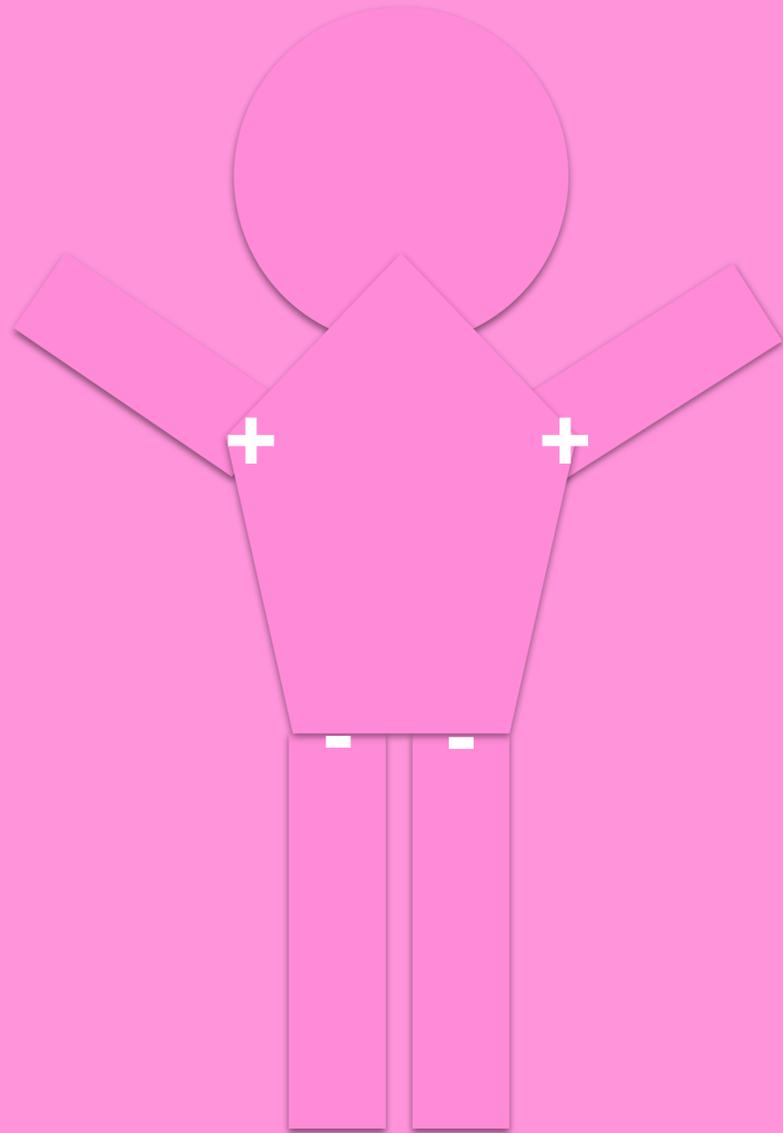


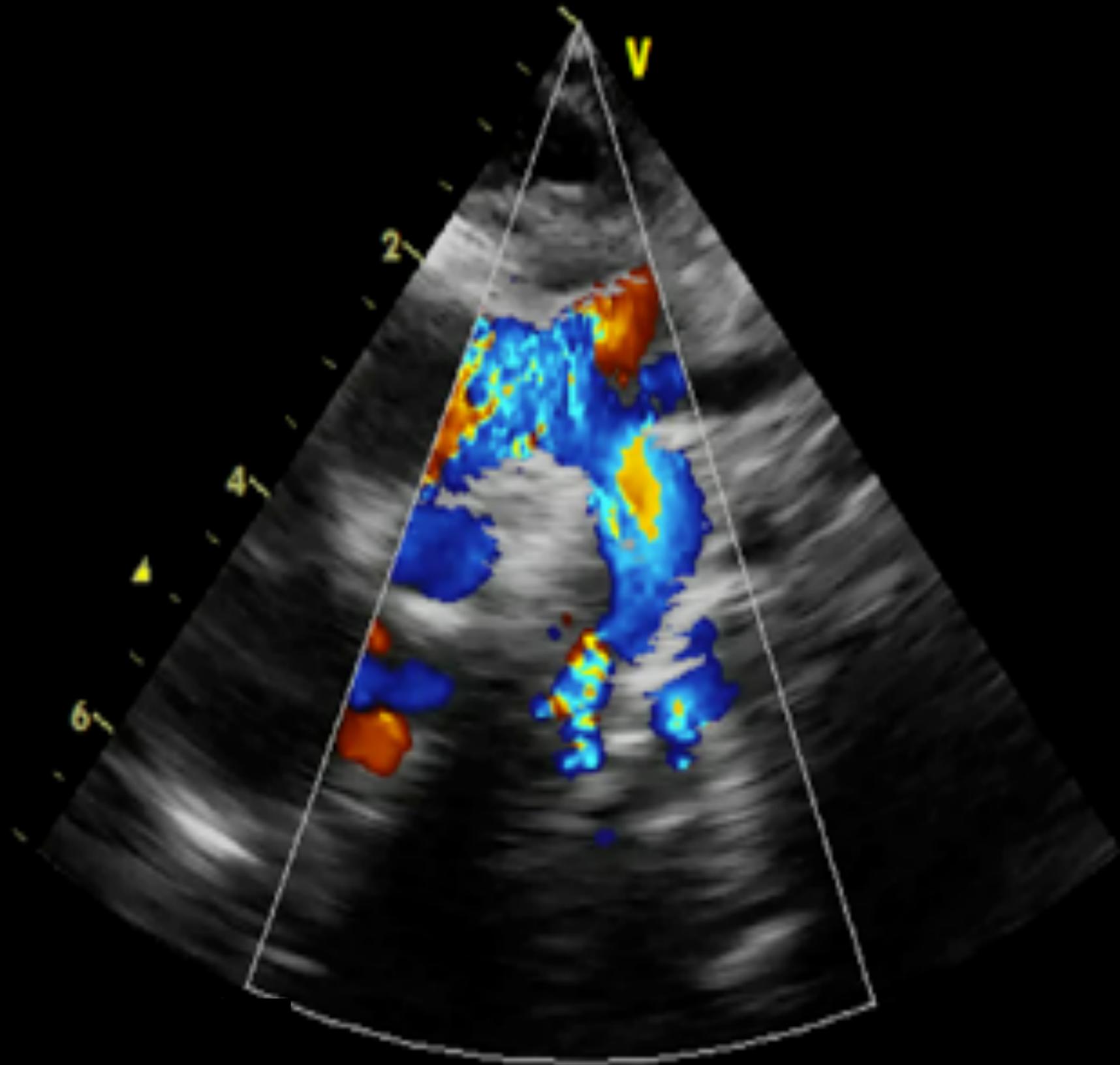
ASSYMETRY

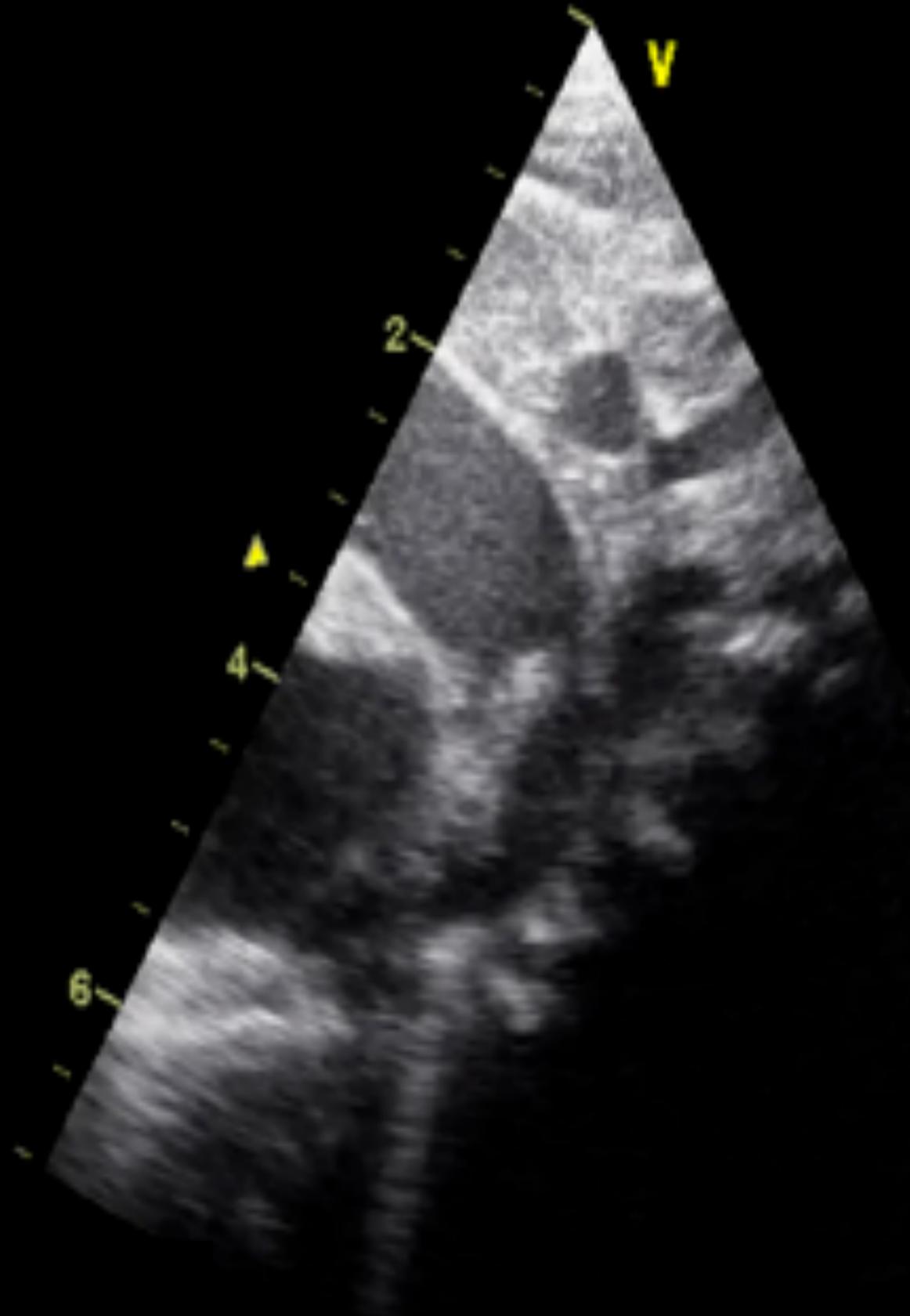


ARTERIAL DUCT

Clinical aspects of neonatal coarctation

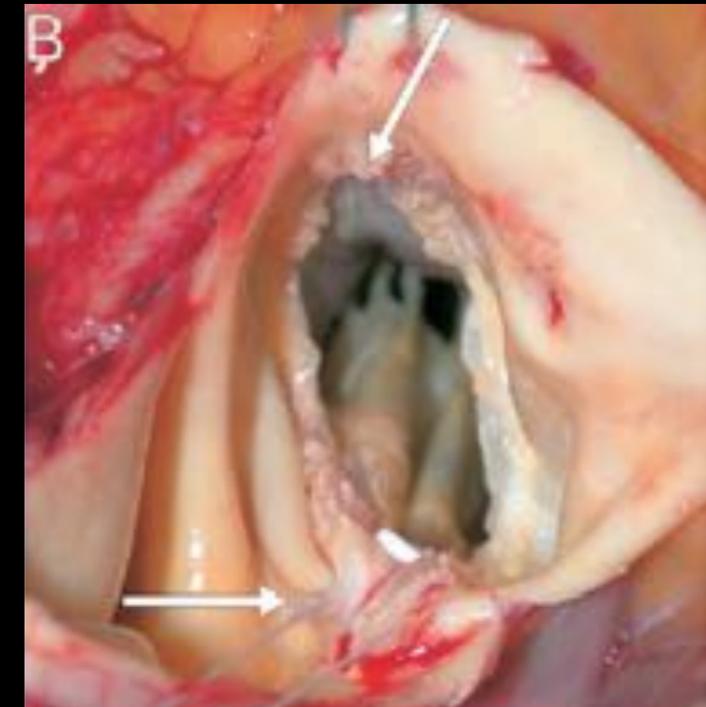
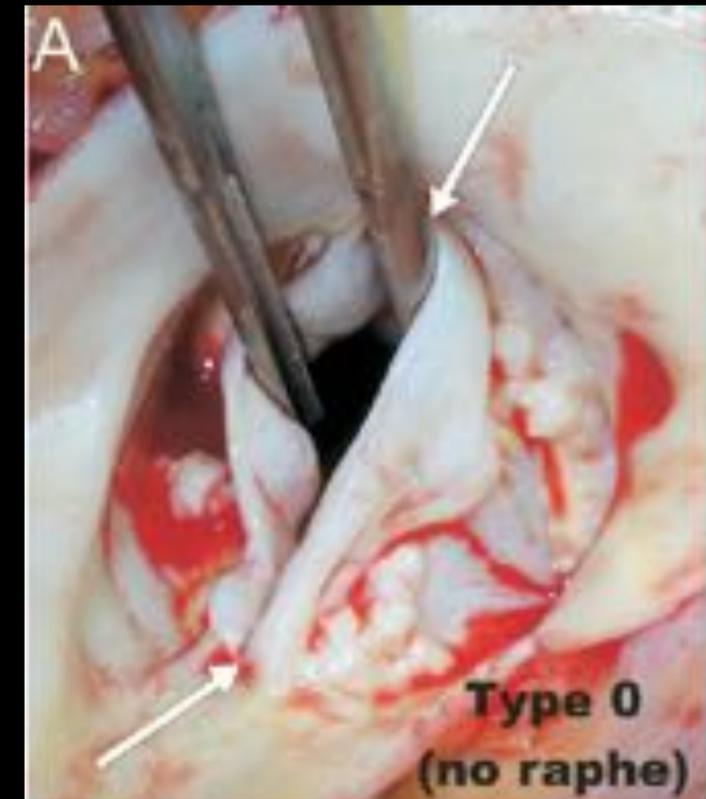






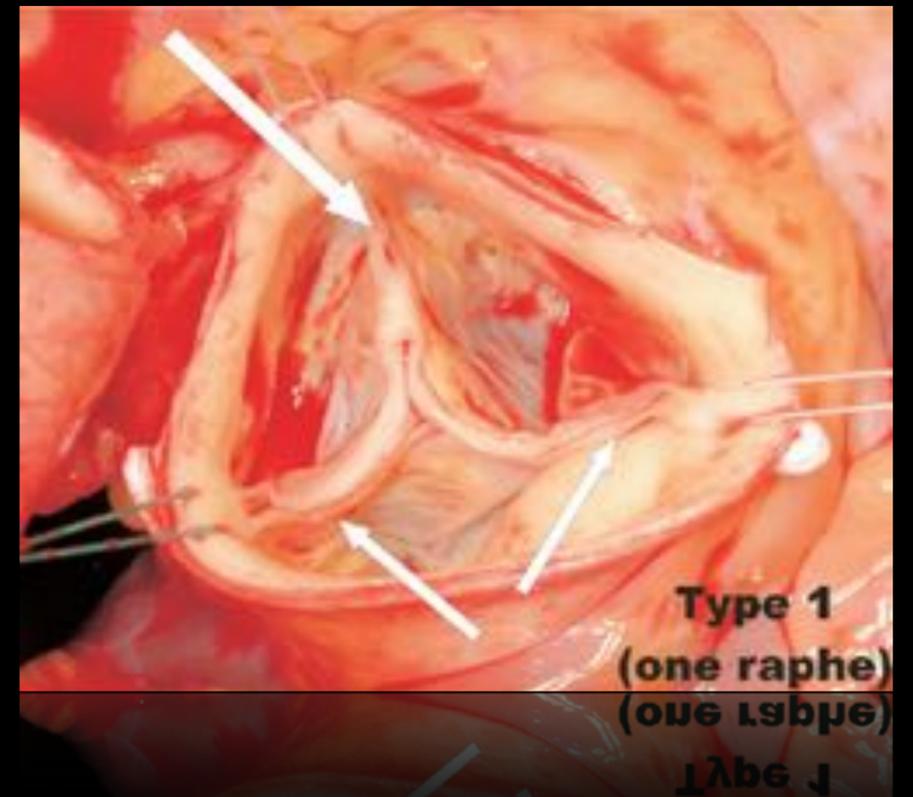
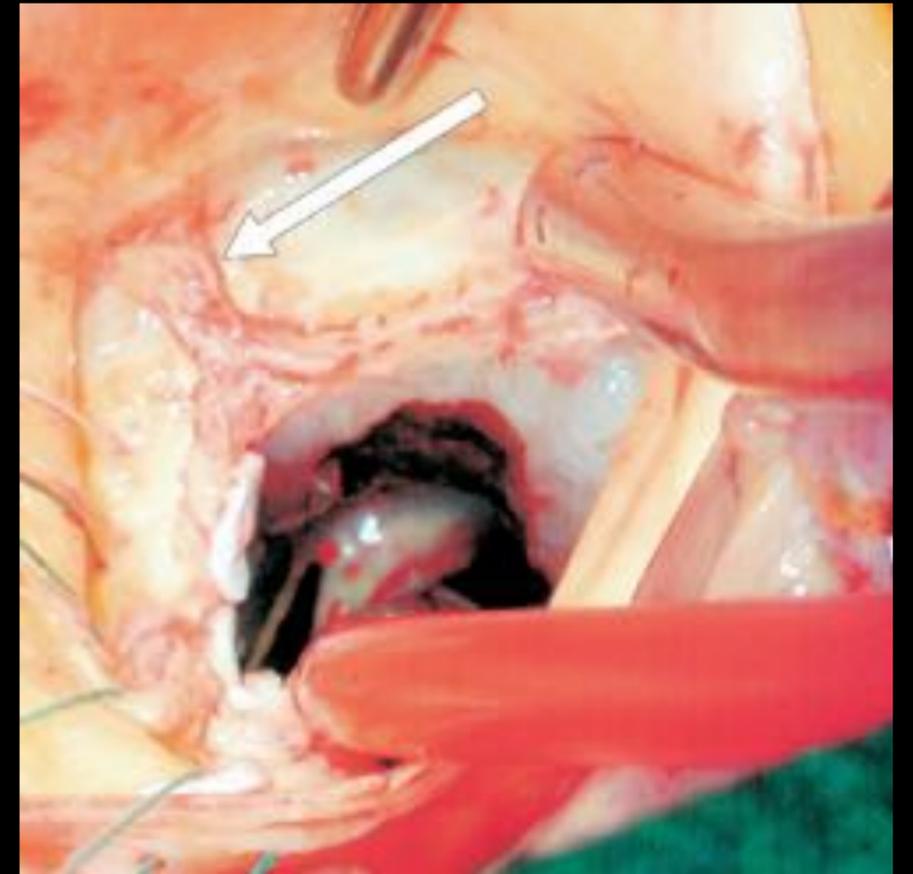
Aortic valve stenosis

Bicuspid aortic valve type 0



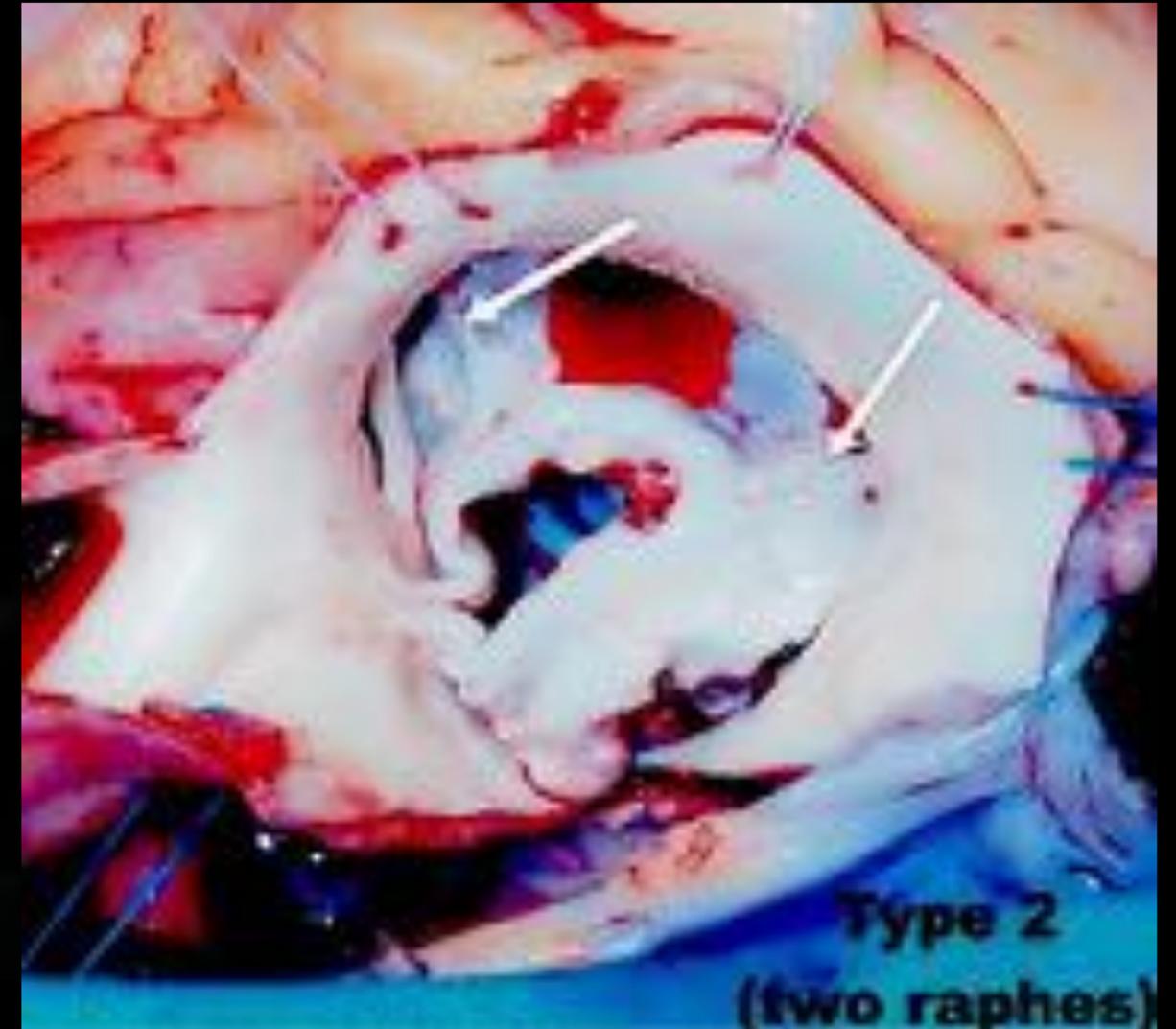
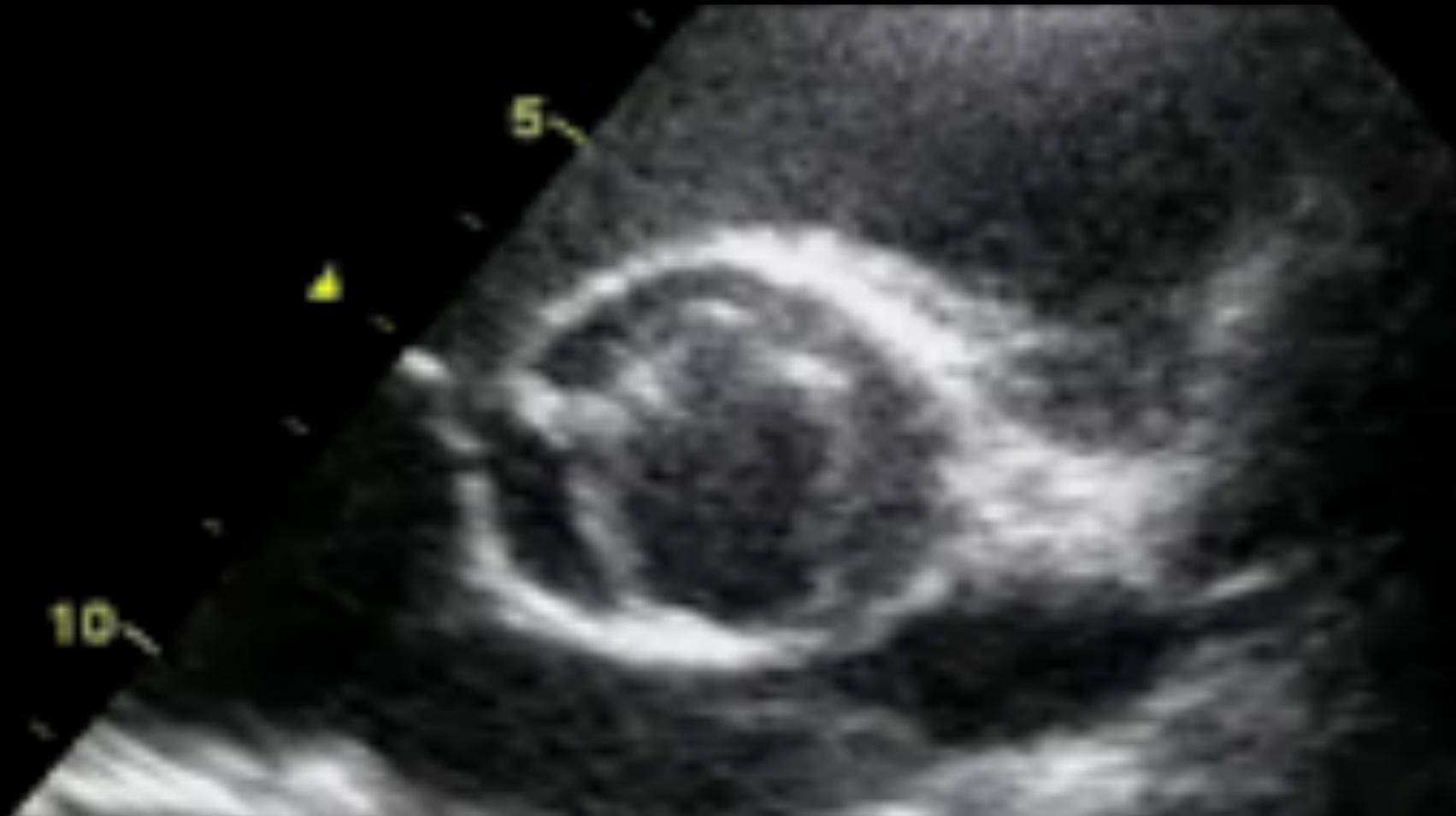
Aortic valve stenosis

Bicuspid aortic valve type 1 R-N



Aortic valve stenosis

Bicuspid aortic valve type 2



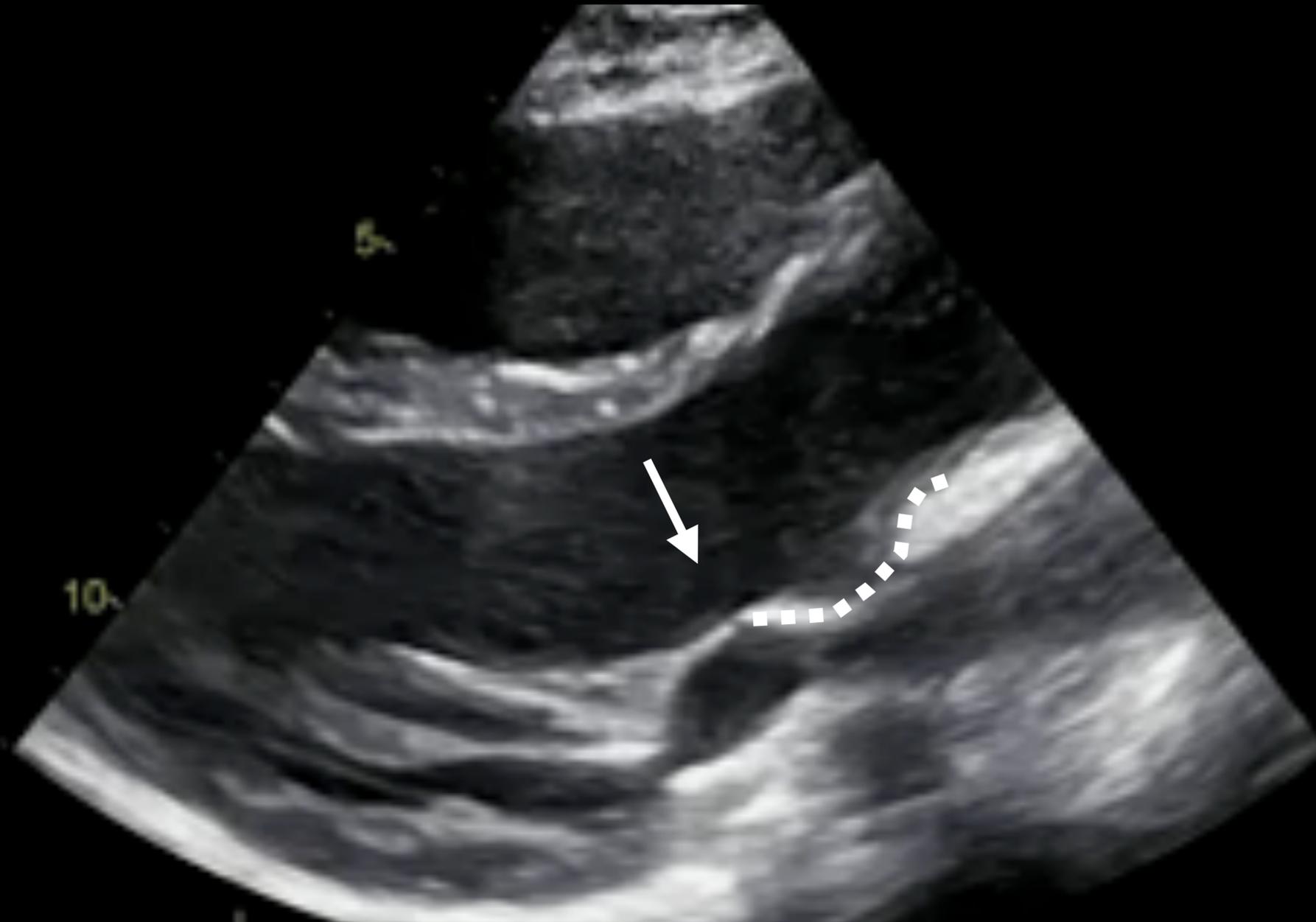
Accessory mitral valve tissue



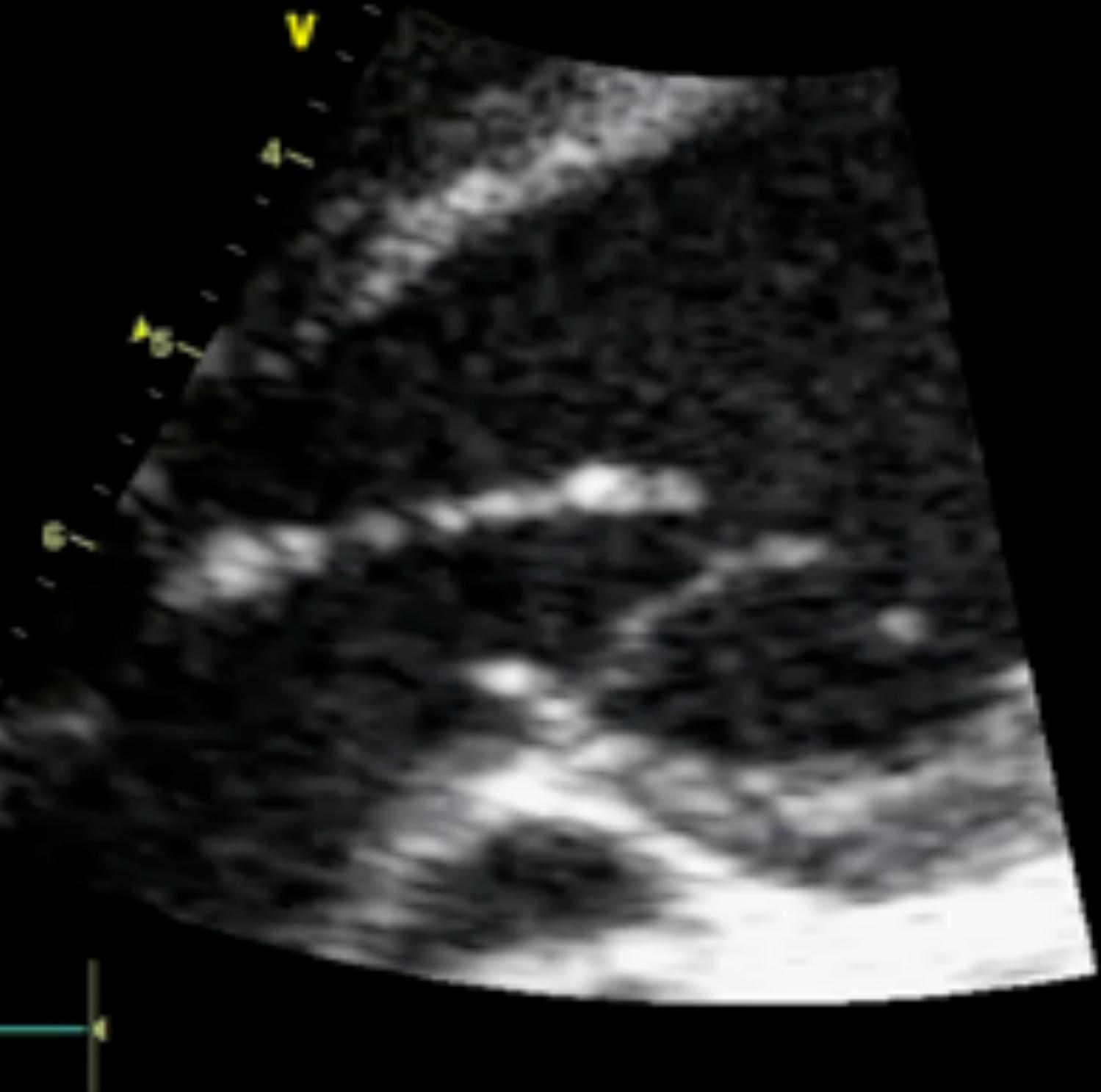
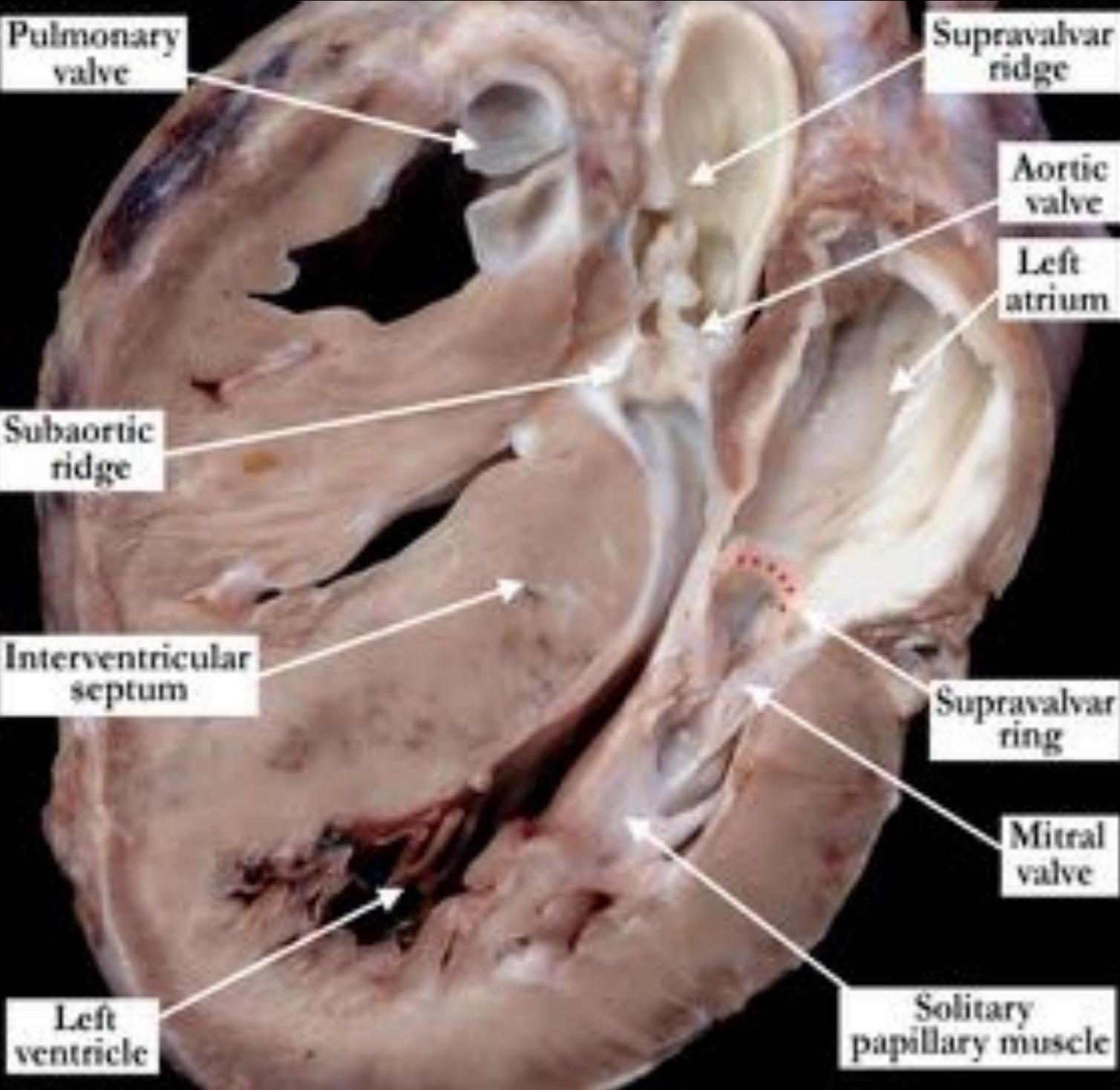
Accessory mitral valve tissue



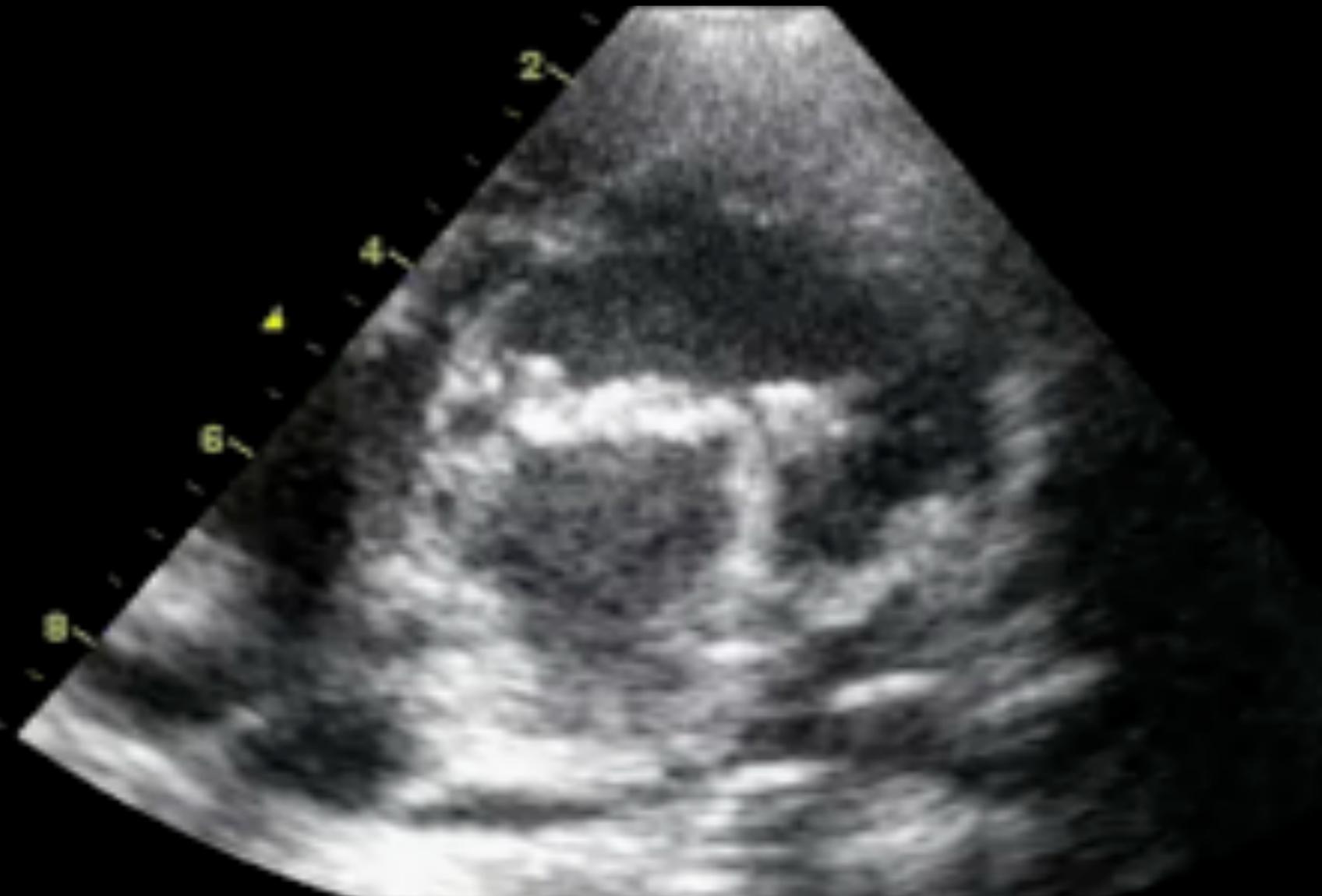
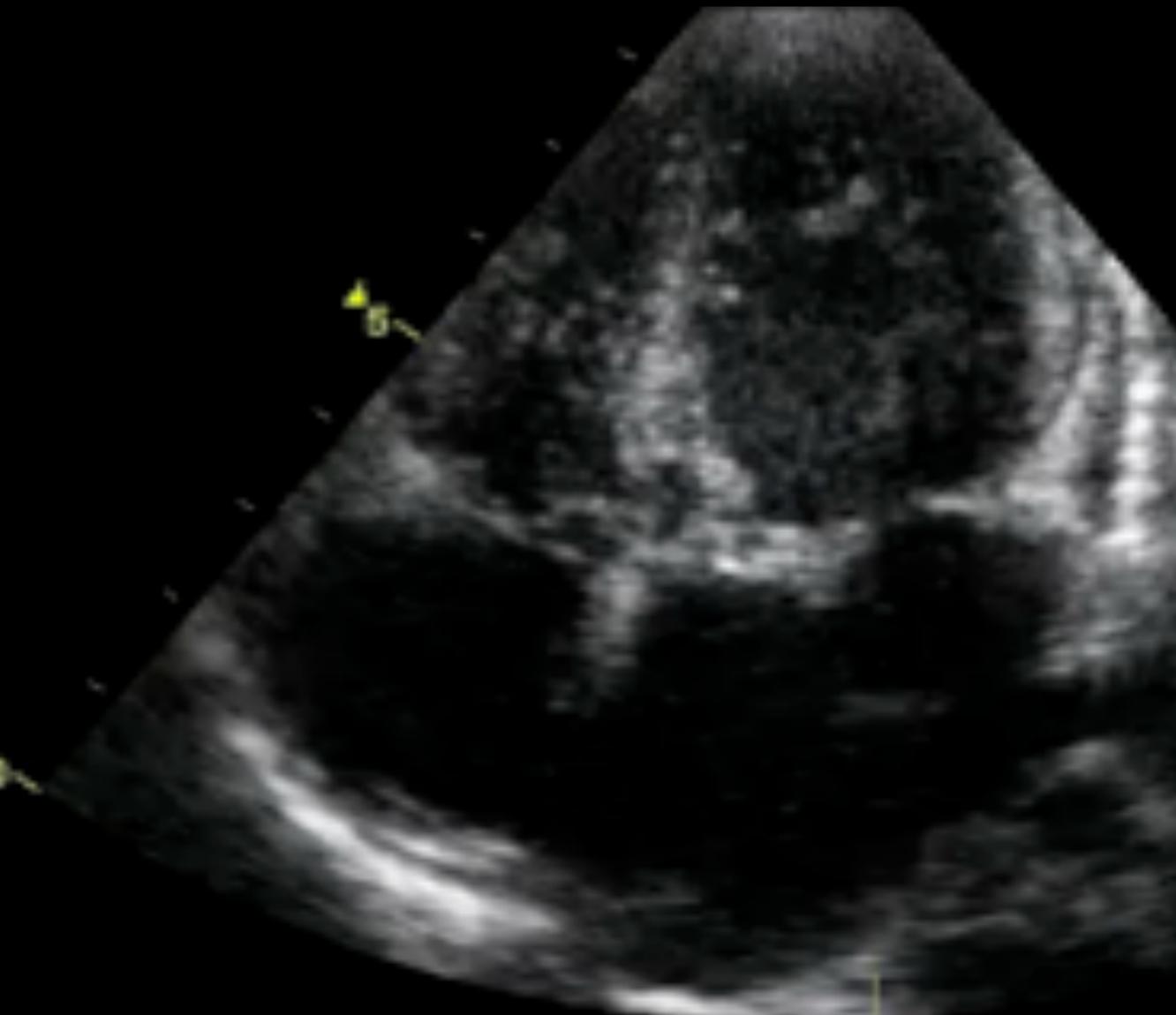
Sub-aortic conus

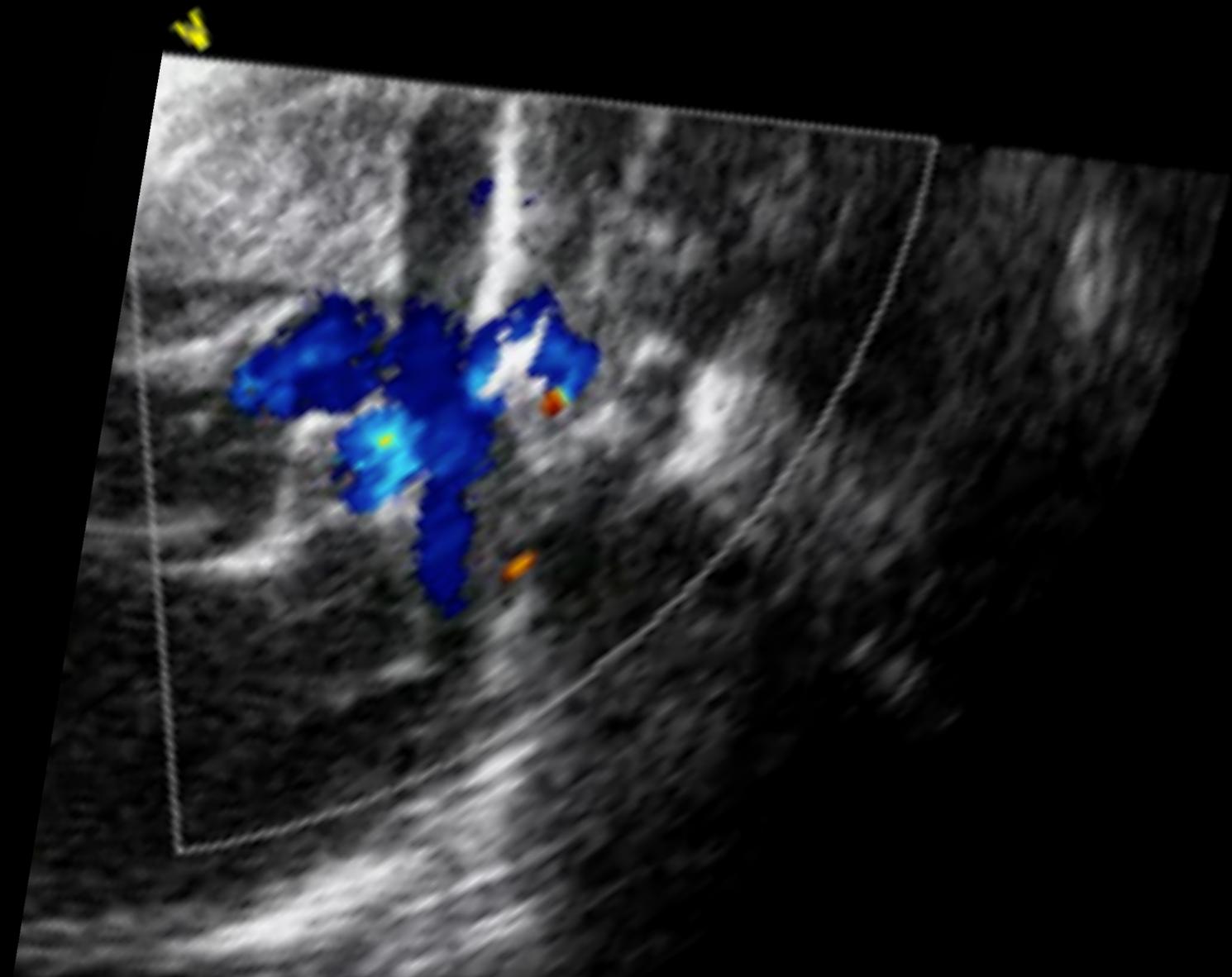
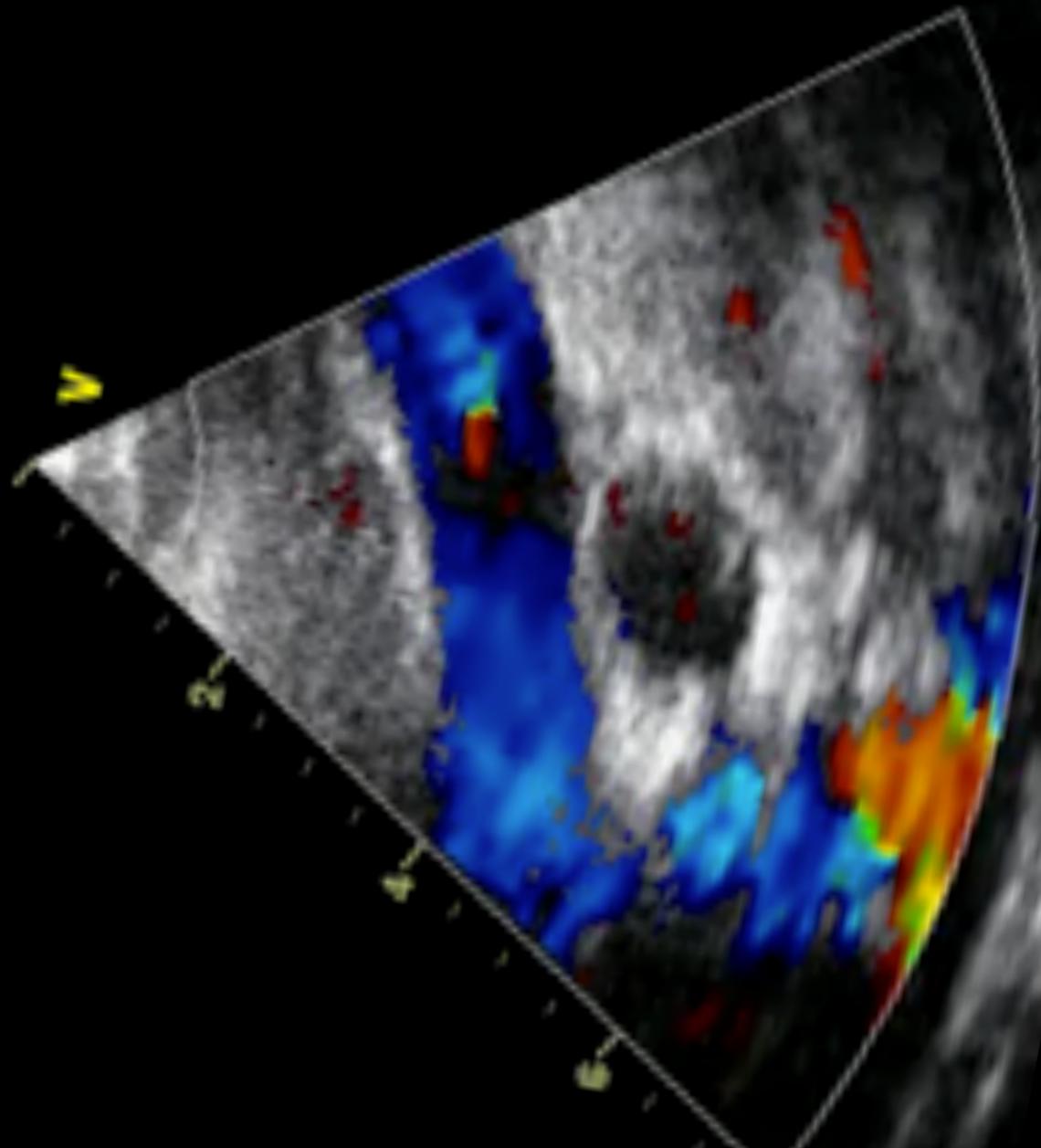


Supravalvar ring

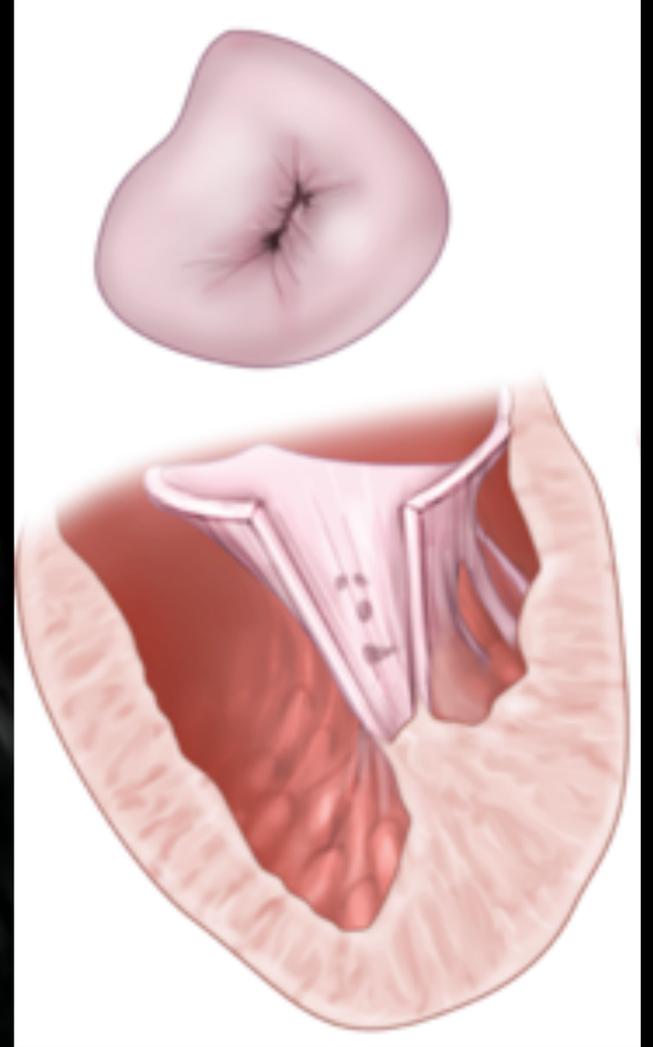
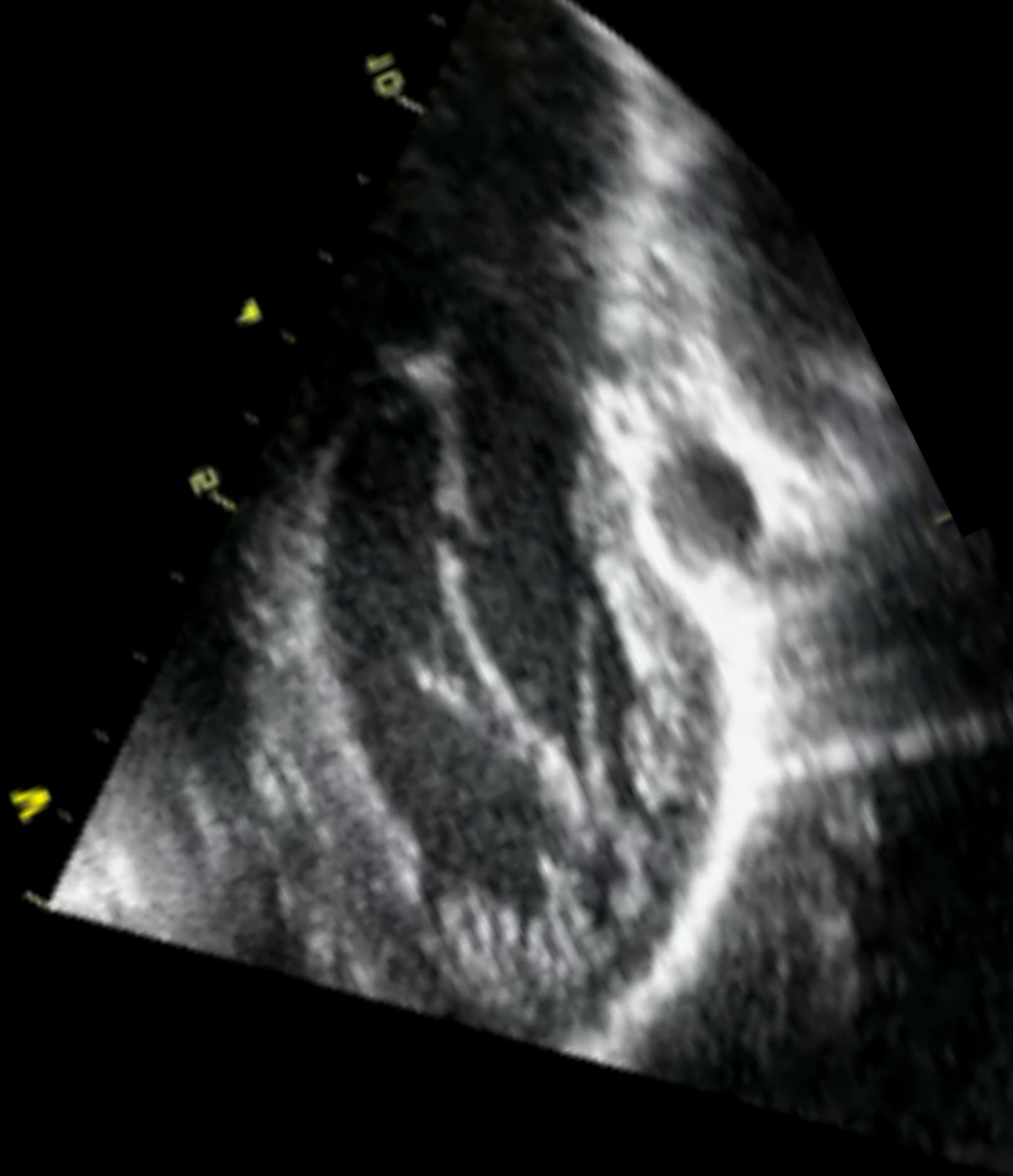


Abnormal septal attach of the mitral valve

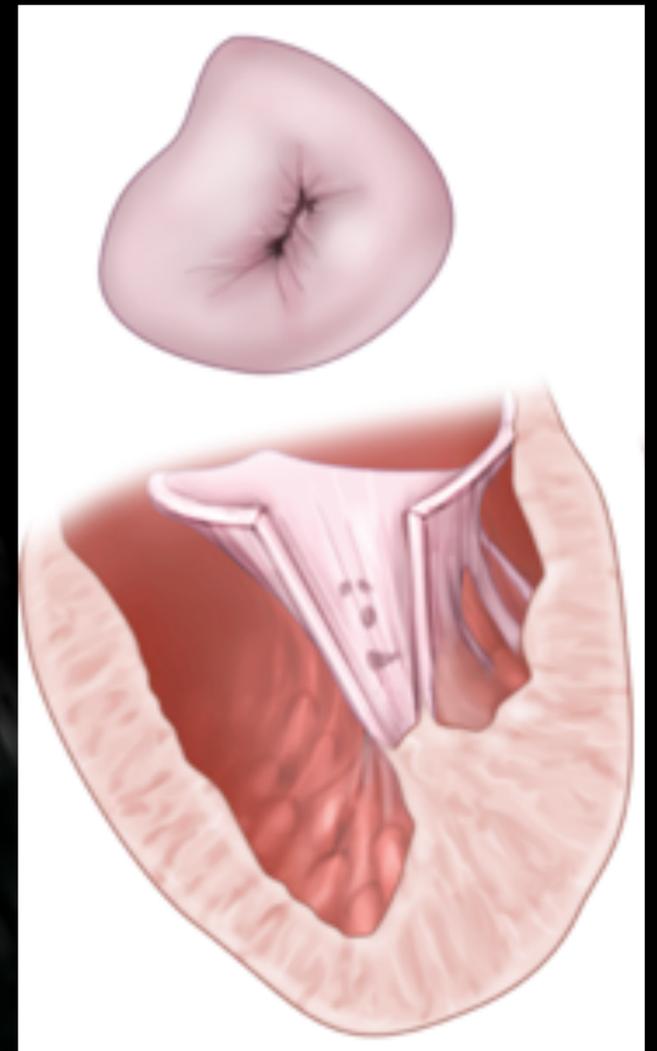
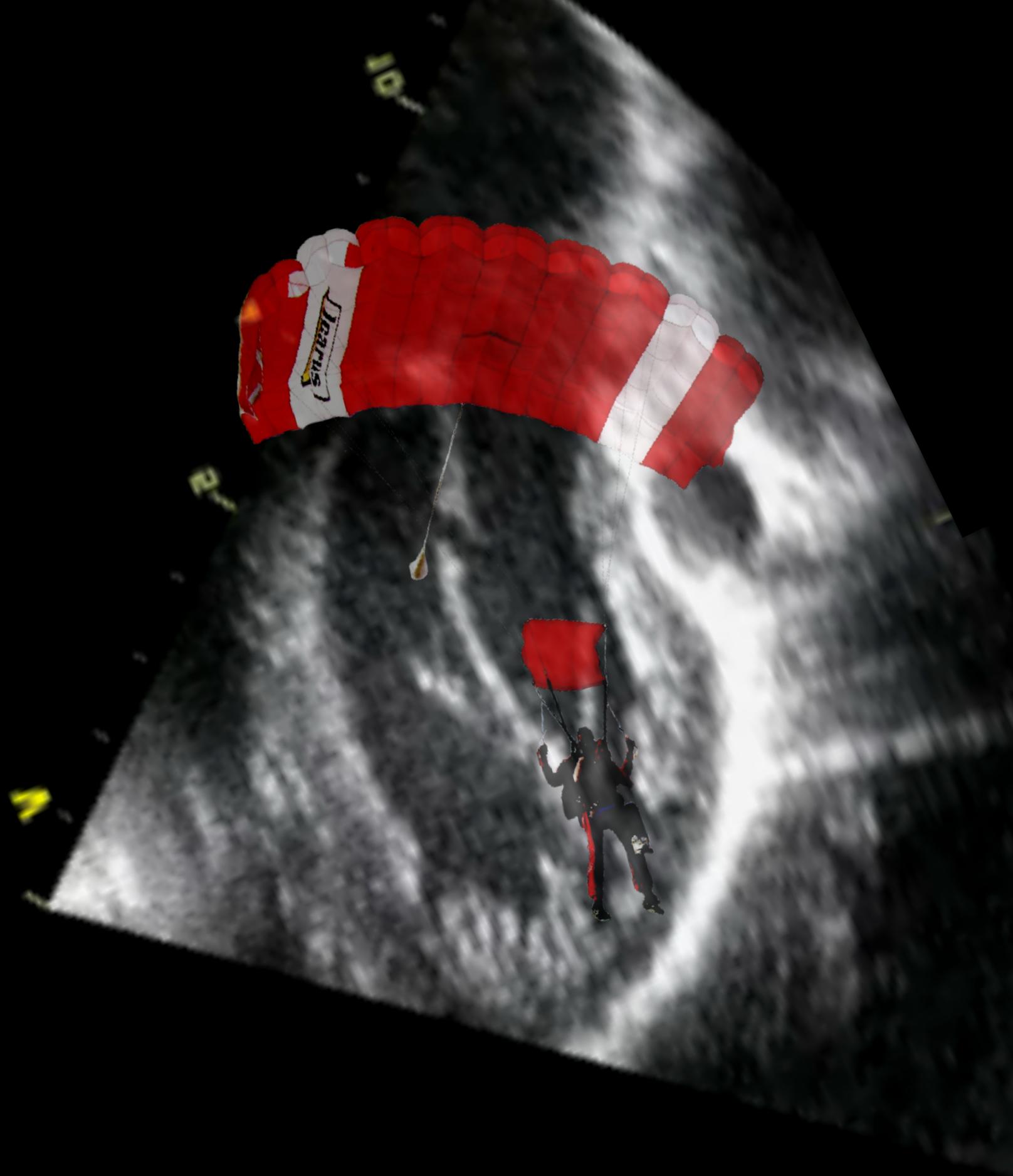




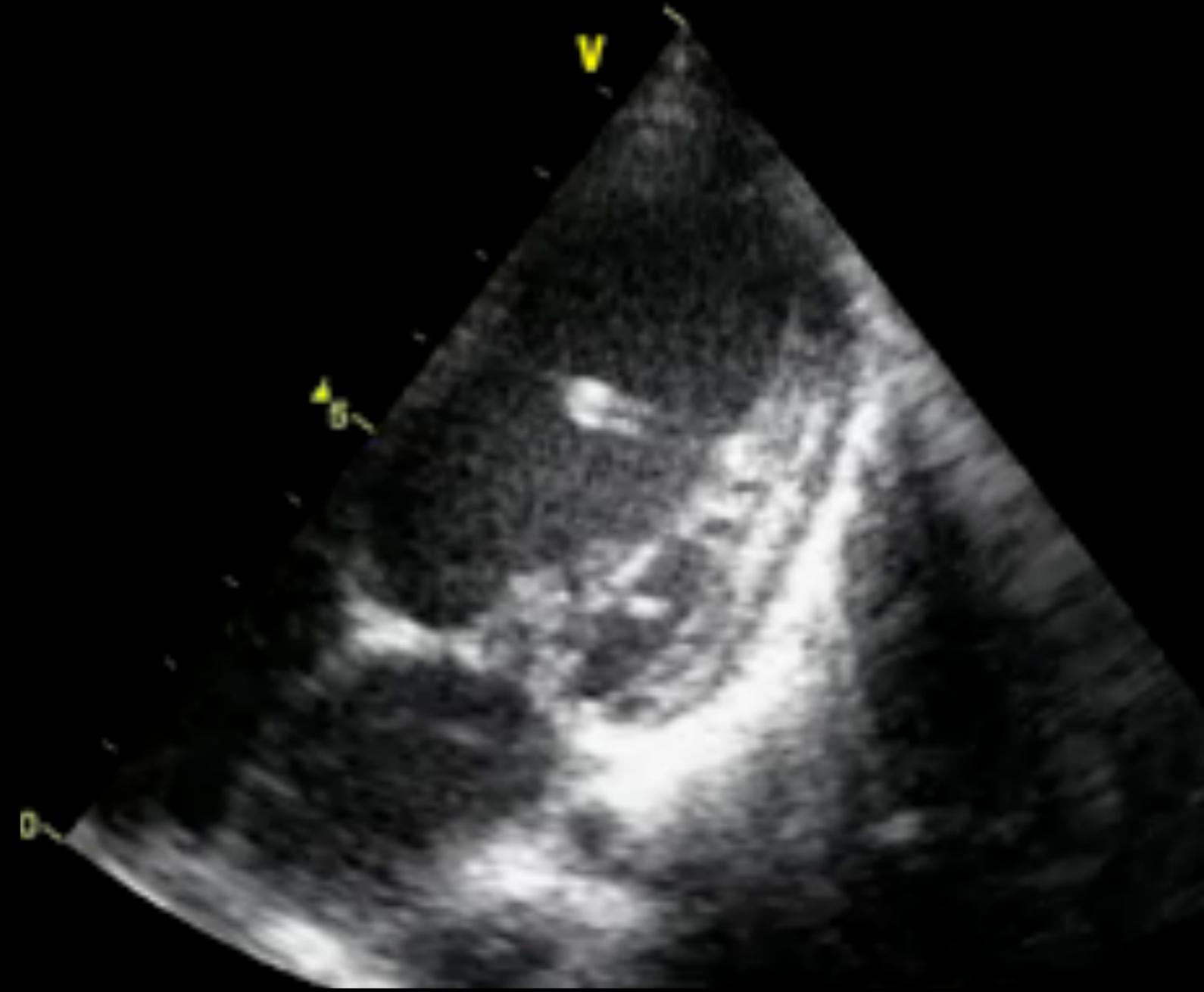
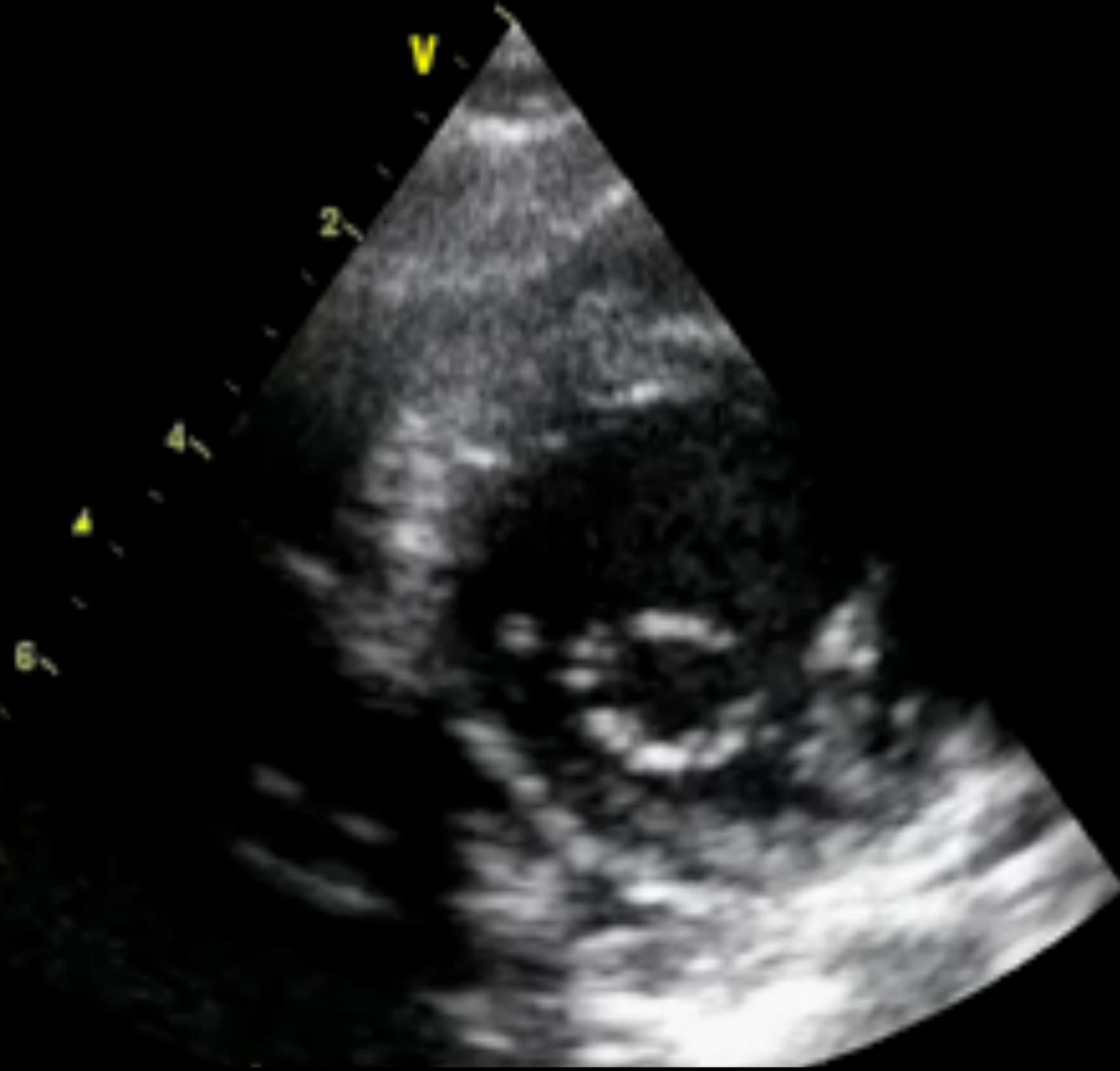
Parachute



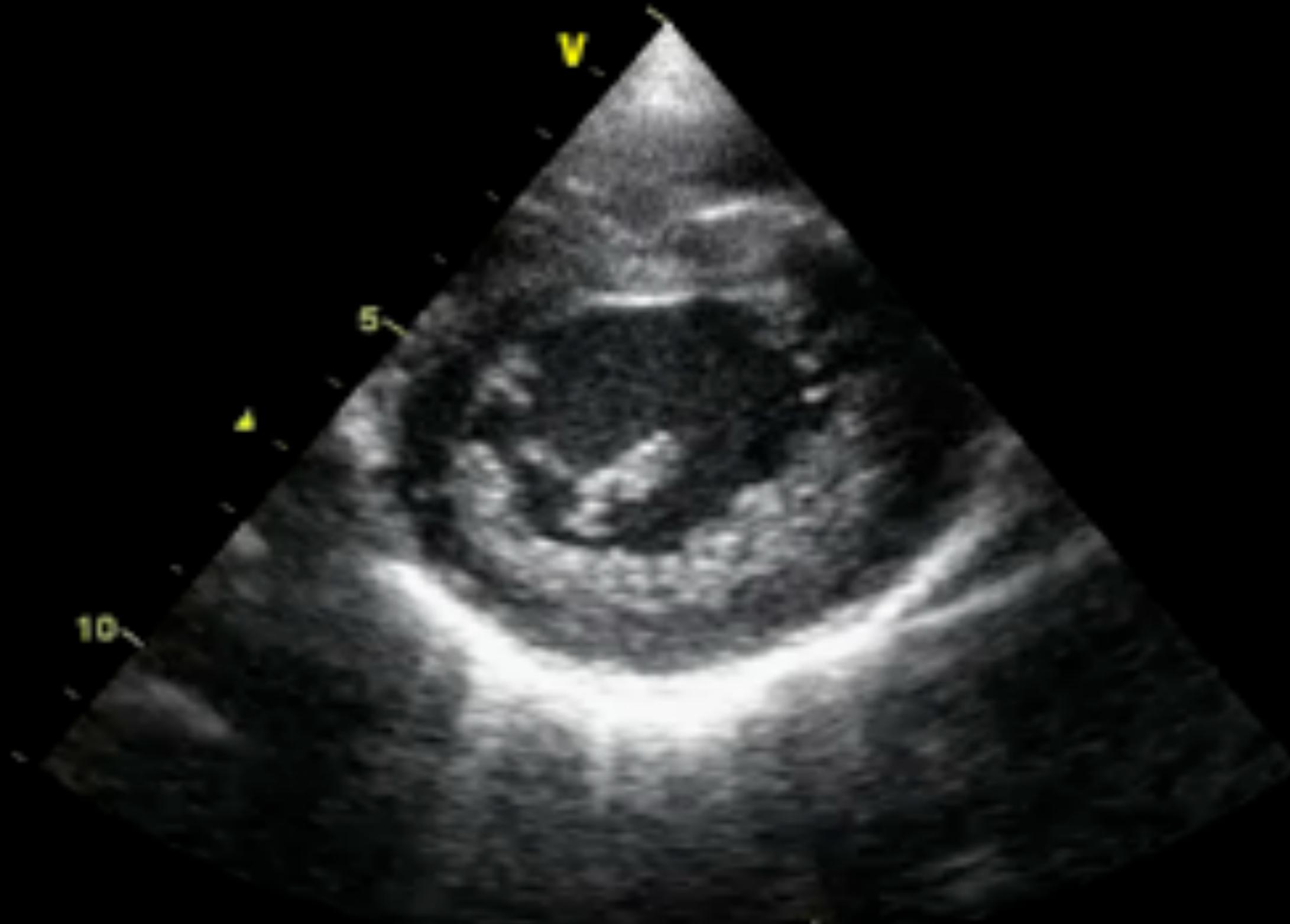
Parachute



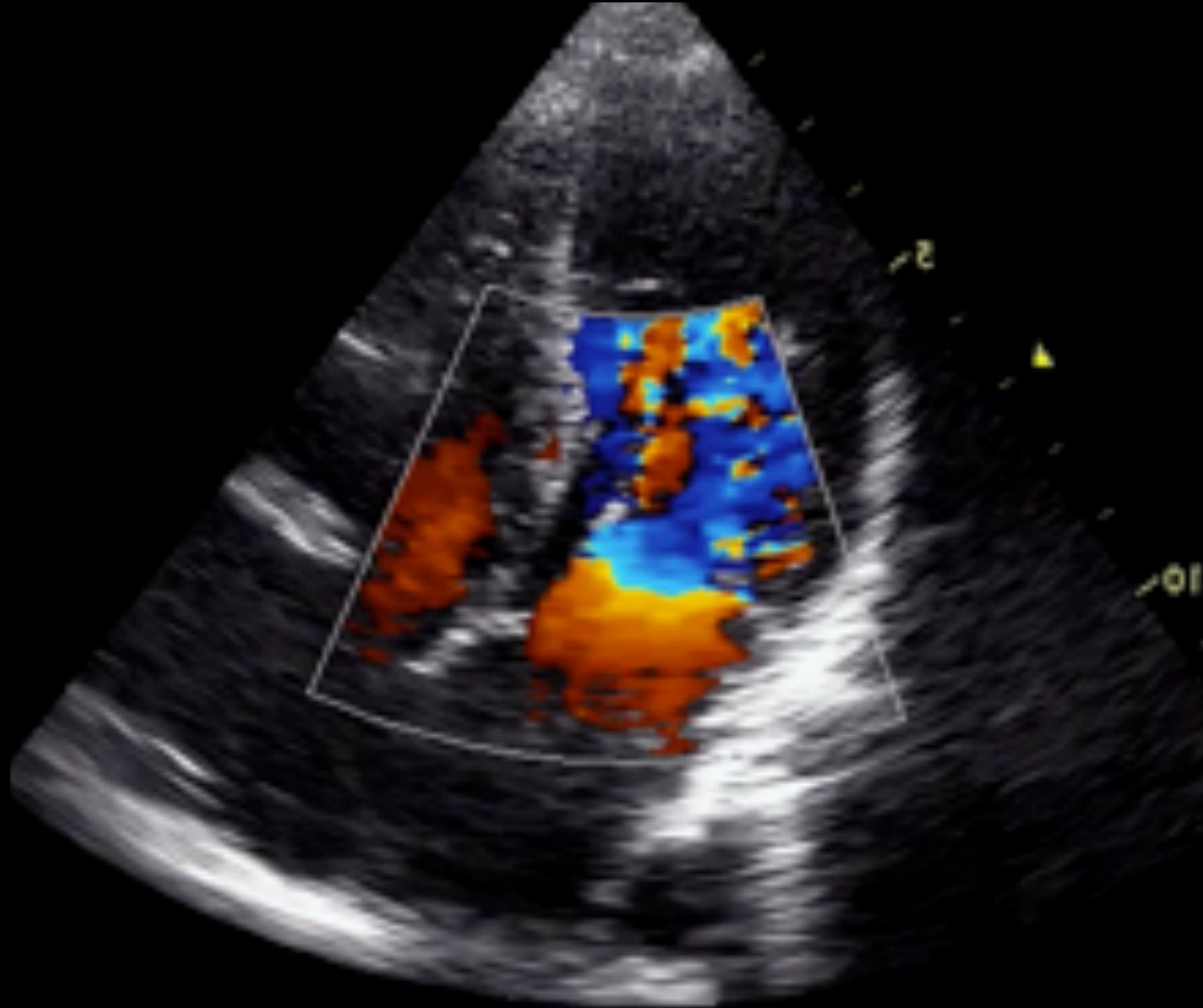
Parachute mitral



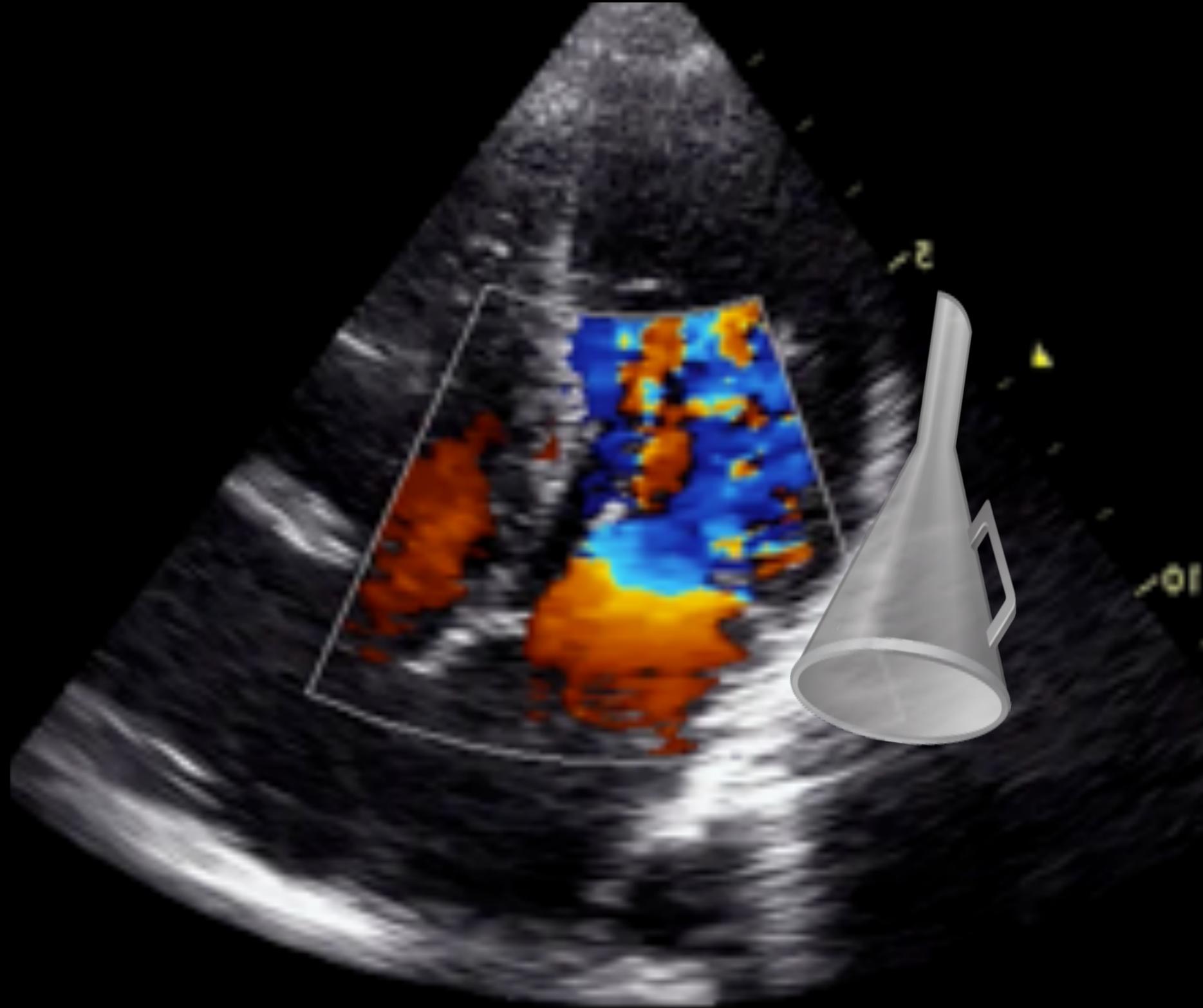
Parachute mitral



Parachute mitral



Parachute mitral

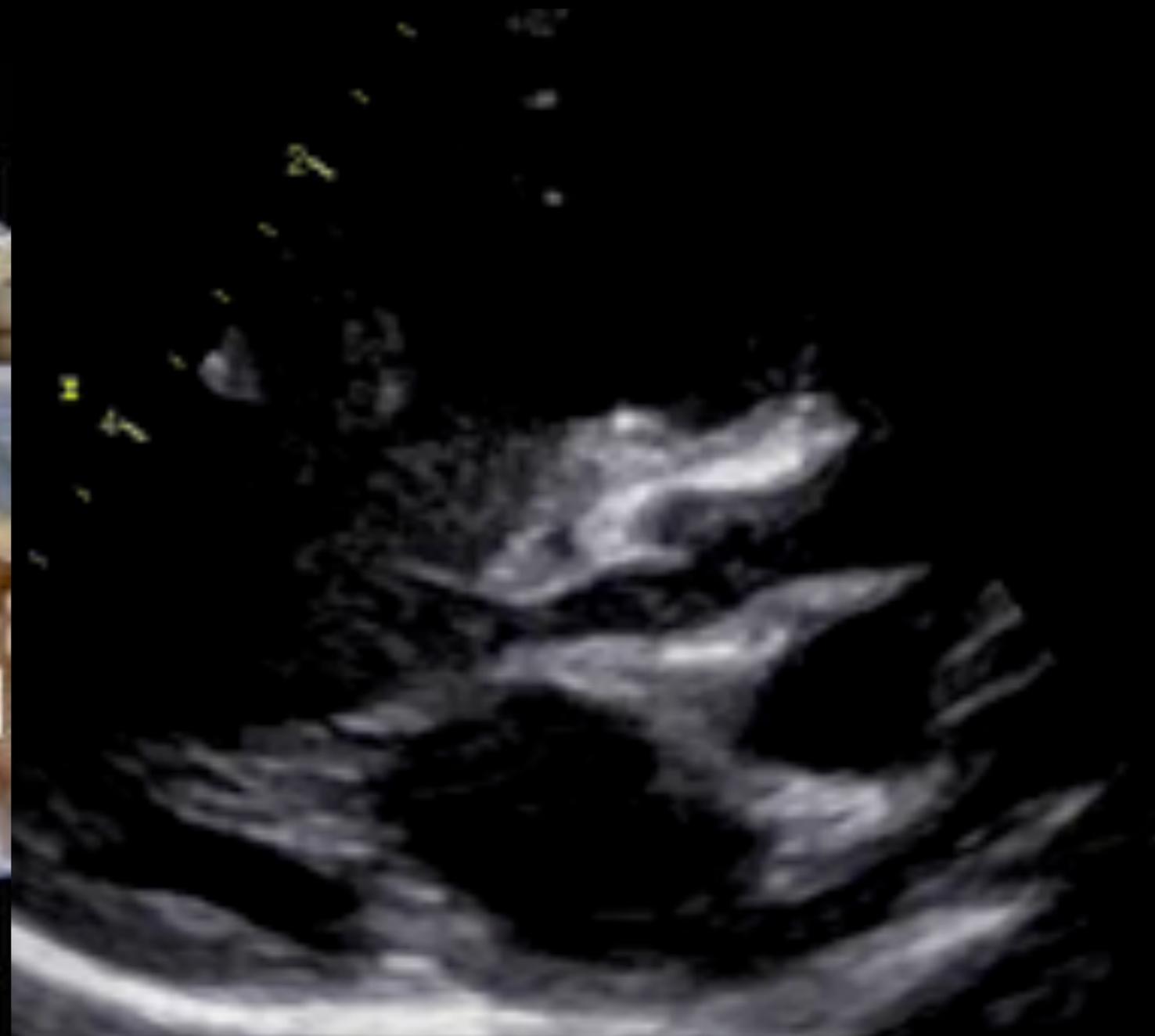
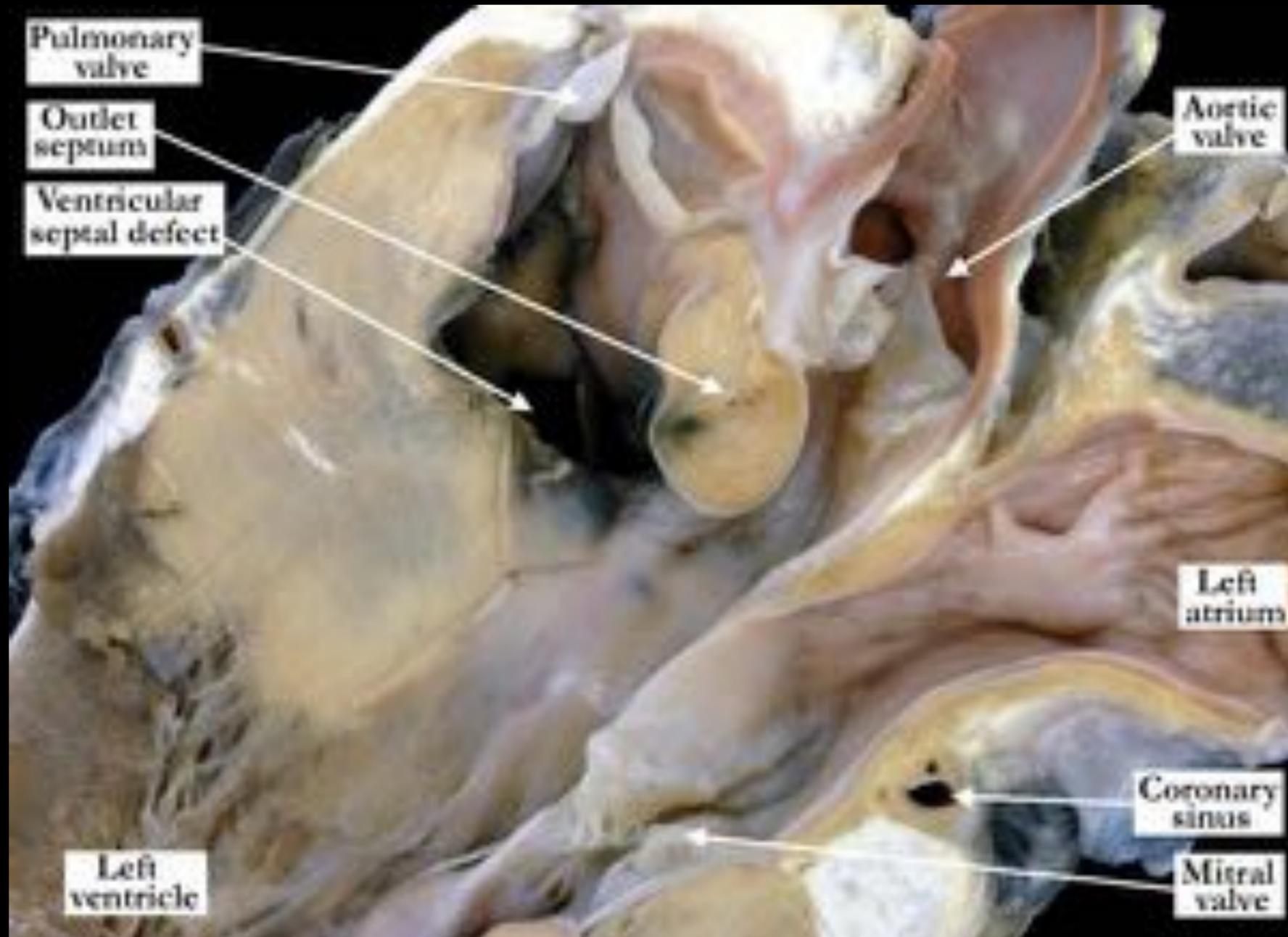


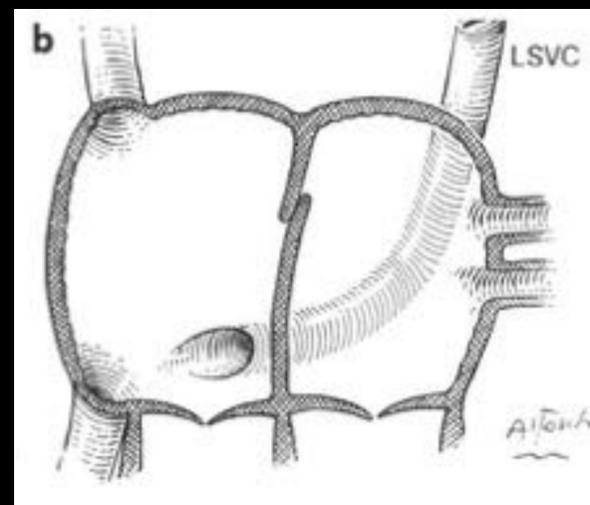
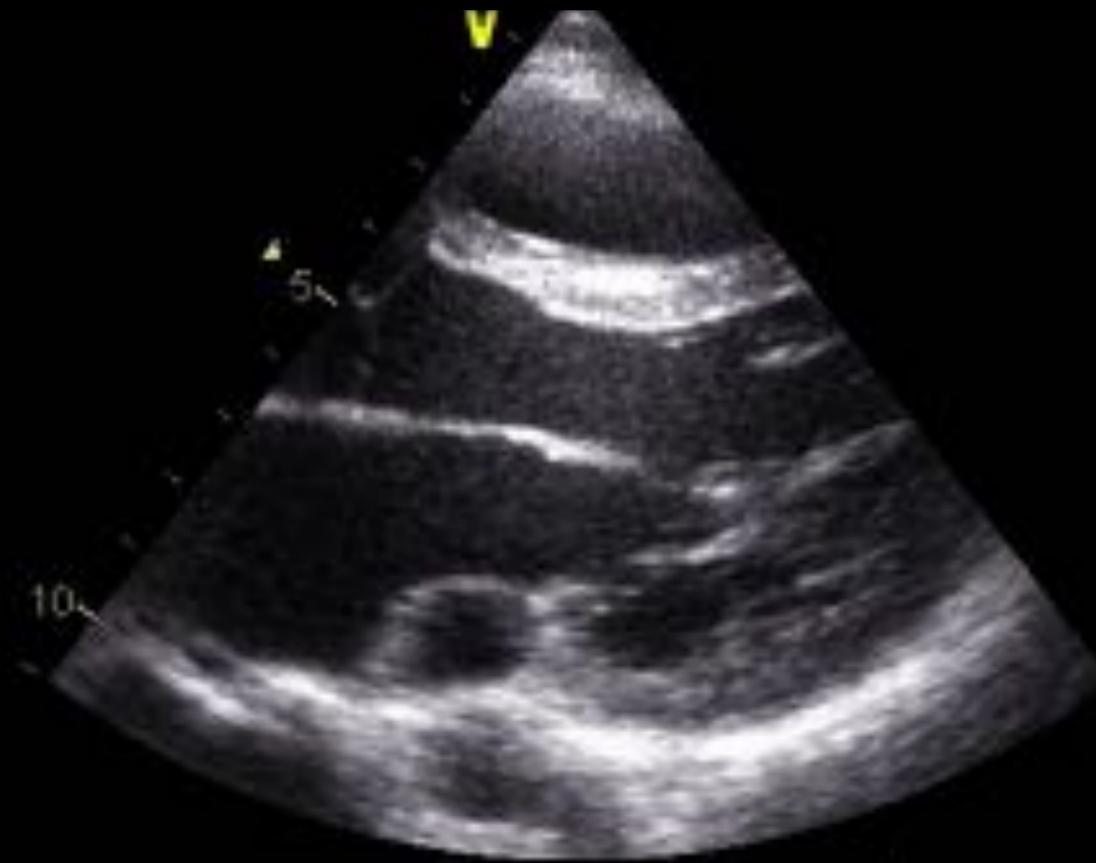
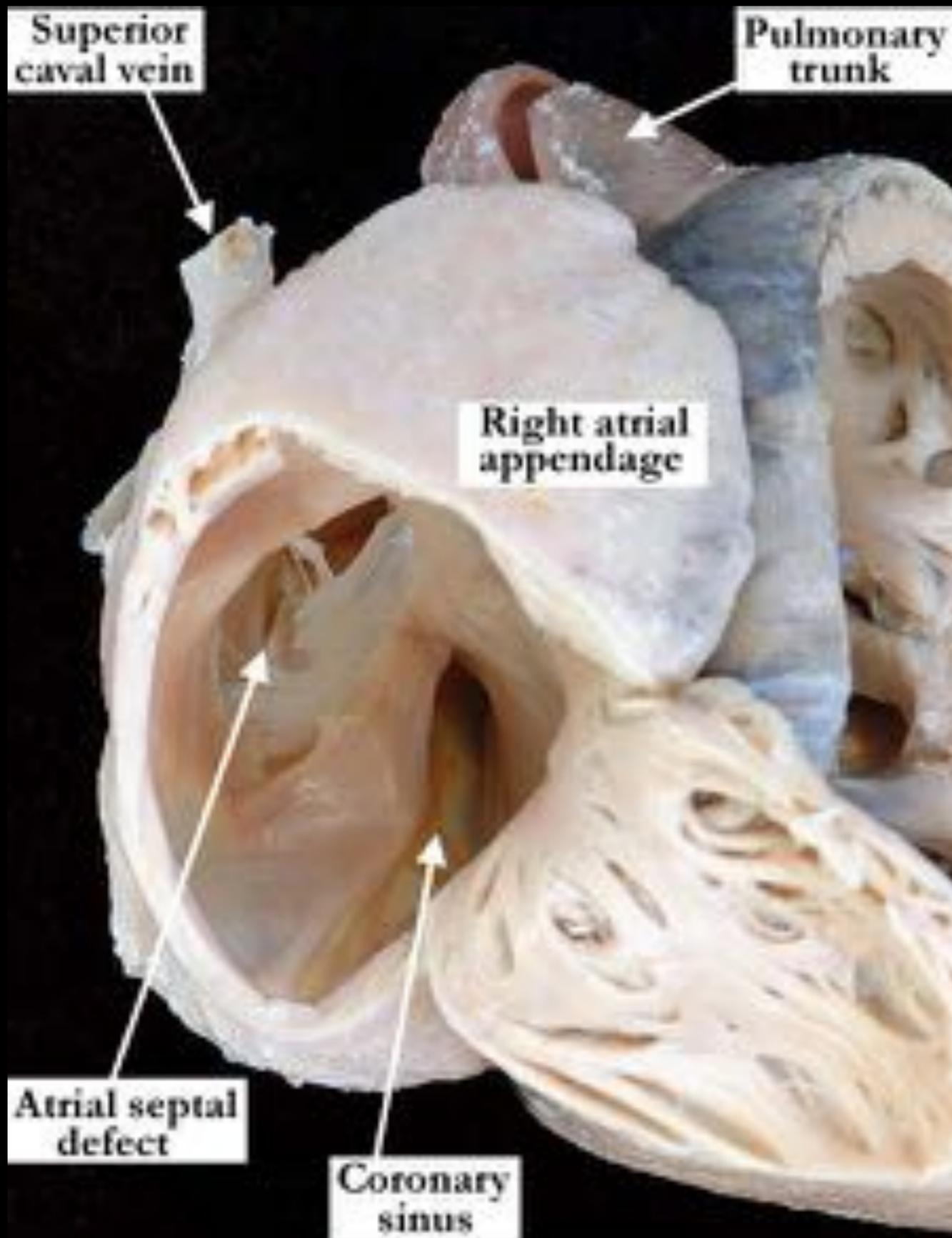
Entonnoir



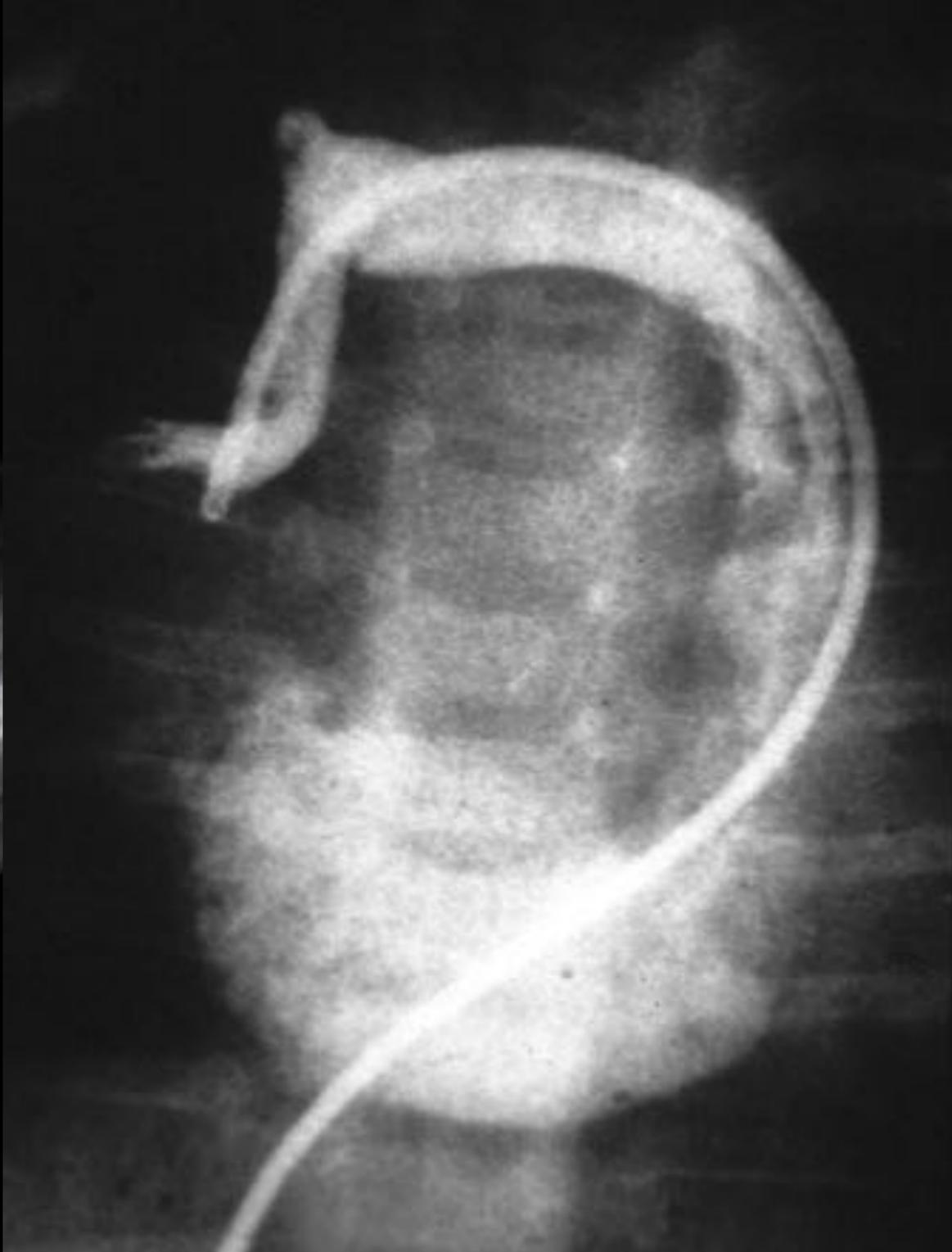
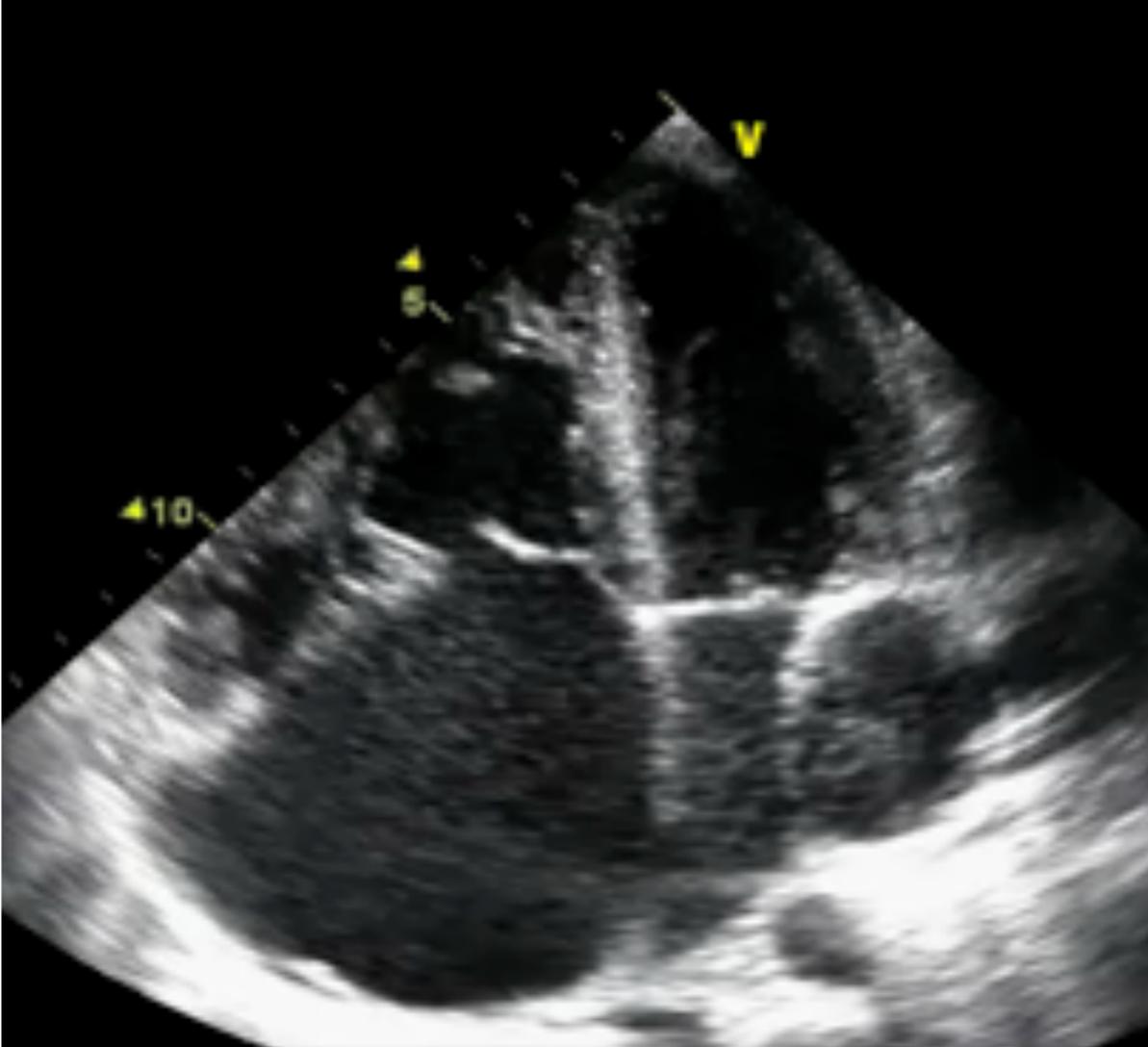
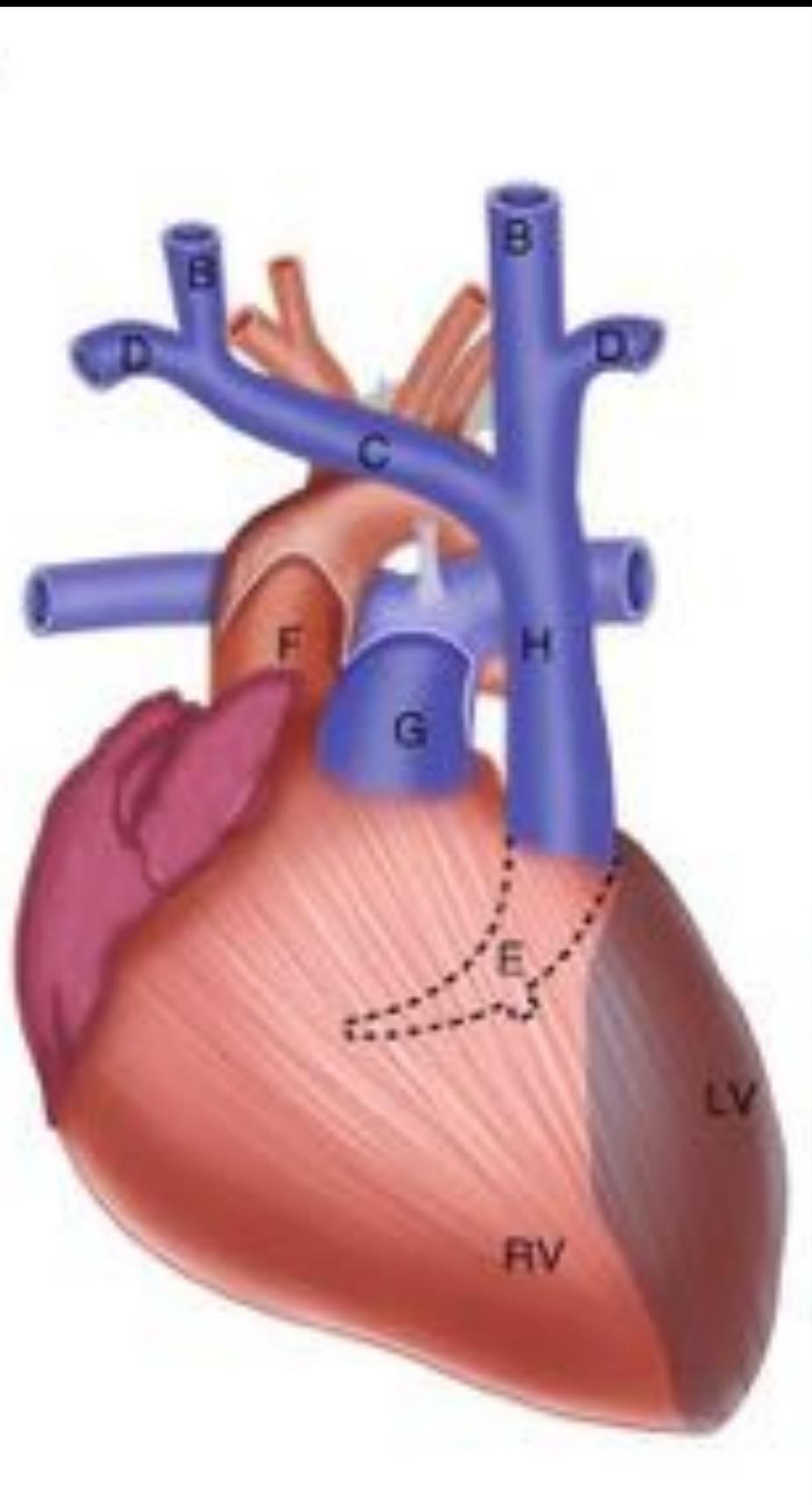
Outlet VSD

Posterior Malalignment

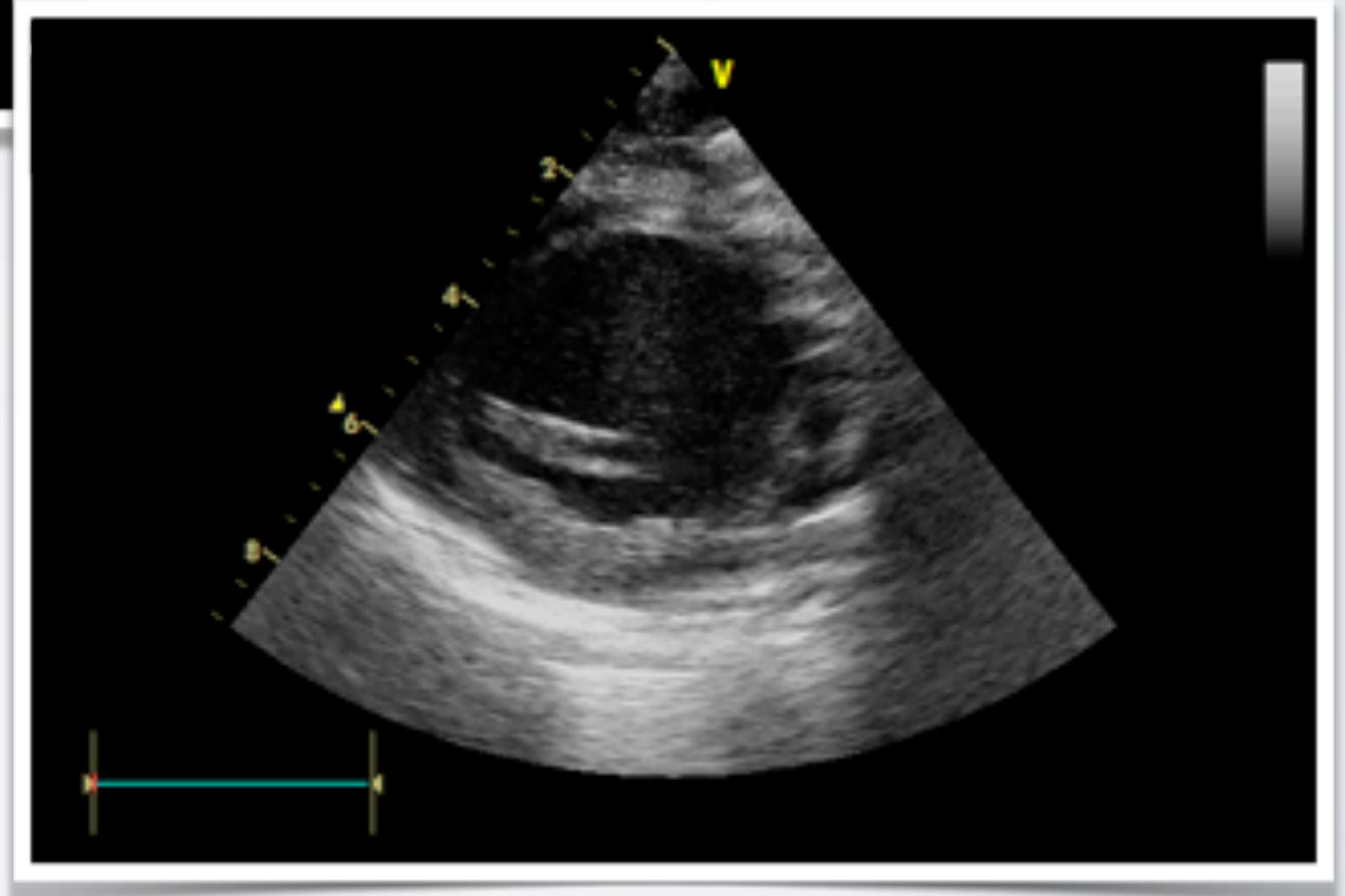
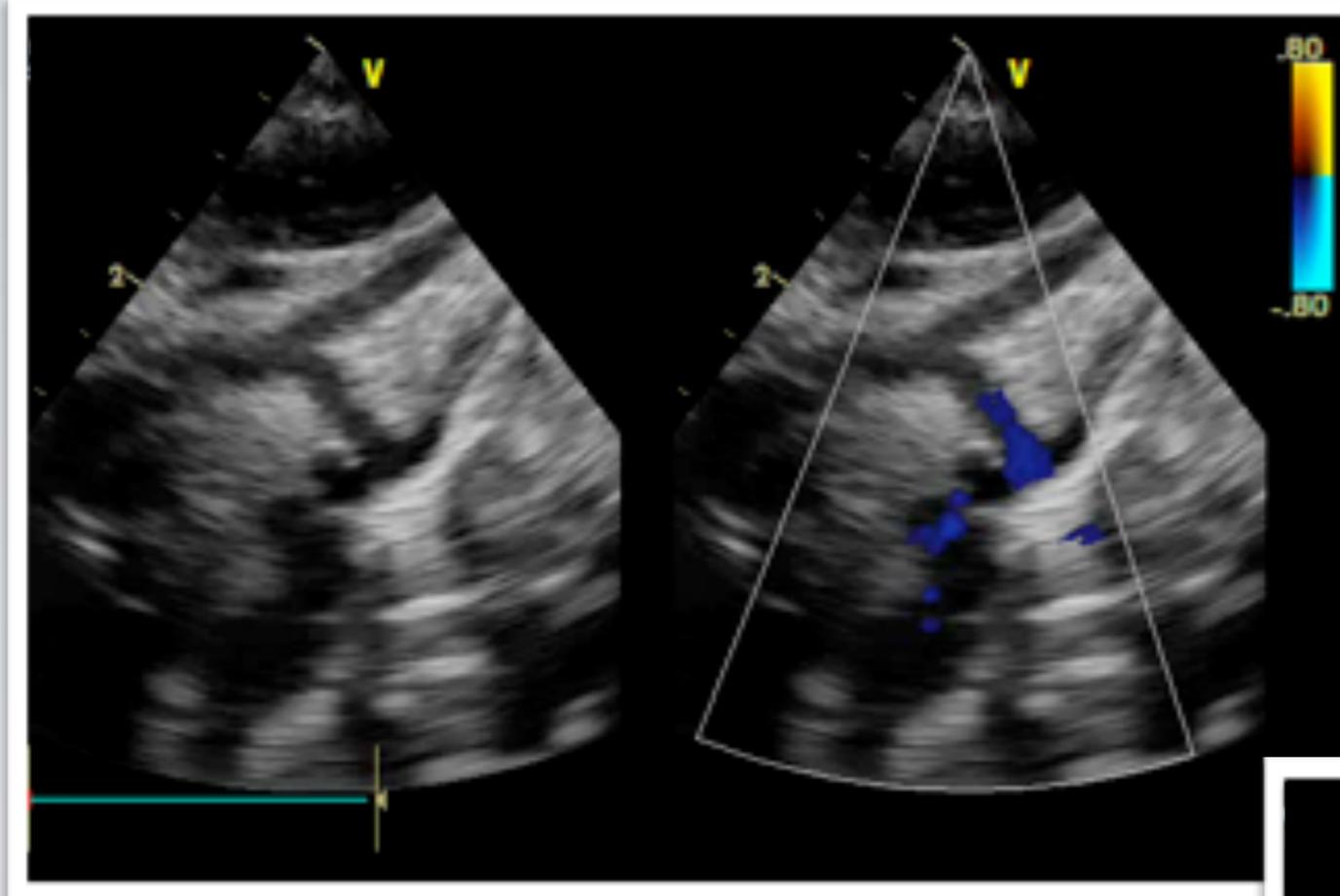




LSCV in coronary sinus

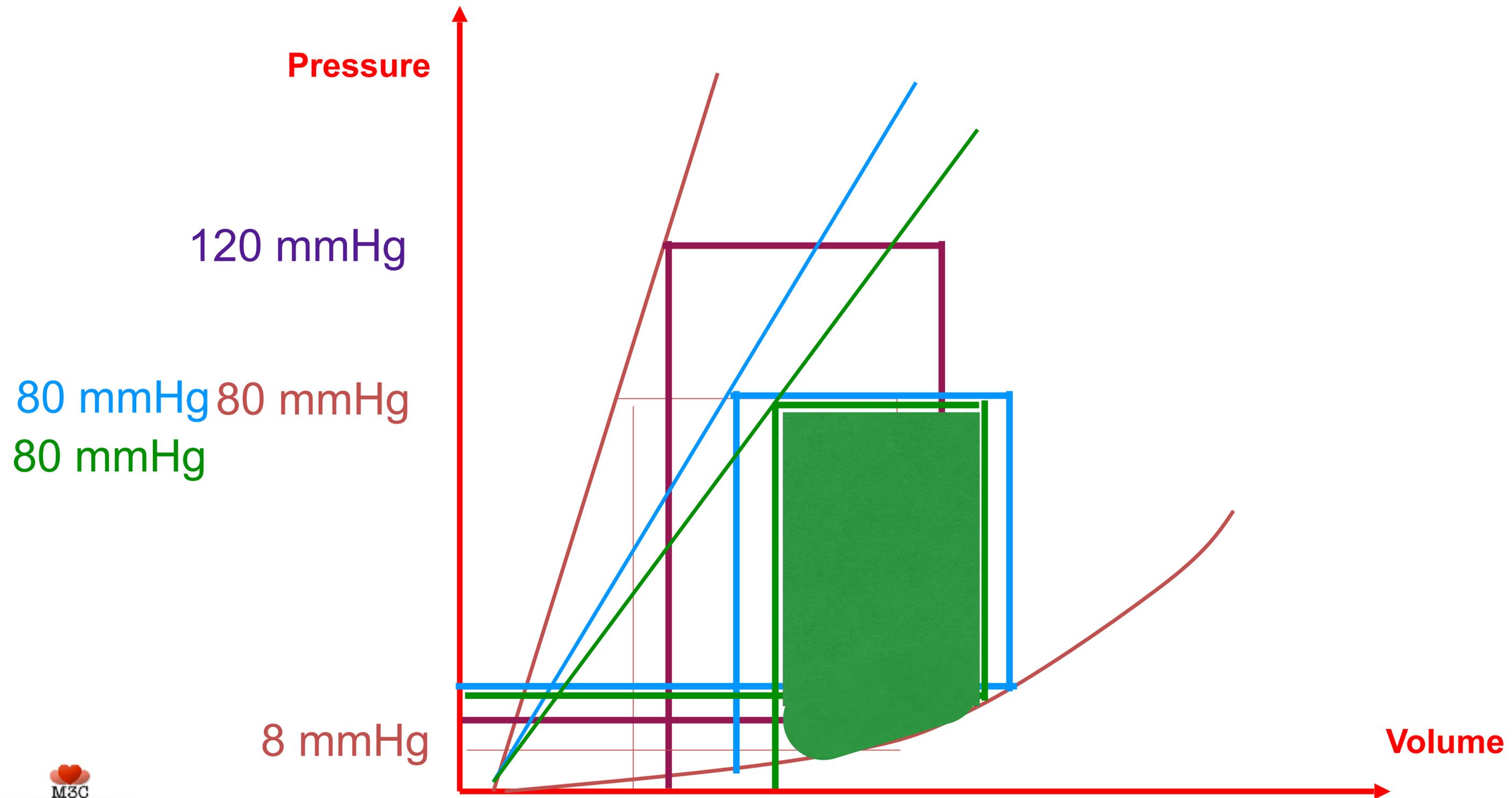


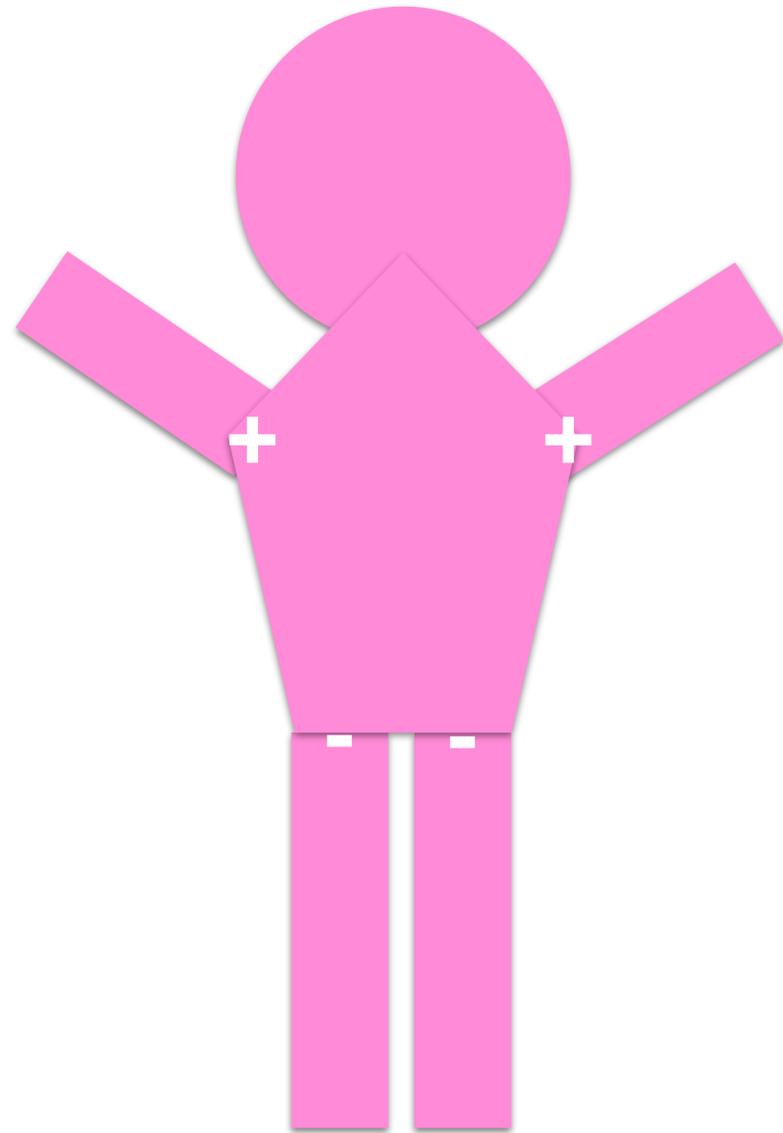
<10% of persisting LSCV

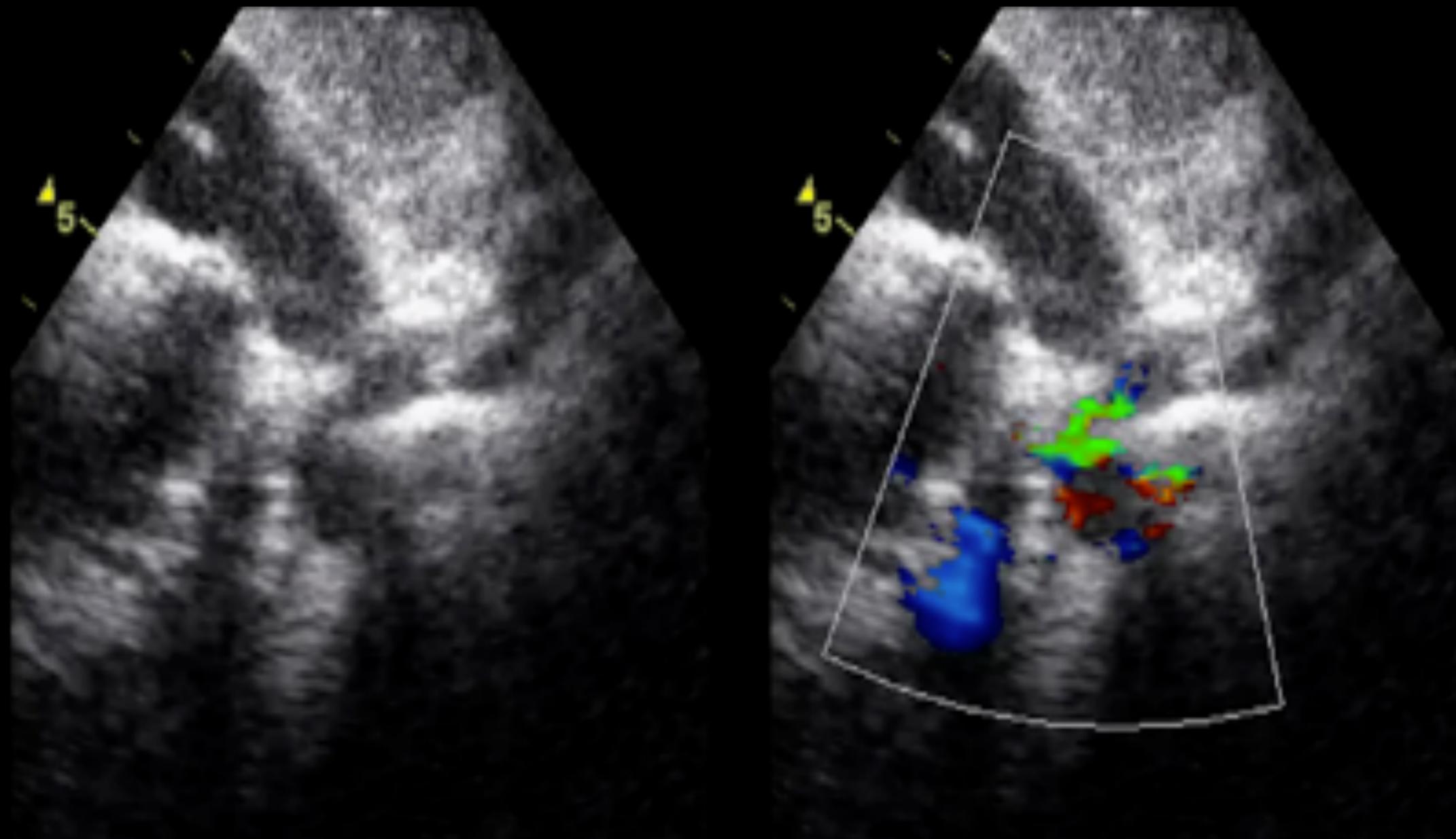


**Neonatal coarctation
with left ventricular
dysfunction**

Pressure volume loop in coarctation







- **Pink coarctation**
- **Arterial duct is closed**
- There are signs of heart failure/LV systolic dysfunction
 - Yes/No
- The price to pay is systemic hypertension
 - Yes/No
- The price to pay is increase LV-TDP
 - Yes/No

If one YES : treat coarctation



- **Pink coarctation**
- **Arterial duct is open with $PVR \ll SVR$**
- There are signs of heart failure/LV systolic dysfunction

- Yes/No

If one YES : treat coarctation

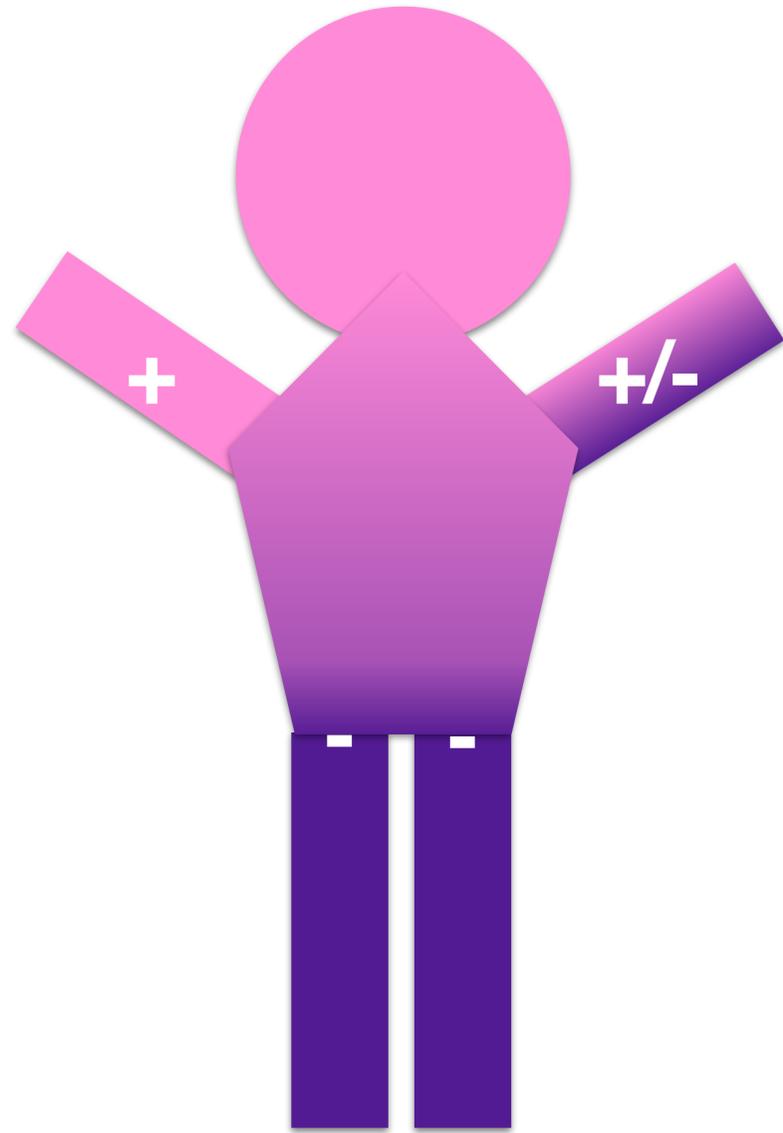
- The price to pay is systemic hypertension

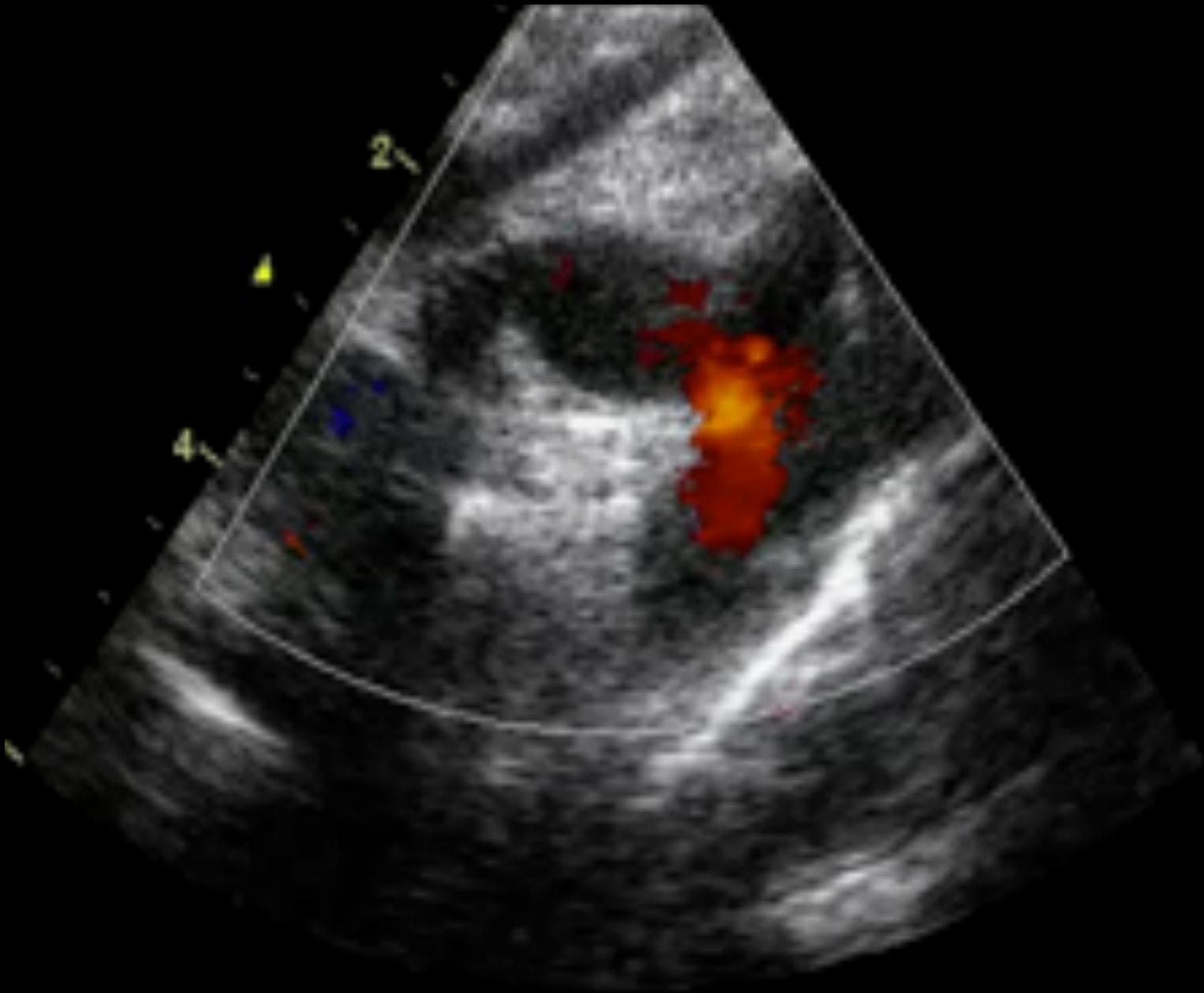
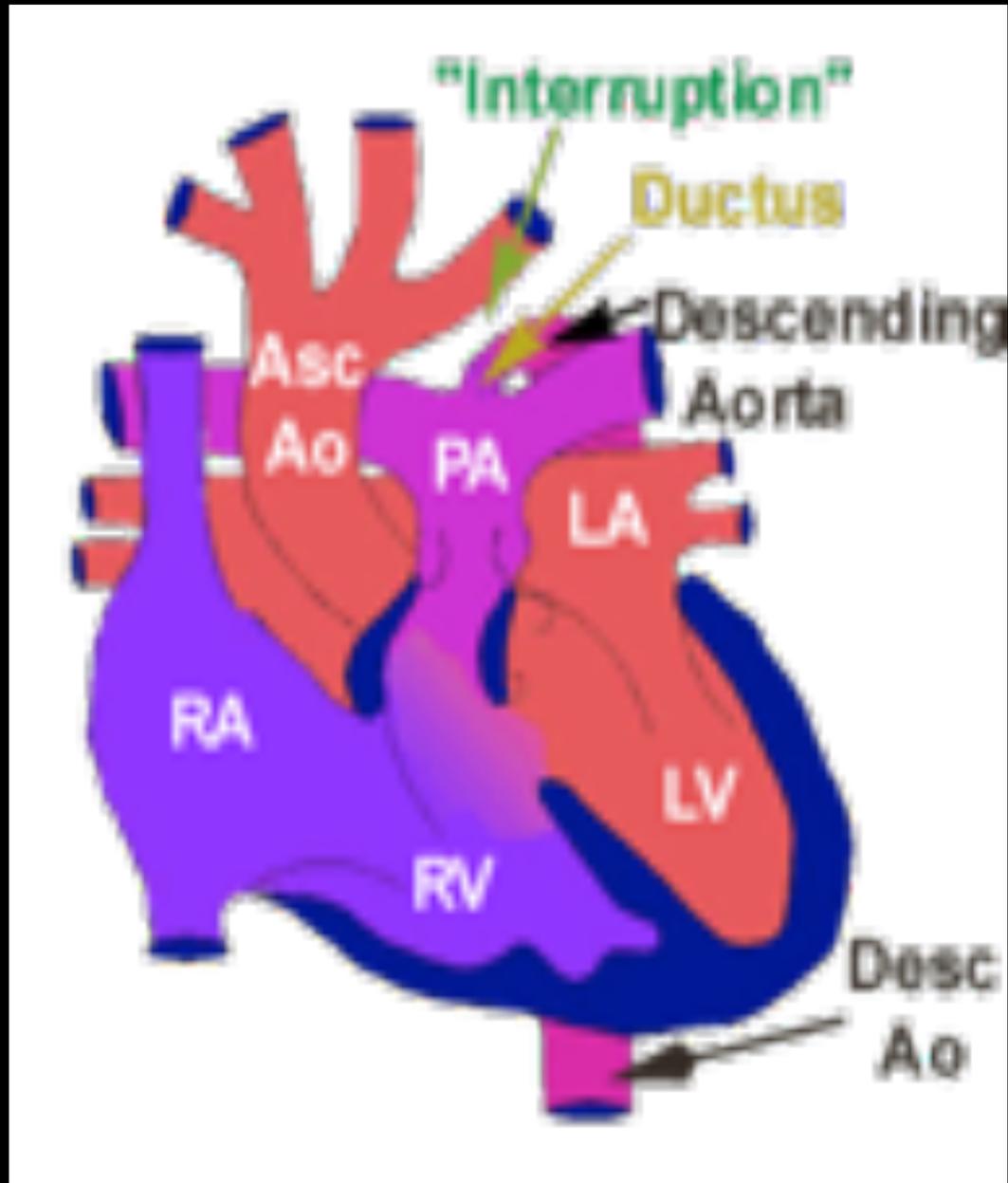
- Yes/No

If all is No : be careful until AD closure

- The price to pay is increase LV-TDP

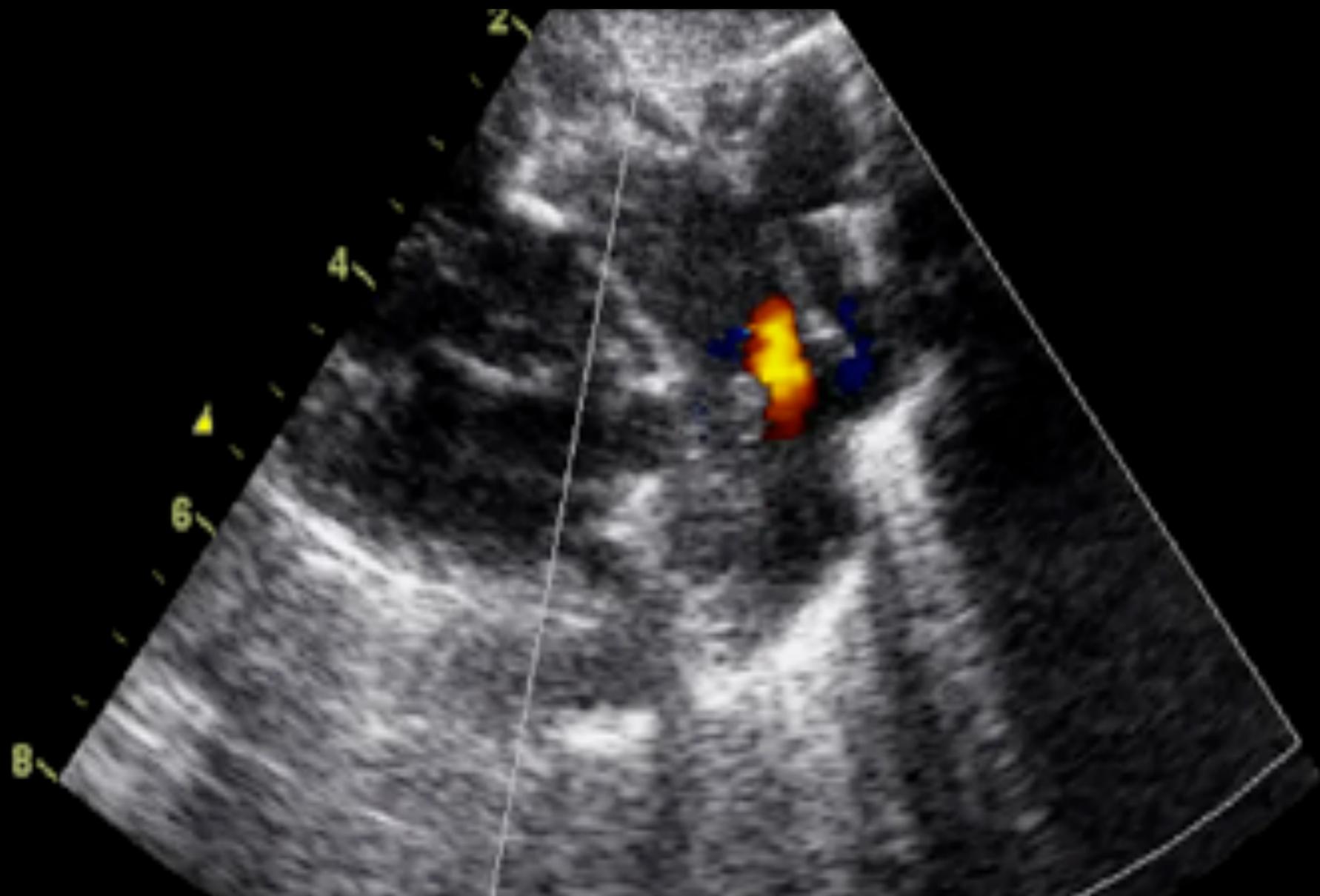
- Yes/No

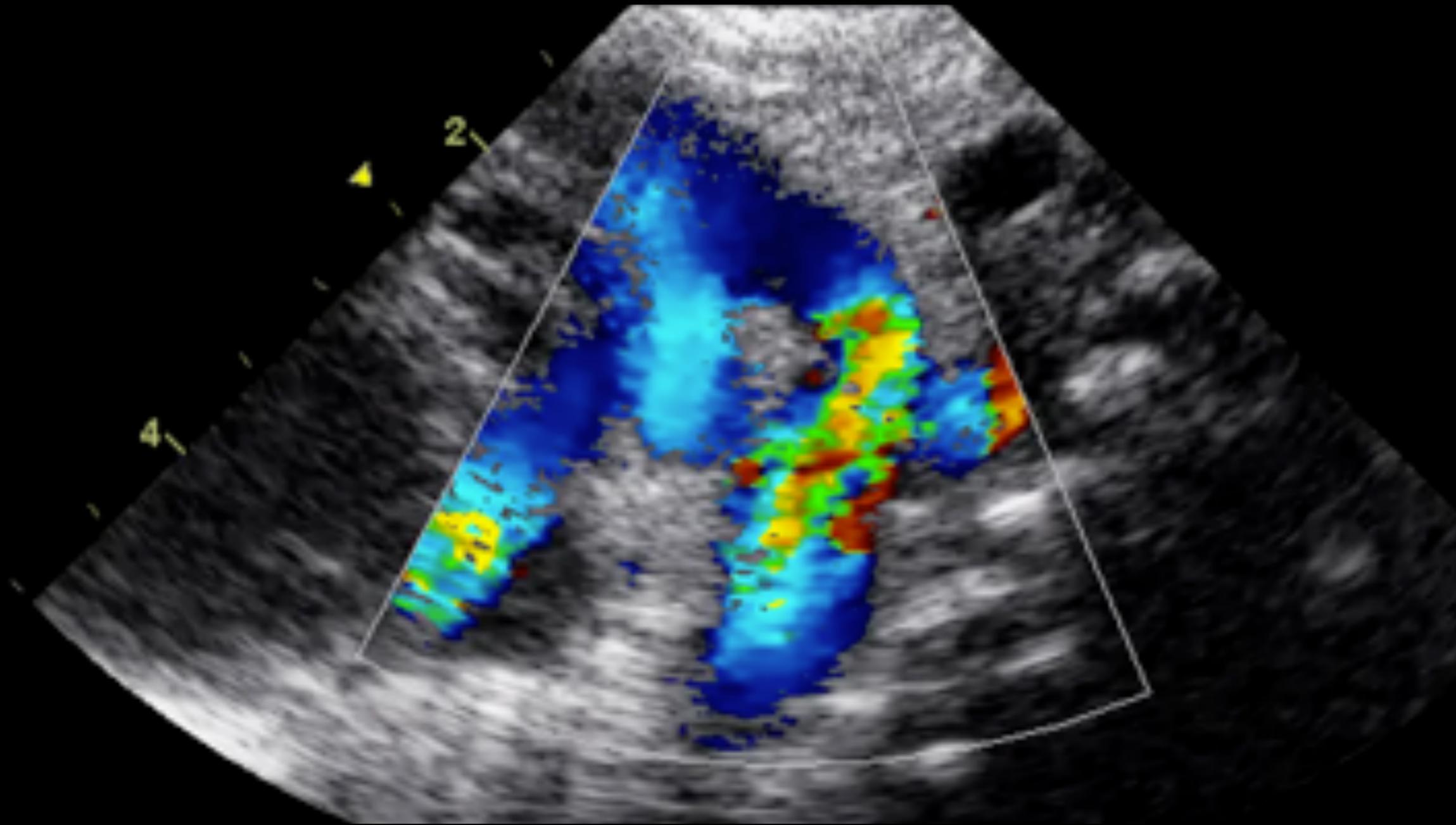




- **Interrupted aortic arch**
- **Arterial duct is open with obligatory right to left shunt in systole (PA to Descending Aorta)**
- **PVR \ll SVR with diastolic left-to-right shunt (Ao to PA)**
- Heart failure is of no importance in the indication
- Systemic hypertension is of no importance
- Increase LV-TDP is of no importance

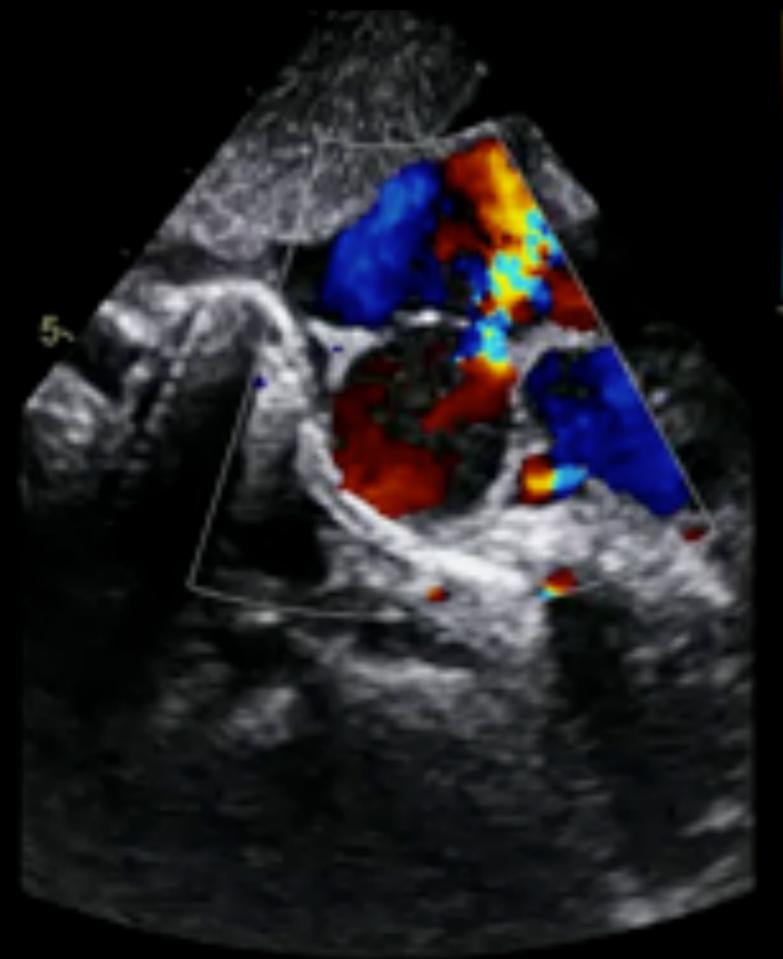
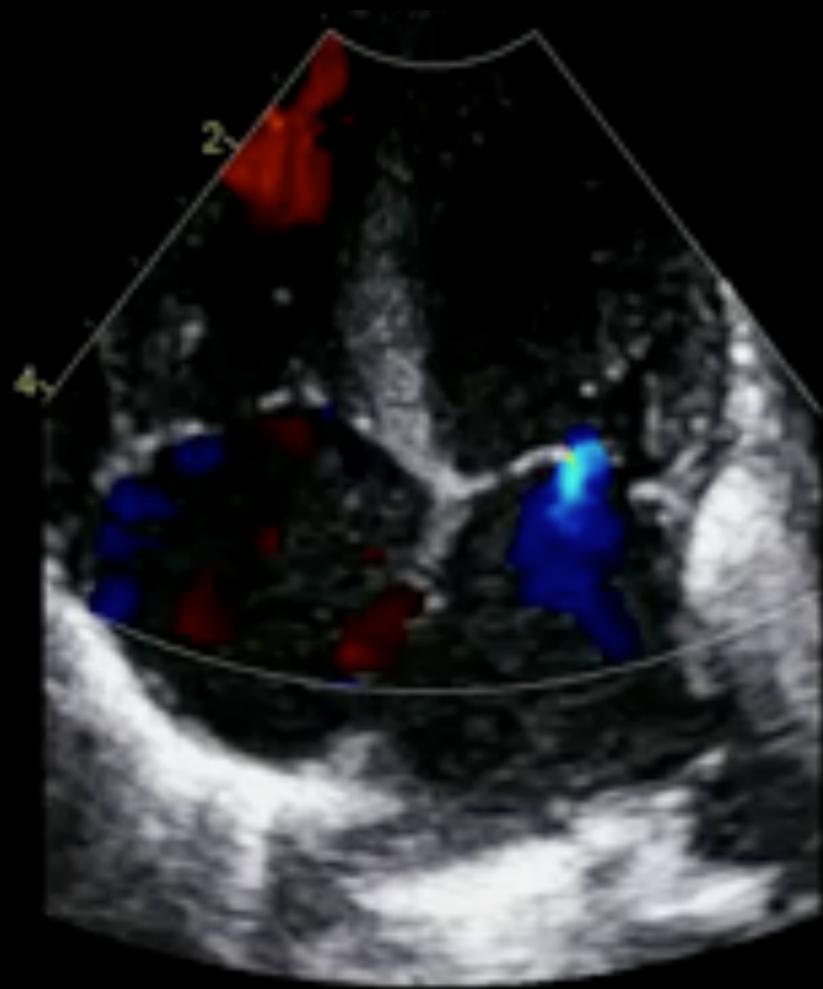
**Treat interrupted aortic arch
as it is a ducto-dependent defect**





- **Coarctation of the aorta**
- **Arterial duct is open with right to left shunt in systole (PA to Descending Aorta)**
- **$PVR \ll SVR$ with diastolic left-to-right shunt (Ao to PA)**

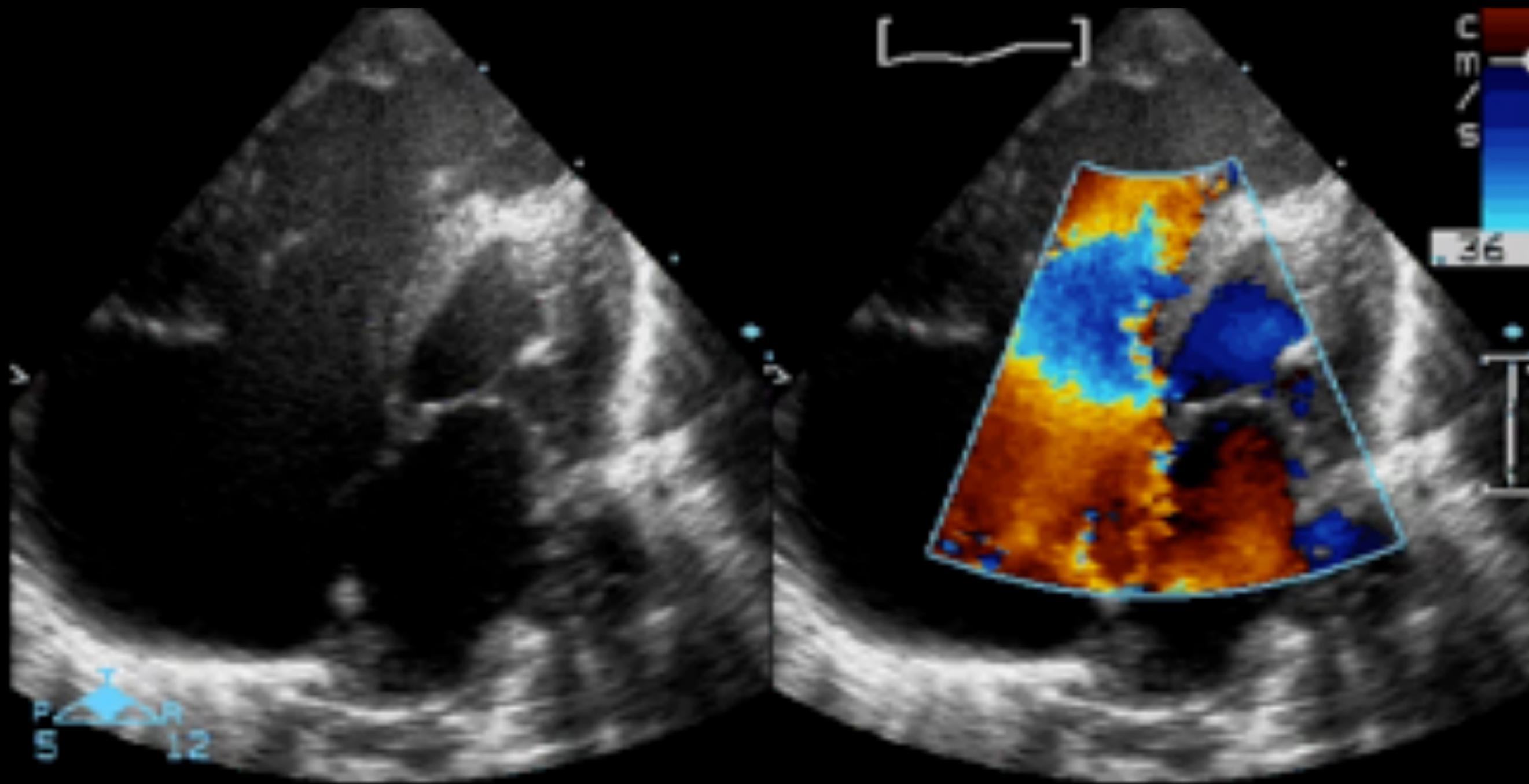
Why is there a systolic right-to-left shunt from PA to Aorta ?



- **Coarctation of the aorta**
- **Arterial duct is open with right to left shunt in systole (PA to Descending Aorta)**
- **PVR \ll SVR with diastolic left-to-right shunt (Ao to PA)**

Why is there a systolic right-to-left shunt from PA to Aorta ?

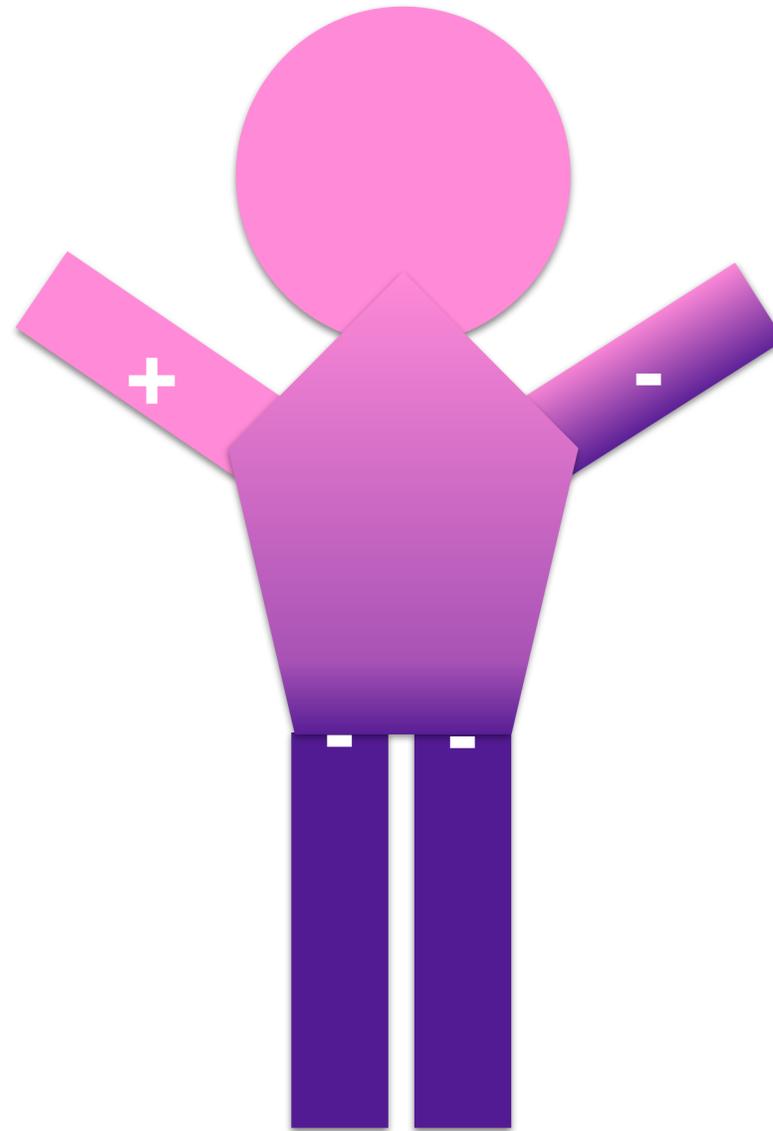
Failing left ventricle



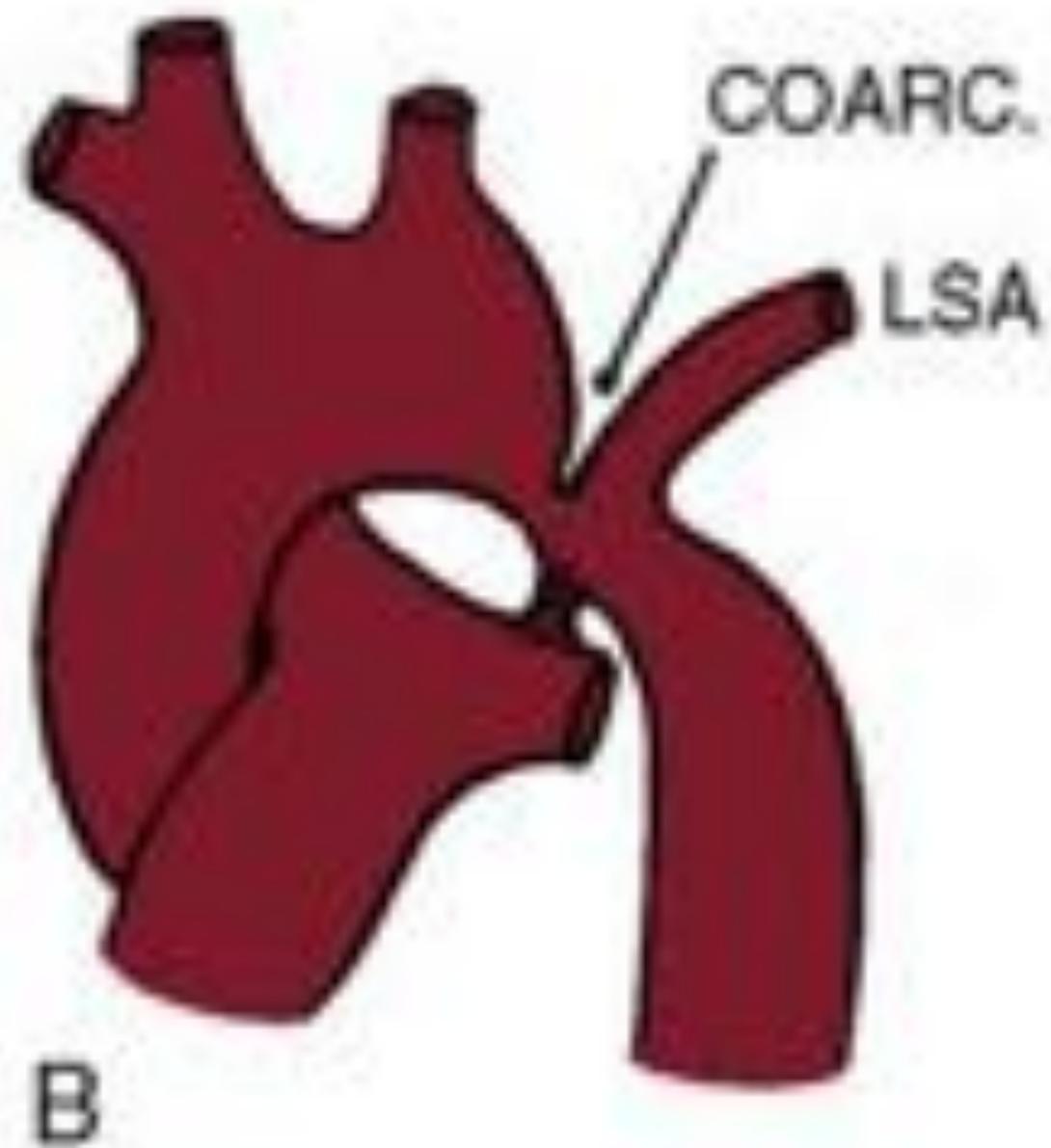
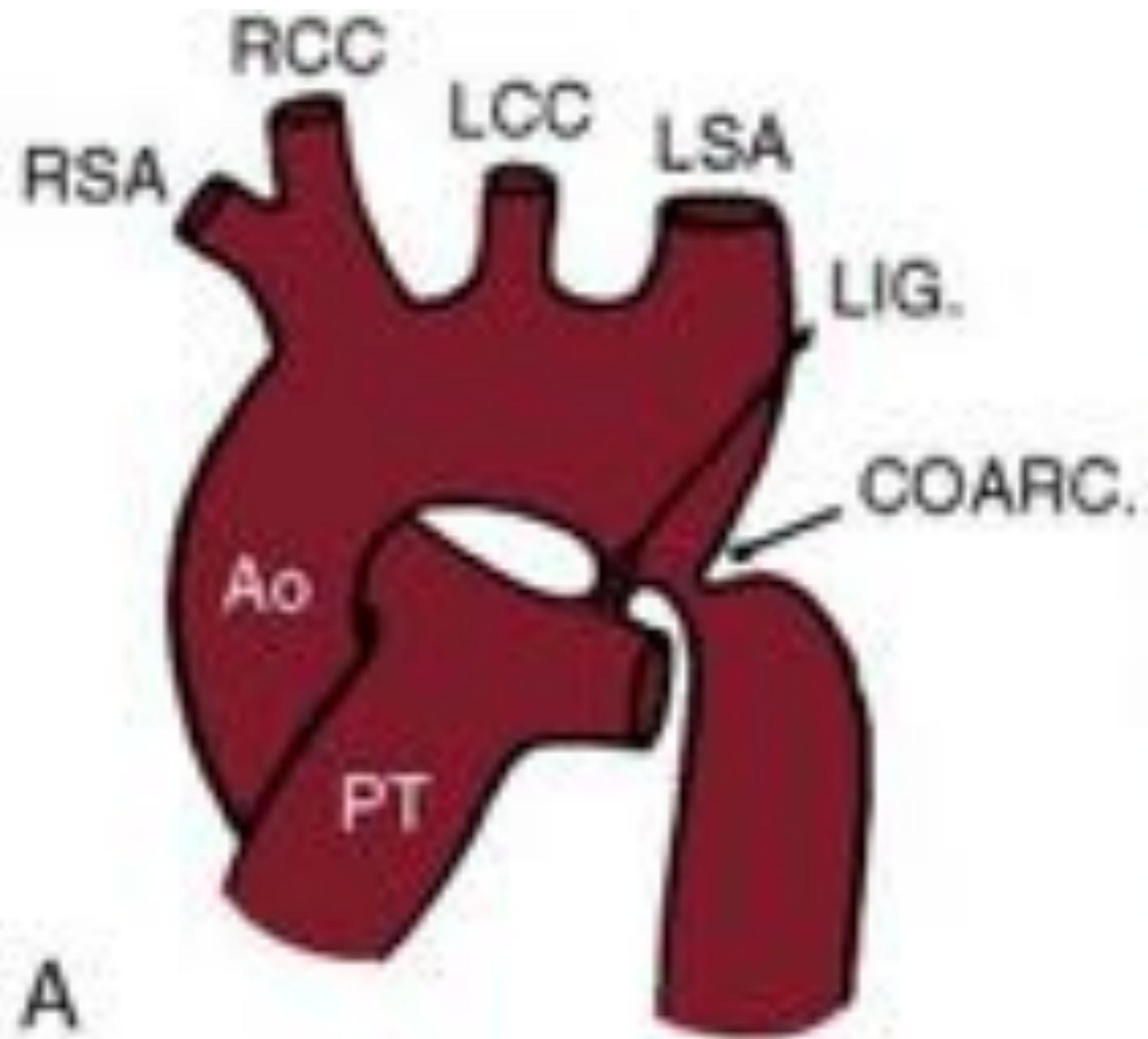
- **Coarctation of the aorta**
- **Arterial duct is open with right to left shunt in systole (PA to Descending Aorta)**
- **$PVR \ll SVR$ with diastolic left-to-right shunt (Ao to PA)**

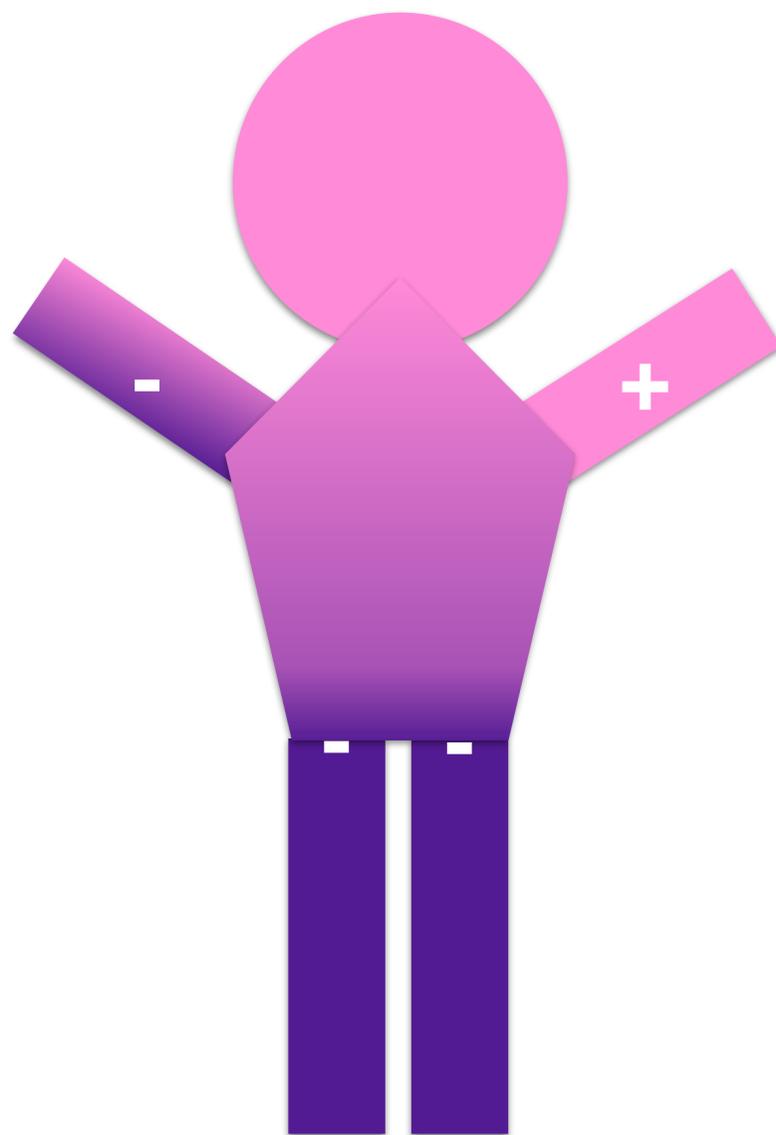
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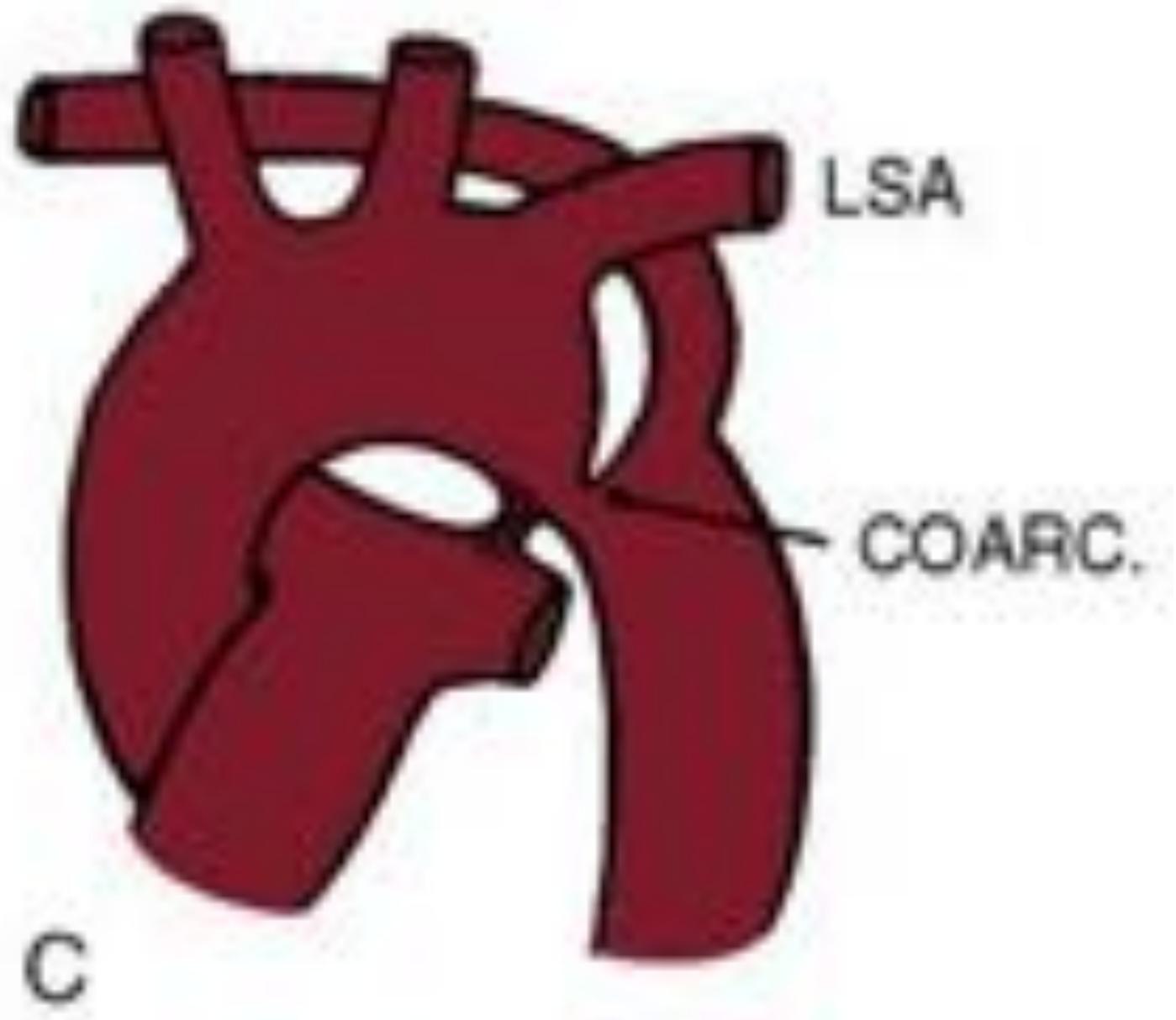
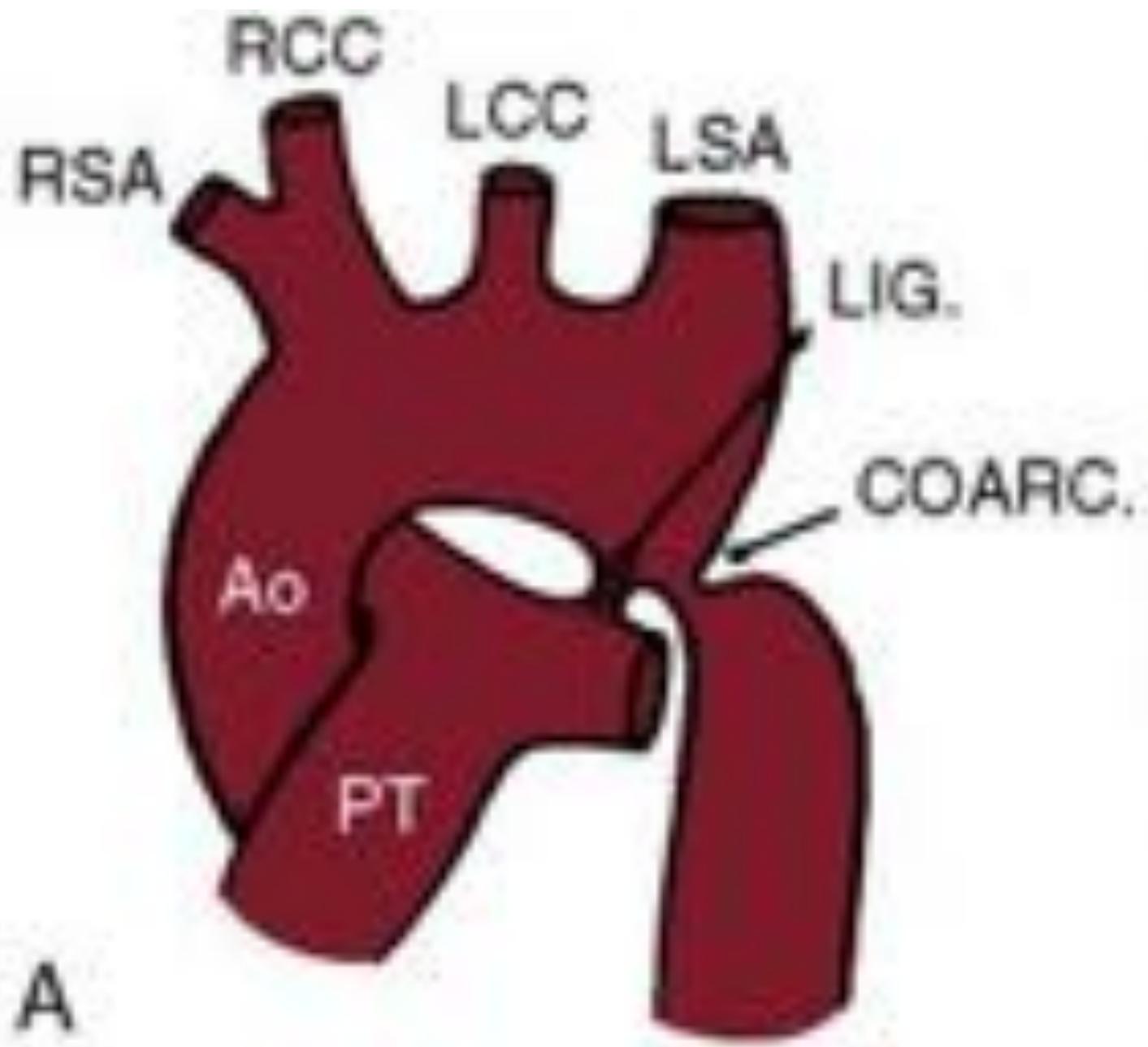
Small left ventricle with or without aortic stenosis



Sub-clavian arteries in coarctation

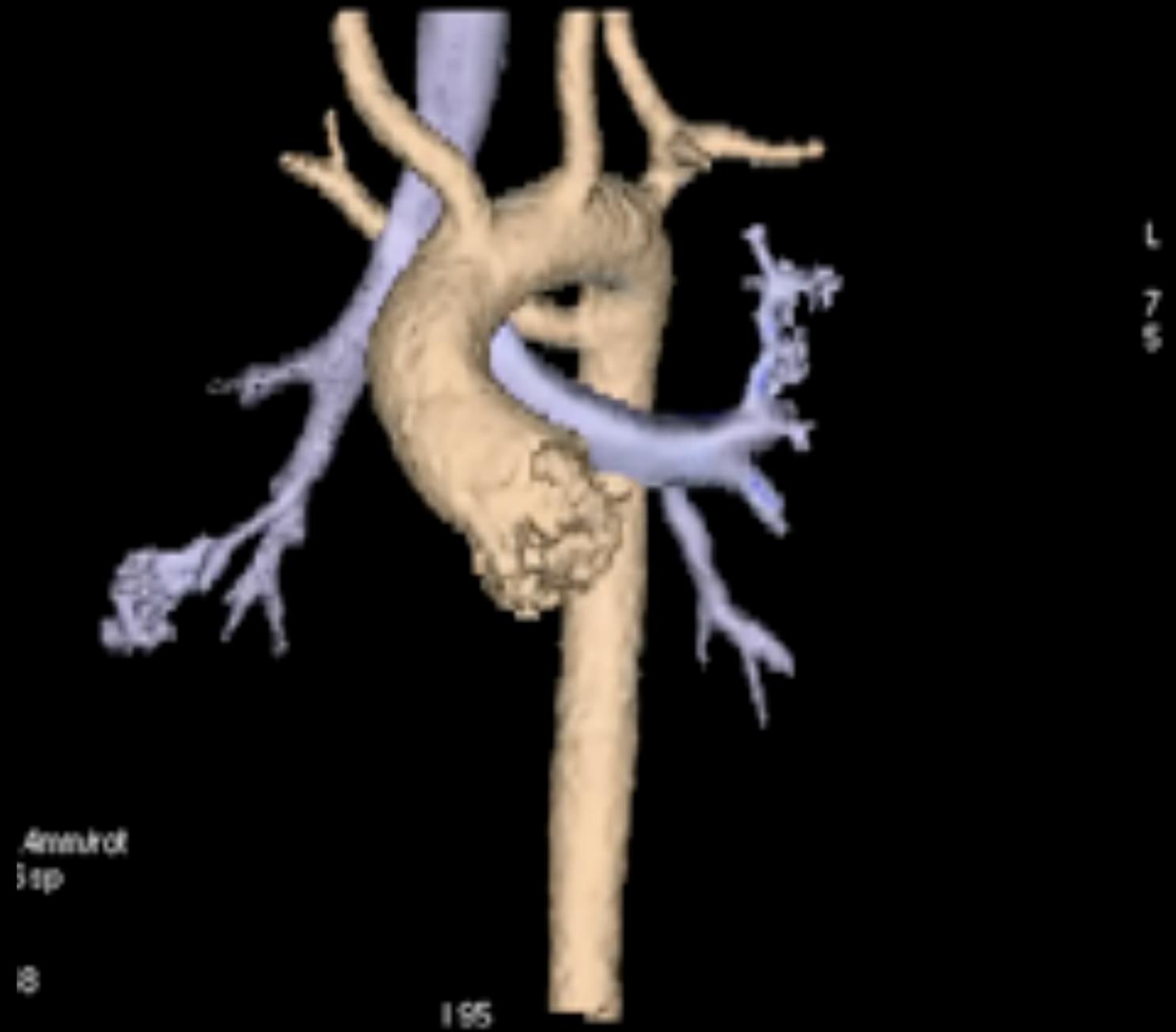
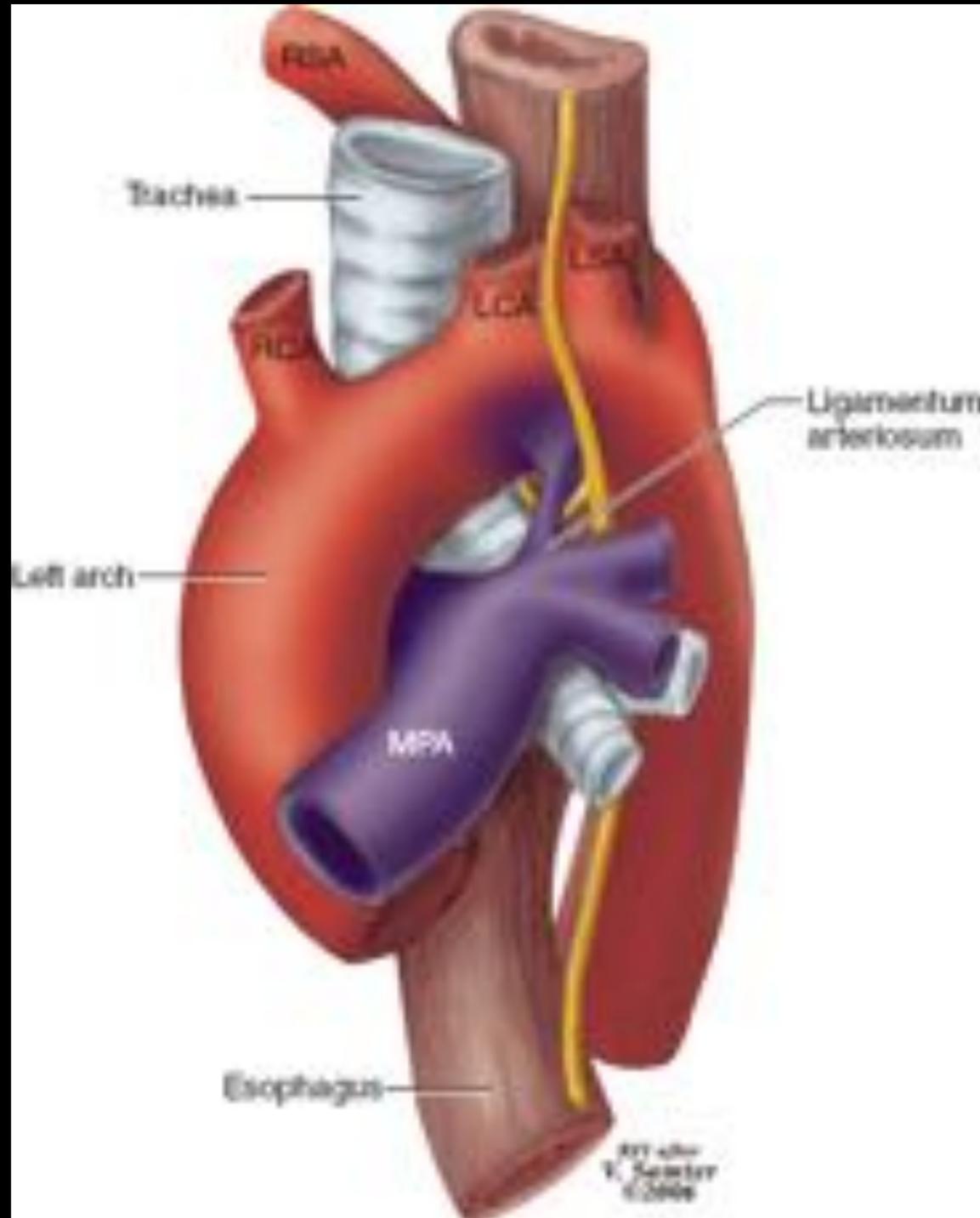




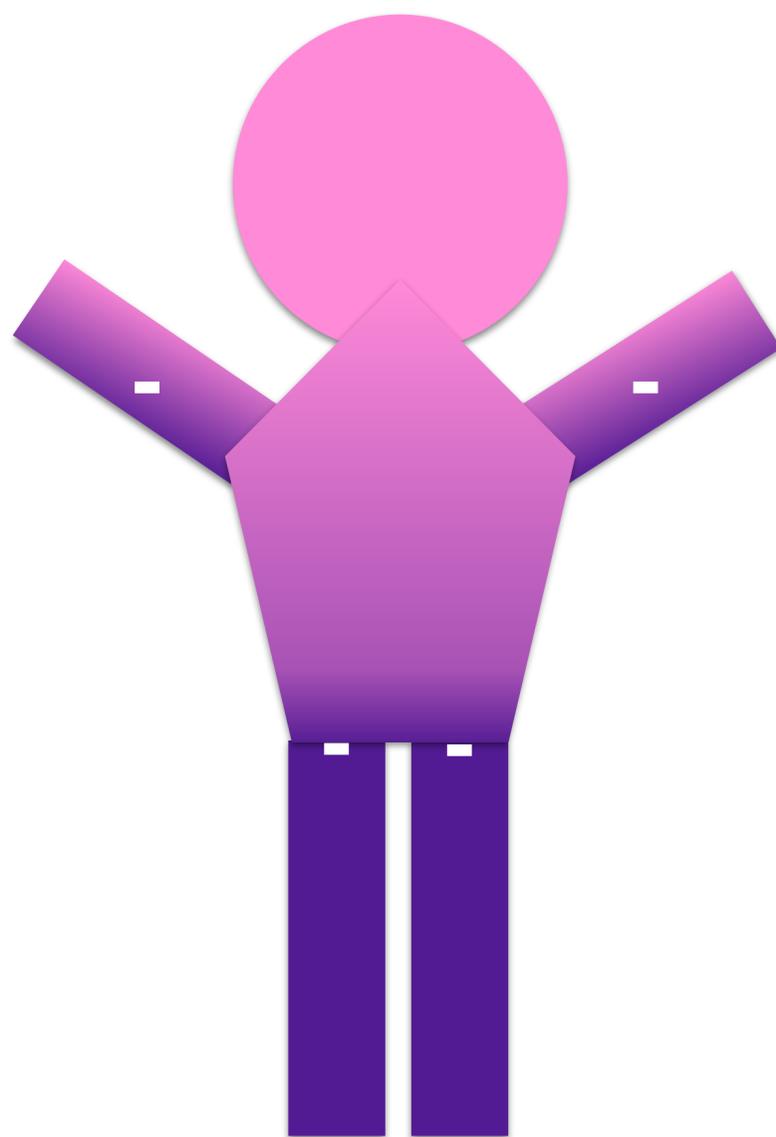


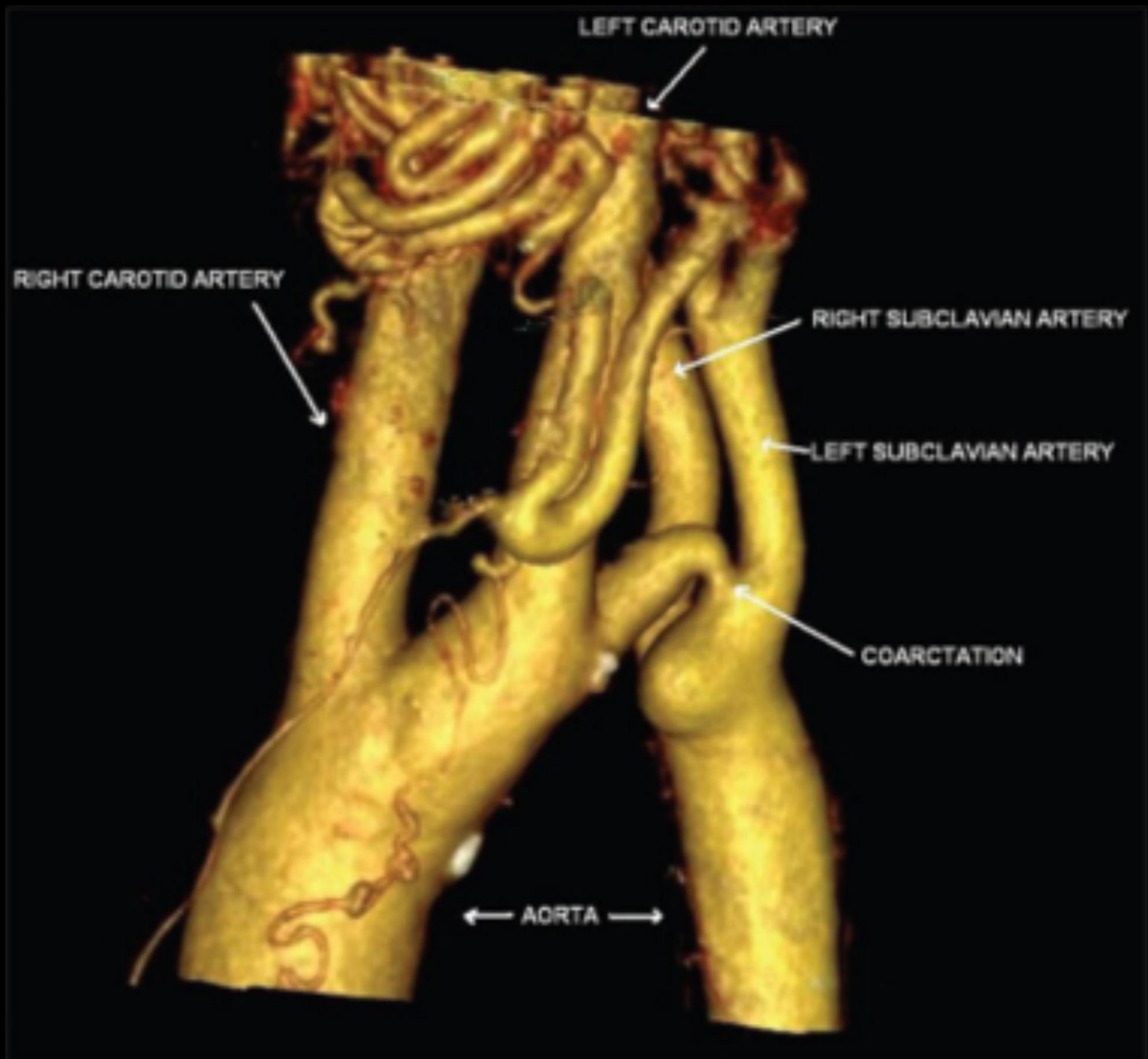
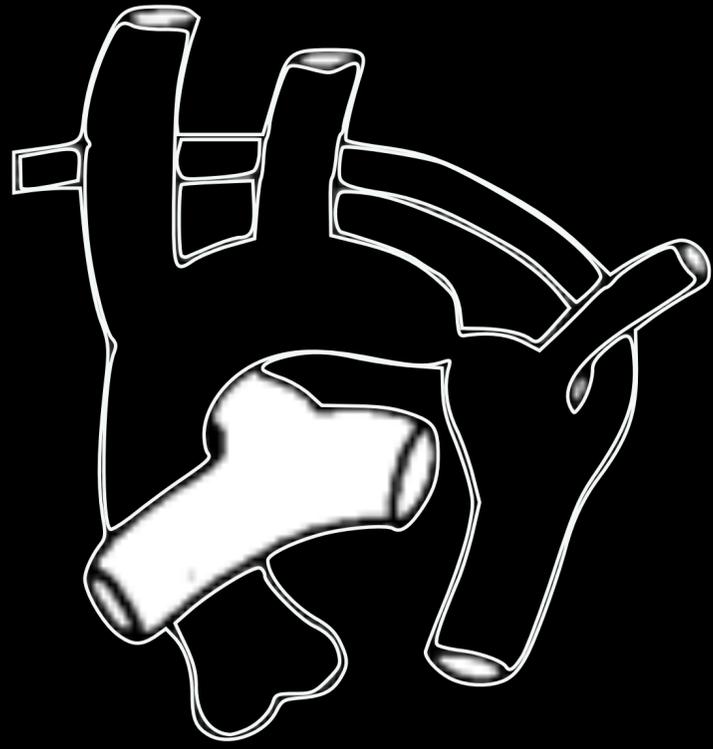
Artère sous-clavière droite rétro-oesphagienne

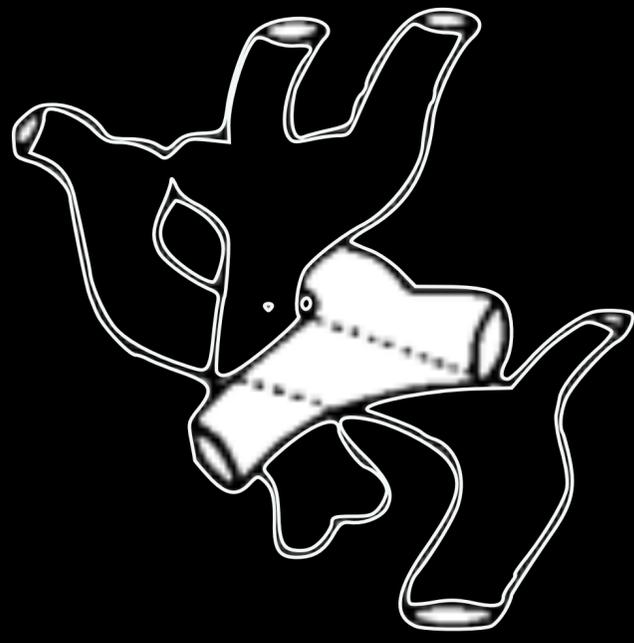
Lusoria



L
7
5







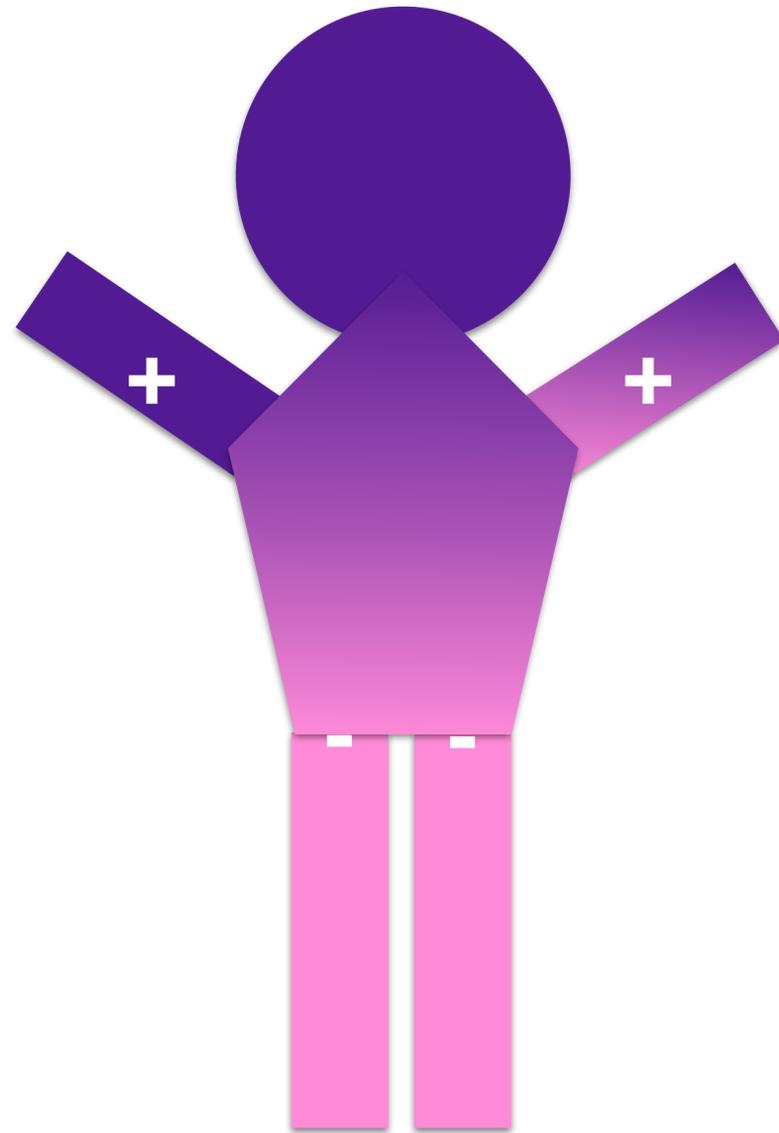
STNDW

R
4
9

L
5
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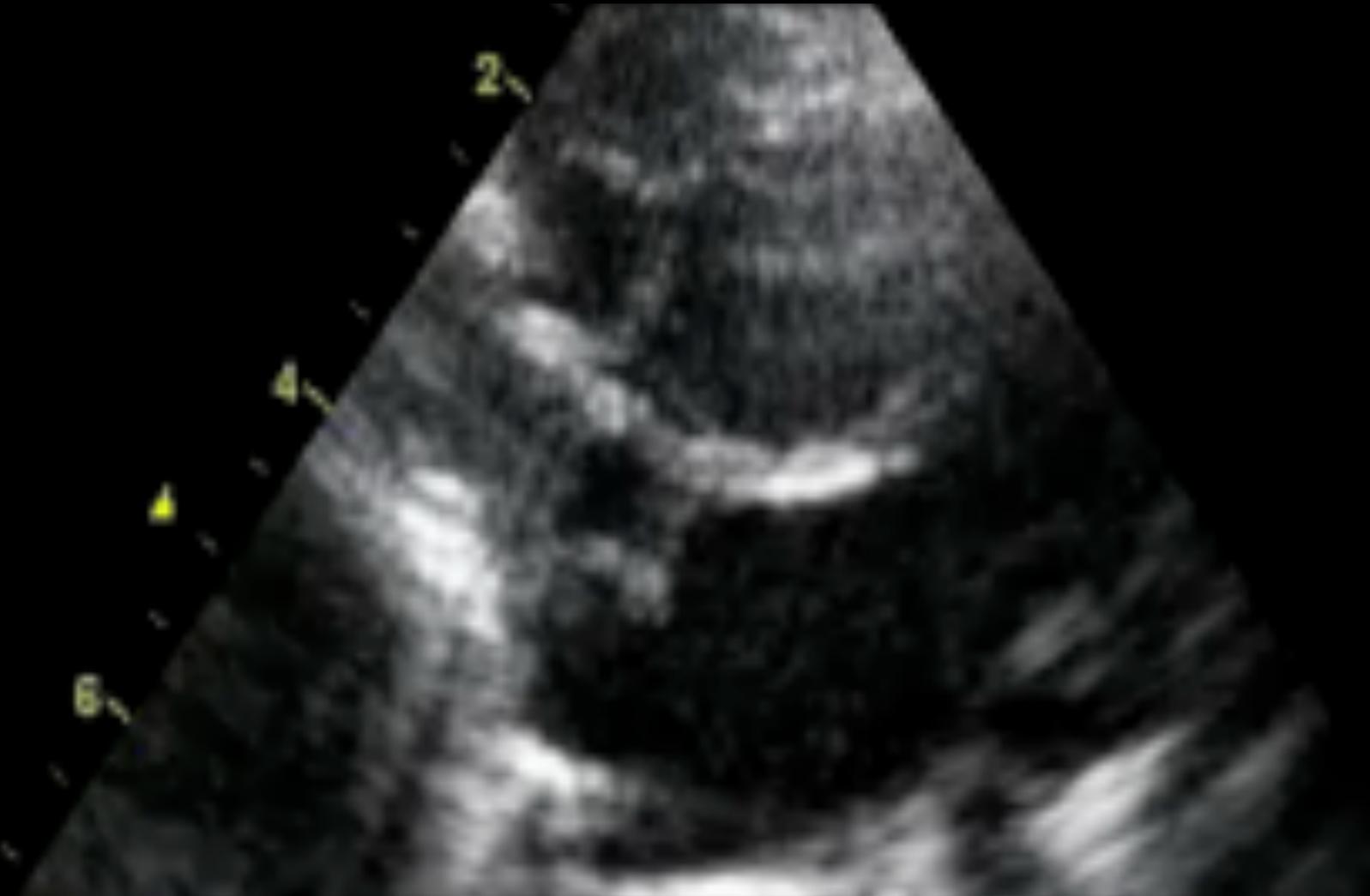
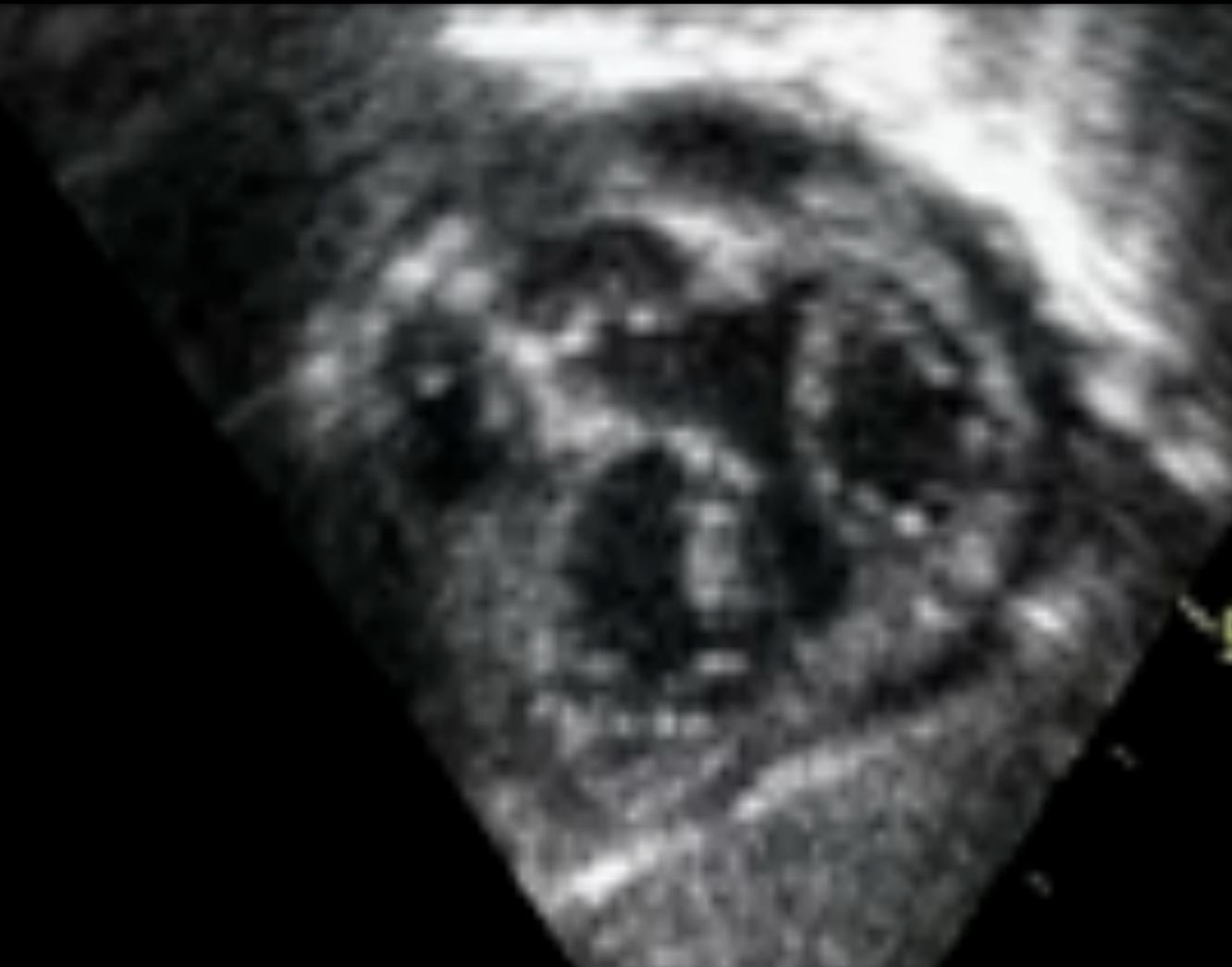


No VOI
kv 80
mA 140
Rot 0.40s / HE+ 39.4mm/hot
0.6mm @ 904:1 / 0.5sp

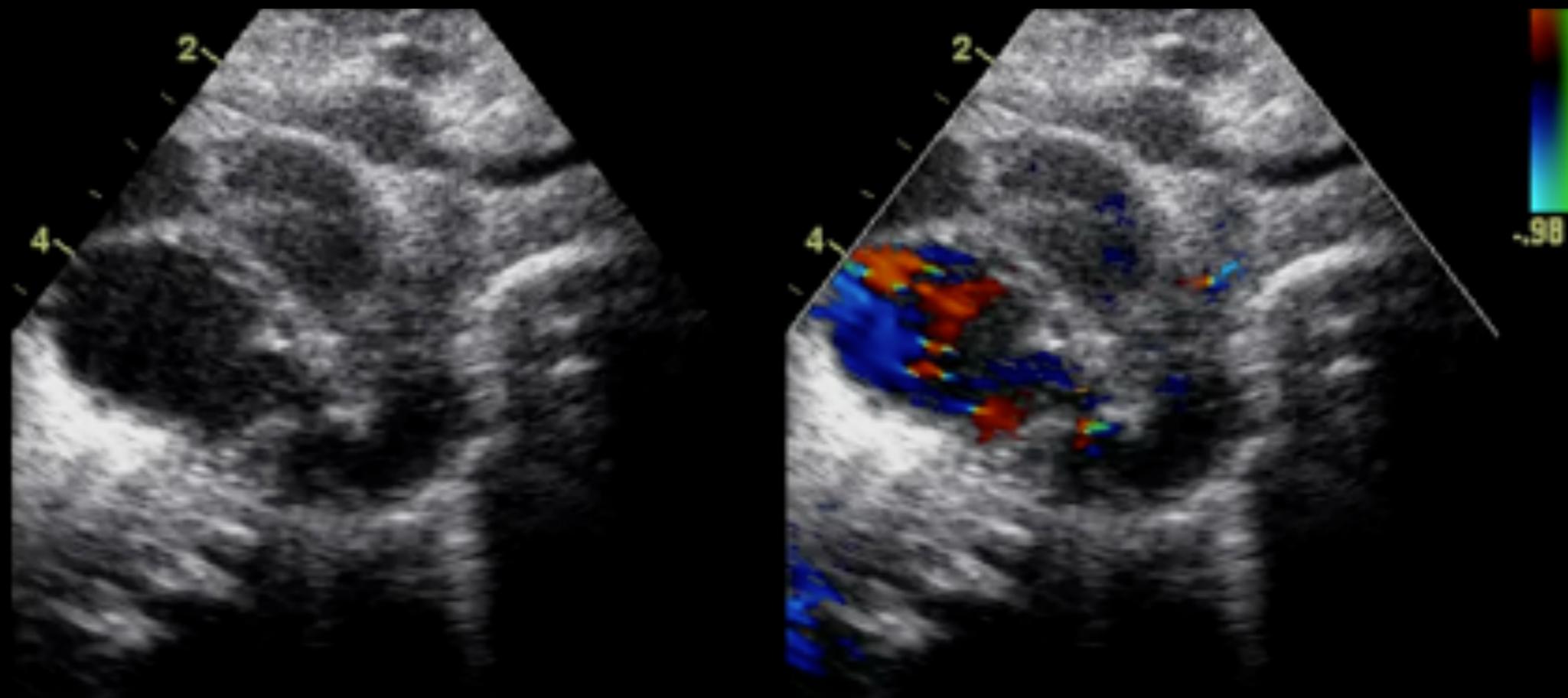


Up side down

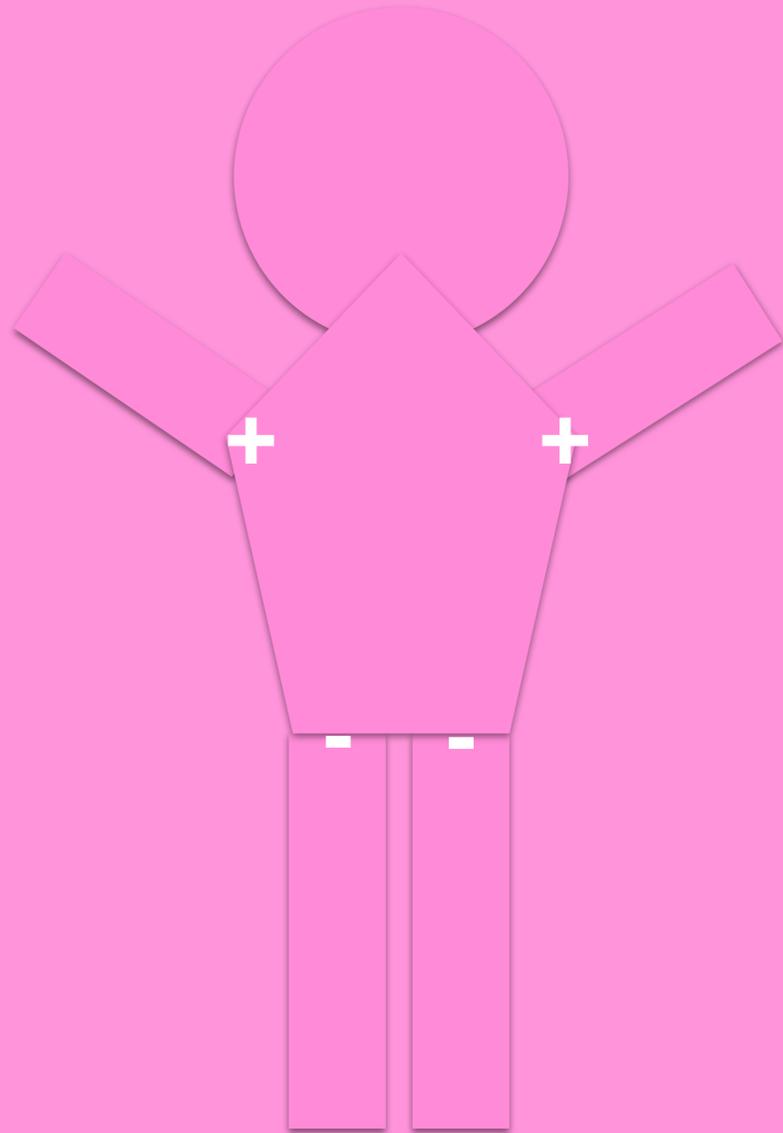
TGA-VSD-Coarctation



TGA-VSD-Coarctation



Treatment of neonatal coarctation



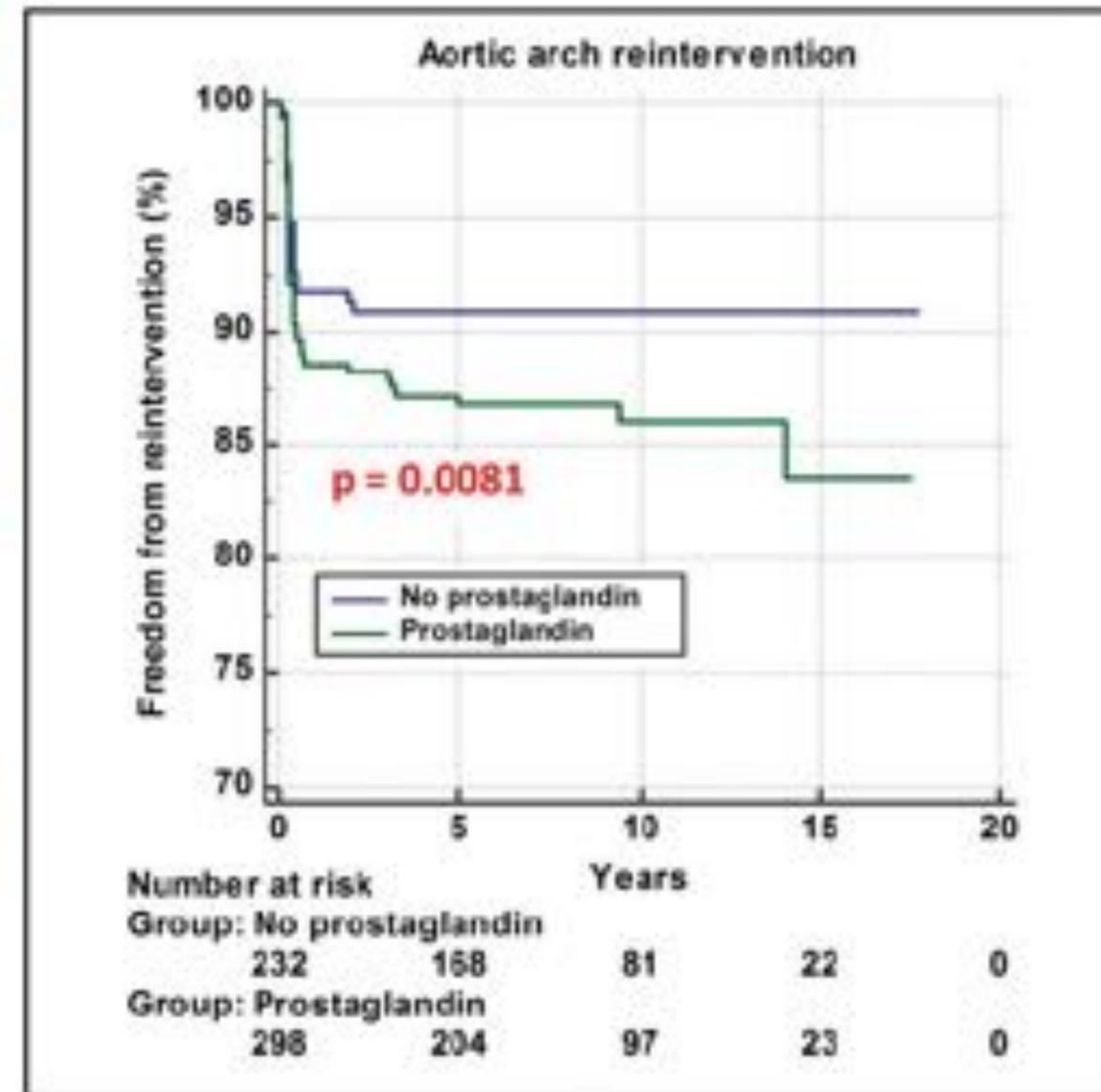
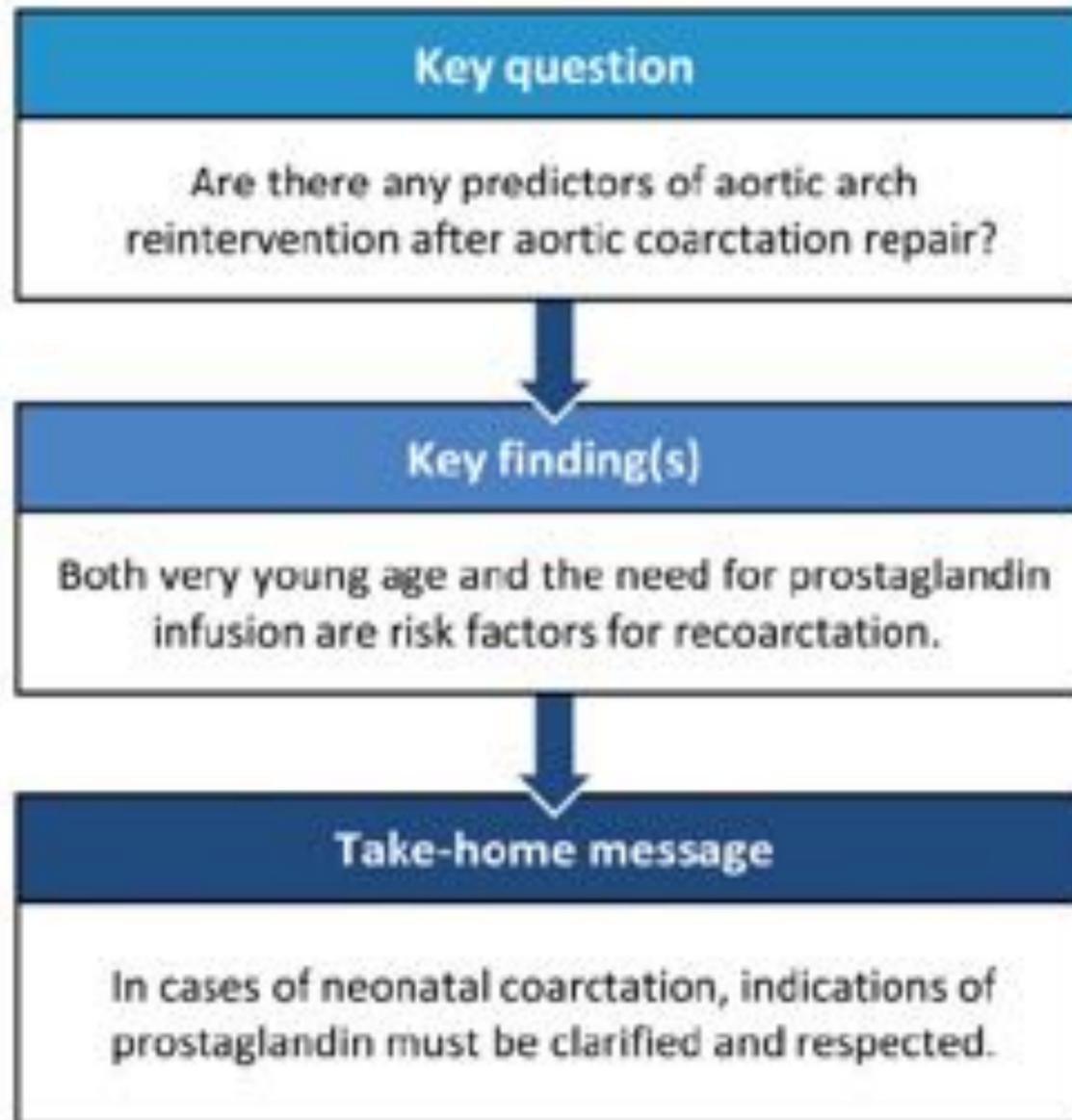
Use of PGE1 in coarctation of the aorta

Until what age can PGE1 treatment be initiated to relieve coarctation ?

- The effect of prostaglandin E1 has been determined to be greater when used in patients younger than 96 hours old; the decreased response in older patients suggests that anatomic closure of the ductus arteriosus has occurred.
- However, there have been reported cases of a “late” effect of prostaglandin E1 on the ductus arteriosus.
- In one patient, the effect of prostaglandin E1 on ductal tissue was seen at **7 weeks of age**, even with complete anatomical closure of the ductus.

Use of PGE1 in coarctation of the aorta

Repair of coarctation with PGE1 increases the risk of re-coarctation





CONGENITAL COARCTATION OF THE AORTA AND ITS SURGICAL TREATMENT

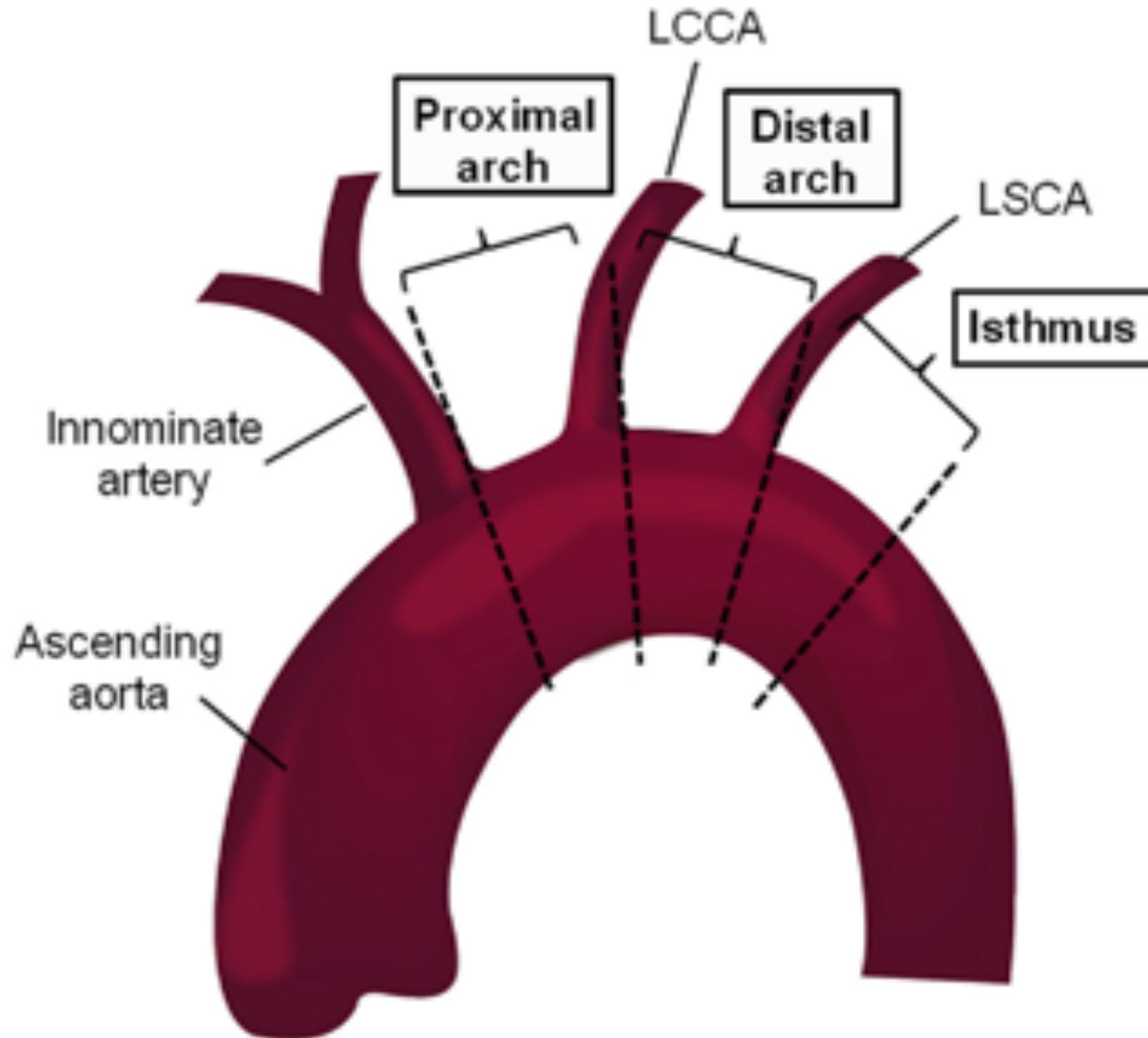
CLARENCE CRAFOORD, M.D.,* AND G. NYLIN, M.D.†
STOCKHOLM, SWEDEN

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THE JOURNAL OF THORACIC SURGERY

As far as we have been able to ascertain from the literature, the only other investigator who has considered the possibility of relieving coarctation of the aortic isthmus by a surgical intervention is the American surgeon, Blalock. The latter, however, has attacked the problem in a more conjectural manner and from a different standpoint, having considered some form of anastomosing operation or plastic reconstruction to be the only way of improving the circulation peripheral to the stricture. He also states that no intervention to correct aortic stenosis has yet been performed on man.

Aortic arch anatomy



Anatomy of the aortic arch and surgical strategy

There is still controversy regarding the definition of hypoplastic aortic arch.

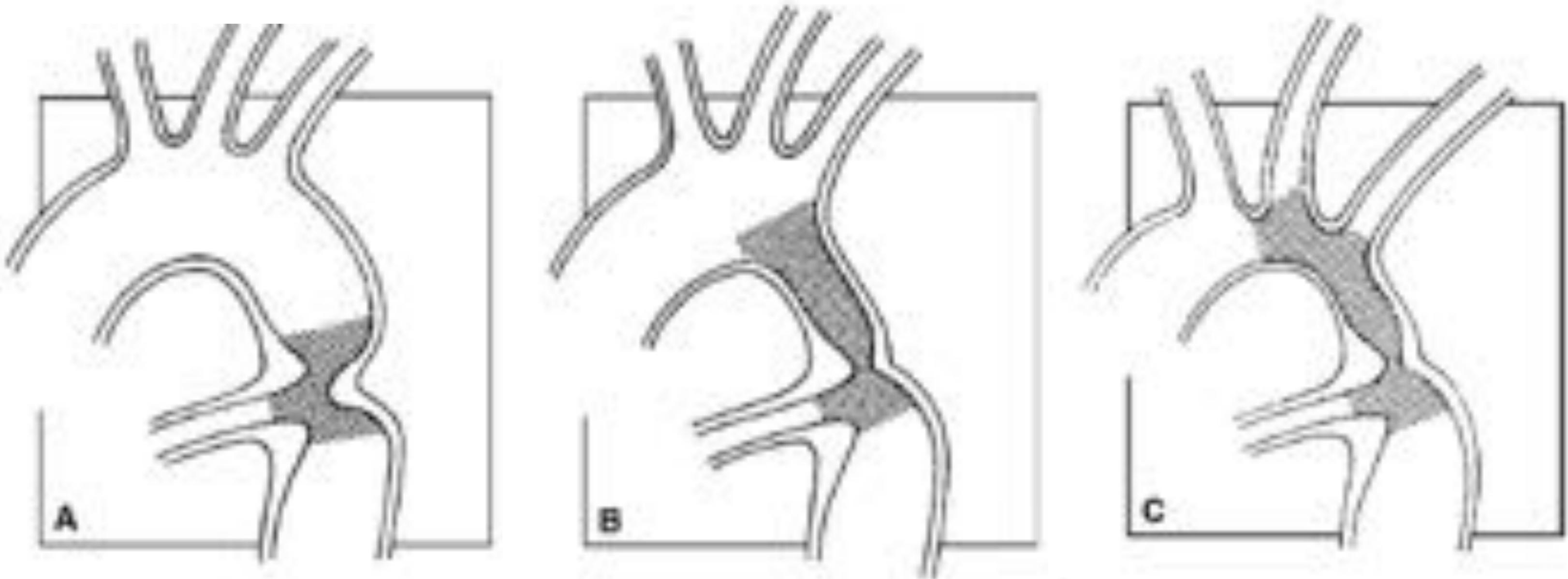
Physiologically, a 50% reduction of the luminal dimension would have important flow dynamic effect.

Other measures include the transverse arch dimension less than the left carotid artery, the distal arch is less than half the diameter of descending aorta at diaphragm, or the z scores.

The last measure needs to be treated with care; a small change in actual dimension can cause a big change in the z scores especially at the extreme end of the Bell curve.

The practical definition by Karl et al that the dimension (mm) of transverse arch should be the baby weight +1, for example, in a 3 kg baby, the transverse arch is acceptable at 4 mm.

Anatomy of the aortic arch and surgical strategy



A



B

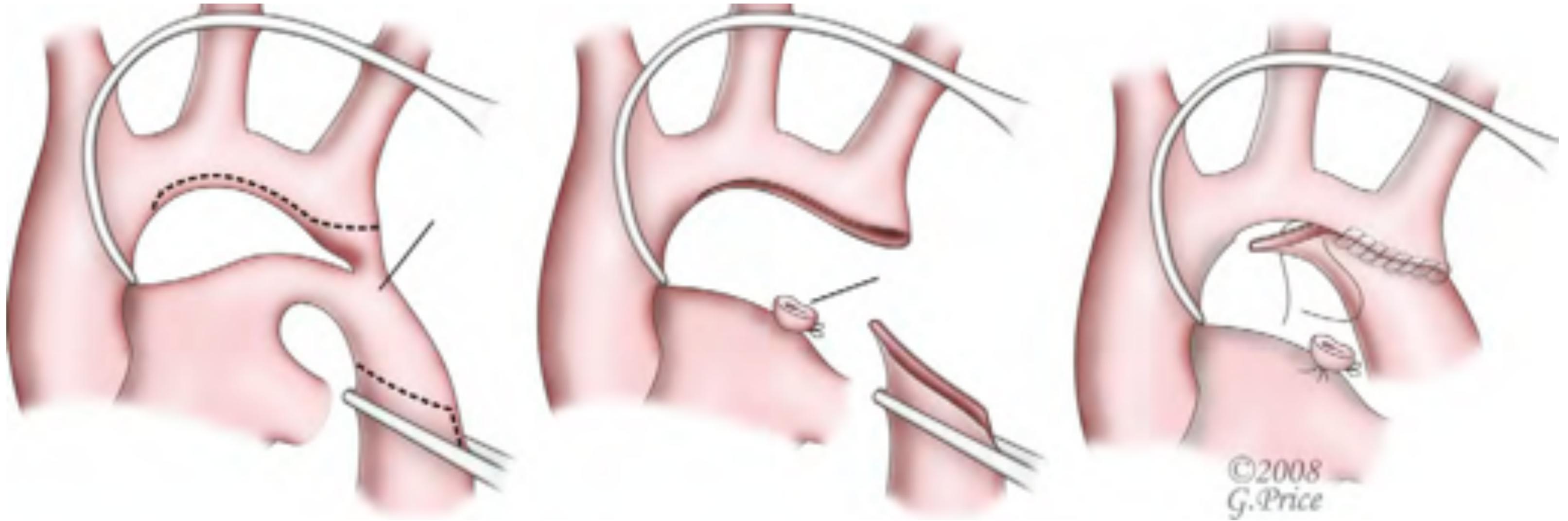


C



D





Extended end-to-end anastomosis

Neonatal coarctation

Complex defect

-variable physiology

-variable anatomy

that are both the determinant factors for the type of repair
and are also linked with outcomes (early and late).

R.Gaudin



O.Raisky



Collective ignorance is the motivation
Curiosity is the strength
Research is the path

Individual experience is the brake
Indifference is the weakness
Argument from authority is the threat



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