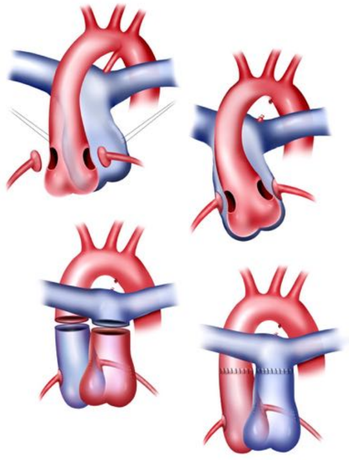
The arterial switch for TGA

Surgical Technique

Necessary/Essential Preoperative Informations



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Malformations Cardiaques Congénitales Complexes-M3C

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Inserm

cardiogen
Filière nationale de santé maladies cardiaques héréditaires

Centre de Référence des Maladies Cardiaques Héréditaires

European Reference Network
for rare or low prevalence complex diseases
Network Respiratory Diseases (ERN-LUNG)

European Reference Network
for rare or low prevalence complex diseases
Network Heart Diseases (ERN GUARD-HEART)

NECKER: January 1987 – July 2016

1364 neonates TGA ± VSD ± arch obstruction

- ✓ 44 early deaths (3.2%)
- ✓ 13 late deaths (0.9%) (all within 1 year)

- ✓ since 2010 : 371 neonates
  - 4 early deaths (1.1%)
  - 1 late death (0.3%)

The Basic arterial switch:
« Surgery for monkeys! »

Basic Transposition

- Type A coronary artery pattern
- No Aorto pulmonary discrepancy
- No commissural malalignement
- Antero post roots
- No VSD
- No aortic arch obstruction

Preop screening and perop analysis

Anything different from the basic form

Expected surgical difficulties:

- « Abnormal » coronaries
- Hypoplastic aortic arch/coarctation
- VSD
- Difficult LV to PA routing
- Side by side vessels
- Aorto-pulmonary discrepancy
- Commissural mal-alignement

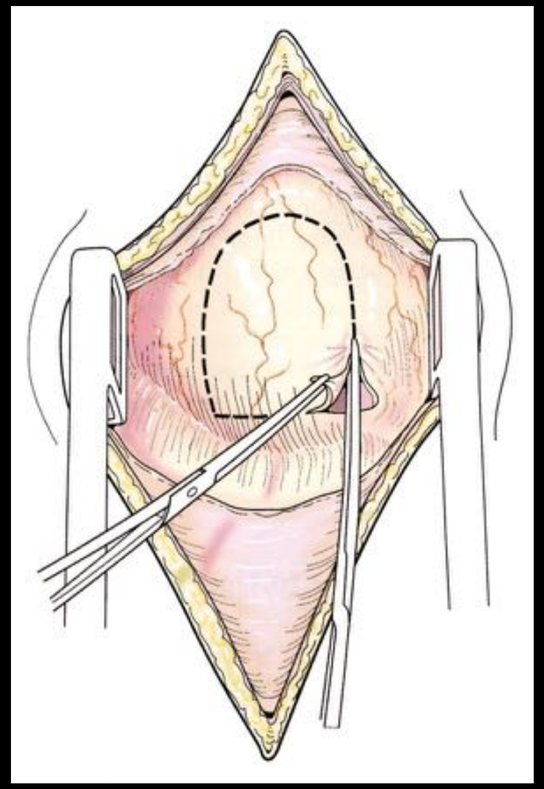
Acurate Diagnostic = Anticipation / Adaptation = SAFETY for the surgical team

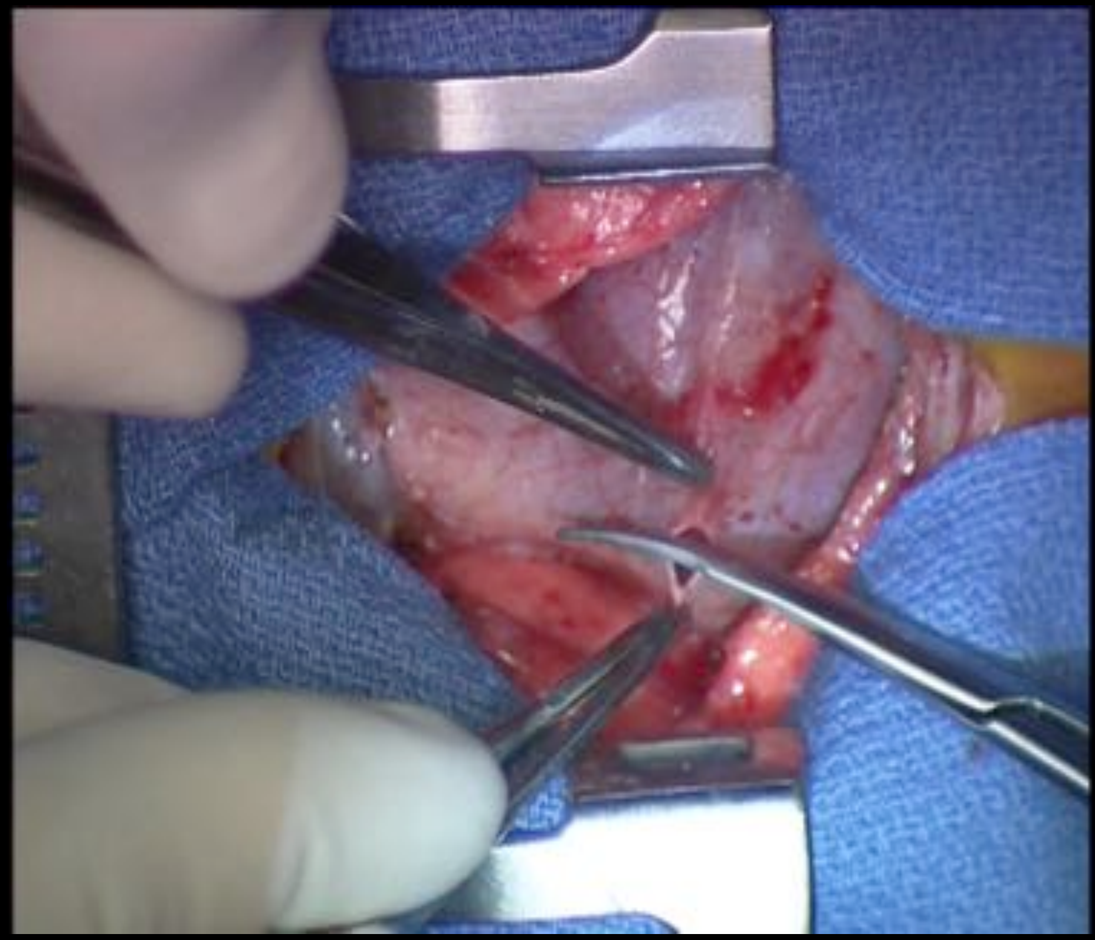
Example: coronary artery pattern type C

- **Parents informations**
- **Surgical team: « Senior senior » surgeon in the room and choice of first assistant/nurse**
- **Adequate operating list (longer operation)**
- **Type of cardioplegia and cooling => Less stress**
- **Type of instruments => Increased safety**
- **Delayed sternal closure/ ICU**

Arterial Switch Operation

pericardial harvesting

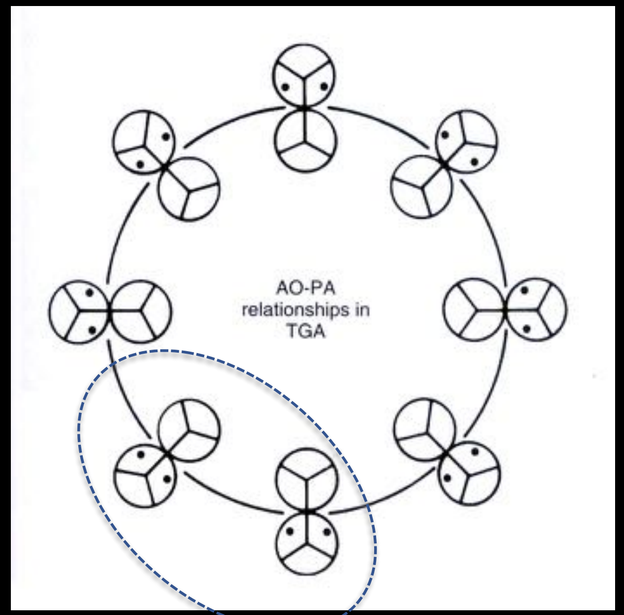


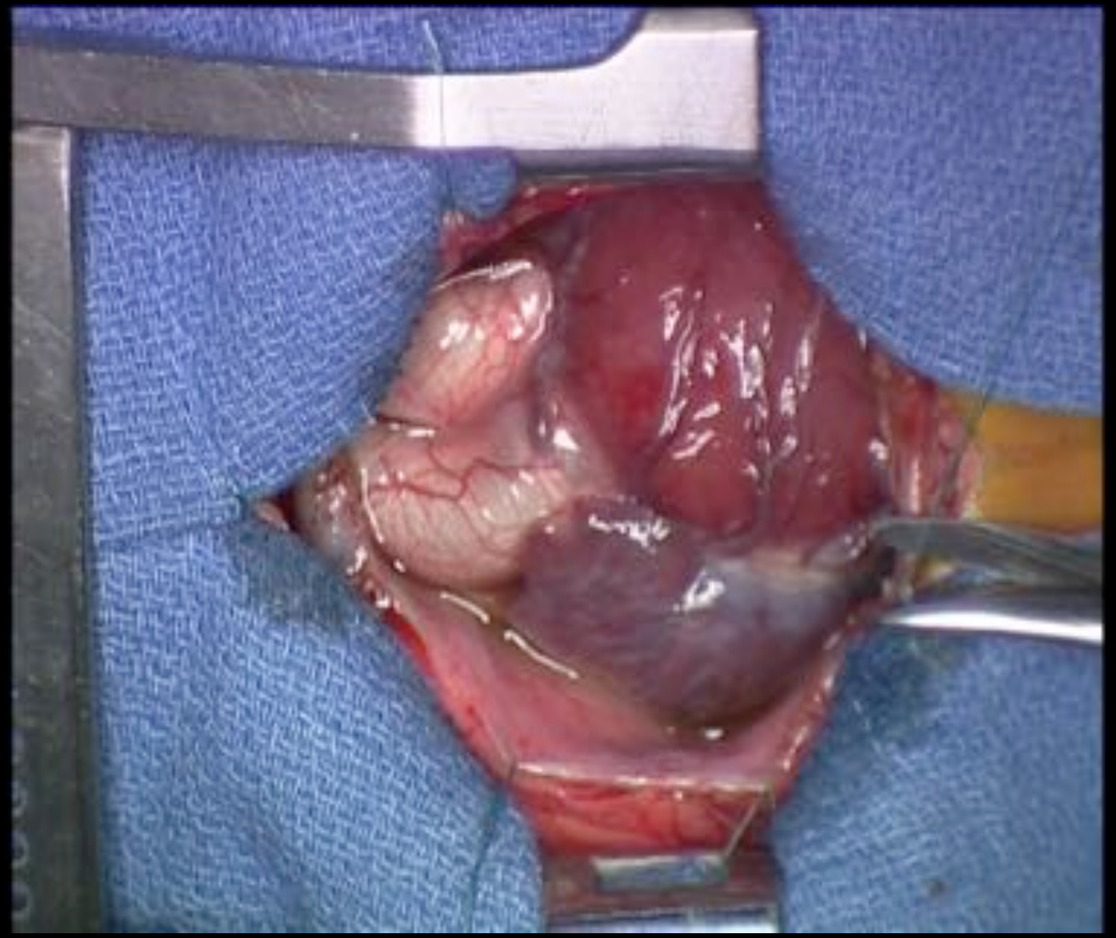


Arterial Switch Operation

Evaluation

Position of the great vessels
Coronary patterns
Ventricular function

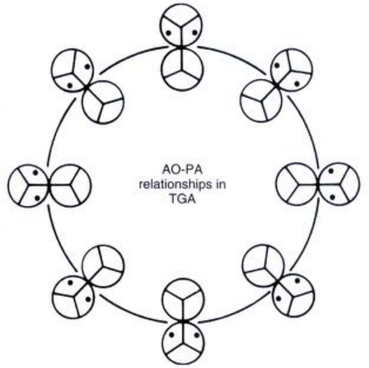




Aorto-pulmonary vessels relationship

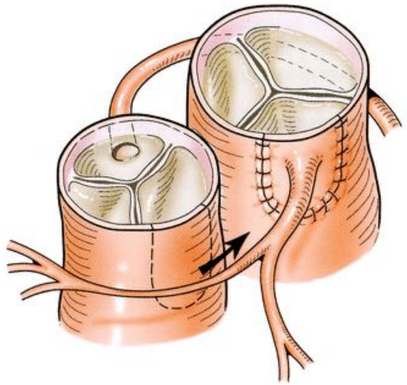
Side by side: Lecompte manoeuver? (stretching of the PA)

Lateral PA anastomosis? (coronary compression)



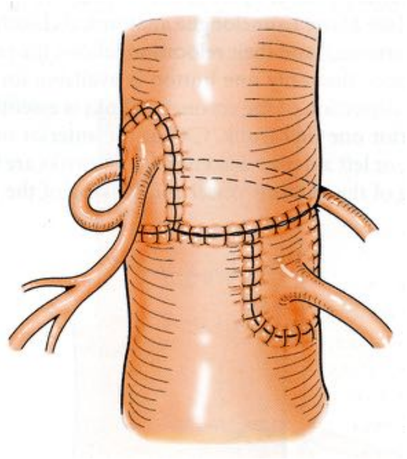
Aorto-pulmonary discrepancy

Coronary reimplantation: Button technique or simple incision (or trap door)

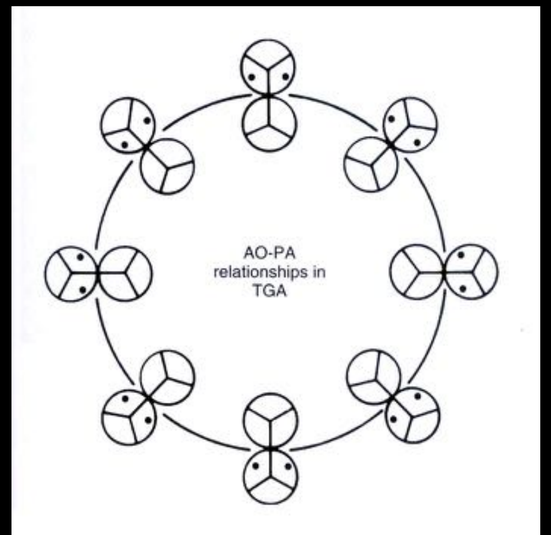


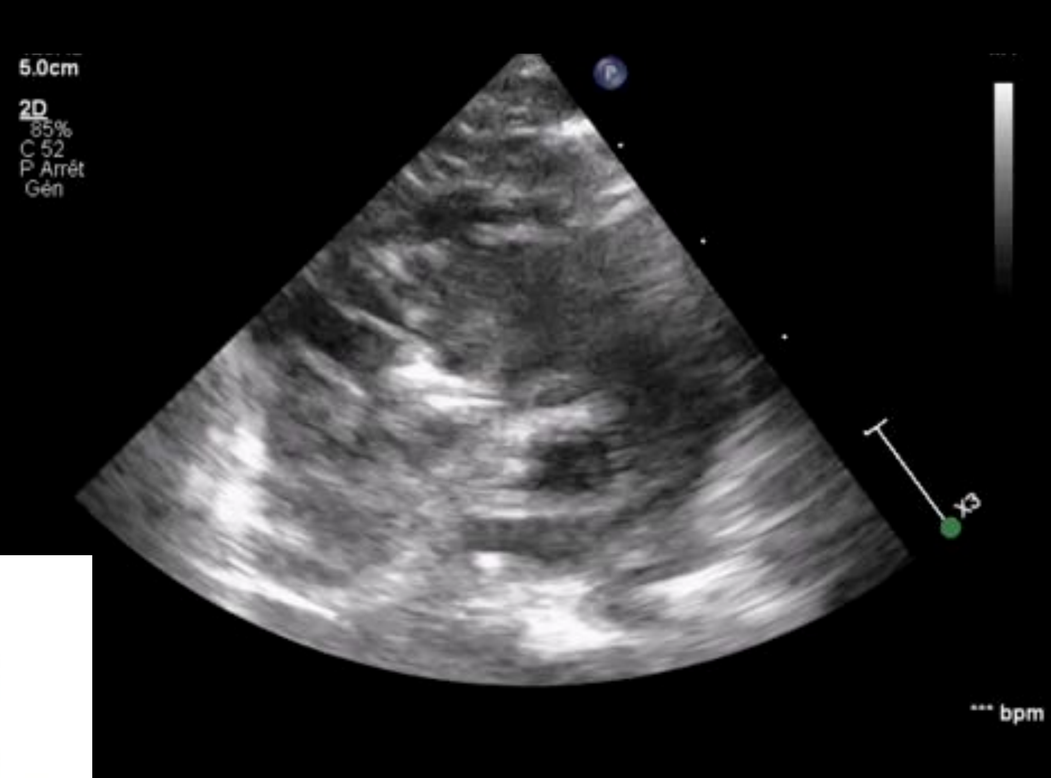
Malalignement of the facing commissure

Difficulties in coronary reimplantation

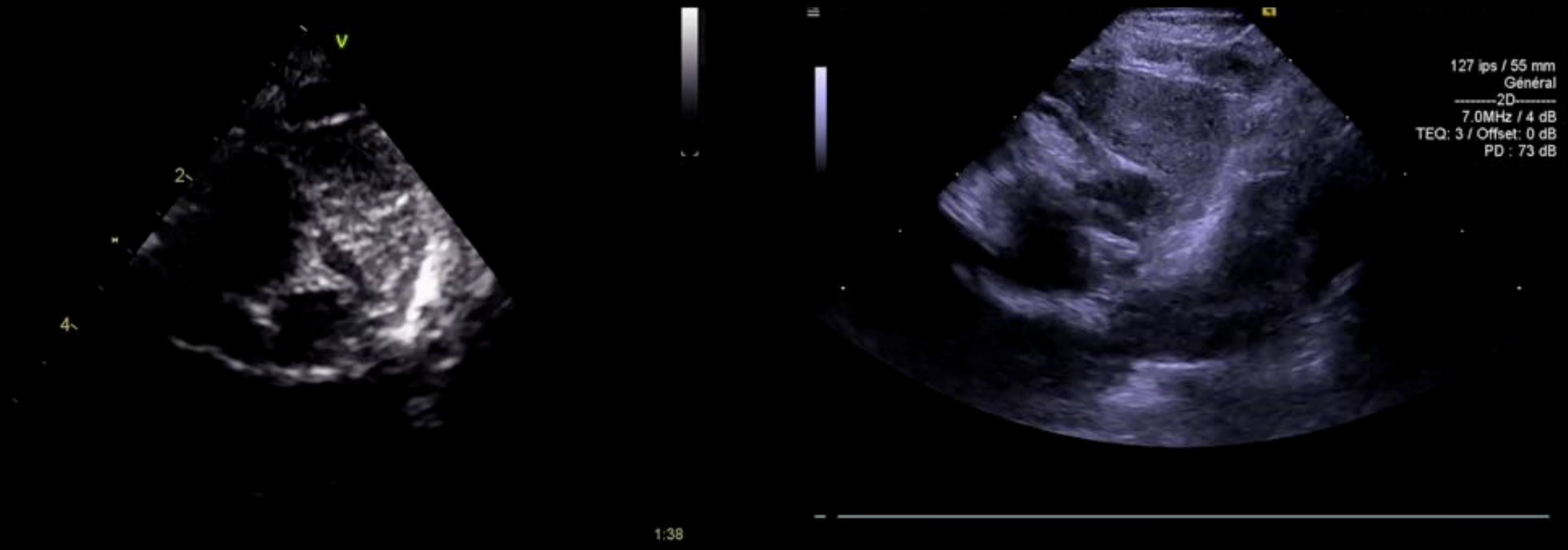


Aorto pulmonary vessels relationship and discrepancy

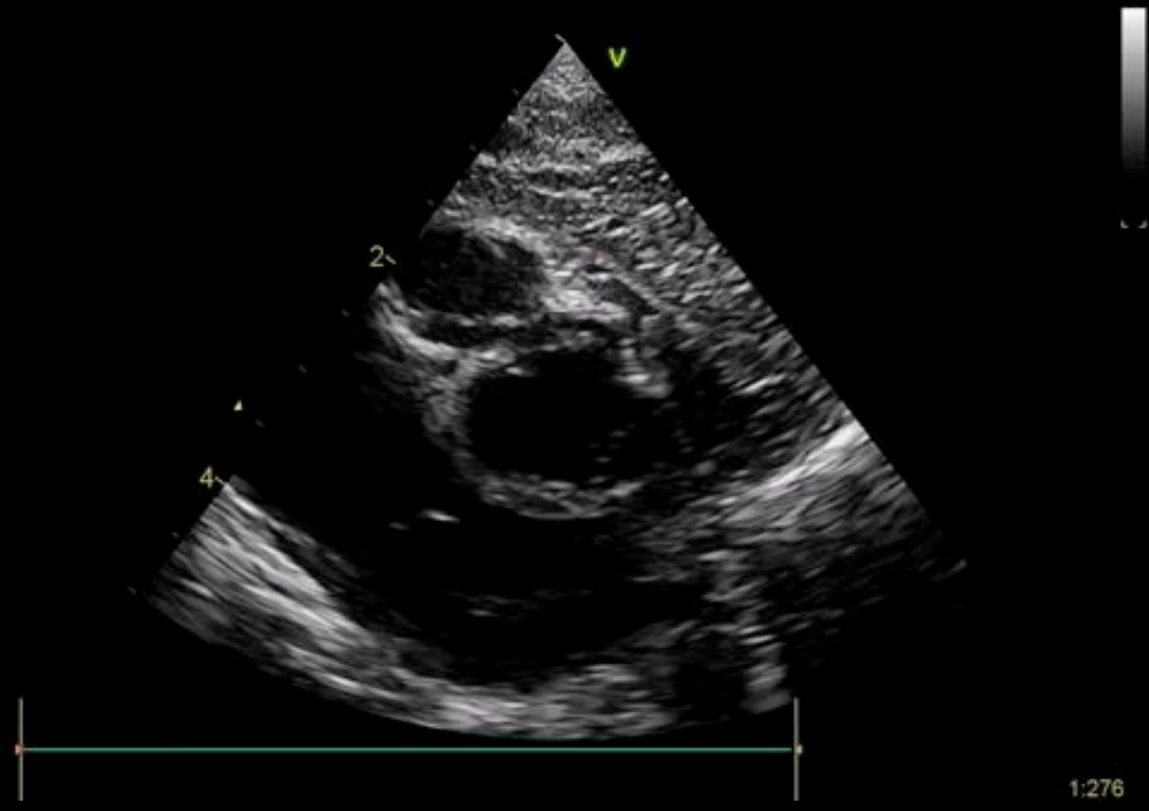




Aorto pulmonary vessels relationship and discrepancy

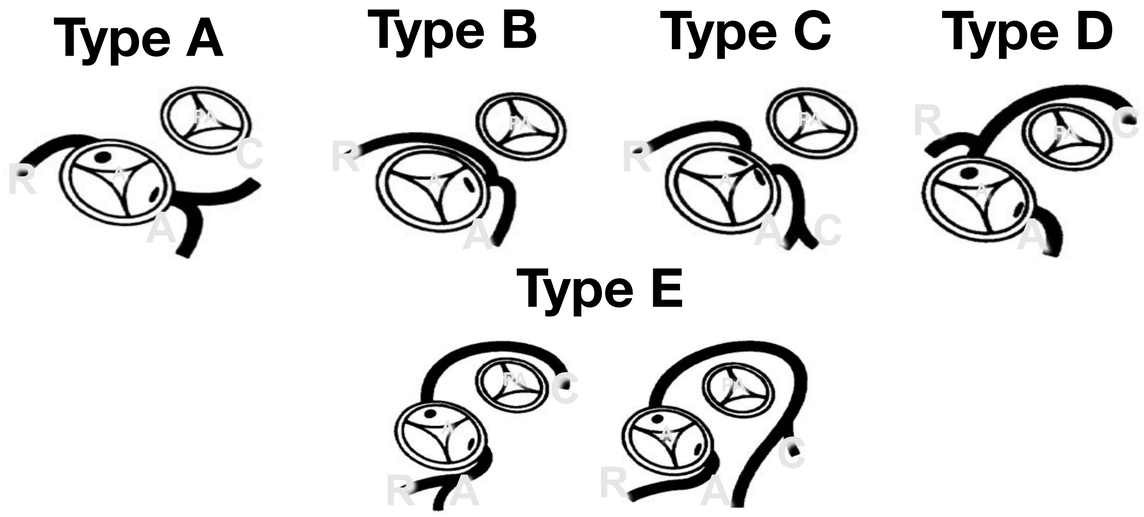


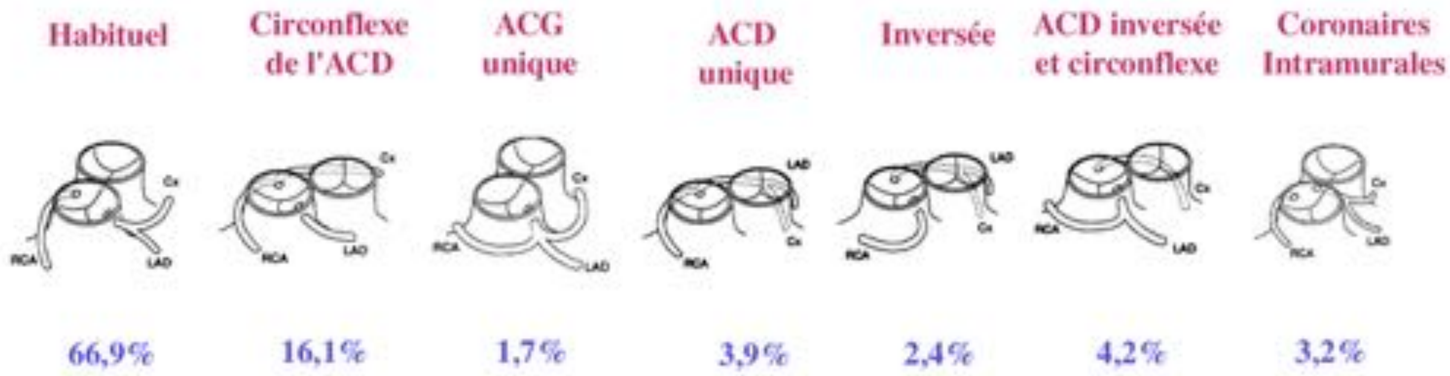
Aorto pulmonary discrepancy



Impact for the type of repair

Coronary patterns





Arterial Switch Operation

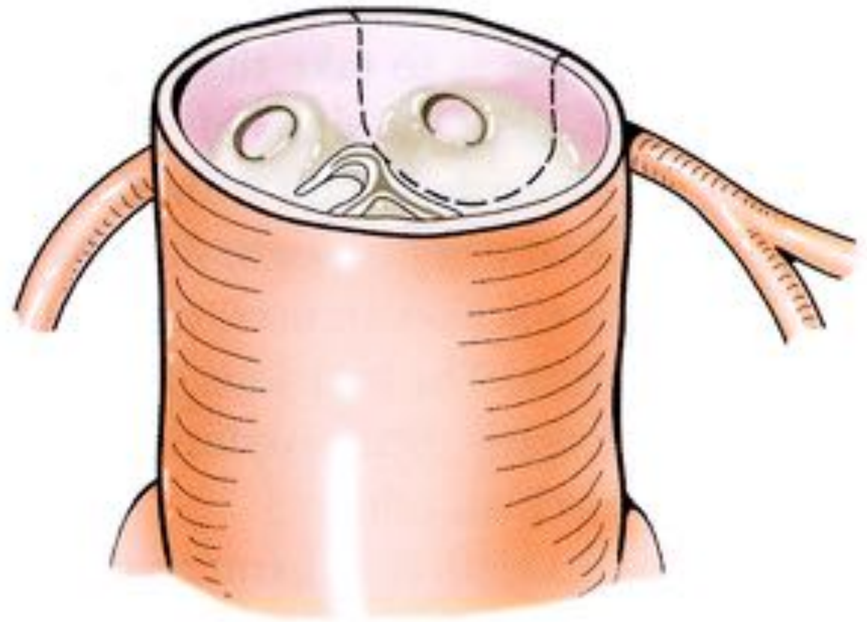
transfer of coronary arteries

variability in coronary anatomy

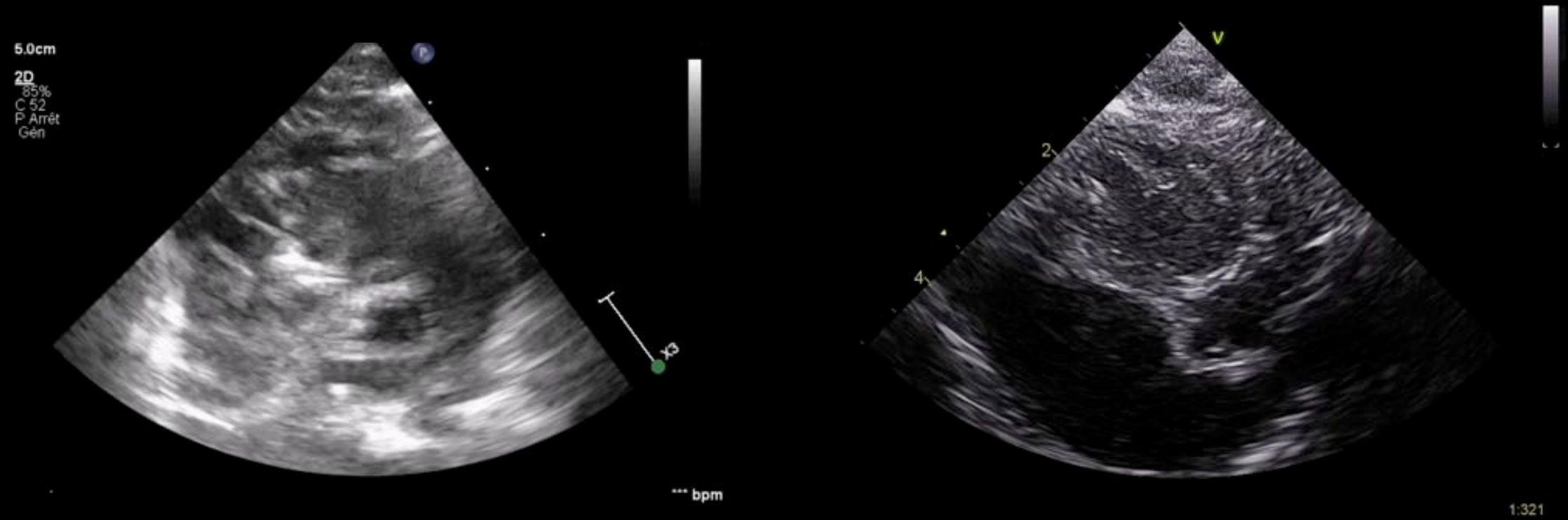
usual anatomy	: 60 %
anterior and/or posterior loops	: 35 %
between great arteries (often intramural)	: 5 %

Arterial Switch Operation

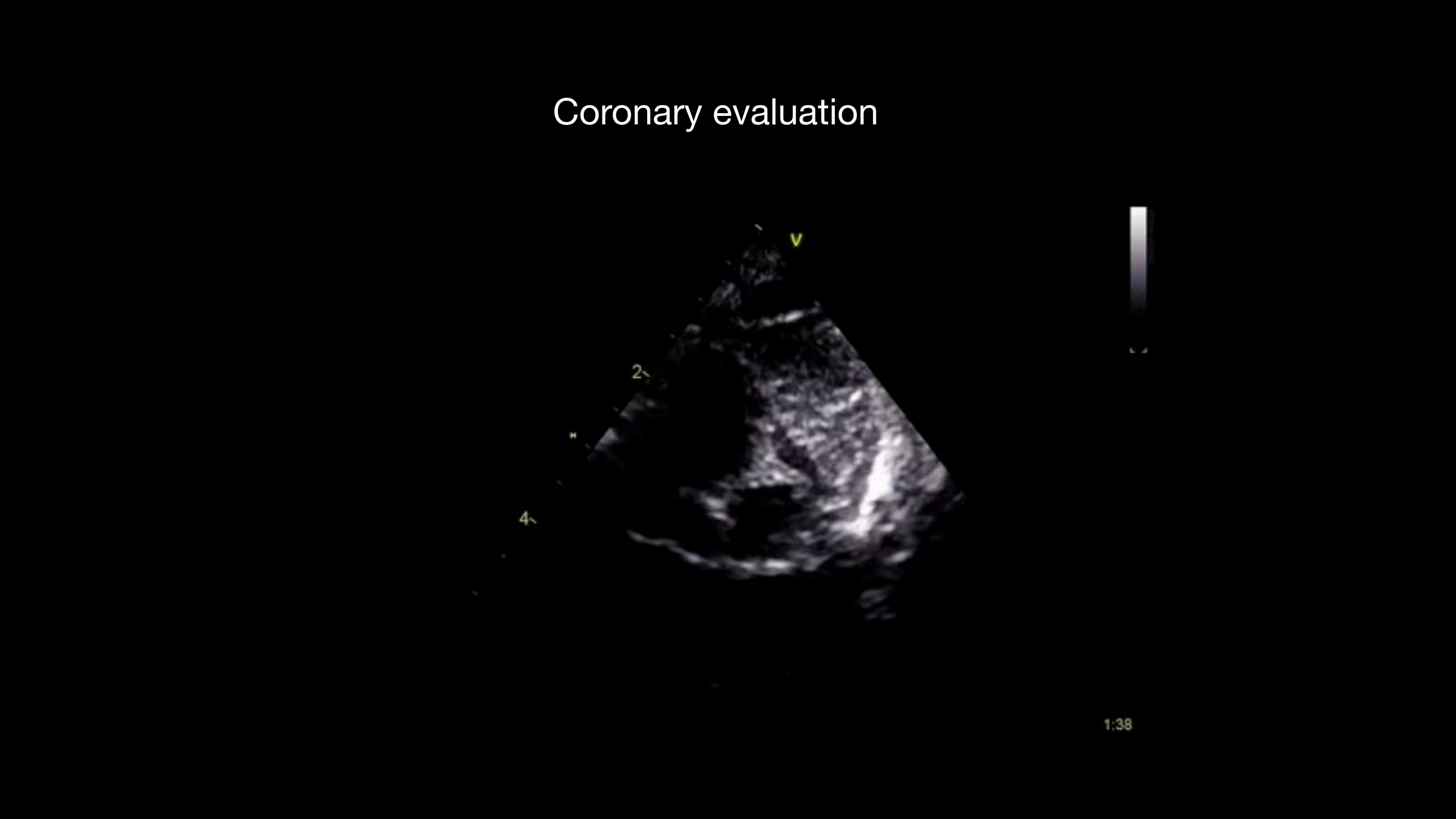
Detachment of coronary arteries
3 questions:
-Number of ostia
-Loops?
-Intra-mural course?



Coronary evaluation

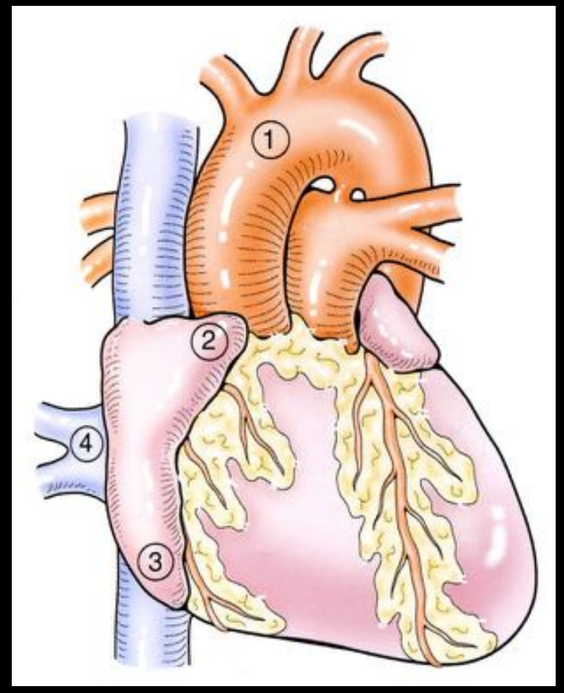


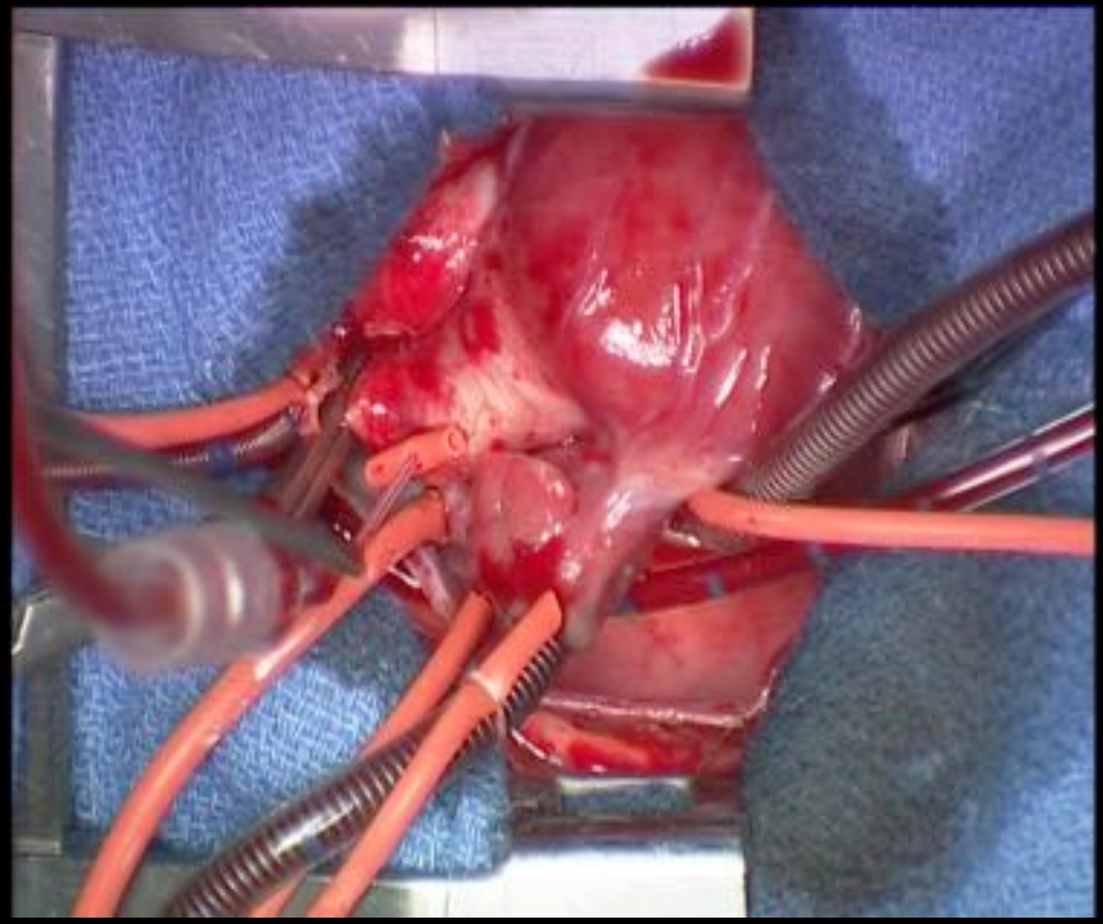
Coronary evaluation



Arterial Switch Operation

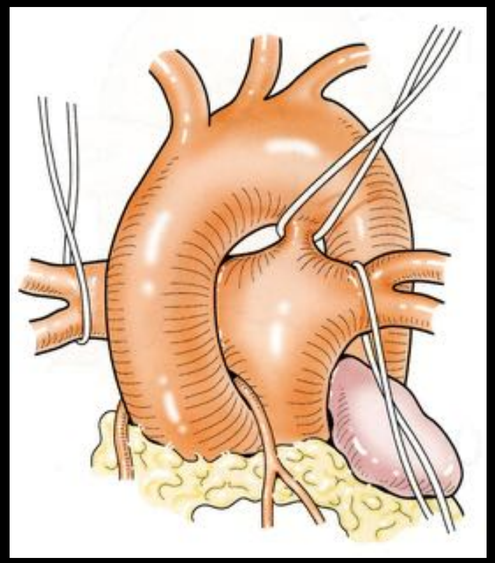
Canulation and bypass

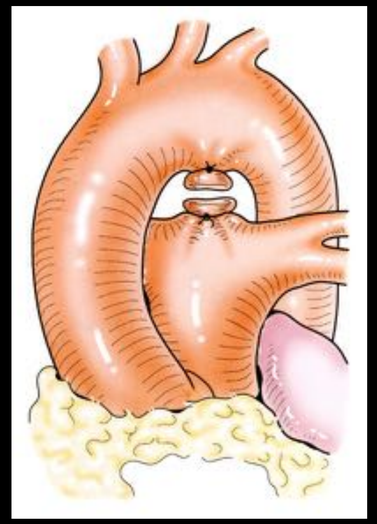


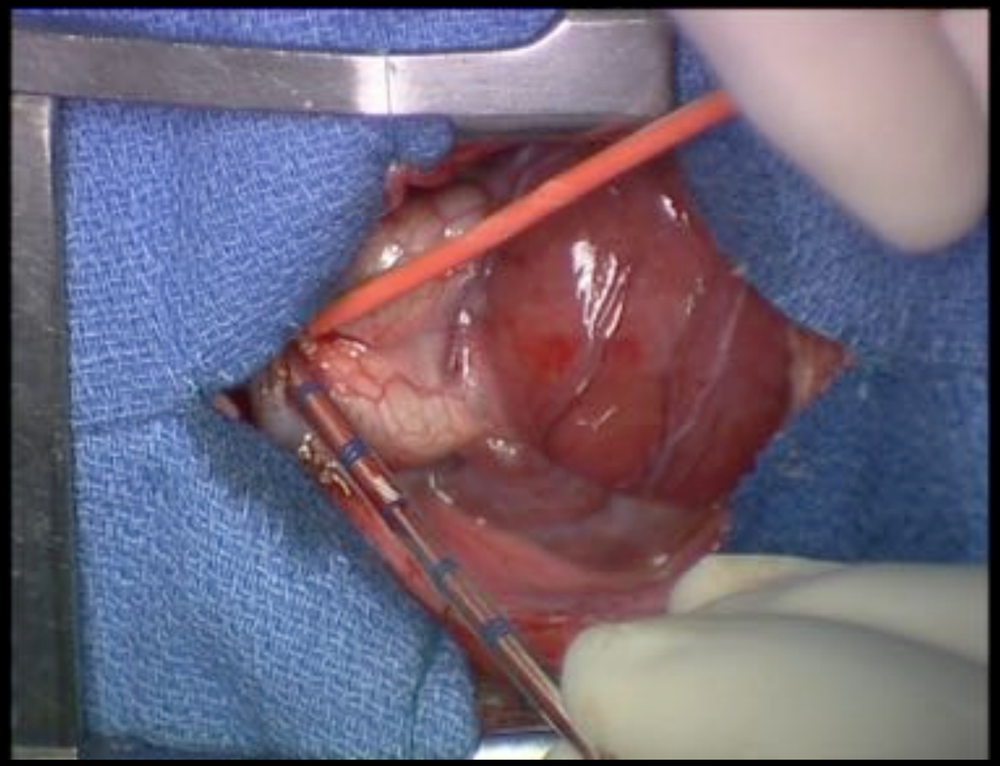


Arterial Switch Operation

Division of the arterial duct



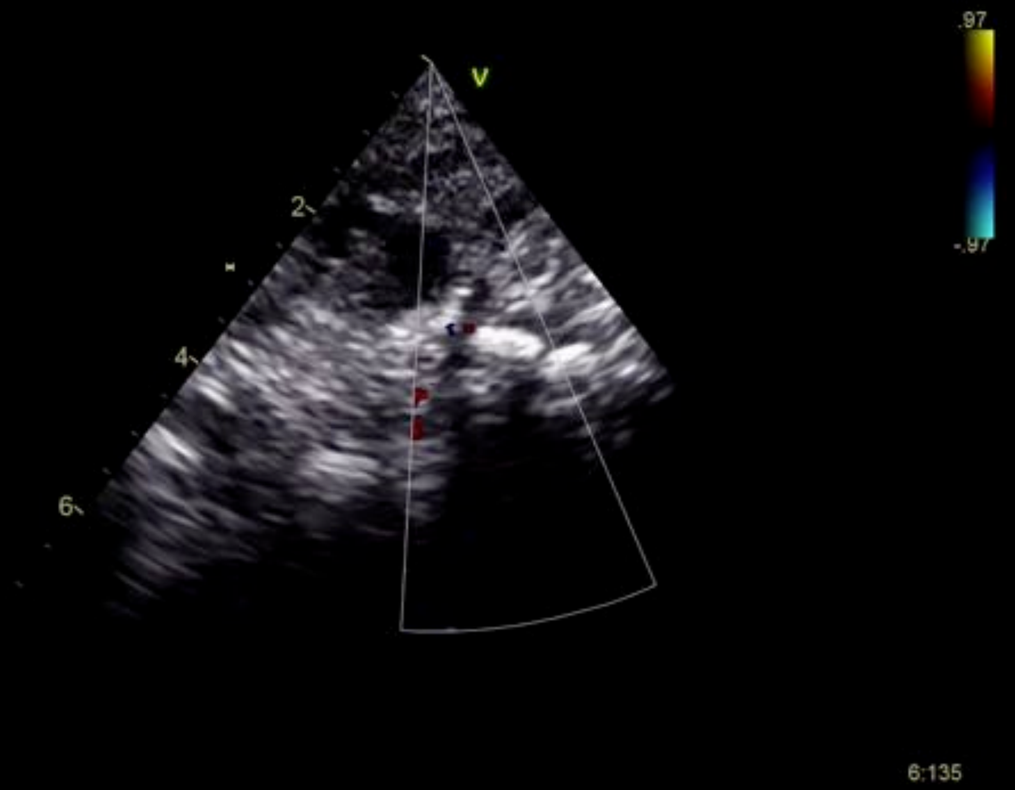


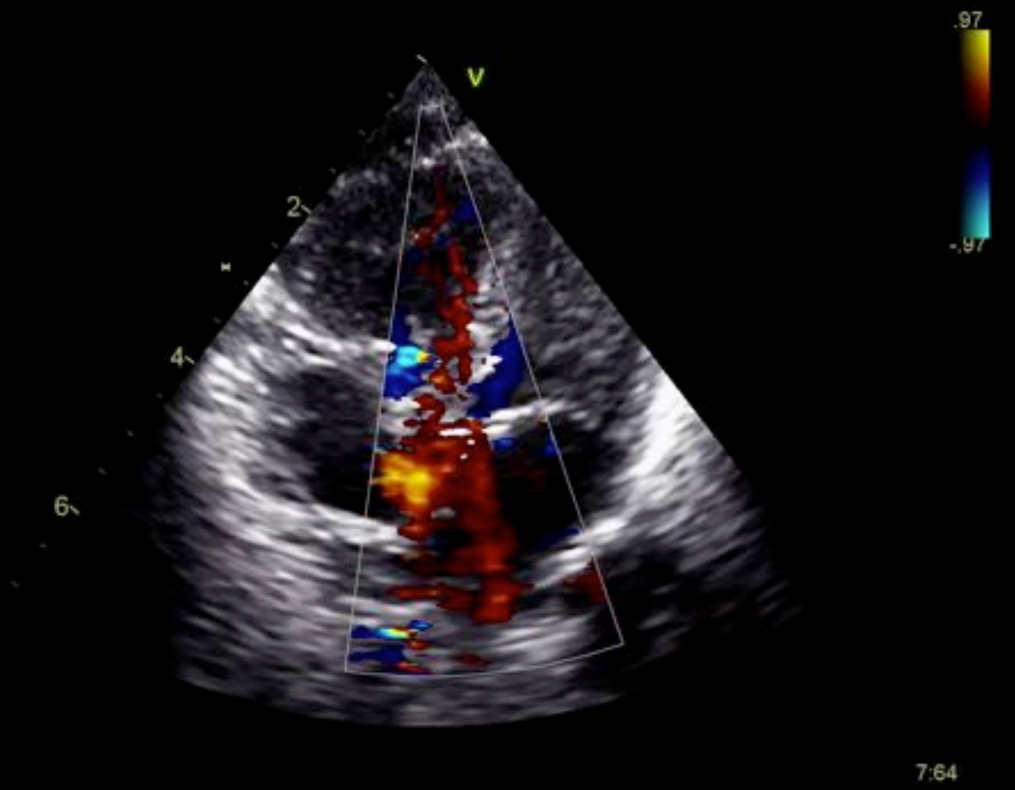


PDA and Collaterals

- Early division of the patent duct to avoid pulmonary blood overflow
- Specific Bypass strategy if presence of collaterals: size of LV vent, hypothermia, low systemic resistance

PDA and Collaterals



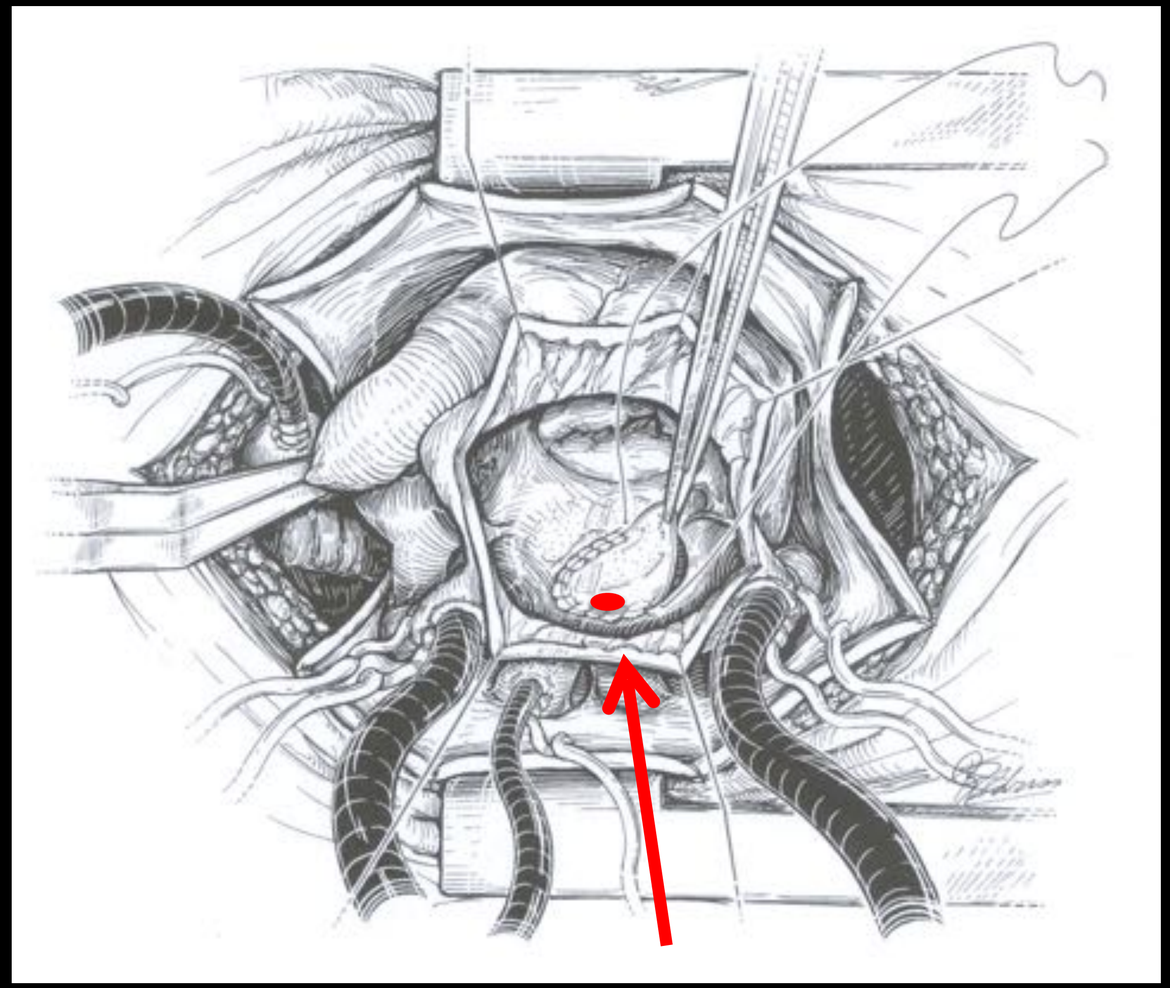


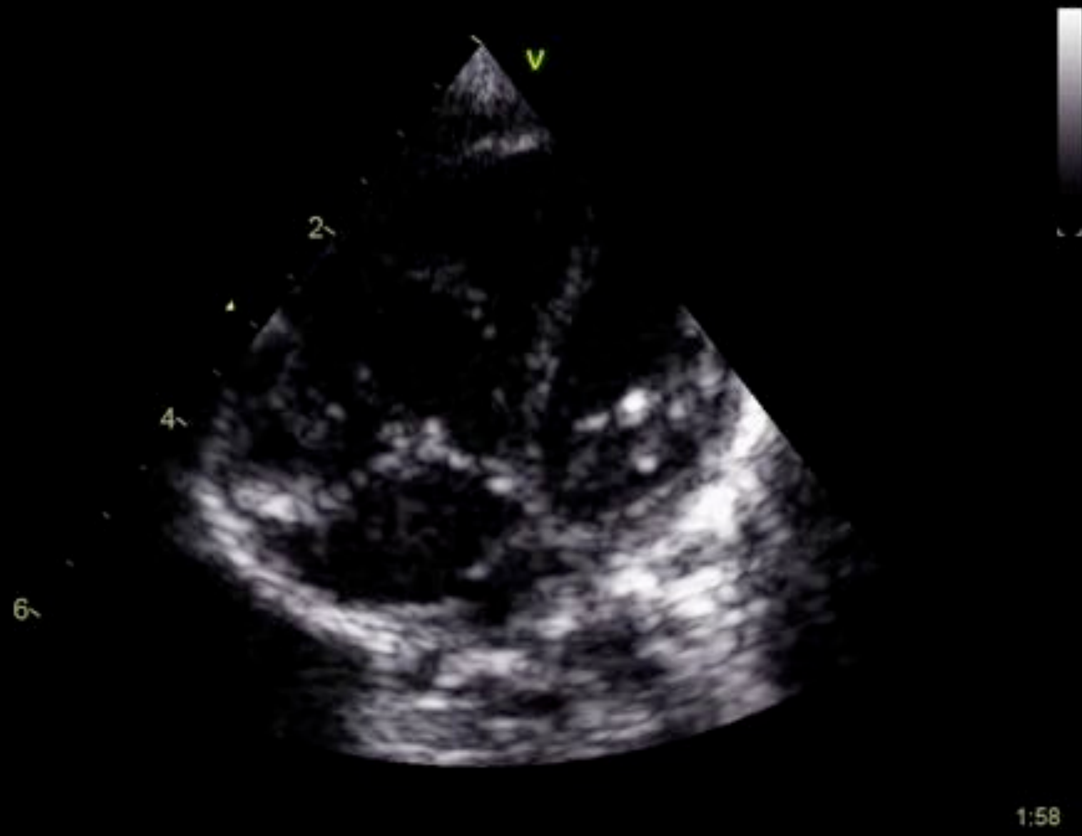
PDA and Collaterals

- Early division of the patent duct to avoid pulmonary blood overflow
- Specific Bypass strategy if presence of collaterals: size of LV vent, hypothermia, low systemic resistance,
- Delayed sternal closure
- Analysis of high LA pressure
- ASD

Arterial Switch Operation

Closure of ASD

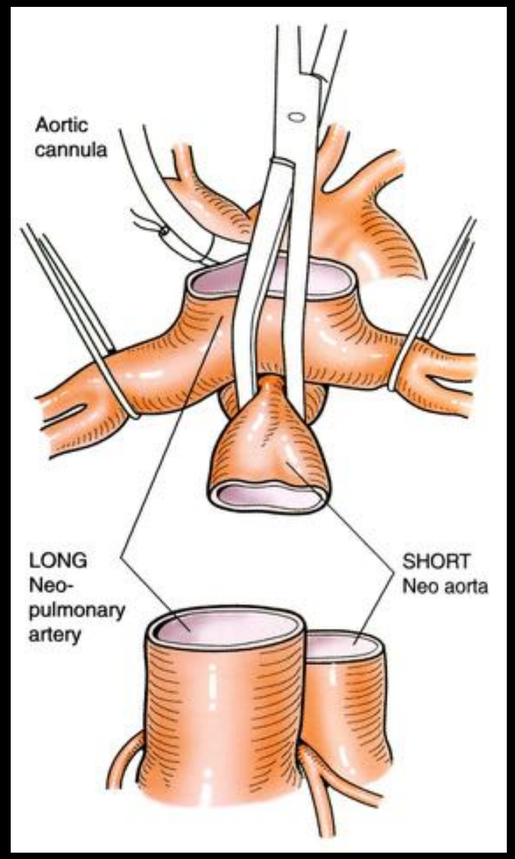


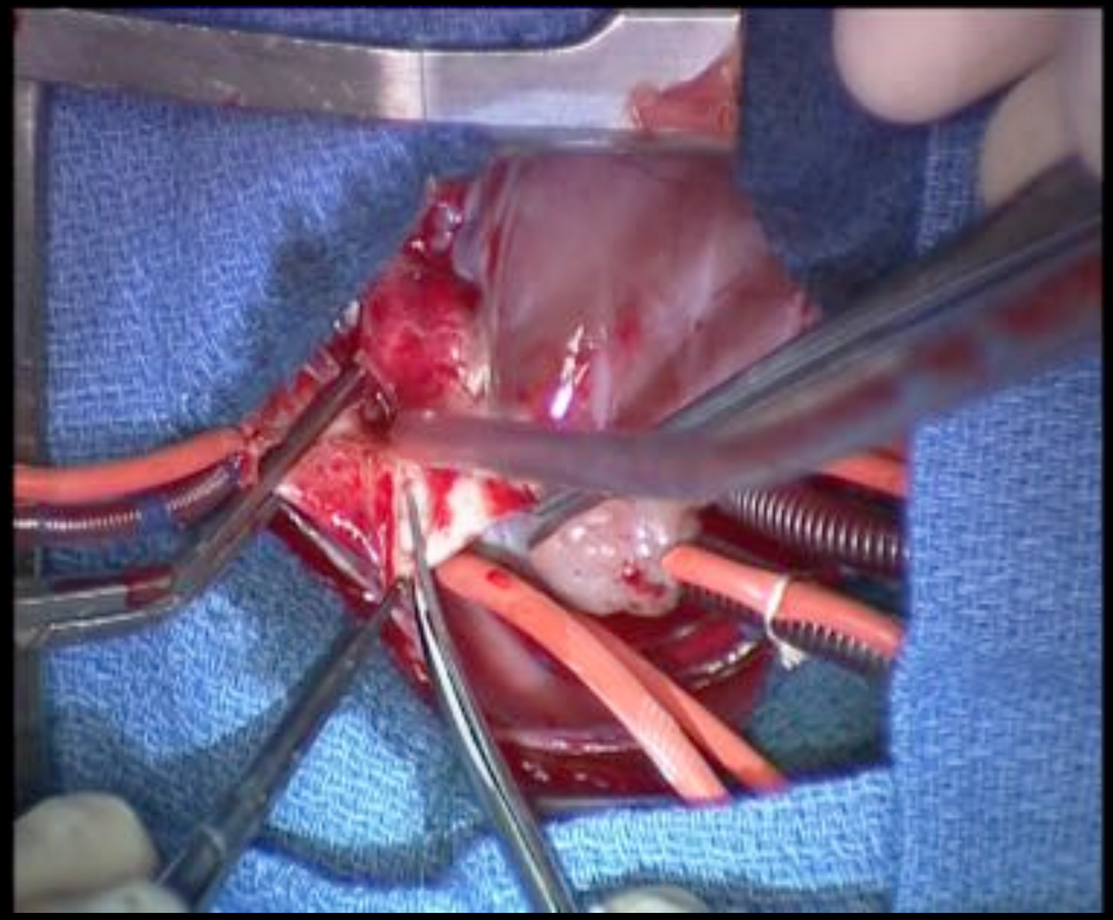


3 mm residual ASD:
Unbalanced ventricule

Arterial Switch Operation

Division of great arteries
Evaluation of the neo aortic valve



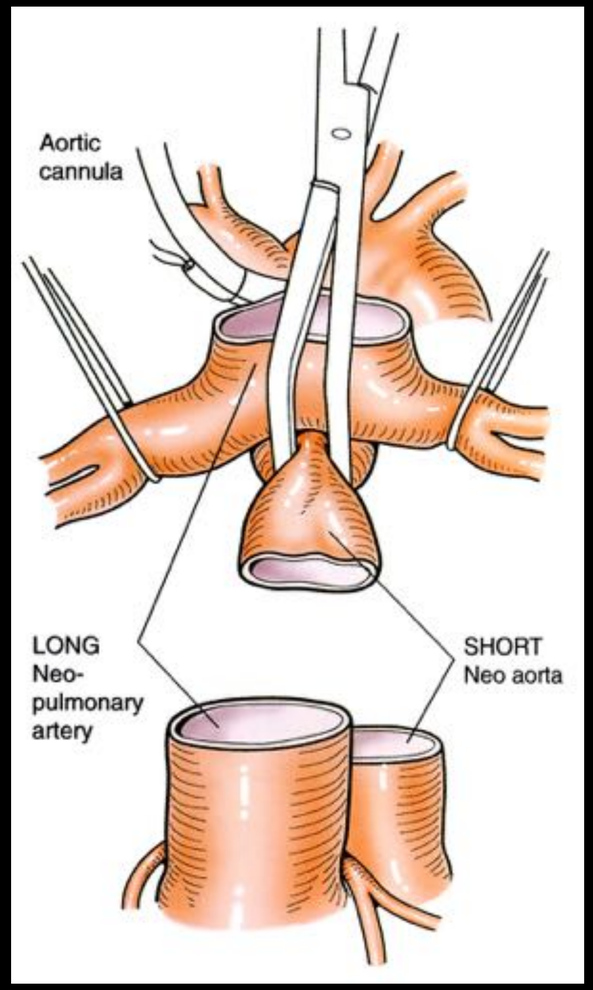


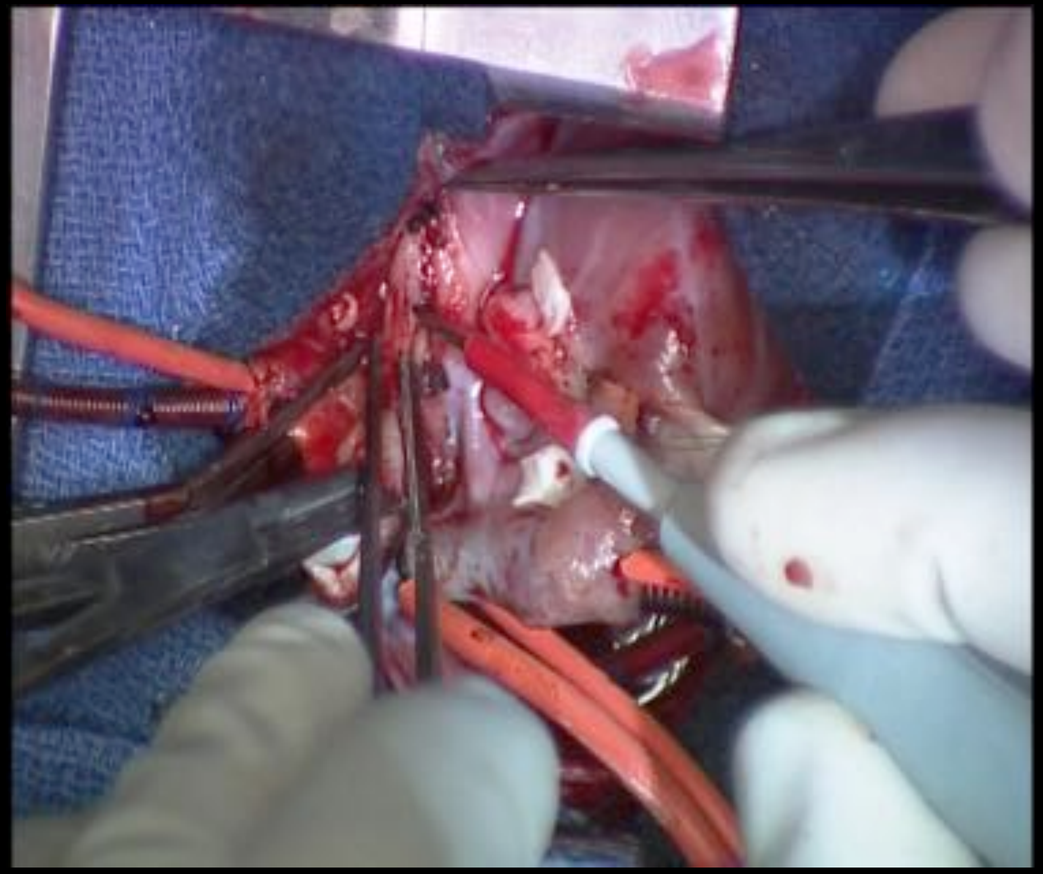
Arterial Switch Operation

Lecompte maneuver

. extensive mobilization of PAs

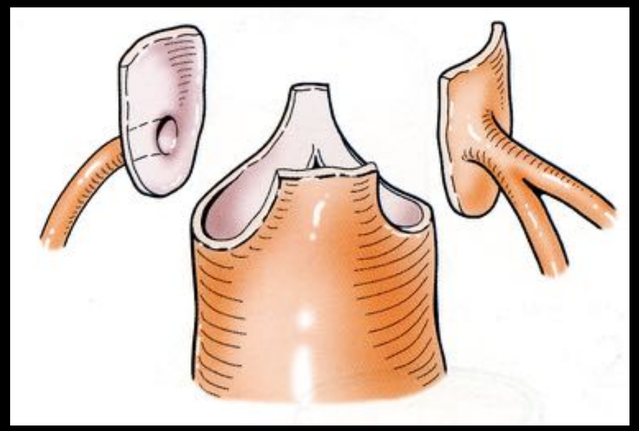
. useless if side-by-side GA

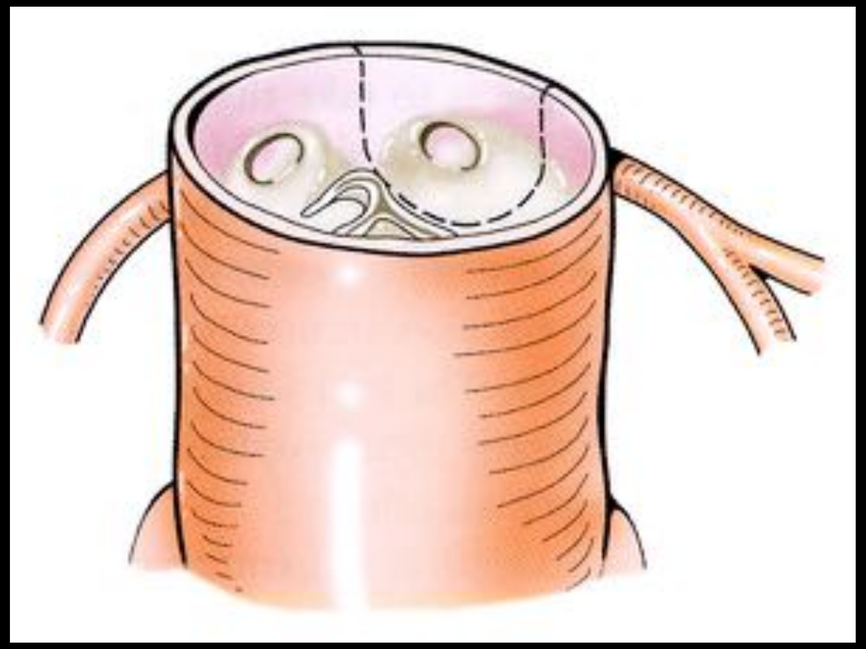


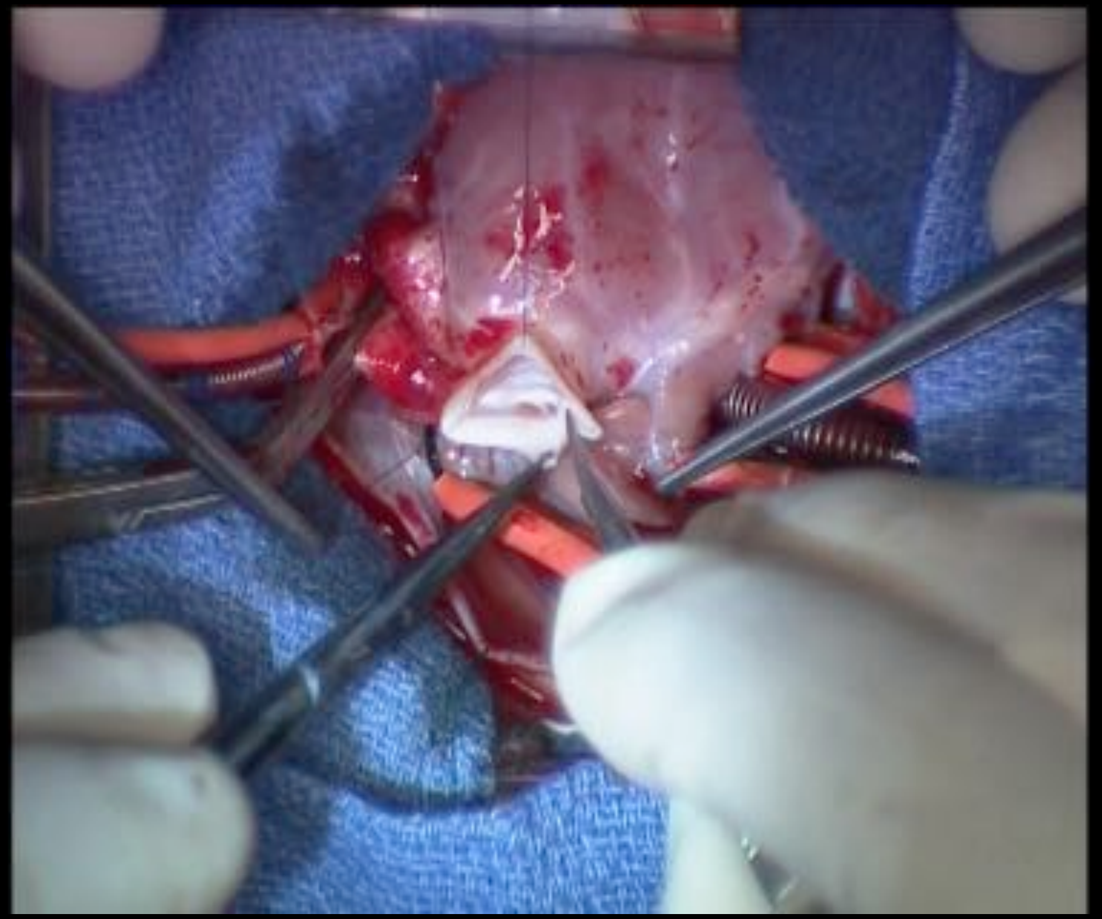


Arterial Switch Operation

Coronary detachment and mobilization

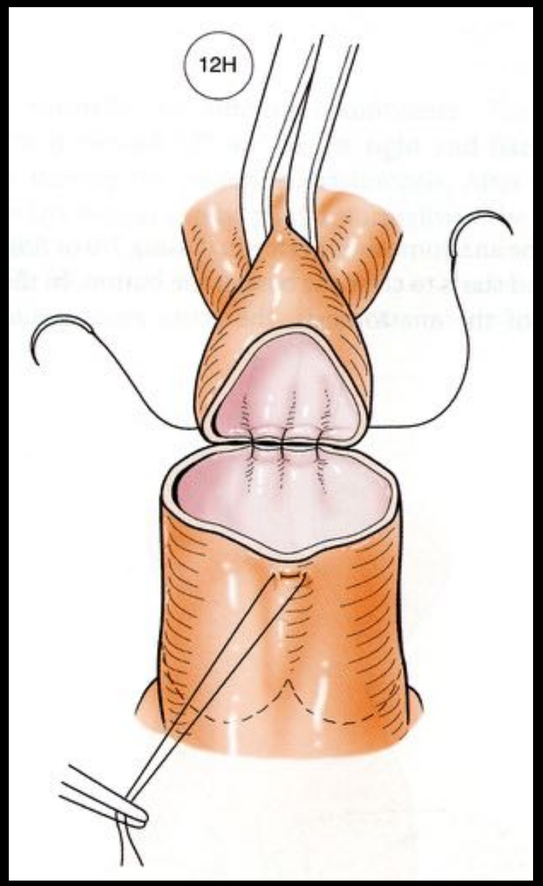


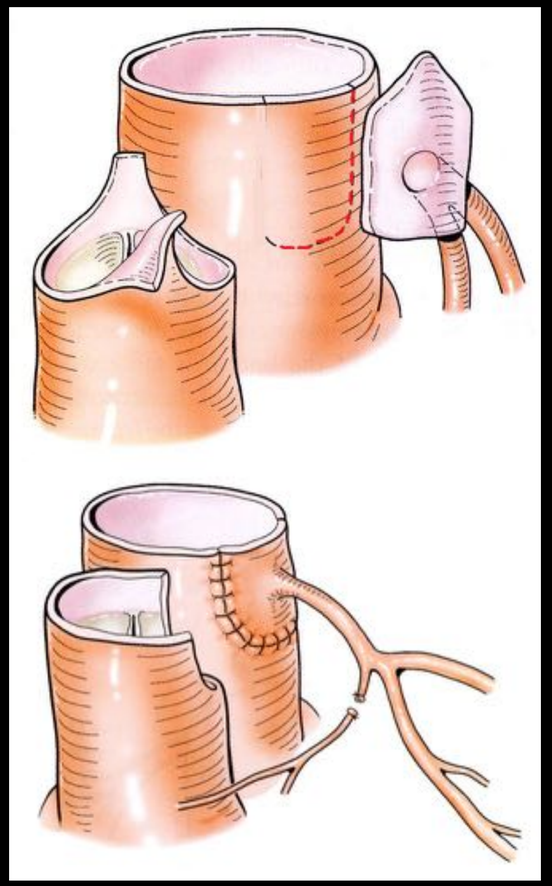




Arterial Switch Operation

transfer of coronary arteries



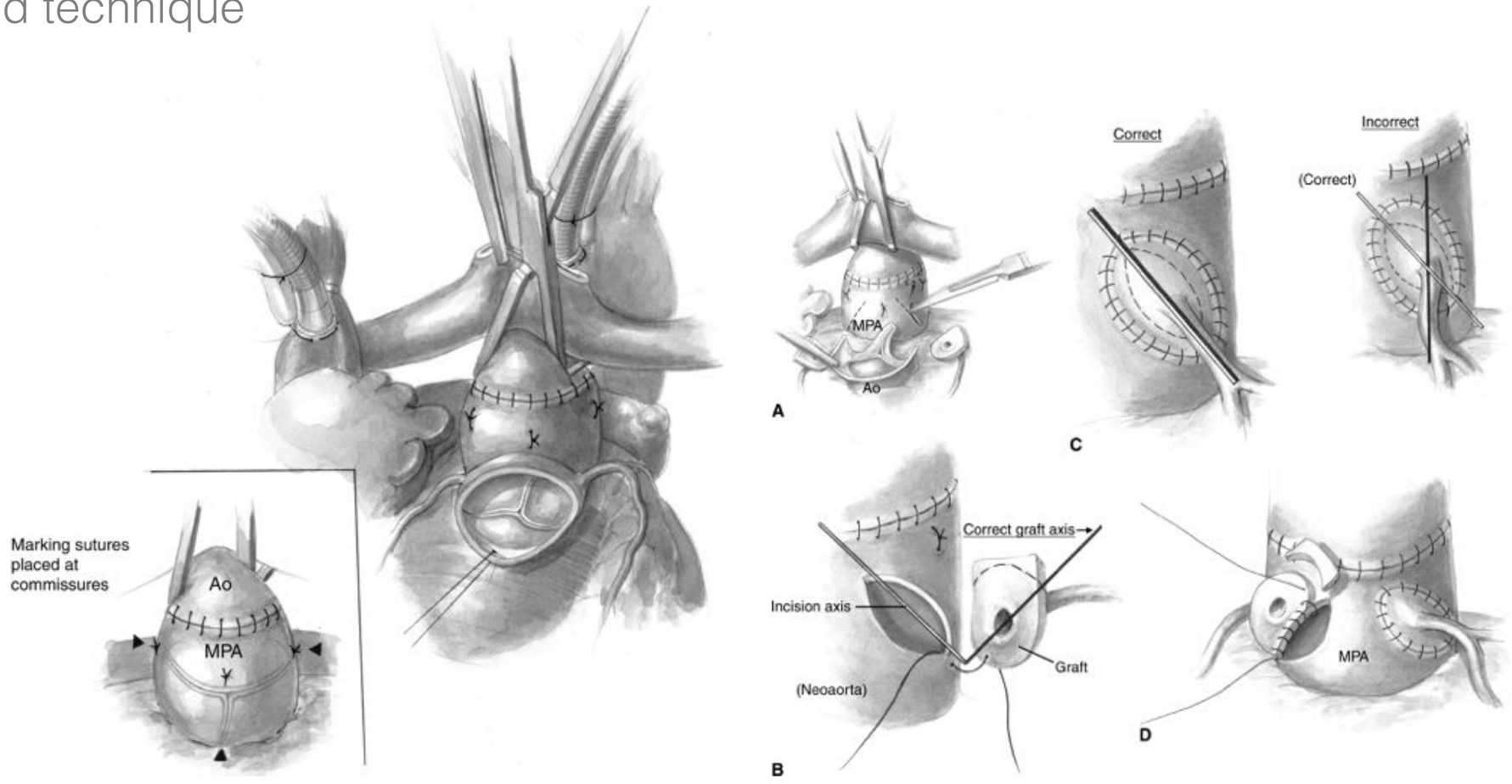


realignement of commissures

Arterial Switch Operation

transfer of coronary arteries : usual coronaries in TGA+VSD

closed technique

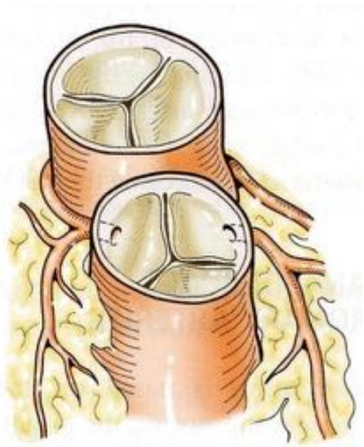


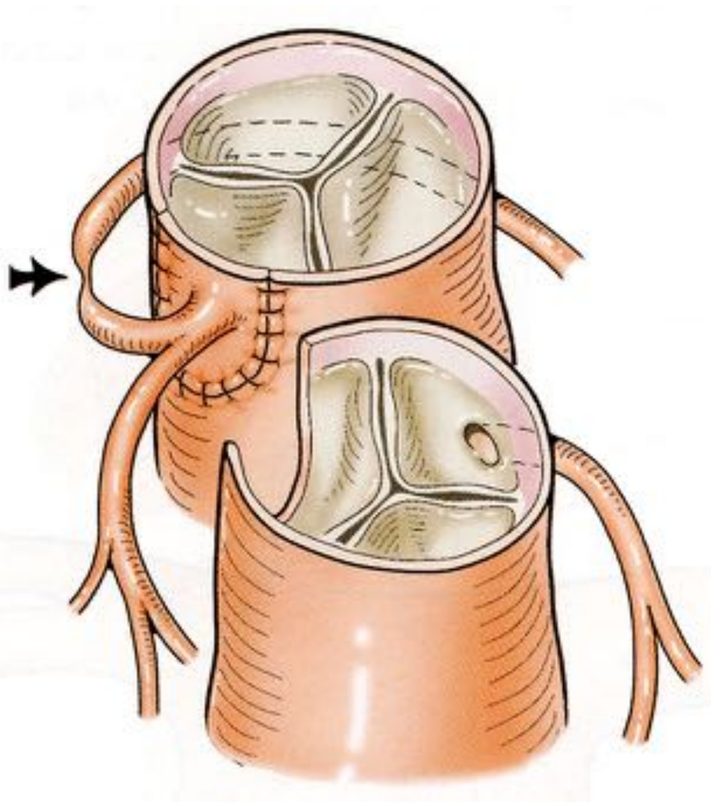
Arterial Switch Operation

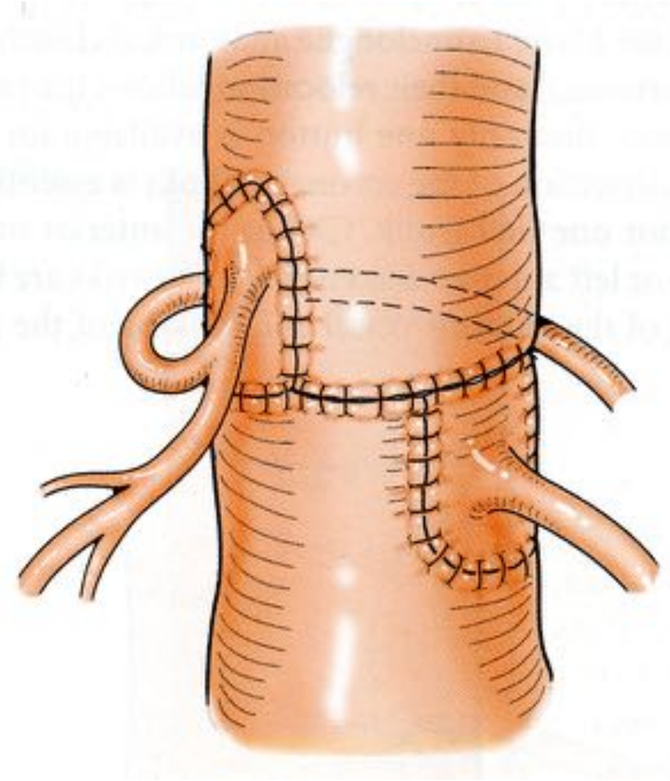
transfer of coronary arteries : Cx from RCA

right ostium : oblique high incision

left ostium : punch hole

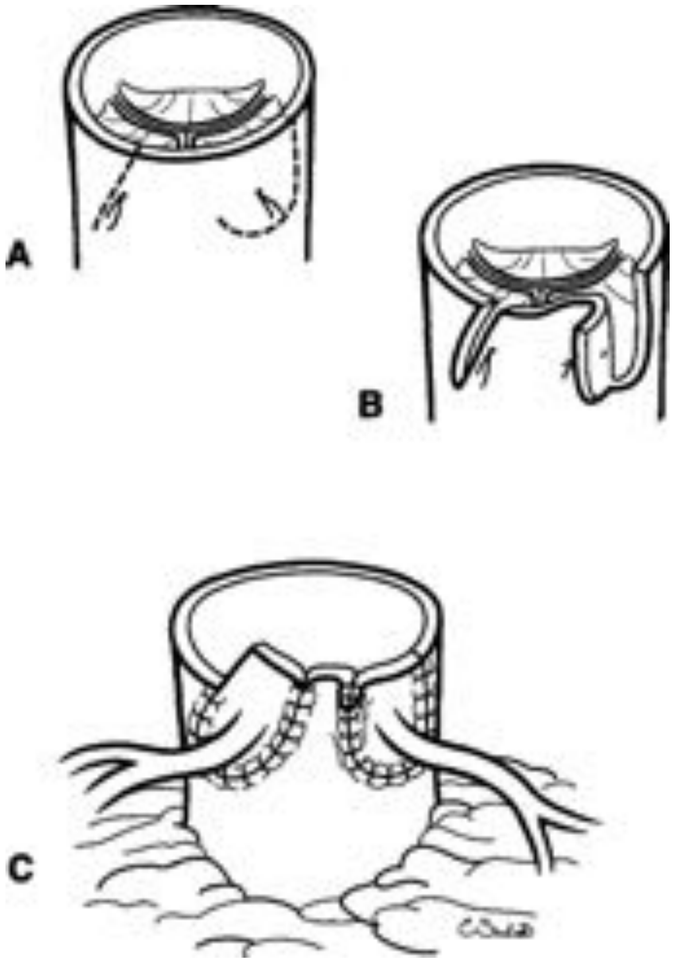






Arterial Switch Operation

transfer of coronary arteries : usual coronaries



left coronary : trap-door reimplantation

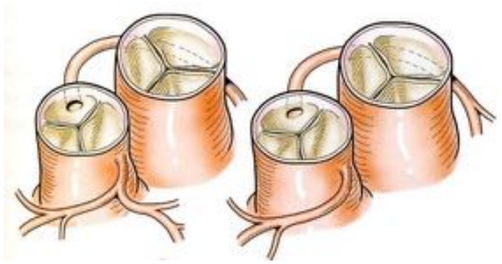
right coronary : oblique high incision

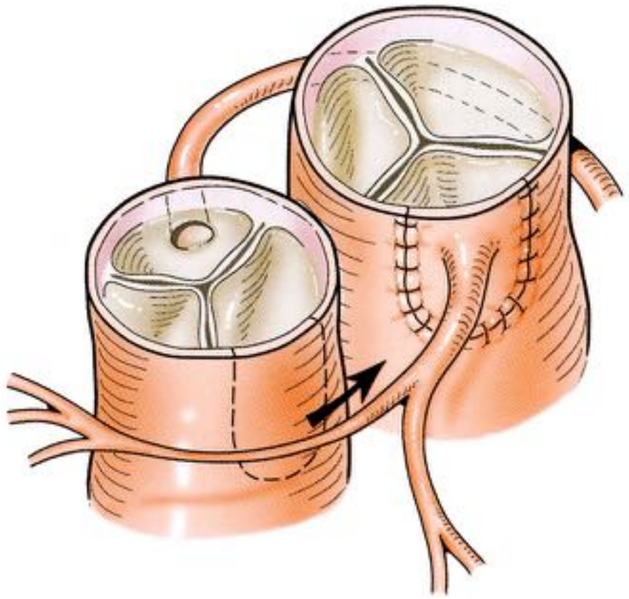
Arterial Switch Operation

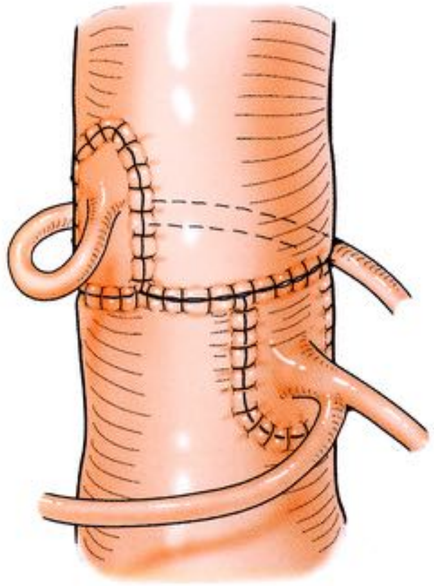
transfer of coronary arteries : double loop

right ostium : oblique high incision

left ostium : punch hole
. extensive mobilization
. shifting pulmonary bifurcation



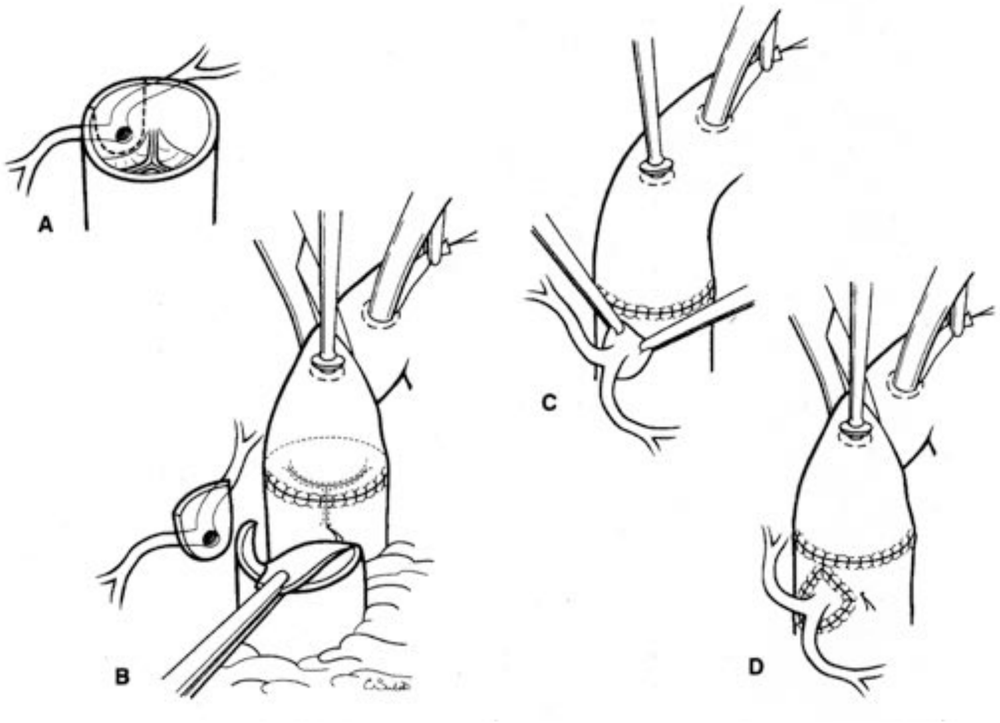


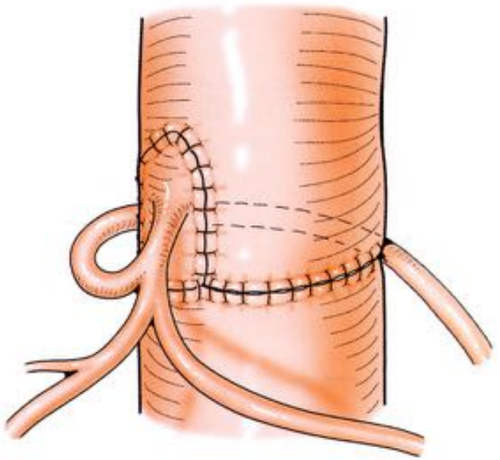


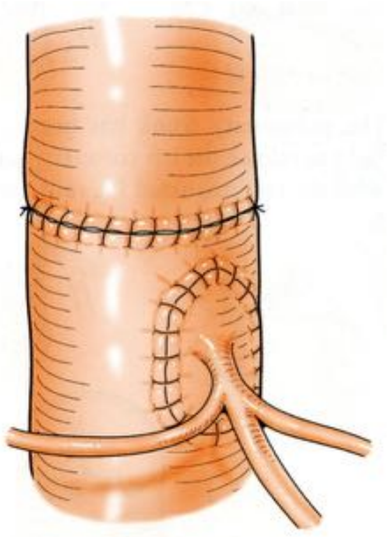
Arterial Switch Operation

transfer of coronary arteries : single coronary artery

closed technique

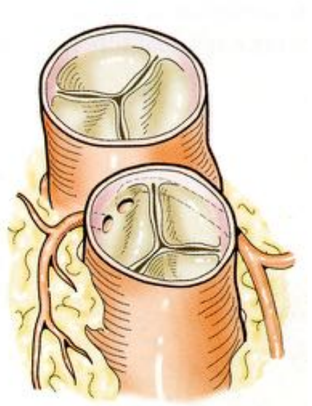


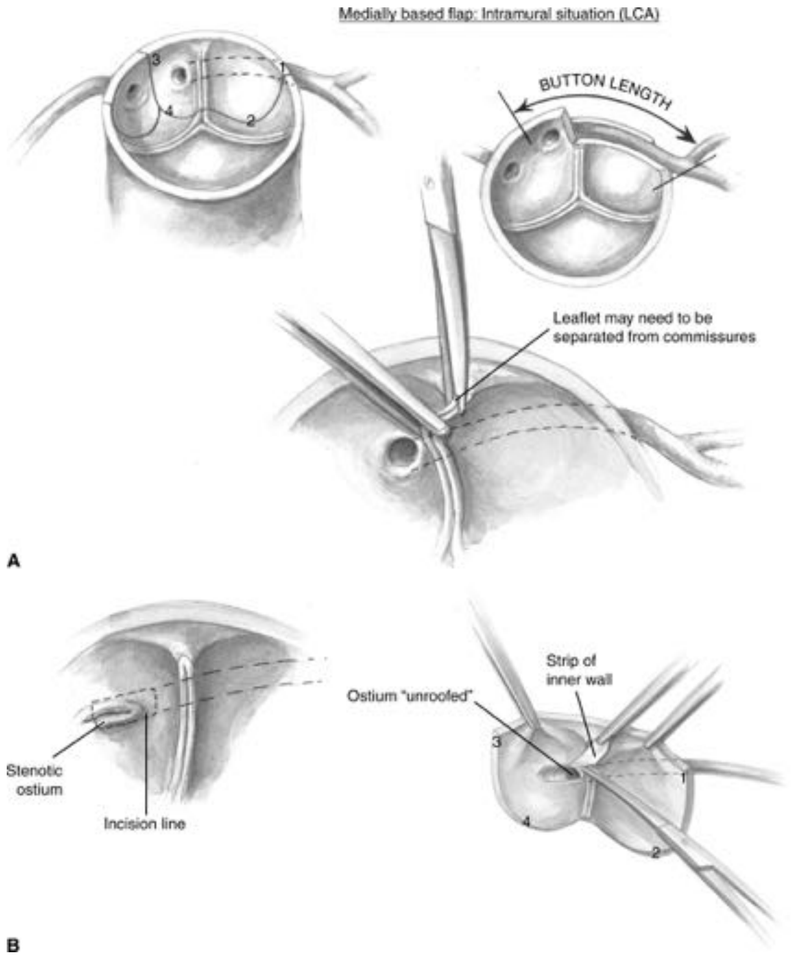


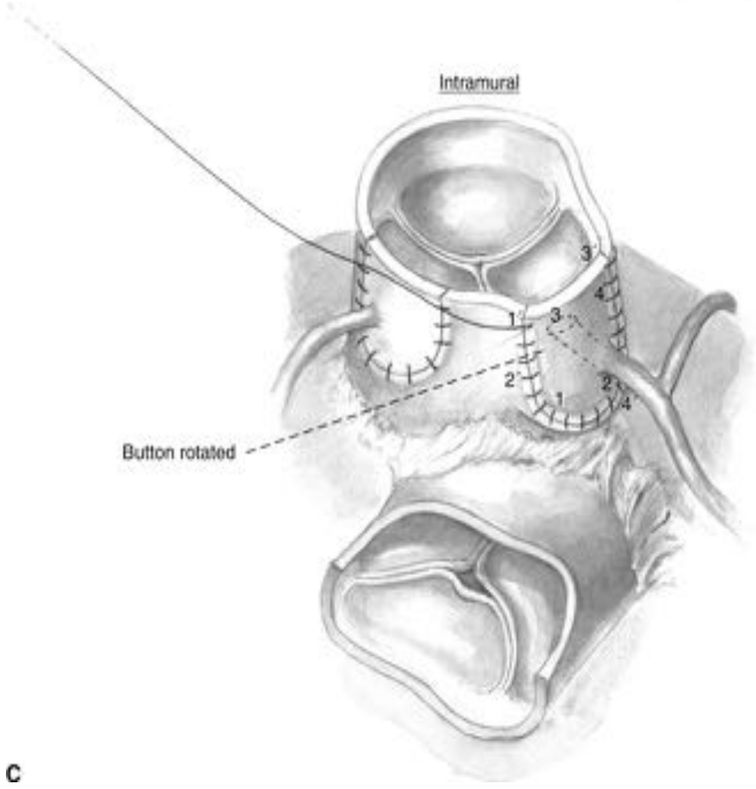


Arterial Switch Operation

transfer of coronary arteries : intramural coronary

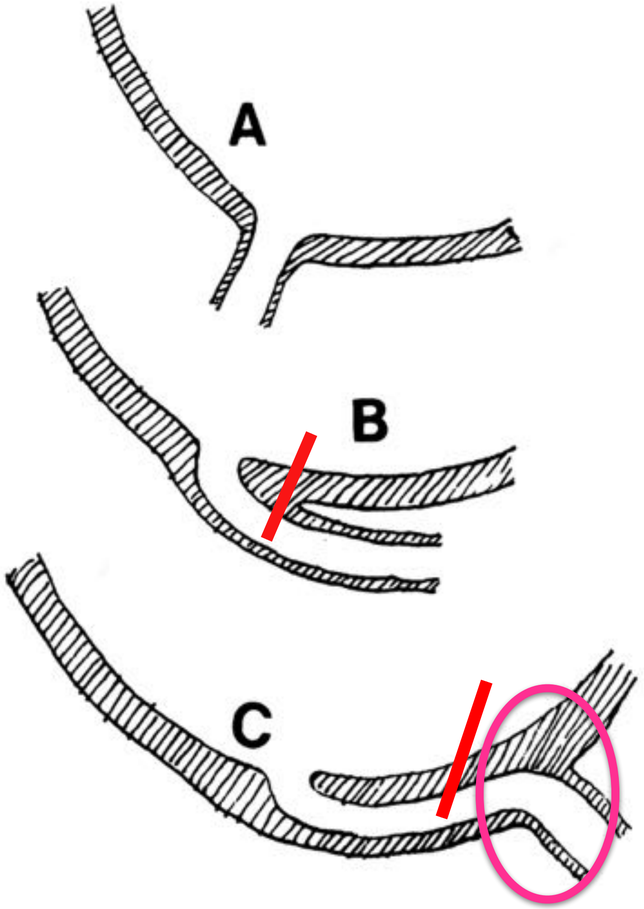


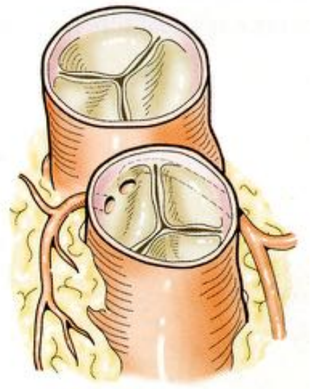




Arterial Switch Operation

transfer of coronary arteries : intramural coronary





. normal coronary ostium

. short intramural segment

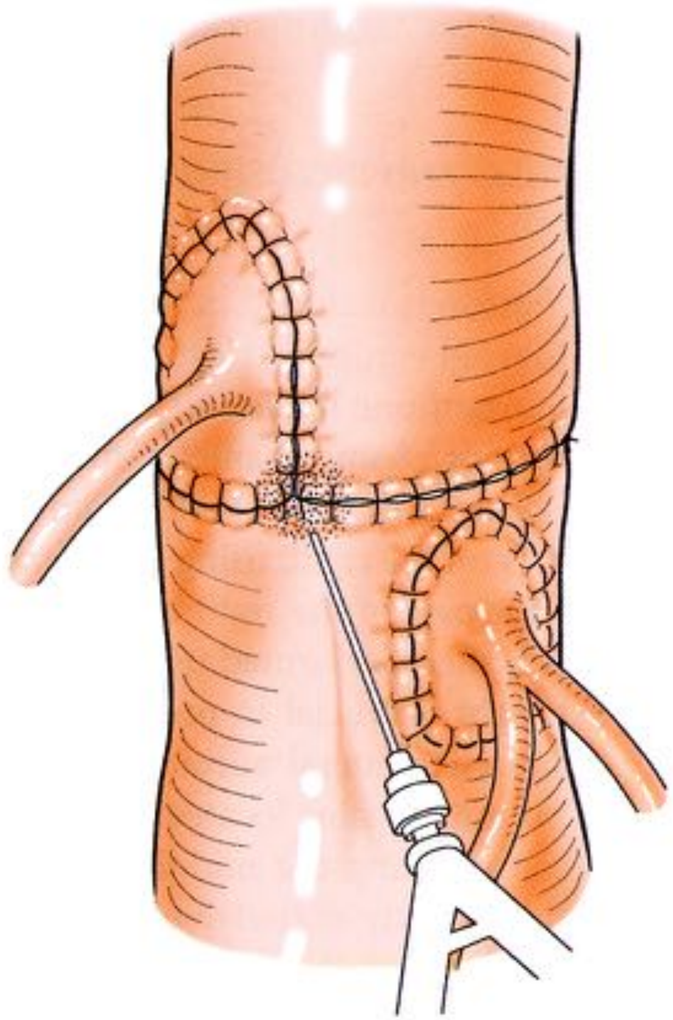
. successful unroofing

. long intramural segment

. residual distal stenosis

Arterial Switch Operation

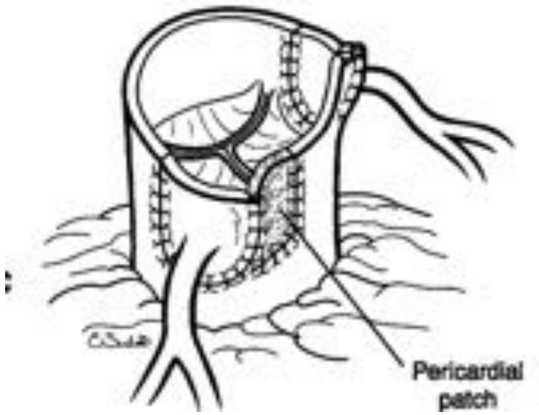
evaluation of coronary perfusion



. blood cardioplegia

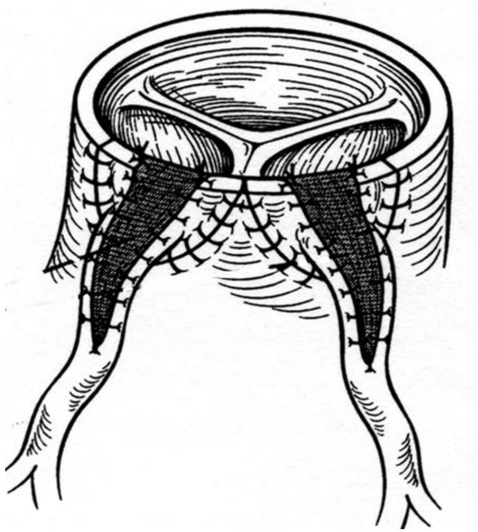
. hemostasis at suture lines

. coronary perfusion
  myocardial coloration
  filling main trunks
  revision +++



Arterial Switch Operation

coronary arteries : intramural coronary



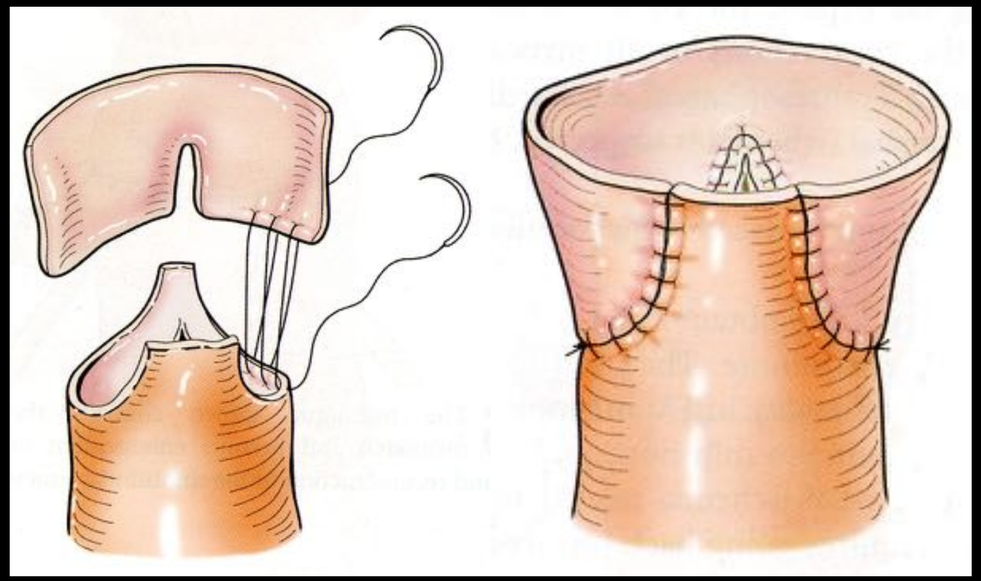
. reimplantation

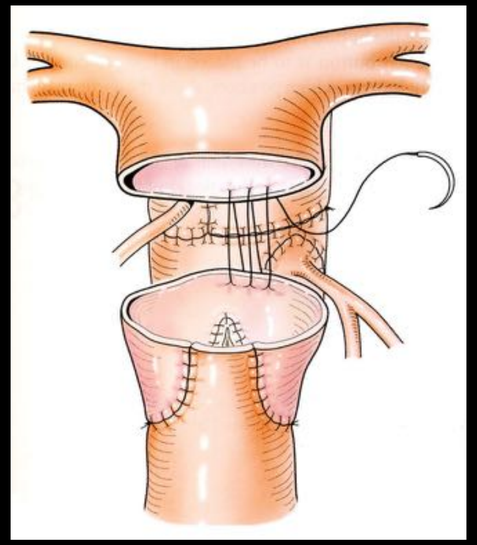
. opening of intramural segment

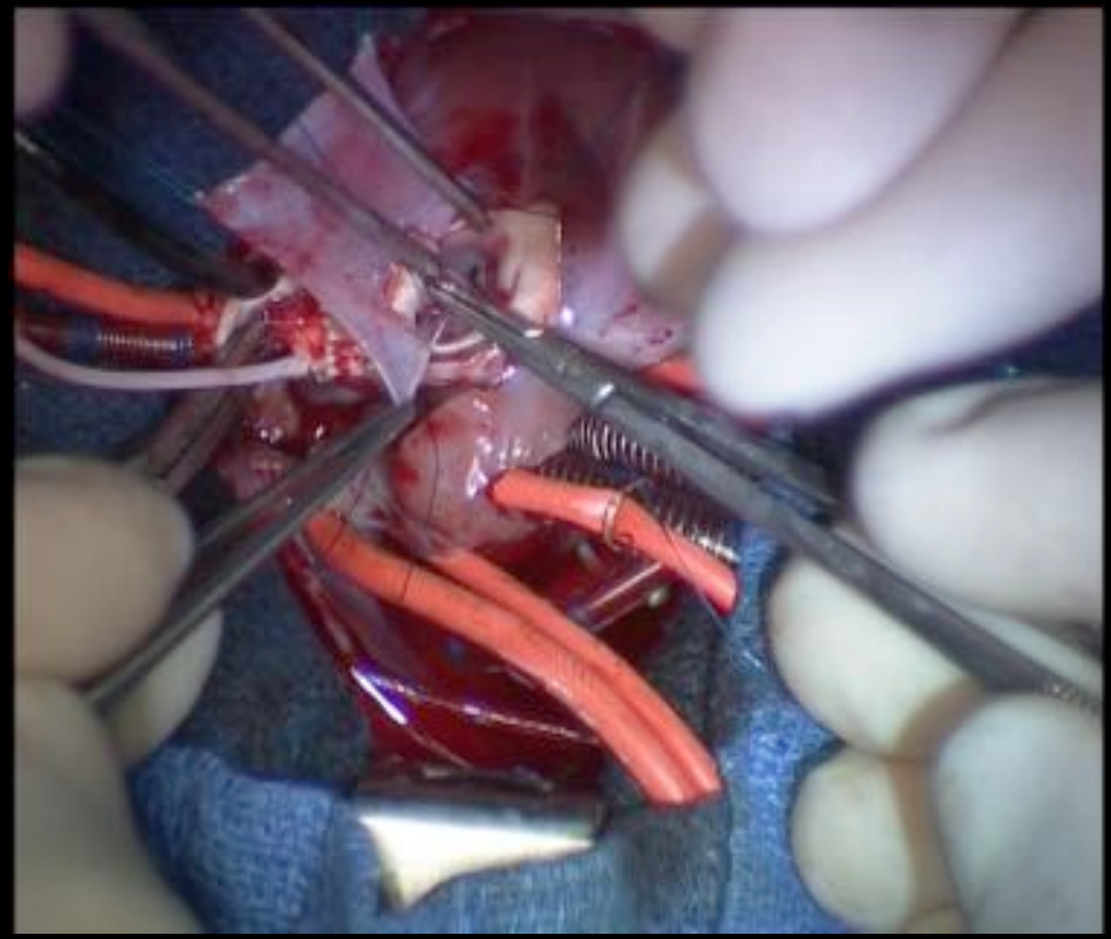
. patch enlargement
(pericardium, pulmonary wall)

Arterial Switch Operation

reconstruction of pulmonary trunk

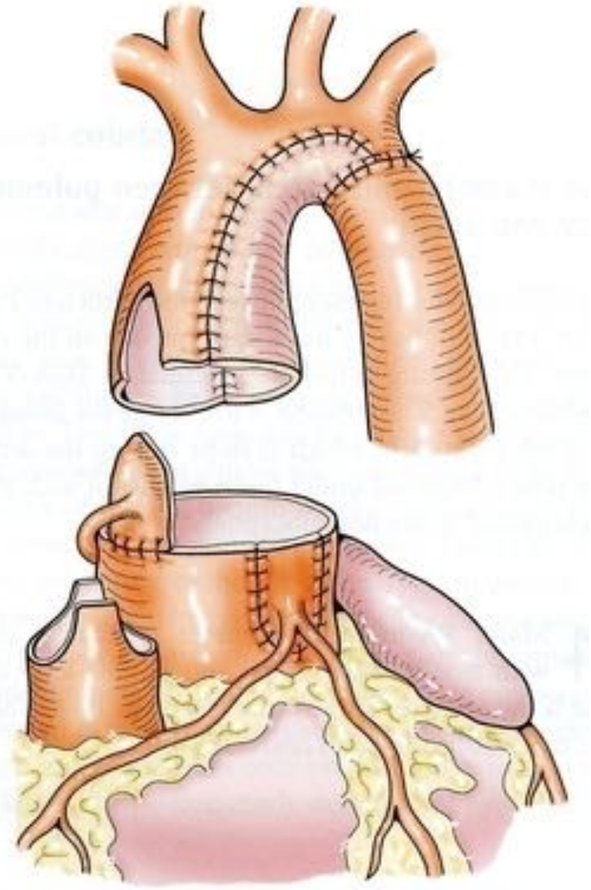




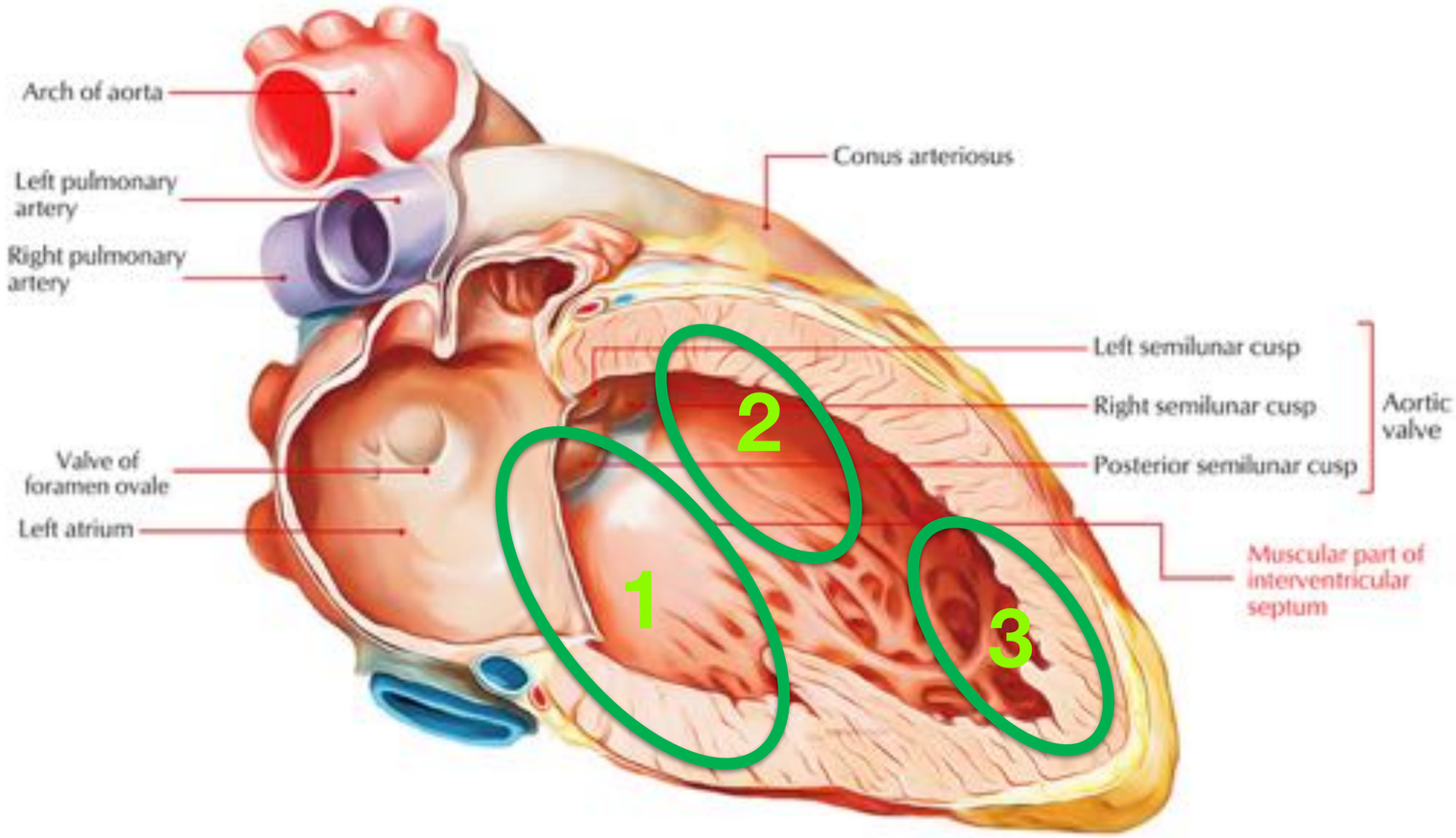


Associated lesions

VSD
Aortic arch hypoplasia or coarctation
Anomalous semi lunar valves
Anomalous AV valve
Straddling and over-riding
Sub-pulmonary obstruction
Taussig-Bing
Unbalanced ventricles and/or AV valves



VSD: type, localization and size, number



VSD: localization and size

Inlet VSD

Outlet VSD

VSD: surgical strategy

Access to the VSD: right atrium, neo-pulmonary root, neo-aorta, right ventriculotomy

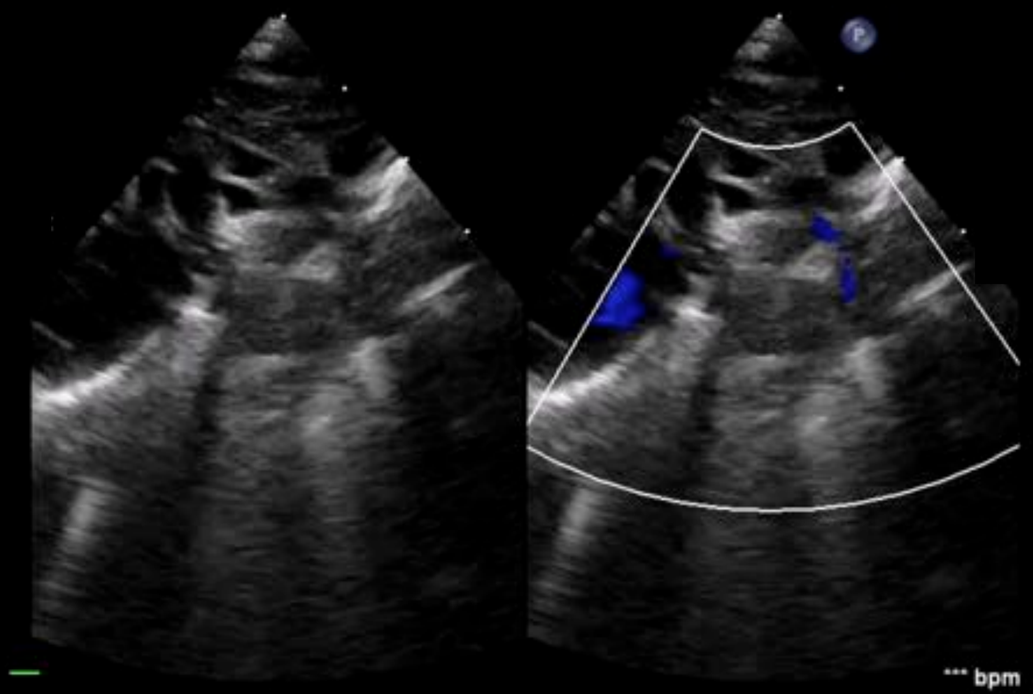
Shape of the patch

Difficulties for complex channel ?

Need for VSD enlargement

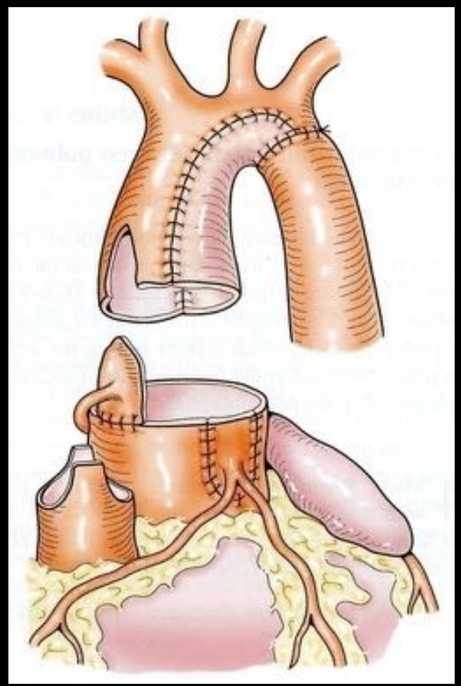
Multiple VSDs: palliation? Switch+/- aortic arch repair + PA banding

Aortic arch hypoplasia and coarctation



Localization and extension of the narrowed portion

2 techniques: enlargement and extended end to end
=> Discrepancy between aortic and pulmonary roots



Subarterial conus
anterior and posterior deviation

Subarterial conus deviation: anterior and posterior deviation

Muscular resection: right side ++

Smaller patch and big bites for realignement

Unbalanced ventricles

« Small » RV

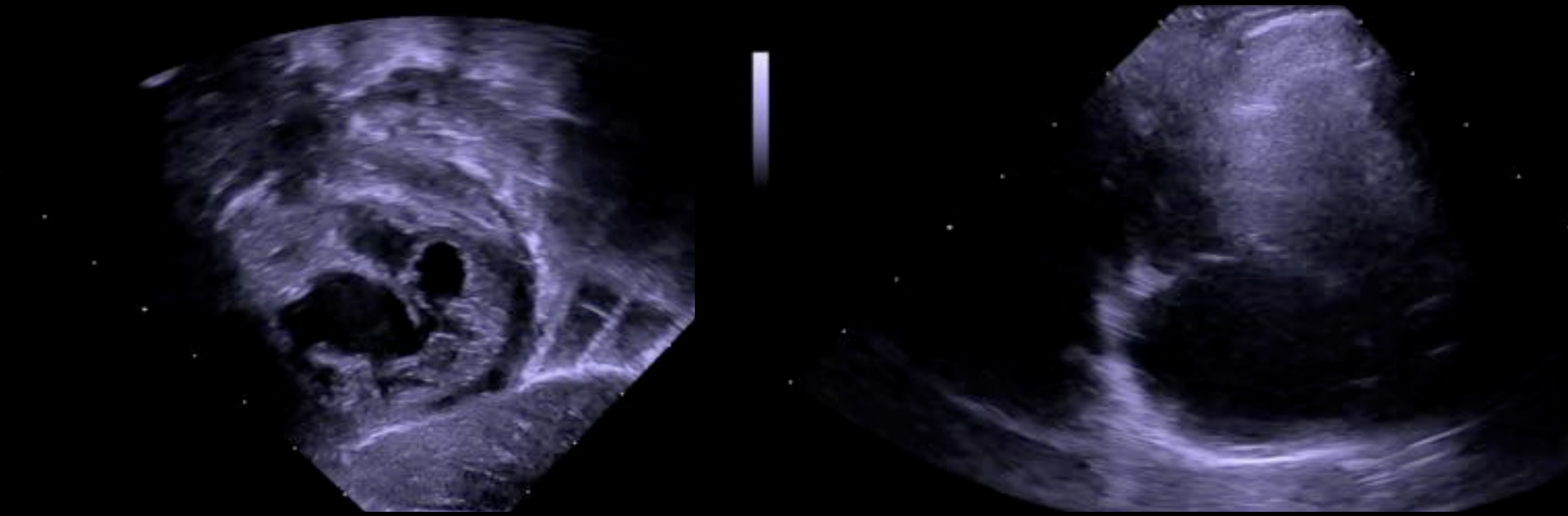
« Small » LV

Unbalanced ventricles

Most common situation: small RV and small tricuspid valve =>
Excellent indication for residual ASD

Small LV: useful to have numbers (Z score), usually minor asymmetry and well tolerated after switch procedure, ASD?

AV valves abnormalities
Straddling and over-riding



Straddling of tricuspid valve

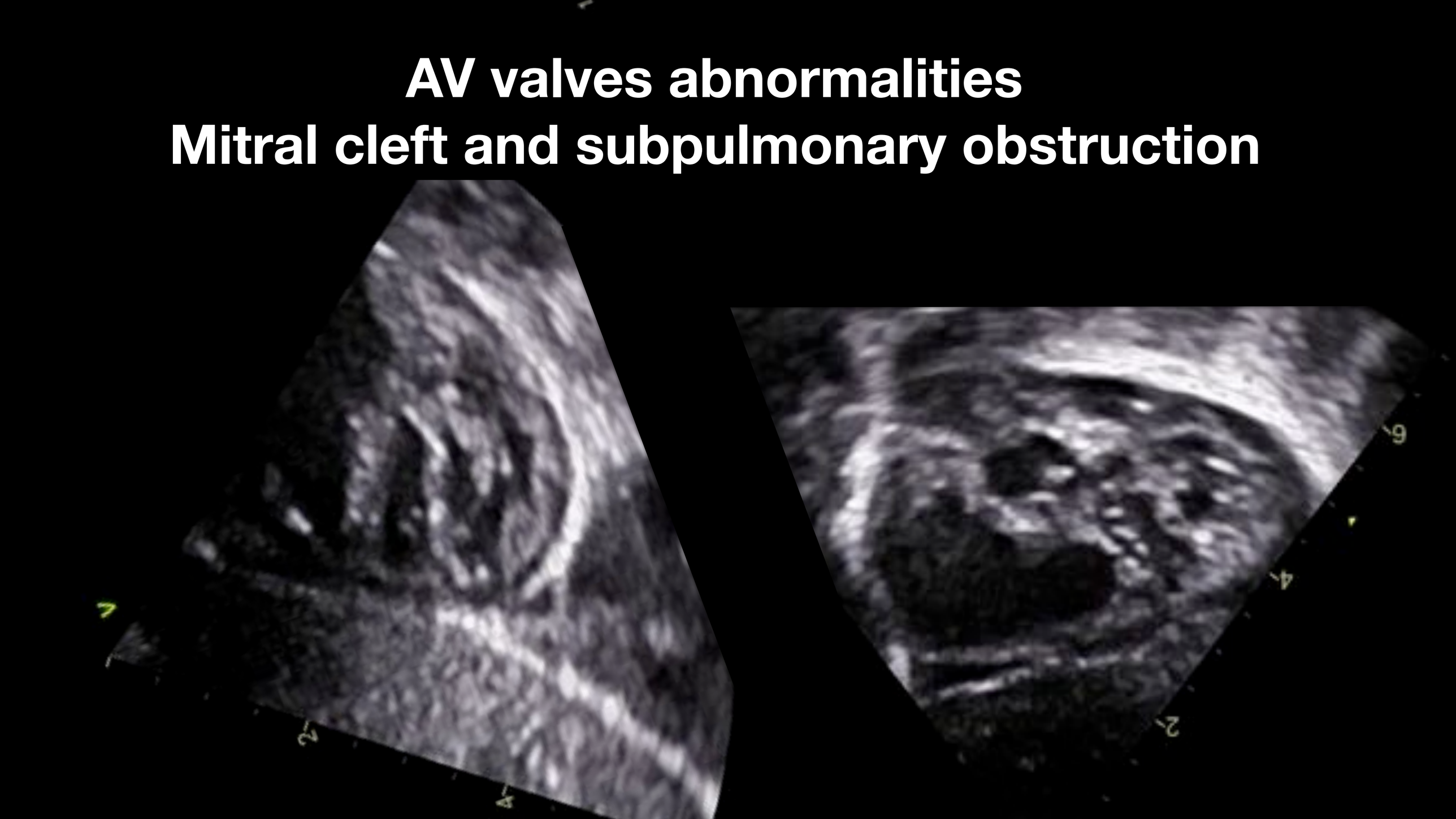
PALLIATION in TGA ?

Multiples VSDs
Difficult intra cardiac septation or channelling
Straddling and over-riding

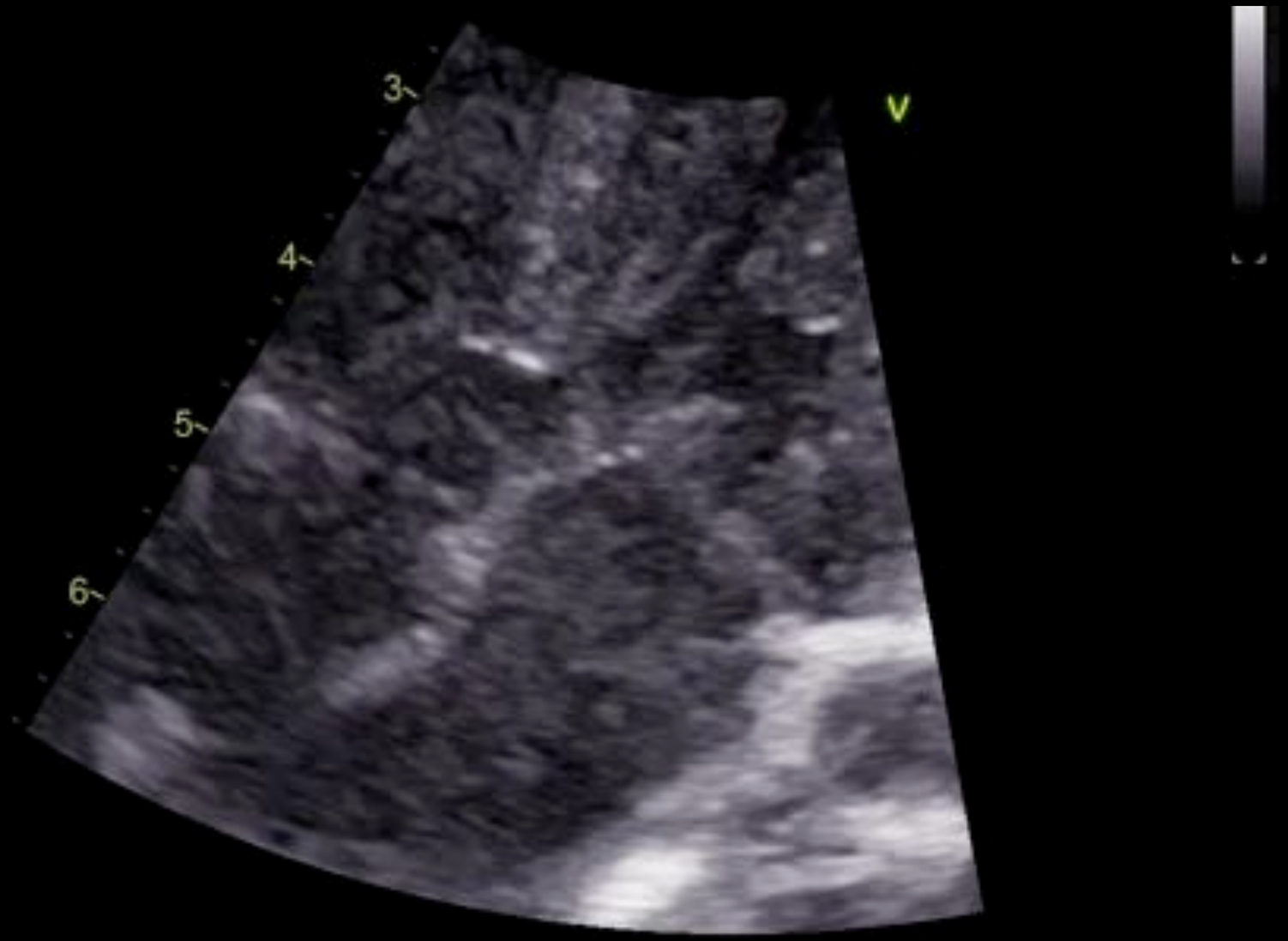
Delay the intra cardiac repair

But avoid inadequate palliation : aortic arch repair with PA banding…

AV valves abnormalities
Mitral cleft and subpulmonary obstruction



AV valves abnormalities
Mitral cleft and subpulmonary obstruction



AV valves abnormalities
Mitral cleft and subpulmonary obstruction

Mitral surgery is feasible but difficult in neonates

Easier to treat regurgitation than sub pulmonary obstruction

Surgical Indication for mitral repair only if mitral dysfunction

Easier at later age

End of operation

. Delayed sternal closure: when difficulties are in the air!
  . revision of coronary anastomosis
  . unusual coronary pattern
  . small weight
  . dilated LV
  . « weak team »

. ECMO
  . unstable hemodynamics
  . despite « reasonable » inotropic support
  . after rulling out coronary malperfusion
  . Coronary angio ++

Conclusion

- Echo screening is a key point for surgical strategy
- Acurate description reduces stress/risk at surgery