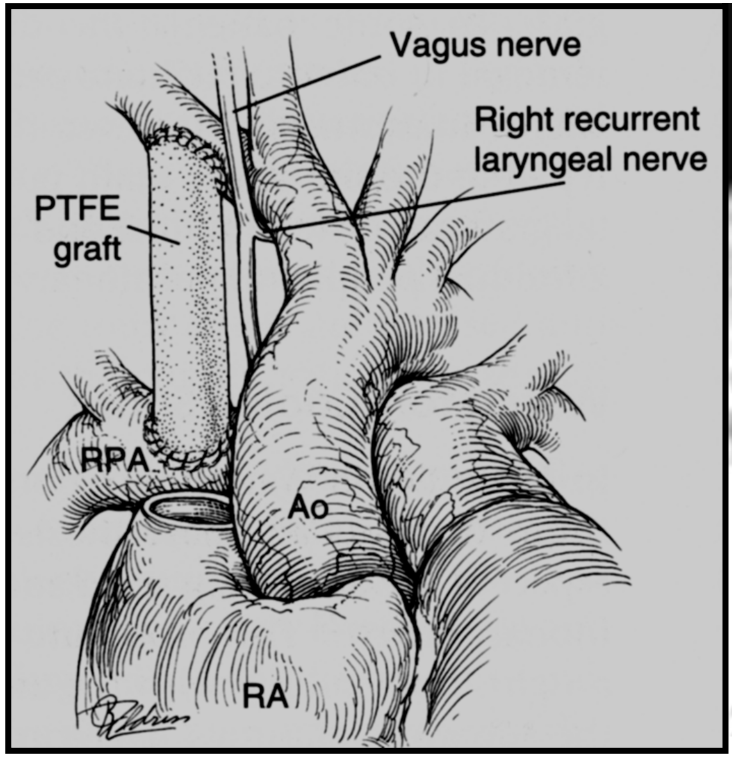
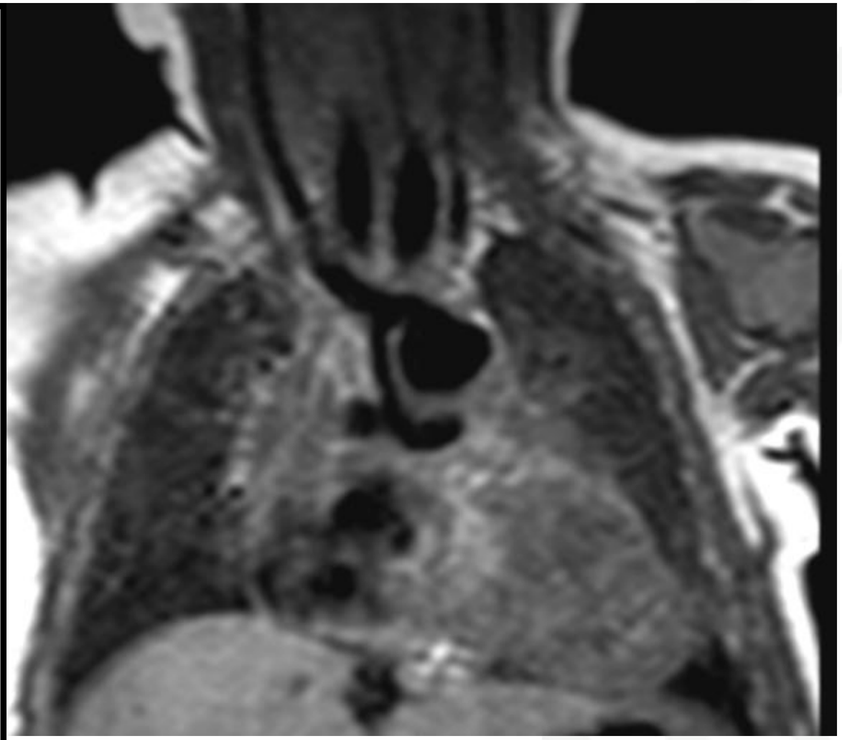


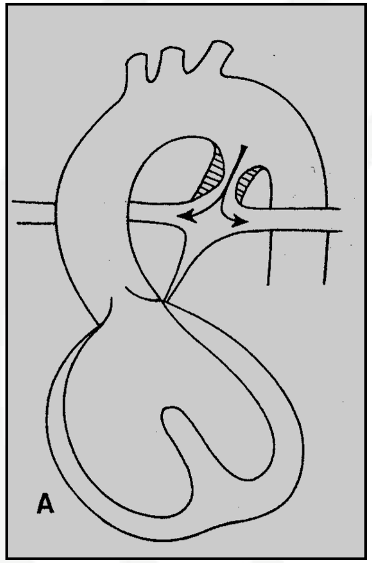


CREATION DE SHUNTS

Drs. Xavier Iriart / Zakaria Jalal

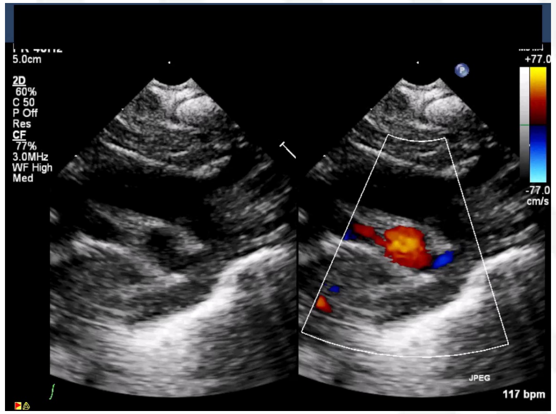
Service des cardiopathies congénitales de l'enfant et de l'adulte- Hôpital cardiologique Haut Lévêque - Bordeaux

Duct dependent Pulmonary Blood Flow



- Anatomy: Atresia/Hypoplasia of Right Heart structures (Tric/ pulm Atresia)

- **Immediate** action to establish **adequate** Pulmonary Blood Flow
    - Prostaglandin to maintain ductal patency
        - Flow: Aorta to Pulmonary artery



- Subsequent need for **Reliable** Pulmonary Blood Flow
    - Modified BT shunt
    - PDA stent

CREATION DE SHUNT AO/AP → *CAHIER DES CHARGES:*

Implique d'assurer (si possible) une balance QP/QS proche de 1

Objectif: optimisation de la DO2 = Qc x CaO2 :

1) **Oxygénation tissulaire satisfaisante (SaO2 = 75-80%)**
2) **Perfusion systémique optimale (SvO2 = 45-60%)**

BUT, A TERME:

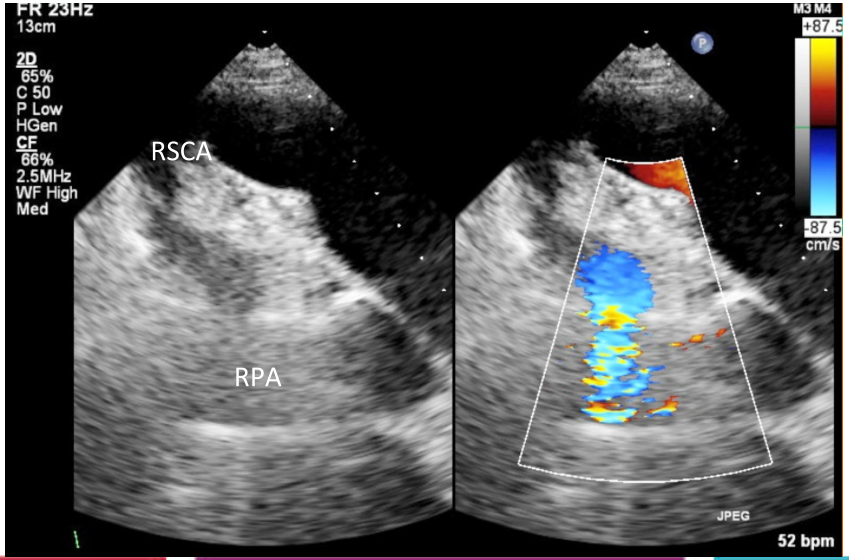
- assurer la survie de l'enfant dans l'attente de la correction complète

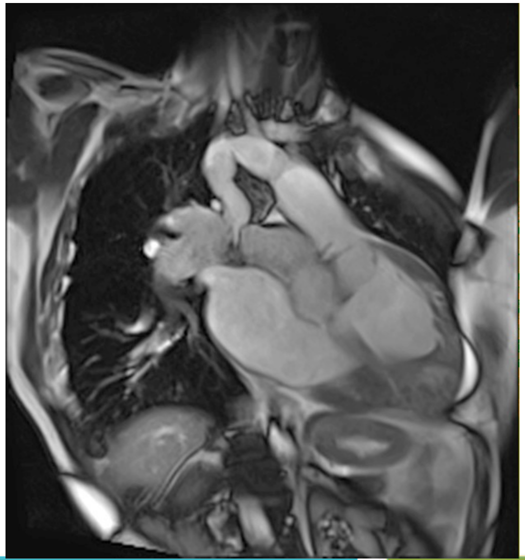
- équilibre QP/QS # 1, gage de:

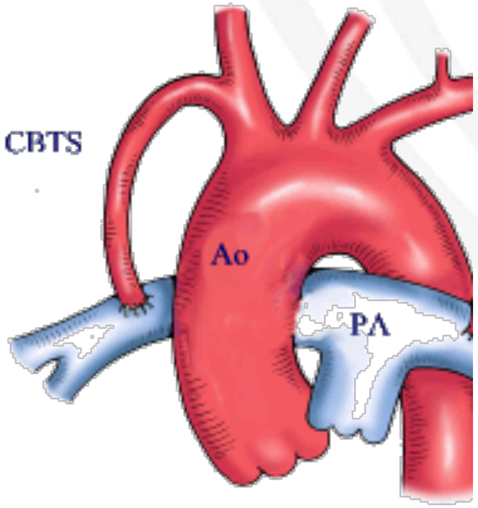
**** préservation de la fonction du futur ventricule systémique ?***
**** en corollaire, pas de fuite de la valve auriculo-ventriculaire systémique ?***
**** préservation du lit vasculaire pulmonaire (cf. futur FONTAN) ?***
**** attention à la distorsion des artères pulmonaires (cf. sténose AP)***

Duct dependent Pulmonary Blood Flow

- First SPS: direct connection between SCA and ipsilateral PA
- Frequent complications
  - Unpredictibility of shunt flow
  - PA branch distortion

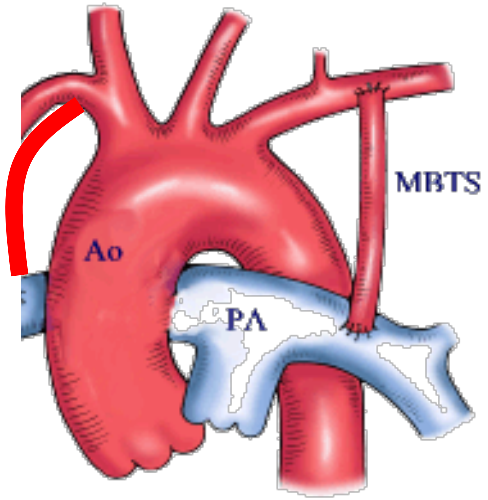


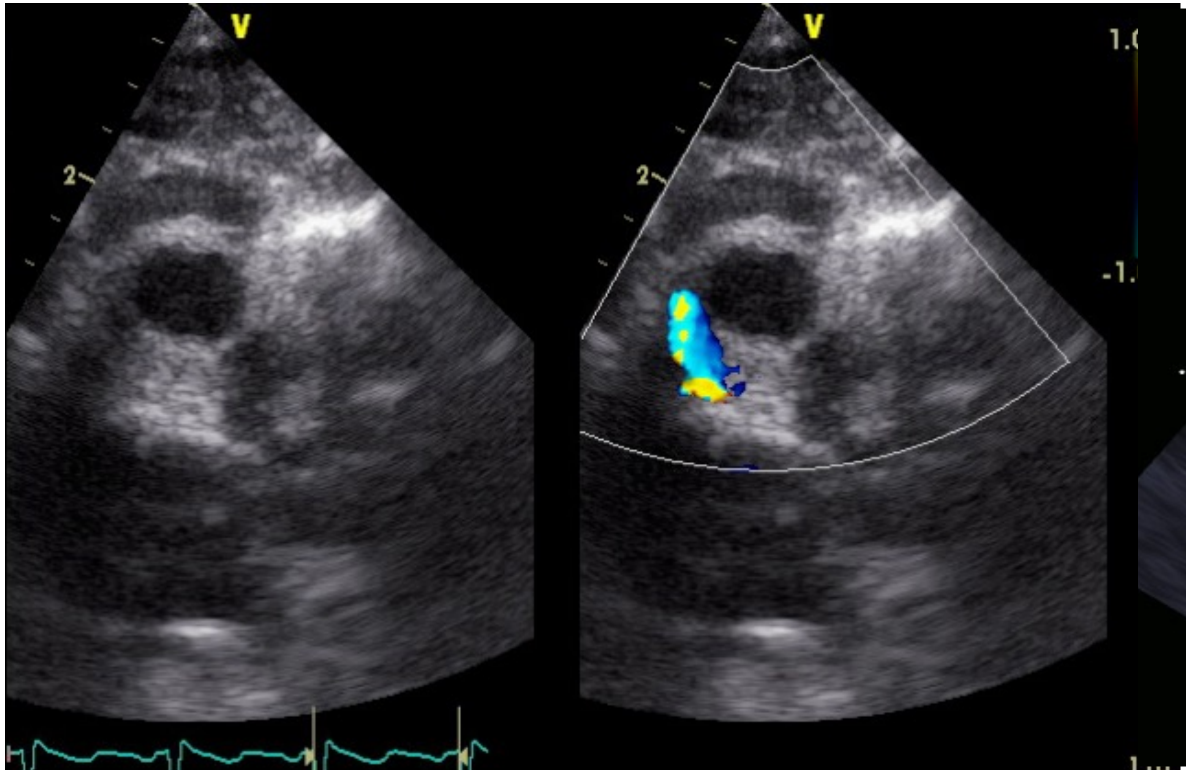


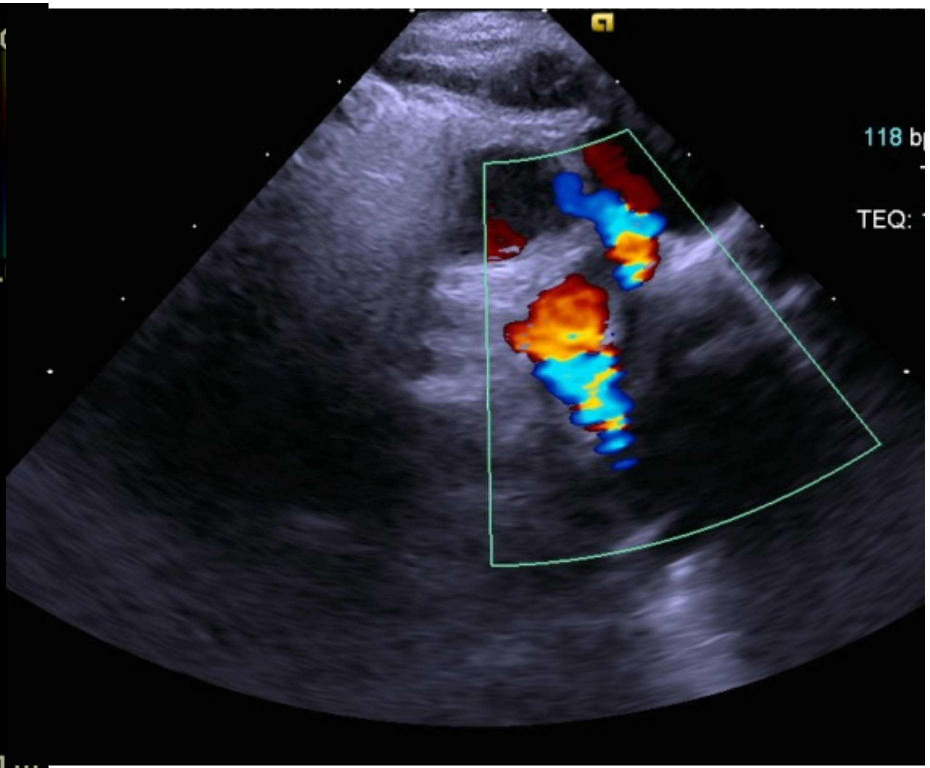


Systemic to pulmonary shunt

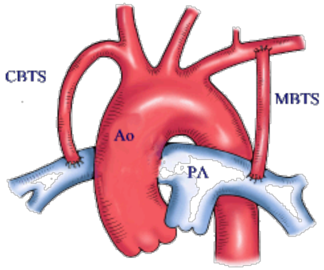
- modified BT shunt: prosthetic PTFE graft (Ø3-4mm)
- Innominate artery or SCA connected to ipsilateral PA branch
- Echo: suprasternal frontal view/ color doppler/ CW doppler





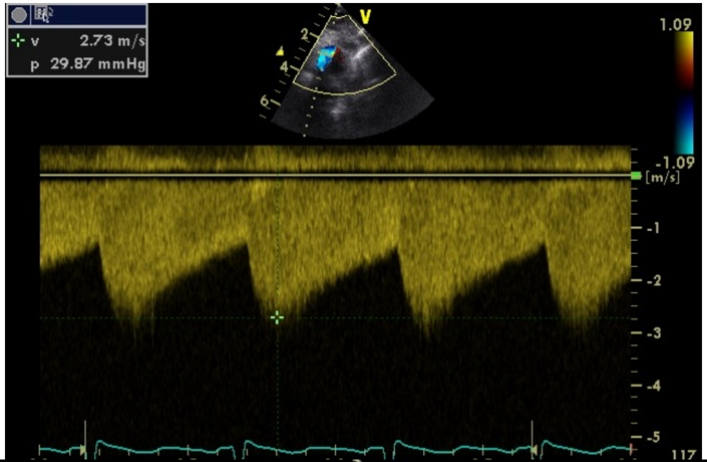


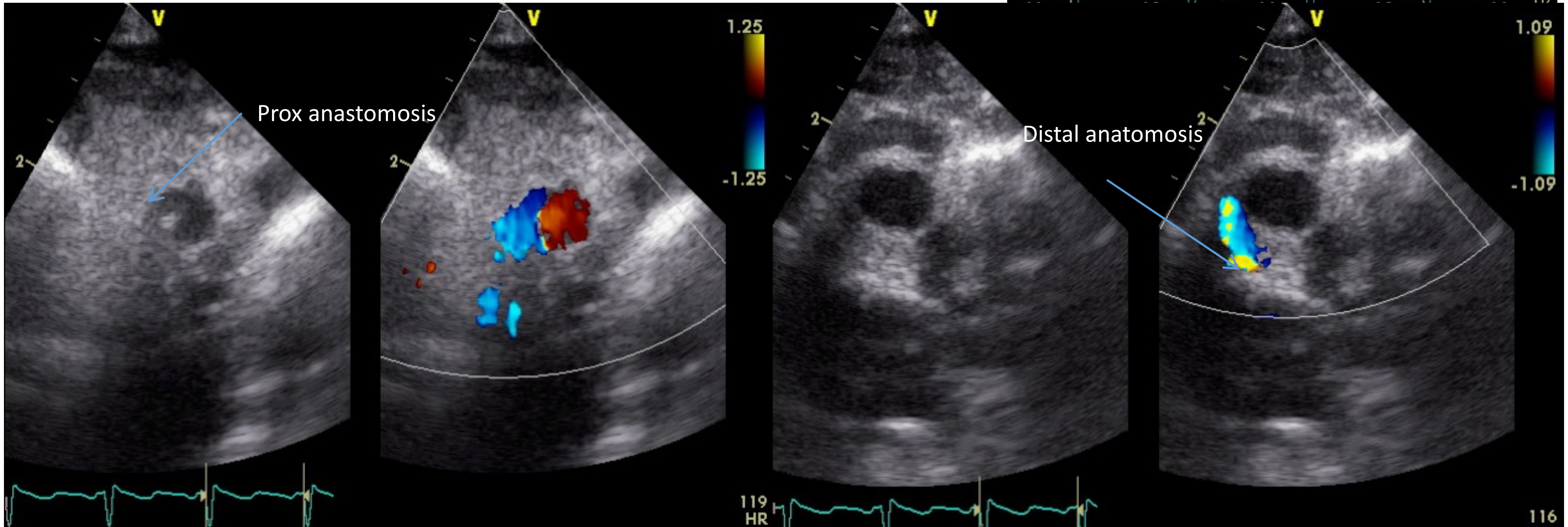
Systemic to pulmonary shunt

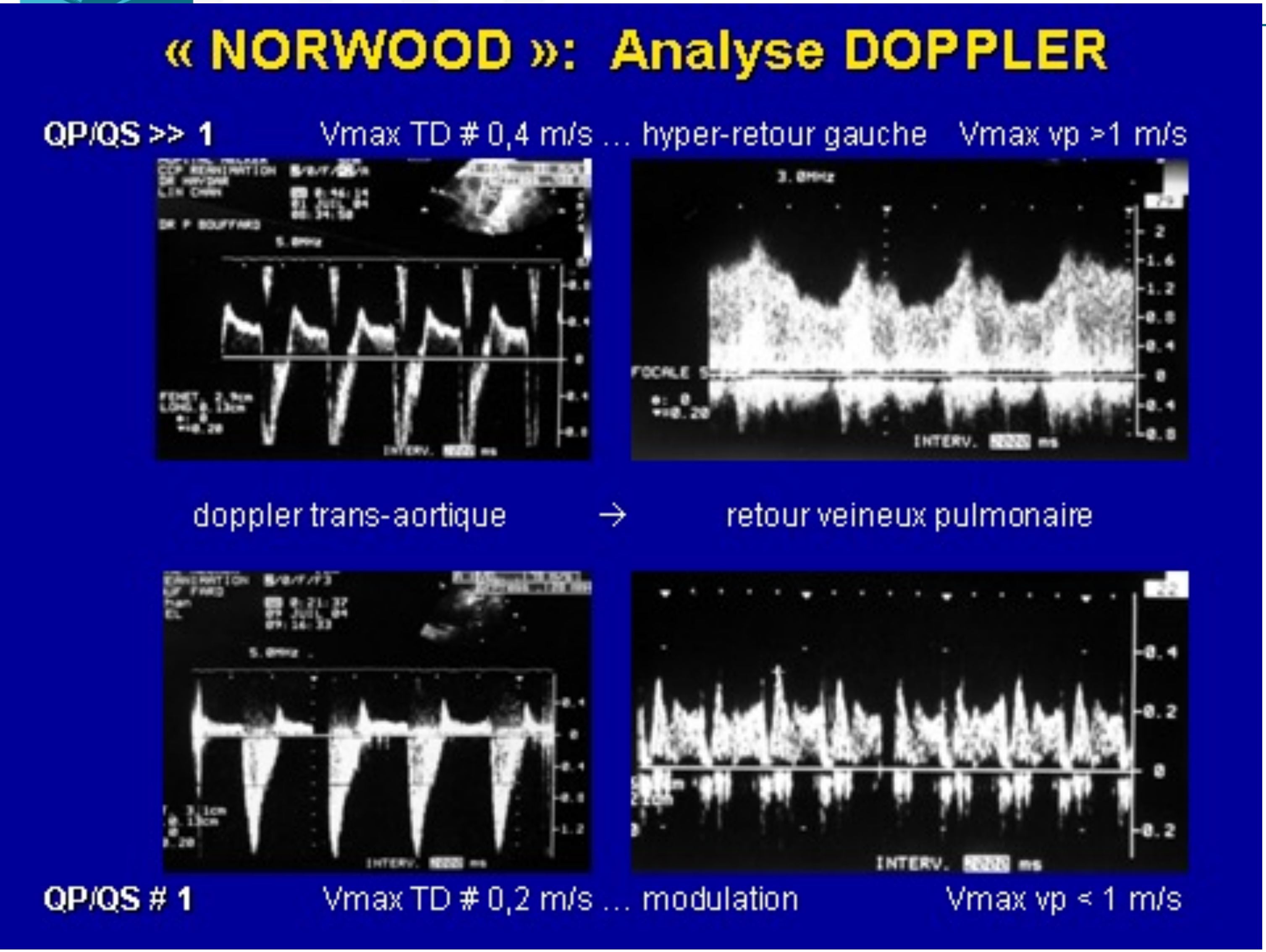


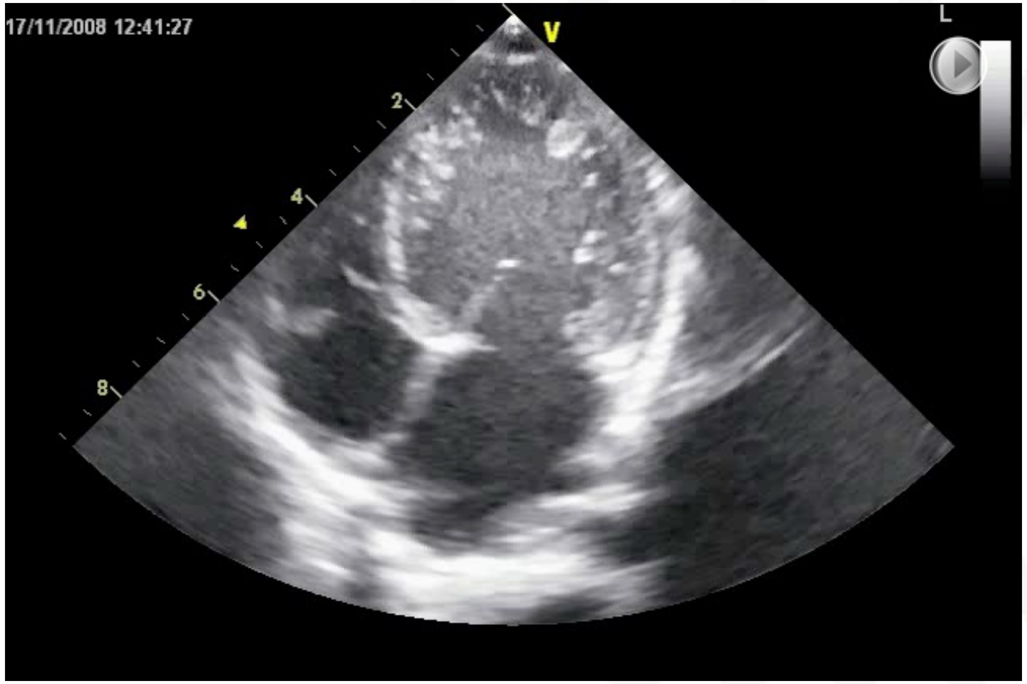
- Imaging: CW doppler: characteristic sawtooth doppler pattern

- Potential anomalies: distortion of inn Artery or PA branch, narrowing of prox or distal anastomosis (challenging)



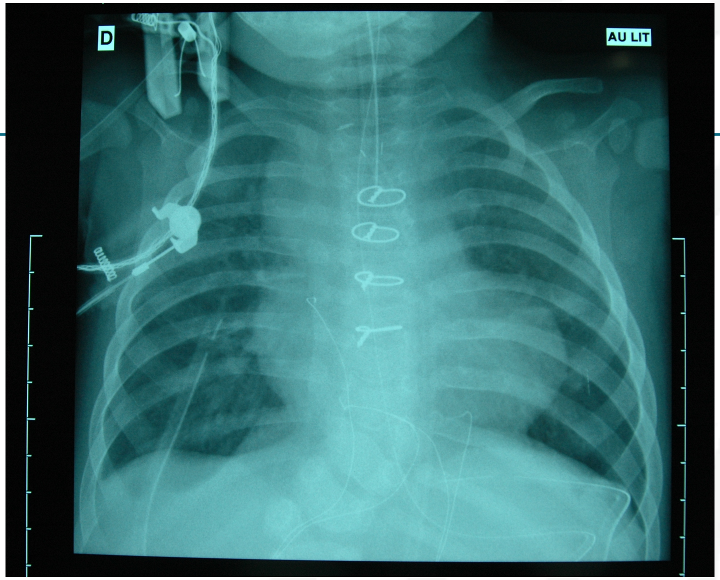


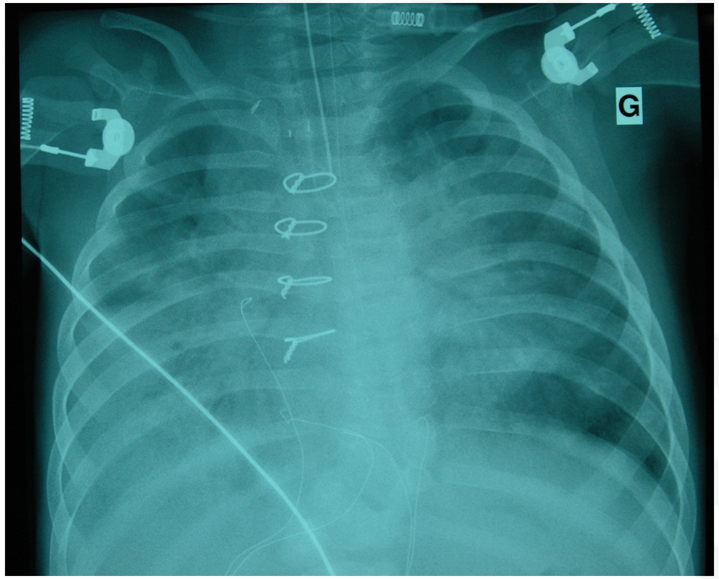

« NORWOOD »: Analyse DOPPLER
QP/QS >> 1
Vmax TD # 0,4 m/s … hyper-retour gauche
Vmax vp >1 m/s
doppler trans-aortique
→
retour veineux pulmonaire
QP/QS # 1
Vmax TD # 0,2 m/s … modulation
Vmax vp < 1 m/s


17/11/2008 12:41:27
V

L'échographie est indissociable de la clinique

- Données cliniques: évaluation du QP/QS, NIRS, diurèse horaire
- Données biologiques: lactates, fonction rénale, troponines
- Le gradient doppler dépendent:
  - De l'hémodynamique: FE, PA, PAP, RVP, volémie
  - De l'anatomie: taille des AP
  - De la chirurgie: taille, longueur, position du blalock
  - De la rhéologie: Ht, volémie
  - De la ventilation
  - L'équation simplifiée de Bernouilli n'est pas applicable pour la mesure des gradients





Comprendre la physiologie

Anesthésie
Myorelaxation
Hypothermie
Douleur

- $SvO2 = Sa02 - \frac{VO2}{Qc.(Hb)k}$

hyperthermie
Acidose
Hypercapnie
K=1.34

Précharge
Postcharge
Inotropisme
FC

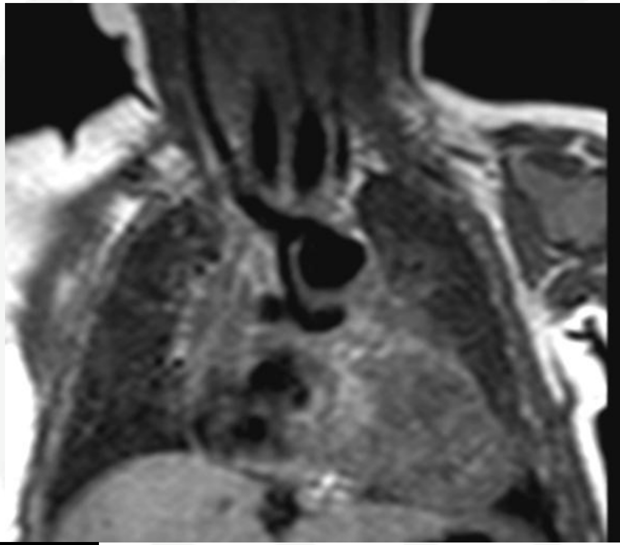
Hémorragie
Hemodilution
Transfusion

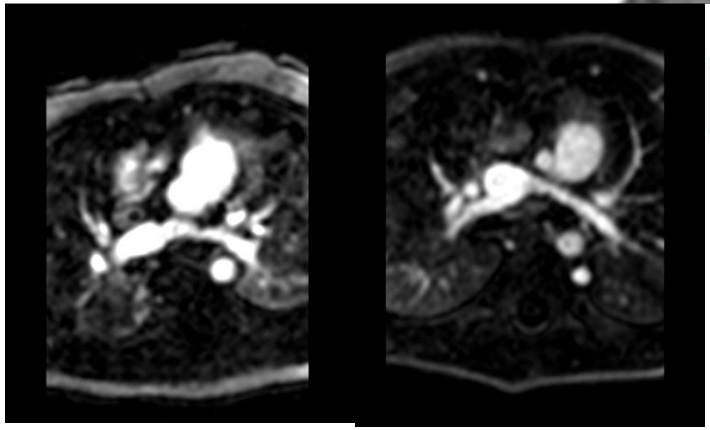
- QP/QS= SaO2 Ao-(SVO2 VCS+VCI/2) / SaO2 VP- SvO2 AP

- Physiologie normale: SaO2 Ao et VP 100%, SvO2 70% (VC=AP) (difficile à évaluer dans cette physiologie)

Visualisation of shunt and PAs

- If there is doubt or for planning next stage of surgery
- CT / MRI / Catheter
- To delineate shunt and branch PA anatomy



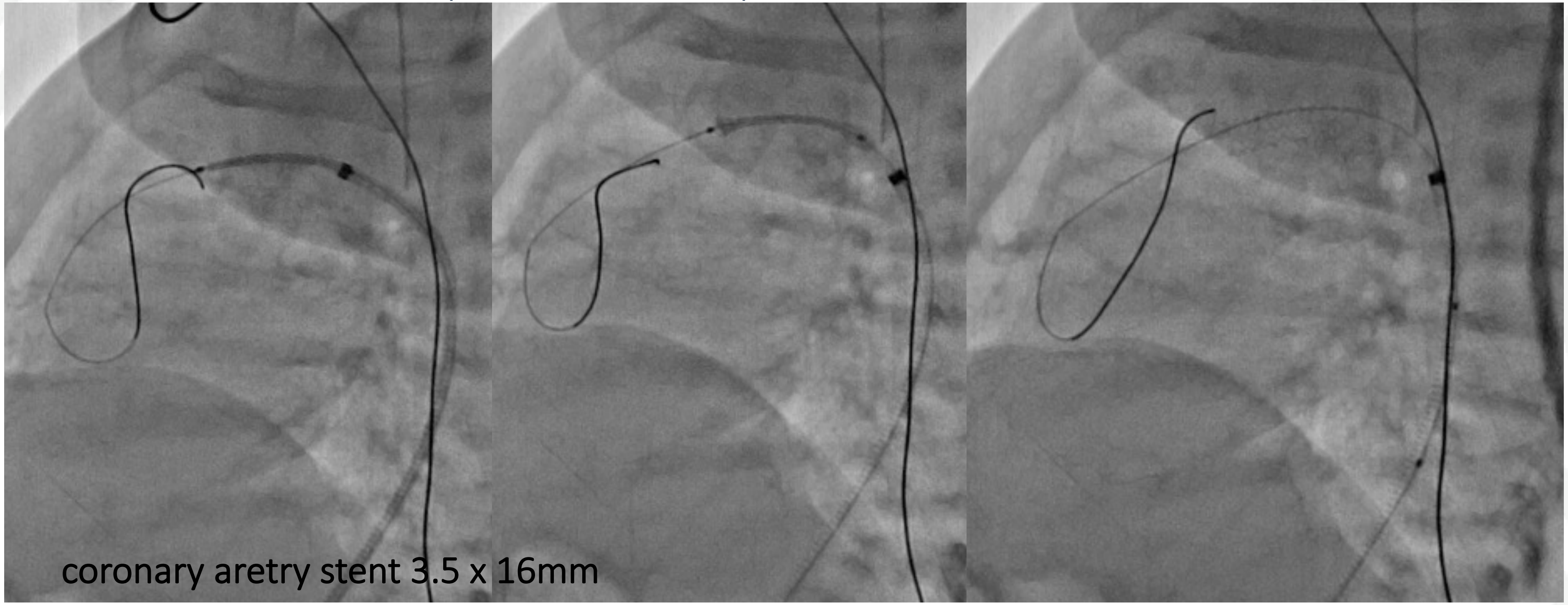


ALTERNATIVE AU BT SHUNT:DUCT STENTING

Pulmonary atresia with IVS. Severe hypoplastic RV. Duct dependent pulmonary flow

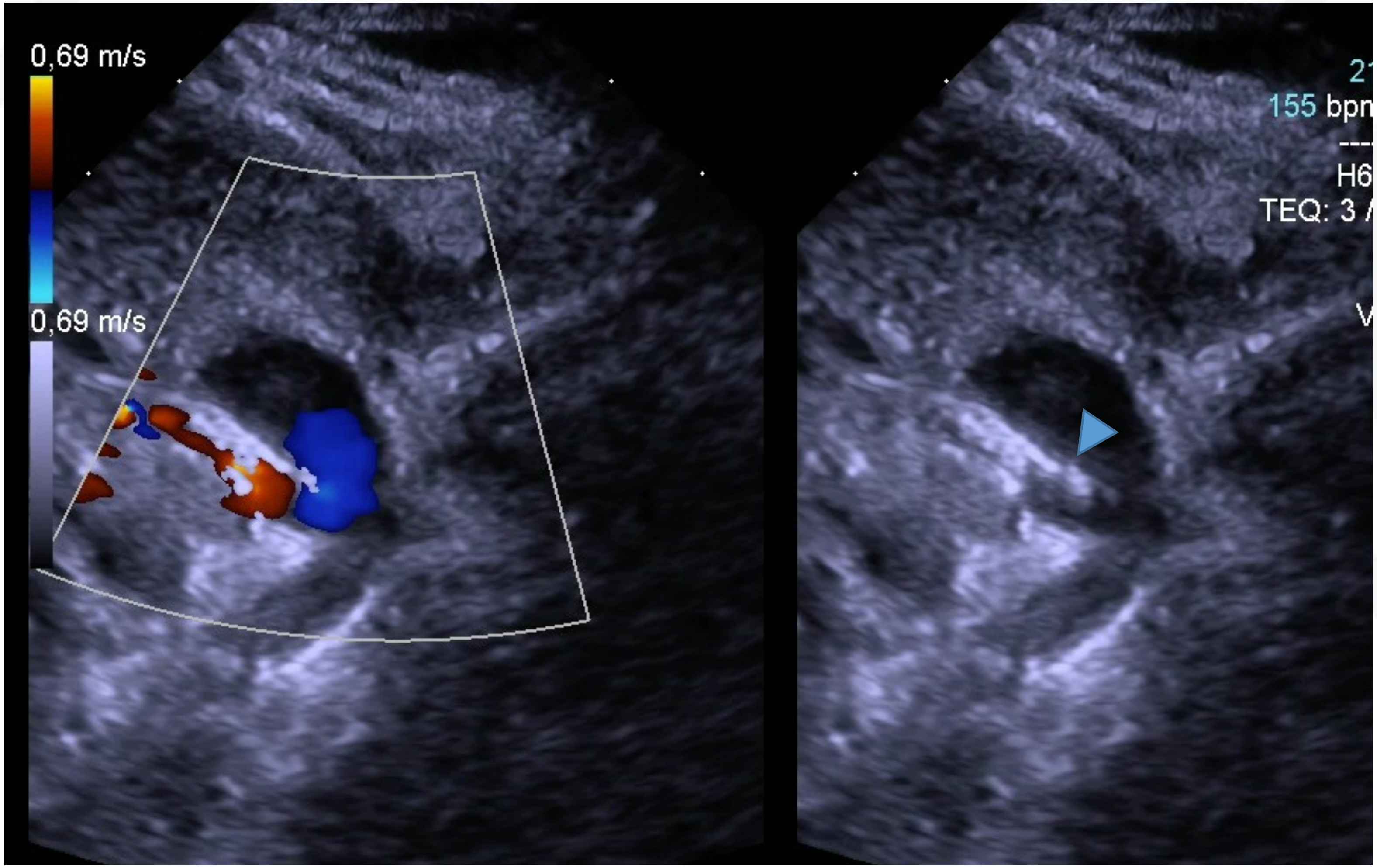
Weight 2kg. O2 Saturation 88% under PGE1

Stop PGE1 6h before the procedure



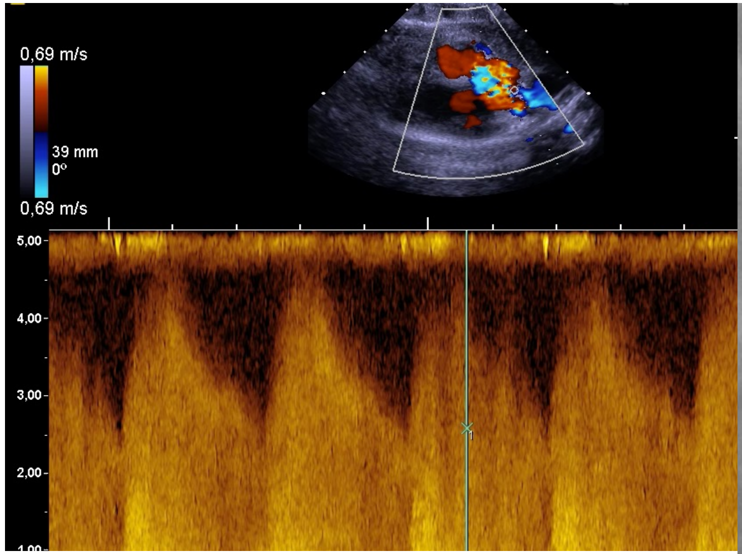
Discharge Day 5 O2 Sat85-90%

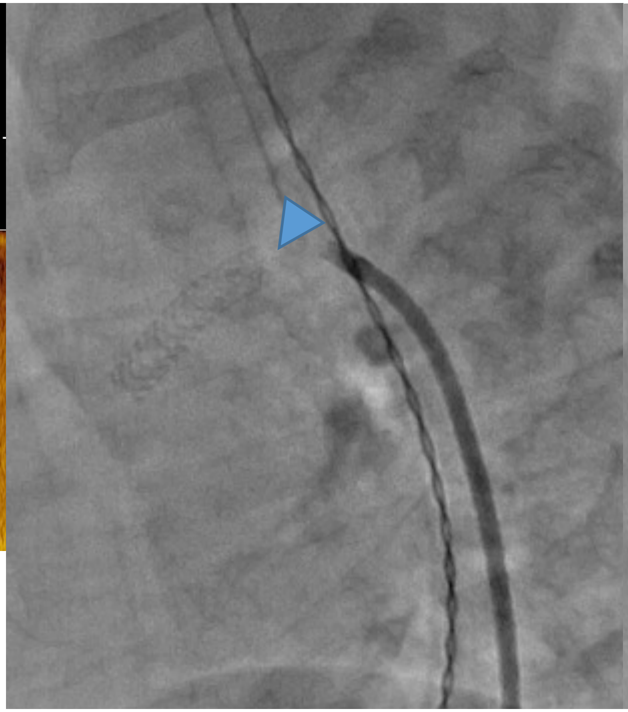
DUCT STENTING

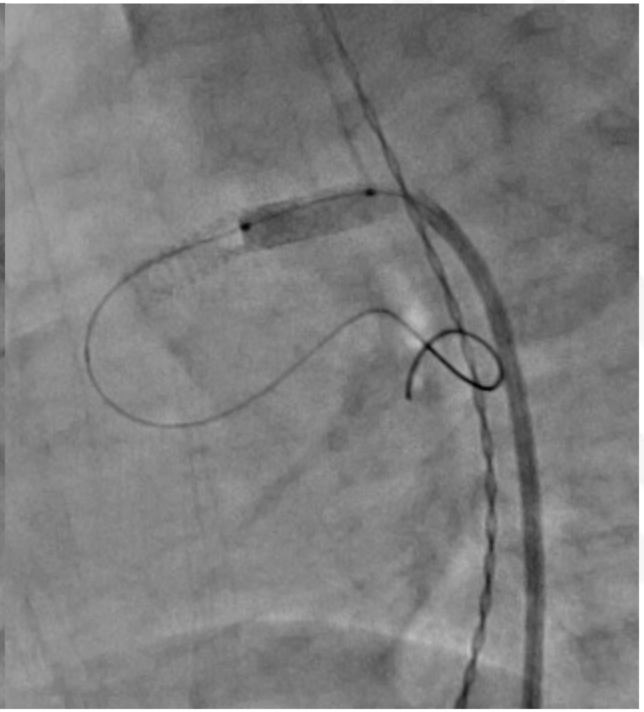


DUCT STENTING

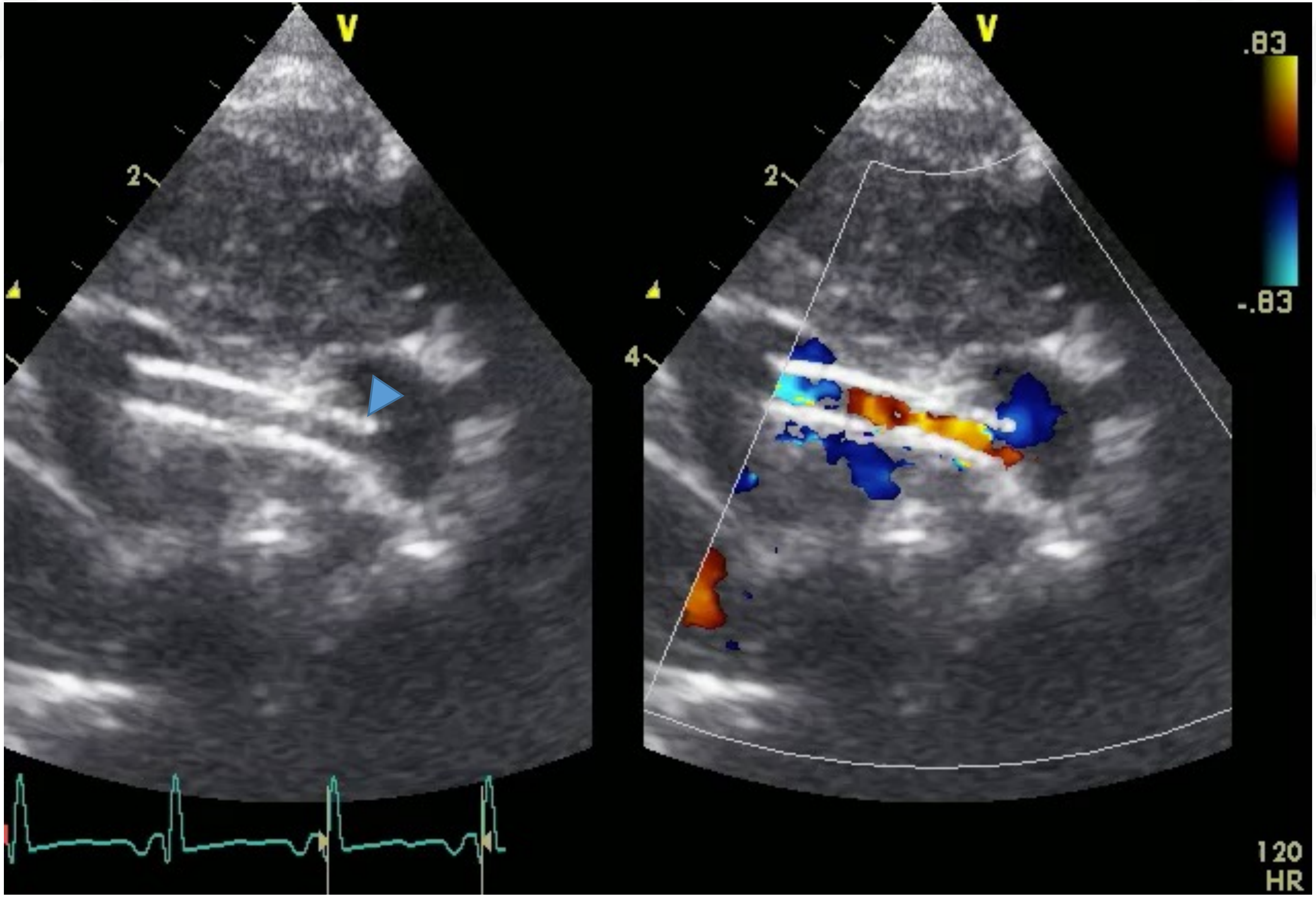
- Acute desaturation at 3 months 60 vs 85%
- Increased peak velocity from 3.5 to 5m/s





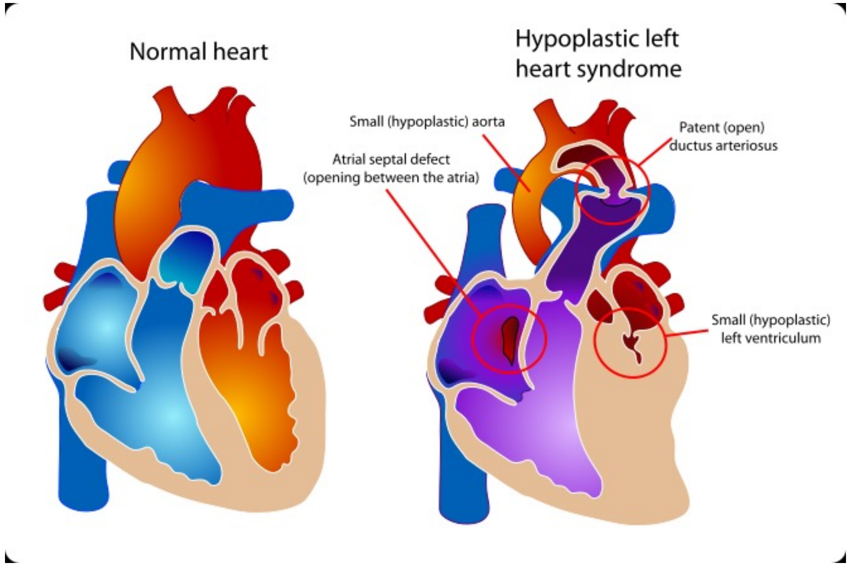


Additional stent on the aortic side



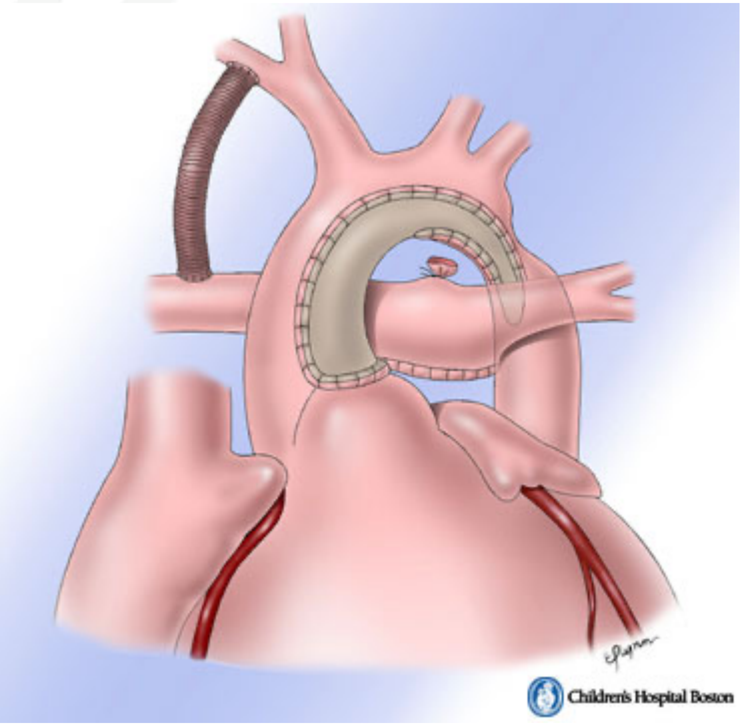
Duct dependent Systemic Blood Flow

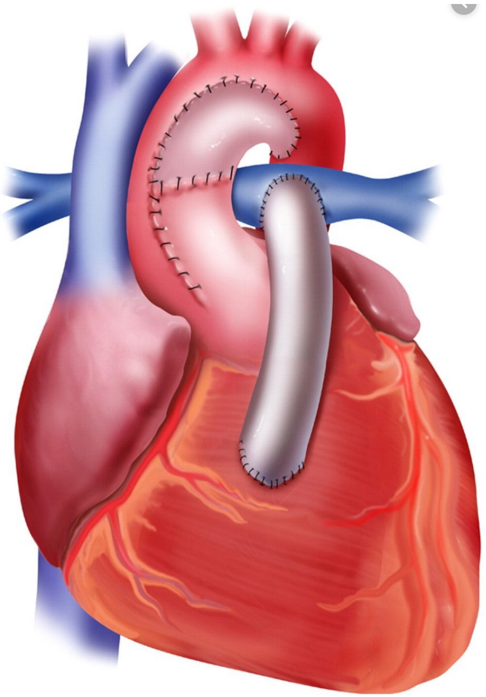
- Anatomy: large spectrum of HLHS
- **Immediate** action to establish **adequate** Systemic Blood Flow
    - Prostaglandin to maintain ductal patency (R to L flow)

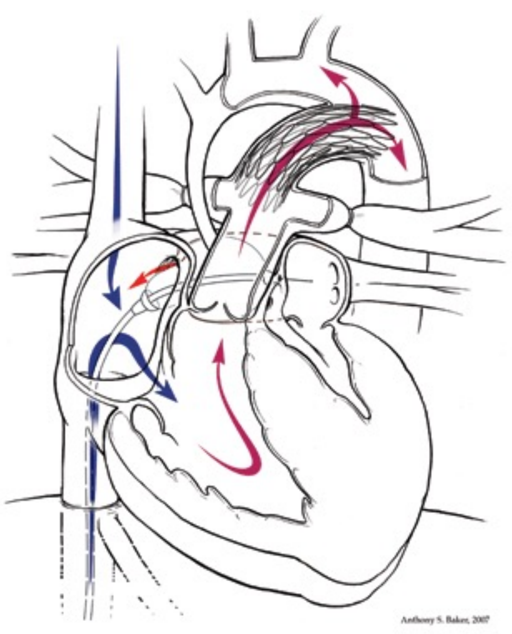


- Subsequent need for **Reliable** systemic circulation
    - Norwood/Hybrid for HLHS
- Balloon or Surgical Aortic Valvotomy in Critical AS

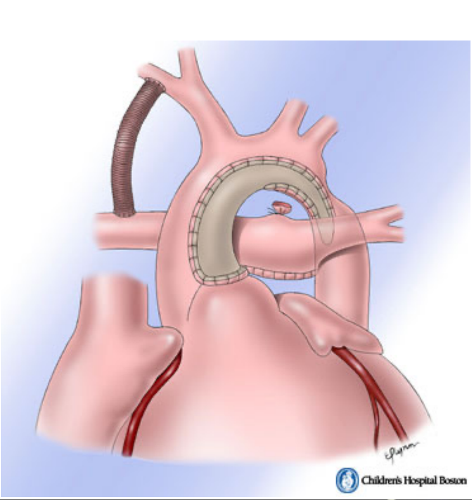
Palliative approach in HLHS

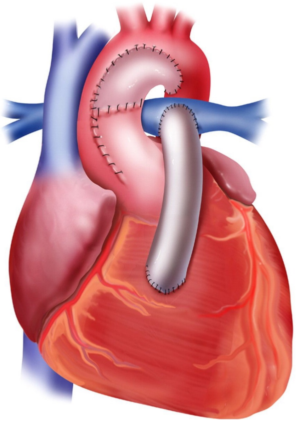


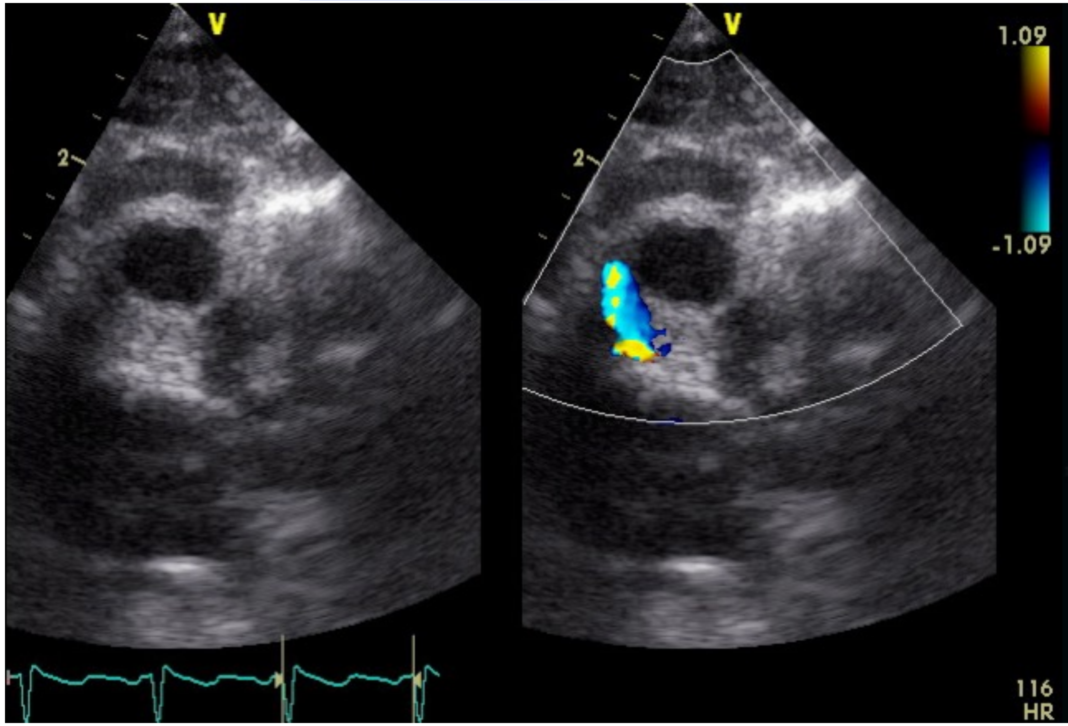


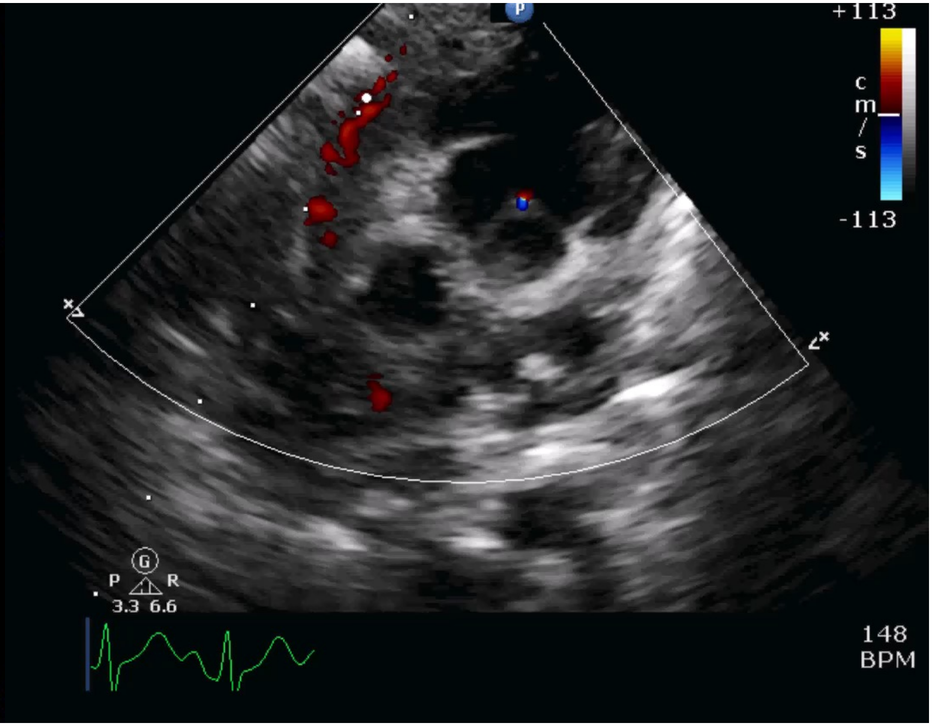


Different shunt types

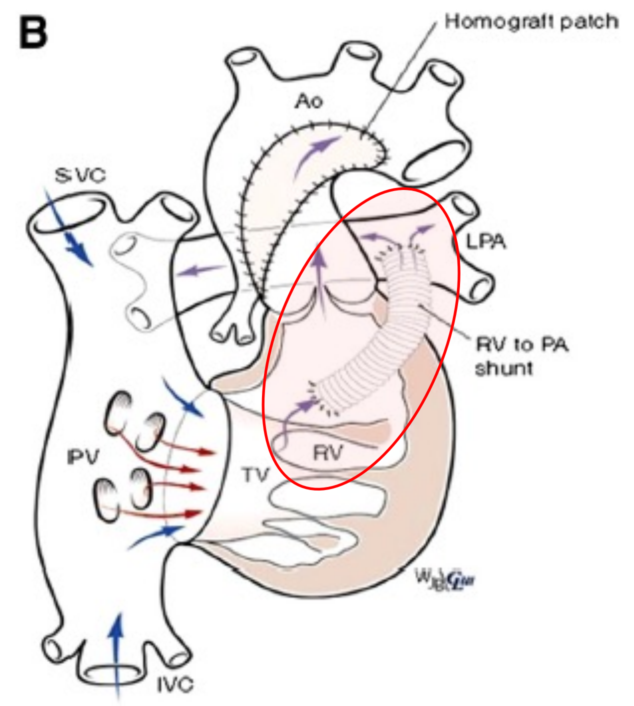




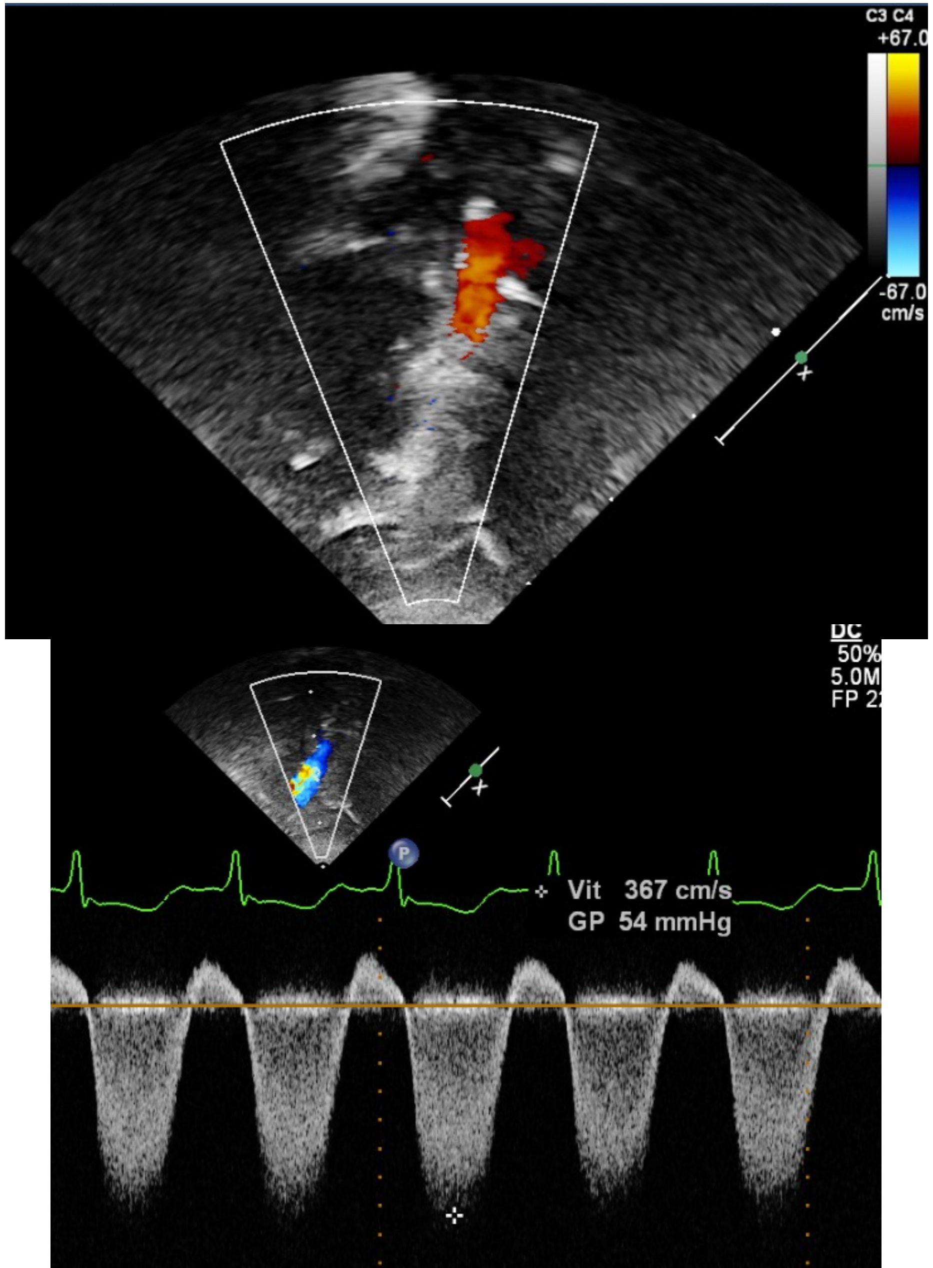


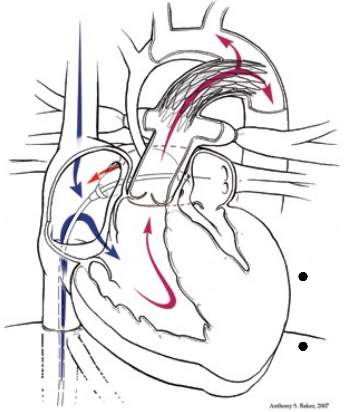


RV to PA conduit



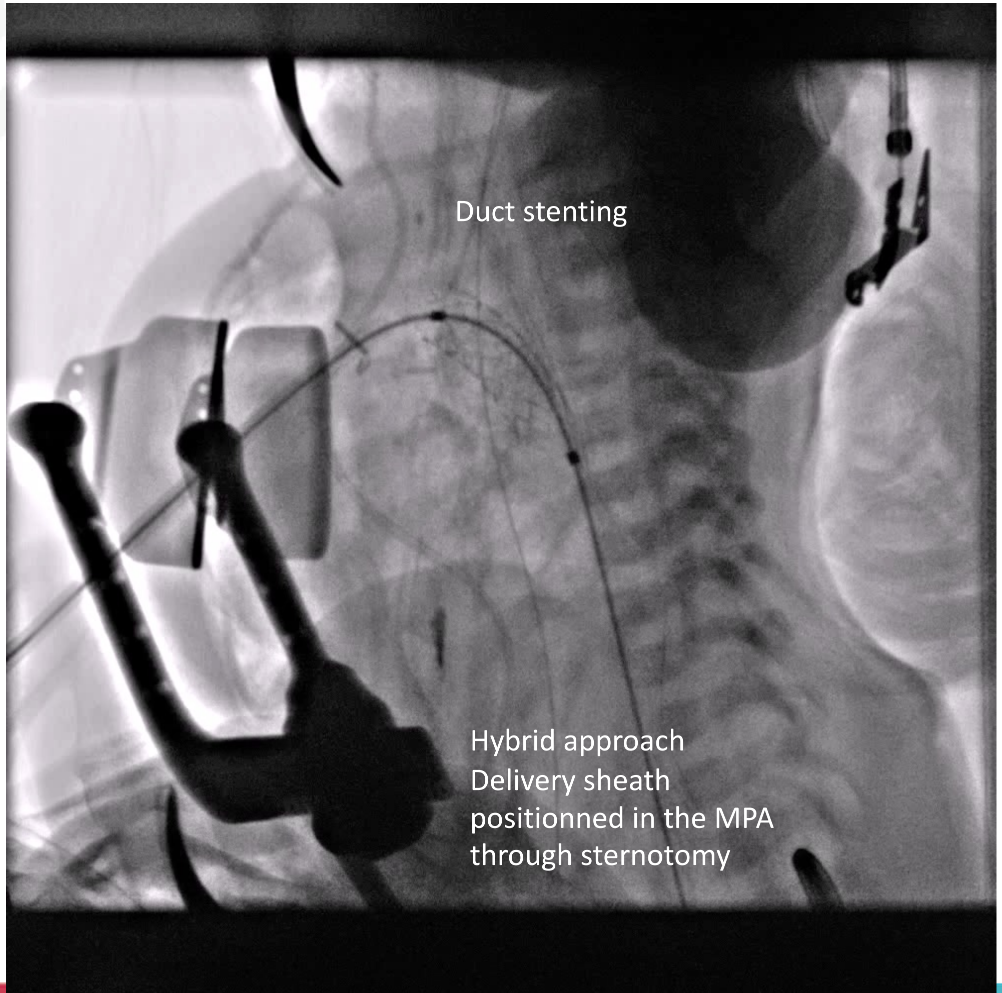
RV-PA Conduit

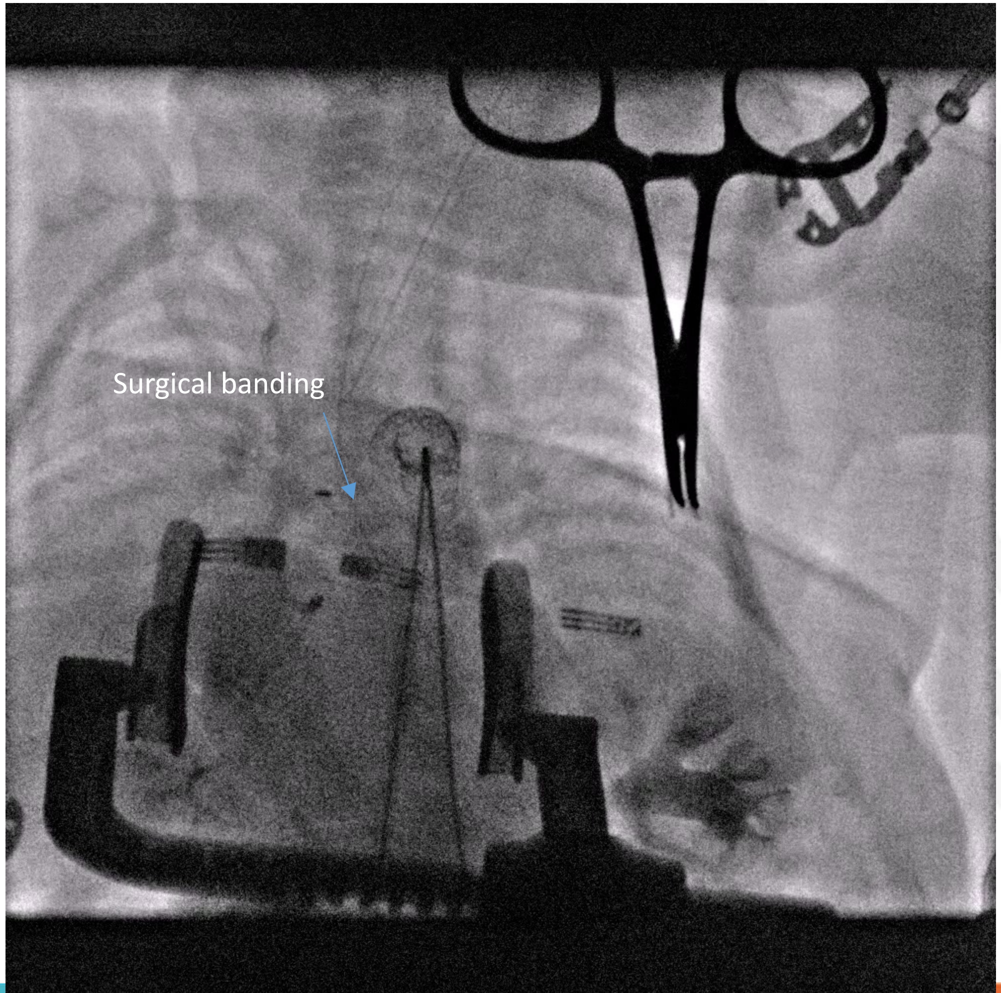




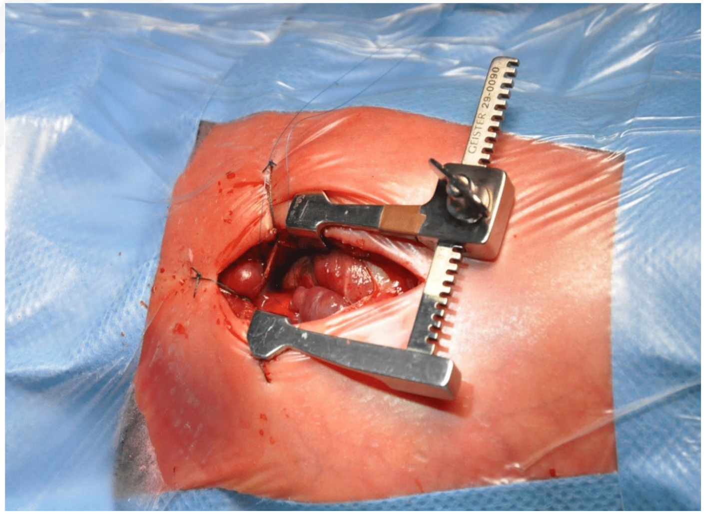
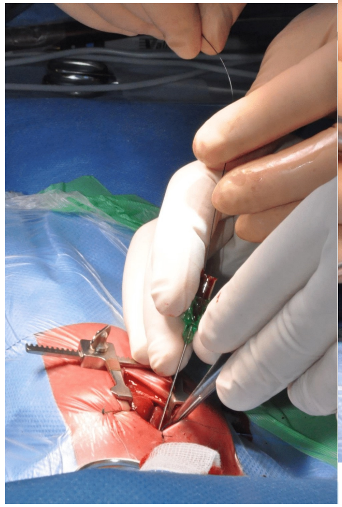
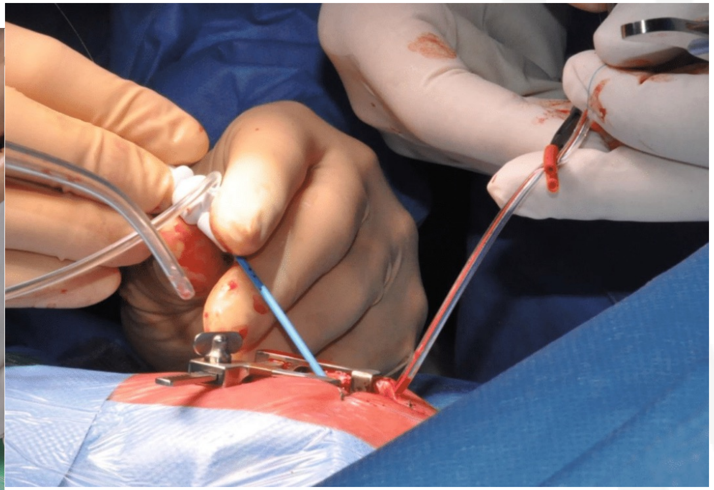
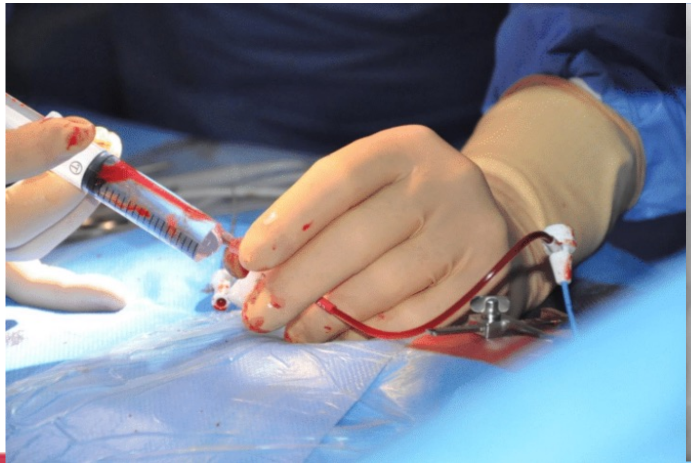
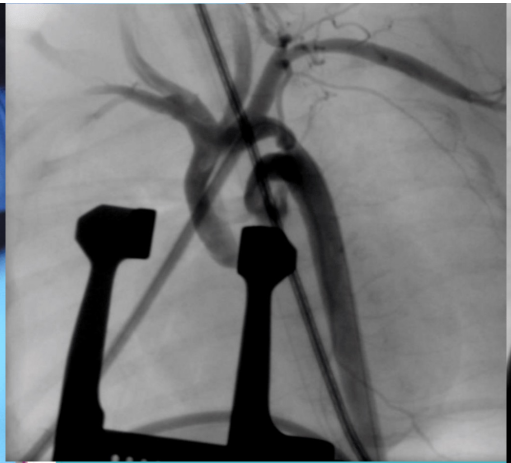
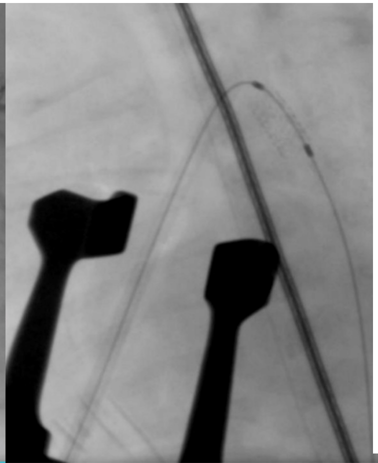
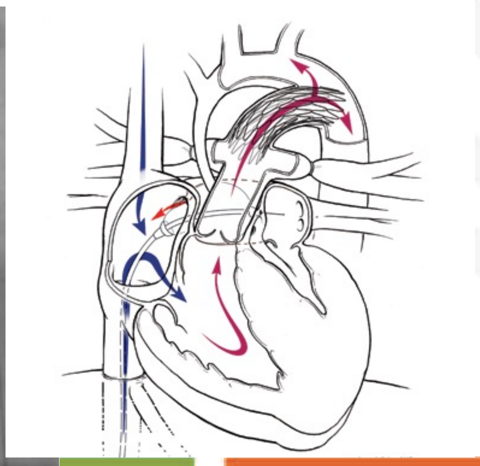
Hybrid palliation

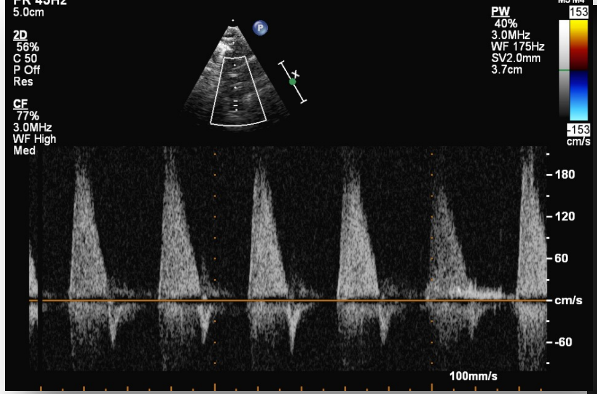
- create a balanced physiology where the single RV supplies the systemic and the pulmonary circulation.
- complex aortic arch reconstruction (including CPB) is postponed to the stage 2 (Glenn)



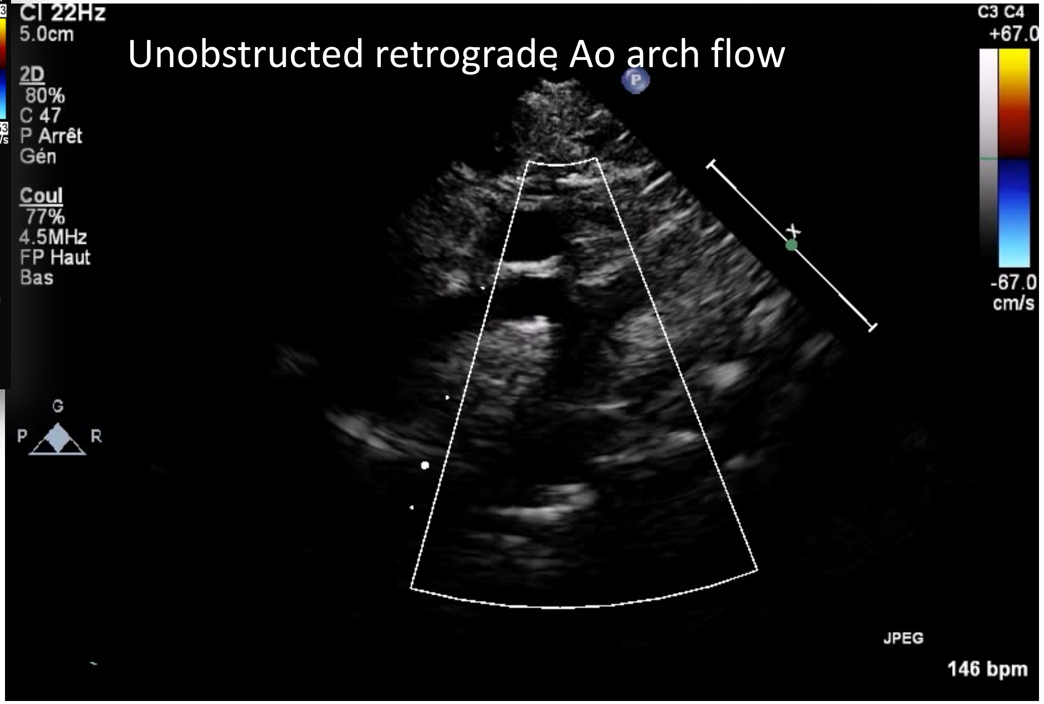


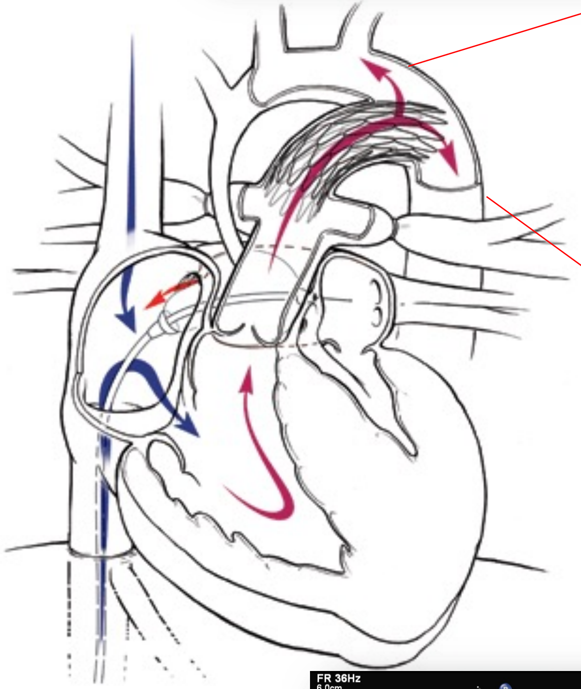
Hybrid procedure

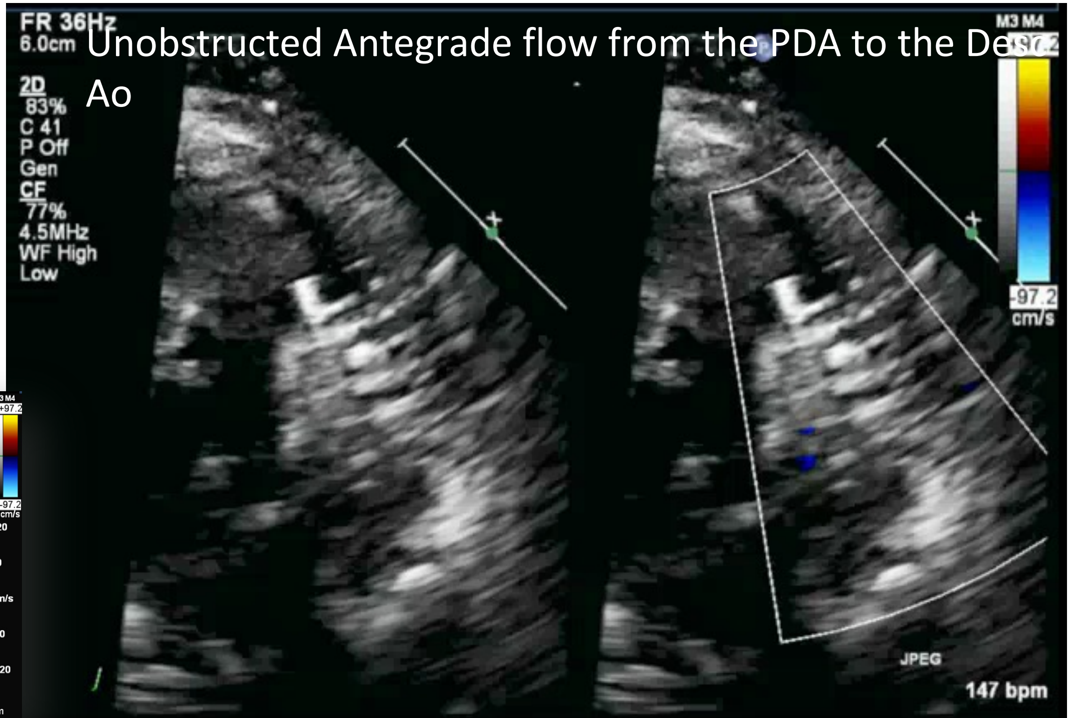


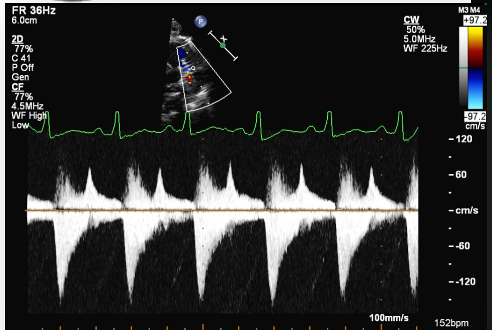
Unobstructed retrograde Ao arch flow

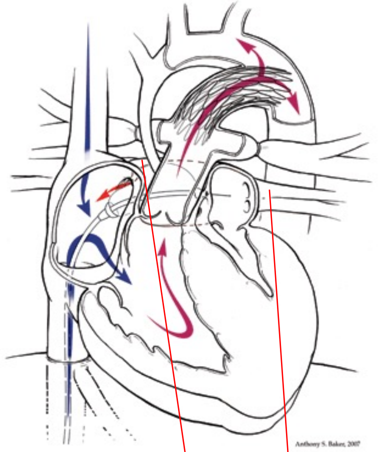


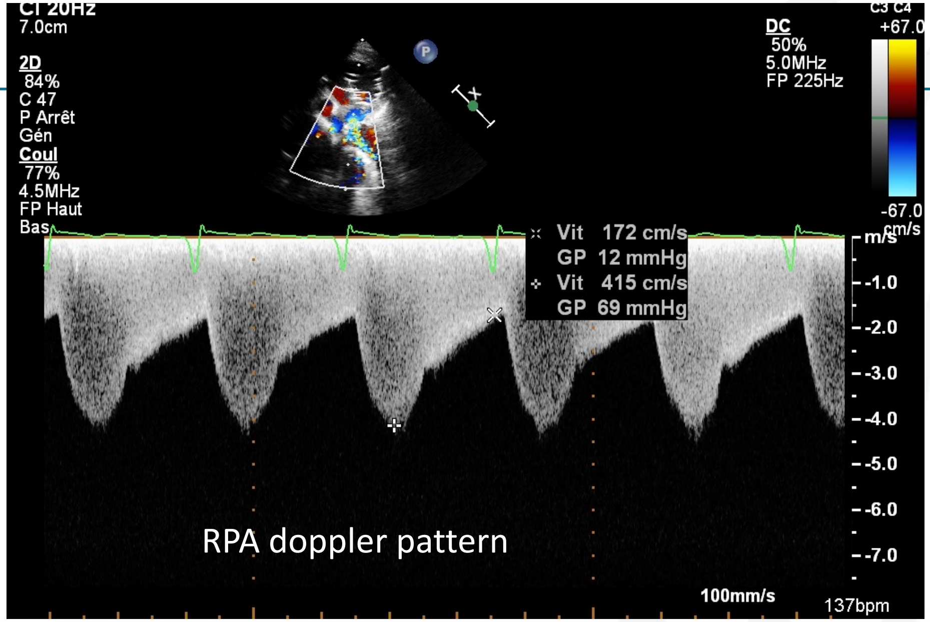


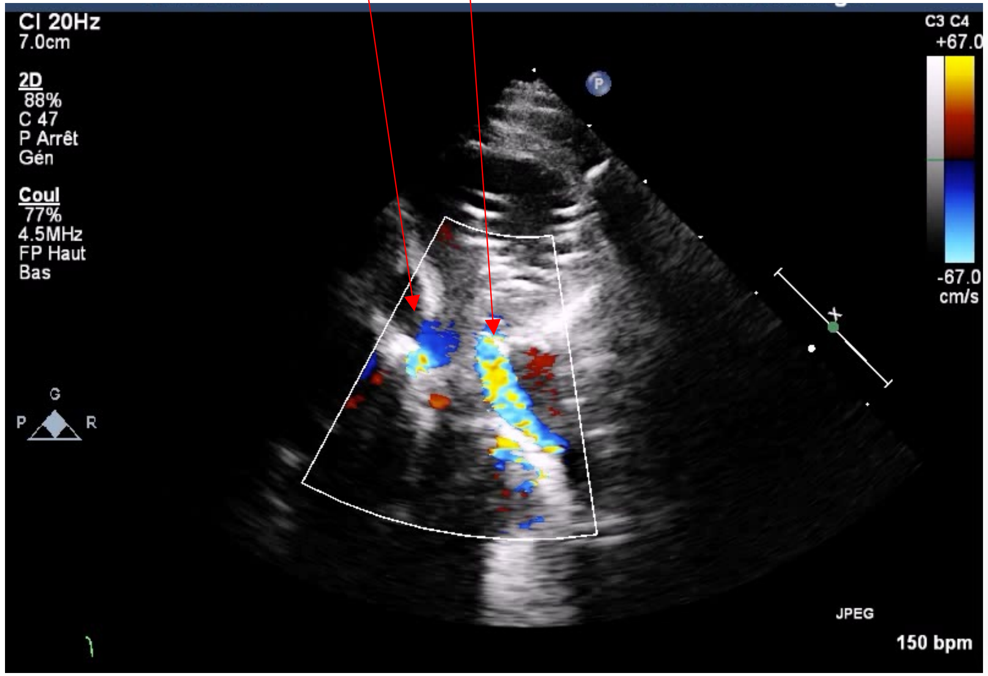
Unobstructed Antegrade flow from the PDA to the Des Ao

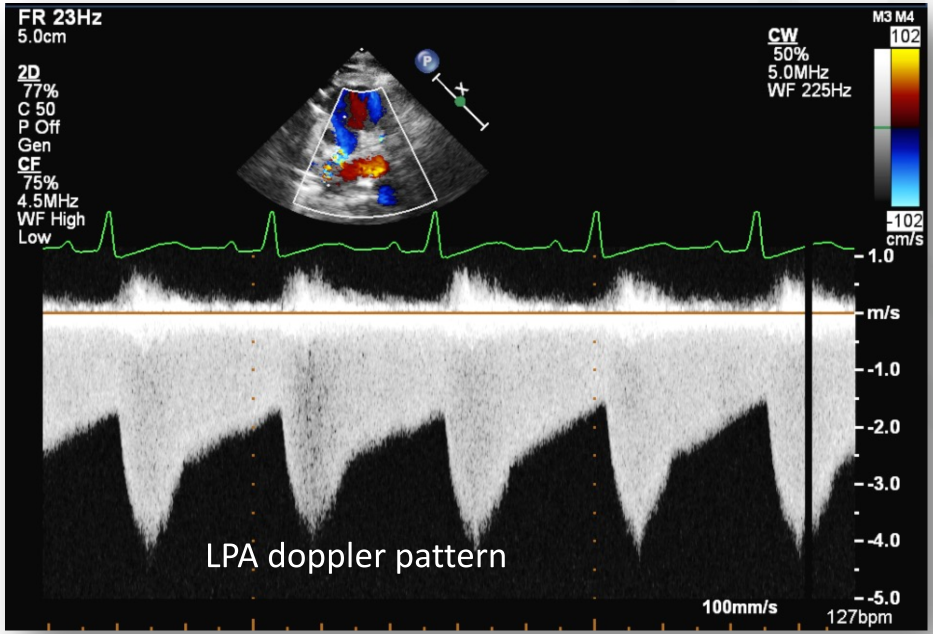







CI 20Hz
7.0cm
2D
84%
C 47
P Arrêt
Gén
Coul
77%
4.5MHz
FP Haut
Bas
DC
50%
5.0MHz
FP 225Hz
+67.0
-67.0
cm/s
Vit 172 cm/s
GP 12 mmHg
Vit 415 cm/s
GP 69 mmHg
m/s
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
RPA doppler pattern
100mm/s
137bpm


CI 20Hz
7.0cm
2D
88%
C 47
P Arrêt
Gén
Coul
77%
4.5MHz
FP Haut
Bas
C3 C4
+67.0
-67.0
cm/s
G
P
R
JPEG
150 bpm


FR 23Hz
5.0cm
2D
77%
C 50
P Off
Gen
CF
75%
4.5MHz
WF High
Low
M3 M4
CW
50%
5.0MHz
WF 225Hz
102
-102
cm/s
1.0
m/s
-1.0
-2.0
-3.0
-4.0
-5.0
LPA doppler pattern
100mm/s
127bpm

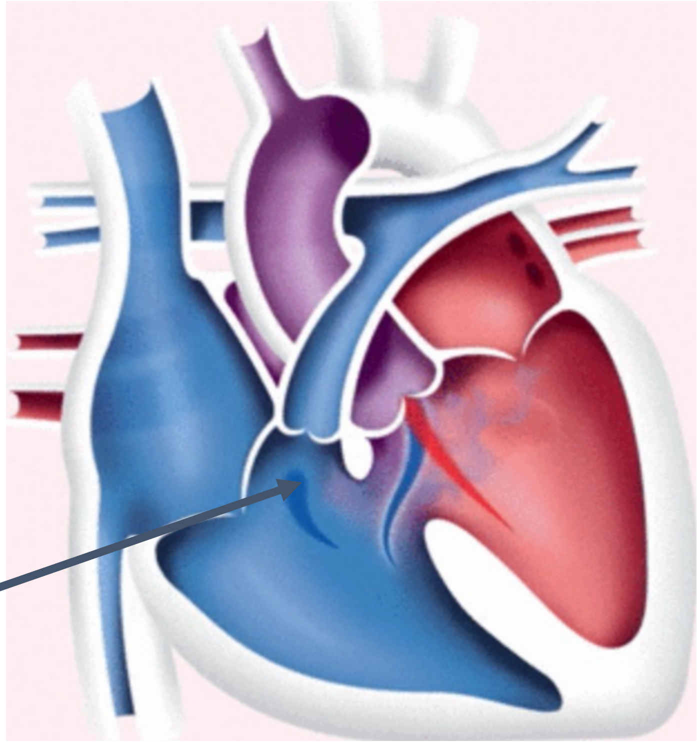
Merci pour votre attention

ALTERNATIVE AU BT SHUNT: STENTING infundibulaire

SIÈGE DE L'OBSTACLE

INFUNDIBULUM

Stenting RVOT



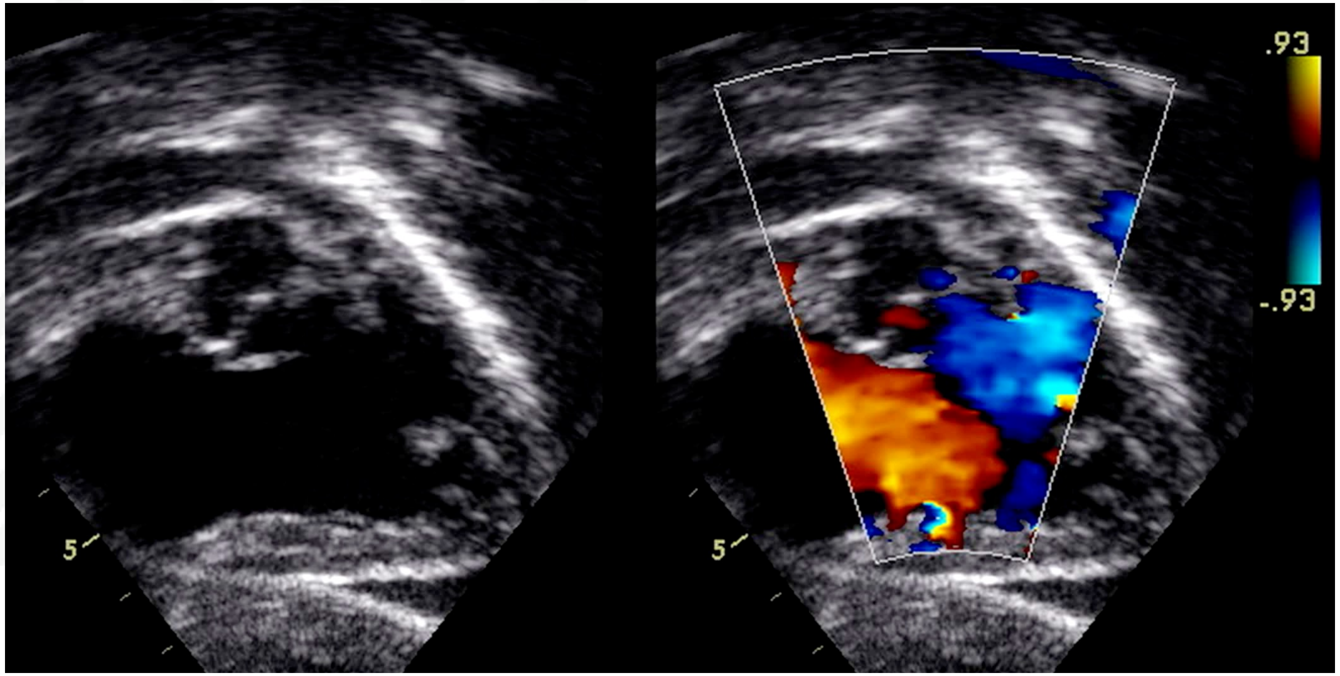
RATIONNEL

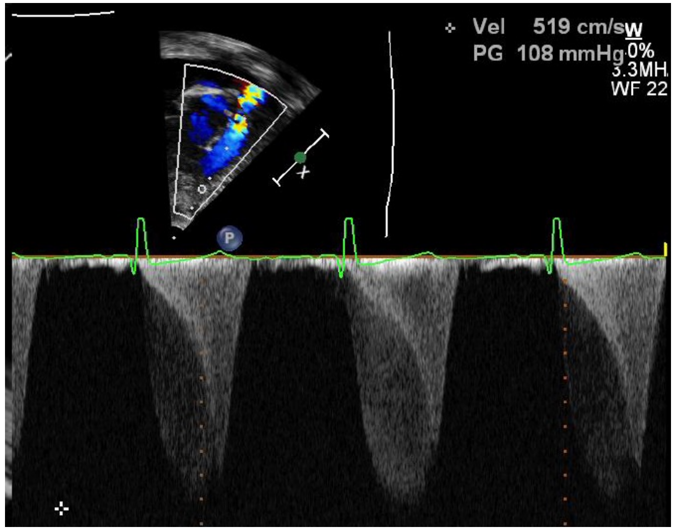
- Ouverture VD-AP sans CEC
- Eviter les effets délétères des shunts

LIMITES

- Taille du stent (hyper/hypodébit)
- Abord vasculaire
- Sélection des patients

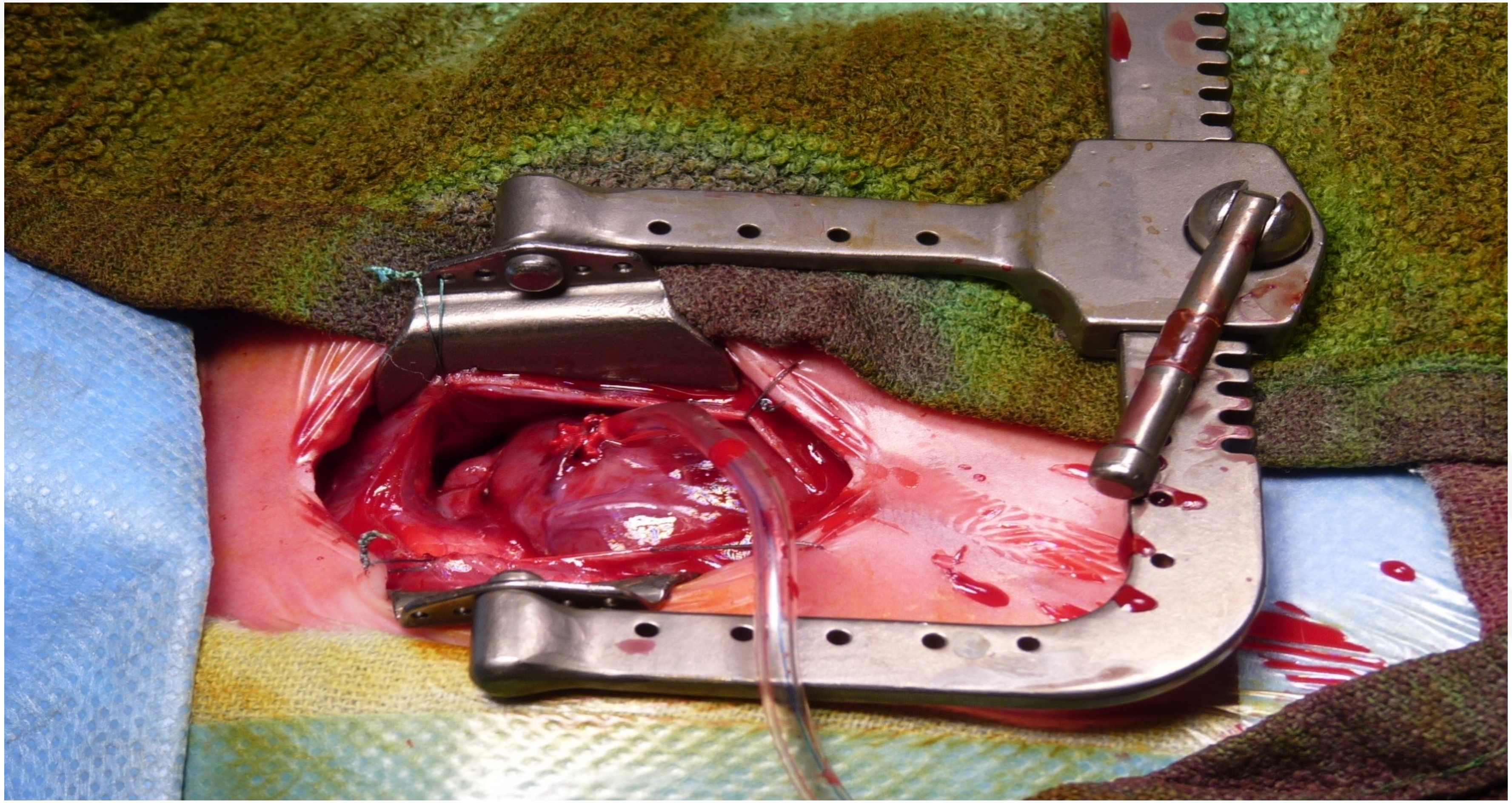
CAS CLINIQUE





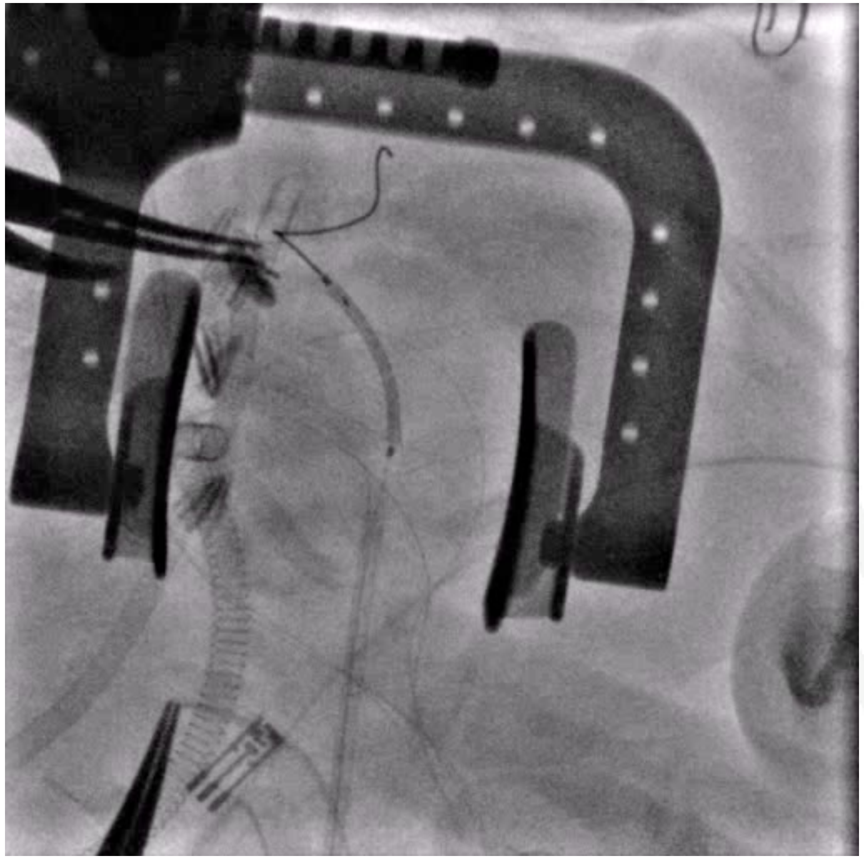
- TOF, Diagnostic anténatal
- Prématurité 30 SA, PN=1800g
- Saturation: 68%, obstacle infundibulaire +++
- PGE1
- Discussion médico-chirurgicale
    - Anastomose systémico-pulmonaire
    - Ouverture VD-AP
    - Stenting infundibulaire
- => Stenting VD-AP par Abord hybride

CAS CLINIQUE

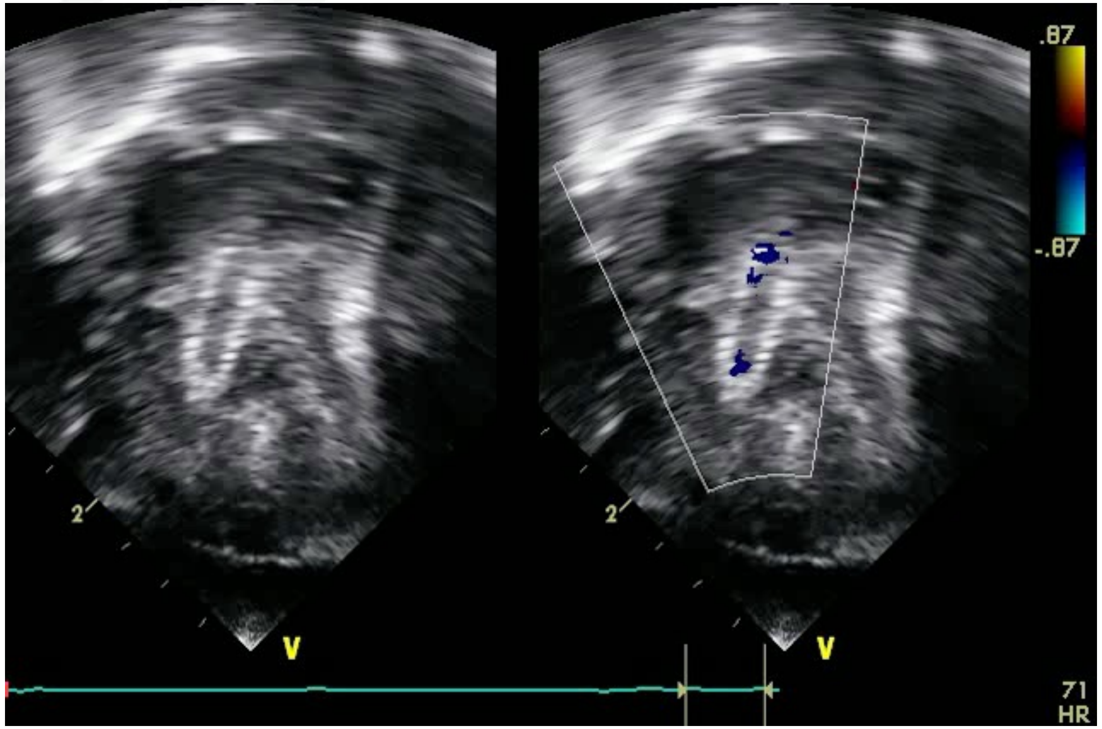


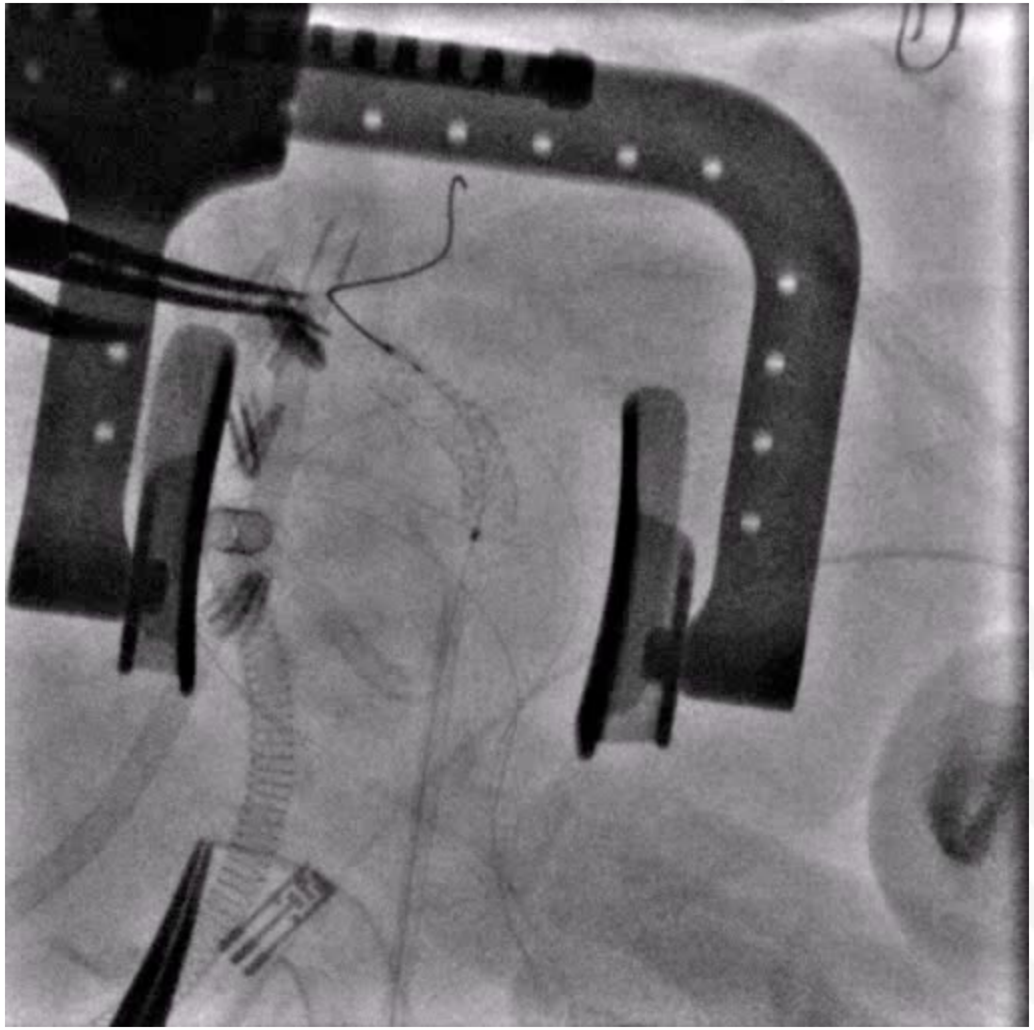
CAS CLINIQUE

Stent Coronaire 5 x 20-mm



CAS CLINIQUE

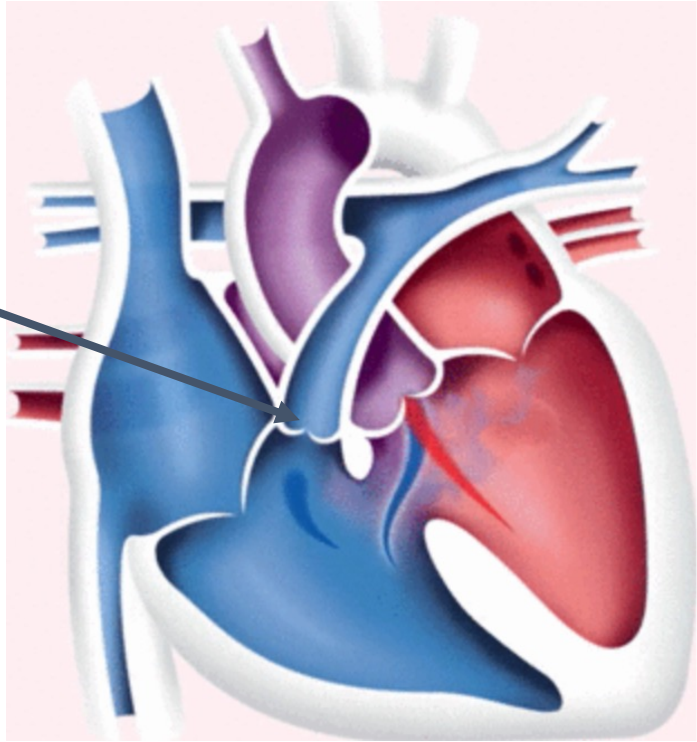




ALTERNATIVE AU BT SHUNT:dilatation /perforation pulmonaire

SIÈGE DE L'OBSTACLE

VALVE
Dilatation
Perforation



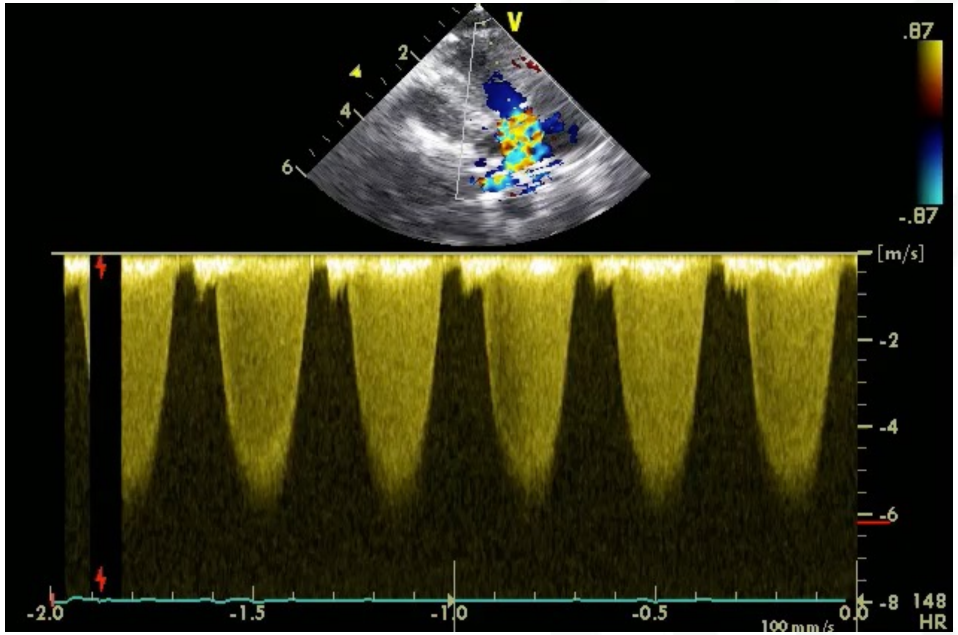
STÉNOSE PULMONAIRE CRITIQUE vs ATRÉSIE PULMONAIRE À SEPTUM INTACT

OBSTACLE VALVULAIRE

Recommendations for Pulmonary Valvuloplasty

Class I

1. Pulmonary valvuloplasty is indicated for a patient with critical valvar pulmonary stenosis (defined as pulmonary stenosis present at birth with cyanosis and evidence of patent ductus arteriosus dependency), valvar pulmonic stenosis, and a peak-to-peak catheter gradient or echocardiographic peak instantaneous gradient of ≥40 mm Hg or clinically significant pulmonary valvar obstruction in the presence of RV dysfunction (*Level of Evidence: A*).

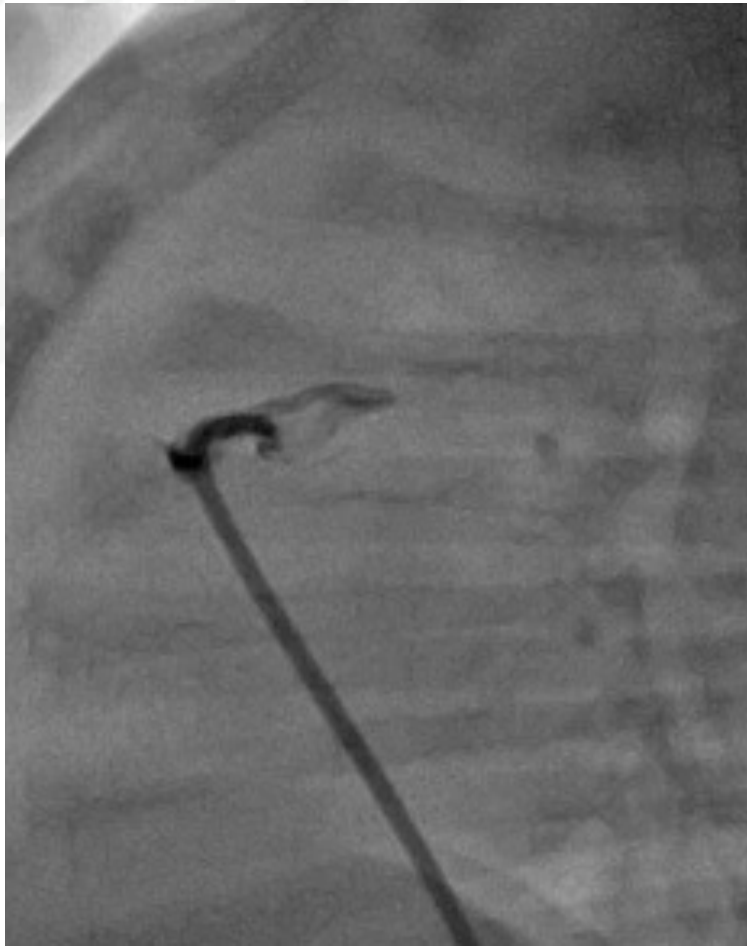


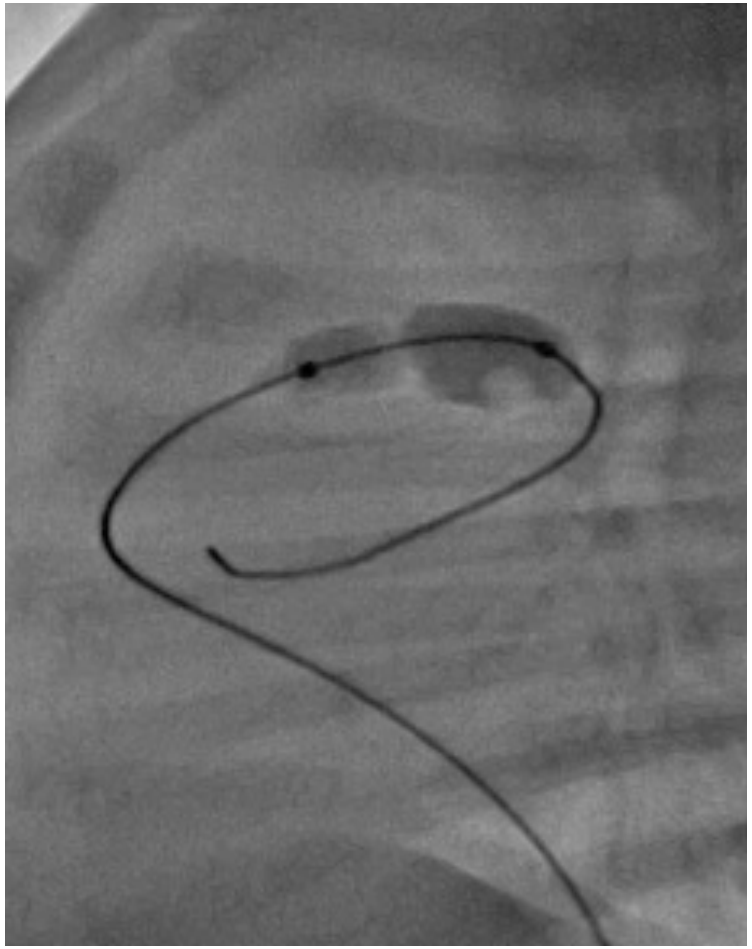
Class IIb

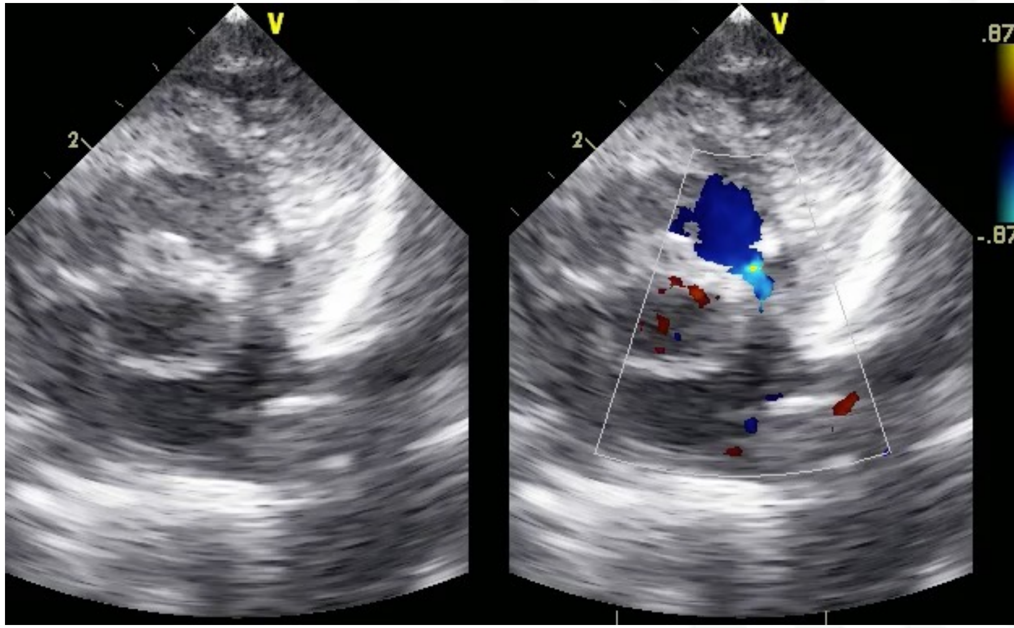
1. Pulmonary valvuloplasty may be considered as a palliative procedure in a patient with complex cyanotic CHD, including some rare cases of tetralogy of Fallot (*Level of Evidence: C*).

OBSTACLE VALVULAIRE

VALVULOPLASTIE AU BALLON
Taille Ballon = 120 à 150% de l'anneau





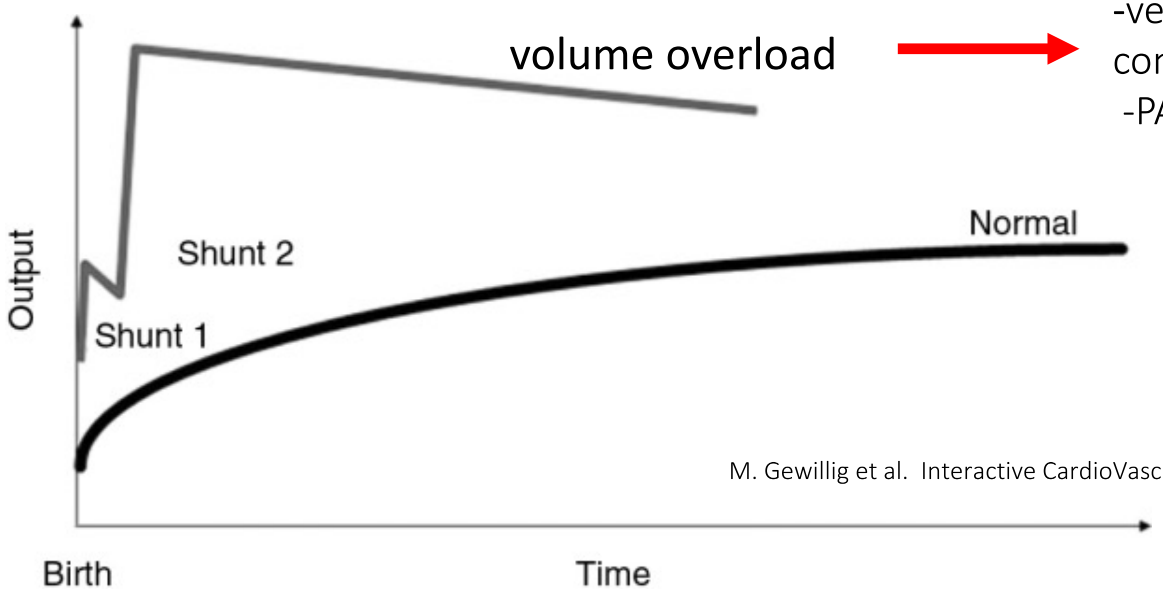


Succès > 95% (Noonan)
Complications faibles

Single ventricle physiology

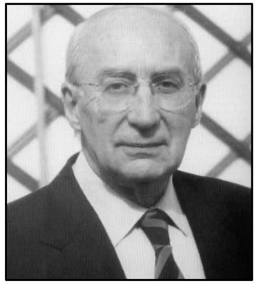
Palliation for UVH in the 1950–1960s

- large systemic to pulmonary artery (PA) shunts for adequate long-term relief of cyanosis
- dictum: “as pink as possible for as long as possible”
- few survivors beyond the 4th decade

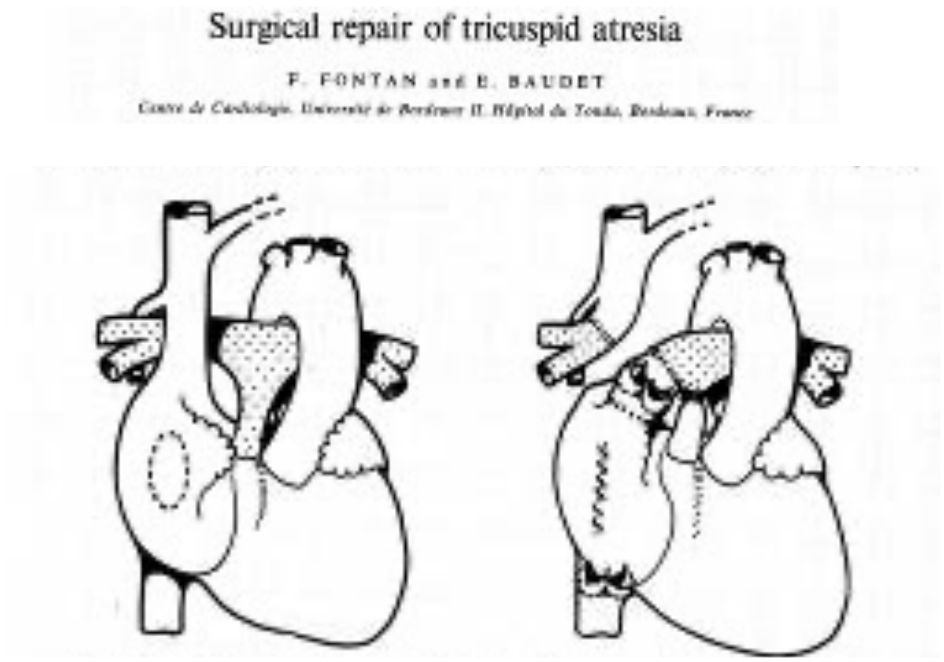


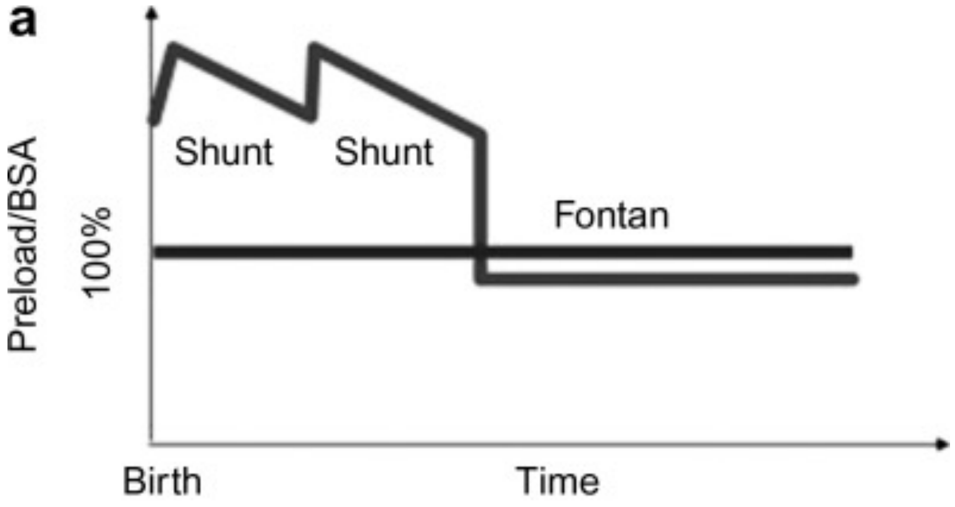
-ventricular dysfunction -congestive HF
-PAH

M. Gewillig et al. Interactive CardioVascular and Thoracic Surgery 2010



The Fontan operation



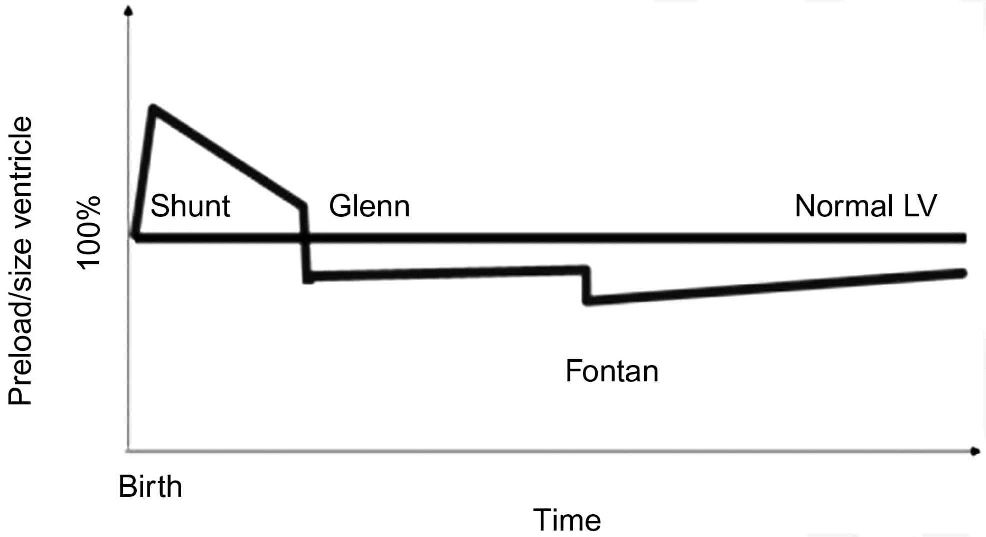


Emphasis shifted towards reducing
the volume load of the ventricle

M. Gewillig et al. Interactive CardioVascular and Thoracic Surgery 2010
Fontan et al. Ann Chir Thorac Cardiovasc 1971

UVH physiology: current strategy

- From 1990's: **The staged palliation**
  - early placement of a PCPC (Glenn)
- Technical modifications
  - Smaller neonatal shunt lasting few months
- Clinical outcomes improvements
- The dictum: "as blue as possible" in order to keep the ventricle maximally unloaded.



Emphasis further shifted to limitation of volume load as early as possible.

M. Gewillig et al. Interactive CardioVascular and Thoracic Surgery 2010