



CENTRE  
HOSPITALIER  
UNIVERSITAIRE  
BORDEAUX

université  
de BORDEAUX

# Création de shunt

**Le point de vue du cardiologue**

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# Quand ?



## Ductodépendance pour la perfusion pulmonaire

Fallot  
APSO (1-2)  
Ebstein  
APSI  
SVP critique

## Ductodépendance pour la perfusion systémique

HLHS  
IAA  
Coarctation aortique



**Quand ?**

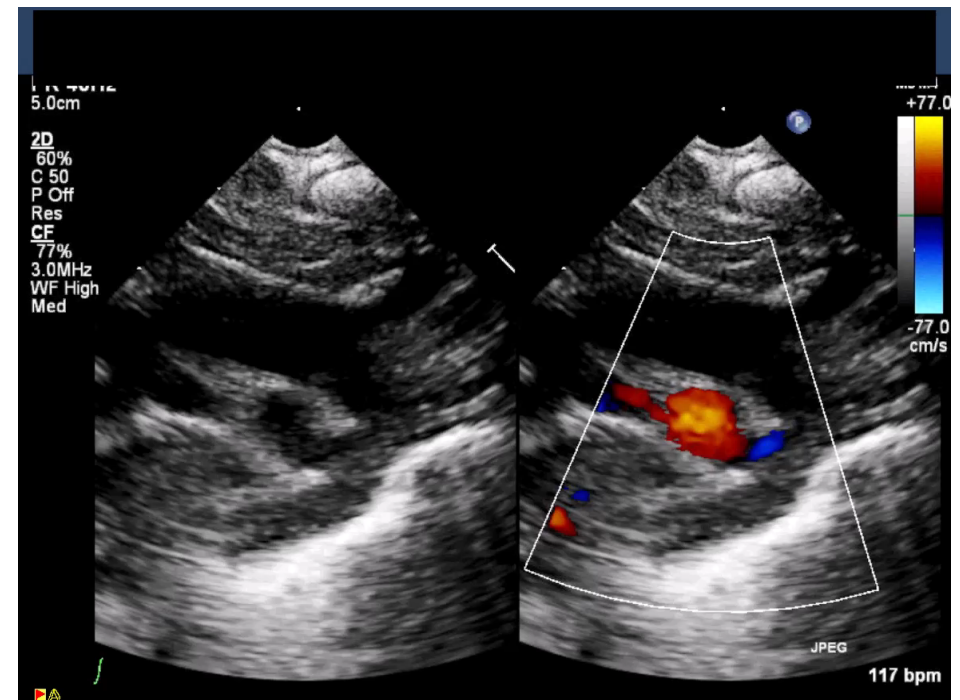
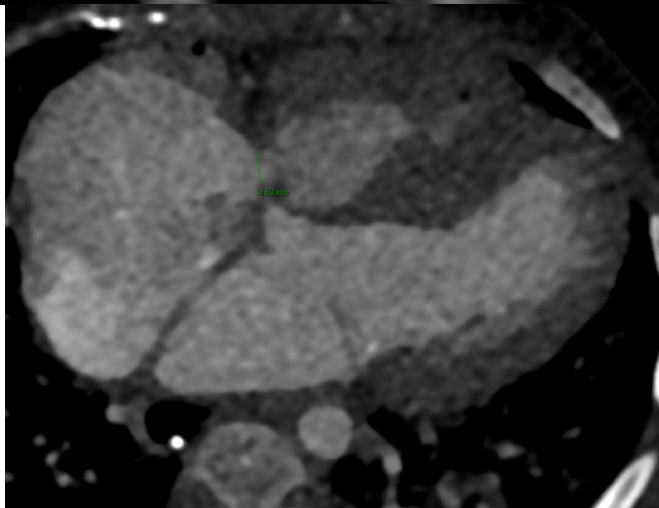
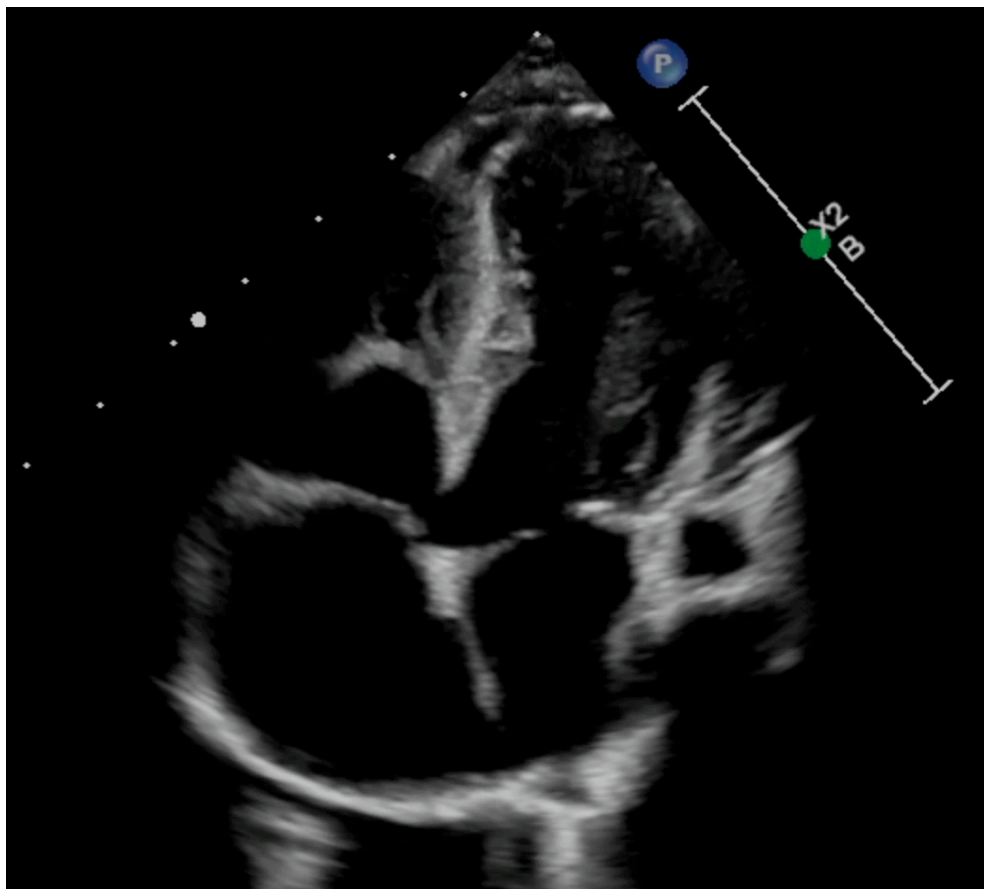


**Ductodépendance  
pour la perfusion  
pulmonaire**

**Ductodépendance  
pour la perfusion  
systémique**

# Ductodépendance pulmonaire

- **Définition** : Atrésie ou hypoplasie de la voie d'éjection pulmonaire sans autre suppléance (MAPCA) → dépendance du CA pour la circulation pulmonaire
- **Conséquence** : désaturation à la fermeture du CA
- **Prise en charge immédiate** :
  - Prostine
  - 250 ug/50 ml G5 : 0,025 ug/kg/min
- **Prise en charge plus durable** : **shunt systémico-pulmonaire**



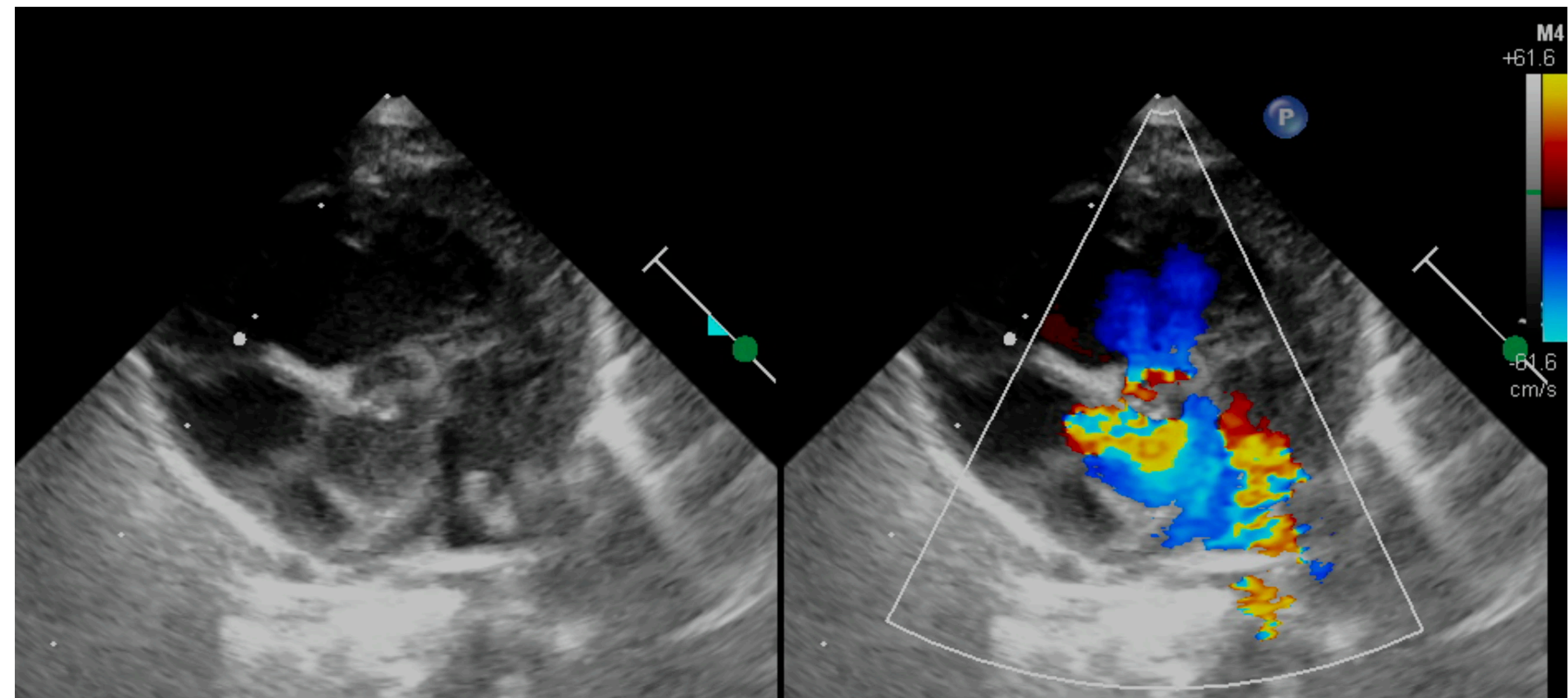
M4

+61.6

-61.6

cm/s

P



# Ductodépendance pulmonaire

## Objectifs du shunt systémico-pulmonaire :

- Survie en attente de la cure complète
- Assurer la croissance des AP en prévenant la distorsion
- En gardant un équilibre du  $Q_p/Q_s$

# Ductodépendance pulmonaire

Quel shunt ?



**BTT shunt**



**Stenting CA**

Ou Prostine au long cours

# Ductodépendance pulmonaire

Quel shunt ?



**BTT shunt**

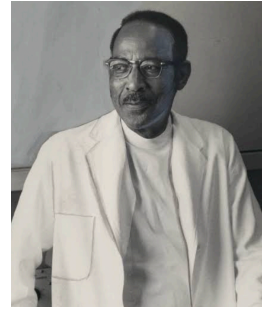


**Stenting CA**

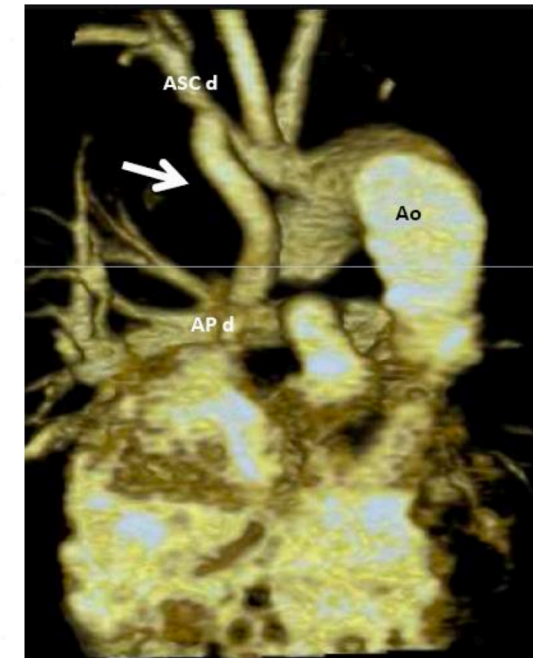
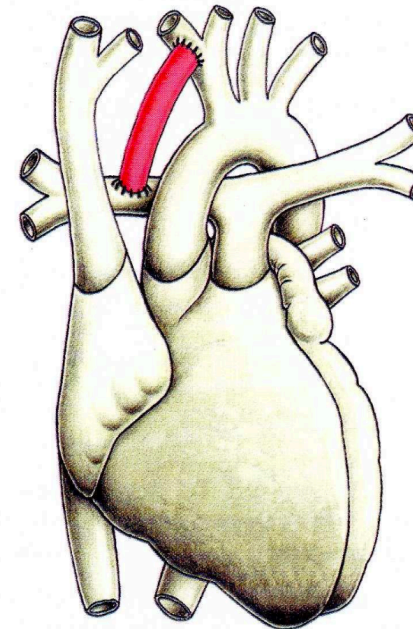
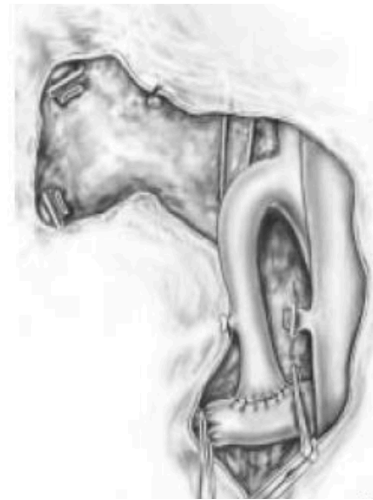
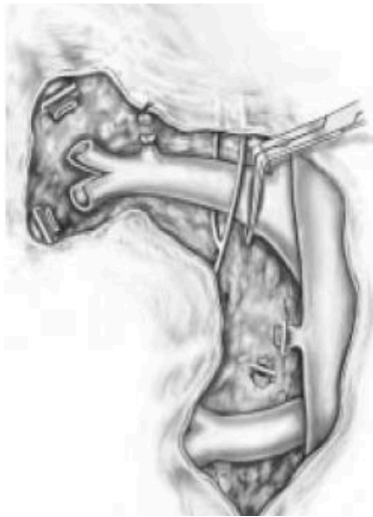
Ou Prostine au long cours



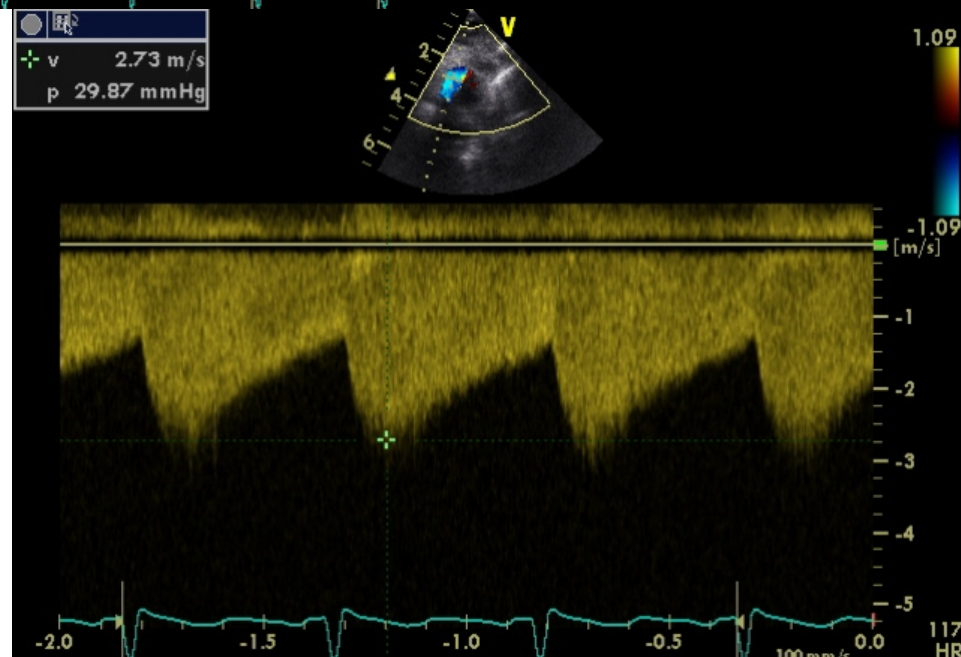
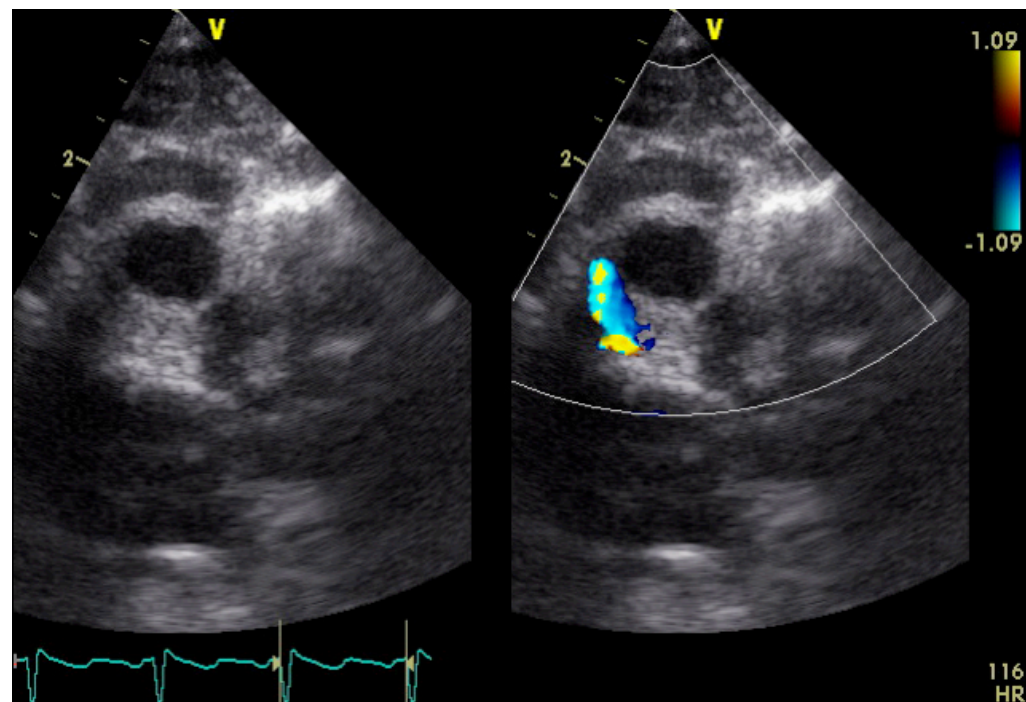
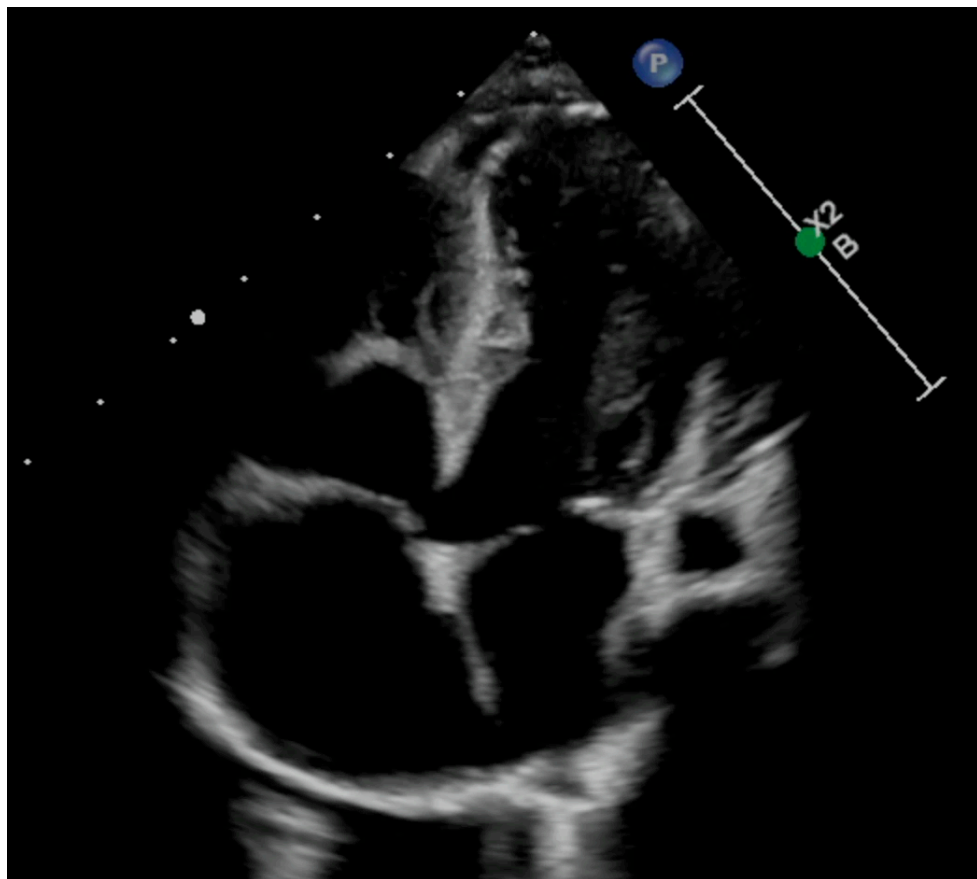
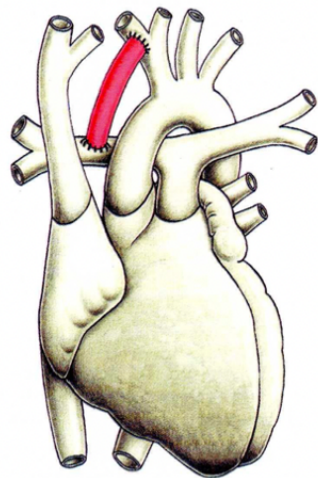
# Blalock – Taussig – Thomas Shunt



- 1ère intervention en 1944 (John Hopkins Hospital, Baltimore)
- Initialement connexion directe ASC sur AP
- Distorsion AP, difficulté d'équilibre et de reproductibilité du Qp/Qs
- Désormais modified BTTS : Tube prothétique en PTFE (3 à 4 mm) entre ASC et AP
- Sternotomie le + souvent. Souvent sans CEC.







# Evaluation ETT du Blalock

- **Visualisation sur toute la longueur** pour confirmer la bonne perméabilité et le bon calibre
- **Vmax du Blalock** : peu utile, dépend de
  - 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
- **VP** :
  - Perméabilité en faveur d'une bonne perméabilité de l'AP
  - Vmax : oriente vers hyperdébit si  $> 0,8 \text{ m/s}$
- **VTD isthme aortique** : reflux attendu, oriente vers hyperdébit  $> 20 \text{ cm/s}$
- **Reflux aorte abdominale**

# Qp/Qs

$$\frac{\text{Sat O}_2 \text{ Ao} - \text{Sat O}_2 \text{ VC}}{\text{Sat O}_2 \text{ VP} - \text{Sat O}_2 \text{ AP}} \rightarrow 30$$

$$100 \leftarrow \text{Sat O}_2 \text{ VP} - \text{Sat O}_2 \text{ AP} \rightarrow \text{Sat O}_2 \text{ Aorte}$$



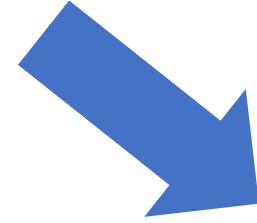
$$\frac{30}{100 - \text{SpO}_2}$$



SpO2 90% : Qp/Qs à 3  
SpO2 85% : Qp/Qs à 2  
SpO2 70% : Qp/Qs à 1  
SpO2 50% : Qp/Qs à 0,6



## Tableau



### Hyperdébit pulmonaire :

- Insuffisance cardiaque
- $SpO_2 > 90\%$
- RT surchargée

### Hypodébit systémique :

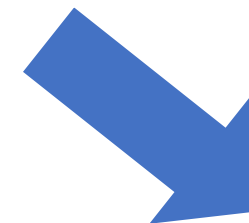
- Hypoperfusion cérébrale / NIRS  
cérébrales basses
- PAM et PAD : basses
- Vol diastolique coronarien
- Entérocolite
- Insuffisance rénale
- **ETT** : vol diastolique (VTD isthme,  
reflux AA), augmentation retour  
gauche (Vmax VP)
- **Biologie** : lactates / cytolyse  
hépatique / hyperkaliémie /  $SvO_2 < 25\%$  de la  $SaO_2$

$Q_p/Q_s$

- $SpO_2 < 70\%$
- PAD normale ou haute
- RT : hypoperfusion



## Causes



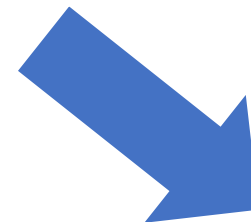
$Q_p/Q_s$

- **Baisse RVP :**
  - *FiO2 trop élevée*
  - *Alcalose ou hypocapnie*
  - *Hématocrite normale ou basse*
- **Élévation RVS :**
  - *Douleur/agitation*
  - *HTA*
  - *Hypothermie*
- **Structurelle :** Blalock trop grand

- **Augmentation RVP :**
  - *Pré-capillaire :*
    - *Acidose/hypoxie/hypercapnie*
    - *Cause pneumologique : atélectasie, épanchement pleural, pneumothorax, pneumopathie, ...*
  - *Post-capillaire :* *dysfonction VU, fuite VAV, ...*
- **Baisse RVS :**
  - *Hyperthermie*
  - *Vasodilatation*
  - *Antalgie/sédation*
- **Structurelle :**
  - *Blalock trop petit*
  - *Thrombose Blalock*



## Prise en charge



$Q_p/Q_s$

- **Augmenter RVP :**

- Accepter acidose/hypercapnie
- $FiO_2$  21%
- PEP
- $Hg > 15g/dl \rightarrow$  Fer, CGR

- **Baisser RVS :**

- Antalgie/sédation
- Vasodilatateurs (MILRINONE), IEC
- Élévation  $T^\circ$  de  $0,5^\circ C$

- **Si inefficace : reprise chirurgicale ++ (clip du Blalock, stenting Blalock pour baisse calibre, changement du Blalock, ...)**

- **Baisser RVP :**

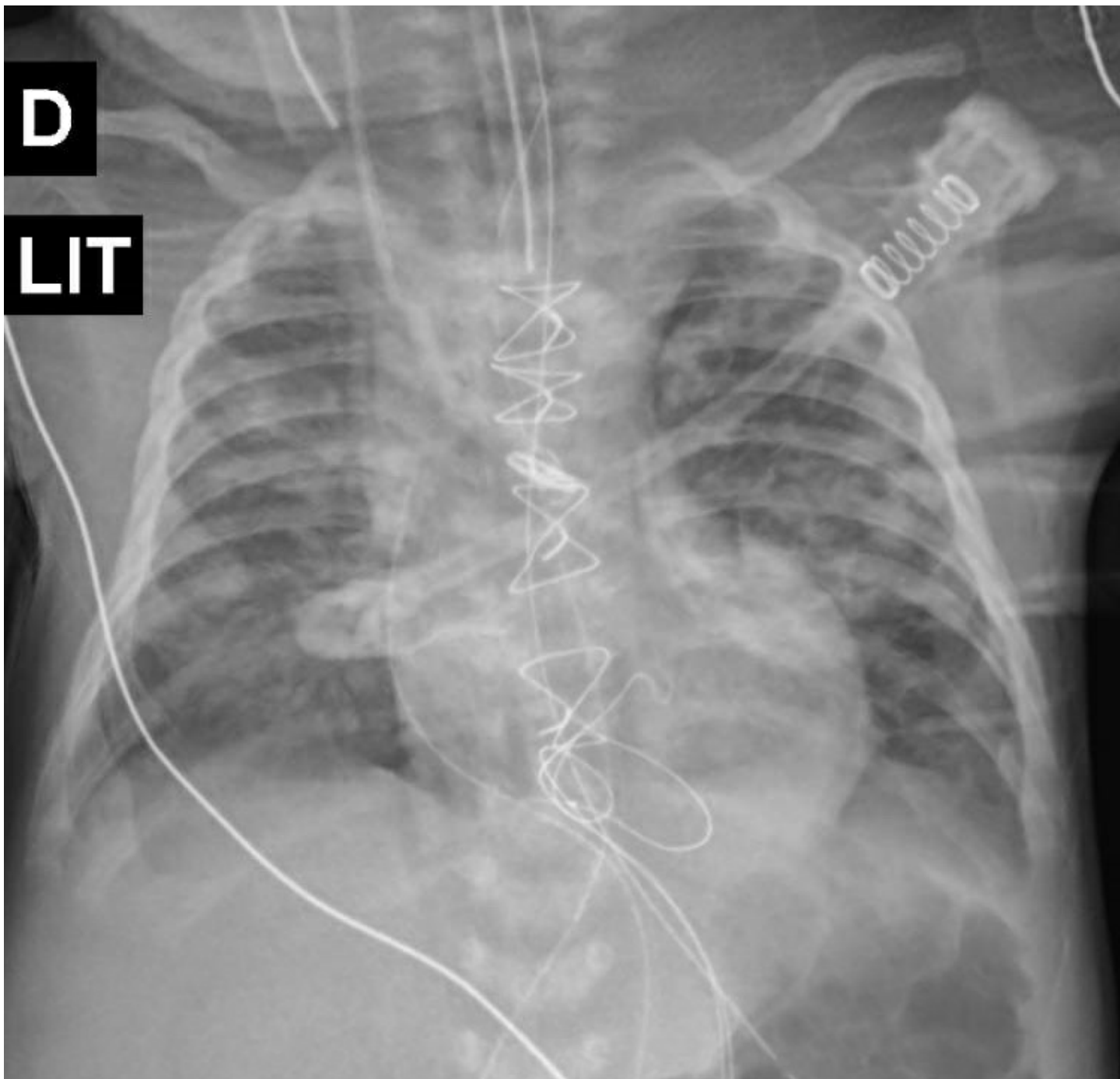
- Normalisation  $pH/CO_2$
- $FiO_2$  100%
- NO
- Traitement d'une atteinte pulmonaire
- Abaisser Ht

- **Augmentation RVS :**

- Baisse  $T^\circ$  de  $0,5^\circ C$
- Baisse vasoplégants
- Vasopresseur (NAD, VP)

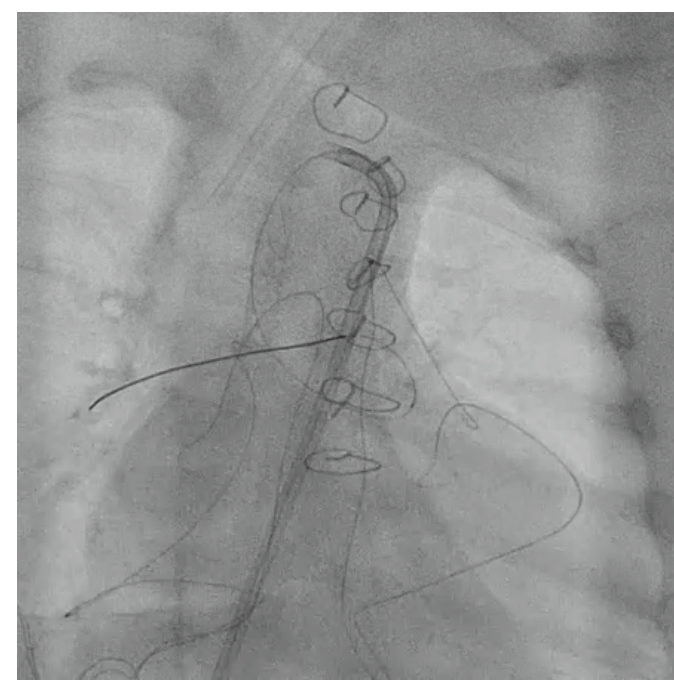
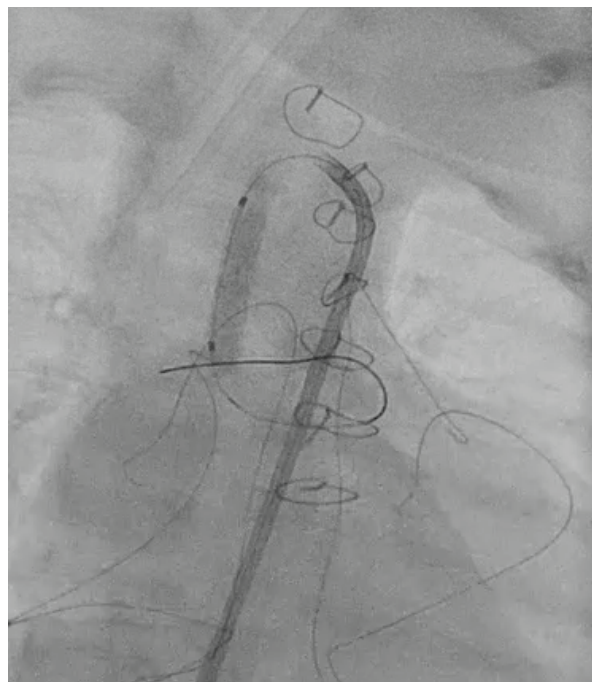
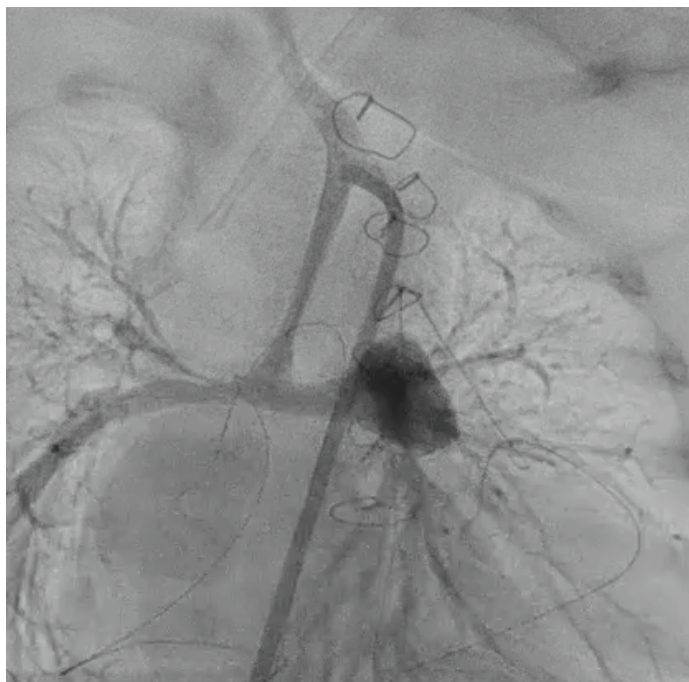
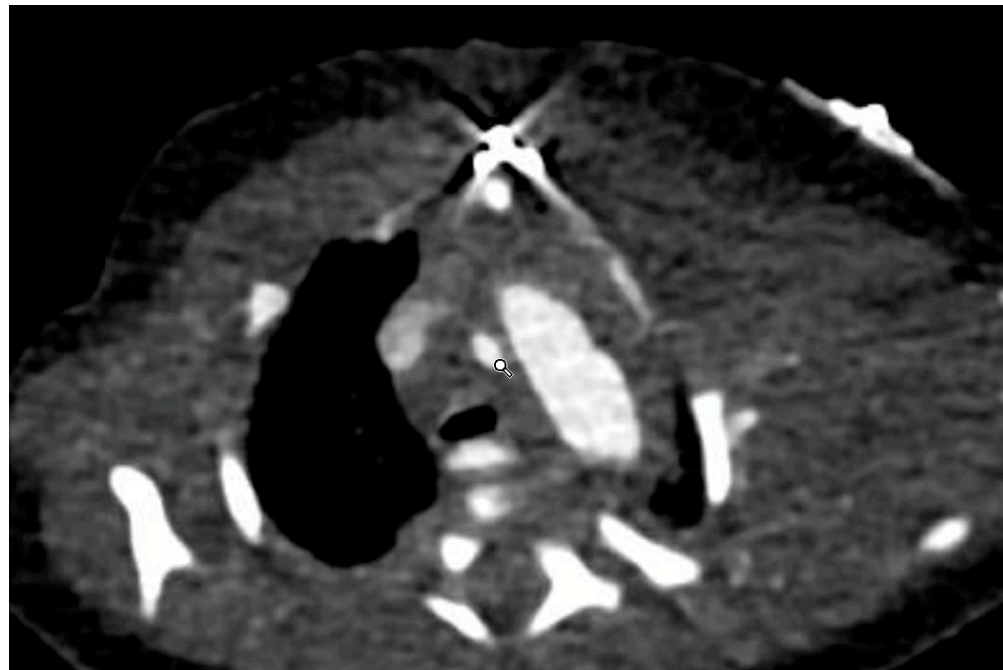
- **Traitement étiologie curable :**

- Thrombose Blalock
- Obstacle post-capillaire : VP, CIA, ..





PO5 Blalock sur APSI  
Désaturation progressive





# A Single-Centre Retrospective Review of Modified Blalock-Taussig Shunts: A 22-Year Experience



**Adrian Tarca, MBBS, BSc<sup>a,\*</sup>, Giulia Peacock, MBBS<sup>a</sup>,  
Elizabeth McKinnon, PhD<sup>b</sup>, David Andrews, FRACS<sup>c</sup>,  
Jelena Saundankar, FRACP<sup>a</sup>**

1 centre : Australie, Perth

185 Blalock

3,5 kg

Mortalité globale 13,5% (6% T4F, 19% APSI)

# Two Thousand Blalock-Taussig Shunts: A Six-Decade Experience

Jason A. Williams, MD, Anshuman K. Bansal, BS, Bradford J. Kim, BA,  
Lois U. Nwakanma, MD, Nishant D. Patel, BA, Akhil K. Seth, BS, Diane E. Alejo, BA,  
Vincent L. Gott, MD, Luca A. Vricella, MD, William A. Baumgartner, MD, and  
Duke E. Cameron, MD

Division of Cardiac Surgery, The Johns Hopkins Medical Institutions, Baltimore, Maryland

Article de 2007  
John Hopkins Hospital, Baltimore, Maryland  
62 ans  
2016 Blalock  
Baisse du nombre de procédure  
Baisse de la mortalité  
Diversification des pathologies

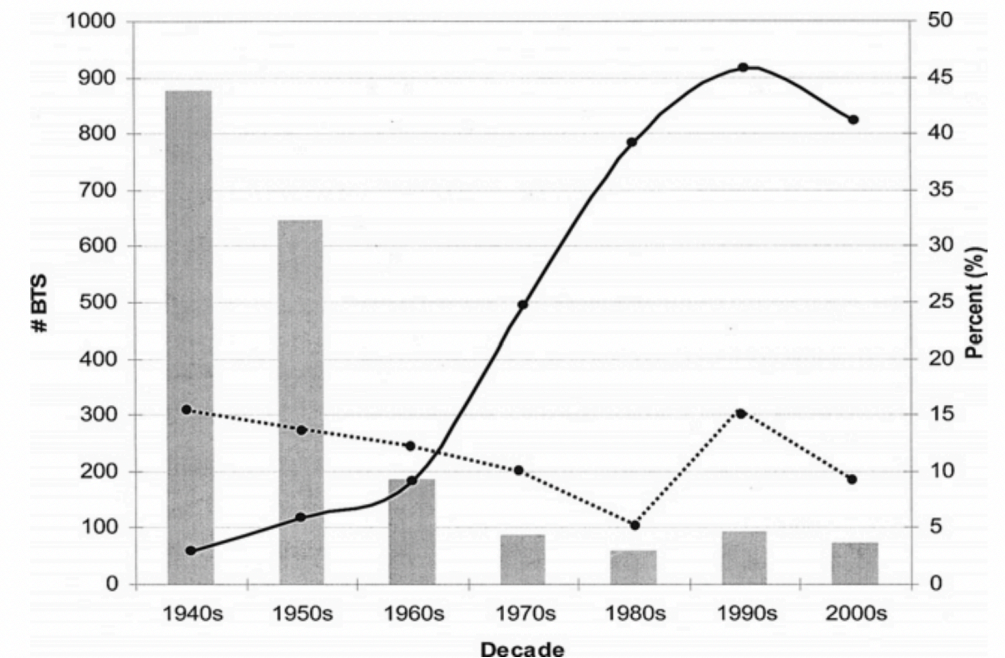


Fig 5. Number of Blalock-Taussig shunt (BTS; gray bars) procedures, percentage of operative mortality (dashed line), and percentage of single-ventricle patients (solid line) by decade.

# Ductodépendance pulmonaire

Quel shunt ?



**BTT shunt**



**Stenting CA**

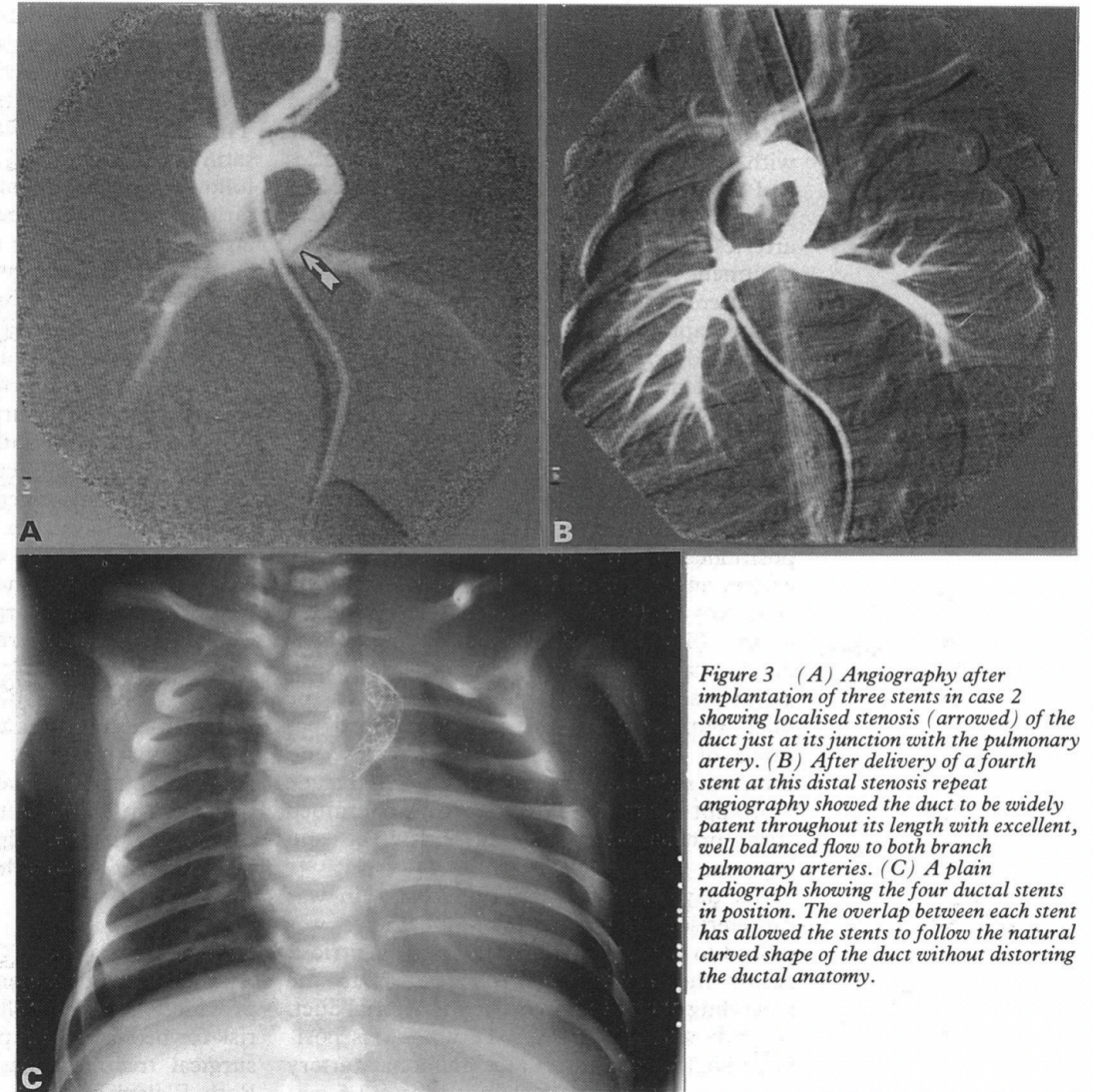


# Stenting canal artériel

*Br Heart J* 1992;67:240-5

## Stenting of the arterial duct: a new approach to palliation for pulmonary atresia

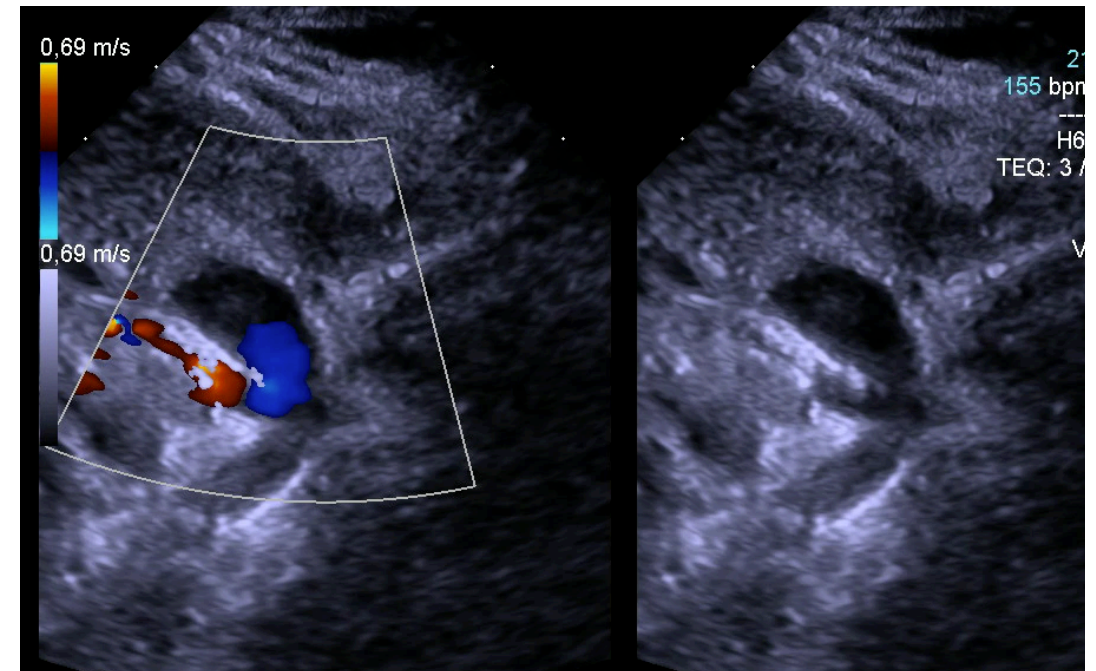
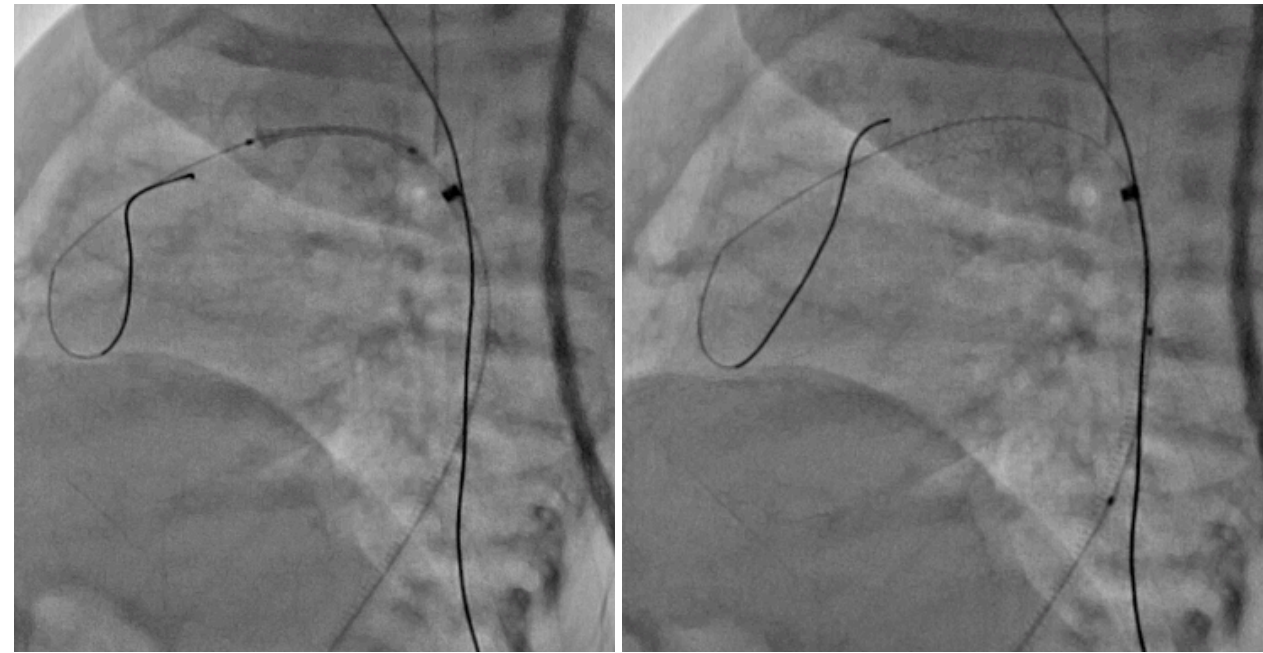
John L Gibbs, Martin T Rothman, Michael R Rees, Jonathan M Parsons,  
Mike E Blackburn, Carlos E Ruiz





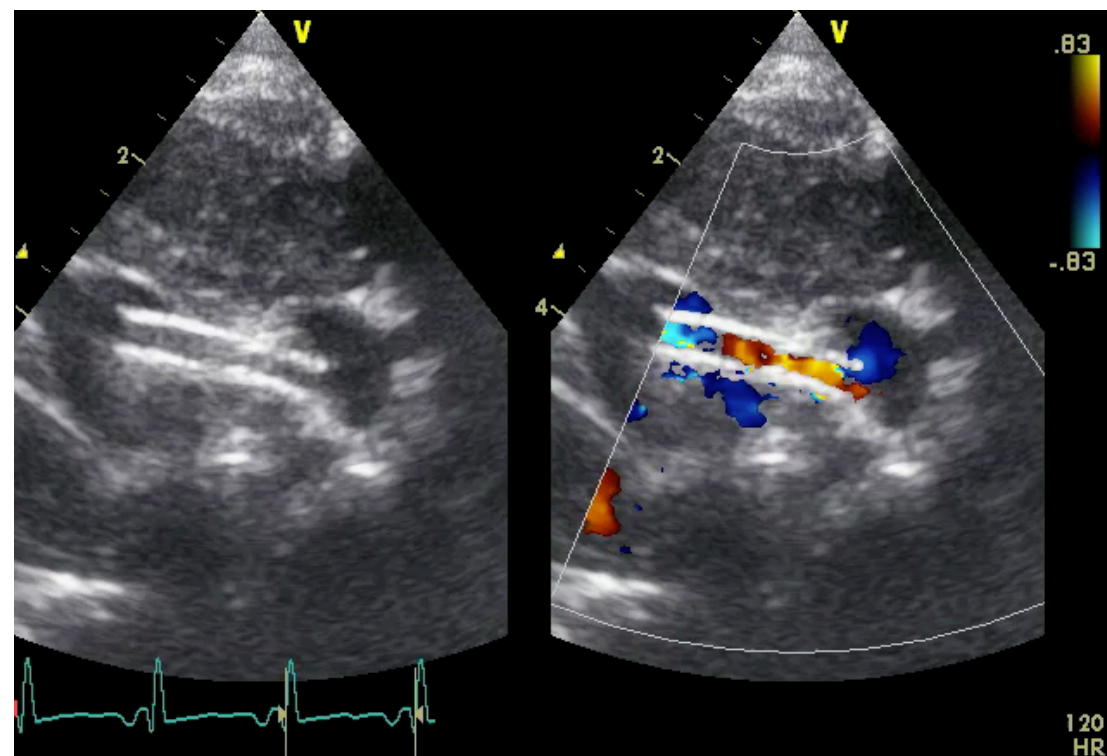
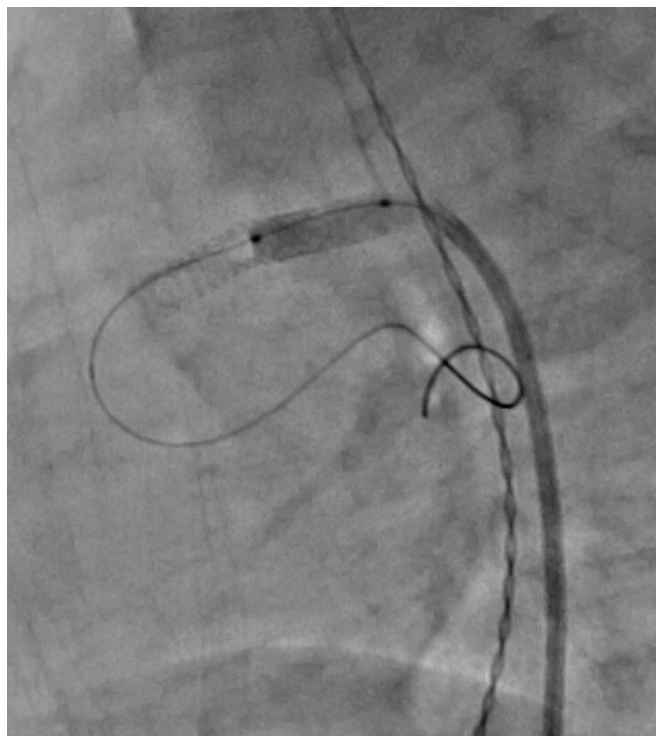
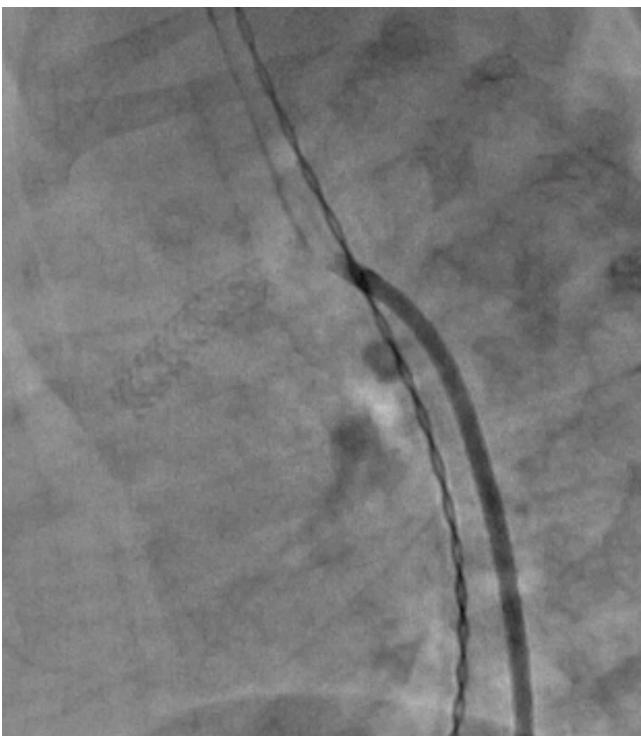
# Stenting canal artériel

- Cathétérisme
- Pas de sternotomie
- Risque de prolifération intrastent
- Déplacement du stent
- Abord retrograde, parfois carotidien
- Stents coronaires



- Même patient à 3 mois
- Désaturations importantes
- Sténose origine CA sur zone non couverte par le stent

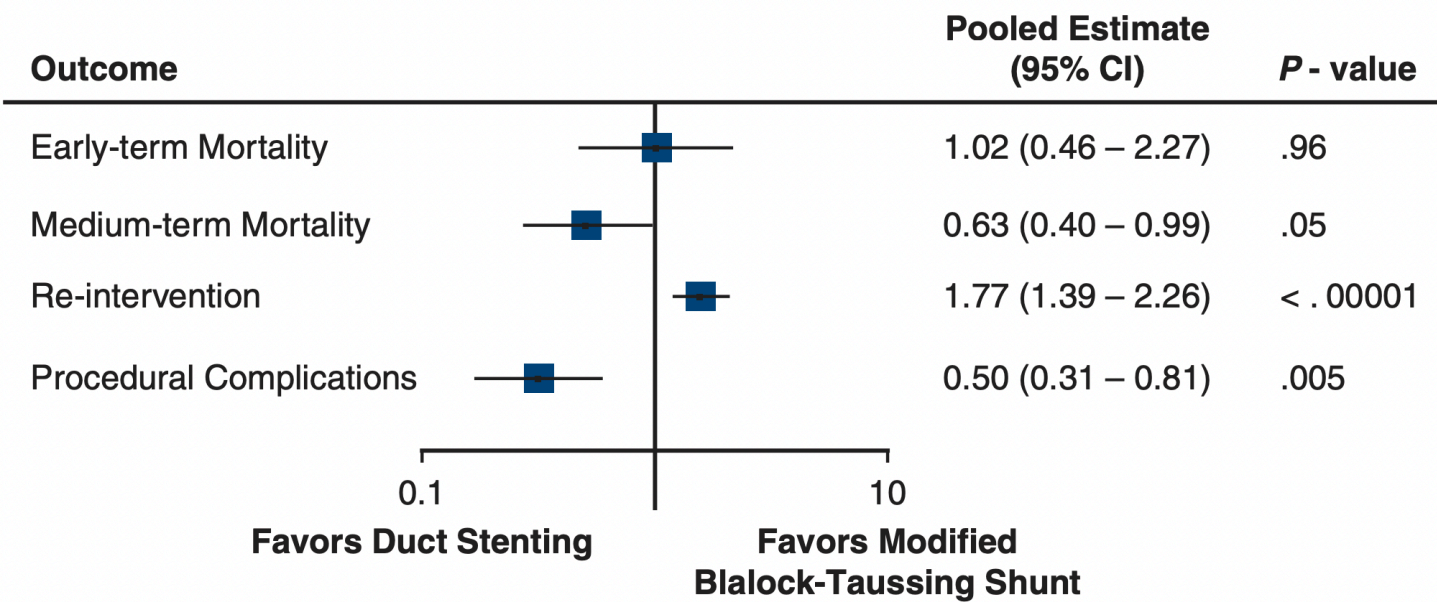
→ Stent additionnel dans le CA



# Duct stenting versus modified Blalock–Taussig shunt in neonates and infants with duct-dependent pulmonary blood flow: A systematic review and meta-analysis



Ali Alsagheir, MBBS, MSc,<sup>a,b</sup> Alex Koziarz, MSc,<sup>c</sup> Ahmad Makhdoum, MBBS, MSc,<sup>d</sup> Juan Contreras, MD,<sup>e</sup> Hatim Alraddadi, MBBS,<sup>a</sup> Tasnim Abdalla, BHSc,<sup>c</sup> Lee Benson, MD,<sup>f</sup> Rajiv R. Chaturvedi, MD, PhD,<sup>f</sup> and Osami Honjo, MD, PhD<sup>e</sup>





# Potts

Aorte descendante – APG  
1946



# Waterston

Aorte ascendante – APD  
1964



Moins bons résultats de ces shunt centraux : distorsion des AP, hyperdébit pulmonaire, mauvaise croissance TAP et AP contro-latérale, calibrage difficile, ...





# Reverse Potts shunt in severe pulmonary hypertension: A 20-year retrospective review

Wei Jiang, Zhongshi Wu, Can Huang, Ting Lu, Haoyong Yuan, Yuhong Liu, Tao Qian<sup>\*</sup>

*Department of Cardiovascular Surgery, The Second Xiangya Hospital of Central South University, Changsha, Hunan, China*

## ARTICLE INFO

### *Keywords:*

Pulmonary arterial hypertension

Reverse Potts shunt

Surgical treatment

## ABSTRACT

Pulmonary arterial hypertension (PAH) is a multifactorial heterogeneous condition characterized by elevated pulmonary artery pressure, leading to increased right ventricular afterload and ultimately resulting in right heart failure. Despite major advances in the management of pediatric PAH in recent years with the development of PAH-specific drug therapy and therapeutic strategies, prognosis still remains unsatisfactory for many children. The Potts shunt, as a palliation in patients with cyanotic congenital heart defects first, receives its 'second life' in treating PAH by creating a shunt between the pulmonary artery and the descending aorta to alleviate right heart burden. Over the past 20 years, accumulated clinical experience have revealed that reverse Potts shunt (RPS) can effectively improve cardiac function and survival time in PAH patients, with midterm survival rates comparable to those of lung transplantation. However, RPS is confronted with some issues that limit its development and application in clinical practice, such as identifying the suitable patient population, determining the optimal timing of intervention, and selecting the appropriate shunt type and size. This review aims to retrospectively summarize the experience of RPS in the treatment of PAH, discuss the main challenges faced in its clinical application, and help to guide clinical practice.

**Quand ?**

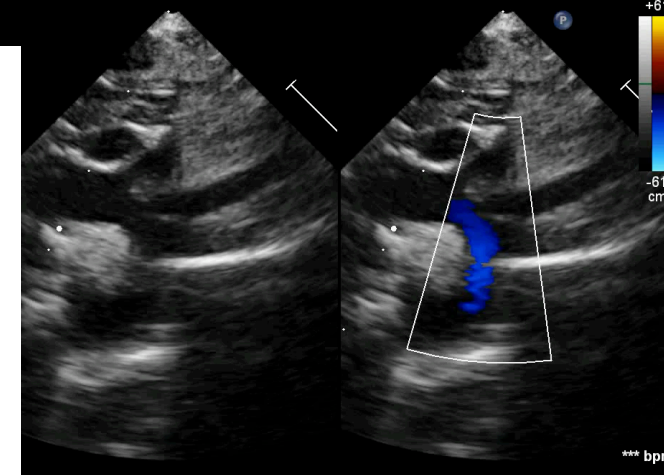
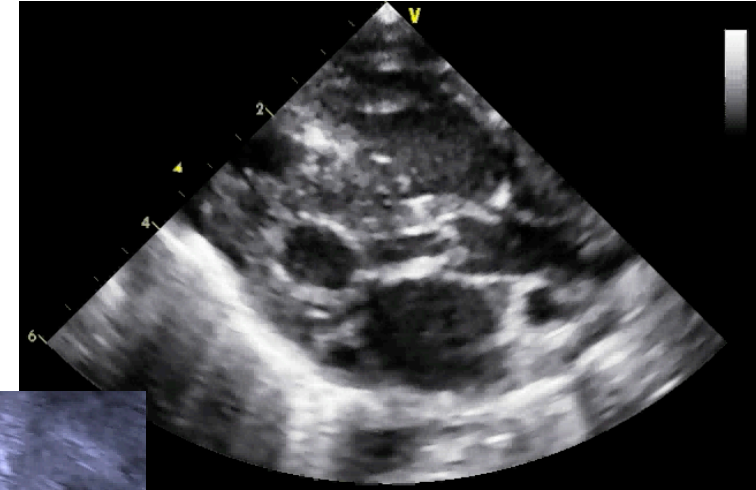
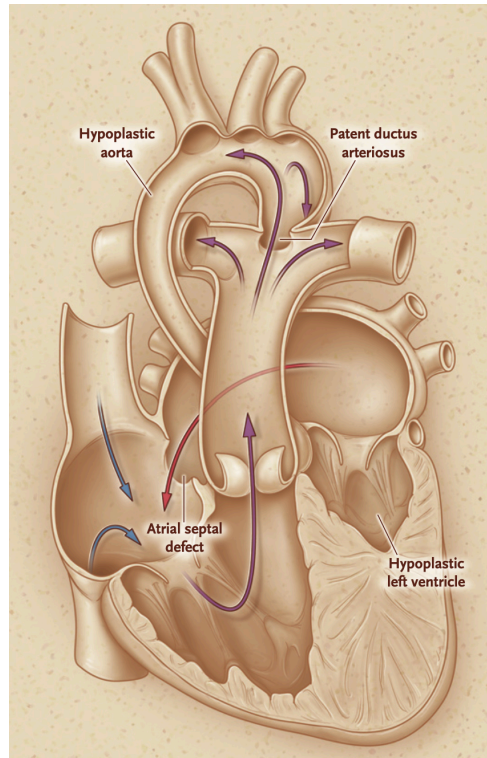


**Ductodépendance  
pour la perfusion  
pulmonaire**

**Ductodépendance  
pour la perfusion  
systémique**

# Ductodépendance systémique

- Spectre large des **HLHS** (hypoplasie du coeur gauche)
- **Prise en charge initiale** : Prostin  
→ Maintenir CA ouvert pour la perfusion systémique
- **Prise en charge + durable** :
  - Norwood Classique
  - Norwood-Sano
  - Hybride

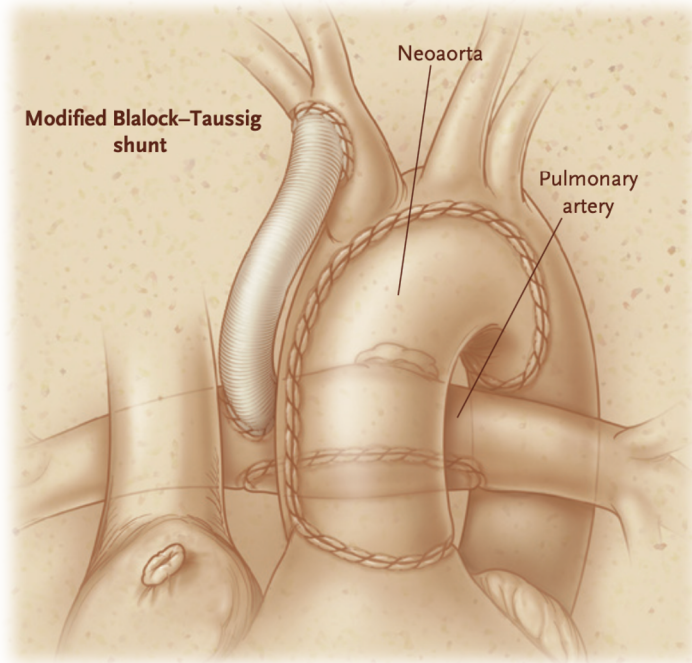




# Syndrome d'hypoplasie du cœur gauche

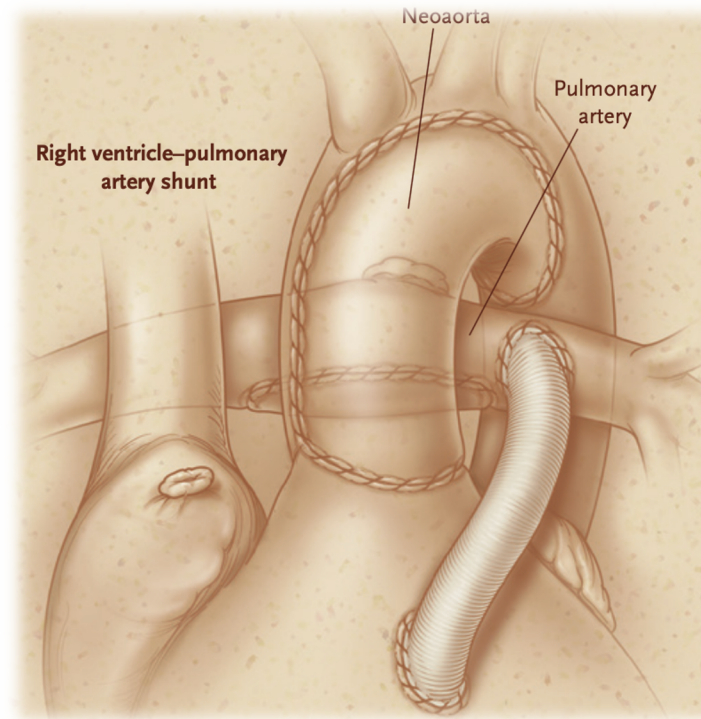
- **Norwood Classique :**

- Reconstruction aortique : Damus-Kaye-Stansel
- mBTTS pour perfusion pulmonaire



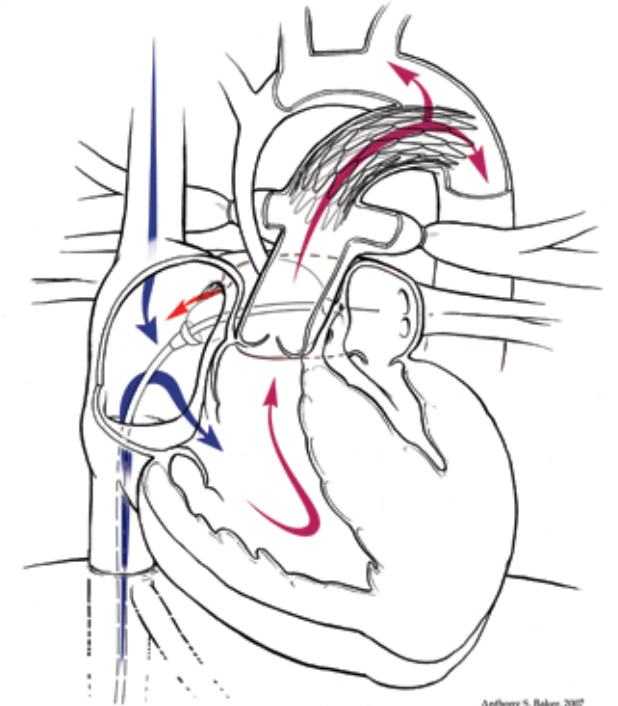
- **Norwood-Sano**

- Reconstruction aortique
- Sano pour perfusion pulmonaire



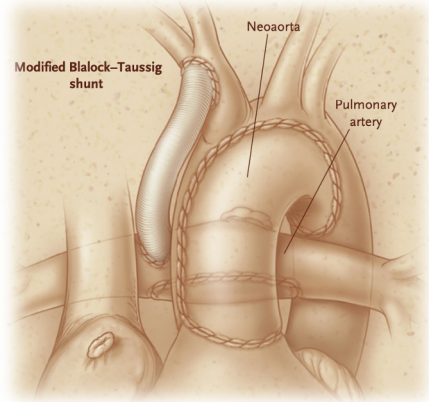
- **Hybride**

- Stenting CA
- Cerclage des AP



# Syndrome d'hypoplasie du cœur gauche

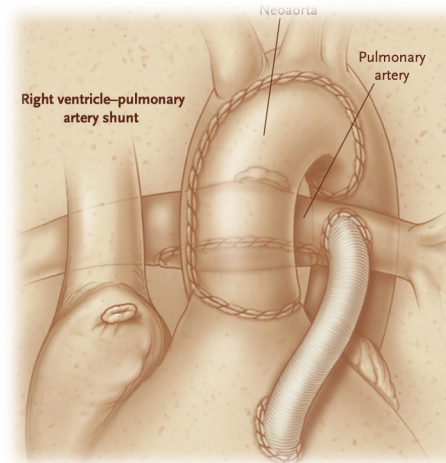
## Norwood Classique :



**Flux continue systolo-diastolique**

→ Vol coronaire

## Norwood-Sano :



**Cicatrice de ventriculotomie :**

→ Arythmie

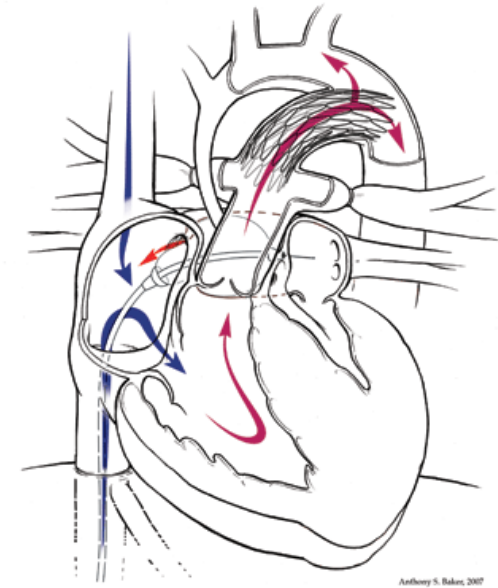
→ Altération FEVU

**Fuite pulmonaire :**

→ Surcharge diastolique

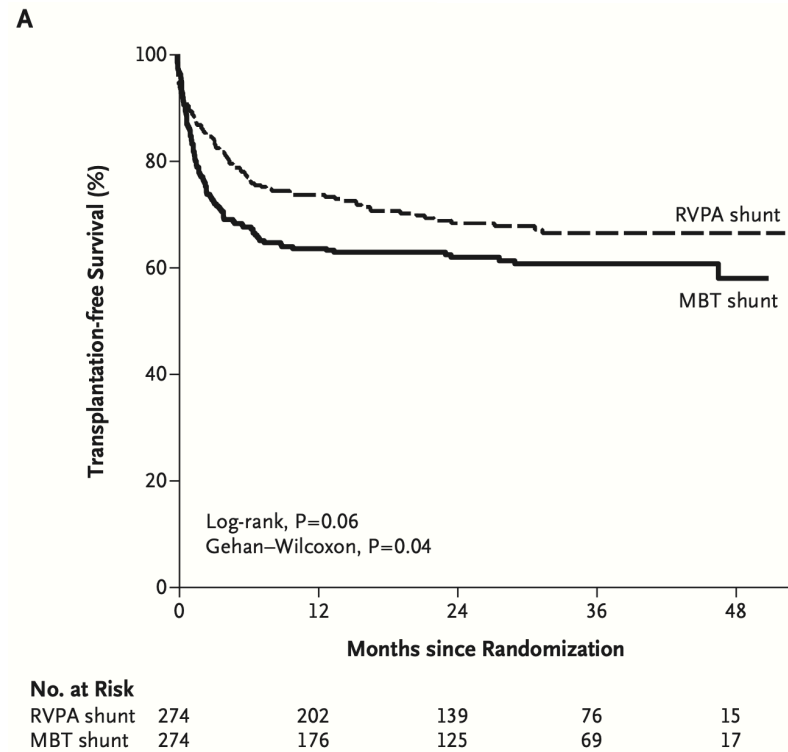
→ Défaut croissance AP

## Hybride :

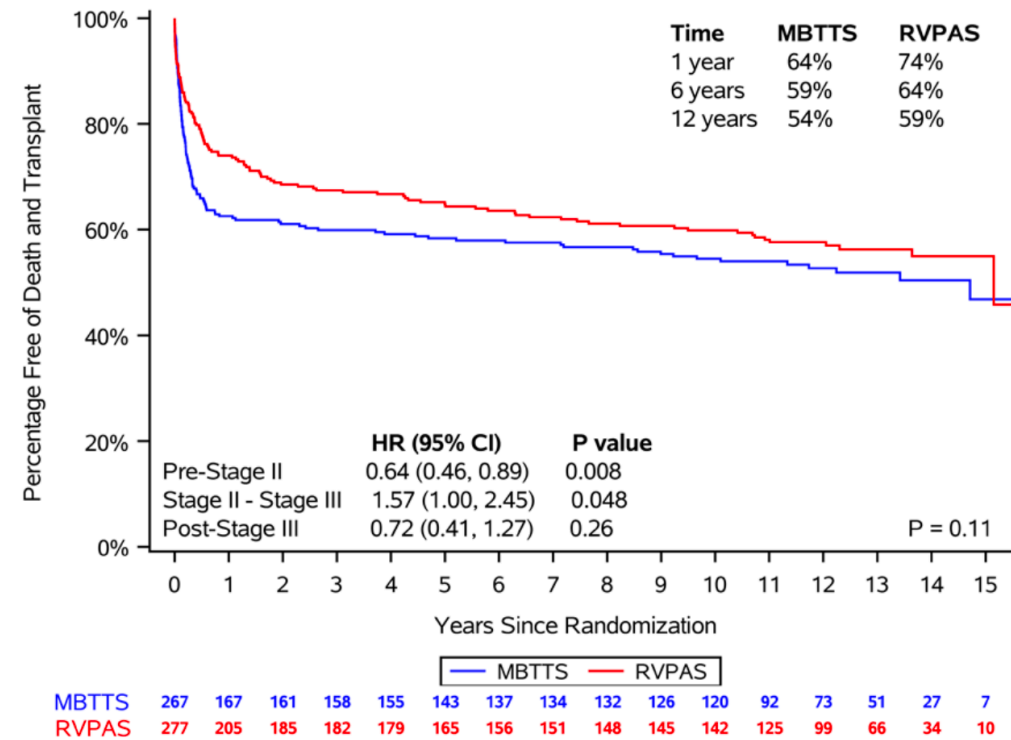


## ORIGINAL ARTICLE

# Comparison of Shunt Types in the Norwood Procedure for Single-Ventricle Lesions

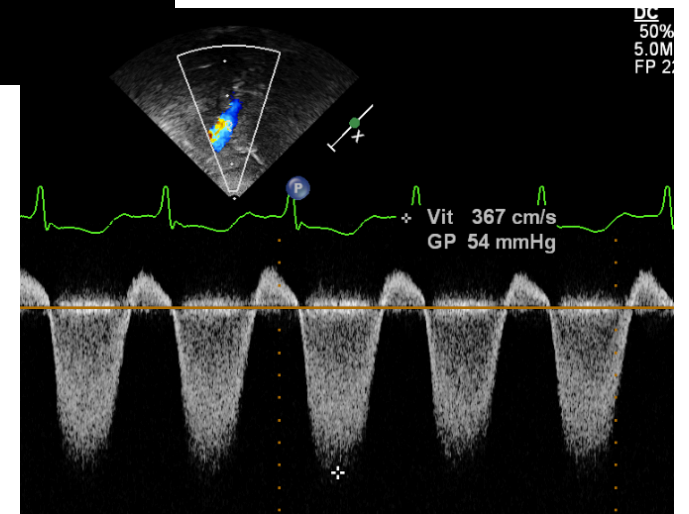
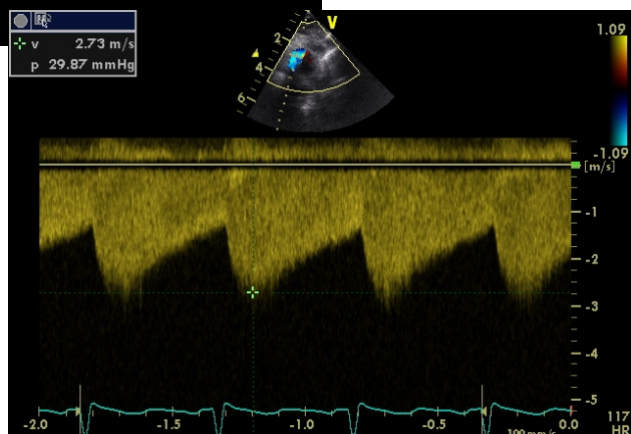
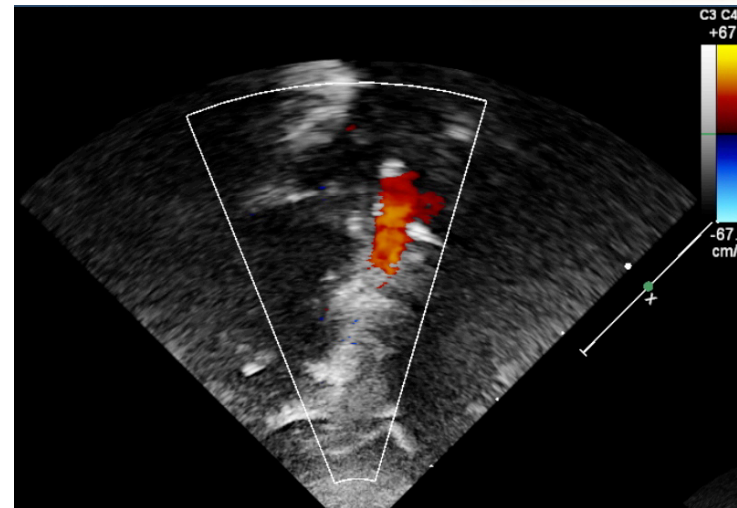
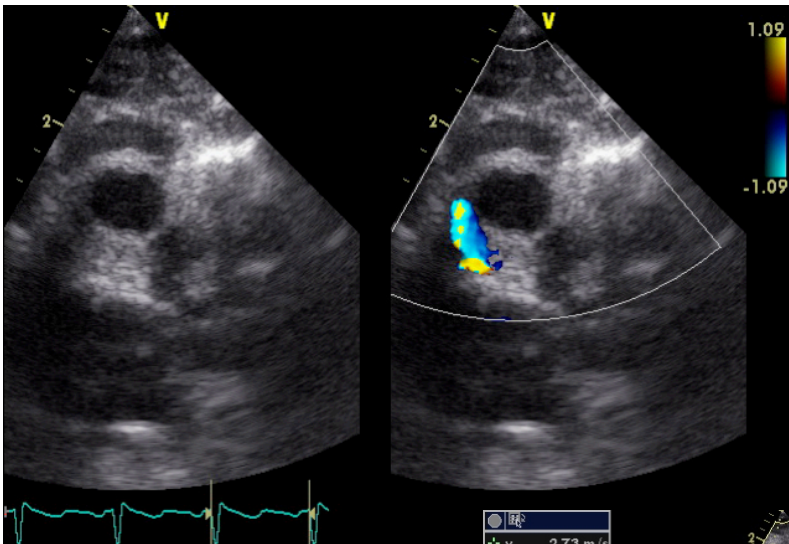
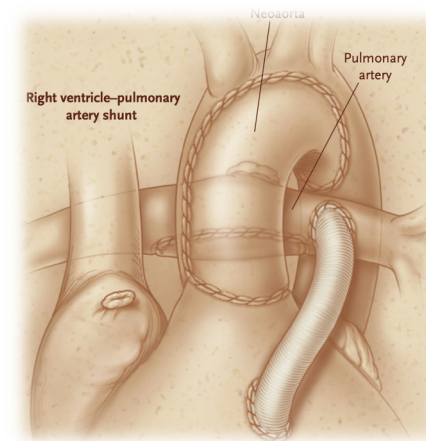
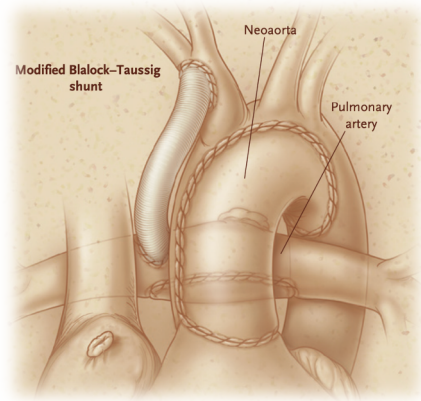


Ohye et al, NEJM, 2010



Godberg et al, Circulation, 2023



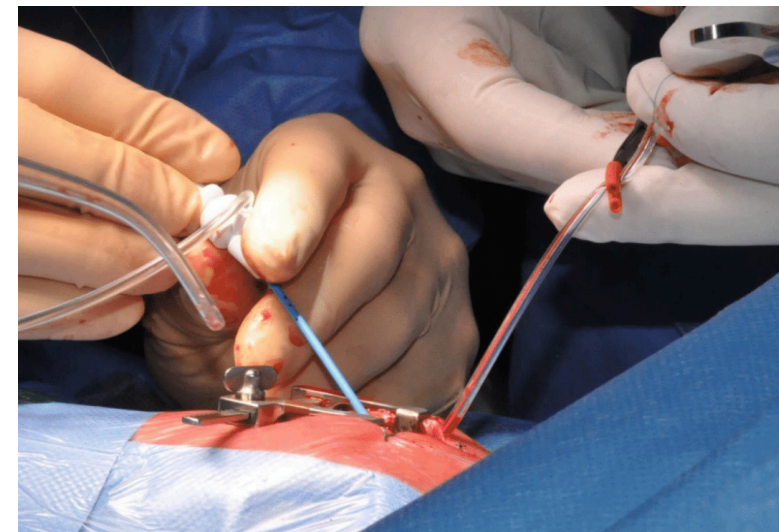
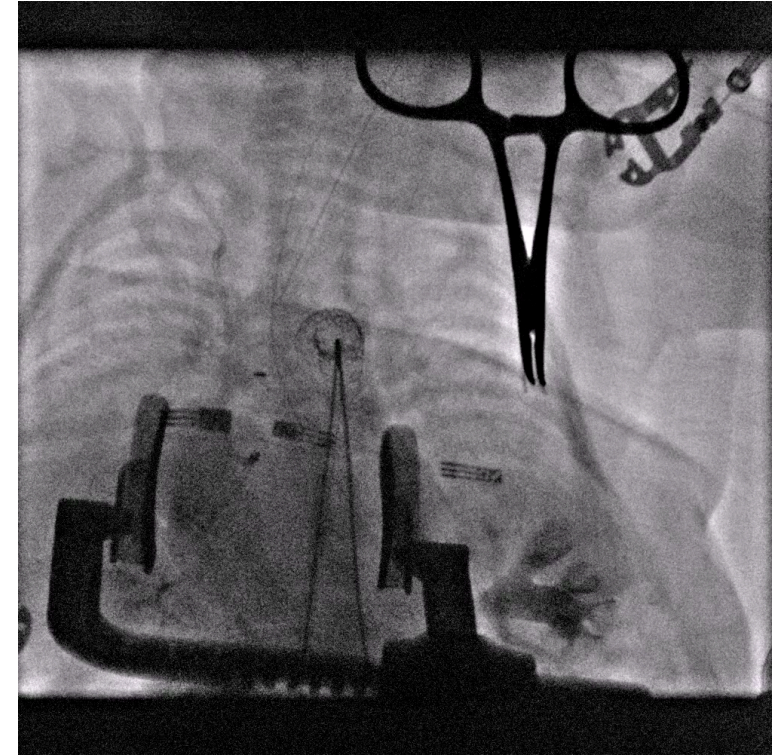
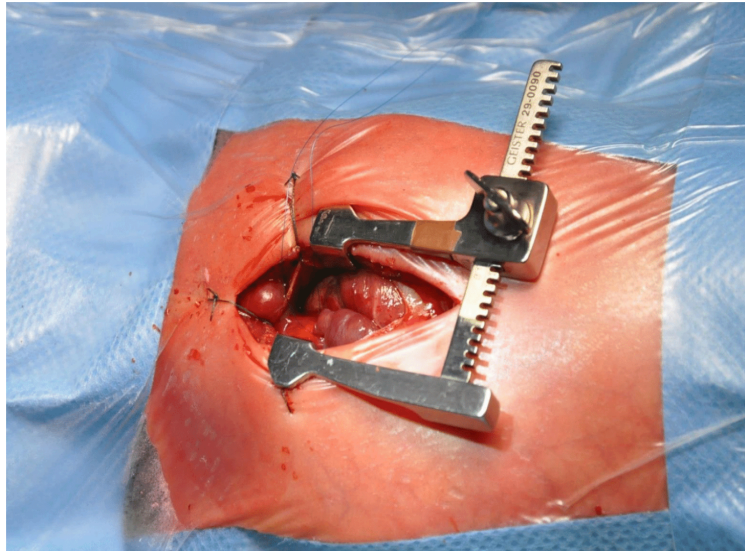
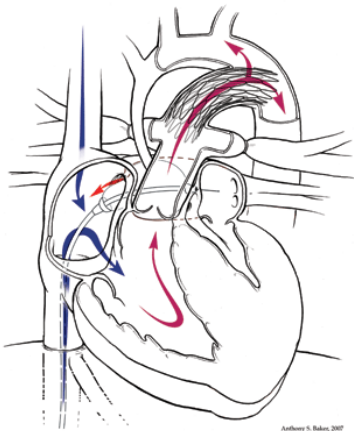




# HLHS – Hybride

- Stenting CA
- Cerclage des AP

→ Reconstruction aortique avec CEC  
= décalée à l'étape 2

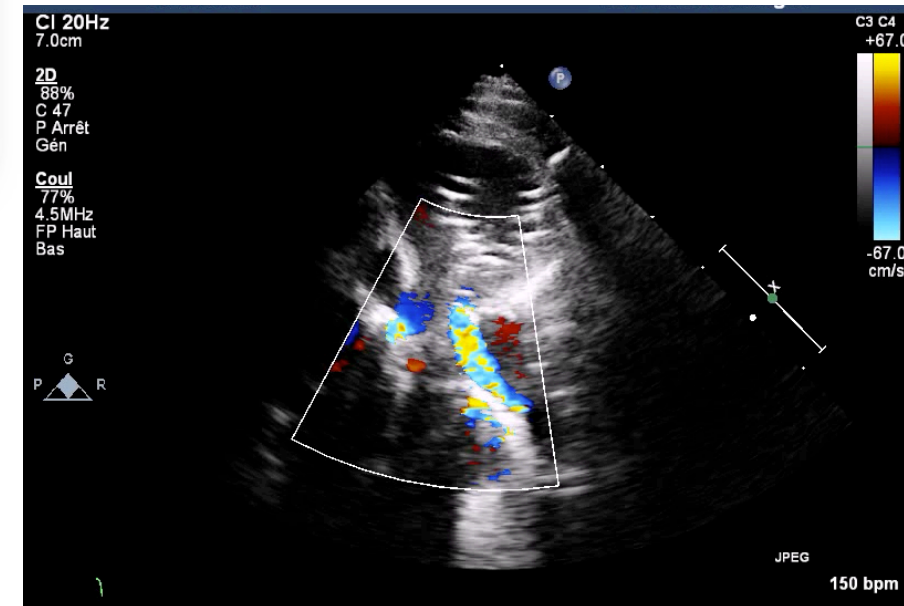
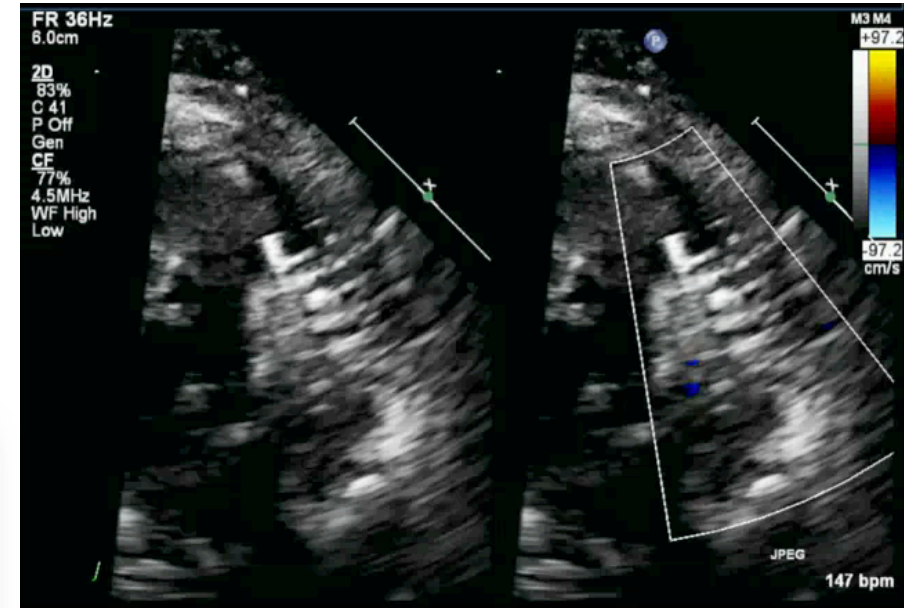
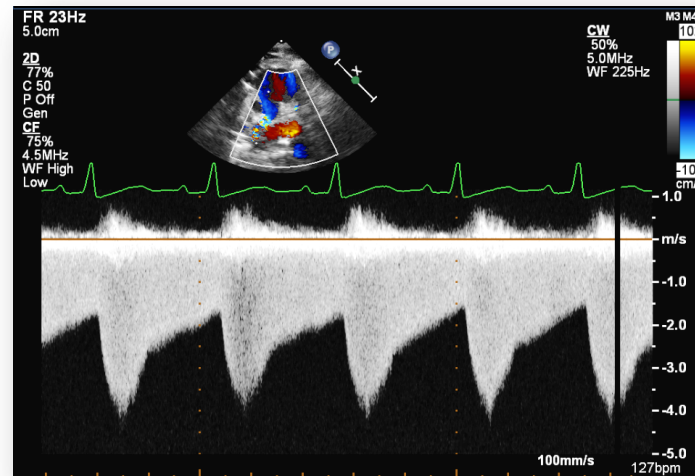
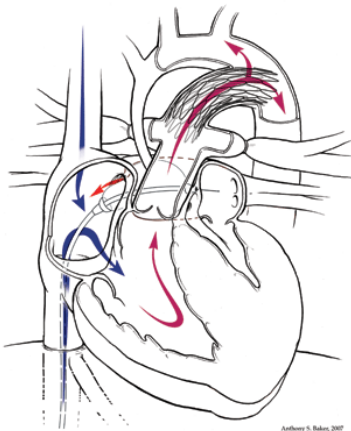




# HLHS – Hybride

- Stenting CA
- Cerclage des AP

→ Reconstruction aortique avec CEC  
= décalée à l'étape 2



# Et après ?



**Réparation  
biventriculaire**



**Programme  
univentriculaire**

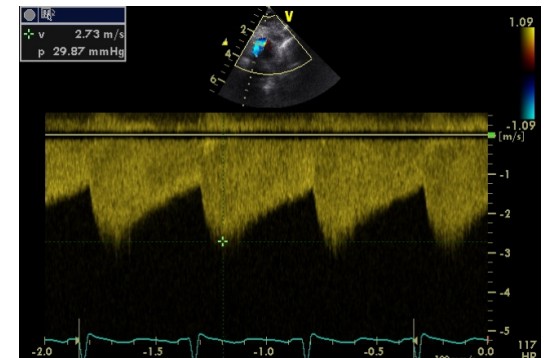
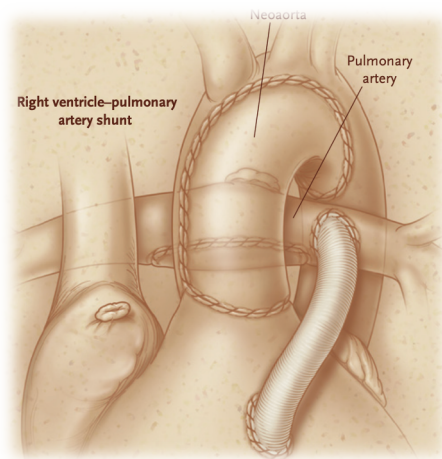
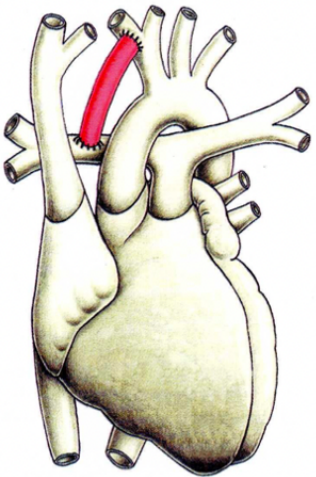
DCPP

DCPT

# Conclusion

- **Ductodépendance pulmonaire :**
  - Prosthèse
  - Blalock vs Stenting du CA
- **Ductodépendance systémique :**
  - HLHS
  - Norwood (Sano ou Blalock) ou hybride
- **Equilibre du  $Q_p/Q_s$  !**

# Création de shunt



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