

Surgeon's View of Hybrid Procedures

Asan Medical Center

Yun, Tae - Jin

Hybrid procedures

-Surgeon's perception-

Aberrational

Beneficial

Collaborative

Detour

Hybrid procedures

-Surgeon's perception-

Aberrational

Beneficial

Collaborative

Det

**Adjunct to conventional procedure
Routine hybrid strategy ?**

Hybrid procedures

-Surgeon's perception-

Aberrational

Beneficial

Collaborative

Detour

Better early outcome: Yes
Better overall outcome: ?

Hybrid procedures

-Surgeon's perception-

Aberrational

Beneficial

Collaborative

Detour



Hybrid procedures

-Surgeon's perception-

Aberrational

Beneficial

Collaborative

Detour



Hybrid procedures in AMC

- **Bilateral PA band / ductal stent for TA (IIc) in 2005**
- **17 hybrid procedures**

Bilateral PA banding / ductal stenting: 8

Draining vein stenting for obstructive TAPVD: 1

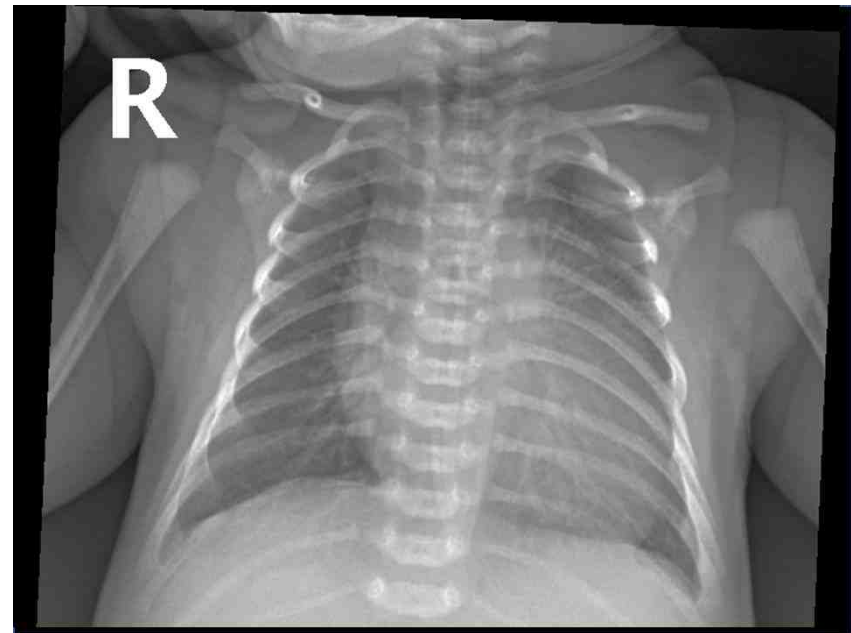
Periventricular muscular VSD closure: 2

RVOT stenting: 6

- **In the OR / C-arm guided**

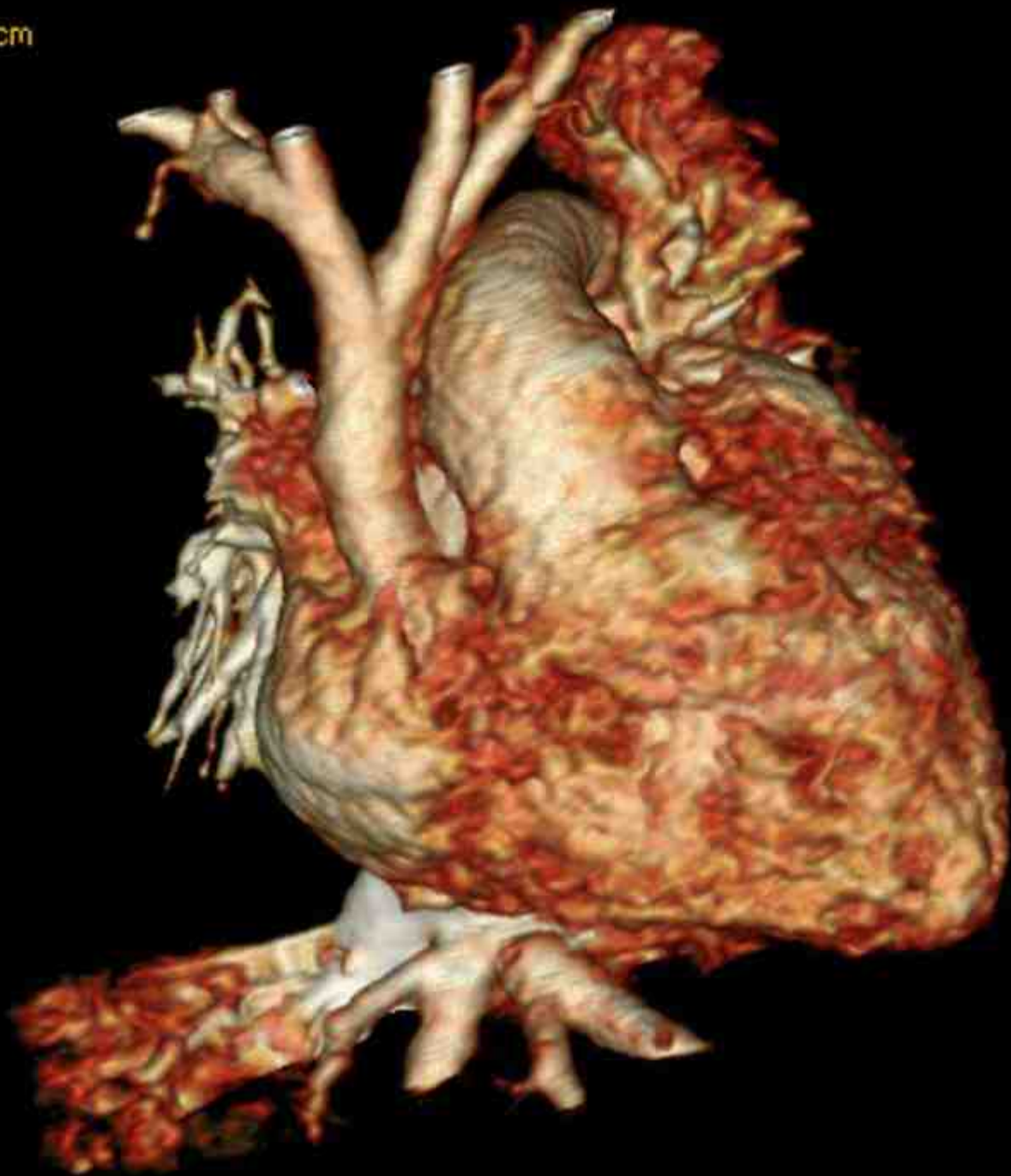
Case 1

- F / 6 days
- Gestational age: 39⁺¹ weeks
- Body weight at Op: 2,820 gm
- ABGA: 7.38-45-52-27-86%
- Echocardiography
 - Tricuspid atresia (IIc), large ASD
 - Non-restrictive VSD
 - d-TGA, Interrupted aortic arch (A)
 - Large ductus with R-L shunt





1.8 cm



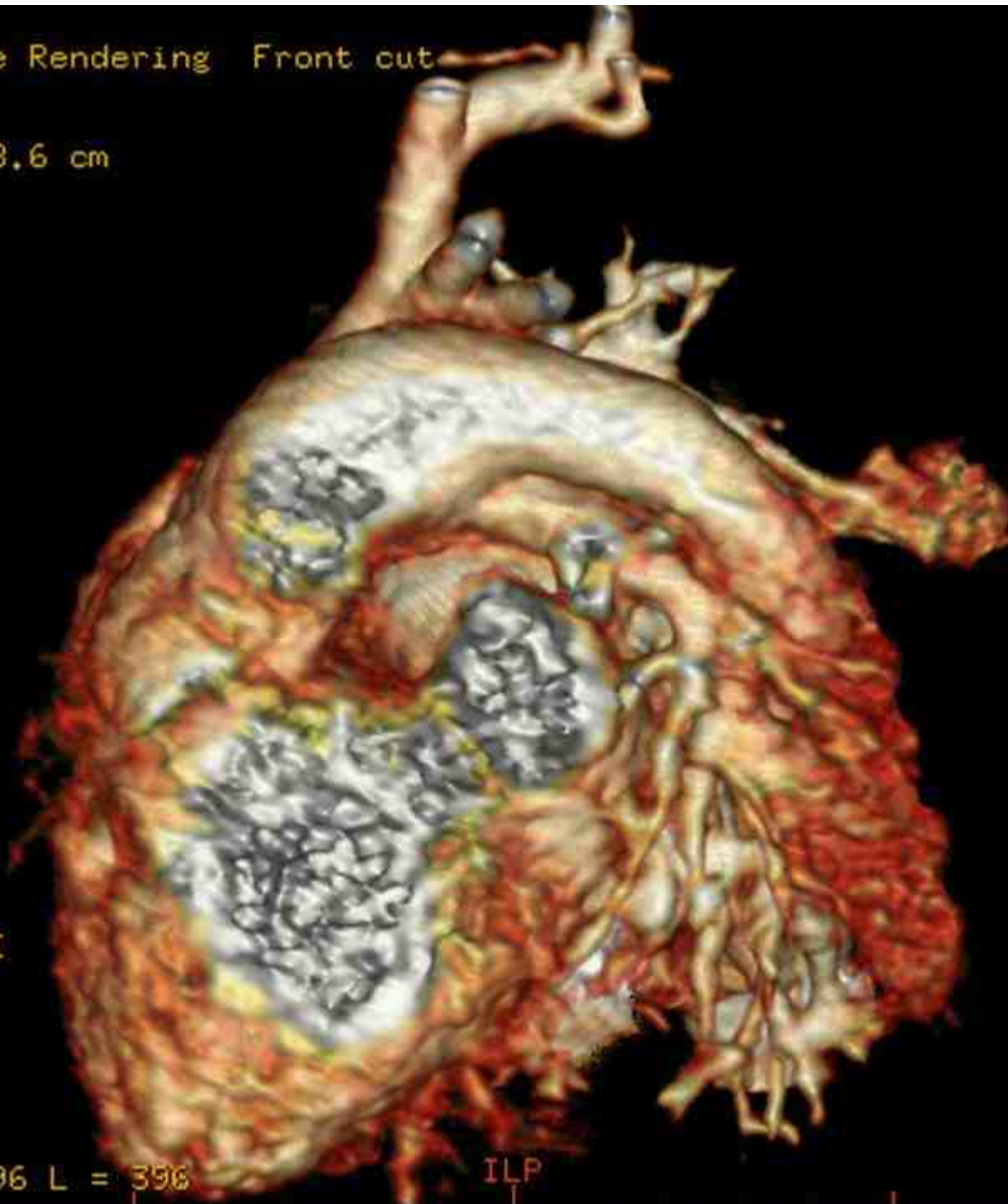
me Rendering Front cut

8.6 cm

01

396 L = 396

ILP



4 goals in Stage I operation for FSV

Optimization of Anatomy and Physiology

- 1) Unrestricted systemic outflow**
- 2) Adjustment of PBF**
- 3) Unrestricted intra-cardiac mixing**
- 4) Associated anomalies:**
 - a. TAPVD (obstructive)**
 - b. Severe AVVR**
 - c. Severe Cardiomegaly**

What should we do?

Conventional approach

1. Arch repair + PAB

2. Norwood type repair

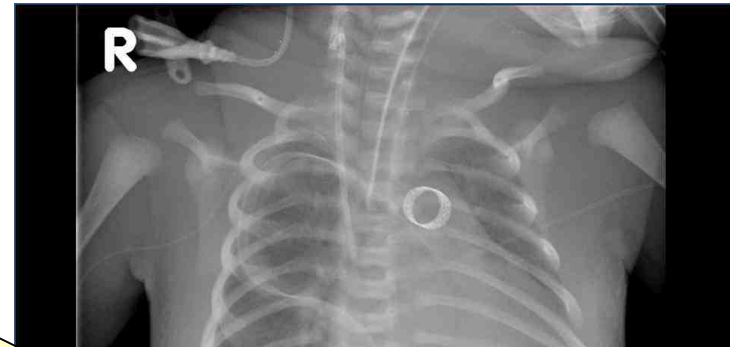
Arch repair + DKS + RV-PA conduit (or shunt)

Detour

Hybrid palliation (bilateal PAB + ductal stent)

Case 1

- Hybrid Op (09.12.8) in the OR
Bilateral PA banding
Ductal stenting



- Postop course
POD 2: Extubation
POD 6: GW tran
POD 19: Discha

- 1. Unrestricted systemic outflow ?**
- 2. Adequate PBF ?**
- 3. Adequate intracardiac mixing ?**
- 4. No significant associated anomaly?**

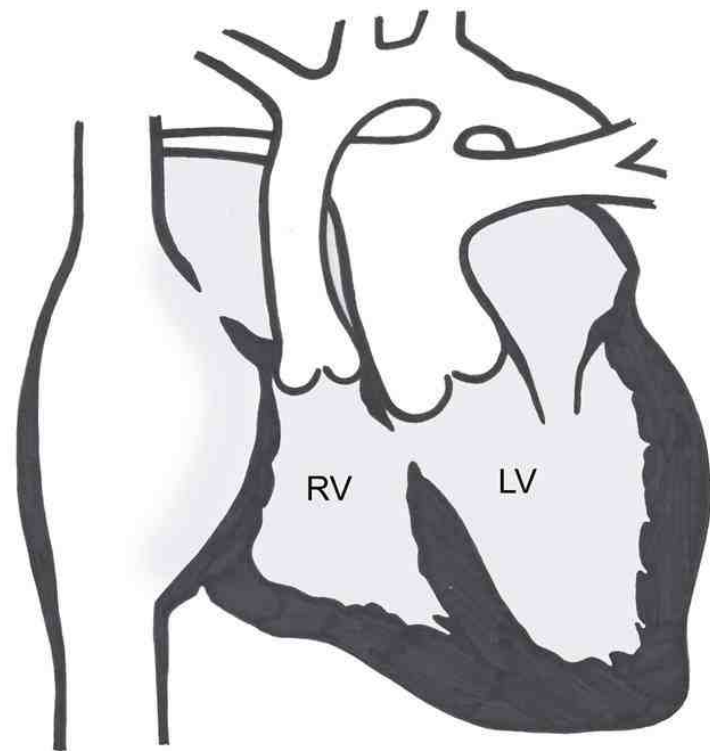
- Currently 5 months old





Case 2

- F/13 days
- Gestational age: 32⁺⁵ weeks
- Body weight at Op: 2,180 gm
- R/O necrotizing enterocolitis
- ABGA: 7.41-51-42-32-78%
- Echocardiography:
 - Tricuspid atresia (IIc), Large ASD
 - Restrictive VSD
 - d-TGA, Severe COA,
 - Large ductus with R-L shunt,
 - Hypoplasia of transverse arch
 - Small ascending aorta (5.5 mm)



What should we do?

Conventional approach

1. Arch repair + PAB

2. Norwood type repair

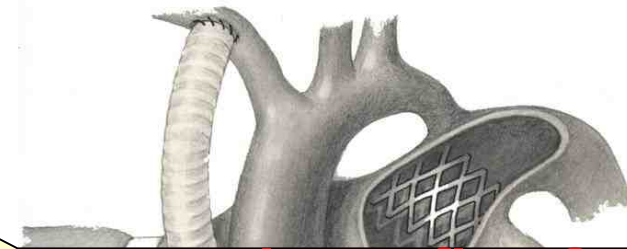
Arch repair + DKS + RV-PA conduit (or shunt)

Detour

Hybrid palliation (bilateal PAB + ductal stent)

Case 2

- Hybrid Op (05.11.24) in the OR
 - Bilateral PA banding
 - Ductal stenting
 - Reverse BT shunt (3.5 cm)

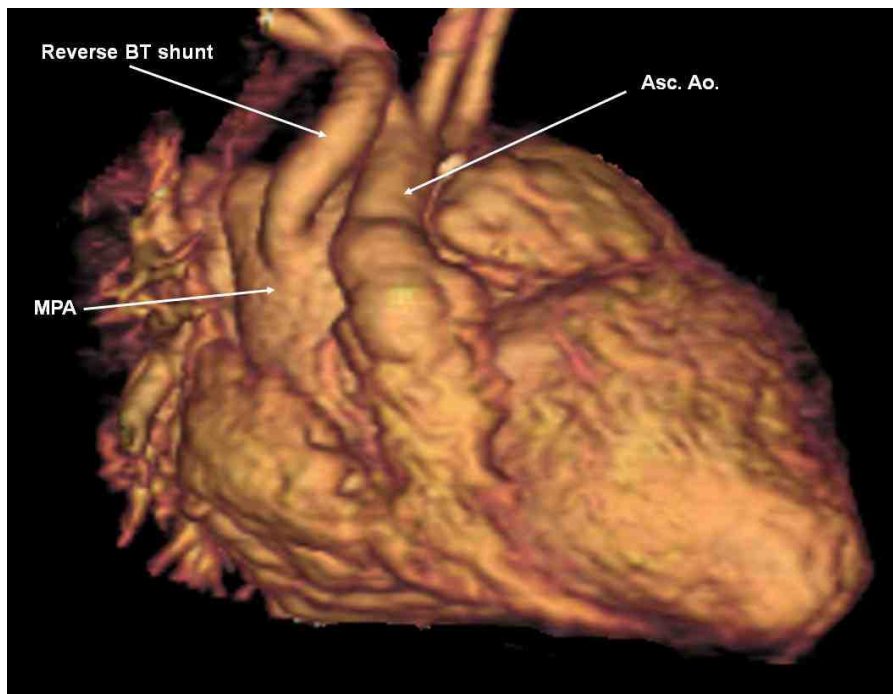


- Postop course
 - POD 17: Extub
 - POD 29: GW tr
 - POD 31: Disch
- BCPS (2006.5)
- ECC Fontan (2008.8.12)

- 1. Unrestrictive systemic outflow?**
- 2. Adequate PBF?**
- 3. Adequate intracardiac mixing?**
- 4. No significant associated anomaly?**

Case 2

Post-op 1 month



Post-op 4 month



Case 2

Reverse Blalock-Taussig Shunt Facilitates the Growth of the Ascending Aorta After Hybrid Palliation

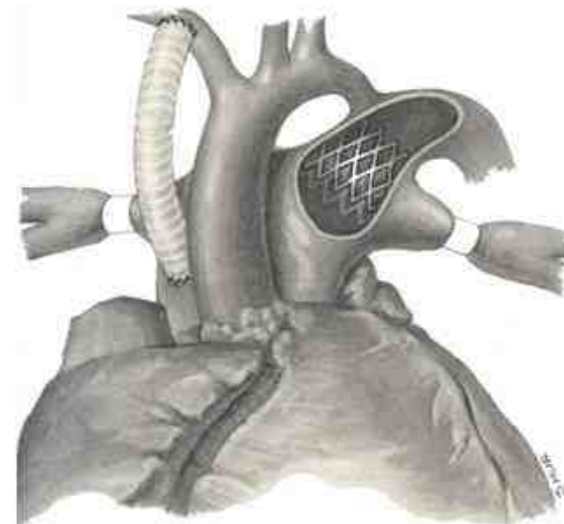
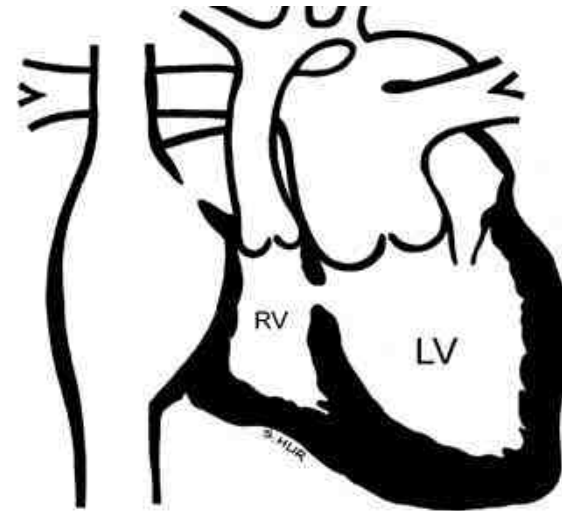
Tae-Jin Yun, MD, PhD, Won-Chul Cho, MD, Sung-Ho Jung, MD, Dong-Man Seo, MD, Hyun-Woo Goo, MD, and Young-Hwue Kim, MD

Divisions of Pediatric Cardiac Surgery and Pediatric Cardiology, and Department of Radiology, Asan Medical Center, College of Medicine, University of Ulsan, Seoul, Republic of Korea

A 13-day-old baby girl with tricuspid atresia (IIc), who was prematurely born at 32 weeks and 5 days of gestation and weighed 2.2 kg, underwent bilateral pulmonary artery banding, ductal stenting, and reverse Blalock-Taussig shunt. Cardiac computerized tomography at 4 months postoperatively showed that the ascending aorta outgrew the somatic growth, presumably thanks to the forward flow through the reverse Blalock-Taussig shunt. At 6 months postoperatively, the patient underwent a successful second-stage operation.

(Ann Thorac Surg 2007;83:1886–8)

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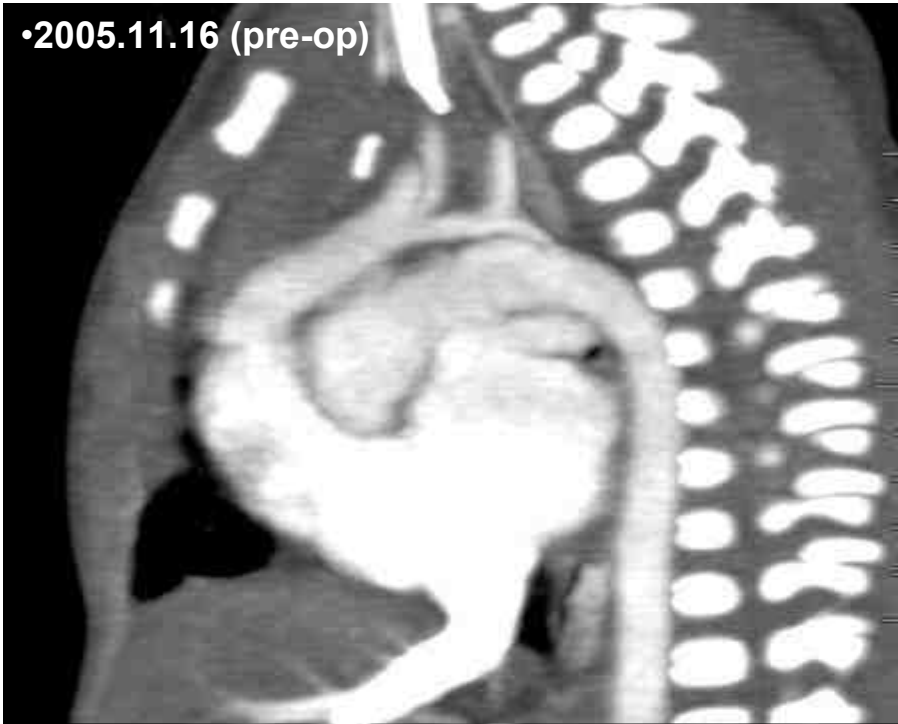
Case 2

Table 1. Changes in the dimensions of the cardiac structures on preoperative and postoperative cardiac computerized tomography

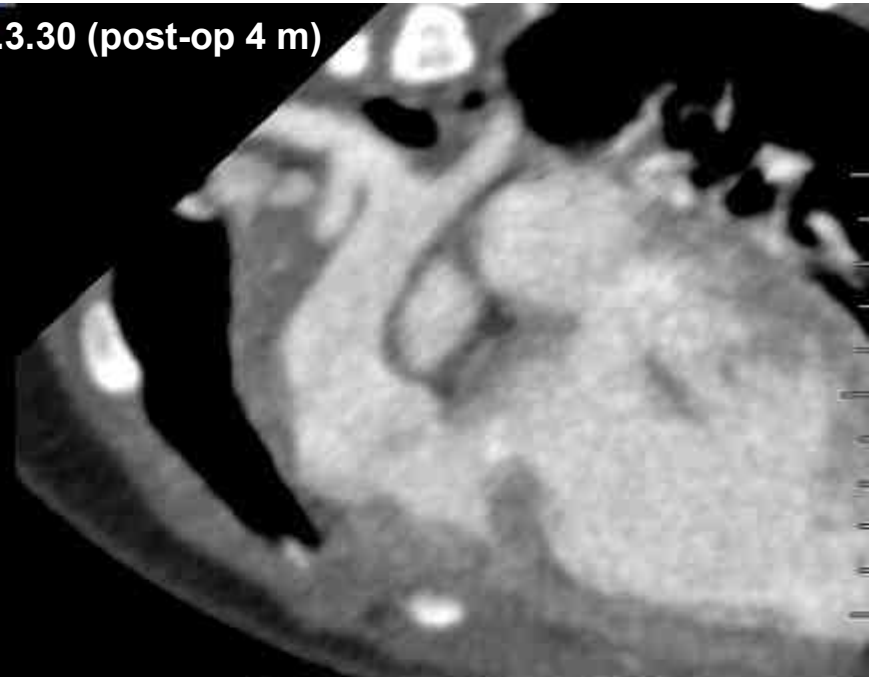
	Preoperative	Post-op.1 month	Post-op.4 month
AVA (mm)	5.0	5.6	9.4
AVA (z)	-4.0	-3.1	-0.8
Asc.Ao (mm)	5.5	6.6	11.7
PVA (mm)	9.5	9.8	11
PVA (z)	2<	2<	2<
MPA (mm)	15.3	17.6	21.3
AVA / PVA	0.53	0.57	0.85
Asc.Ao / MPA	0.36	0.38	0.55
VSD (mm)	3.9	3.9	4.1
VSDAI (cm ² /m ²)	0.80	0.79	0.55
VSD / AVA	0.78	0.69	0.44

Post-op, Postoperative; AVA(mm), aortic valve annulus diameter in mm; AVA(z), aortic valve annulus diameter in z-score; Asc.Ao (mm), ascending aorta diameter in mm at the sino-tubular junction; PVA(mm), pulmonary valve annulus diameter in mm; PVA(z), Pulmonary valve annulus diameter in z-score; MPA(mm); main pulmonary artery diameter in mm at the bifurcation; VSD, Ventricular Septal Defect; VSDAI, VSD area index

•2005.11.16 (pre-op)



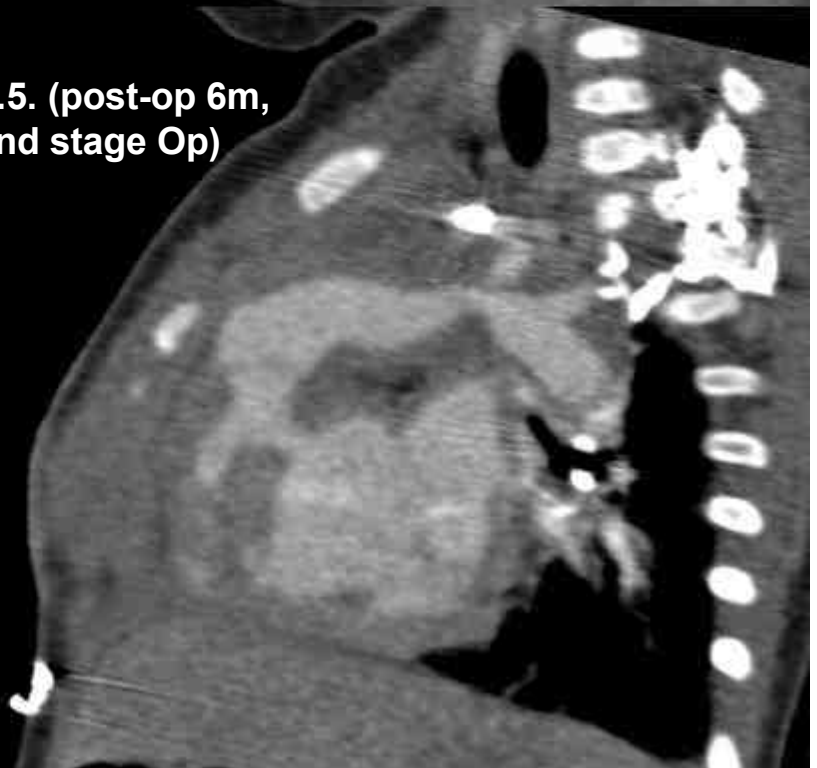
2006.3.30 (post-op 4 m)



2005.12.21 (post-op 1 m)



2006.6.5. (post-op 6m, after 2nd stage Op)





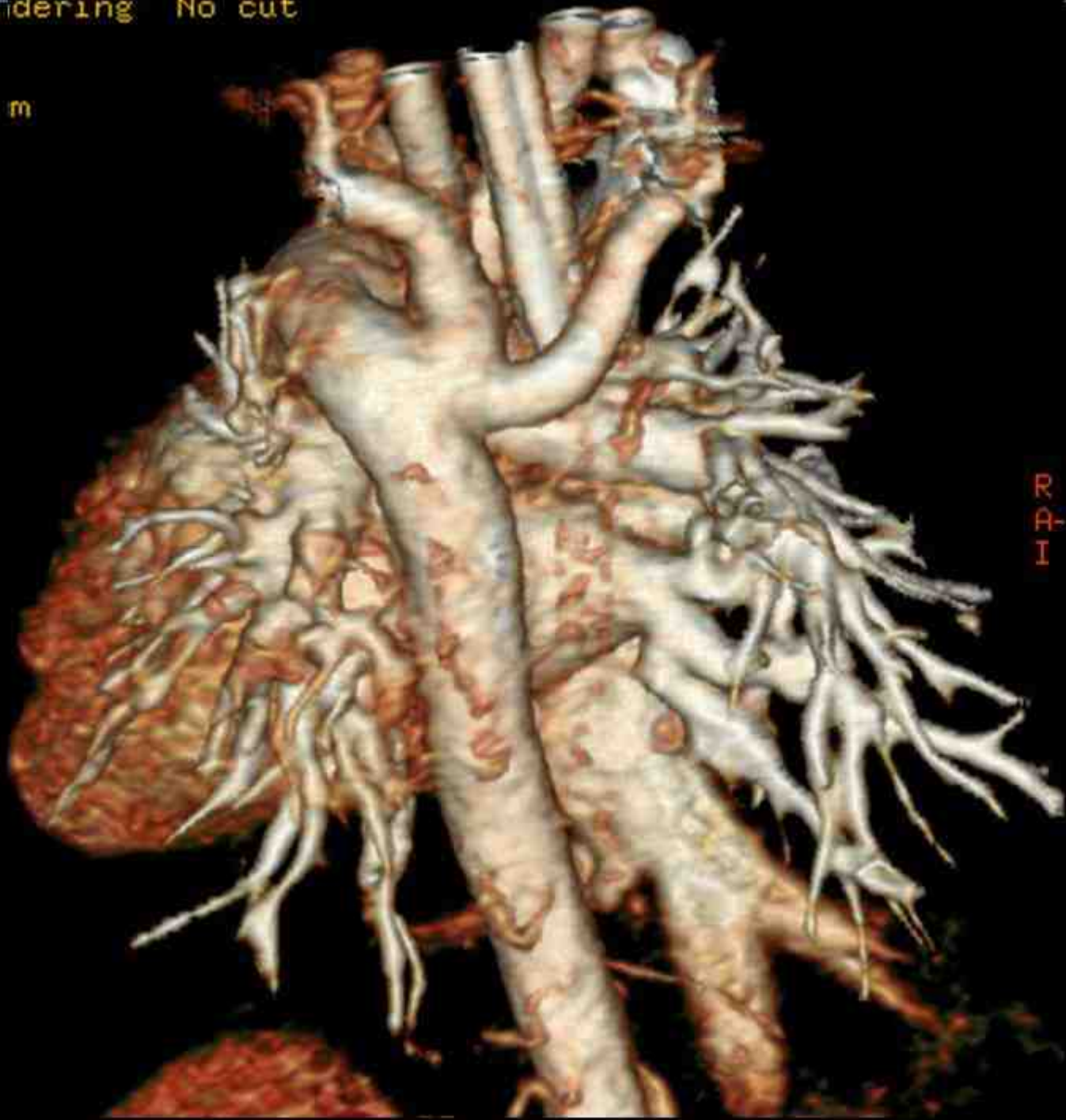
Case 3

- F / 7 days
- Gestational age: 38+3 weeks
- Body weight at Op: 2,520 gm
- ABGA: 7.41-39-37-24-72%
- Echocardiography
 - Normally related heart, levocardia
 - Balanced ventricles
 - PFO type ASD (3-4 mm)
 - Mild MR /TR, no MS
 - Multiple small VSDs
 - Aortic valve atresia, small ascending Ao
 - Large ductus with R-L shunt
 - Retrograde arch flow



idering No cut

m



R
P
I

What should we do?

Conventional approach

1. Norwood type repair

Arch repair + DKS + RV-PA conduit (or shunt)

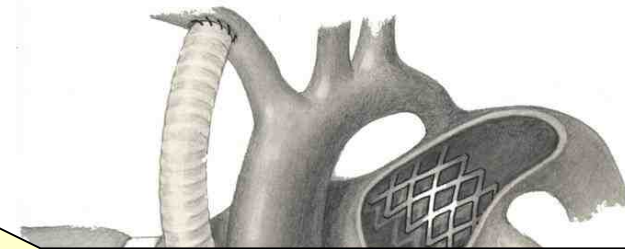
2. VSD extension + Yasui operation

Detour

Hybrid palliation (bilateal PAB + ductal stent)

Case 3

- Hybrid Op (06.11.7) in the OR
 - Bilateral PA banding
 - Ductal stenting
 - Reverse BT shunt (3.5 mm)

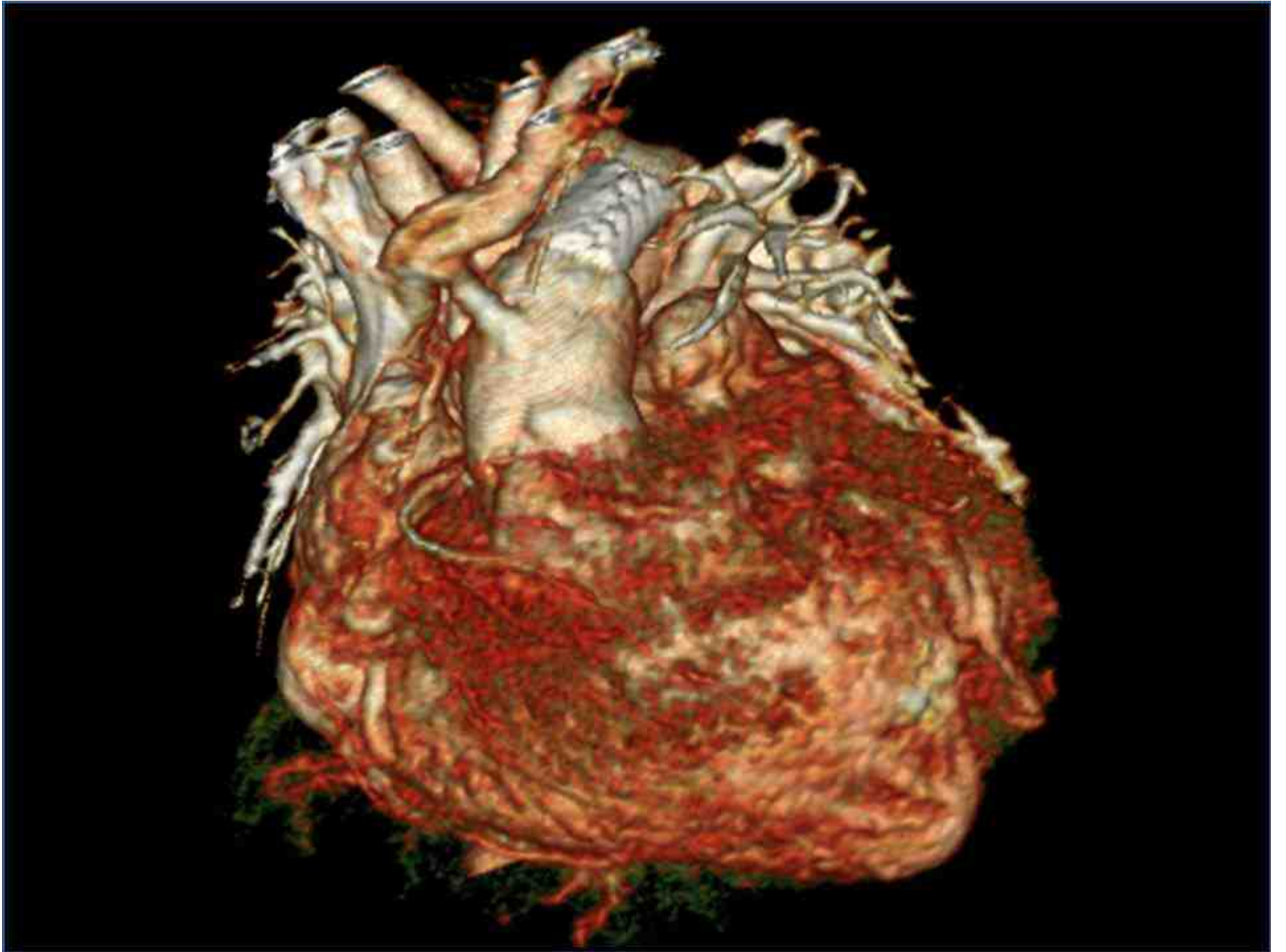


- Postop course
 - POD 2: Extuba
 - POD 6: GW tra
 - POD 9: Discha

- 1. Unrestrictive systemic outflow?**
- 2. Adequate PBF?**
- 3. Adequate intracardiac mixing?**
- 4. No significant associated anomaly?**

- Atrial septec
- BCPS: 07.09.04
- ECC Fontan: 09.12.15





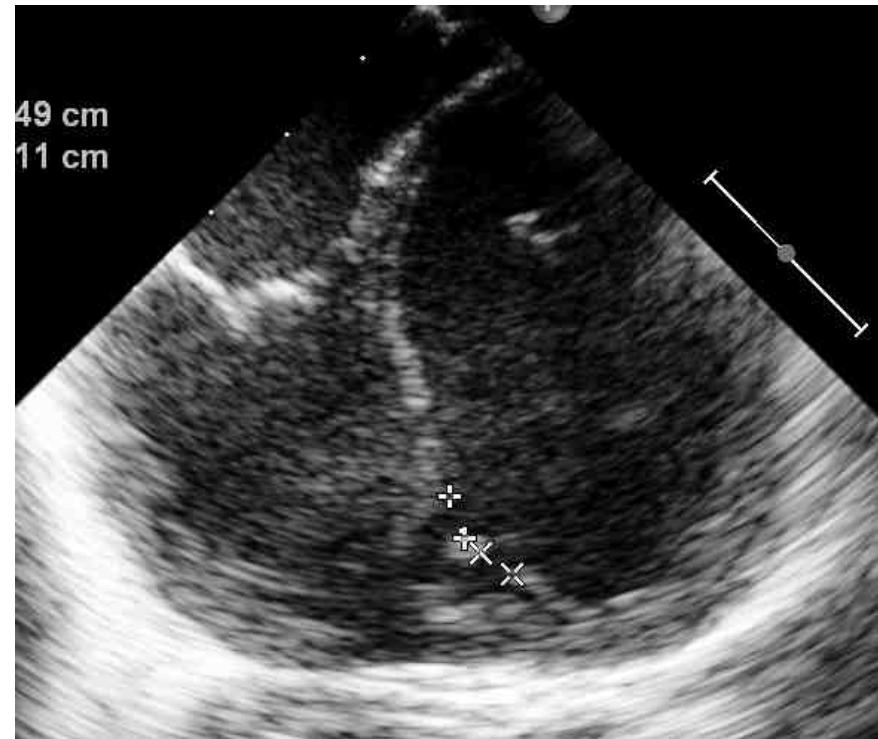






Case 4

- M / 26 months
- Body weight at Op: 12.7 kg
- s/p PAB for m-VSD
- Echocardiography
 - tight PA banding
 - MPA velocity : 3.9 m/sec
 - multiple muscular VSDs 2 sites
 - TR Gr 1/4 (TR velocity 4.5m/sec)
 - MR trace(A2 jet)
 - Ventricular function looks good
 - No pericardial effusion



What should we do?

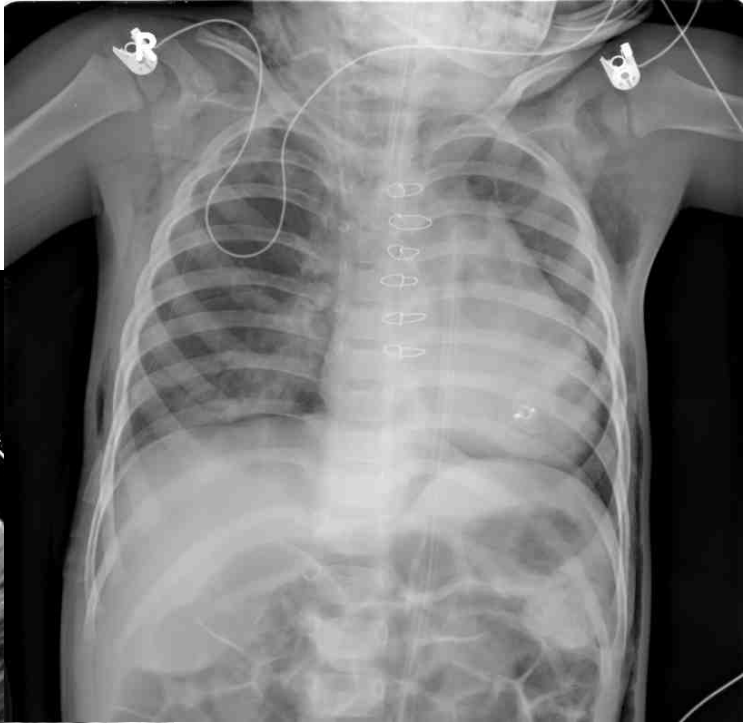
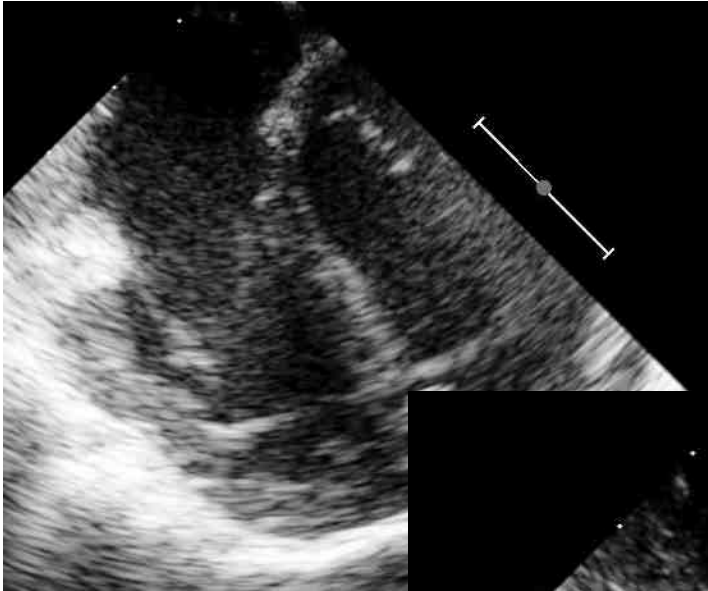
Conventional approach

VSD repair via RV-tomy or LV-tomy

Detour

Hybrid palliation (periventricular device closure)

Case 4



Case 5

- F / 26 days
- Gestational age: 37+4 week
- Body weight at Op: 2,249 gm
- R/O neonatal sepsis
- ABGA: 7.41-51-42-32-78%
- Echocardiography

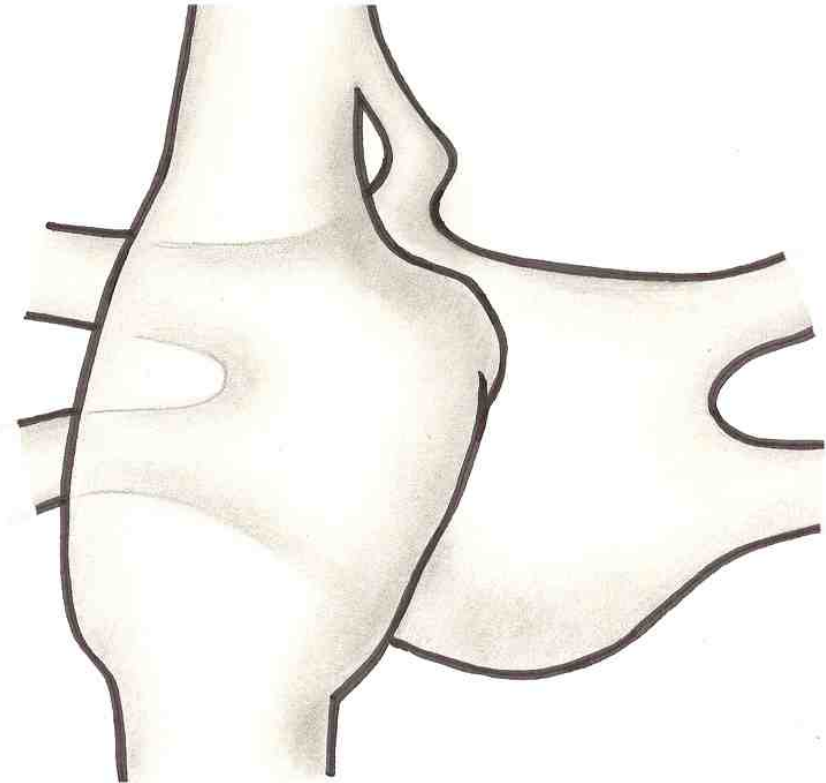
Right atrial isomerism

Unbalanced AVSD with small LV

DORV without PS

Bilateral SVC

Supracardiac TAPVD draining to SV
RA junction with severe obstruction

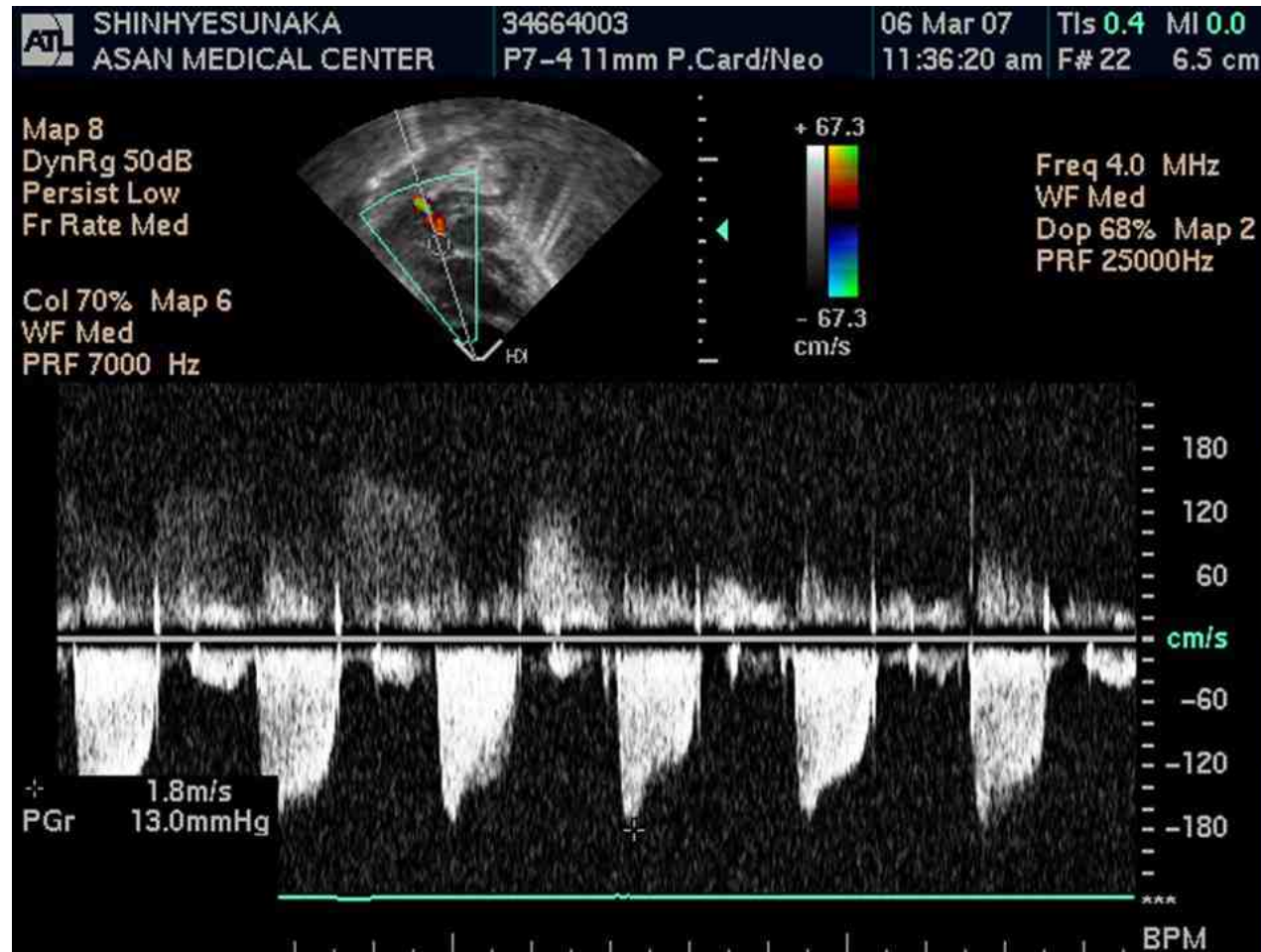


Case 5



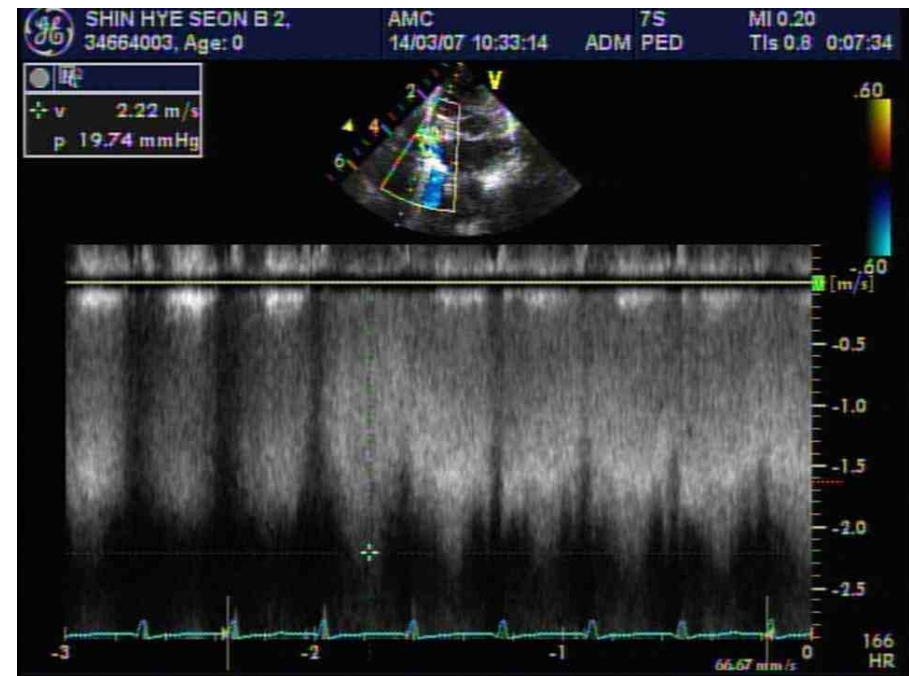
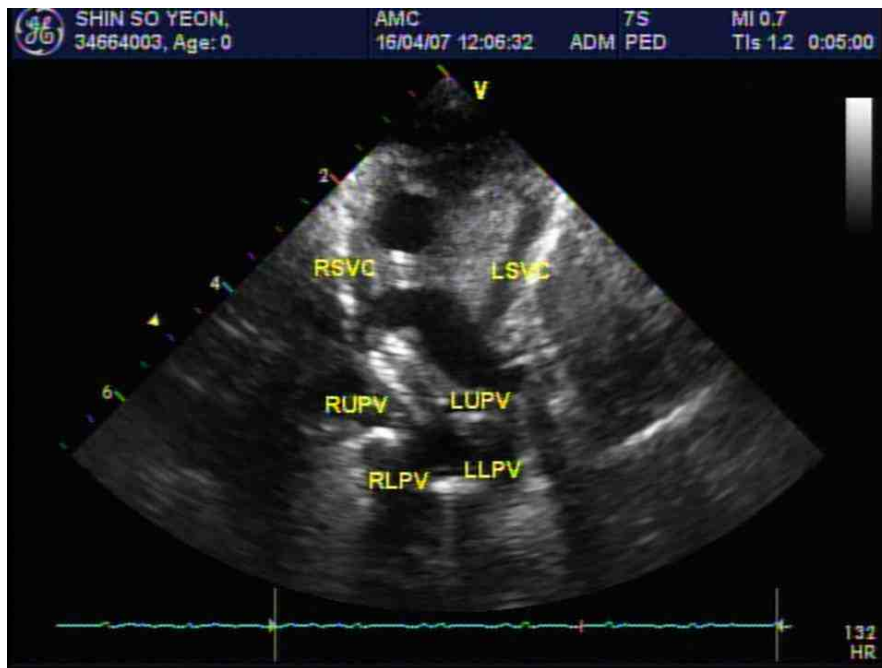
Cardiac CT at postnatal day 1

Case 5



Echocardiography at age 1 day

Case 5



Echocardiography at age 8 day

What should we do?

Conventional approach

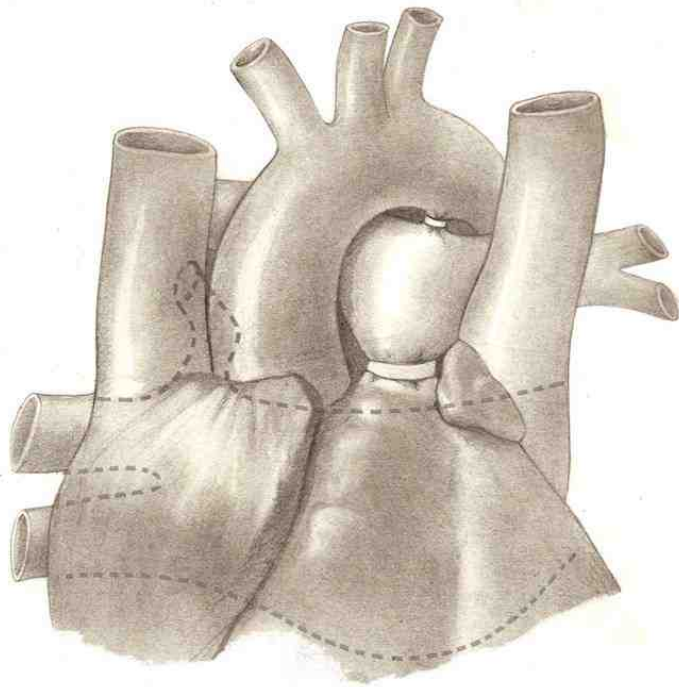
1. Withdrawal
2. PDA ligation + PA banding
3. PDA ligation + PA banding + TAPVD repair

Detour

Hybrid palliation (TAPVD draining v. stent)

Case 5

Hybrid palliation for RAI, TAPVD
(Age: 24 days, BWt: 2.29kg)

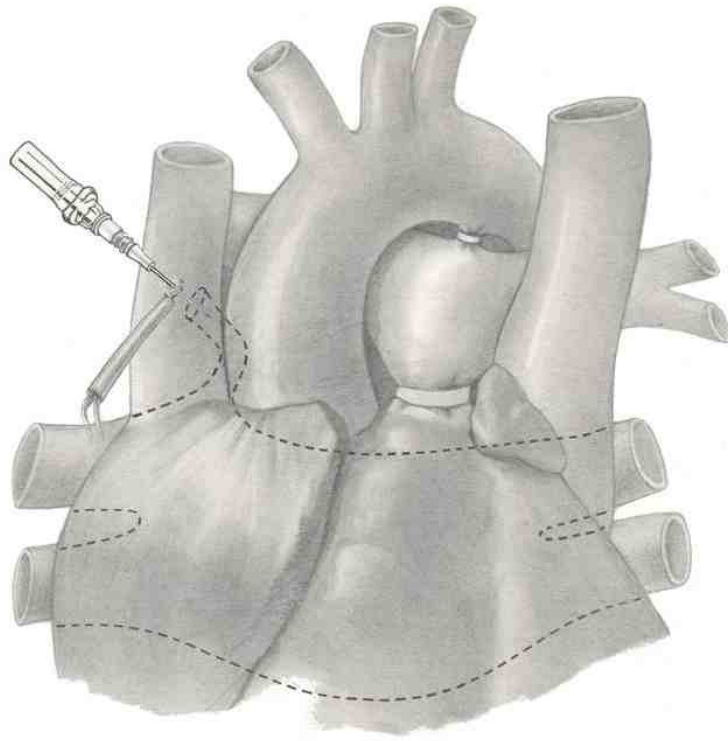


PDA ligation

PAB

Case 5

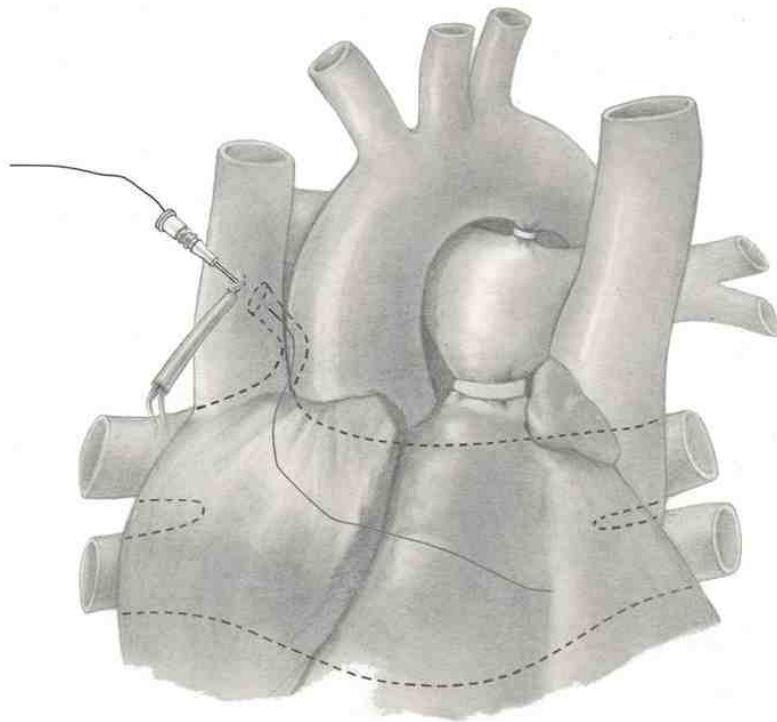
Hybrid palliation for RAI, TAPVD
(Age: 24 days, BWt: 2.29kg)



**Introduction
of angiocath
(22G)**

Case 5

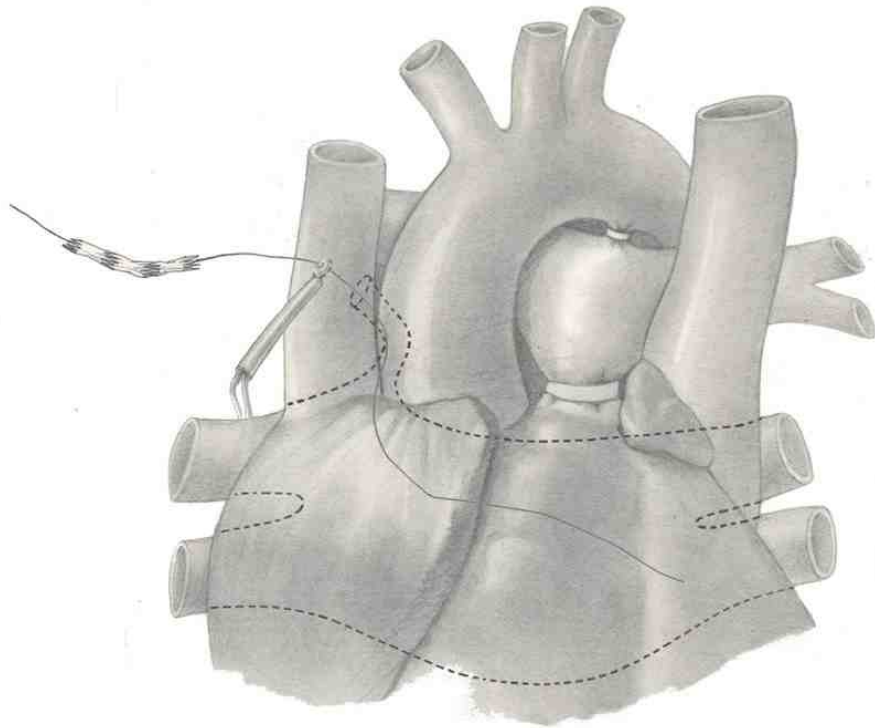
Hybrid palliation for RAI, TAPVD (Age: 24 days, BWt: 2.29kg)



Introduction
of guide wire

Case 5

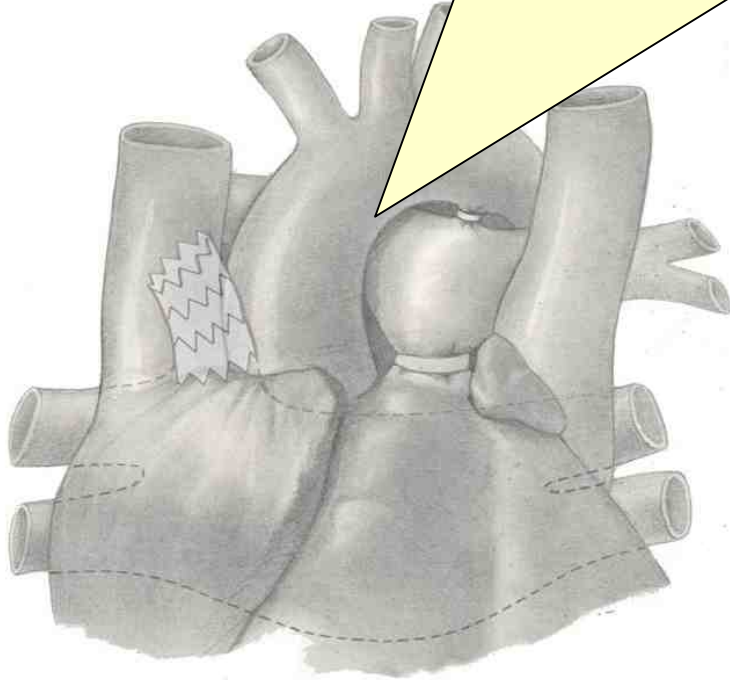
Hybrid palliation for RAI, TAPVD
(Age: 24 days, BWt: 2.29kg)



**Introduction
of stent**

Hy

- 1. Unrestrictive systemic outflow ?**
- 2. Adequate PBF ?**
- 3. Adequate intracardiac mixing ?**
- 4. No significant associated anomaly?**



Placement of stent
(Drug eluting, 4.5 mm, Endeavor TM.
Medtronic Inc. Minneapolis)

Case 5

Postoperative course

POD #0 : Open sternum, NO / vasopressin

POD #4: PAB tightening due to high SaO₂

POD #7 : Delayed sternal closure

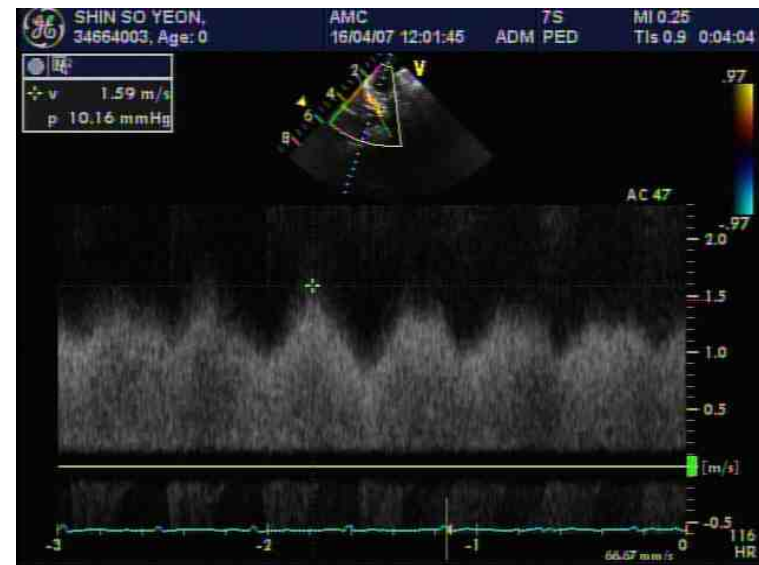
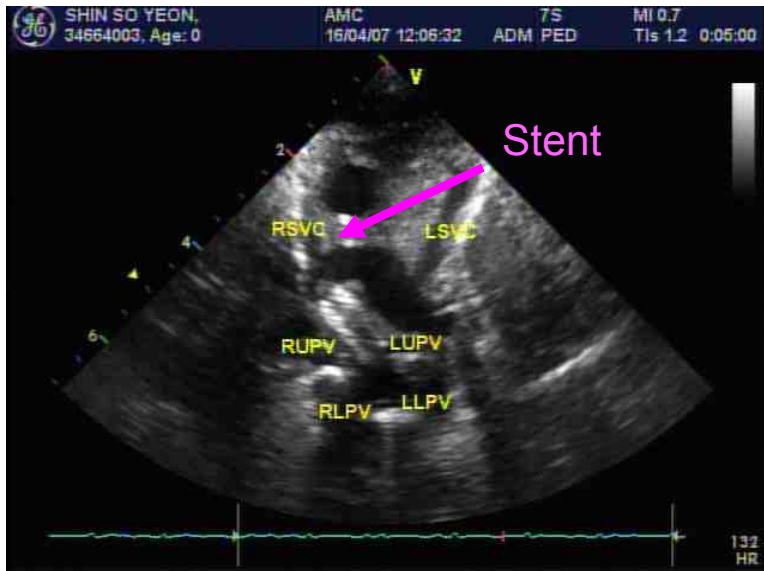
POD #10 : Extubation

POD #13 : GW transfer, SaO₂: 90%

POD #18: mild desaturation (SaO₂: 70%)

Case 5

- **Post op. echo (POD # 18)**
 - adequate stent and PAB position
 - PAB vel. : 2.5 m/sec
 - TAPVD draining site velocity: 1.5 m/sec
continuous flow



Case 5

- **Discharge with O₂ inhalation at age 48 days**
- **2nd Admission**

Age: 52 days (POD 28 days)

C.C : Abrupt desaturation

PICU admission

BWt. 2.7kg

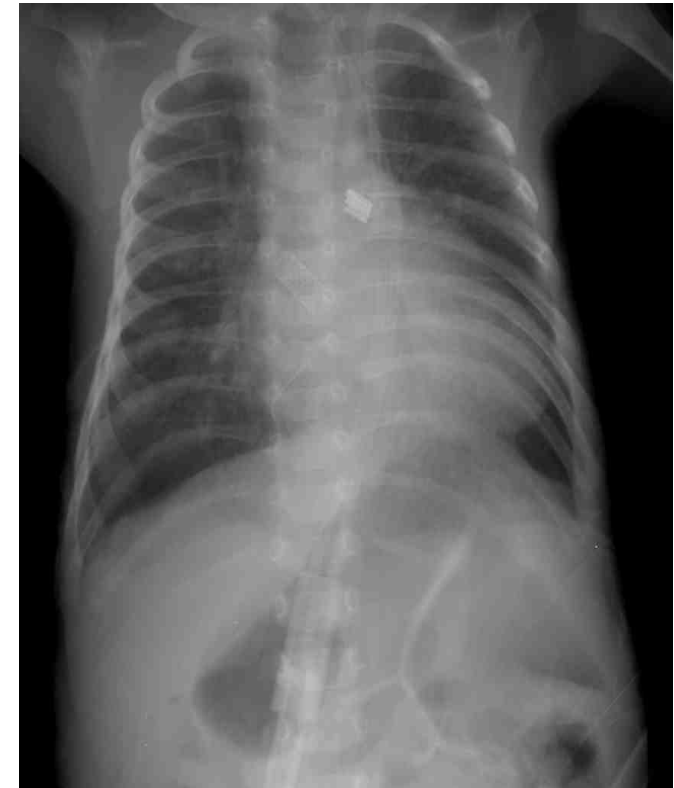
Initial ABGA

7.11- 41-19-15%

Echo findings

Stenosis at the SVC end of stent

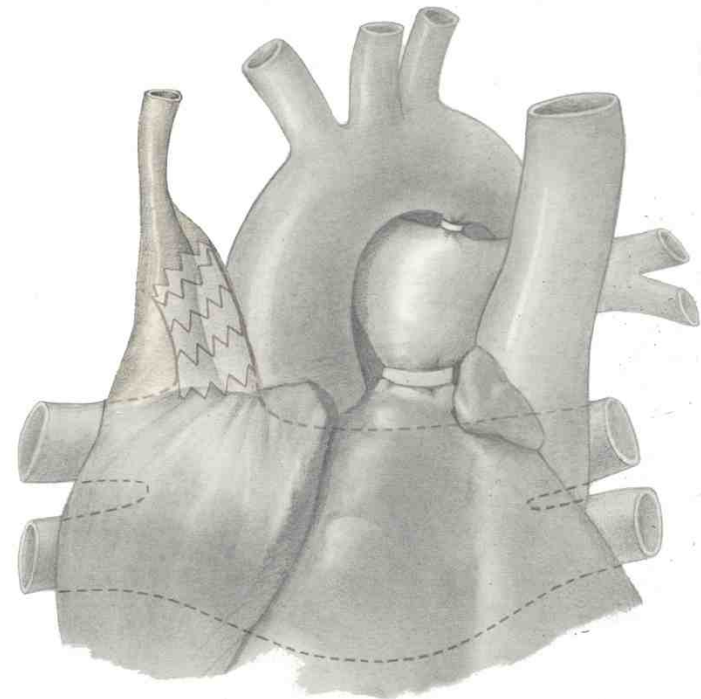
Velocity at the stent end: 3 m/sec



Case 5

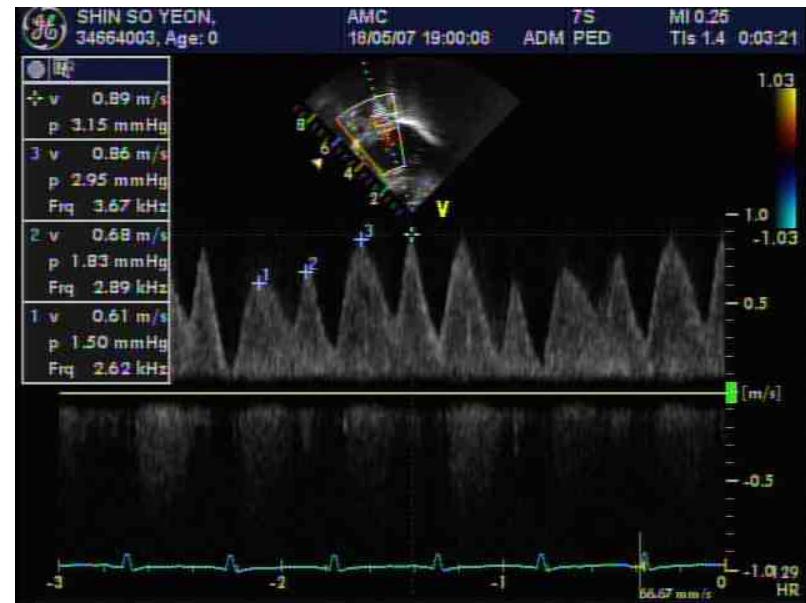
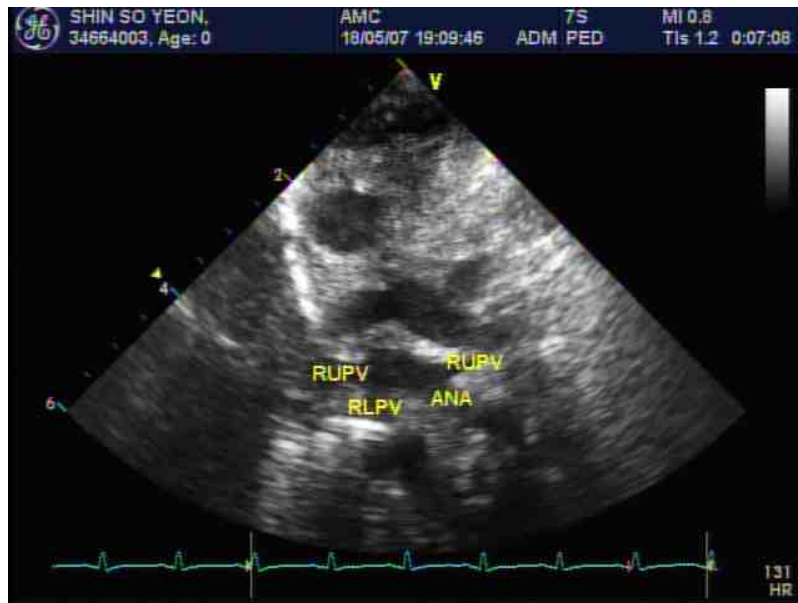
Emergency re-operation

- **Op findings**
 - Stent – patent
 - Rt. SVC stricture
- **Op proceure**
 - Stent removal
 - TAPVR repair with sutureless technique
 - Opened sternum



Case 5

- Postop. echo (POD # 22, Age: 84 days)



Negative results - Congenital

Hybrid palliation for right atrial isomerism associated with obstructive total anomalous pulmonary venous drainage

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Received 1 November 2007; received in revised form 30 December 2007; accepted 1 January 2008

Abstract

A twenty-four-day-old girl, who was prematurely born at 36 weeks of gestation, and weighed 2.2 kg, and diagnosed with right atrial isomerism, functionally single ventricle, bilateral superior vena cava (SVC) and obstructive supracardiac total anomalous pulmonary venous drainage (TAPVD) draining to the junction between the right SVC and the right atrium, underwent a hybrid procedure in the operating room, which consisted of pulmonary artery banding, ductus ligation and stenting of the draining vein of TAPVD. Obstruction at the drainage site of TAPVD was initially relieved after stenting, but, one month after the procedure, the distal end of the stent became stenotic and she received bilateral sutureless repair of TAPVD. At postoperative seven months, she underwent bidirectional cavopulmonary shunt uneventfully, and she has been followed-up for two months in a stable state without any problem in the pulmonary venous pathway.

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Keywords: TAPVD; Right atrial isomerism; Hybrid procedure

1. Introduction

Although the prognosis of right atrial isomerism (RAI) associated with obstructive total anomalous pulmonary venous drainage (TAPVD) is very poor even in contemporary series [1, 2], cooperative TAPVD repair upon initial palliation

necrotizing enterocolitis, antimicrobial treatment was initiated. From the 15th day of life, she began to show desaturation (70%), tachypnea, and pulmonary venous congestion on chest X-ray. Follow-up echocardiography revealed that the draining site of TAPVD had become

Contemporary management of right atrial isomerism: Effect of evolving therapeutic strategies

Tae-Jin Yun, MD,^a Osman O. Al-Radi, MD,^b Ian Adata, MD,^a Christopher A. Caldarone, MD,^b John G. Coles, MD,^b William G. Williams, MD,^b Jeffrey Smallhorn, MD,^b and Gani S. Van Arsdall, MD^b

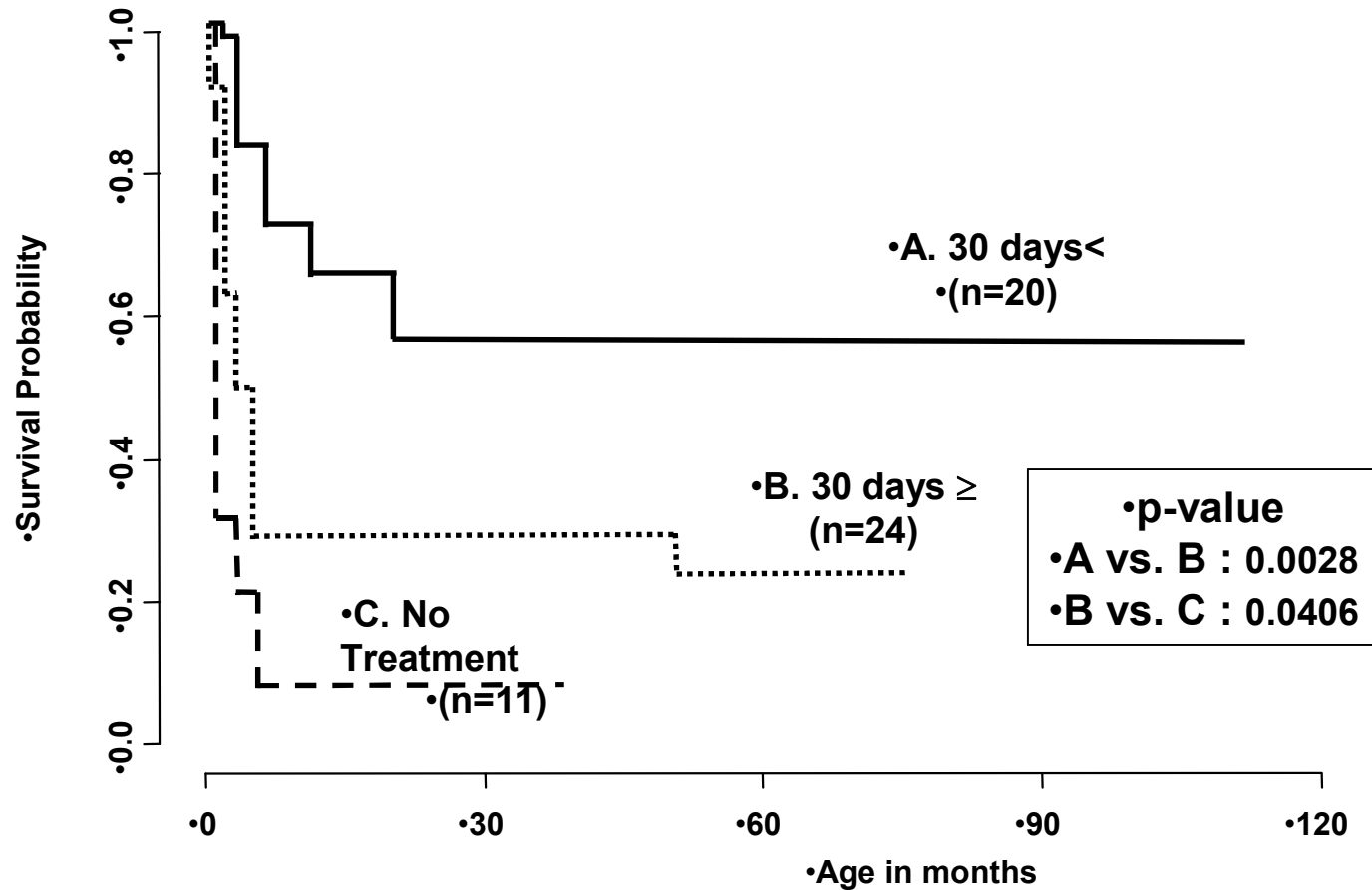


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Objectives: Infants with right atrial isomerism have poor outcomes because of a complex combination of cardiac anomalies. Aggressive management of total anomalous pulmonary venous drainage might have a positive effect on the prognosis.

Methods: Outcomes of all children with right atrial isomerism from 1994 to the present were reviewed. Management of total anomalous pulmonary venous drainage evolved from no repair or conventional surgical technique to primary sutureless repair on initial palliation. Cox survival models were used to identify variables associated with reduced survival.

Results: There were 55 children enrolled in the study. The median age at the initial visit was 2 days. Fifty-one patients had total anomalous pulmonary venous drainage (obstructive in 22 patients). Withdrawal of treatment occurred in 11 (20%) of 55 patients during an interval of institutional bias toward no treatment. Thirteen (24%) of 55 patients had palliations without total anomalous pulmonary venous drainage repair, and 3 (23%) of 13 survived. Thirty-one (56%) of 55 patients had operations that included total anomalous pulmonary venous drainage repair, of whom 13 (42%) of 31 underwent primary sutureless repair for total anomalous pulmonary venous drainage. Sixteen (52%) of 31 survived, and their current status 1 to 10 years (median, 5.8 years) after repair is post-Fontan (7/16 [44%]), postbidirectional Glenn (6/16 [38%]), and others (3 [20%]). In patients who underwent total anomalous pulmonary venous drainage repair (n = 31), 2 risk factors of decreased survival



•Figure 4. Survival after birth for patients with first surgical intervention after age of 30 days(A), with first surgical intervention during neonatal period (B) and with no treatment (C). Patients with neonatal surgical intervention had significantly worse prognosis than patients who had surgical intervention after 1 month of age (P=0.0028), although neonatal palliation group had better outcome compared to treatment withdrawal group (P=0.0406).





Hybrid procedures

-Surgeon's perception-

Aberrational

Beneficial

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