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POSDRU 2007-2013
Instrumente Structurale
2007-2013
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ȘI PERSOANELOR VÂRSTNICE
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UNIVERSITATEA DE MEDICINĂ ȘI
FARMACIE "CAROL DAVILA"
BUCUREȘTI

AD-COR Program inovativ de formare in domeniul cardiologiei pediatrice
POSDRU/179/3.2/S/152012

Data: **14-09-2015**

MODUL TEORETIC

Emergency in Neonatal Cardiac Surgery

Imputernicit: Prof. Dr. Tammam Youssef

Activitate prestata de I.R.C.C.S. POLICLINICO SAN DONATO – MILANO, ITALIA in baza contractului nr. 18/22144/29.07.2015

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Beneficiar: Universitatea de Medicină și Farmacie „Carol Davila” București

Emergency in Neonatal Cardiac Surgery

Alesandro Frigiola
Tammam Youssef

IRCCS Policlinico San Donato

Physiologic, Hematologic,
Immunologic and Metabolic differences from adults

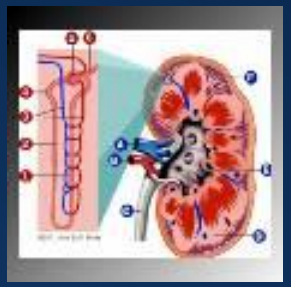
Newborn physiology

Multiorgan immatury

- metabolic
- respiratory
- neurological
- renal
- myocardial

Total body water post CPB

600 – 1000 gm



Reduced Renal Function

Edema

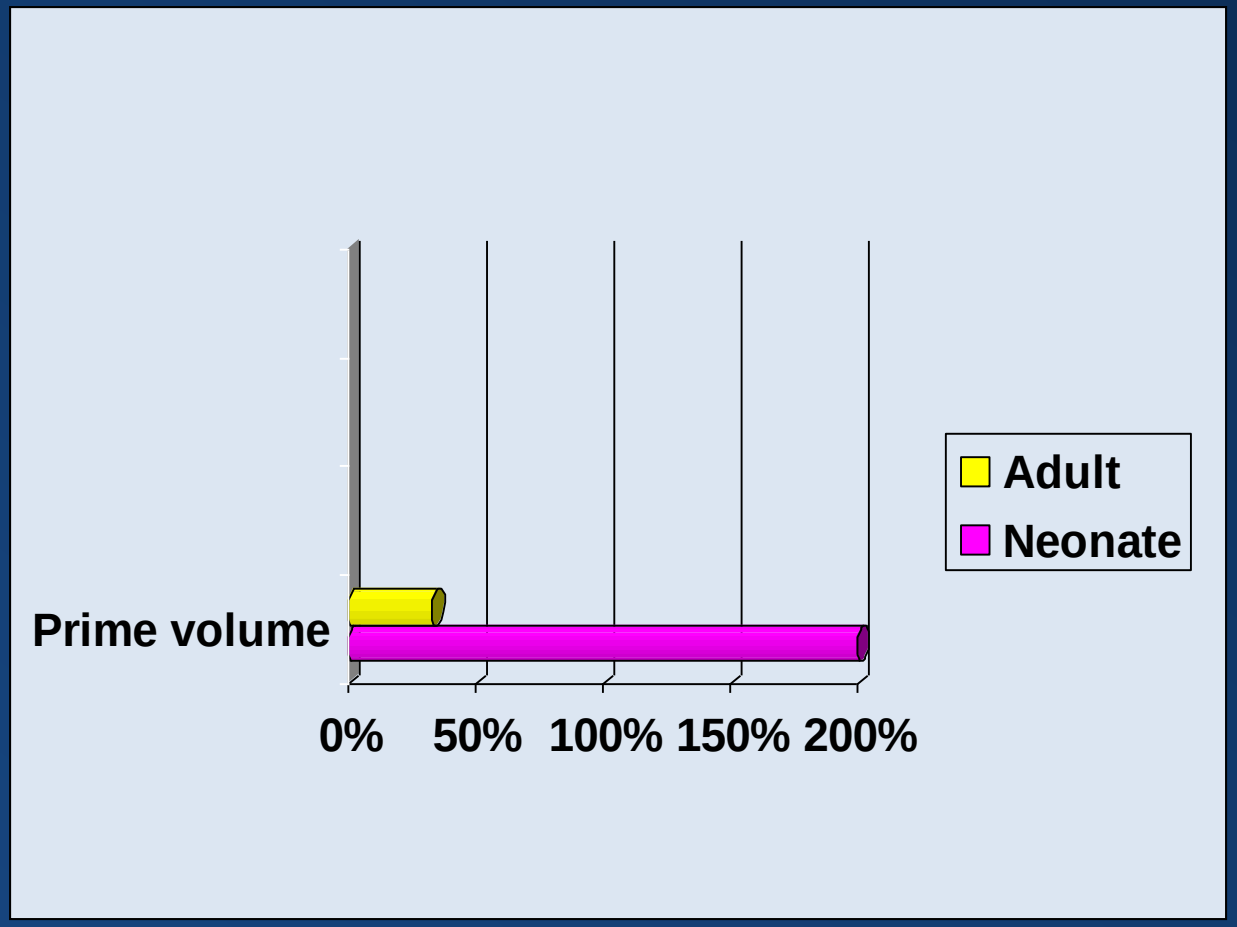
Thorax

Lungs

Myocardio

Reduced pulmonary compliance
Increased cardiac filling pressure

Circuit miniaturization
Control inflammatory response
Improved perfusion techniques



Congenital heart disease in Italy

3.000 new cases per year

40% with symptoms in the first month of life

Urgent cardiac procedures

Neonatal cardiac surgery procedures performed routinely

Coarctation repair
Systemic to pulmonary shunt
Patent ductus art. closure
Pulmonary artery banding
Norwood procedure for HLHS
Arterial switch operation
Truncus arterious repair
Interrrupted aortic arch repair
TAVPR repair
Aortic stenosis repair
Pulm. Stenosis or atresia with IVS repair

Initial therapeutic indications

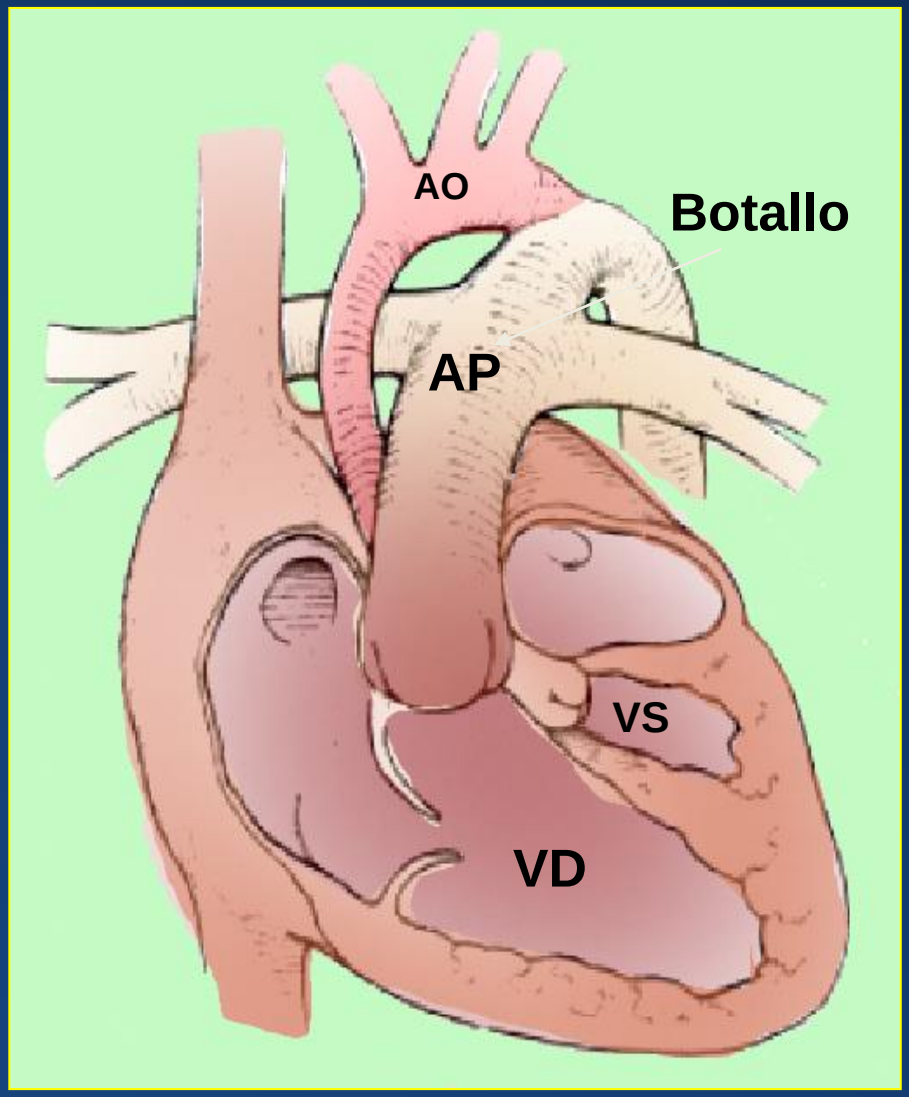
- **Surgery**

TGA	Switch
Hypoplastic left heart syndrome	Norwood
TAPVC	Correction
Coarctation	Anastomosi T-T
Aortic Arch Interruption	Correction

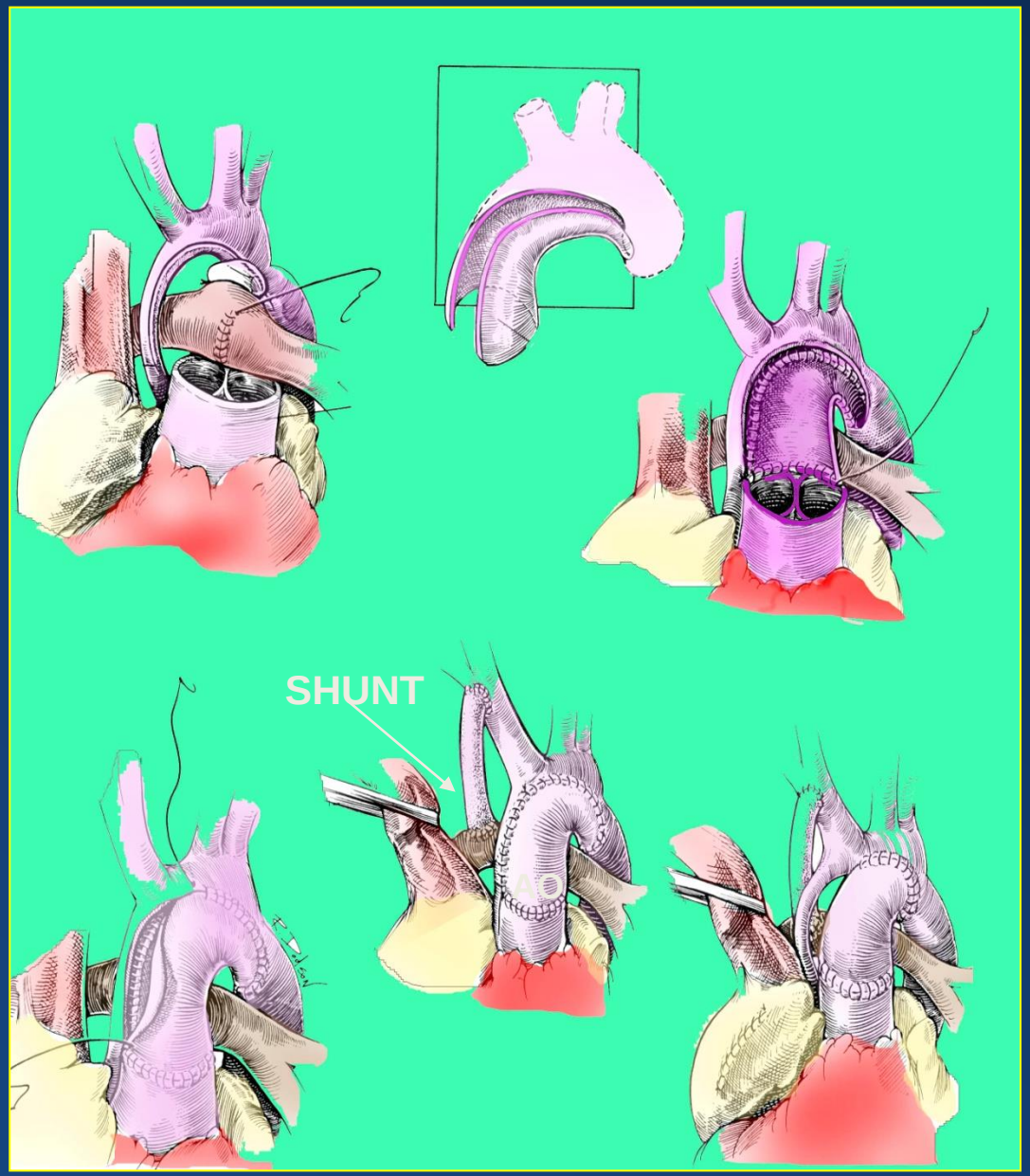
- **Hemodynamic procedures**

TGA	Atrial Septostomy
Aortic Stenosis	Valvuloplasty
PS or PA with intact IVS	Valvuloplasty

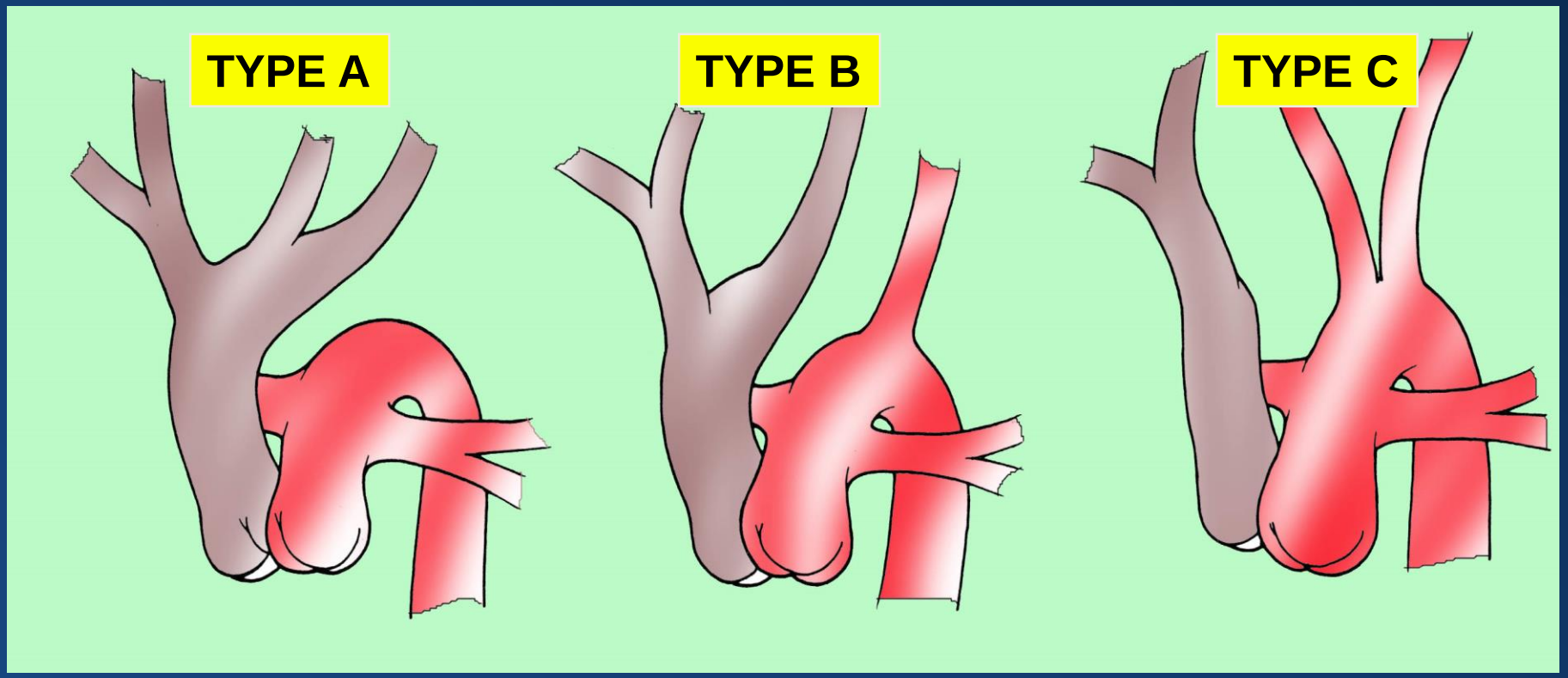
Hypoplastic heart syndrom



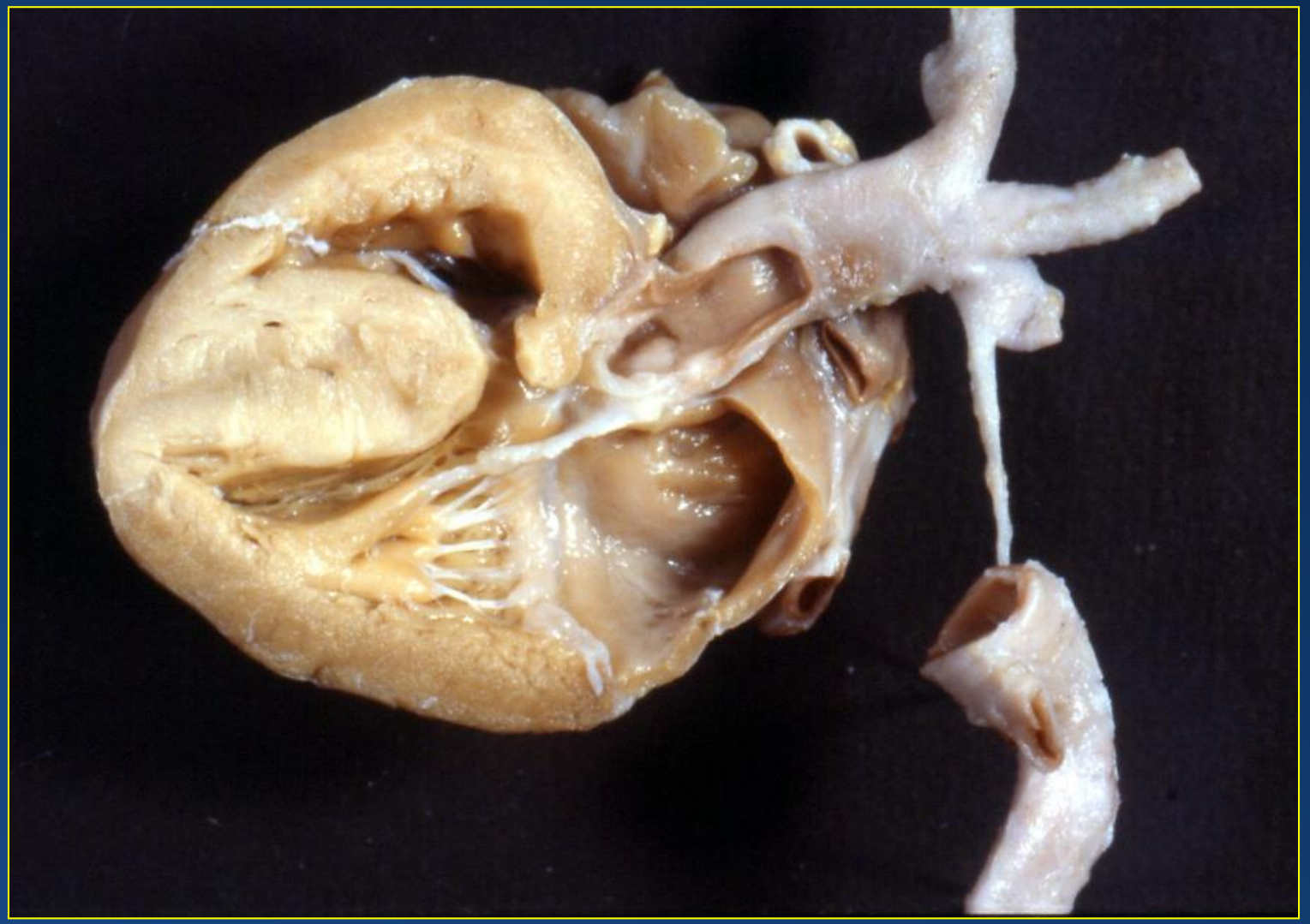
Hypoplastic heart syndrom (Norwood)



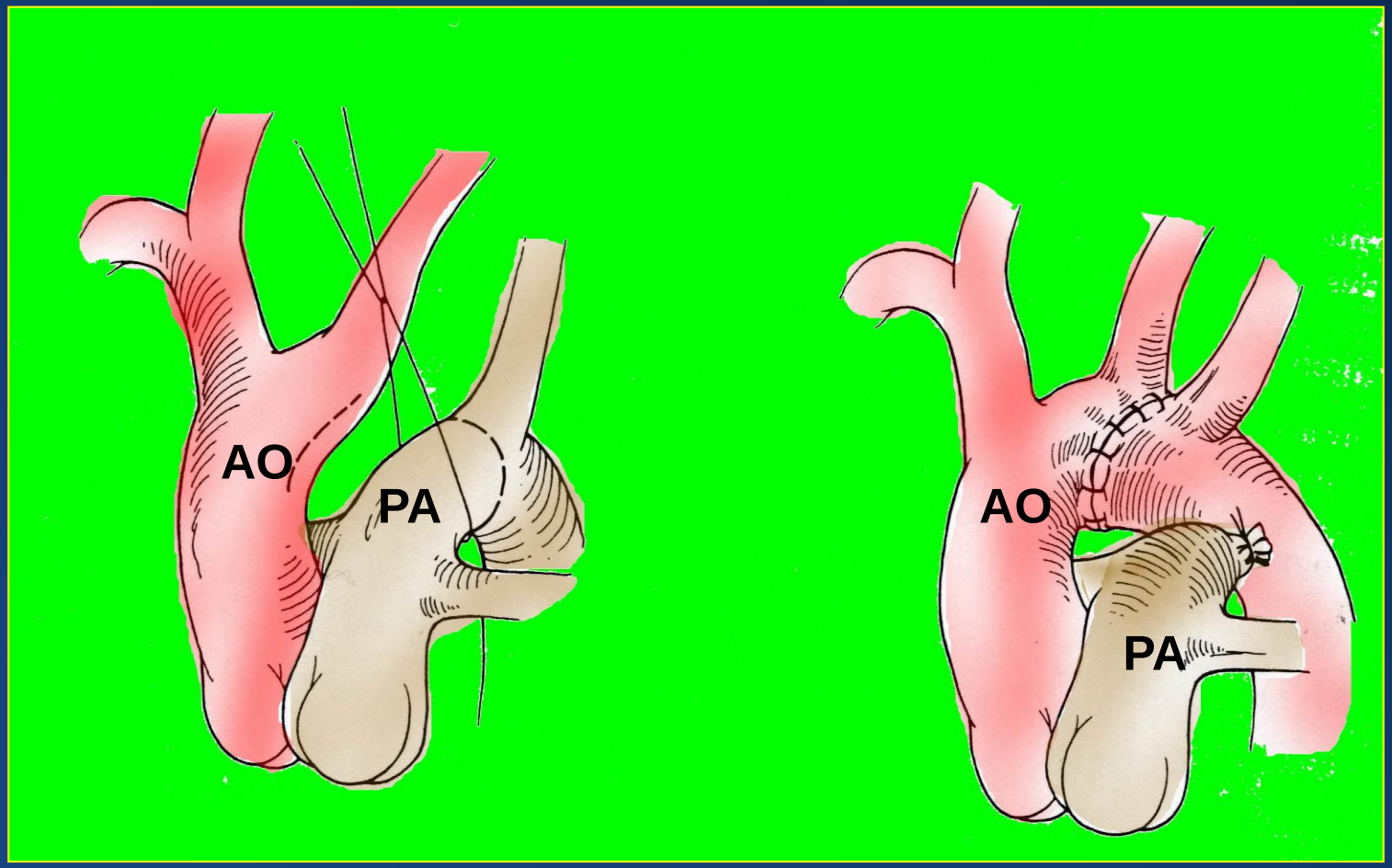
Aortic arch interruption



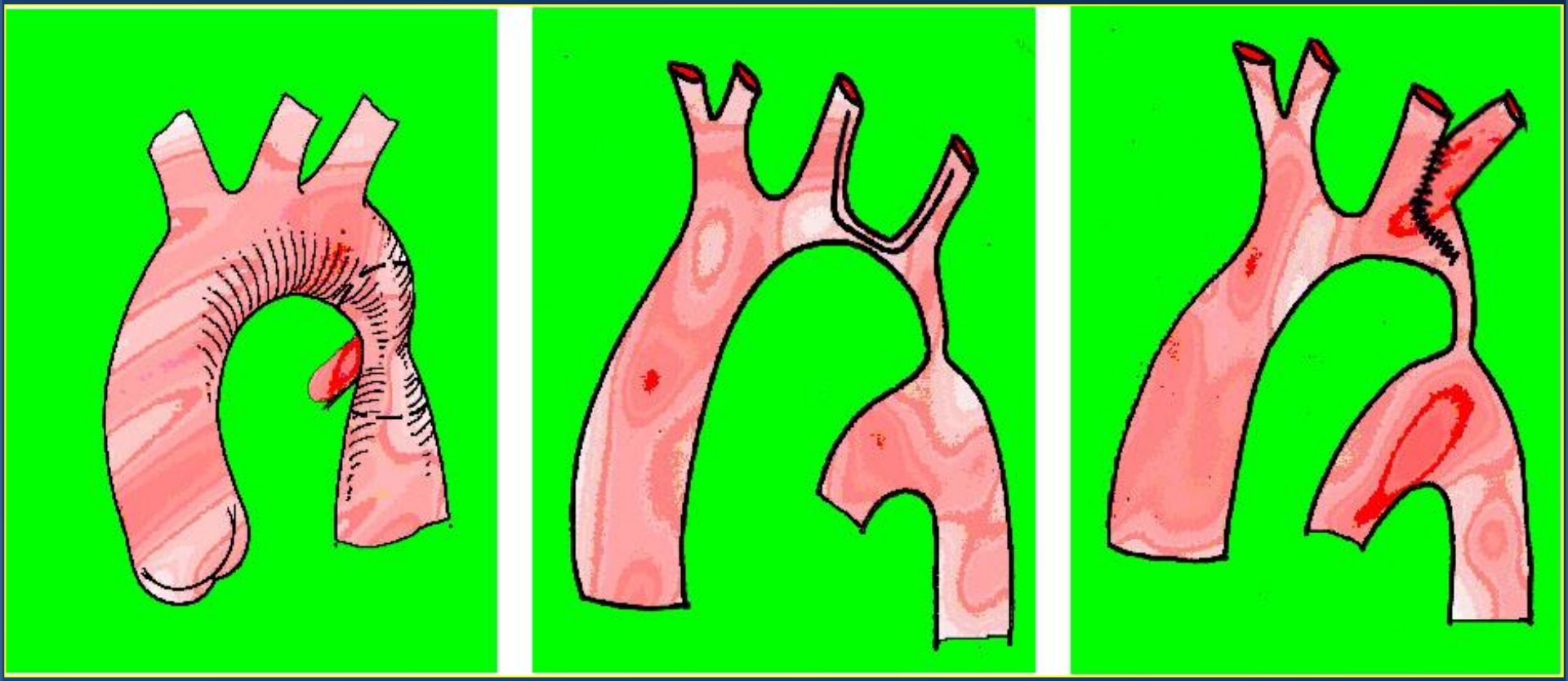
Aortic arch interruption



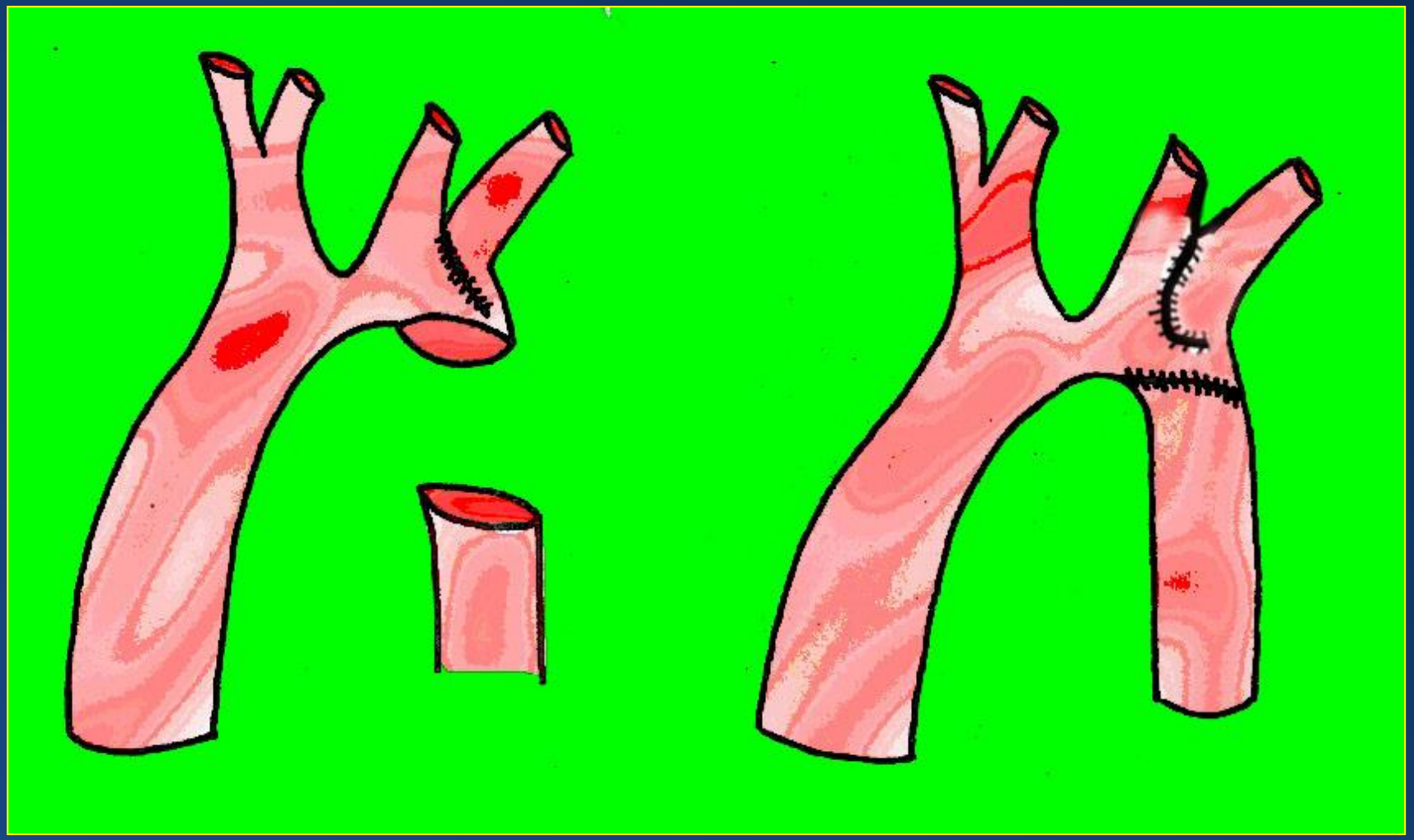
Aortic arch interruption



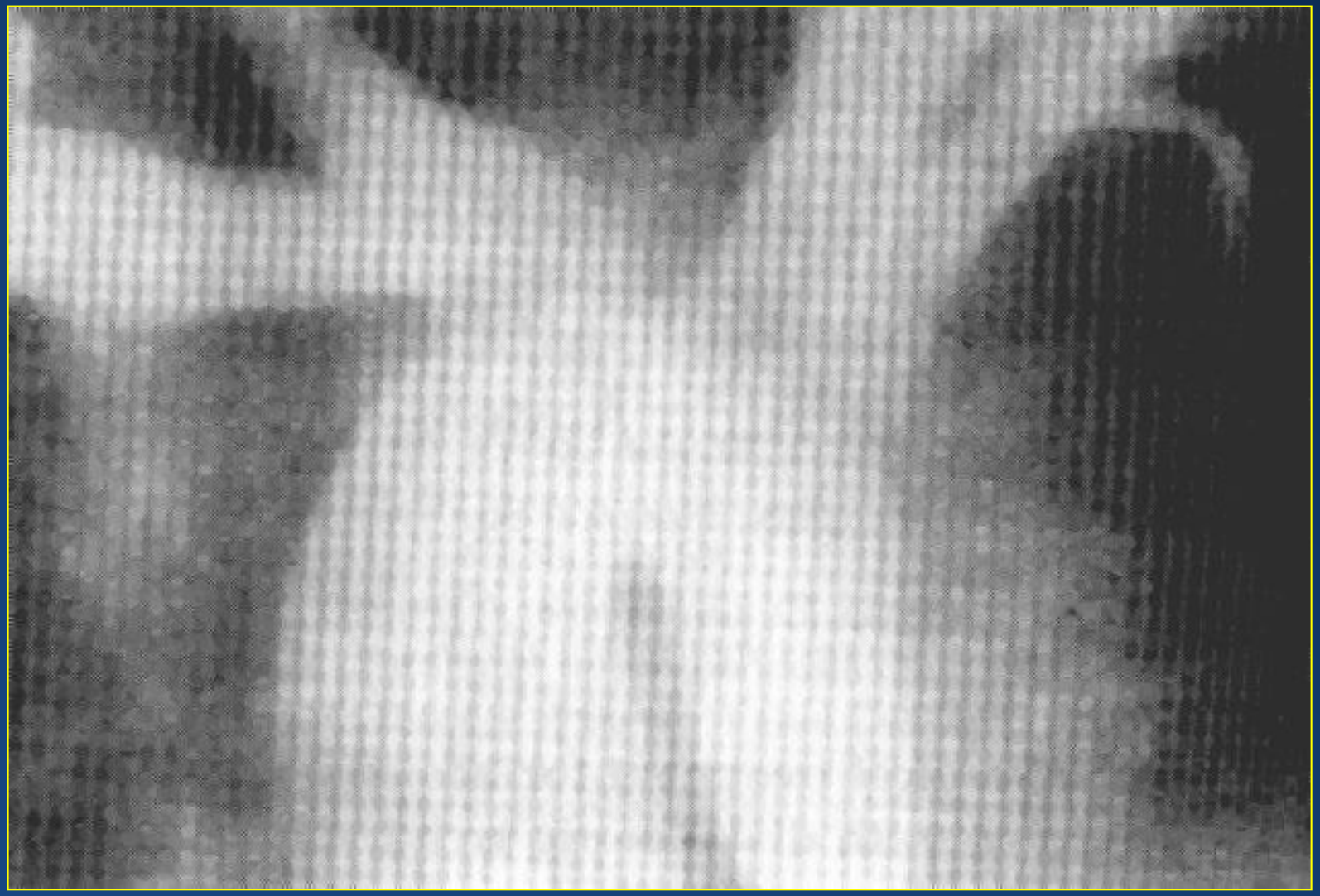
Aortic coarctation



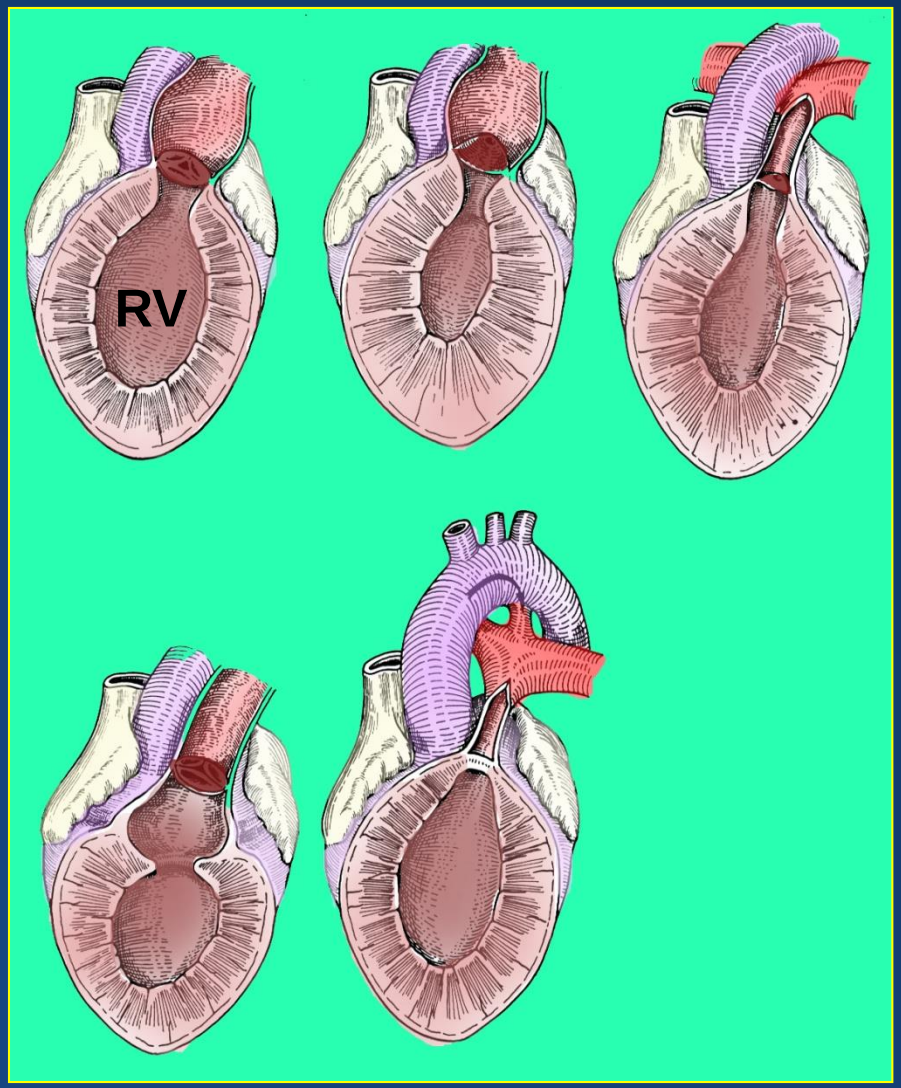
AORTIC COARCTATION WITH HYPOPLASTIC ARCH



Post-op angio



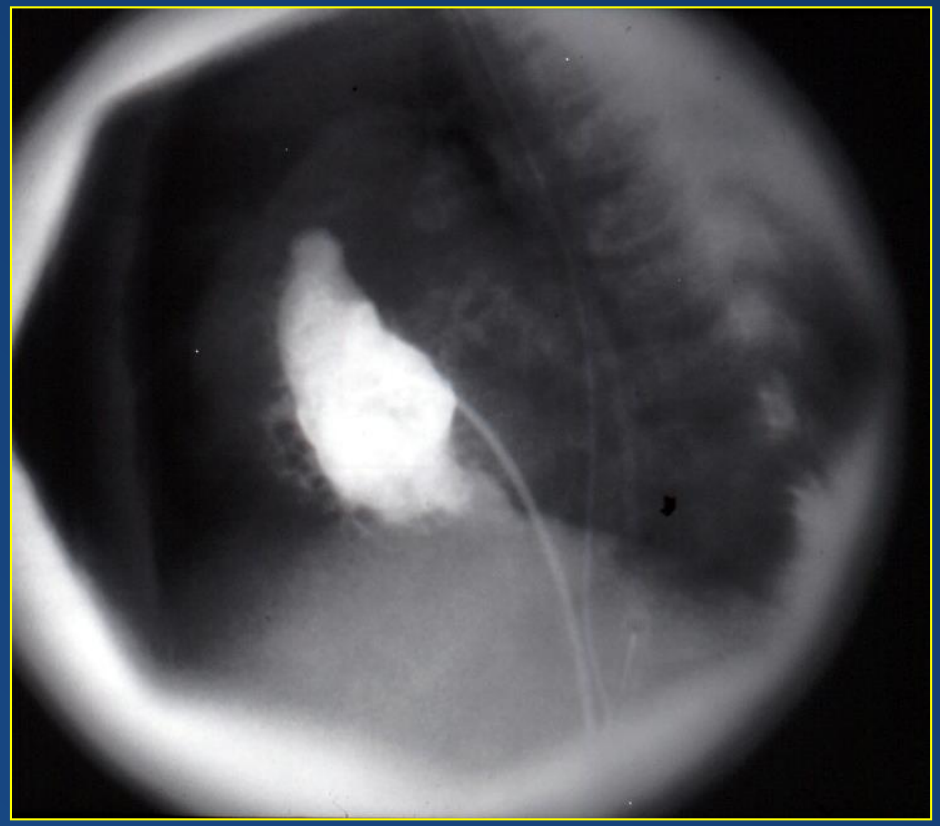
Pulmonary atresia with intact ventricular septum



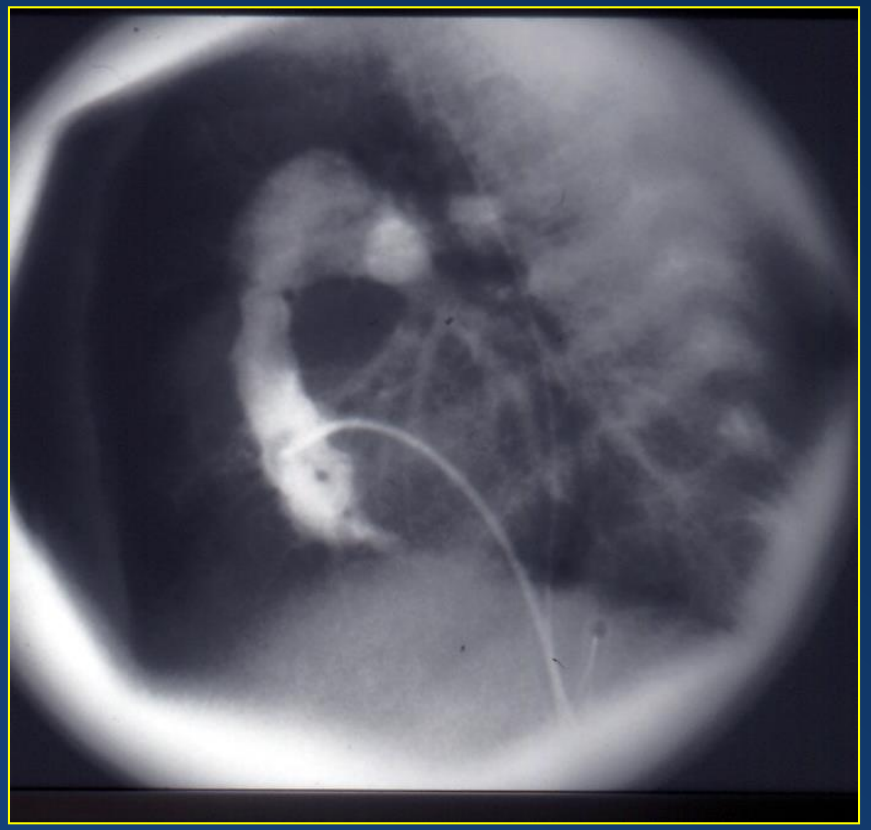
Post dilatation

Critical Pulmonary Stenosis

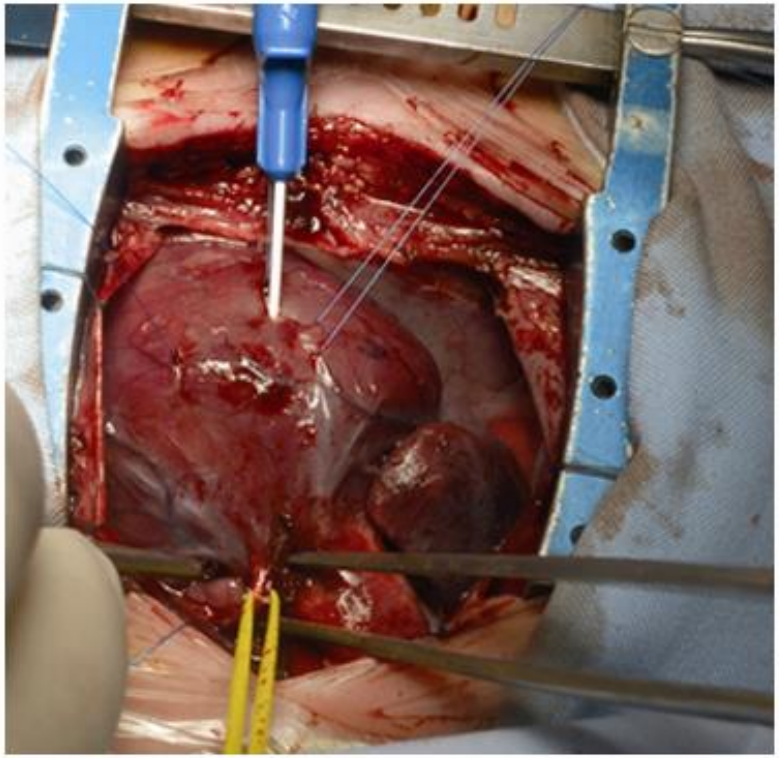
Pre-



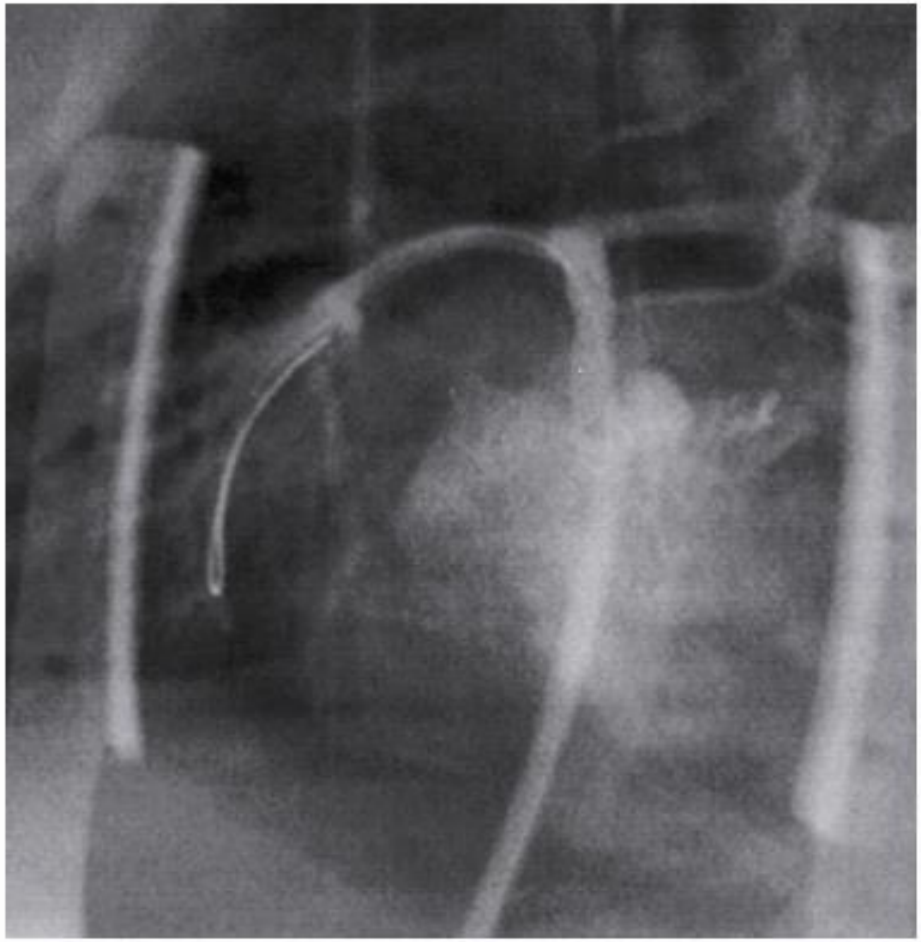
Post-

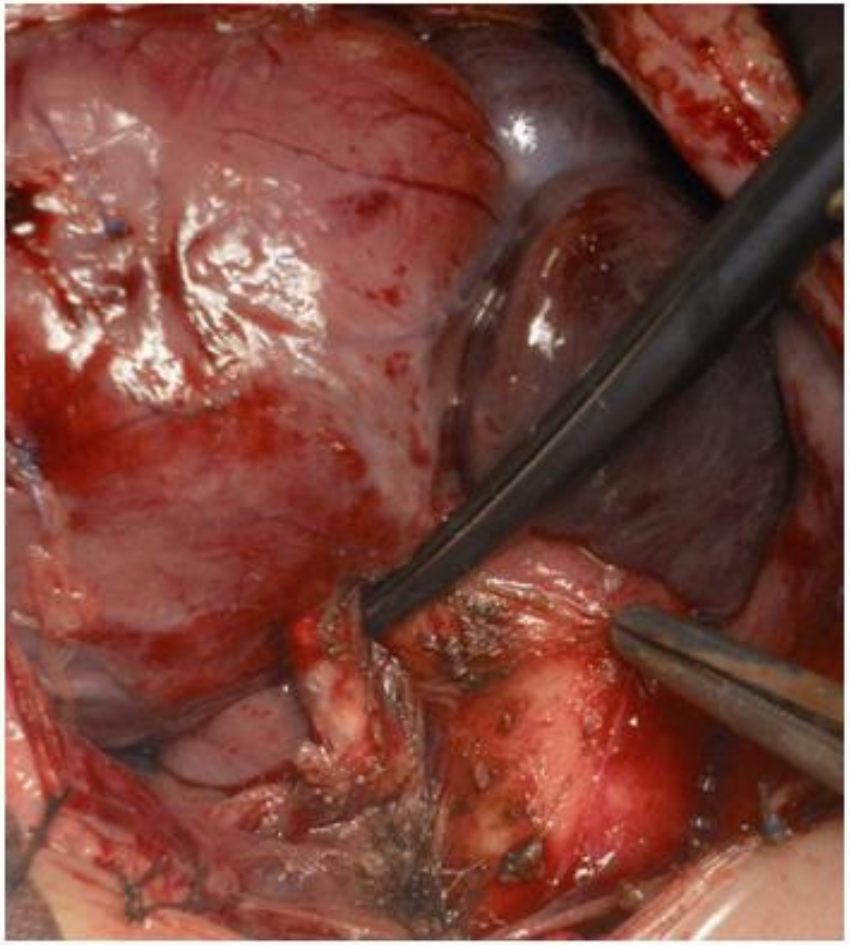


Pulmonary atresia: hybrid procedure

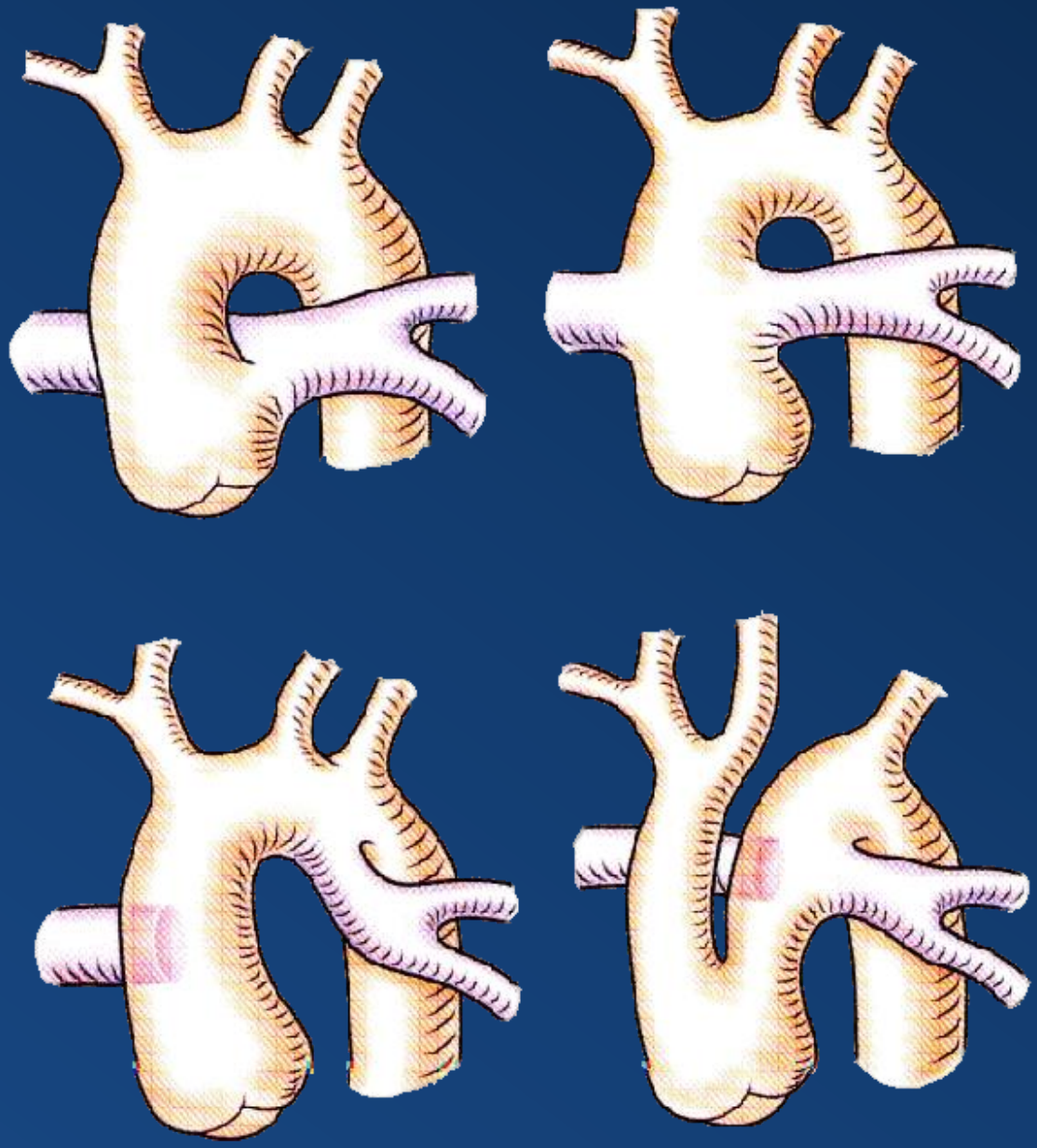


Pulmonary atresia: hybrid procedure

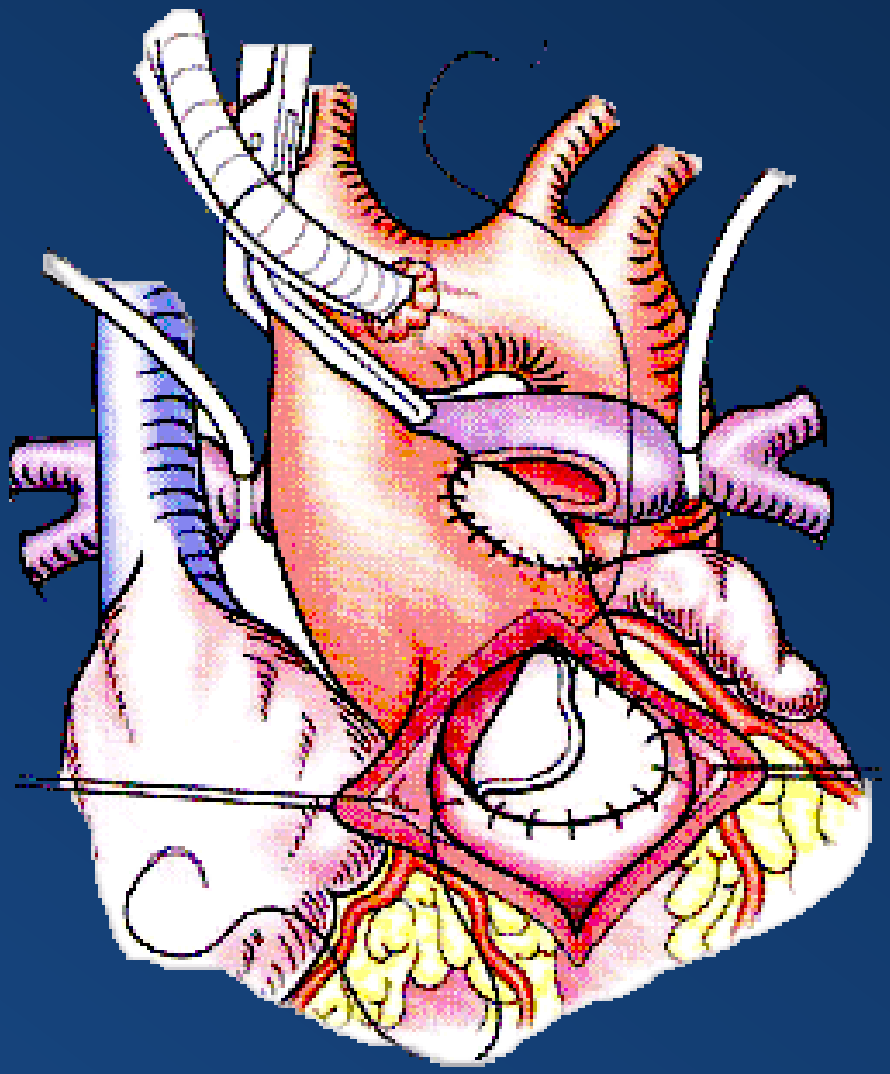




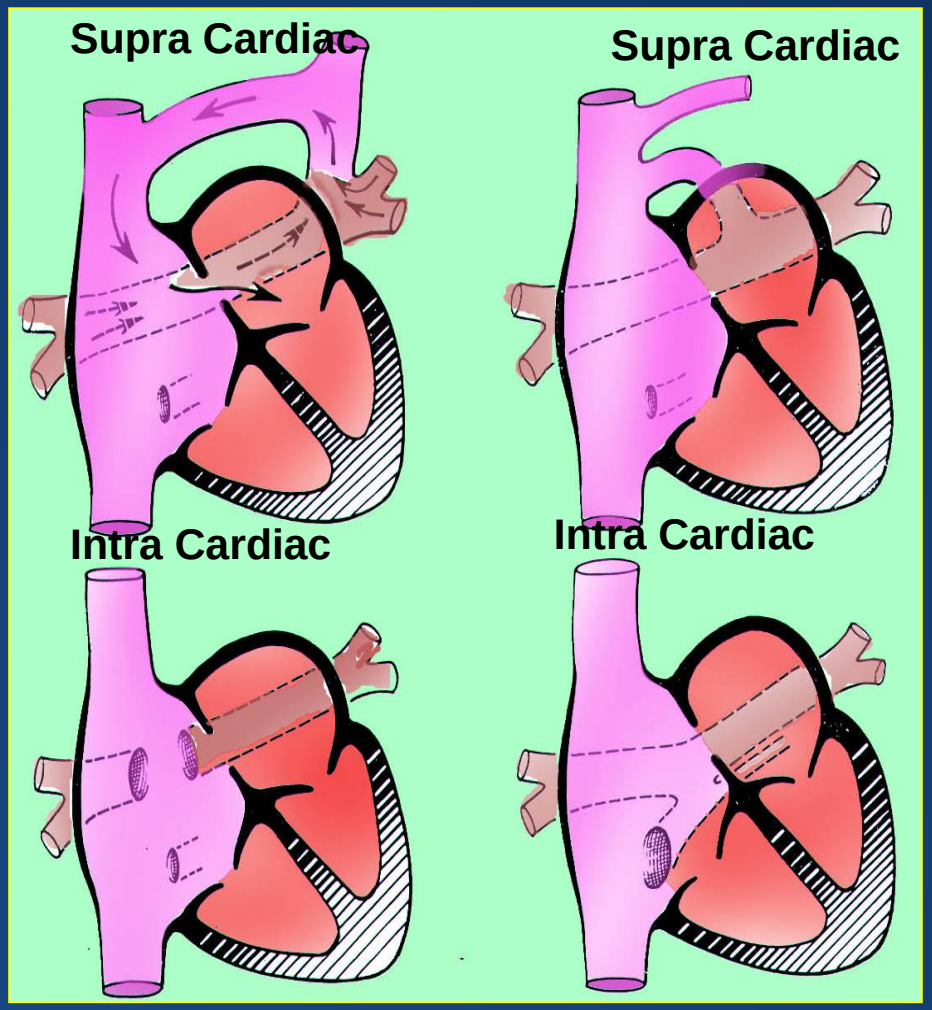
Truncus arteriosus

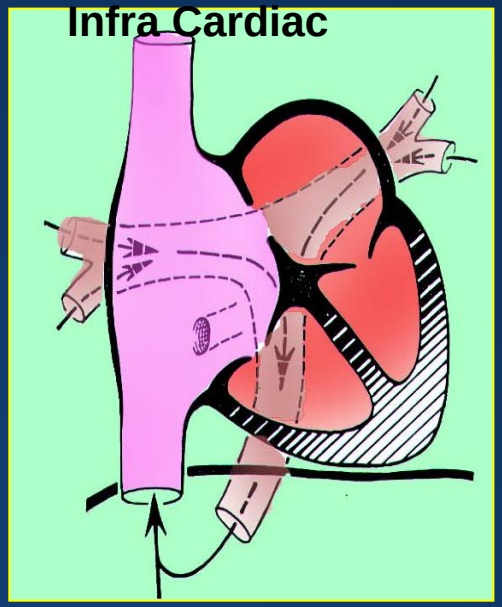


Truncus Arteriosus Surgical Correction

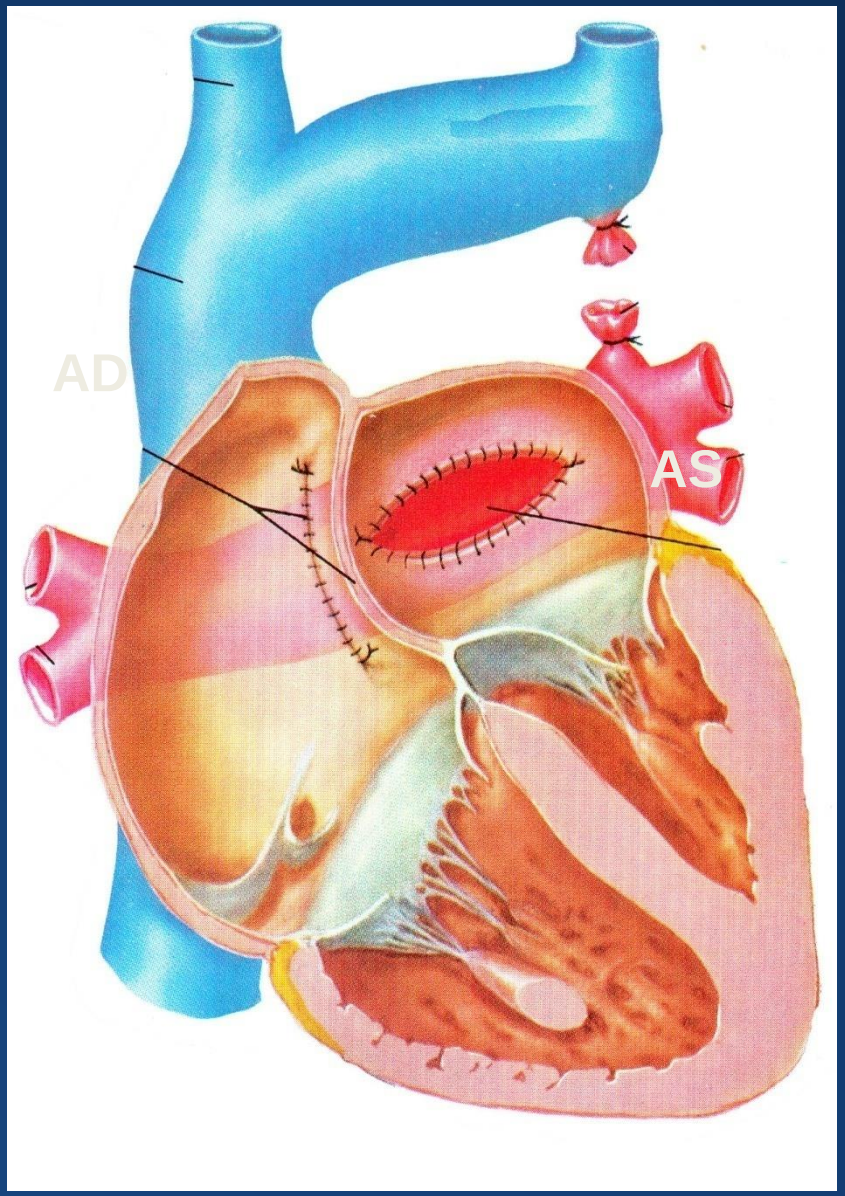


Total Anomalous Pulmonary Venous Connection
TAPVC

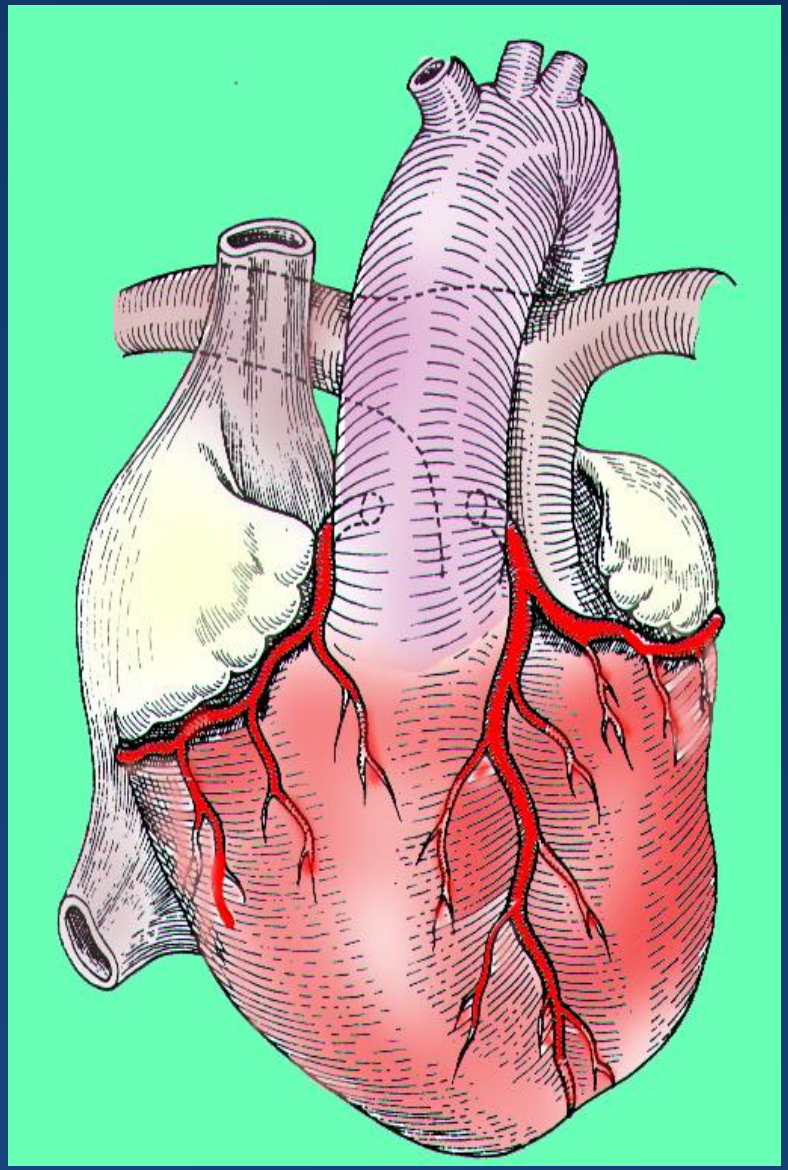




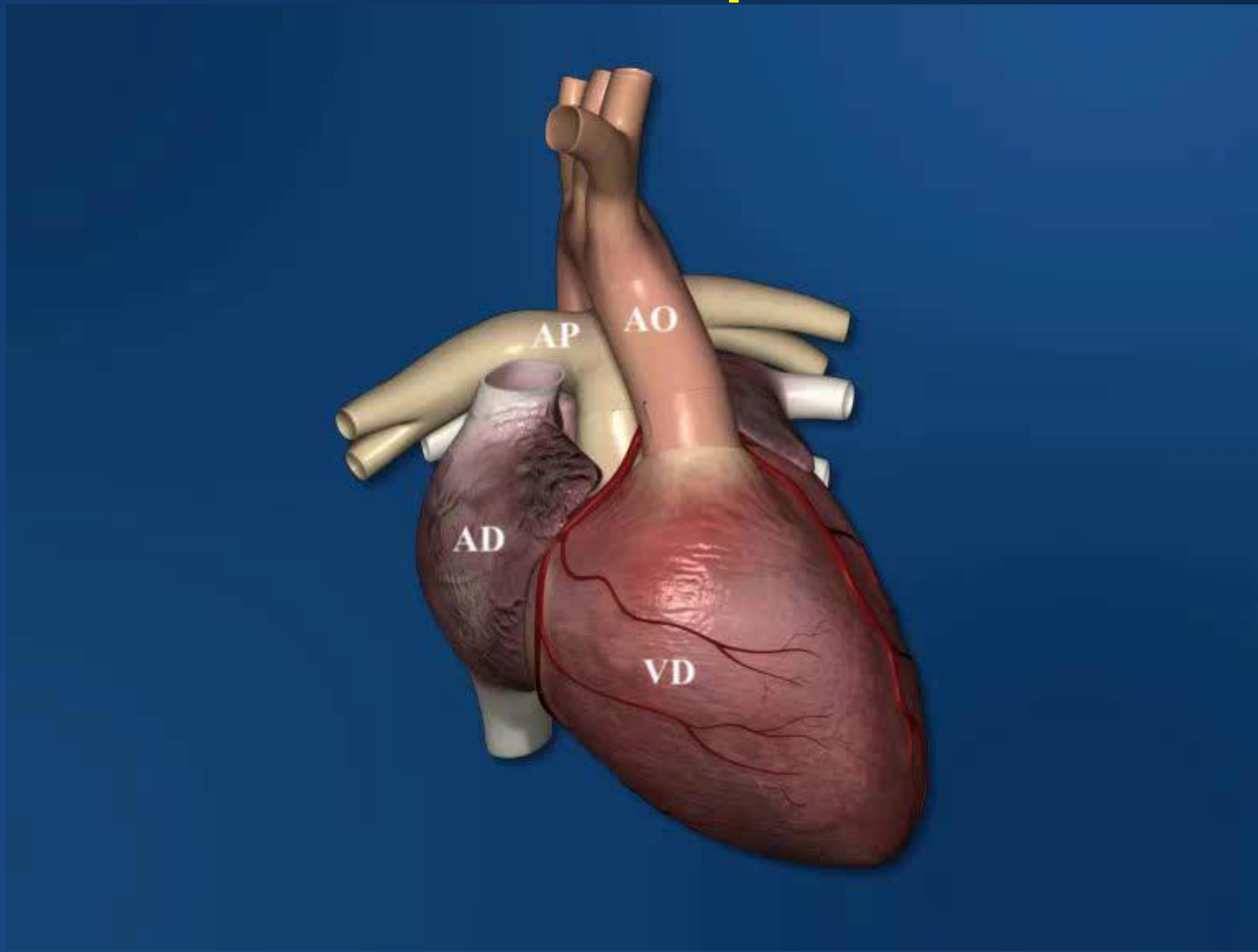
Total Anomalous Pulmonary Venous Connection
Surgical Correction



TGA



TGA: switch operation



Birth defects

More than 7-9 million children are born, every year, with a serious congenital disorder.

The most common serious c. disorders are:

- ✓**Congenital heart defects**
- ✓**Neural tube defects**
- ✓**Down syndrome**

World health statistics 2008

Pediatric mortality

9.000.000 children die every year

3.500.000 die with the first 28 days of life

World health statistics 2008

Pediatric mortality

260.000 neonatal death are caused by congenital anomalies

> 130.000 are due to heart diseases

World health statistics 2008

Mortality in neonatal cardiac surgery

Year	Mortality (%)	
1970	50-60	
1980	40	
1990	30	
2000	15	
2010	10 (ESCTS)	7.8(STS)

Surgical treatment in neonatal congenital heart disease.
Bove E. L. et al, Arch Dis Child. 1983
(Mortality 57%)

Pediatric cardiac mortality

Relationship between patient volume and outcome

Both annual surgeon volume and annual hospital volume are inversely correlated to mortality rate

Jen Kins KJ et al, PEDIATRICS 1995; 95 (3)

Hannan EL et al, PEDIATRICS 1998; 101 (6)

Pediatric cardiac mortality

Center volume/ mortality rate

Large volume centers	Mortality %
≥ 350 cases per year	8.4
For complex cases	

Low volume centers	Mortality %
< 350 cases per year	14.8%
For complex cases	

Welke et al, ANN THORAC SURG 2010:89

STS CONGENITAL HEART SURGERY DATA SUMMARY
JANUARY 2006 - DECEMBER 2009 PROCEDURES
NEONATES (0 - 30 DAYS) PTS 27,351

Year	Operations Submitted	Discharge Mortality # / Eligible	Discharge Mortality % of patients
2006	6,346	361 / 3,228	11.2%
2007	6,832	383 / 3,420	11.2%
2008	7,581	377 / 3,734	10.1%
2009	6,592	327 / 3,298	9.9%
Total	27,351	1,448 / 13,680	10.6%

(EACTS DATA BASE)

Most Common Surgical Procedures

Procedure	n	Mortality %
ASO	2,154	5.99
CoA repair	2,012	4.63
PDA surgical closure	1,829	5.80
B-T shunt	1,501	12.0
Norwood procedure	1,216	36.2
ASO + VSD	657	9.55
TAPVC repair	426	16.5
IAA repair	283	19.2

ASO = arterial switch operation; B-T = Blalock-Taussig; CoA = coarctation of the aorta; IAA = interrupted aortic arch; PDA = patent ductus arteriosus; TAPVC = Total anomalous pulmonary vein connection; VSD = ventricular septal defect.

Andrzej Kanzy et al : Ann. Thorac Surg 2010

Progress in neonatal Cardiac Surgery

Pre-natal Diagnosis

Post-natal Diagnosis

Surgical Techniques

Extracorporeal Circulation

Perioperative management

Postoperative management

Preoperative advances

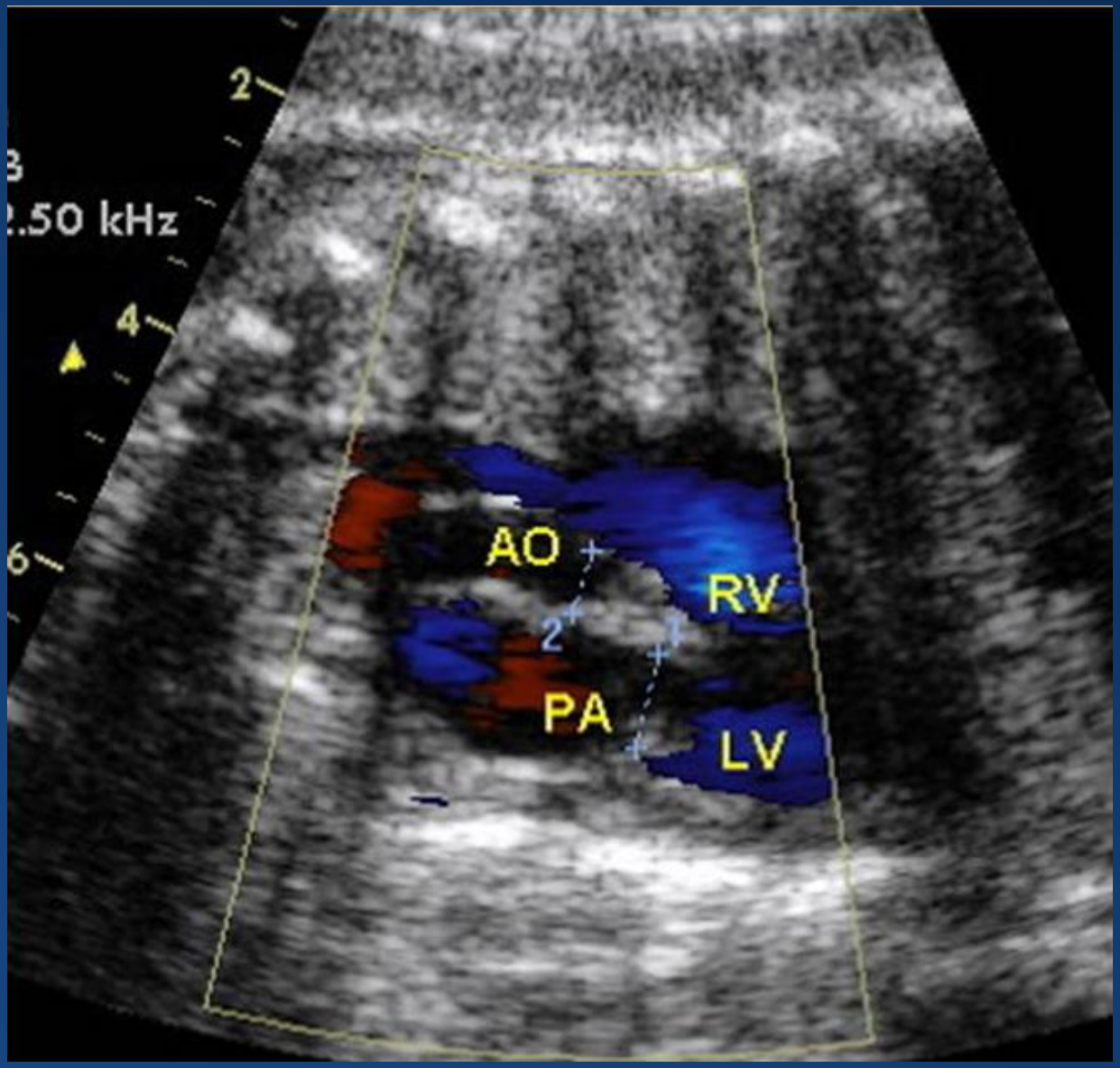
- Fetal diagnosis

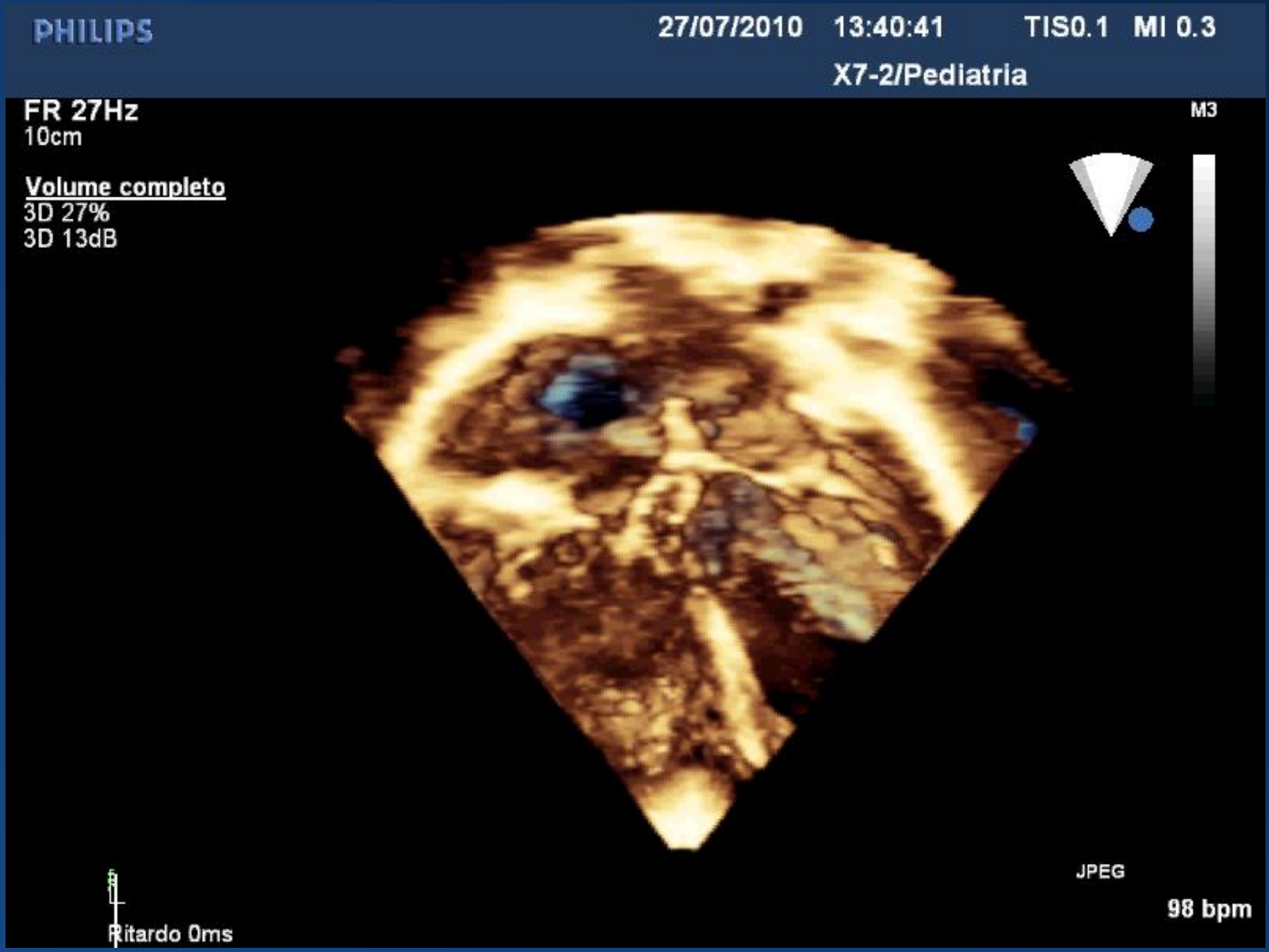
- Ventilatory manipolation of pulmonary vasc. Res?

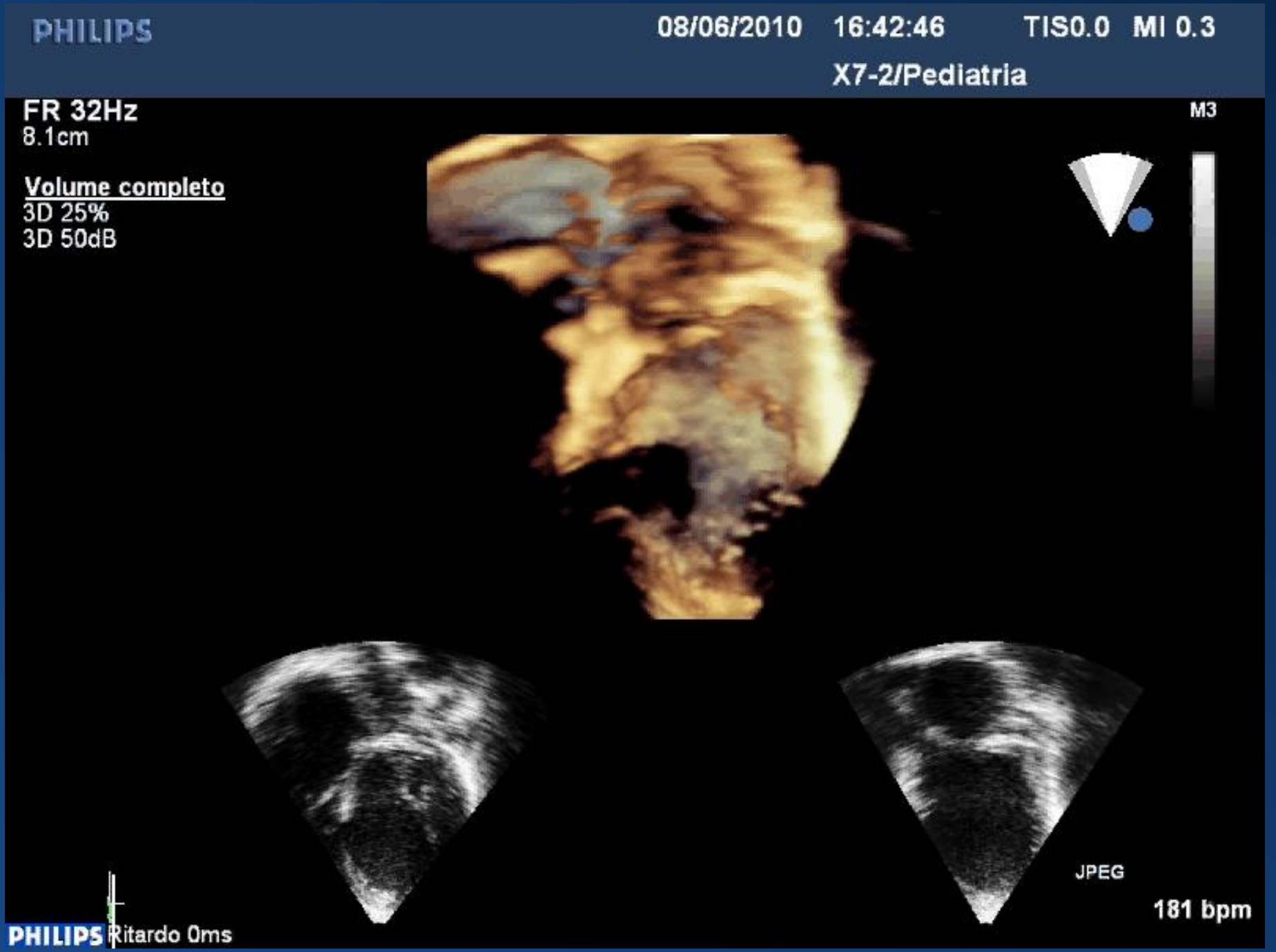
- Percutaneous interventional procedures

- Diagnostic tools (MMR Tangio)

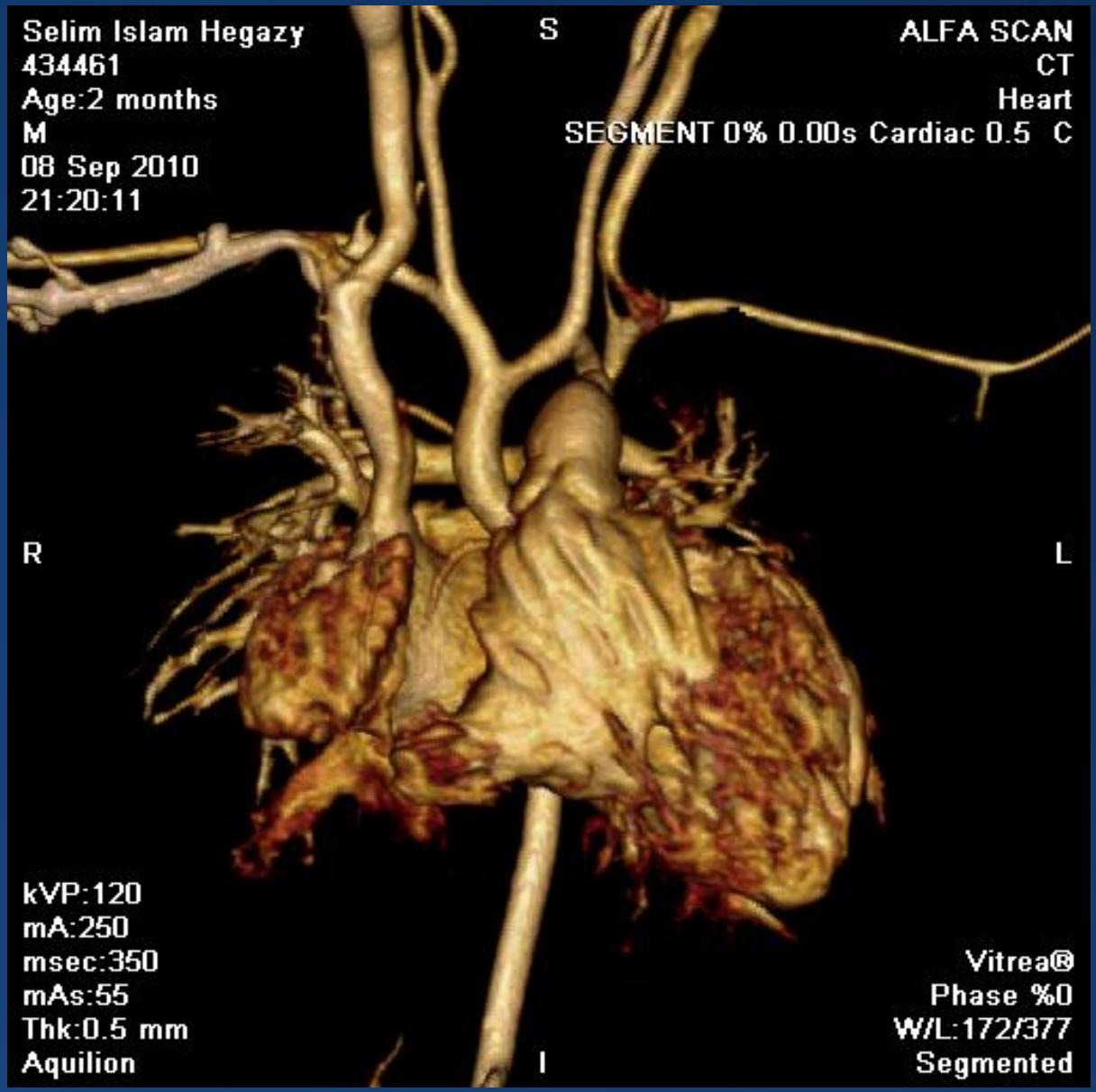
Fetal Echo: TGA




PHILIPS
27/07/2010 13:40:41 TIS0.1 MI 0.3
X7-2/Pediatria
FR 27Hz
10cm
M3
Volume completo
3D 27%
3D 13dB
JPEG
98 bpm
Ritardo 0ms


PHILIPS
08/06/2010 16:42:46 TIS0.0 MI 0.3
X7-2/Pediatria
FR 32Hz
8.1cm
Volume completo
3D 25%
3D 50dB
M3
JPEG
181 bpm
PHILIPS Ritardo 0ms

CT angiography



Intraoperative advances

- Attenuation of infiammatoty response
- Myocardial protection
- Ph management
- Circulatory arrest versus low-flow by pass
- Ibrid procedures

Progress in cardiac surgery

ECC

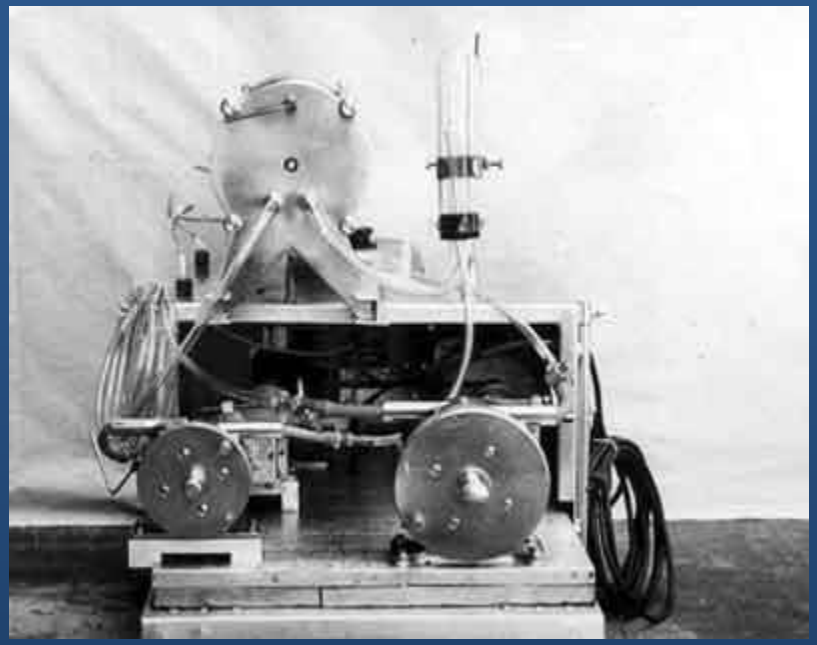
Circuit miniaturization

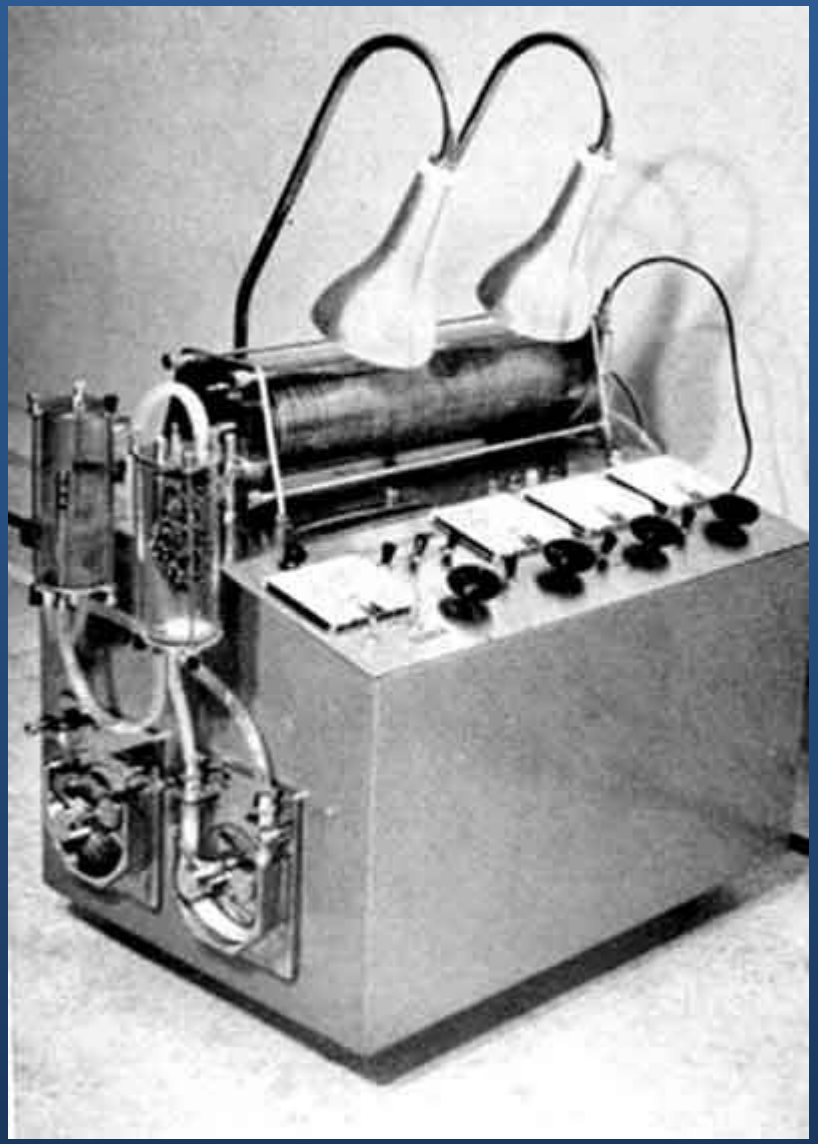
Control inflammatory responses

Hypothermic low flow

Cerebral blood flow control systems

FIRST MACHINE FOR EXTRACORPOREAL CIRCULATION





ABOUT OXYGENATION

SECOND GENERATION

LILLIPUT 2

KIDS NEONATAL FAMILY

D100 KIDS Neonatal oxygenator is the
WORLD'S SMALLEST OXYGENATOR

D130 KIDS Neonatal Arterial Filter is the
WORLD'S SMALLEST ARTERIAL FILTER

Dideco **KIDS** is the

FIRST and **ONLY**

CPB SYSTEM

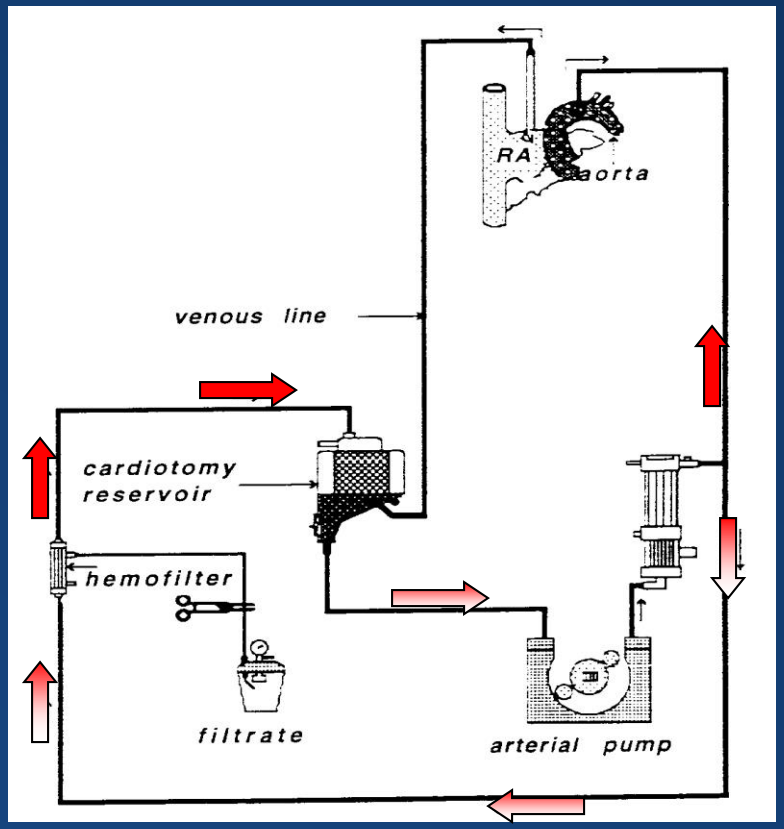
EXCLUSIVELY DEDICATED to
NEONATAL PATIENTS

PRIME VOLUME DIFFERENCES

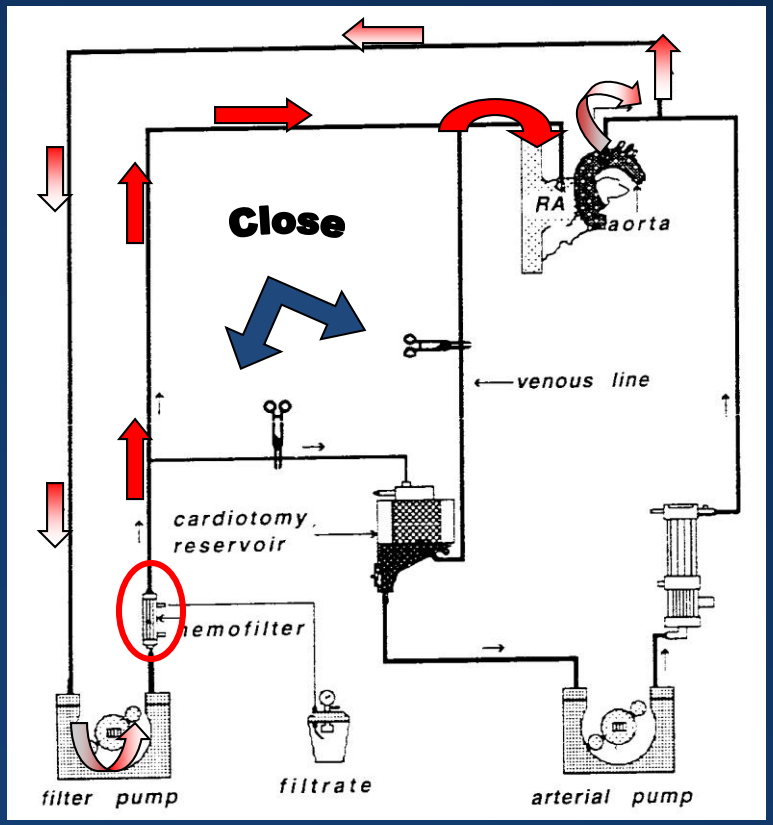
- LILLIPUT 1 ---------- 203.4 ml
- LILLIPUT 2 ---------- 380.8 ml
- KIDS D100 ---------- 167.4 ml

Ultrafiltration

CLASSIC

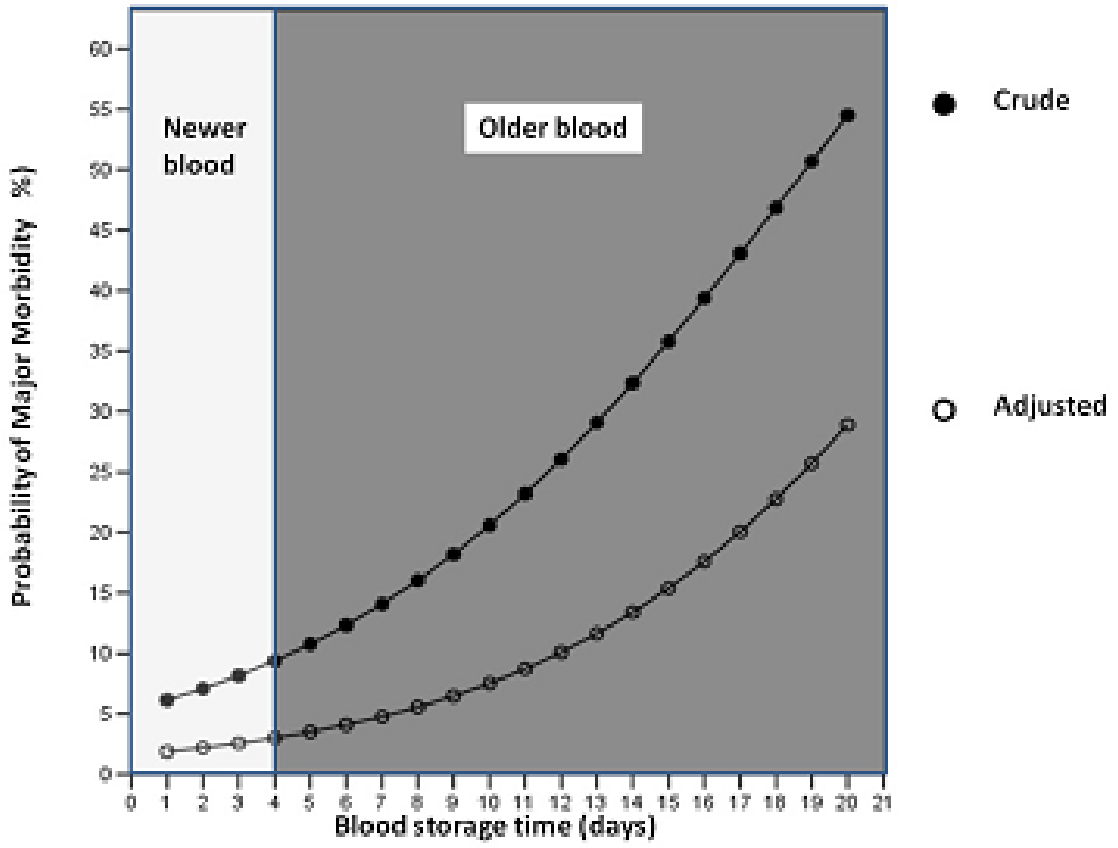


MODIFIED



Perioperative management

Figure 2



Crude and adjusted likelihood of experiencing major morbidity in the group receiving blood prime.

Perioperative management

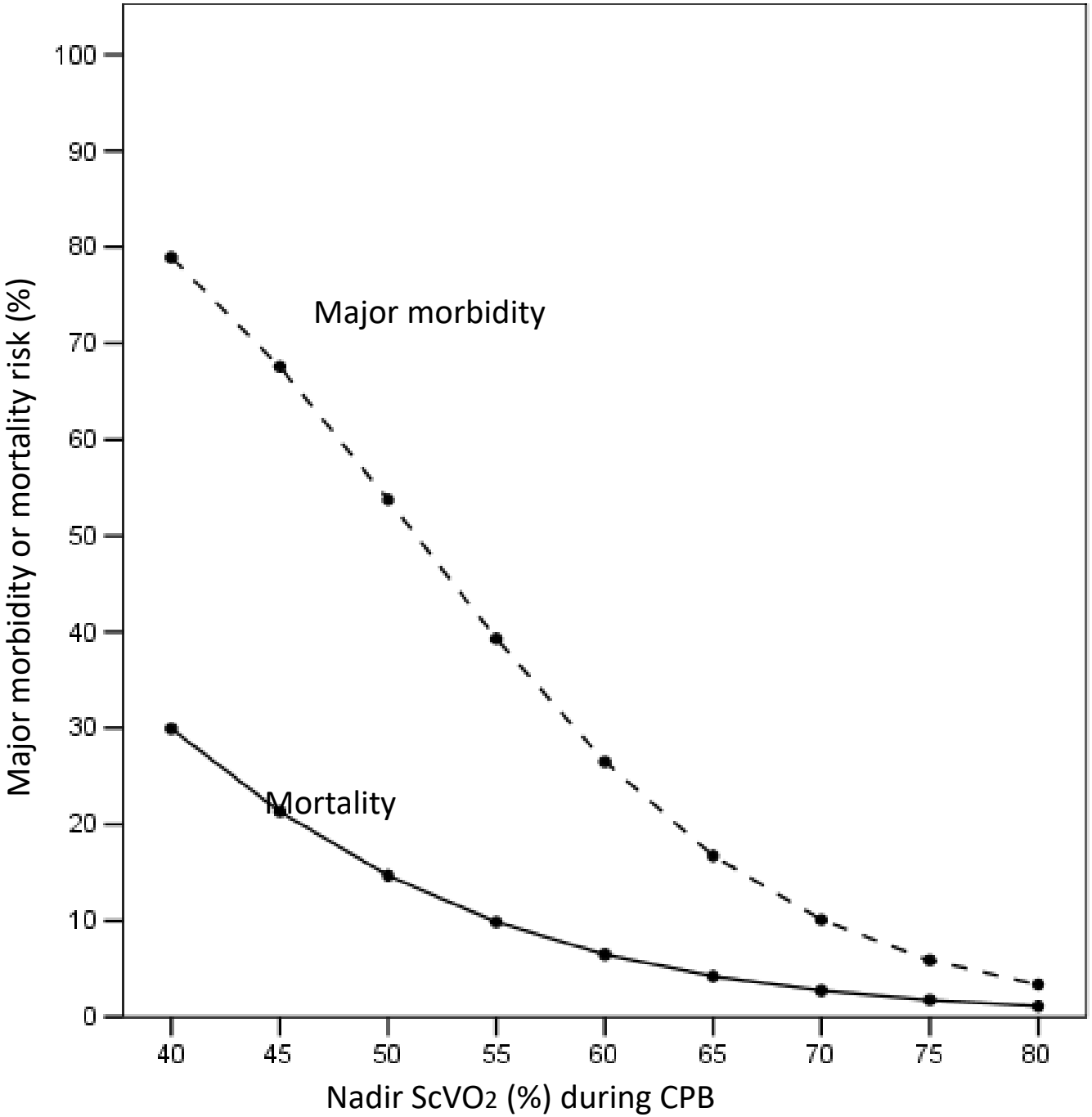


Figure 2

Perioperative management

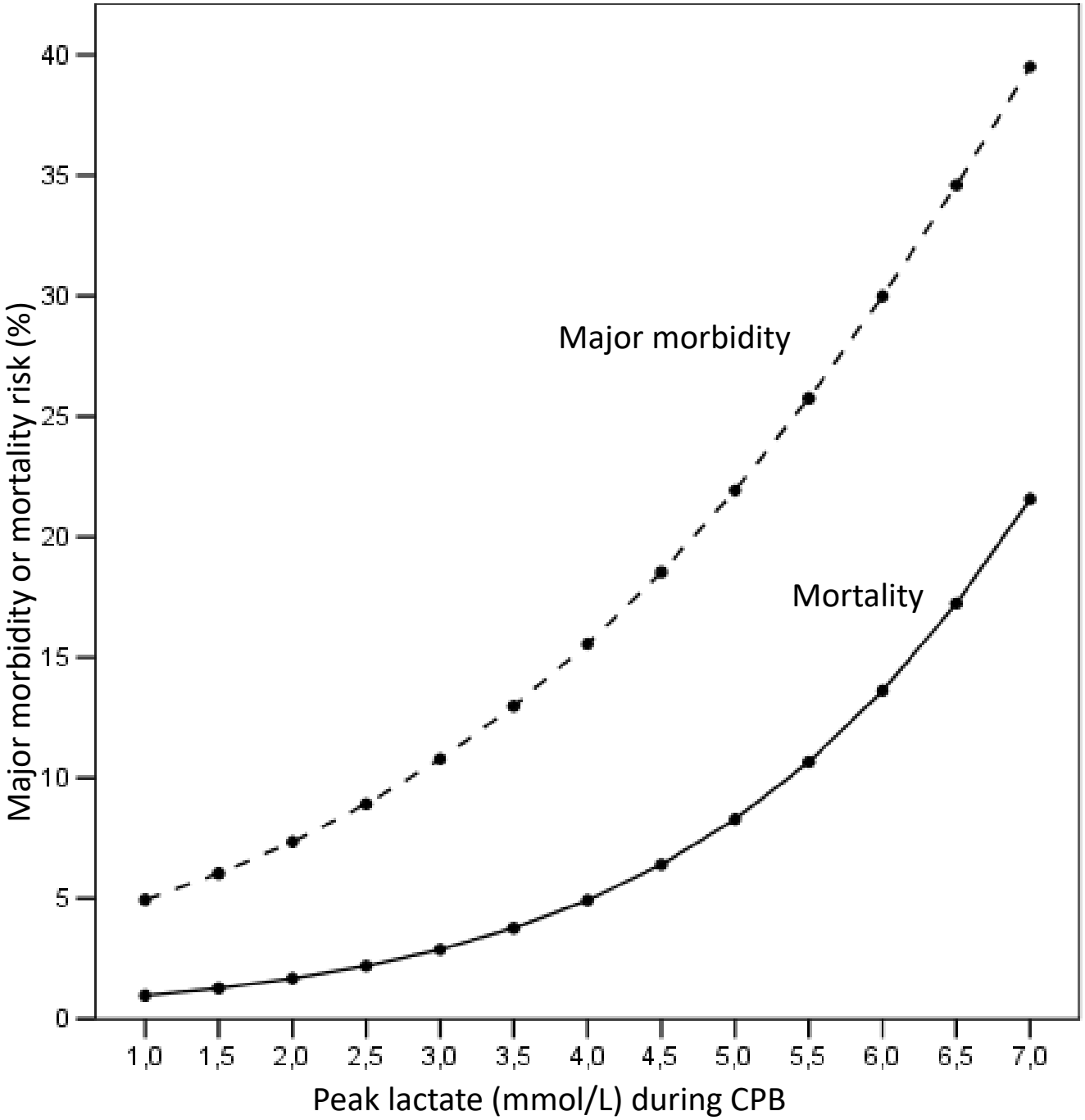


Figure 3

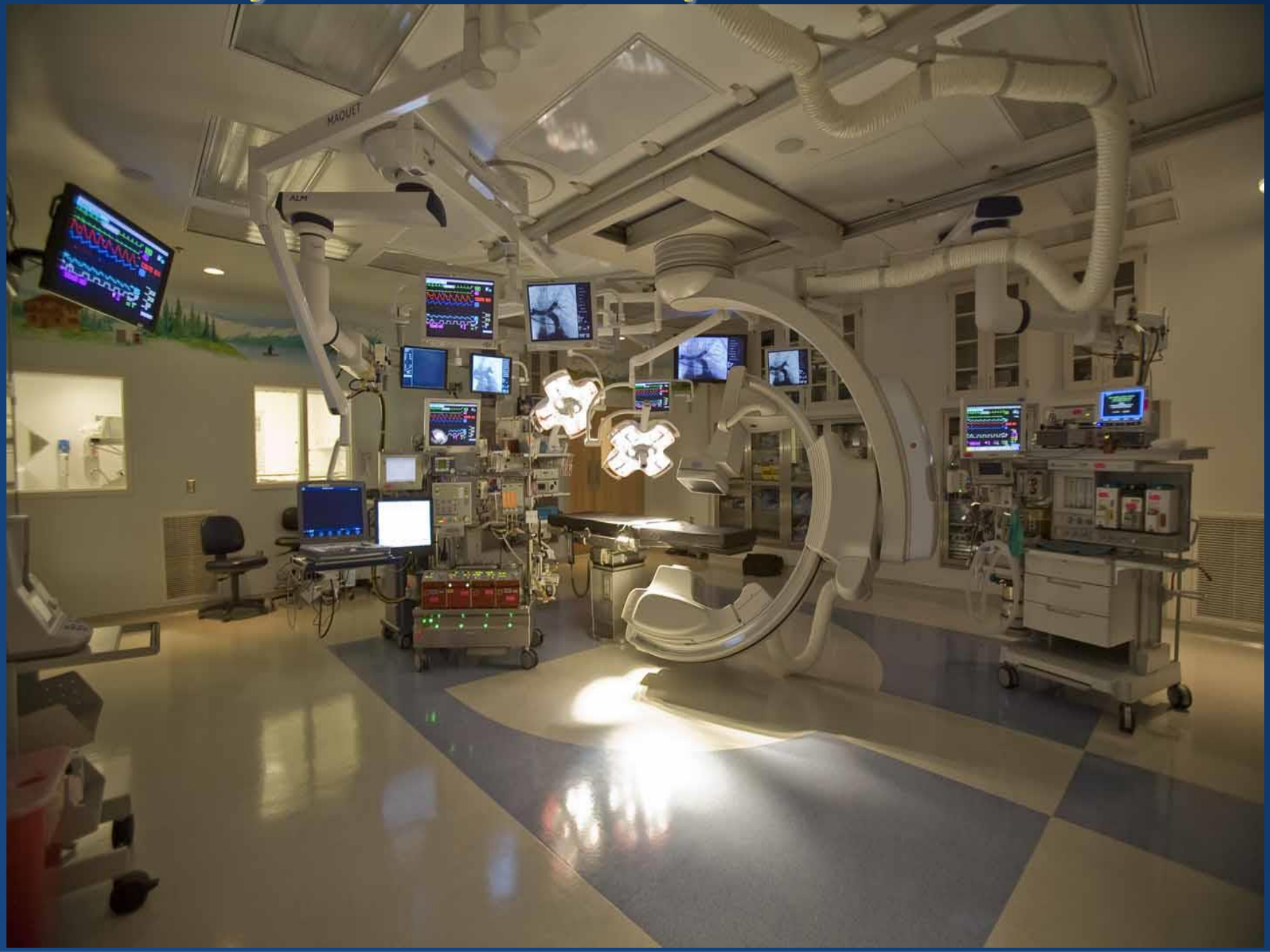
Progress in neonatal cardiac surgery

Post-operative management

- Ventilatory techniques customized
- Nitric oxide
- Circulatory support

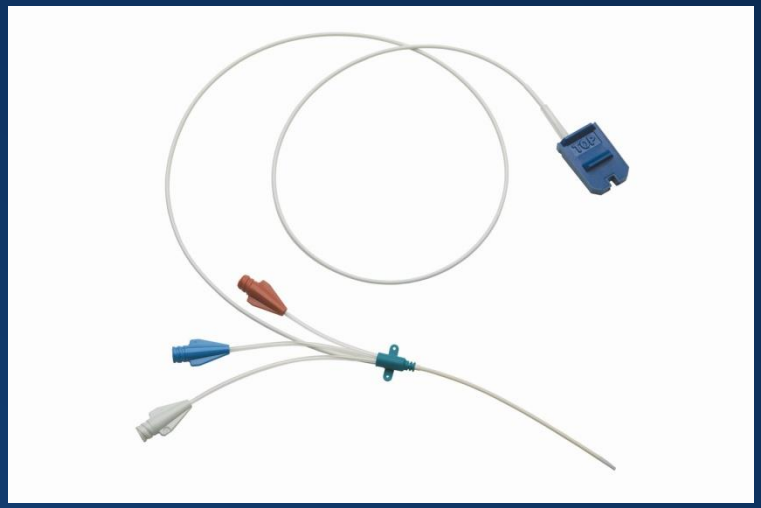
Operating Room for Hybrid Procedures

Hybrid Cardiac Operative Suite



What is PediaSat?

- Continuous ScvO2 monitoring
- Pediatric sized
- Multiple Lumens



Model	5cm	8cm	15cm
4.5F	X	X	
5.5F		X	X

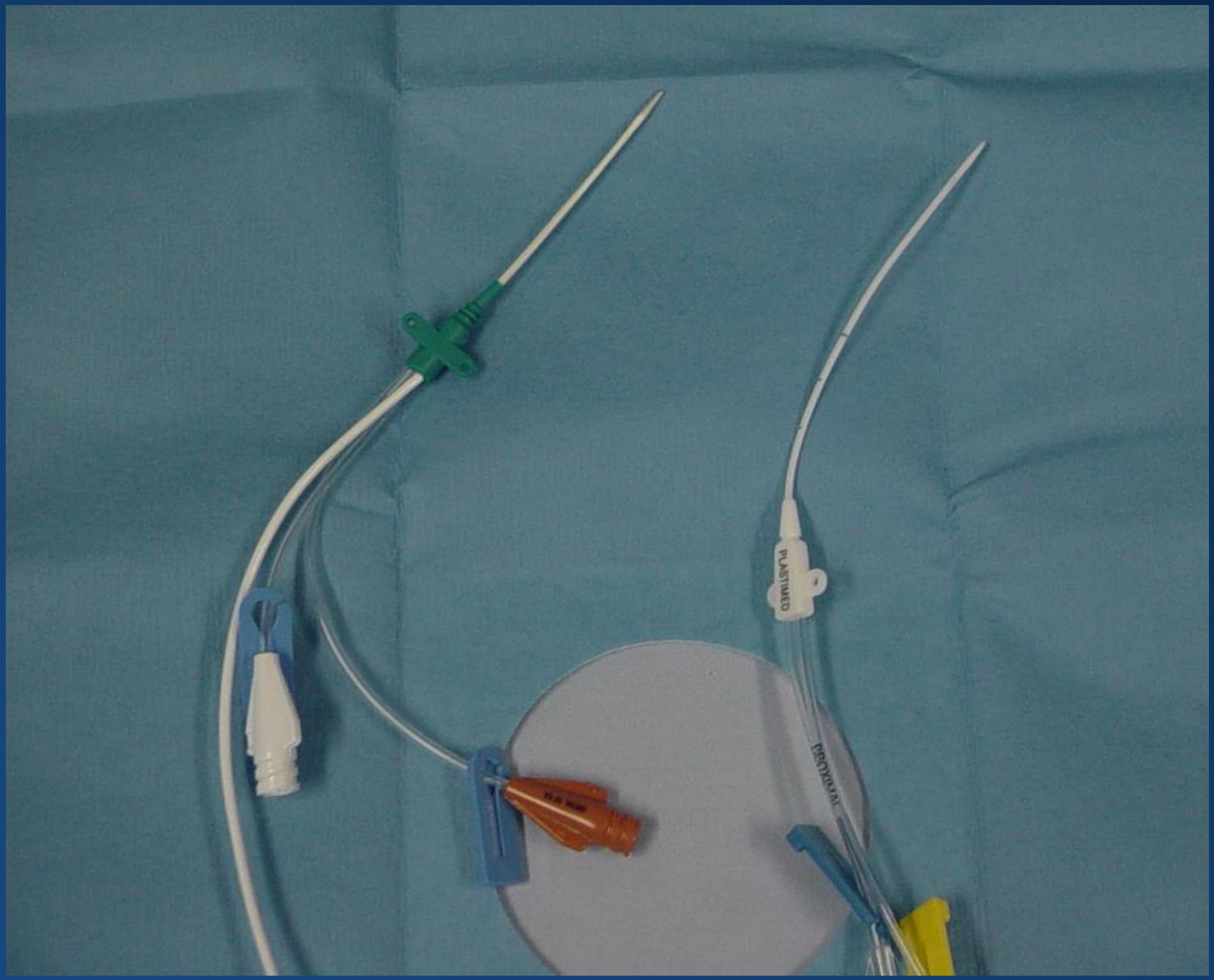
Assumptions:

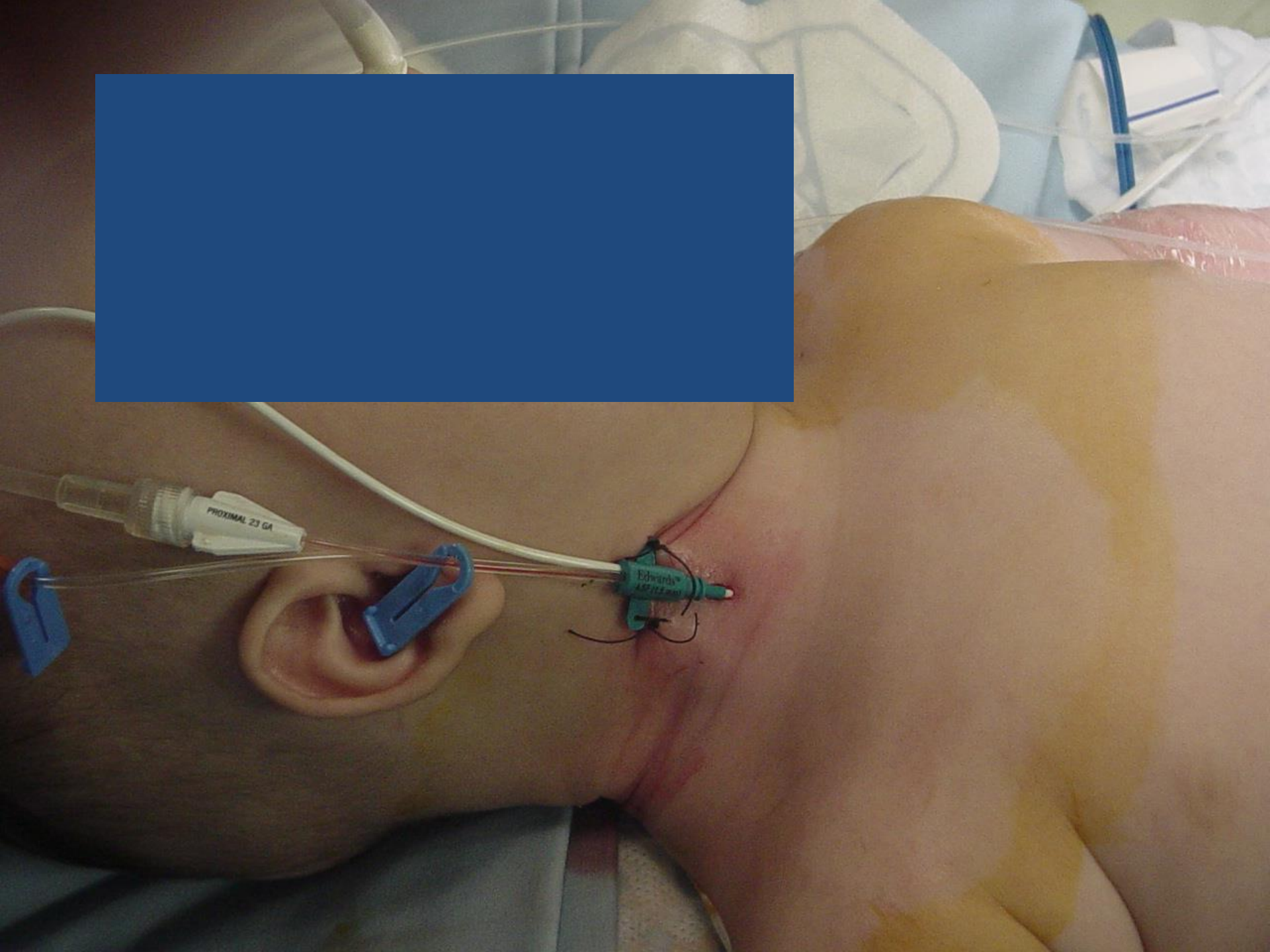
4.5 F: birth - 36 months

5.5F: >36 months

Peds <3 mos: 5 cm

Peds >3 mos: 8cm, 15 cm

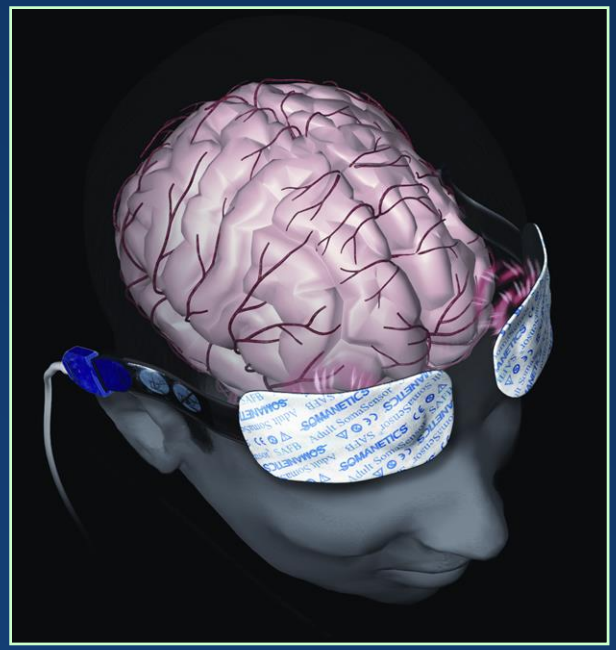

PLASTIMED


PROXIMAL 23 GA
Edwards

Noninvasive Monitoring

Methodologies for Noninvasive Assessment

- Cerebral Near-Infrared Spectroscopy (NIRS)

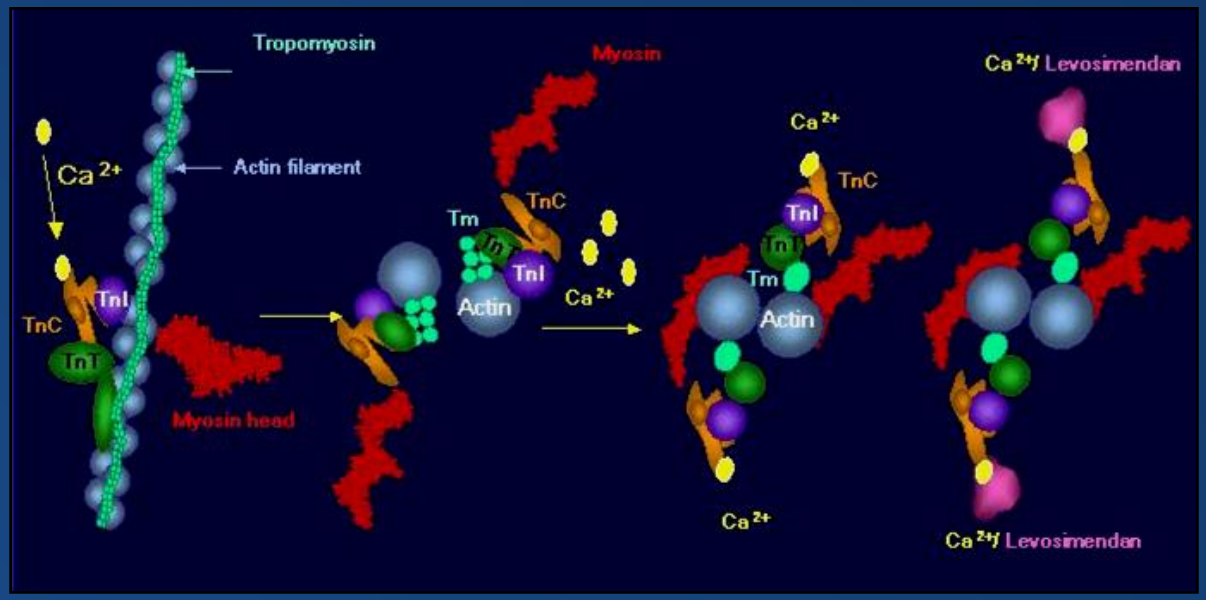


THE HEMOSTASYS – COAGULATION BEDSIDE LABORATORY

San Donato Pediatric Intensive Care

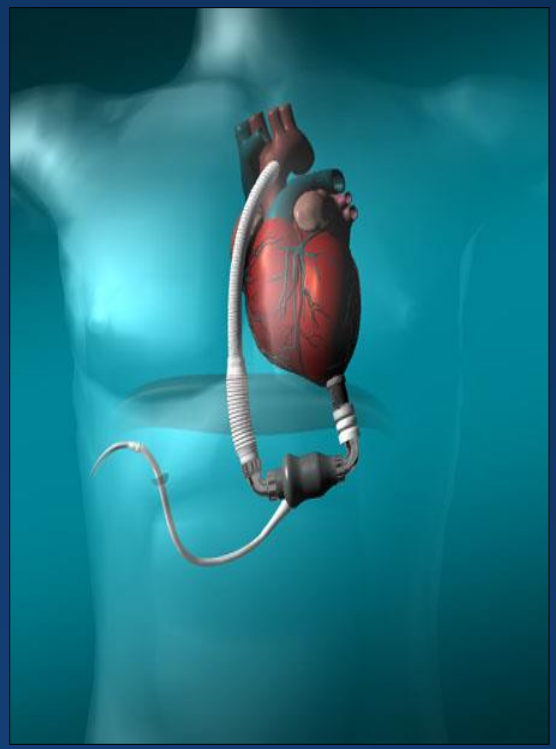
New Medical Strategies

- Calcium Sensitizers (Levosimendan)
  - Enhancement of contractility by binding to troponin C and increasing myofilament sensitivity to calcium
  - Vasodilation via K+-dependent ATP channels and inhibition of PDE.



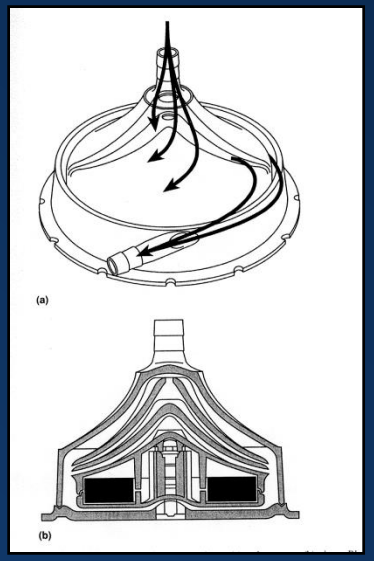
Ventricular Failure and Assist Device

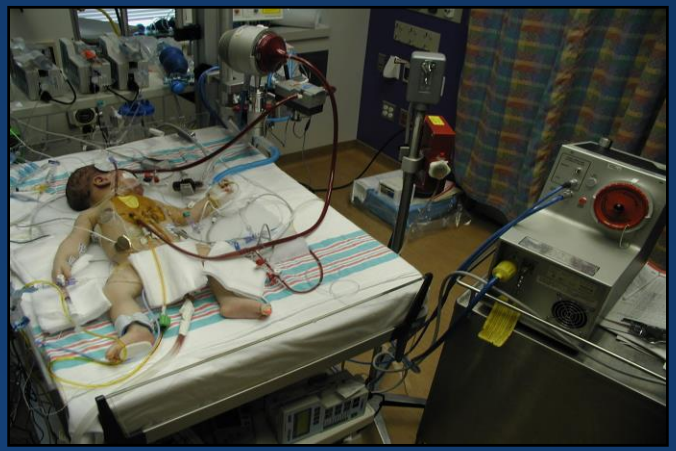
- Acute
- Chronic



Ventricular Failure and Assist Device

- Short Term (Acute)
  - Ventricular Assist Device (VAD)
    - Centrifugal pump
    - Acrylic rotator cones
    - 50 and 80 mL volumes with up to 10 L of flow
    - Right or left or single ventricle support





Targeting Mixed Venous Saturation

- few studies have specifically targeted resuscitation to a mixed venous saturation of ≥70%
- prospective, randomized trial in adults:

  treatment to a mixed venous saturation ≥70% did not reduce mortality compared with therapy targeting a normal CI

  (Gattinoni et al. *NEJM* 1995)

Neonatal Dialysis Machine (new prototype)

CARPEDIEM

Cardio Renal Pediatric Dialysis Emergency Machine

Un progetto combinato di

Associazione Amici del Rene di Vicenza (ONLUS)

Associazione Bambini Cardiopatici nel Mondo (ONLUS)


NEFROLOGIA
DIALISI E TRAPIANTO RENALE
CARDIO
RENAL
PEDIATRIC
DIALYSIS
EMERGENCY
MACHINE
VICENZA

TOWARDS MINIATURIZATION

Operational Characteristics

	ADULT	NEONATE
Body Weight	75 Kg	3 Kg
Blood Volume	5.5 L	200 ml
Extracorporeal Circuit Priming	350 ml	15 ml
Blood Flow	300 ml/min	30 ml/min
Ultrafiltration range	3000 ml/24h	200 ml/24h
Accuracy	± 10 ml/min	±0.1 ml/min


CARPEdiem
MEDICA

NEONATAL MORTALITY - SAN DONATO

YEARS	NUMBER	MORTALITY	%
2000-2005	182	32	17 %
2006-2009	122	16	13 %
2010-2011	81	8	10 %

Conclusioni 1

La terapia chirurgica dei neonati con cardiopatie congenite complesse rappresenta la sfida più difficile e stimolante per il cardiochirurgo

La collaborazione con ostetrici, cardiologi pediatri e neonatologi migliora i risultati chirurgici in questi pazienti

Conclusioni 2

La realizzazione di unità centralizzate, dovrebbe essere l'obiettivo per l'ottimizzazione delle risorse ed il miglioramento dei risultati