Foetal Cardiology: How to predict perinatal problems

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Cardiopathies

Incidence: 8-12 / 1000 births (1%)

Most frequent:
- Ventricle Septum Defect 20%
- Atrium Septum Defect 9%
- Patent Ductus Arteriosus

Impossible prenatal diagnosis

Prenatal detection of heart defects: 30-60%
Tertiary centers: 80%

Foetal heart: parallel circuit

Communications

- Atrial: foramen ovale
- Arterial: ductus arteriosus
Prenatal cardiac prediction: limitations

• Can be reliably described:
  - Cardiac anatomy and function

• Difficult to describe:
  – septum defects
  – Predict adequate flow if PS
  – Predict adequate flow if AS – small isthmus
  – Predict size of isthmus after ductal closure

• Cannot be predicted:
  – Competence of atrial flap valve after birth
  – Extension of ductal constriction to Ao or Le PA
Cardiac Anatomy

Courtesy: 'Fetal Cardiology'; S. Nagel, NH. Silverman, U. Gembruch
Normal cardiac anatomy
Foetal heart: asymmetric growth

Normal heart

Classical HLHS
HLHS: neonatal management

• Norwood sequens
  – Norwood type operation < 14 d
  – Glenn shunt 6 - 12 m
  – Fontan TCPC 2 – 5 y
  – (HTX) .. ?

• Neonatal HTX

• Sedare et consolare
Possible flow restrictions to the left heart

Dilated sinus coronarius with left VCS
Restrictive foramen ovale
Asymmetric 4 chamber 19 w PMA
persistent left VCS
Asymmetric 4 chamber  38 w PMA
Restrictive foramen ovale
Asymmetric 4 chamber: postnatal
Table 1 Normal range for fetal great arteries: aorta (AO; n = 637), pulmonary artery (PA; n = 637) and aorta/pulmonary artery ratio (AO/PA; n = 490). The internal diameters were measured at the level of the valves, when the valves were closed.

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<th>$P_{2.5}$</th>
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$P_{2.5} = AO \pm 1.96SD$; $PA \pm 1.96SD$; $AO/PA \pm 1.96SD$. $P_{97.5} = AO + 1.96SD$; $PA + 1.96SD$; $AO/PA + 1.96SD$. For the $AO$, SD = 0.00146T + 0.016. For the $PA$, SD = 0.0018T + 0.011. For the $AO/PA$, SD = 0.0002T + 0.0901. AO = 0.0247T - 0.164. PA = 0.0283T - 0.705. AO/PA = -0.0017T + 0.958. T, gestational age in weeks.

**AO/AP = 0.9**

Shapiro, Ultrasound Obstet Gynecol, 1998;12:404-418
Aortic arch: growth patterns

Normal
Ao/AP ≈ 0.9

?  

Preaductal coarctation
Ao/AP < 0.5
Prenatal prediction of Coarctation Aortae

Asymmetric 4 chamber

3V-view: AO/AP
Prediction of coarctation aortae

Prenatal
- difficult to predict size of isthmus after ductal closure
- extension of ductal constriction

postnatal normal

postnatal coarctation
Cardiac problems: timing - localisation

- **Labour room**
  - Activation of lung circuit
  - Closure atrial flap valve (complete < 3%)

- **D 1-5: Maternity**
  - Closure arterial duct

- **> D 6: Home**
  - Drop pulmonary vascular resistance
Cardiopulmonary problems in labour room:
Inadequate oxygenation

- Lung pathology
  - Hypoplasia, hernia, pneumothorax
- Severe heart dysfunction: hydrops
- Inadequate pulmonary arterial perfusion
  - Hypoplasia vessels
  - Extreme pulmonary hypertension
    - Prenatal constriction arterial duct
- Abnormal pulmonary venous return
  - TAPVU with obstruction (Right atrial isomerism)
  - Pulmonary vein PV stenosis
- Restrictive flow pulmonary blood to aorta
  - Intact atrial septum & TGA
  - Intact atrial septum & HLHS – severe MS
Prenatal prediction
Smooth stay in labour room

• Normal appearance of lungs
• No hydrops
• Adequate PA
• Normal PV to LA
• Unrestrictive flow PV to Aorta
Smooth stay in labour room:
Unrestrictive flow PV to Aorta

normal

UVH, TA, TAPVU, TGA
Inadequate oxygenation in labour room

Complete closure atrial flap valve
intact atrial septum IAS (< 3%)
Transposition Great Arteries
TGA survival : f° of shunt
TGA : management

- ( Umbilical catheter through flap valve 1-3% )
- Prostaglandin IV
- ( Rashkind balloon septostomy )
- Arterial switch ( † < 3%)
Rashkind balloon septostomy
Cardiopathies with problems after ductal closure

Left heart problems
• HLHS
• coarctation aortae/interrupted aortic arch
• Critical AS

Right heart problems
• Pulmonary valve atresia / critical PS
  Isolated or complex (Tetralogy of Fallot, univentr. heart)
• Transposition of the great arteries
Smooth stay in maternity: adequate flow PA & Aorta after ductal constriction

- Small istmus
- Coarctation
- Hypoplastic arch
- Normal
- Mild subPS - PS
- Severe subPS - PS
- Atresia MAPCA’s
Critical AS with Mitral valve regurgitation
Balloon dilatation neonatal critical AS

LV end diastolic

LV end systolic
Cut-off pigtail in LA; 0.018" Terumo wire through MiV > apex > AoV > femoral artery; fix in groin.
BD neonatal critical AS

5 mm Tyshack balloon over 0.018" Terumo wire
Critical PS with Tricuspid regurgitation
PA-IVS : fulguration PuV

Premature, 2600 g; PA – IVS , hypoplastic & suprasystemic RV 120 mmHg, TS
Fulguration PuV

5F Ri coronary Judkins
Fulguration PuV

0.014 Standard wire in Desc Ao
3.0 mm coronary balloon Viva 20 Boston Scientific (over wire or through 5F guiding Ri coronary)
Fulguration & BD PuV

6 mm Tyshack balloon; residual waist at level annulus
RV post Fulguration & BD PuV
Technique : schema
Critical PS – IVS : stenting PDA

3 mm / 20 mm stent in 2600g premature neonate
Isolated “agenesis” Pulmonary valve 28w
Isolated “agenesis” Pulmonary valve 35 w
Isolated “agenesis” PuV  37 w neonate
Isolated “agenesis” PuV  37 w neonate
Tetralogy of Fallot, 16 weeks PMA
septal defects
muscular VSD
AV-canal AVSD
30% trisomy 21
RA tumor 35 w PMA
RA tumor 38 w PMA
RA tumor: tamponnade

- Urgent deliver: sectio
- Simultaneously:
  - Intubation
  - Pericardial drain
  - IV line
  - Umbilical catheter: fluid replacement

- Diagnostics
  - Echocardiogram
  - MR
RA tumor: CXR
RA haemangioma
MRI: tissue characterising: haemangioma
Prenatal diagnosis: impact

• Advantages
  – Plan adequate help in labour room
  – Maintain optimal cardio-respiratory condition
    • No excessive cyanosis
    • No circulatory shock
  – Adequate counseling & guidance of family

• Disadvantages
  – Difficult diagnoses (septal defects / open ductus / coarctation)
  – Late appearance of some heart problems (tumors / valve stenoses)
  – No test of duct dependency