The Fetal Heart: Beyond the 4-Chamber View

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What do these patients have in common?

- Normal 4-chamber views

When a 4-chamber isn’t good enough

- Normal Transposition of the Great Arteries
- Tetralogy of Fallot

Goals

- Why fetal echo makes a difference
  - Normal fetal circulation
  - The fetal echocardiogram – (beyond the 4-chamber)

Definition

Fetal echocardiography
A detailed sonographic evaluation that is used to identify and characterize fetal heart anomalies and malfunctions before delivery

“Basic” fetal cardiac screening
“Extended basic” cardiac screening
Know the Adversary

**Congenital Heart Disease**
- Most common congenital anomaly (~ 8/1000)
- A leading cause of infant mortality and morbidity
- Often occurs in low-risk pregnancy

Making a Difference

- Improved pre-operative stability
  - Ductal-dependent lesions
- Neurodevelopmental outcomes
  - Parental understanding
  - Societal cost benefits
  - Overall mortality???

Indications for Fetal Echo

**Fetal Indications**
- Abnormal screening U/S
- Chromosomal abnormality
- Arrhythmia
- Extra-cardiac anomaly
- Hydrops
- Increased 1st trimester NT
- Concern for twin-twin

**Maternal Indications**
- Family history of CHD
- Teratogen exposure
  - Alcohol, AED
- Metabolic disorders
  - Diabetes, PKU
- In vitro fertilization
- Autoimmune dz
- Inheritable disorders
  - Marfan’s, Noonan’s

The Fetal Echocardiogram

**Timing of Study**
- “optimally” between 18–22 weeks
- Earliest 4 chamber view: 14-15 weeks (EFCI)
- Transvaginal: 10-14 weeks
- Beyond 32-34 weeks: ratio of amniotic fluid to fetal size decreases → degr. image quality

What Types of Defects Can We See?

- Septal
- Endocardial cushion
- Right-sided obstruction
- Left-sided obstruction
- Conotruncal
- Single ventricle
- Complex
Goals of fetal circulation

1. Preferential streaming of oxygenated blood to the myocardium and brain
   - O₂ rich blood received in the RA via the DV, not the LA from the pulm veins

2. Recycling of blood through the placenta (via the DAO) for re-oxygenation
   - i.e. blue blood to the placenta

The Fetal Echocardiogram

- Fetal position
  - Left vs. Right

- Abdominal situs

- Cardiac position

- Fetal biometry

It's not always normal

Right-sided stomach, left-sided heart

Fetal Echo Protocol

- Obtain a 2D AND color flow in 4 major imaging views
- Transverse views (short axis of the BABY):
  - 4-chamber
  - 5-chamber
  - 3-vessel view

- Arches (long axis of the BABY)
  - Branchial arch
  - Aortic arch
  - Br-eval view

- Short-axis of the HEART
  - Great Arteries
  - Ventricles

- Long-axis of the HEART
  - LVOT
  - RVOT
Transverse Imaging Planes

LVOT

4-chamber


RVOT

Transverse Imaging Planes

Three vessel View

RVOT

Outflow tracts

LVOT


RVOT

Normal Outflow Tracts?

LVOT


RVOT
Three vessel view


RVOT

Long-axis of the BABY

Bi-caval view

The Arches

Bicaval View

Aortic Arch

Aortic Arch Color

Ductal Arch

Aortic Arch Hypoplasia

Aortic Arch Hypoplasia

The Short Axis Views

The Short-Axis

Short-Axis Color

Long axis of the HEART

Long Axis View

Long Axis Color

Long Axis Pathology
Measurements
- Atrioventricular valve diameters
- Semilunar valve diameters
- Ascending aorta
- Transverse aortic arch
- MPA and branches

Parameter(z): www.parameterz.com

Doppler Investigation
- AV valve inflow
- Aortic outflow
- Pulmonary outflow
- Pulmonary veins
- Patent foramen ovale
- Ductus arteriosus
- Aortic arch
- Umbilical artery
- Umbilical vein
- MCA
- Ductus venosus

Ultrasound Safety During Pregnancy
- Ultrasound energy expenditure can be high
- No confirmed harmful effects from ultrasound
- Theoretical risks:
  - Mechanical energy – cavitation (MI)
  - Thermal energy (TIS/TIB)
- ALARA – As low as reasonably achievable

WFU Fetal Heart Program
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Summary
- Congenital heart disease is most common congenital anomaly
- Prenatal diagnosis improves outcomes
- Enhanced imaging from a greater number of views will lead to more pick-ups