Let's Do Numbers Where And How To Measure Cardiac Structures

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Disclosures

- No disclosures

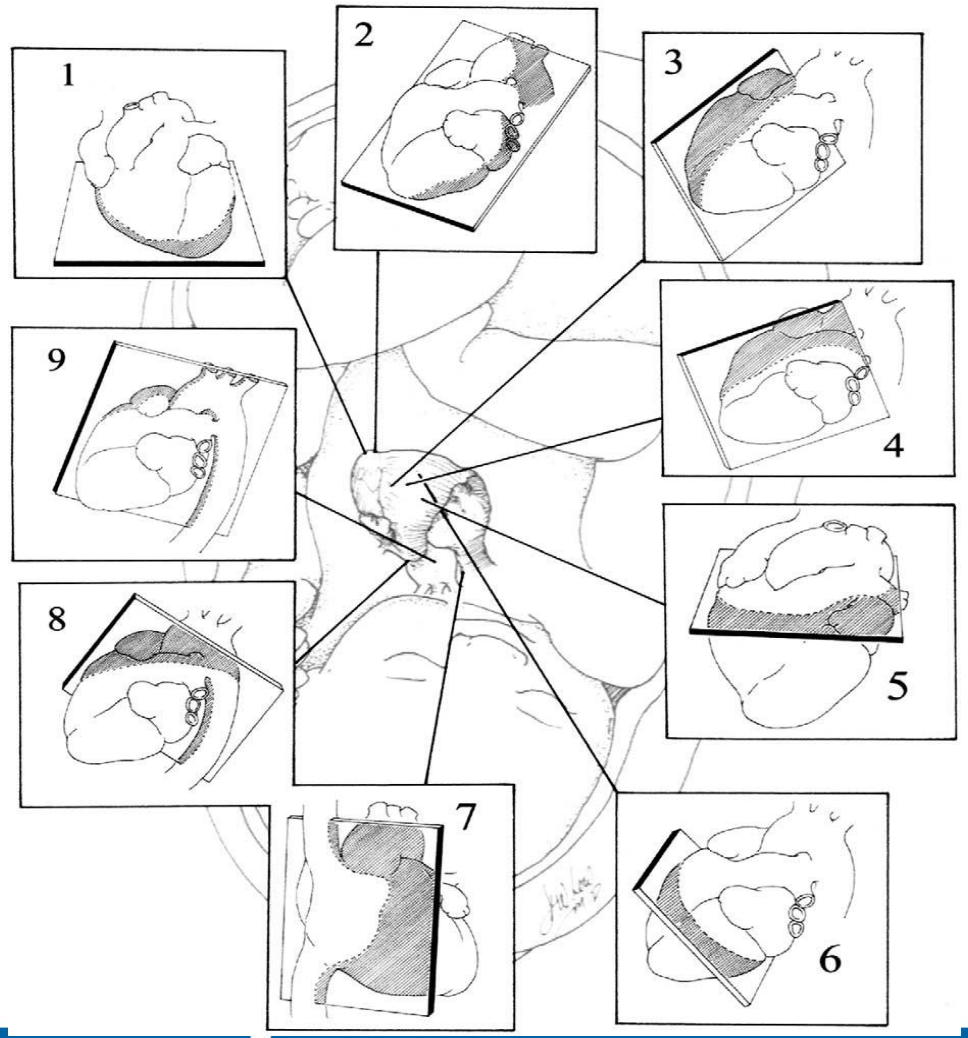
Objectives

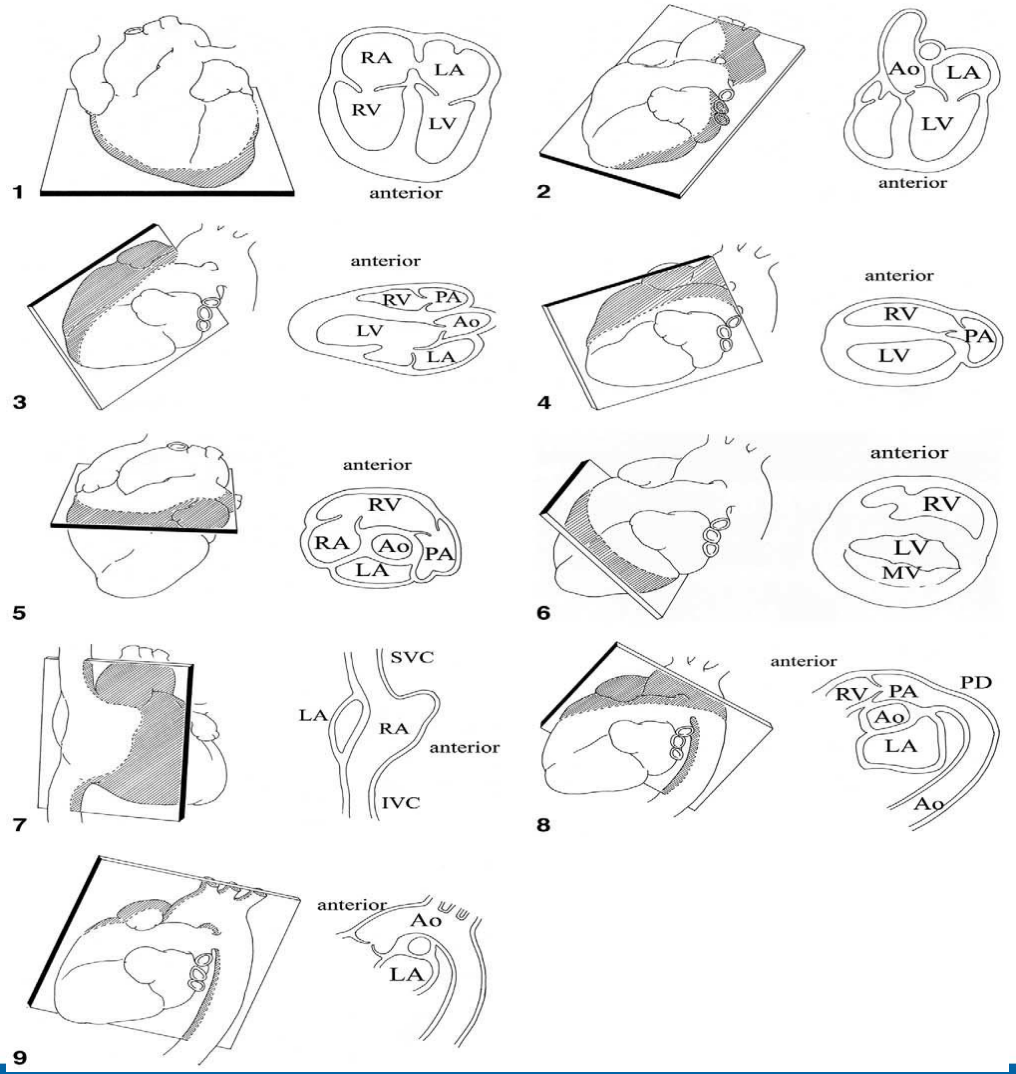
- To explain the importance of fetal cardiac measurements.
- To improve the consistency of fetal cardiac measurements.
- To define the cardiac pathology and determine the severity through fetal cardiac measurements

ASE Guidelines for Cardiac Measurements

- American society of echocardioigraphy (ASE) set out guidelines for fetal echo and how to standardize cardiac measurements.
- Take aways:
  - Valve annulus should be measured hinge point to hinge point
  - Measure the valves at the maximum expansion
    - Inflow valves - early diastole
    - Outflow valves - early systole
  - Doppler of cardiac valves are parallel to flow
  - Reproducibility – use the best plane to measure the valve annulus size (Ex. Inflow valves best seen in 4 chamber view)

ASE Guidelines





“Good checklist, on the other hand are precise. They are efficient, to the point and easy to use even in the most difficult situations. They do not try to spell out everything – a checklist cannot fly a plane. Instead, they provide reminders of only the most critical and important steps – the ones that even the highly skilled professional using them could miss. Good checklists are above all practical.”

- Atul Gawande author of *The Checklist Manifesto*

Fetal Checklist

- ☐ Stomach Side
- ☐ Apex
- ☐ SVC
- ☐ IVC
- ☐ Pulmonary Veins
- ☐ Foramen Ovale
- ☐ Tricupsid Valve
  - o Doppler
- ☐ Mitral Valve
  - o Doppler
- ☐ Ventricular Septum
- ☐ RV Size
- ☐ RV Function
- ☐ LV Size
- ☐ LV Function
- ☐ Pulmonary Valve
  - o Doppler
- ☐ Aortic Valve
  - o Doppler
- ☐ LVOT Long Axis
- ☐ RPA
- ☐ LPA
- ☐ Aortic Arch
- ☐ Ductal Arch
- ☐ Heart Rate/Rhythm
- ☐ Effusions

Biometry:

- ☐ CT Ratio
- ☐ Femur Length
- ☐ Abdominal Circumference
- ☐ Ductus Venous
  - o Doppler
- ☐ Head Circumference
- ☐ BPD
- ☐ MCA
  - o Doppler
- ☐ Umbilical Artery
  - o Doppler
- ☐ Umbilical Vein
  - o Doppler

- ☐ Referring Physician
- ☐ Ordering Physician
- ☐ Sonographer Name

Z Scores

- Z score or standard score measures the deviation above or below the average standard.
- Gestational age and z-scores help determine if the size of the valve/heart structure is normal, dilated, or hypoplastic.
- Z-scores can be compared and help monitor the progression of the heart structures. (dilated/hypoplastic)

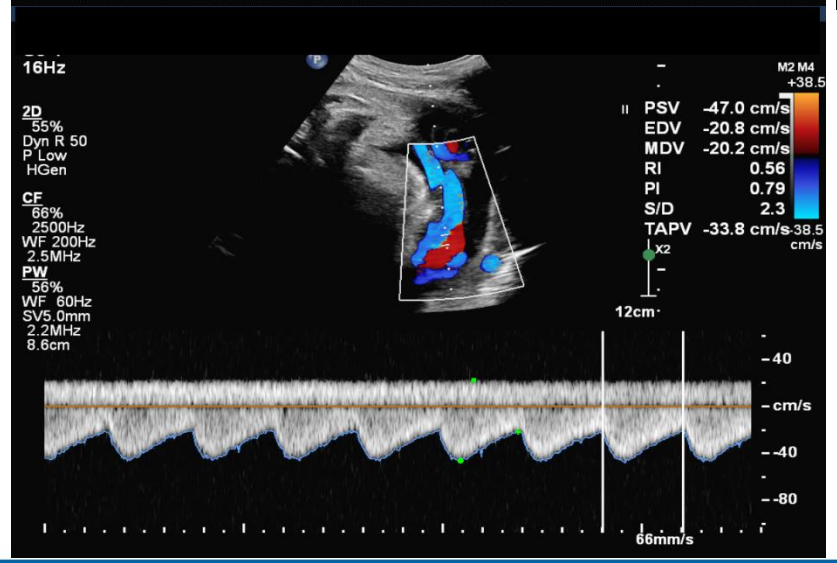
- http://parameterz.blogspot.com/2008/09/fetal-echo-z-scores.html
  - Most commonly used at CMH
- http://fetal.parameterz.com/
  - Multiple z-scores

Fetal Biometry

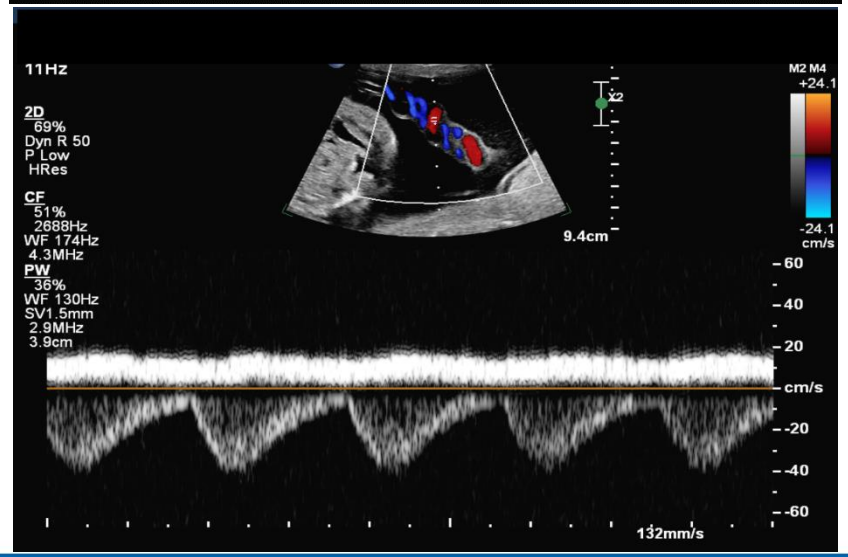
Biometry:

- ☐ CT Ratio
- ☐ Femur Length
- ☐ Abdominal Circumference
- ☐ Ductus Venous
  - o Doppler
- ☐ Head Circumference
- ☐ BPD
- ☐ MCA
  - o Doppler
- ☐ Umbilical Artery
  - o Doppler
- ☐ Umbilical Vein
  - o Doppler

Normal

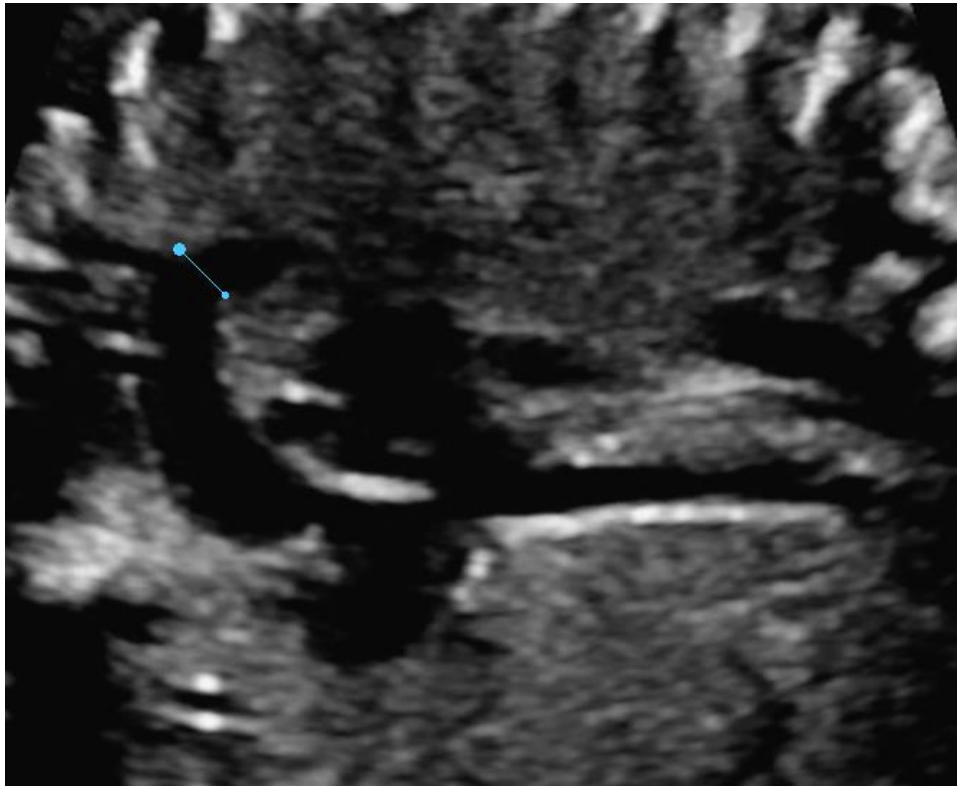


Abnormal

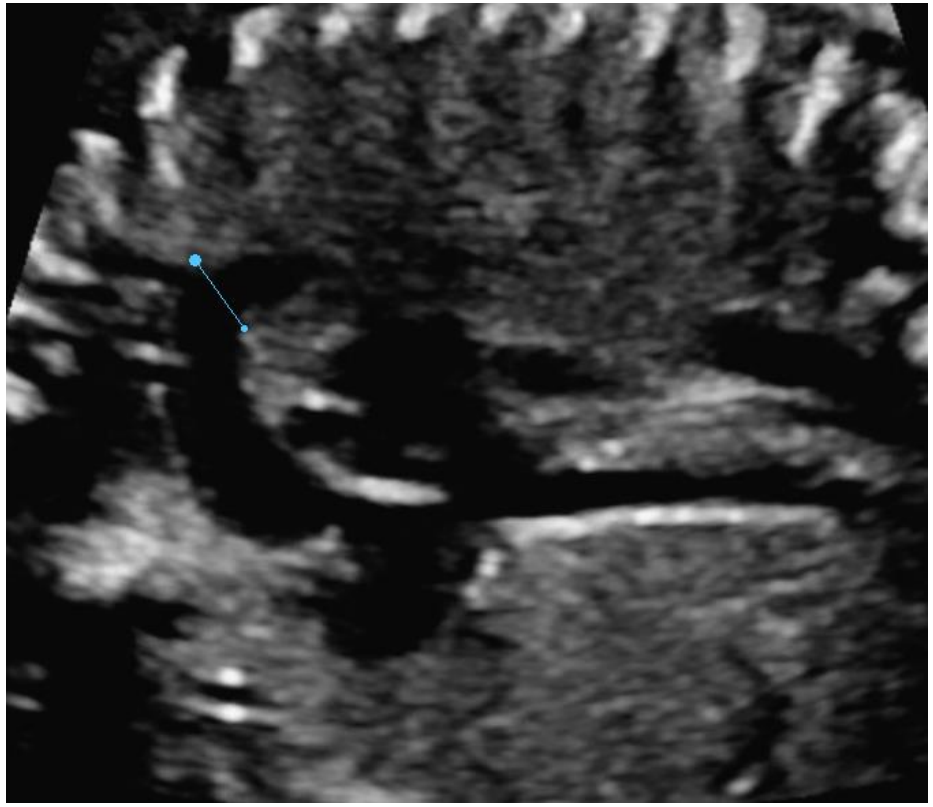


Importance of fetal cardiac measurements

- To improve consistency of fetal cardiology measurements.



Correct



Incorrect

Importance of fetal cardiac measurements

- To understand the importance of fetal cardiology measurements.

23 weeks normal heart

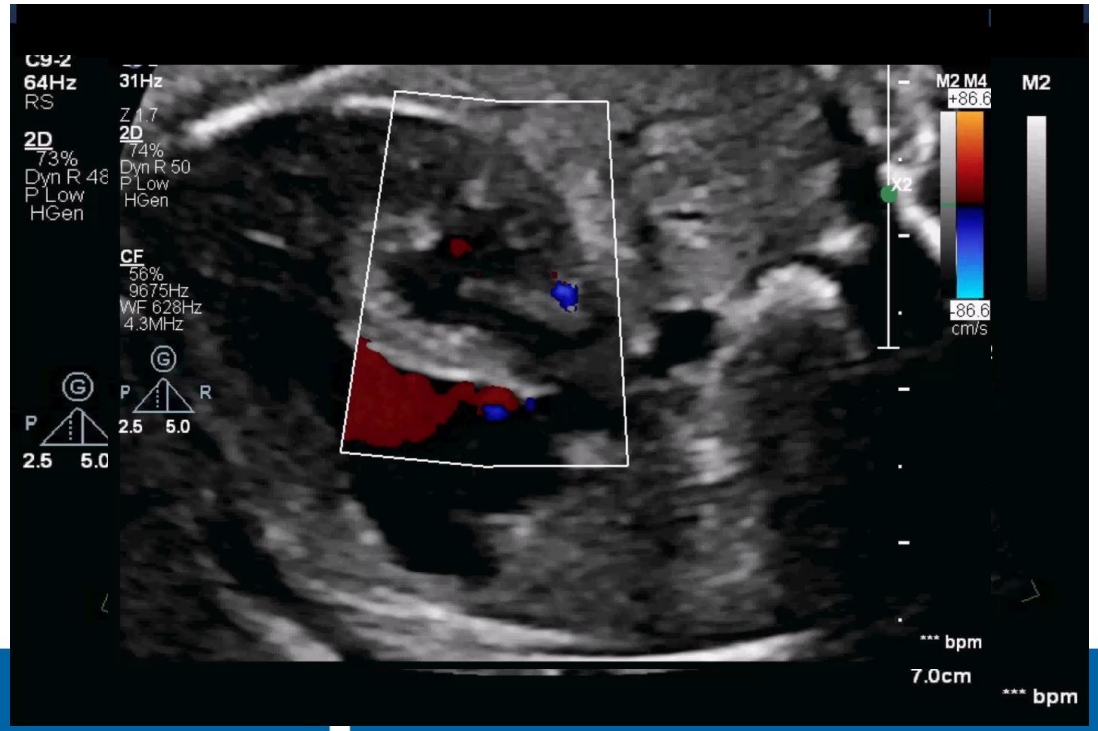
36 weeks gestation
Lt. side measures normal

35 weeks gestation moderate
hypoplastic left side structures

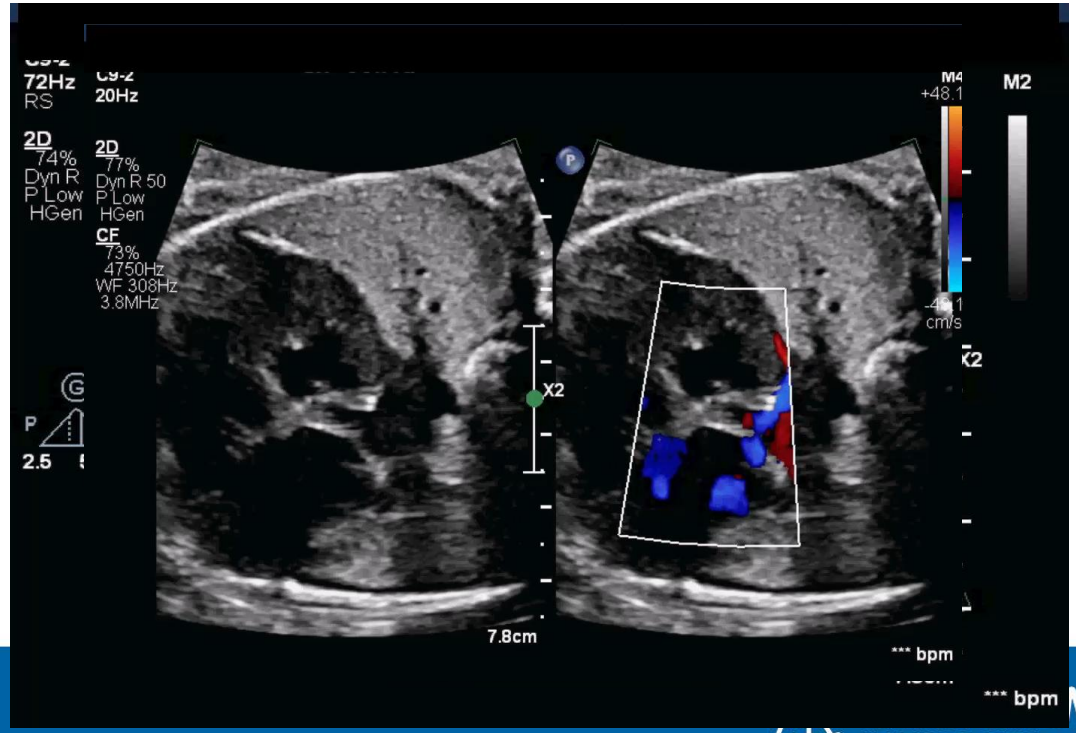
Importance of fetal cardiac measurements

- To define the cardiac pathology and determine the severity.

28 weeks MS/AA

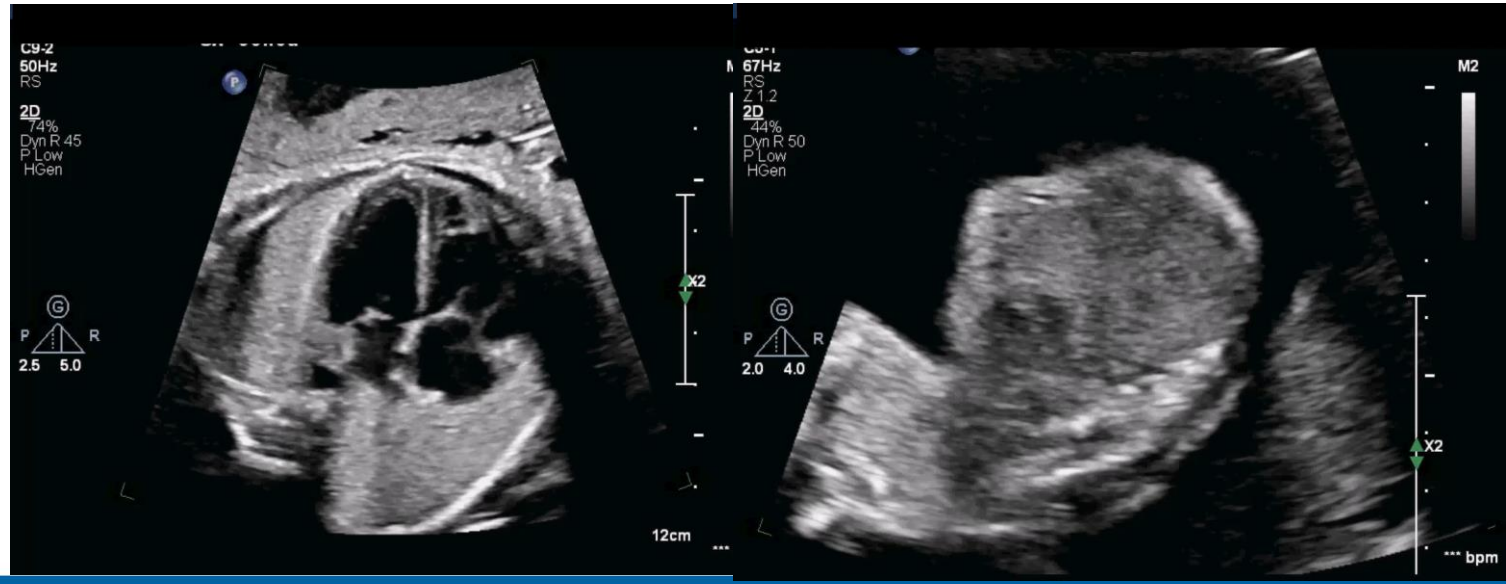


38 weeks MS /AA



Examination

- Fetal measurements aren’t easy, but consistency is key.
- Multiple scanning positions, sweeps, and views are essential to imaging a fetal heart.
- Frustrations with fetal measurements
  - Fetal positioning
  - Fetal movement/breathing
  - Shadowing
  - Gestational age
  - Heart rate/rhythm
  - Technical difficulties
  - Small structures
  - Maternal body habitus



Tips and Tricks

- Zoom, Zoom, Zoom
- Focus on specific structure/valve
- Optimize (gain and compression)
- Scroll through the clip to find the best spot to measure
- Think outside the box
- Ask for help

Normal Study

Cardiac Output

- Reason's for performing cardiac output:
  - Fetal Anemia
  - Arteriovenous malformation
  - Sacrococcygeal teratoma
  - Myelomeningocele
  - Cardiomyopathy
  - Heart block
  - Twin to Twin Transfusion

- Focused Cardiac Measurements
  - Left cardiac output(LCO)
    - Aortic annulus size
    - LVOT VTI Doppler
    - Aortic Valve VTI Doppler
    - Heart rate across aortic valve
  - Right Cardiac Output(RCO)
    - Pulmonary annulus size
    - RVOT VTI Doppler
    - Pulmonary Valve VTI Doppler
    - Heart rate across PV
  - RCO is typically higher than the LCO

Cardiac Outputs

- CO = CSA x VTI x HR
- Optimizing cardiac output:
  - Diameter accuracy – the diameter can cause an error in CO
    - Long and short axis
  - Doppler angle – best possible angle parallel to flow
  - Use consistent units –mL/min
- Normal cardiac output values
    - Right cardiac output is usually higher than left cardiac output.
    - 400-500mL/kg /min normal combined cardiac output

Vein of Galen patient

Define the Pathology Severity

- 2 ventricle or single ventricle?
- Mild, moderate, severe or hypoplastic
- Coarct or hypoplastic arch?
- Prostaglandins or no prostaglandins needed?

Coa

TOF

Boston Z-Scores (Measurements & Calculations)

Measurement Name	Value	Z-Score	Predicted	Normal Range
AoV annu area (vs. BSA(Haycock))	0.27 cm^2			
AoV LAX (z) (vs. BSA (Haycock))	0.58 cm			
AAO LAX (z) (vs. BSA (Haycock))	0.86 cm			
LPA (z) (vs. BSA (Haycock))	0.34 cm			
MPA (z) (vs. BSA (Haycock))	0.52 cm			
MV A4C (z) (vs. BSA (Haycock))	0.76 cm			
PV annu area (vs. BSA (Haycock))	0.20 cm^2			
PV LAX (z) (vs. BSA (Haycock))	0.50 cm			
RPA (z) (vs. BSA (Haycock))	0.39 cm			
TV A4C (z) (vs. BSA (Haycock))	0.93 cm			

Conclusion

- Consistency improves our standard practice of fetal echocardiography
- Measuring fetal heart structures improves the diagnosing of pathology and severity of a fetal heart.
- If you see something, say something

Resources

- Lopez, L., 2010. *Recommendations for Quantification Methods during the perfomance of pediatric echo*. [ebook] New York: American Society of Echocardiography, p.7. Available at: <https://www.asecho.org/document/5175#page=1> [Accessed 6 April 2022].
- Rychik, J. (2004). *American Society of Echocardiography Guidelines and Standards for Perfomance of Fetal Echocardiogram*, *17*, 1–8.
- Lee, W., Anton, T., Copel, J., & Devore, G. (2010). *AIUM Practice Parameter for the Performance of Fetal Echocardiography*, 1–14.

Reference Links

- https://www.asecho.org/document/5175#page=13
- https://www.onlinejase.com/action/showPdf?pii=S0894-7317%2804%2900382-7

- http://parameterz.blogspot.com/2008/09/fetal-echo-z-scores.html
  - Most commonly used at CMH
- http://fetal.parameterz.com/


Children's Mercy
KANSAS CITY