A sonographers approach

Basic Fetal Cardiac Imaging

Leading the witness

- What referring provider saw
  - Abnormal 3VV, right left discrepancy, valve regurgitation, no cardiac views
- Genetics
  - Have they had genetic testing done?
- Family history
  - Kids/parents with defects; especially left sided lesions
- Extracardiac anomalies
  - Defects associated

Different syndromes

- Trisomy 18
  - Ventricular septal defects
- Trisomy 21
  - Atrioventricular septal defect
- DiGeorge
  - Tetralogy of fallot
- Williams
  - Supra aortic stenosis
- Turners
  - Aortic stenosis/Coarctation
- Noonan
  - Pulmonary stenosis
- When in doubt… Dr. Google

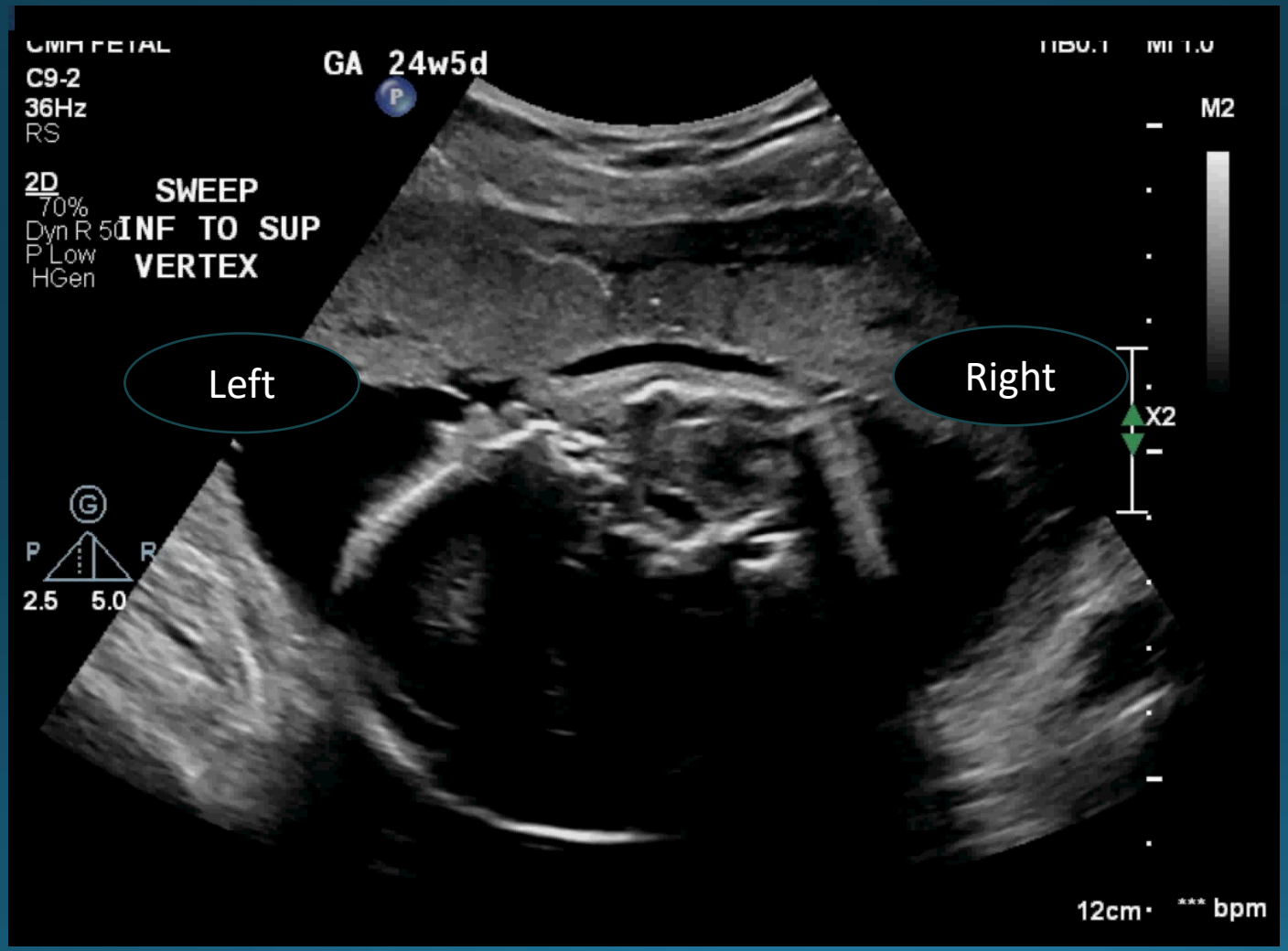
Stills and sweeps
ASE update

- Should include both still and moving images, accompanied by a structured report. Required motion clips include but are not limited to the following:
  - Axial sweep from the stomach to the upper mediastinum, to include the four-chamber view, arterial outflow tracts, as well as the great vessel and arch views
  - Four-chamber view: 2D and color
  - Left ventricular (LV) outflow tract view: 2D and color
  - Right ventricular (RV) outflow tract view: 2D and color
  - 3VV and 3VT views: 2D and color Doppler ultrasound
  - Sagittal view of the aortic and ductal arches: 2D and color Doppler ultrasound

Determining Situs

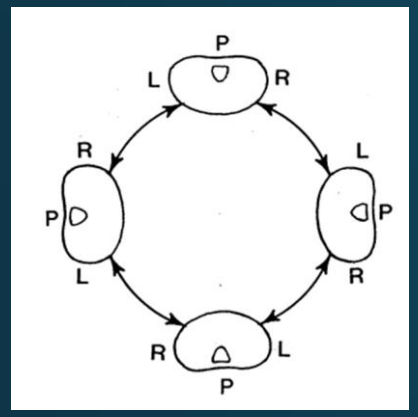
- Once fetal lie is determined
- Is the stomach and heart on the left?
- Why is this so important?
  - Dextrocardia, Mesocardia and abnormal cardiac axis associated with congenital heart defects and extracardiac anomalies

Normal situs sweep



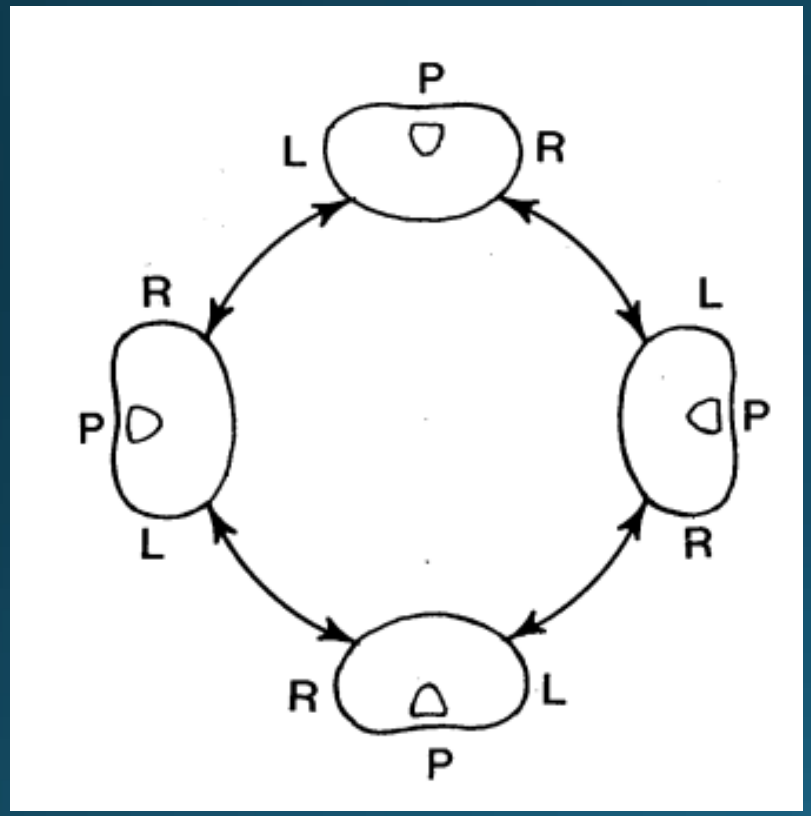
The Cordes method

- To Start: lay fetal body out with head on the right side of screen
  - If fetus is vertex: start with notch at 12 o'clock
  - If fetus is breech: start with notch at 6 o'clock
- Once you have fetus head to right of screen, rotate 90 degrees clockwise until you round out thorax
- Scan down fetus to stomach and then back up to heart



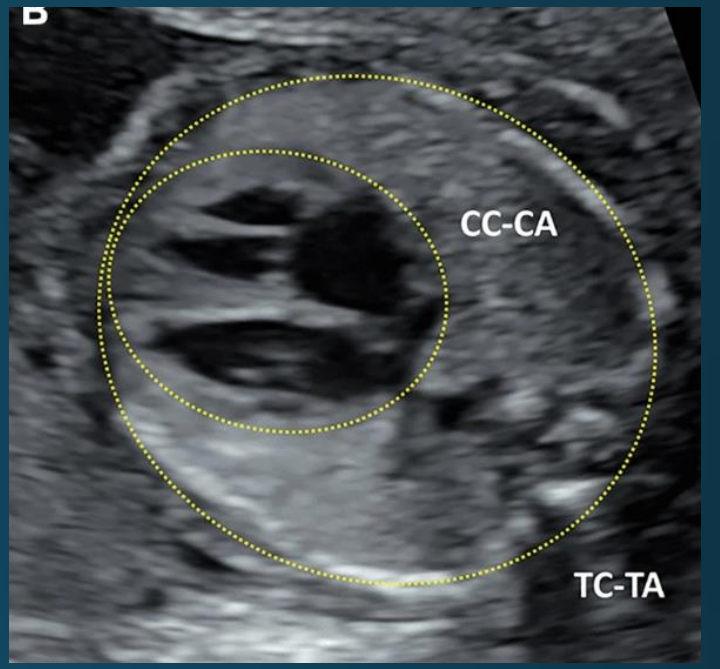
The Cordes method

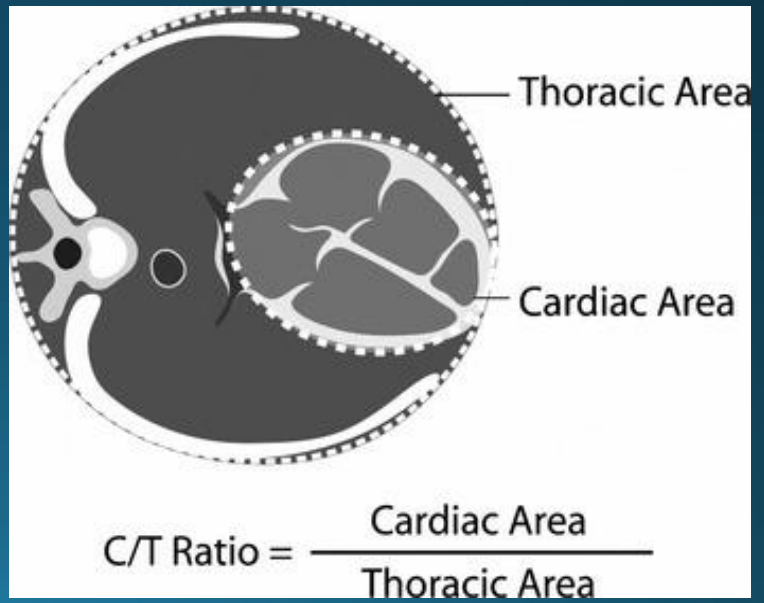
The Cordes method



CT ratio

- At the level of the 4-chamber view
  - Normal heart is generally no larger than a third of the chest area
- Measure the cardiac circumference end-diastole by positioning ellipse surrounding the cardiac apex, the outer epicardial borders, and the upper edge of the atrial septum
- Measure thoracic circumference by encircling the area covering the posterior edge of the vertebra, the outer borders of the ribs, and the anterior chest wall without including subdermal tissues.



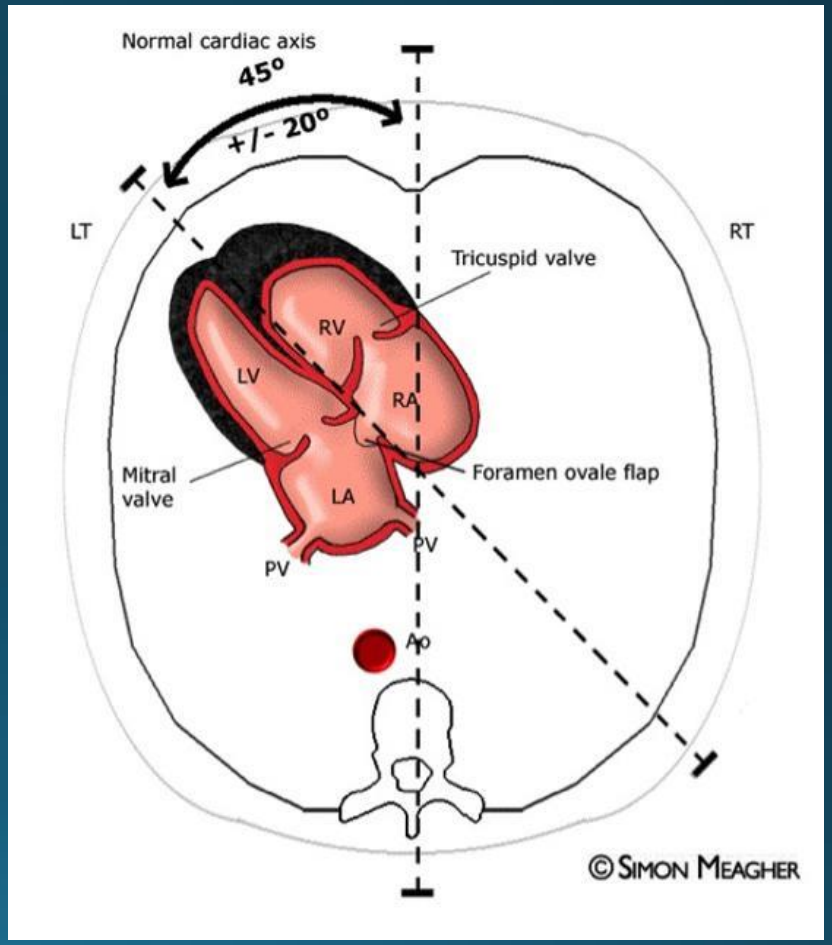


- Increased C/T ratio associated with cardiomegaly
- Cardiomegaly can be an indicator of extracardiac or cardiac abnomalities

Cardiac axis

How to measure

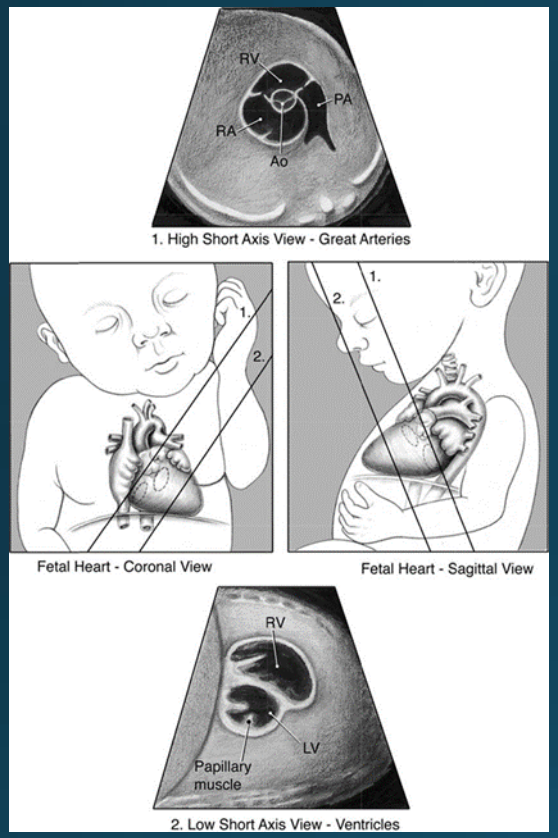
- Obtain an axial image of the chest at the level of the 4 chamber view
  - A single full rib should be visible on each side
- Magnify fetal chest
- Draw a line posteriorly from the spine thru chest anteriorly; dividing into two equal halves
- Trace the long axis of the heart thru ventricular septum

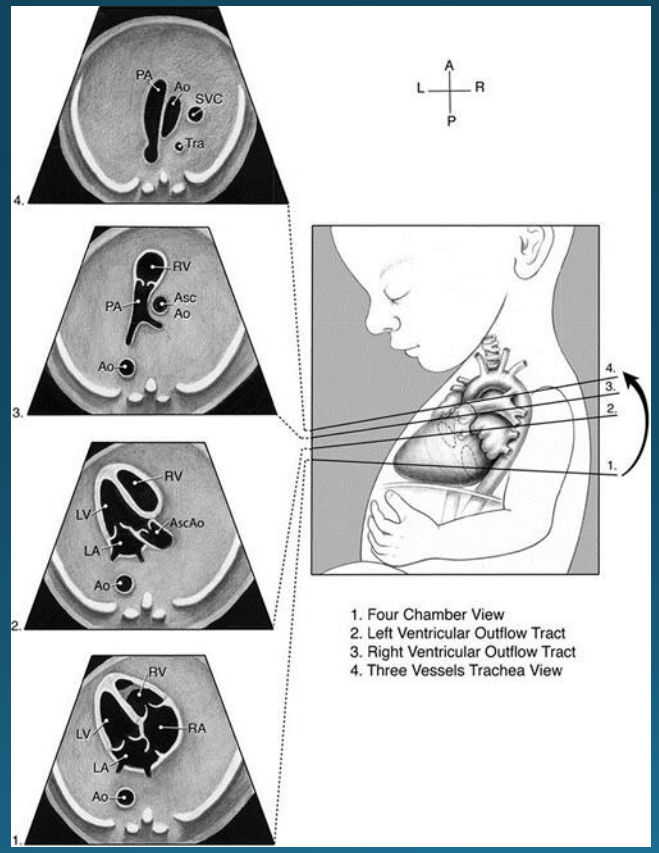


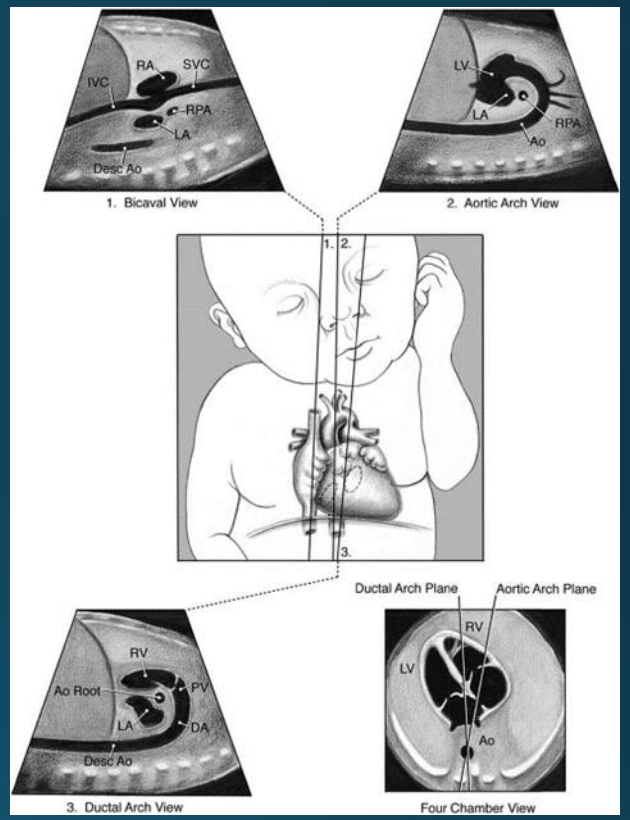
Cardiac axis

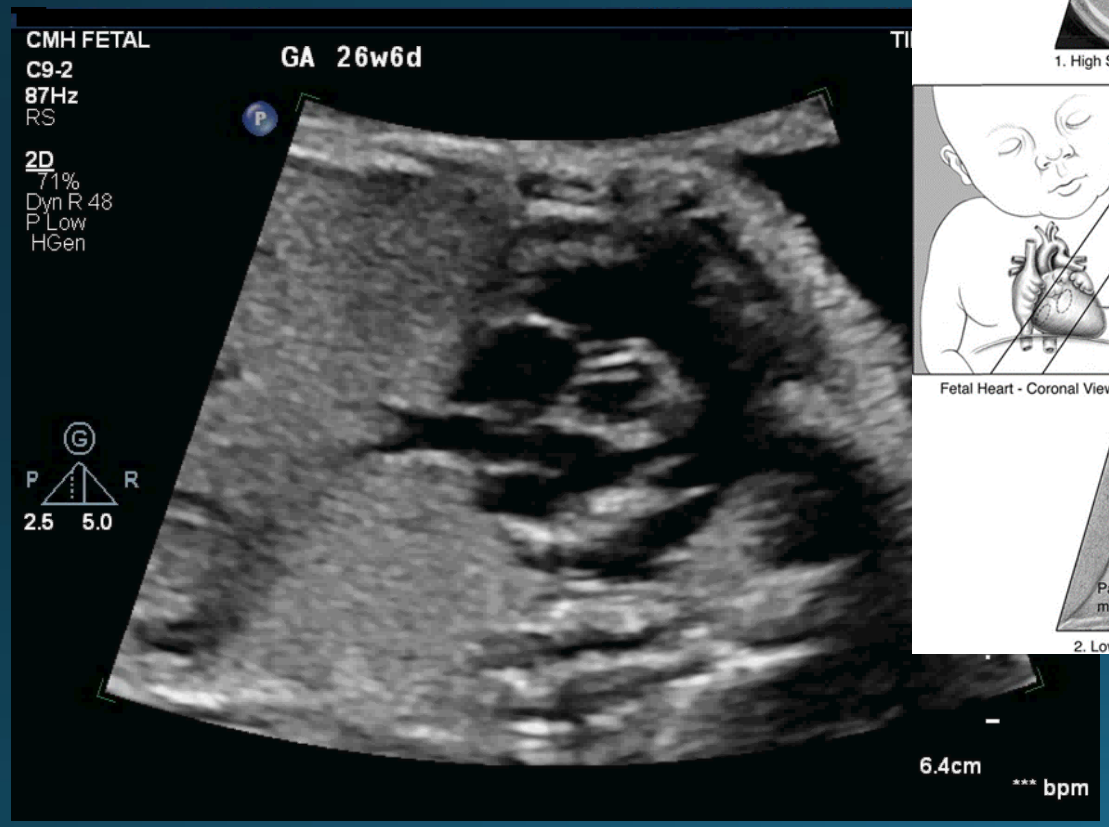
- Left axis deviation (>75 degrees) can be associated with conotruncal defects and coarctation, which may not otherwise be detectable from a four-chamber view.
- Right cardiac deviation (heart axis from 25 degrees to the left of midline to anywhere in the midline or right side of the chest) can be associated with:
  - Polysplenia/asplenia, situs inversus, AVSD, double-outlet right ventricle (DORV), or common atria.
- Cardiac position deviated into the right chest
  - left-sided congenital diaphragmatic hernia or space-occupying mass

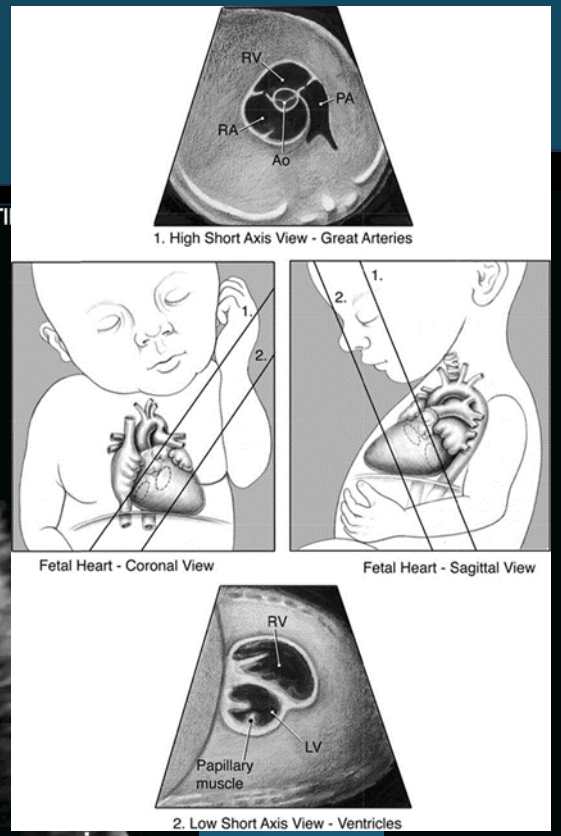
Fetal echo views

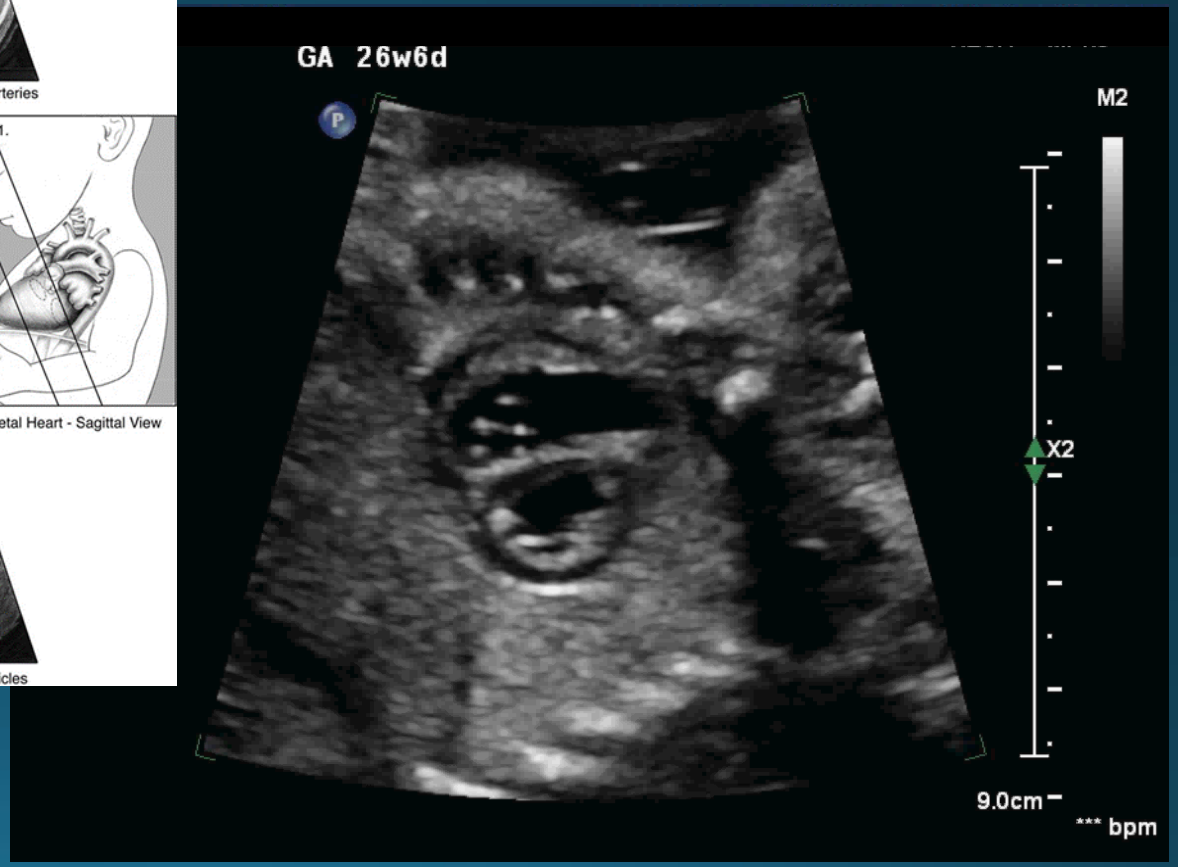


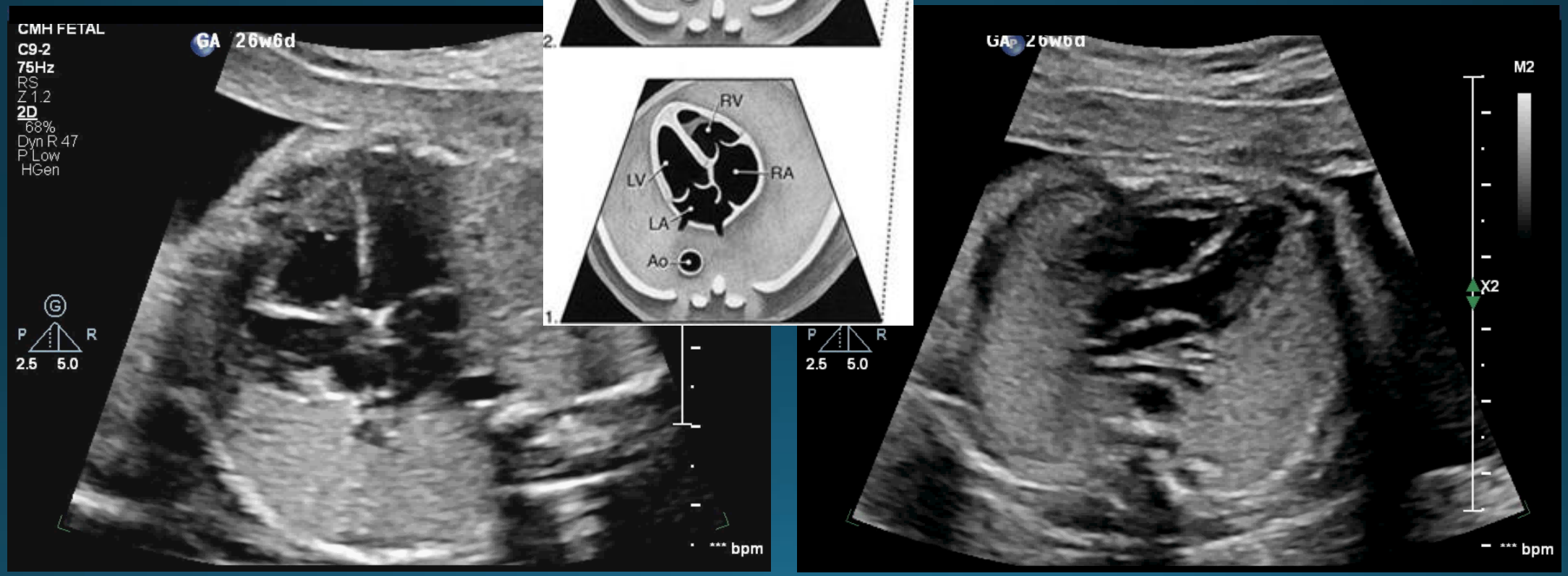


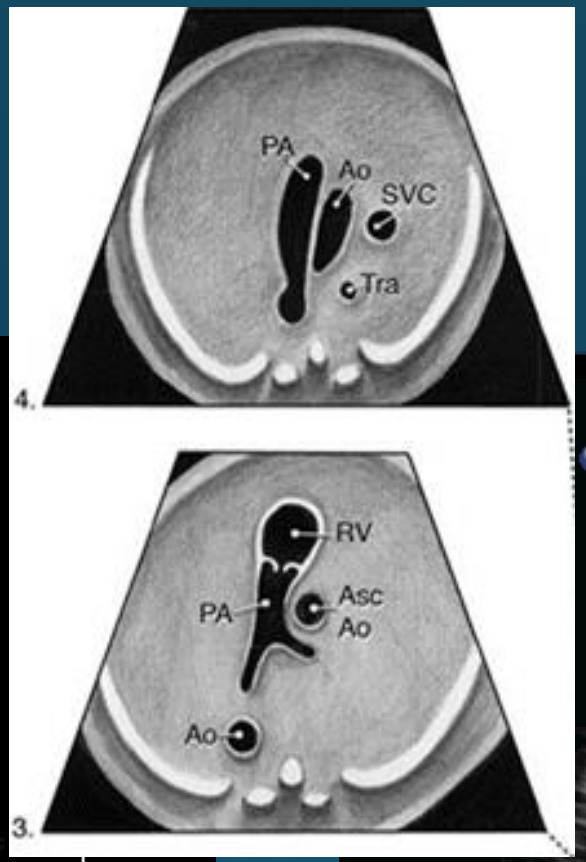


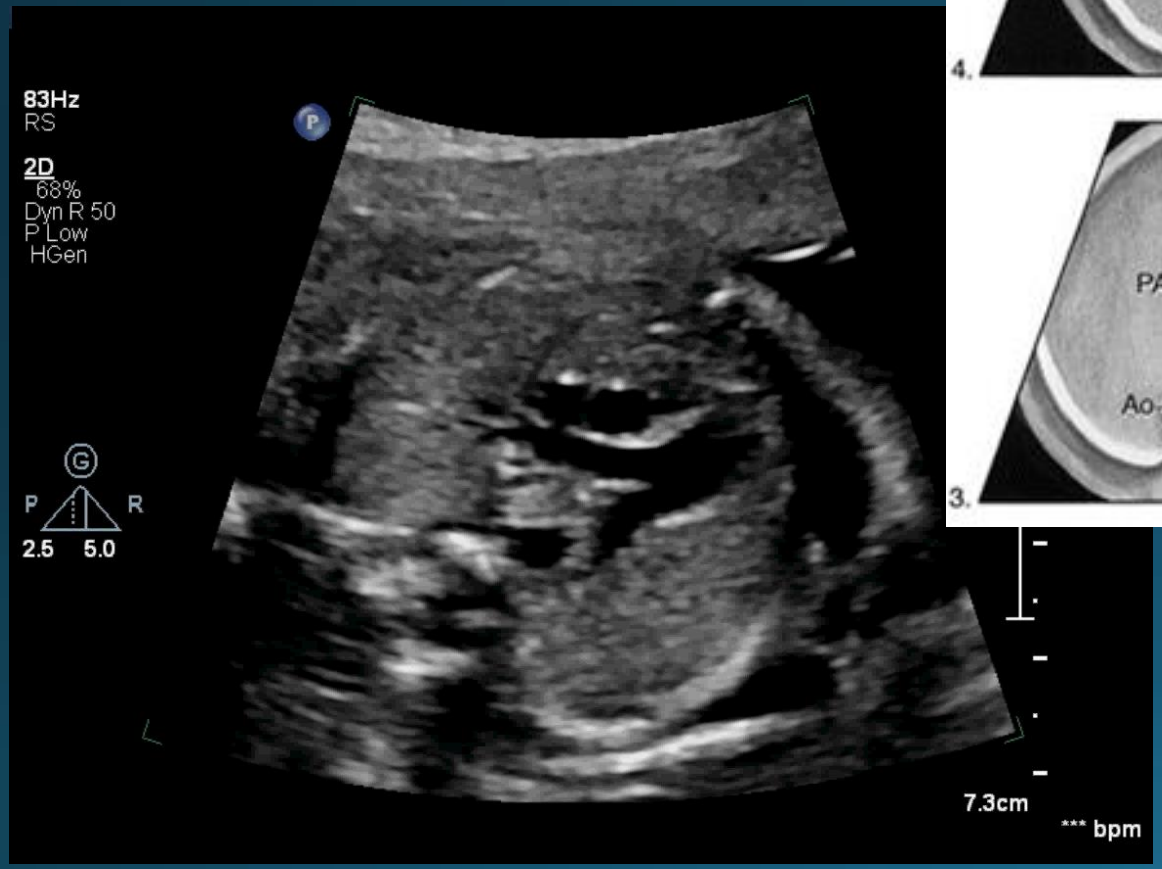

CMH FETAL
C9-2
87Hz
RS
2D
71%
Dyn R 48
P Low
HGen
GA 26w6d
P
G
P
R
2.5
5.0
6.4cm
*** bpm

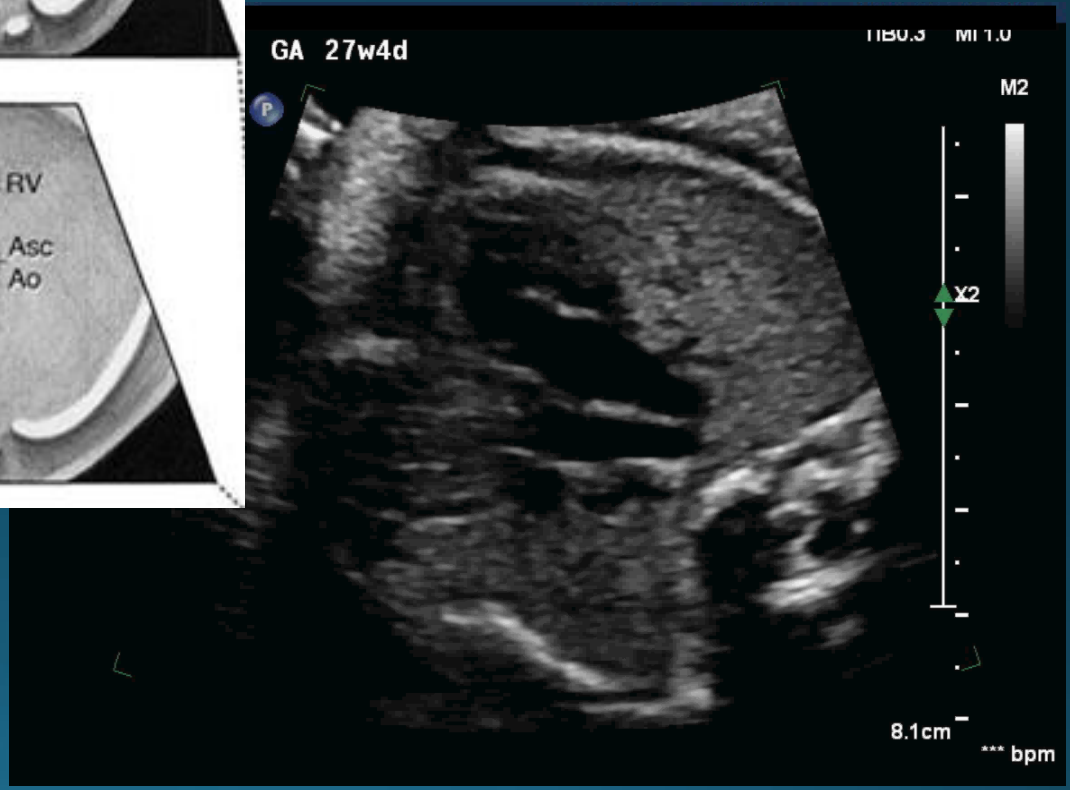

RV
PA
RA
Ao
1. High Short Axis View - Great Arteries
1.
2.
Fetal Heart - Coronal View
1.
2.
Fetal Heart - Sagittal View
RV
LV
Papillary muscle
2. Low Short Axis View - Ventricles

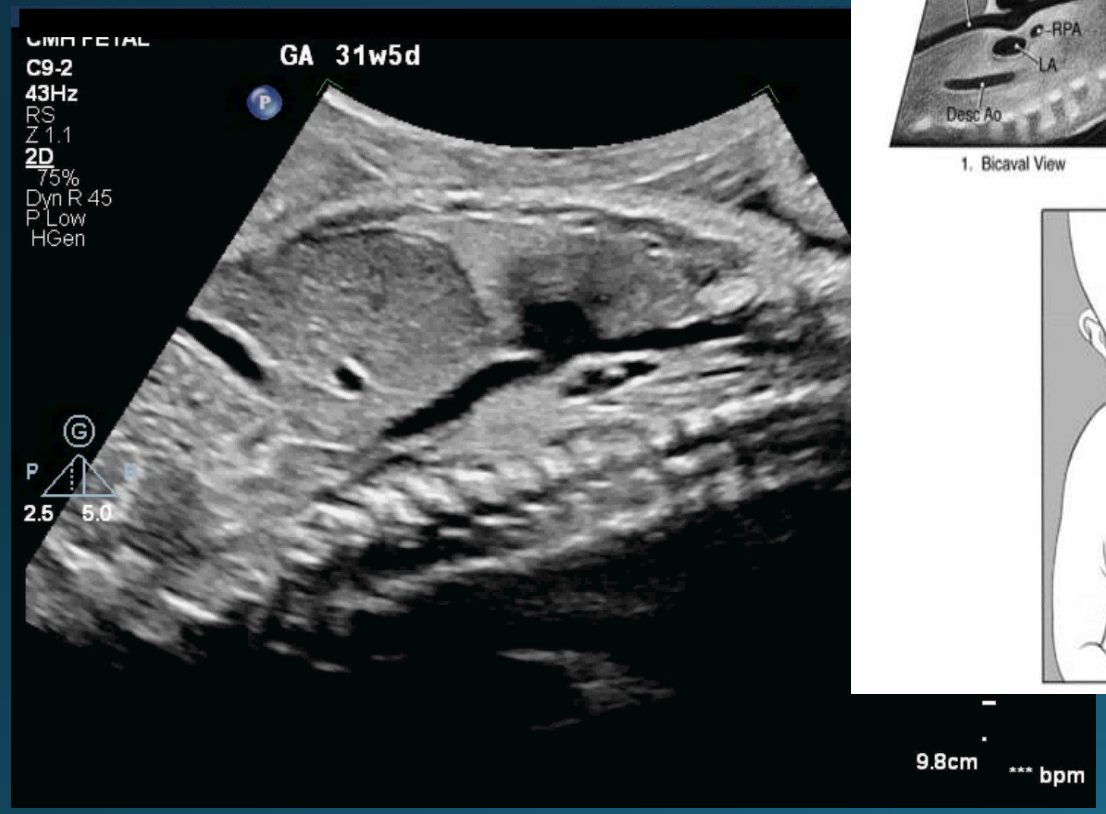

GA 26w6d
P
M2
X2
9.0cm
*** bpm

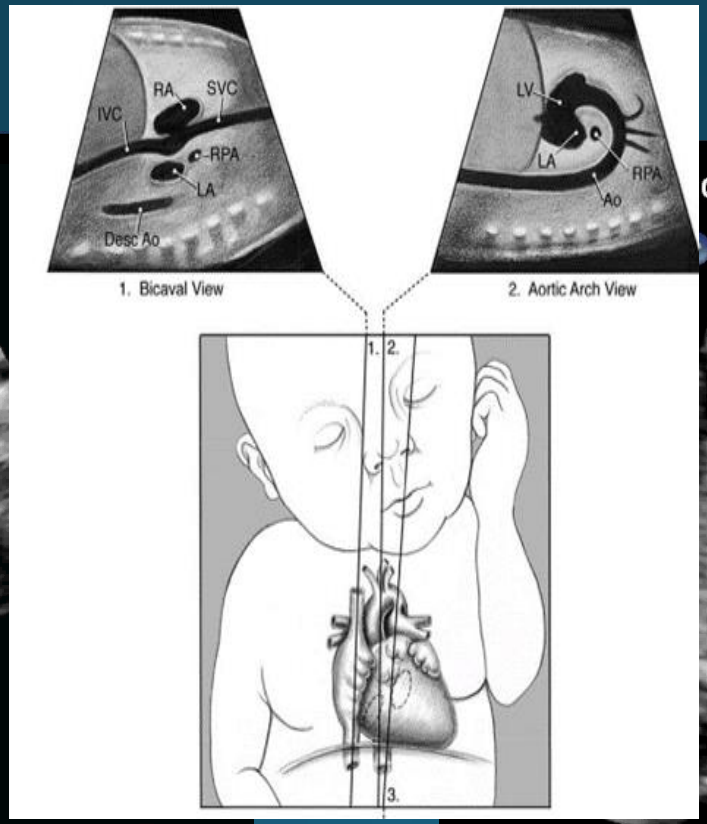

CMH FETAL
C9-2
75Hz
RS
Z 1.2
2D
68%
Dyn R 47
P Low
HGen
GA 26w6d
P
R
2.5
5.0
*** bpm
RV
LV
AscAo
LA
Ao
2.
RV
LV
RA
LA
Ao
1.
GA 26w6d
M2
X2
*** bpm


PA
Ao
SVC
Tra
4.
RV
PA
Asc
Ao
Ao
3.


83Hz
RS
2D
68%
Dyn R 50
P Low
HGen
P
R
2.5
5.0
7.3cm
*** bpm

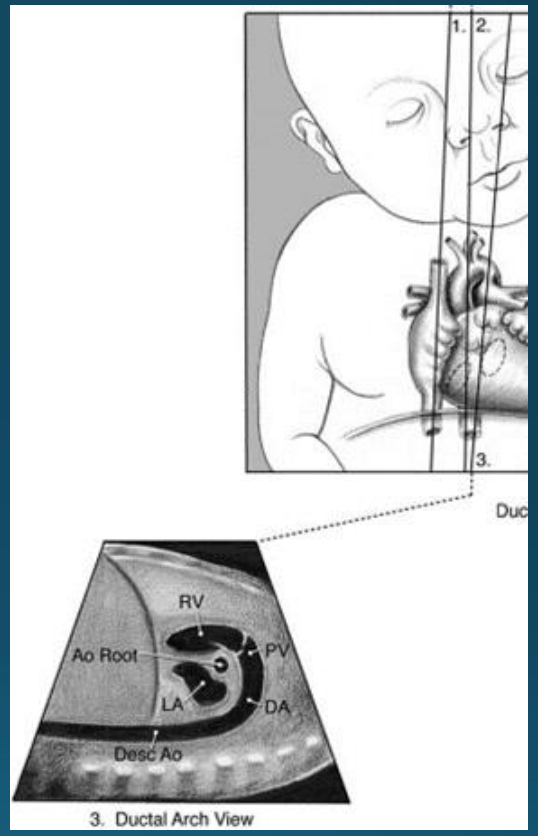

GA 27w4d
M2
X2
8.1cm
*** bpm


GA 31w5d
C9-2
43Hz
RS
Z 1.1
2D
75%
Dyn R 45
P Low
HGen
2.5
5.0
9.8cm
*** bpm


RA
SVC
IVC
RPA
LA
Desc Ao
1. Bicaval View
LV
LA
RPA
Ao
2. Aortic Arch View
1. 2.
3.


GA 24w5d
TIB0.3
MI 1.0
M2
X2
8.2cm
*** bpm


CMH FETAL
C9-2
86Hz
RS
2D
65%
Dyn R 47
P Low
HGen
GA 26w6d
TIB0.8 MI 0.8
M2
P
G
P R
2.5 5.0
X2
9.8cm
*** bpm


1. 2.
3.
RV
Ao Root
PV
LA
DA
Desc Ao
3. Ductal Arch View

Nomenclature

Anderson vs Van Praagh

- Two main schools of nomenclature are typically used: the Van Praagh/Boston school and the Anderson/European school
- Regardless of the names used, description of the heart typically includes evaluation of:
  - (1) atrial anatomy, (2) AV connections, (3) ventricular looping, (4) ventriculoarterial connections, and (5) description of the great arteries

Segmental approach

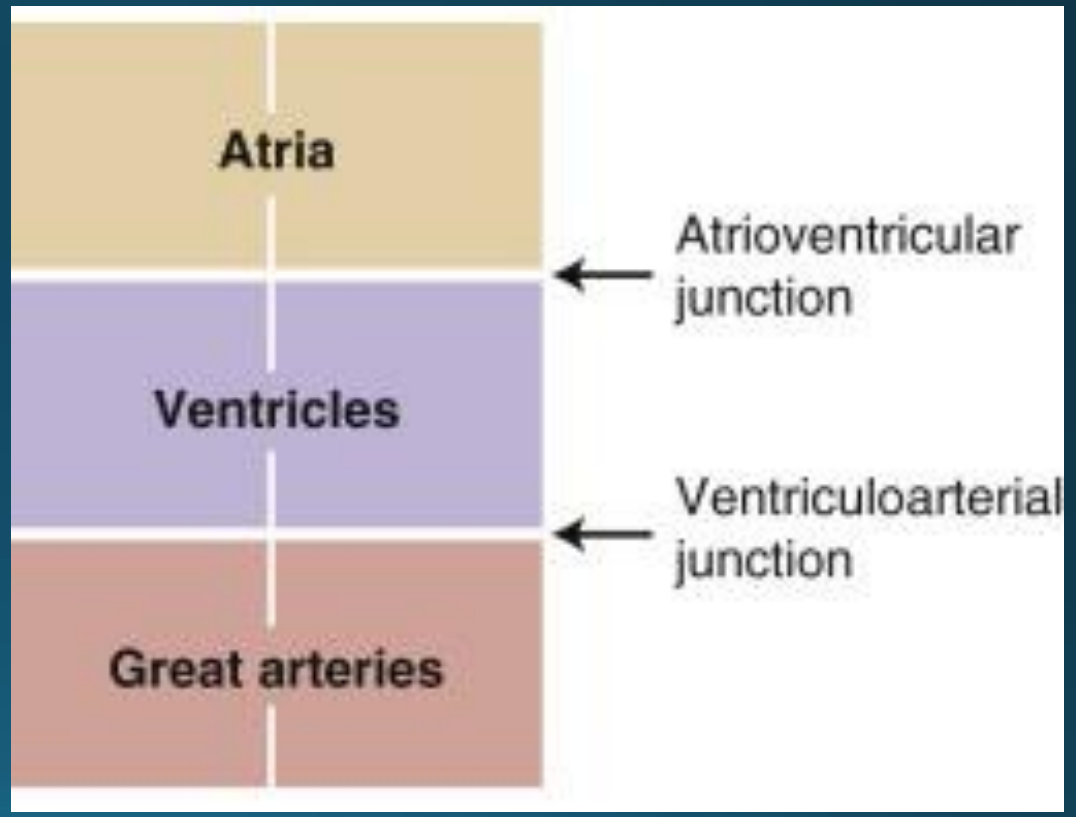
Describing the heart

- Mental checklist:
  - Systemic veins
  - Pulmonary veins
  - Atria
  - Atrioventricular connections
  - Ventricles
  - Outflow tracts
  - Great vessels
  - Ductal and aortic arches
- Remember…in nature anything is possible

Initial sweeps for cardiac anatomy

Keep it simple

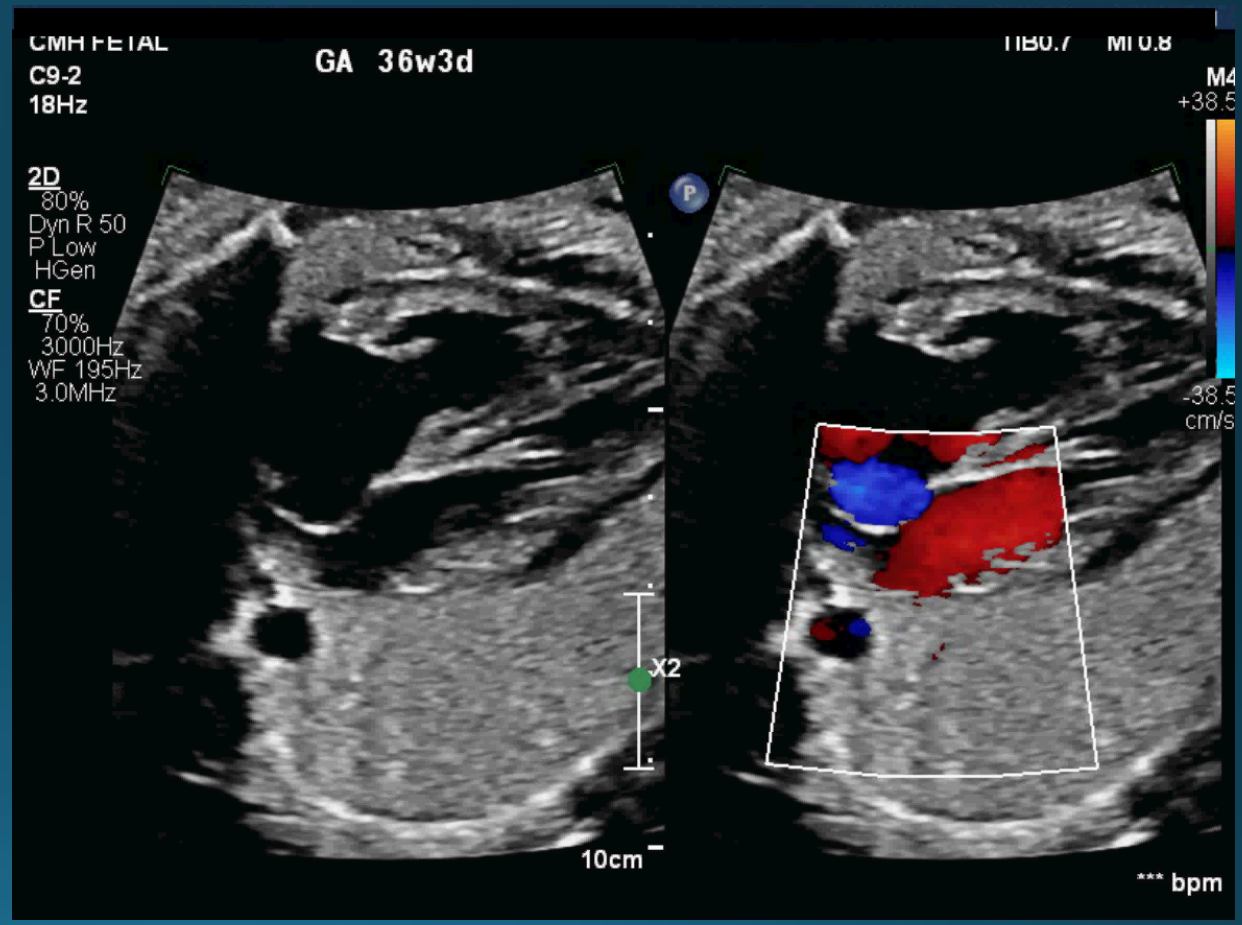
- How many chambers are there?
- How many valves?
  - Do they look mobile and thin?
- Is there a clear path for blood flow?
  - The sub pulmonic and subaortic regions are wide open
- Great arteries coming off correct ventricle



Four chamber view

Atria

- Two atria, approximately equal in size
- Foramen ovale flap in left atrium
- Septum primum present (near to crux)
- Pulmonary veins enters left atrium

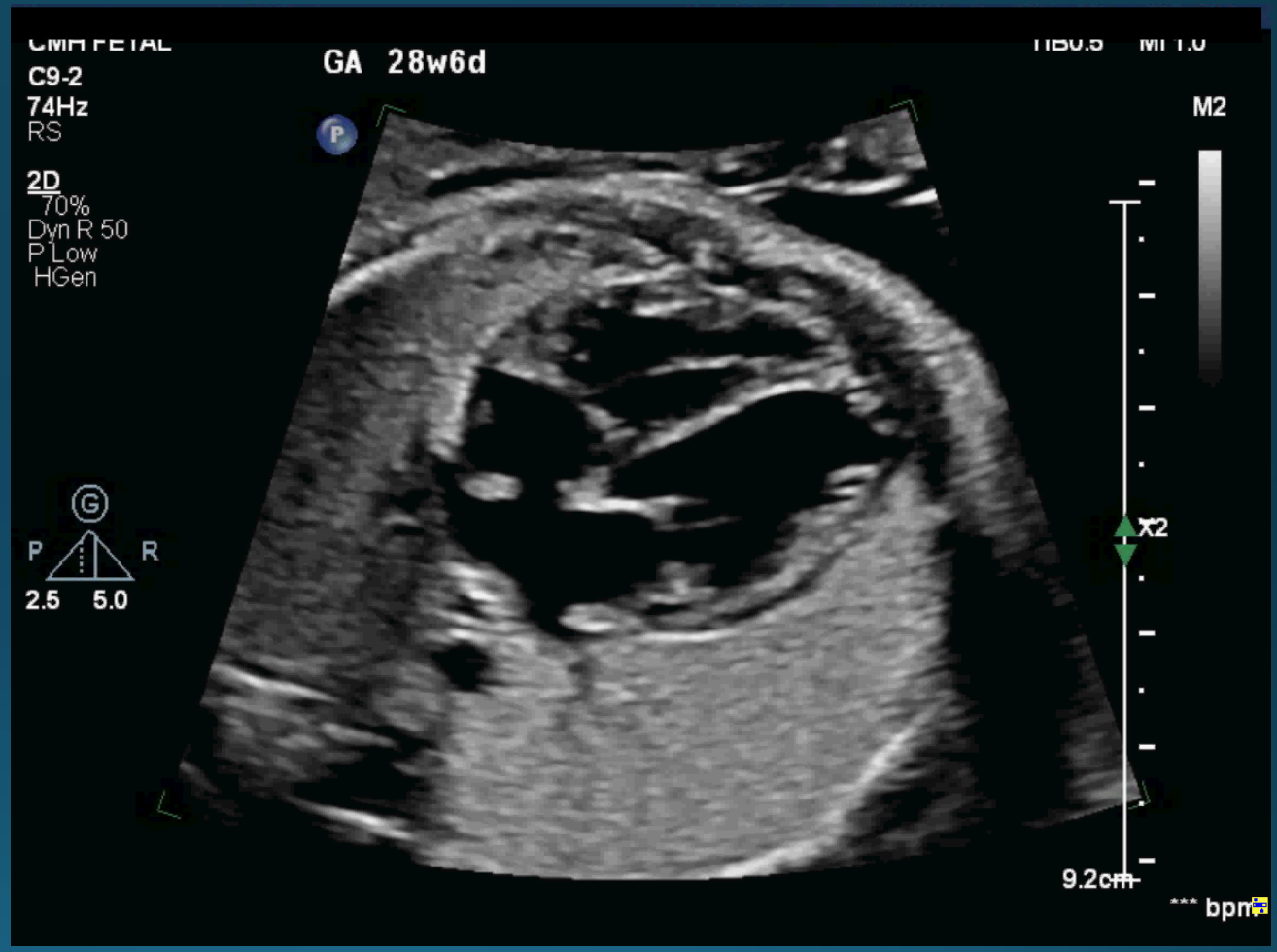


Ventricles

- Position
- Atrial connections
- Ventricular anatomy
  - VSD?
- Size discrepancies?
- Function
- Effusion?

Right vs Left

- Right Ventricle trabeculated and triangular
  - Perfect world: moderator band
- Left ventricle is smooth walled and bullet shaped
  - Super perfect world: false tendon
  - Apex forming-normal heart
- Valves follow the ventricle
  - Tricuspid valve is septophilic(attaches to interventricular septum)
  - Mitral valve is septophobic (no septal attachments-its scared!)

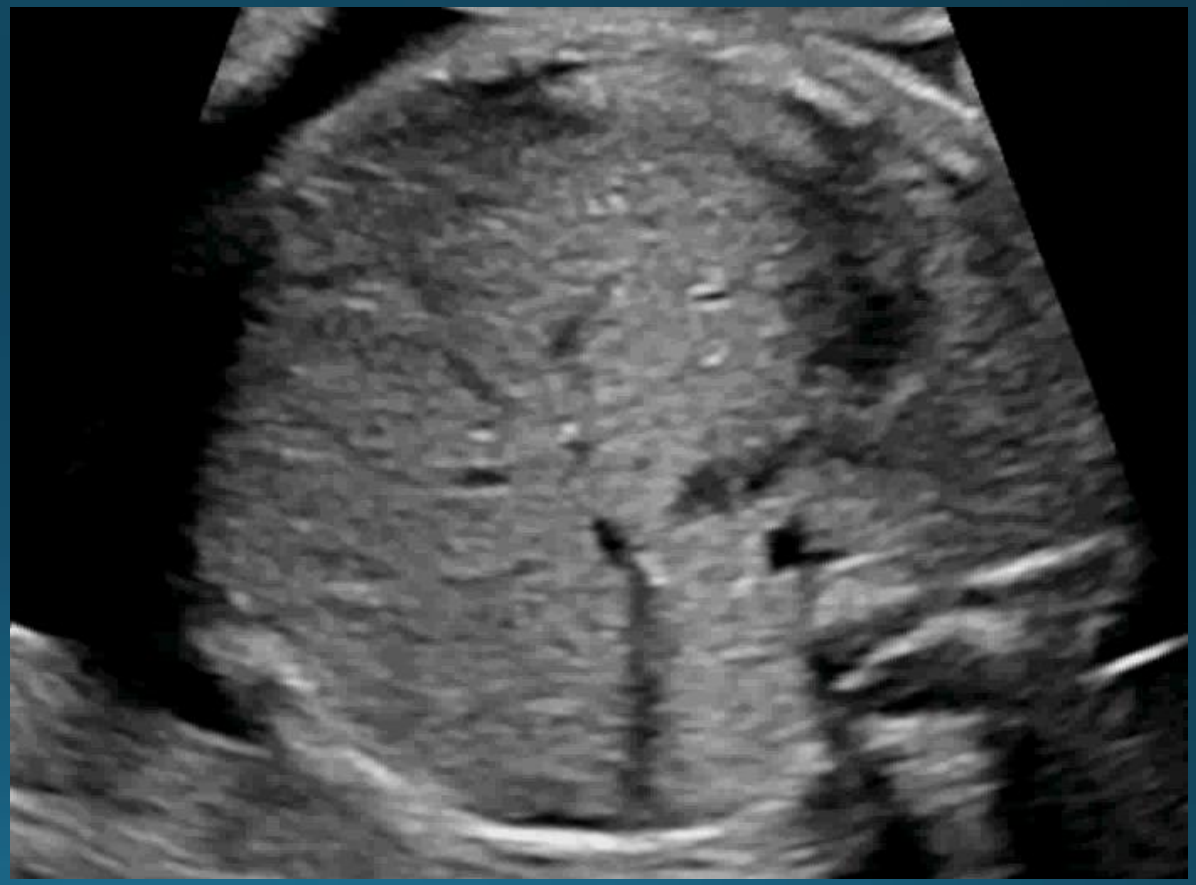


AV valves

- Intact cardiac crux
- Two atrioventricular valves open and move freely
- Offset valves
  - Tricuspid valve leaflet inserts in ventricular septum closer to cardiac apex than the mitral valve leaflet

Great arteries

- Cross over
- What ventricle coming off of
- Size
- Valves opening
- Arch branching
- Any extra vessels?
  - LSVC



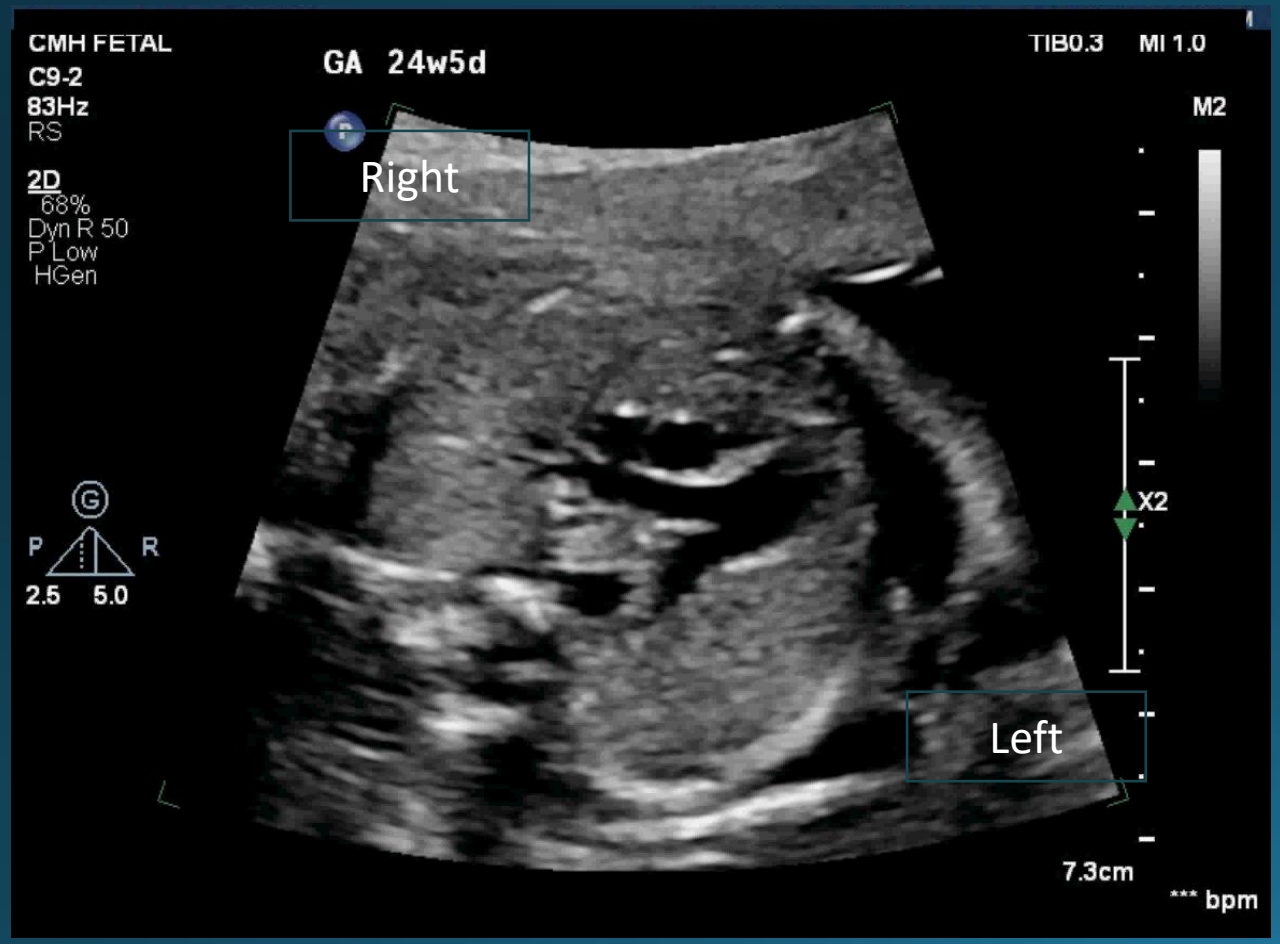
Dont get in your head

- Ideal scenarios
  - Time constraints
  - How baby is laying
  - Other factors
- Are you answering the question?
  - Its not always textbook

- Most important views:
  - 4 chamber
  - 3VT

Three vessel view

Iac required



- The MPA/DA, ascending aorta and SVC are seen
- From left to right; Pulmonary artery-Ascending aorta-SVC
- Pulmonary artery and ascending aorta diameter are similar
  - SVC is smaller
- Forward flow that is laminar
- You may see trachea, one or both PAs

Three vessel trachea view

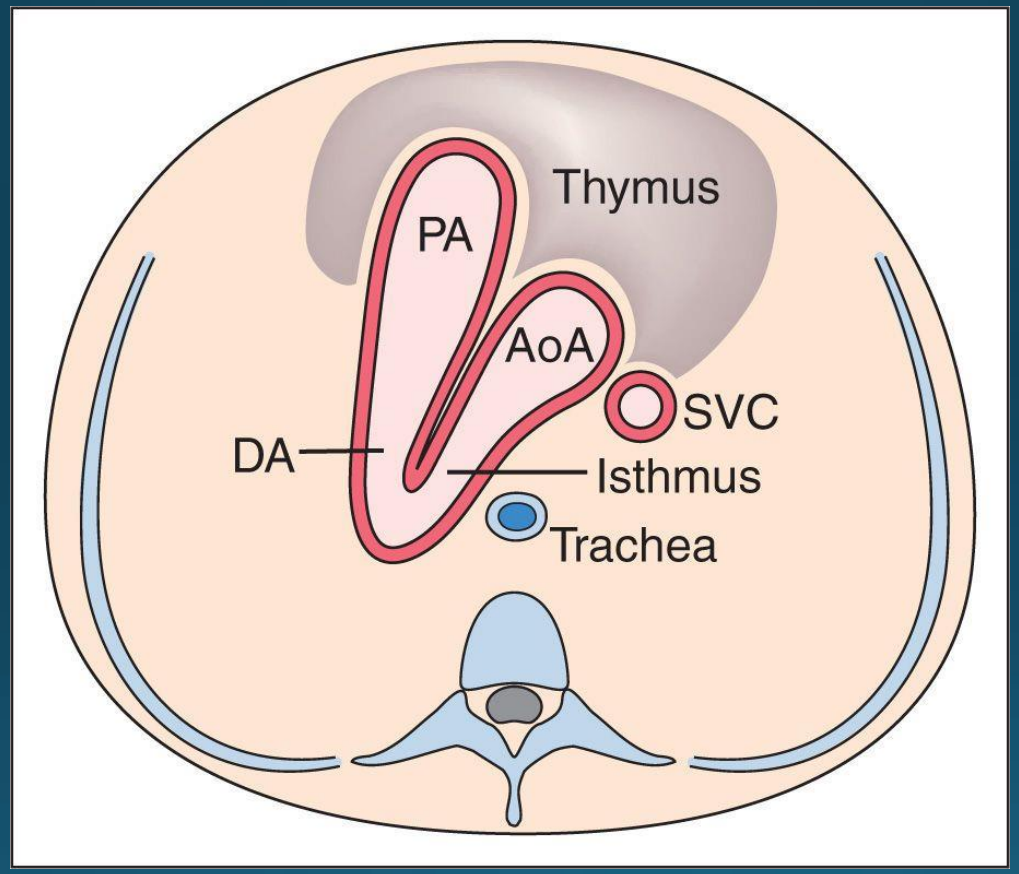
How to:

- From a 4chamber sweep slightly superior towards head
  - Note LVOT, RVOT, 3 vessel view than 3 vessel trachea view..just a couple millimeters
- If fetus is spine up move over and lay the heart horizontal sweep up from there

Mental check list:

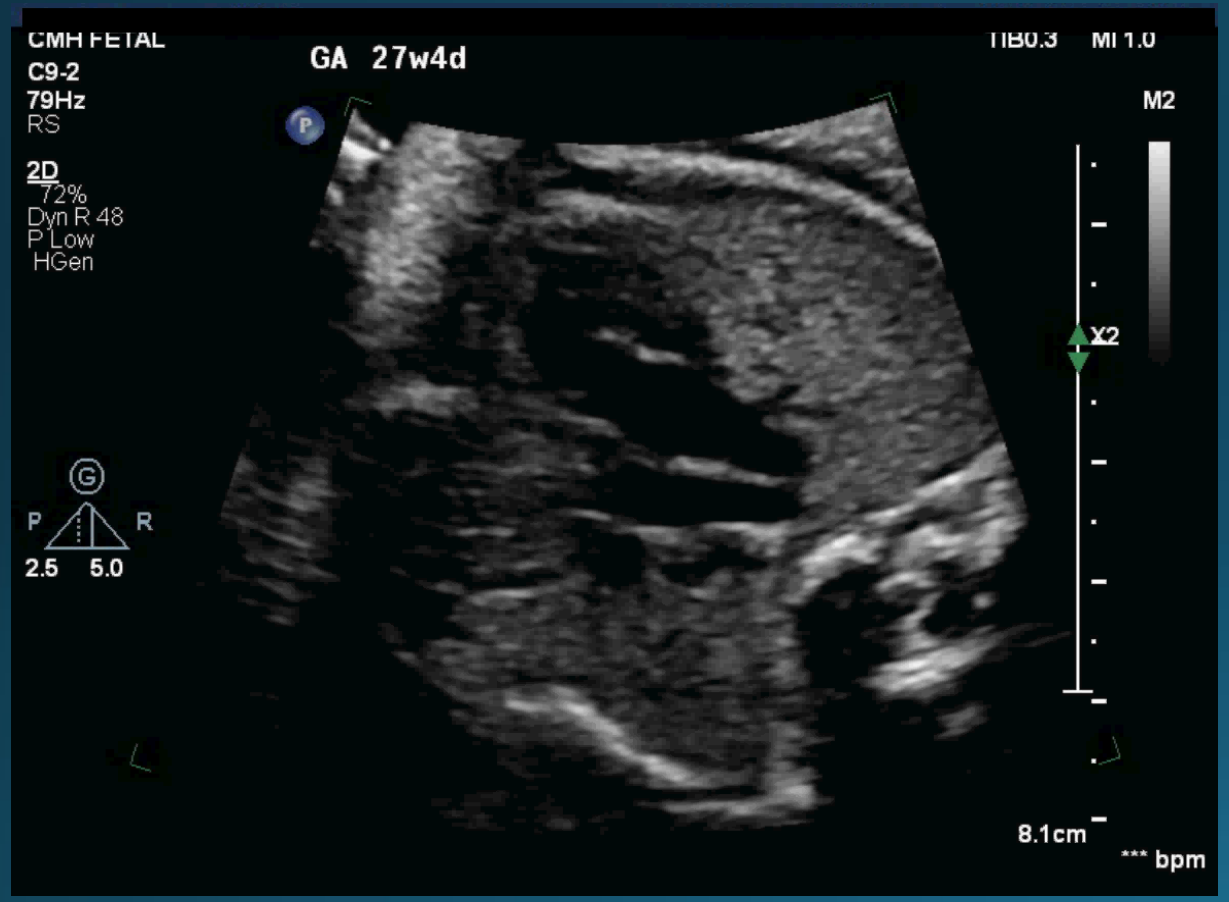
- Transverse aortic arch and isthmus merge into the descending aorta, as does the pulmonary trunk and ductus arteriosus, creating a V-shaped
- “V” shaped-with trachea to the right
- From fetal right to left, increasing in size:
  - SVC-AO-PA

Left



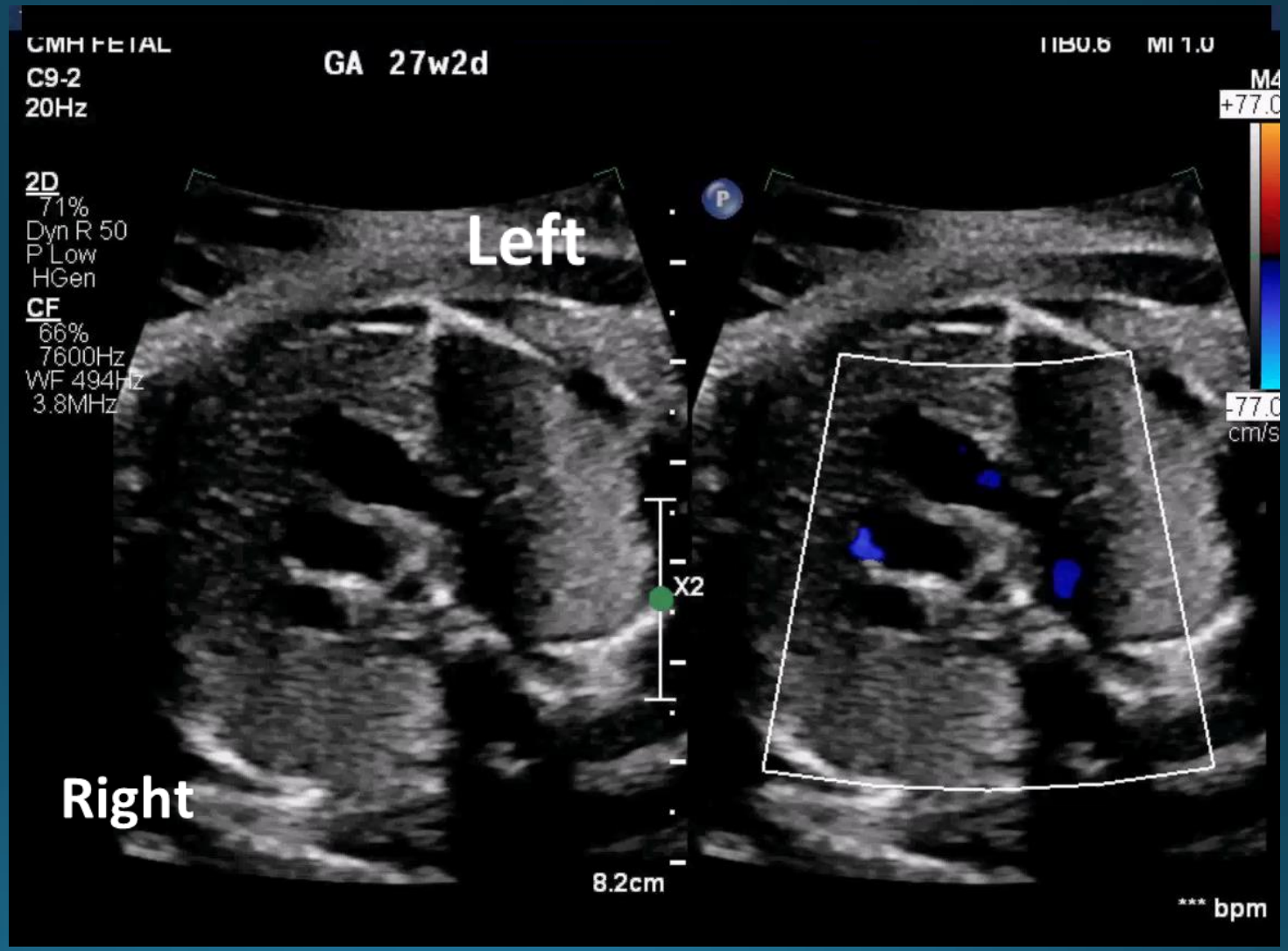
Right

The three vessel trachea view



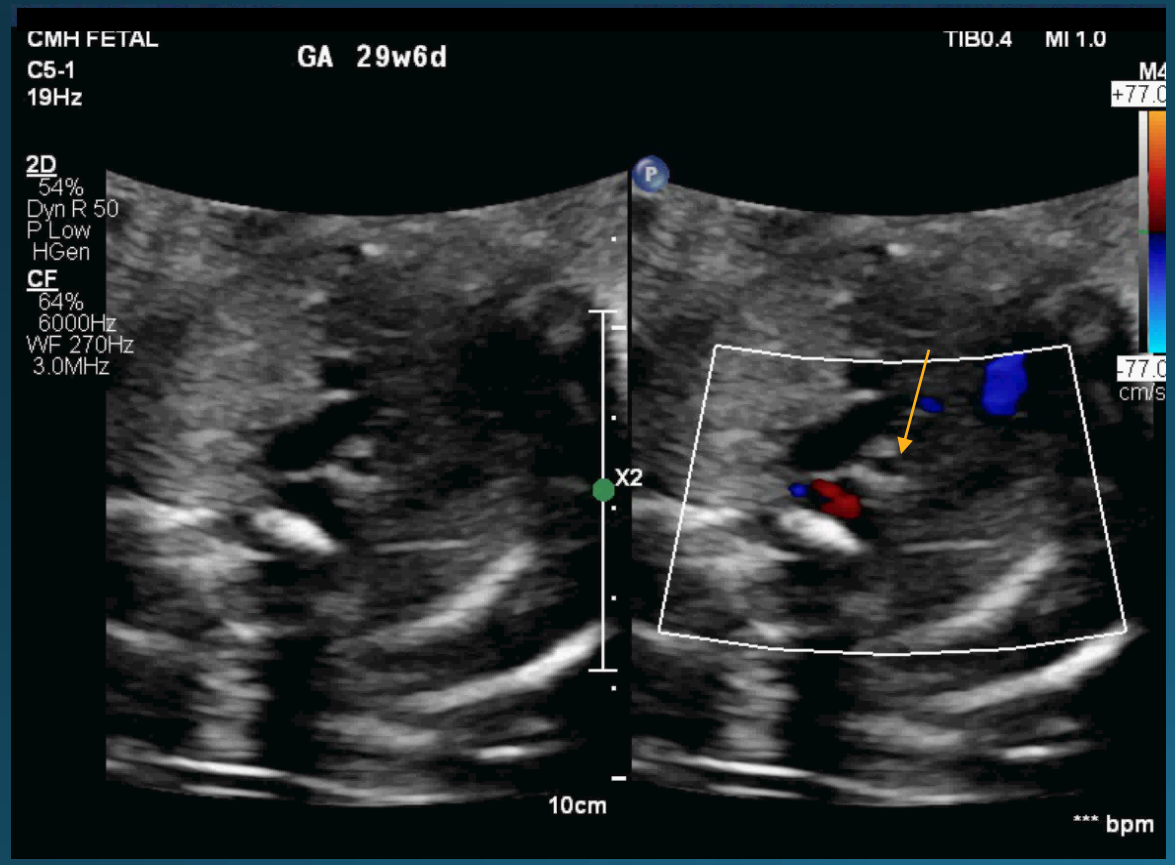
- Pulmonary artery/ductal arch and transverse arch of the aorta meet as they join the descending aorta
  - Both the SVC and trachea are seen
- From a 4chamber sweep slightly superior towards head
  - Note LVOT, RVOT, 3 vessel view than 3 vessel trachea view
- If fetus is spine up large movement over and lay the heart horizontal sweep up from there
- Don’t be fooled by the the esophagus

Normal 3 vessel trachea view

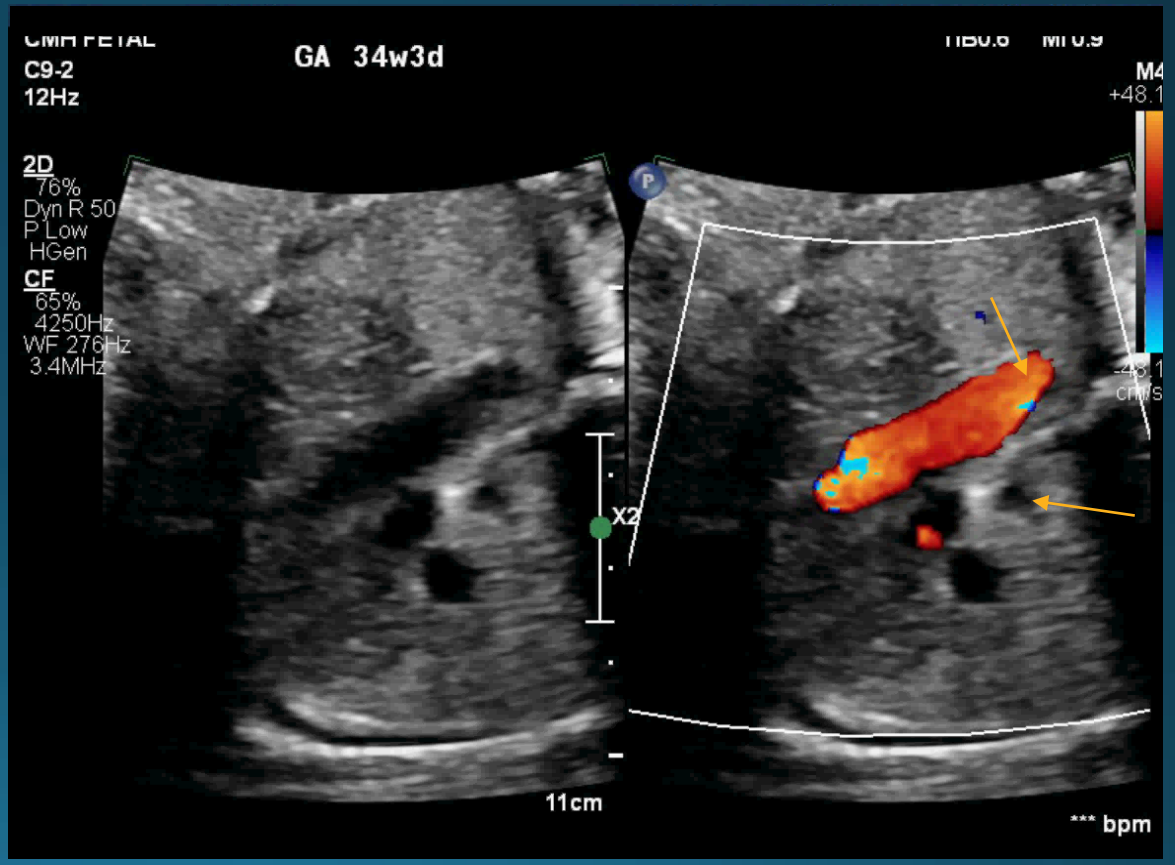


A few abnormals…

Right aortic arch

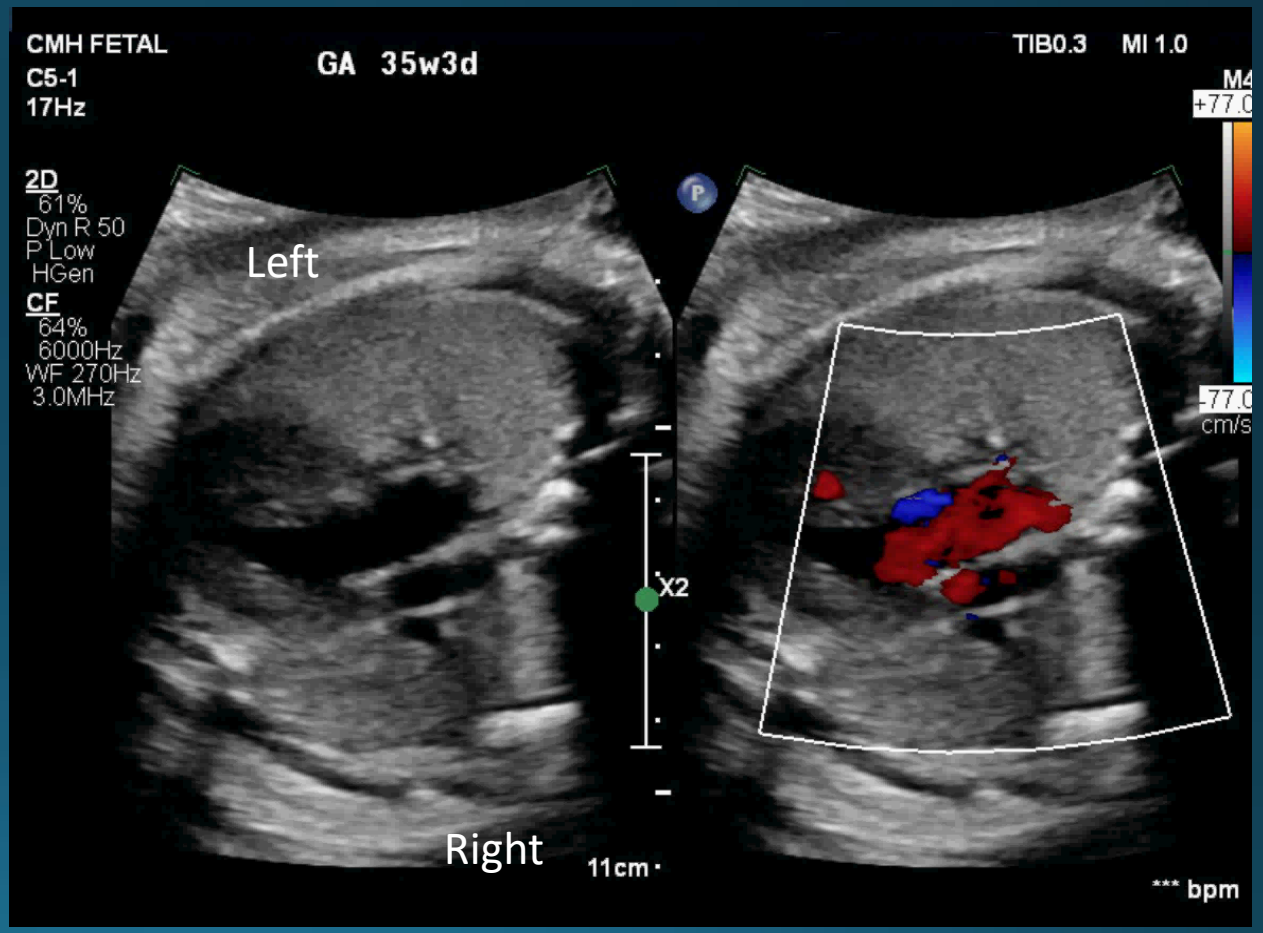


Interrupted aortic arch



LSVC

Coarctation

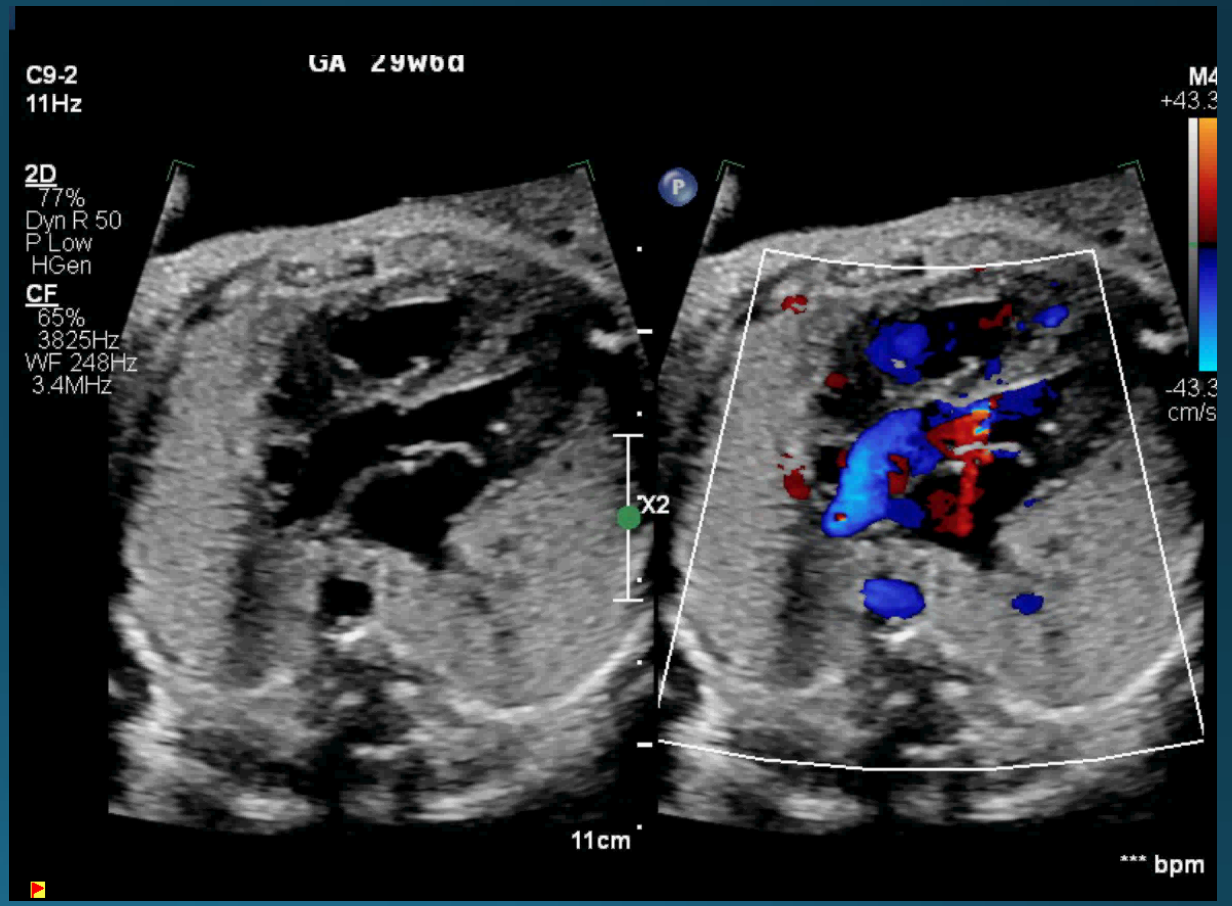


Is sweeping really THAT important?

- 4 chambers
- Left Ventricle on the left, Right Ventricle on the right-Normal size
- Pulmonary veins into LA
- Valves are unobstructed
- No effusions

DTGA

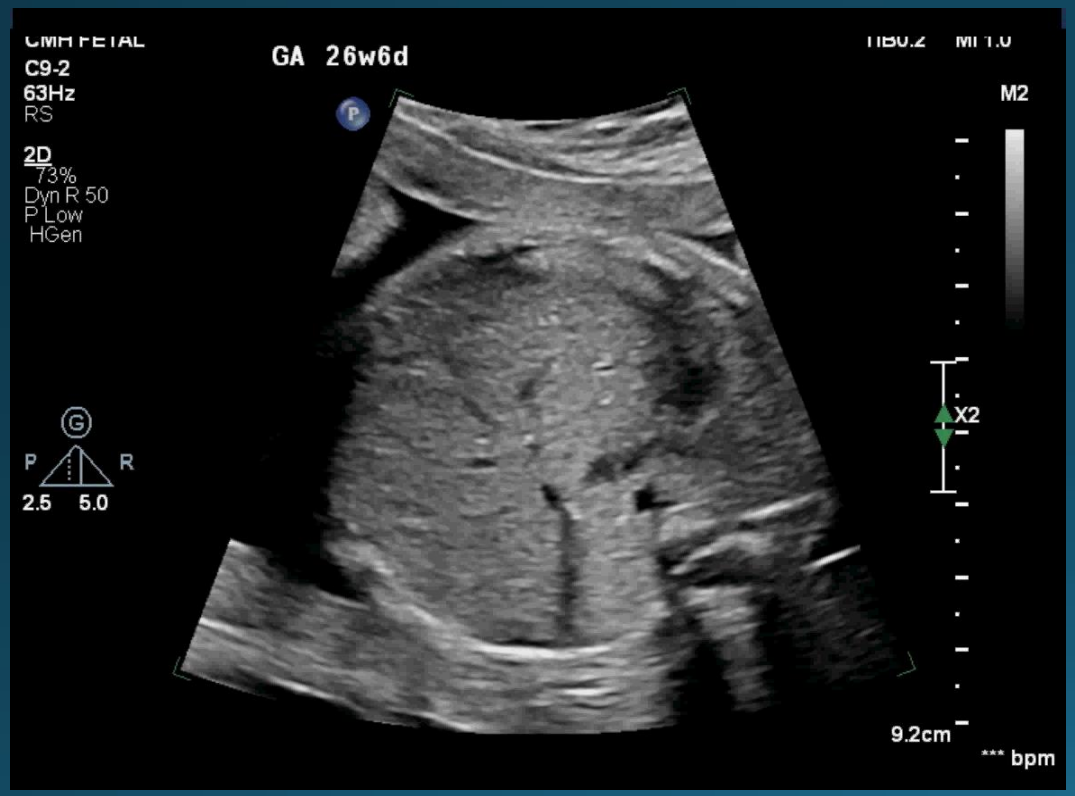
- No crossover of great vessels
- Vessel off the right ventricle doesn't branch
- Left pulmonary artery coming off the great artery arising from left ventricle

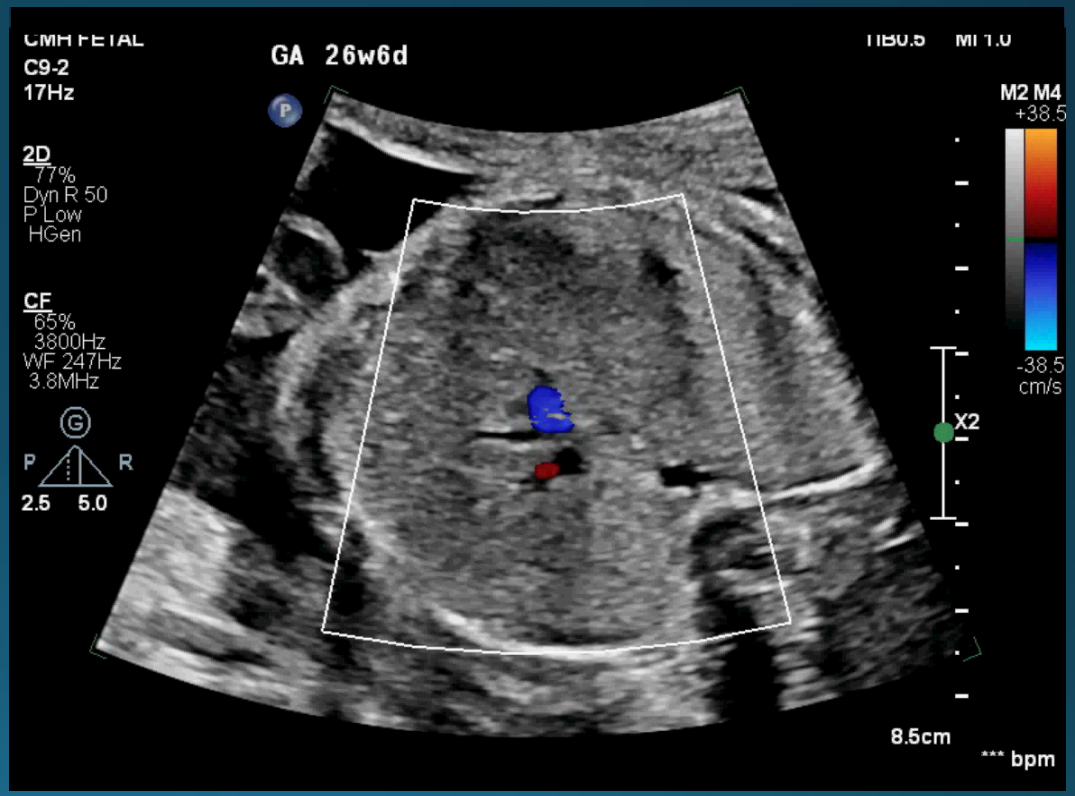


Why outflows matter

- Cardiac defects associated with normal four chamber
  - Tetralogy of Fallot
  - Transposition of great arteries
  - Double outlet Right ventricle
  - Small ventricular septal defect
  - Truncus
  - Mild aortic/pulmonary stenosis
  - Arch anomalies
- Can catch these with the 3VV

The sneaky membranous VSD

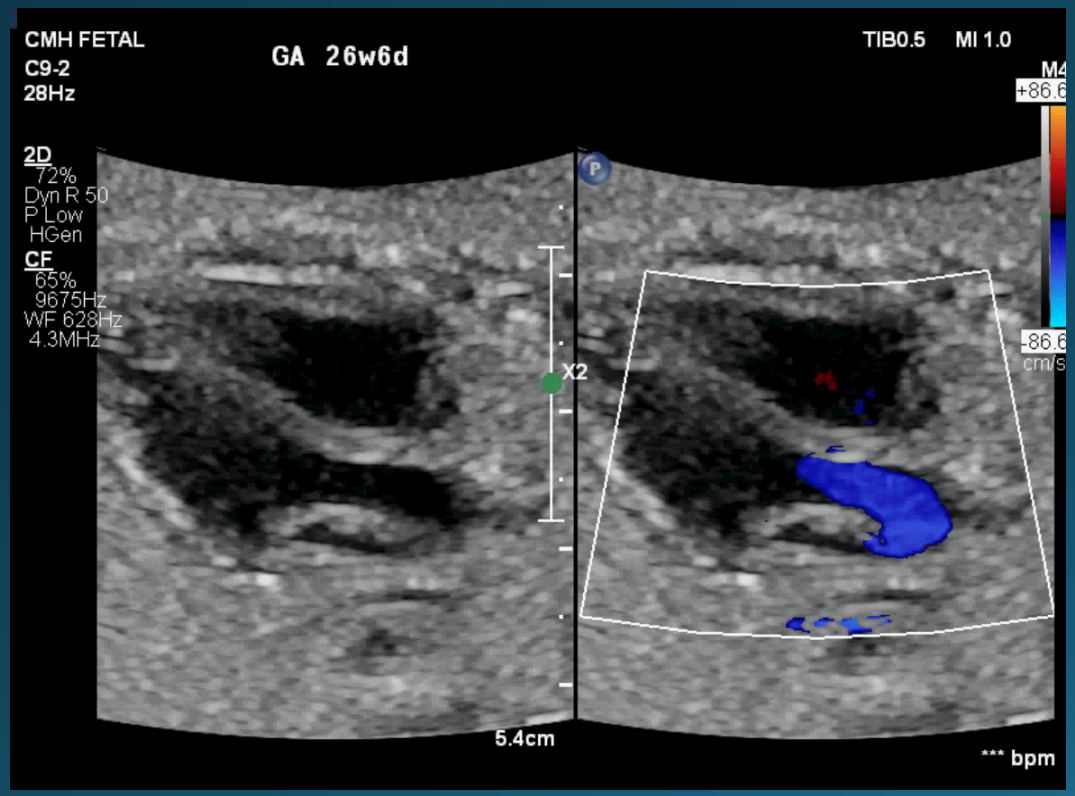


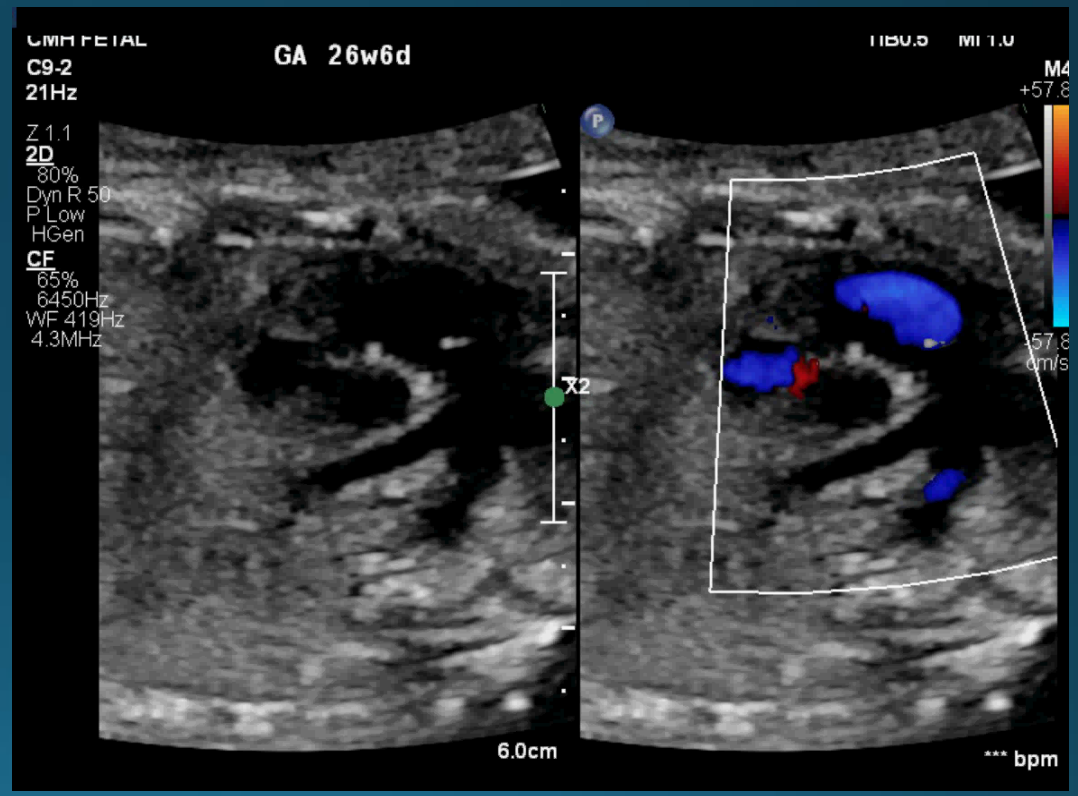


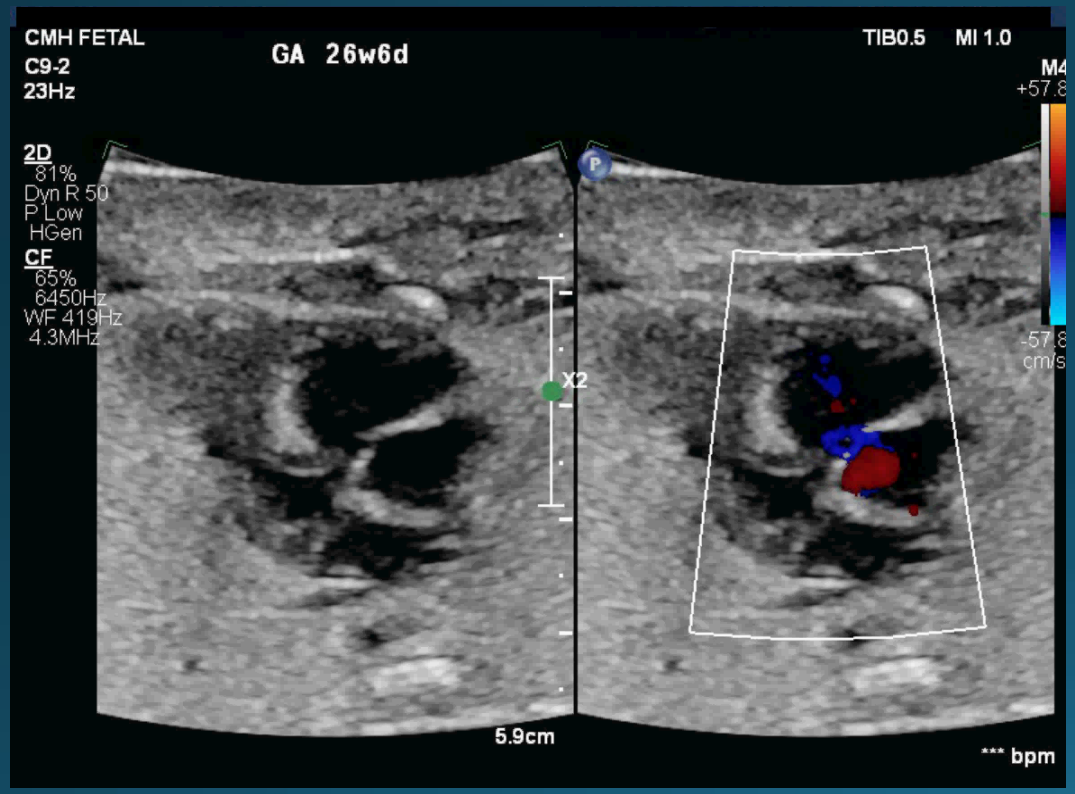
If VSD is suspected

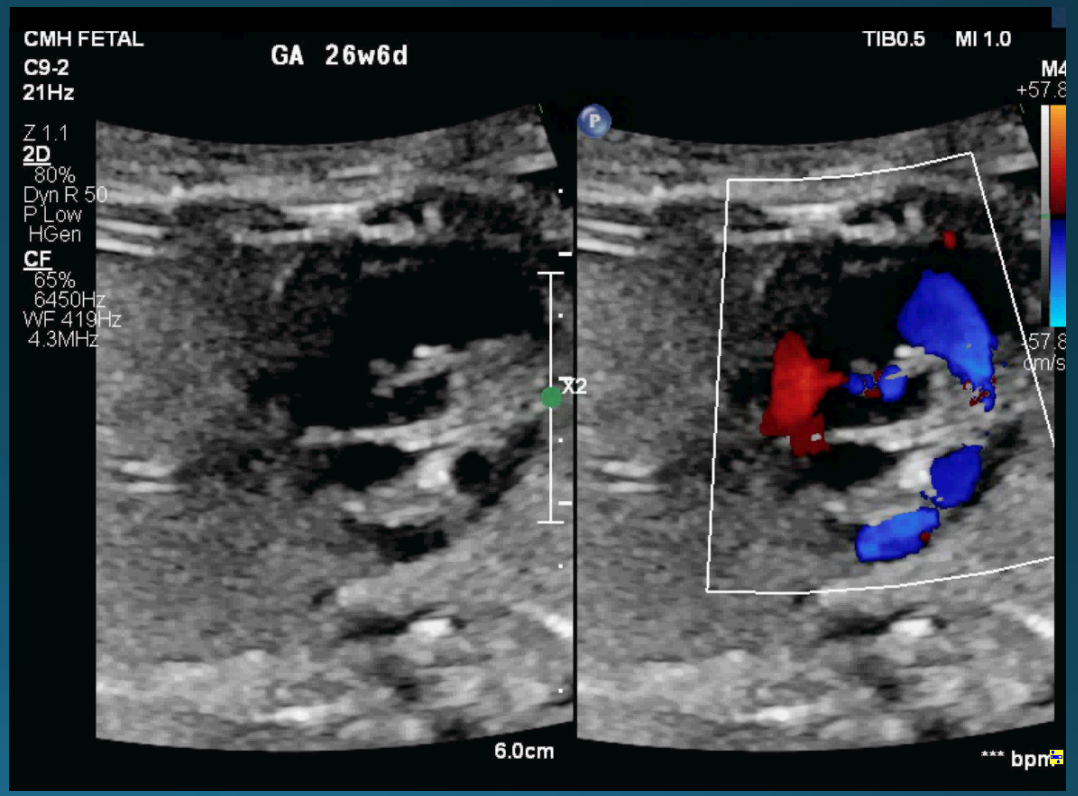
- Lower NL
- Sweep slightly
- Image in two planes

Bonus views/ discussions






CMH FETAL
C9-2
23Hz
GA 26w6d
TIB0.5 MI 1.0
M4
+57.8
2D
81%
Dyn R 50
P Low
HGen
CF
65%
6450Hz
WF 419Hz
4.3MHz
X2
-57.8
cm/s
5.9cm
*** bpm

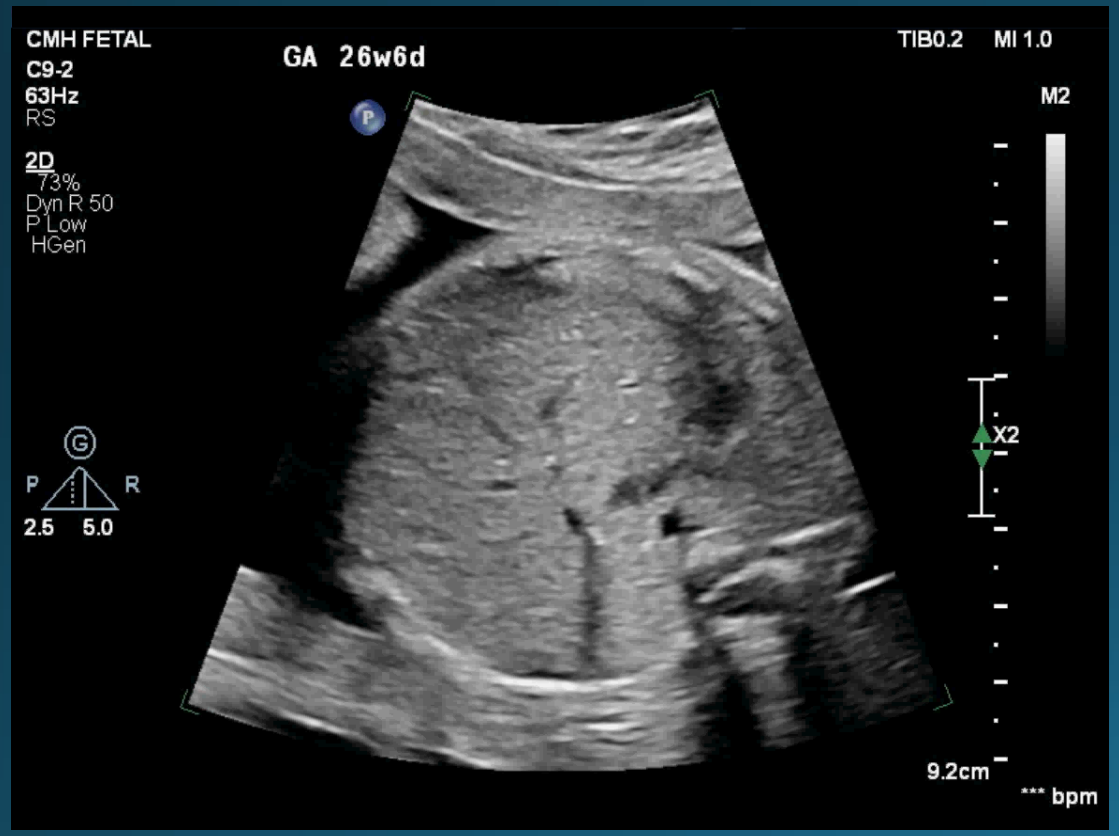

CMH FETAL
C9-2
21Hz
GA 26w6d
TIB0.5 MI 1.0
M4
+57.8
Z 1.1
2D
80%
Dyn R 50
P Low
HGen
CF
65%
6450Hz
WF 419Hz
4.3MHz
X2
-57.8
cm/s
6.0cm
*** bpm

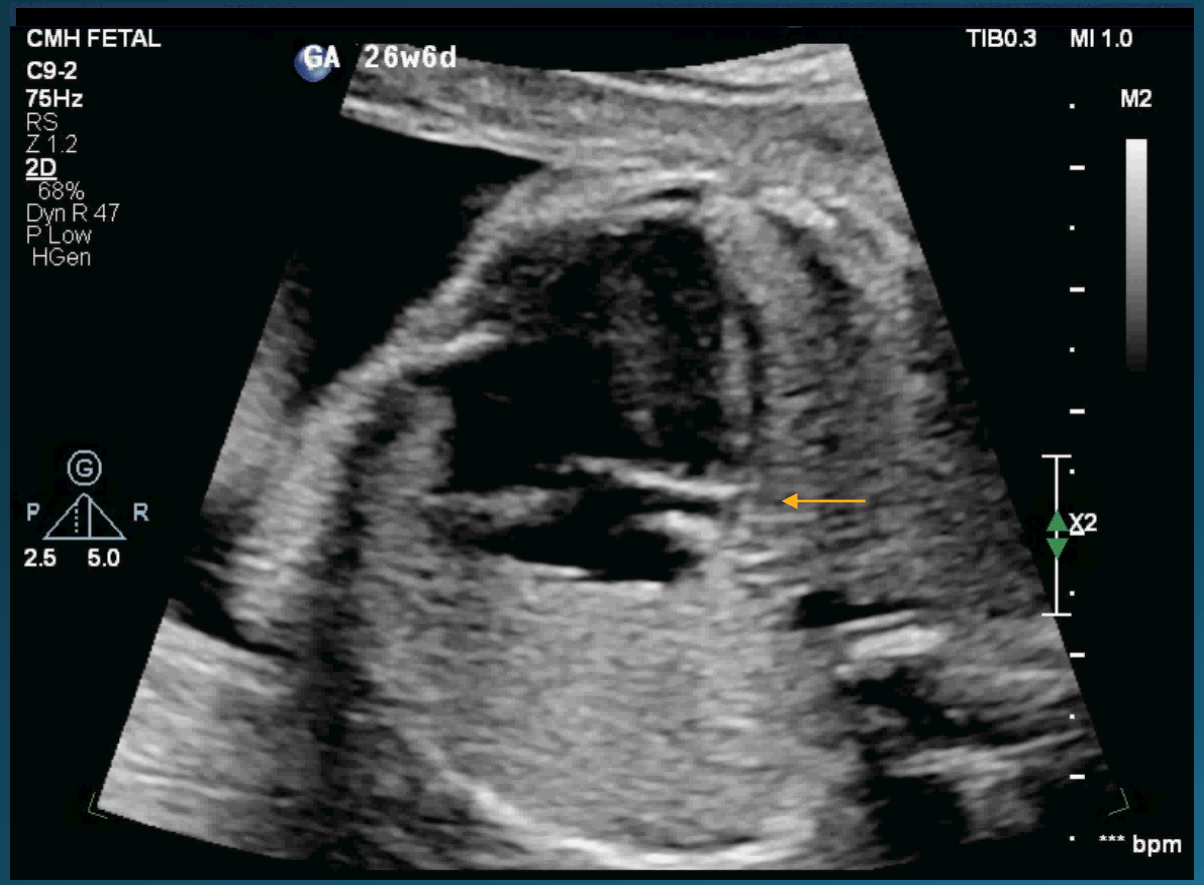

GA 36w3d
C9-2
47Hz
RS
2D
76%
Dyn R 44
P Low
HGen
M2
X2
P
R
2.5
5.0
10cm
*** bpm

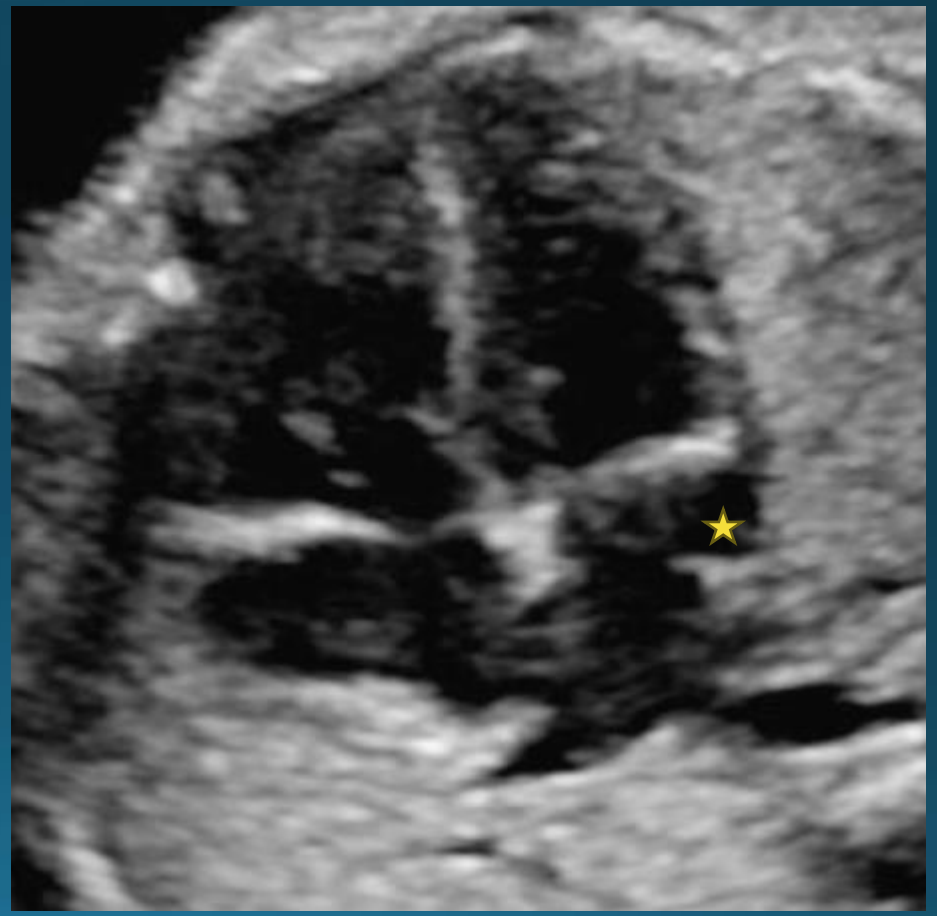
4chamber

Bonus

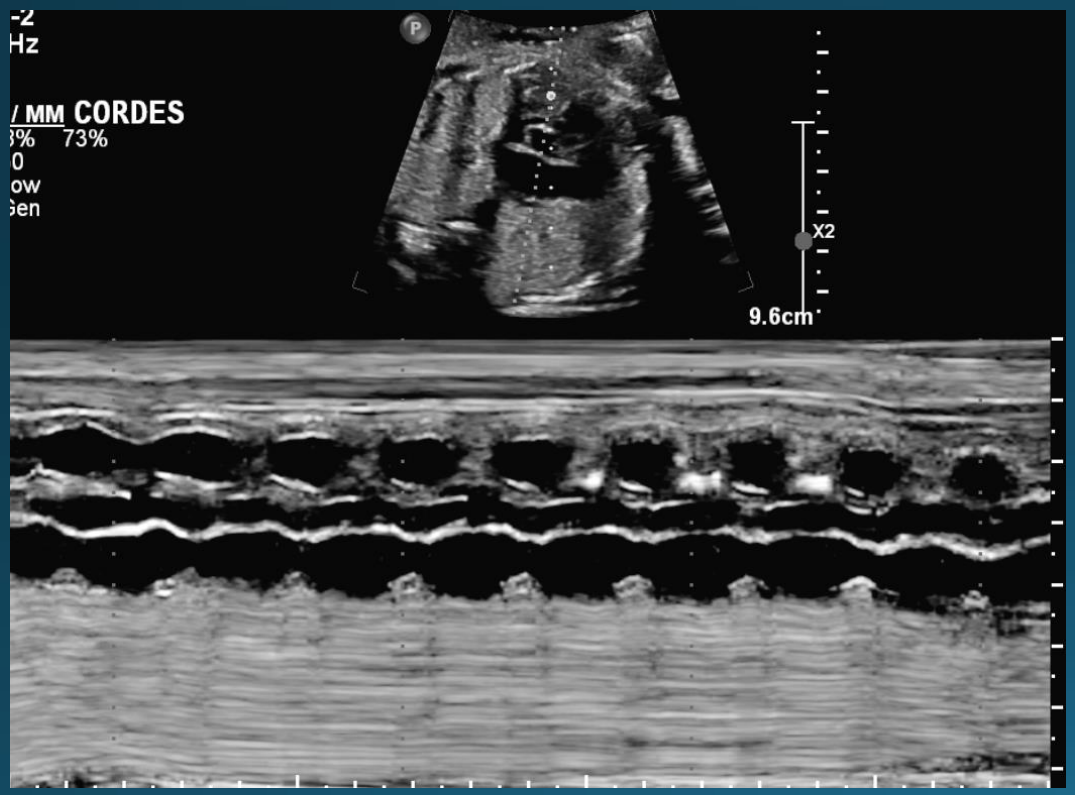
Coronary sinus size




CMH FETAL
C9-2
75Hz
RS
Z 1.2
2D
68%
Dyn R 47
P Low
HGen
GA 26w6d
TIB0.3 MI 1.0
M2
X2
P
R
2.5 5.0
*** bpm



Rhythm

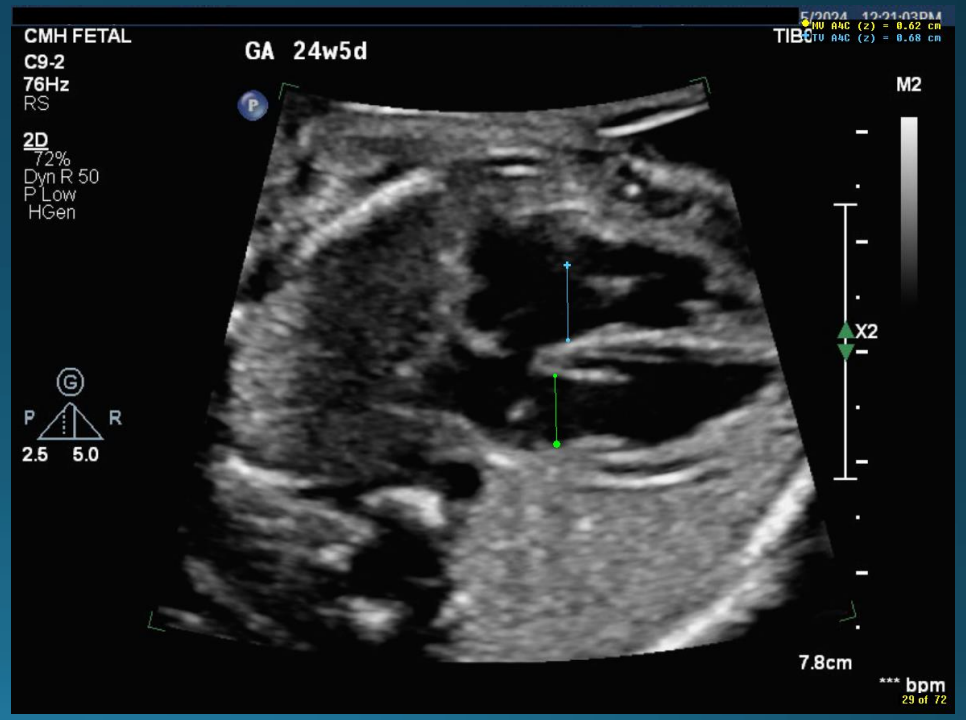

MM CORDES
73%
X2
9.6cm


GA 28w6d
C9-2
61Hz
RS
2D
72%
Dyn R 50
P Low
HGen
M2
P
R
2.5
5.0
X2
11cm
*** bpm

Tricuspid and mitral valve

Measurements

- Early diastole-valves are open at widest point
  - Hinge to hinge



Aortic and pulmonary valves

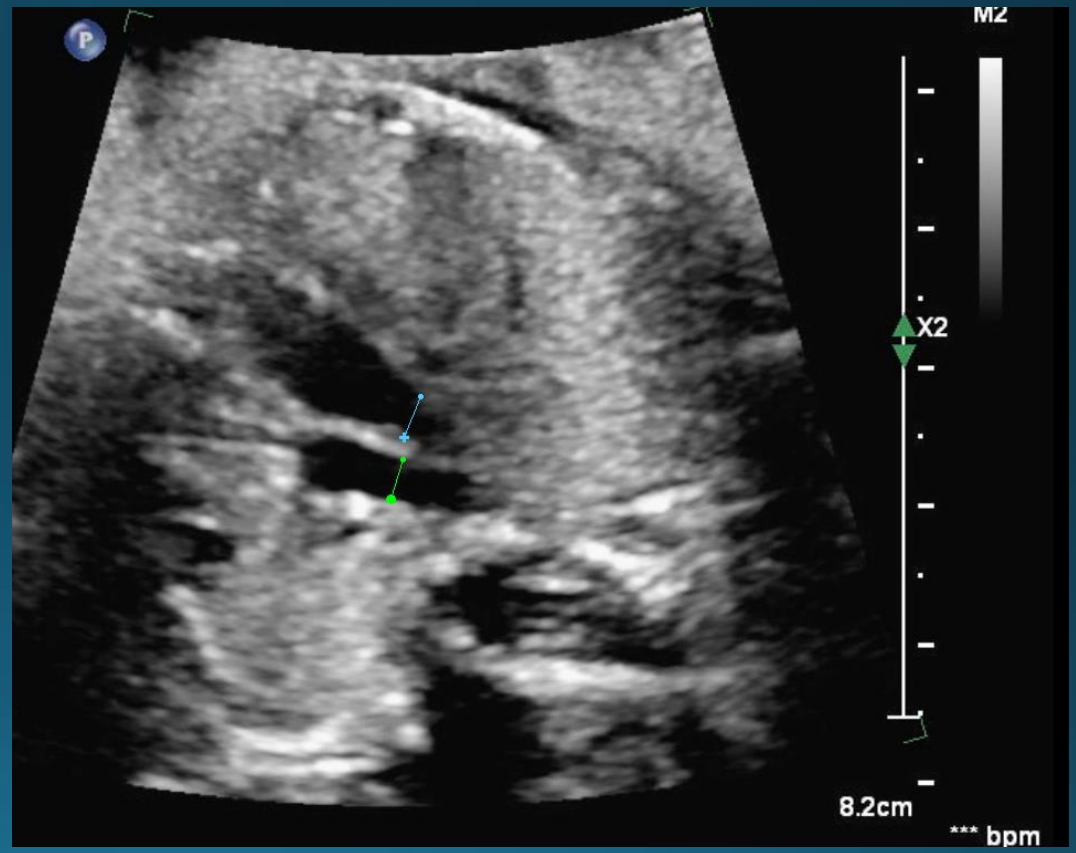
Measurements

- Semilunar valve (aortic and pulmonary annulus) measured at end-diastole/ early systole open or closed

- Main pulmonary artery diameter proximal to bifurcation in
- Branch pulmonary diameter(s) in systole

- Transverse aortic arch
- Aortic isthmus
- Can measure from long axis of the aortic arch and/or 3VT in systole

- Aortic isthmus



References

- Guidelines and Recommendations for Performance of the Fetal Echocardiogram: An Update from the American Society of Echocardiography