ISUOG Basic Training

Obtaining and Interpreting Heart Views Correctly

Learning Objectives

At the end of the lecture you will be able to:

- Describe how to assess cardiac situs
- Describe the key features of the 4 planes required to assess the fetal heart correctly
- Recognise the differences between the normal & most common abnormal cardiac ultrasound appearances of the 4 planes

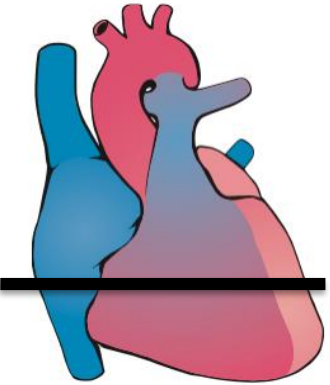
GUIDELINES

ISUOG Practice Guidelines (updated): sonographic screening examination of the fetal heart

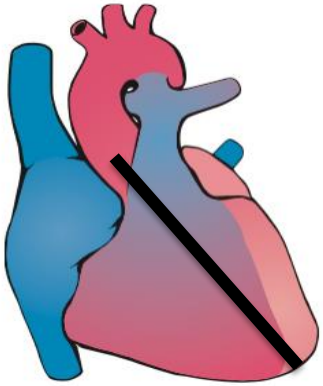
Ultrasound Obstet Gynecol 2013; 41: 348–359

Key Questions

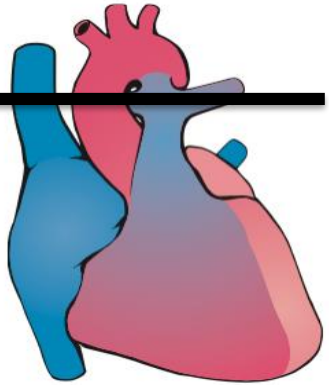
- What are the key ultrasound features of plane 7?
- What probe movements are required to move through the 4 cardiac planes correctly?
- What are the key ultrasound features of plane 10?
- Which abnormalities should be excluded after correct assessment of planes 7, 8, 9 &10?



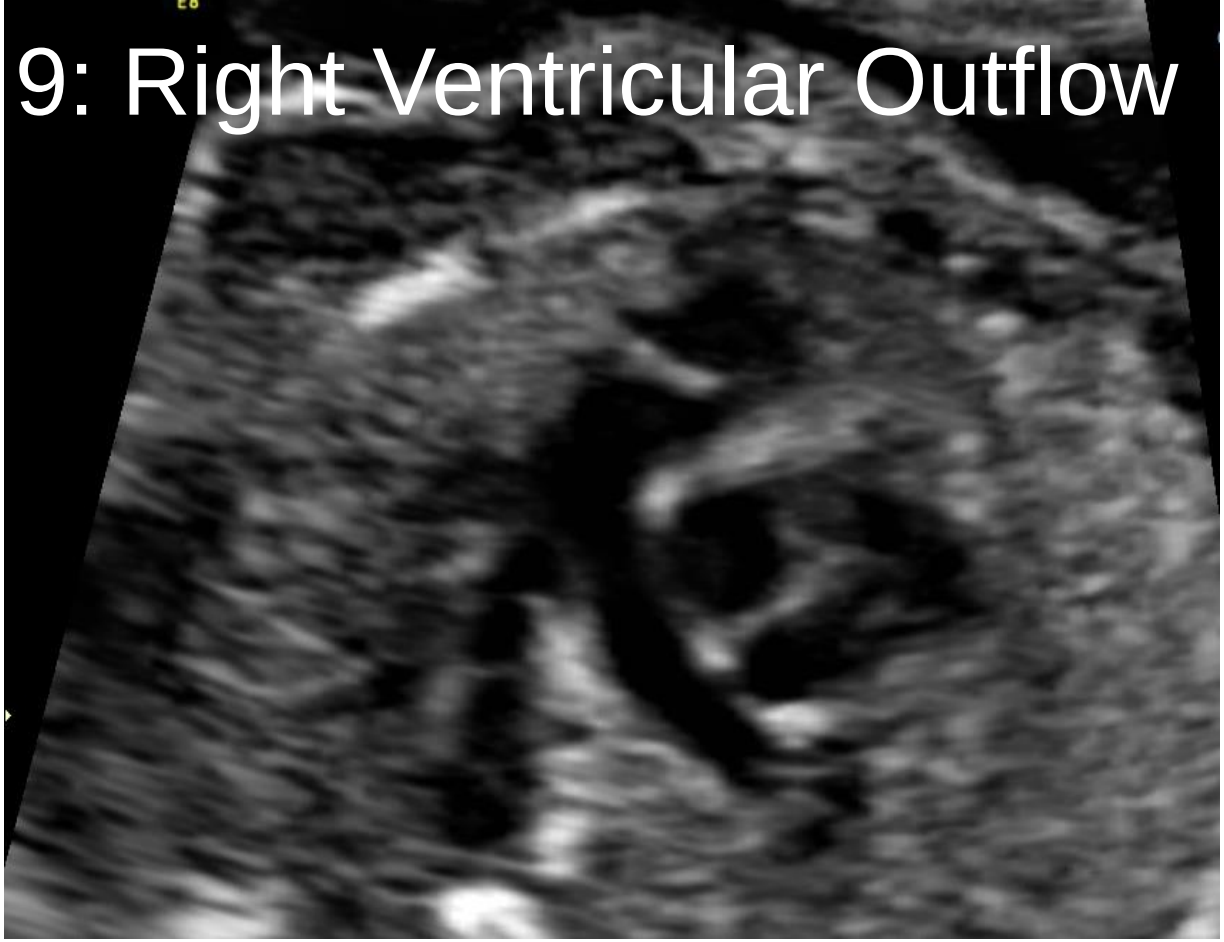
7: Four-Chamber View

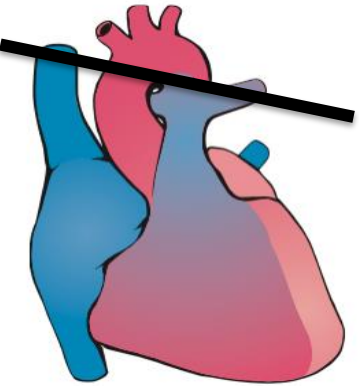


8: Left Ventricular Outflow



9: Right Ventricular Outflow



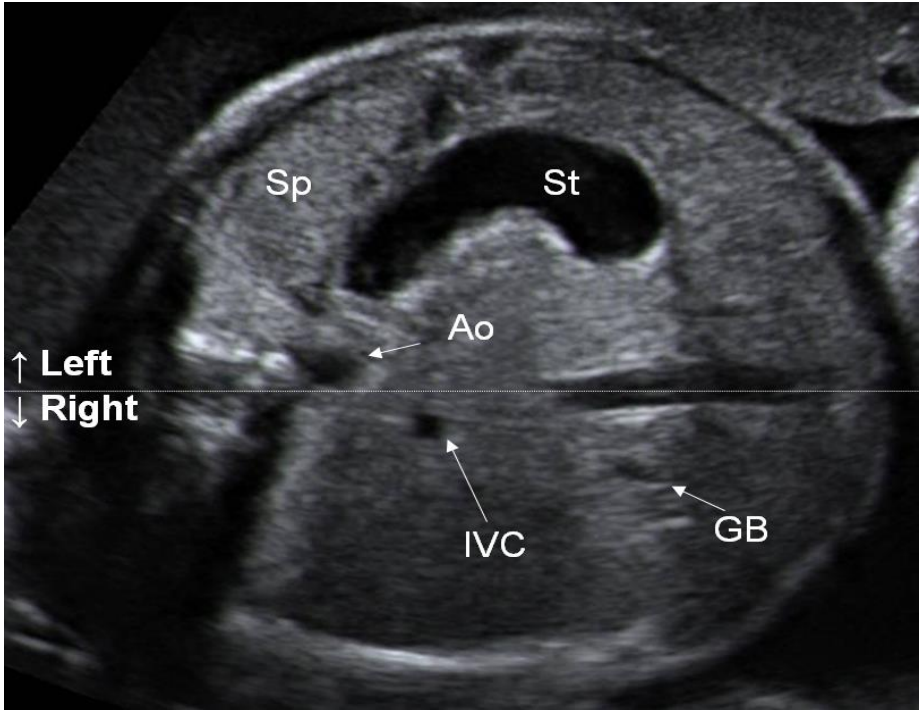


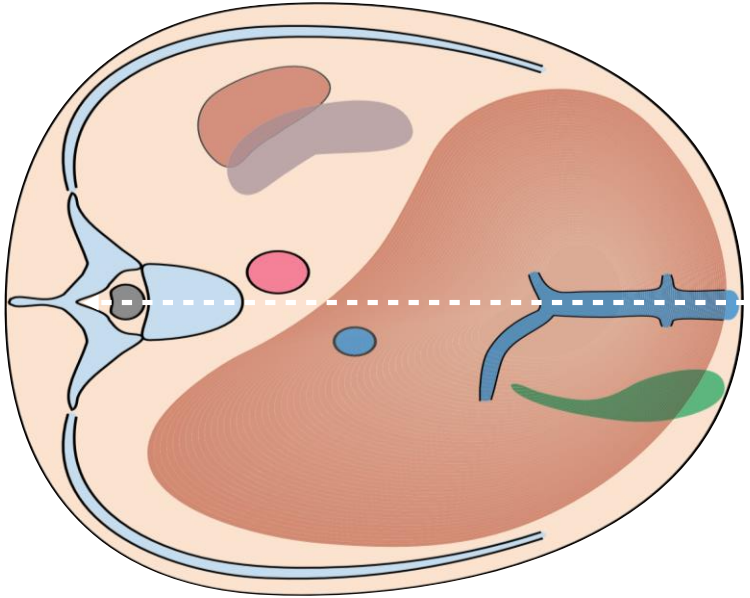
10: Three-Vessel-Trachea

7: Four-Chamber View

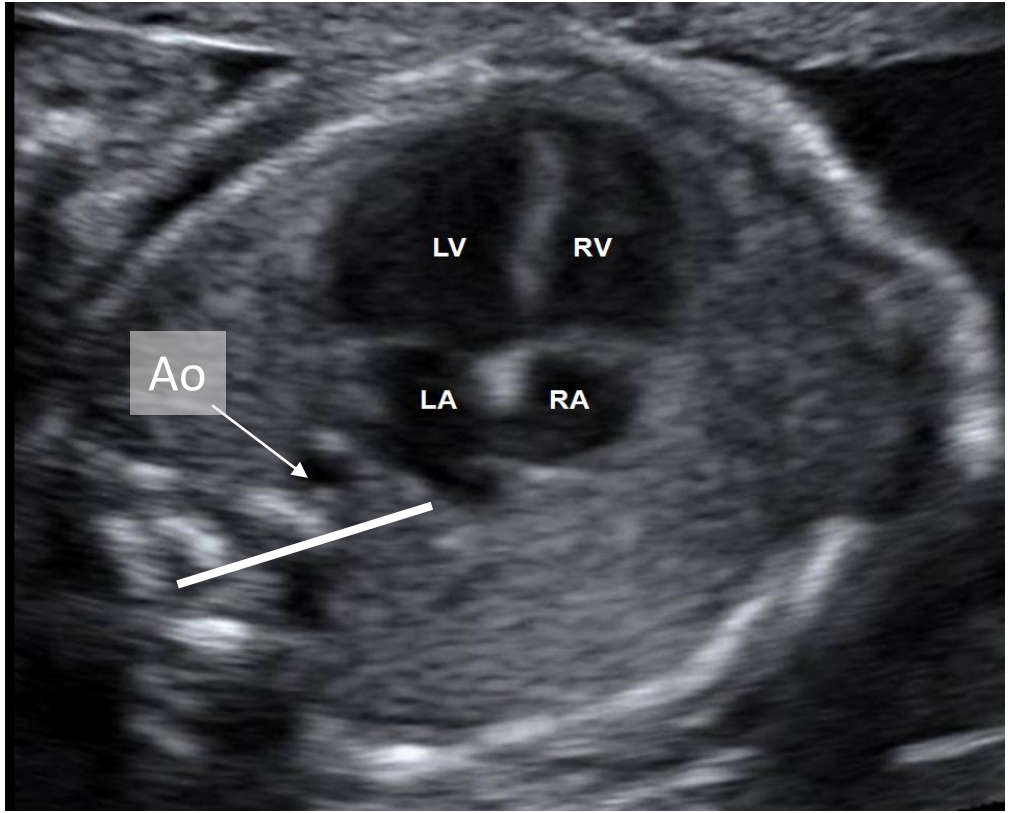
- Fetal laterality (identify right and left sides of fetus)
- Stomach and heart on left

Normal Situs – Abdominal Circumference





Normal Situs - Chest



Practical Guide To Fetal Echocardiography – Abuhamad, Chaoui – 2nd Edition

Types of Fetal Situs

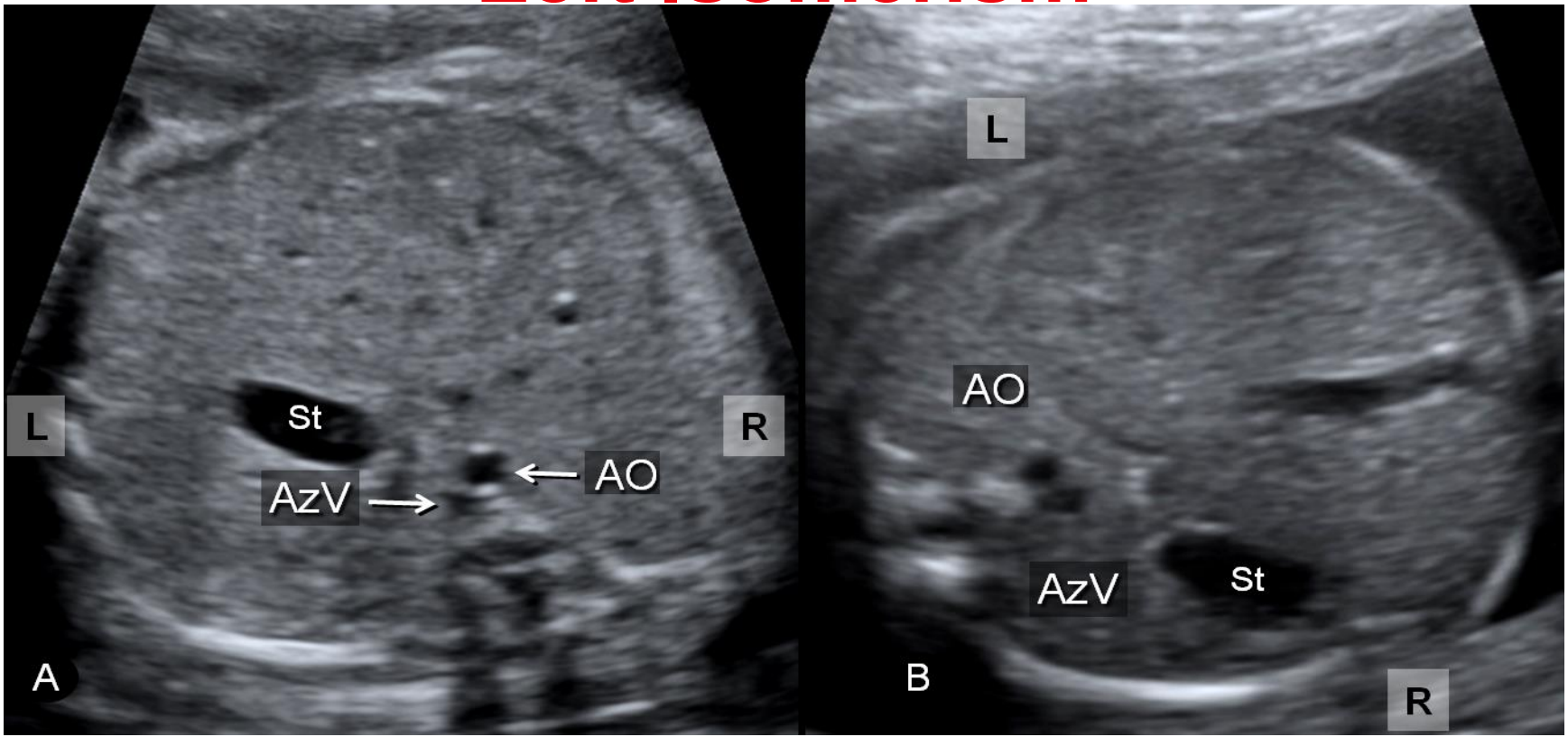
Situs	Findings	
	Right side	***Left side***
Solitus (normal)	Morphologic right atrium Major hepatic lobe Inferior vena cava Trilobed lung Short eparterial bronchus	Morphologic left atrium Stomach Descending aorta Bilobed lung Long hyparterial bronchus
Inversus	Morphologic left atrium Stomach Descending aorta Bilobed lung Long hyparterial bronchus	Morphologic right atrium Major hepatic lobe Inferior vena cava Trilobed lung Short eparterial bronchus
Ambiguous (heterotaxy)	Variable	Variable

Types of Fetal Situs

Situs	Incidence	CHD
Solitus	Common	Not Increased
Inversus*	1/100	Slightly Increased (0.3 – 5%)
Ambiguous	1/10,000	Increased

*: Kartagener syndrome in 20%

Left Isomerism



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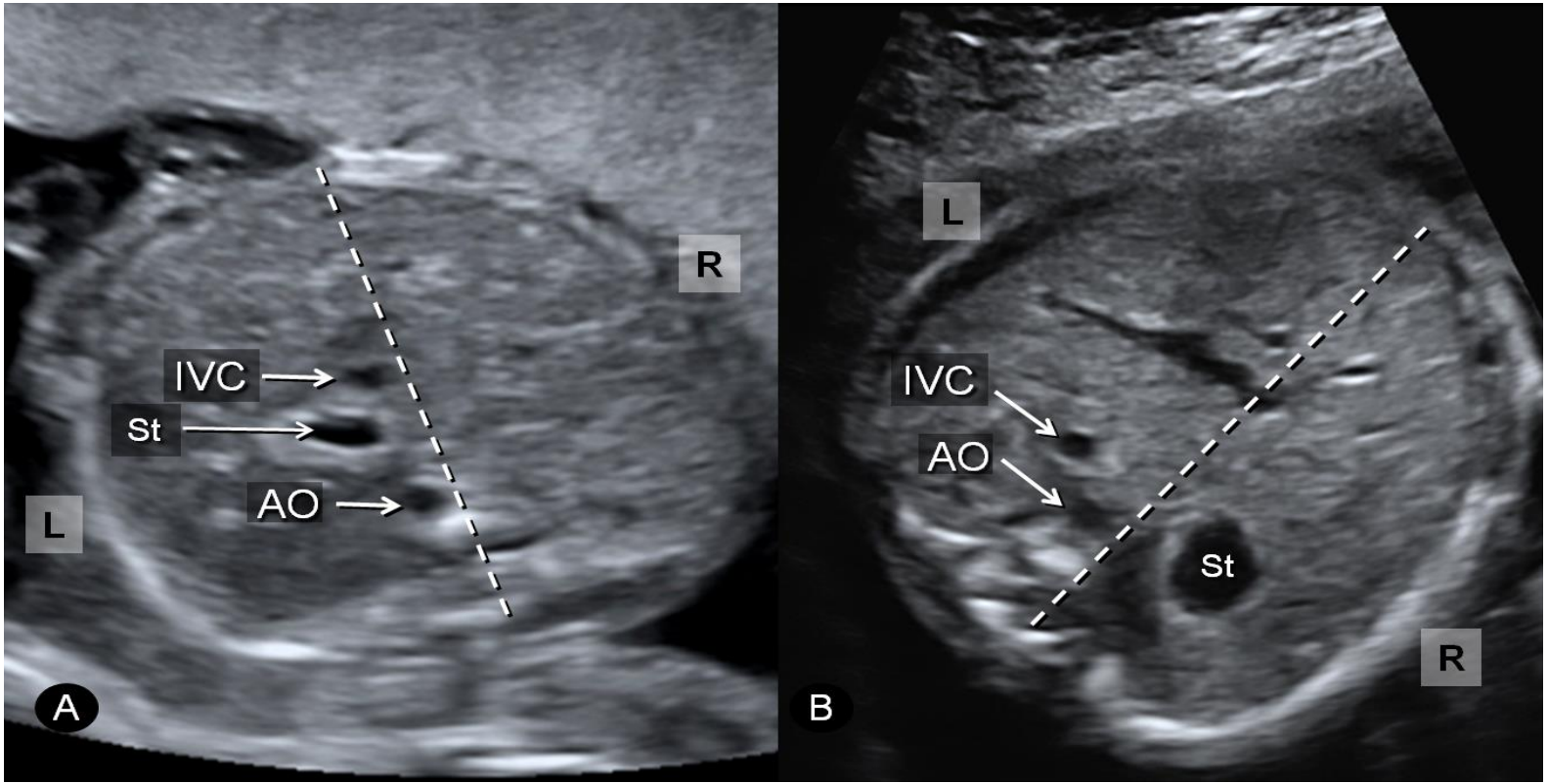
Right Isomerism



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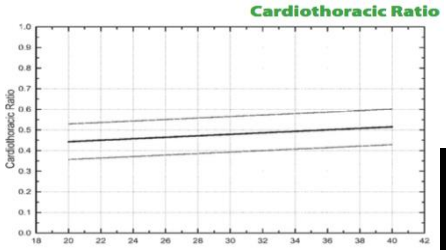
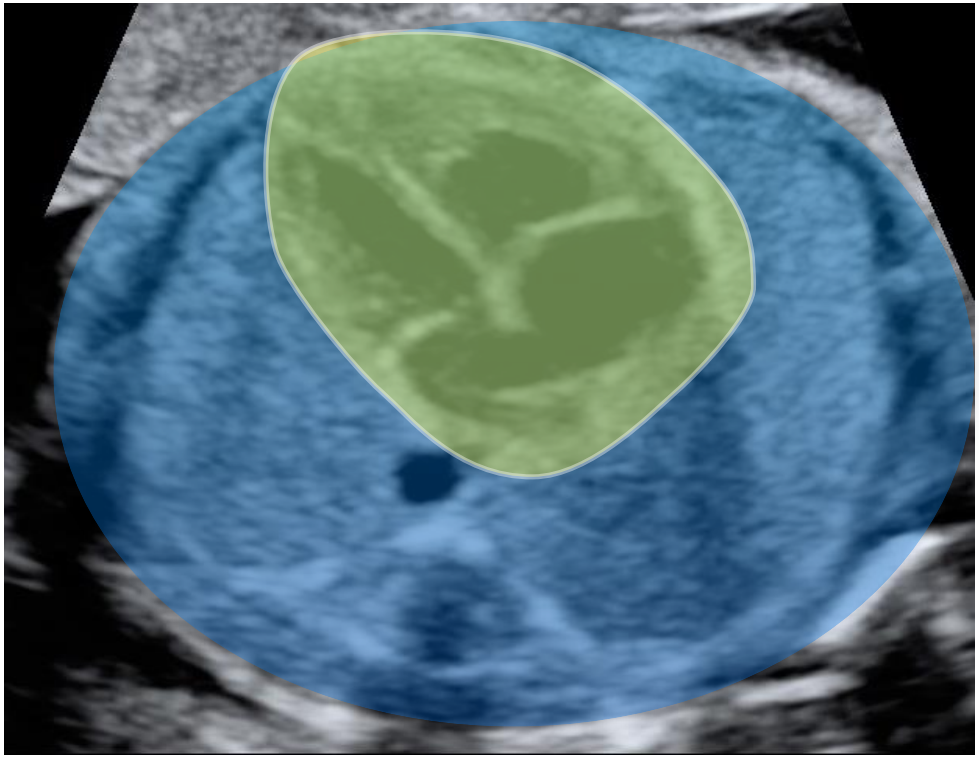
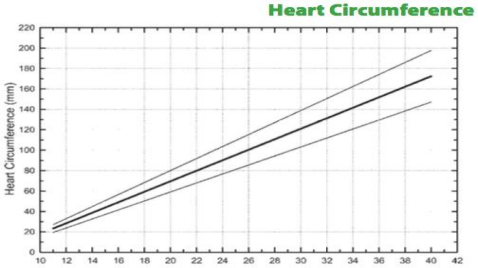
7: Four-Chamber View

- Fetal laterality (identify right and left sides of fetus)
- Stomach and heart on left
- Heart occupies a third of thoracic area
- Majority of heart in left chest

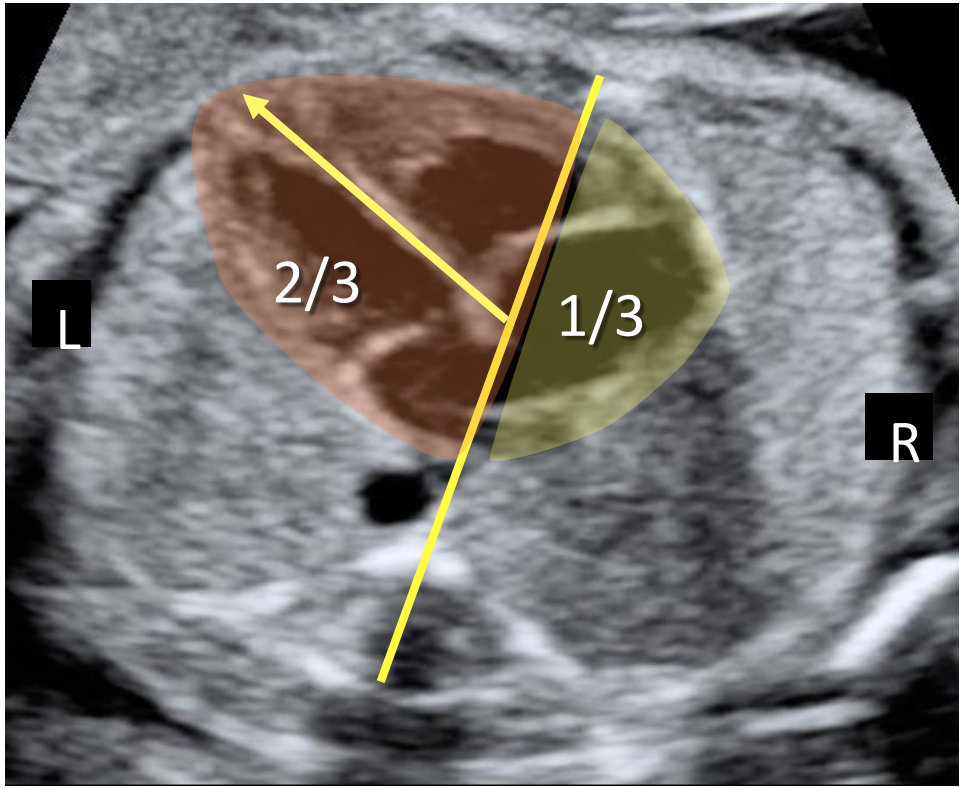
Heart Size


Cardiothoracic Ratio
Cardiothoracic Ratio

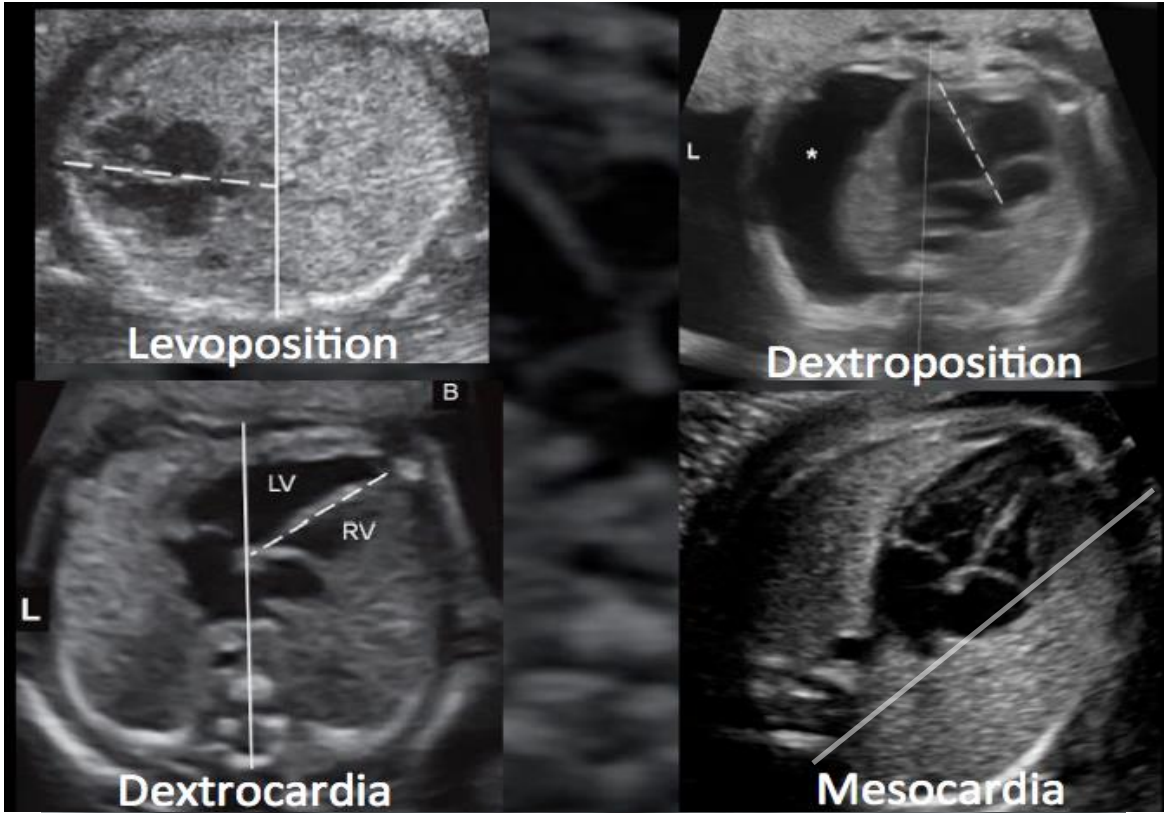



Heart Circumference
Heart Circumference (mm)

Cardiac Position



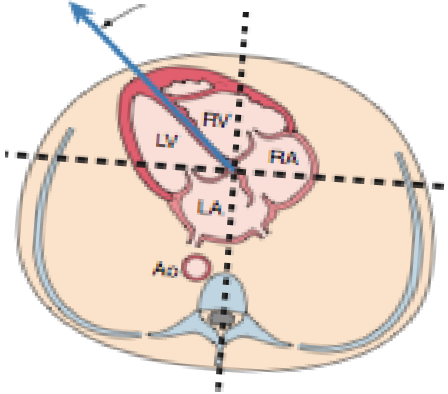
Cardiac Position

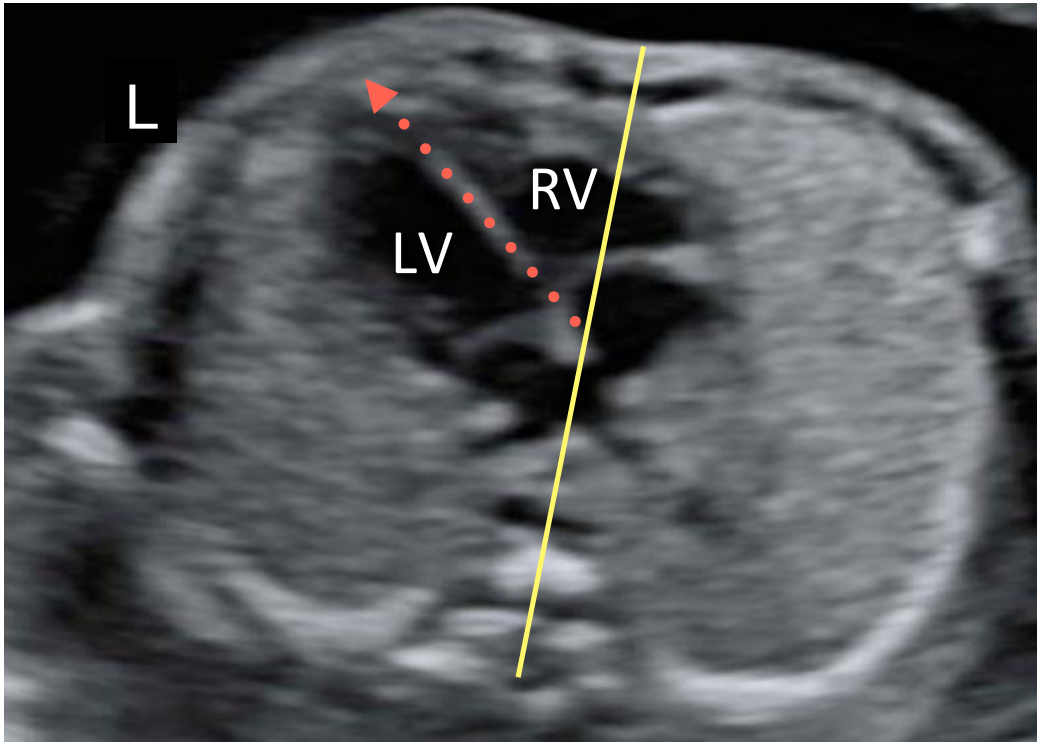


7: Four-Chamber View

- Fetal laterality (identify right and left sides of fetus)
- Stomach and heart on left
- Heart occupies a third of thoracic area
- Majority of heart in left chest
- Cardiac axis (apex) points to left by 45◦ ± 20◦

Cardiac Axis

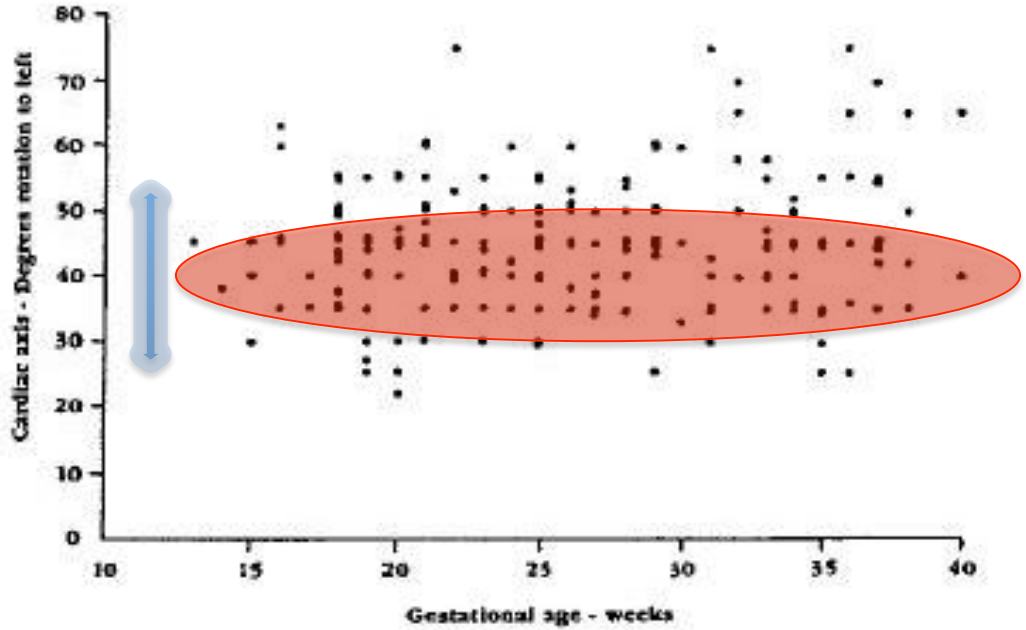




Cardiac Axis

Data From Normal Fetuses (n=183)

- Axis at around 45%
- Range of normal +/- 20 degrees
- No change with gestation

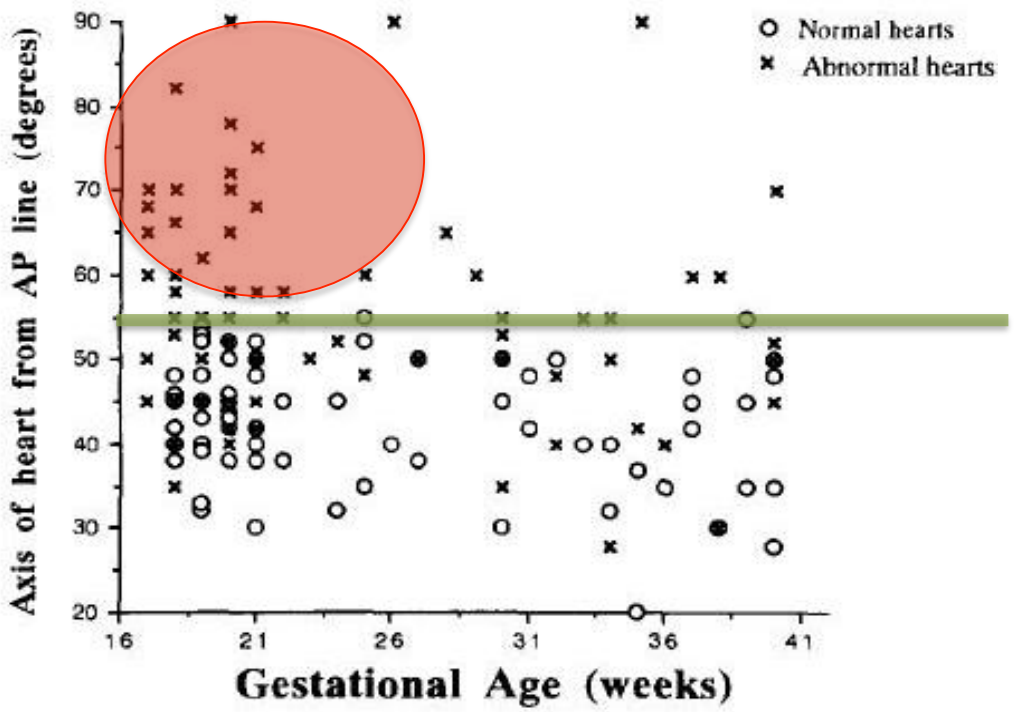


Obstet. Gynecol. 1987;70:1987

Abnormal Cardiac Axis

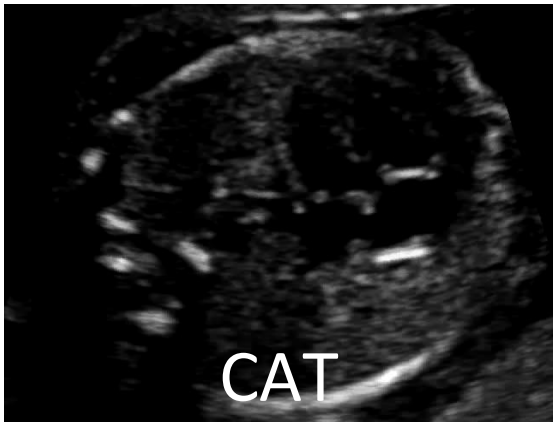
Left Axis Deviation

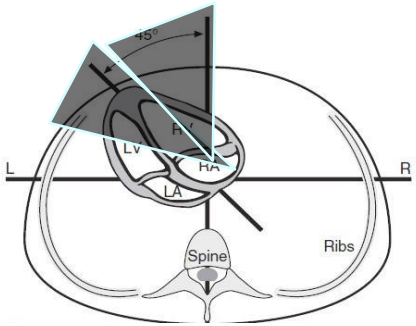
- Most abnormal cardiac axis are left axis deviations
- Most are diagnosed in second trimester

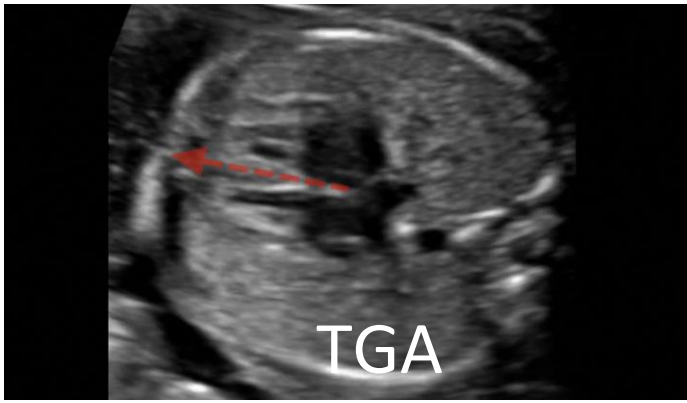


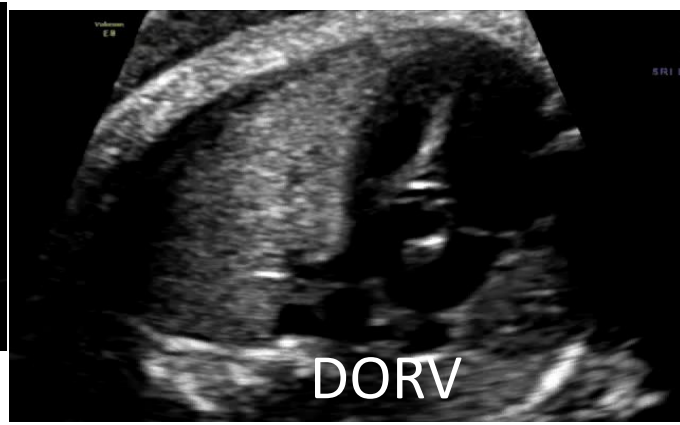
Obstet. Gynecol. 1995;85:97

Cardiac Axis









7: Four-Chamber View

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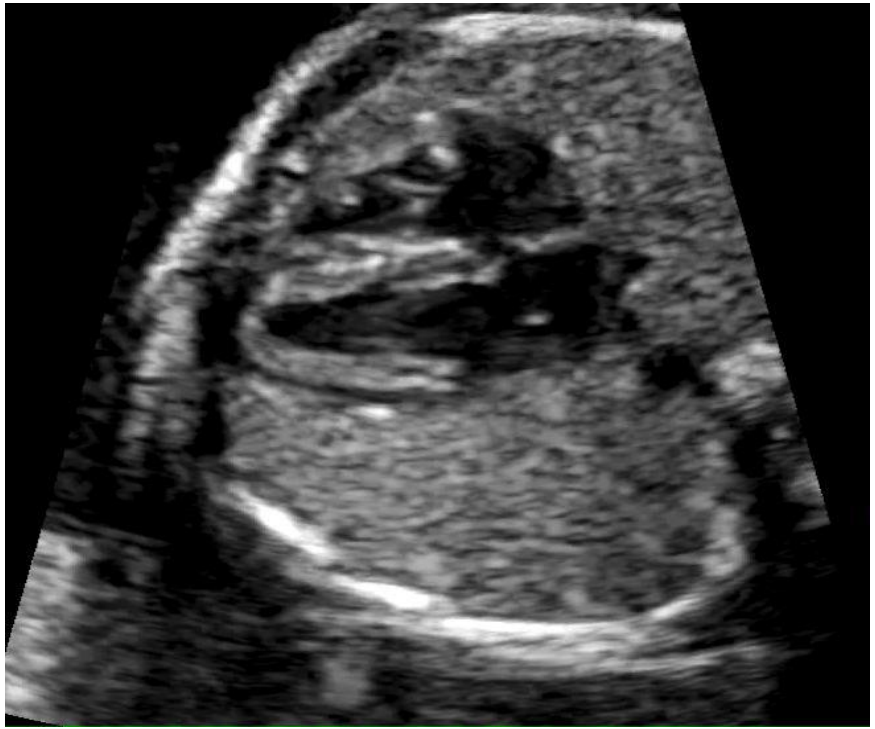
- Stomach and heart on left
- Heart occupies a third of thoracic area
- Majority of heart in left chest
- Cardiac axis (apex) points to left by 45◦ ± 20◦
- Four chambers present

Four-Chamber View

Apical

Four-Chamber View



Axial

Four-Chamber View

Basal

Atrial Chambers

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

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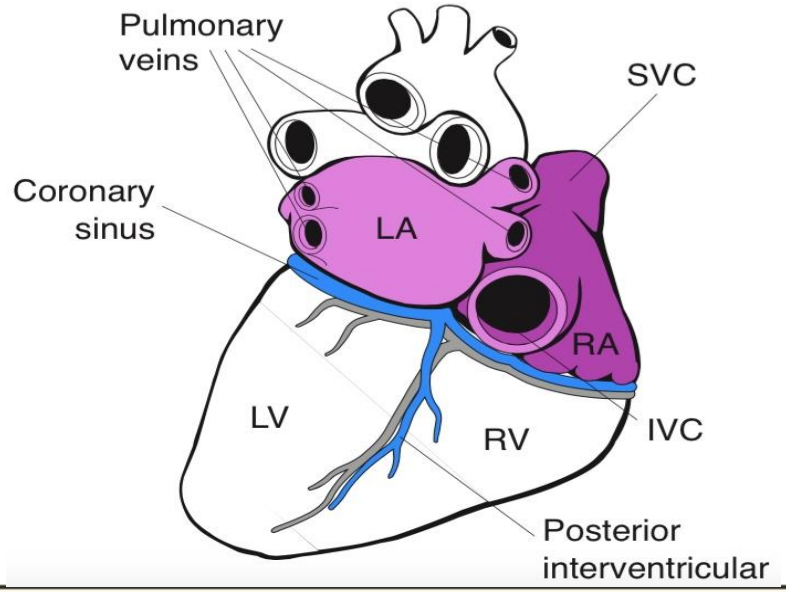
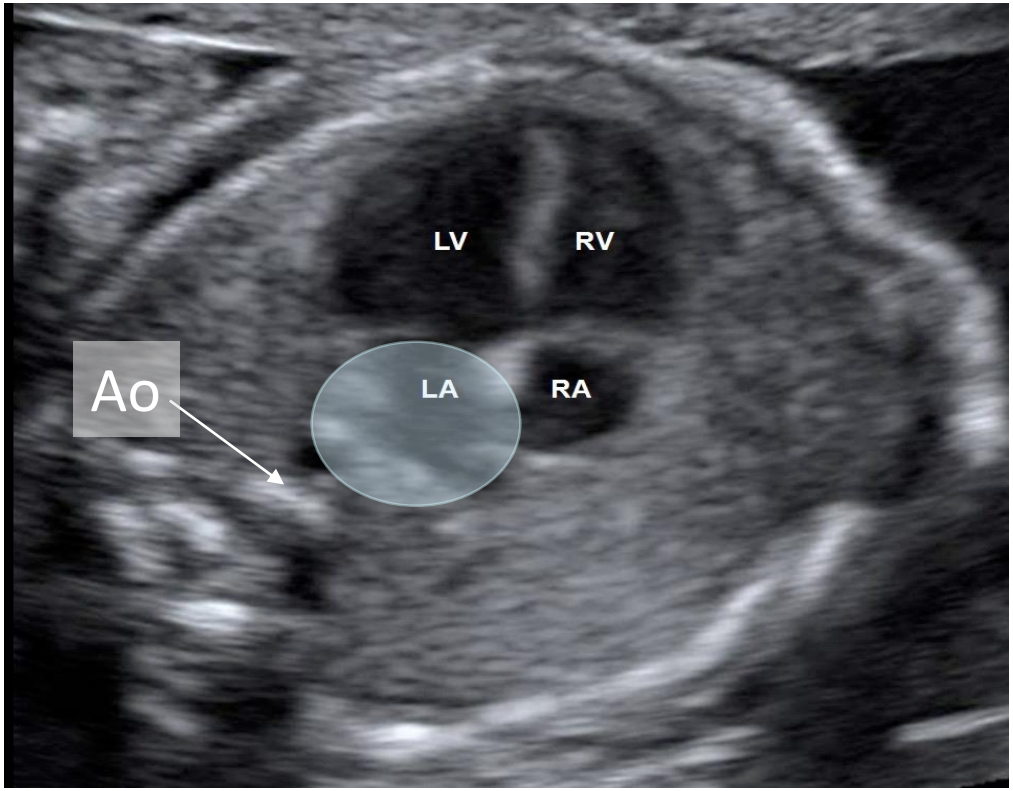
Left Atrium



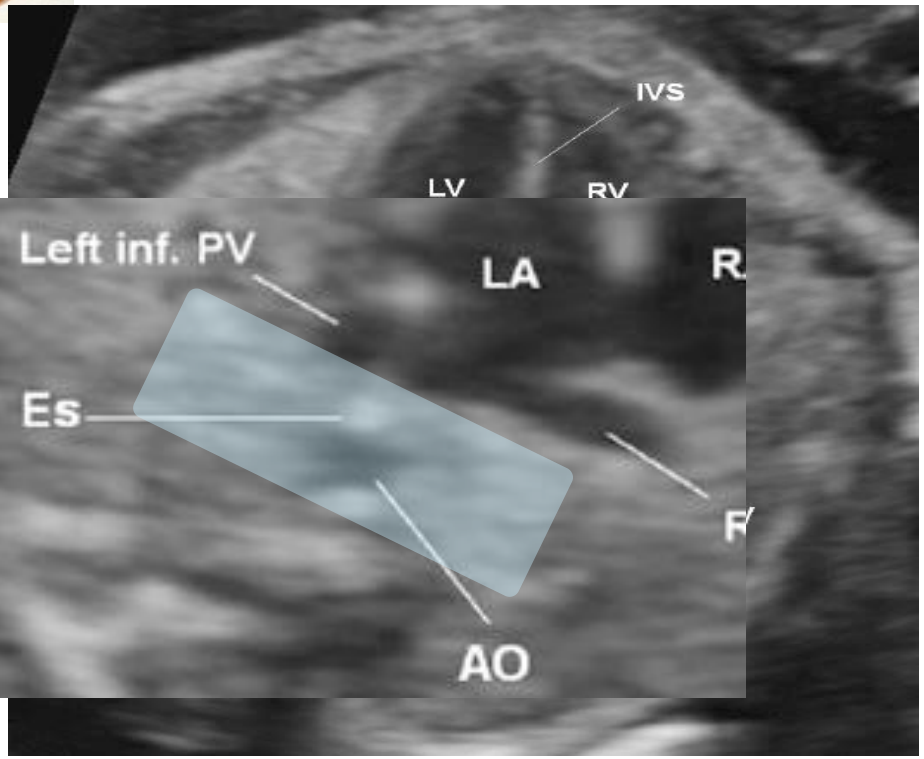
Posteriorly located, over the spine
Anterior and posterior portion is smooth
Receives four pulmonary veins
Left atrial appendage is narrow, fingerlike with coarse walls

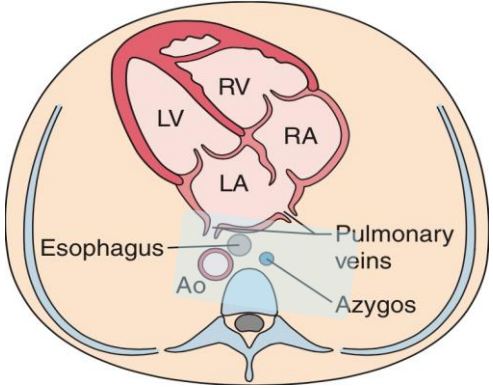
Left Atrium



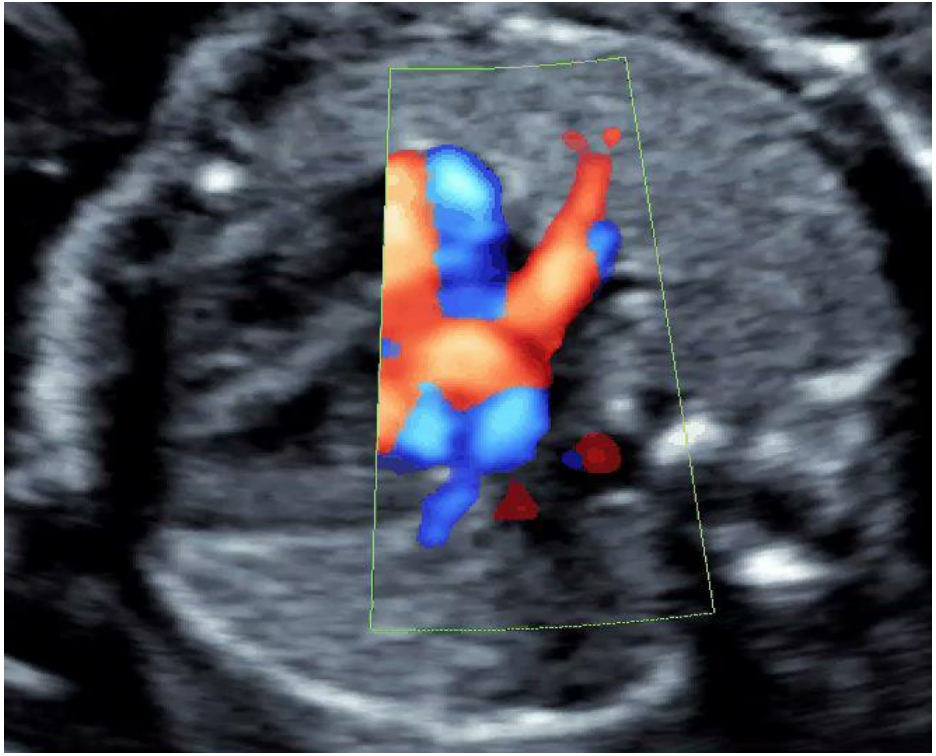

7

Left Atrium


IVS
LV
RV
Left inf. PV
LA
Es
AO


RV
LV
RA
LA
Esophagus
Pulmonary veins
Ao
Azygos

Pulmonary Veins

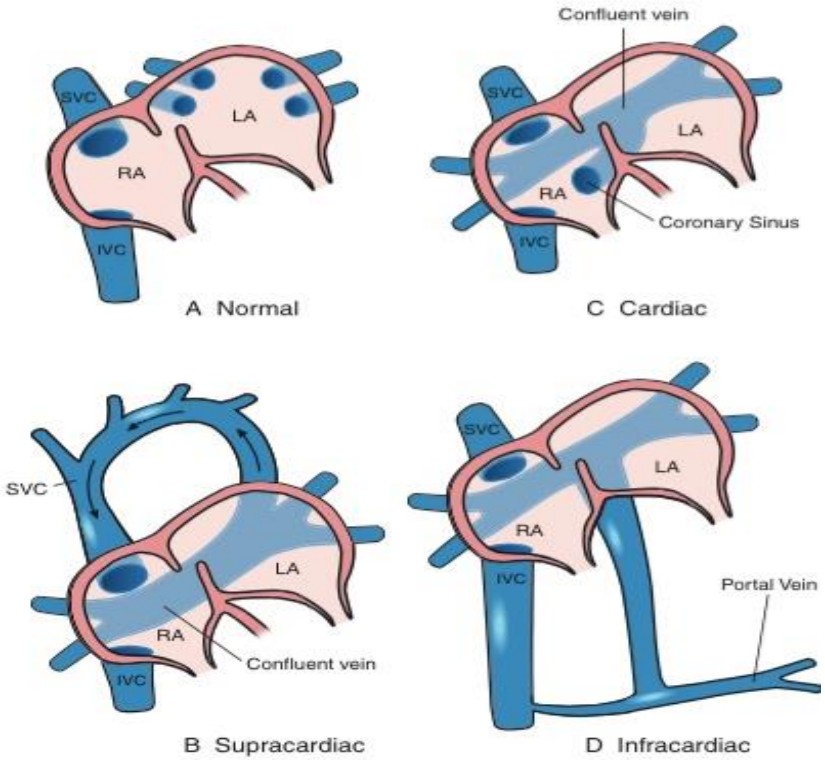


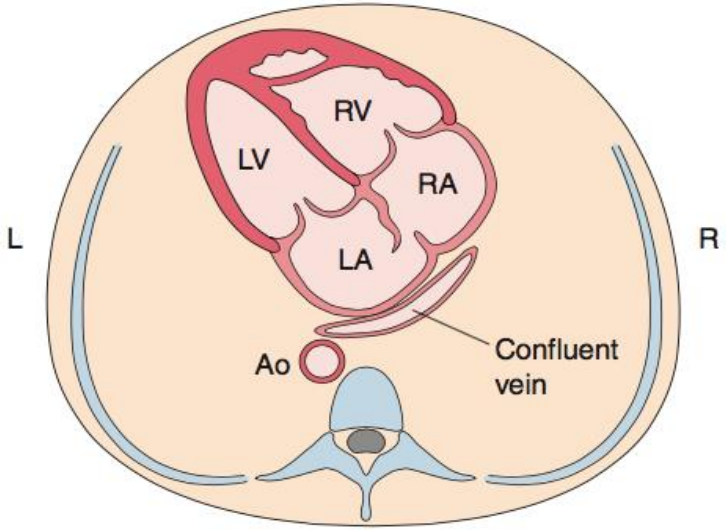
Left Atrium

Closed Esophagus

Open Esophagus

Left Atrium





TAPVR

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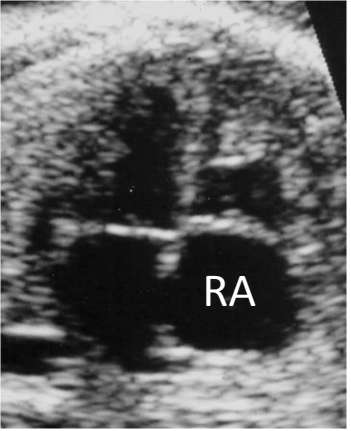
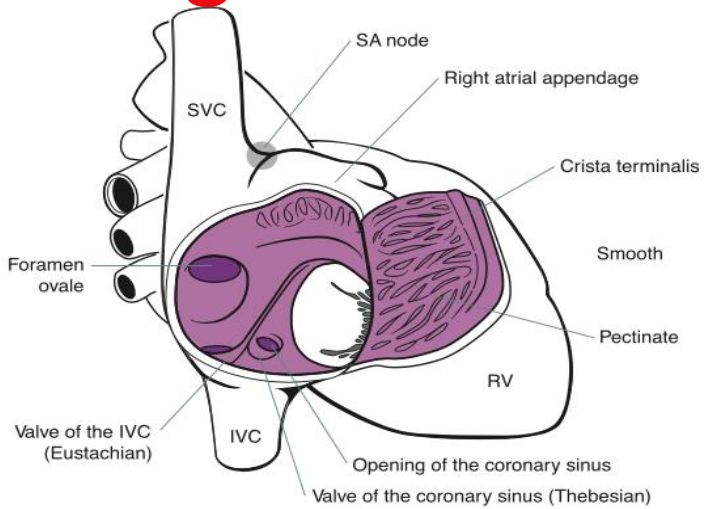
Right Atrium





Anteriorly located, to the right of the left atrium
Posterior portion is smooth; anterior portion is trabeculated
Receives the inferior vena cava, superior vena cava, and coronary sinus
Contains the sinoatrial and atrioventricular nodes
Right atrial appendage is pyramidal in shape with broad base

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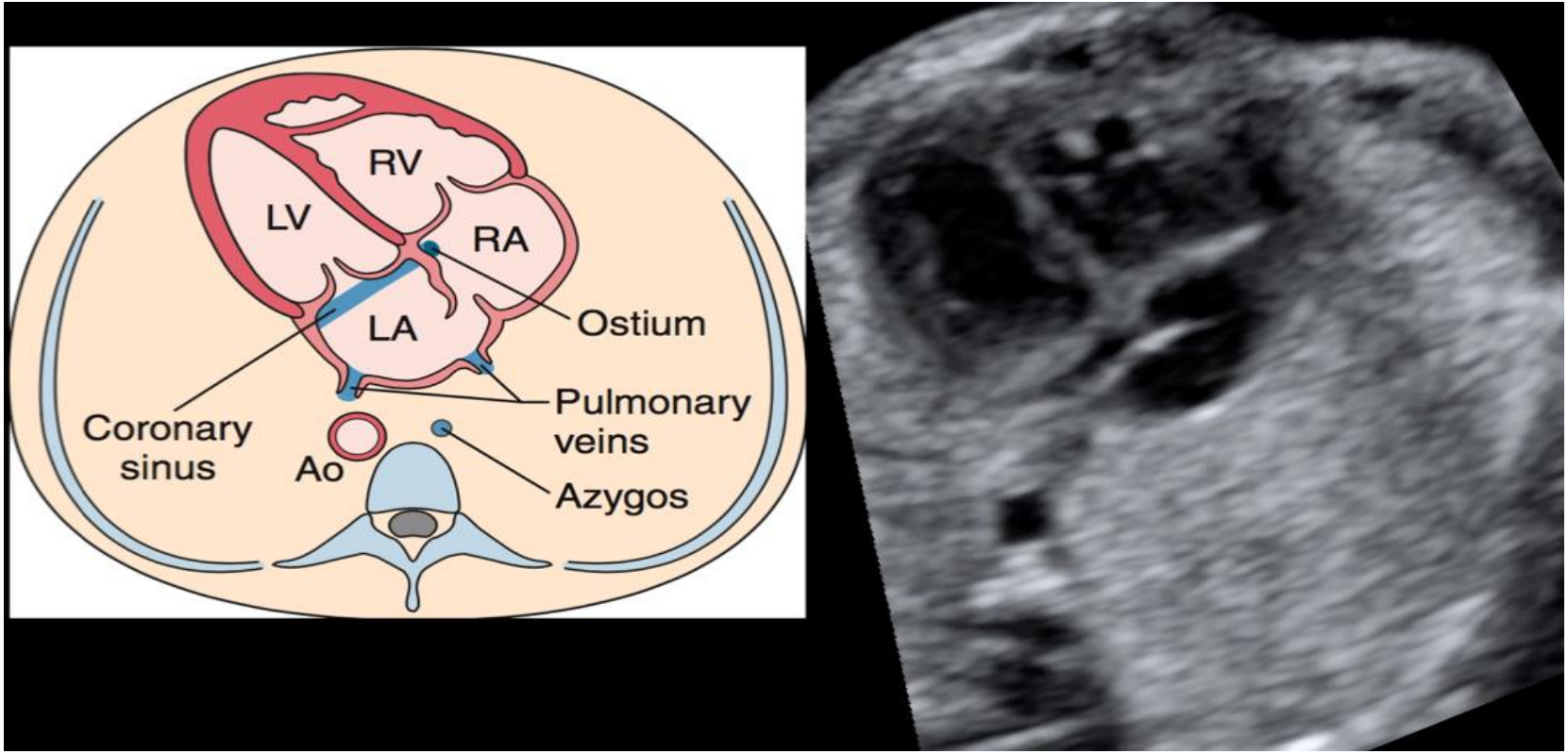
Right Atrium



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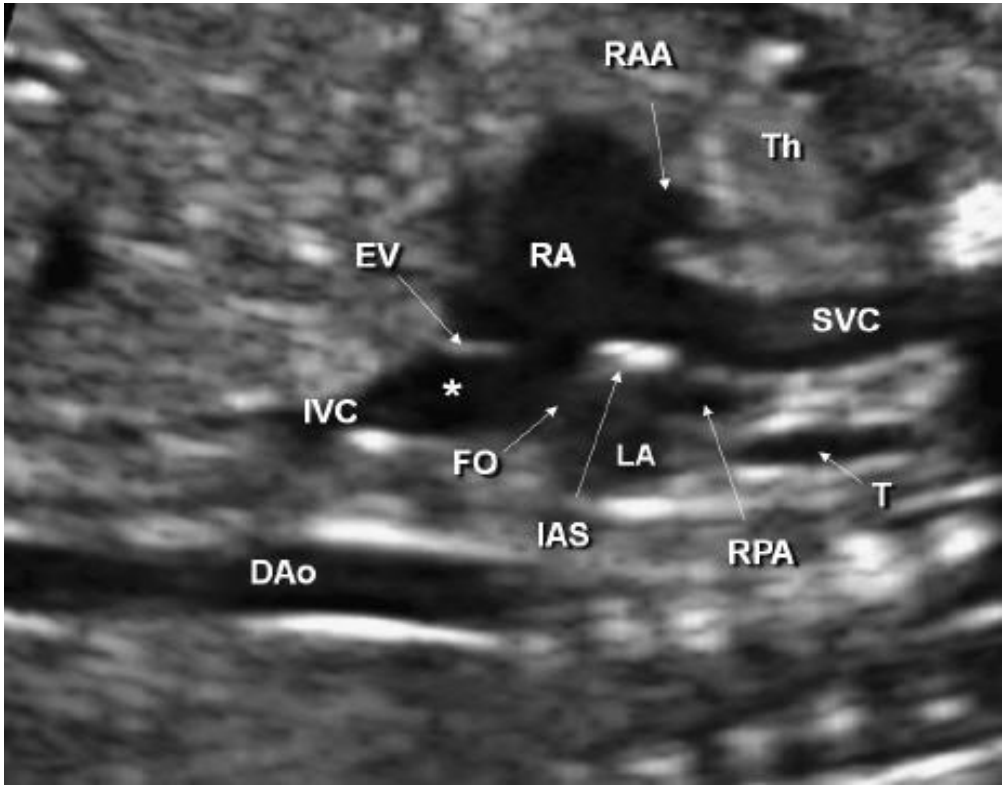
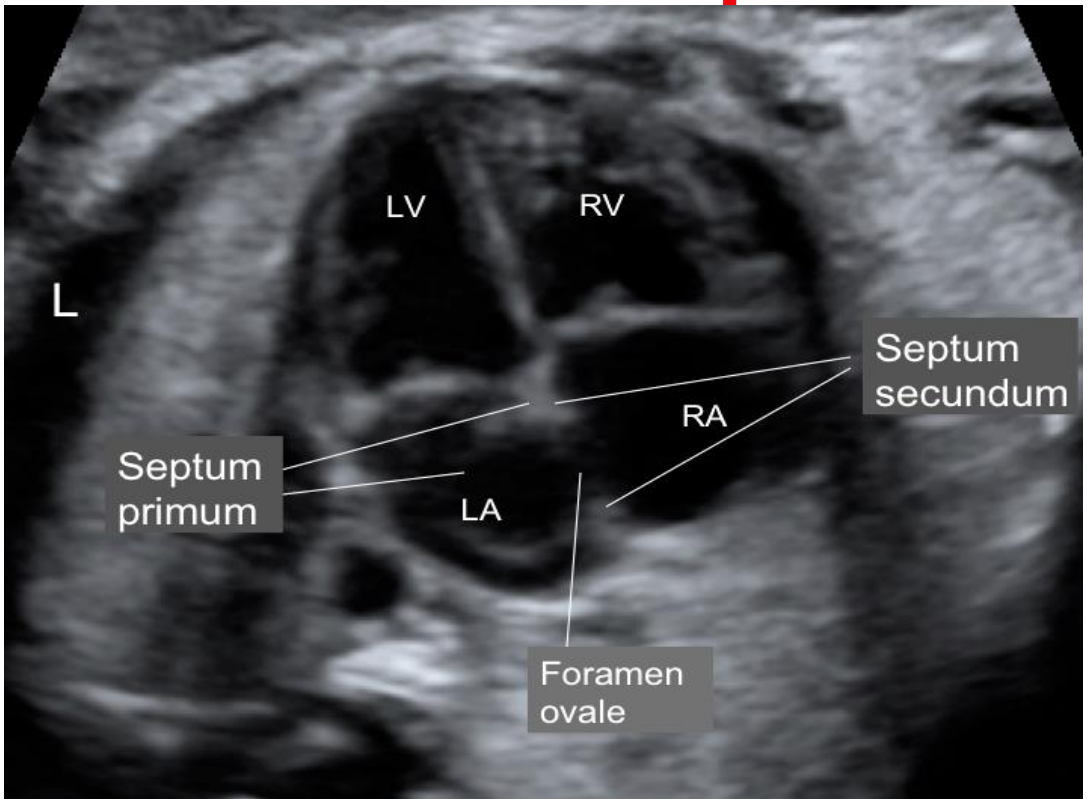
Right Atrium



Interatrial Septum

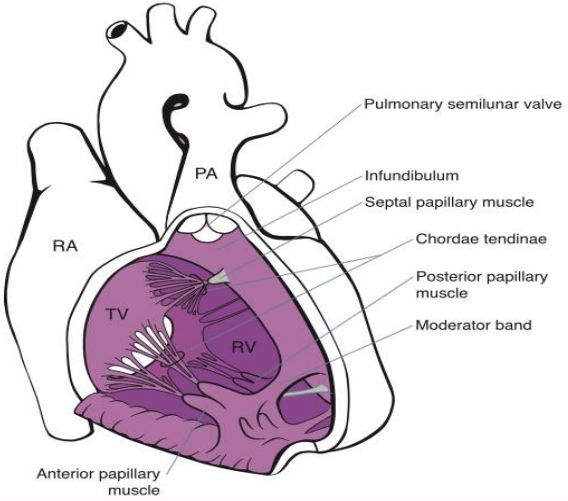


Ventricular Chambers

- Two ventricles, approximately equal in size
- No ventricular wall hypertrophy
- Moderator band at right ventricular apex
- Ventricular septum intact (apex to crux)

Ultrasound Obstet Gynecol 2013; 41: 348–359

Right Ventricle



Inlet and apical regions are heavily trabeculated
Crescent shaped, most anterior chamber, located below sternum
Outlet (infundibulum) is smooth
Moderator band located in apical region
Tricuspid atrioventricular valve
Tricuspid valve is more apically inserted on the septum than the mitral valve
Ventricular wall receives direct chordae tendineae insertions
Three papillary muscles

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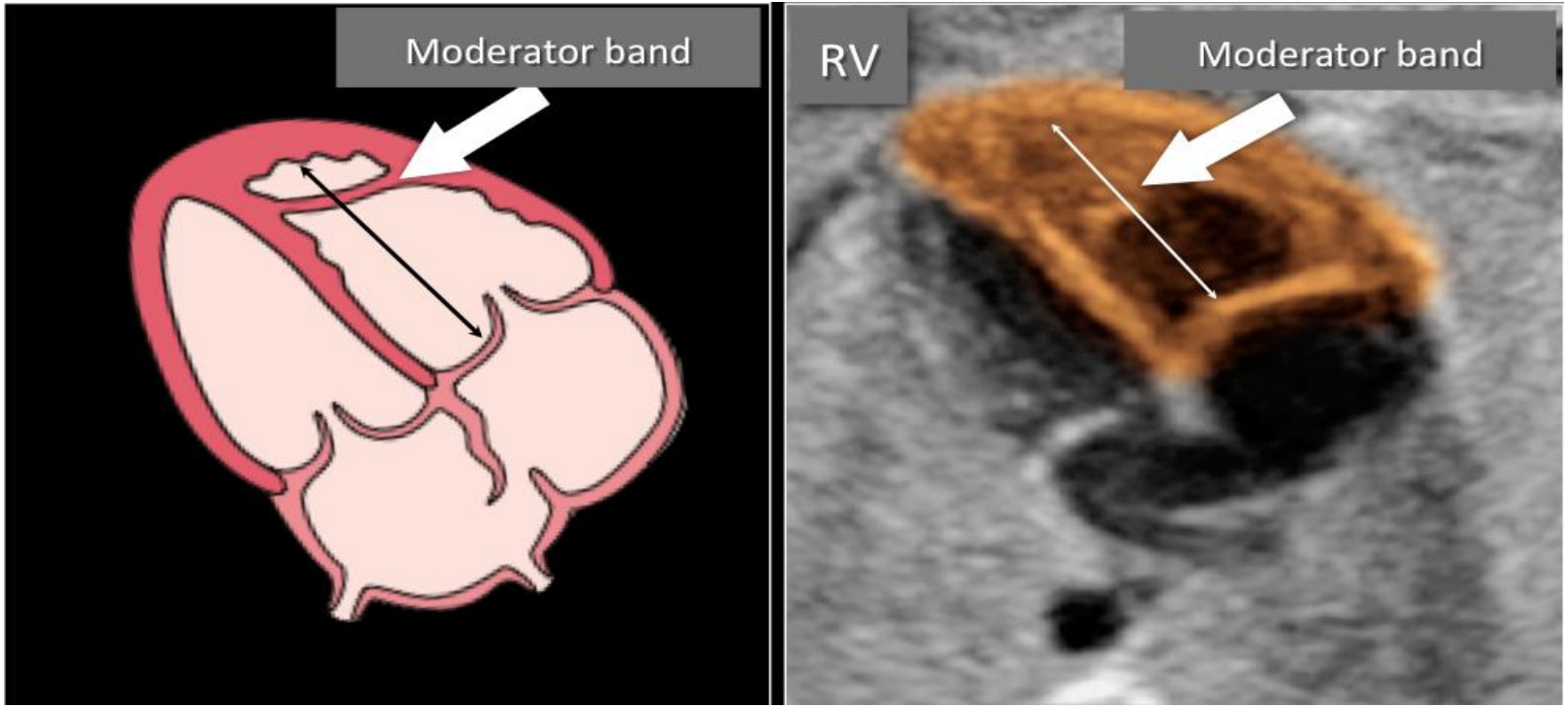
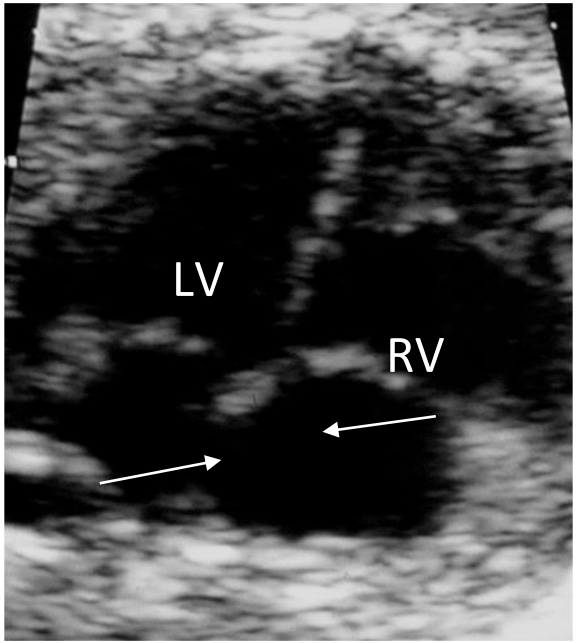
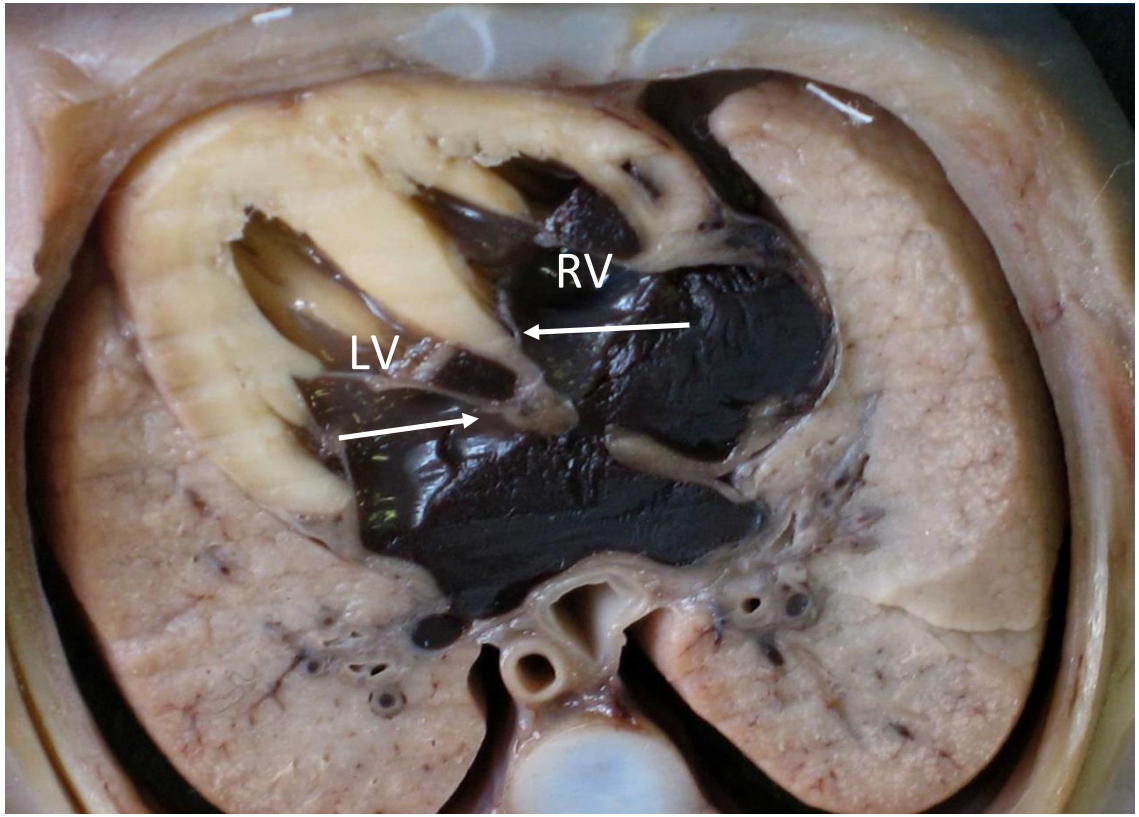
Right Ventricle

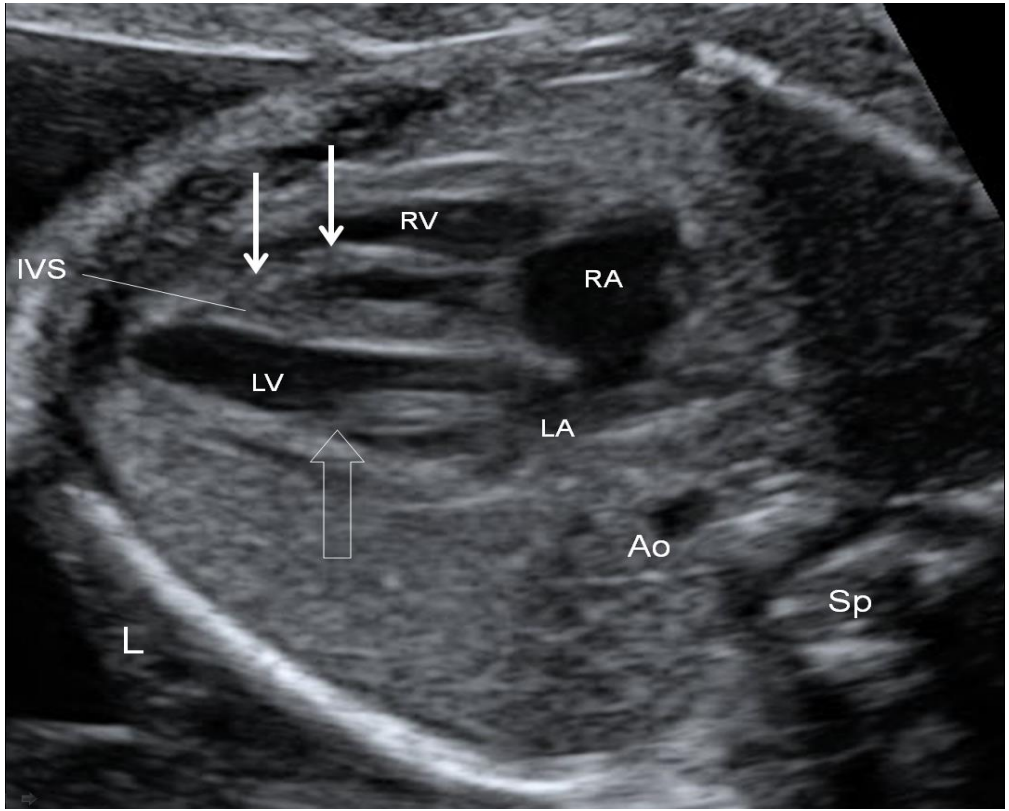


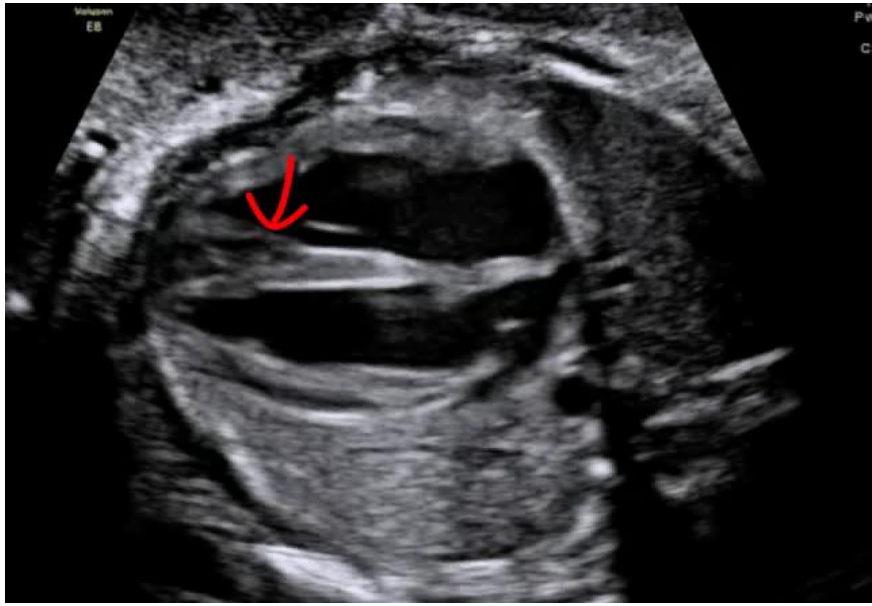
Right Ventricle



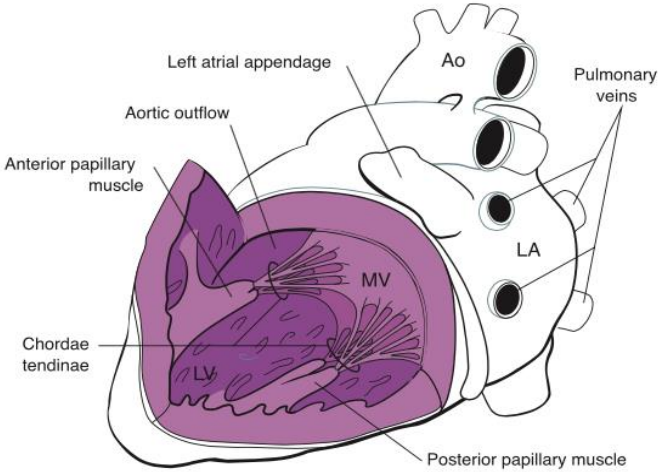


Right Ventricle





Left Ventricle



Conical in shape, posterolateral location with a smooth inlet
Bicuspid atrioventricular valve (mitral)
Close anatomic relationship of inlet and outlet (mitral and aortic valves)
Two prominent papillary muscles that insert into the free ventricular wall
No moderator band
Ventricular wall receives no direct chordae tendineae insertions

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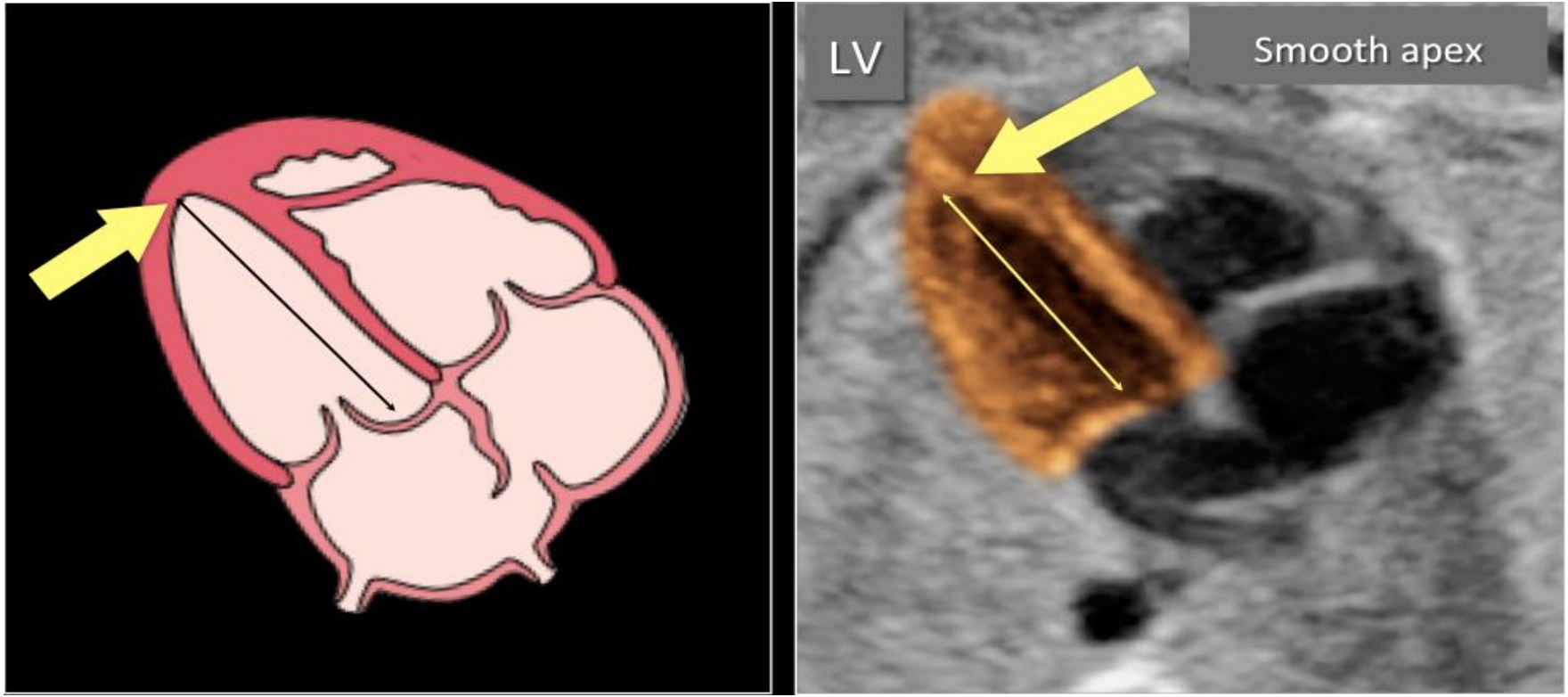
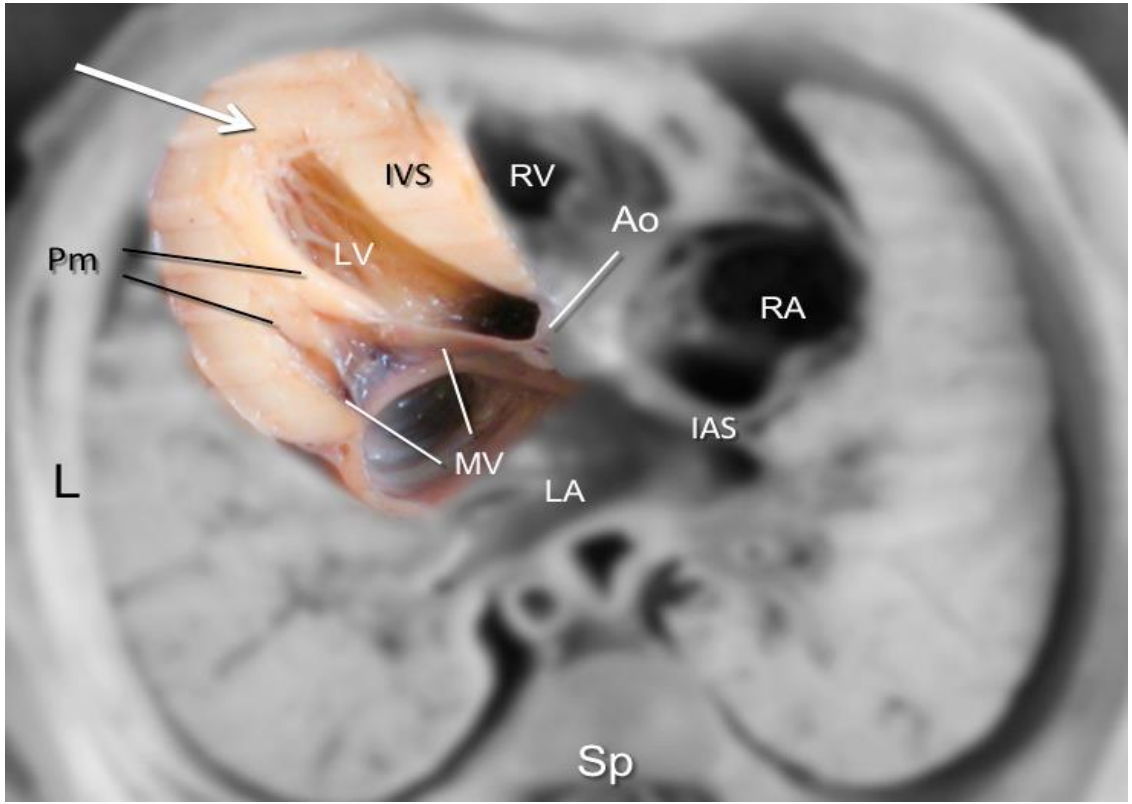
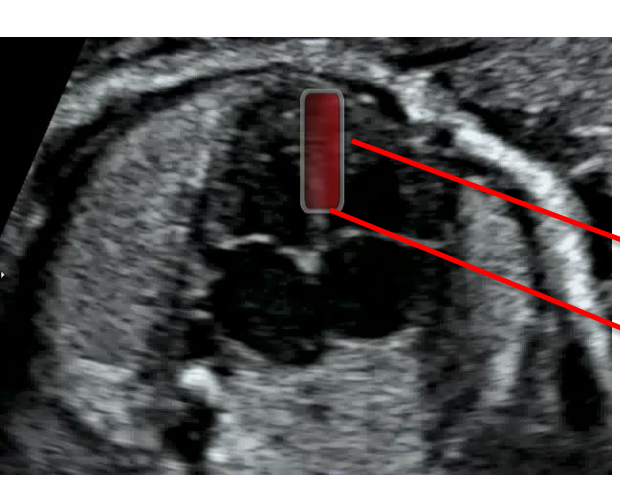
Left Ventricle

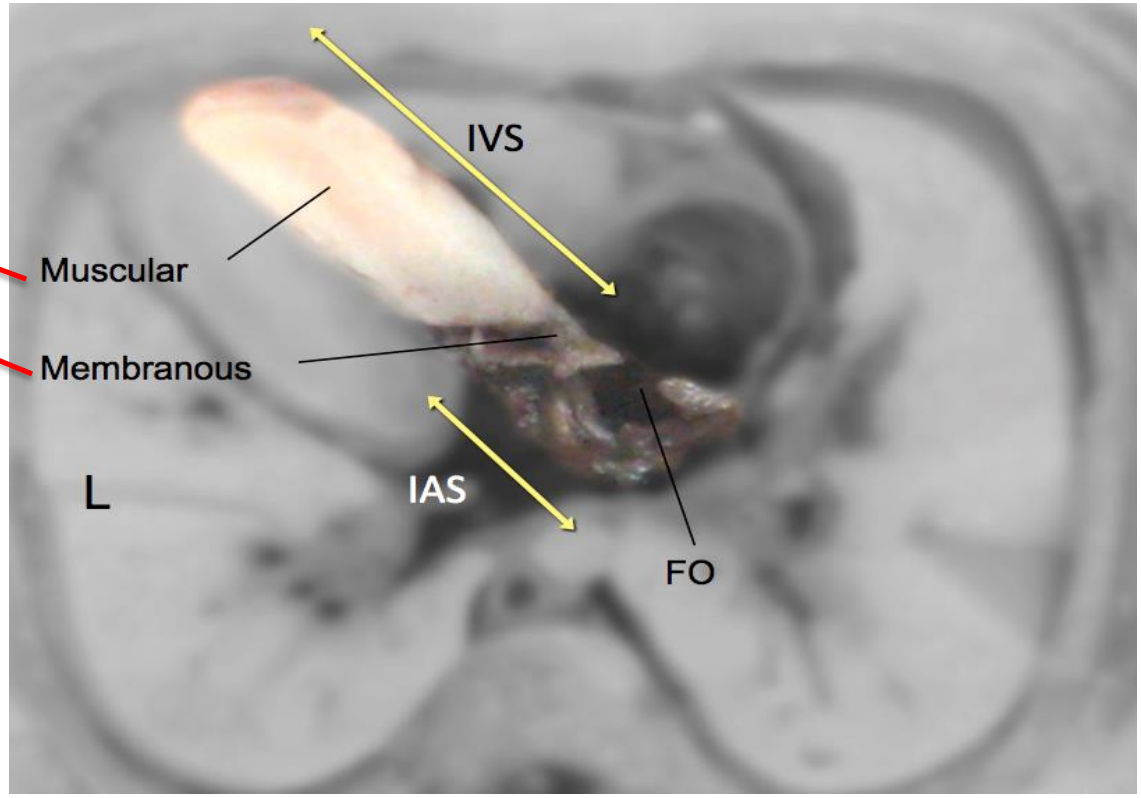


Left Ventricle

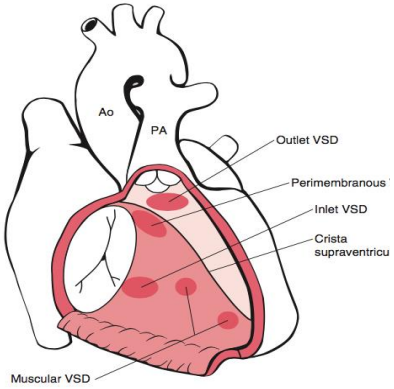


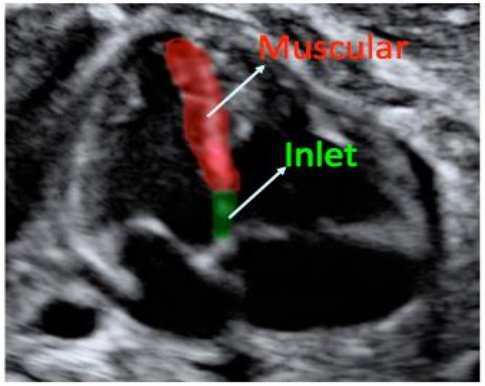
Ventricular Septum

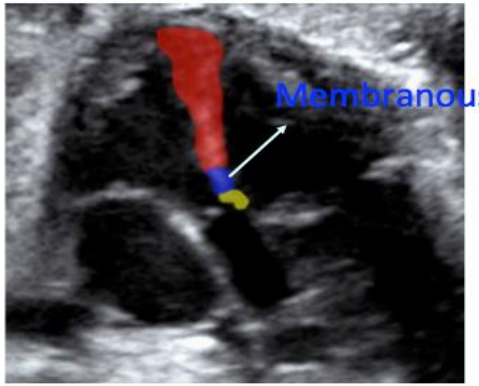


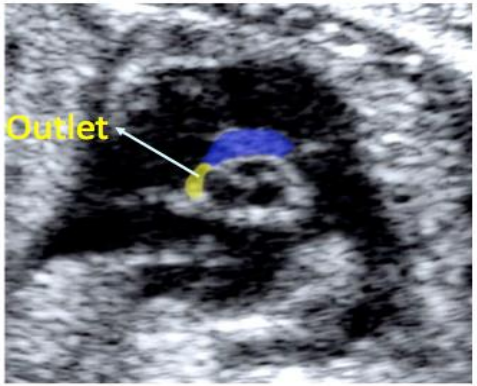


Ventricular Septum

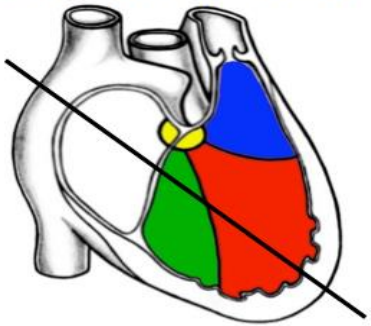




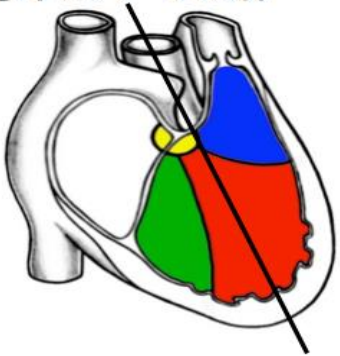




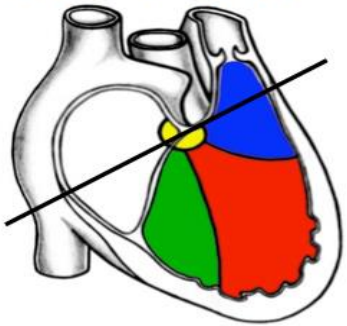
4-chamber view



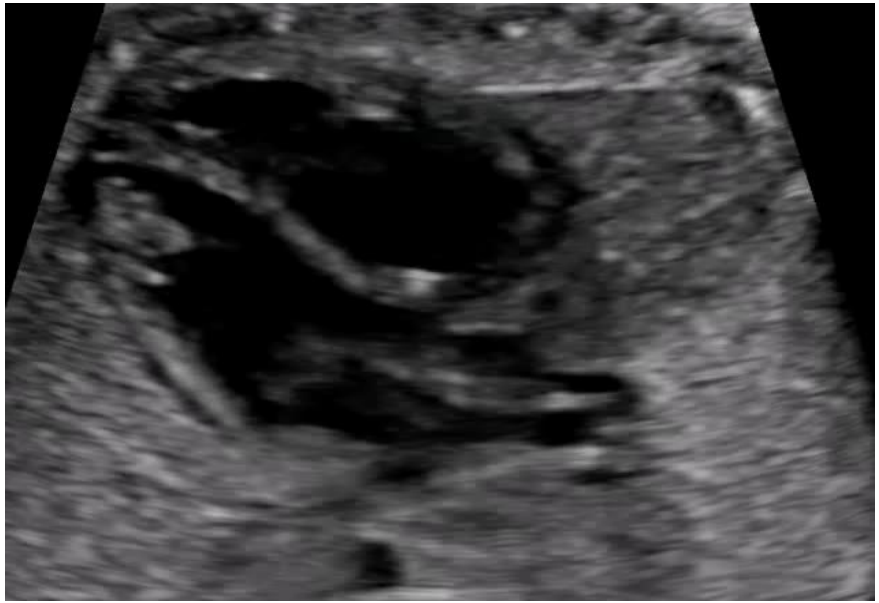
LVOT view

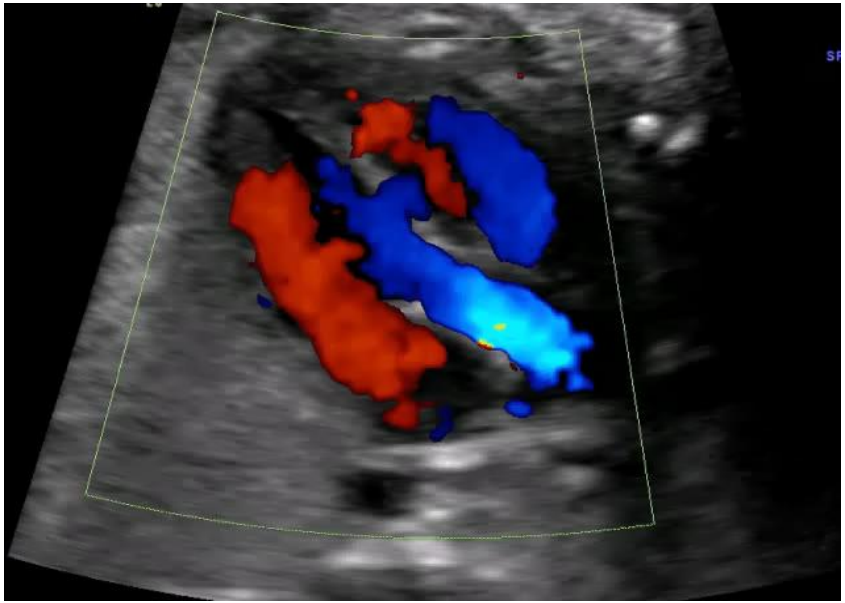


RVOT view



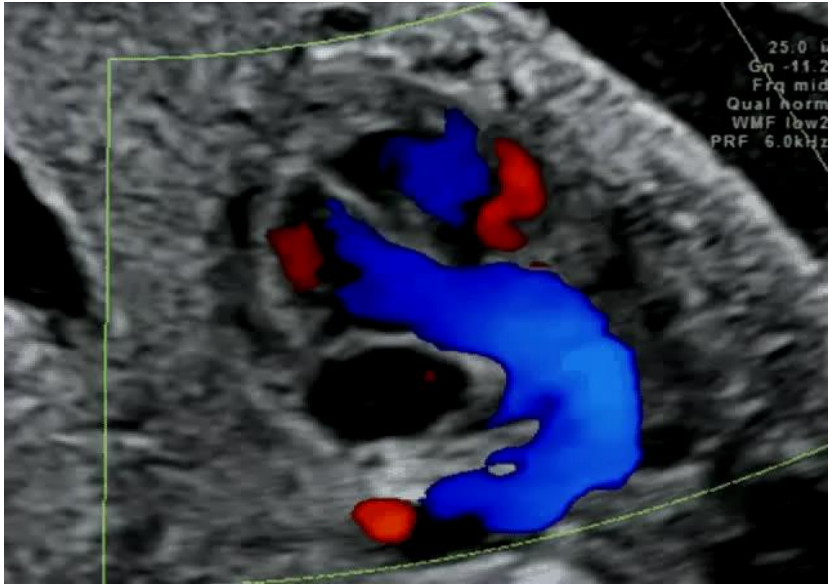
Ventricular Septum





Muscular

Ventricular Septum



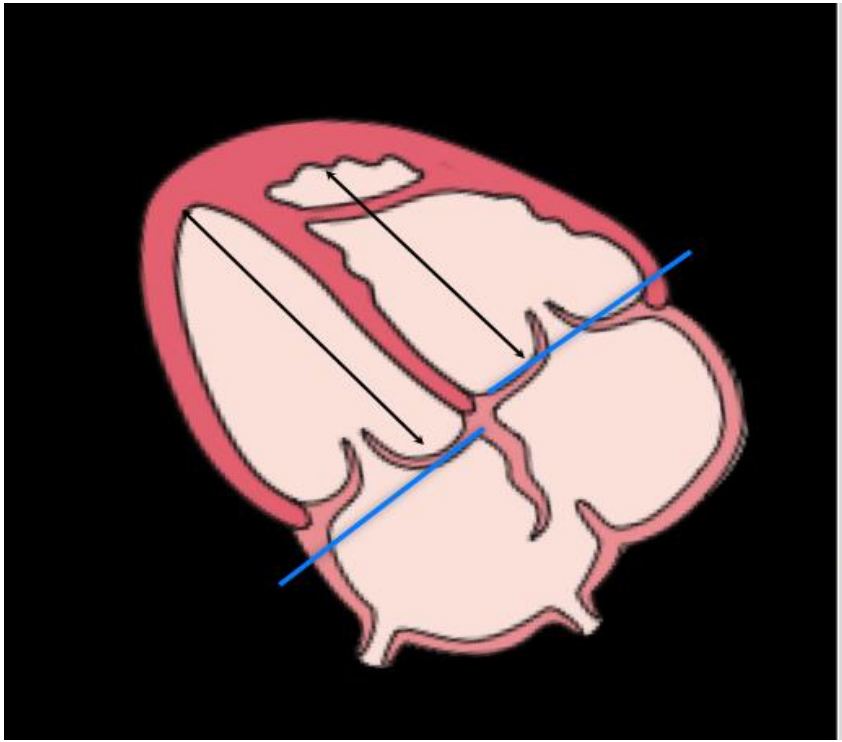
Perimembranous

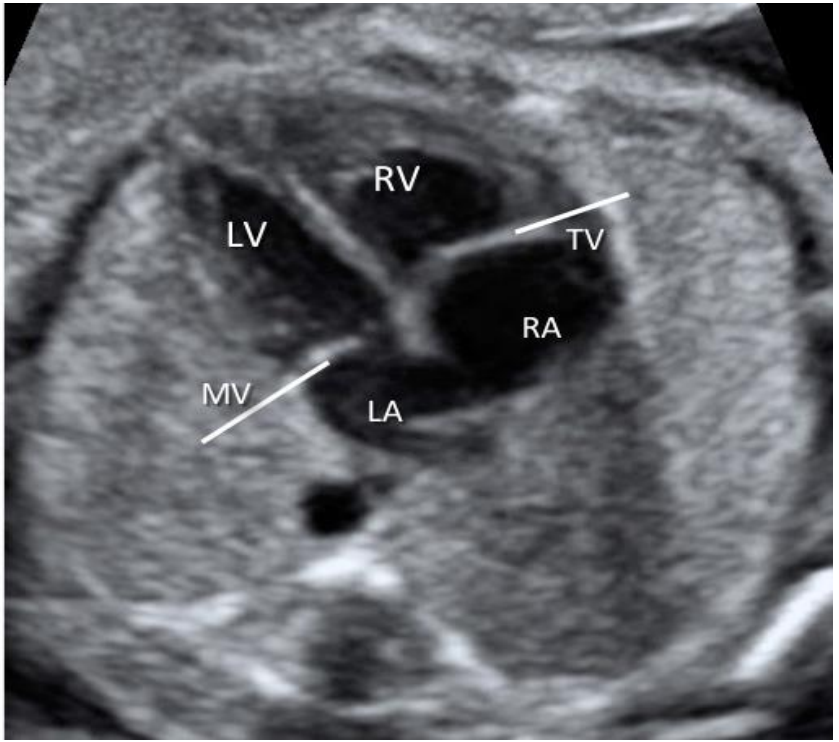
Atrioventricular Junction & Valves

- Intact cardiac crux
- Two atrioventricular valves open and move freely
- Differential offsetting: tricuspid valve leaflet inserts on ventricular septum closer to cardiac apex than does mitral valve

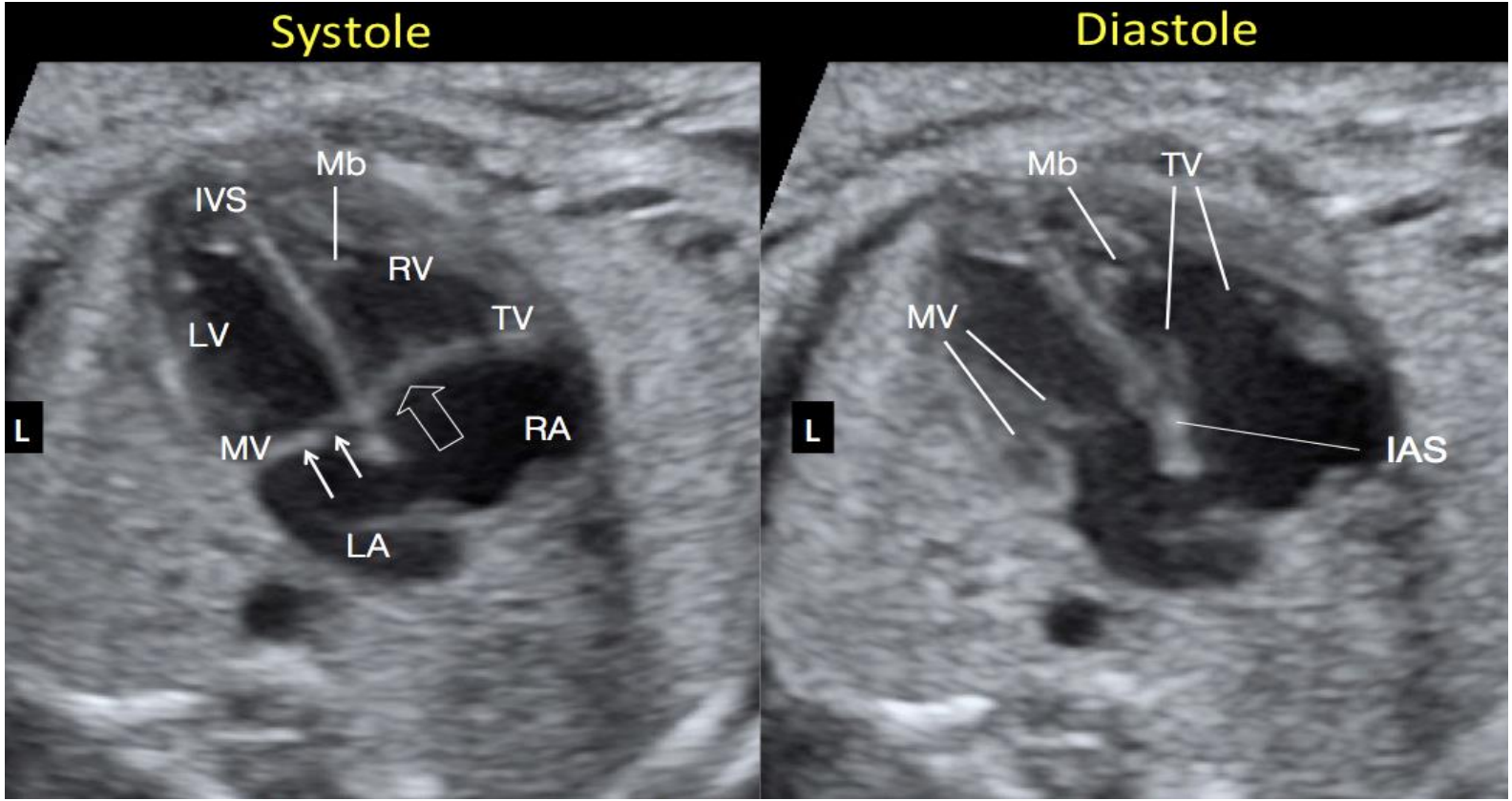
Ultrasound Obstet Gynecol 2013; 41: 348–359

Atrioventricular Valves





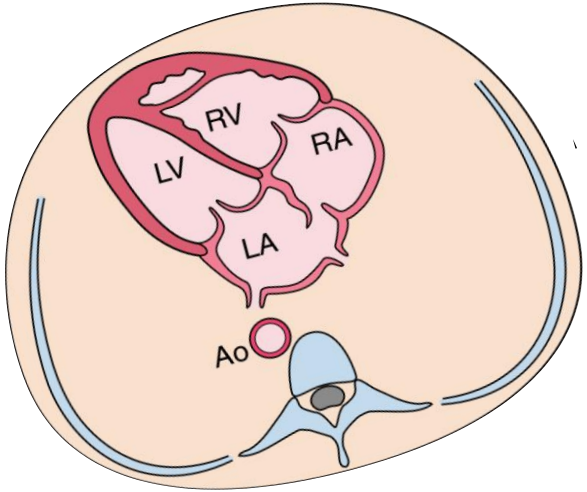
Atrioventricular Valves



7: Four-Chamber View

- Fetal laterality (identify right and left sides of fetus)
- Stomach and heart on left
- Heart occupies a third of thoracic area
- Majority of heart in left chest
- Cardiac axis (apex) points to left by 45◦ ± 20◦
- Four chambers present
- Regular cardiac rhythm

Regular Cardiac Rhythm



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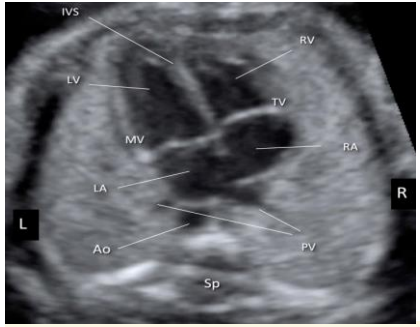
- Fetal laterality (identify right and left sides of fetus)
- Stomach and heart on left
- Heart occupies a third of thoracic area
- Majority of heart in left chest
- Cardiac axis (apex) points to left by 45◦ ± 20◦
- Four chambers present
- Regular cardiac rhythm
- No pericardial effusion

Four Chamber View



Four-Chamber View

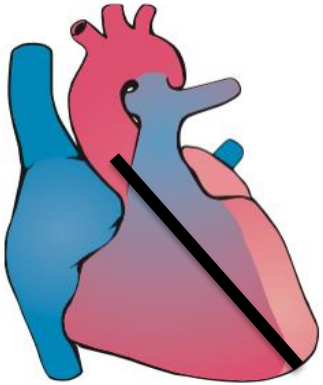
Normal-size heart in chest
Transverse plane of fetal chest with one complete rib on each side of fetal lateral chest wall
Descending aorta in front and to the left of the fetal spine
Apex of fetal heart pointing to the left upper chest at about a 45-degree angle
Atria equal in size
Foramen ovale in midsection of atrial septum with leaflet of foramen ovale in left atrium
Two inferior pulmonary veins, seen as slitlike opening in posterior wall of left atrium
Patent atrioventricular valves
Tricuspid valve septal leaflet more apically inserted on the septum than mitral valve
Ventricles equal in size and contractility
Intact ventricular septum
Moderator band in right ventricular apex

From Practical Guide To Fetal Echocardiography: Normal & Abnormal Hearts– Abuhamad, Chaoui – 3rd Edition

Cardiac Abnormalities Commonly Associated with a Normal Four-chamber View of the Heart

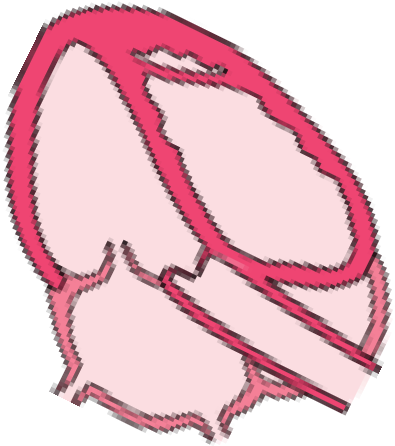
Tetralogy of Fallot
Transposition of great arteries
Double outlet right ventricle
Small ventricular septal defects
Common arterial trunk
Mild semilunar valves stenosis
Aortic arch abnormalities

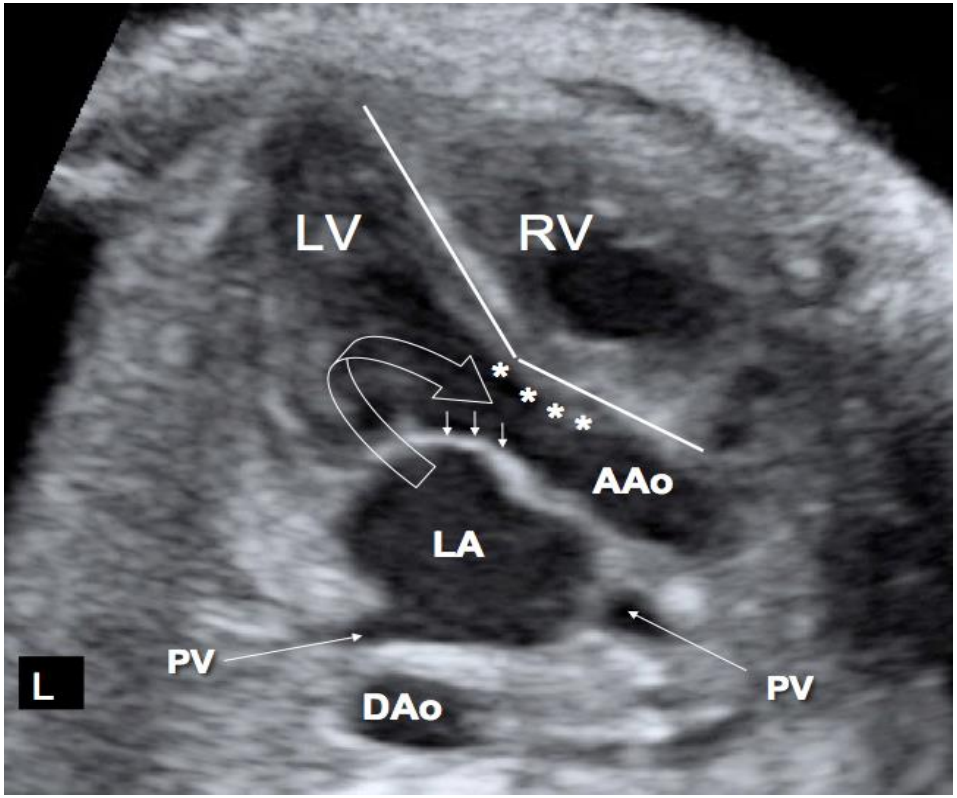
From Practical Guide To Fetal Echocardiography: Normal & Abnormal Hearts– Abuhamad, Chaoui – 3rd Edition



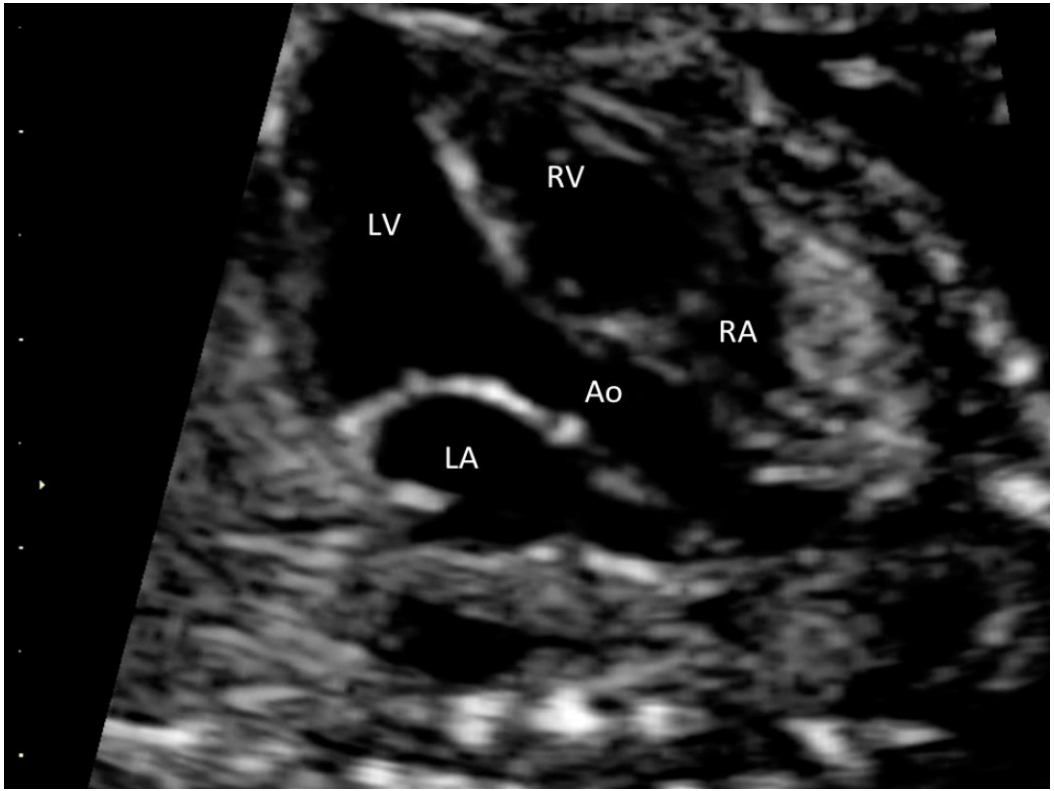
8: Left Ventricular Outflow

Left Ventricular Outflow

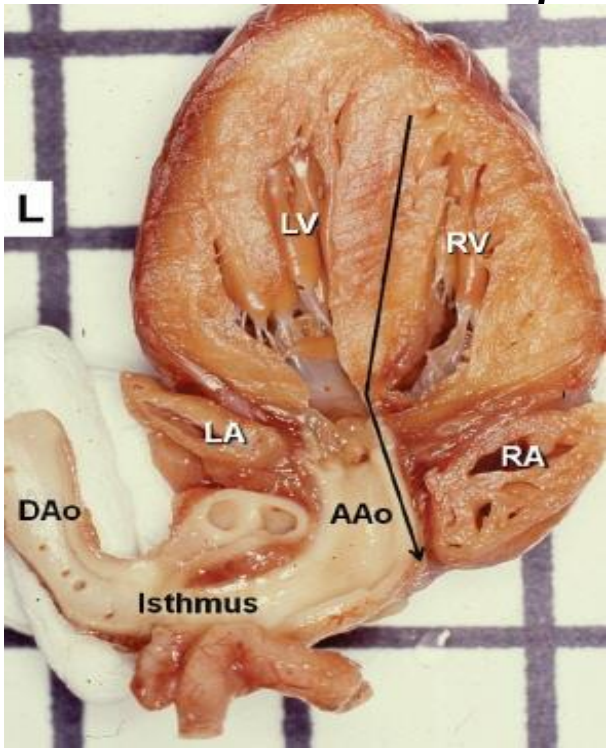




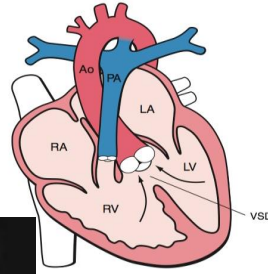
Left Ventricular Outflow

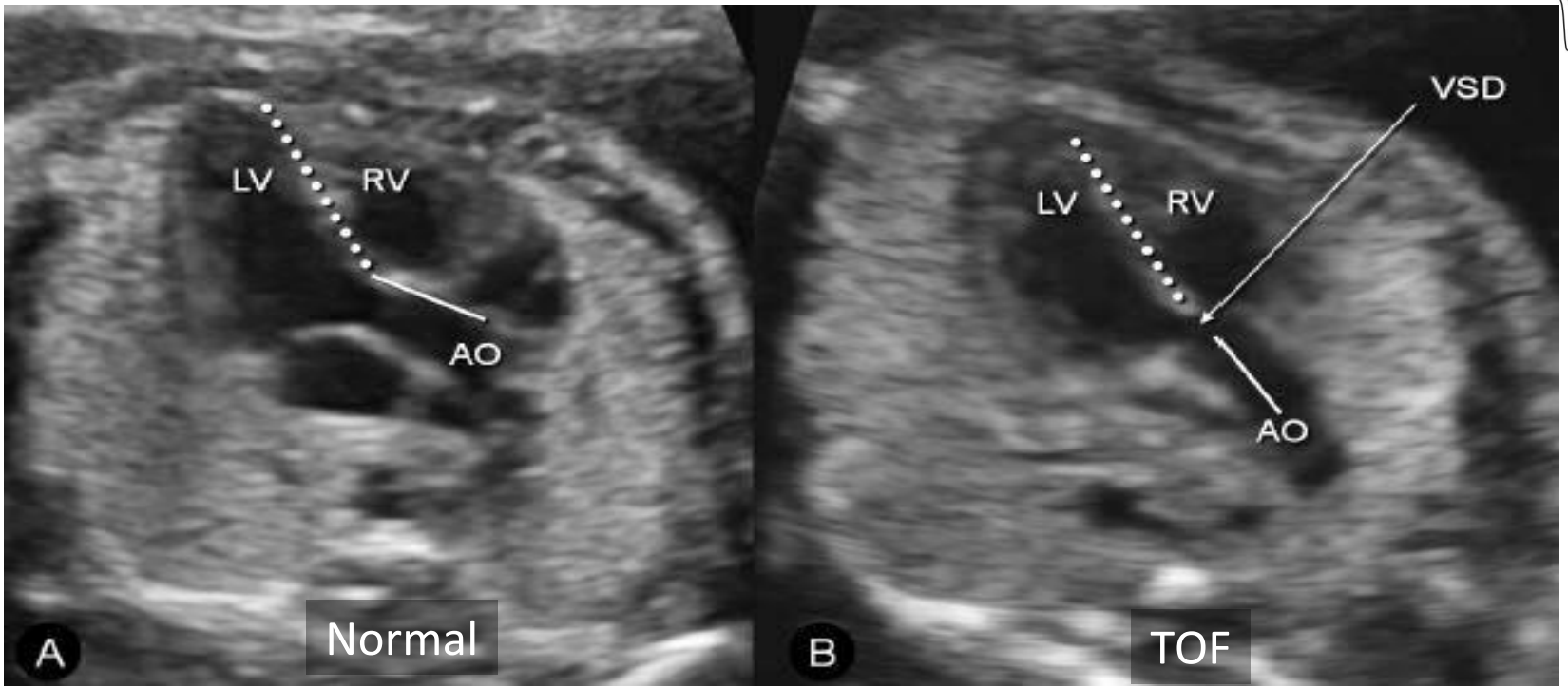


Left Ventricular Outflow

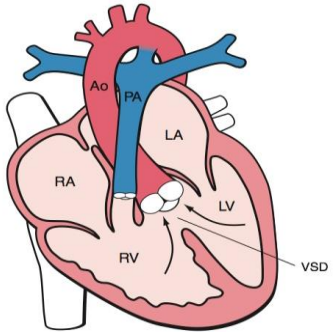


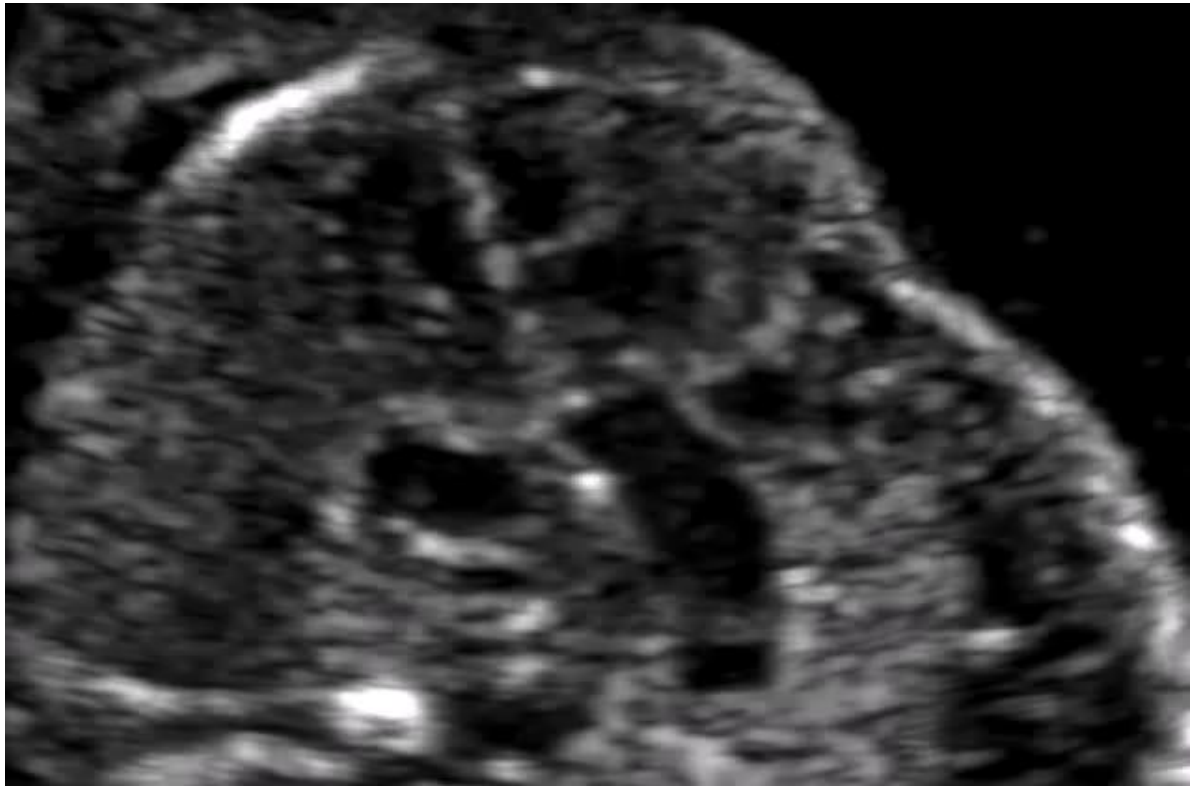
Left Ventricular Outflow

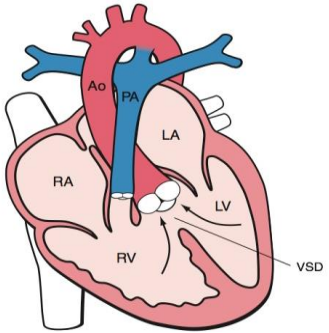




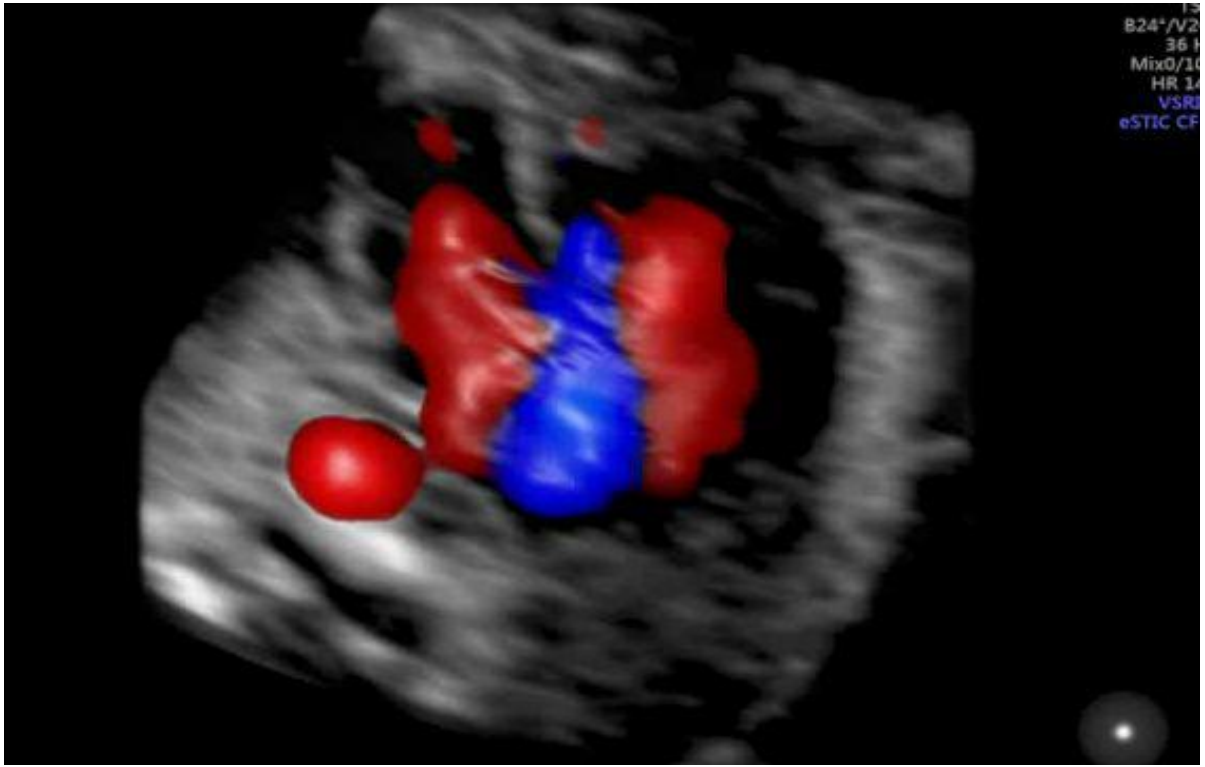
Left Ventricular Outflow



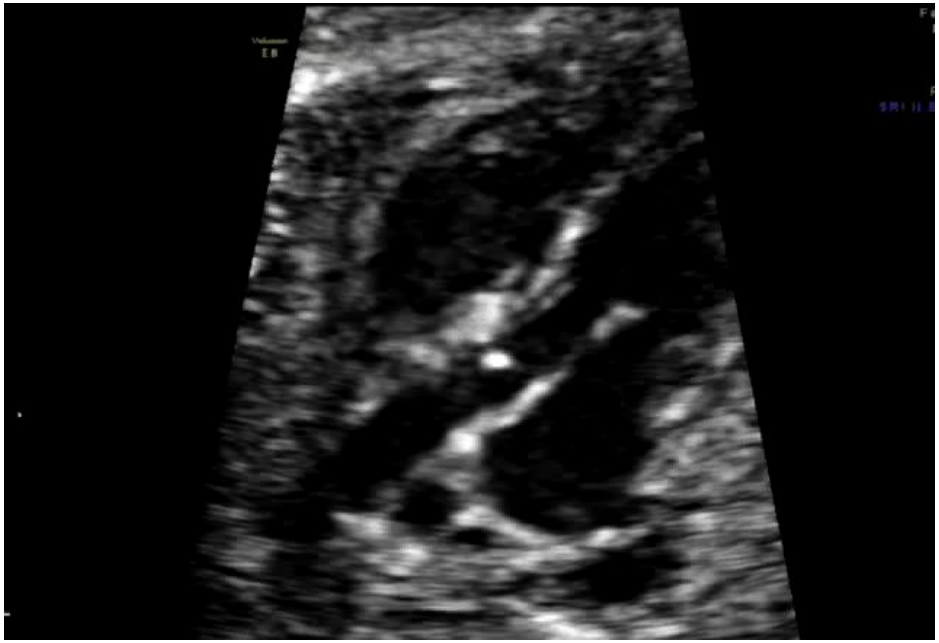


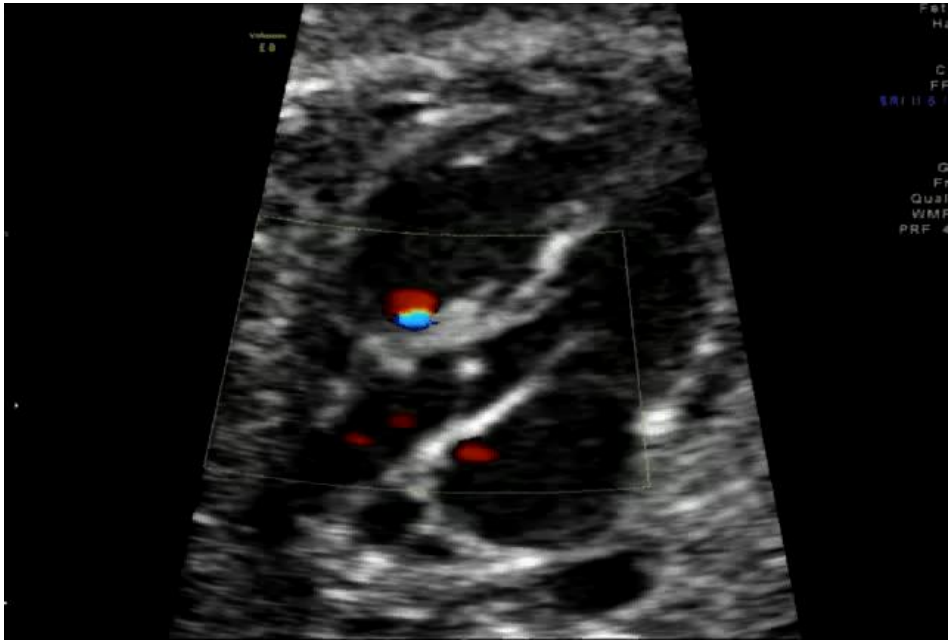


Left Ventricular Outflow

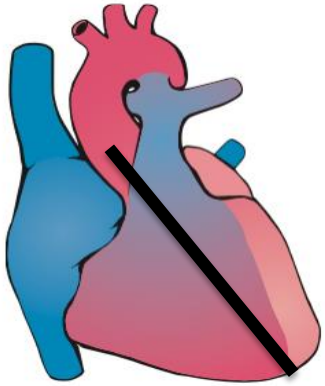


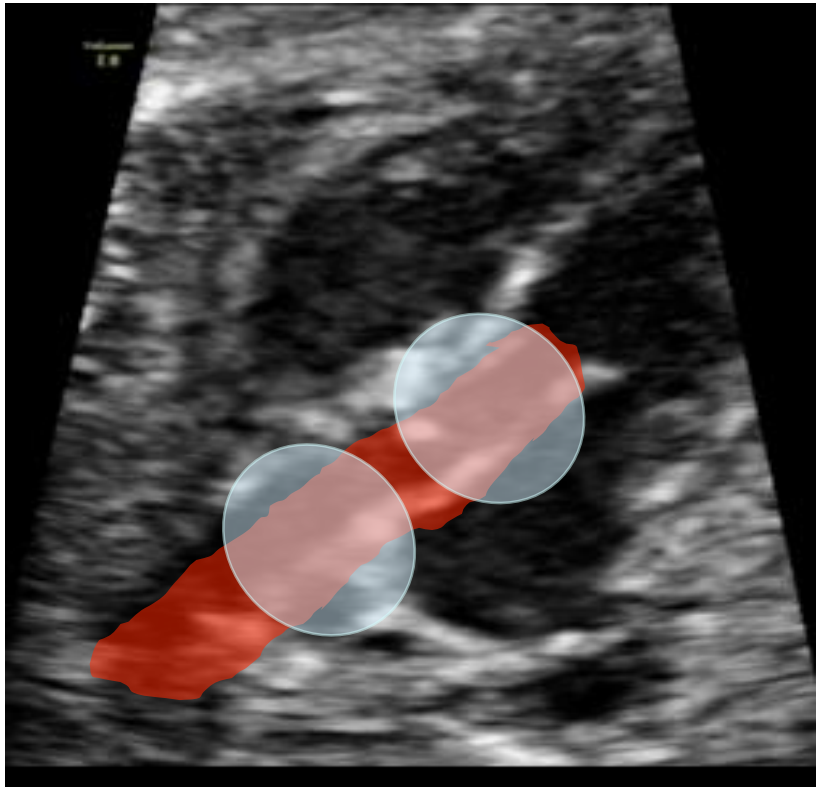
Left Ventricular Outflow





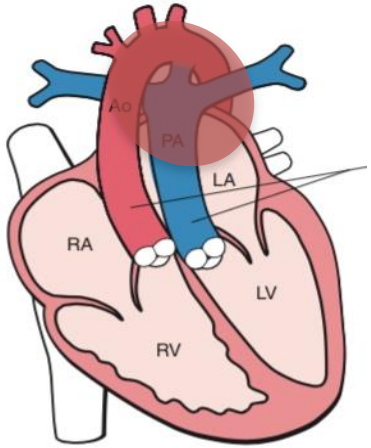
Left Ventricular Outflow

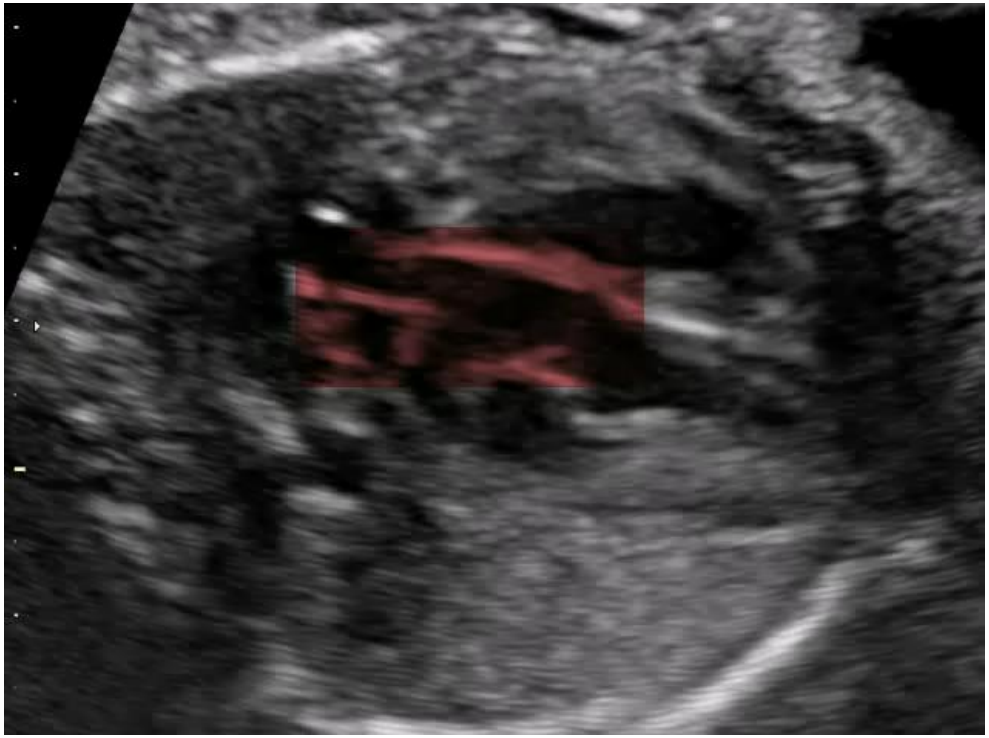




Left Ventricular Outflow

Left Ventricular Outflow





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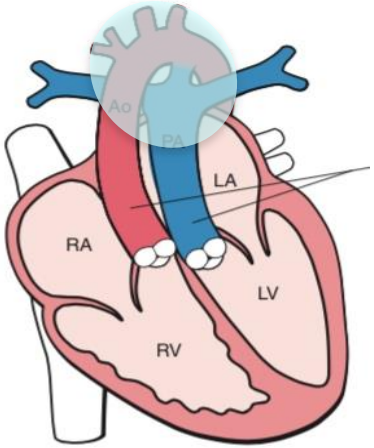
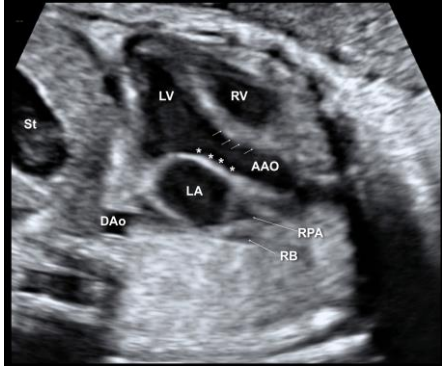
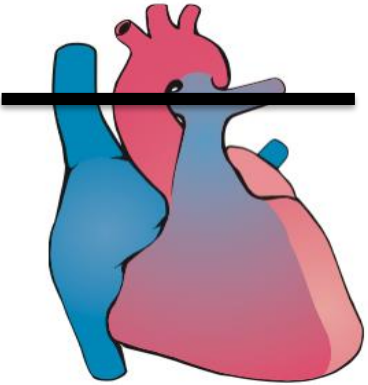


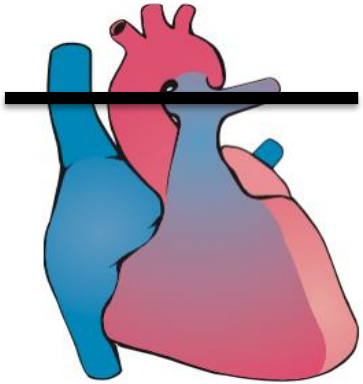
Left Ventricular Outflow



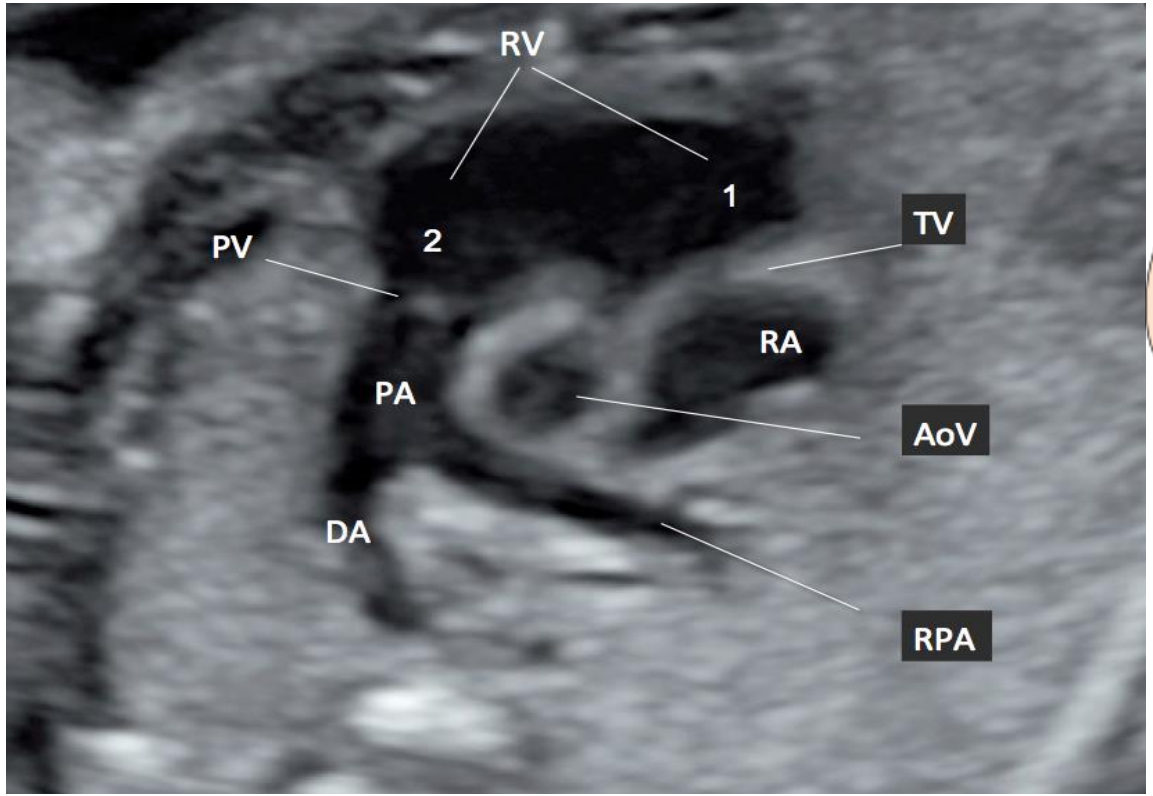
- Mitral - aortic continuity
- Aorta within left ventricle
- Angle of ascending aorta with ventricular septum
- Aorta does not divide
- Close observation of aortic valves

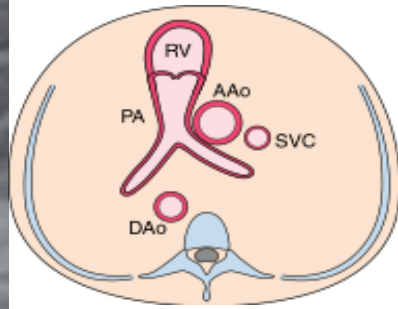


9: Right Ventricular Outflow

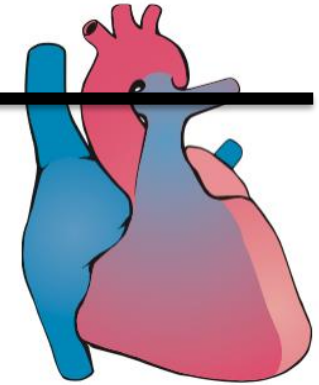


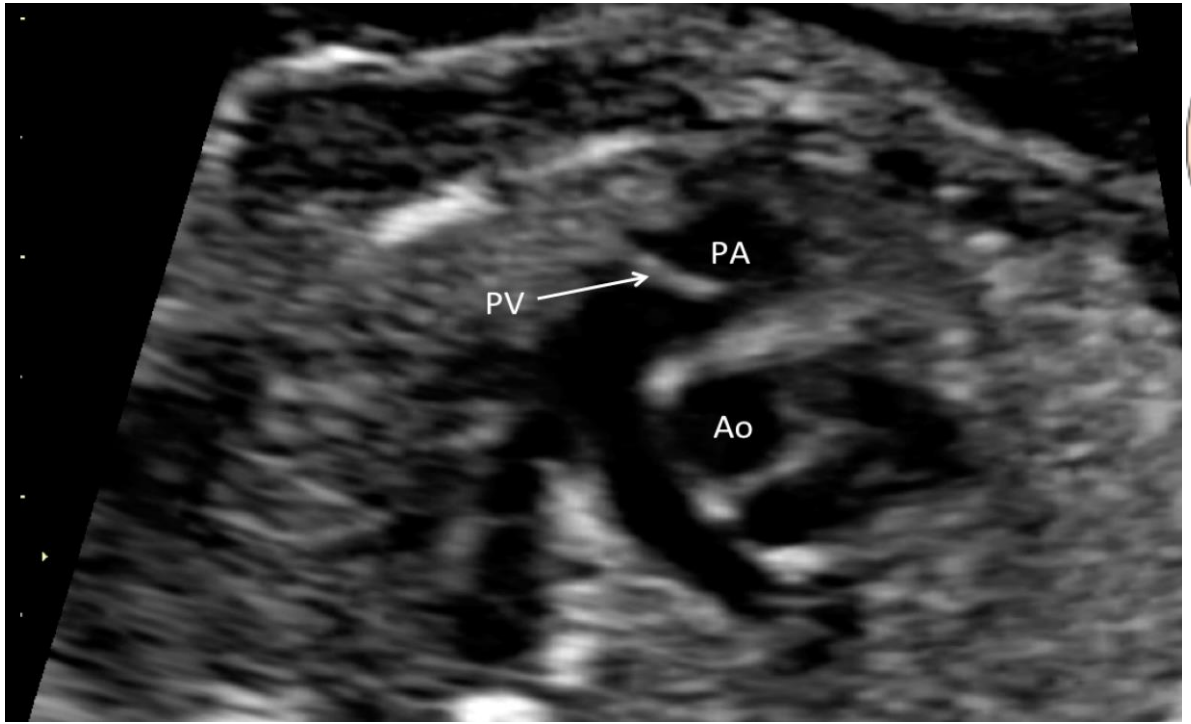
Right Ventricular Outflow

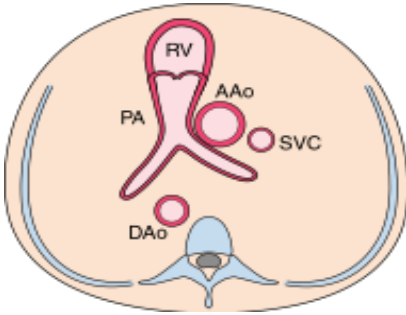


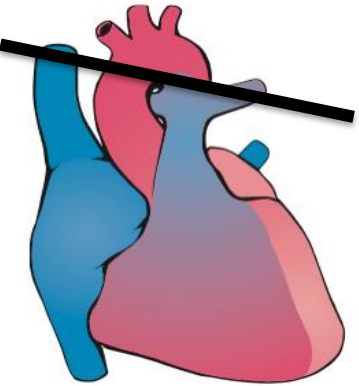


Right Ventricular Outflow

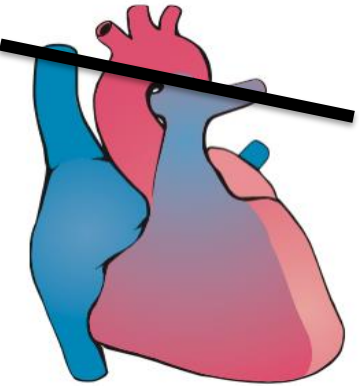




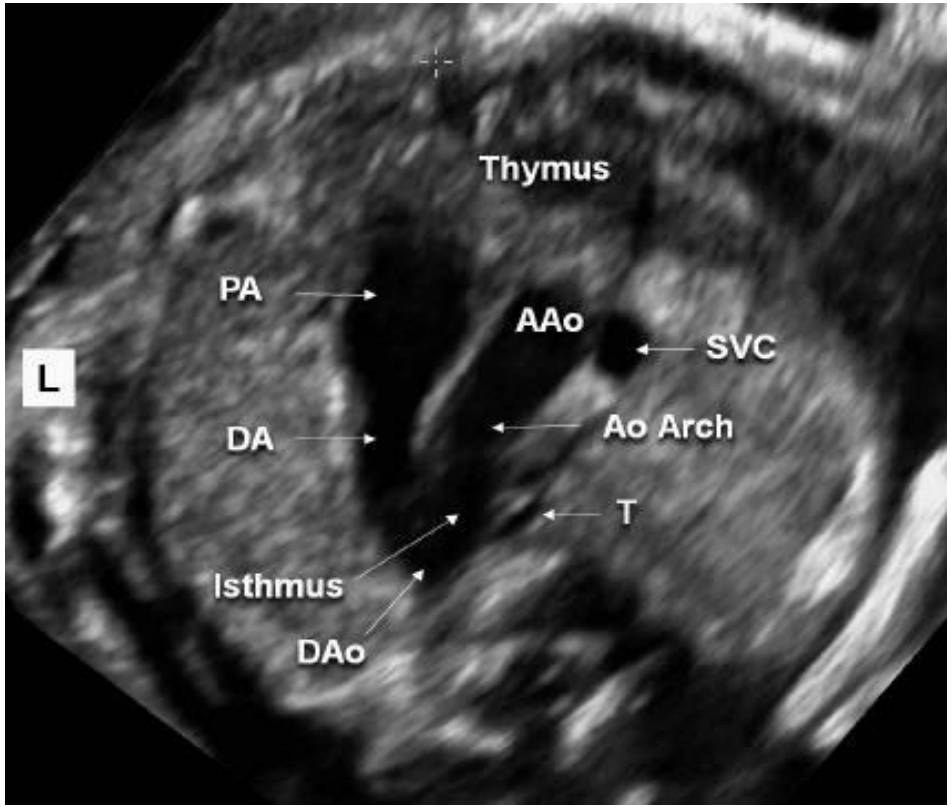


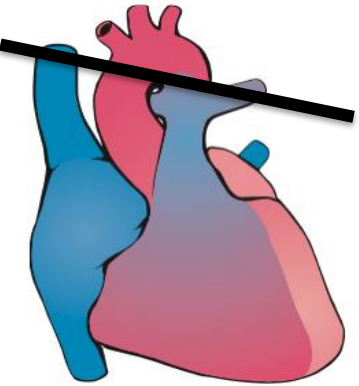


10: Three-Vessel-Trachea

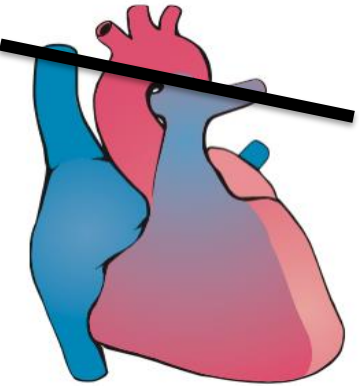


Three-Vessel Trachea





Three-Vessel Trachea



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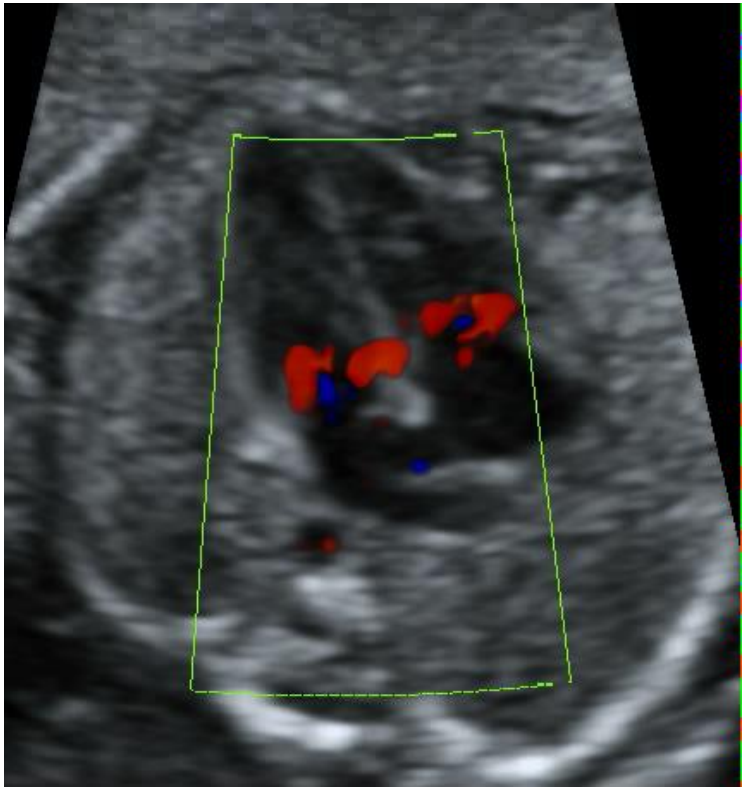

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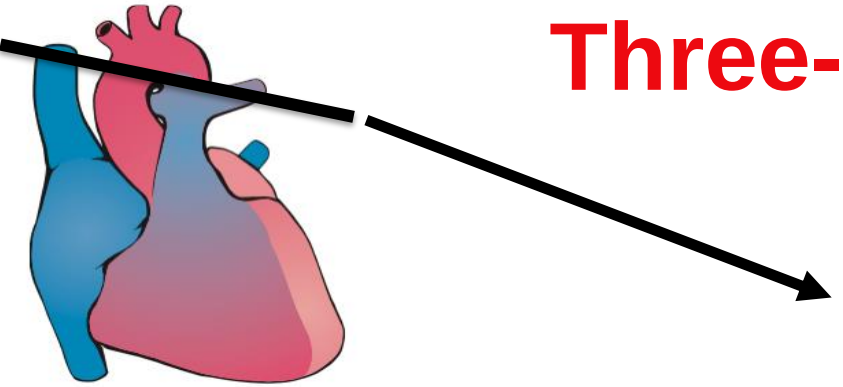
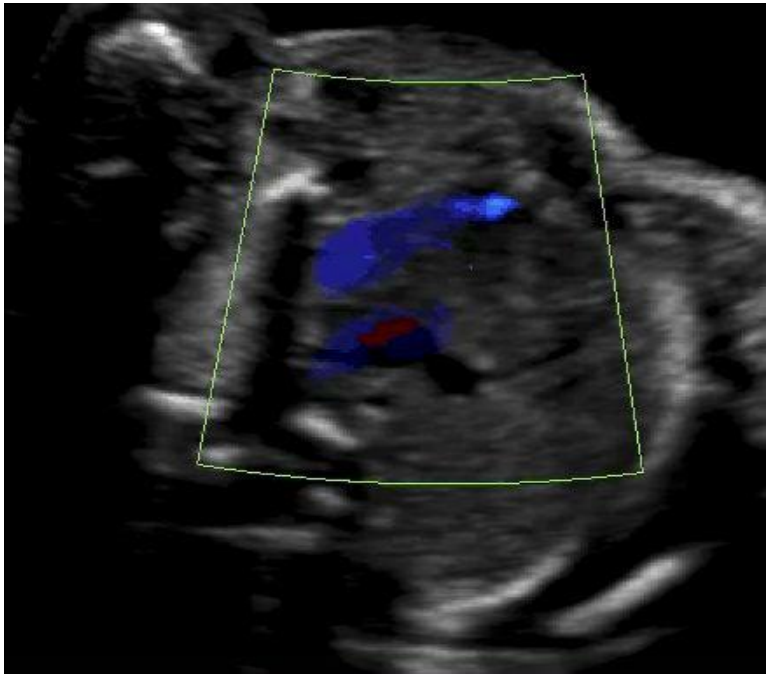
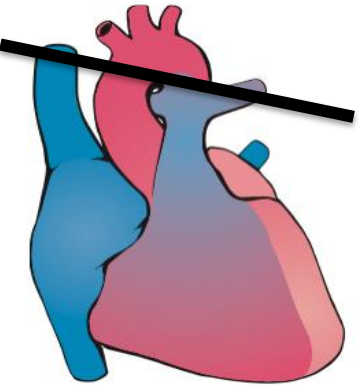
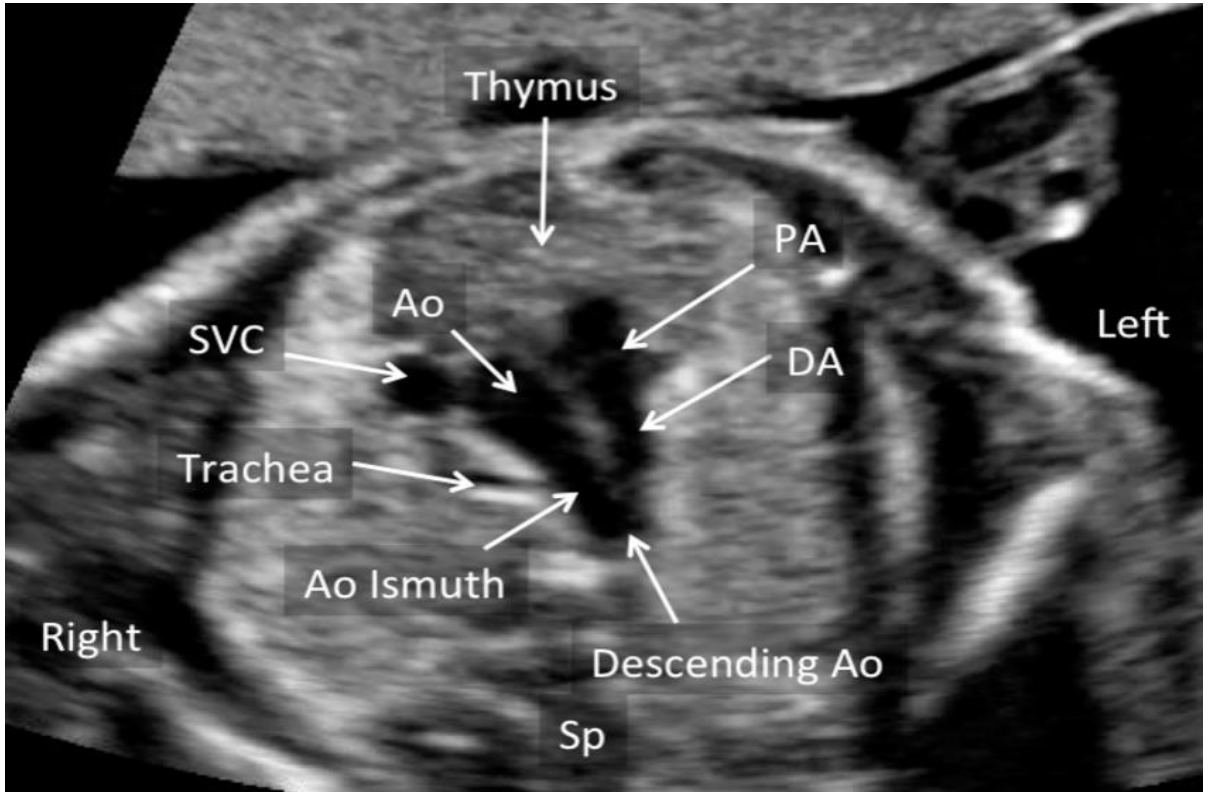






Three-Vessel Trachea



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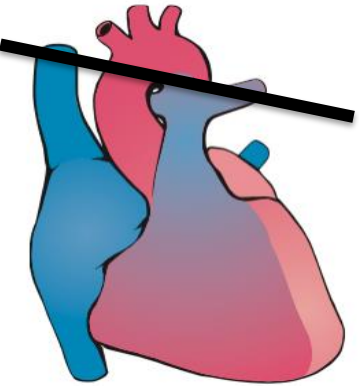
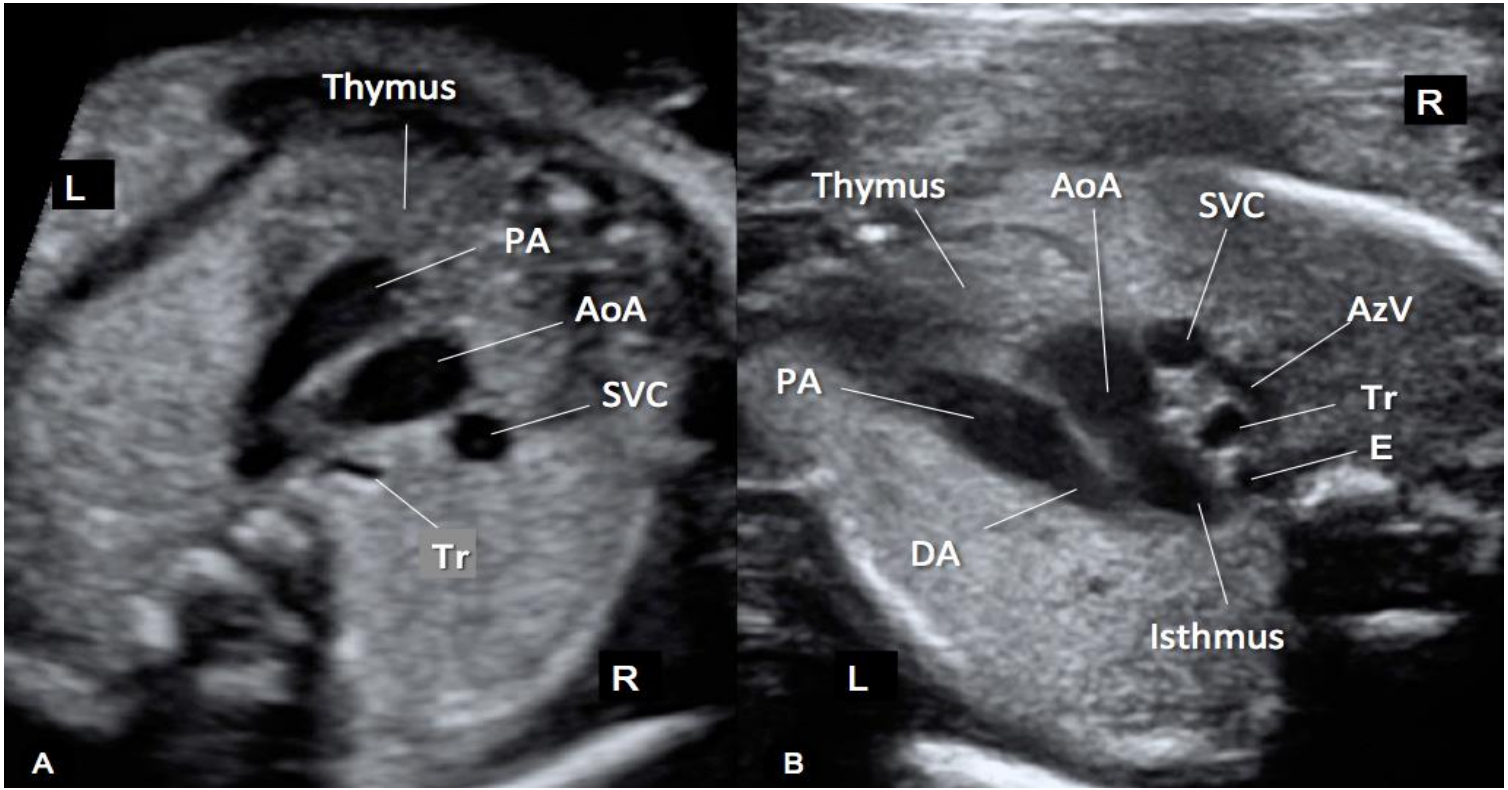
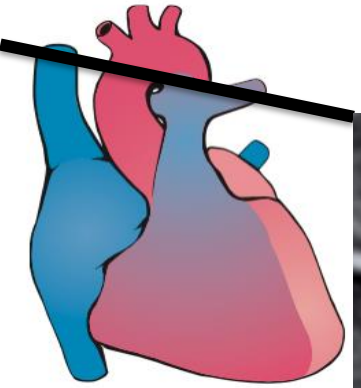
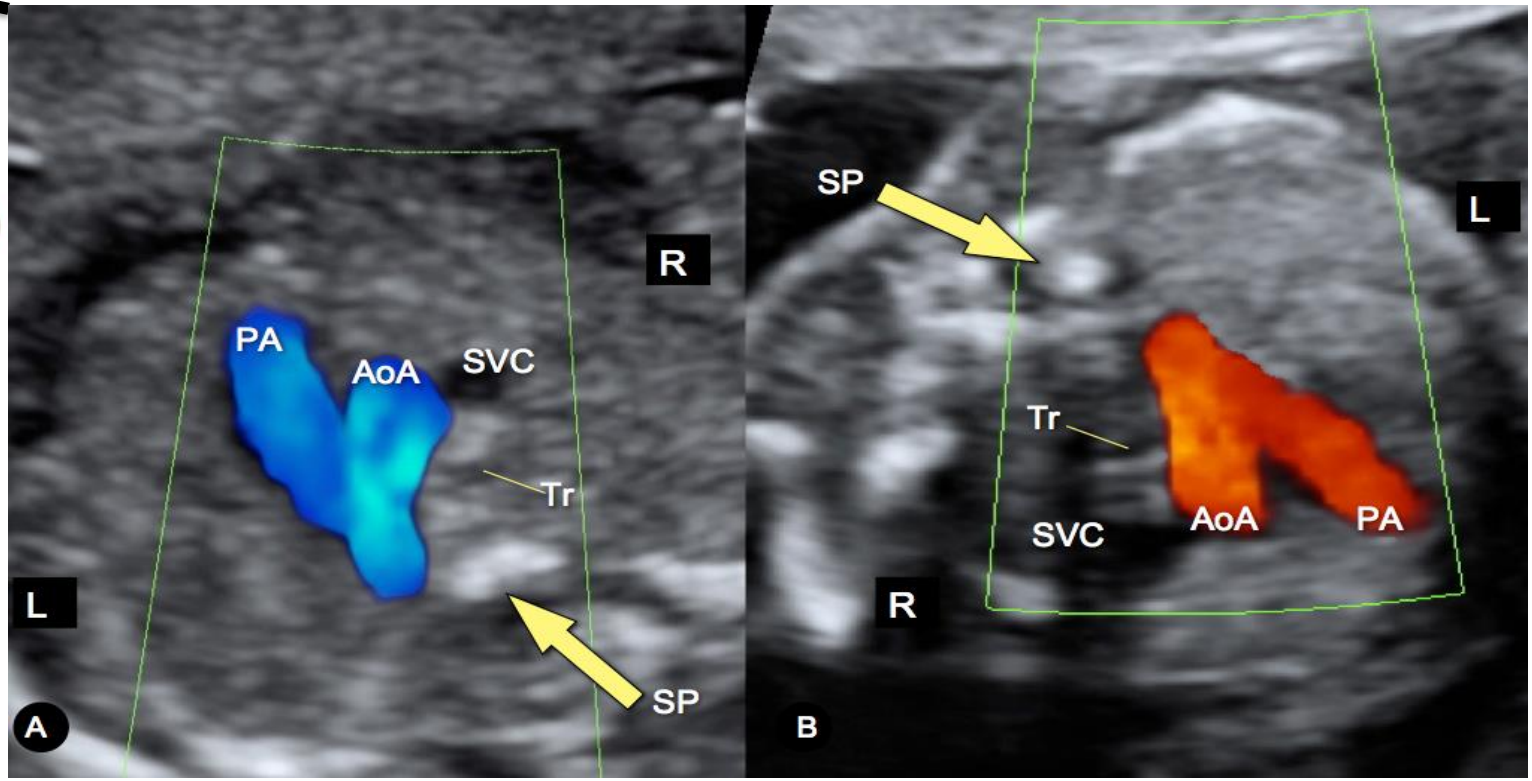




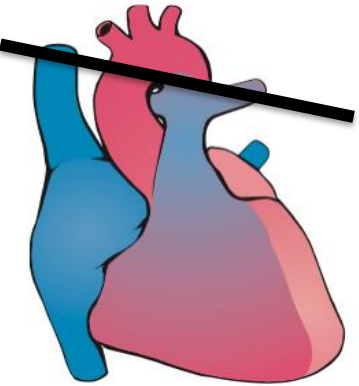
Three-Vessel Trachea

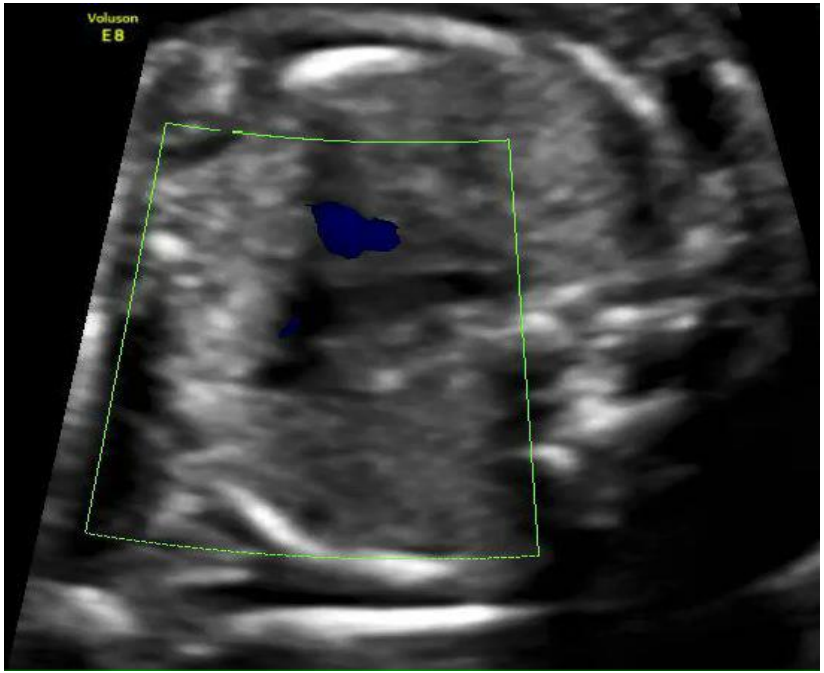


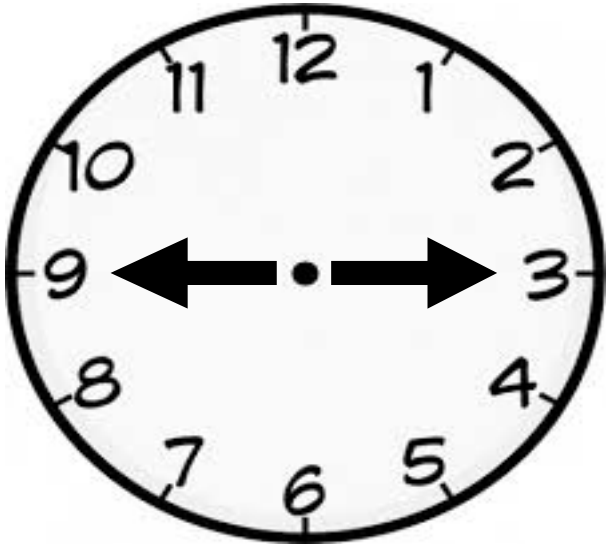


Blood flows towards the spine

Three-Vessel Trachea







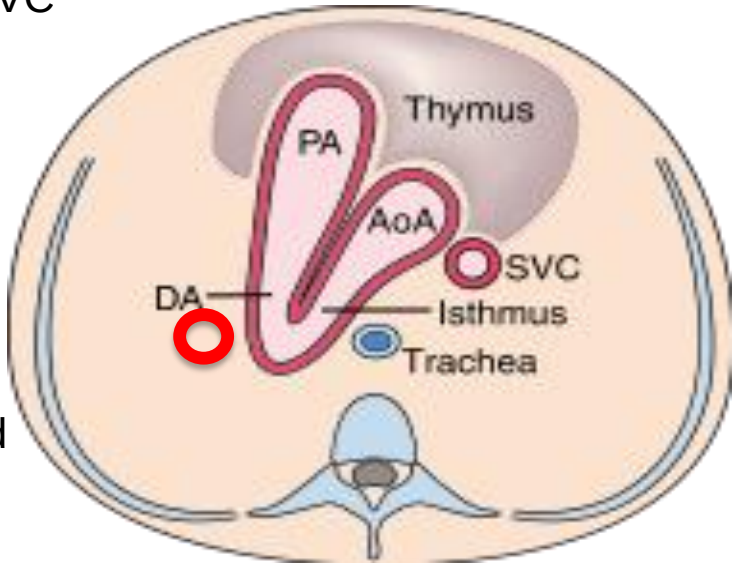
Spine

Checklist Three-Vessel-Trachea

Course & size of PA, Ao & SVC

Thymus present

Course & size of DA & Ao Isthmus



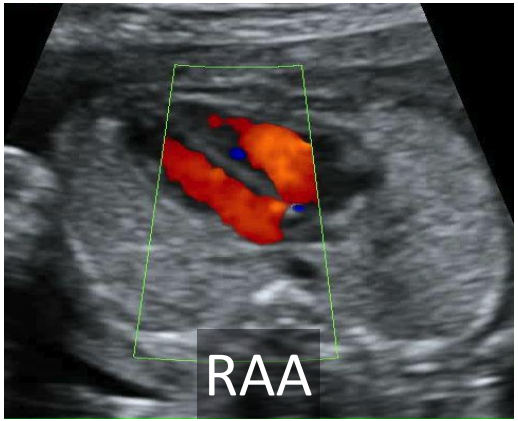
Flow assessment by color Doppler

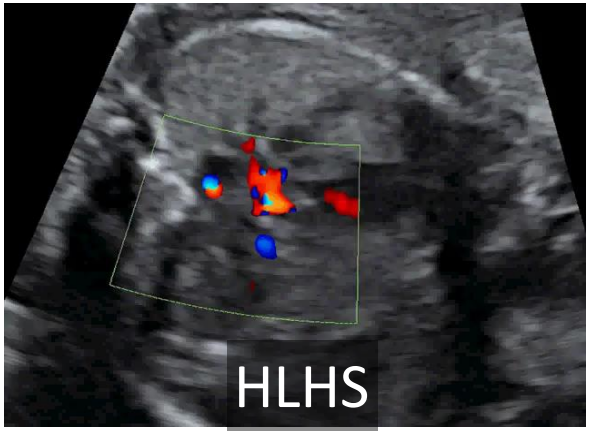
Ao arch & DA right or left sided

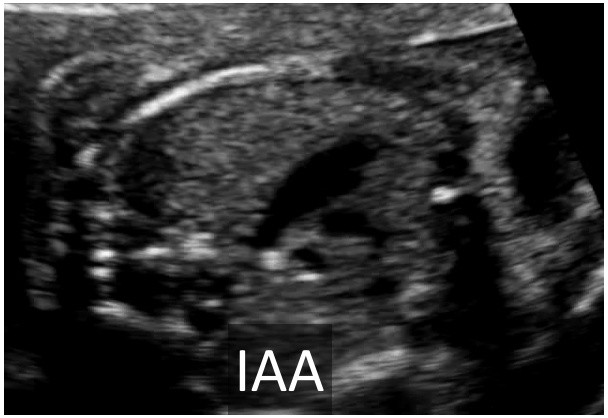
Presence of atypical vessels

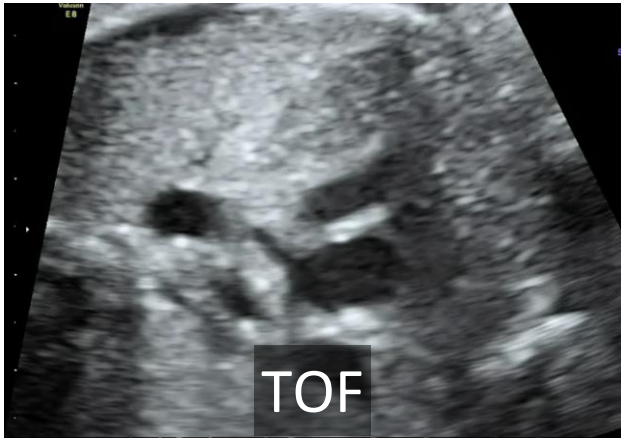
- LSVC
- TAPVR


TGA

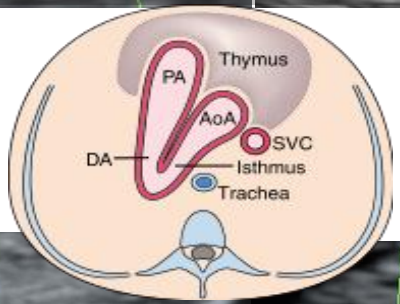

RAA

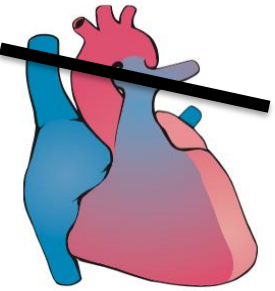

HLHS


IAA

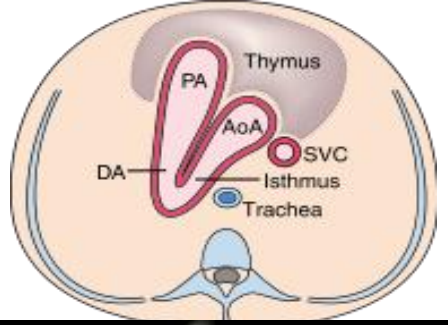

TOF

Three-Vessel Trachea





Three-Vessel Trachea



Abnormal in:	PS / PA
HLHS	Critical Ao Stenosis
HRHS	Coarctation of Ao
TGA	ARSA
DORV	LSVC
TOF	TA-VSD
CAT	RAA
TAPVR	Double Ao Arch
PA-VSD	Ebstein
	Interrupted Ao Arch

Courtesy of Dr. Chaoui

Conclusion

- Normal situs
- Normal axis
- Ventricles equal in size and contractility

- LVOT arises with an angle
- LVOT does not divide
- Normal valves

- PA anterior
- PA and Ao same size
- Normal valves

- 3 vessels seen
- Ao and PA normal size
- DA & Ao Arch to left of trachea

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