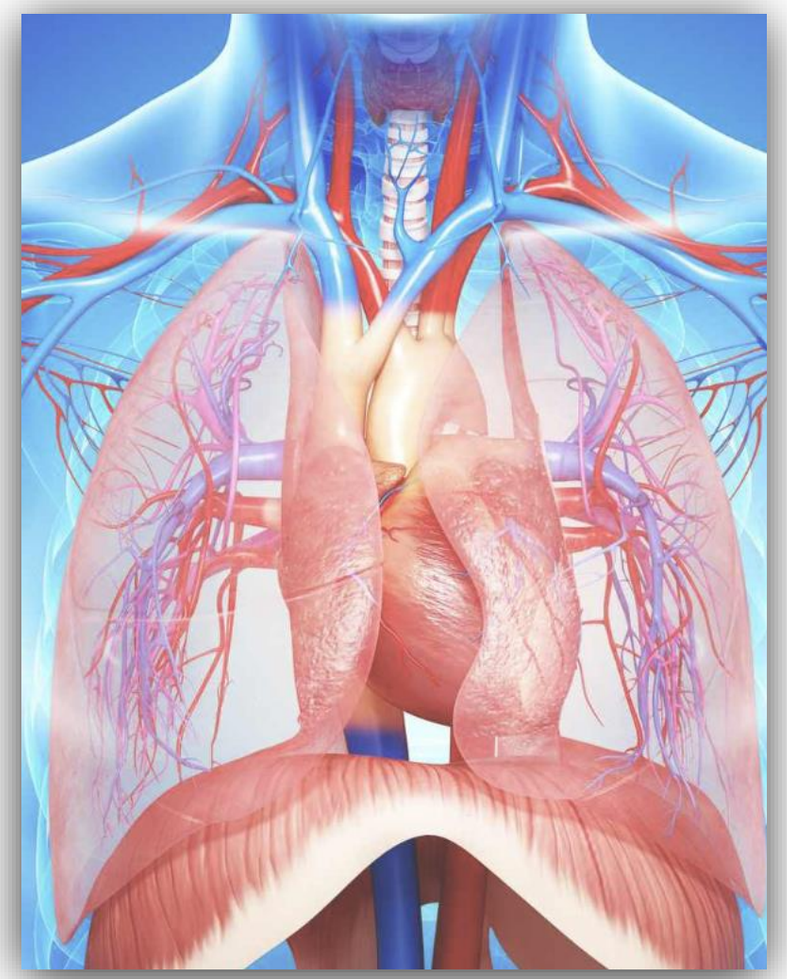
OB GYN SONOGRAPHY REVIEW

Fetal Chest, Lungs & Heart

Course Outline

- Lung Development
- Heart Development
- Sonographic Anatomy
- Chest Abnormalities
  - Thoracic and pulmonary
  - Heart and great vessels



Lung Development

Developmental Phases

- Embryonic phase (9 - 19 weeks)
  - Air-conducting bronchi and bronchioles form
- Canalicular phase (17 - 27 weeks)
  - Lung tissue become vascularized and early lumina form
- Saccular phase (30 - 38 weeks)
  - Appearance of primordial alveoli
- Alveolar phase(38 weeks – term)
  - Increase in number and maturity of alveoli

Factors Necessary for Lung Development

- Adequate thoracic space
- Normal fetal breathing movements
- Fluid production in the lungs (*pulmonary surfactant*)
- Adequate amount of amniotic fluid

Heart Development

Developmental Phases

- Cardiovascular tube formation (4 - 4.6 weeks)*
  - Linear tube formation; begins beating
- Looping (5 - 6 weeks)
  - Tube bends into asymmetric right and left sides. Chambers begin to form
- Atrial septation (6.8 - 9 weeks)
  - Septa primum and secundum form. Endocardial cushions form

** Menstrual weeks*

Developmental Phases

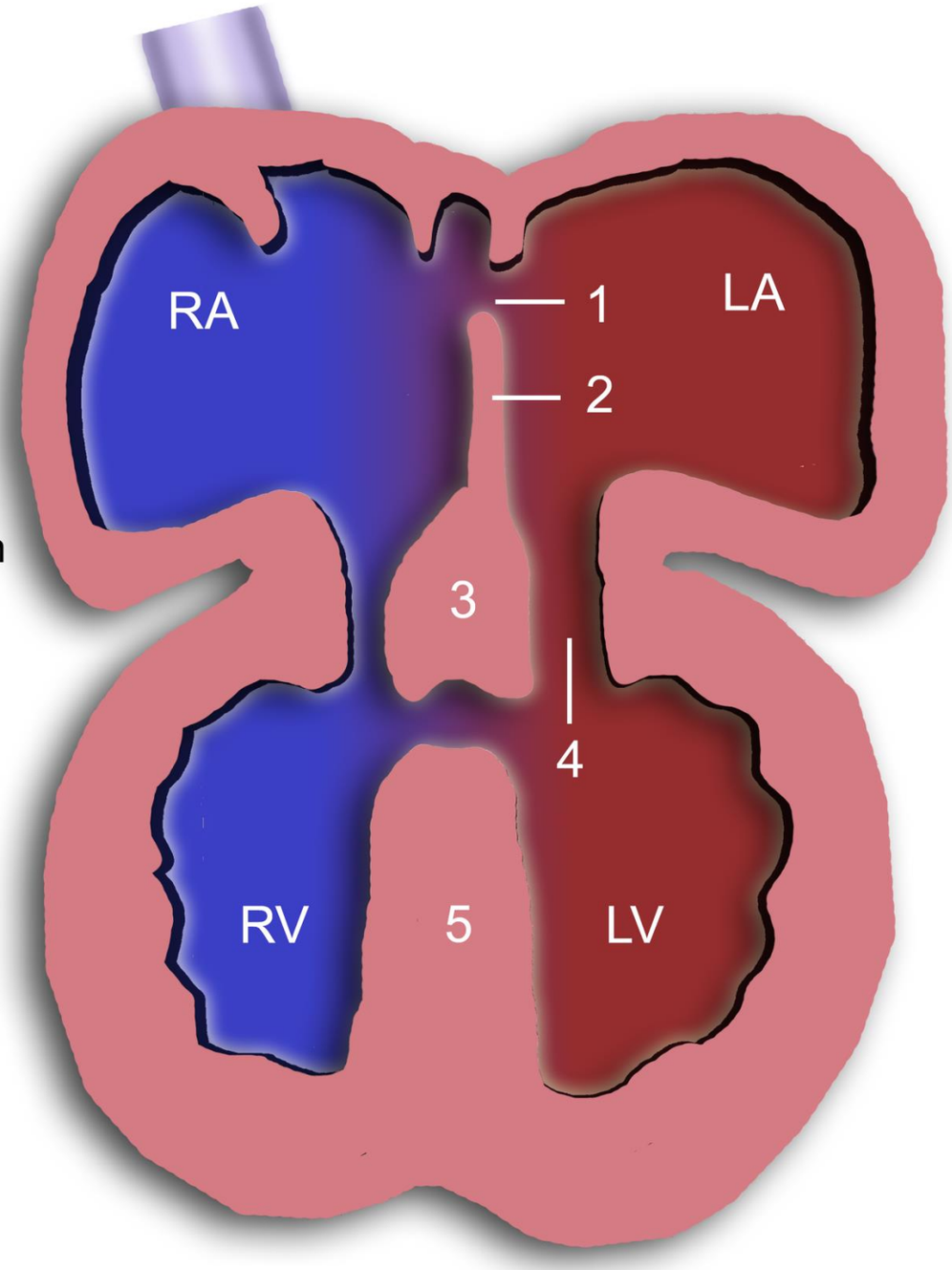
- Outflow tract separation (7 - 10 weeks)
  - Single outflow tract (*truncus arteriosus*) separates into aorta and pulmonary artery
- Ventricular septation (7.4 – 8.6 weeks)
  - Interventricular septum forms to separate right and left ventricles.
- Embryological development of heart is complete by 9 menstrual weeks

** Menstrual weeks*

HEART DEVELOPMENT AND ANATOMY

1 = foramen ovale
2 = septum primum
3 = endocardial cushions
4 = interventricular foramen
5 = interventricular septum

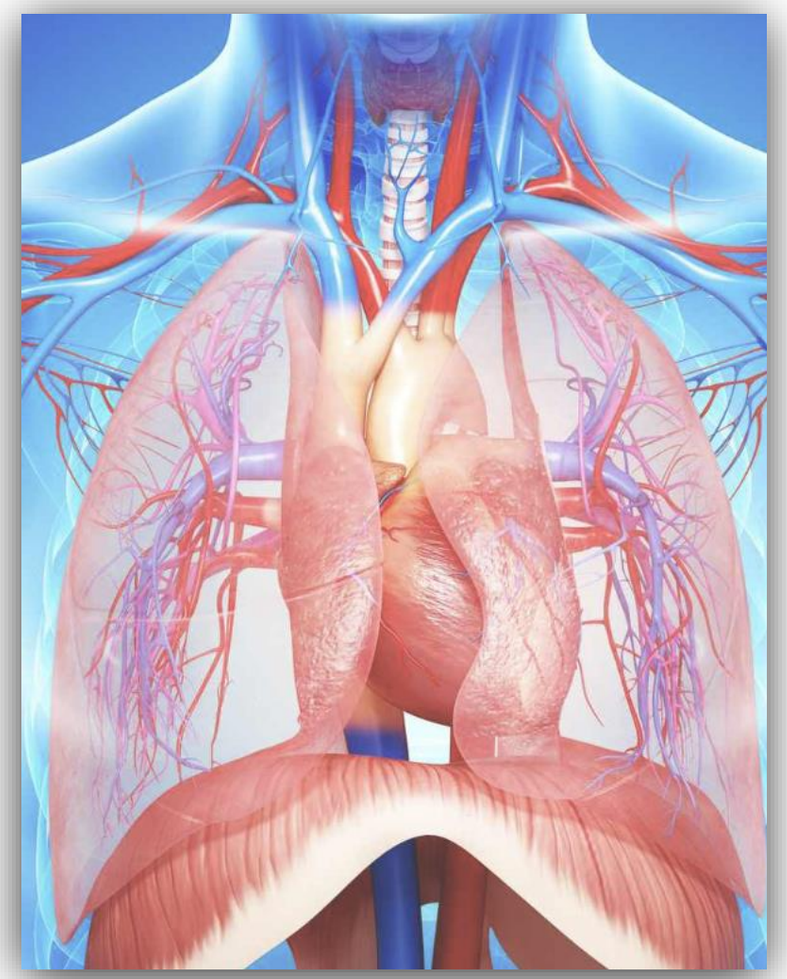
LA - = left atrium
RA = right atrium
LV = left ventricle
RV = right ventricle



Sonographic Anatomy

Sonographic Anatomy

- Chest Size
- Lungs
- Diaphragm
- Great Vessels
- Heart



Chest Size

- Chest size is indirect indicator of normality of its contents
- Axial section:
  - Heart occupies 1/3 of thoracic cavity
  - Lungs occupy remaining space
- Variations in this proportion may indicate pulmonary hypoplasia or cardiomegaly

CHEST SIZE

Normal proportions

CHEST SIZE

Cardiomegaly

Lungs

- Solid, homogeneously echogenic structure filling thoracic space not occupied by heart
- ⬆ echogenicity compared to abdominal viscera
- Identified from late 1st trimester
- Right lung slightly larger than left

LUNGS

Normal lung echogenicity

Diaphragm

- Muscular structure separating thoracic and abdominal cavities
- Demonstrated as a hypoechoic, curvilinear structure between cavities
- Useful landmark in assessing integrity and correct location of thoracoabdominal viscera
- Important consideration in diagnosis of diaphragmatic hernia

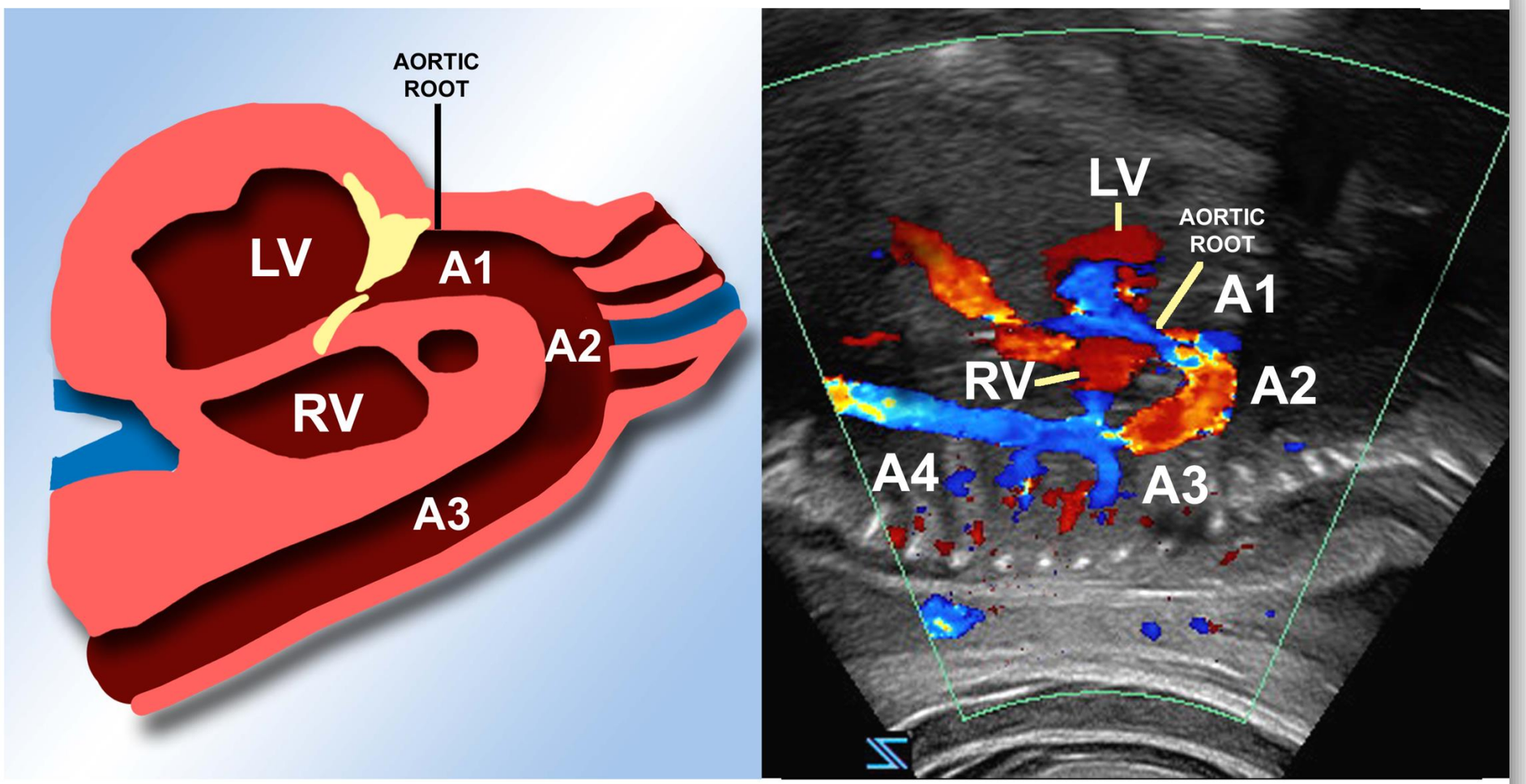
DIAPHRAGM

Hypoechoic, curvilinear structure

Great Vessels

- Great vessels include:
  - Superior vena cava
  - Ascending and descending thoracic aorta
  - Pulmonary arteries
  - Ductus arteriosus
  - Aortic arch branches
- Can be visualized as early as 14 weeks

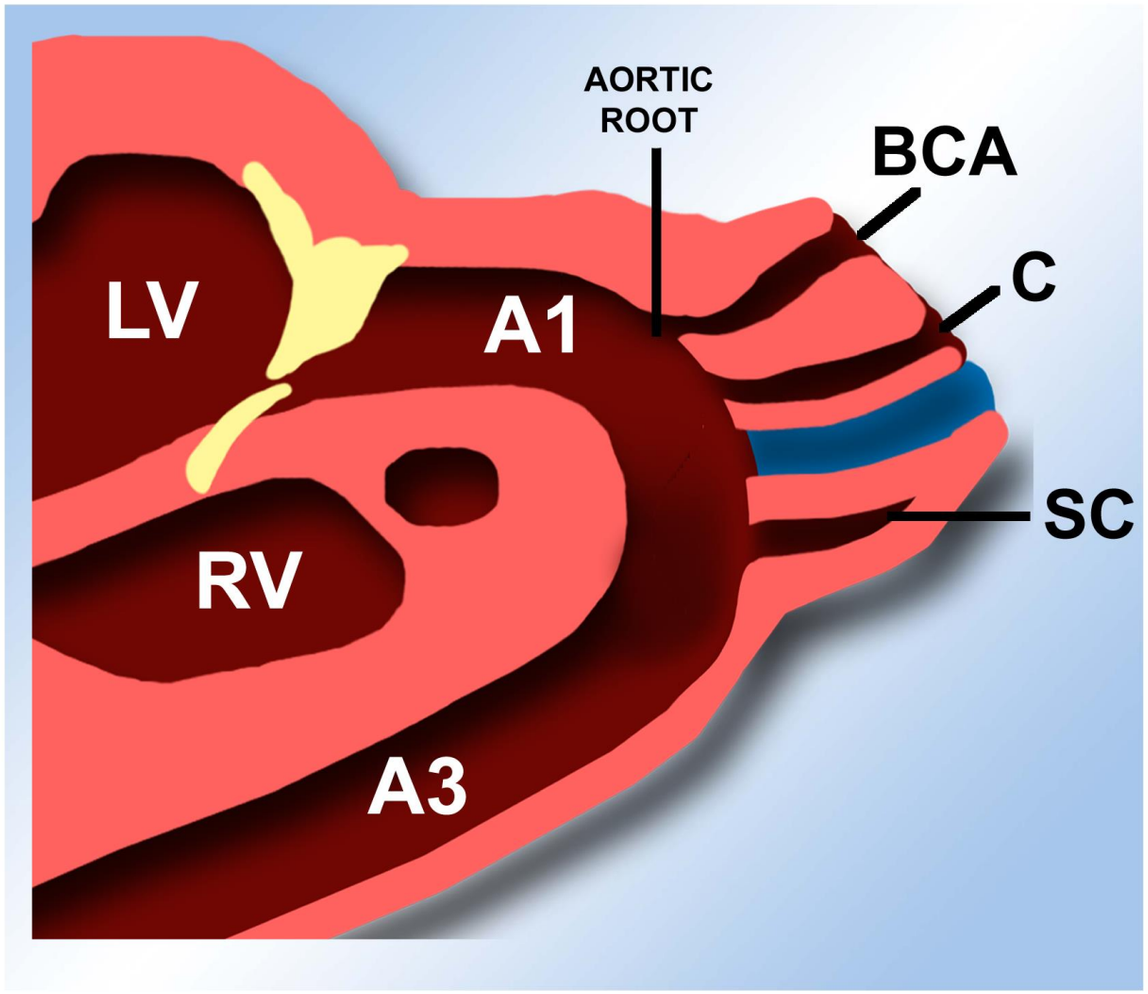
GREAT VESSELS

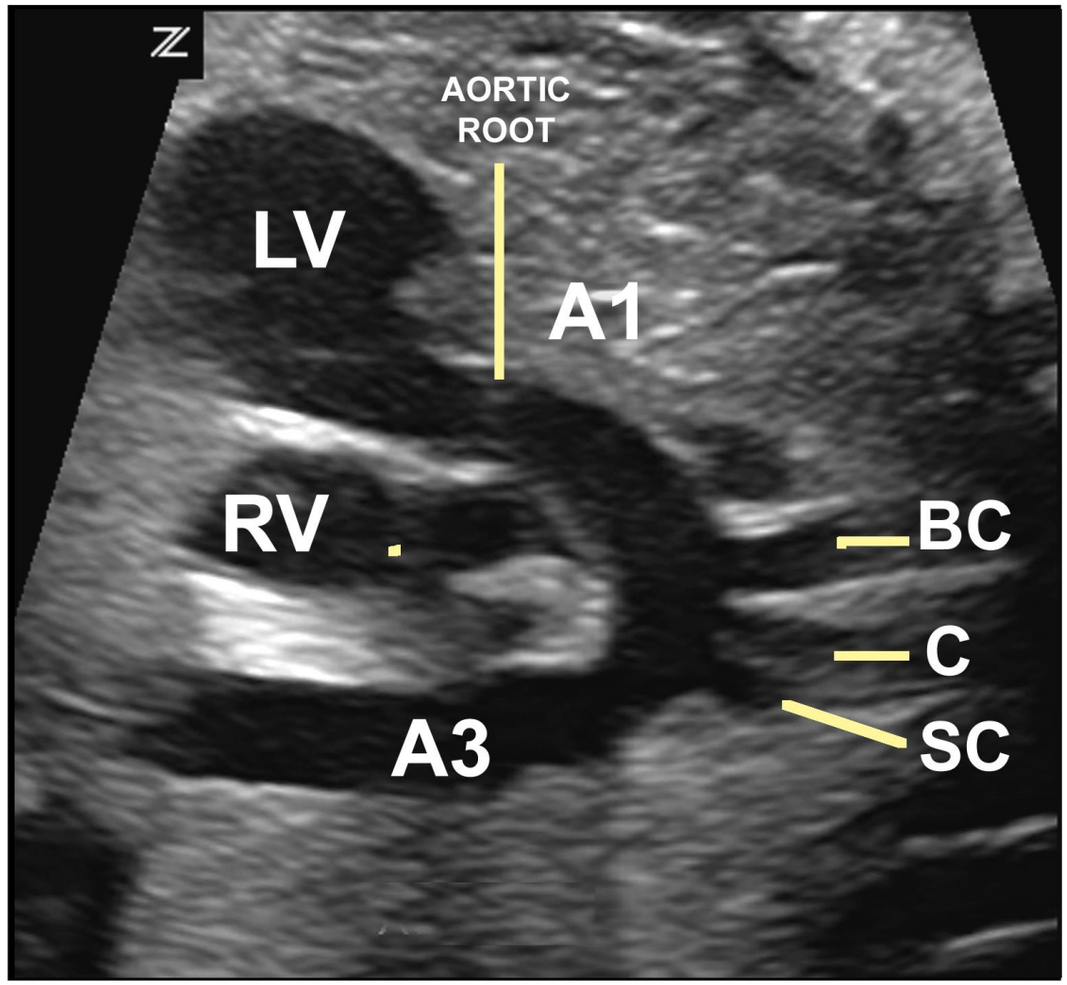


A1 = ascending aorta
A2 = aortic arch
A3 = descending aorta
A4 = thoracic aorta

1 = aortic root
LV = left ventricle
RV = right ventricle

AORTIC ARCH BRANCHES





A1 = ascending aorta
A3 = descending aorta

LV = left ventricle
RV = right ventricle

BC = brachiocephalic artery
SC = subclavian artery
C = common carotid artery

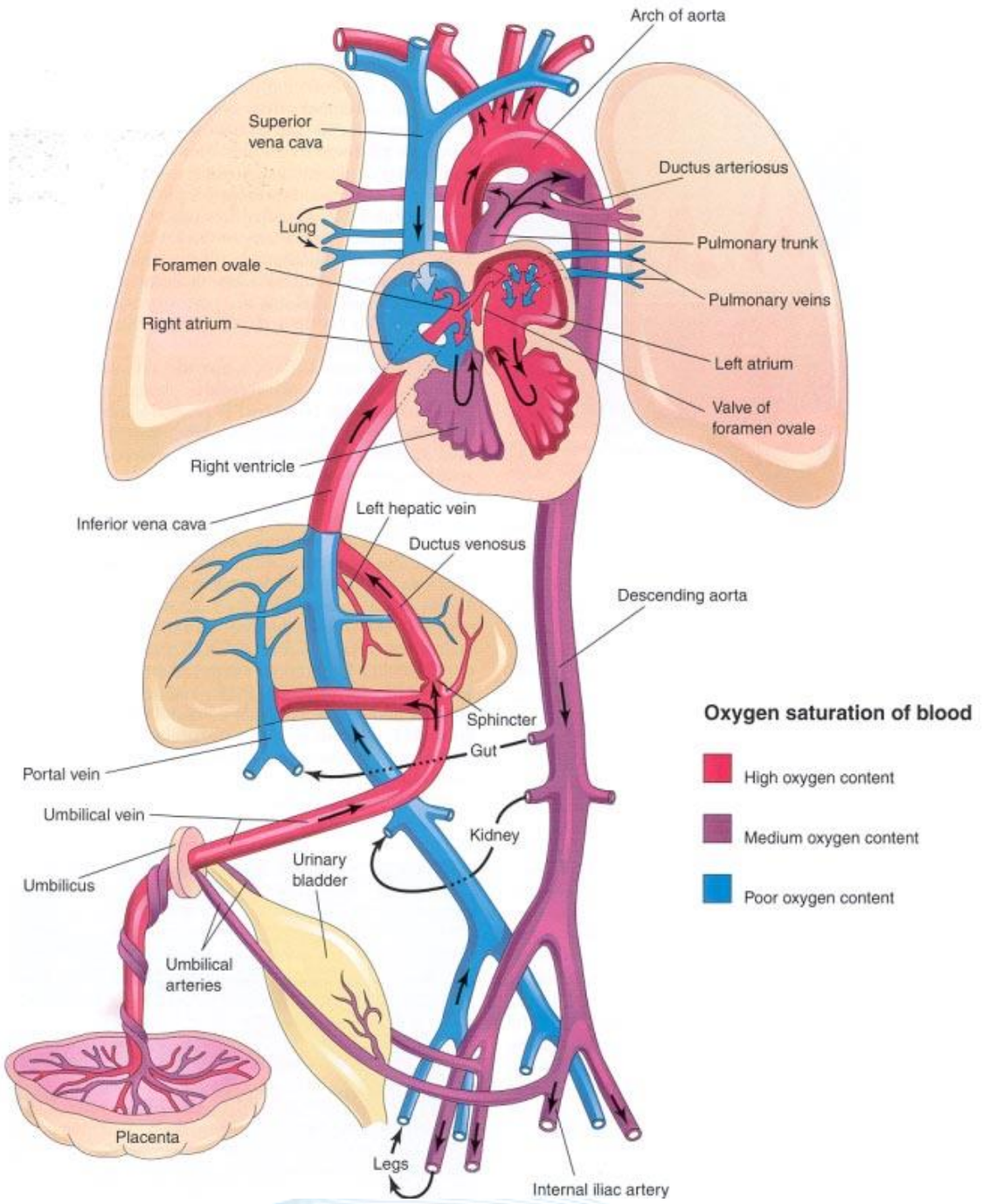
Heart – Cardiovascular Circulation

- Umbilical vein ➡ liver via *ductus venosus* and *portal sinus*
- Hepatic circulation & ductus venosus ➡ *IVC*
- IVC ➡ *right atrium*
- Right atrium 40% ➡ *foramen ovale* ➡ *left atrium* ➡ *systemic*
- Right atrium 60% ➡ *right ventricle*
- Right ventricle ➡ *(92%) pulmonary a.* ➡ *ductus arteriosus* ➡ *systemic*
- Right ventricle ➡ *(8%)* ➡ *right ventricle* ➡ *pulmonary a.* ➡ *lungs*

CARDIOVASCULAR CIRCULATION

Right atrium:
- 40% left atrium
- 60% right ventricle

Right ventricle:
- 92% pulmonary a. (ductus)
- 8% pulmonary a. (lungs)



Heart

- Routine sonographic examination of the fetal heart should include assessment of:
  - Situs (*visceroatrial*) – correct side of chest
  - Chambers (*ventricular loop*) – relation of ventricles to atria
  - Great vessel connections (*truncus arteriosus*) – relation of arteries to ventricles

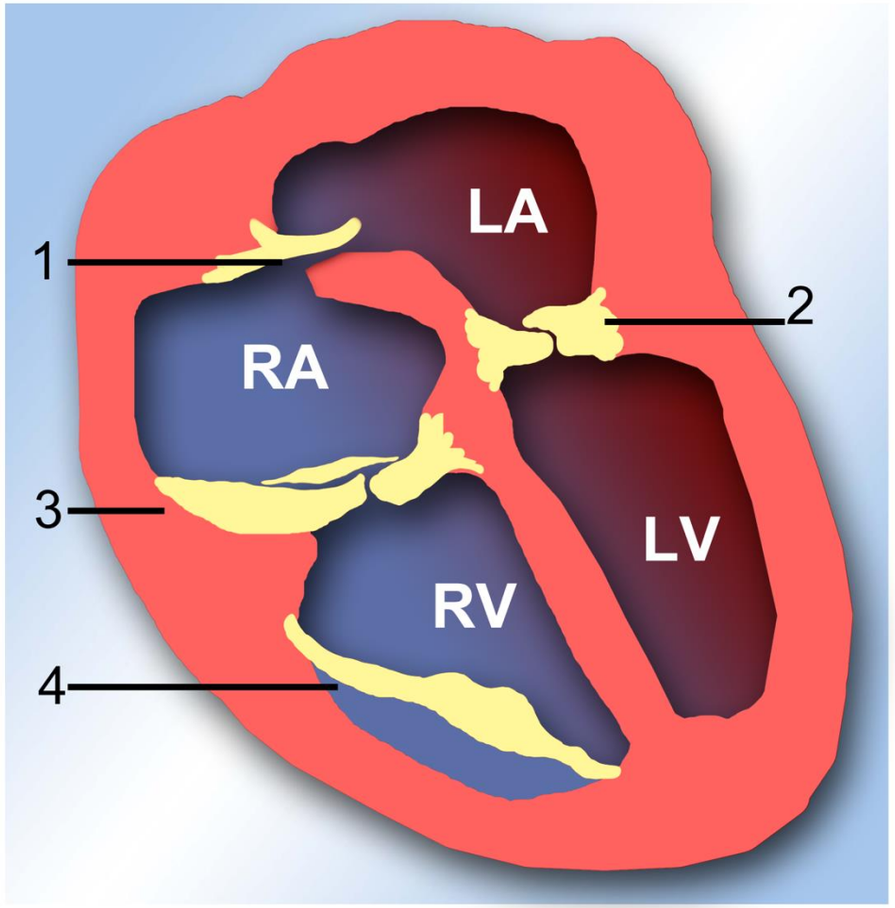
Routine Views

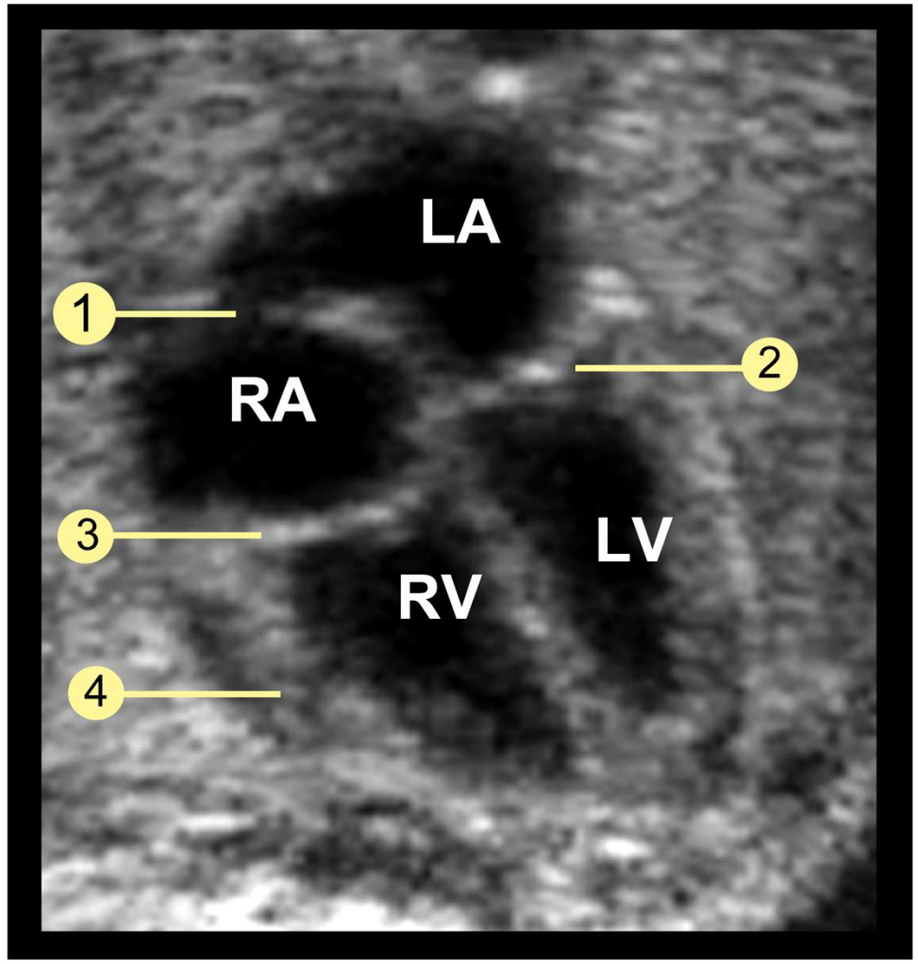
- Four-chamber
- Left ventricular outflow tract (LVOT)
- Right ventricular outflow tract (RVOT)
- Apical five-chamber view

Four-Chamber View

- Single most important view (≈ 90% of anomalies can be detected)
- Findings include:
  - Apex of heart point 45° to left anterior chest wall
  - Ventricles are symmetrical in size
  - Flap of foramen ovale opens into left atrium
  - Moderator bands are present in apex of right ventricle
  - Valves separate both atria from ventricles

HEART – FOUR-CHAMBER VIEW





LV = left ventricle
RV = right ventricle
LA = left atrium
RA = right atrium

1 = foramen ovale
2 = mitral valve
3 = tricuspid valve
4 = moderator band

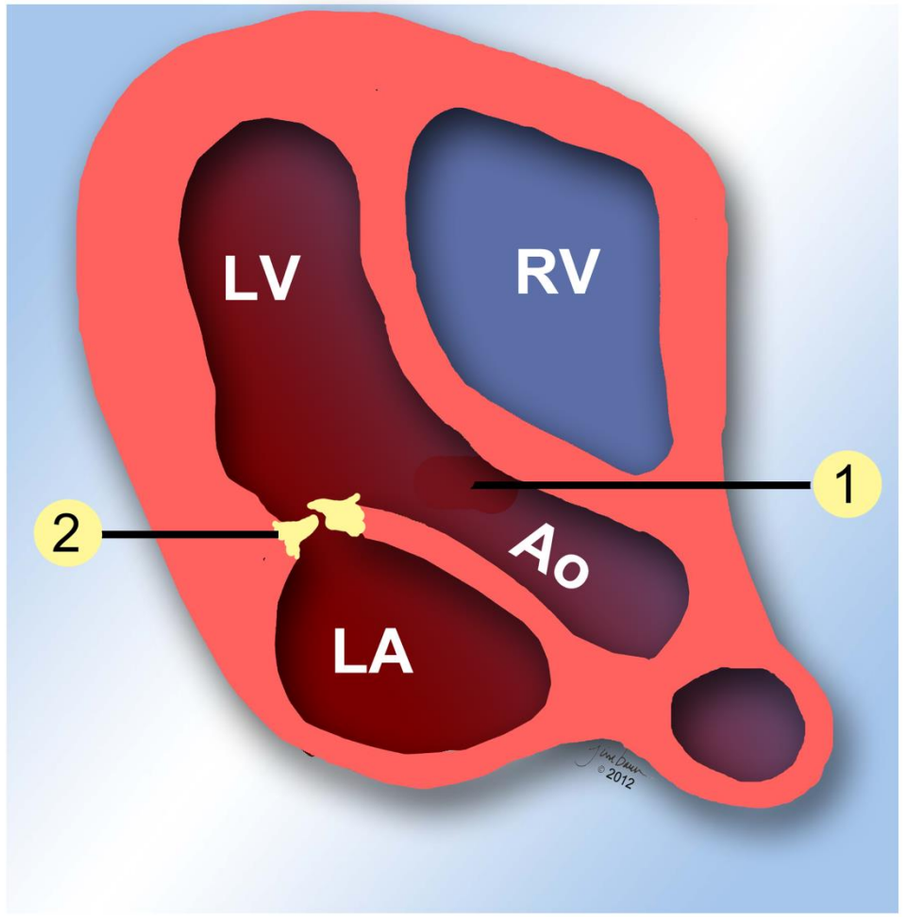
Four-Chamber View

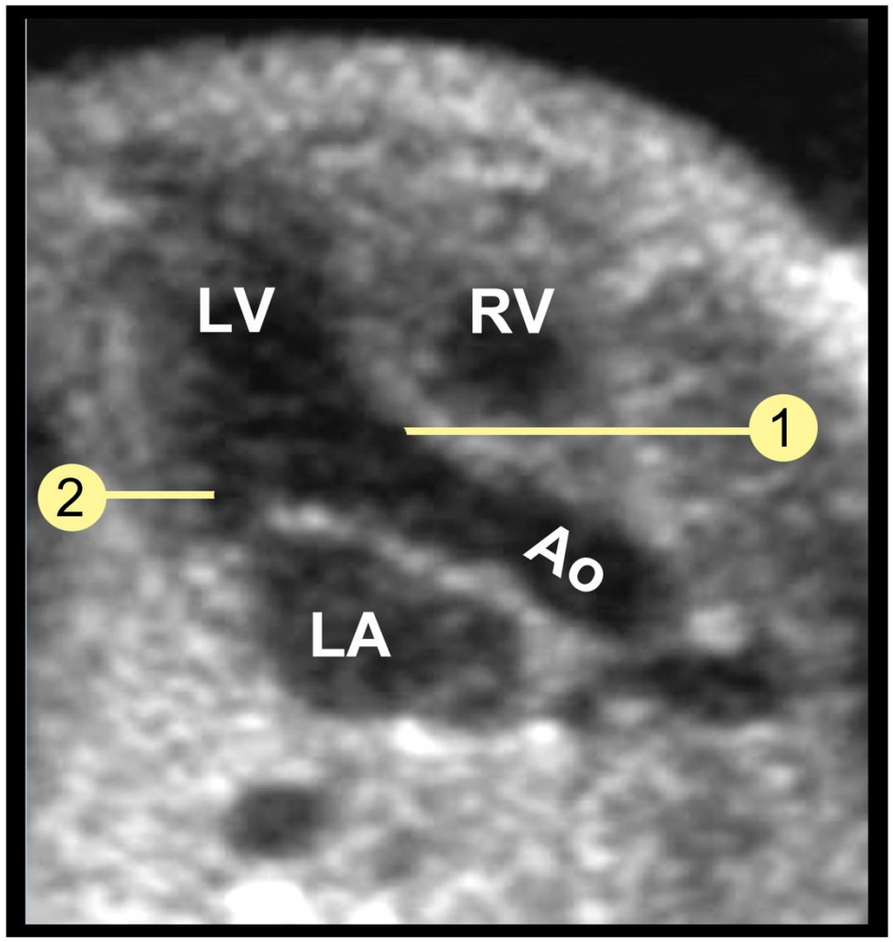
- Conditions visualized include:
  - Ventricular septal defects (VSD)
  - Atrial septal defects
  - Single ventricle
  - Ebstein’s anomaly
  - Hypertrophied or dilated ventricles
  - Cardiomyopathy
  - Endocardial cushion defects

Left Ventricular Outflow Tract (LVOT)

- Demonstrates relation of left ventricle to aorta
- Findings include:
  - Aortic and left ventricle continuity
  - Left atrium
  - Aortic root
  - Ventricular septum

HEART – LVOT





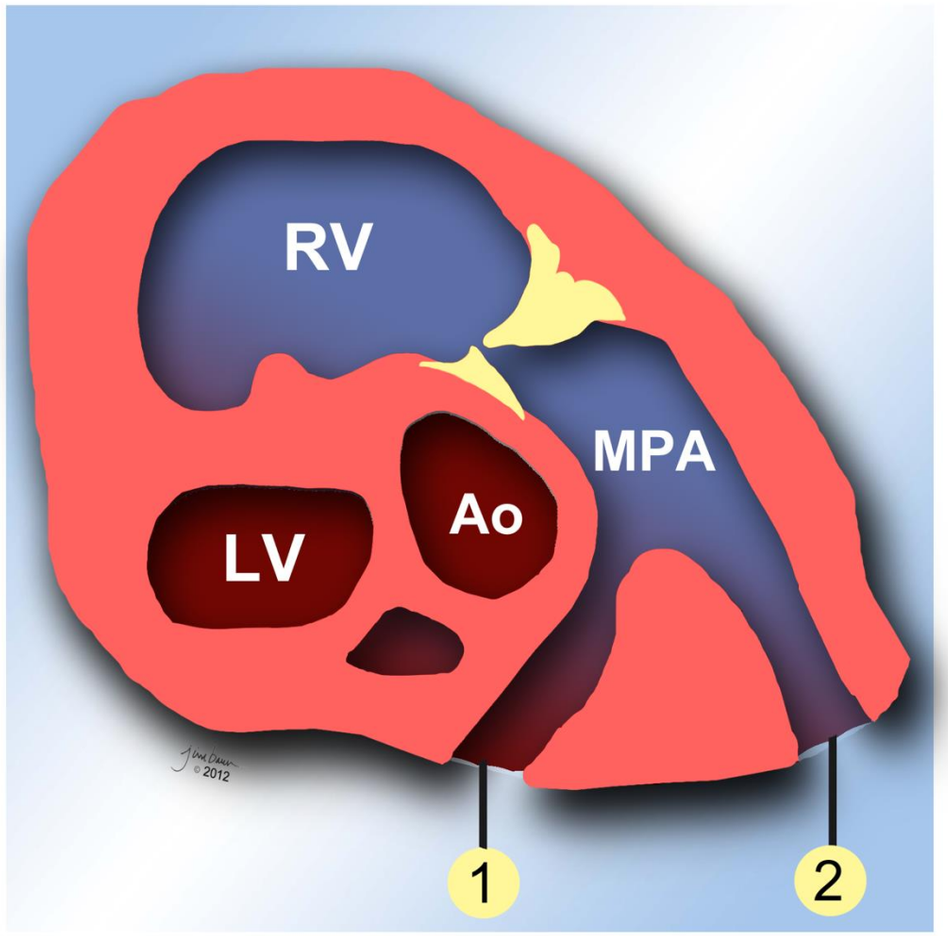
LV = left ventricle
RV = right ventricle
LA = left atrium
Ao = aota

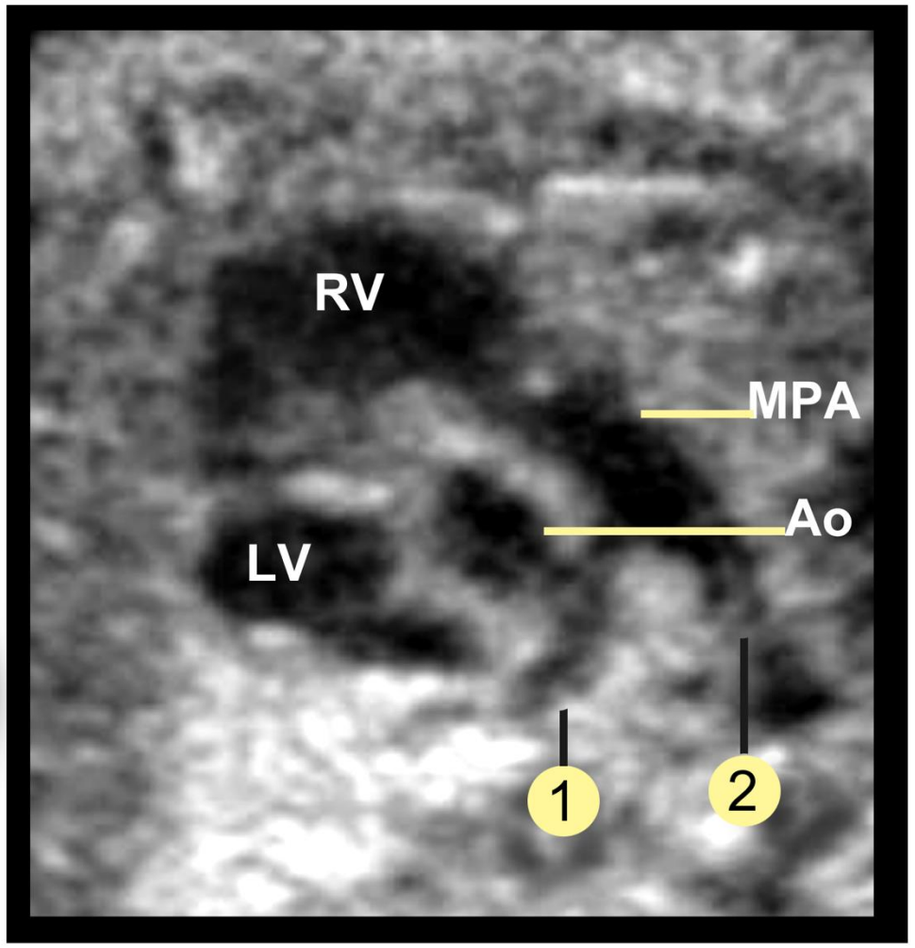
1 = aortic root
2 = mitral valve

Right Ventricular Outflow Tract (LVOT)

- Demonstrates relation of right ventricle to pulmonary artery
- Findings include:
  - Pulmonary artery exiting right ventricle and crossing over ascending aorta
  - Pulmonic valve separating right ventricle from main pulmonary artery
  - Right ventricle

HEART – RVOT





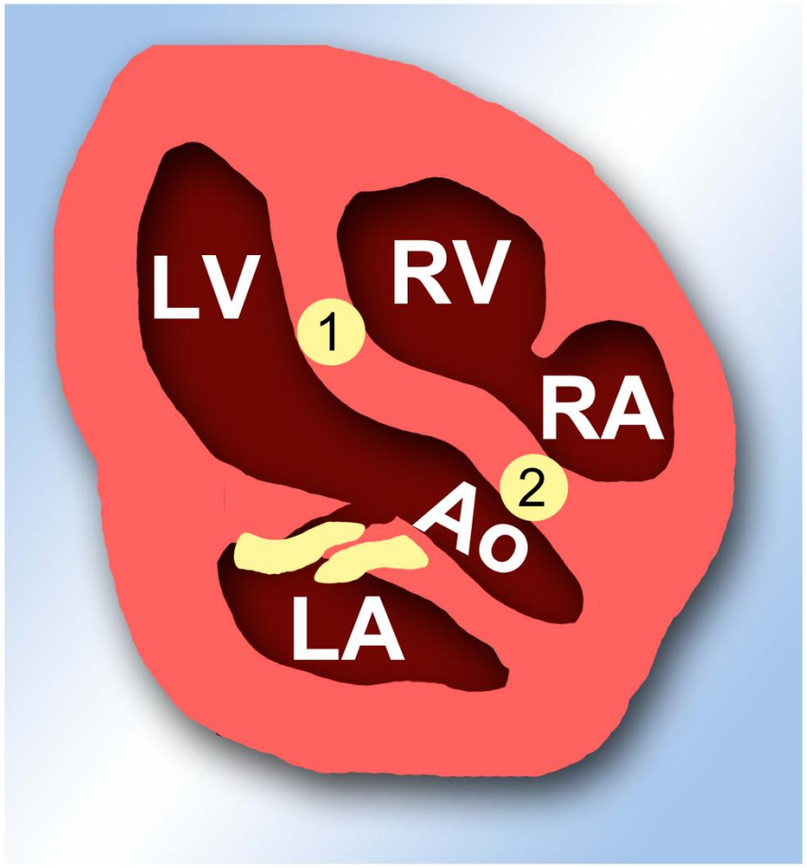
RV = right ventricle
LV = left ventricle
Ao = aorta
MPA = main pulmonary artery

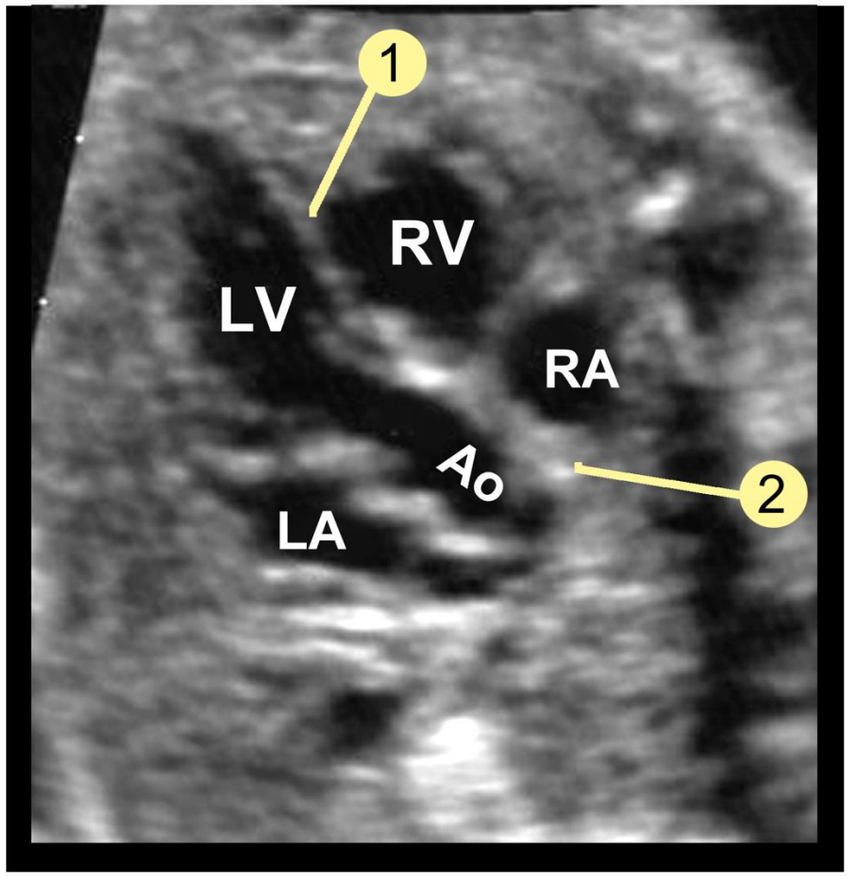
1 = left pulmonary artery
2 = right pulmonary artery

Apical Five-Chamber View

- Useful adjunct to four-chamber view in assessing integrity of cardiac chambers, septa, and LVOT
- Findings include:
  - Both ventricles and interventricular septum
  - Both atria and interatrial septum
  - Aortic root
  - LVOT

HEART – APICAL FIVE-CHAMBER VIEW





1 = intraventricular septum
2 = =intra-atrial septum

LV = left ventricle
RV = right ventricle
LA = left atrium
RA = ritgh atrium
Ao = aorta

Thoracic and Pulmonary

Thoracic and Pulmonary Abnormalities

- Pulmonary hypoplasia
- Pleural effusion
- Pulmonary sequestration
- Congenital diaphragmatic hernia
- Cystic adenomatoid malformation of the lung
- Tracheal atresia
- Chest masses

Pulmonary Hypoplasia

- Condition characterized by deficient or incomplete development of the lungs

- Usually a sequela to one of four conditions necessary for lung development
  - Adequate thoracic space
  - Normal fetal breathing movements
  - Fluid production in the lungs (*pulmonary surfactant*)
  - Adequate amount of amniotic fluid

Pulmonary Hypoplasia

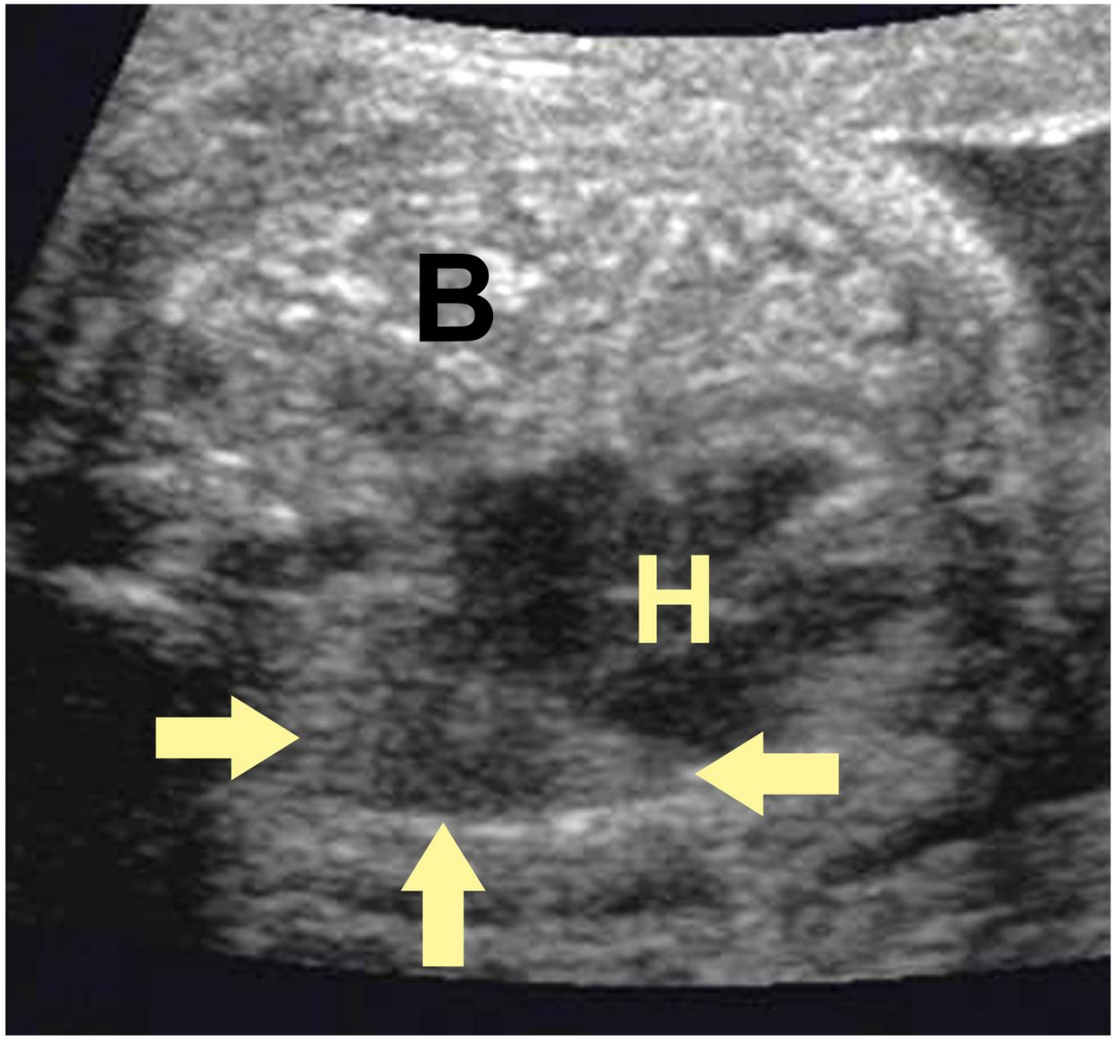
- Associated abnormalities include:
  - Diaphragmatic hernia
  - Sequestration of the lung
  - Agenesis of the diaphragm
  - Intrathoracic masses
  - Thanatophoric lung

Pulmonary Hypoplasia

- Sonographic findings include:
  - Reduced head-to-chest ratio
  - Reduced thoracic circumference
  - Oligohydramnios frequently associated

PULMONARY HYPOPLASIA

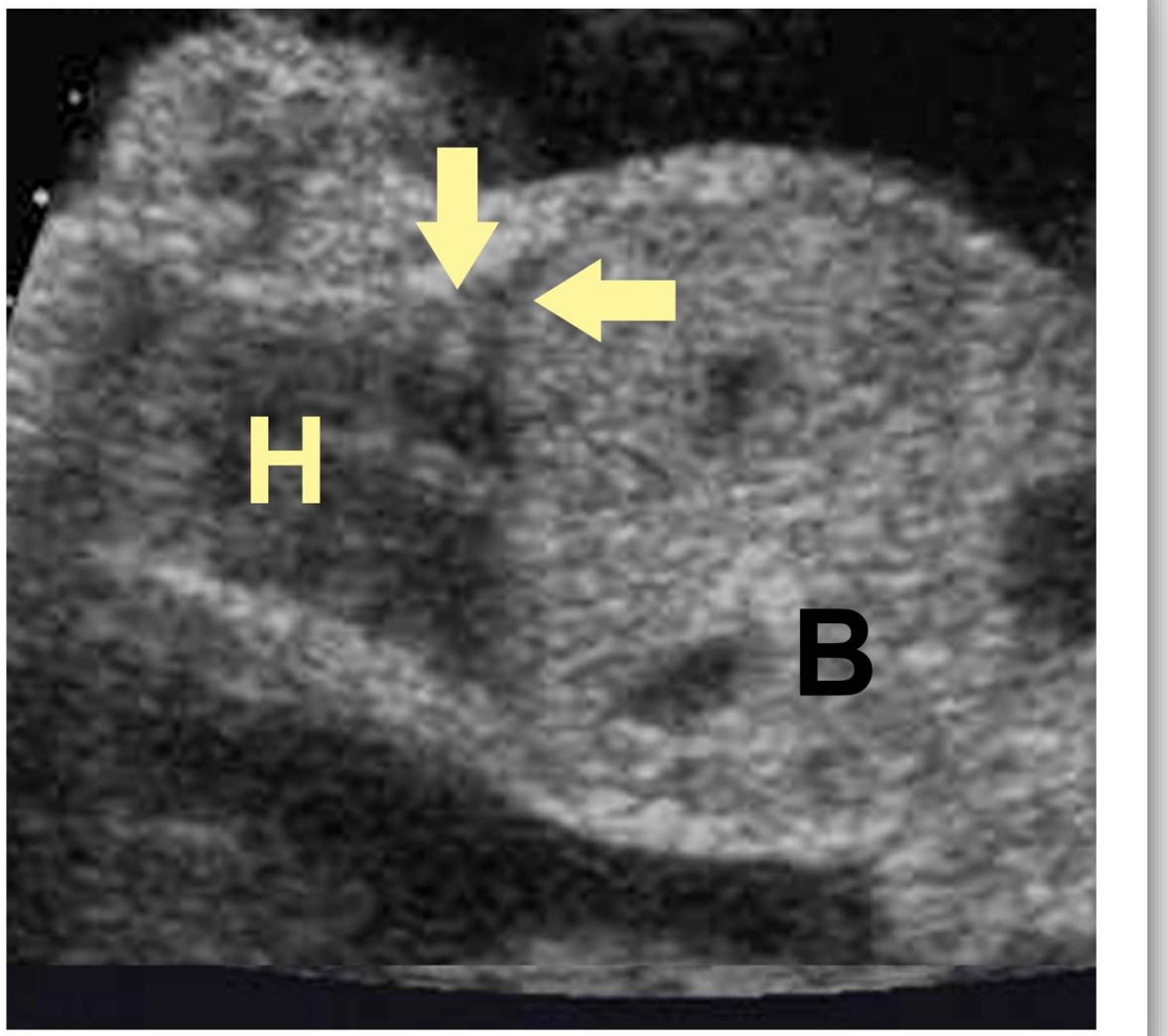
B = bowel
H = heart
Arrows = hypoplastic lung



Diaphragmatic hernia

PULMONARY HYPOPLASIA

B = bowel
H = heart
Arrows = hypoplastic lung



Thanatophoric dysplasia

Pleural Effusion

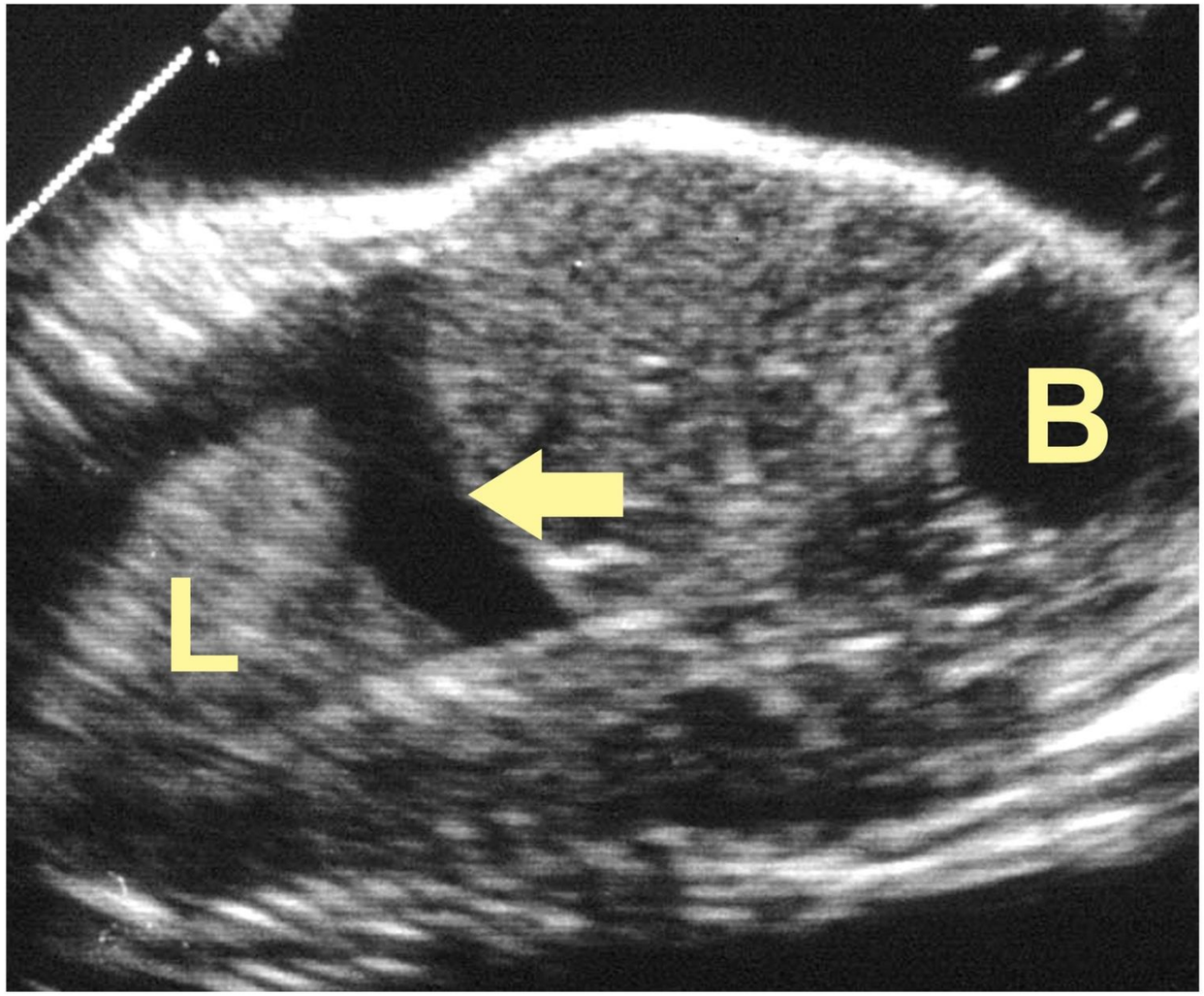
- Collection of fluid in the pleural cavity
- Also called *hydrothorax*
- *Chylothorax:* primary type caused by lymphatic leakage
- Causes include:
  - Hydrops fetalis (most common) ☑
  - Congenital cardiac anomalies
  - Congenital lung anomalies
  - Chromosomal abnormalities

Pleural Effusion

- Sonographic findings include:
  - Anechoic fluid surrounding the lung and conforming to the shape of the pleural cavity
  - May be uni- or bilateral

PLEURAL EFFUSION

L = lung
B = bladder
Arrows = pleural fluid



Hydrops fetalis

Pulmonary Sequestration

- An accessory fragment of lung that has no connection to the tracheobronchial tree
- Maintains its own separate, arterial circulation
- Two types:
  - Intralobar: adjacent to normal; lung, no separate pleura
  - Extralobar: separate from adjacent lung; individual pleura

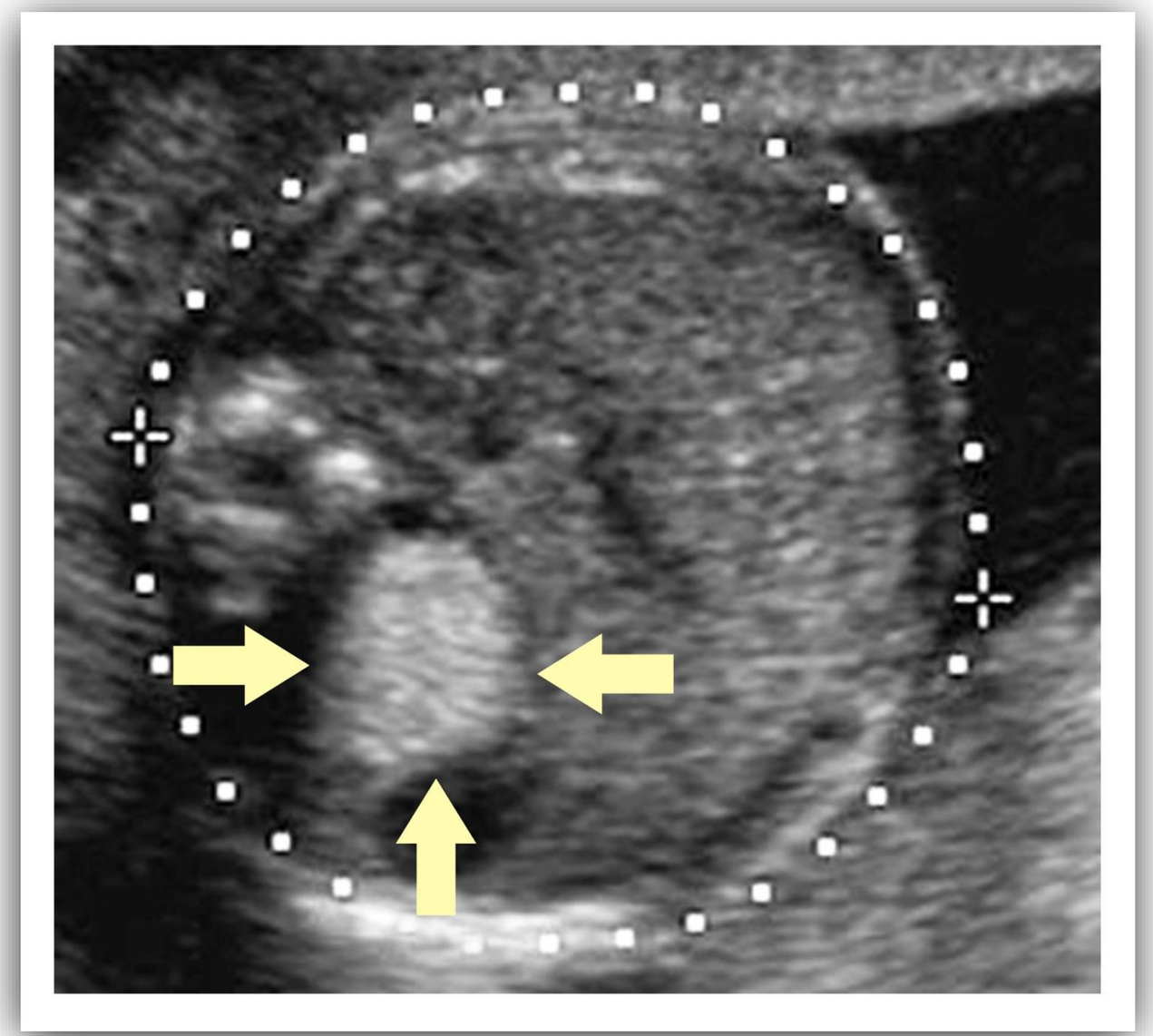
Pulmonary Sequestration

- Associated abnormalities include:
  - Diaphragmatic hernia
  - Diaphragmatic eventration
  - Congenital heart disease

Pulmonary Sequestration

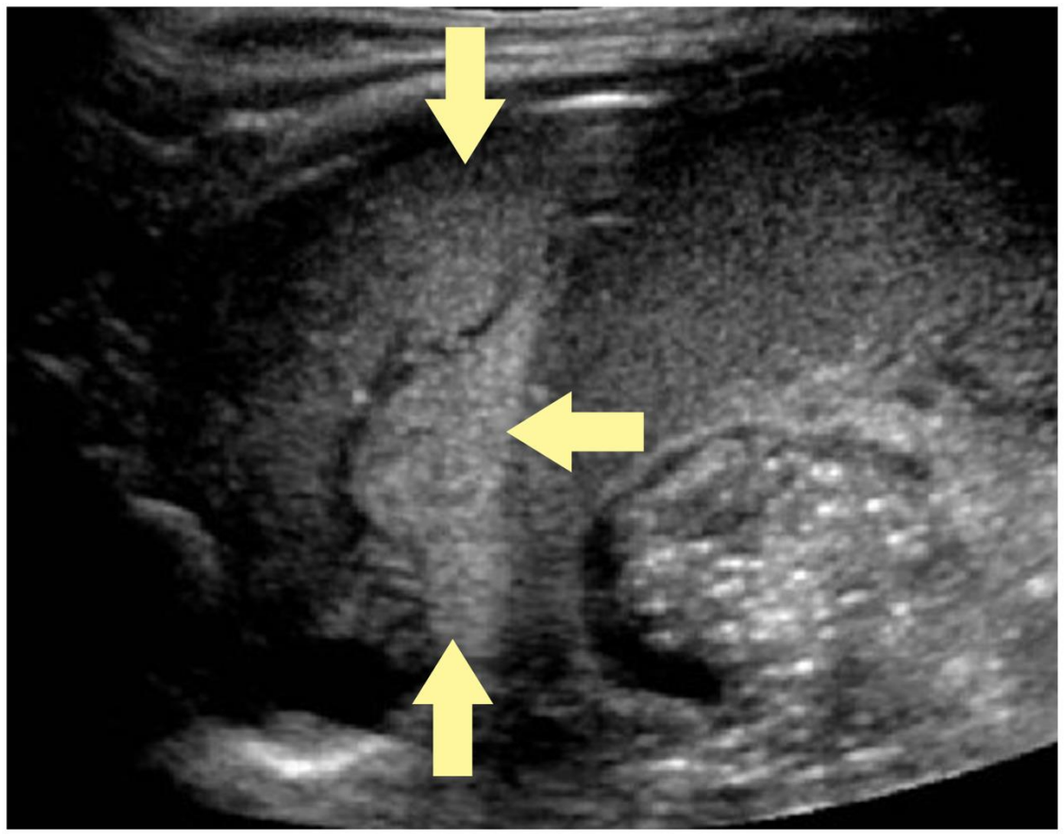
- Sonographic findings include:
  - Well-defined, solid echogenic mass adjacent to normal appearing lung
  - Identification of an independent feed vessel arising from the aorta
  - Possible sonographic signs of hydrops fetalis

PULMONARY SEQUESTRATION

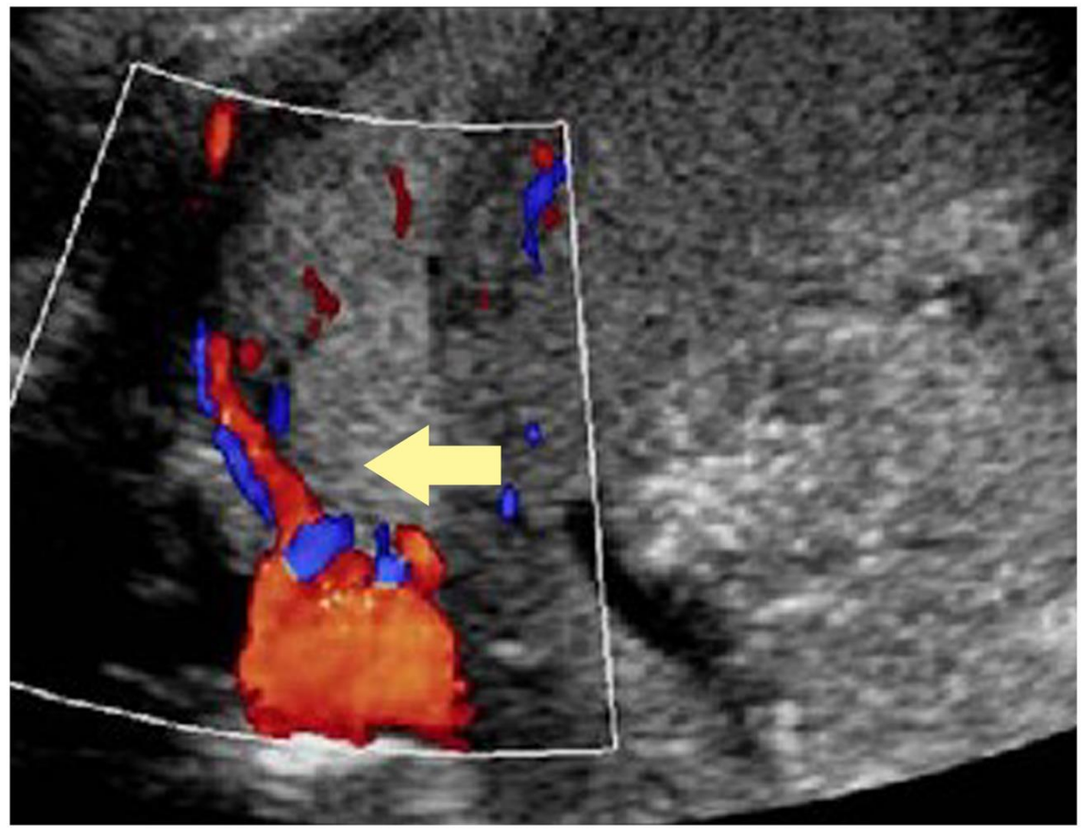


Arrows = sequestered segment

PULMONARY SEQUESTRATION



Echogenic sequestered lobe (*arrows*).



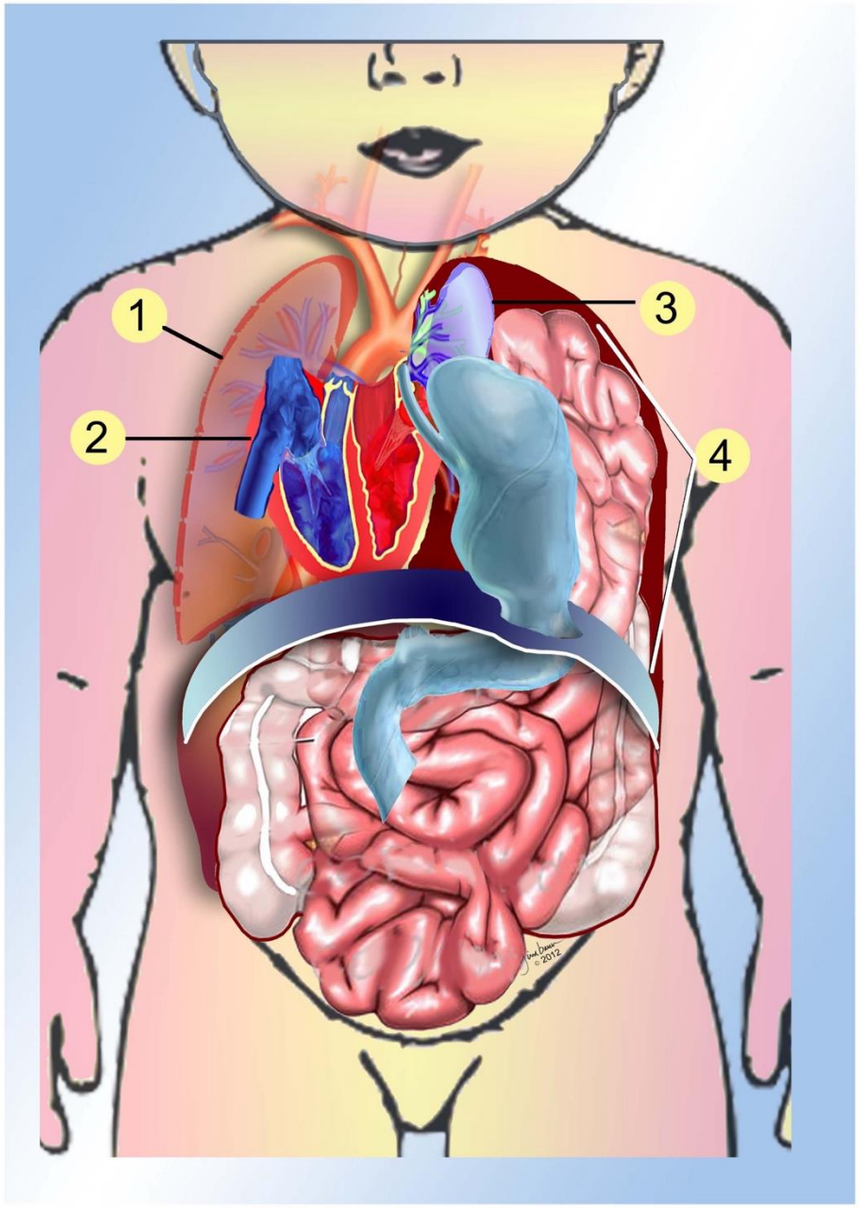
Feed vessel originating from the aorta (*arrow*).

Congenital Diaphragmatic Hernia (CHD)

- Herniation of abdominal viscera into thoracic cavity through a diaphragmatic defect
- Results from incomplete fusion of diaphragmatic structures in embryo
- Left side (*Bochdalek*): most common ≈ 95%
- Right side (*Morgagni*): rare ≈ 2%

CONGENITAL DIAPHRAGMATIC HERNIA

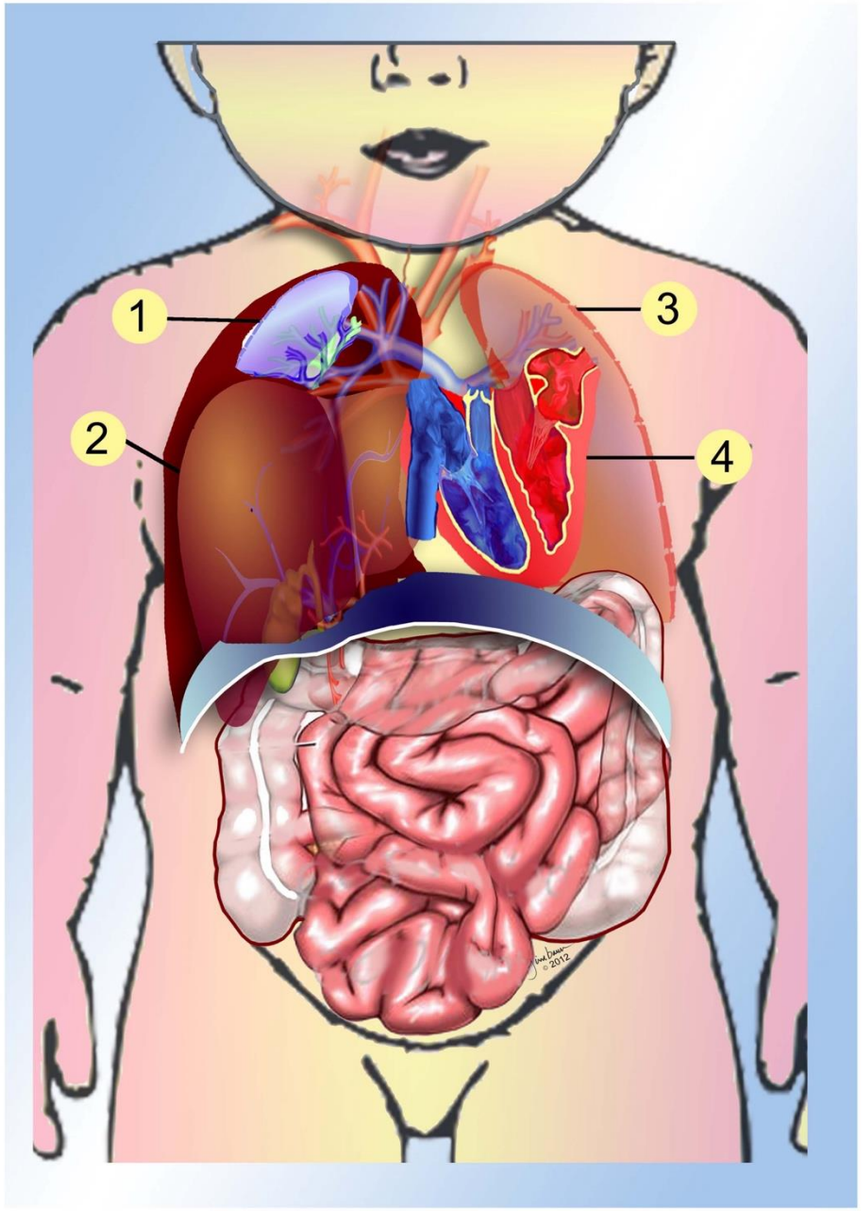
Left-sided (Bochdalek)



1 = right lung
2 = displaced heart
3 = hypoplastic left lung
4 = herniated viscera

CONGENITAL DIAPHRAGMATIC HERNIA

Right-sided (Morgagni)



1 = hypoplastic right lung
2 = liver
3 = left lung
4 = displaced heart

Congenital Diaphragmatic Hernia (CHD)

- Associated abnormalities include:
  - Pulmonary hypoplasia ☑
  - Pulmonary sequestration
  - Trisomies 13, 18, 21
  - Turner syndrome
  - Neural tube defects
  - Congenital cardiac anomalies

Congenital Diaphragmatic Hernia (CHD)

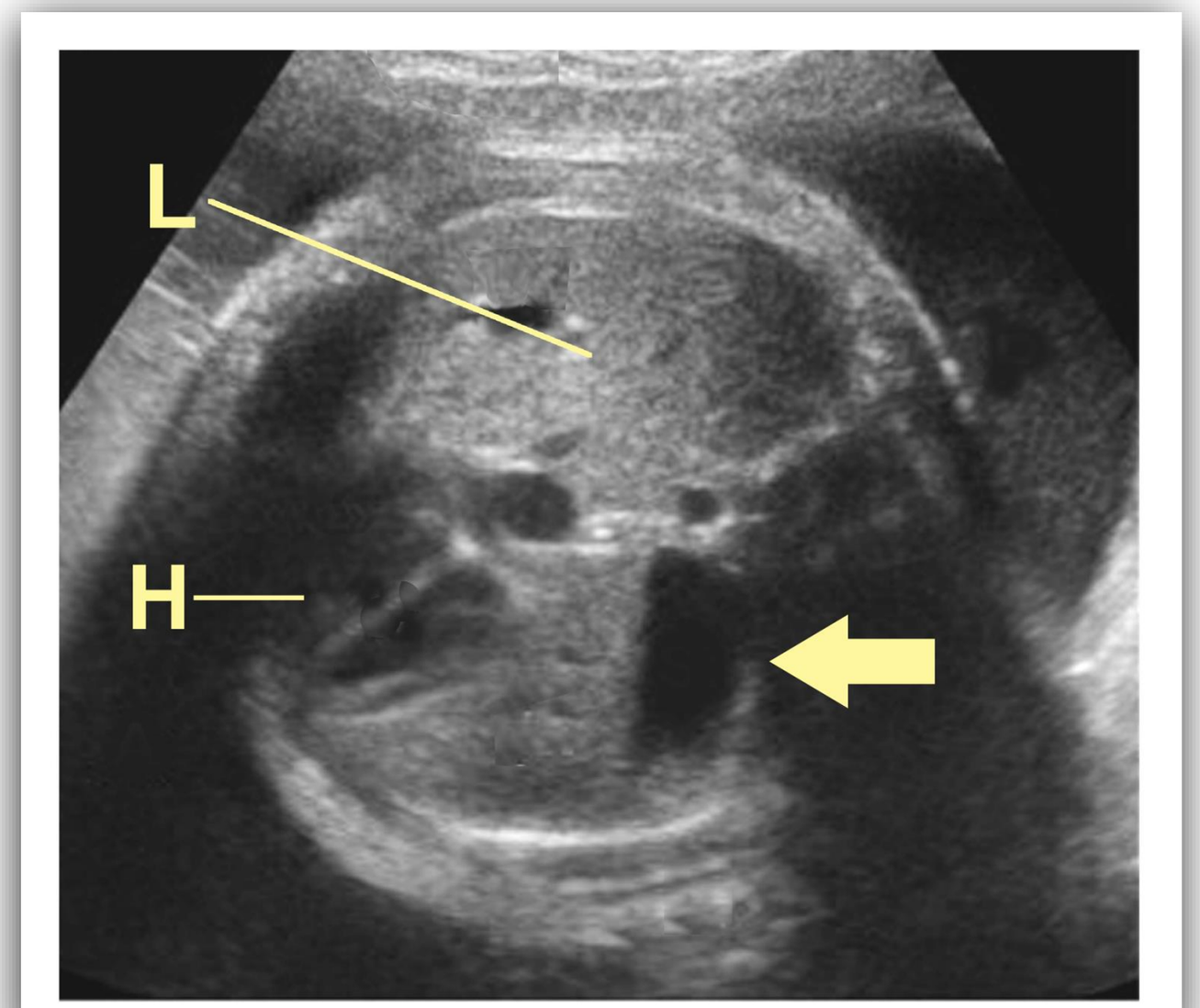
- Sonographic findings include:
  - Cardiomediastinal shift to the nonherniated side of chest
  - Stomach/bowel loops at same level as heart (*left-sided*)
  - Hepatic veins and liver in thorax (*right-sided*)
  - Absent bowel loops on abdomen
  - Polyhydramnios

CONGENITAL DIAPHRAGMATIC HERNIA

Cardiomediastinal shift

CONGENITAL DIAPHRAGMATIC HERNIA

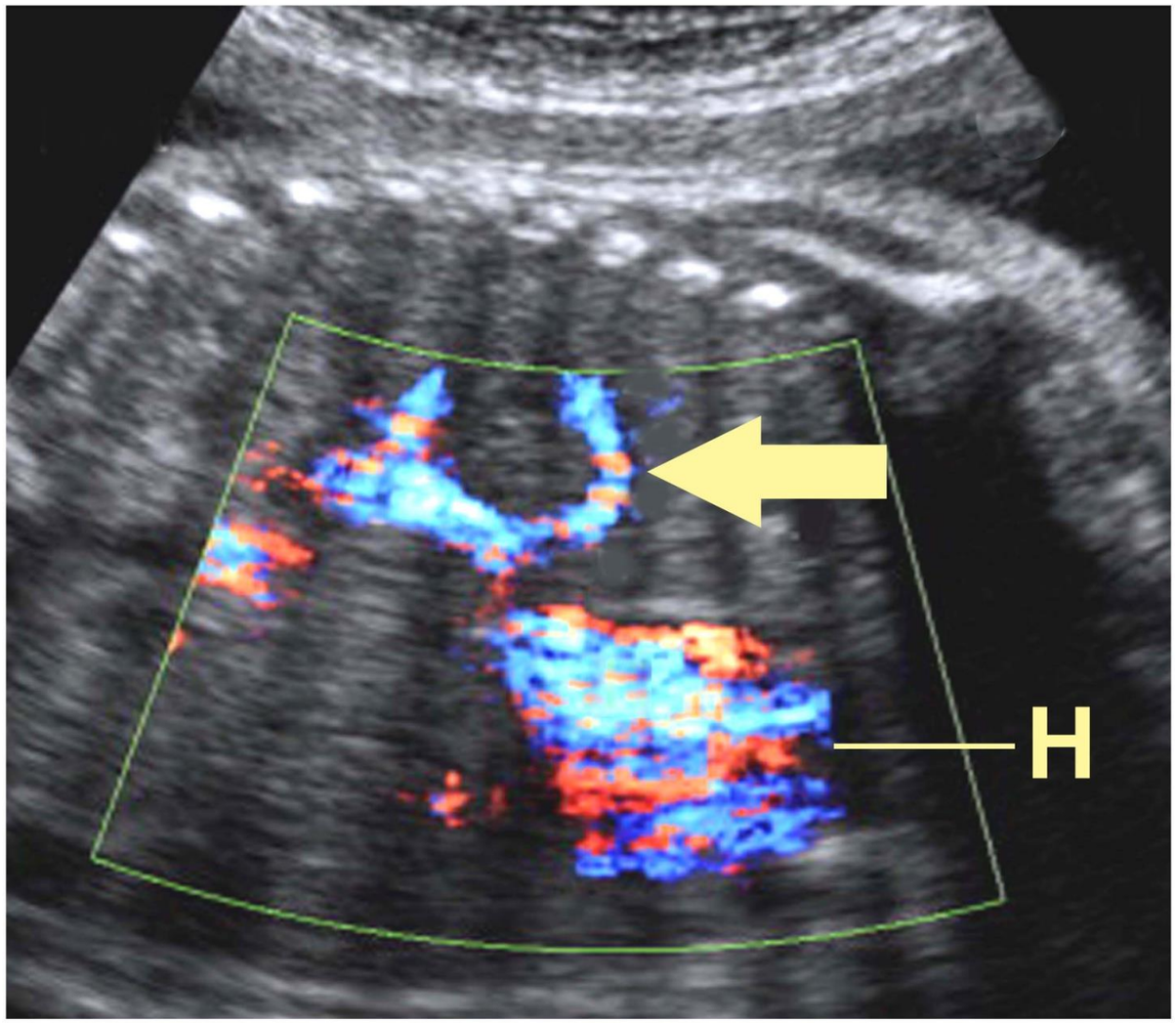
H = heart
L = liver
Arrow = stomach



Stomach at same level as heart

CONGENITAL DIAPHRAGMATIC HERNIA

H = heart
Arrow = hepatic vein



Right-sided hernia

Cystic Adenomatoid Malformation of the Lung (CAML)

- Abnormality in which normal lung tissue is replaced by nonfunctioning cystic tissue
- Three classes based on cyst size:
  - Type I: large cysts (*most common*) ≈ 70%
  - Type II: multiple cysts (<1.2 cm in size)
  - Type III: microcystic lesions causing mediastinal shift
- Prognosis depends on extent of lung replacement

CYSTIC ADENOMATOID MALFORMATION OF THE LUNG

Type I | Type II | Type III

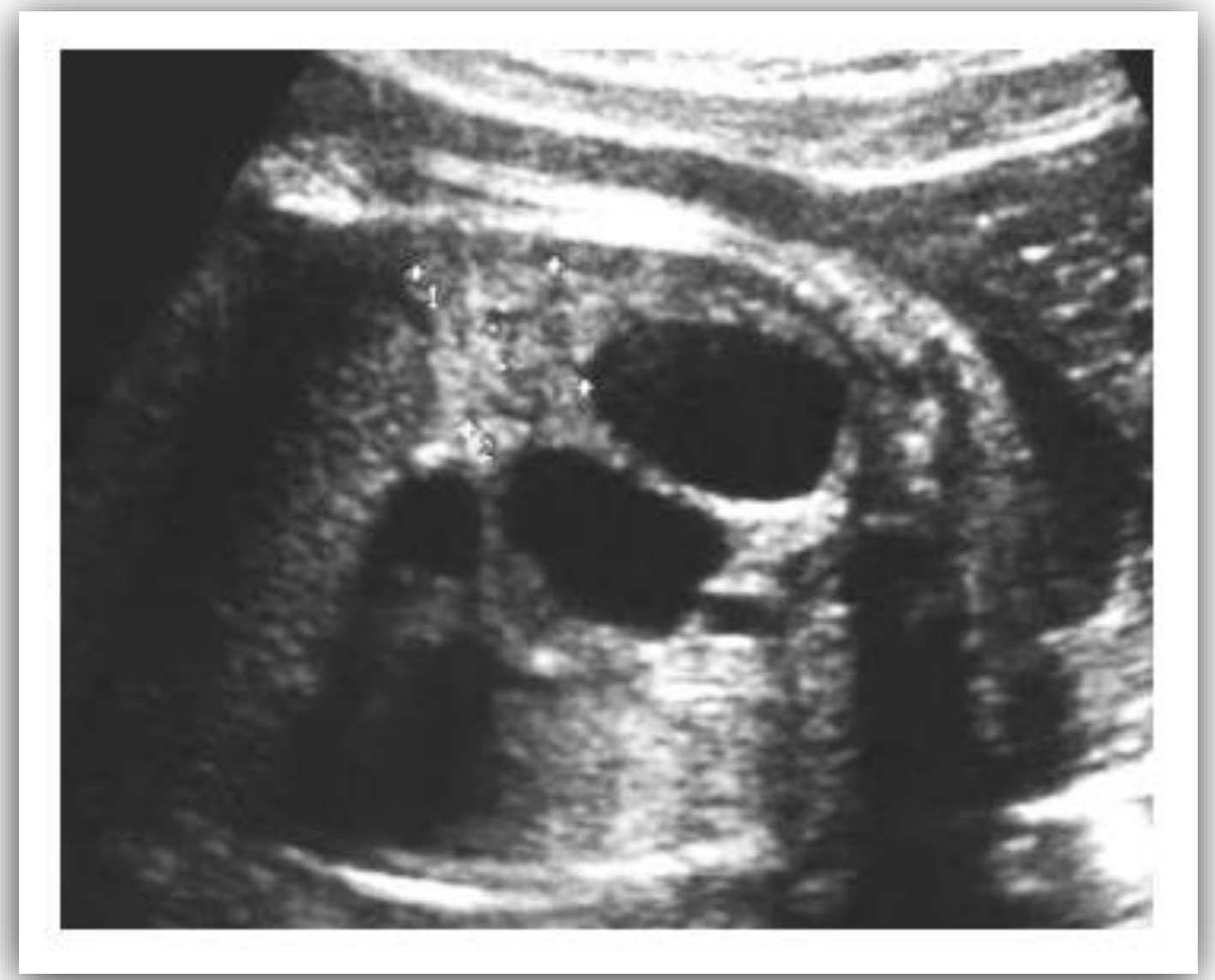
Cystic Adenomatoid Malformation of the Lung (CAML)

- Associated abnormalities include:
  - Pulmonary sequestration
  - Renal agenesis
  - Hydrops fetalis
  - Polyhydramnios

Cystic Adenomatoid Malformation of the Lung (CAML)

- Sonographic findings based on type and extent:
  - *Type I*: nonvascular cystic masses in the fetal lung
  - *Type II*: homogeneously echogenic lobe(s)
  - *Type III*: mediastinal shift with lateral displacement of heart

CYSTIC ADENOMATOID MALFORMATION OF THE LUNG



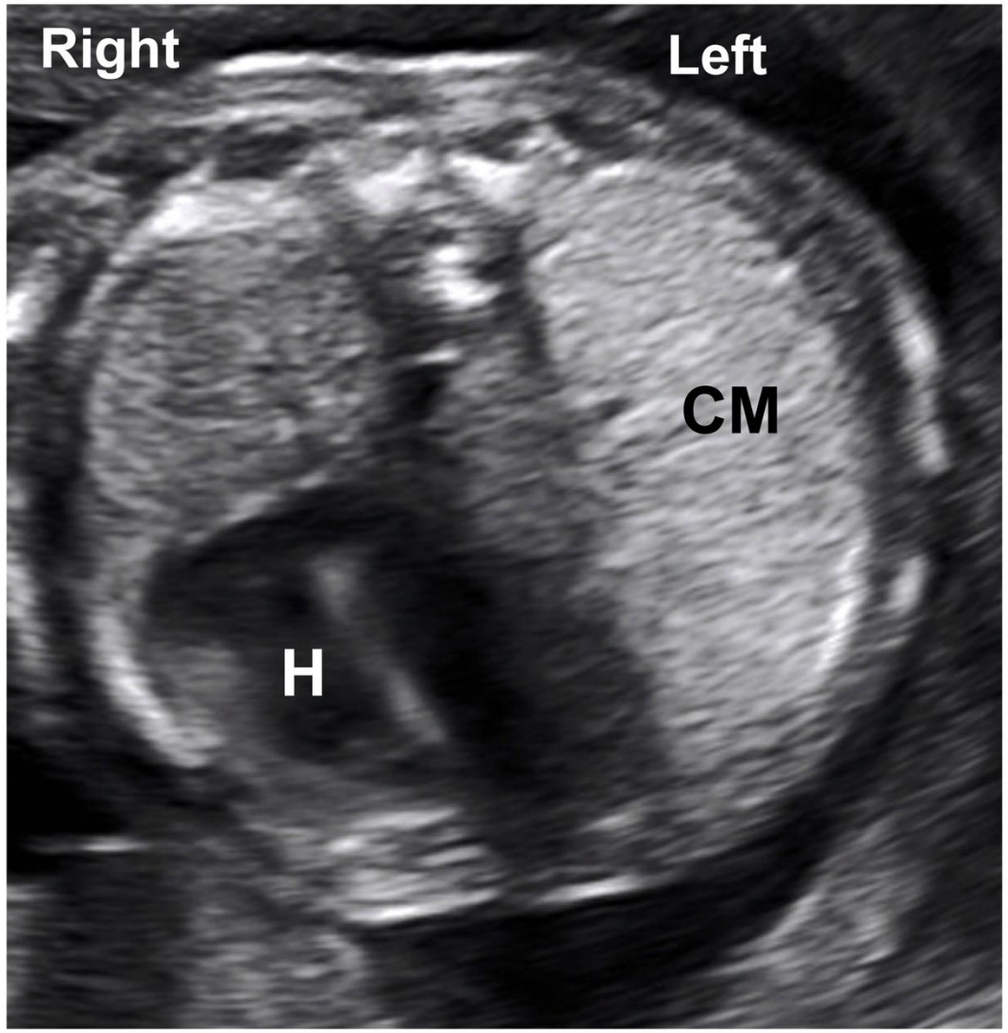
Nonvascular cystic mass

CYSTIC ADENOMATOID MALFORMATION OF THE LUNG

Homogeneously echogenic lobe

CYSTIC ADENOMATOID MALFORMATION OF THE LUNG

H = heart
CM = cystic mass



Mediastinal shift with lateral displacement of heart

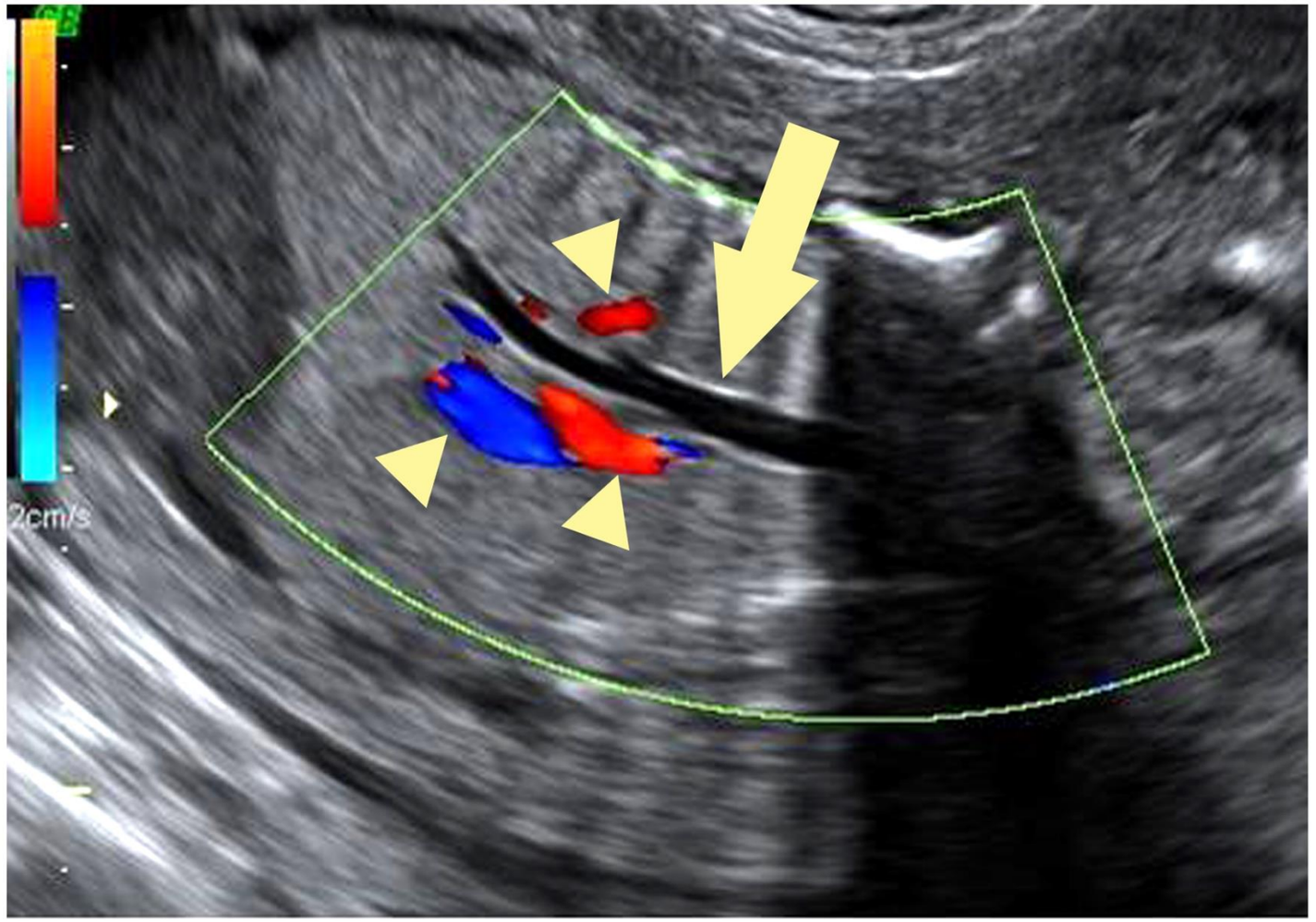
Tracheal Atresia

- Rare pulmonary anomaly in which trachea fails to form or is obliterated by external compression
- Uniformly lethal
- Associated abnormalities include:
  - Renal anomalies
  - CNS malformations
  - Tracheoesophageal atresia

Tracheal Atresia

- Sonographic findings include:
  - Bilateral diffusely echogenic lungs
  - Fluid-filled trachea
  - Enlarged lungs adjacent to a relatively small heart
  - Polyhydramnios

TRACHEAL ATRESIA



Fluid-filled trachea (arrow) and pulmonary vasculature (arrowheads)

Chest Masses

- Rare but easily detected sonographically as they dramatically distort intrathoracic architecture
- May include (in addition to those mentioned above):
  - Teratomas
  - Enteric cysts
  - Thymic masses
- Pathological differentiation not possible with prenatal US

Chest Masses

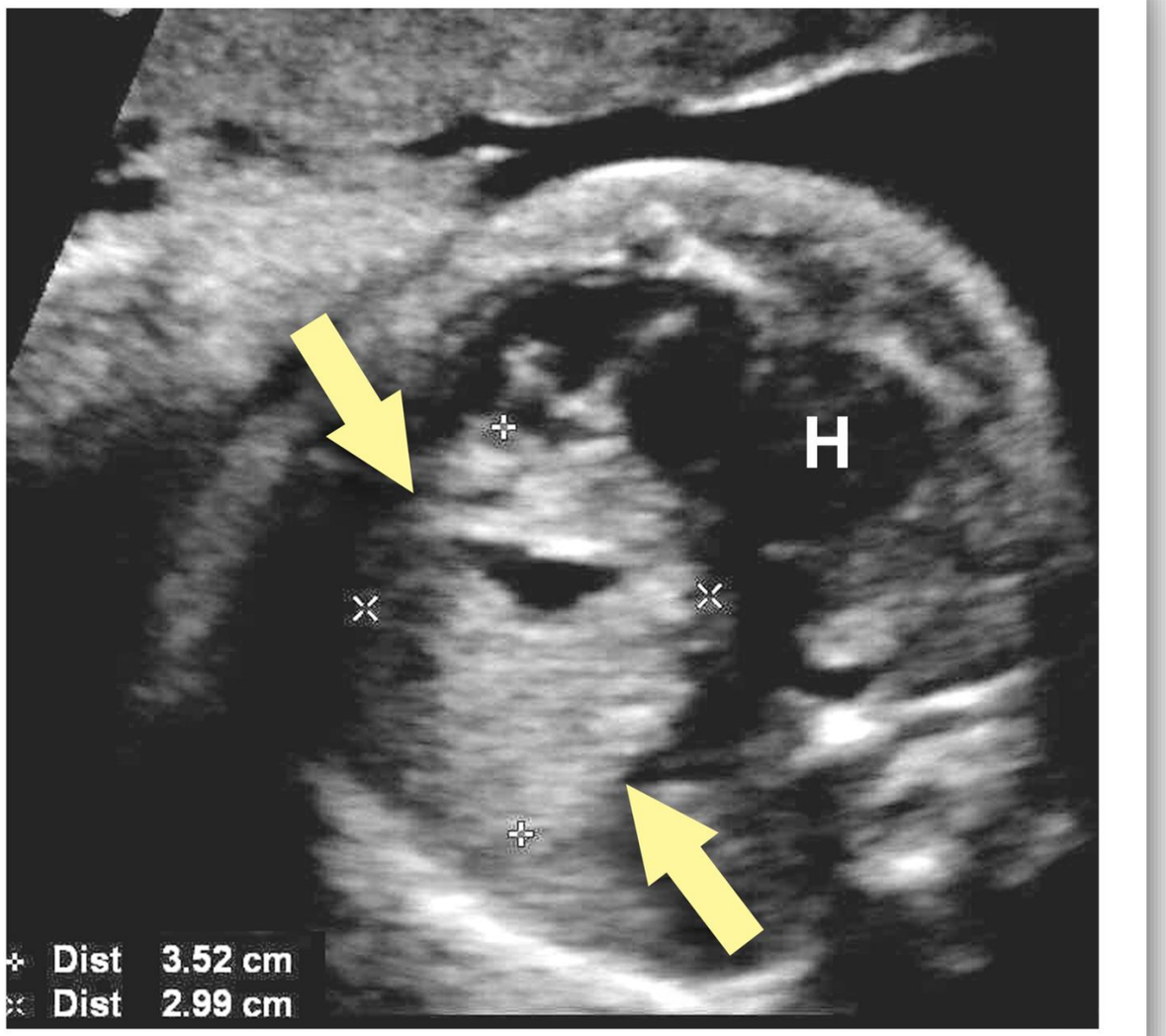
- Associated abnormalities include:
  - Pulmonary hypoplasia
  - Congenital heart disease
  - Tracheal atresia

Chest Masses

- Sonographic findings include:
  - Presence of a sonographically complex mass in thoracic cavity
  - Displaced mediastinal structures
  - Pleural effusions

CHEST MASSES

H = heart
arrows = mass



Sonographically complex mass displacing heart

Heart and Great Vessels

Heart and Great Vessel Abnormalities

- Septal defects
- Conotruncal anomalies
- Single ventricle anomalies
- Disproportionate ventricular size
- Positional abnormalities
- Cardiac wall abnormalities

Septal Defects

- Structural abnormalities inside the heart that allow anomalous circulatory communication between the chambers
- Arise from failure of embryologic processes that seal off cross-chamber foramina
- Types include:
  - Ventricular septal defects (VSD)
  - Atrial septal defects (ASD)
  - Atrioventricular septal defects (ASVD)

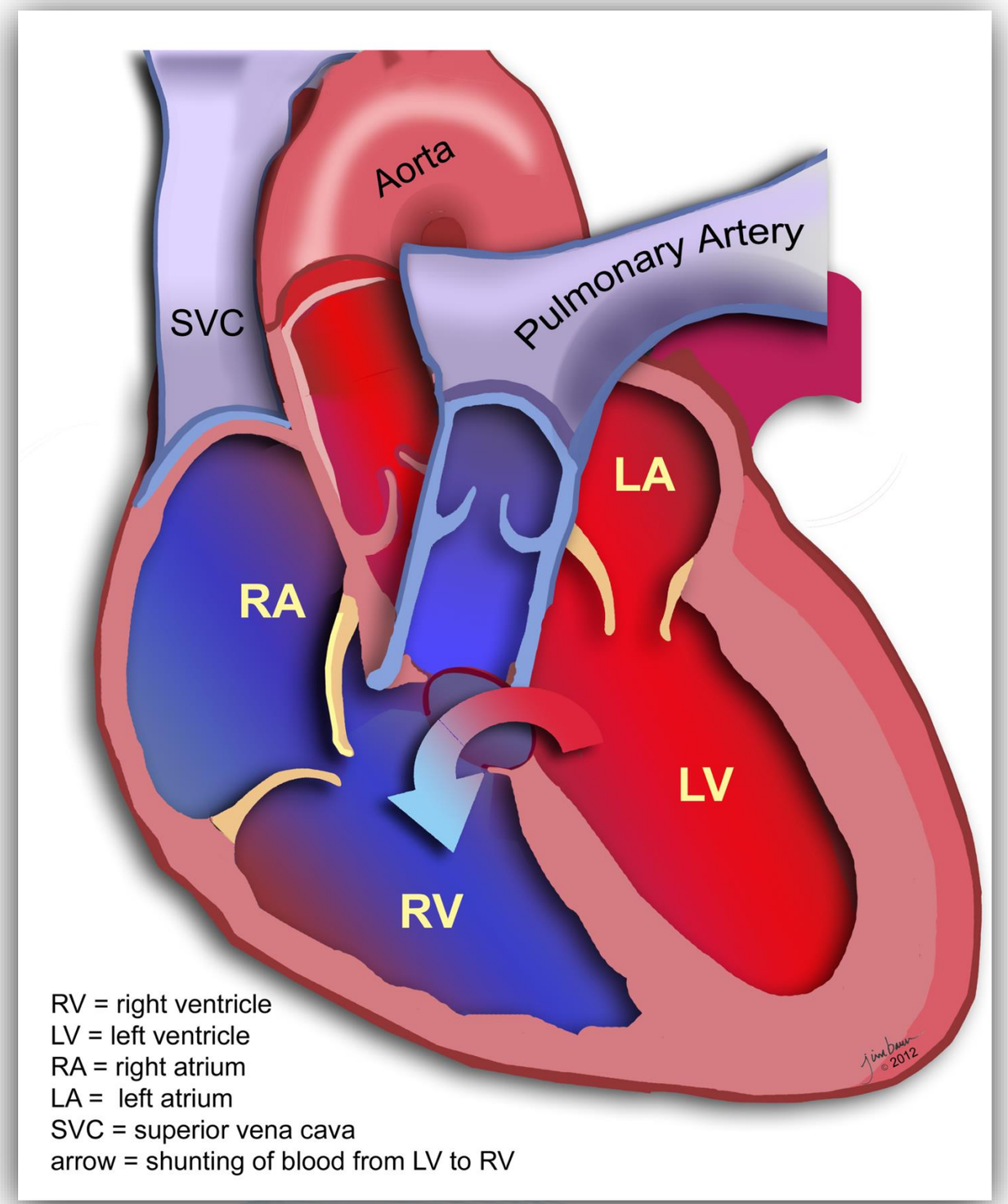
Ventricular Septal Defects (VSD)

- Abnormal communication between right and left ventricles via a defect in intraventricular septum
- Most common congenital cardiac anomaly
- May be isolated defect or occurring in association with many other cardiac defects

Ventricular Septal Defects (VSD)

- Associated abnormalities include:
  - Tetralogy of Fallot ☑
  - Truncus arteriosus
  - Double-outlet right ventricle
  - Aortic coarctation
  - Tricuspid atresia

VENTRICULAR SEPTAL DEFECTS



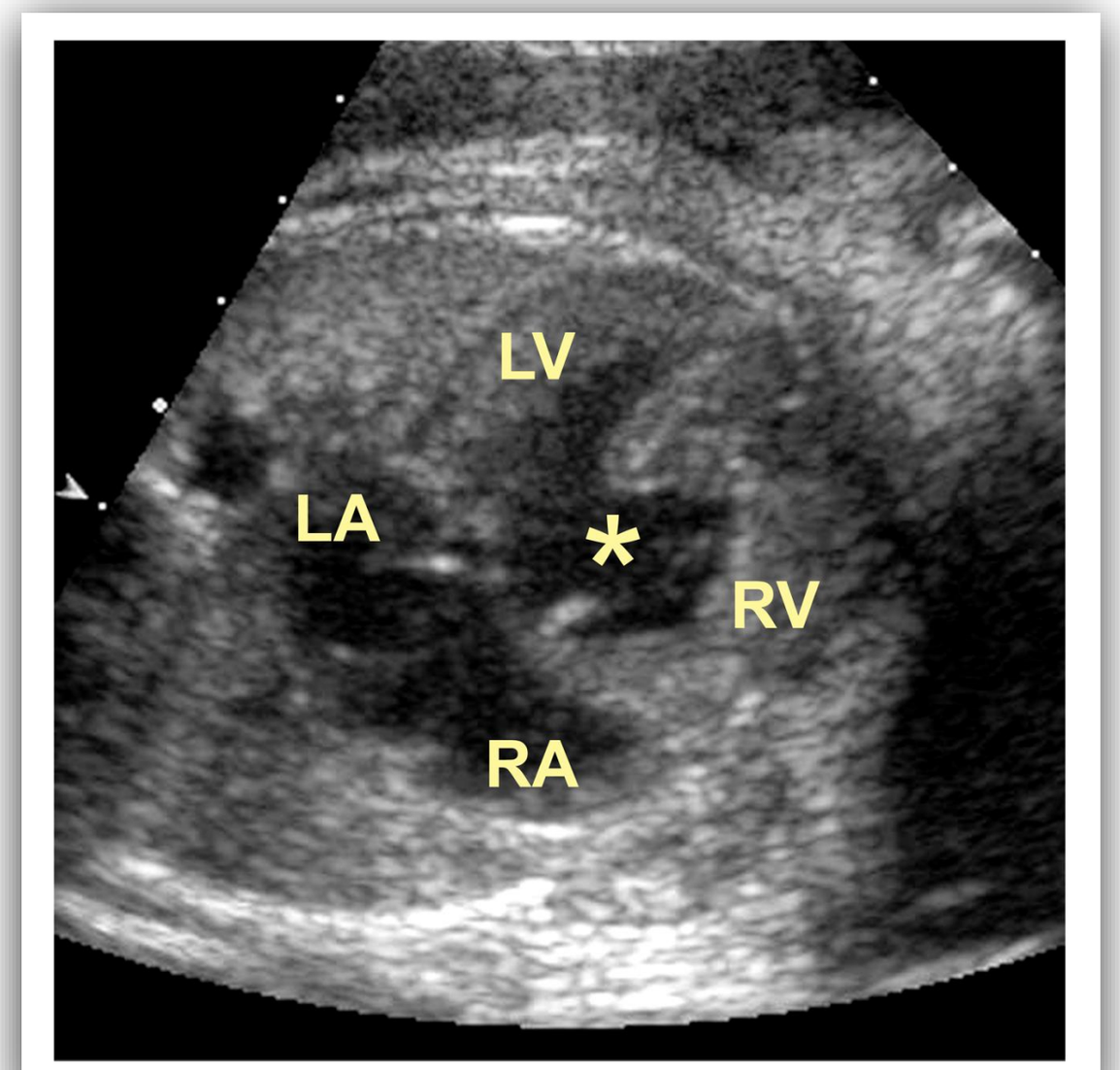
RV = right ventricle
LV = left ventricle
RA = right atrium
LA = left atrium
SVC = superior vena cava
arrow = shunting of blood from LV to RV

Ventricular Septal Defects (VSD)

- Sonographic findings include:
  - Visualization of defect in intraventricular septum
  - Shunting of blood between the ventricles seen with color Doppler imaging

VENTRICULAR SEPTAL DEFECTS

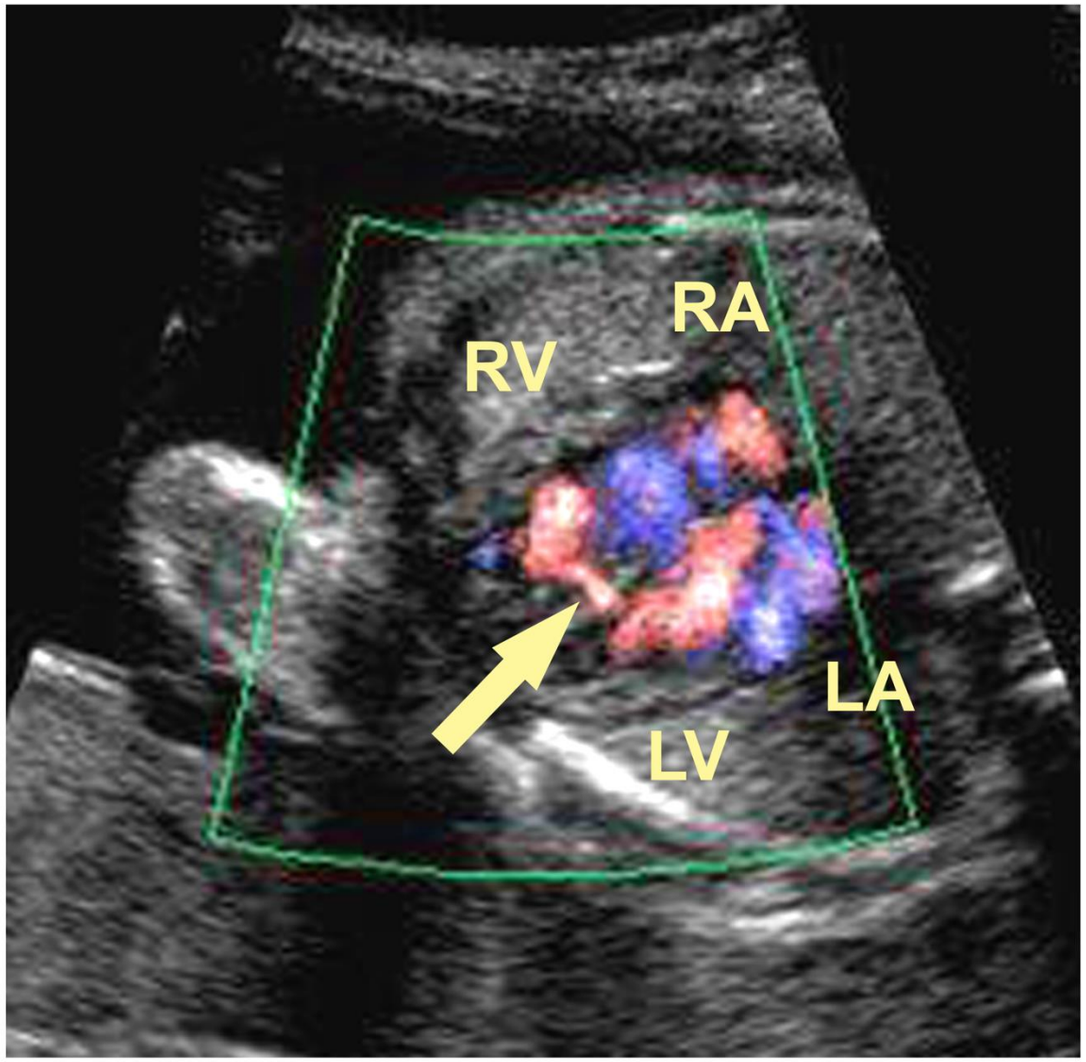
RA = right atrium
LA = left atrium
RV = right ventricle
LV = left ventricle
asterisk = defect



Defect in intraventricular septum

VENTRICULAR SEPTAL DEFECTS

RA = right atrium
LA = left atrium
RV = right ventricle
LV = left ventricle
arrow = shunting of blood

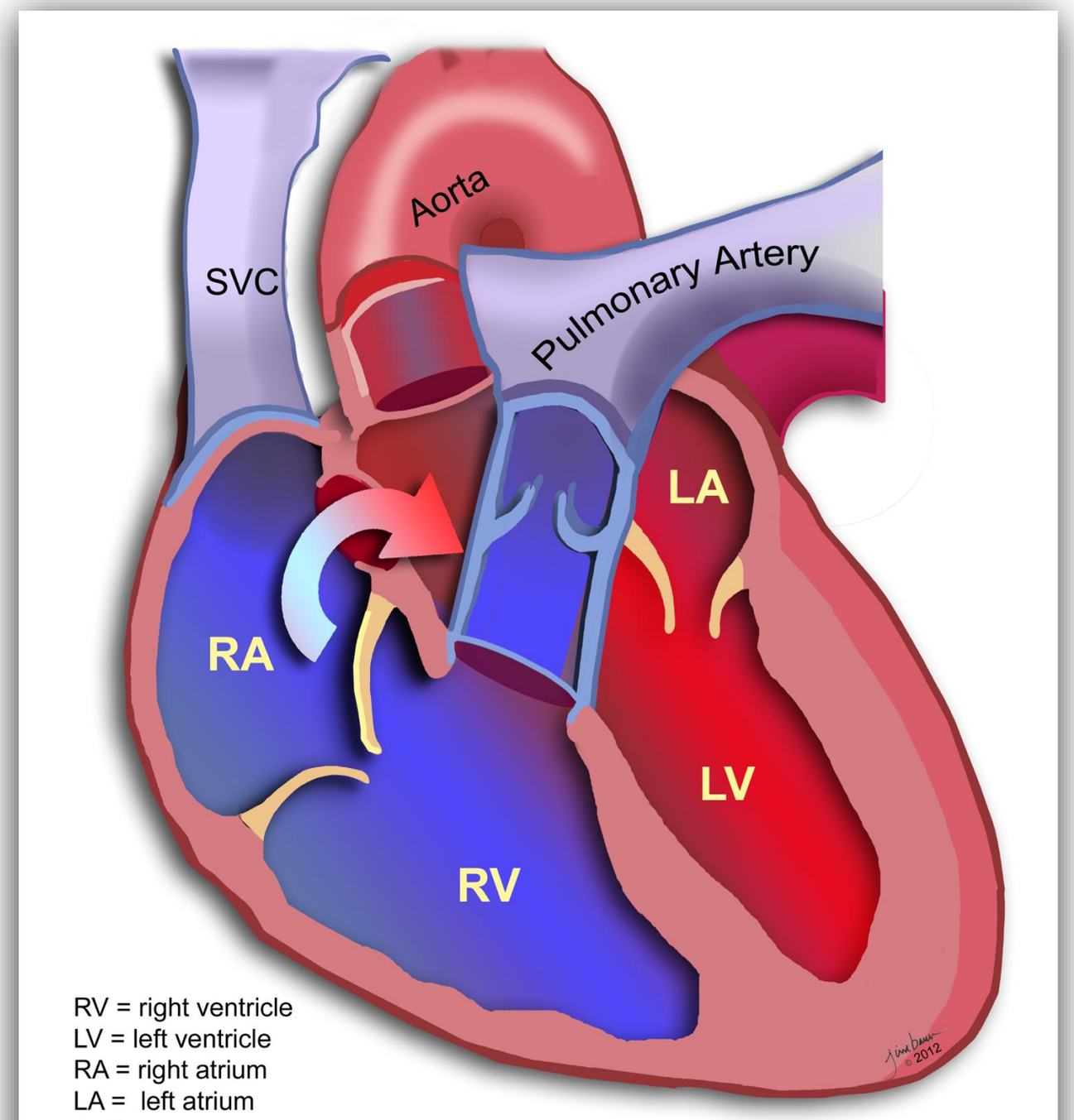


Shunting of blood between ventricles

Atrial Septal Defects (ASD)

- Abnormal communication between right and left atria
- In fetus, there is normal communication between atria via the *foramen ovale*
- Difficult to make prenatal diagnosis
- Three major types of ASD:
  - Secundum ASD
  - Primum ASD
  - Sinus venosus

ATRIAL SEPTAL DEFECTS



RV = right ventricle
LV = left ventricle
RA = right atrium
LA = left atrium
SVC =superior vena cava
arrow = shunting of blood from RA to LA

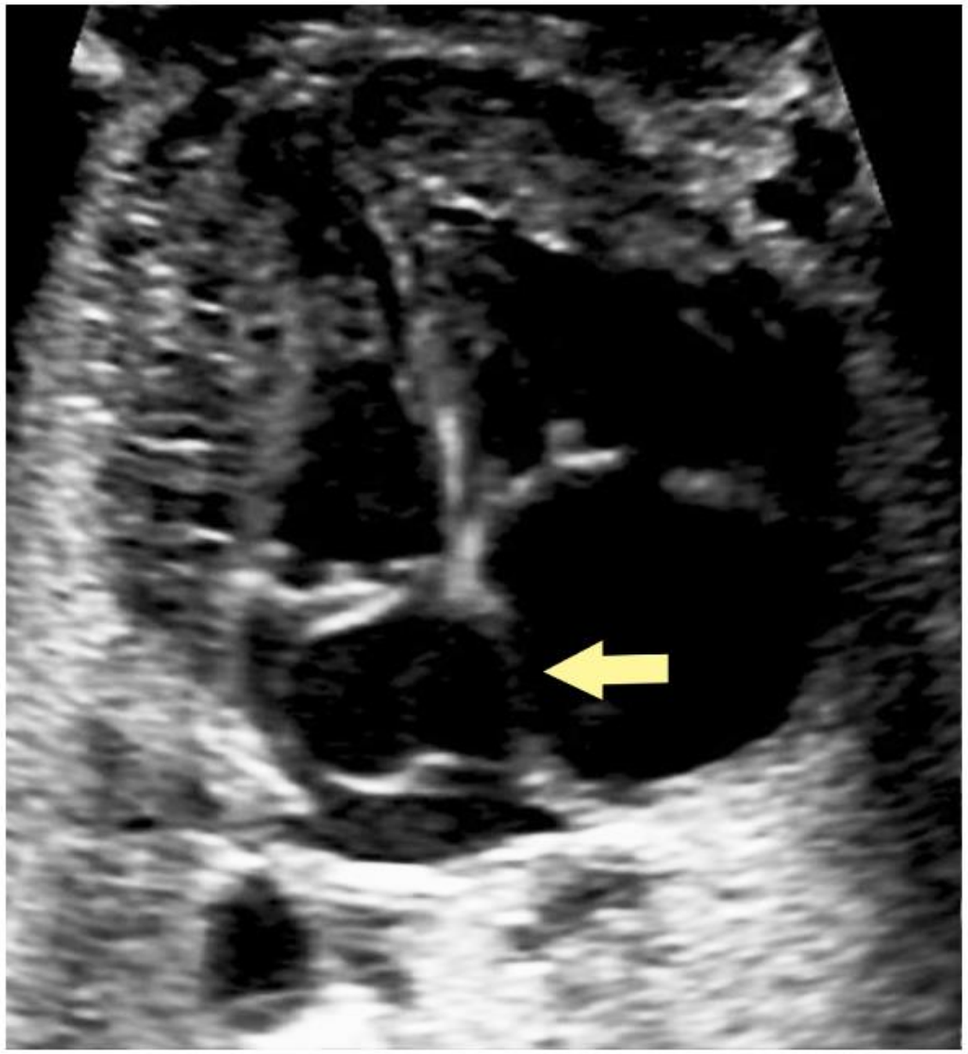
Atrial Septal Defects (ASD)

- Associated abnormalities include:
  - Trisomy 21 (Down syndrome)
  - Holt-Oram syndrome
  - Ellis-van Creveld syndrome
  - Mitral valve prolapse
  - Total anomalous pulmonary venous return

Atrial Septal Defects (ASD)

- Sonographic findings include:
  - Difficult diagnosis secondary to normal foramen ovale
  - Visualization of large defect in interatrial septum
  - Enlarged pulmonary vasculature
  - Left atrium normal size; other chambers may be enlarged

ATRIAL SEPTAL DEFECTS

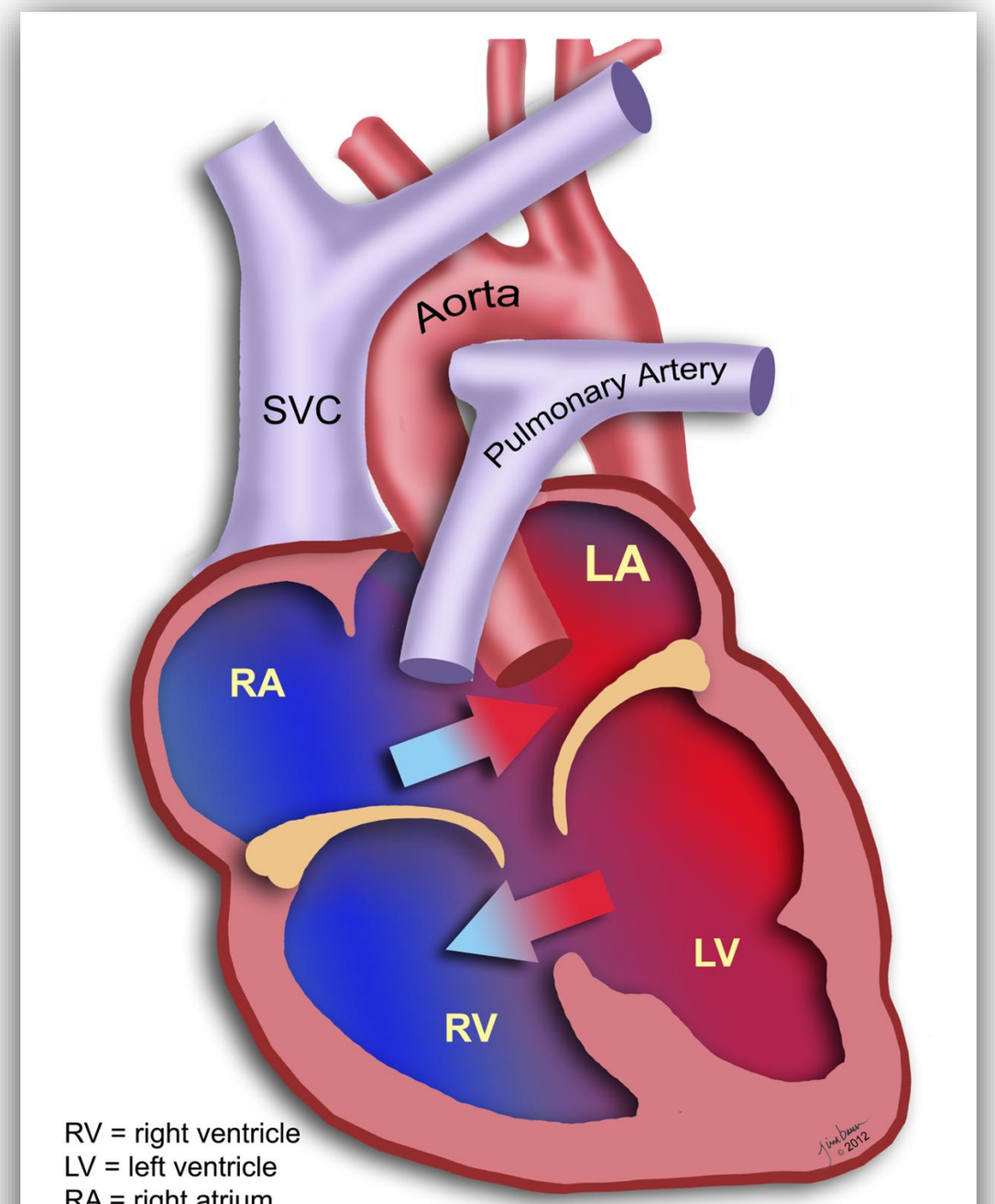


Large defect in interatrial septum

Atrioventricular Septal Defects (ASVD)

- Combination of cardiac anomalies affecting both atrial and ventricular septa
- Affects one or both tricuspid and mitral valves
- Also called *endocardial cushion defect*

ATRIOVENTRICULAR SEPTAL DEFECT



RV = right ventricle
LV = left ventricle
RA = right atrium
LA = left atrium
SVC =superior vena cava
arrows = mixing of right and left heart blood

Atrioventricular Septal Defects (ASVD)

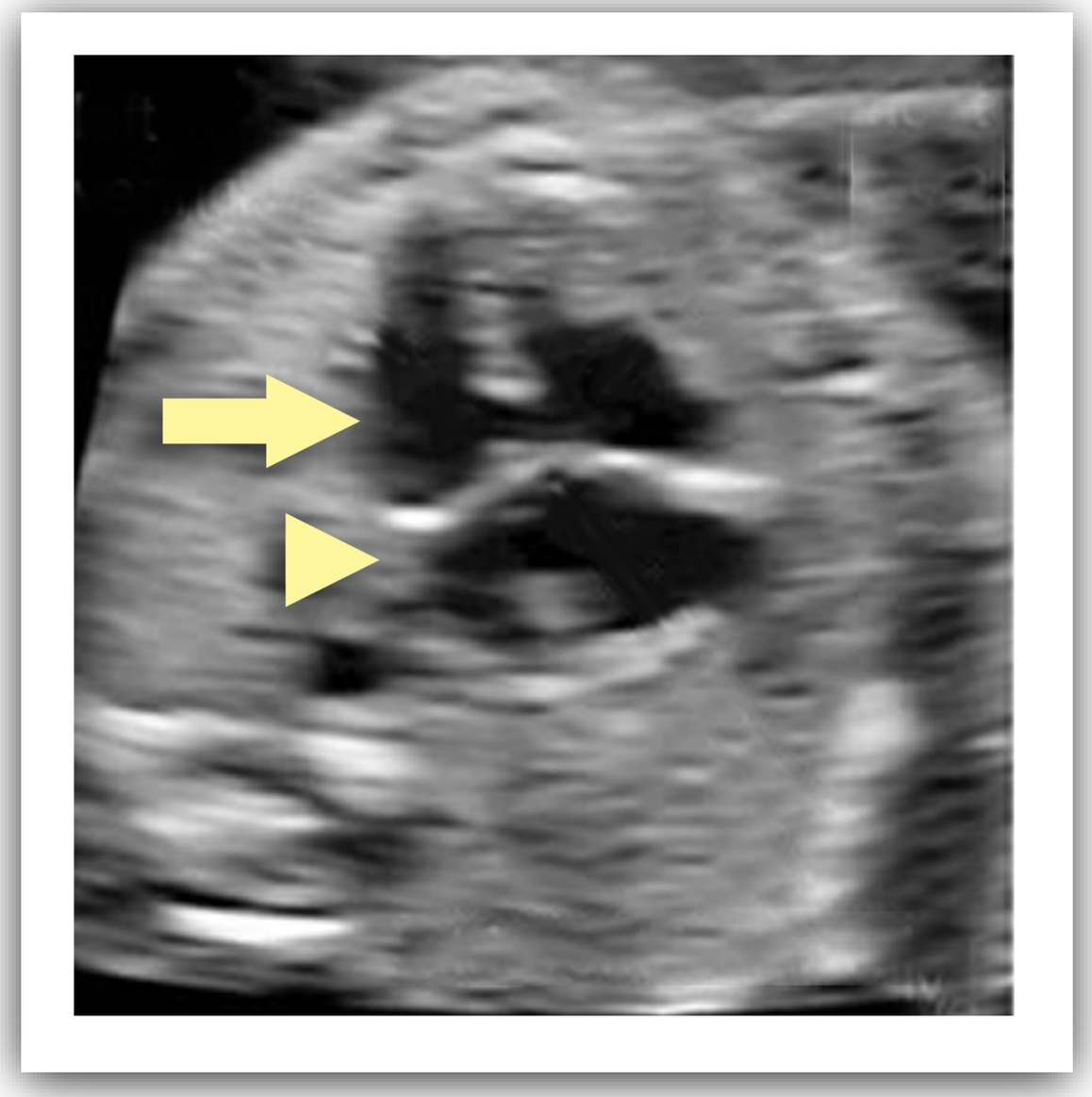
- Associated abnormalities include:
  - Trisomy 21 (50% of fetuses)
  - Trisomy 18 (25% of fetuses)
  - Holt-Oram syndrome
  - Ells-van Creveld syndrome
  - Total anomalous pulmonary venous return

Atrioventricular Septal Defects (ASVD)

- Sonographic findings include:
  - Large defect along the cardiac midline
  - Common valve cusps meeting at same level during systole
  - Valve cusps opening toward AVSD during diastole

ATRIOVENTRICULAR SEPTAL DEFECTS

arrowhead = ASD
arrow = VSD



Defect along cardiac midline

Conotruncal Anomalies

- Malformations of the cardiac outflow tracts and great arteries
- Results from failure of formation and rotation of *ductus arteriosus* and connection with both ventricles
- Types include:
  - Tetralogy of Fallot
  - Transposition of the great arteries
  - Persistent truncus arteriosus
  - Double-outlet right ventricle

Tetralogy of Fallot

- Relatively common cardiac anomaly accounts for 10% of all congenital heart disease
- Four features: ☑
  - Overriding aorta: aortic valve connected to both ventricles
  - Ventricular septal defect
  - Right ventricular outflow obstruction
  - Right ventricular hypertrophy

Tetralogy of Fallot

- Associated abnormalities include:
  - Pulmonary hypoplasia
  - Patent ductus arteriosus
  - Atrial septal defect
  - Prune belly syndrome
  - Transposition of great vessels

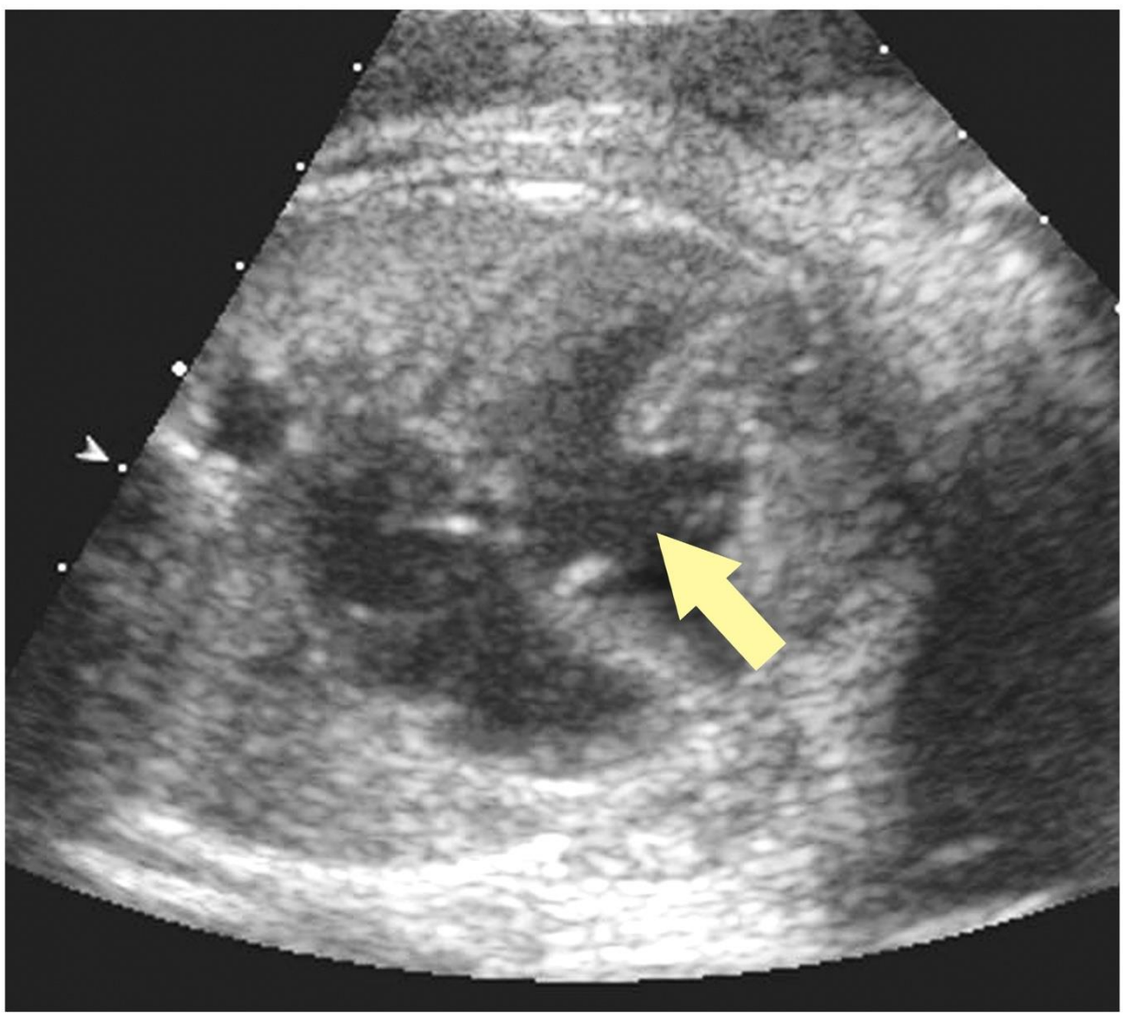
Tetralogy of Fallot

- Sonographic findings include:
  - Y-shaped overriding aorta with outflow from both ventricles
  - Ventricular septal defect
  - RVO abnormalities
  - Hydrops fetalis
  - Polyhydramnios

TETRALOGY OF FALLOT

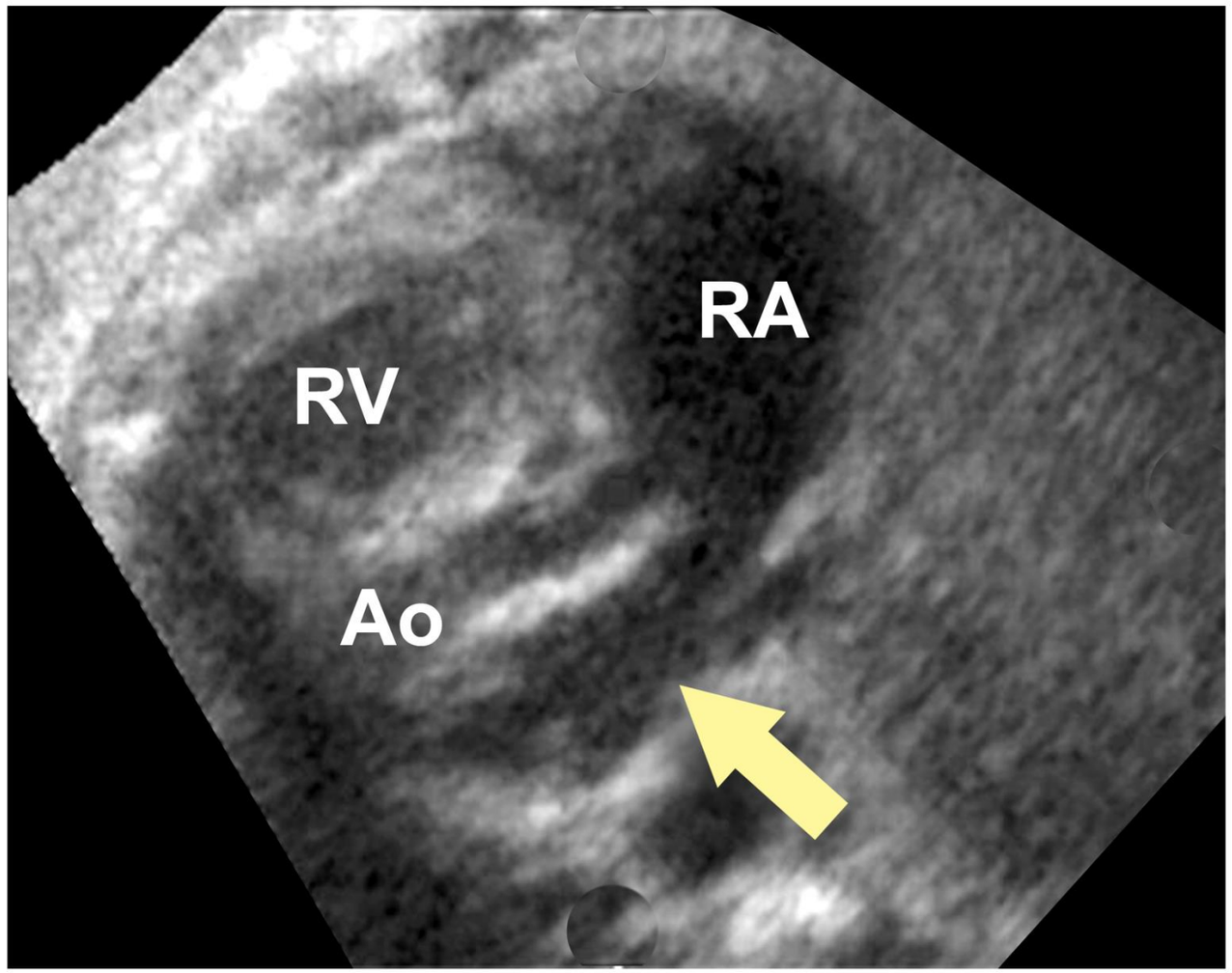
Overriding aorta

TETRALOGY OF FALLOT



VSD

TETRALOGY OF FALLOT



RVO obstruction
Arrow = dilated pulmonary artery

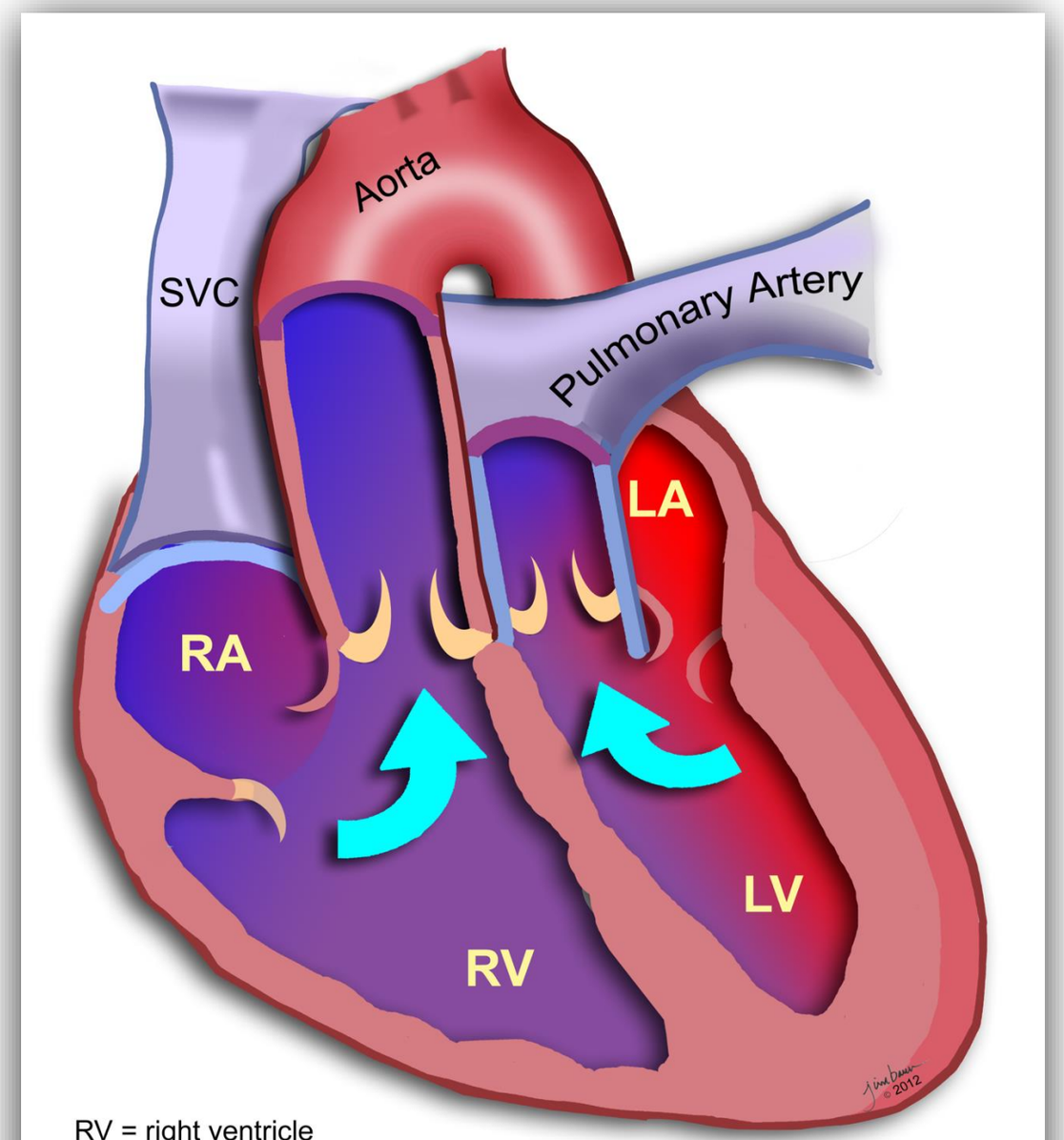
Transposition of Great Arteries

- Origins of aorta and pulmonary artery are reversed
  - Aorta arises from right ventricle
  - Pulmonary trunk arises from left ventricle
- Associated abnormalities include:
  - Ventricular septal defect
  - Patent ductus arteriosus (*in neonates*)
  - Patent foramen ovale (*in neonates*)
  - Atrial septal defect

Transposition of Great Arteries

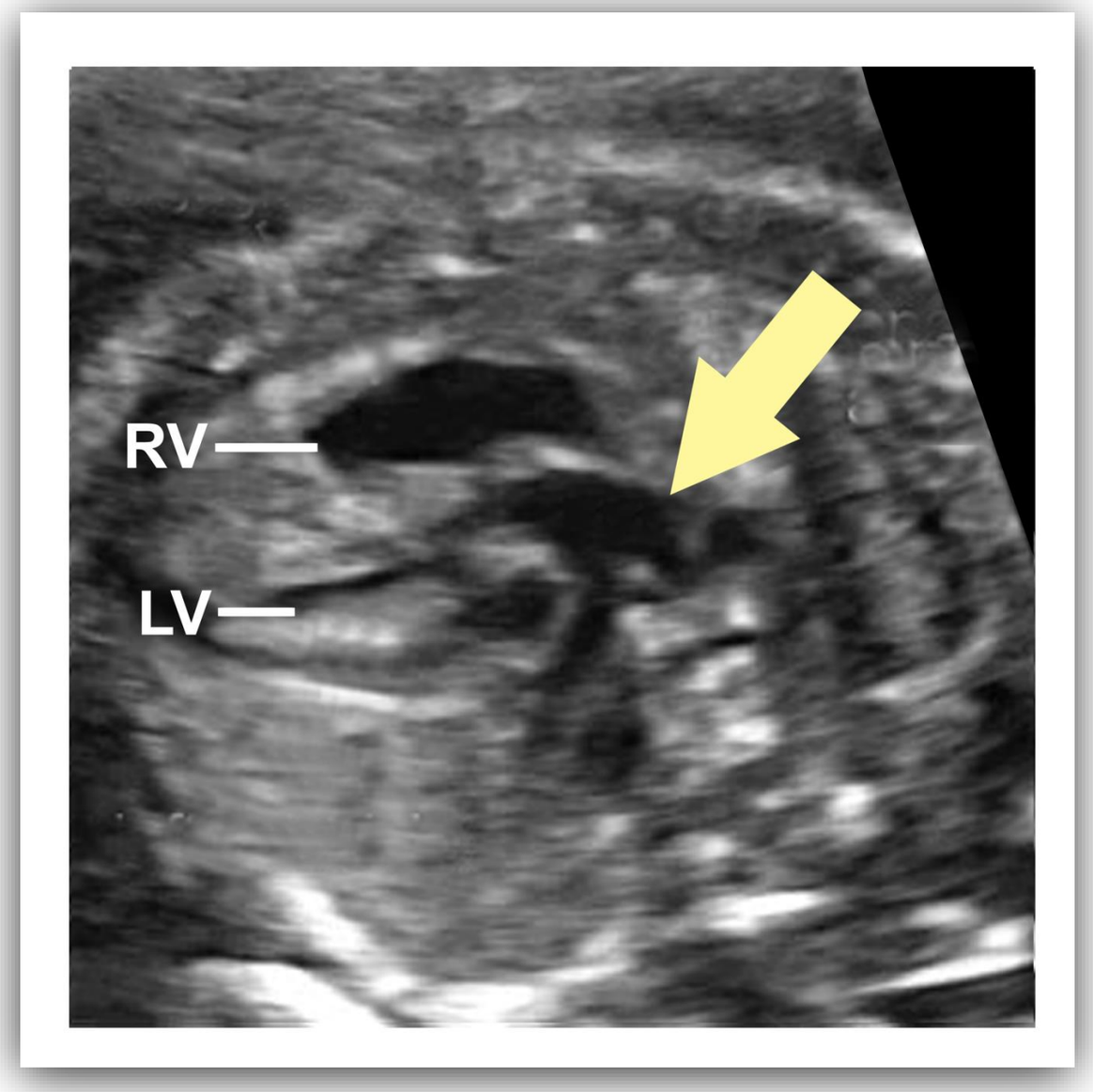
- Sonographic findings include:
  - Aorta arising from right ventricle (RVOT image)
  - Pulmonary trunk arising from left ventricle (LVOT image)
  - “Parallel channel” sign – aorta and pulmonary artery coursing side by side

TRANSPOSITION OF GREAT ARTERIES



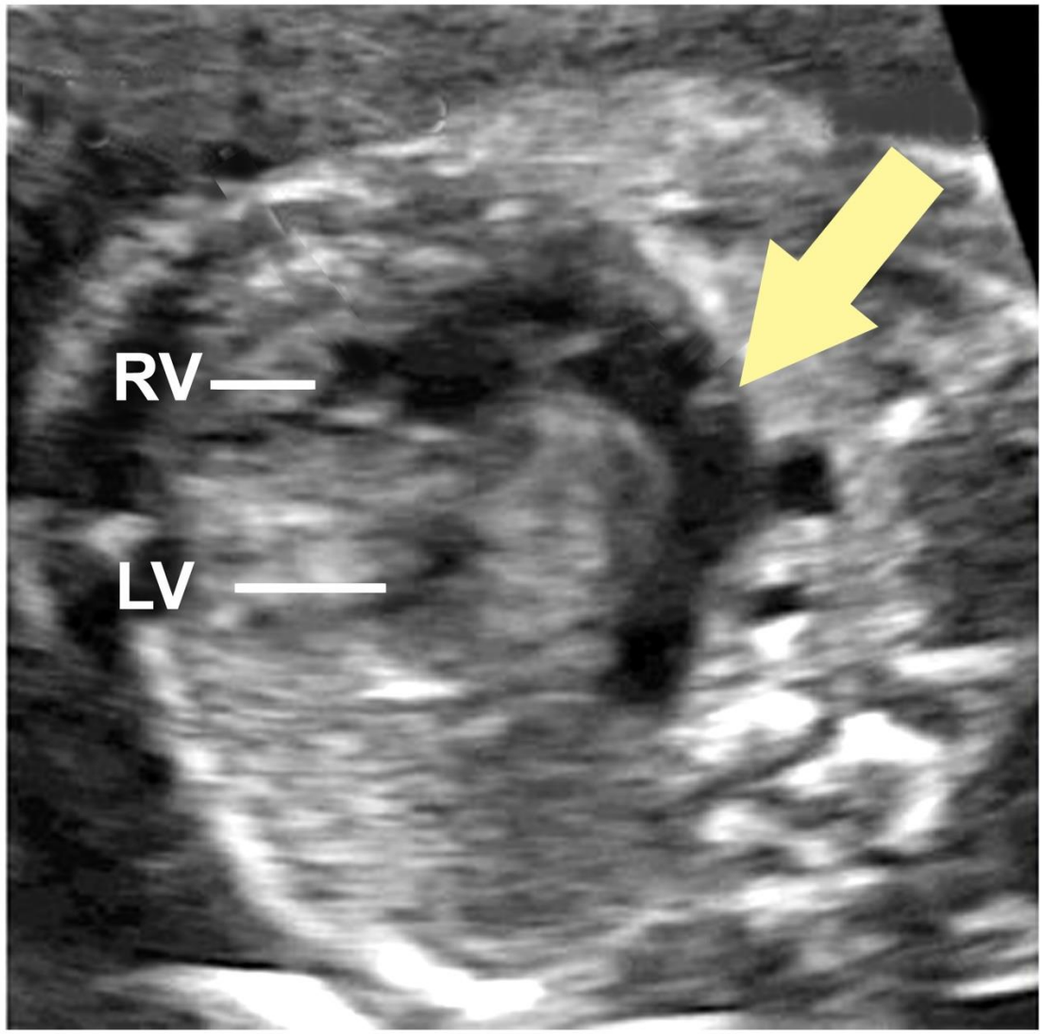
RV = right ventricle
LV = left ventricle
RA = hypoplastic right atrium
LA = hypoplastic left atrium
SVC =superior vena cava

TRANSPOSITION OF GREAT ARTERIES



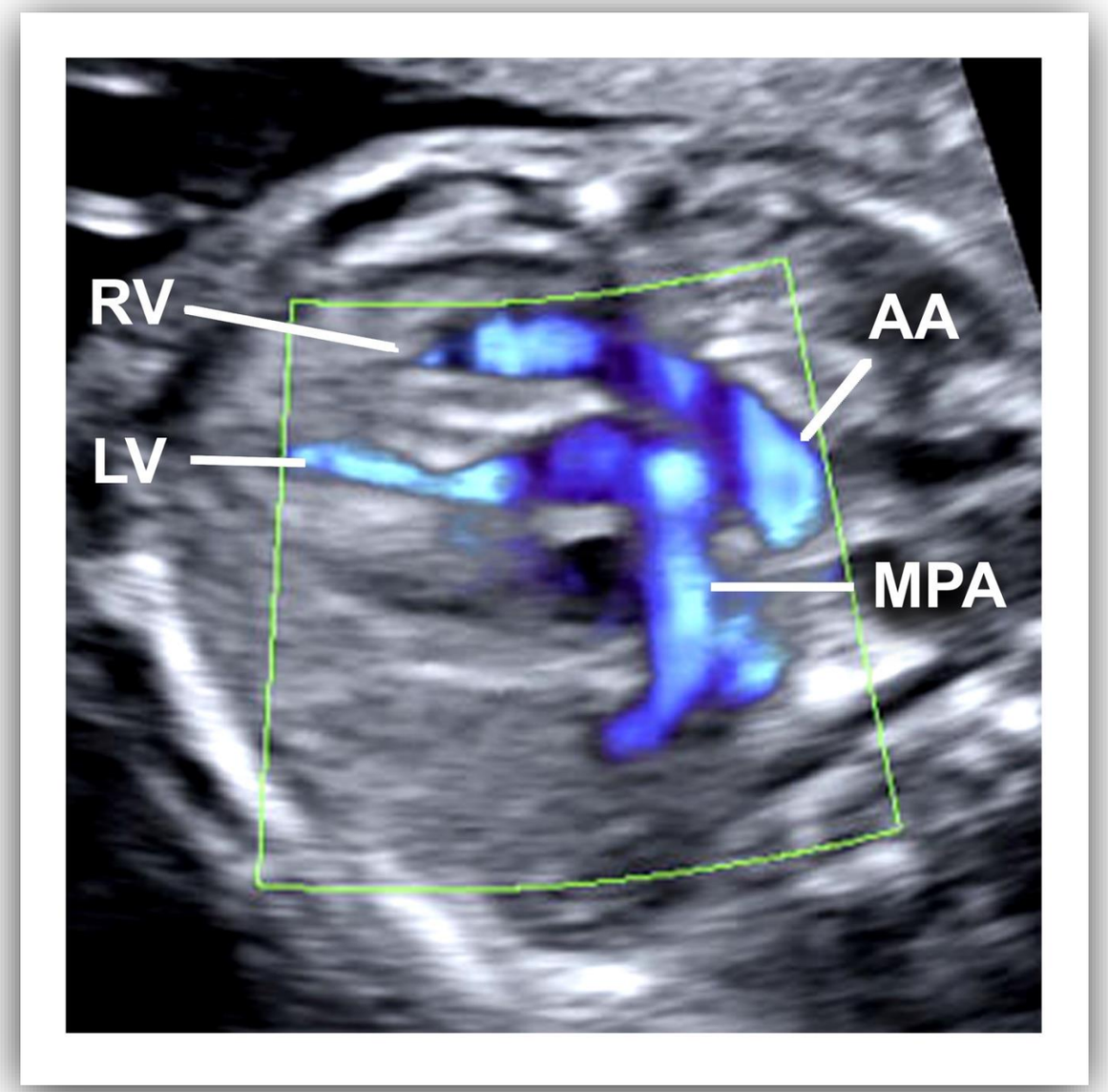
Pulmonary artery arising from LV

TRANSPOSITION OF GREAT ARTERIES



Aorta arising from RV

TRANSPOSITION OF GREAT ARTERIES



“Parallel channel” sign

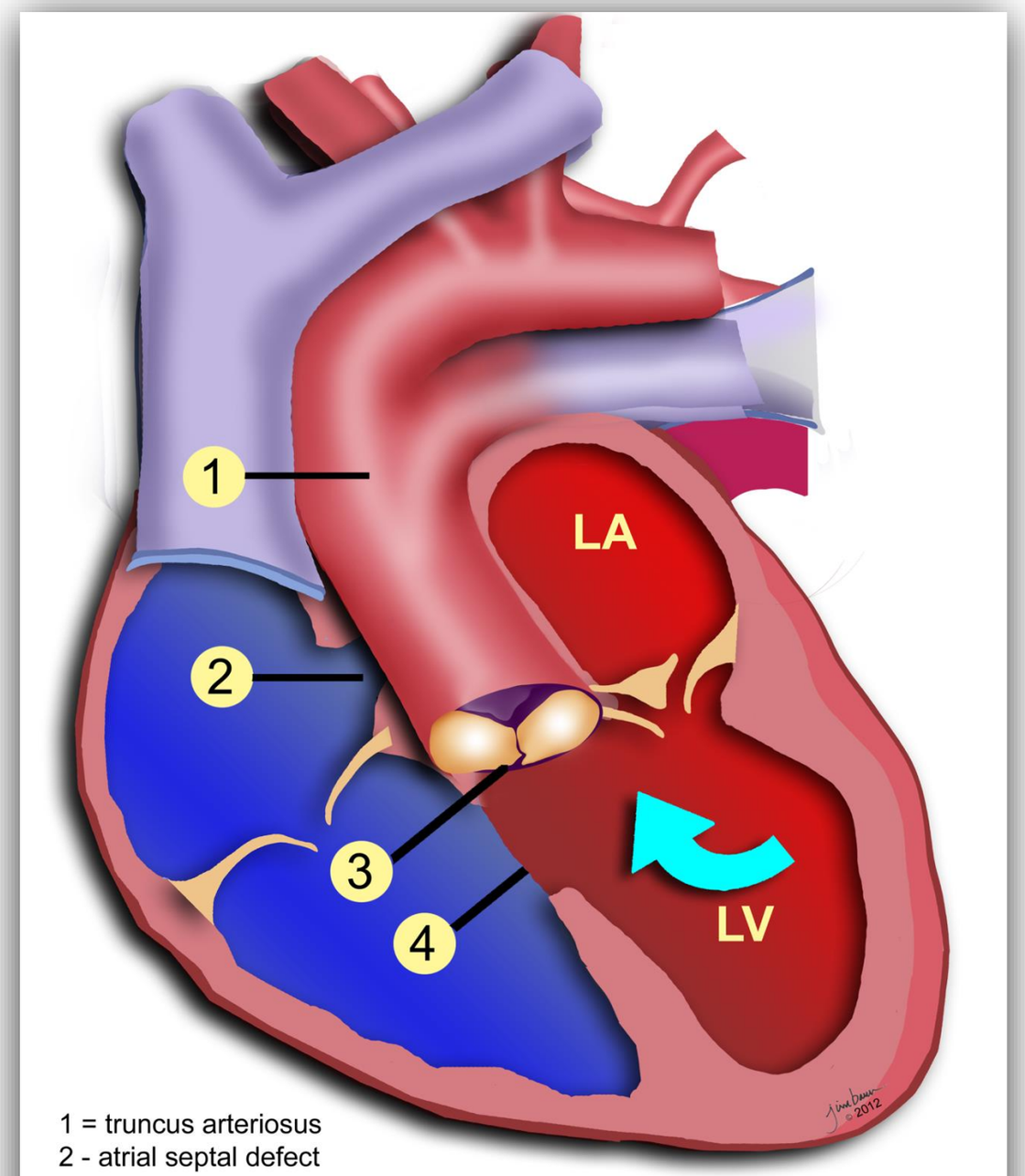
Persistent Truncus Arteriosus

- Presence of a single great artery arising from both ventricles and a large concomitant VSD
- Arises from failure of single embryonic truncus to partition into two separate outflow arteries
- Associated abnormalities include:
  - Ventricular septal defect
  - Right-sided aortic arch

Persistent Truncus Arteriosus

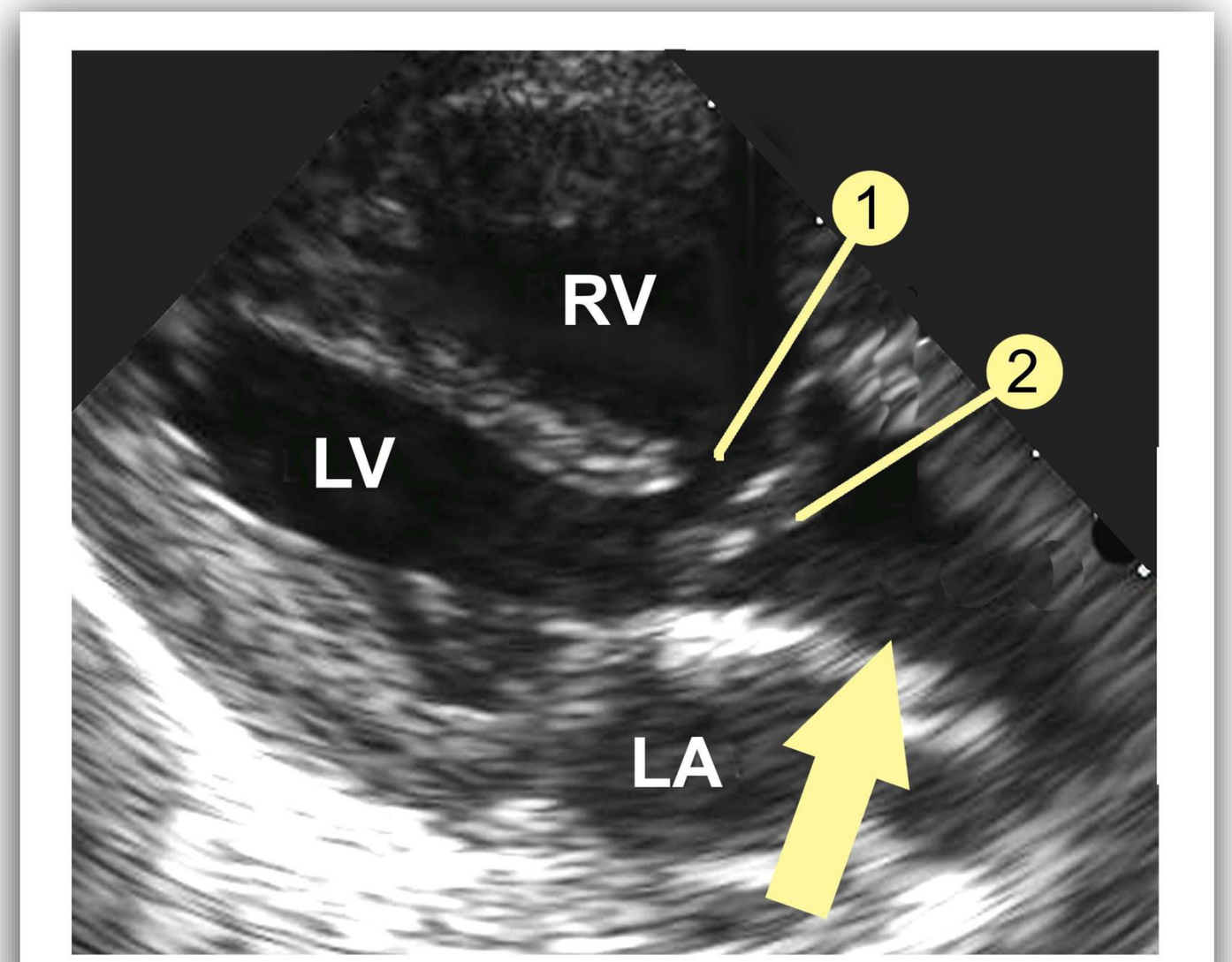
- Sonographic findings include:
  - Single great artery arising from truncal root
  - Aorta and main pulmonary artery arising from a common arterial trunk
  - Large VSD
  - Abnormal appearing single truncal valve

PERSISTENT TRUNCUS ARTERIOSUS



PERSISTENT TRUNCUS ARTERIOSUS

1 = VSD
2 =abnormal truncal valve



Single great artery arising from both ventricles

Double-Outlet Right Ventricle

- Abnormality in which both aorta and pulmonary artery arise from right ventricle
- Rarely an isolated finding – usually one component in complex other cardiac anomalies
- VSD virtually always presents

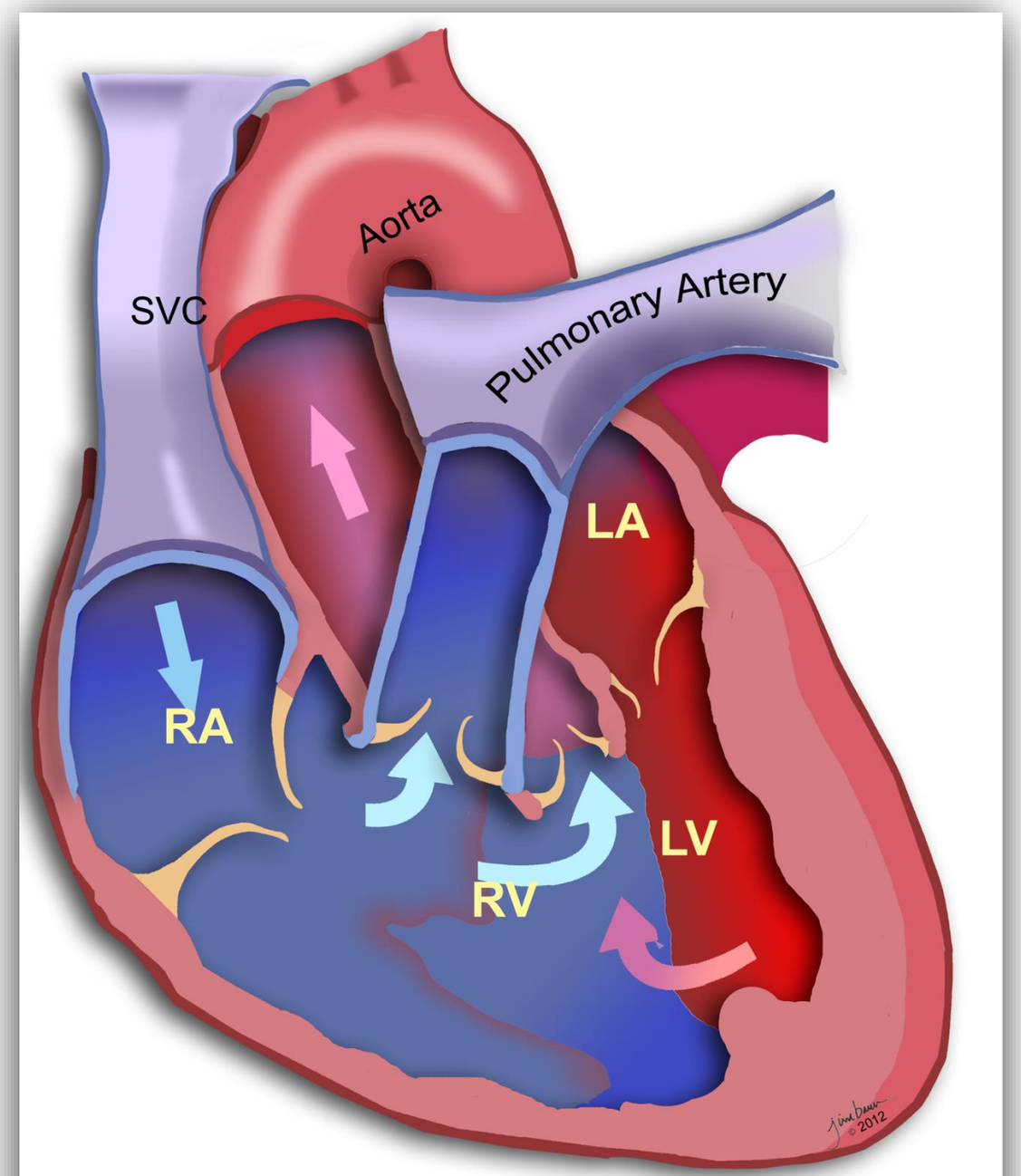
Double-Outlet Right Ventricle

- Associated abnormalities include:
  - Trisomy 18 (Edwards syndrome)
  - Trisomy 13 (Patau syndrome)
  - Pulmonary stenosis
  - Coarctation of aorta
  - Anomalous pulmonary venous return
  - TE fistula

Double-Outlet Right Ventricle

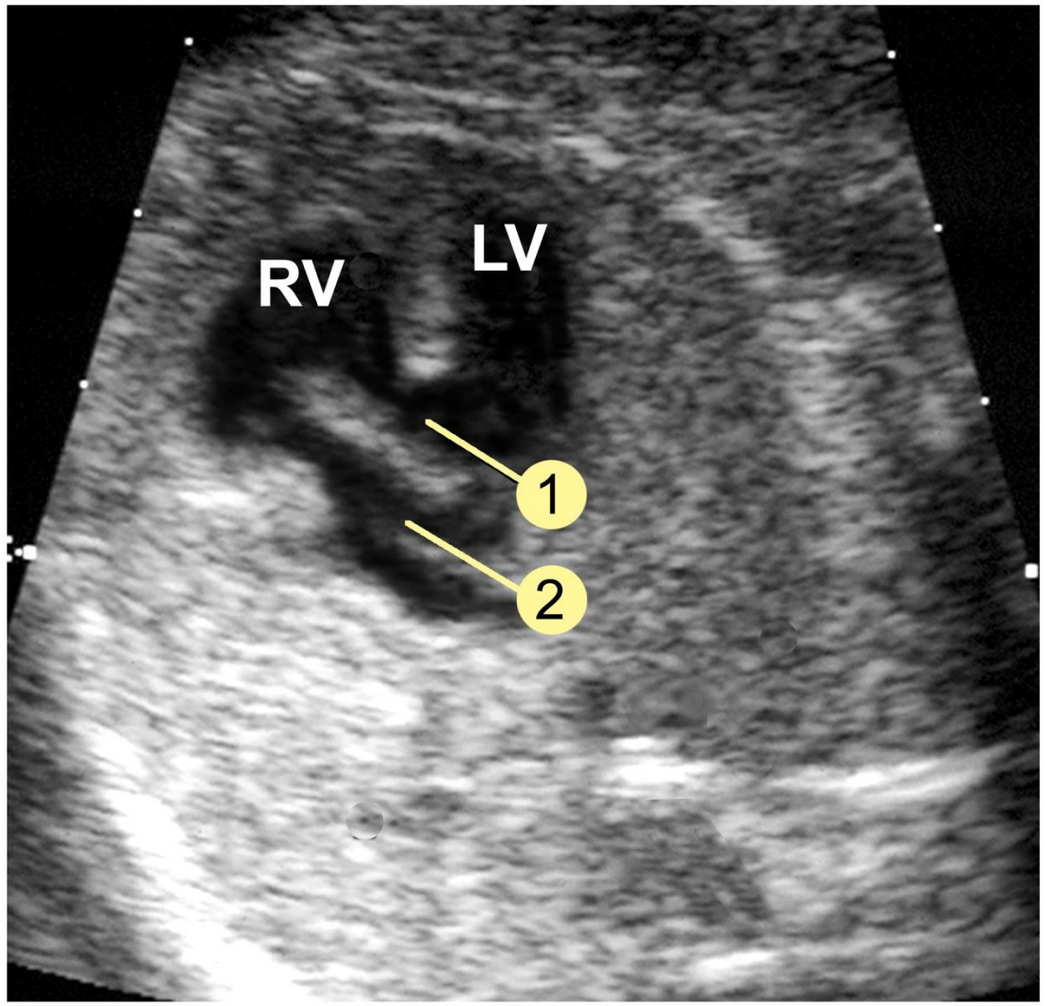
- Sonographic findings include:
  - Linear alignment of aorta and pulmonary trunk
  - Ventricular septal defect
  - Shared origin of aortic root and pulmonary trunk

DOUBLE-OUTLET RIGHT VENTRICLE

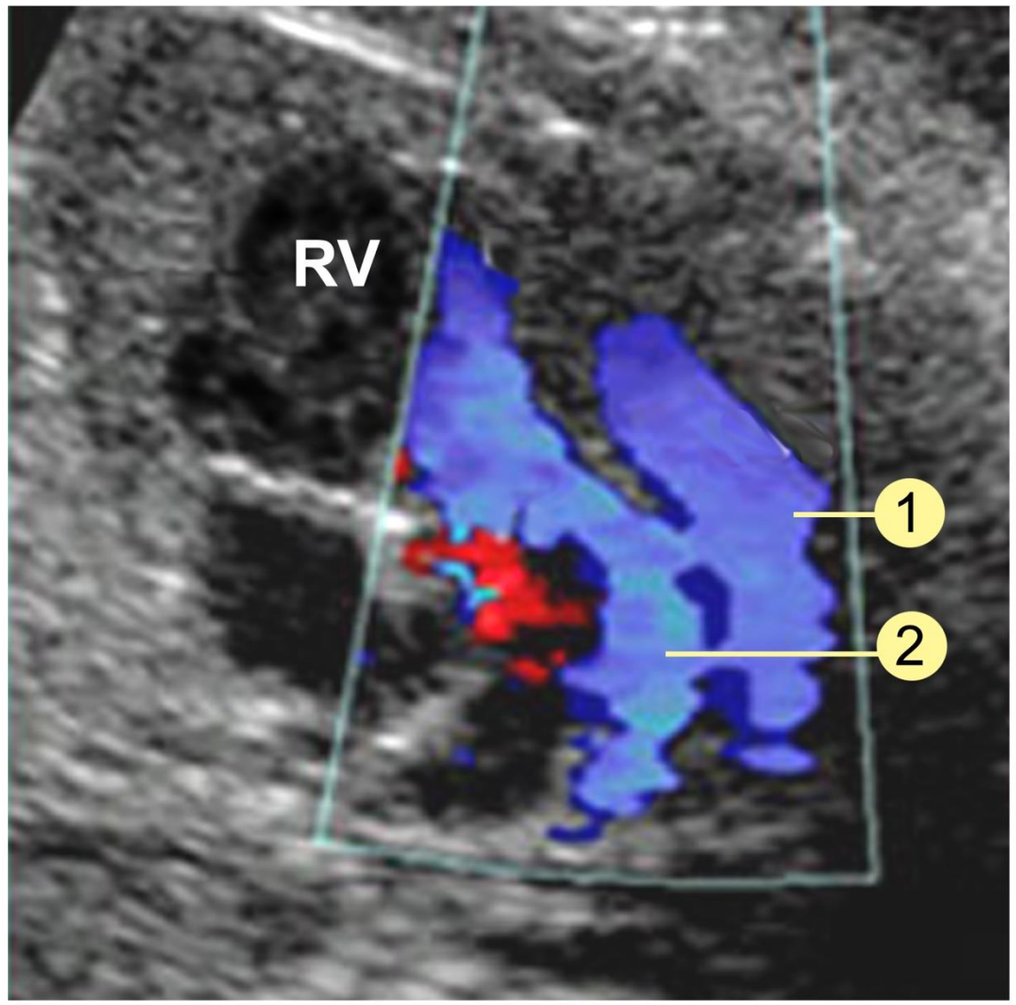


blue arrows = double oulet, aorta & pulmonary artery

DOUBLE-OUTLET RIGHT VENTRICLE



Linear alignment of aorta and pulmonary artery.



Simultaneous outflow direction during systole.

1 = aorta
2 =pulmonary artery

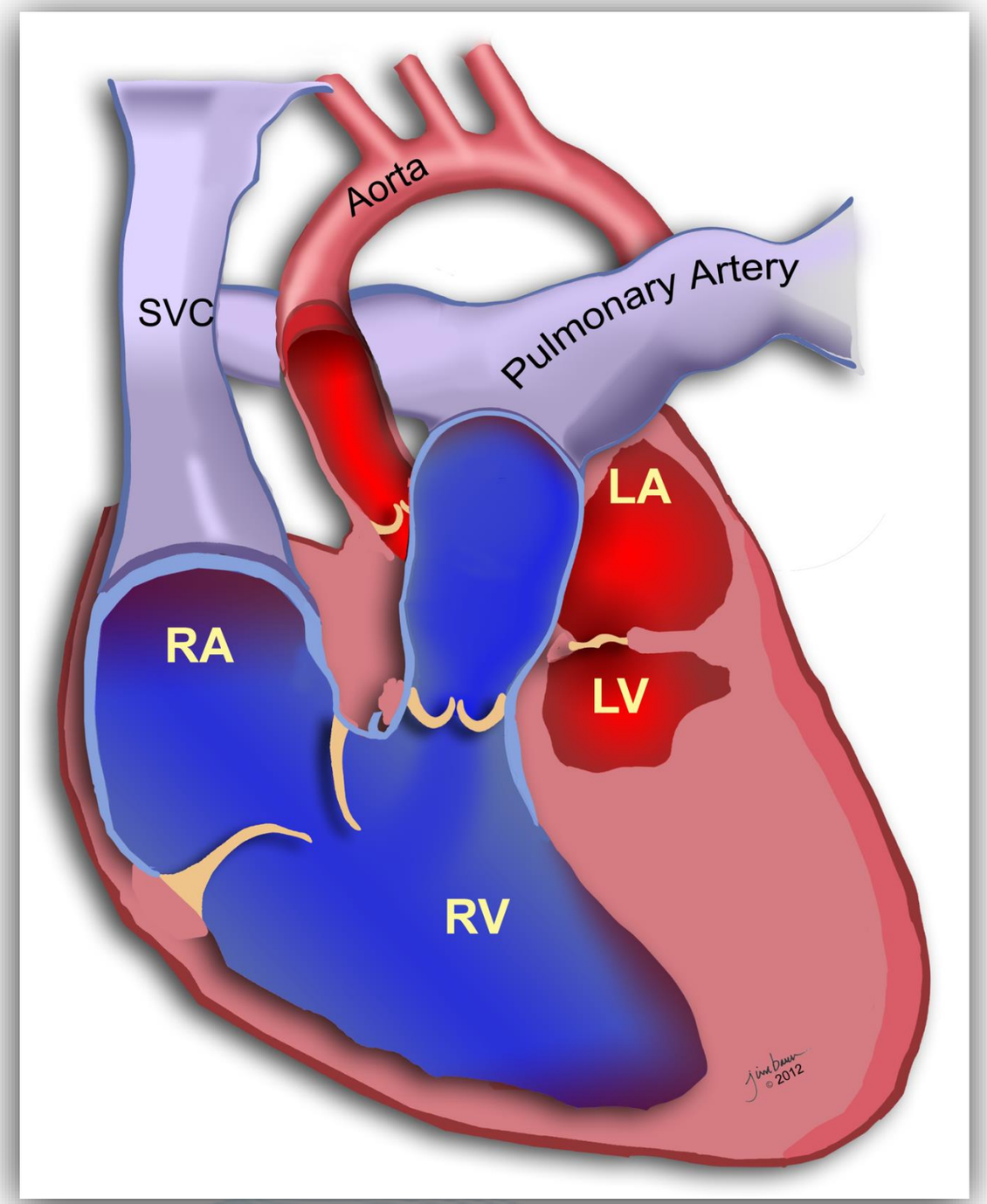
Single Ventricle Anomalies

- Generic term referring to any fetal congenital cardiac anomaly characterized by presence of only one functioning ventricle
- Types include:
  - Hypoplastic heart syndrome
  - Tricuspid atresia
  - Double-outlet right ventricle
  - Double-inlet left ventricle

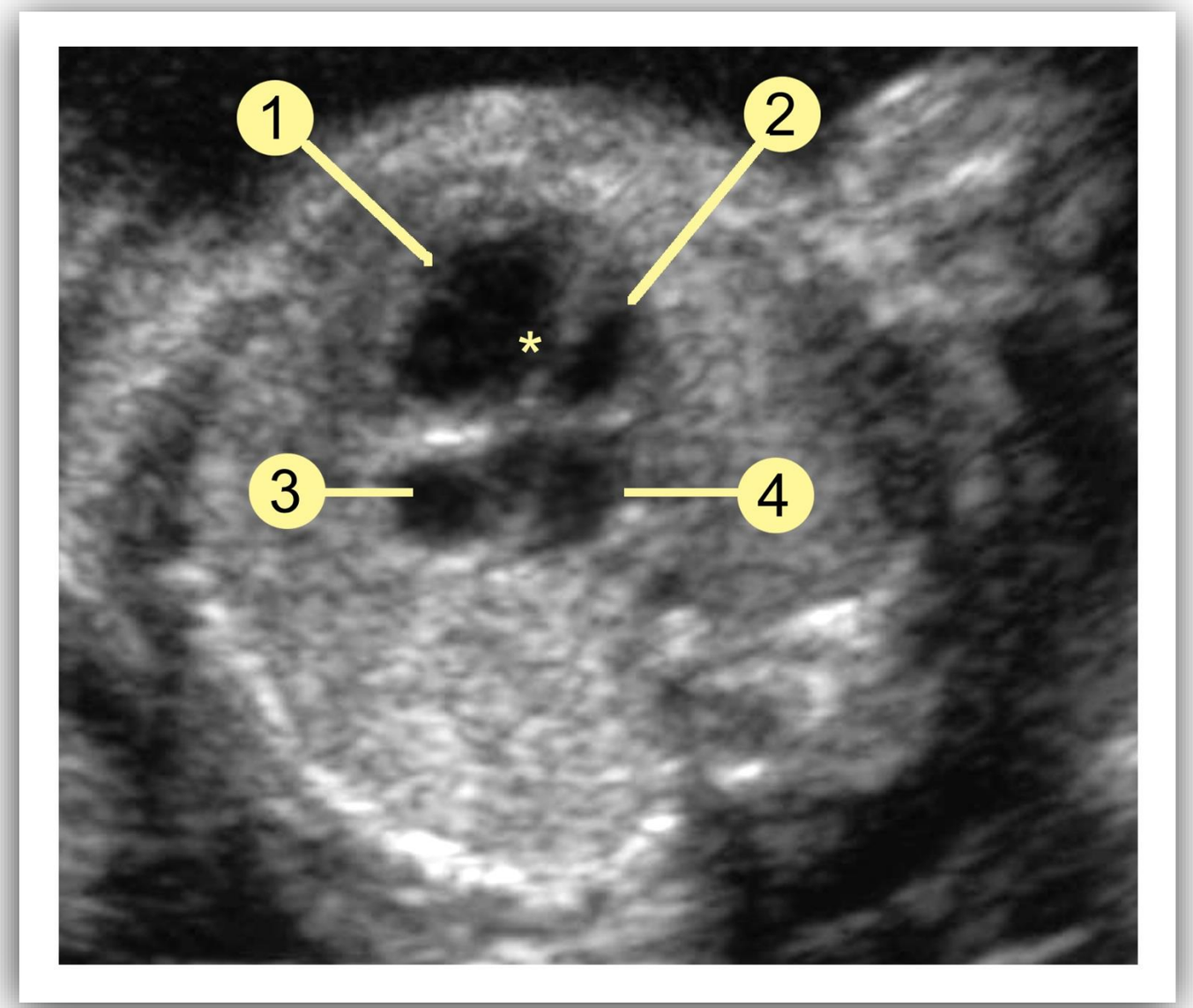
Hypoplastic Heart Syndrome

- Hypoplastic left heart syndrome (more common): ☑
  - Incomplete development of left heart structures: ventricle, atrium, mitral valve, aortic valve and aorta
- Hypoplastic right heart syndrome (less common):
  - Incomplete development of right heart structures: ventricle, atrium, tricuspid valve, pulmonic valve and vena cava

HYPOPLASTIC LEFT HEART



HYPOPLASTIC LEFT HEART

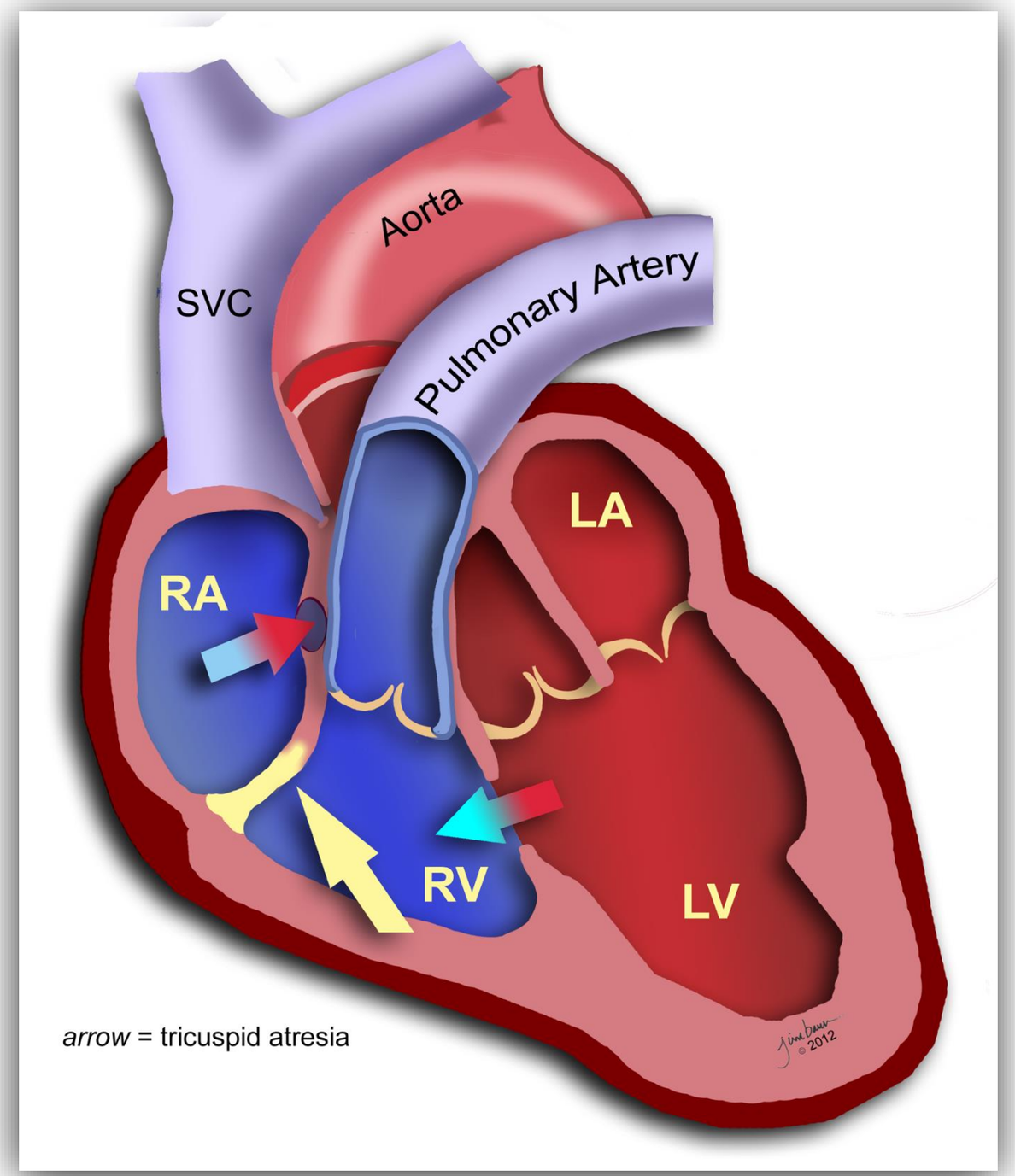


1 = RV
2 = LV
3 = LA
4 = LA

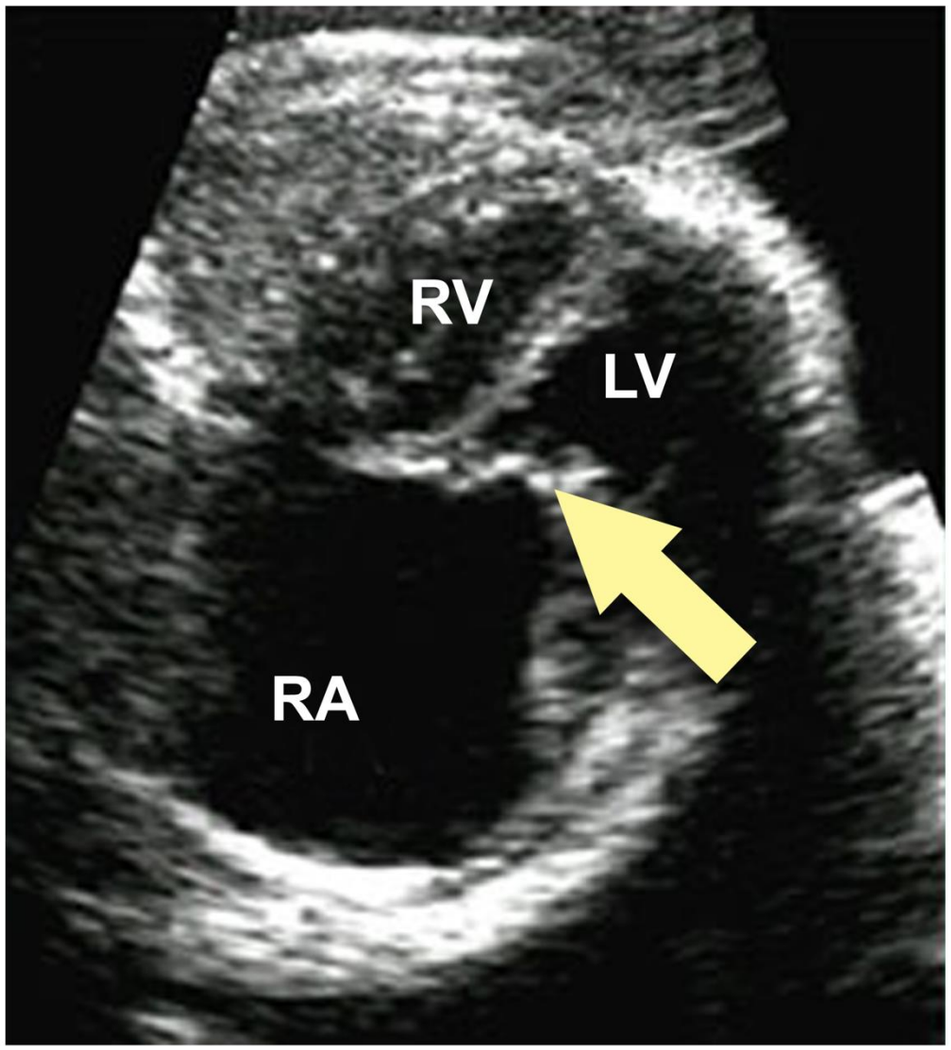
Tricuspid Atresia

- Failure of formation of tricuspid valve and right ventricular inlet
- No direct communication between right atrium and ventricle
- Compromised outflow into pulmonary artery
- Increased flow into left atrium via *foramen ovale* can result in cardiac overload

TRICUSPID ATRESIA

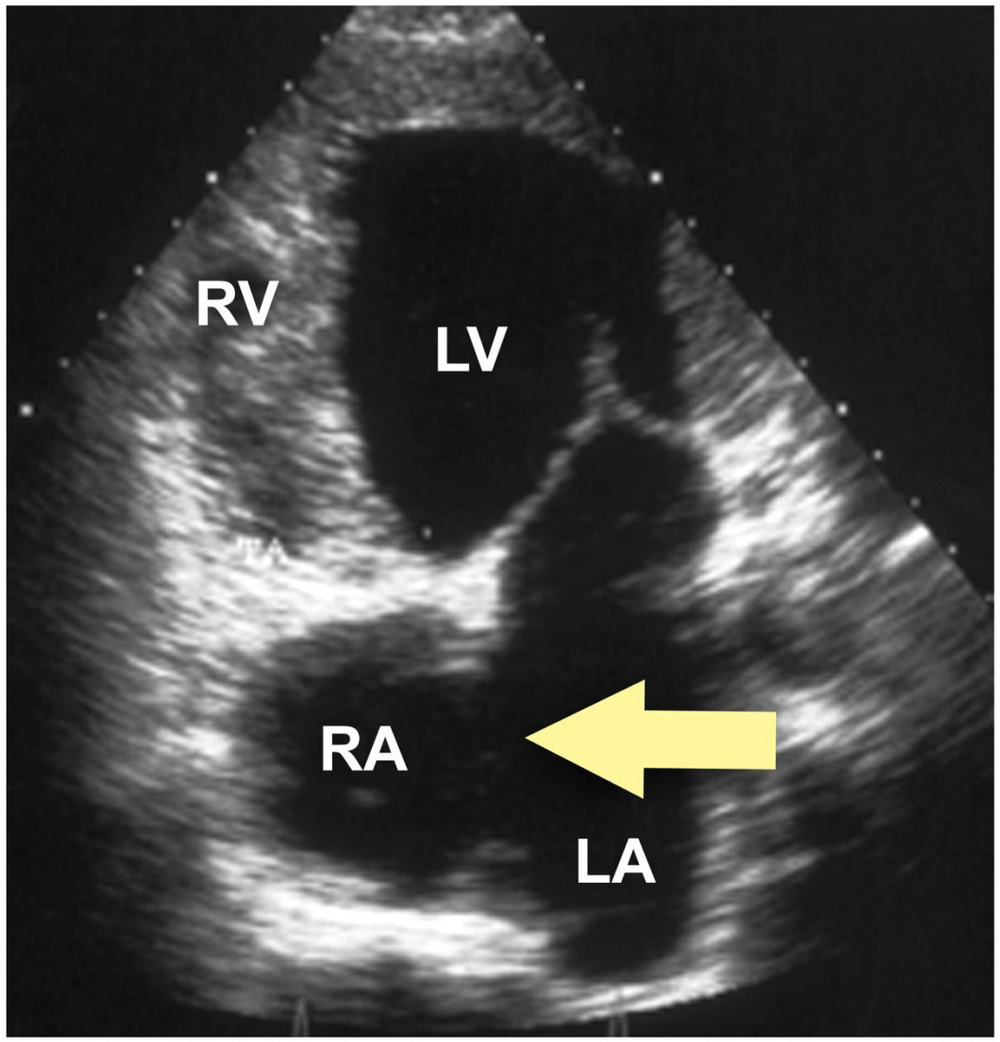


TRICUSPID ATRESIA



Enlarged right atrium, hypoplastic right ventricle and absent tricuspid valve (*arrow)* in a fetus.

TRICUSPID ATRESIA



Dramatic right ventricular atrophy and a large ASD (*arrow*) in an adult with tricuspid atresia.

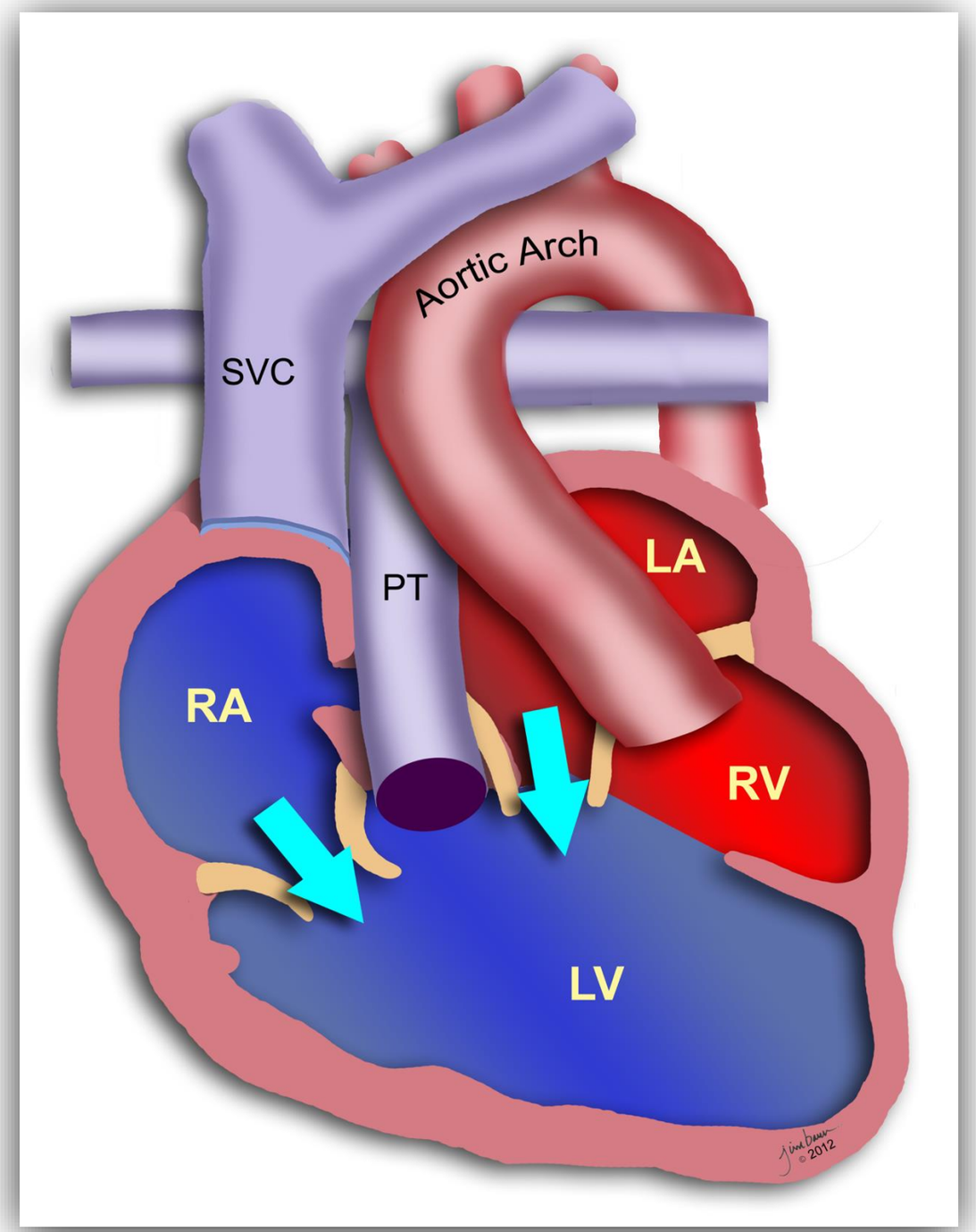
Double-Inlet Left Ventricle

- Conotruncal abnormality affecting both cardiac chambers and valves
- Both right and left atria feed into left ventricle
- Right ventricle is hypoplastic or completely absent

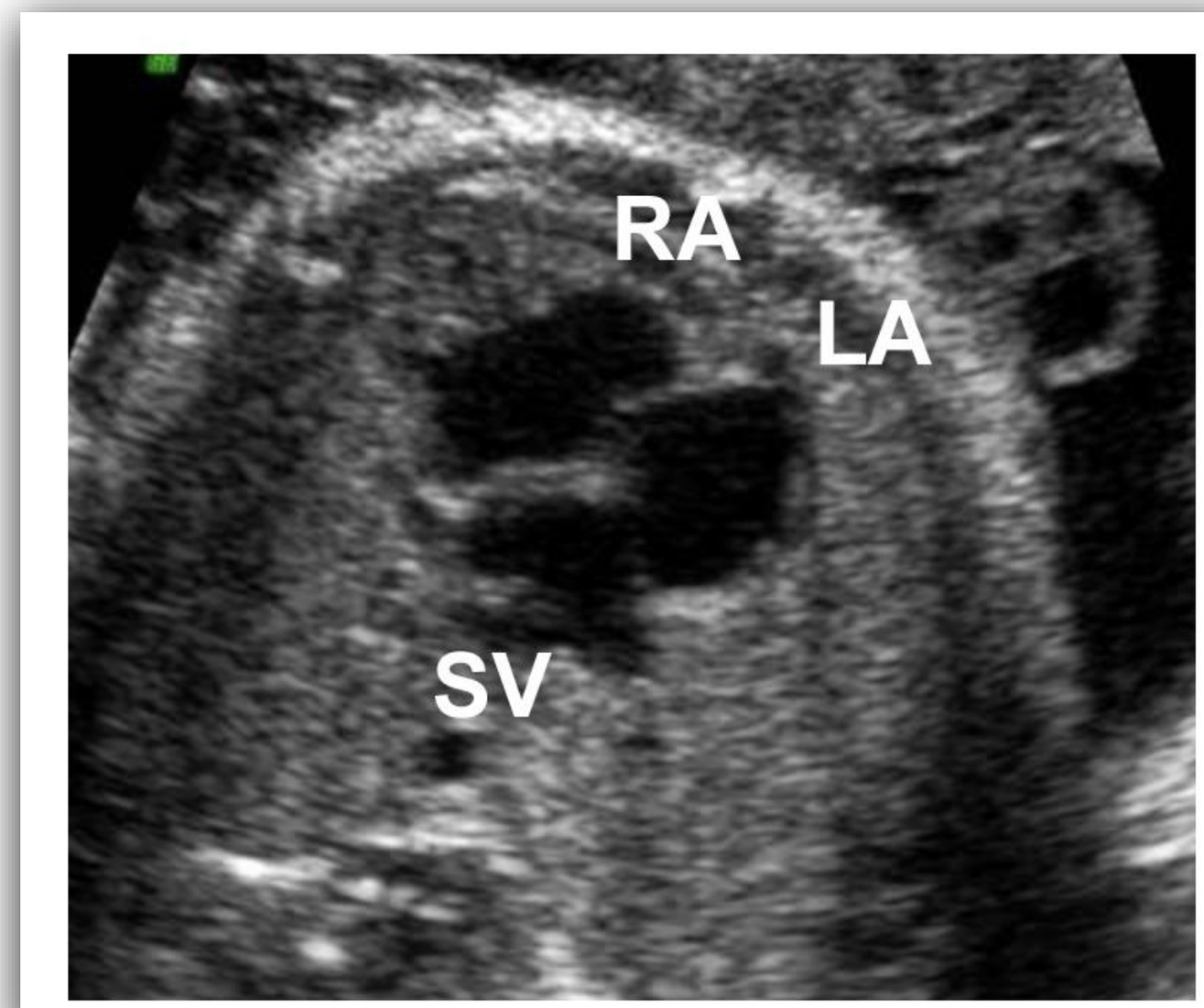
Double-Inlet Left Ventricle

- Associated abnormalities include:
  - Coarctation of aorta
  - Pulmonary atresia
  - Pulmonic valve stenosis
- Sonographic findings include:
  - Single ventricular chamber of four-chamber view
  - Two atria with valves present on four-chamber view

DOUBLE-INLET LEFT VENTRICLE



DOUBLE-INLET LEFT VENTRICLE



RA = right atrium
LA = left atrium
SV = single ventricle

Disproportionate Ventricle Size

- Ebstein’s anomaly
- Coarctation of aorta

Ebstein's Anomaly

- Rare congenital cardiac anomaly in which tricuspid valve is displaced inferiorly in the right ventricle
- Valve leaflets are incompletely separated and may be adherent to *chordae tendinae*
- Tricuspid regurgitation is common and may cause right ventricular overload

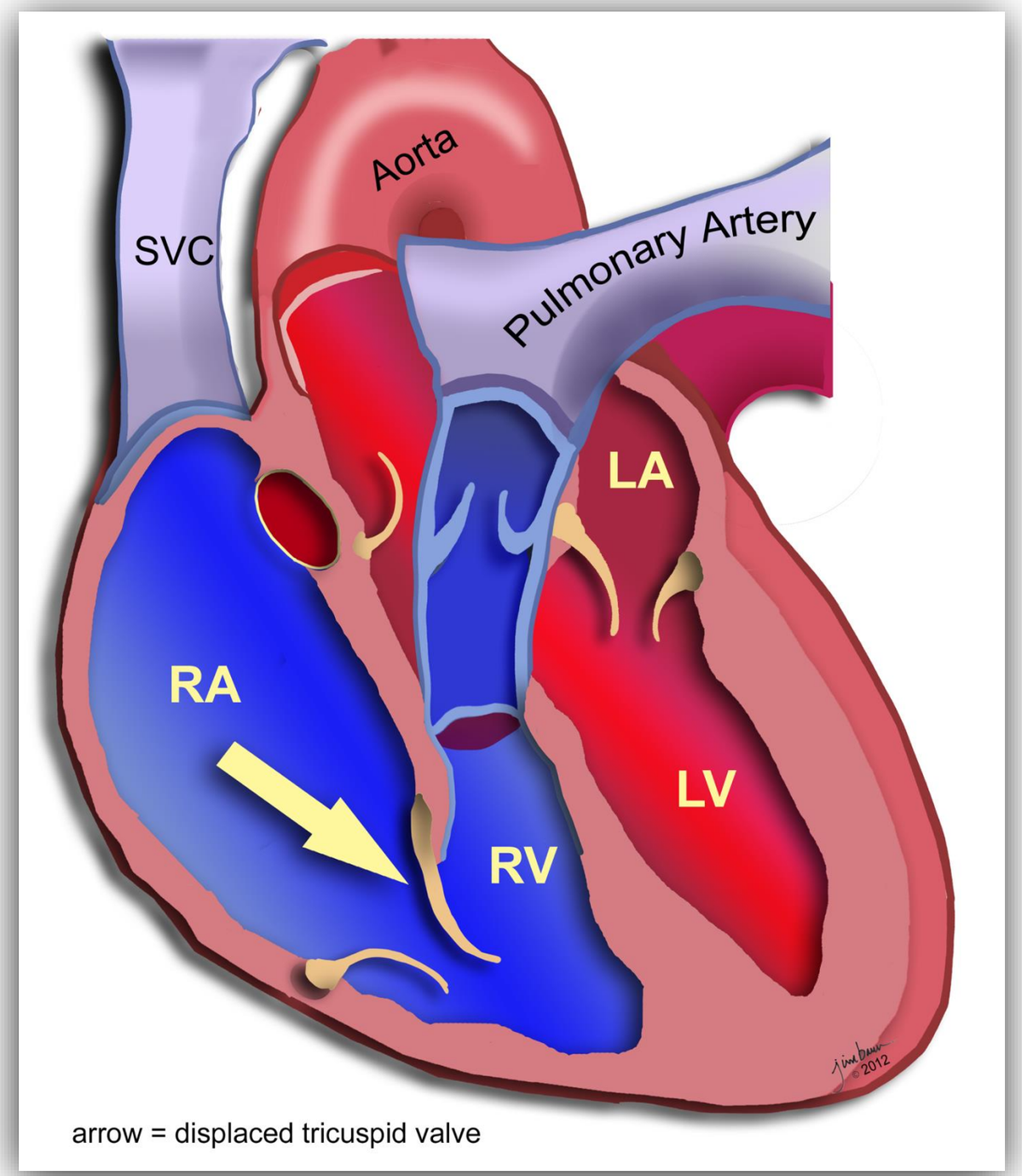
Ebstein's Anomaly

- Associated abnormalities include:
  - Trisomy 13 (Patau syndrome)
  - Trisomy 18 (Edward syndrome)
  - Turner syndrome
  - Pulmonary atresia/stenosis

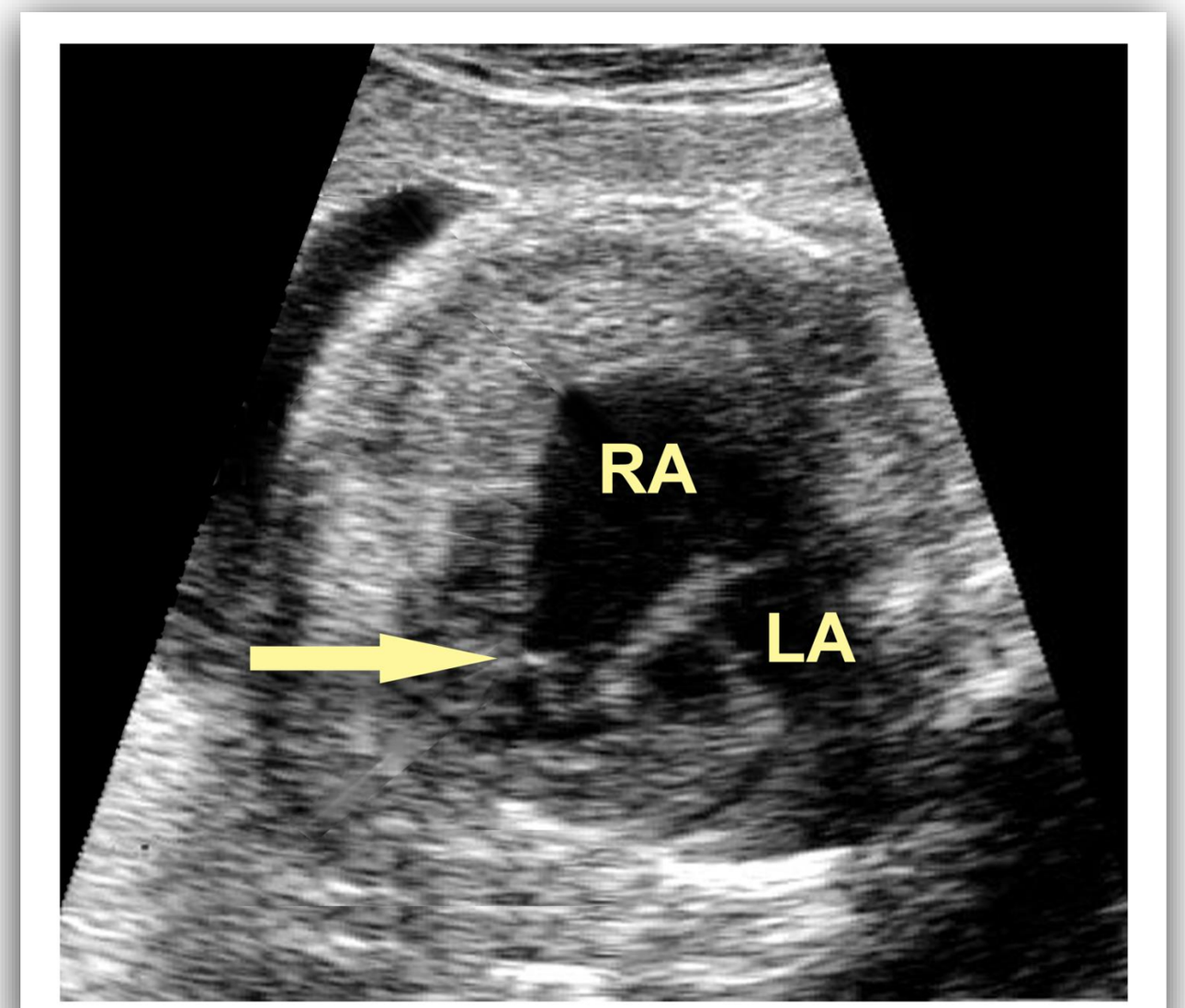
Ebstein's Anomaly

- Sonographic findings include:
  - Enlarged right atrium
  - Inferior displacement of tricuspid valve
  - Tricuspid regurgitation
  - Pericardial effusion if cardiac function is severely compromised

EBSTEIN'S ANOMALY

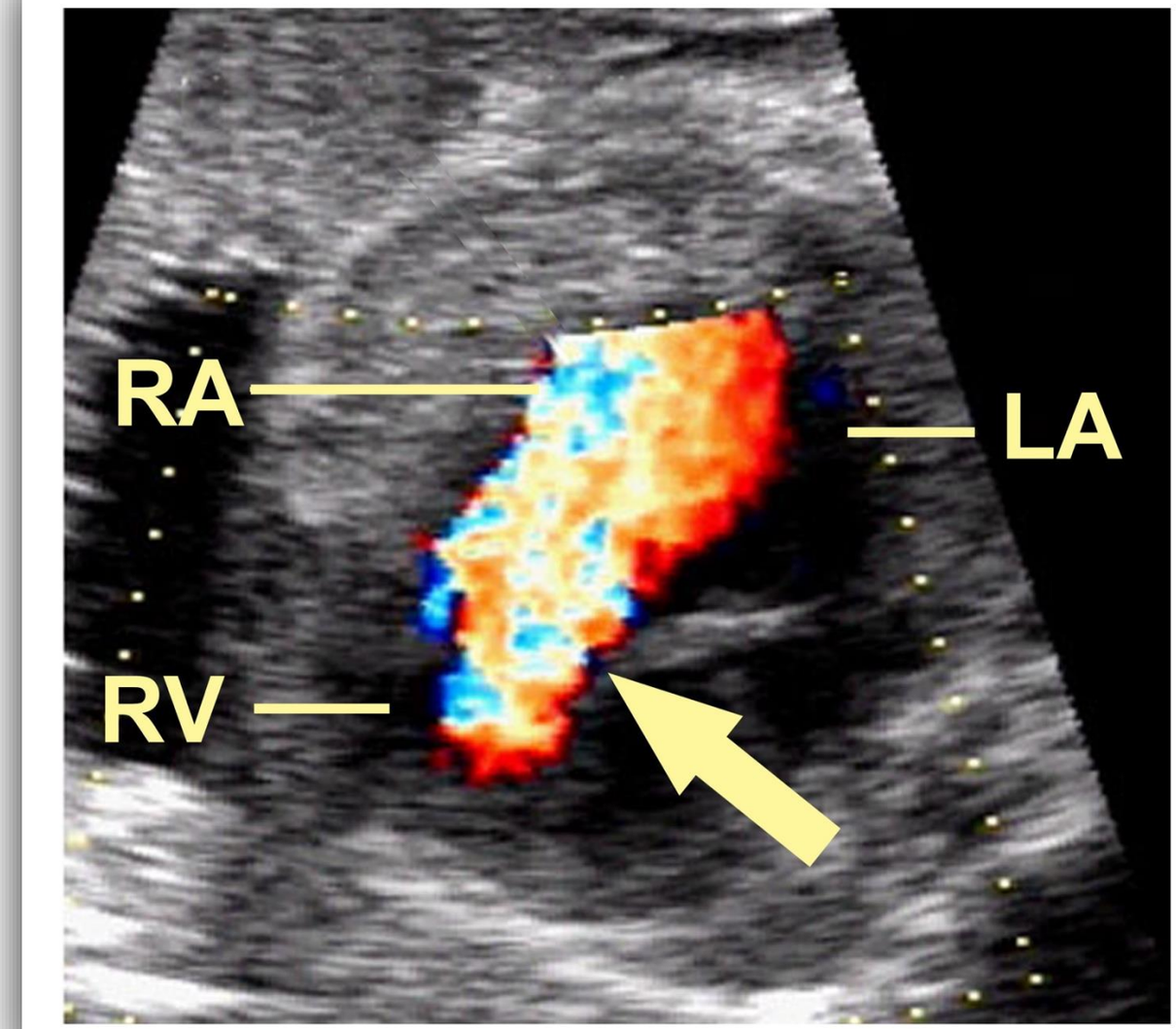


EBSTEIN'S ANOMALY



Arrow = inferiorly displaced tricuspid valve

EBSTEIN'S ANOMALY



Arrow = tricuspid regurgitation

Coarctation of Aorta

- Narrowing of the aortic lumen
- Hemodynamically significant stenosis reduces volume of blood in aorta and results in arch hypoplasia
- Infantile and adult types. Infantile is detectable with prenatal US

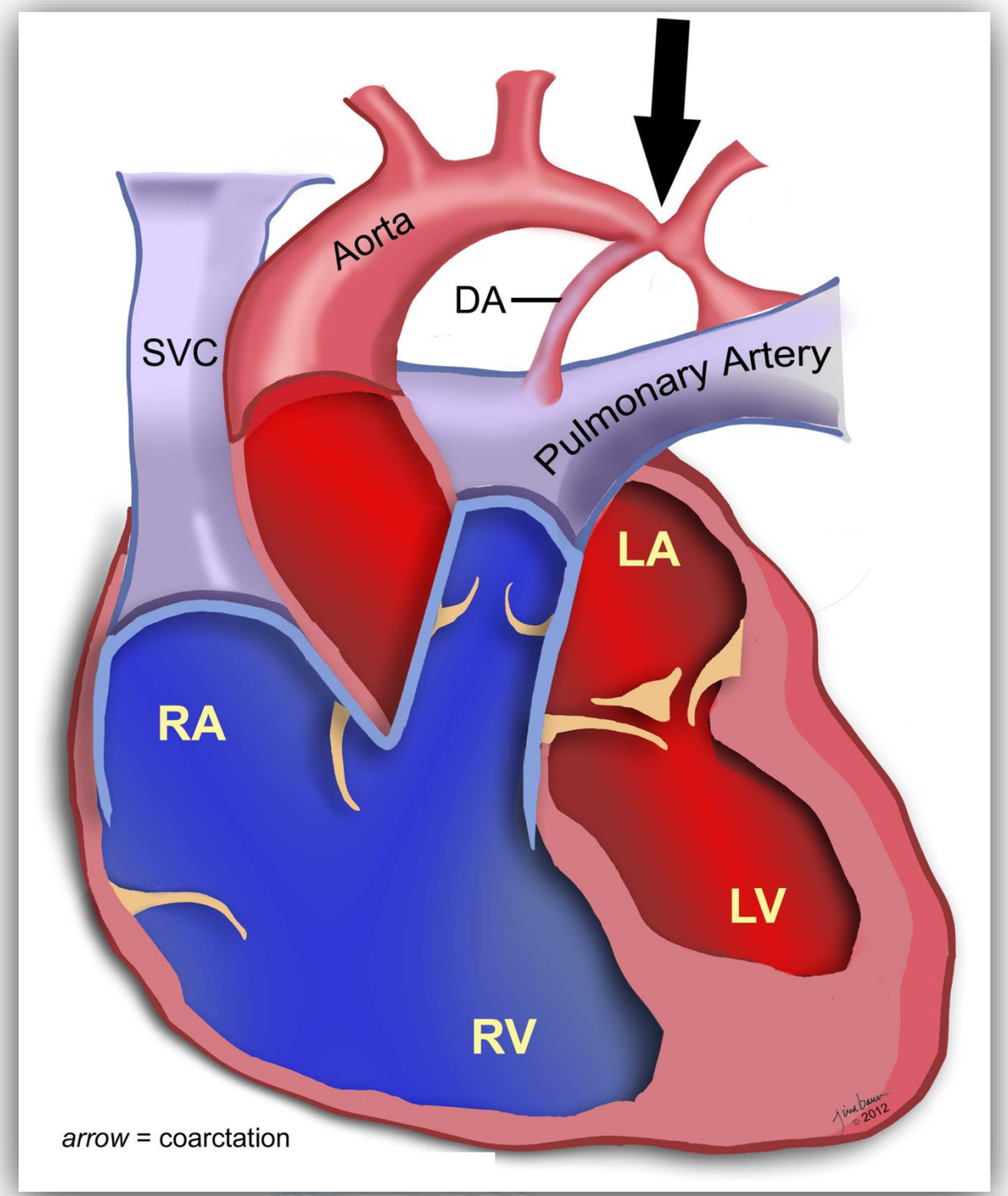
Coarctation of Aorta

- Associated abnormalities include:
  - VSDs
  - Mitral valve anomalies
  - Single ventricle
  - Transposition of great vessels
  - Double-inlet left ventricle
  - Tetralogy of Fallot
  - Hypoplastic left heart syndrome

Coarctation of Aorta

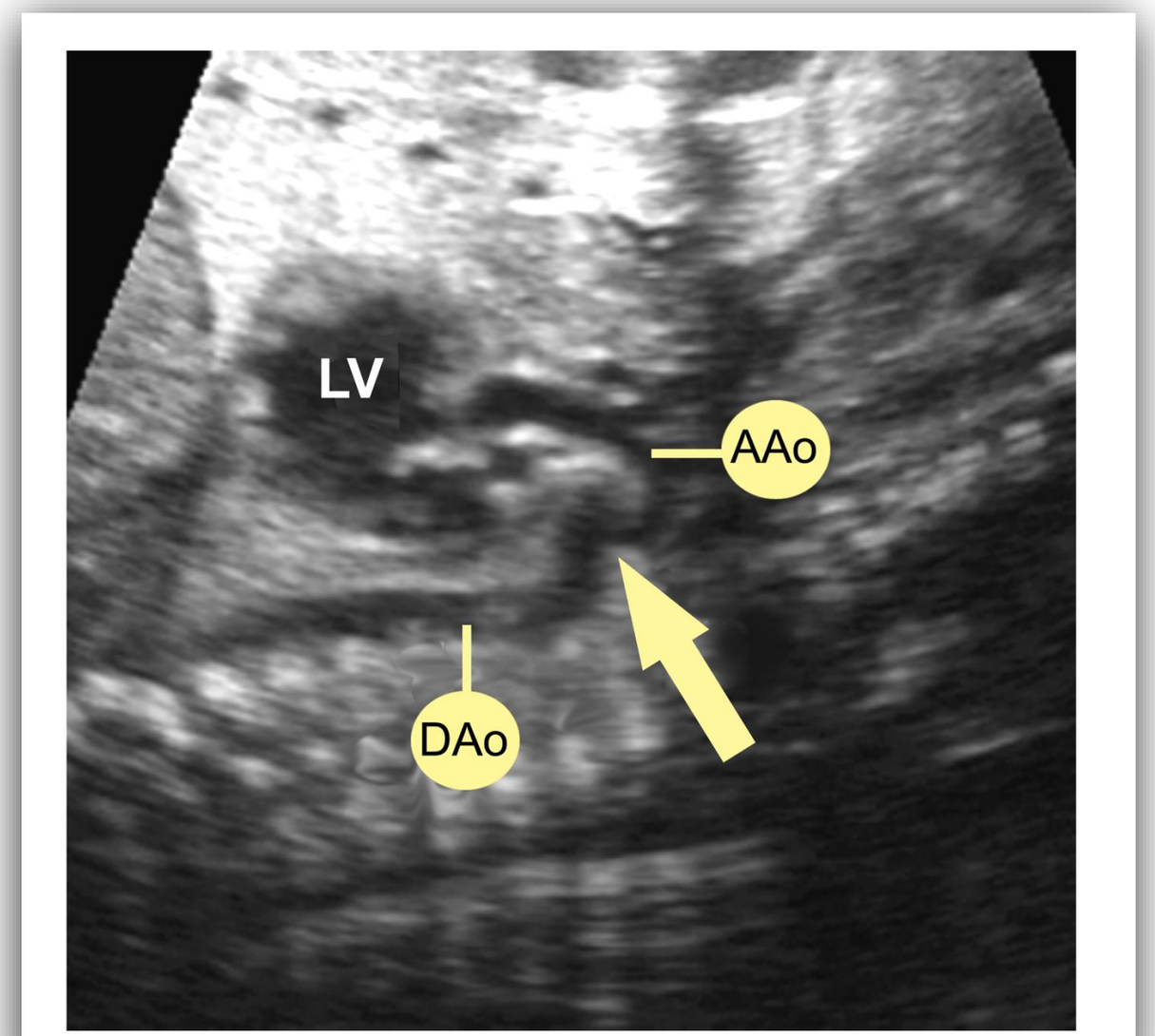
- Sonographic findings include:
  - Narrowed aortic arch
  - Contraductal shelf (*residual fibrotic tissue from ductis*)
  - Ventricular disproportion
  - Doppler may demonstrate elevated velocities distal to stenotic area

COARCTATION OF AORTA



COARCTATION OF AORTA

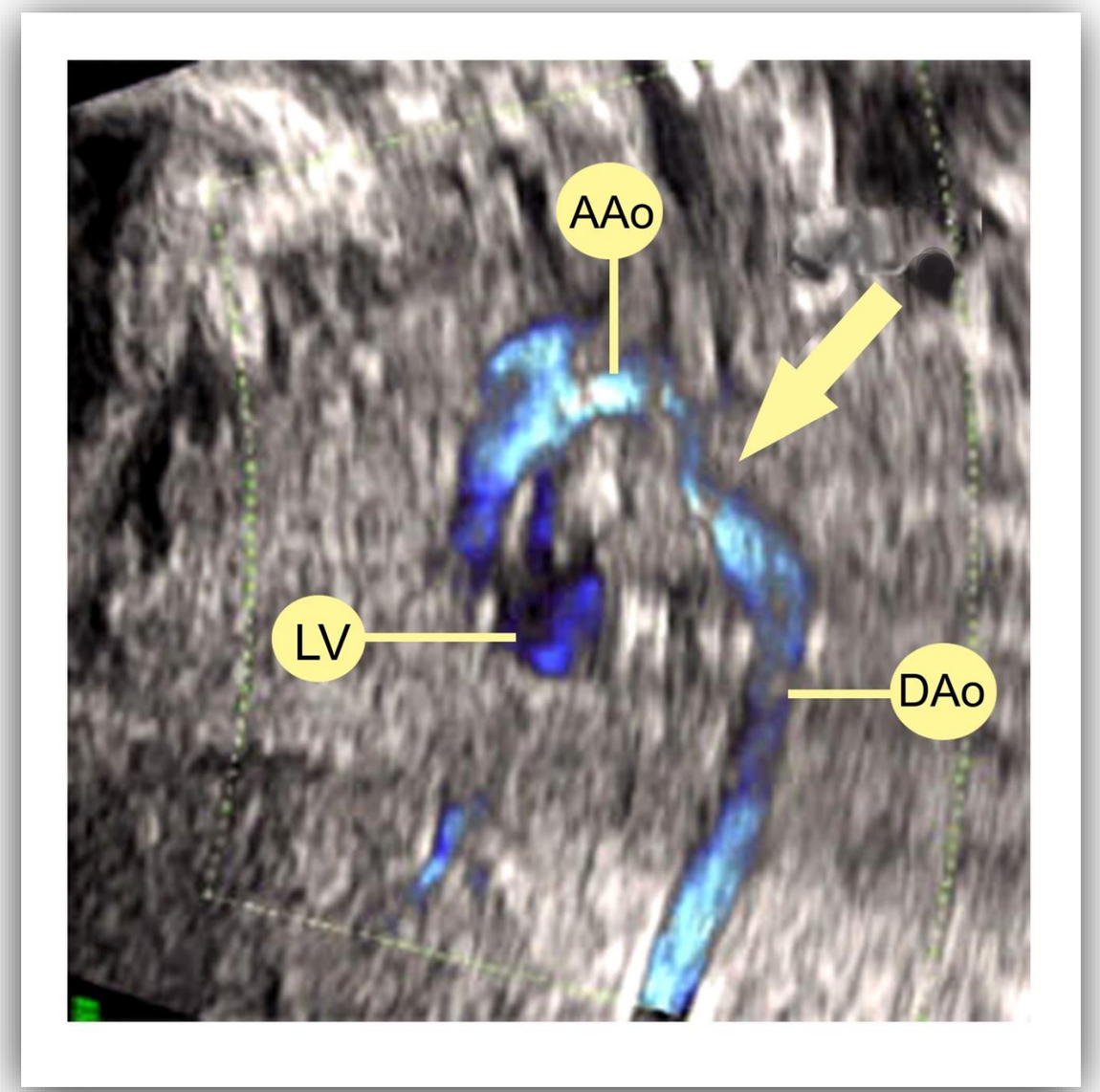
LV= left ventricle
AAo = aortic arch
DAo = descending aorta



Arrow = coarcted segment

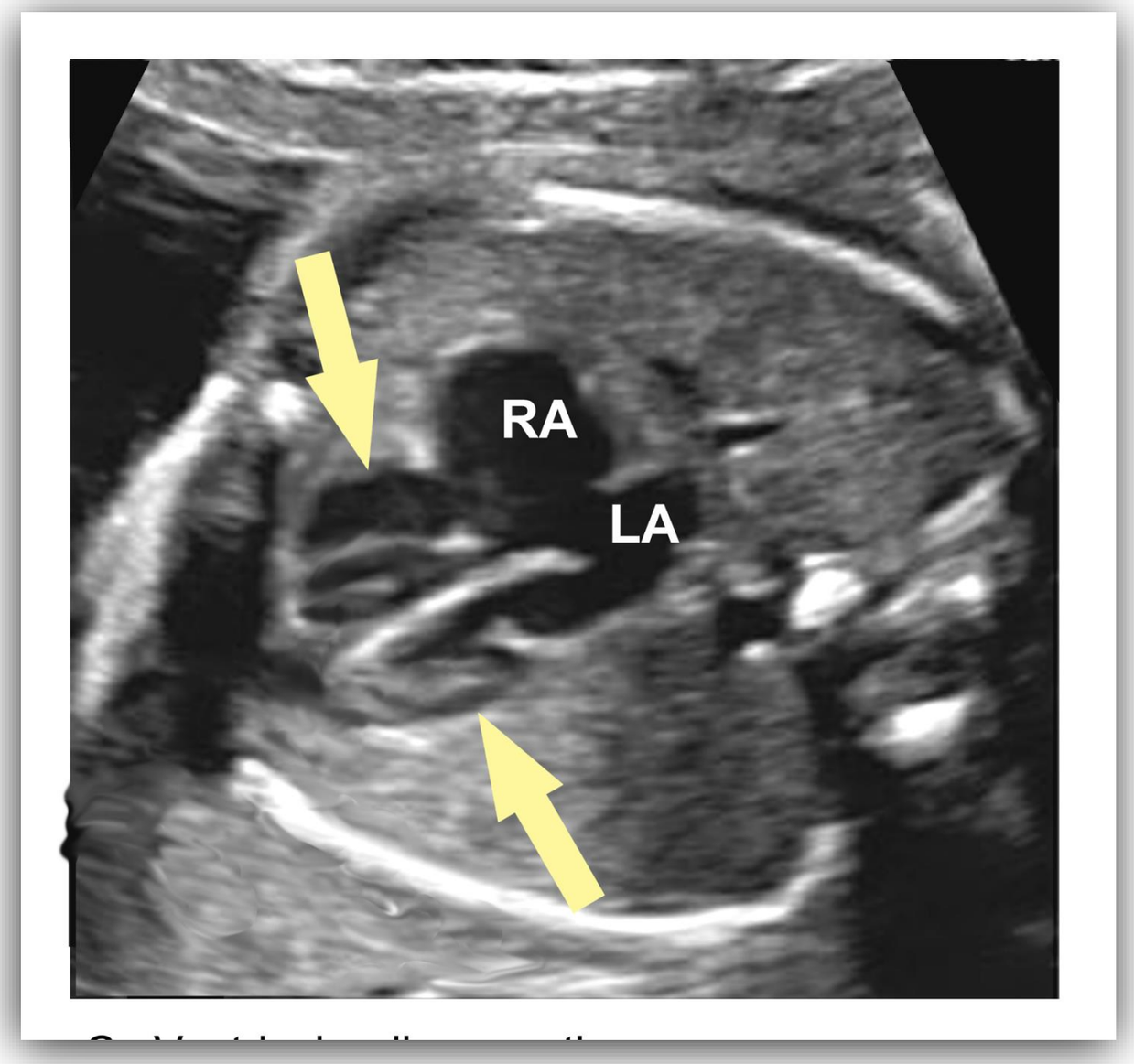
COARCTATION OF AORTA

LV= left ventricle
AAo = aortic arch
DAo = descending aorta



Arrow = tricuspid regurgitation

COARCTATION OF AORTA



Arrow = ventricular disproportion

Positional Abnormalities

- Routine four-chamber view normally demonstrates heart seated in center of chest with apex pointing to left at ≈ 45° angle
- Heart is bordered on both sides by homogeneously echogenic lung
- Deviations from this configuration raise specter of:
  - Diaphragmatic hernia
  - Situs abnormalities
  - Ectopia cordis

Situs Abnormalities

- Variations in laterality of thoracic and abdominal organs
- May be harbinger of other complex congenital abnormalities
- Two primary situs abnormalities:
  - *Situs inversus*: complete reversal of normal right-left laterality of organs in chest and abdomen
  - *Situs ambiguous* (*heterotaxy syndrome*): incomplete right-left mirroring of intrathoracic contents. Typically many complex anatomic abnormalities associated

Situs Abnormalities

- Associated abnormalities include:
  - Intestinal malrotation
  - Cardiac defects
  - Transposition of great vessels
  - Biliary atresia
  - Total anomalous pulmonary venous return
  - Polysplenia

Situs Abnormalities

- Sonographic findings include:
  - Reversal of laterality of landmark anatomic structures
    - Heart on right
    - Liver and stomach on left
  - Other congenital anatomic abnormalities

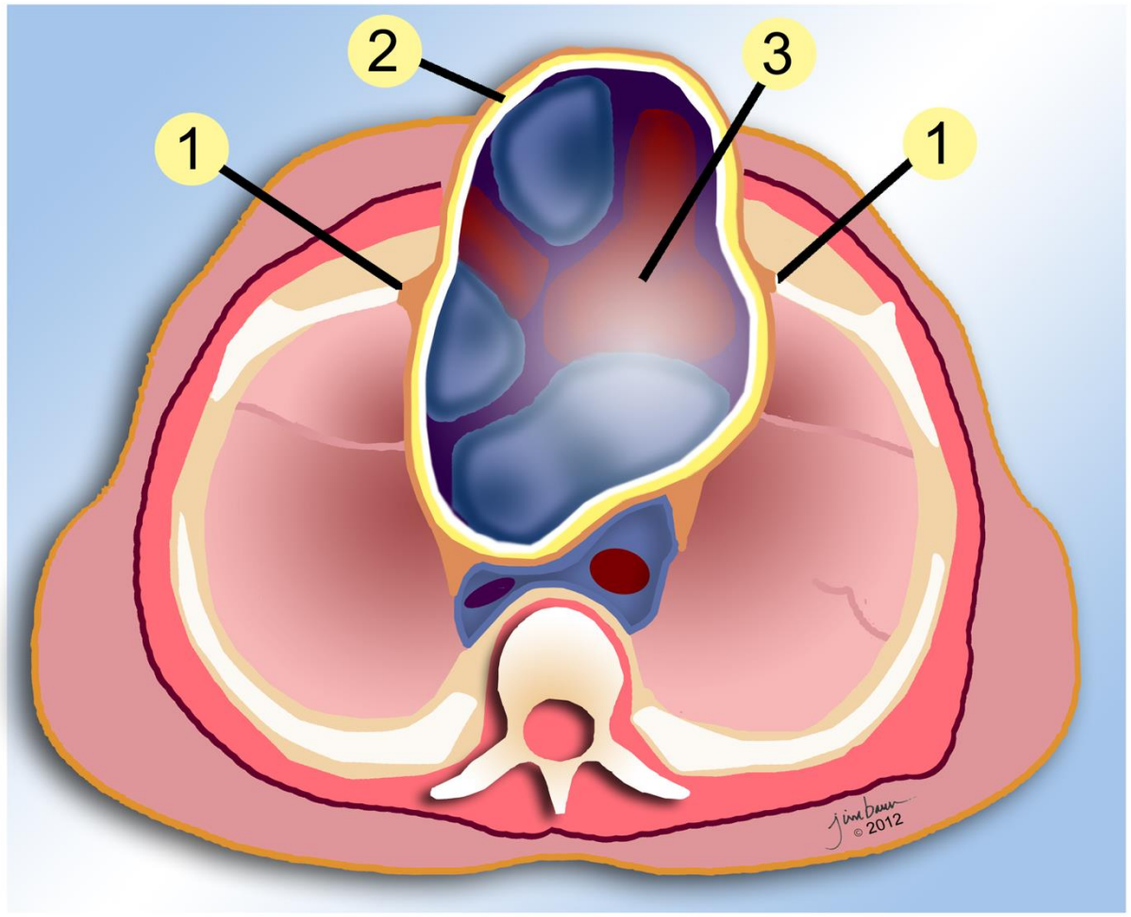
Ectopia Cordis

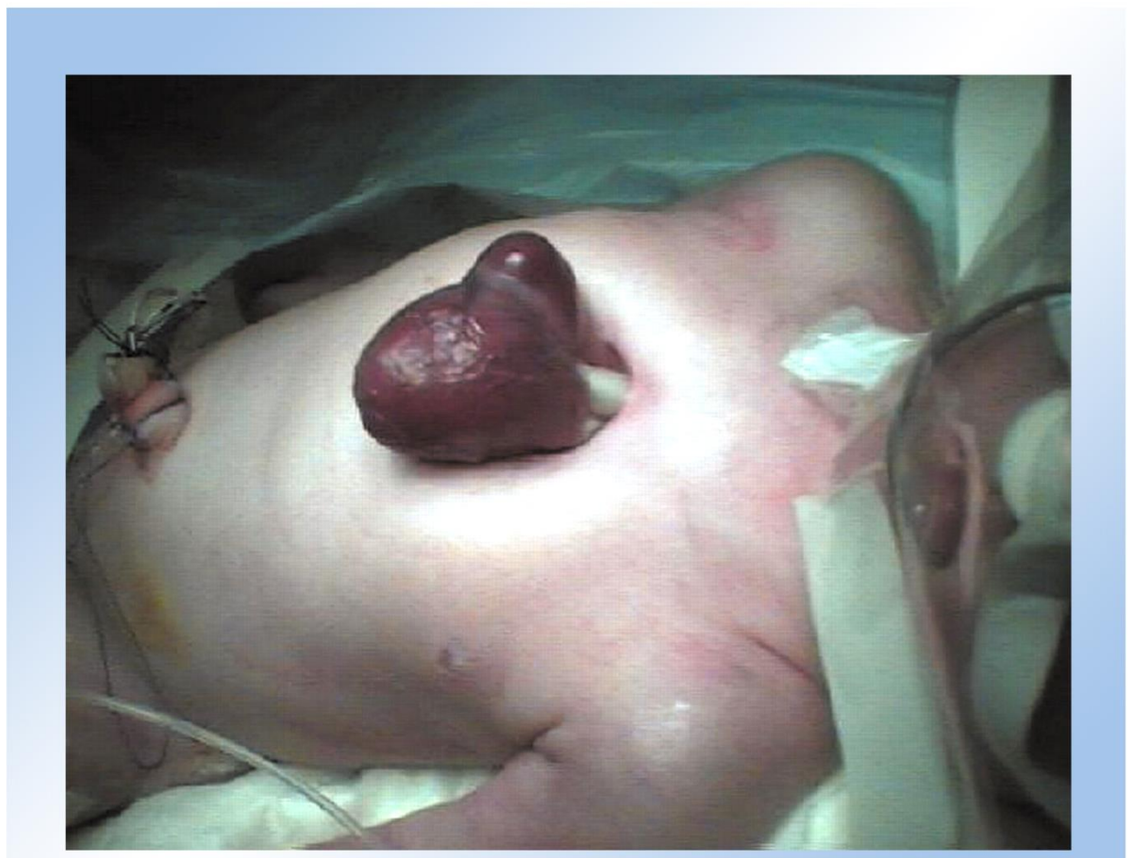
- Rare malformation in which part or all of heart is located outside thoracic cavity
- Failure of embryonic midline mesoderm to fuse leaves a cleft in anterior thoracic wall
- Associated abnormalities include:
  - Omphalocele
  - Congenital diaphragmatic hernia
  - Congenital heart disease
  - Pentalogy of Cantrell

Ectopia Cordis

- Sonographic findings include:
  - Identification of heart outside thoracic cavity
  - Small thorax

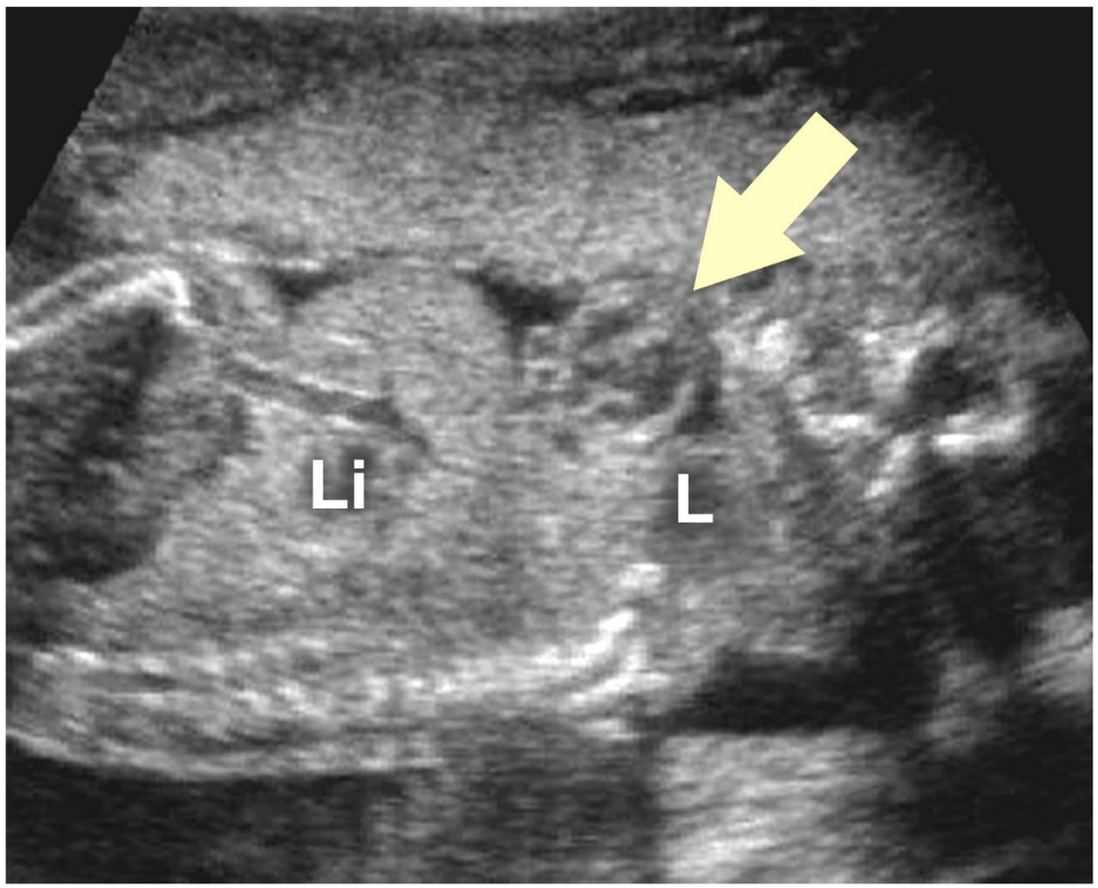
ECTOPIA CORDIS



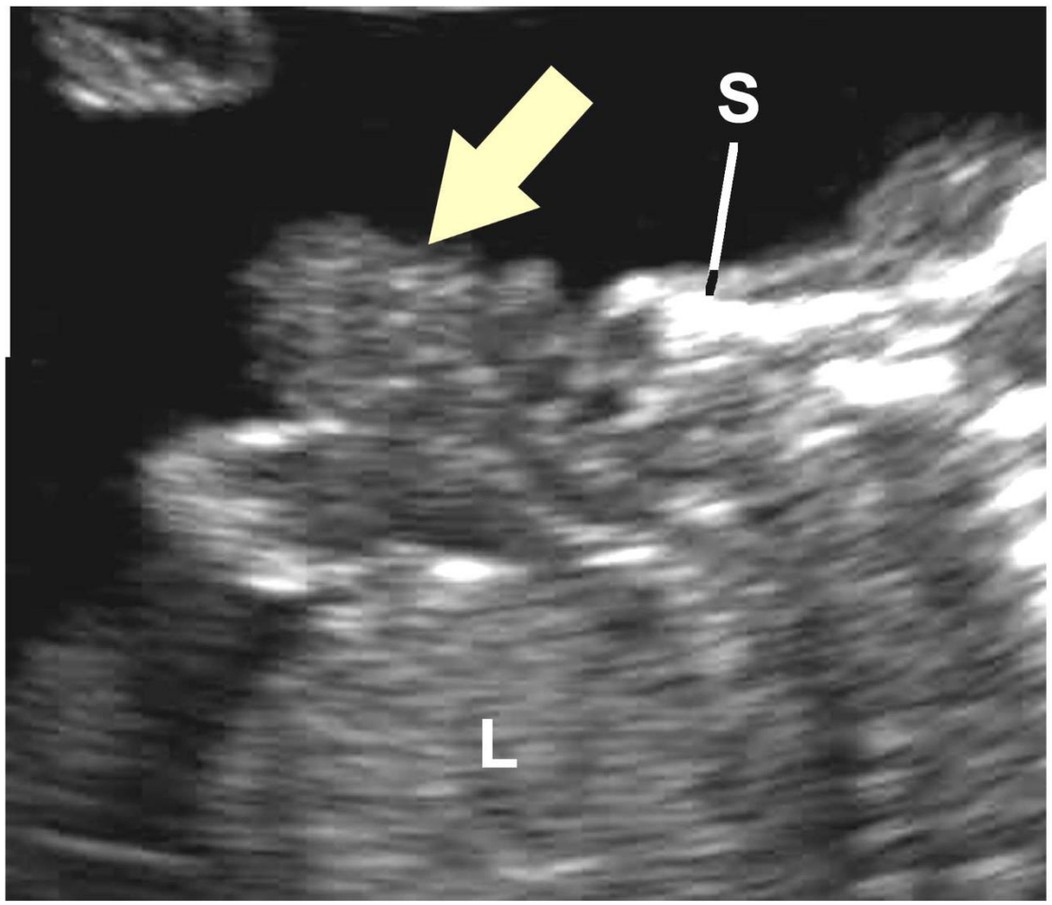


1 = sternal defect
2 = pericardium
3 = herniated heart

ECTOPIA CORDIS



Sagittal scan throught the fetus.



Transverse scan through anterior thorax.

Arrow = herniated heart

Cardiac Wall Abnormalities

- Focal or diffuse distortion of normal, symmetrical appearance of cardiac wall suggests presence of a congenital anomaly such as:
  - Cardiomyopathy
  - Cardiac tumors
  - Pericardial effusions

Cardiomyopathy

- Abnormality of myocardium that ultimately leads to heart failure
- Etiology may be intrinsic, extrinsic, genetic, or idiopathic
- Cardiomegaly most obvious subjective sonographic finding

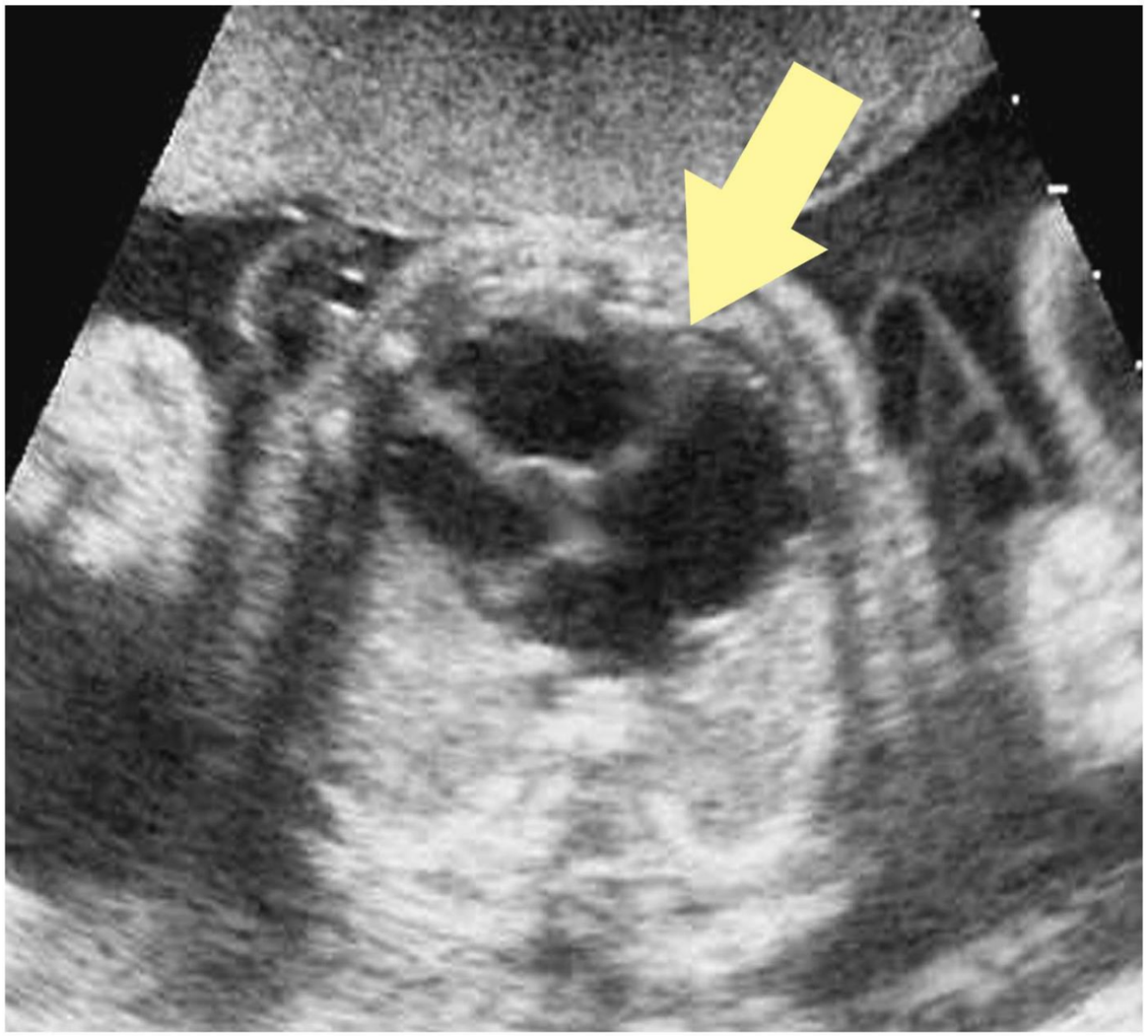
Cardiomyopathy

- Associated abnormalities include:
  - Congenital infection
  - Twin-to-twin transfusion syndrome
  - Maternal diabetes
  - Various syndromes

Cardiomyopathy

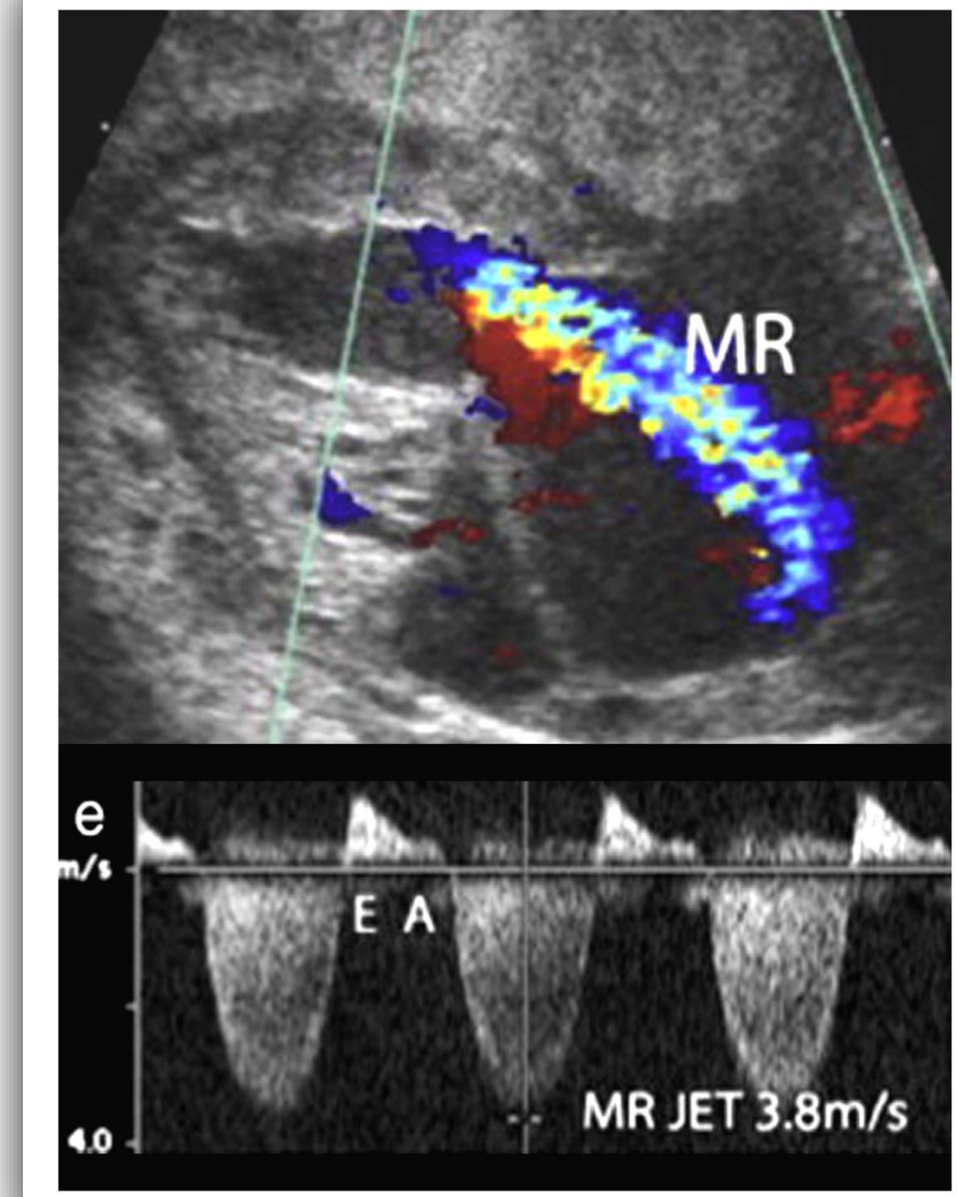
- Sonographic findings include:
  - Cardiomegaly
  - Dilated cardiac chambers
  - Thickened ventricular septum and myocardium
  - Atrioventricular valve regurgitation

CARDIOMYOPATHY



Cardiomegaly

CARDIOMYOPATHY



AV valve regurgitation with elevated velocities

Cardiac Tumors

- Rare abnormality
- Most common cardiac tumor is *rhabdomyosarcoma*

- Less common tumors include:
  - Teratoma
  - Fibroma
  - Hemangioma
  - Myxoma

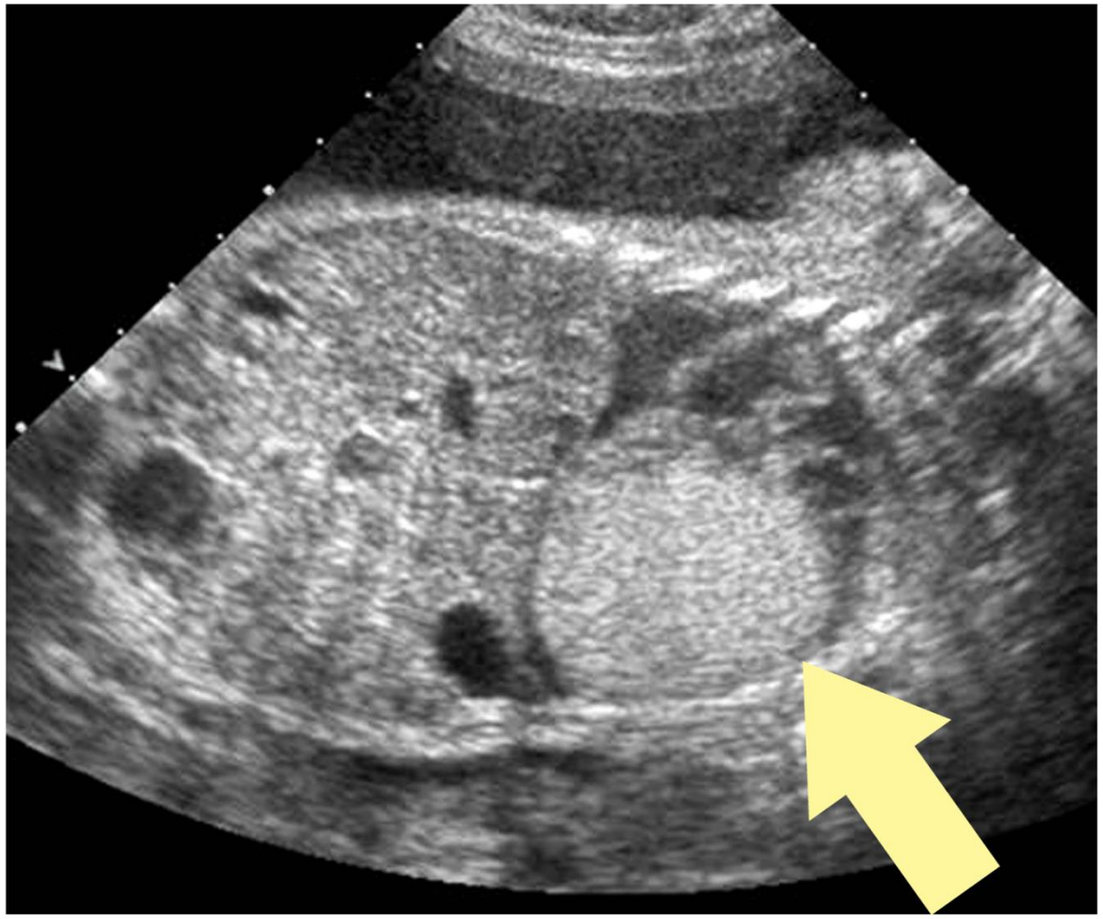
Cardiac Tumors

- Associated abnormalities include:
  - Pericardial effusion
  - Pleural effusion
  - Hydrops fetalis
  - Pulmonary hypoplasia

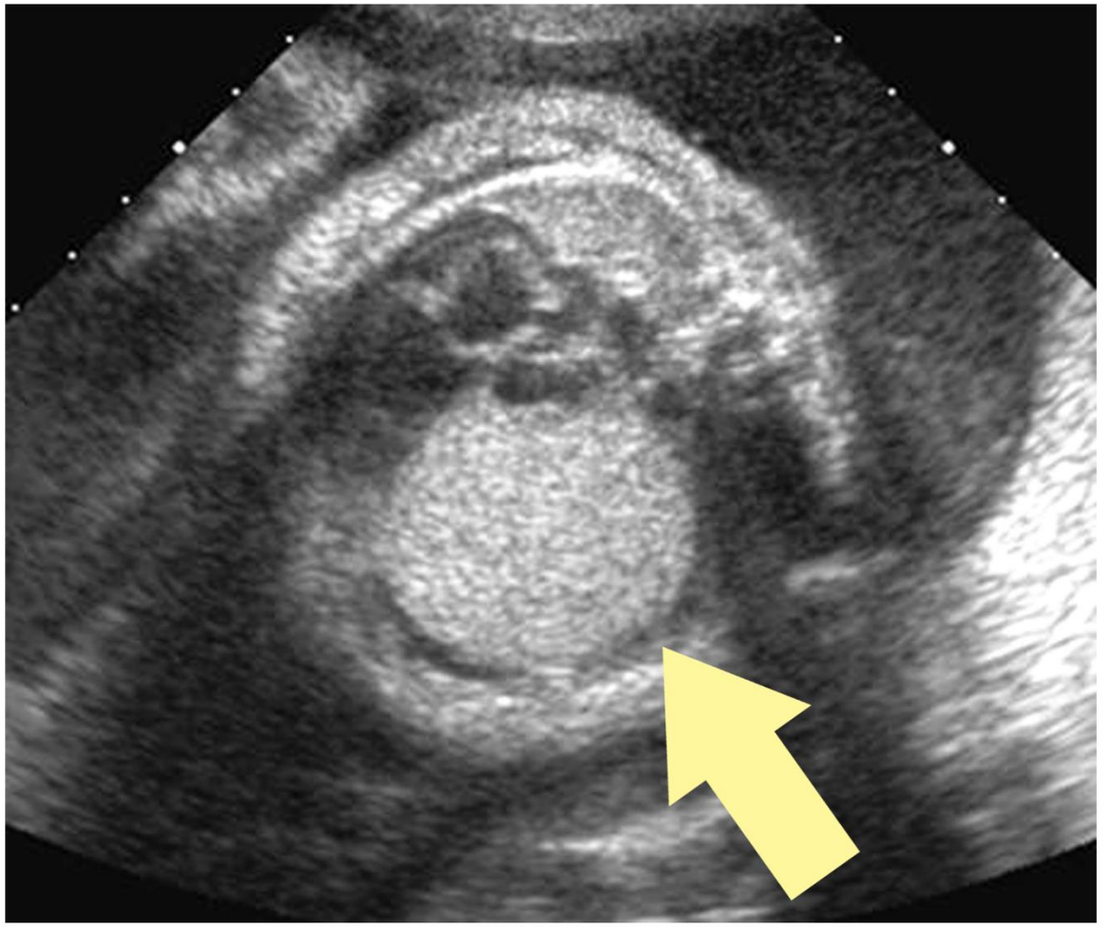
Cardiac Tumors

- Sonographic findings include:
  - Echogenic masses within fetal heart
  - Solid or complex appearing
  - Distortion of normal cardiac morphology
  - Displacement of heart form normal position in chest

CARDIAC TUMORS



Coronal section

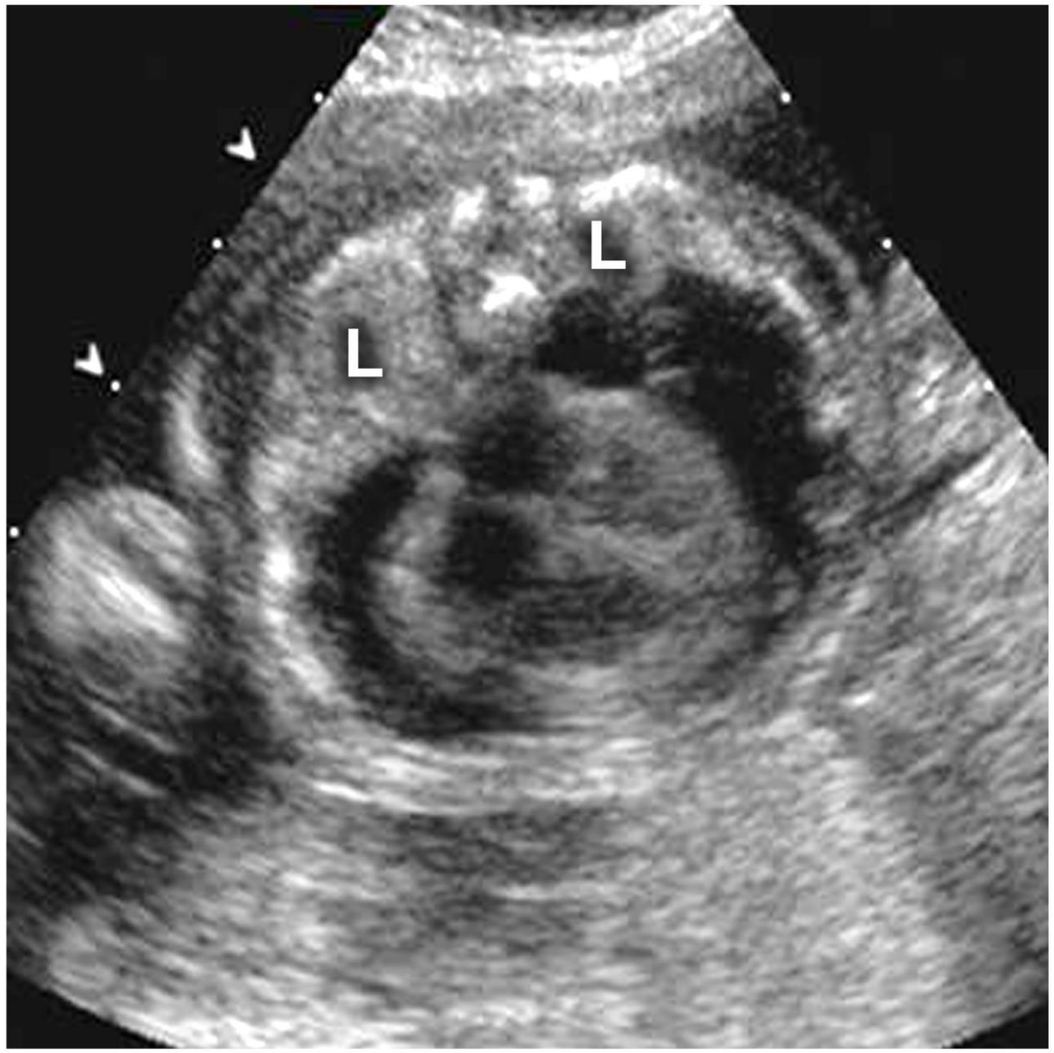


Axial section

Pericardial Effusions

- Accumulation of fluid in the pericardial sac
- One of the earliest indicators of impending hydrops
- Associated abnormalities include:
  - Hydrops fetalis
  - Cardiac anomalies
  - Cardiac tumors
  - Trisomy 21 (Down syndrome)

PERICARDIAL EFFUSION



Pericardial effusion with compressed lungs (L)

OB GYN SONOGRAPHY REVIEW

Fetal Chest, Lungs & Heart