

HEART AND LUNGS

NORMAL SONOGRAPHIC ANATOMY

THORAX

Axial and coronal sections demonstrate integrity of thorax, fetal breathing movements, and overall size and shape.

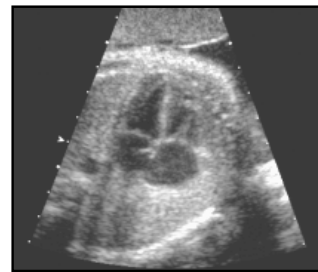
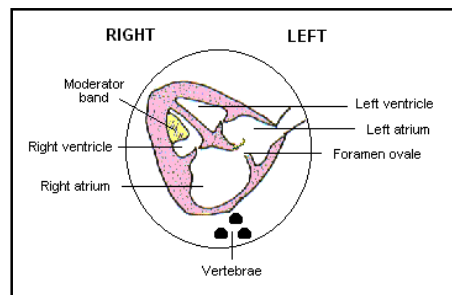
LUNG

Coronal section demonstrates relationship of pulmonary parenchyma to heart and chest wall.

FETAL ECHOCARDIOGRAPHY

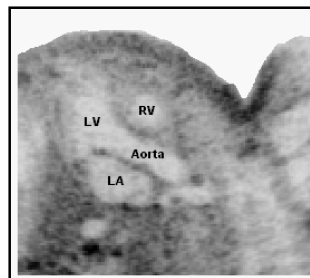
Four chamber view: The four chamber view is the SINGLEMOST important image of the fetal heart. 95% of all anatomic abnormalities can be demonstrated if an adequate image is obtained. Normal findings include:

- Apex of heart points 45° to left anterior chest wall
- Ventricles approximately same size ($R \geq L$ later in pregnancy)
- Flap of foramen ovale opens into left atrium
- Prominent moderator bands present in apex of right ventricle
- Valves separate both atria from ventricles



Left ventricular long axis view:

- Sagittal section shows aortic arch and its branches
- Relationship of aorta and pulmonary arteries to ventricles



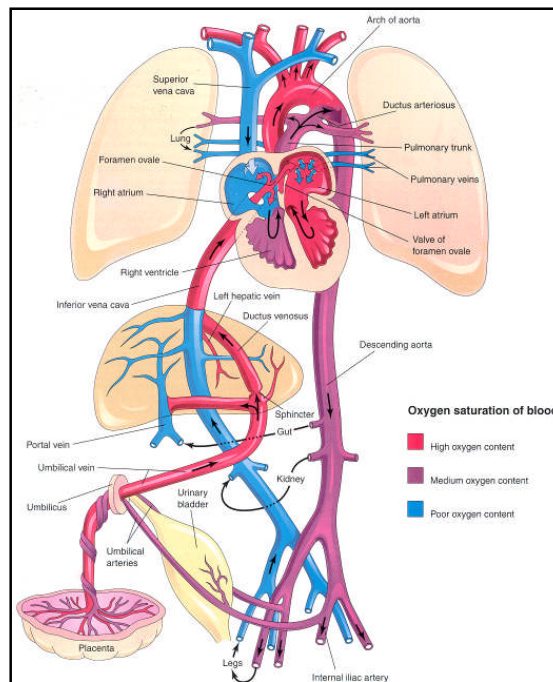
FETAL CARDIAC HEMODYNAMICS

Blood enters the fetal heart via the conduits into the right atrium. The ductus venosus and the hepatic veins empty into the IVC which directs blood into the right atrium. The eustachian valve and the crista dividens channel blood through the right atrium toward the foramen ovale and into the left atrium. Blood flow through the heart is proportioned as follows:

- 40% right atrial blood → foramen ovale → left atrium → systemic
- 60% right atrial blood → right ventricle.

Of this 60%, right ventricular output is as follows:

- 92% → main pulmonary artery → ductus arteriosus → systemic
- 8% → right ventricular blood → pulmonary artery → lungs



ECHOCARDIOGRAM ABNORMALITIES:

Useful in diagnosing a variety of fetal cardiac and cardiovascular related anatomic and physiologic abnormalities including:

- Structural heart abnormalities
- Fetal arrhythmias
- Assessment of hydrops fetalis
- Prediction of hydrops fetalis
- Assessment of ductal patency in patients receiving indomethacin
- Coarctation of the aorta and other obstructive lesions

ABNORMAL POSITIONAL FINDINGS:

- Diaphragmatic hernia
- Complex congenital heart disease
- Thoracic ectopia cordis (Pentalogy of Cantrell)
- Extra - cardiac abnormalities of the thorax

ABNORMAL CARDIAC SIZE:

- Cardiomegaly
- Pulmonary hypoplasia

DISPROPORTIONATE VENTRICLES:

- Usually associated with a complex cardiac abnormality
- Coarctation of the aorta
- Unilateral ventricular hypoplasia
- Single ventricle

SEPTAL DEFECTS:

- Atrial septal defect (ASD)
- Endocardial cushion defect
- Ventricular septal defect (VSD)

ABNORMAL CARDIAC WALL:

- Cardiomyopathies
- Focal masses (rhabdomyomas)
- Pericardial effusions
- Atrioventricular defect

CARDIAC ANOMALIES

Types of cardiac anomalies that can be detected during a comprehensive, routine fetal survey between 16 and 22 weeks include:

ATRIAL SEPTAL DEFECT (ASD)

Any abnormal opening between the atria is referred to as an atrial septal defect. In the newborn, hemodynamic considerations include right to left shunting of blood. Since this pattern is normal in the fetus, ASD is not significant hemodynamically.

SONOGRAPHIC FINDINGS

- Relies on demonstration of echo dropout at the level of atrial septum
- Since foramen ovale is normally open, prenatal diagnosis is unlikely

VENTRICULAR SEPTAL DEFECTS (VSD)

Ranks first in frequency of all cardiac anomalies. Caused by incomplete closure of interventricular (IV) foramen and failure of the membranous part of IV septum.

SONOGRAPHIC FINDINGS

- Demonstration of an opening between the ventricles
- Larger defects are easier to diagnose



HYPOPLASTIC HEART SYNDROME

Usually affecting the left side, hypoplastic heart syndrome is a lethal condition. It typically affects the ventricle, the atrium and the aorta. The unaffected side may be enlarged. Fetal hydrops may occur if pulmonary venous return is obstructed.

SONOGRAPHIC FINDINGS

- Absent or markedly small ventricle on 4 chamber view
- Absent or small atrium and aorta

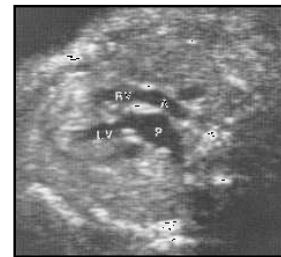


TRANSPOSITION OF THE GREAT ARTERIES (TGA)

The origin of the great vessels are transposed so that the aorta arises from right ventricle and pulmonary trunk arises from left ventricle.

SONOGRAPHIC FINDINGS

- Correct right - left orientation is a MUST
- Images of outflow tract demonstrates anomalous origin of great arteries
- Difficult sonographic diagnosis

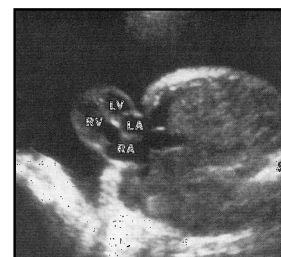


ECTOPIA CORDIS

In ectopia cordis, all or part of heart is located outside of chest cavity. It is frequently associated with intracardiac anomalies and omphalocele in Pentalogy of Cantrell.

SONOGRAPHIC FINDINGS

- Small thorax
- Extension of soft tissue outside thoracic cavity in which cardiac activity is noted.



OTHER CARDIAC ANOMALIES

Contemporary real-time ultrasound imaging systems allow for complete echocardiographic examination of the fetal heart. Color blood flow mapping and M-mode techniques allow specialists in fetal cardiac imaging to diagnose many problems prenatally. Some other conditions that can be diagnosed using ultrasound include:

- **Endocardial cushion defects:** atrial or ventricular septal defects resulting from failure of the common AV orifice to separate into mitral and tricuspid valves.
- **Tetralogy of Fallot:** consists of four anatomic abnormalities: large VSD, overriding aorta, pulmonary infundibular stenosis, right ventricular hypertrophy
- **Ebstein's anomaly:** downward displacement of the septal and posterior leaflets of the tricuspid valve
- **Truncus arteriosus:** failure of the aorta and pulmonar artery to form as completely separate vessels. Variations on exact configuration varies.
- **Ventricular hypertrophy:** in utero hypertrophy is most commonly associated with cardiac outlet obstruction but may be associated with maternal diabetes.
- **Cardiac tumors:** rare. Most common types are rhabdomyomas and rhabdosarcomas.

PULMONARY ANOMALIES

CYSTIC ADENOMATOID MALFORMATION OF THE LUNG (CAML)

Cystic adenomatoid malformation is typically a unilateral condition characterized by the replacement of normal lung parenchyma with cysts. In cases where the lesions are large enough, the mediastinum may be shifted away from midline. Three classes of CAML exist based on the size of the cysts:

- Type I large cysts
- Type II multiple small cysts < 1-2 cm
- Type III non-cystic lesions producing a mediastinal shift

Associated abnormalities may include:

- Non-immune hydrops fetalis
- Polyhydramnios

SONOGRAPHIC FINDINGS

- Demonstration of a non-pulsatile cystic mass in the fetal lung
- Lateral displacement of the heart
- Sonographic signs of hydrops fetalis
- Polyhydramnios



PULMONARY SEQUESTRATION

The separation of a mass of pulmonary parenchyma from the normal lung results in pulmonary sequestration. This "mass" receives its blood supply from the systemic circulation and does not communicate with the bronchial tree. Non-immune hydrops may be present.

SONOGRAPHIC FINDINGS:

- Homogenous, echogenic, intrathoracic mass
- Sonographic signs of hydrops fetalis may be present

