Sonography of the Fetal Heart

Outflow Tracts

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Routine 2nd & 3rd Trimester Fetal Ultrasound
Assess four-chamber view and outflow tracts

Heart - Four Chamber View

Assess
- Position in thorax
- Chamber size
- Ventricular septum

To Exclude
- Thoracic mass
- Situs inversus
- Ventricular hypoplasia
- Ebstein anomaly
- Septal defect
- Endocardial cushion defect

Position of Heart in the Thorax

Thoracic structure
- Situs
- Extrinsic compression
- Displacement

Dextrocardia

Heart in the right hemithorax

Etiology
- Situs abnormality – high association with cardiac anomalies
- Left thoracic mass displacing heart to the right
- Right pulmonary agenesis
Situs Inversus

Complete (situs inversus totalis)
< 3% risk for cardiac anomalies
20% have Kartagener syndrome bronchiectasis, nasal polyps

Partial situs inversus
40% have severe anomalies cardiac, polysplenia, asplenia

Situs Ambiguous – Heterotaxy

Asplenia
Bilateral right-sidedness
Mortality 90 - 95 %

Polysplenia
Bilateral left-sidedness
Mortality 80 %

Four Chamber View

Anomalies identified
- Ventricular septal defect
- Atrioventricular defects
  atrioventricular canal
- Hypoplastic left ventricle
  mitral or aortic atresia
- Hypoplastic right ventricle
  tricuspid or pulmonic atresia
Four Chamber View

Anomalies identified
- Dilated left ventricle – aortic stenosis
- Thick-walled right ventricle – pulmonic stenosis
- Dilated right atrium – Ebstein’s
- Pericardial effusion
- Pericardial teratoma

Ventricular Septal Defect

Ultrasound findings
- Interruption of ventricular septum
- Four chamber view may be normal
- Flow with color Doppler
  - Right → Left
**Atrioventricular Canal**

Large defect in central portion of heart
Endocardial cushion defect
Communication between Atria and ventricles

Ultrasound findings
Defects in
- Atrial septum
- Ventricular septum
- Atrio-ventricular valves

**Hypoplastic Left Ventricle**

Small or absent left ventricle
Associated with stenosis or atresia
- Foramen ovale
- Mitral valve
- Aortic valve

Mild asymmetry may be seen with coarctation of the aorta

**Detection rate:**
1993 - 10% prenatal diagnosis
2003 - 50% prenatal diagnosis

Prenatal detection improves outcome
↓ Time to surgery
↓ Postoperative mortality
(0% vs. 34%)
Hypoplastic Left Ventricle

Ultrasound findings
Small or absent left ventricle
Poor left ventricular contractility
+/- Small left atrium
+/- Small aorta

Hypoplastic Right Ventricle

Ultrasound findings
Small or absent right ventricle
Poor right ventricular contractility
+/- Small pulmonary artery

23 weeks
34 weeks
**Ebstein Anomaly**

Tricuspid valve malformed
septal leaflet displaced into right ventricle
dysplastic
Prognosis worse with congestive heart failure in utero
persistent arrhythmias

**Ultrasound findings**

Enlarged right atrium
Tricuspid valve dysplasia
Tricuspid regurgitation ± Hydrops

**Ventricular Diverticulum**

Outpouching from apex of ventricle
Left more common than right
+/- part of Cantrell syndrome
+/- s/p myocardial ischemia
Ultrasound findings
Outpouching from ventricle
Without contractility
Thin walled
+/- Hydrops

**Left ventricular diverticulum**

33 weeks
36 weeks
Right ventricular diverticulum

Cardiac Tumors

Rhabdomyomas
Associated with tuberous sclerosis especially if multiple
Ultrasound findings
Discrete mass +/- Hydrops

Cardiac rhabdomyoma

Pericardial Effusion

Early hydrops
Down syndrome
2° to pericardial tumor teratoma arteriovenous malformation
Cardiac Arrhythmias

Premature atrial contractions
Supraventricular tachycardia
Heart block

Atrial fibrillation

Atrial flutter

Supraventricular Tachycardia

Heart block
Heart - Outflow Tracts

Assess To Exclude
Outflow tract Tetralogy of Fallot
aorta Truncus arteriosus
pulmonary artery Transposition of
the great vessels

Left ventricular outflow tract – Aorta

Outflow tracts

AO Cox & Beus
Left ventricular outflow tract – Aorta

AO Washington

Right ventricular outflow tract
Pulmonary Artery

Aortic Stenosis

Obstruction to left ventricular outflow
If critical or severe progresses to
hypoplastic left ventricle
Ultrasound findings
Narrow or poorly functioning
aortic valve
Changes in left ventricle
Dilated or small
+/- Poor contractility
+/- Endocardial brightening

Aortic stenosis
Aortic stenosis with Post-stenotic Dilatation

Coarctation of the Aorta
- Focal narrowing of thoracic aorta
  - Typically near junction with ductus arteriosus
- Associated with
  - Turner syndrome
  - Bicuspid aortic valve
  - Ventricular septal defect
- Ultrasound findings
  - Mild ventricular asymmetry
  - left < right

Coarctation of the Aorta – 34 weeks

Coarctation of the Aorta – 31 weeks

Ascending Aortic Dilatation

Etiology
- Marfan syndrome
- Ehlers-Danlos syndrome
- Aortic stenosis with poststenotic dilatation
- Complex congenital heart anomaly e.g., Tetralogy of Fallot

Dilated aorta with Marfan
**Pulmonic Stenosis**
- Obstruction to right ventricular outflow
- If critical or severe progresses to hypoplastic right ventricle
- Ultrasound findings
  - Narrow or poorly functioning pulmonic valve
  - Right ventricle small, thick walls
  - +/- Poor contractility
  - Tricuspid regurgitation
  - Reversed flow in ductus arteriosus

**Outflow Tracts**
- Anomalies identified with normal four-chamber view
- Tetralogy of Fallot
- Truncus arteriosus
- Double outlet right ventricle
- Transposition of the great vessels

**Tetralogy of Fallot**
- Characteristics
  - Pulmonic stenosis
  - Ventricular septal defect
  - Overriding aorta
  - Right ventricular hypertrophy
- Ultrasound findings
  - Pulmonic stenosis
  - Ventricular septal defect
  - Overriding aorta
**Transposition of the Great Vessels**

Reversed ventricular outflow tracts
- Pulmonary artery arises from left ventricle
- Aorta arises from right ventricle

Ultrasound findings
- Outflow tracts arise in parallel
- Pulmonary artery from left ventricle
- Aorta from right ventricle
- Normal four chamber view

Detecton rate:
- 10-20% for 1993-2003
- Improving now that outflow tracts are part of routine fetal survey

Prenatal detection improves outcome
- ↓ Hospital stay
- ↓ Perinatal mortality (0% vs. 6%)
- ↓ Postoperative mortality (0% vs. 8.5%)

**Truncus Arteriosus**

Single large outflow vessel
Gives rise to
- pulmonary arteries
- systemic arteries
- coronary arteries

± Normal four chamber view
- ventricular septal defect common
Double Outlet Right Ventricle

Ultrasound findings
- Aorta arises from right ventricle
- Pulmonary artery arises from right ventricle
- Ventricular septal defect (often)
- Transposition of the great vessels (usually)
- Hypoplastic left ventricle (often)

The End