Heart and Circulatory System I

Daphne T. Hsu, MD
Professor of Clinical Pediatrics
dh17@columbia.edu

Outline

- Vasculogenesis
- Embryonic Folding
- Formation of the Primary Heart Tube
- Looping
- Atrial Septation
- Primate Ventricular Septum
- Atrioventricular Canal/Endocardial Cushions
- Conotruncal Septation
- Ventricular septation
- Congenital Heart Defects

CARDIOVASCULAR SYSTEM: EARLY DEVELOPMENT: WEEK 3

EMBRYONIC FOLDING: WEEK 4

Formation of Heart Tube (17-22 days)

Heart Development: 26 days
PRIMITIVE HEART TUBE: WEEK 4

VENTRICULAR LOOPING
END WEEK 4

NORMAL: Loop to the RIGHT:
Levocardia!

ABNORMAL: Loop to the LEFT:
Dextrocardia!

FROM TUBE TO FOUR CHAMBERS
INTERNAL VIEW

Formation of Primitive Ventricles

Atrial Septation: 3 Septums
Primum, Secundum, Intermedium
Endocardial Cushion: 80 days

Endocardial Cushions

- Atrioventricular Canal: Divide between the atria and ventricles
- Endocardial Cushions: Four tissue expansions found in periphery of AV canal
  - Atrial septation
  - Atrioventricular valve formation:
    - Mitral and Tricuspid Valves
  - Ventricular septation

Endocardial Cushions

- Superior-Inferior cushions
  - Septum Intermedium
  - Inferior atrial septum
  - Posterior/superior ventricular septum
- Right and Left Cushions
  - Ventricular myocardium
  - Mitral valve
  - Tricuspid valve

Atrioventricular Valve Formation

- Left and Right Endocardial Cushions

FOUR CHAMBERS- ULTRASOUND VIEW

@ 20 wks

Congenital Heart Defect:
Endocardial Cushion Defect

Normal
Endocardial Cushion Defect
Ventricular Outflow Tracts and Great Arteries

- **Truncus Arteriosus**: common arterial trunk from the primitive ventricle
- **Conus (Bulbus) Cordis**: outflow portion of the primitive ventricle
- **Bulbar Ridges**: Tissue ridges at junction of the conus and truncus
  - Conotruncal septum
  - Semi-lunar valves (aortic and pulmonic)
- **Truncal Ridges**: Within Truncus
  - Septation of the Aorta and Pulmonary arteries

Formation of the Conotruncal Septum

Semilunar Valve Formation

Formation of the Aorta and Pulmonary Artery

Conotruncal Formation

Defects of Conotruncal Septation

- **Persistent Truncus Arteriosus**
  - Failure of conotruncal septation
- **Transposition of the Great Arteries**
  - Failure of helical twisting during truncal septation
- **Tetralogy of Fallot**
  - Malalignment of conoventricular septum
Persistent Truncus Arteriosus

- Failure of helical twisting during truncal septation
- Aorta arises from RV
- Pulmonary artery arises from LV
- VSD in 20% of cases

Transposition of the Great Arteries

- Failure of helical twisting during truncal septation
- Aorta arises from RV
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Tetralogy of Fallot

- Malalignment of conoventricular septum
  1. Ventricular septal defect
  2. Aortic valve override
  3. Pulmonary stenosis
  4. Right ventricular hypertrophy

Ventricular Septum

- Primitive Septum
- Endocardial Cushion
- Conotruncus
- Membranous

Ventricular Septal Defect (VSD)
Muscular VSD

Endocardial Cushion (Inlet VSD)

Supracristal VSD

Membranous VSD

Echocardiogram: Membranous VSD

Angiogram: VSD
Heart Formation

- Heart structures form completely by week 12
- Week 3-4: Vitelline Stage
  - Heart tube forms
  - “Looping” occurs
  - Venous system starts to form
- Week 5
  - Placenta provides nutrients and liver takes of hematopoiesis

Heart Formation con’t

- Weeks 5-8
  - SVC, IVC form
  - Right and Left Atrium divide
  - Ventricles start to form
  - Aorta and pulmonary arteries
- Weeks 8-12
  - Ventricles and mitral and tricuspid valves
  - Aorta and pulmonary artery, aortic arch
- Week 12: Fetal Circulation begins

From Primitive Heart Tube to Four Chambers: External View

HEART AND ITS NEIGHBORHOOD: WEEK 4

Multiple Defects: Bilateral Left-Sidedness

- Systemic Veins
  - Interrupted IVC
  - Bilateral SVC
- Common Atrium
- Common Ventricle
  - VSD: endocardial cushion
- Pulmonary veins:
  - Ipsilateral
- Pulmonary Stenosis