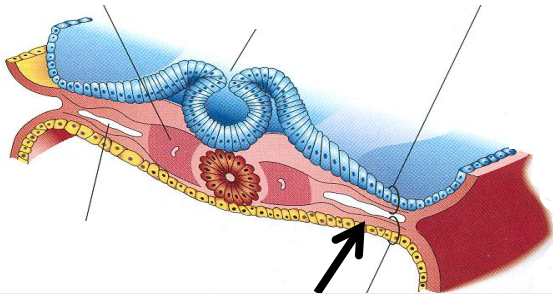


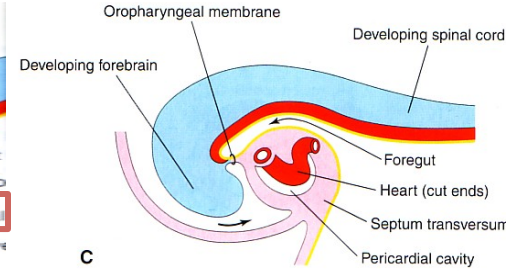
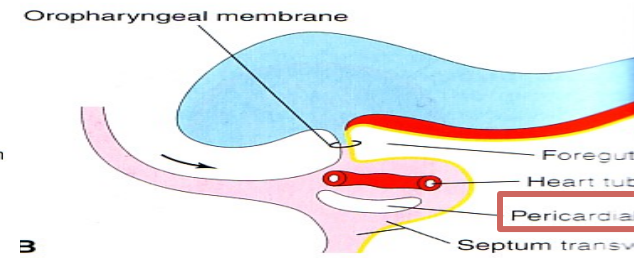
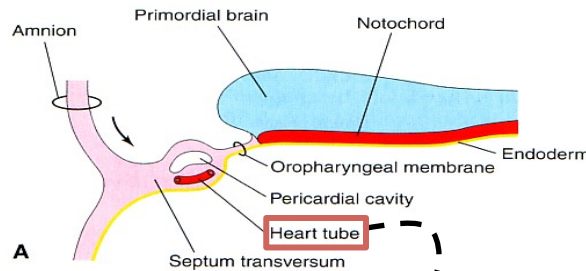
Heart Development



- * **CVS** is the first major system to function in the embryo.
- * The **heart** begins to **beat** at (22nd – 23rd) days.
- * **Blood flow** begins during the **beginning** of the 4th week and can be visualized by **Ultrasound Doppler**



Splanchnic Mesoderm



* Formation of Heart Tube

1. The **heart** is the **first functional organ to develop**.
2. It develops from **Splanchnic Mesoderm** in the wall of the **yolk sac** (Cardiogenic Area): **Cranial** to the **developing Mouth & Nervous system** and **Ventral** to the **developing Pericardial sac**.
3. The heart primordium is first evident at **day 18** (as an Angioplasmic cords which soon canalize to form the **2 heart tubes**).
4. As the Head Fold completed, the developing heart tubes **change position** and become in the **Ventral** aspect of the **embryo**, **Dorsal** to the **developing Pericardial sac**.

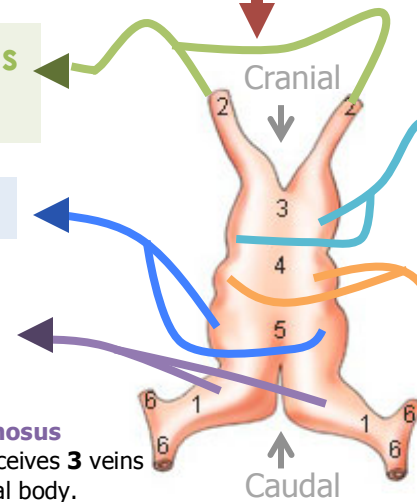
* Development of Heart Tube

- **After Lateral Folding** of the **embryo**, the 2 heart tubes approach each other and fuse to form a **single Endocardial Heart tube** within the **pericardial sac**.
- **Fusion** of the two tubes occurs in a **Craniocaudal direction**.
- The **heart** tube grows **faster** than the **pericardial sac**, so it shows **5 alternate dilations** separated by **constrictions**.

2. Truncus arteriosus (Arterial end)

5. Common Atrium

1. Sinus Venosus (Venous end)



3. Bulbus Cordis.

- The **bulbus cordis** forms the smooth upper part of the **two ventricles**.
- **Right Ventricle:** **Conus Arteriosus** or (**Infundibulum**) which leads to the **pulmonary trunk**.
- **Left ventricle:** **Aortic Vestibule** leading to **ascending aorta**.

- * **Bulbus cordis & ventricle grow faster** than other regions.

4. Common Ventricle

What Is the Shape of the Heart Tube?

- 2 **S-Shaped Heart Tube (Loop Formation)**
 - 1 **U-shaped Heart Tube (Bulboventricular loop)**
- As the Heart develops it bends upon itself

- * **Atrium** and **Sinus venosus** become **Cranial** in position & **Dorsal** to the **Truncus arteriosus**, **Bulbus cordis**, and **Ventricle**.
- * **Sinus venosus** (opens in the dorsal surface of the **atrium**) has developed 2 lateral expansions, (Horns): **Right and Left**

* Veins Draining into Sinus Venosus

Each **horn** of the sinus venosus receives **3** veins

1. **Common cardinal** from the fetal body.
2. **Vitelline** from the yolk sac.
3. **Umbilical** from the placenta.

* Fate of Sinus Venosus

- **Right Horn** → forms smooth posterior part of right atrium.
- **Left Horn & Body** → **atrophy & form the Coronary Sinus**.
- **Left Common cardinal vein** → forms the **Oblique Vein** of Left Atrium.

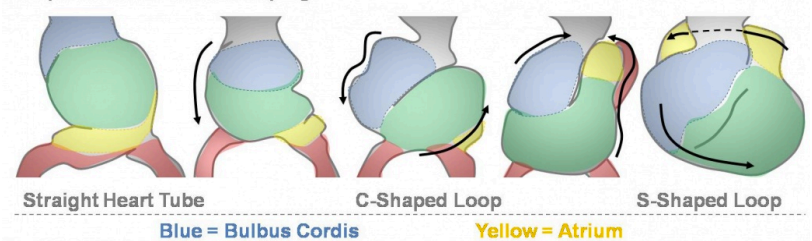
Right Atrium:

- **Rough Trabeculated** anterior part (**musculi pectanti**) of right atrium is derived from primordial common atrium.
- These two parts are demarcated by the **crista terminalis** **internally** and **sulcus terminalis** **externally**.

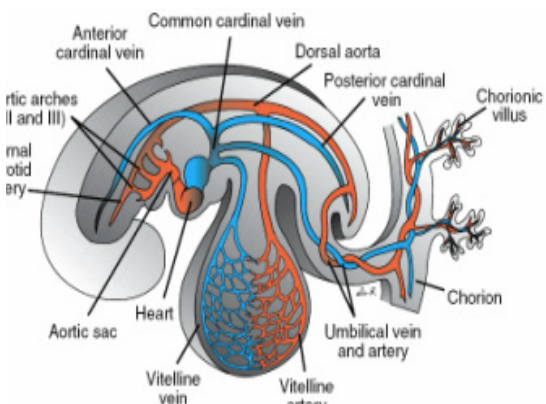
Left Atrium:

- **Rough Trabeculated** part: derived from the common primordial atrium.
- The **smooth** part: derived from **absorbed Pulmonary Veins**.

Sequence of Events in Looping



Blue = Bulbus Cordis
Yellow = Atrium



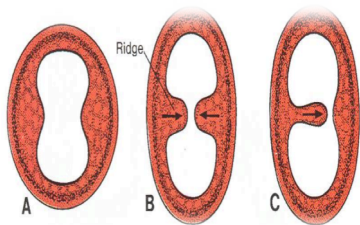
3. Partitioning of Primordial Ventricle:

Muscular part of the interventricular septum. Division of the primordial ventricle is first indicated by a median muscular ridge, the primordial interventricular septum. It is a thick crescentic fold which has a concave upper free edge. This septum bounds a temporary connection between the two ventricles called Interventricular foramen

Interventricular Septum:

The Membranous part of the IV septum is derived from:
 1- A tissue extension from the right side of the endocardial cushion.
 2- Aorticopulmonary septum.
 3- Thick muscular part of the IV septum

It begins by the middle of **4th week**. It is completed by the end of **5th week**
 - **Endocardial Cushions:** They appear around the middle of the 4th week as Mesenchymal Proliferation



2. Partition of the Common Atrium:

Septum Primum: grows from the roof of the common atrium towards the fusing endocardial cushions (**septum intermedium**) So it divides the common atrium into right & left

Partitioning of Primordial Heart:

1. Partitioning of the atrioventricular

The two AV endocardial cushions approach each other and fuse to form the **Septum Intermedium**. Dividing the AV canal into right & left canals and separate the primordial atrium from the ventricle.

4. partition of Truncus Arteriosus:

In the 5th week, proliferation of mesenchymal cells (Endocardial Cushions) appear in the wall of the truncus arteriosus, they form a Spiral Septum:
 A. It divides the Lower part of the TA into Right & Left parts
 B. It divides the Middle part of TA into Anterior & Posterior parts.
 C. It divides the Upper part of the TA into Left & Right parts.

Ostium Primum:

The two ends of septum primum reach to the growing **endocardial cushions** before its central part. Now the septum primum bounds a foramen called **ostium primum**. It serves as a shunt, enabling the oxygenated blood to pass from right to left atrium. The ostium primum become smaller and disappears as the septum primum fuses completely with the septum intermedium to form the AV septum.

Septum Secundum:

The upper part of septum primum shows gradual resorption forming an opening called ostium secundum. Another septum descends on the right side of the septum primum called Septum Secundum. It forms an incomplete partition between the two atria. Consequently a valvular oval foramen forms, (**Foramen Ovale**).

Fate of foramen Ovale:

Its site is represented by the Fossa Ovalis:
 Its floor represents the persistent part of the septum primum. Its limbus (anulus) is the lower edge of the septum secundum.

1. Atrial Septal Defects

Types :

1. Absence of both septum primum and septum secundum, leads to common atrium.
2. Absence of Septum Secundum
3. Large (Patent) foramen ovale : Excessive resorption of septum primum

2. VENTRICULAR SEPTAL DEFECT

Roger's disease:

Absence of the *Membranous* part of interventricular septum (persistent IV Foramen). Usually accompanied by other cardiac defects.

Falot's Tetralogy:

- 1-VSD.
- 2- Pulmonary stenosis.
- 3-Overriding of the aorta
- 4- Right ventricular hypertrophy.

MAJOR CARDIAC ANOMALIES

3. TRANSPOSITION OF GREAT ARTERIES

due to abnormal rotation or malformation of the **aorticopulmonary septum**, so the right ventricle joins the aorta, while the left ventricle joins the pulmonary artery. It is one of the most common causes of cyanotic heart disease in the

4. Persistent Truncus

It is due to failure of the development of **aorticopulmonary (spiral) septum**. It is usually accompanied with VSD. It forms a single arterial trunk arising from the heart and supplies the systemic, pulmonary & coronary