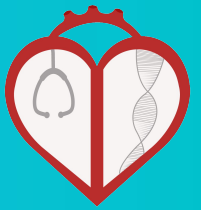
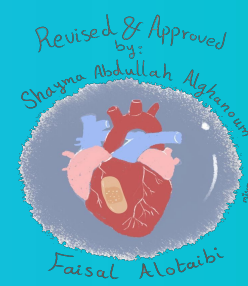




Anatomy Team
MED 439



MED439
KING SAUD UNIVERSITY

The development of the heart

Cardiovascular Block - Lecture 2

Color index:

Important

In male's slides only

In female's slides only

notes

Extra information, explanation

Don't forget to check the [Editing File](#)

Objectives:

- Describe The Formation, site, union division of the heart tubes.
- Describe the formation and fate of the sinus venosus.
- Describe the partitioning of the common atrium and common ventricle.
- Describe the partitioning of the truncus arteriosus.
- List the most common cardiac anomalies.

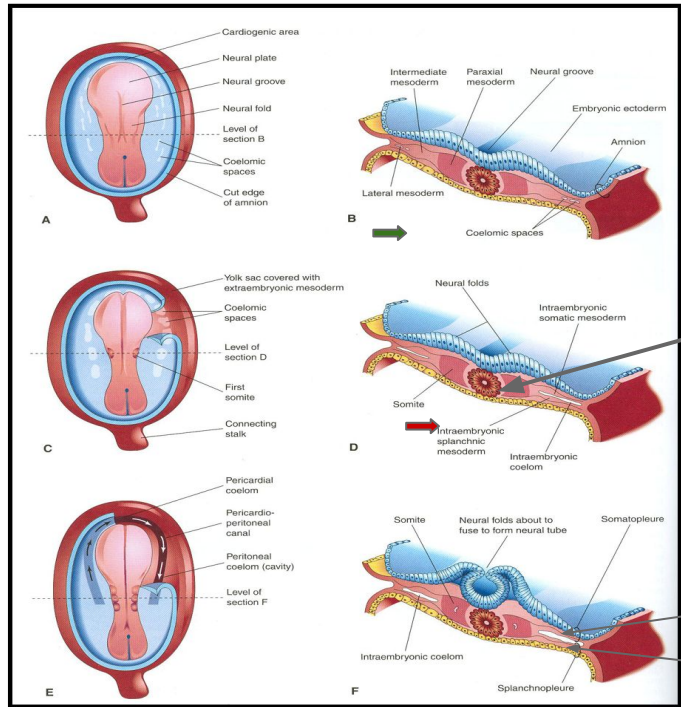
Development of the heart



The CVS is the first major system to function in the embryo.

The heart begins to beat at (22nd – 23rd) days.

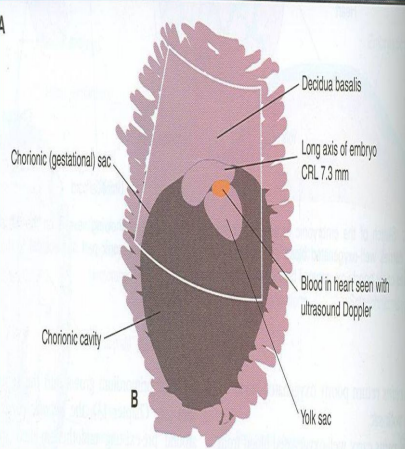
Blood flow begins during the beginning of the **fourth week** and can be visualized by Ultrasound Doppler



Notochord: stimulates neural tube formation

Somatic mesoderm

Splanchnic mesoderm



Formation Of The Heart Tube

1

The heart is the first functional organ to develop.

2

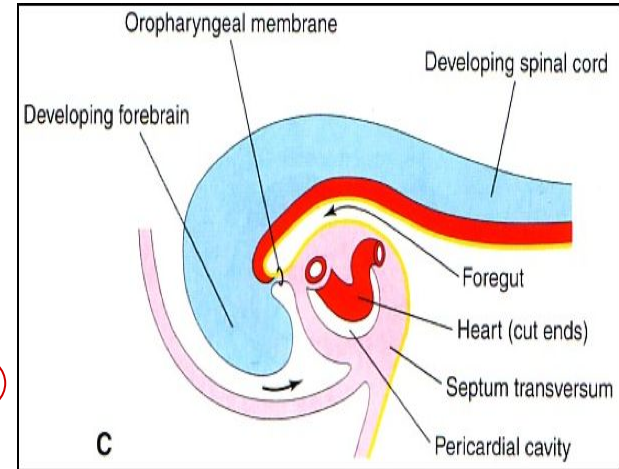
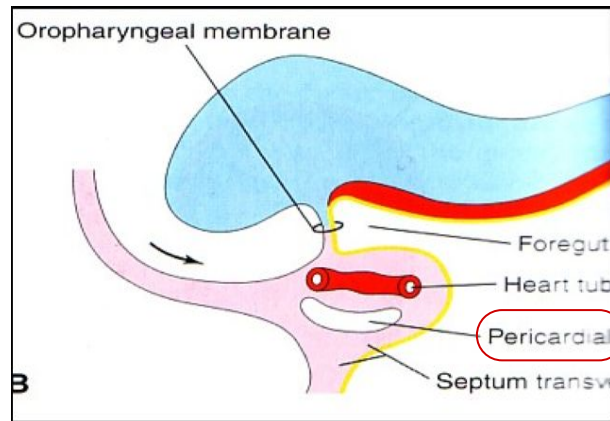
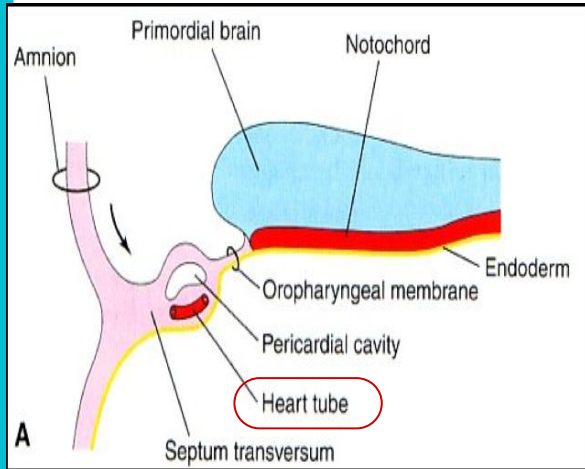
It develops from **Splanchnic Mesoderm** in the wall of the yolk sac (Cardiogenic Area): Cranial to the developing Mouth & Nervous system and **Ventral to the developing Pericardial sac.**

3

The heart primordium is first evident at day **18** (as an **Angioplastic cords** which soon canalize to form the 2 heart tubes).

4

As the **Head Fold completed**, the developing heart tubes **change their position** and become in the **Ventral aspect of the embryo, Dorsal to the developing Pericardial sac.**



Development of the 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**.

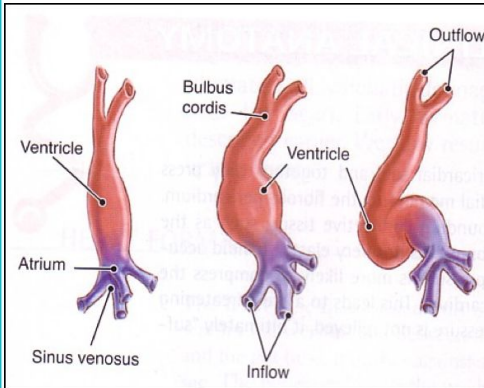
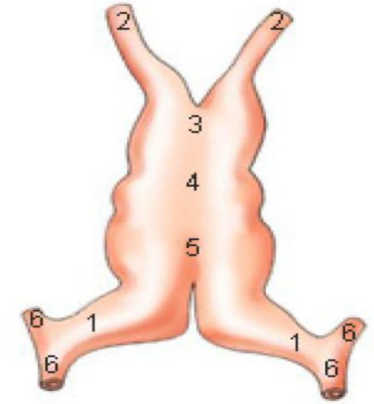
These are:

1. Sinus Venosus.
2. Truncus Arteriosus.
3. Bulbus Cordis.
4. Common Ventricle.
5. Common Atrium.

The endocardial heart tube has 2 ends

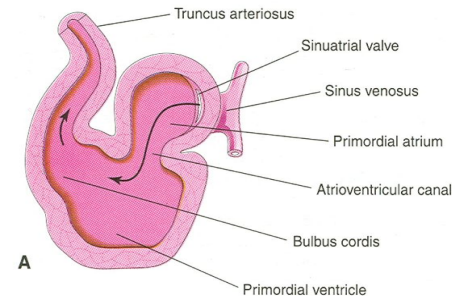
Venous end
(Caudal): Sinus Venosus.

Arterial end
(Cranial): Truncus arteriosus



What is the shape of the Heart Tube? U-SHAPED HEART TUBE

- Bulbus cordis and ventricle grow faster than other regions.
- So the heart bends upon itself forming **The U shaped heart tube, (Bulboventricular Loop)**.



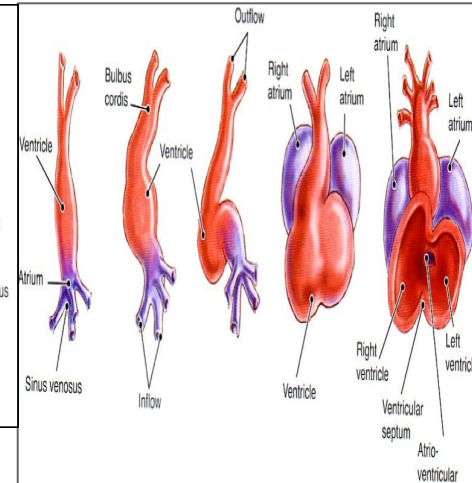
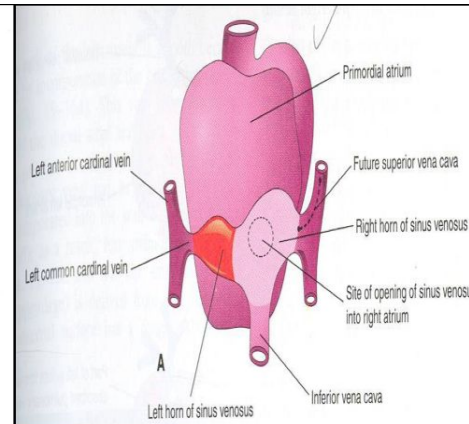
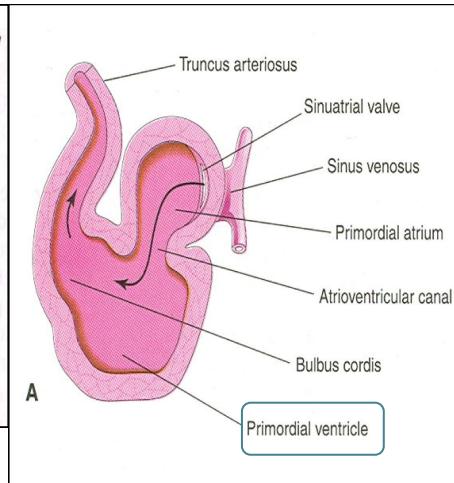
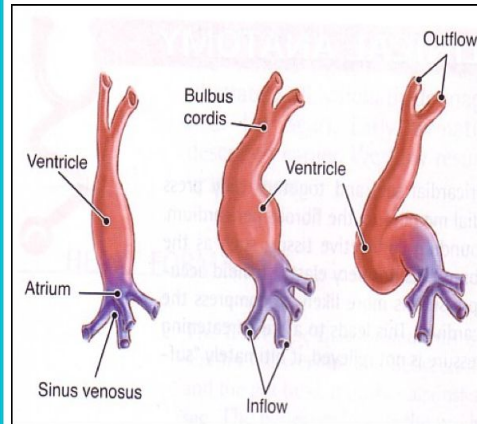
The shape of the heart

- As the heart tube develops it bends, **upon itself and forms S shaped heart tube.**

"Heart tube is a U shape and while developing it becomes S shaped"

- **SO**, the **Atrium and Sinus venosus** become **Cranial in position & Dorsal** to the **Truncus arteriosus, Bulbus cordis, and Ventricle.**

- By this stage the sinus venosus (opens in the dorsal surface of the atrium) has developed 2 lateral expansions, (Horns) :Right and Left



Sinus Venosus

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

1. Common cardinal
2. Vitelline
3. Umbilical

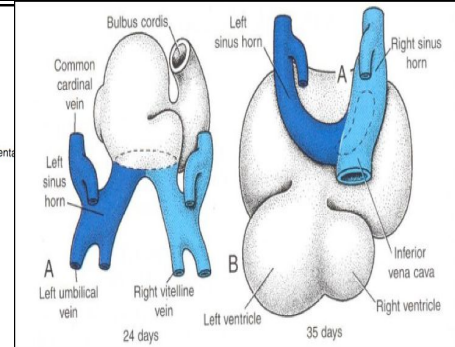
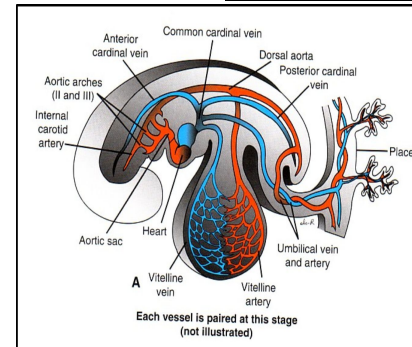
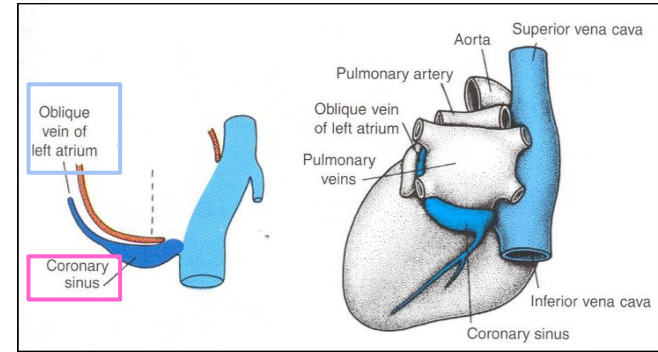
Veins Draining into Sinus Venosus

C Cardinal vein from the fetal body.

- **Vitelline** from the yolk sac.
- **Umbilical** from the placenta.

Fate of Sinus Venosus

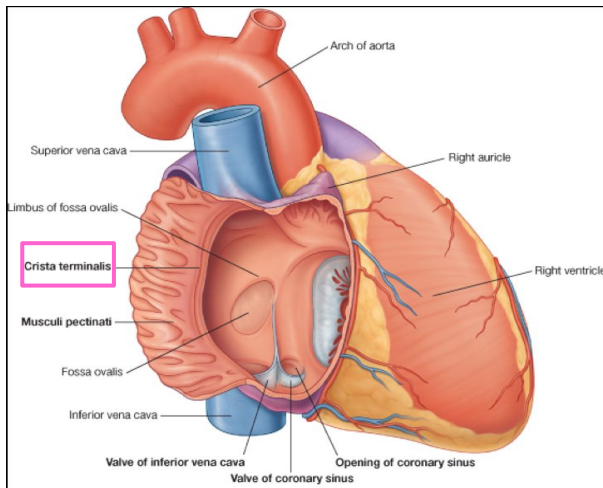
- The **Right Horn** forms the smooth posterior part of the right atrium.
- The **Left Horn and Body** atrophy and form the **Coronary Sinus**.
- The Left Common cardinal vein forms the **Oblique Vein of the Left Atrium**.



Development of the atriums

Right Atrium

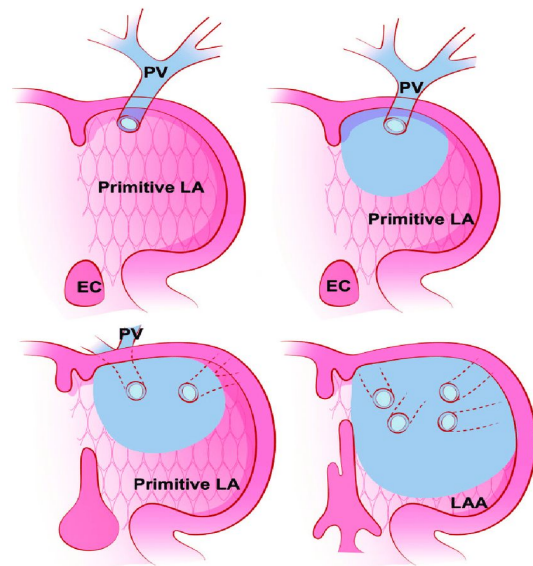
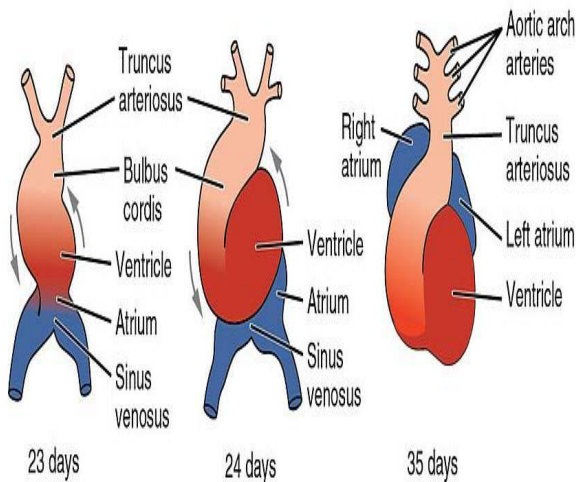
- The **right horn** of the sinus venosus forms the **smooth posterior part** of the right atrium.
- **Rough Trabeculated anterior part** (musculi pectinati of the right atrium) is derived from the primordial common atrium.
- These two parts are demarcated by the **crista terminalis** internally and **sulcus terminalis** externally.



Atriums

Left Atrium

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



Partitioning of Primordial Heart:



[Helpful video](#)

Partitioning **begins** by the middle of **4th week**.

It is **completed** by the end of **5th week**.

All events take place during this period

5 Partitioning events

- 1 - Atrioventricular canal
- 2 - Common atrium
- 3 - Common ventricle
- 4 - Bulbus cordis
- 5 - Truncus arteriosus

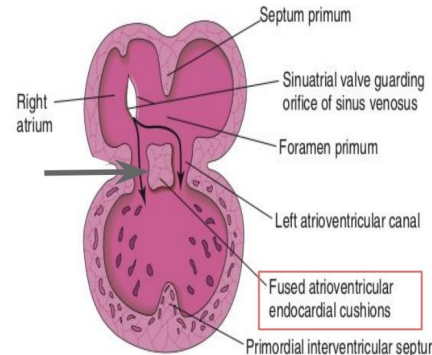
1 - Partitioning of Atrioventricular canal

• **Two** anterior & posterior (ventral & dorsal) **subendocardial/ endocardial cushions** are formed on **the dorsal and ventral walls of the AV canal**.

• The AV **subendocardial/endocardial** cushions approach each other and **fuse together** to form the **septum intermedium**.

• **Dividing** the AV canal into **right** & **left** canals.

• These canals **partially connect** the **primordial atrium** and **primordial ventricle**.



2 - Partition of the Common atrium

2.1 - Septum Primum :

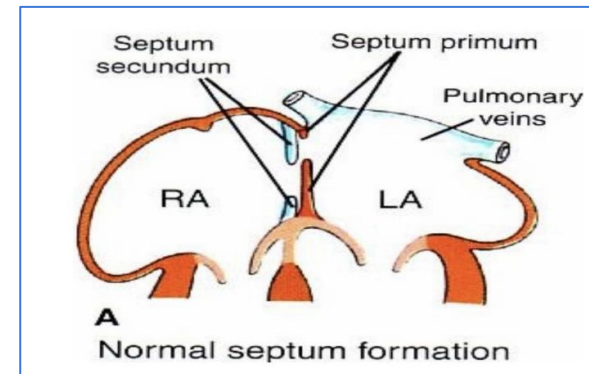
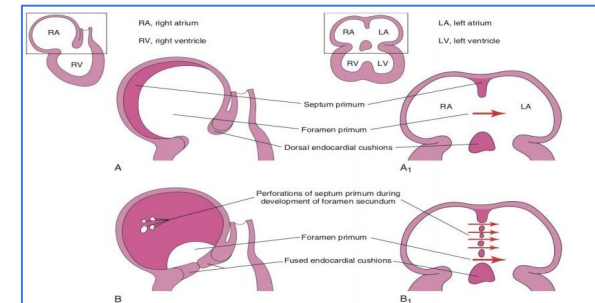
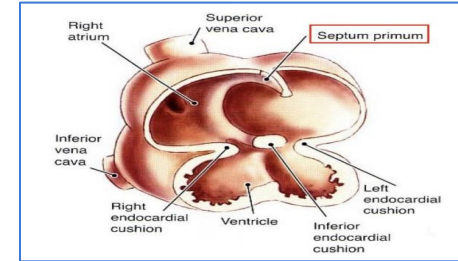
A sickle-shaped septum, grows from **the roof** of the common atrium **towards the septum intermedium**. **divides the common atrium into right & left halves**

2.2 - Ostium Primum :

- At first the two ends of the septum primum reach to the growing subendocardial cushions before its central part.
- So the septum primum bounds a foramen at this stage called **ostium primum**.
- It serves as a shunt, enabling the oxygenated blood to pass from right atrium to left atrium.
- The ostium primum become smaller and disappears as the septum primum fuses completely with **subendocardial cushions/septum intermedium** to form the **interatrial/AV septum**.

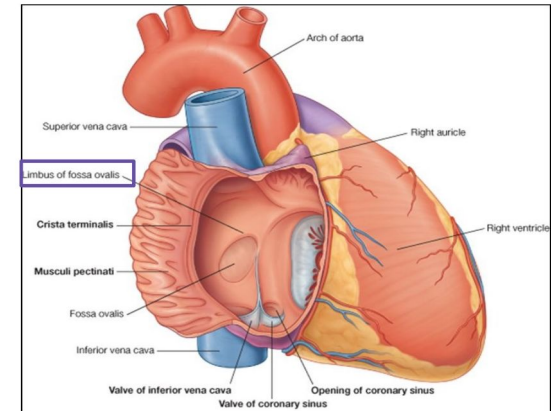
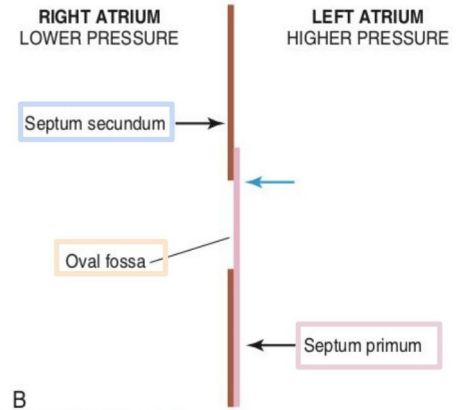
2.2 - Septum Secundum :

- The upper part of septum primum that is attached to the roof of the common atrium shows **gradual resorption** (اختفاء تدريجي) forming a **new 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 foramen forms, called **foramen ovale**.



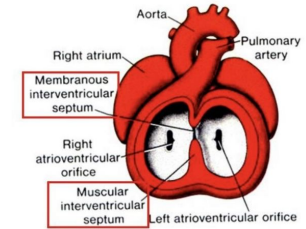
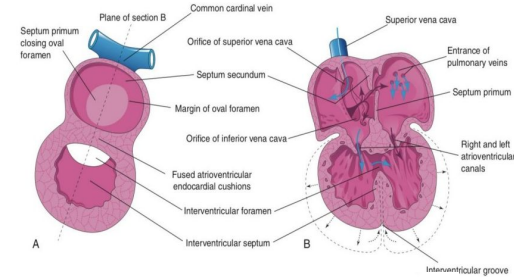
Fate of foramen Ovale

- **At birth** when the lungs inflated and pulmonary circulation begins **the pressure in the left atrium increases and exceeds that of the right atrium.**
- The valve of the foramen ovale is pressed against the septum secundum and obliterates the foramen ovale.
- **So the two septae oppose each other and fuse together.**
- Its site is **represented in adult by the Fossa Ovalis.**
- **The septum primum forms the floor of the fossa ovalis.**
- The **septum secundum** forms **the margin** of the fossa ovalis which is called the limbus ovalis or **annulus ovalis**.



3 - Partition of the Common Ventricle

- It's a **Muscular** part of the **interventricular septum**.
- Division of the primordial ventricle is first indicated by **a median muscular ridge** called **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 the **interventricular foramen(IVF)**.



Interventricular Septum

The membranous part of the IV septum is derived from

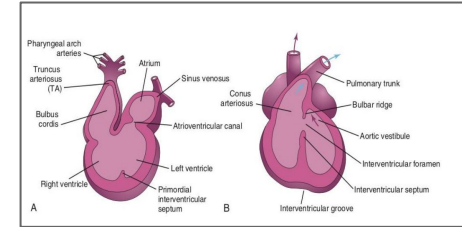
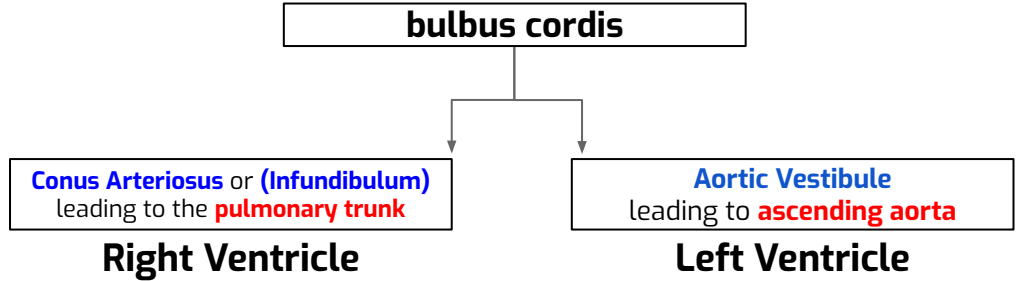
1. A tissue extension from the right side of the **endocardial cushion**.

2. **Aorticopulmonary septum**.

3. Thick muscular part of the IV septum.

4- Bulbus Cordis

The bulbus cordis forms the smooth **upper part** of the two ventricles.



5 - Partition of Truncus Arteriosus

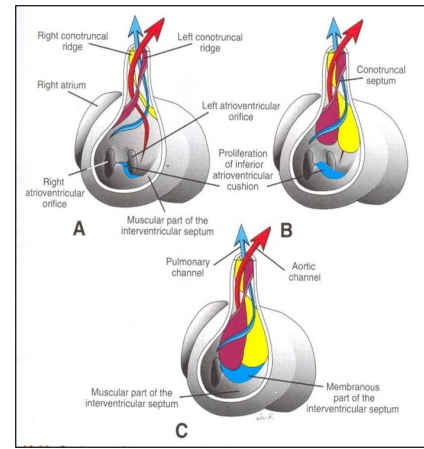
In the 5th week, proliferation of mesenchymal cells (Endocardial Cushions) appear in the wall of the truncus arteriosus ,

They form a **Spiral Septum**. It divides the lower, middle & upper parts of Truncus Arteriosus into:

- A. Lower part of TA :Right & Left parts
- B. Middle part of TA :Anterior & Posterior parts.
- C. Upper part of TA :Left & Right parts.

A spiral septum develops in the Truncus arteriosus dividing it into:

- 1- **Pulmonary trunk** : pulmonary artery joins the right ventricle
- 2- **Aorta** : the aorta joins the left ventricle



Major Cardiac Anomalies

Atrial Septal Defects (ASD)

Types:

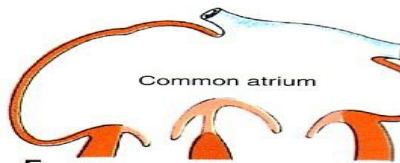
1- Absence of both septum primum and septum secundum leads to **common atrium**.

2- Absence of septum secundum.

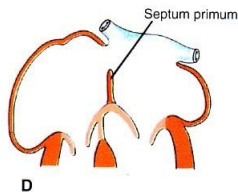
3- Large (**patent foramen ovale**): excessive resorption of septum primum.

Ventricular septal defect (VSD)

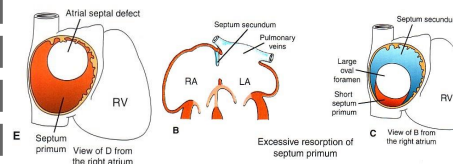
Roger's disease: Absence of the membranous part of interventricular septum (**persistent IV foramen**) usually accompanied by other cardiac defects.



F Absence of septum primum and septum secundum



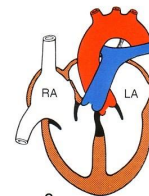
D Absence of septum secundum



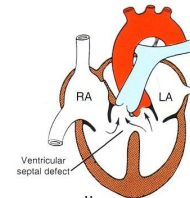
E

B

C



G Normal ventricular septum development



H Ventricular septal defect (VSD)

Major Cardiac Anomalies

Tetralogy of fallot

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

¹narrowing of pulmonary artery

² يطلع الشريان الأورطي من اليمين واليسار

³ ضيق وما يقدر pulmonary artery يتضخم جدار البطين لأن
يضخ الدم بقوة العضلة العادية فتتضخم عشان تدفع الدم

Transposition of Great Arteries (TGA)

TGA is due to **abnormal rotation or malformation of the aortic pulmonary 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 newborn. Associated with blue baby

Often associated with VSD or ASD or **PDA** الشرايين تتبدل أماكنها

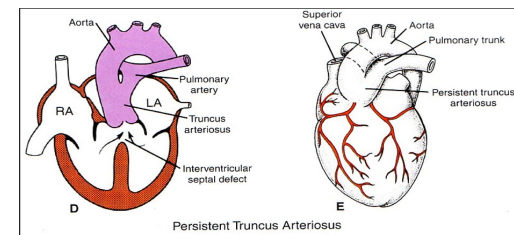
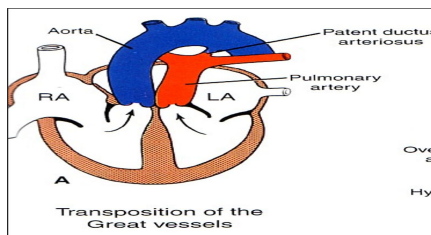
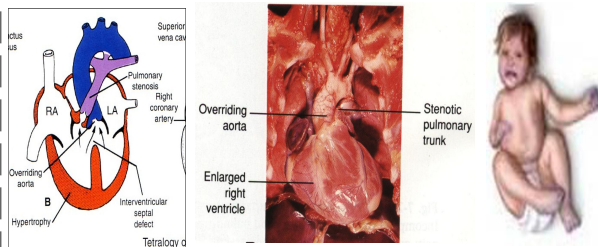
Persistent truncus arteriosus

It is due to failure of the development of aortic pulmonary spiral septum.

ما اكتمل انفصال الشرايين فالدم يختلط



It is usually accompanied with VSD
It forms a **single arterial trunk** arising from the heart and supplies the **systemic, pulmonary & coronary circulations.**



MCQ

Q1: Which of the following clinical signs would be most obvious on examination of a patient with fallot tetralogy?

- A.** Pulmonary hypertension
- B.** Diffuse rach
- C.** Lack of femoral pulse
- D.** Cyanosis

Q4: Blood flow begins during:

- A.** Beginning of the 4th week
- B.** End of the 4th week
- C.** Middle of the 4th week
- D.** Beginning of the 5th week

Q2: The conus arteriosus is derived from which of the following?

- A.** Truncus arteriosus
- B.** Bulbus cordis
- C.** Common venosus
- D.** Sinus venosus

Q5: The right horn of sinus venosus forms:

- A.** The rough anterior wall of the right atrium
- B.** The smooth posterior wall of the right atrium
- C.** Atrophy and forms coronary sinus
- D.** The oblique vein

Q3: The heart primordium is first evident at:

- A.** 17 days
- B.** 18 days
- C.** 22-23 days
- D.** 24 days

Q6: The bulbus cordis begins by the:

- A.** 3rd week and completed by 5th week
- B.** 3rd week and completed by 4th week
- C.** 4th week and completed by 5th week
- D.** 4th week and completed by 6th week

MCQ

Q7: An abnormality associated with blue coloring of the body

- A. ASD
- B. TGA
- C. Persistent truncus arteriosus
- D. VSD

Q10: Patent foramen ovale is type of?

- A. Tetralogy of fallot
- B. ASD
- C. TGA
- D. VSD

Q8: The partition of TA divide at what week?

- A. 5th week
- B. 6th week
- C. 3rd week
- D. 22 days

Q11: Which of the following septums forms the floor of the fossa ovalis?

- A. Septum primum
- B. Septum secundum
- C. Subendocardial cushions
- D. Septum intermedium

Q9: Cause of Rogers disease

- A. Absence of septum secundum
- B. Absence of septum primum
- C. Absence of membranous part of IV septum
- D. Abnormal rotation

Q12: Which of the following forms the smooth posterior wall of the right atrium?

- A. Left horn
- B. Right horn
- C. Left common cardinal
- D. Pulmonary veins

SAQ :

1: When do all partitioning events of the embryo heart take place?

2: List all types of partitioning which take place during the formation of the heart.

3: The spiral septum divides the Truncus arteriosus into 2 parts, list them and mention the significance of each one

SAQ Answers :

1: Start at the middle of 4th week and ends by the end of 5th week



2:

- 1 - Atrioventricular canal
- 2 - Common atrium
- 3 - Common ventricle
- 4 - Bulbus cordis
- 5 - Truncus arteriosus

3:

- 1- Pulmonary trunk : pulmonary artery joins the right ventricle
- 2- Aorta : the aorta joins the left ventricle

Team leaders

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- Ghada Aljedaie
- Joud alnujaidi 
- Shahad almezel
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- Bader Alrayes
- Nawaf Alsaadi
- Mohammed Akresh
- Ibrahim Alabdulkarim 

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