أهلا وسهلا

الأستاذ الدكتور يوسف حسين

كلية الطب - جامعة مؤتة – الأردن

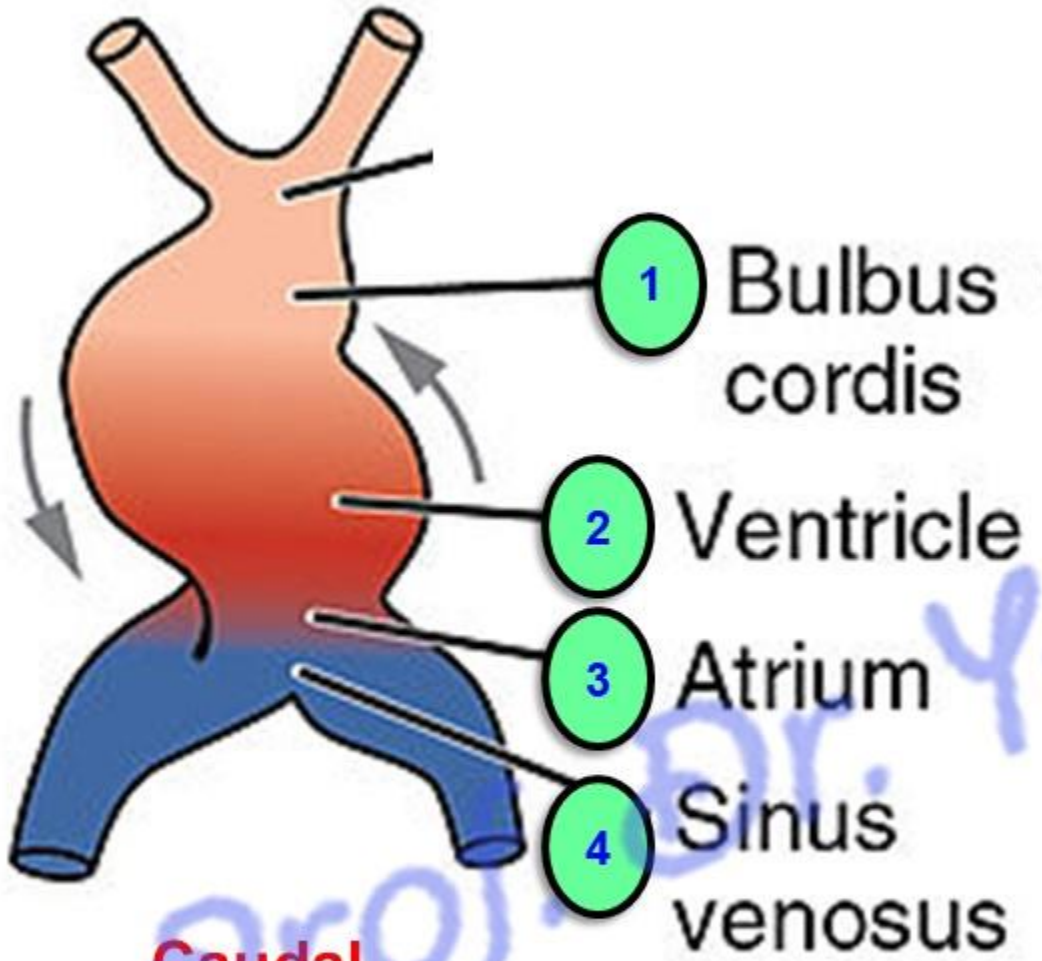
دكتوراة من جامعة كولونيا المانيا

Development of the heart

Intended Learning Outcomes (ILOs)

By the end of this lectures, you should be able to

- Differentiation of the heart tube
- Derivatives (fate) of the Sinus Venosus
- Development of the interatrial septa
- Development of the bulbar septum
- Development of the interventricular septa
- Congenital anomalies of the heart
- Cardiac shunts



** Differentiation of the heart tube

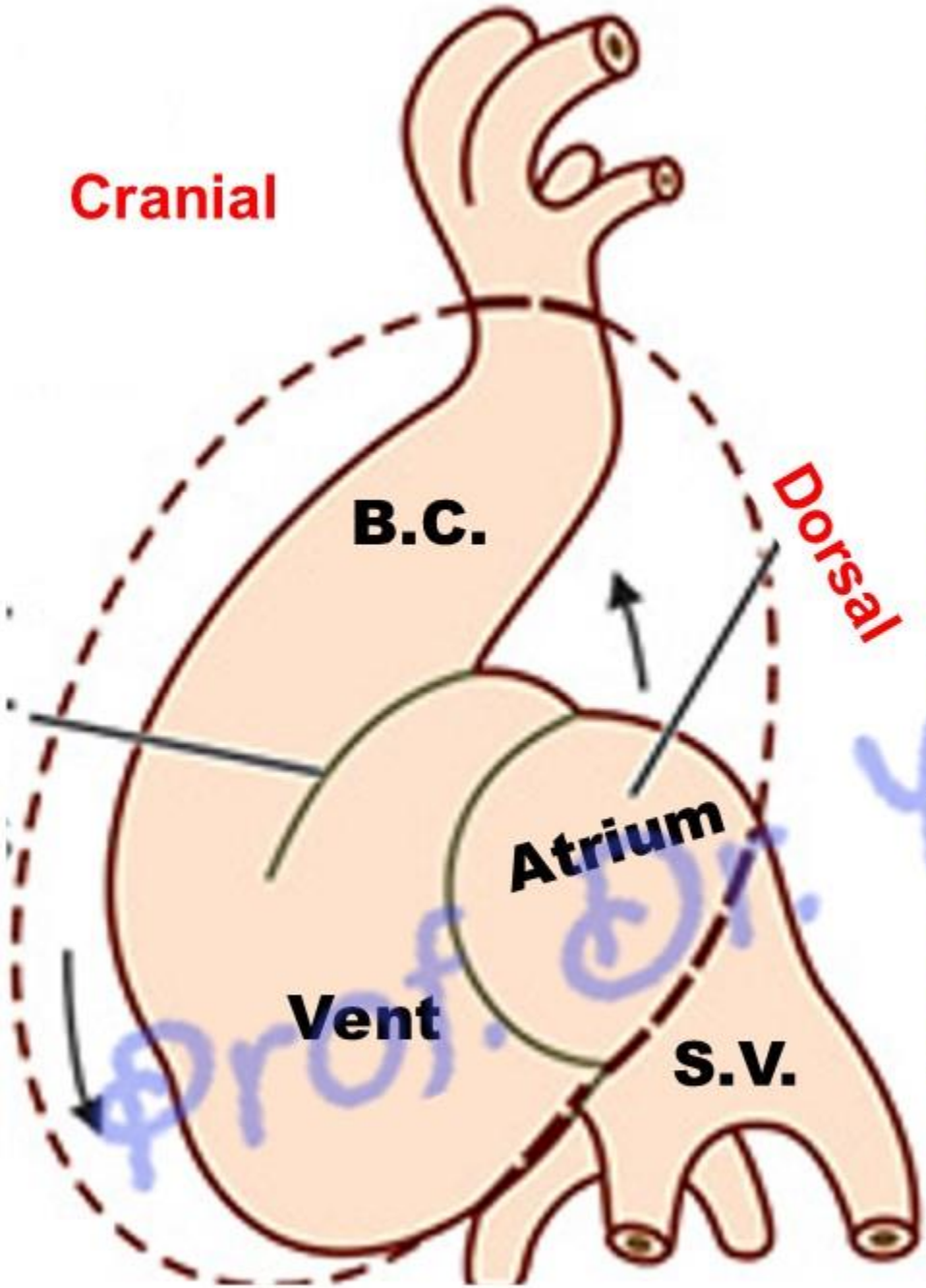
* Unequal growth of the heart tube leads to the formation of **4 dilated sacs** separated from each other by narrow constrictions.

* The sacs arranged as follows:

1. **Bulbus cordis (most cranially).**
2. **Primitive ventricle.**
3. **Primitive atrium.**

- The atrium and ventricle are connected by **atrioventricular canal**.

4. **Sinus venosus (most caudally).**

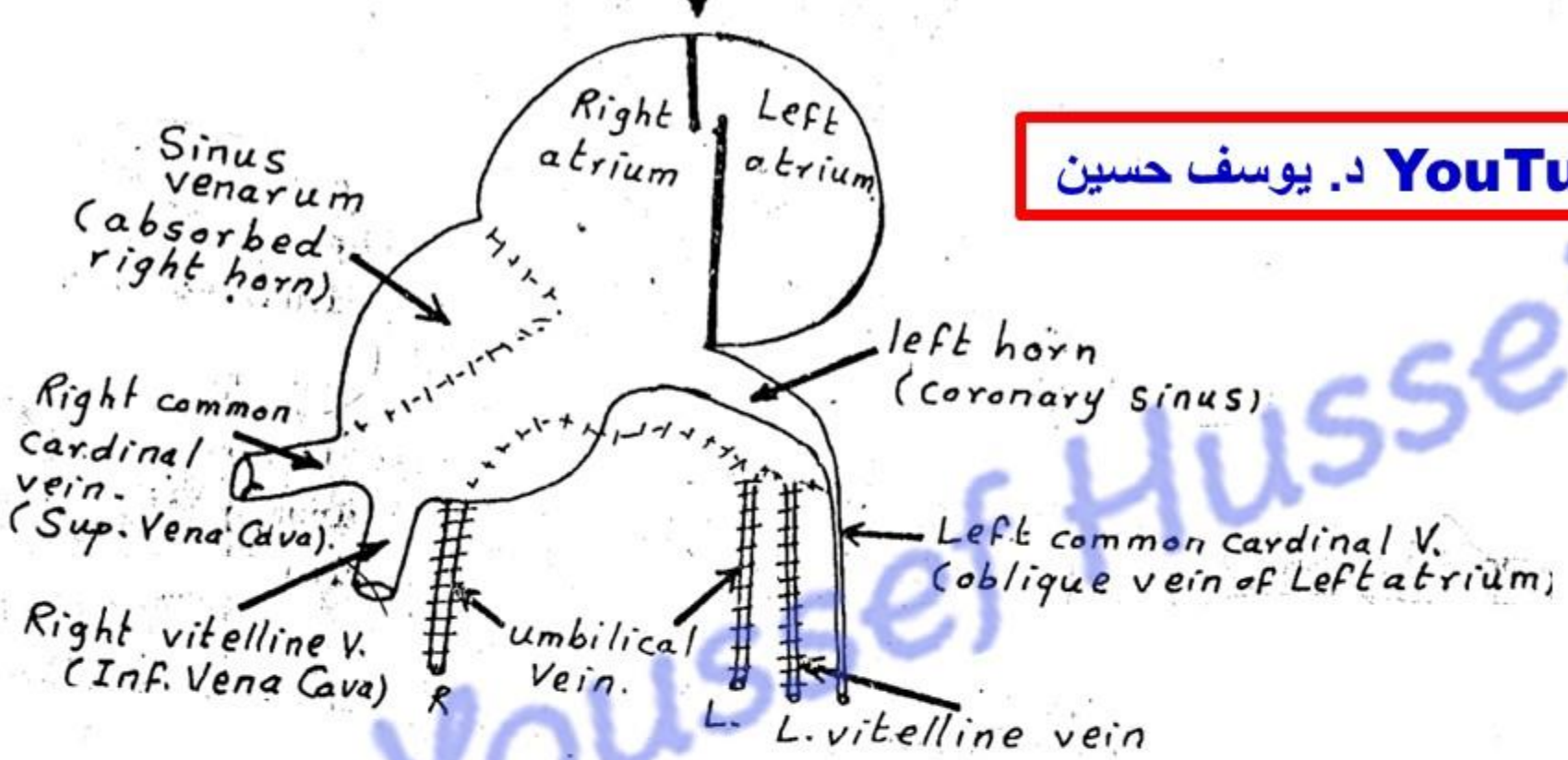


* Rapid growth of the heart tube than the pericardium resulted in dorsal folding of the heart tube on itself forming **S-shaped loop**. This will result in the following:

1- The primitive atrium lies cranial and dorsal to the primitive ventricle

2- The bulbus cordis lies cranial to the primitive ventricle.

3- The sinus venosus lies caudal to the primitive atrium.



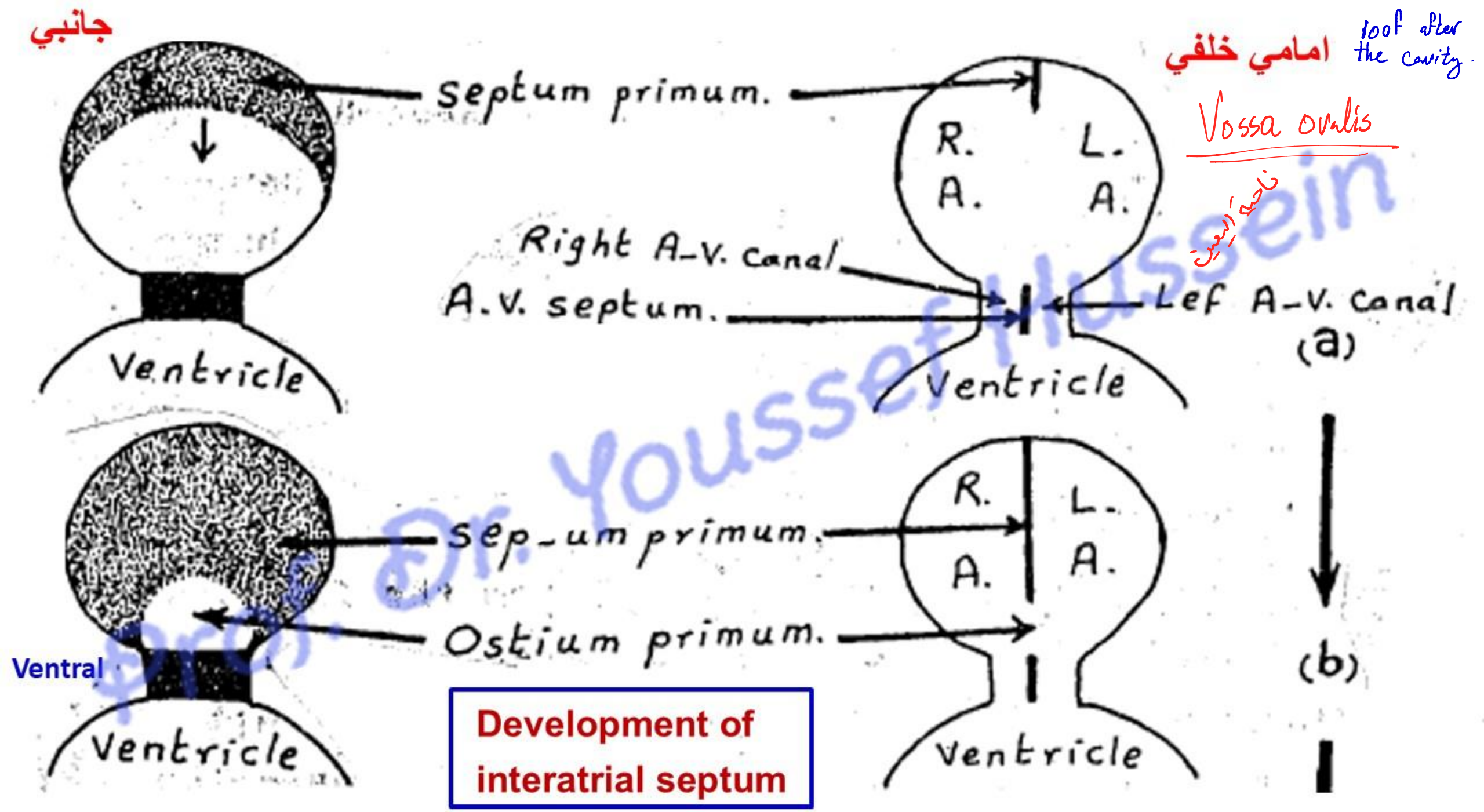
Derivatives (fate) of the Sinus Venosus

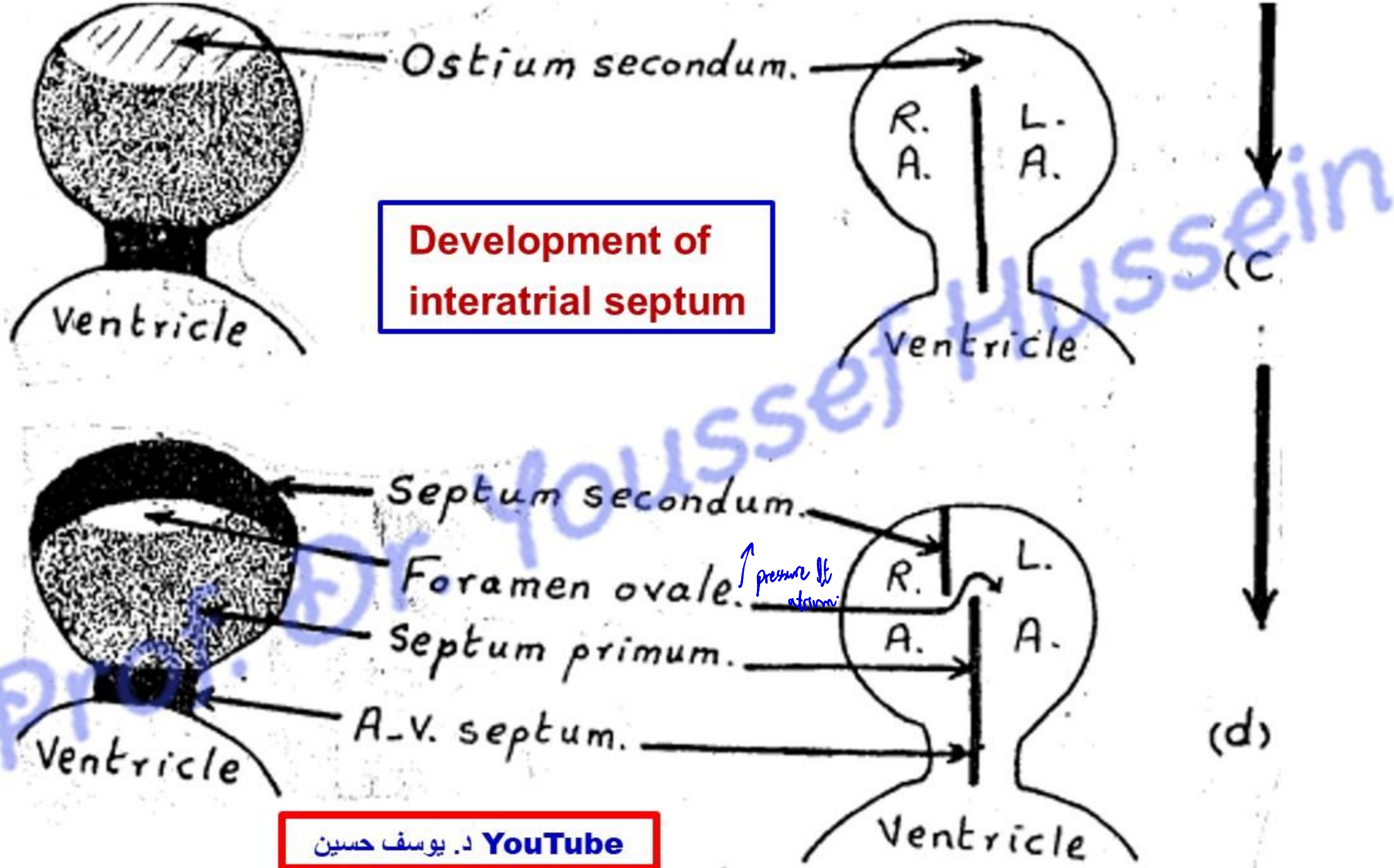
- The sinus venosus is formed of a body and **2 horns** (right and left).
- Each horn receives 3 veins:

1. **Common cardinal vein** drains blood from the **body** of the embryo.
2. **Vitelline vein** drains blood from the **yolk sac**.
3. **Umbilical vein** carried oxygenated blood from the **placenta**.

Derivatives (fate) of the Sinus Venosus

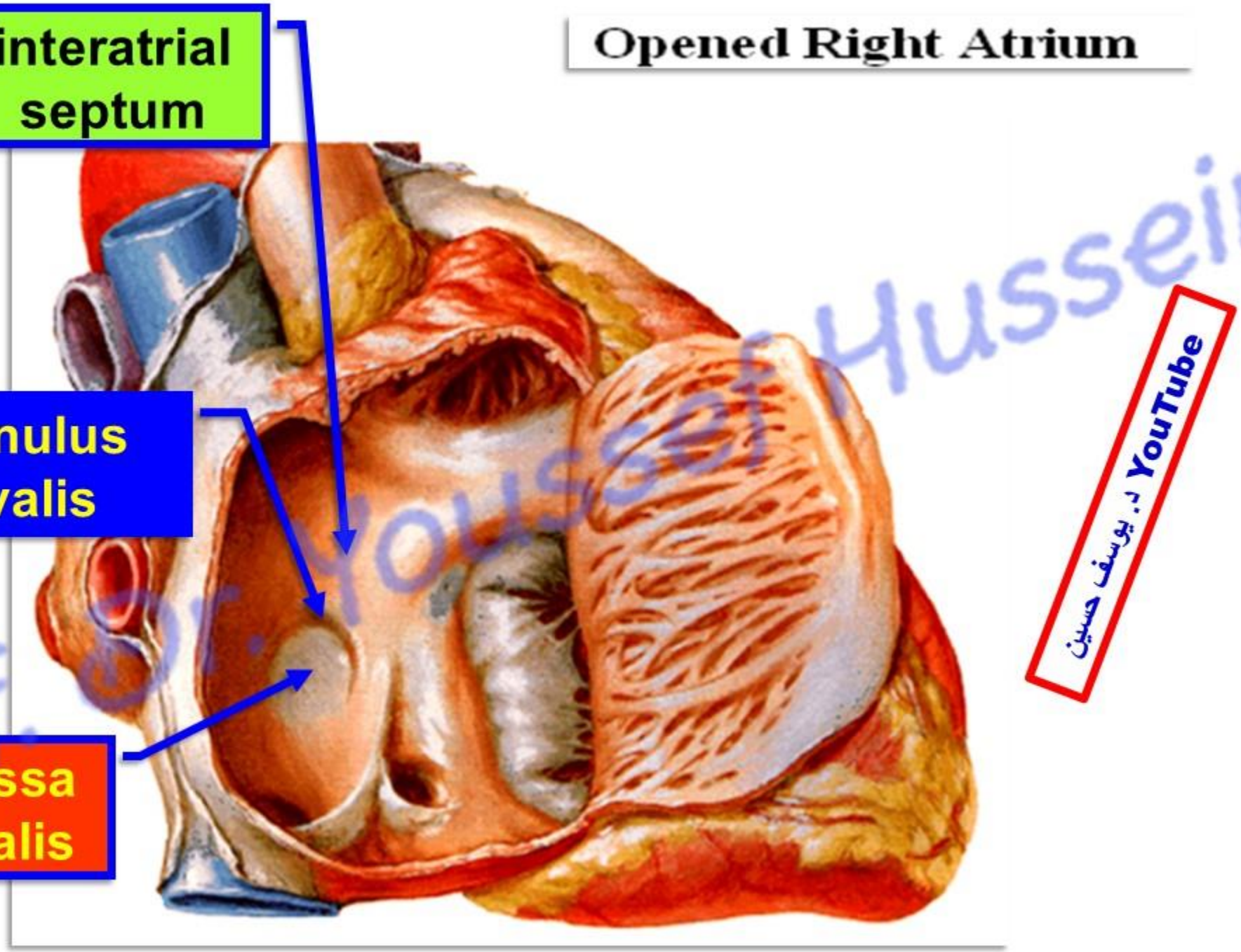
	right side	left side
Horn	Smooth posterior part of the right atrium	coronary sinus
Common cardinal vein	superior vena cava	oblique vein of the left atrium
Vitelline vein	inferior vena cava	degenerated
Umbilical vein	Degenerated	After labor forms ligamentum teres of the liver





Development of interatrial septum

Opened Right Atrium



• Development of the inter-atrial septa

- It divides the common atrium into right and left atria as follows.

1- Septum primum;

- A sickle shaped septum descends from the roof of the common atrium and grows towards the atrioventricular septum.
- The anterior and posterior ends of the septum reach the atrioventricular septum before the central part. As a result, a temporary opening called **ostium primum** between the lower end of the septum primum and atrioventricular septum.
- **Before closure** of the ostium primum, another foramen appears by breaking of the upper part of the septum primum called **ostium secondum**.
- Both ostium primum and ostium secondum are necessary to passage of blood from the right atrium to left atrium during foetal life.

2- Septum secondum;

- Another sickle-shaped septum descends from the roof of the atrium to the **right side of the septum primum** till covers the ostium secondum.
- The gap between the lower edge of the septum secondum and upper edge of the septum primum is called **foramen ovale**. This foramen allows the passage of blood from the right atrium to the left atrium.
- **After birth, foramen ovale is closed by apposition of the 2 septa due to increase pressure in LA**; the septum primum forms floor of the fossa ovalis and lower edge of the septum secondum forms annulus ovalis.

Ectopia cordis: The costal surface of the heart is exposed to the surface due to defect in the sternum.

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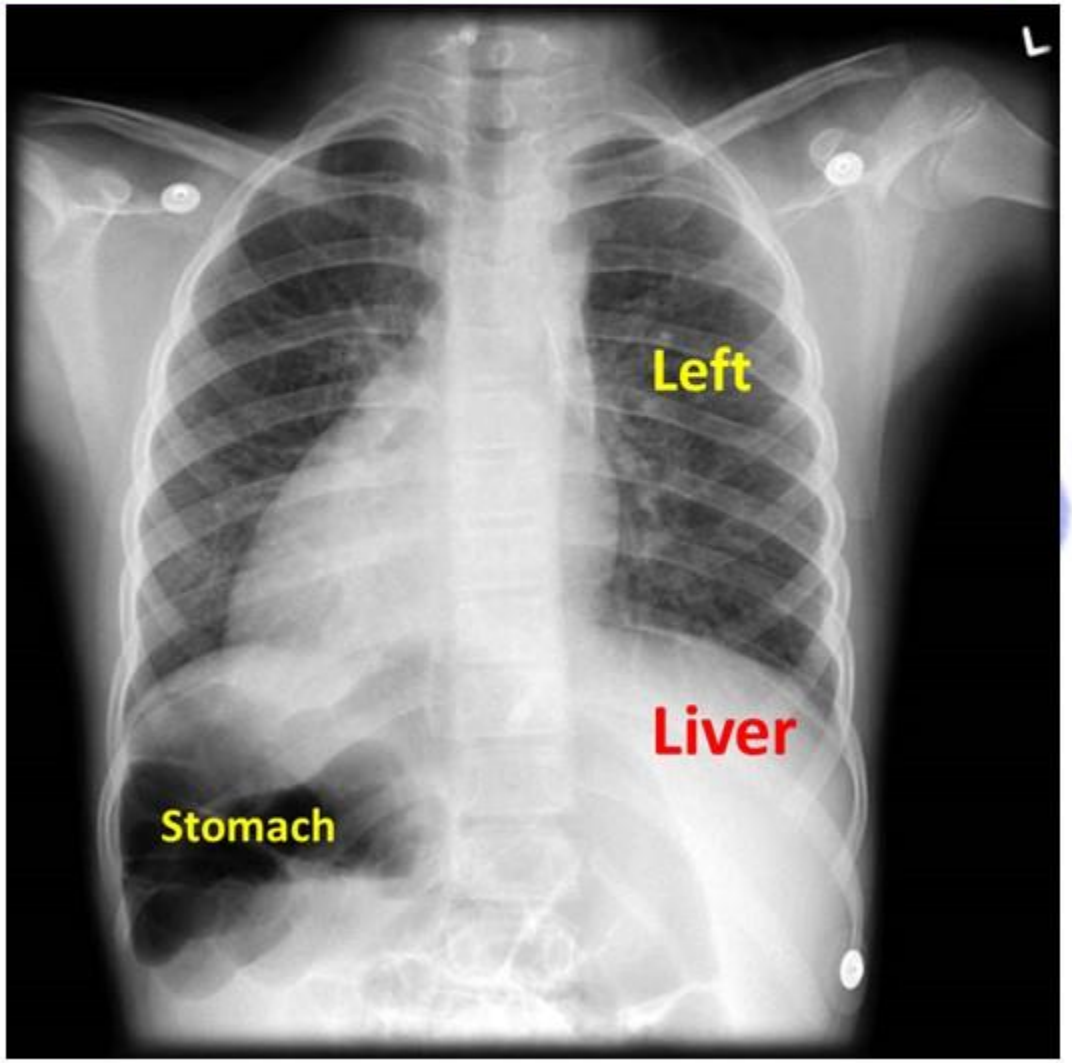
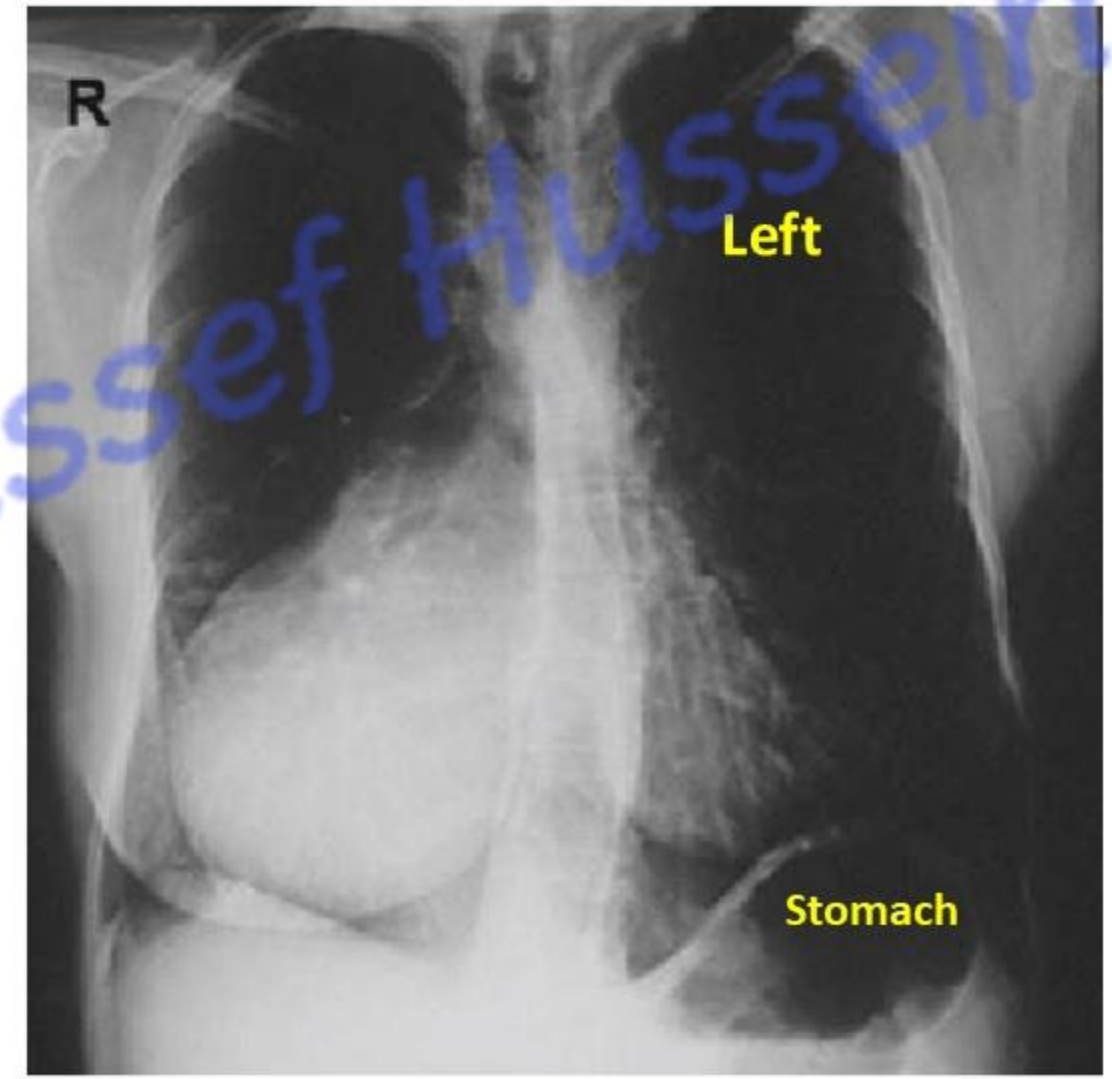
Dextrocardia: the apex of the heart is directed to the **right** side with

Complete situs inversus



Partial situs inversus



• Congenital anomalies of the interatrial septa

1- Common atrium: due to failure of development of the interatrial septum.

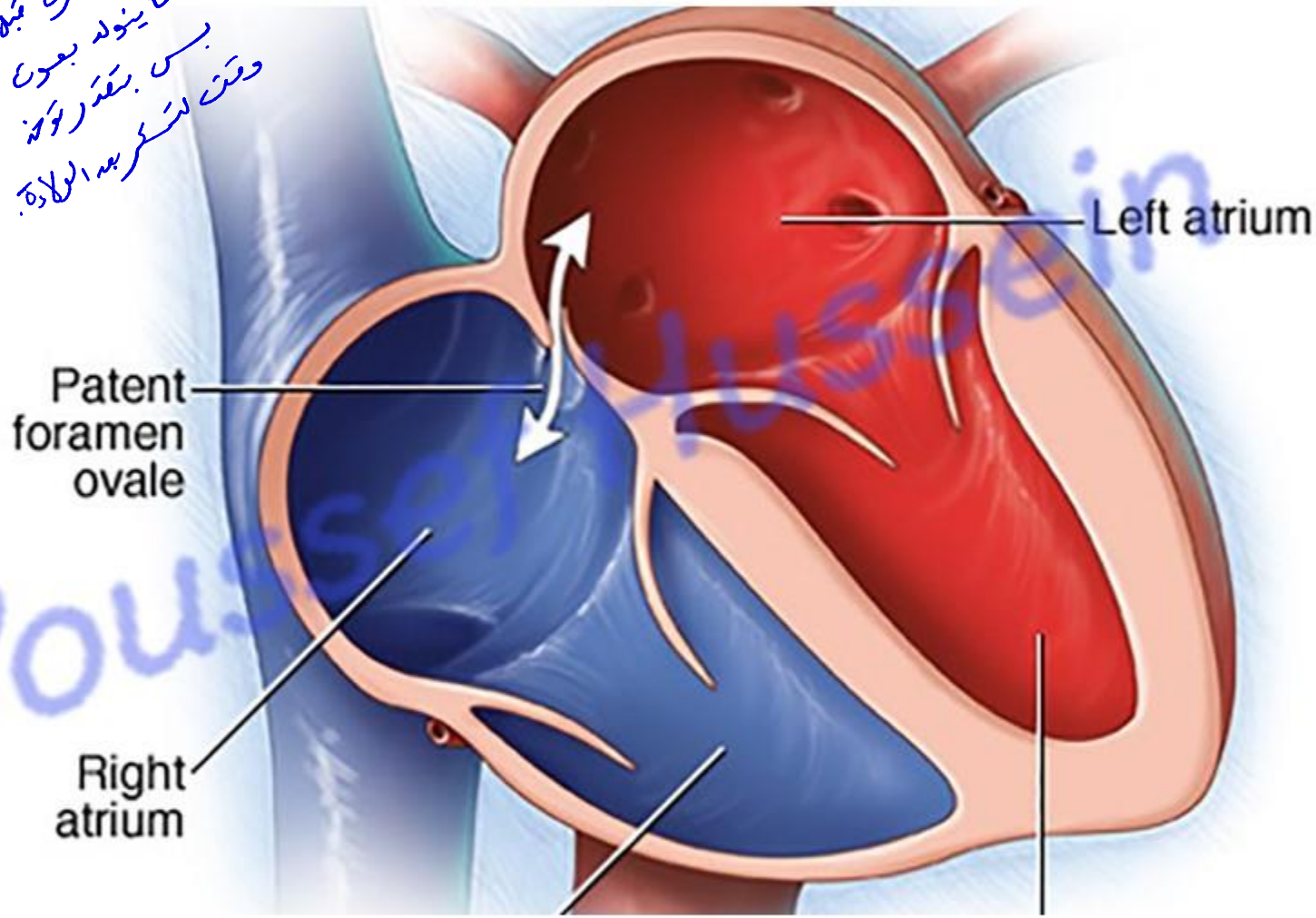
2- Patent ostium primum: incomplete descend of the septum primum to close the ostium primum.

3- Patent ostium secondum: failure of development of the septum secondum or excessive breaking down of the septum primum.

4- Patent foramen ovale: failure of closure of the foramen ovale after birth.

- This leads to shunt of the blood from the left to the right atrium with the result of right atrium enlargement.

5- Premature closure of the foramen ovale: leading to hypertrophy of the right atrium and ventricle



The foramen ovale normally closes after birth. BUT may close 6 months to a year after the baby's birth.

- **The proximal part:** is absorbed and added to the ventricle (infundibulum of RV or vestibule of LV).

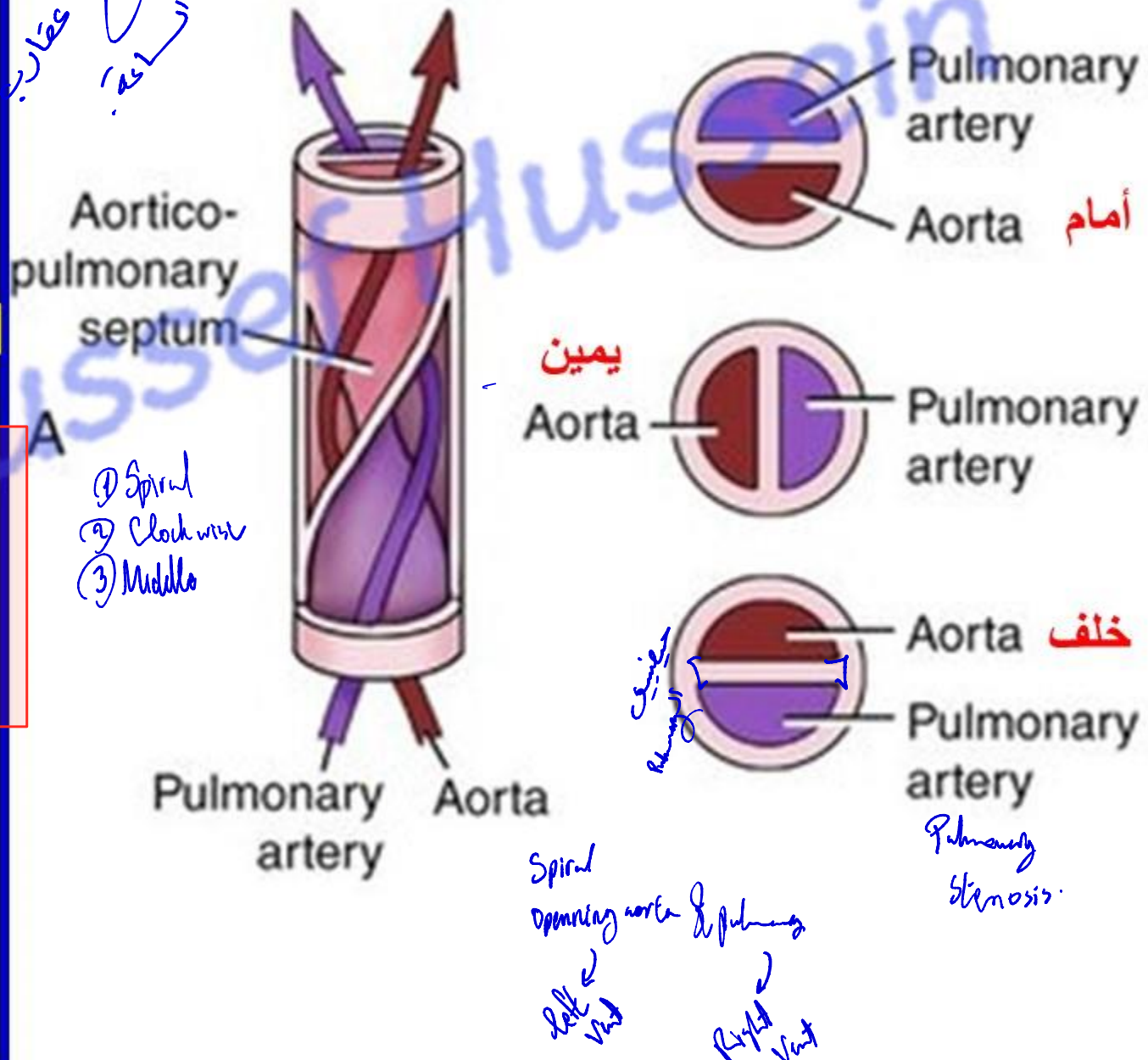
* **The distal part [truncus arteriosus]:** is divided into aorta and pulmonary trunk by a **bulbar (spiral) septum.** It **rotates in a clockwise direction**.

I. **Lower part**: The septum is **transverse**. The **aorta** lies **behind** the pulmonary trunk. **SO**, the aorta opens into LV and pulmonary trunk opens into RV

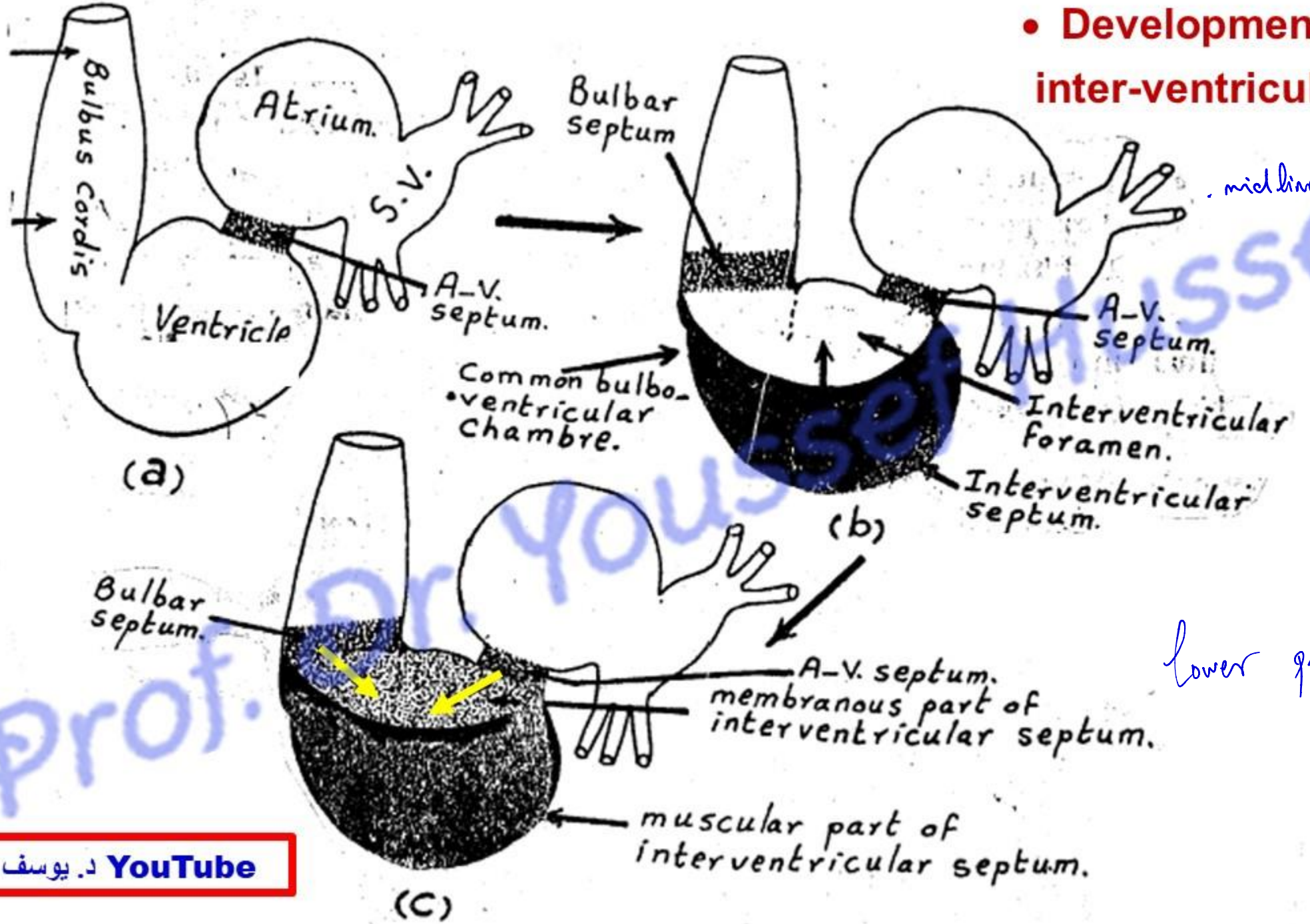
II. **Middle part:** the septum is **anteroposterior**. The **aorta** lies to the **right side** of the pulmonary trunk.

III. **Upper part:** The septum is **transverse**. The **aorta** lies in **front** of the pulmonary trunk.

Development of the bulbus cordis



• Development of the inter-ventricular septa



نزل بالـ midline ④.

lower part → muscular.

• Development of the interventricular septa

1- Muscular part of the septum:

- A sickle-shaped septum developed from the floor of the common ventricular chamber
- It ascends upward towards the bulbar septum and atrioventricular septum leaving an opening called **interventricular foramen** connecting the two ventricles and forms **muscular** part of interventricular septum.

2- Bulbar septum and **atrioventricular septum** descends **downward to** meet the upper margin of muscular part forming **membranous part of the interventricular septum**

- **Congenital anomalies of the ventricle**

- **Cor bilocular:** the heart consists of one atrium and one ventricle due to due to failure of development of the septa.
- **Cor trilocular,** the heart consists of 2 atria and one ventricle due to absent of the interventricular septum.

Valvular anomalies may be Stenosis or regurgitation

Cor trilocular

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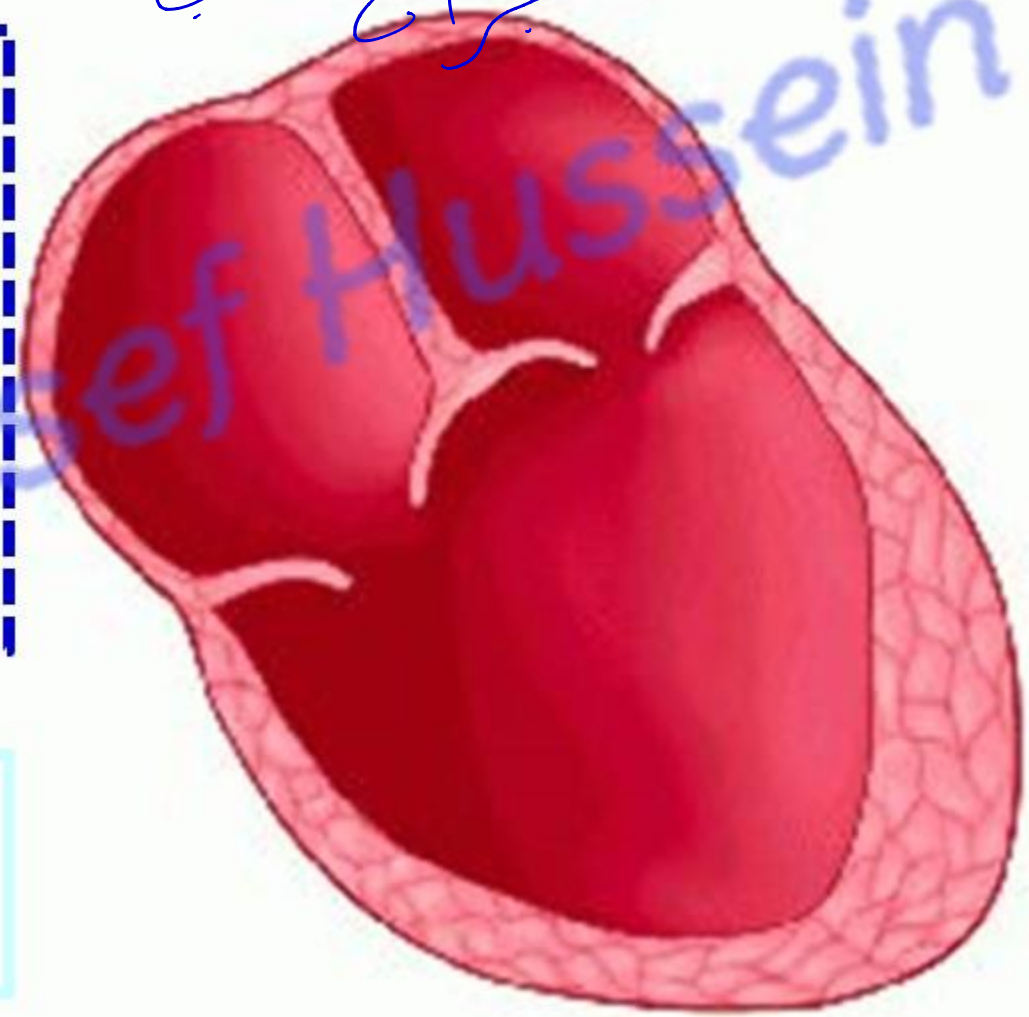
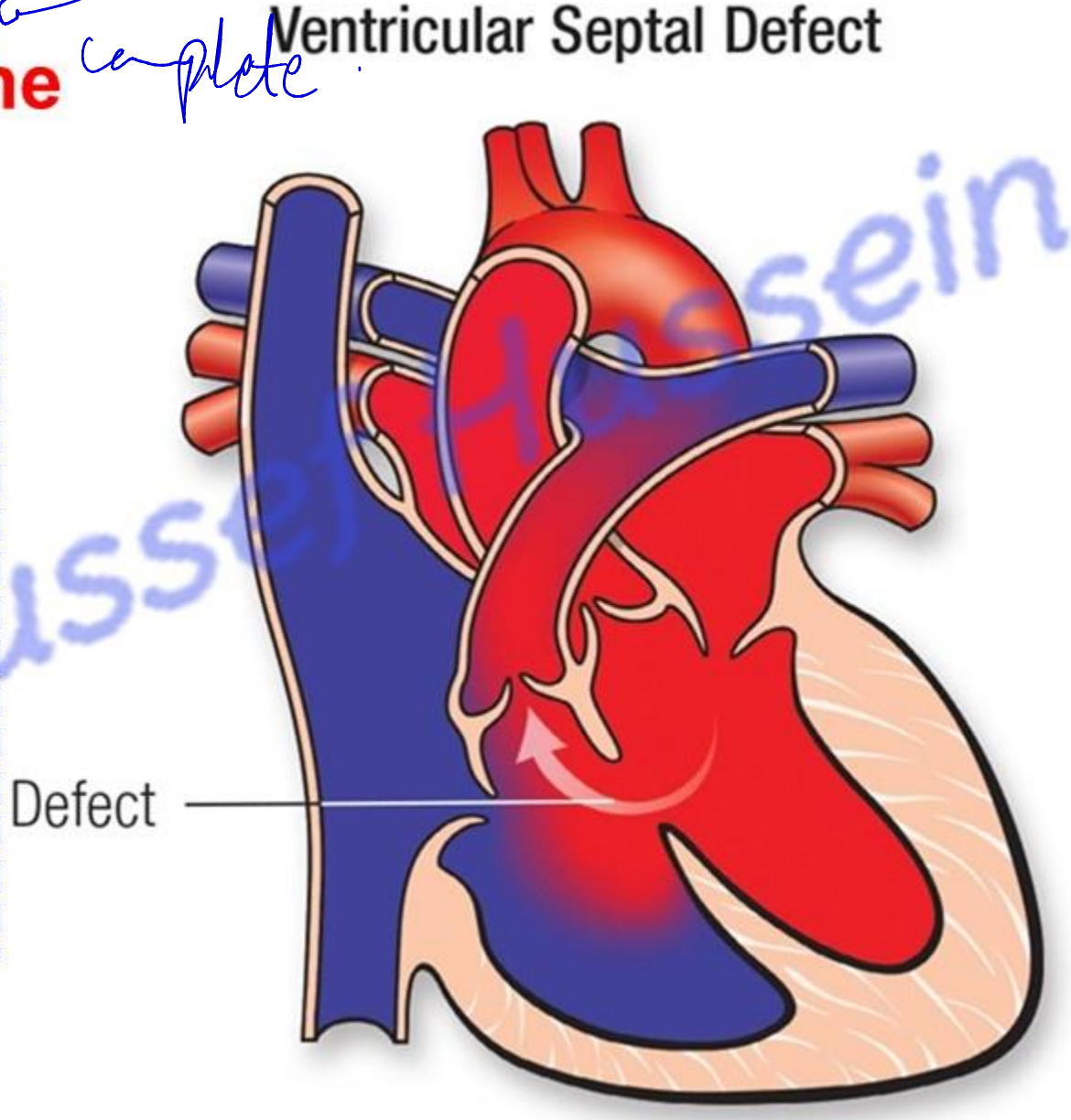


• Congenital anomalies of the ventricle

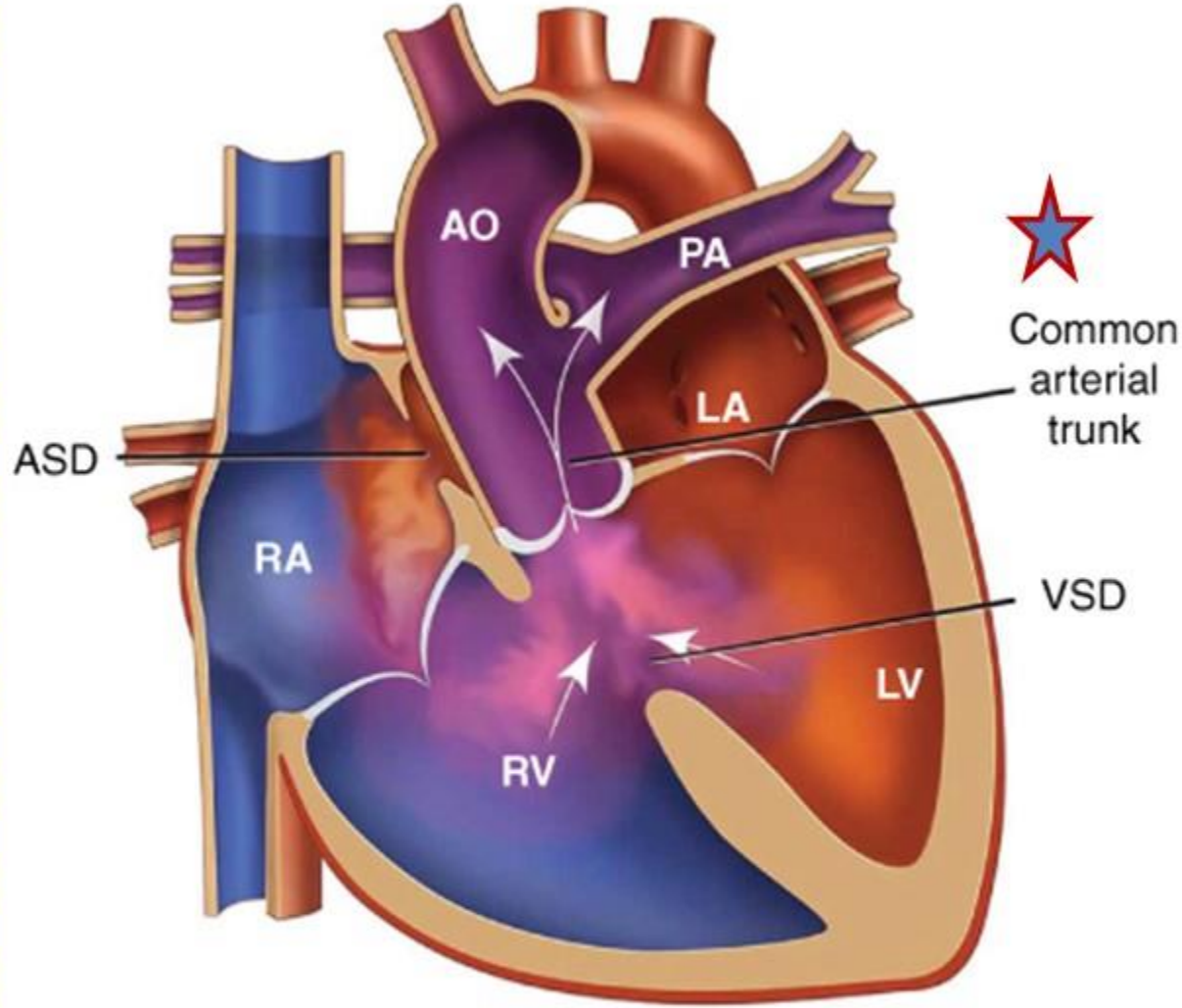
➢ **Ventricular septal defect (VSD):** due to failure of development of the membranous part of the interventricular septum.

- It allows the passage of the blood from the left ventricle to the right ventricle leading to **cyanosis**.



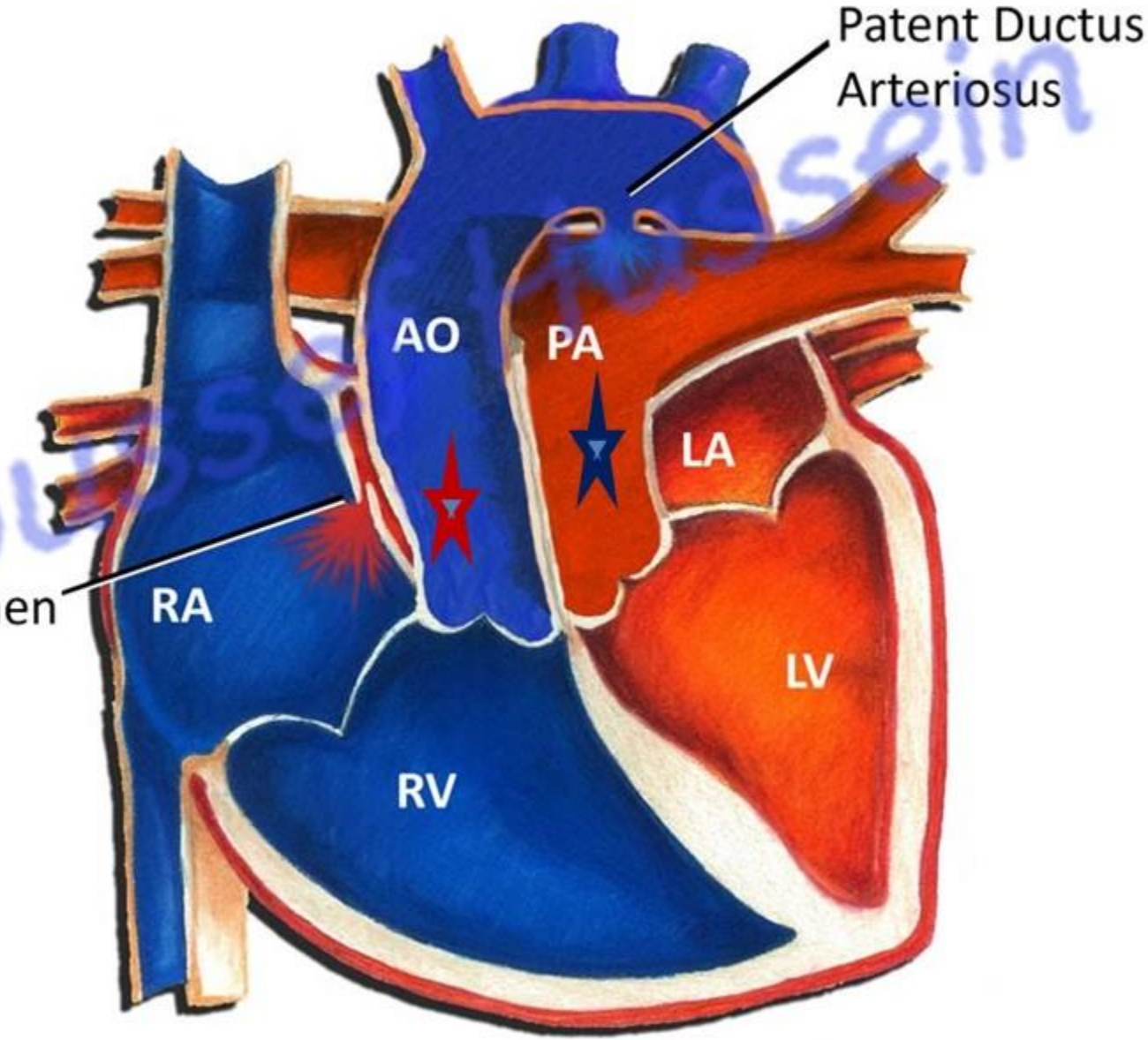
Anomalies of the bulbar septum

- **Persistent truncus arteriosus (bulbus cordis) (common arterial trunk):** due to failure of development of the bulbar (**aorticopulmonary)** septum and so the great vessels arise as a common trunk and receives blood from both ventricles (**Ventricular Septal Defect**).



Transposition of the Great Arteries

- **Transposition of the great vessels**
- Aorta arises from the right ventricle while the pulmonary trunk arises from the left ventricle due to **reversed rotation of the bulbar septum (Anticlockwise)**



• Fallot's tetralogy

- It is caused by

1) Anterior displacement of the bulbar septum.

2) Failure of development of the membranous septum.

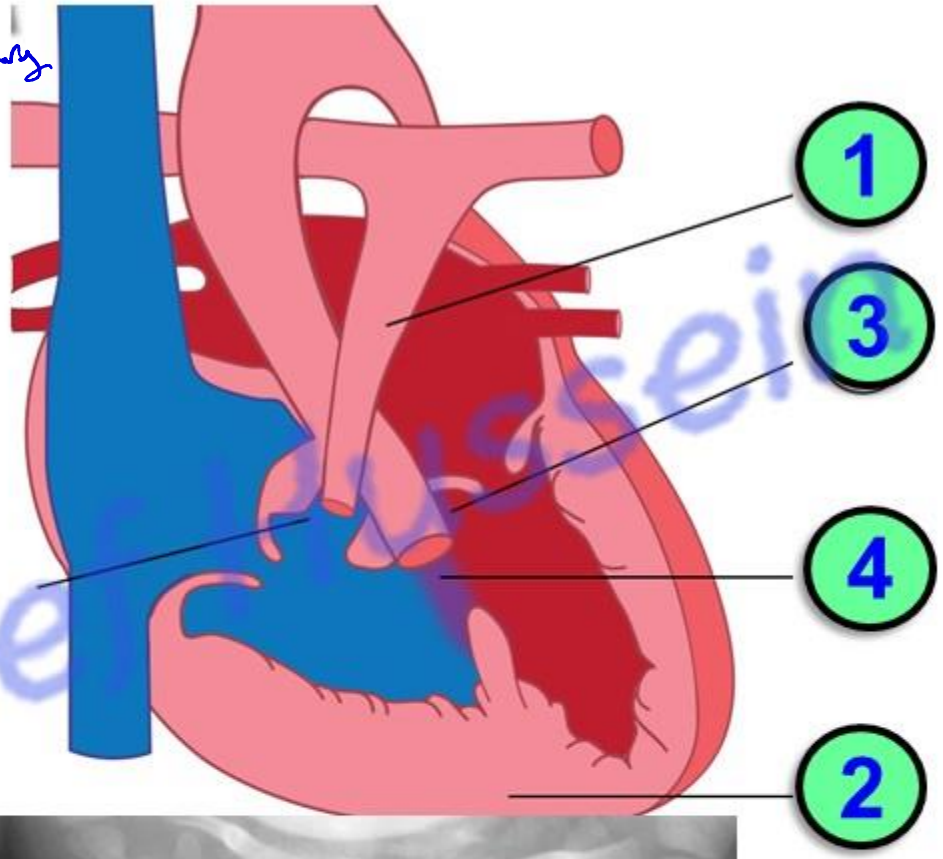
- It consists of (PROV):

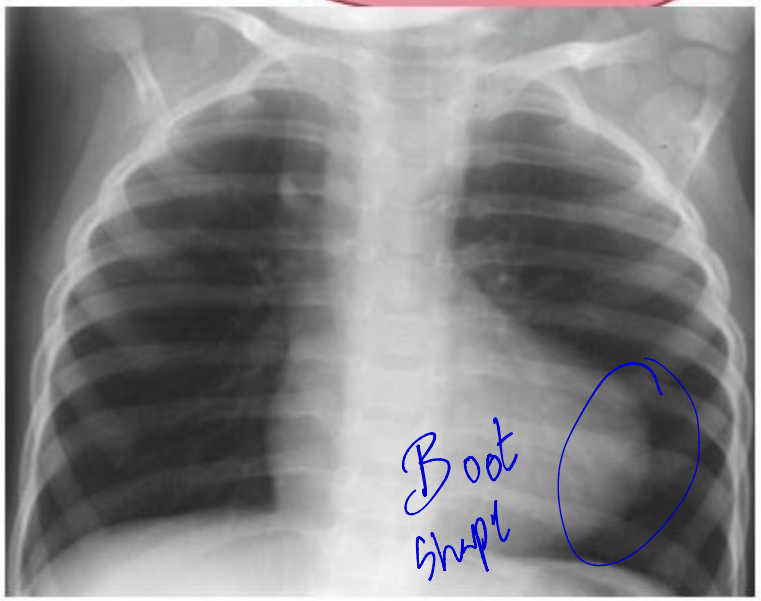
1- **Pulmonary stenosis** (most important determinant for prognosis)

2- **Right ventricular hypertrophy** (boot-shaped heart on CXR).

3- **Overriding of the aorta** (the aorta arises from the 2 ventricles due to anterior displacement of the bulbar septum).

4- **Ventricular septal defect** [VSD] due to failure of development of the membranous part of the interventricular septum





RIGHT-TO-LEFT SHUNTS

- Early cyanosis—"blue babies."
- Often diagnosed prenatally or become evident immediately after birth.
- Usually require urgent surgical treatment and/or maintenance of a PDA
- The 5 T's:

1. Truncus arteriosus (common arterial trunk)
2. Transposition of great vessels
3. Tricuspid atresia (absent)
4. Tetralogy of Fallot
5. TAPVR Total anomalous pulmonary venous return (Pulmonary veins drain into right atrium)

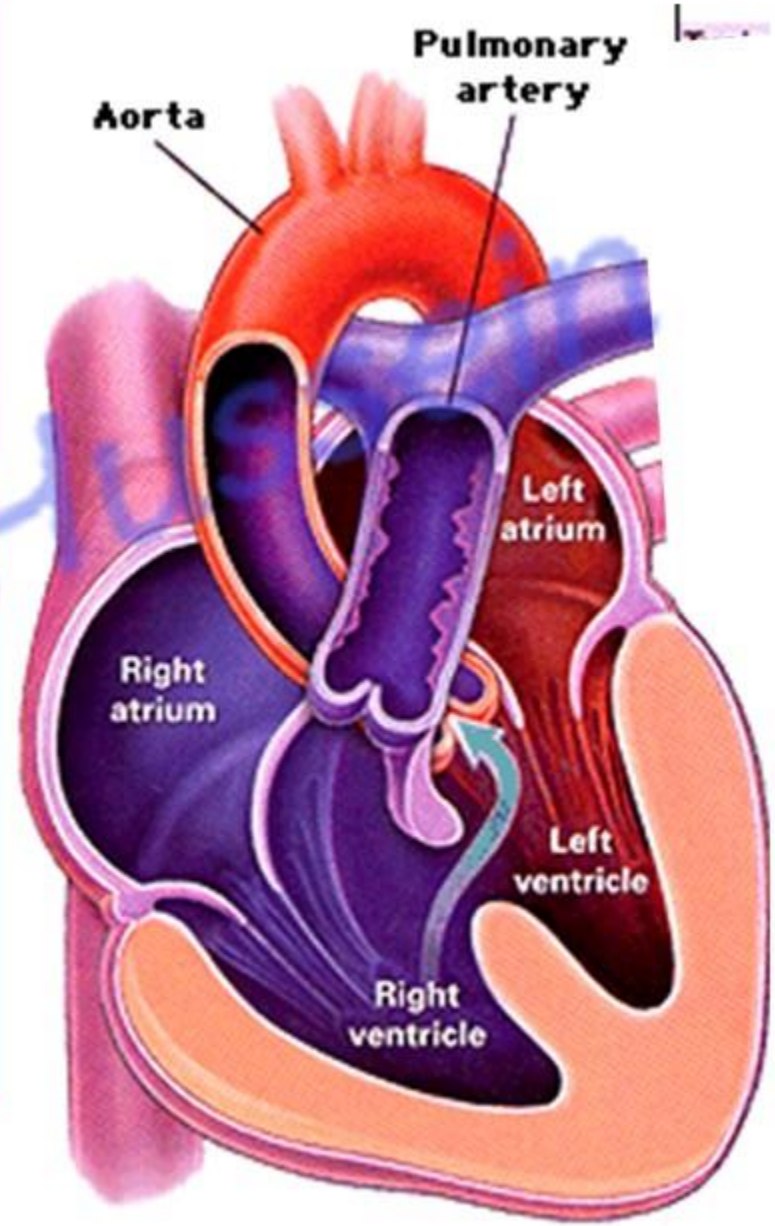
Prof. Dr. Youssef Hussein Anatomy - YouTube

LEFT-TO-RIGHT SHUNTS

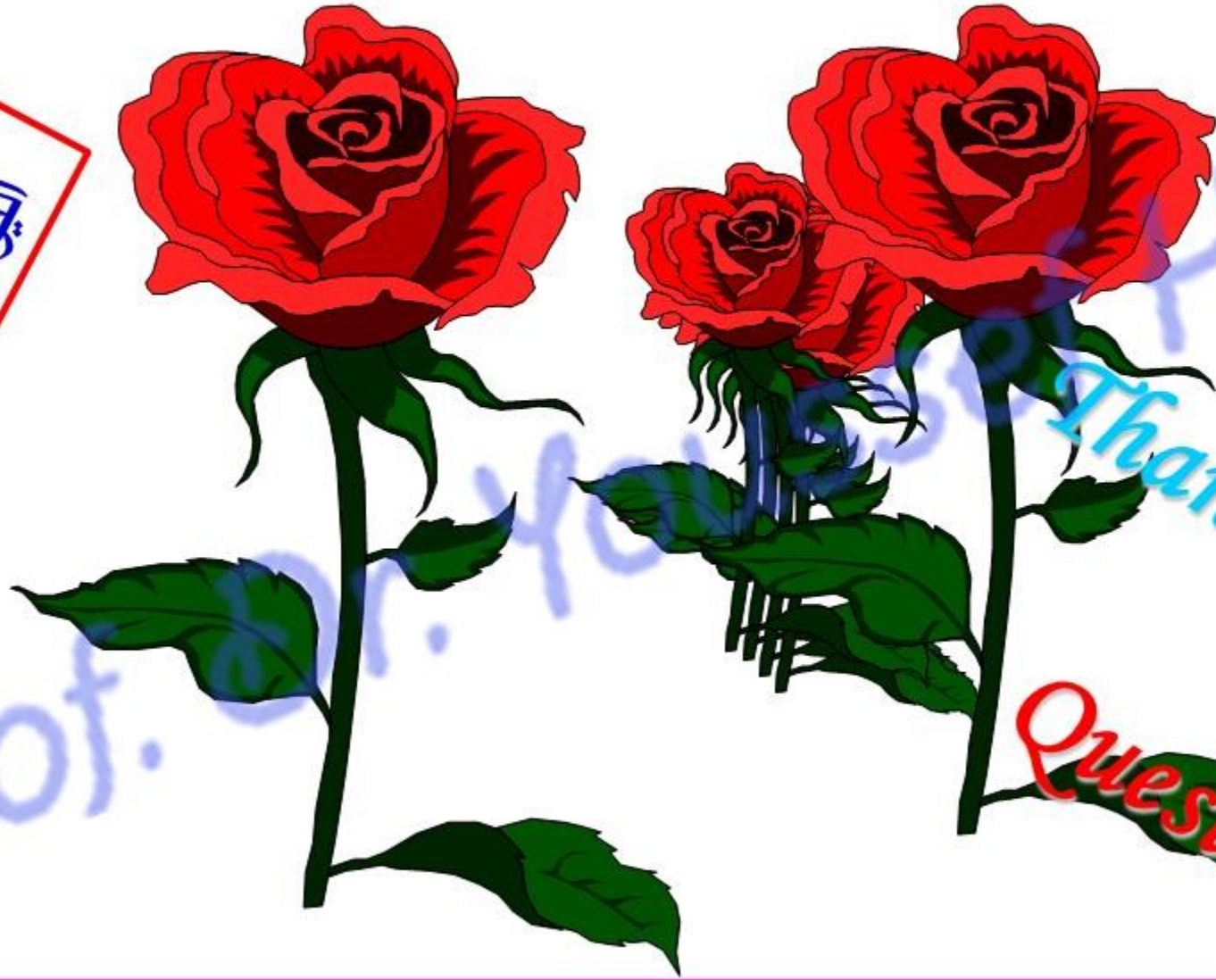
- **Acyanotic,** Patients complain of **excessive fatigue upon exertion; late cyanosis.**
- **Frequency: VSD > ASD > PDA.**

- **Eisenmenger syndrome**

- **Uncorrected left-to-right shunt -- increase pulmonary blood flow --- pulmonary arterial hypertension --- RVH --- inverted shunt becomes right to left (when RV pressure > LV pressure).**



https://www.youtube.com/channel/UCVSNqbibj9UWYaJdd_cn0PQ



Thank you

Questions

https://www.youtube.com/@ProfDrYoussefHusseinAnatomy/playlists