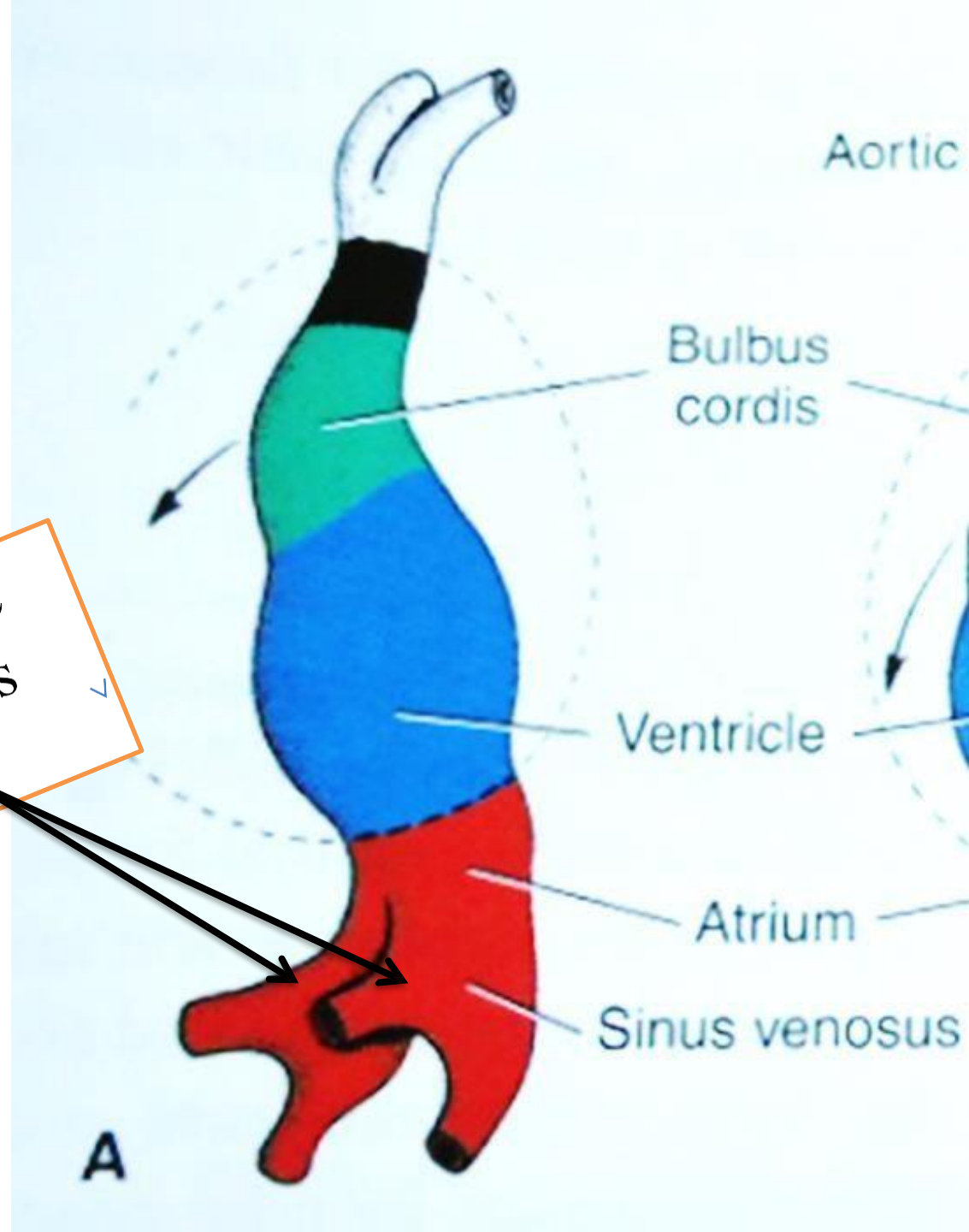


# Development of Major Blood Vessels

## Venous system

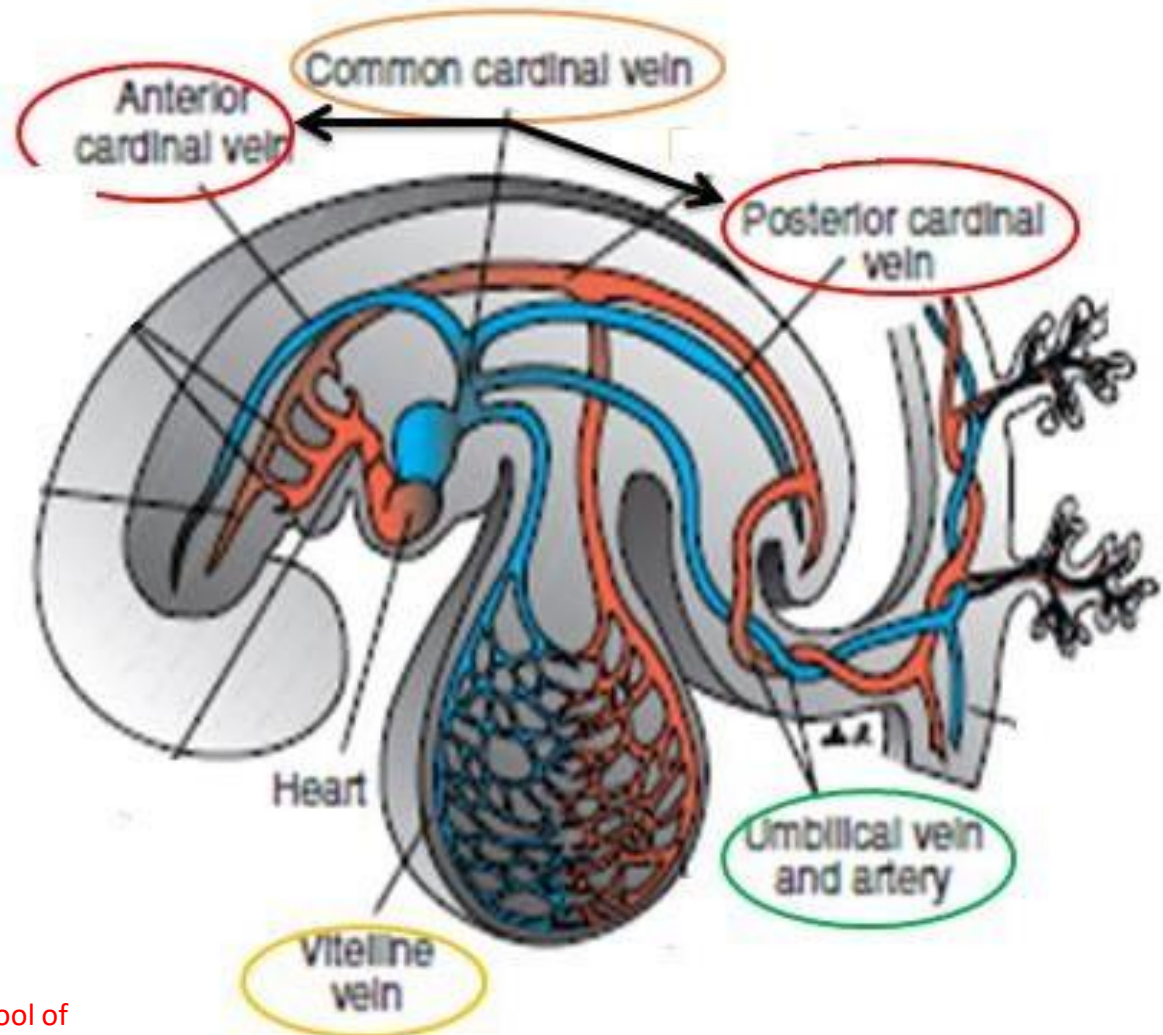
Remember that the sinus venosus has two horns



**The sinus venosus represent the venous end**

of the heart It receives 3 veins:

- 1- Common cardinal vein → body wall**
- 2- Umbilical vein → from placenta**
- 3- Vitelline vein → from yolk sac**



However!!!!

The **left sinus horn** of the sinus venosus is losing its importance and blood from the left side is **rechanneled** toward the right

**Why the left sinus horn loses  
Its importance????**

Due to

## left-to-right shunts of blood

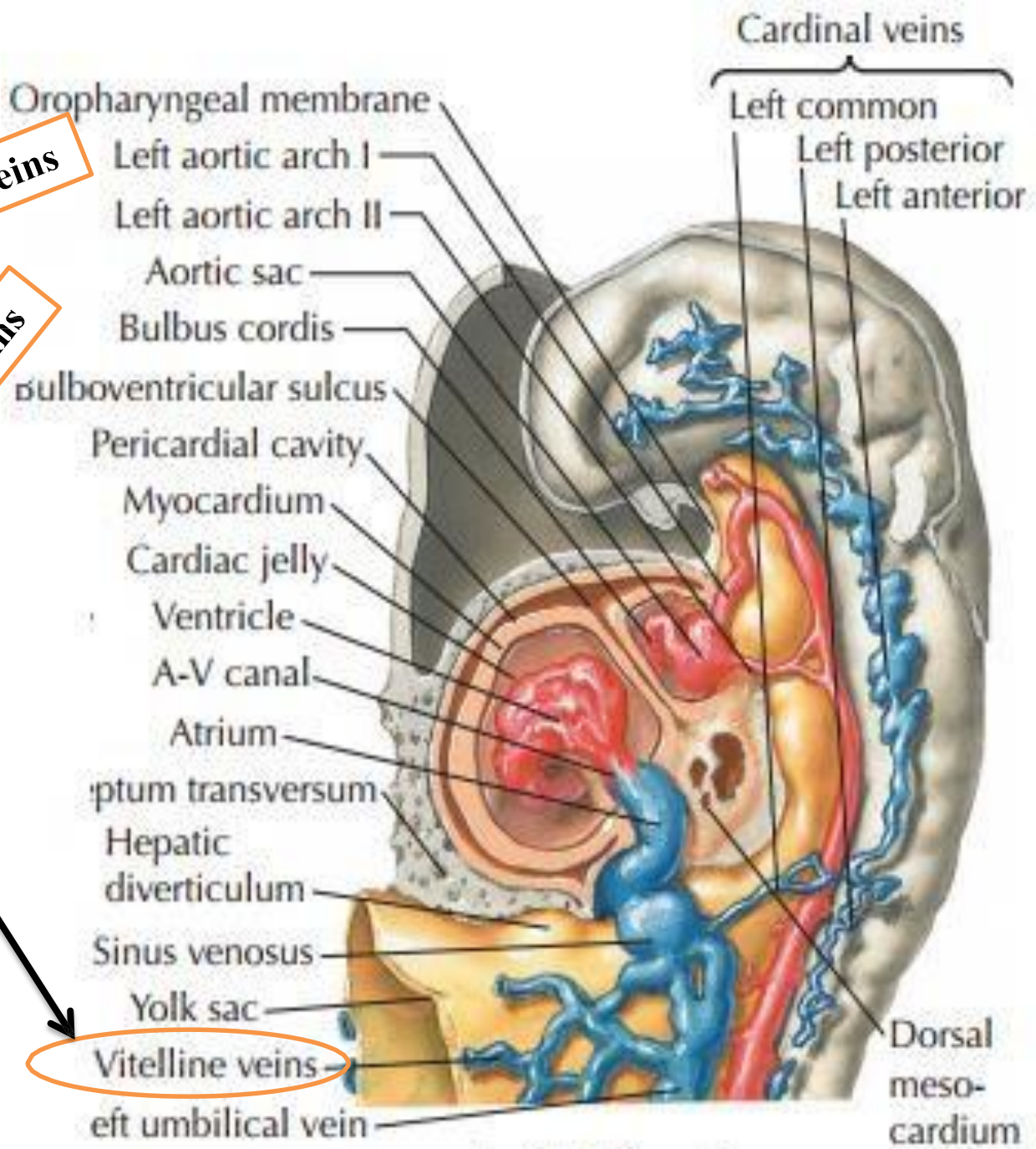
**1-The first left-to-right shunt is a result of the transformation of both vitelline and umbilical veins**

**2-The second left-to-right shunt occurs when the left anterior cardinal vein becomes connected To the right anterior cardinal vein by an oblique anastomosis**

**Left brachiocephalic**

Transformation of the vitelline veins

A-Vitelline Veins (omphalomesenteric) veins



Sagittal dissection

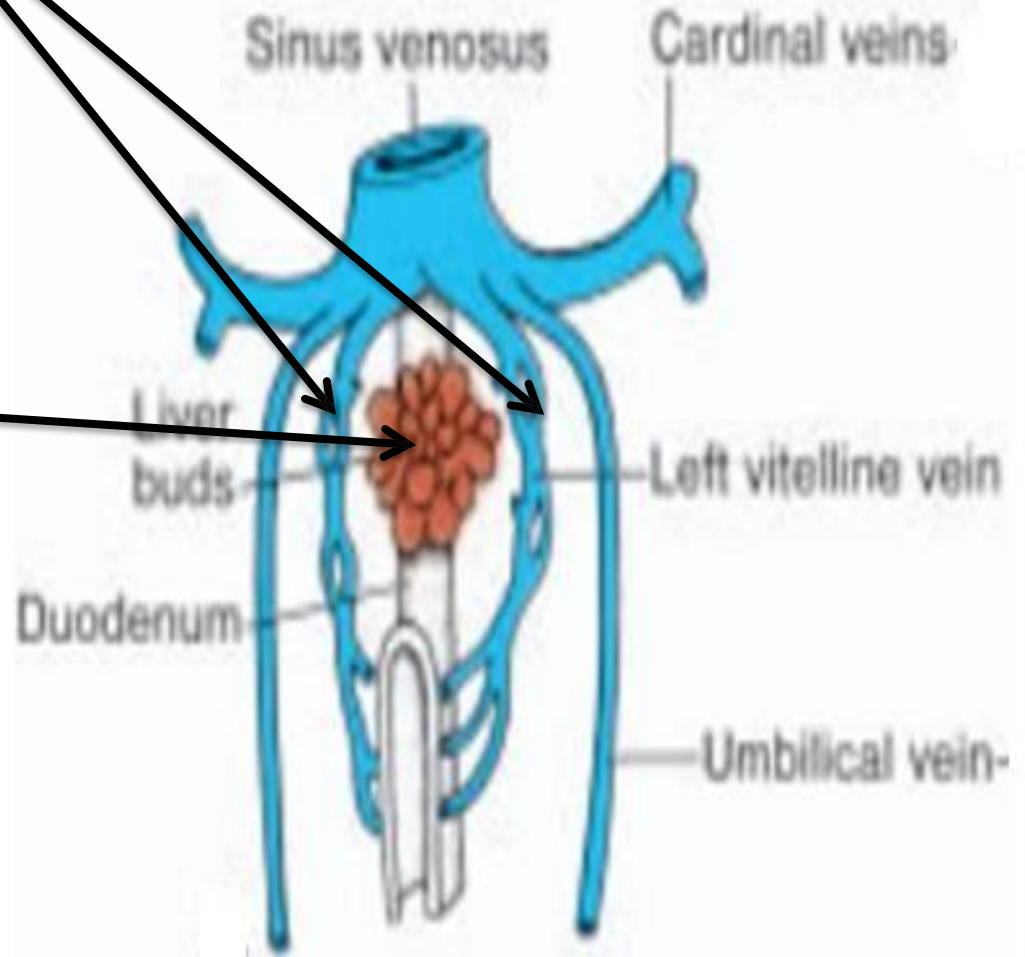
## Vitelline Veins (omphalomesenteric) veins

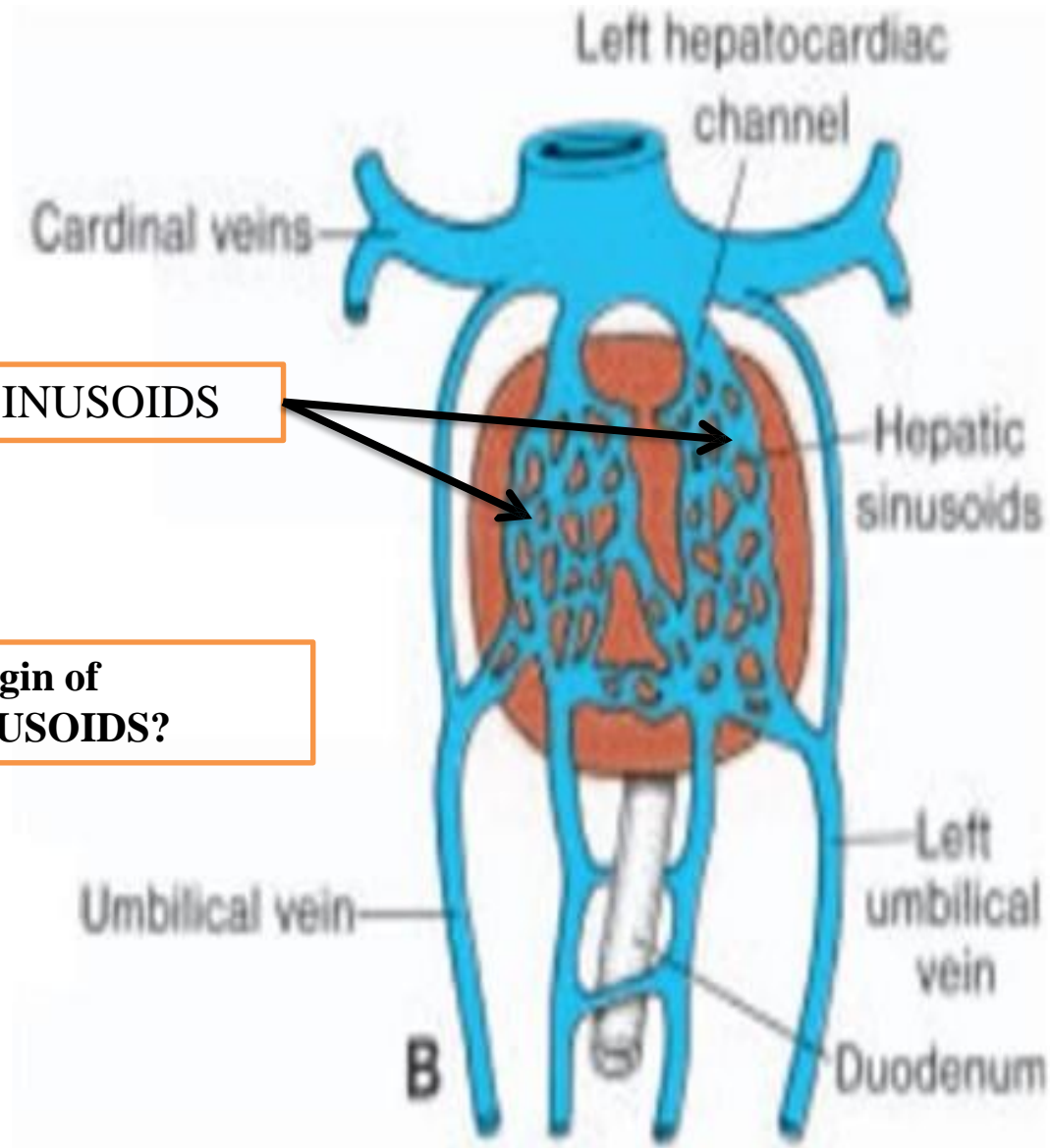
1-The vitelline veins form a plexus around the developing duodenum then it enters **the sinus venosus**

2-The growing liver cords interrupt the course of the vitelline veins, and form an extensive vascular network

Called

**THE HEPATIC SINUSOIDS**





## THE HEPATIC SINUSOIDS

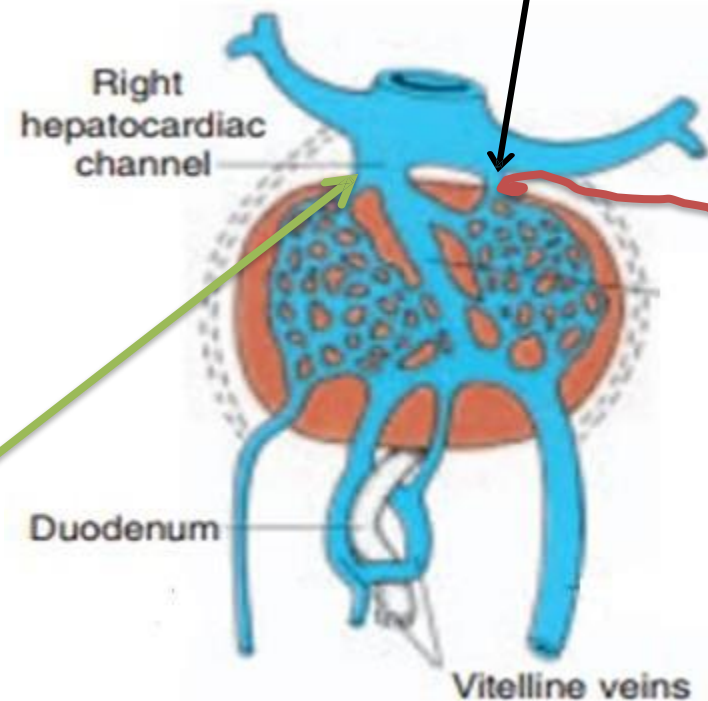
What is the origin of the HEPATIC SINUSOIDS?



It should be noted that at this time the left sinus horn of the sinus venosus is losing its importance and blood from the left side of the liver is rechanneled toward the right, resulting in an enlargement of the right vitelline vein

Also called  
**(right hepatocardiac channel)**

Notice how the left vitelline vein is redirected to the right vitelline vein which is in its turn getting bigger



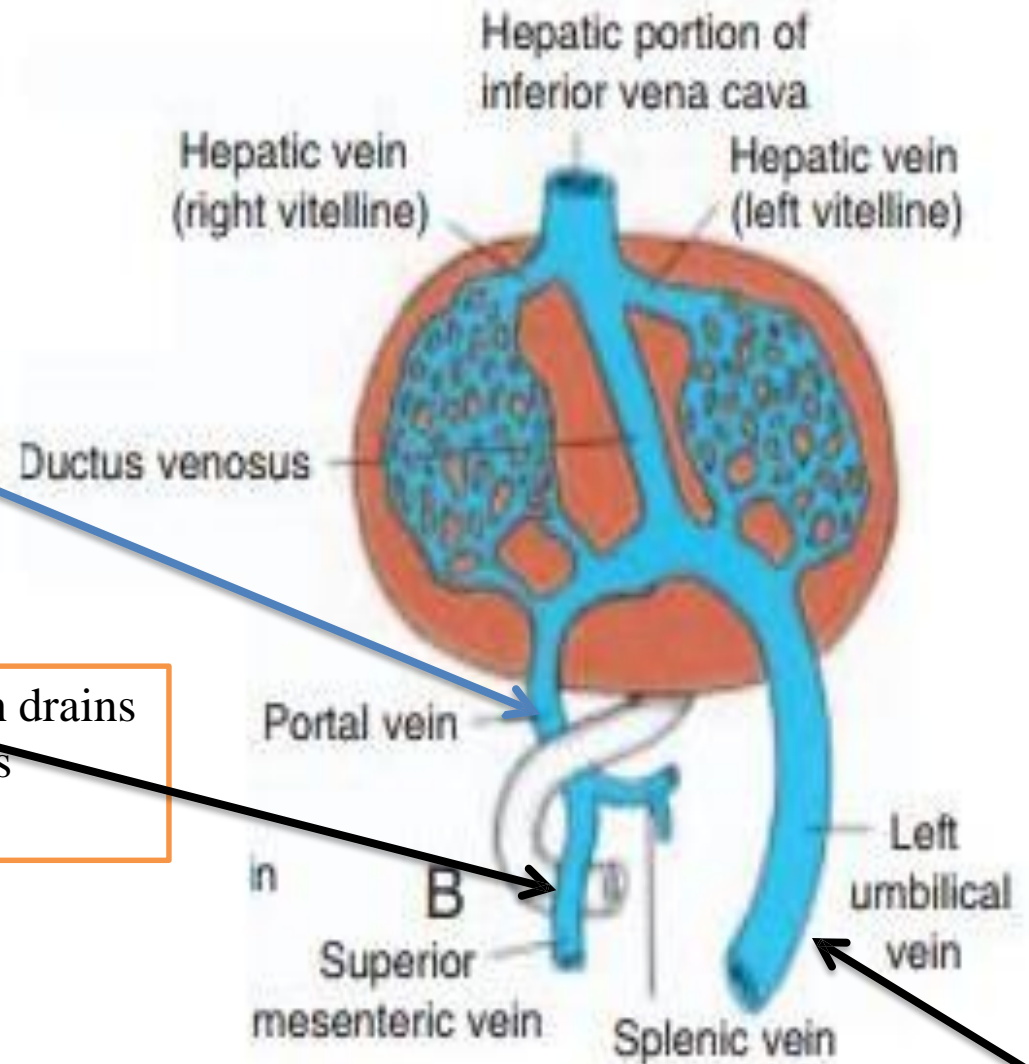
3-The right hepatocardiac channel forms the hepatocardiac portion of

**The inferior vena cava**

4-The proximal part of the left vitelline vein disappears

5- The anastomotic network around the duodenum develops into a single vessel,  
The portal vein

6- The **superior mesenteric vein**, which drains the primary intestinal loop, derives from the **right vitelline vein**



7- The distal portion of the left vitelline vein also disappear

# Right vitelline vein

You should know by now;  
1-the origin of all of the following:

**THE HEPATIC SINUSOIDS**

The hepatocardiac portion  
of the **inferior vena cava**

**The portal vein**

**The superior mesenteric vein**

2- what is the fate of the left vitelline vein

The proximal part of the left vitelline vein disappear

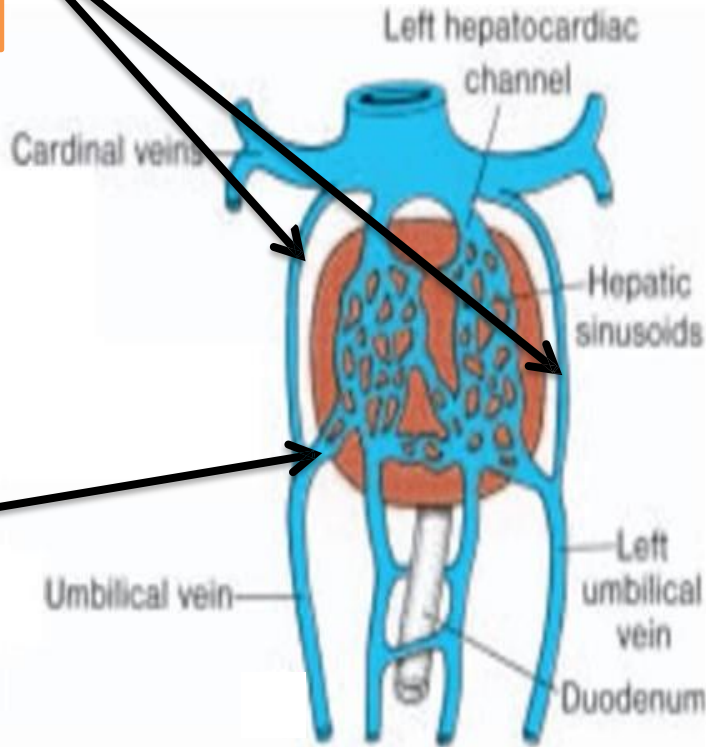
The distal portion of the left vitelline vein also disappear

Left vitelline vein

## Transformation of the umbilical veins

### B-Umbilical Veins

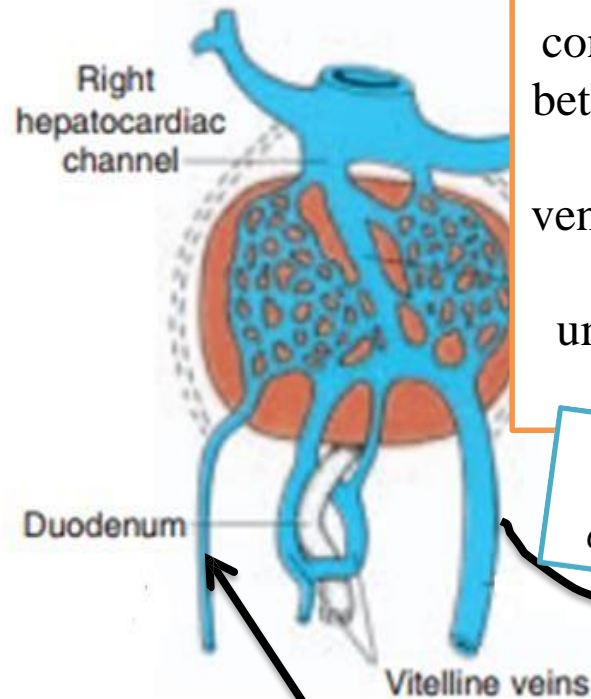
1-Initially the umbilical veins pass on each side of the liver



A

2-Some connect to the hepatic sinusoids

3-The proximal part of both umbilical veins disappear



B

No connection between the sinus venosus and the umbilical veins

How they will connect?

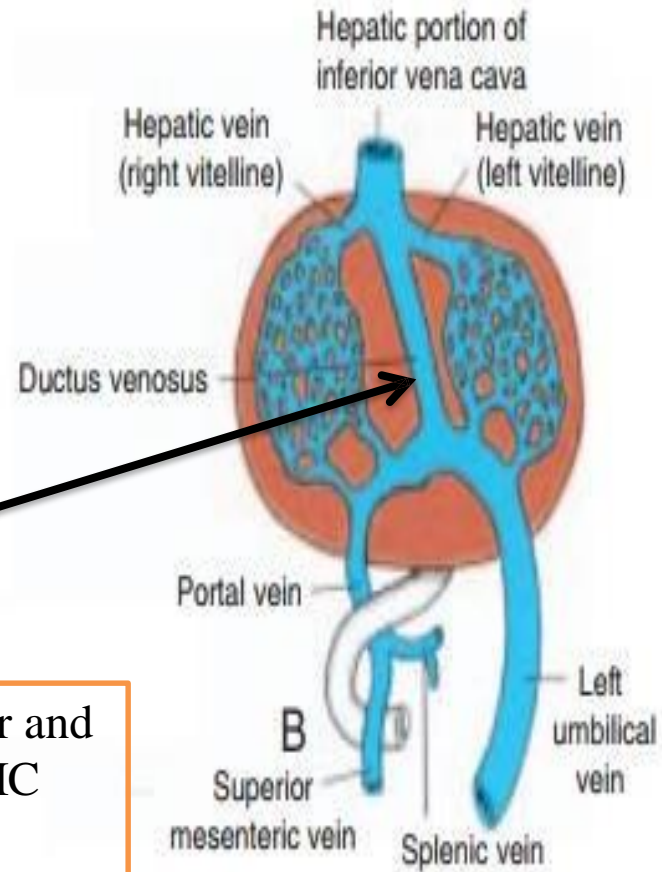
Compare between umbilical veins in A and B

4-The remainder of the right umbilical vein then disappears, so that **the left vein is the only one** to carry blood from the placenta to the liver

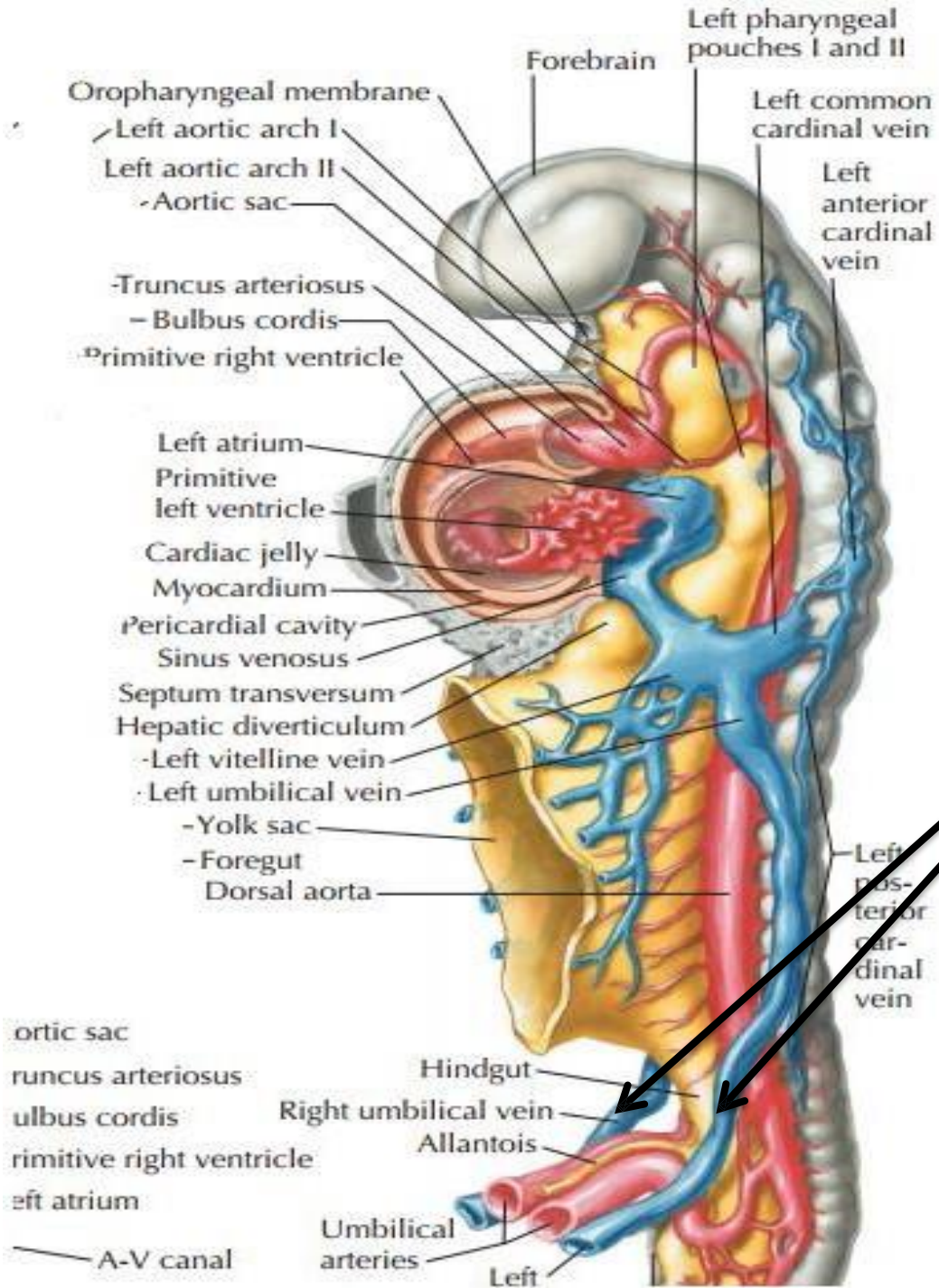
5- With the increase of the placental circulation, a direct communication forms between **the left umbilical vein** and **the right hepatocardiac channel** To Form

## **The ductus venosus**

This vessel bypasses the sinusoidal plexus of the liver and directly connects the left umbilical vein to **HEPATIC PORTION OF THE INFERIOR VENA CAVA**



6- After birth the left umbilical vein and ductus venosus are **obliterated** **left umbilical vein forms..... the ligamentum teres hepatis** **ductus venosus forms.....the ligamentum venosum**

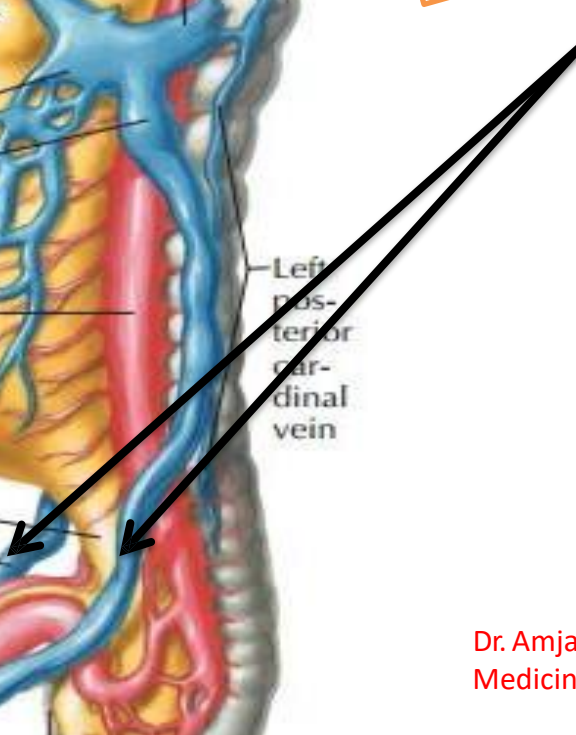


you should have known the answer to the question asked previously



**Why the left sinus horn looses Its importance????**

**Umbilical Veins**



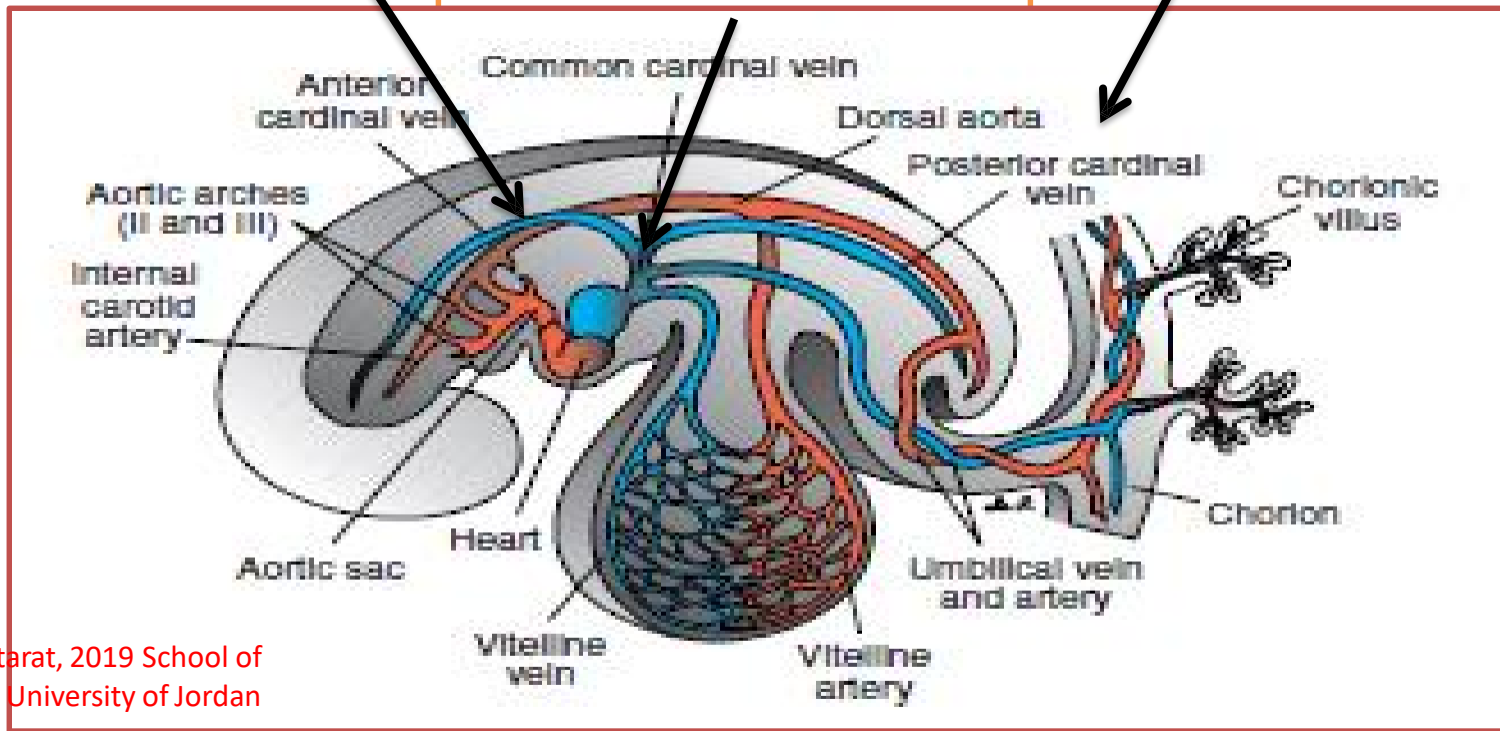
# C- Cardinal Veins

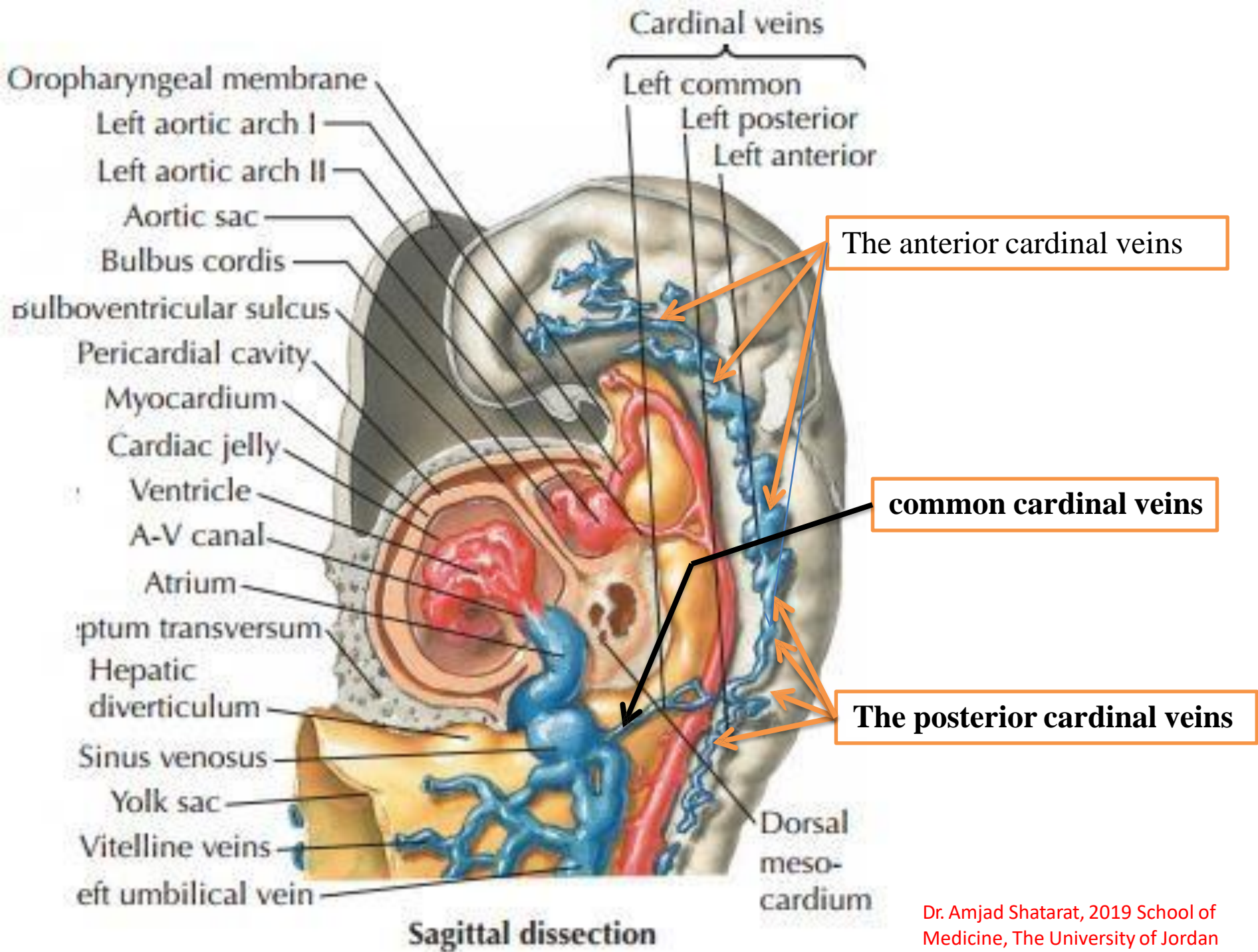
1-This system consists of:

**Right and left anterior cardinal veins**  
which drain the cephalic part of the embryo

**Right and left posterior cardinal veins**  
which drain the rest of the embryo

join before entering the  
sinus horn and form the  
**short  
right and left common  
cardinal veins**







The anastomosis between the anterior cardinal veins develops into

**the left brachiocephalic vein.**

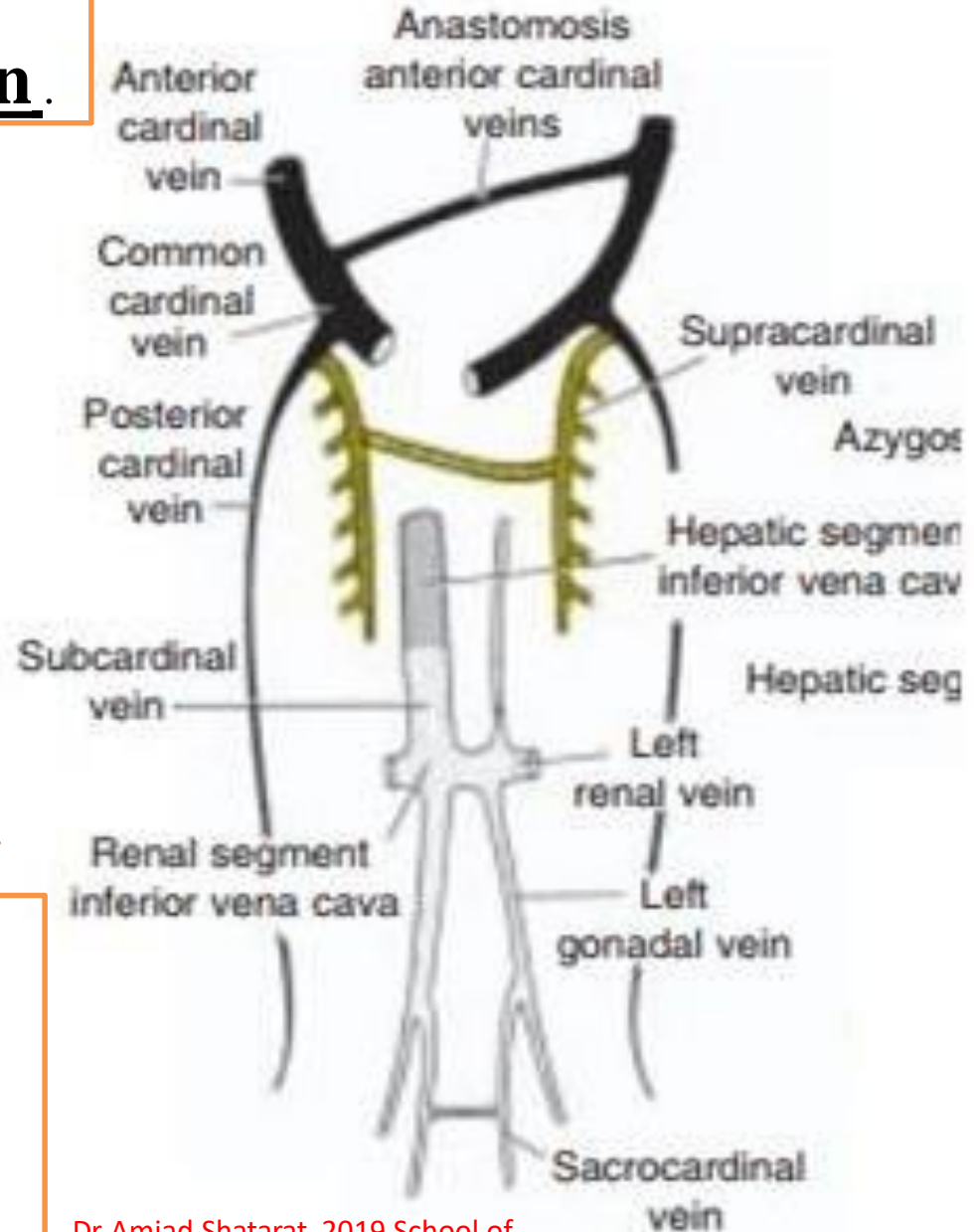


4- Most of the blood from the left side of the head and the left upper extremity is then channeled to the right

Now, you should have understood



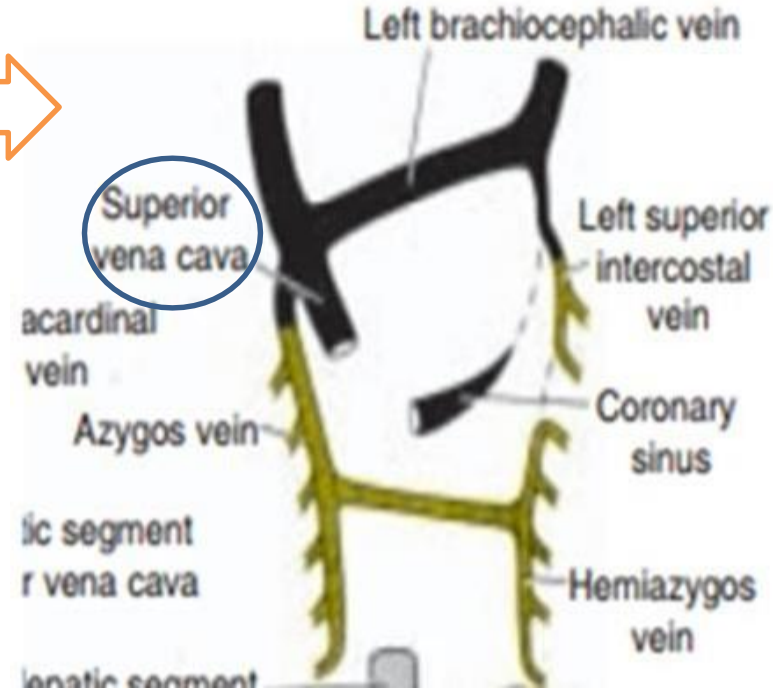
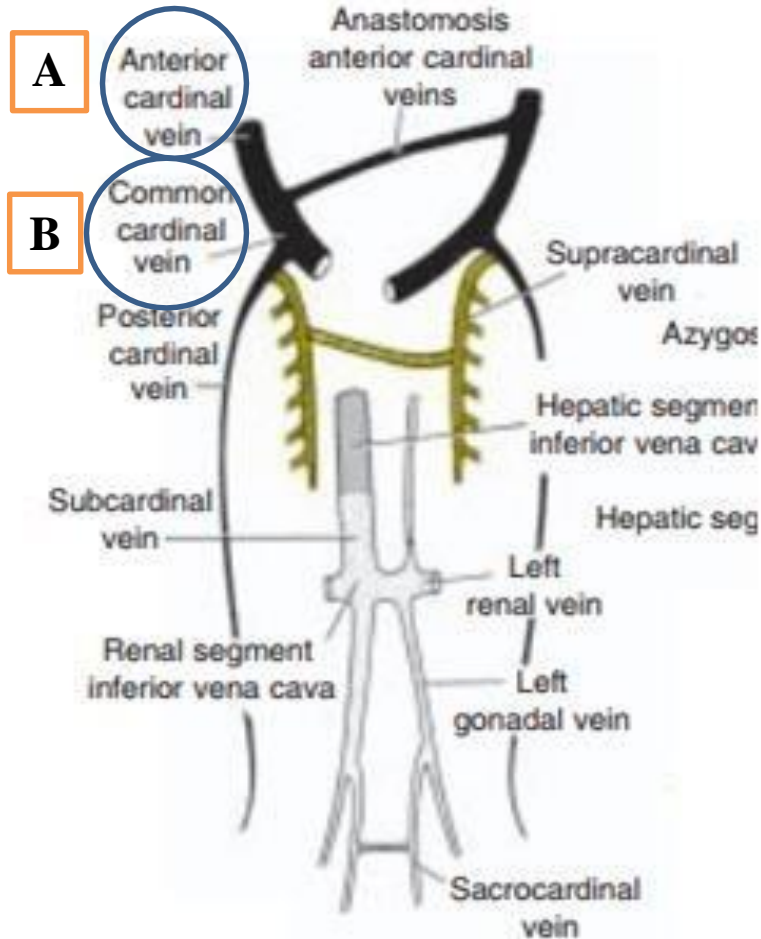
**The second left-to-right shunt occurs when the left anterior cardinal vein becomes connected to the right anterior cardinal vein by an oblique anastomosis**



6- The superior vena cava is formed  
by

**A-The right common cardinal vein**

**B-The proximal portion of the right anterior cardinal vein**



Dr. Amjad Shatarat, 2019 School of  
Medicine, The University of Jordan

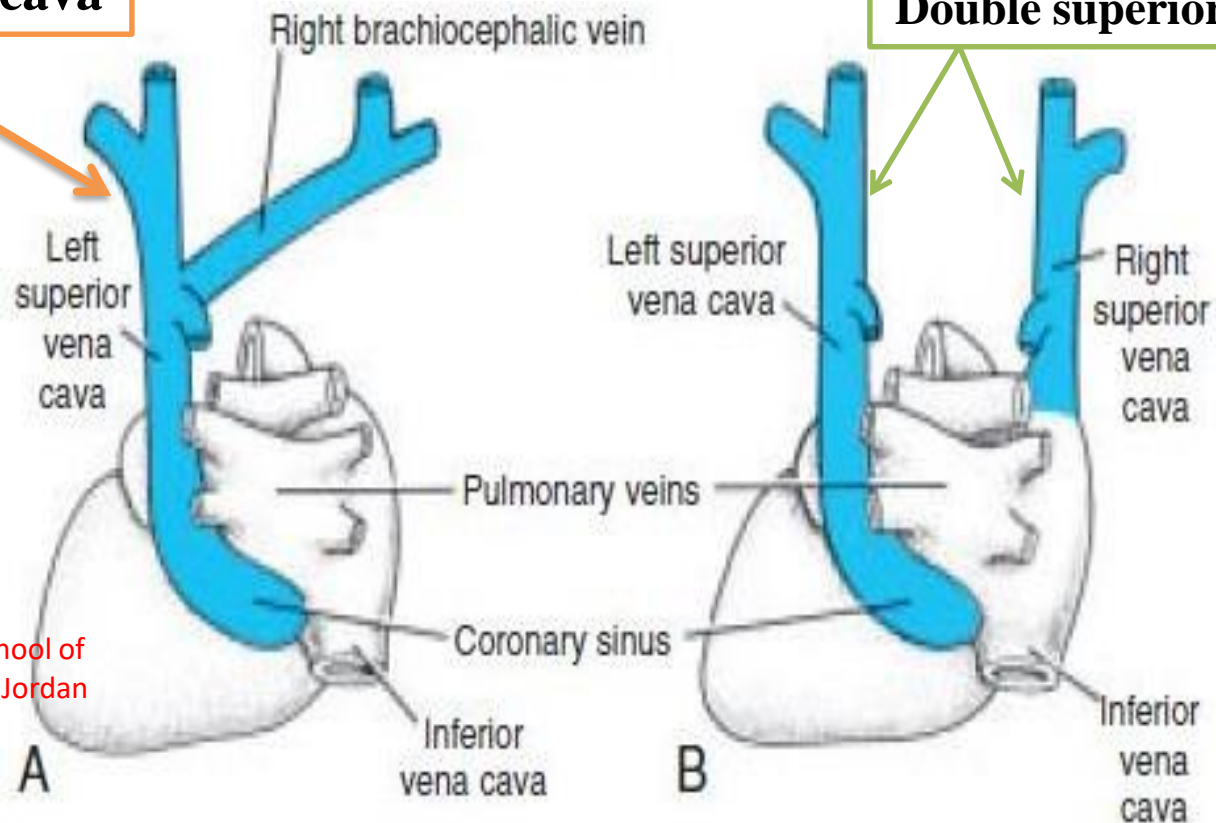
# Clinical correlates

Failure of the right brachiocephalic vein to form

Persistence of the left anterior cardinal vein

**Left superior vena cava**

**Double superior vena cava**

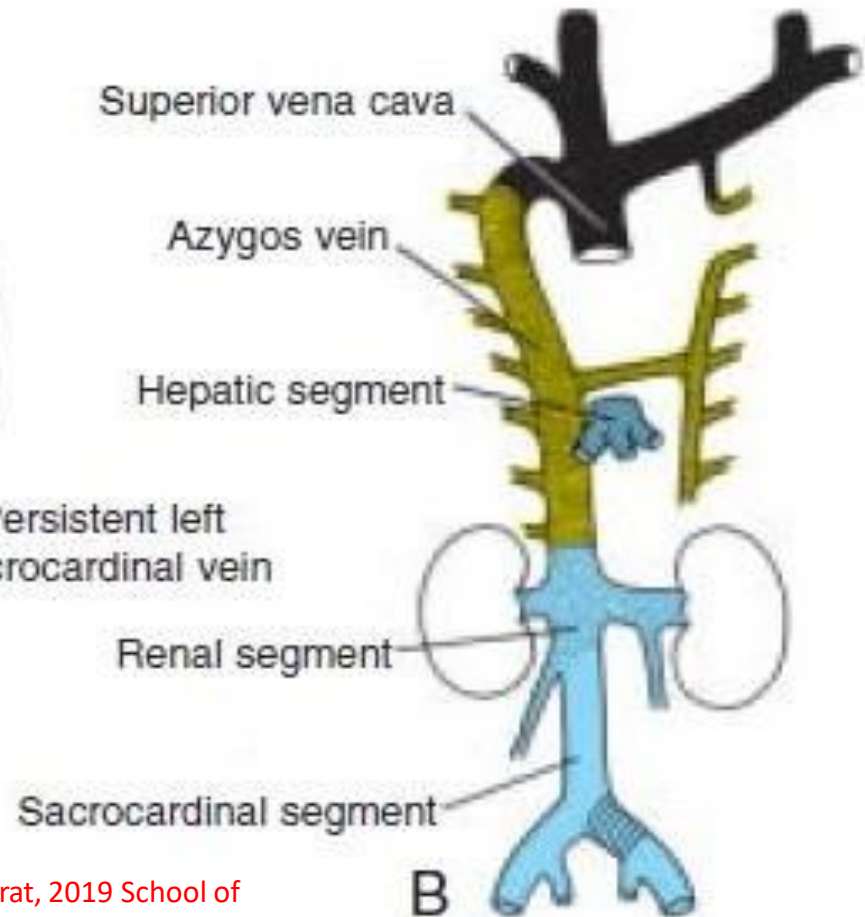
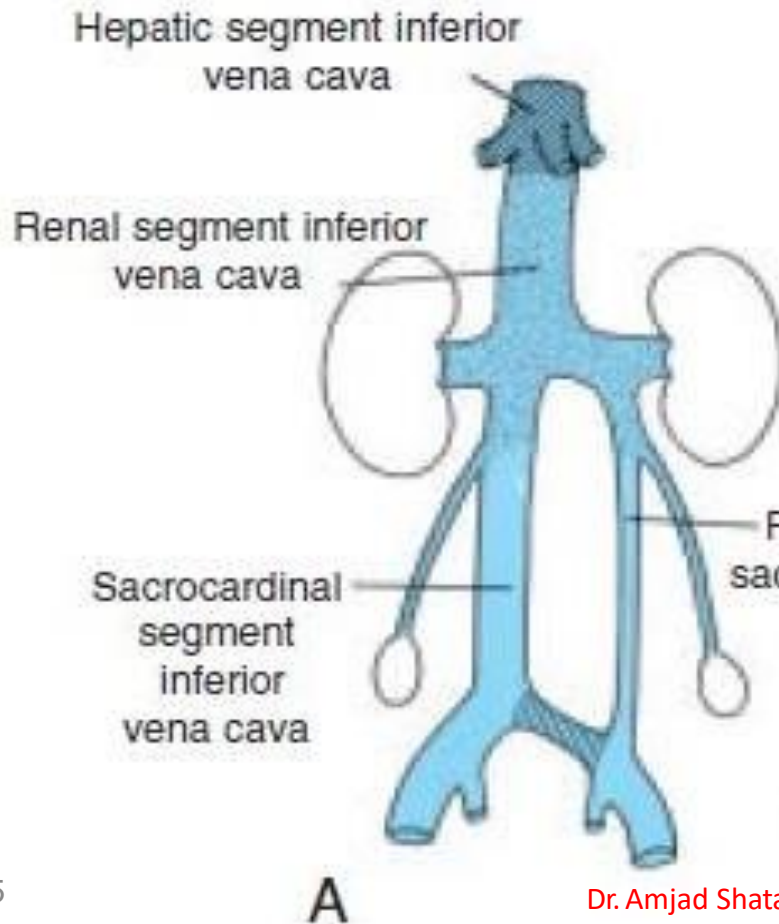


Dr. Amjad Shatarat, 2019 School of Medicine, The University of Jordan

# Clinical correlates

**Double inferior vena cava:  
Left sacrocardinal vein remain  
connected to the left subcardinal vein**

**Absence of the inferior cava : The right  
subcardinal vein fails to make the  
connection with the liver**



# Development of Major Blood Vessels

## Arterial system

# Ductus Arteriosus and Ligamentum Arteriosum

- Functional closure of the DA is usually completed 10 to 15 hours after birth.
- Anatomical closure of the DA and formation of the ligamentum arteriosum usually occurs by the 12th postnatal week

# Patent ductus arteriosus (PDA)

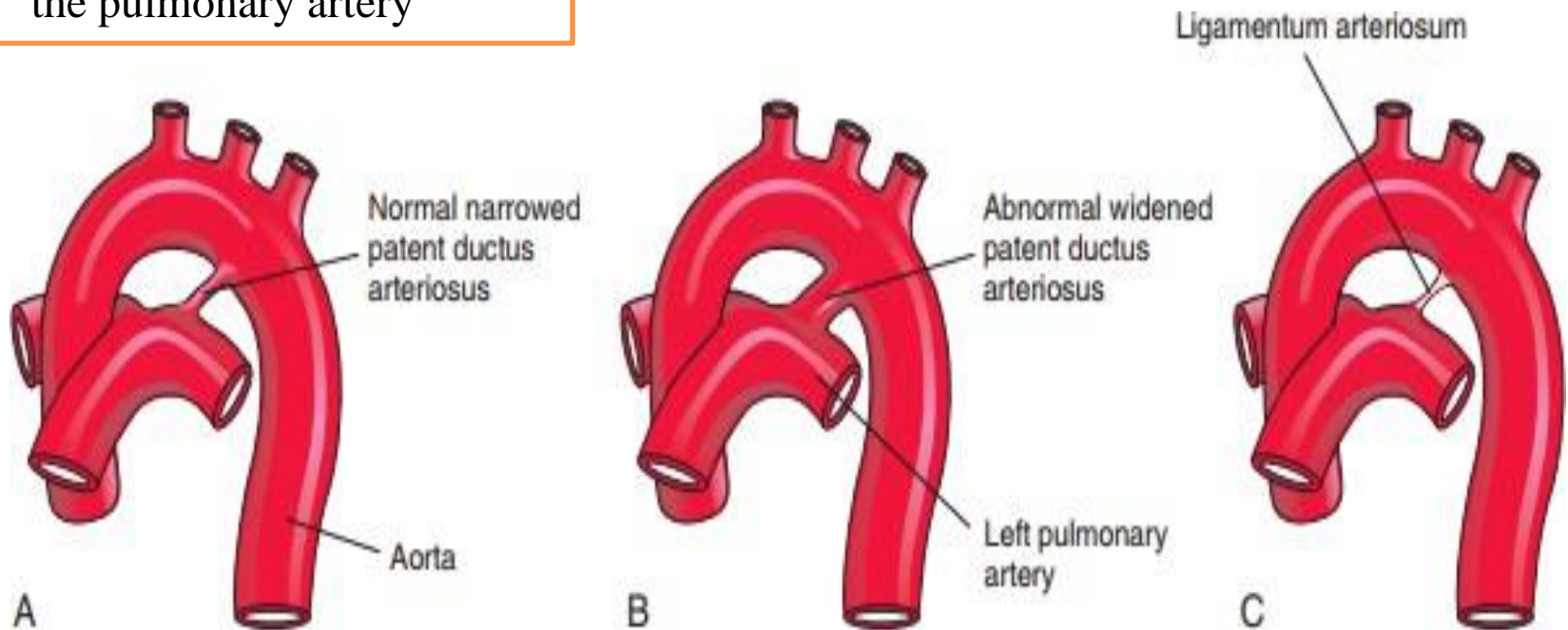
a common birth defect, occurs two to three times more frequently in females than in males

Functional closure of the PDA usually occurs soon after birth;

however, if it remains patent (open), aortic blood is shunted into the pulmonary artery

PDA is the most common birth defect associated with **maternal rubella infection during early pregnancy**. **Preterm neonates** and those born at high altitude may have PDA; this patency is the result of hypoxia (**decrease of oxygen**) and immaturity.

The embryologic basis of PDA is failure of the DA to involute after birth and form the ligamentum arteriosum



**Figure 14-34** Closure of the ductus arteriosus (DA). **A**, The DA of a neonate. **B**, Abnormal patent DA in a 6-month-old infant. **C**, The ligamentum arteriosum in a 6-month-old infant.

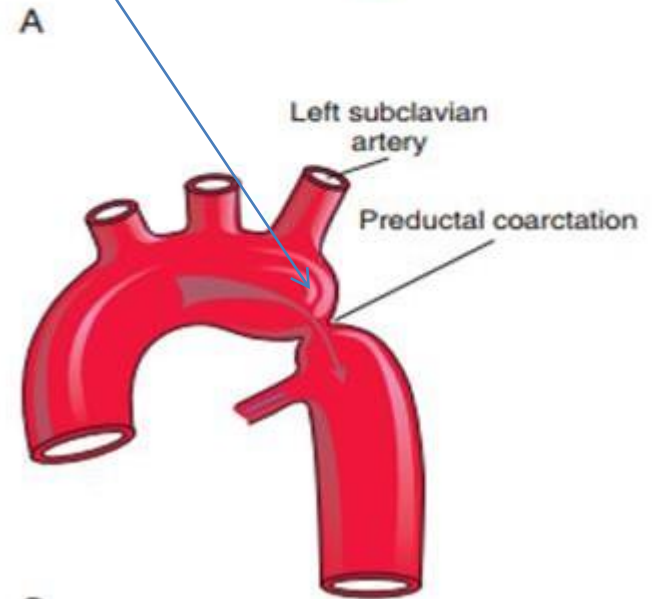
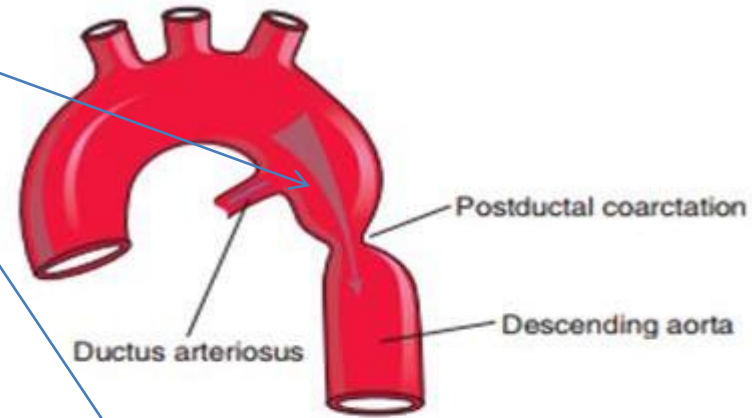
# Coarctation of the aorta

❖ is a congenital narrowing of the aorta just ***proximal, opposite, or distal*** to the **site of attachment of the ligamentum arteriosum..**

❖ However, most constrictions occur distal to the origin of the left subclavian artery, at the entrance of the DA (**juxtaductal coarctation**).

❖ occurs in approximately 10% of children with CHDs.

A classification system of preductal and postductal coarctations is commonly used; however, in 90% of cases, the coarctation is directly opposite the DA. Coarctation occurs two times as often in males as in females,



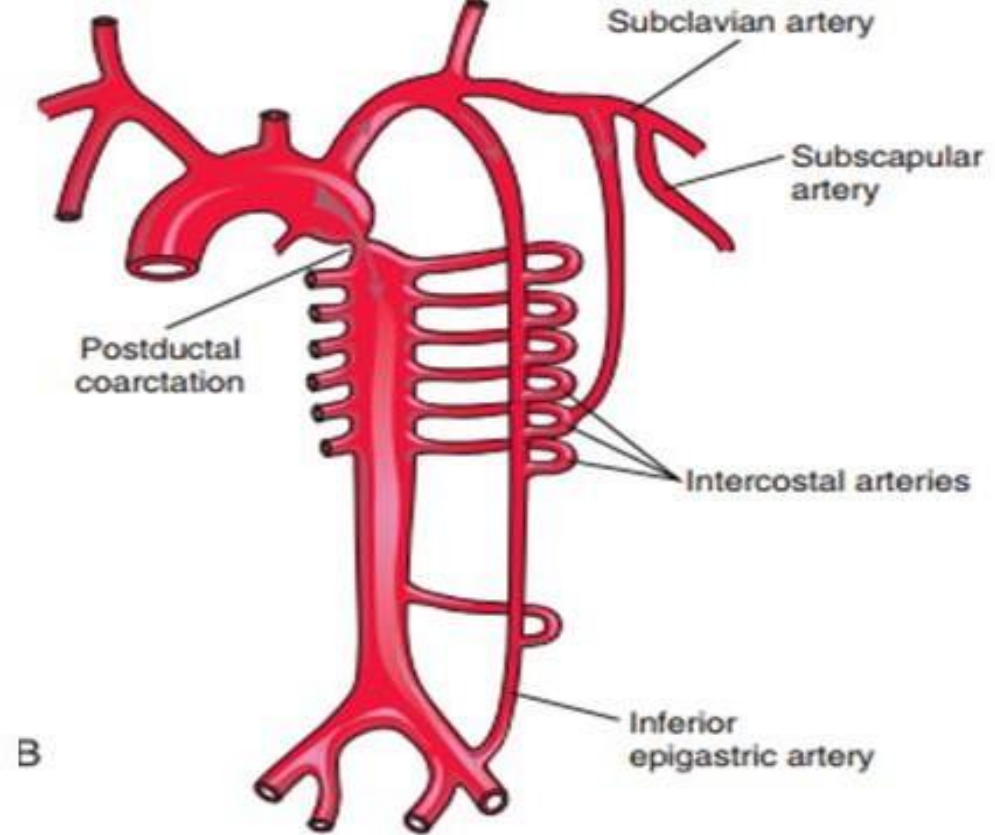


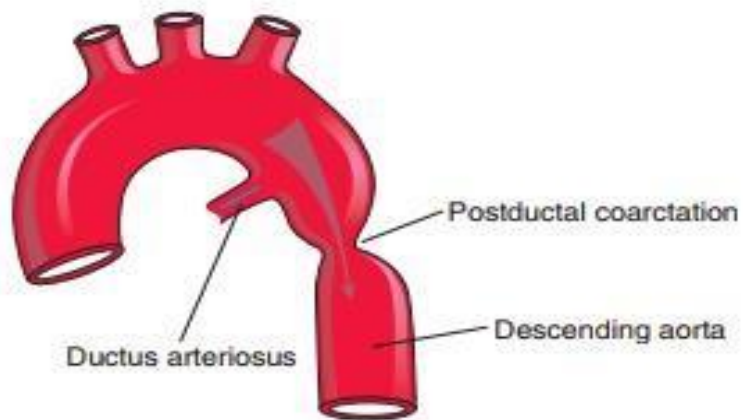
Cause: this condition is believed to result from an unusual quantity of ductus arteriosus muscle tissue in the wall of the aorta.

When the ductus arteriosus contracts, the ductal muscle in the aortic wall also contracts, and the aortic lumen becomes narrowed. Later, when fibrosis takes place, the aortic wall also is involved, and permanent narrowing occurs

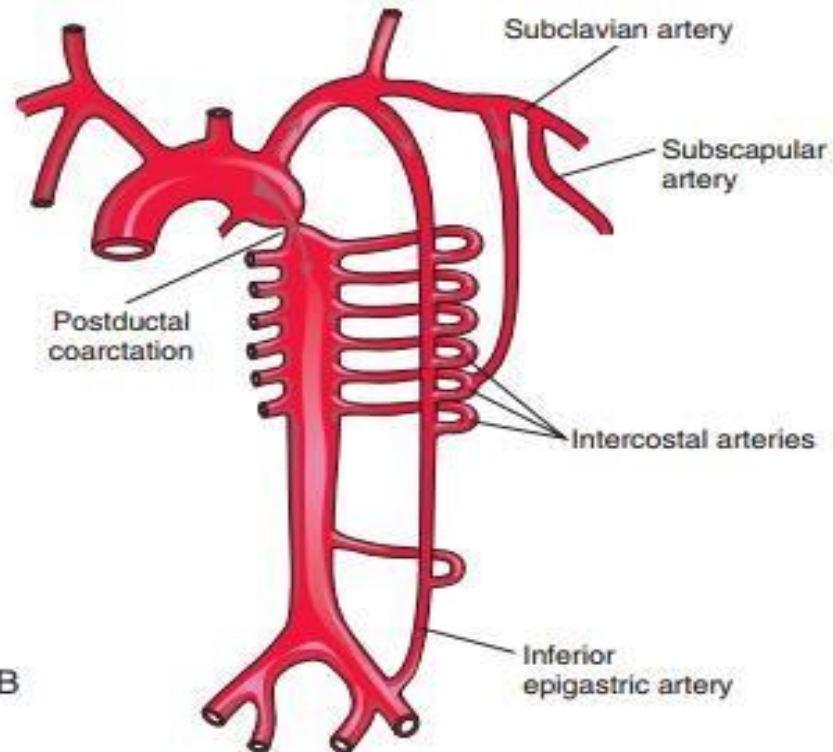
Clinically, the cardinal sign of aortic coarctation is **absent or diminished pulses in the femoral arteries of both lower limbs.**

To compensate for the diminished volume of blood reaching the lower part of the body, an enormous **collateral circulation develops, with dilatation of the internal thoracic, subclavian, and posterior intercostal arteries.** The dilated intercostal arteries erode the lower borders of the ribs, producing characteristic notching, which is seen on radiographic examination. The condition should be treated surgically

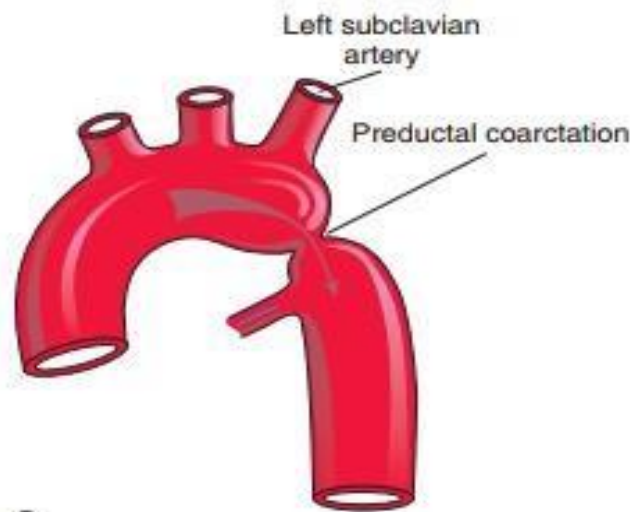




A



B



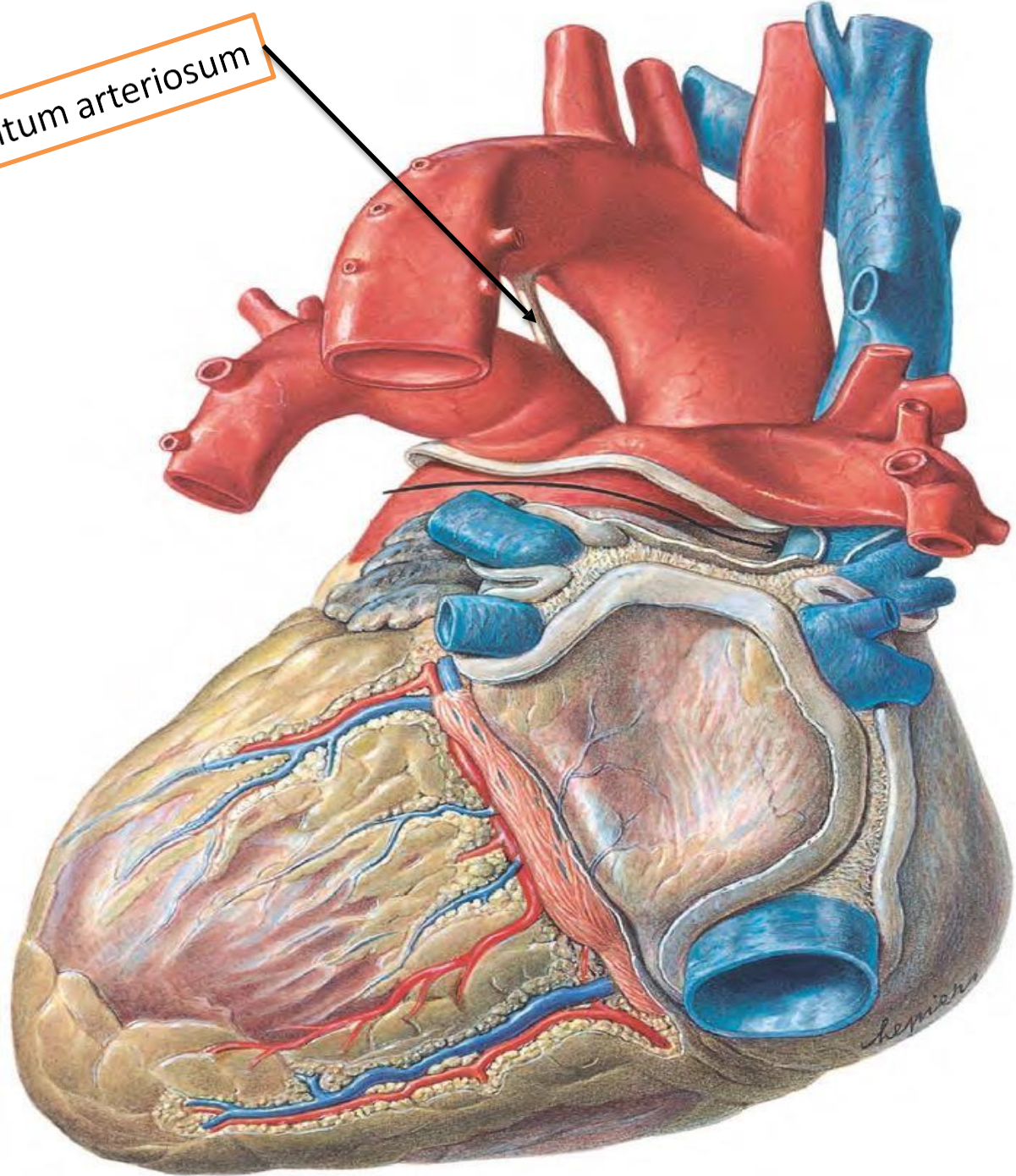
C



D

**Figure 14-28** A, Postductal coarctation of the aorta. B, Common routes of the collateral circulation that develop in association with postductal coarctation of the aorta. C, Preductal coarctation. Arrows indicate flow of blood. D, Preductal coarctation (arrow) in the aorta in an adult.

Ligamentum arteriosum



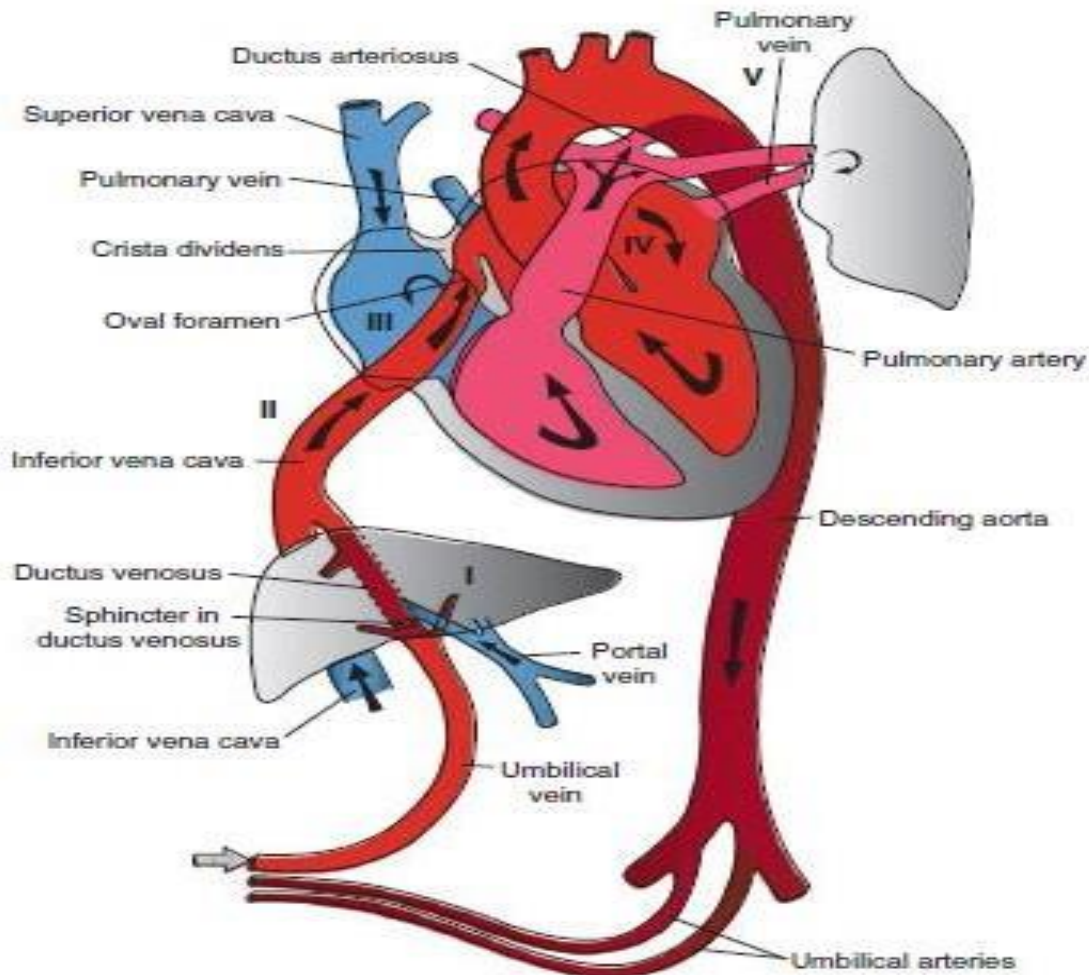
# FETAL CIRCULATION

## Arterial systems associated with the fetal heart

During fetal circulation,

- oxygenated blood flow from the placenta to the fetus passes through *the umbilical vein*.
- Three vascular shunts develop in the fetal circulation to bypass blood flow around the liver and lungs
- **The ductus venosus** allows oxygenated blood in the umbilical vein to bypass the sinusoids of the liver into the inferior vena cava and to the right atrium.
- From the right atrium, oxygenated blood flows mostly through the **foramen ovale** into the left atrium then left ventricle and into the systemic circulation.
  - The foramen ovale develops during atrial septation to allow oxygenated blood to bypass the pulmonary circulation. Note that this is a right-to-left shunting of blood during fetal life.
- During fetal circulation, the superior vena cava drains deoxygenated blood from the upper limbs and head into the right atrium. Most of this blood flow is directed into the right ventricle and into the pulmonary trunk.
- **The ductus arteriosus** opens into the underside of the aorta just distal to the origin of the left subclavian artery and shunts this deoxygenated blood from the pulmonary trunk to the aorta to bypass the pulmonary circulation

# fetal circulation



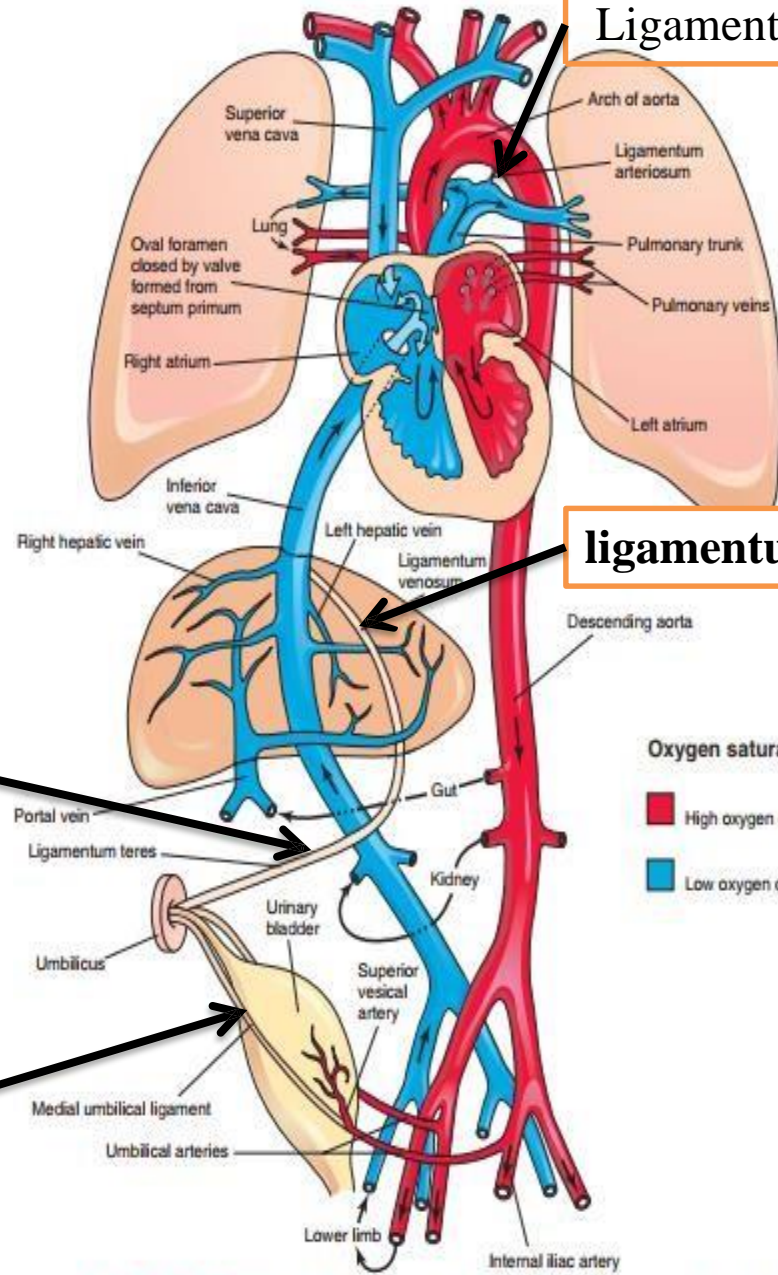
**Figure 13.49** Fetal circulation before birth. Arrows, direction of blood flow. Note where oxygenated blood mixes with deoxygenated blood in: the liver (I), the inferior vena cava (II), the right atrium (III), the left atrium (IV), and at the entrance of the ductus arteriosus into the descending aorta (V).

# Circulatory Changes at Birth

- **During prenatal life, the** placental circulation provides the fetus with its oxygen, but after birth, the lungs take on gas exchange.
- In the circulatory system, the following changes take place at birth and in the first postnatal months:
  - (1) the ductus arteriosus closes
  - (2) the oval foramen closes
  - (3) the umbilical vein and ductus venosus close and remain as the **ligamentum teres hepatis and ligamentum venosum**
  - (4) **the umbilical arteries form the medial umbilical ligaments.**



Ligamentum arteriosum



ligamentum venosum

ligamentum teres hepatis

the umbilical arteries form the medial umbilical ligaments.

**Figure 14-33** Neonatal circulation. The adult derivatives of the fetal vessels and structures that become nonfunctional at birth are shown. The arrows indicate the course of the blood in the infant. The organs are not drawn to scale. After birth, the three fetal shunts cease to function, and the pulmonary and systemic circulations become separated.

The End  
Thank you