AORTIC ARCH SYSTEM

The major arteries in an early embryo are represented by a pair of vessels

THE DORSAL AORTAE,

which run with the long axis of the embryo and form the continuation of the endocardial heart tubes.

The cranial portion of each dorsal aorta forms an arc on both sides of the foregut, thus establishing the first pair of aortic arch arteries, termed aortic arches

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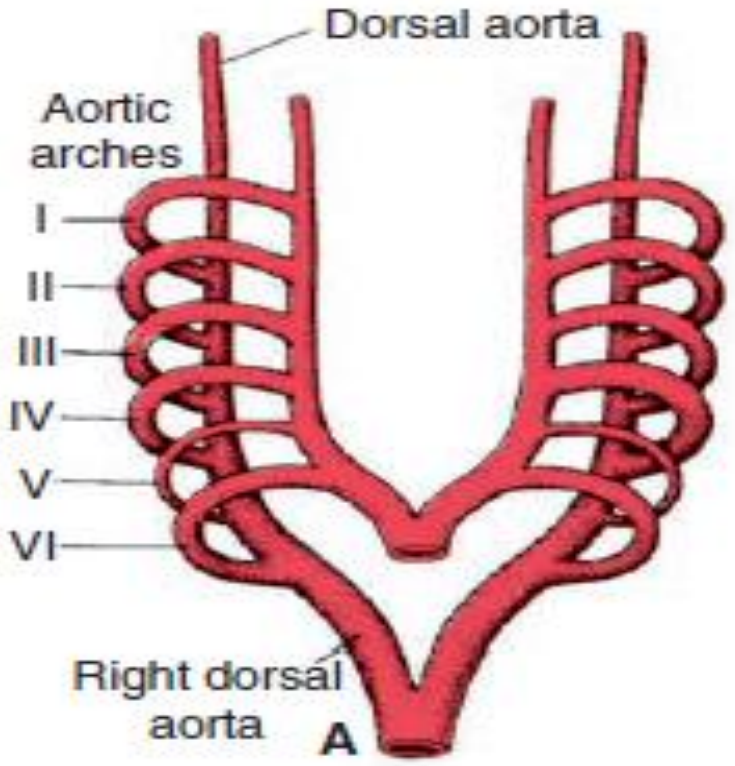
Arterial System

- ***Aortic Arches***
- they run within branchial (pharyngeal) arches
- These arteries, the **aortic arches, arise from the aortic sac, the most distal** part of **the truncus arteriosus .**
- The aortic sac, giving rise to a total of five pairs of arteries.
- The pharyngeal arches and their vessels appear in a cranial-to-caudal sequence, so that they are not all present simultaneously.
- Consequently, the five arches are numbered I, II, III, IV, and VI .
- *During further development,* this arterial pattern becomes modified, and some vessels regress completely.



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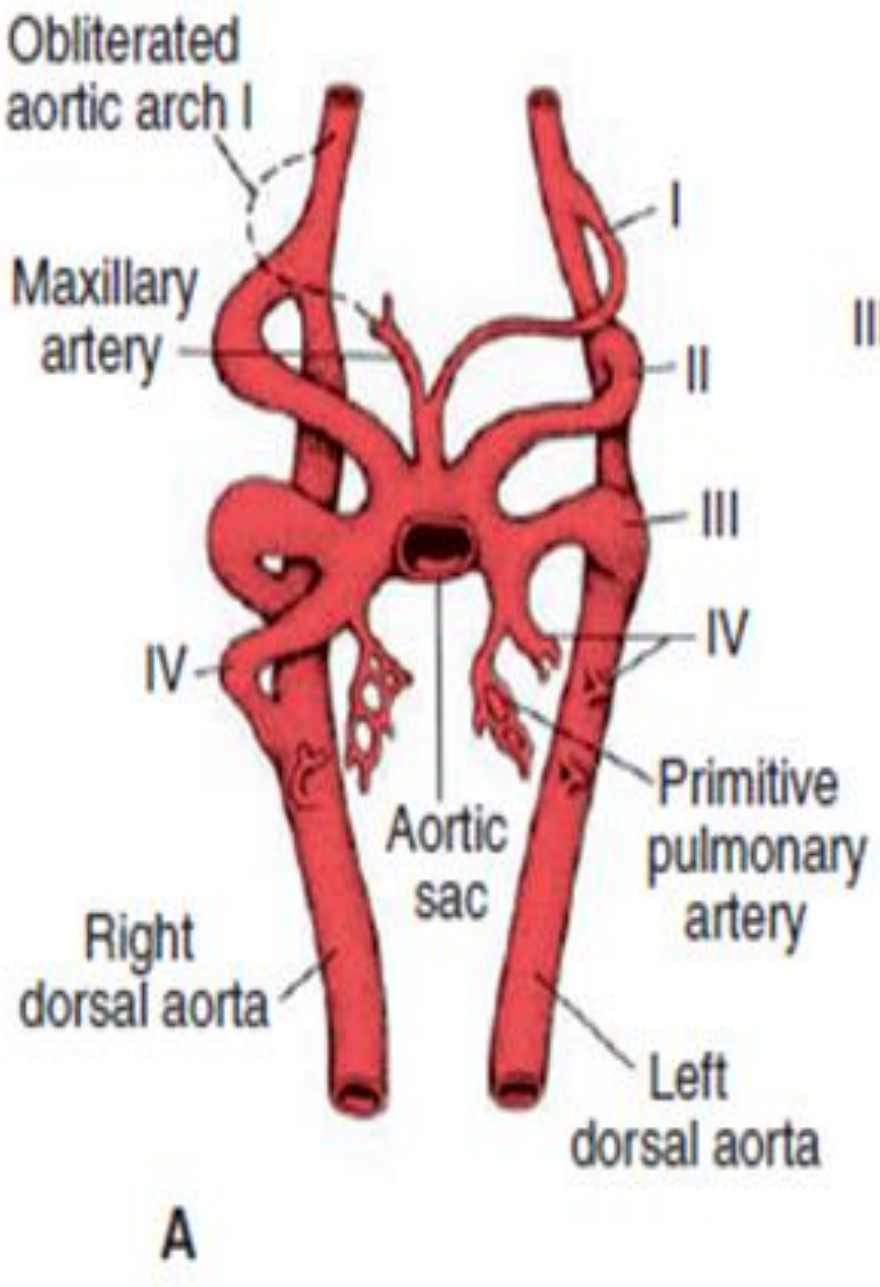
- Division of the **truncus arteriosus** by the **aorticopulmonary** septum divides the outflow channel of the heart into the **ventral aorta and the pulmonary trunk.**

The aortic sac then forms right and left horns, which subsequently give rise to
the **brachiocephalic artery and the proximal segment of** the **aortic arch, respectively .**



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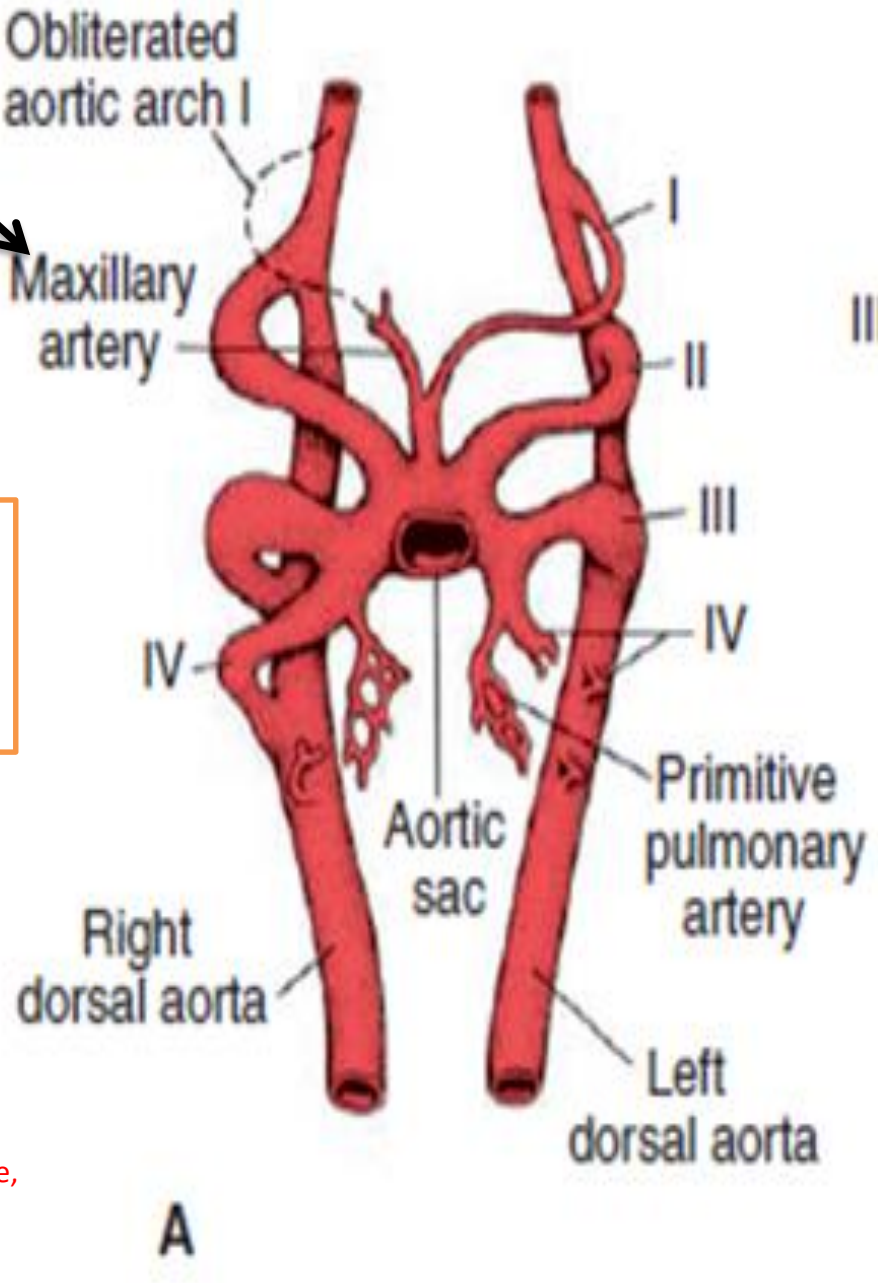
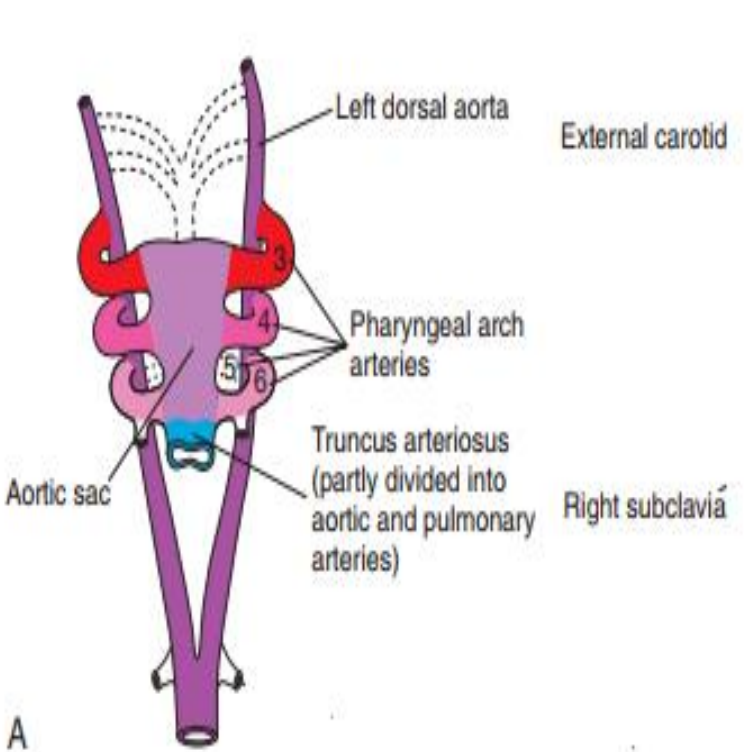
The first pair of arteries largely disappears but remnants of them form **part of the maxillary arteries,** which supply the ears, teeth, and muscles of the eyes and face

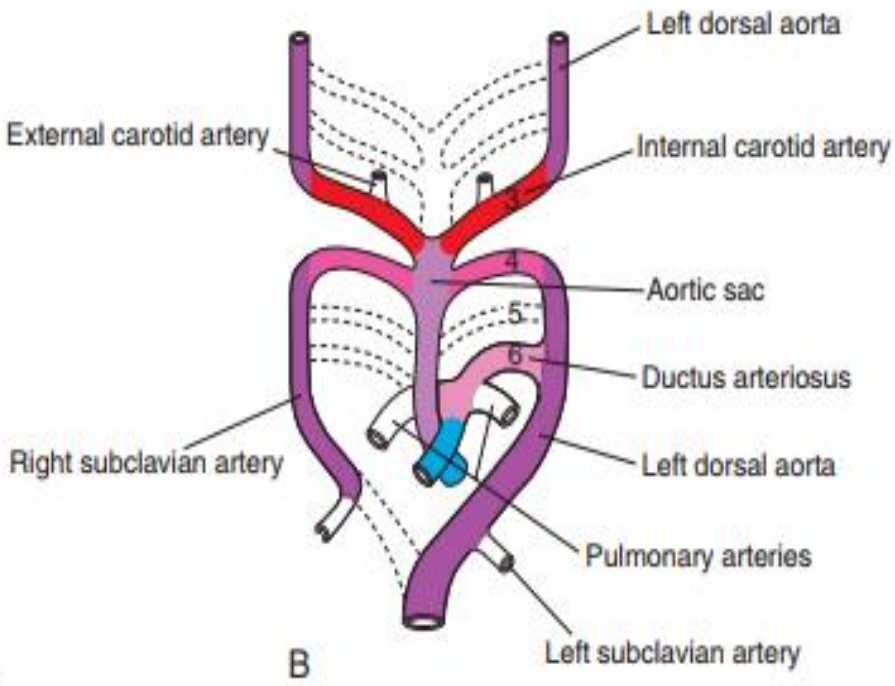
Derivatives of Second Pair of Pharyngeal Arch Arteries

Dorsal parts of these arteries persist and form the stems of **the small stapedial arteries**; these small vessels run through the ring of the stapes, a small bone in the middle ear



Derivatives of Third Pair of Pharyngeal Arch Arteries



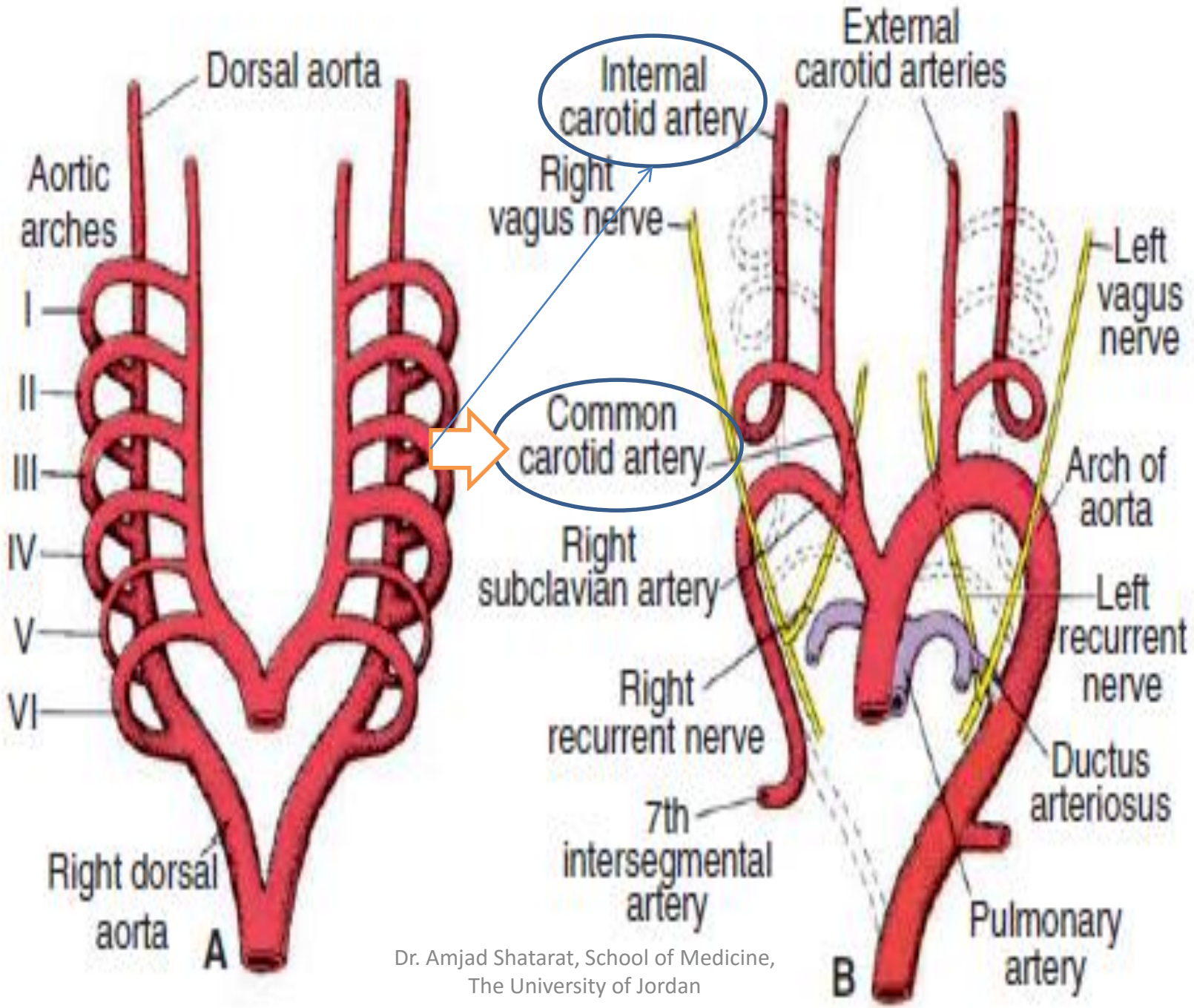


<u>Proximal parts</u> of these arteries form

THE COMMON CAROTID ARTERIES

<u>Distal parts</u> of these arteries join with **<u>the dorsal aortae</u>** to form

THE INTERNAL CAROTID ARTERIES

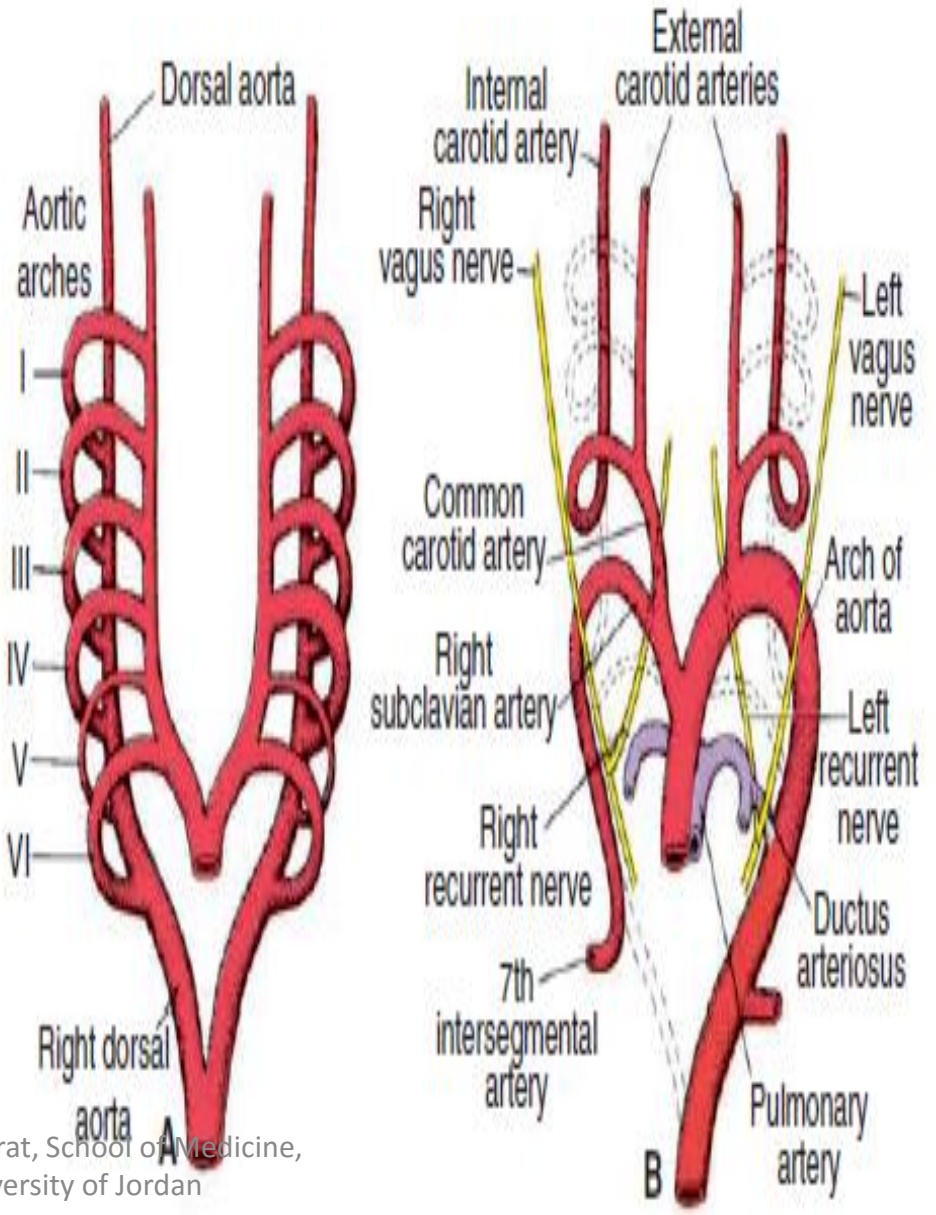

Dorsal aorta
Aortic arches
I
II
III
IV
V
VI
Right dorsal aorta
A
Internal carotid artery
External carotid arteries
Right vagus nerve
Left vagus nerve
Common carotid artery
Arch of aorta
Right subclavian artery
Left recurrent nerve
Right recurrent nerve
Ductus arteriosus
7th intersegmental artery
Pulmonary artery
B

Derivatives of Fourth Pair of Pharyngeal Arch

- The fourth aortic arch persists on both sides, but its ultimate fate is different on the right and left sides.

On the left, it forms **part of the arch of the aorta**, between the left common carotid and the left subclavian arteries.

On the right, it forms the most proximal segment of **the right subclavian artery**, the distal part of which is formed by a portion of the right dorsal aorta and the seventh intersegmental artery .

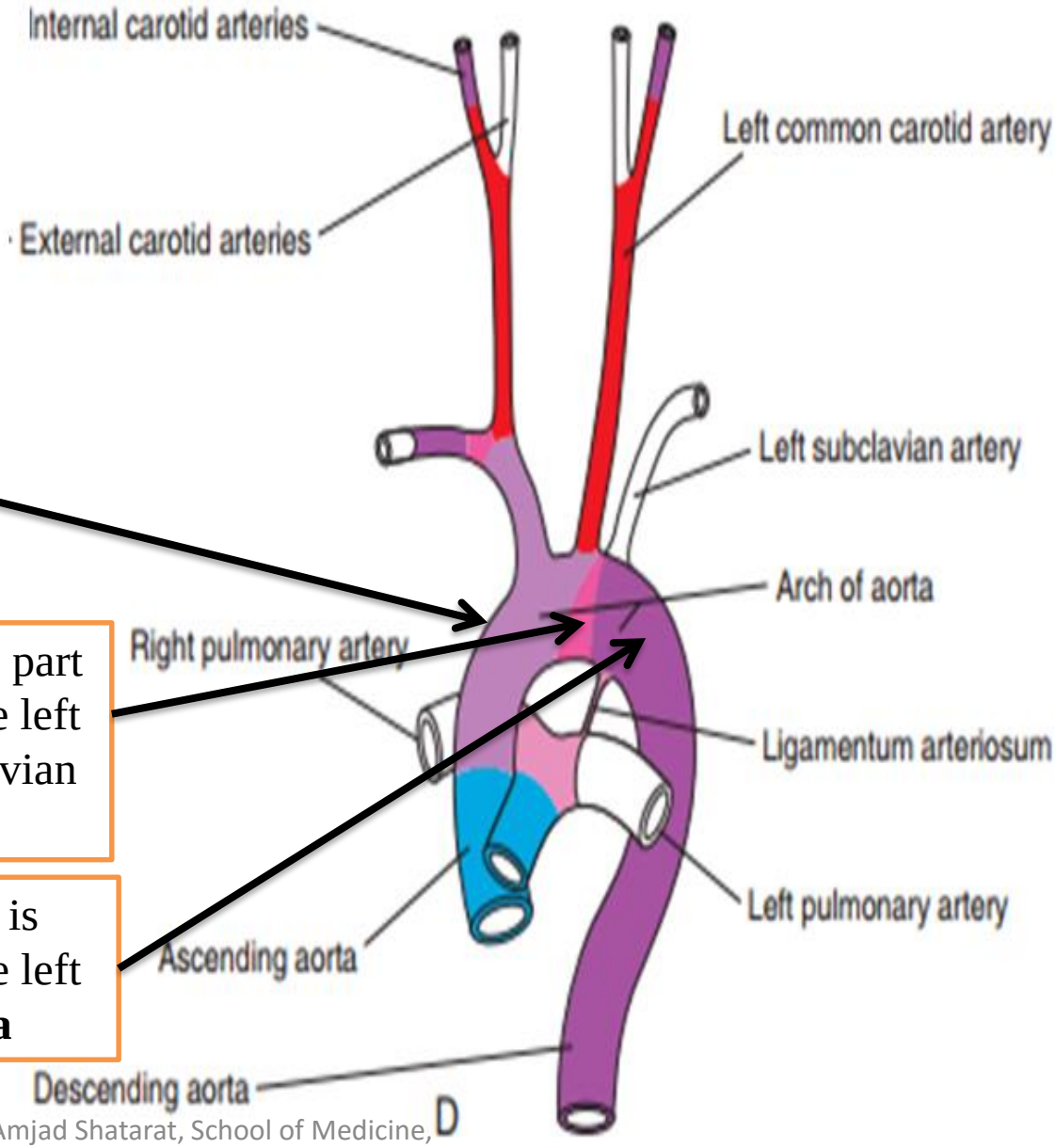


ARCH of the Aorta

1-The proximal part of the arch artery develops **from the aortic sac**

2- **left fourth aortic arch** , it forms part of the arch of the aorta, between the left common carotid and the left subclavian arteries.

the distal part is derived from the left **dorsal aorta**



The **fifth aortic arch either never forms or forms incompletely** and then **regresses**.

The **sixth aortic arch**

also known as the pulmonary arch, gives off an important branch that grows toward the developing lung bud .

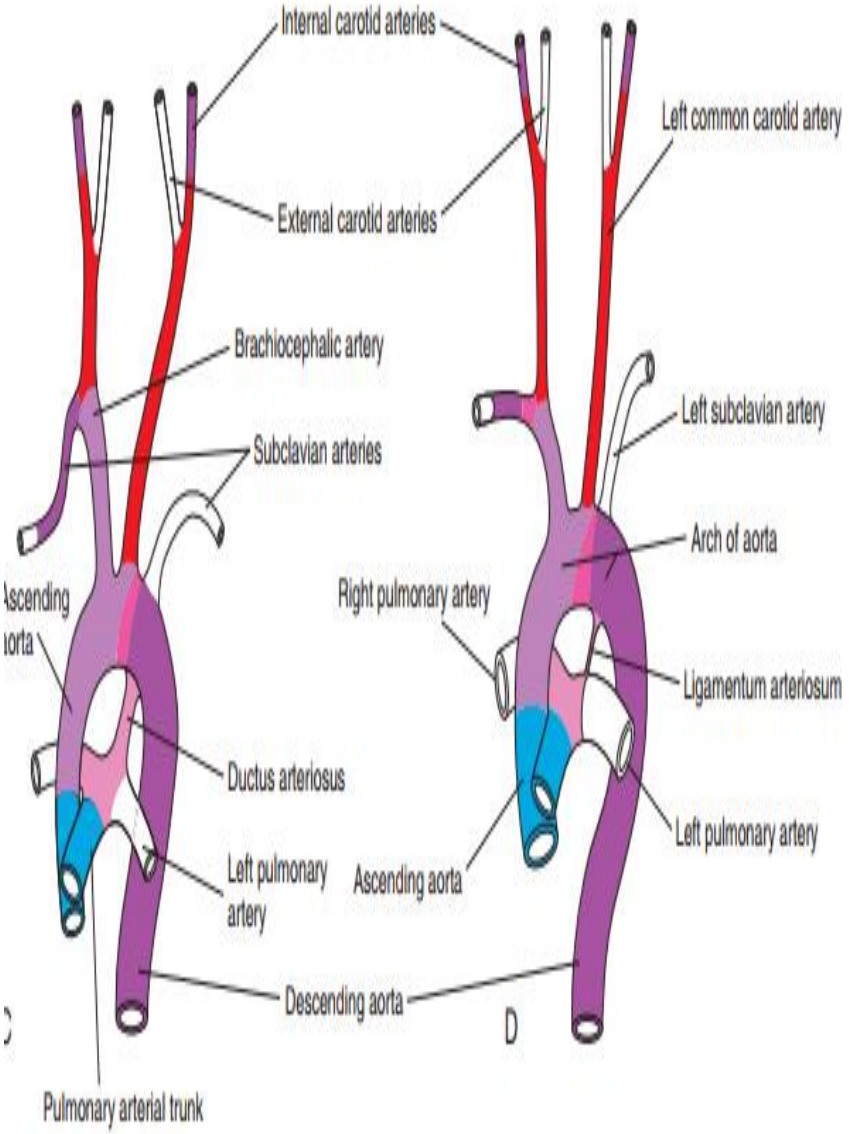
*On **the right side**, the **proximal*** **part** becomes the proximal segment of the **right pulmonary artery**.

The **distal portion** of this arch loses its connection with the dorsal aorta and **disappears**.

On **the left**, the distal part **persists** during intrauterine life as

THE DUCTUS ARTERIOSUS

The proximal part of the artery persists as the proximal part of the left pulmonary artery.



Arch	Arterial Derivative
1	Maxillary arteries
2	Hyoid and stapedial arteries
3	Common carotid and first part of the internal carotid arteries[a]
4 Left side	Arch of the aorta from the left common carotid to the left subclavian arteries[b]
Right side	Right subclavian artery (proximal portion)[c]
6 Left side	Left pulmonary artery and ductus arteriosus
Right side	Right pulmonary artery

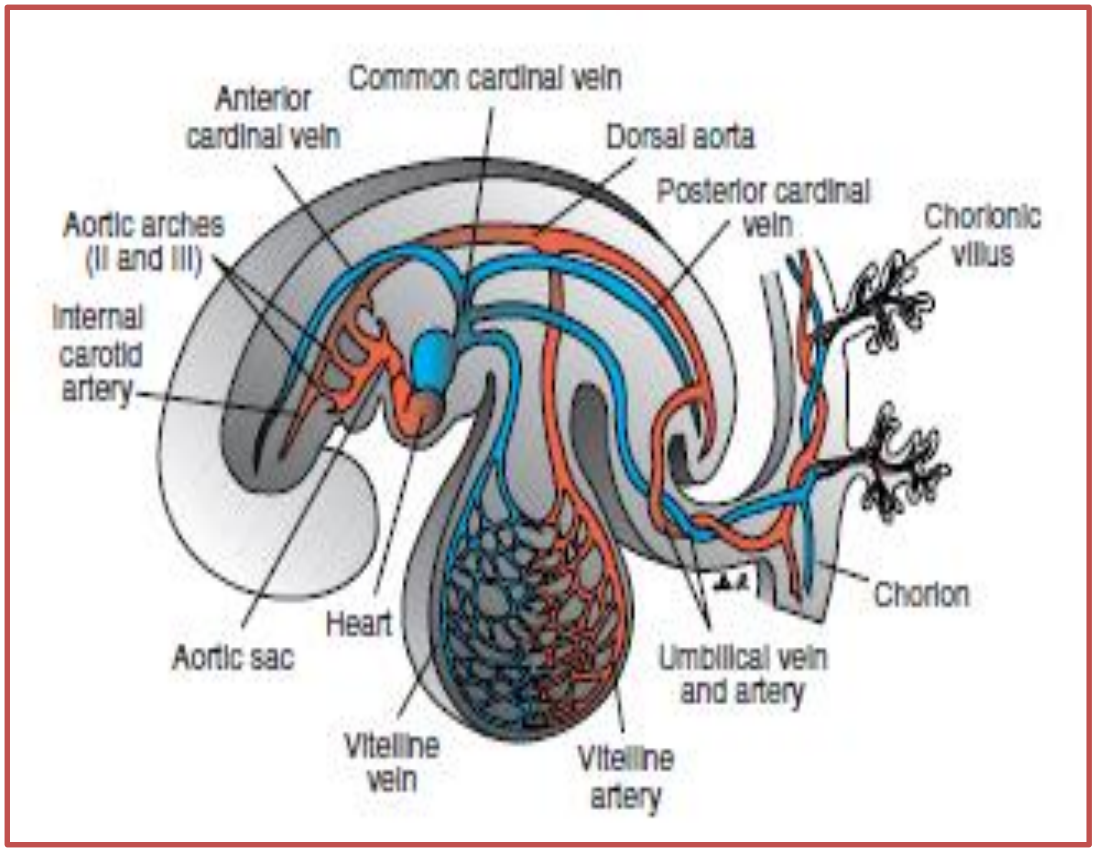
- The vitelline arteries, initially a number of paired vessels supplying the yolk sac

- gradually fuse and form the arteries in the dorsal mesentery of the gut

- In the adult, they are represented by the ***celiac and superior mesenteric, arteries***.

- The inferior mesenteric arteries are derived ***from the umbilical arteries***.

Vitelline and Umbilical Arteries



- These 3 vessels supply derivatives of

the foregut, midgut, and hindgut, respectively

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The **umbilical arteries**

- The umbilical arteries, initially paired ventral branches of the dorsal aorta,
- course to the placenta in close association with the allantois .
- During the fourth week, each artery acquires a secondary connection with the dorsal branch of the aorta, the common iliac artery, and loses its earliest origin.

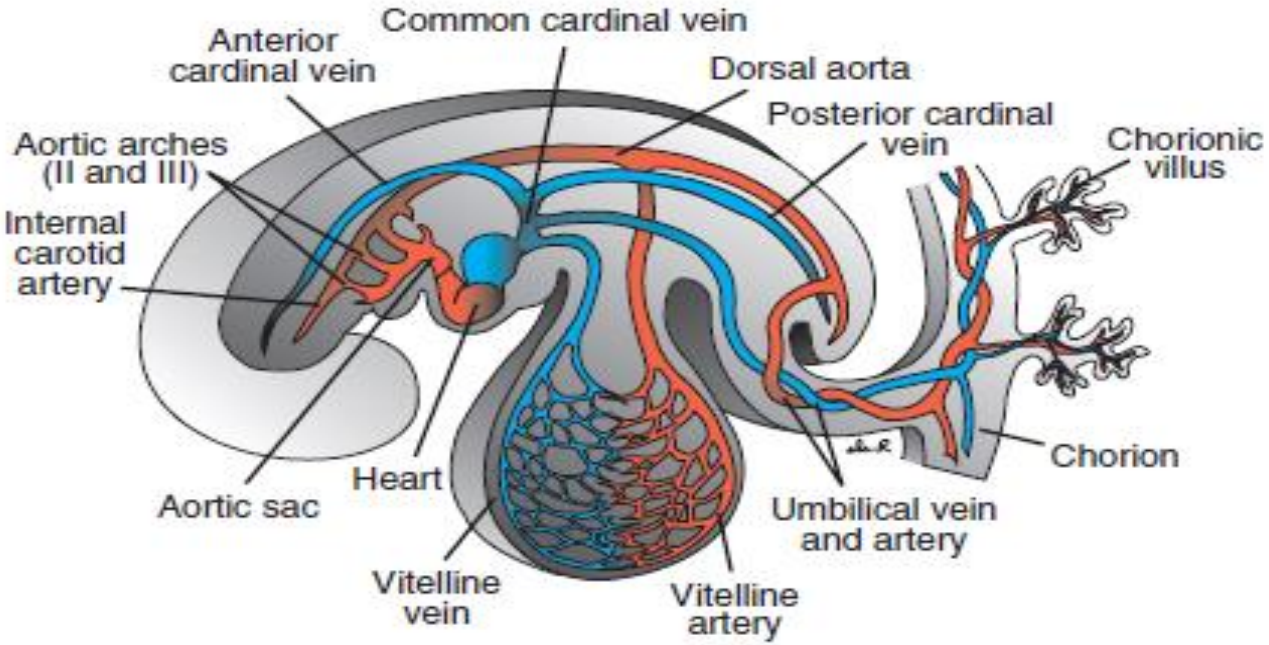

Figure 13.35 Main intraembryonic and extraembryonic arteries (*red*) and veins (*blue*) in a 4-mm embryo (end of the fourth week). Only the vessels on the left side of the embryo are shown.

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

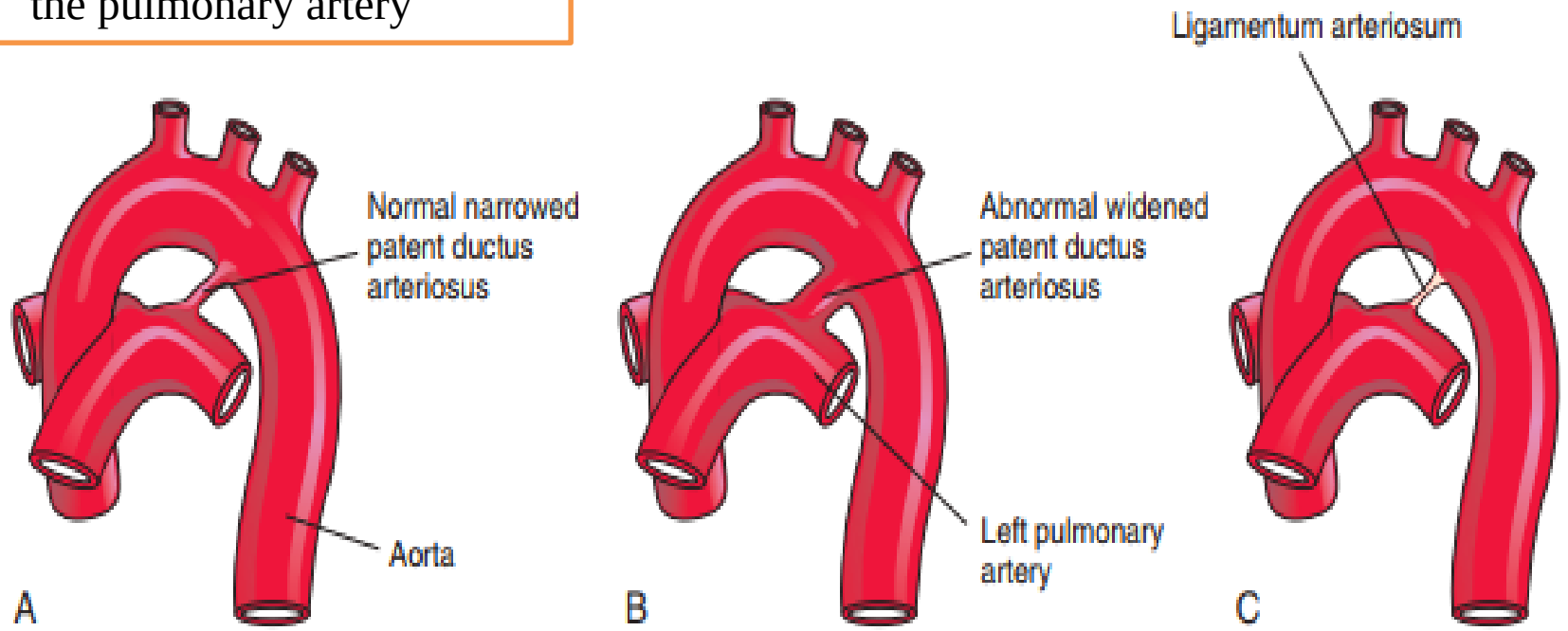

Figure 14–34 Closure of the ductus arteriosus (DA). A, The DA of a neonate. B, Abnormal patent DA in a 6-month-old infant. C, The ligamentum arteriosum in a 6-month-old infant.

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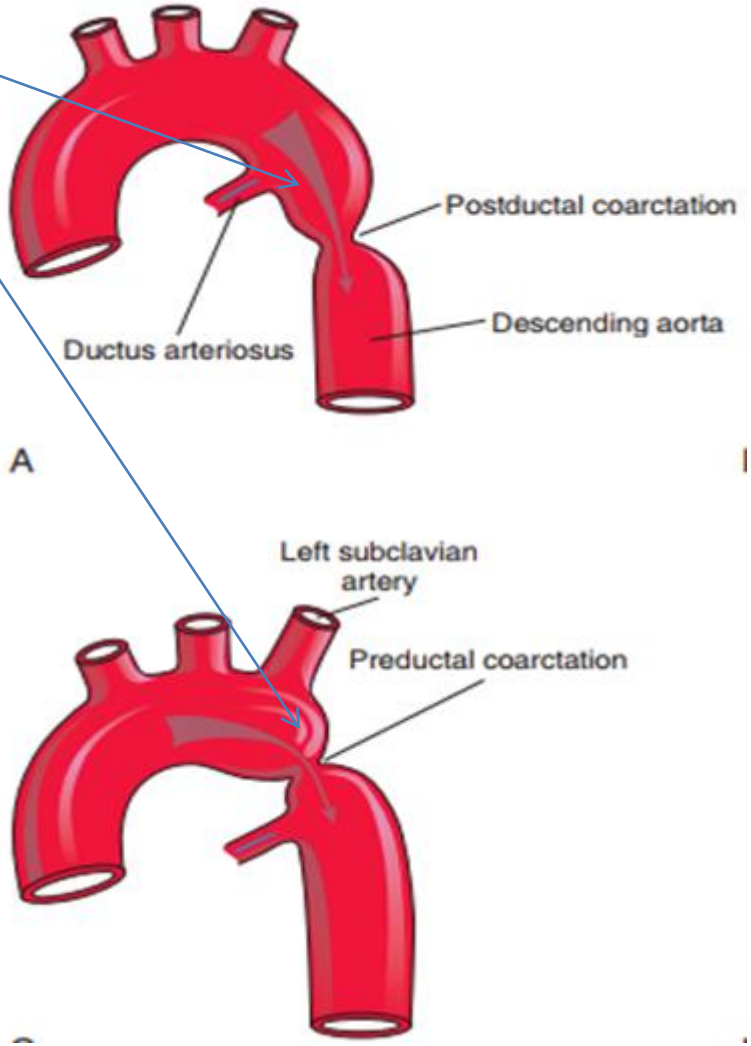
Coarctation of the aorta

❖ 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,

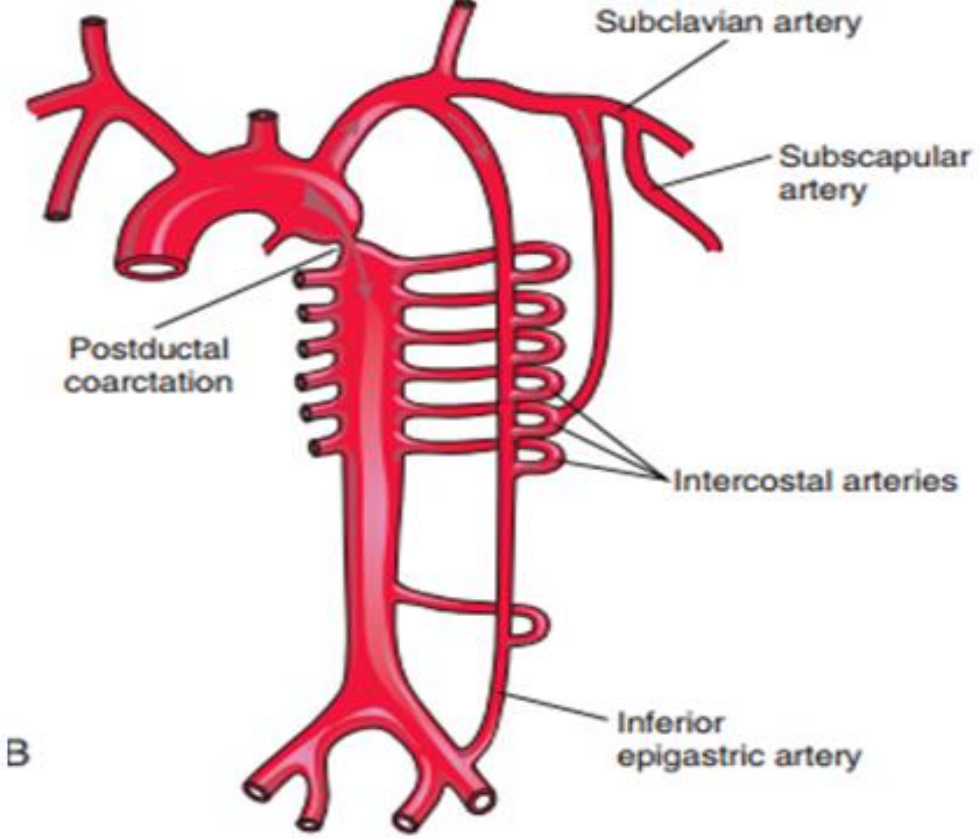


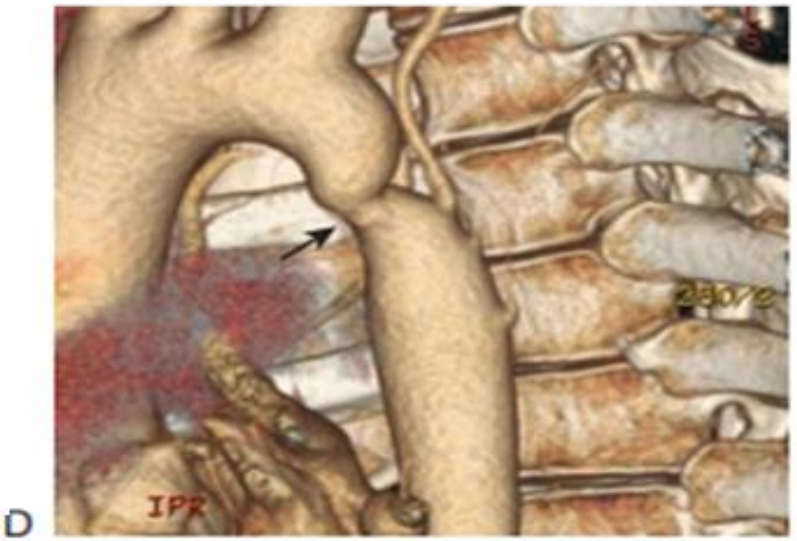
Cause: this condition is believed to result from an unusual quantity of ductus arteriosus muscle tissue in the wall of the aorta.

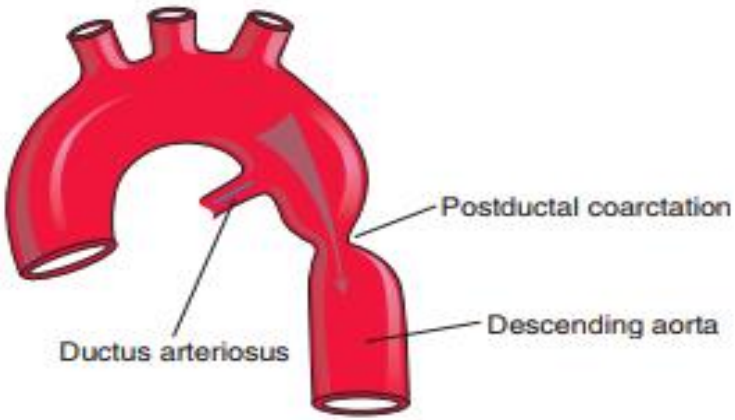
When the ductus arteriosus contracts, the ductal muscle in the aortic wall also contracts, and the aortic lumen becomes narrowed. Later, when fibrosis takes place, the aortic wall also is involved, and permanent narrowing occurs

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

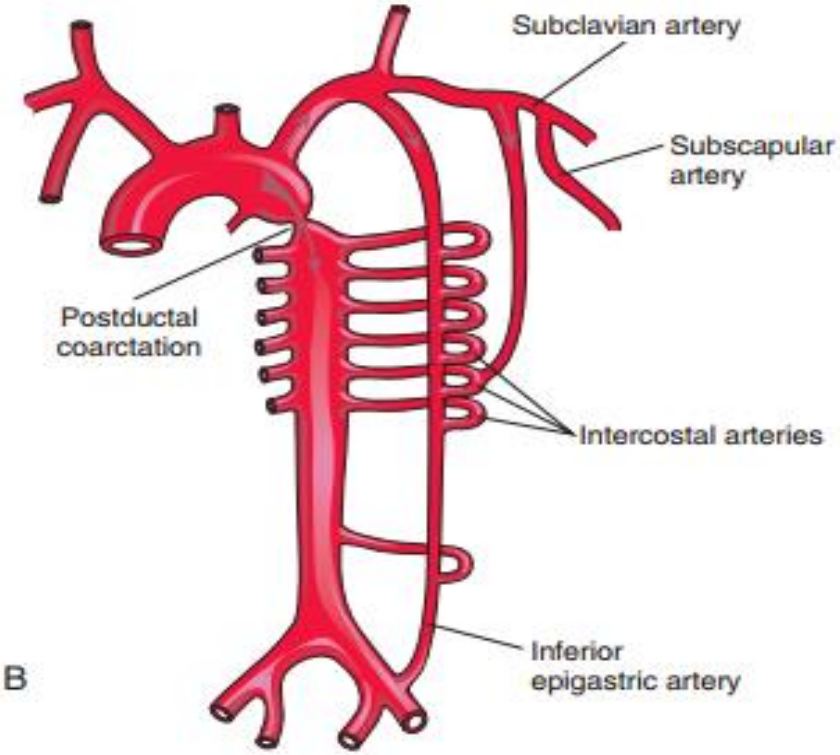
To compensate for the diminished volume of blood reaching the lower part of the body, an enormous **collateral circulation develops, with dilatation of the internal thoracic, subclavian, and posterior intercostal arteries.** The dilated intercostal arteries erode the lower borders of the ribs, producing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







A



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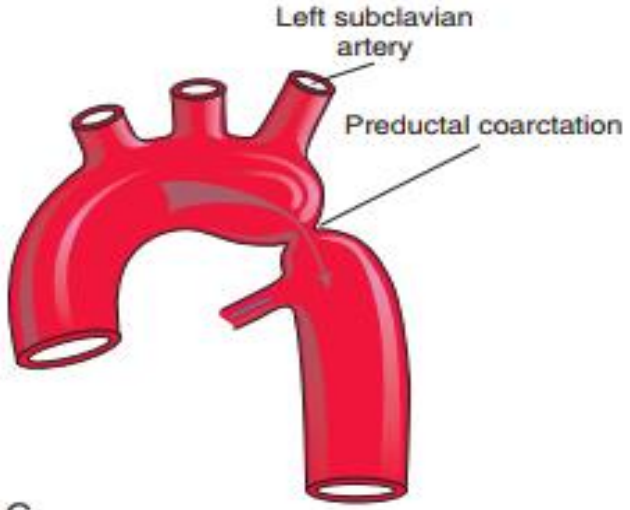
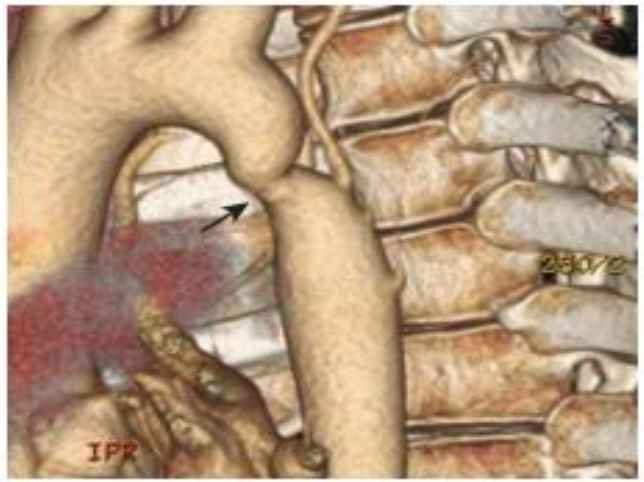
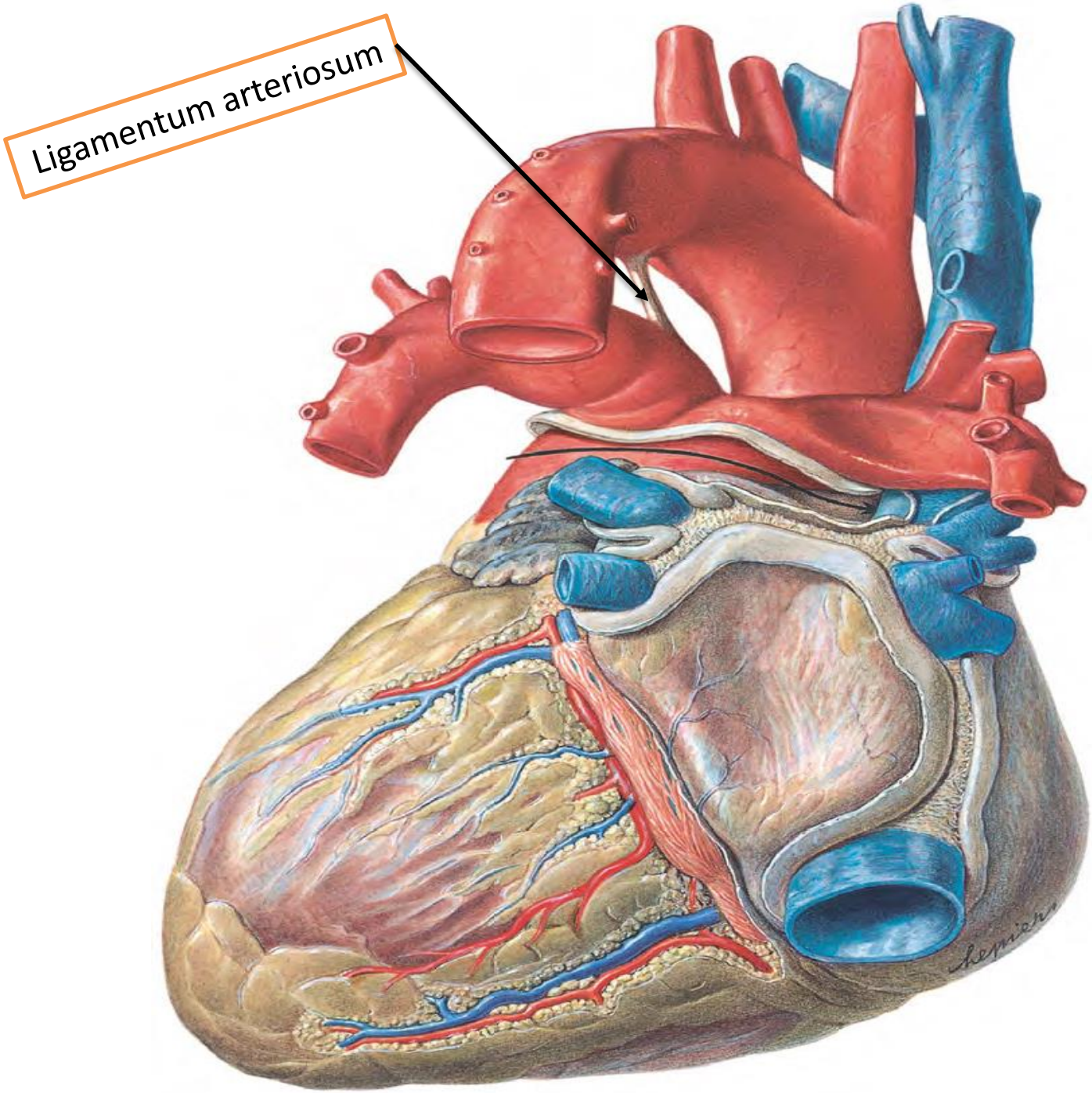


C



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 flood 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-toleft 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

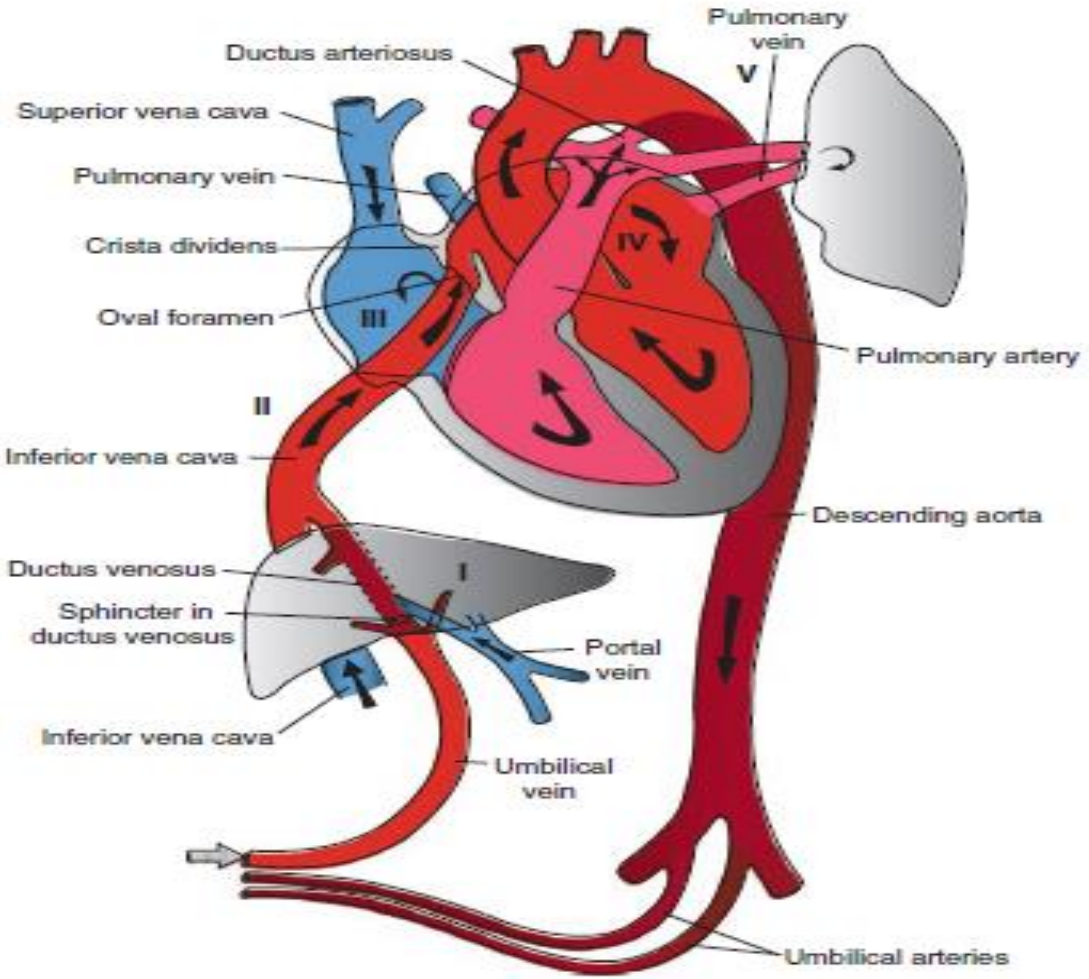


Figure 13.49 Fetal circulation before birth. *Arrows*, direction of blood flow. Note where oxygenated blood mixes with deoxygenated blood in: the liver (*I*), the inferior vena cava (*II*), the right atrium (*III*), the left atrium (*IV*), and at the entrance of the ductus arteriosus into the descending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

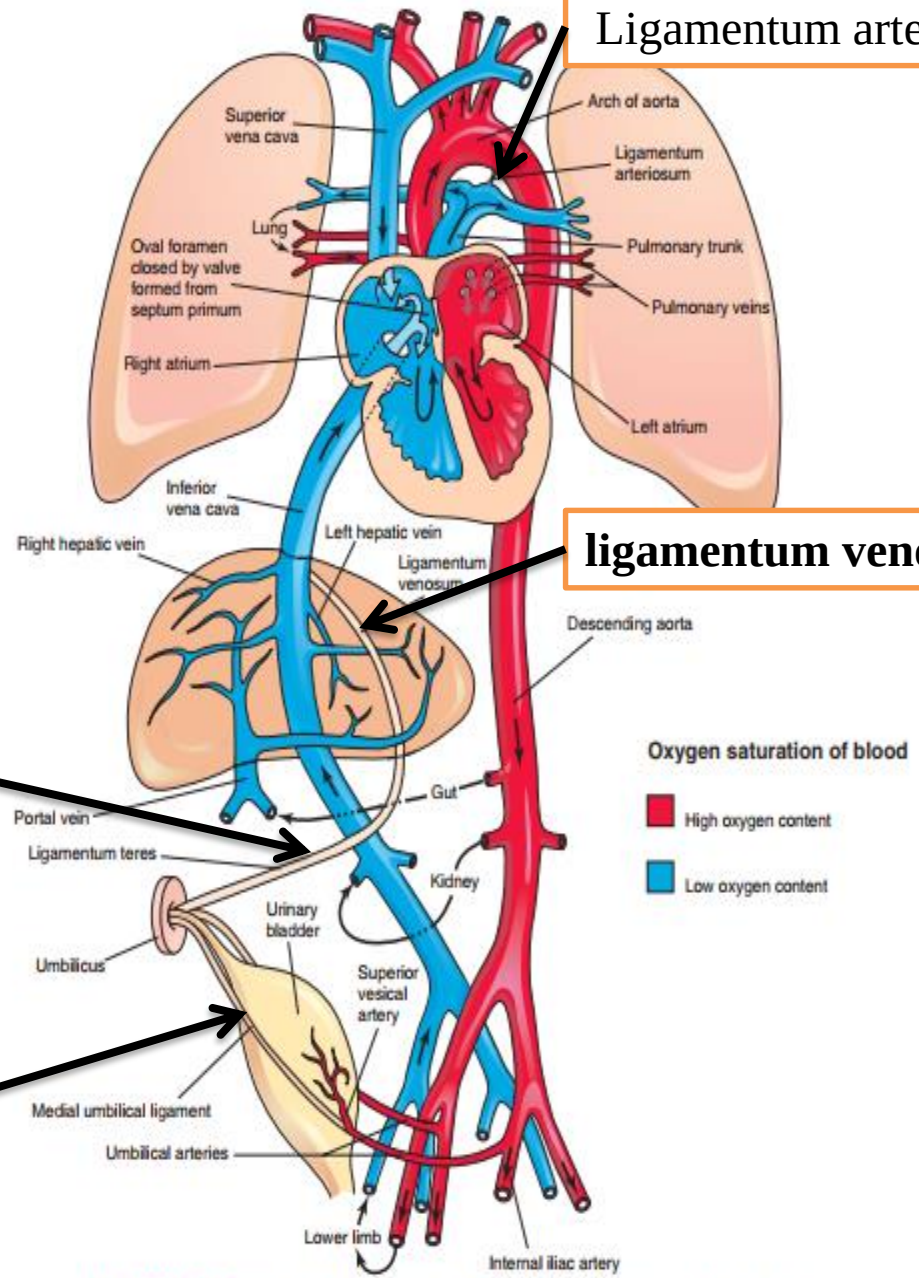


Figure 14–33 Neonatal circulation. The adult derivatives of the fetal vessels and structures that become nonfunctional at birth are shown. The arrows indicate the course of the blood in the infant. The organs are not drawn to scale. After birth, the three fetal shunts cease to function, and the pulmonary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

ligamentum venosum

ligamentum teres hepatis

the umbilical arteries form the **medial umbilical ligaments.**

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انتهى بحمد الله

The End
Thank you