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## **Objectives**

- Describe formation of aortic arches.
- Describe formation of vitelline and umbilical arteries.
- Describe formation of coronary arteries.
- Correlate this knowledge to clinical conditions.

# Aortic arches

**The pharyngeal arches:** It is formed during the 4<sup>th</sup> - 5<sup>th</sup> weeks of development.

- Each arch receives its own cranial nerve and artery.

**The aortic arches:** It arises from the aortic sac (the most distal part of the truncus arteriosus) and terminates in the right and left dorsal aortae.

- The aortic arches are embedded in the mesenchyme of the pharyngeal arches.

**The aortic sac:** It contributes a branch to each new pharyngeal arch so it is giving rise to total of 6 pairs of arteries.

- The 5<sup>th</sup> arch is not formed or incompletely formed and then regresses.

**The dorsal aortae:** It remains paired in the region of the arches but caudal to this region they fuse to form a single vessel.

**Fate of the aortic sac:** It forms right and left horns giving rise to:

- Brachiocephalic artery
- Proximal segment of the arch of aorta respectively.

**Fate of the aortic arches:**

- **The 1<sup>st</sup> aortic arch:** It disappeared and a small portion persists to form the maxillary artery.

- **The 2<sup>nd</sup> aortic arch:** It disappeared and a small portions persists to form the hyoid and stapelial arteries.

- **The 3<sup>rd</sup> aortic arch:** It forms the common carotid, external carotid artery and the first part of internal carotid artery.

- The remaining part of the internal carotid is formed by the cranial portion of dorsal aorta.

- **The 4<sup>th</sup> aortic arch:** It persists on both sides but its fate is different on the right and left sides.

- **On the left side:** It forms part of the arch of the aorta (between the left

common carotid and the left subclavian arteries).

- **On the right side:** It forms the most proximal segment of the right subclavian artery while the distal part is formed by a portion of the right dorsal aorta and the 7<sup>th</sup> intersegmental artery.

- **The 5<sup>th</sup> aortic arch:** It is never formed or incompletely formed and then regresses.

- **The 6<sup>th</sup> aortic arch:** It is known as the pulmonary arch, it gives 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 side:** The proximal part form the left pulmonary artery and distal part persists during intrauterine life as the ductus arteriosus.

**Other changes occurs in the aortic arches:**

**1. The dorsal aorta** between the 3<sup>rd</sup> and 4<sup>th</sup> arches is obliterated.

**2. The right dorsal aorta** between the 7<sup>th</sup> intersegmental artery and the junction with the left dorsal aorta disappears.

**3. Growth of the forebrain and elongation of the neck** pushing the heart into the thoracic cavity.

- The carotid, brachiocephalic arteries elongate and the left subclavian artery is fixed in the arm at the origin of the left common carotid artery.

**4. The course of the recurrent laryngeal nerves becomes different:**

- **On the right side:** The distal part of 5<sup>th</sup> and 6<sup>th</sup> aortic arch disappear so the nerve hooks around the right subclavian artery.

- **On the left side:** The 6<sup>th</sup> aortic arch persists so the nerve hooks around the arch of aorta.

## **Vitelline arteries**

- It is a number of paired vessels supplying the yolk sac and it is gradually fuses and form the arteries in the dorsal mesentery of the gut.

**Derivatives in adult:** They are represented by the **celiac and superior mesenteric arteries.**

- The inferior mesenteric artery is derived from the umbilical arteries.

- These 3 vessels supply derivatives of the foregut, midgut and hindgut respectively.

## **Umbilical arteries**

- They are paired branches of the dorsal aorta in the placenta.

- During the 4<sup>th</sup> week each artery is connected with the dorsal branch of aorta (common iliac artery) and loses its earliest origin.

**Derivatives:**

- The proximal part of the artery persist as **internal iliac and superior vesical arteries**

- The distal parts form the **medial umbilical ligaments**.

## **Coronary arteries**

- They are derived from two sources:

**1. Angioblasts:** It is formed from the sinus venosus that are distributed over the heart surface by cell migration.

**2. Epicardium:** Some epicardial cells undergo an epithelial to mesenchymal transition induced by the underlying myocardium.

- **The newly formed mesenchymal cells:**

Contribute to endothelial and smooth muscle cells of the coronary arteries.

- **Connection of the coronary arteries to the aorta:** It occurs by ingrowth of arterial endothelial cells from the arteries into the aorta.

## **Clinical applications**

**1. Patent ductus arteriosus:** It is one of the most frequent abnormalities.

- It is more common in pre mature.
- It may be single or with heart defects.

**2. Coarctation of the aorta:** It is congenital narrowing of the arch of aorta.

- It may be preductal or postductal (the most common type).

**3. Abnormal origin of the subclavian artery:**

- It occurs when the artery develops from distal portion of right dorsal aorta and 7<sup>th</sup> intersegmental artery.

**4. Double aortic arch:** The right dorsal aorta persist between the 7<sup>th</sup> intersegmental artery and its junction with the left dorsal aorta.

**5. Right aortic arch:** The left 4<sup>th</sup> aortic arch and left dorsal aorta are obliterated and replaced by corresponding vessels in the right side.