Quadrant II – Transcript and Related Materials

Programme: Bachelor of Science (Third Year)

Subject: Zoology

Course Code: ZOC 103

Course Title: Anatomy of animal body systems

Unit: Unit 5-Circulatory system

Module Name: Evolution of aortic arches in Vertebrates.

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Notes:

Development of aortic arches

When the heart is forming below the pharynx in the mid-ventral line, a blood vessel called ventral aorta also arises below the pharynx in the mid-ventral line. This ventral aorta grows backwards to join the conus of heart and also grows anteriorly and divides into two branches which course dorsally in the mandibular region and run backwards as paired dorsal aortae.

The paired dorsal aortae from both sides join in the mid-dorsal line to form the dorsal aorta proper. Subsequently a number of vessels arise connecting the ventral aorta and the paired dorsal aortae, each coursing between adjacent pharyngeal pouches just anterior to the visceral cleft. These connections are called aortic arches.

Embryonic aortic arches

During the embryonic stages, Six pairs of aortic arches develop in most gnathostomes and are named according to the name of the visceral clefts.

These are designated by roman numerals-I,II,III,IV,V and VI. The first aortic arch is named Mandibular arch.

The second aortic arch becomes hyoid arch. remainder called third, fourth, fifth & sixth aortic arches

The heart pumps blood into the aortic arches via the ventral aorta. These aortic arches carry blood to the lateral dorsal aortae, from where it goes either to the head region or to the posterior region through dorsal aorta.

M**odification of aortic arches in different vertebrates**

- The number of aortic arches is different in different adult vertebrates but they are built on the same fundamental plan in embryonic life.
- The differences in number of aortic arches are due to the complexity of heart circulation in the mode of living from aquatic (gill) to terrestrial (lung) respiration.
- There is a progressive reduction of aortic arches in the vertebrate series during evolution.

cyclostomes:

- In lampreys (Petromyzon) there are eight pairs of aortic arches and in hag fishes (Bdellostoma) there are fifteen pairs. The aortic arch is divided into afferent branchial artery and efferent branchial artery.
- In lampreys each aortic arch divides and sends branches to the posterior hemi-branch and anterior hemi- branch of the adjacent gill pouch. In hagfishes each arch supplies to the hemi-branch of a single gill-pouch.

Elasmobranchs:

- Generally there are five pairs of aortic arches in elasmobranchs but in some cases there is a variation. In Hexanchus there are six pairs of aortic arches. In Heptranchias there are seven pairs. In elasmobranchs the first pair of aortic arches (mandibular) disappear. Second to sixth pair of aortic arches (II-VI) persist as branchial arteries. Each aortic arch is divided into afferent and efferent branchial arteries.
- Five pairs afferent arteries arise from ventral aorta and supply deoxygenated blood to the respective gills. The ventral aorta divides into two branches, called innominate arteries which again bifurcate into the

first and second afferent branchial arteries. From the gills the oxygenated blood is collected by efferent branchial arteries.

- In elasmobranchs there are nine pair's efferent branchial arteries of which the first eight arteries form a series of four complete loops but ninth efferent branchial artery collects blood from the demi- branch of the fifth gill pouch.

Teleost:

- In teleosts there are four pairs of aortic arches. First pair (mandibular) and second pair (hyoidean) are lost, only four pairs (third to sixth) persist as branchial arteries. Four pairs afferent branchial arteries arise from the ventral aorta.
- They supply deoxygenated blood to the gills for aeration. The ventral aorta bifurcates anteriorly to form the first pair of afferent branchial arteries. In sturgeon (Acipenser) and Amia each afferent branchial arch bifurcates as in elasmobranchs.

Dipnoans:

- Among dipnoans there are four or five aortic arches that develop from the ventral aorta which supply blood to the gills. In the Protopterus the aortic arches retain second, third, fourth, fifth and sixth. The arches like the fish have afferent and efferent divisions. They have two pulmonary arteries which develop from the efferent division of the sixth arch. There is no second efferent branch in Neoceratodus.