J. Mar. biol. Ass. India, 1966, 8 (1): 159-162

STUDIES ON THE CEPHALOCHORDATES OF MADRAS COAST*

II. The histology of the blood vascular system

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The histology of the blood vessels of cephalochordates is bound to be of interest because of the phenomenon of regular reversal of heart beat (Azariah, 1965). Nicol (1960) felt that ' it is desirable to obtain a sound histological picture of the structure of the vascular walls ' of the group. Hence a detailed study was made.

The author's thanks are due to Prof. C. P. Gnanamuthu for guidance and to Prof. G. Krishnan for helpful suggestions.

Material and Methods

Lancelets of the species *Branchiostoma lanceolatum* were dredged from the Madras inshore area and were maintained in the laboratory aquarium. Though the detailed histology was made out from sections, interpretations were corrected by close observations on fresh material.

Lancelets were anaesthetised with menthol and fixed in sea water-Bouin. Imbedding in esterwax proved better than imbedding in paraffin wax. Sections were cut (transverse and sagittal) 5 to 10 μ thick in 20°C. in the cold room. Sections were stained in Mallory's triple stain or Heidenhain's iron-haematoxylin. From the stained slides the author was able to make the following observations. To complete the present treatment a detailed description of the main blood vessels is also given.

Blood Vascular System

Main blood vessels

Figure 1 shows the general arrangement of blood vessels. The U-shaped tubular sinus venosus (S) is lodged below the oesophagus and above the midgut diverticulum. The one limb of the U-shaped sinus venosus is continued forwards as the endostylar vessel (EA) while the other limb runs forwards along the dorsal side of the diverticulum. The endostylar artery in its course ventral to the endostyle is dilated into vascular bulbils (B) at the bases of the primary gill bar of each side. Each bulbil is situated within the skeletal fork of the gill bar. Three arteries are given off from the upper lip of each bulbil. These arteries run upwards along the primary gill bar to join the epibranchial artery of either side which are continued behind the pharynx to unite with the dorsal aorta (D).

* Formed part of the thesis approved for the award of the degree of Master of Science of the University of Madras.

The three arteries of the gill bar, proceeding from the bulbils, are so arranged that one is nearer the atrium and another is nearer the lumen of the pharynx, the 3rd is in between. The artery near the atrial end and the middle artery runs up close to the skeleton of the primary gill bar. The artery near the pharyngeal end runs upwards through the tissue of the gill bar.

The dorsal aorta (D), which runs behind the pharynx, is oval in cross section having a height of 57 μ and a breadth of 38 μ. The dorsal aorta becomes rounded and more circular in the ilio-colon ring. From the dorsal aorta arteries are given off to the viscera and towards the end of the aorta it ends in several plexus, which are gathered together to form the posterior cardinal vein (PC) on either side. Each posterior cardinal vein runs close to the ventral edge of the myotome of each side and above the pterygeal muscle close to the lateral epithelium. The anterior cardinal veins (AC), which convey the blood posteriorly from the buccal plexus, meet the posterior cardinal vein to form the two ducts Cuvieri (DC) which open on either side into the sinus venosus (S). There appears to be no valve.

The blood supplied to the viscera, through a number of arteries from the dorsal aorta, is gathered from the capillary (C) around the gut by the subintestinal vein (SI) which runs forwards along the ventral margin of the gut. This vessel appears posteriorly where it runs ventral to the midgut diverticulum. It breaks into capillaries and forms a kind of portal system from which blood is gathered and led out by the efferent hepatic vein (EV) on the dorsal side of the diverticulum. This posteriorly becomes continuous with one of the two limbs of the U-shaped sinus venosus.

Sinus venosus (Figs. 2-4)

The endothelial membrane consists of greatly flattened cells (EC), slightly swollen at the level of the nucleus (N) (Fig. 4). The average size of the cells varies from 4.5 μ to 9 μ. The oval shaped nuclei (N), planted in a homogenous ground matrix are seen at the periphery of the endothelium. In certain places narrow capillaries (SC) 5 μ thick, which supply blood to the wall of the sinus venosus, can be made out. Outside the endothelial layer is the muscular layer (NM) varying in its thickness from 1.4 μ to 5.6 μ. These non-striated muscles (NM) are not uniformly distributed but are alternated with thicker and thinner patches, the latter at the swollen cells of the endothelium. These muscle bands appear in the living condition as vertical strips.

Aorta (Figs. 5 & 6)

All the aorta, namely, the endostylar artery with the bulbils, epibranchial artery, dorsal aorta, consist of the same two vascular tissues as that of the sinus venosus. However, the thickness of the muscle layer is relatively thinner than the sinus venosus. There are three to eight endothelial cells in the aorta. All the aortae are muscular.

The epibranchial arteries

The epibranchial arteries, which run on the ventrolateral side of the notochord and close to the epipharyngeal groove, are composed of a very thin endothelium. The vessel appears in shape, to be a right angle triangle with a base of 31-34 μ, single celled thin branches are given to the epipharyngeal groove on either side. Branches arise to join the epibranchial arteries of both sides which run below the notochord and above the epipharyngeal groove. When both the epibranchial arteries join at

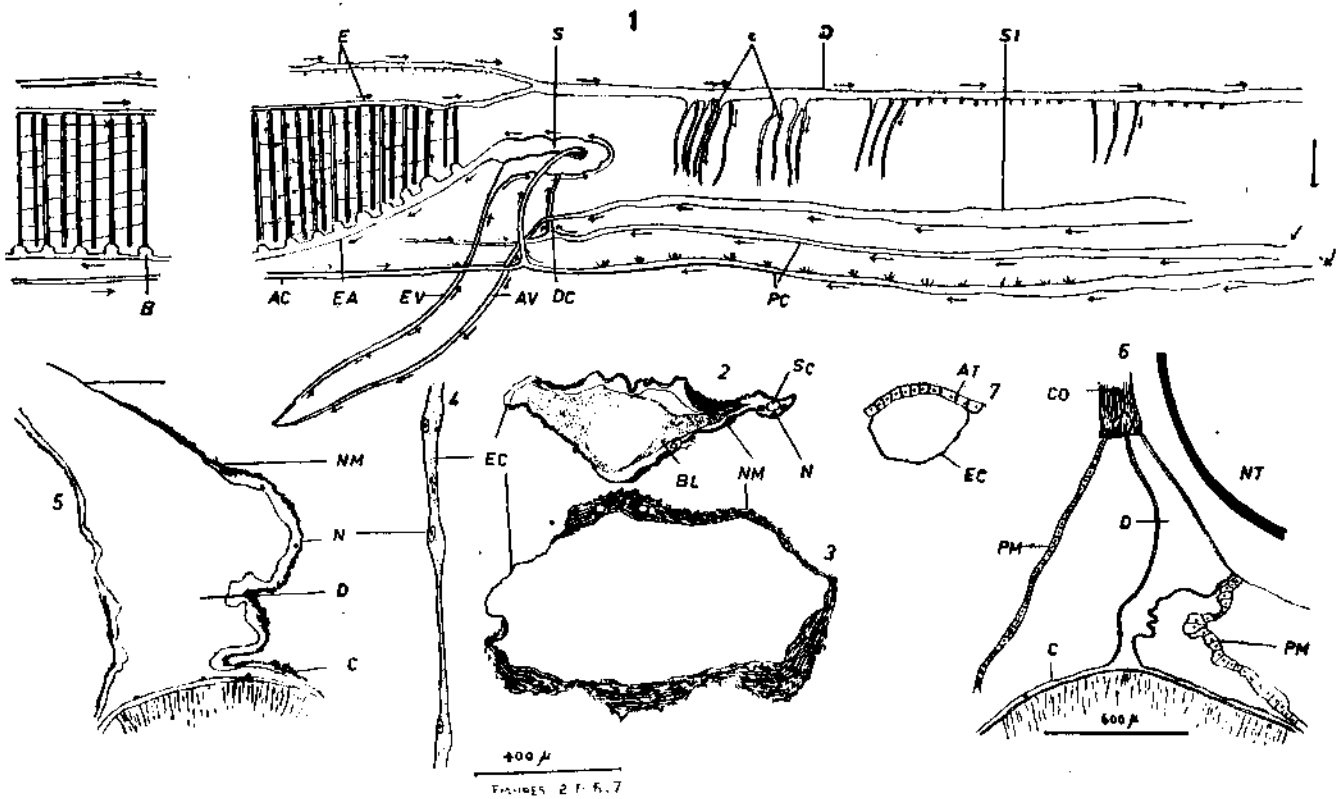

FIG. 1. General arrangement of blood vessels; 2 & 3. T. S. through different regions of the sinus venosus; 4. Sagittal section of the endothelium of sinus venosus; 5 & 6. dorsal aorta over the anterior and posterior regions respectively, of the midgut; 7. endothelial wall of the cardinal vein. AT. atrial epithelium; BL. blood; CO. connective tissue; NT. notochord; PM. peritonial membrane.

the region of the oesophagus to form the dorsal aorta it measures 105 μ and appears to be boat shaped.

As the dorsal aorta reaches the midgut the thickness of the endothelium is retained but the depth increases, making the aorta laterally compressed.

Veins (Fig. 7)

The typical veins namely the cardinal veins, and ductus Cuvieri consist of only an endothelial tube with occasional indistinct muscular envelope. The calibre is uniform and measures 21 μ across. Comparison shows that the walls of the arteries are thicker than that of the veins. The walls of the veins are seen collapsed rather than in a contracted state. However, the subintestinal vein, as an exception, consists of both endothelial and non-striated muscular tissue. This vein is seen mostly in a contracted state with the peritonial membrane abutting its ventral floor.

Capillaries

The calibre of the capillary is irregularly cylindrical with numerous dilations and narrowings. The thickness of the capillary is less than one μ (about 0.52 μ) and consists of only endothelial lining. The endothelial cells vary from 17 μ to 28 μ in length. In the epibranchial artery capillaries arise on either side. In the anterior midgut region the aorta itself arches over the gut and gives off thin capillaries on either side (Fig. 5). In the posterior midgut region the dorsal aorta gives rise to short branches ventrally, each of which divides into two capillaries which run on either side of the gut (Fig. 6). From the ilio-colon region onwards posteriorly, undivided single capillaries are given off from the aorta. The capillaries that supply the myotomes and the notochord arise from the dorso-lateral region of the aorta and run in between the myotomes and the notochord. After supplying the notochord they run in between the myosepta.

Summary

The morphological details of the circulatory system and the histological structure of the entire blood vascular system are described.

References

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