

THE CIRCULATORY SYSTEM OF THE AMPHIUMA

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This paper is a companion paper to Weigart and Churchill's¹ in which the amphiuma is classified and described in detail.

The heart of the amphiuma is situated in the anterior part of the coelomic cavity near the ventral side of the animal. It lies within a rather tough, thin-walled pericardial sac.

When the pericardium is opened on the ventral side, the following parts of the heart are seen: the ventricle, atrium, conus arteriosus, and truncus arteriosus. The ventricle is a somewhat flattened sac with very thick muscular walls and lies in the right side of the pericardial cavity. The atrium appears as a dark, soft-walled sac lying along the left side, with numerous finger-like processes partially clasping the ventricle. The atrium is divided internally into right and left auricles by an auricular septum. The conus arteriosus, leading from the anterior end of the right side of the ventricle is a short, thickened muscular tube extending obliquely across the right auricle. Anteriorly it is continued into the larger, thinner walled truncus arteriosus. The truncus arteriosus soon divides into two diverging trunks which give off (1) the right and left pulmonary arteries running posteriorly to the lungs and (2) two aortic arches.

On the dorsal side of the heart is the thin-walled, tube-like sinus venosus. Anteriorly the sinus venosus receives on each side the right and left ducts of Cuvier. Posteriorly the sinus venosus receives the large post caval vein and appears as a slightly enlarged continuation of it. Lying along the right side of the sinus venosus and adherent to it is the pulmonary vein which crosses over to enter the anterior end of the left auricle.

The arterial system begins in the truncus arteriosus which bifurcates to form two pairs of aortic arches symmet-

¹ See page 12.

rically placed on either side of the middle line curving dorsally in a half-hoop-like fashion in the region immediately in front of the spiracles. On each side the more anterior of these two arches branches to give off the external and internal carotid arteries. The larger internal carotid runs forward along the roof of the pharynx to enter the skull midway between the angles of the jaws. The external carotid proceeds anteriorly along the ventral side immediately beneath the skin to the extreme anterior end of the lower jaw.

The second of the aortic arches meets its fellow arch of the opposite side at a median point on the dorsal body wall to form the dorsal aorta. A short distance back of its origin the dorsal aorta gives off the subclavian arteries which pass laterally to the anterior appendages. Each subclavian artery gives off a very small lateral cutaneous branch running posteriorly parallel to the sides of the body.

A short distance posterior to the heart there is an anterior gastric artery from the dorsal aorta to the anterior end of the greatly elongated stomach. Farther back there is also a posterior gastric artery to the stomach. These two gastric arteries anastomose over the stomach and give off eight or ten splenic arteries to the spleen and three or four branches to the pancreas. Posterior to the stomach the dorsal aorta gives off the coeliaco-mesenteric artery which divides into two branches, the hepatic artery to the liver and an artery to the small intestine.

There are twenty-two to twenty-six small posterior mesenteric arteries from the dorsal aorta supplying the intestine and rectum.

There are about eighteen pairs of reproductive arteries (spermatic or ovarian) which arise from the dorsal aorta and are distributed to the reproductive organs and fat bodies.

The renal arteries are small, paired vessels, three to four in number, which arise from the dorsal aorta and are distributed to the kidneys.

Near its posterior end the dorsal aorta gives off two iliac arteries, one to each side, each of which gives off an epigastric artery to supply the ventral body wall, a femoral

artery to the hind limb, and a vesical artery to the bladder.

There are about twenty parietal arteries given off from the dorsal side of the dorsal aorta to the back. Of these parietal arteries four or five are paired; the others occur singly. There are also numerous very small segmental arteries which are plainly visible encircling the trunk when the skin of the animal is removed.

With the exception of the blood coming from the lungs, all of the blood is returned to the heart through the ducts of Cuvier and the postcaval vein which enter the sinus venosus. The two ducts of Cuvier are greatly elongated. On each side the duct of Cuvier receives the posterior cardinal vein and the short anterior cardinal vein which is formed by the junction of the external jugular vein and the lingual vein. The external jugular passes forward and receives the internal jugular from the brain and dorsal head region. The lingual vein arises anteriorly on the ventral side of the body, receives the subclavian vein from the fore limb and enters the anterior cardinal vein in the region of the spiracle.

The large postcaval vein is formed by the union of two branches which lie between the kidneys along their inner edges. The postcava proceeds forward ventral to the dorsal aorta through the elongated liver and enters the posterior end of the sinus venosus. In the liver the postcava receives four or five pairs of hepatic veins. Along its posterior half the postcava receives about seven pairs of veins from the reproductive organs (spermatic or ovarian).

The caudal vein arises in the extremity of the tail and proceeds forward. Immediately posterior to the kidneys it divides into two branches, the renal portals, which run forward laterally along the outer margin of each kidney to anastomose with the post cardinal veins upon leaving the kidneys.

The postcardinal veins proceed forward one on each side of the postcava and enter the ducts of Cuvier. Throughout their length the postcardinal veins receive numerous branches, the thoracic and lumbar veins, from the dorsal body wall. A short distance posterior to the heart there is a branch from the hepatic portal vein to each post cardinal

which probably carries blood from the anterior part of the hepatic portal vein through the postcardinal veins to the heart.

There is a hepatic portal system which carries venous blood to the liver. It consists of (1) the abdominal vein which receives blood from the femoral and pelvic veins, bladder and ventral body wall and (2) the hepatic portal vein which carries blood from the stomach, intestine, spleen, and pancreas. Blood from the elongated stomach is carried to the hepatic portal vein by about fifteen gastric veins. There are about thirty mesenteric veins. Blood is carried from the abdominal vein to the hepatic portal vein by about five rather large branches. The hepatic portal vein gives off about six short large branches to the liver. .

A comparison of the circulatory system of the amphiuma with that of the necturus shows interesting differences in the distribution of blood vessels due to the great length of the amphiuma:

- (1) The amphiuma has two aortic arches, whereas the necturus has three efferent branchial arteries.
- (2) In the amphiuma there are two gastric arteries instead of one.
- (3) There is a branch from each postcardinal vein to the hepatic portal vein.
- (4) The anterior half of the abdominal vein sends four or five prominent branches to the hepatic portal vein and also enters the postcava just below the heart.
- (5) The amphiuma has many more gastric veins and posterior mesenteric veins supplying the much lengthened stomach and intestine than has the necturus.