TOPIC: GENERAL CHARATERISTICS AND CLASSIFICATION OF HERDMANIA

LECTURE NO:04

BSC PART 1-PAPER II-GROUP A

DATE: 27TH MARCH 2020

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TYPE STUDY OF HERDMANIA

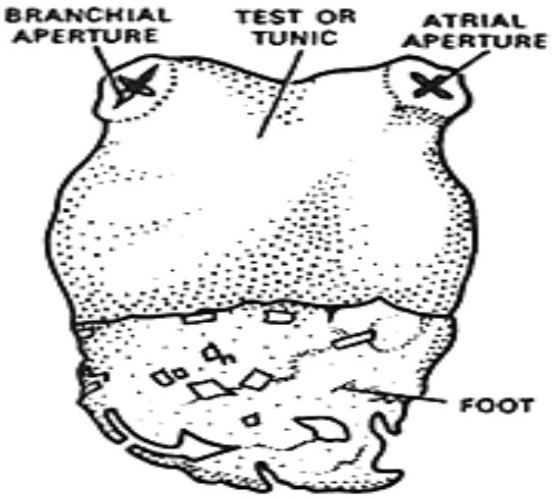

Fig: 3.6 Hardmania in test

HABIT AND HABITATE

Herdmania Momus is on e of the most commonly encountered species of ascidians.

This solitary ascidian is sometimes referred to as the *red-throated ascidian*, as its two siphons are vivid red in colour. Most solitary ascidians that are encountered are so covered in algae that the coloration is often not visible. When found at depth, the red colouration s may not be visible, as lower frequencies of light are absorbed by the layers of water above.

MORPHOLOGY OF HERDMANIA

Body wall

The body-wall of Herdmania is called mantle. It is thick and muscular in the antero-dorsal region of the body. It is thin, non-muscular and transparent in the postero ventral region. It shows epidermis, mesenc hyme and inner epidermis.

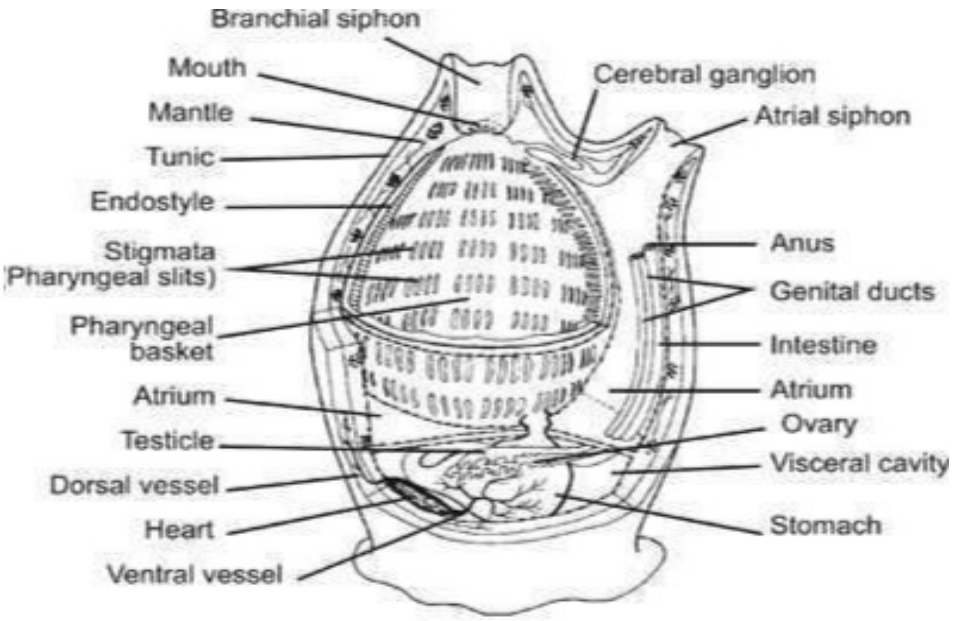

Fig 3.7 Internal organs of Hermania

Epidermis: is single layer of cells. It covers the branchial and atrial apertures and siphons. The epidermis is interrupted at places where spicules and blood-vessels pass from the mantle into the test.

Mesènchyme: develops from the mesoderm. It has connective tissue containing blood-sinuses, muscle-fibers, nerve fibers and cells. The muscle fibers are long and flat. They contain large nuclei.

Inner epidermis: is single layer of flat cells. It forms the lining of the atrial cavity.

The body-wall, protects visceral organs, the outer epidermis secretes the test, while the musculature brings contraction of the body and the siphons

DIGESTIVE SYSTEM

Down from the pharynx is *Herdmania*'s D-shaped gut loop composed of the oesophagus (the decending arm), the stomach (an enlargmenet at the base of the U) and the ascending arm (the intestine) and then the terminal end (the rectum and anus). The oesophagus connects to the branchial sac below the dorsal lamina so that food caught by the branchial sac may be channeled to the stomach (Degnan 1991). The stomach, much like our own, is lined with cells that secrete digestive enzymes and the intestine is likely the site of absorption. A network of tubules called the pyloric gland

covers the outer wall of the anterior intestine and opens into the base of the stomach, secreting digestive enzymes, removing blood borne toxins and storing glycogen. Cauliflower shaped liver lobules protrude from the pyloric portion of the gut and the gut loop is loosely associated with the body wall. Excretory organs are lacking and thus Herdmania must rely on diffusion of ammonia across the pharynx. Other metabolic by-products are stored in nephrocytes which accumulate in tissue and are only released at death. This is known as storage excretion.

Mouth:

It forms the opening of branchial siphon marking the anterior end of the body. It is guarded by four lobes derived from the test.

Buccal Cavity:

Mouth leads into a laterally compressed cavity of branchial siphon, called buccal cavity or stomodaeum. A strong branchial sphincter, present at the base of siphon, regulates the opening of mouth. A circlet of highly branched delicate branchial tentacles, richly supplied by nerves, is also found at the base of siphon. These are 64 in number and are of four different sizes: 8 large (5 mm), 8 medium (2.5 mm), 16 small (1.5 mm) and 32 very small (0.5 mm). The free ends of tentacles meet at the centre forming a sort of strainer which prevents entry of larger food particles into pharynx.

Pharynx:

Buccal cavity leads into the pharynx which occupies the major part of the body or atrial cavity. It is differentiated into a prebranchial zone and a branchial sac.

(a) Prebranchial zone:

This is smaller anterior region having smooth walls without folds, cilia and stigmata or gill slits. It

is separated from the branchial sac by two circular thin parallel ciliated ridges

called anterior and posterior peripharyngeal bands, enclosing a narrow ciliated peripharyngeal groove.

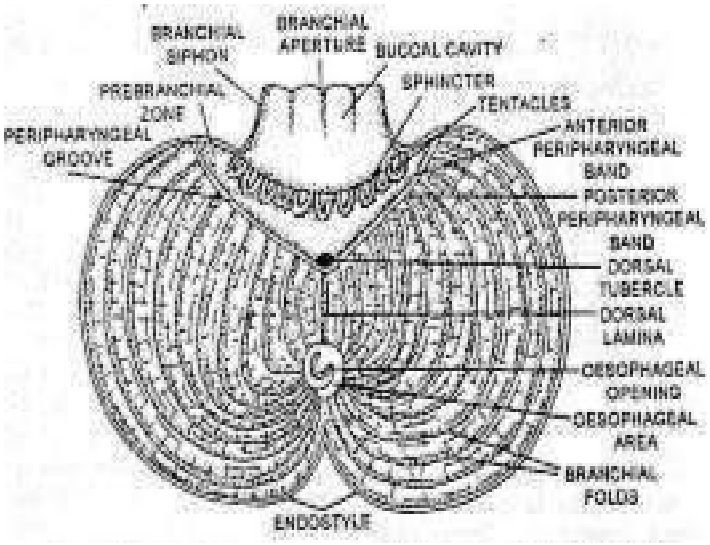

Fig.3.8 Herdmania pharynx cut along mid-ventral line.

The anterior peripharyngeal band is a complete ring and mid dorsally in front of it lies a smaller dorsal tubercle made of two

spiral coils. The posterior peripharyngeal band is interrupted mid-dorsally by the dorsal lamina and mid-ventrally by the endostyle.

(b) Branchial sac:

This is tlarger posterior region of pharynx and is also known as branchial basket. Because its wall is perforated by numerous gill slits or stigmata, each side of branchial sac bears about 200,000 stigmata arranged in several transverse rows.The epithelial lining of the stigmata bears long cilia called lateral cilia. Pharyngeal wall is divided into stigmatic rectangular areas by longitudinal and transverse bars, each area having 5 or 6 stigmata. All the bars of the wall are highly vascular and contain their corresponding blood vessels. Some other structures also are associated to branchial sac which has their role in digestion.

(i) Trabeculae:

Trabeculae are hollow strands, containing a blood vessel, connecting outer wall of branchial sac to the mantle. The inner wall of branchial sac bears 9 to 10 longitudinal branchial folds to increase its surface area.

(ii) Dorsal lamina:

It is a thin flap or fold extended mid-dorsally from the posterior pharyngeal band. It is 1 to 1.5 cm long, bears 20 to 30 conical

tapering tongue like processes called languets. These languets hang down from dorsal lamina into the cavity of the branchial sac. The languets are covered by ciliated epithelium. They form a sort of groove for conducting food.

(iii) Endostyle:

This is a shallow mid-ventral groove lying on the floor of the banchial sac. Anteriorly it joins to the peripharyngeal groove. The marginal folds of endostyle merge with the posterior peripharyngeal band.

These folds reach up to oesophageal opening as thin retropharyngeal folds. Structurally, endostyle consists of five longitudinal ciliary tracts (1 median, 2 lateral pairs) alternating with four longitudinal tracts of mucus secreting glandular cells. Endostyle is homologous to the hypopharyngeal groove of cephalochordates and thyroid glands of vertebrates.

(iv) Oesophageal area:

The posterior most region of branchial sac has a small circular oesophageal area. Its opening is guarded by two semi-circular lips. This area is devoid of blood vessels, folds and stigmata.

(v) Oesophagus:

It is very short, curved and thick walled tube. It contains four longitudinal ciliated grooves, connects branchial sac with the stomach.

(vi)Stomach:

It is wider than the oesophagus, thin walled, sphinctered at both ends and has a smooth inner lining.

(vii)Intestine:

It is a thin walled, U-shaped tube formed by a proximal, ventral or descending limb and a distal dorsal or ascending limb, both united anteriorly. The intestinal loop thus formed encloses the left gonad.

(viii)Rectum:

Intestine leads into the rectum, internally lined by cilia. It curves dorsally to open into the atrium or cloaca through the anus. Anus is guarded by four lips.

(ix)Cloaca:

The atrium or cloaca leads into the atrial siphon and opens outside through the atrial aperture.

NERVOUS SYSTEM

The dorsal hollow nerve cord of all ascidians is lost during larval metamorphosis leaving the adult body plan secondarily simplified and divergent from other chordates. Remnants of the neural tube form the brain and the neural gland. The brain, termed the cerebral ganglion, is located in the connective tissue between the two siphons. The nerves here control body, pharynx and siphon contraction. The neural gland lies

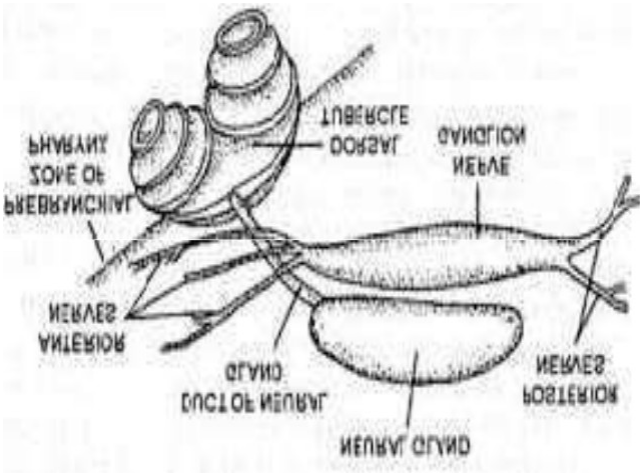

Fig 3.9 Neural Gland and nerve ganglion Herdmania

beneath the brain but actually has no nerves. Sensory organs are alsolost during the transition from larvae to adult but sensory cells remain on the surface of the siphons, Buccal tentacles on the atrium are used to control the water flow through the pharynx.

CIRCULATORY SYSTEM

The circulatory system is well developed and closed type. It includes (i) heart and pericardium (ii) blood vessels and (iii) Blood.

Heart and Pericardium: is a non contractile, elongated and transparent tube about 7.0 cm long and 3.0 mm wide running obliquely below the right gonad.

It is closed at both the ends and is filled with a colourless pericardial fluid with corpuscles similar to those of blood. Its wall is thick, made of connective tissue and contains blood sinuses and is internally lined by squamous epithelium.The heart is enclosed within the pericardium and is attached to its wall along its entire length by a thin mesentery like connective tissue flap.It is formed by an infolding of the pericardium but it is highly contractile, thin walled and contains striated muscles.Both ends of the heart are open. There are no valves but a pear shaped body present midway in the pericardial body which probably regulates the flow of blood in the heart

(ii) Blood Vessels:

The major blood vessels have definite walls, but the smaller ones lack them.

(a) Ventral aorta:

The ventral or subendostylar vessel is the largest vessel of the body arising from the

ventral

end of the heart. At its point of origin it first gives out a stout ventral test vessel supplying blood to the ventral side of the test.It then bifurcates into an anterior and a posterior hypobranchial branch running below the entire length of endostyle. Both the branches give off 40-56 pairs of transverse vessels to wall of branchial sac and several fine vessels to the endostyle and mantle. The anterior branch joins two circular vessels at the base of branchial siphon-peripharyngeal vessel and sub-tentacular vessel.

Lateral branch sends tentacular branches into each tentacle and 6-8 siphonal vessels into the branchial siphon. The posterior branch supplies a minor branch to oesophagus area.

(b) Dorsal aorta:

It is a stout vessel lying mid-dorsally on the dorsal wall of branchial sac. It is not connected to the heart, but communicates ventral aorta through 5-7 pairs of transverse vessels of the branchial sac and the circular peripharyngeal and subtentacular vessels. Dorsal aorta supplies branches to neural complex dorsal tubercle and 6-8 siphonal vessels into the mantle of branchial siphon.

(c) Branchio-visceral vessel:

It arises from posterior part of the dorsal aorta and immediately divides into two branches. First branch, right oesophageal vessel is short and supplies the right liver lobe and right side of oesophgus. Second branch, the ventro-intestinal vessel is stout and long and supplies blood to left side of oesophgus, stomach, intestine rectum, left gonad and left liver lobe.

(d) Cardio-visceral vessel:

It arises from the dorsal end of the heart and supplies blood to several organs. Immediately near origin it sends a right hepatic vessel to right liver lobe and an oesophageo-test vessel to oesophagus and test.A main dorsal branch sends a test vessel, a left oesophageal and a right

gonadial vessels to supply blood to respective organs. It also gives off 6-8 siphonal vessels into the wall of atrial siphon. A middle branch or left gonadial vessel passes obliquely into the left gonad. The main ventral branch soon divides into a dorso- intestinal vessel to left liver lobe, stomach and intestine, a gastric vessel to stomach and a dorsal test vessel to test.

(iii) Blood:

Blood is slightly reddish, transparent and hypertonic to sea water. It contains a few colourless, amoeboid leucocytes, 6 to 7 types of coloured corpuscles with or without nucleus and the nephrocytes

having vacuoles and colloidal cytoplasm. Pigment found in corpuscles may be orange, yellowish-brown or yellowish-green but never red and doesn't take part in respiration.

Course of circulation:

In Herdmania, there is no valve in the heart and the flow of blood is maintained by peristaltic waves. The heart of ascidians is unique in the animal kingdom for changing the direction of flow of blood through it by reverse peristalsis at regular intervals. The arteries and veins change their roles when reversal of flow of blood occurs periodically. When the heart-beats ventro-dorsally it pumps oxygenated blood into the cardio visceral vessel which is distributed to the various parts of the body.The de-oxygenated blood from viscera is collected by the branchio-visceral vessel and passes through dorsal aorta to finally reach into the transverse branchial vessels for oxygenation. During reversal phase, the de-oxygenated blood collected through cardio-visceral vessel from viscera is pumped into ventral aorta and is distributed into transverse branchial peripharyngeal, subtantacular and test vessels. The blood now gets oxygenated and is collected by dorsal aorta and distributed once again to viscera through branchio-visceral vessel. Deoxygenated blood from viscera is collected by cardio-visceral vessel and brought back to the heart to restart the cycle.