

EXCRETORY SYSTEM

Nephridia are the excretory and osmoregulatory organs of leech. These are segmentally arranged, hollow tubes present one pair in each segment from 6th to 22nd segment. Thus, in total there are seventeen pairs of nephridia in *Hirudinaria*. These nephridia are of two types:

1. Pretesticular nephridia. First six pairs of nephridia in the segments 6–11 are without testis sacs and are called pretesticular nephridia.

2. Testicular nephridia. The remaining eleven pairs of nephridia are with testis sacs; they are called testicular nephridia. They are found in segments from 12th to 22nd.

1. Testicular Nephridia

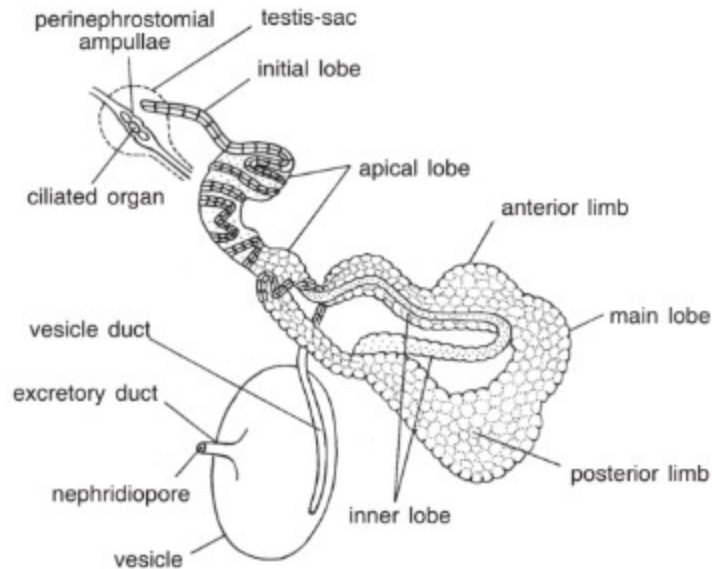
A typical testicular nephridium is a horse-shoe shaped structure. It consists of six parts: (i) Main lobe; (ii) Vesicle and vesicle duct; (iii) Apical lobe; (iv) Inner lobe; (v) Initial lobe or testicular lobe; and (vi) Ciliated organ

(i) Main lobe. It forms horse-shoe proper of nephridium. It lies in a ventro-lateral position between the adjacent diverticula of crop. It consists of two unequal limbs: a longer **anterior limb** and a shorter **posterior limb**. Histologically main lobe comprises of large-sized polyhedral cells.

(ii) Vesicle and vesicle duct. From the ventral end of anterior limb of the main lobe arises a narrow **vesicle duct** which runs posteriorly to open into the vesicle. The **vesicle** or **bladder** is a large, oval, non-contractile thin-walled sac, lined internally by a non-ciliated epithelium. A short narrow **excretory duct** arises from the inner side of vesicle which opens to the exterior through **nephridiopore** surrounded by sphincter muscles.

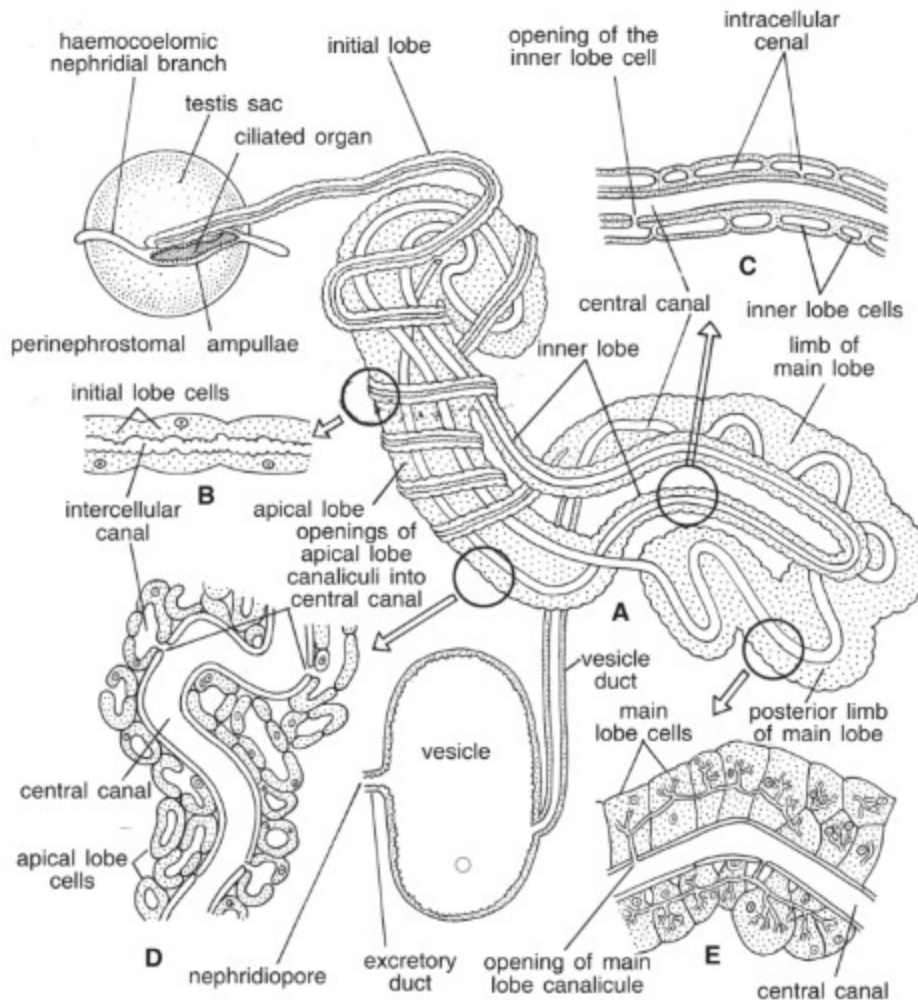
(iii) Apical lobe. The posterior limb of the main lobe continues to form stout **apical lobe**. It lies in an antero-posterior position beneath the gut. The free end of apical lobe is bent on itself like the handle of a walking stick. The cells lining the apical lobe are large with regular intercellular canals.

4. Inner lobe. Running between the two ends of main lobe and situated in its concavity is found a short narrow **inner lobe**. It runs forward along the outer border of apical lobe for about half its length and then joins the apical lobe. Its cells are long and tubular. It carries a central lumen.



Hirudinaria. A testicular nephridium.

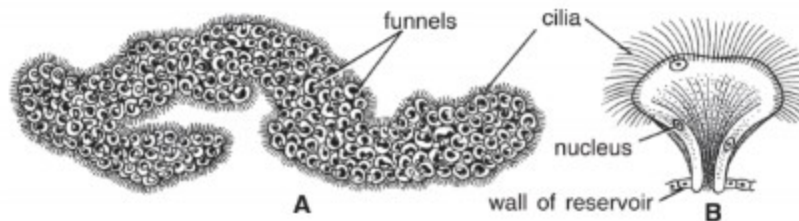
(v) **Initial lobe.** It is slender, much elongated transparent cord-like structure. It remains coiled around the apical lobe. Its posterior end joins the anterior limb of the main lobe. Anterior end of initial lobe is free and blind and extends over the testis sac to lie close to **perinephrostomial ampulla**. Histologically, initial lobe consists of a single row of elongated hollow cells placed end to end having the intracellular canal which gives off several diverticula in each cell.



Hirudinaria. Histology. A—A complete testicular nephridium showing central canal; B—A part of initial lobe in L.S.; C—A portion of inner lobe in L.S.; D—A portion of apical lobe in L.S.; E—A portion of main lobe in L.S.

(vi) **Ciliated organ.** A ciliated organ is completely enclosed within the perinephrostomial ampulla which is a dilation of the haemocoelomic system. A ciliated organ consists of a central **reservoir** which is perforated and a peripheral part containing closely-set **ciliated funnels**. The reservoir is spongy mass of connective tissue cells which manufacture **coelomic amoebic corpuscles**. The outer wall of ciliated funnel is perforated by numerous minute openings for the ciliated funnels. Each ciliated funnel is like an ear-lobe, with about one-fourth of its margin incomplete along one side and is covered with outwardly directed cilia on its margin and inner surface

Ciliated organ corresponds to coelomoduct of polychaeta and not to nephrostomes of nephridia. In the embryo, the ciliated organ remains connected with the nephridium and probably performs



Hirudinaria. A—Entire ciliated organ; B—A single funnel.

excretory function. In the adult, it loses excretory function and has no direct connection with the nephridium. Ciliated organ of adult, however, becomes associated with the haemocoelomic system and manufactures coelomic corpuscles.

There exists a central canal which originates in anterior part of apical lobe and traverses through the different lobes of nephridium and finally enters the vesicle duct. It forms a long continuous passageway across the nephridium and carries the excretory products secreted by the glandular cell masses of the nephridium and finally discharges into the vesicle through the vesicle duct.

2. Pre-testicular Nephridium

The first six pairs of nephridia are situated in segments 6th to 11th which lack testis sacs, perinephrostomial ampullae and ciliated organs. They are called pretesticular nephridia and resemble the testicular nephridia in structure. However, their initial lobes end loosely in the general connective tissue on either side of the ventral nerve cord.

Physiology

Nephridium of leech is both **osmoregulatory** (Haupt 1974) and **excretory** in function. Excess of water and nitrogenous wastes (chiefly **ammonia**) are excreted out by the nephridium. Nephridial gland cells separate the waste products from the haemocoelomic fluid. The excretory fluid is collected in the vesicle and voided through the nephridiopores. Leech excrete watery osmotic urine. The salts are reabsorbed from the urine by the nephridial tissues.

Waste particles are also picked up by botryoidal tissues (and by vasofibrous tissue) and are retained for life. Amoeboid corpuscles in the coelomic fluid are also phagocytic and play an important role in excretion.

COMPARISON OF NEPHRIDIA OF NEREIS AND HIRUDINARIA

Comparison of excretory system of nephridia of *Nereis* and *Hirudinaria*.

	<i>Nereis</i> (<i>Neanthes</i> ; clamworm)	<i>Hirudinaria</i> (Leech)
1.	Excretory system consists of nephridia only.	1. Excretory system consists of nephridia and botryoidal tissue .
2.	Nephridia are segmentally arranged coiled tubes of very large size.	2. Nephridia are segmentally arranged coiled tubes of large size.
3.	Paired nephridia are found in all segments except few anterior and posterior segments of the body.	3. Paired nephridia are found only in the segments from sixth to twenty-second.
4.	All nephridia are alike.	4. Nephridia are of two types: (i) Pre-testicular nephridia , which are six pairs in number and located from segments sixth to eleventh, one pair in each segment. (ii) Testicular nephridia , which are eleven pairs in number and distributed one pair in each segment from twelfth to twenty second.

	<i>Nereis (Neanthes; clamworm)</i>	<i>Hirudinaria (Leech)</i>
5.	All nephridia are exonephric , i.e., they open out by nephridiopores situated at the base of parapodium.	5. All nephridia are exonephric , i.e., they open directly to the exterior by nephridiopores.
6.	All nephridia are provided with internal openings, the nephrostomes .	6. Adult's nephridia are without nephrostomes; these are probably represented by ciliated organs .
7.	A typical nephridium is made of a small narrow neck and an oval main body	7. A typical testicular nephridium is made of a main lobe , a vesicle with duct, an apical lobe , an initial lobe and a ciliated organ
8.	Each nephridium is an oval and irregular in shape.	8. Each nephridium is horse-shoe shaped.
9.	Sac-like vesicle is not found.	9. Sac-like vesicle or bladder is present.
10.	Nephridia remove excretory wastes from blood and coelomic fluid.	10. Nephridia remove excretory wastes from haemocoelomic fluid.
11.	No other excretory organ/tissue is found.	11. The botryoidal tissue is also involved in excretion (removal and permanent storage).
12.	Ammonotelic.	12. Ammonotelic.

Differences Between Testicular and Pretesticular Nephridia

Differences in testicular and pretesticular nephridia of leech.

	<i>Testicular nephridia</i>	<i>Pretesticular nephridia</i>
1.	These are associated with testis-sacs.	1. These are not associated with testis-sacs.
2.	These are eleven pairs in number and are present in only those segments that have testis-sacs.	2. These are six pairs and are present in those segments which do not have testis-sacs.
3.	Testicular nephridium has six parts—main lobe, inner lobe, apical lobe, initial lobe, vesicle, ciliated organs.	3. Ciliated organ is absent.