POLYSTOMA

BY

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Classification proposed by Boeger and Kritsky (1993)

Kingdom: Animalia

Subkingdom: Bilateria

Infrakingdom: Protostomia

Phylum: Platyhelminthes Minot, 1876

Class: Monogenoidea Bychowsky, 1937

Sub Class: Polystomatoinea Lebedev, 1986

Order: Polystomatidea Lebedev, 1988

Family: Polystomatidae Gamble, 1896

Polystoma Zeder, 1800

Polystomoides Ward, 1917

Eupolystoma Kaw, 1950

According to Noble & Noble (1982) flatworms are divided into four main classes namely Turbellaria, Trematoda, Cestoidea and Monogenea.
Endoparasite in the urinary bladder of frogs and toads.

Heavy infection is, however, not known in the adult host.

Young forms may be found attached to the gills of tadpoles.
Structure of Polystoma

- Body leaf-like, Dorso-ventrally flattened; measure not more than 3 cm in length.
- Attached to its host by opisthaptor.
- Opisthaptor contains three pairs of suckers, two anchors and six marginal chitinous hooks.
- Anterior mouth, shortly behind on ventral side is gonopore.
- Head glands (secretory) and head organs (adhesive nature) present, function primarily as auxiliary attachment organs.
- Near suckers, certain gland cells present in body wall and these cells secrete into prohaptors and opisthaptors.
Body Wall

- Body surface covered by thin layer of non-cellular cuticle.
- Beneath cuticle (protective), thin layer of circular muscles.
- Below circular muscles a thin layer of diagonal muscles found.
- Below diagonal muscles, a thick layer of well-developed longitudinal muscles.
- Loose parenchyma packed between body wall and internal organs consisting of cells, fibrils and spaces.
- If inner and outer parenchyma is separated, 
  - Medial zone --- termed medullary parenchyma
  - Outer zone --- cortical parenchyma.
- The parenchyma serves as a site of glycogen storage.
• Mouth, located at anterior end of the body.
• Mouth leads into muscular pharynx which in turn leads into the oesophagus.
• Oesophagus opens into intestine (Inverted ‘Y’) with the caeca bifurcating.
• The caeca give rise to numerous diverticula, some of these extend into disc-shaped opisthaptor.
• The intestinal caeca, lined with epithelial cells either closely packed or sparsely arranged.
• Polystoma feeds primarily on blood, sloughed epithelial cells and mucus.
• It derive oxygen and other chemicals from lying aquatic environment.
• Hence, the body wall is important as an absorptive layer.
• Although nothing is known about digestive enzymes present.
• A black pigment is often produced that is a breakdown product of ingested haemoglobin.
Excretory system, protonephritic type with flame cells at the end of collecting tubules.

There are two main lateral tubes which begin anteriorly and extend posteriorly.

Each tube makes a ‘U’ curve prior to reaching the posterior end of the body.

Toward the end of each ascending tube, there is a swelling known as contractile bladder.

The tubes leaving the bladder empty to the outside through two separate nephridiopores situated dorso-lateral to the mouth.

The flame cells are located at the free ends of branches of these main collecting tubes.
The brain is arranged in a well formed circumoesophageal ring.

Nerve fibres extend from circumoesophageal ring anteriorly, laterally and posteriorly
- one pair ----- being dorsal,
- one pair ----- ventro-lateral,
- one pair ----- ventral.

The ventral nerves, which are most highly developed, are often connected by a series of transverse commissures.

Branches of nerve fibres innervate the various sucker muscles and other portions of body.

One or two pairs of eye spots are commonly present.

Each eye is composed of a rounded retinal cell surrounded by rods made up of pigment granules.
Reproductive System

**Male reproductive system** - contains a single testis which lies in the middle of the body. Vas deferens passes forward and terminates at the tip of the penis through which it traverses.

Penis opens to the outside through the genital atrium located on the ventral surface of the body behind the caecal bifurcation.

**Female reproductive system** - contains a single ovary situated towards the anterior side. The ovary is elongated. The oviduct arises from the surface of the ovary. Two longitudinal vitelline ducts are connected by a transverse duct; a median vitelline duct connects with the oviduct and another genito-intestinal canal opens into the vitelline ducts, one on each side, are a pair of vaginae.

Oviduct after receiving the vitelline duct continues as ovo-vitelline duct and opens into a small chamber called ootype where eggs are assembled.

Numerous unicellular glands collectively known as Mehlis’ gland, surround and secrete into the ootype. The secretions of these glands apparently serve as a lubricant that facilitates the passage of completely formed eggs from the ootype up the uterus. A uterus containing fertilised eggs comes out of the ootype to open into the genital atrium.

Functionally, the common vitelline duct is the tube through which the shell-forming materials and some yolk are carried into the oviduct. The seminal receptacle serves as a storage for spermatozoa received by the female during copulation. The male cirrus is inserted in the vagina of the female during copulation and spermatozoa are introduced down this tubular canal.
The monoecious adult of Polystoma inhabits the urinary bladder of frogs and toads. During the winter months the gonads are non-functional, but activity commences with the coming of spring, producing large eggs. The number of eggs produced ranges from 4 to 122 per day for one week. These eggs are expelled to the exterior.
Fig. 40.3. Polystoma integerrimum. Site selection and migration in Amphibia.
Embryonic development within the egg-capsule (shell) is affected by temperature. At suitable temperature above 50° F., development of the onchomiracidium normally takes less than three weeks. If, however, the temperature drops below 50° F., development may take six to thirteen weeks.

The correlation between the hatching of P. integerrimum eggs and the development and metamorphosis of the frog is one of astounding natural synchronisation and suggests a hormonal influence.

The barrel-shaped onchomiracidium, which bears 16 arrow-shaped hook-lets on its opisthaptor, emerges from the egg and becomes free-swimming at the time that the tadpoles lose their external gills and acquire internal ones.

The larva actively seeks out such a tadpole and enters the gill-chamber, in which it becomes attached to the gill-filaments by its armed opisthaptor. In this attached position, development continues for about eight weeks while the larva subsists on mucus and sloughed host cells.
When the frog undergoes further metamorphosis by losing its gills and developing into a young adult, the worm passes out of the branchial chamber, migrates down the host’s alimentary canal, and eventually becomes established in the host’s urinary bladder, which by this time has developed.

During its migration, the larva loses its ciliated epidermis through atrophy, develops six suckerlets on the ctylophore, loses its larval hooks, and develops adult-type anchors, in other words, the larva matures. In the bladder of the frog, sexual maturity of the parasite is attained within three years.

In exceptional situations in which larva of Polystoma integerrimum becomes attached to the external gills of a younger tadpole, an unnatural acceleration in larval development takes place.

Shortly before the tadpole metamorphosis into an adult, the Polystoma larva develops into a neotenic form, i.e., it becomes sexually mature and produces viable eggs. The other anatomical characteristics of the neotenic worm are not like those of urinary bladder form.

The correlation between the maturation process of the host and the developmental pattern of the parasite again strongly suggests that the parasite is controlled by the hormonal influence of the host.

Hyman (1951) suggested that the neotenic form may be an alternating one with the urinary bladder form, whereby the larvae produced from eggs laid by the branchial form directly invade the urinary bladder of the frog through the anus. Gallien (1935), however, proposed that the larvae of branchial forms leave the host and seek out other tadpoles at the internal gill stage and follow the normal pattern after that.
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