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Male reproductive system of some digenetic trematodes

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Abstract. A histological study of the male reproductive system undertaken in the present study has been concentrated on trematodes with a cirrus sac. Special attention has been focussed on the terminal genitalia. Five species of trematodes, *Fasciola gigantica*, *Acanthocolpus liodorus*, *Stephanostomoides dorabi*, *Rhynchocreadium singhia* and *Prosorhynchus manteri* have been considered for the present study.

Keywords. Trematodes; cirrus sac; prostate glands; cirrus.

1. Introduction

The trematode fauna being parasitic has attracted the attention of scientists ubiquitously. Since time immemorial various aspects of this parasitic group have been studied in detail. Although the biology of this group has attracted the attention for a few years, presently physio-pathology, histopathology and life cycle studies are in vogue, but systematics is the only aspect left unimpeded. One particular aspect that should cause concern to the biologists and systematists, is the most neglected, apparently most simple, male genitalia of trematodes. Even though one finds a wide array of orientation in this system, this has not caught the needed attention. It is with this intention a special attention has been focussed to bring to light the true significance of this system. Another point of interest is that only anatomical characteristics were observed from the whole mounts for this system to a large extent. The present study throws light especially on the importance of histological study of this system. The details which escape the scrutiny of anatomical study, turn out in many a case to be of systematic importance. The orientation of the system can also be better understood histologically. In this study attention has been focussed on trematodes in which the male terminal genitalia are separate from the female, enclosed in a cirrus sac.

2. Material and methods

The parasites on collection from different hosts were fixed immediately in different fixatives to accomplish both anatomical and histological details. Some of these parasites were fixed in FAA under appropriate cover glass pressure and later stained with alum caramine to study the anatomical aspects. Other parasites were fixed in Susa and Bouin's fixatives. After dehydration, through graded series of alcohols, infiltration and sectioning, Heidenhain's Azan and hematoxylin stains were applied to study the histology of the male genitalia. All the parasites of the present study are of common

occurrence and atleast 15 specimens have been examined on an average for each of the above species. Measurements are in millimetres unless otherwise mentioned.

3. Observations

3.1 *Fasciola gigantica Cobbold*, 1890 (figure 1)

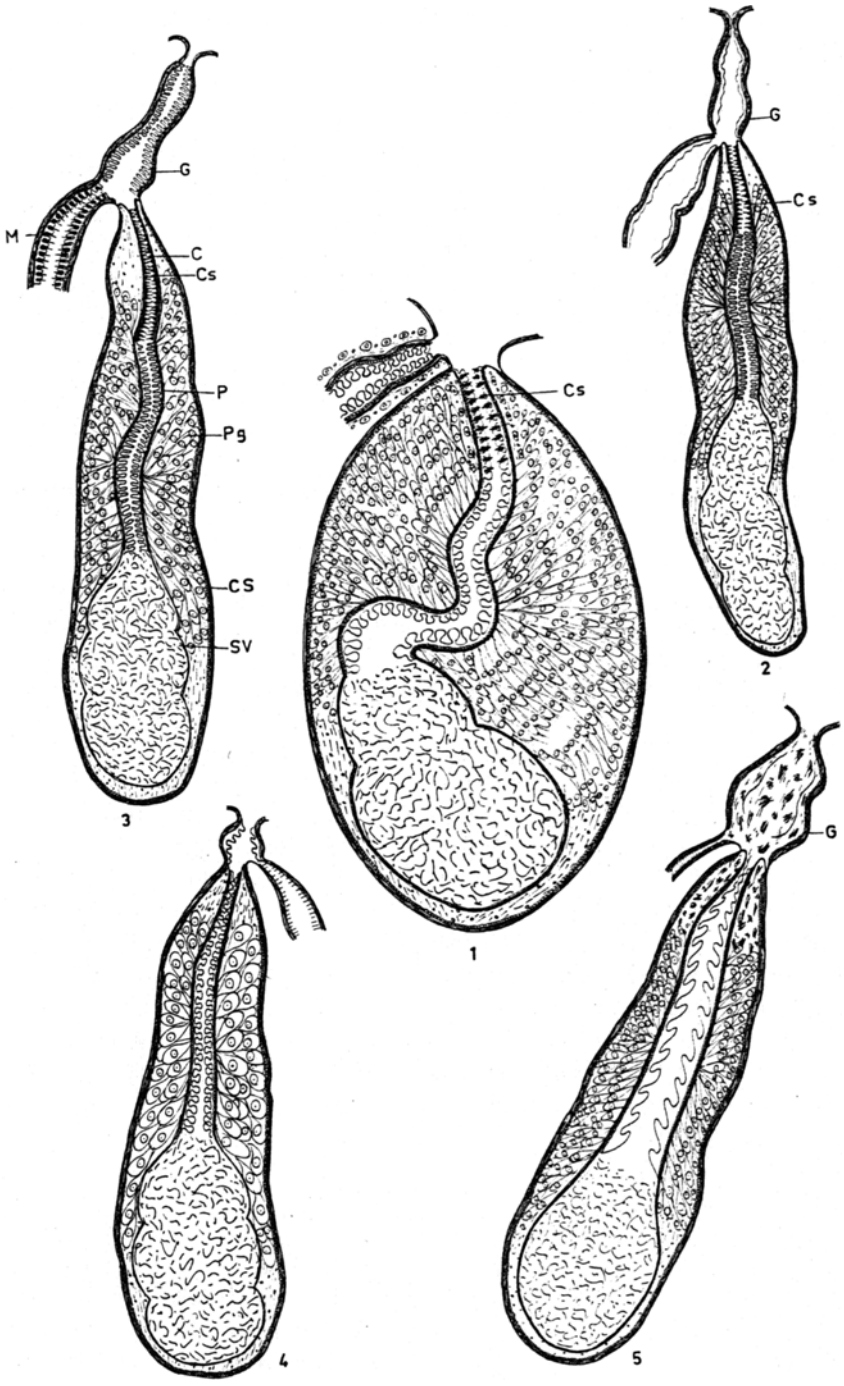
This parasite was collected from the bile duct of *Bos indicus*.

The two testes are highly branched, situated in the middle of the body, post-acetabular, post-ovarian and tandem in position.

The two vasa efferentia which come from the testes run anteriorly and join each other above the acetabulum and below the cirrus sac. The common duct, the vas deferens enters the cirrus sac leading into a bipartite saccular seminal vesicle. The epithelium of the seminal vesicle lies on a dense, granular basement membrane, below which a thin layer of interstitial tissue containing circular and longitudinal muscles is present. Surprisingly in one specimen of *F. gigantica* a large number of spermatogonial cells have entered the seminal vesicle. The seminal vesicle narrows and leads into a tubular, sinuous duct, the pars prostatica which is covered by a syncytial tegument that lies on a dense, granular basement membrane, below which a thick layer of interstitial tissue is present containing a single layer of circular muscles and a thick layer of longitudinal muscles. The base of the syncytial tegument is folded. It is aspinose. Prostate gland cells open into the pars prostatica, although they are present around the seminal vesicle and cirrus to a certain extent. Prostate gland cells are pear-shaped and long, with their narrow duct like anterior part passing through the interstitial tissue and then into the syncytium of pars prostatica. Nucleus of the cells is conspicuous and round in shape containing a single nucleolus. Each prostate gland cell is 0·014–0·017 broad and the nucleus measures 0·007. The prostate secretions are of two types, globular and granular. Pars prostatica leads into a highly muscular, tubular, spiny, eversible, cirrus. The cirrus is lined by a syncytial tegument, which lies on a thick, granular basement membrane, which is thrown into a number of papillae, the syncytial tegument following the pattern of the basement membrane. Below the basement membrane lies a thick layer of interstitial tissue containing a single layer of circular muscles and a thick layer of longitudinal muscles. A number of conspicuous, stout spines are present embedded in the syncytial tegument of the cirrus. On either side of the cirrus sub-tegumental cells are present. The cirrus opens independently into the genital atrium. The cirrus, pars prostatica and seminal vesicle are enclosed in a muscular, cirrus sac which is covered by a syncytial tegument. The cirrus sac measures 0·268–0·272 × 0·136–0·138 and is pre-acetabular. Metraterm is a muscular, saccular and multi-lobed structure which leads independently into the genital atrium. It is covered by a syncytial tegument, and is devoid of spines and is surrounded by subtegumental cells. The genital atrium is simple and is covered by a syncytial tegument, the nature of which resembles the body tegument. The genital pore is median.

Discussion

Threadgold (1975a) gave ultrastructural details of the prostate gland of *F. hepatica*. In the present study it has been observed that *F. gigantica* mostly resembles *F. hepatica*.



Figures 1–5. Cirrus sac. **1.** *F. gigantica*, **2.** *A. liodorus*, **3.** *S. dorabi*, **4.** *R. singhia*, **5.** *P. manteri*.

Abbreviations: C—cirrus; Cs—cirrus spines; CS—cirrus sac; G—genital atrium; P—pars prostatica; Pg—prostate gland cells; SV—seminal vesicle.

Threadgold (1975b) described the duct surrounded by prostate gland cells as the ejaculatory duct. In the present study this duct has been referred to as pars prostatica. He also described that the cirrus and cirrus sac are covered by a modified syncytial tegument. Such a nature has also been reported by Wittrock (1976) in *Quinqueserialis quinqueserialis*. Even in the present study it has been observed that the pars prostatica, cirrus, and cirrus sac are covered by a modified syncytial tegument. Threadgold (1975b) observed spines in the syncytium of both cirrus and cirrus sac. But in *F. gigantica* spines are observed only in the syncytium of the cirrus. Cirrus sac is aspinose. Subtegumental cells are observed on either sides of the cirrus. These subtegumental cells are of similar to the subtegumental cells of the general body surface as was observed by Threadgold (1975b).

3.2 *Acanthocolpus liodorus Luhe*, 1906 (figure 2)

This parasite has been collected from the intestine of the marine fish, *Chirocentrus dorab*.

Testes are elongated, rod-like, situated in the posterior region of the body, post-acetabular, pre-ovarian, intercaecal, tandem in arrangement, median in position. The testes are unequal in size, the anterior testis is smaller (0·359–0·373 × 0·097–0·152) than the posterior testis (0·414–0·483 × 0·097–0·138).

Seminal vesicle is saccular, thin-walled and tripartite. The tripartite nature is well pronounced with deep intrusion of the walls into the lumen. Pars prostatica is covered by a syncytial tegument, the underlying interstitial tissue is thick. The base of the syncytial tegument is much folded. Prostate gland cells are pear shaped, each gland cell is 10 μm broad and the nucleus measures 3 μm. The cirrus is muscular, covered by a syncytial tegument, the base of the syncytial tegument is folded. The cirrus is spiny and the spines are rose thorn shaped; pointed end of the spine is very long and the base is bulbous. Spines are numerous and present on either side at the inner surface of the cirrus touching the base of the syncytial tegument and directed towards the lumen of the duct. The cirrus leads into a tubular, conspicuous genital atrium. The cirrus sac is moderately thick and is aspinose and is prominent, elongated, commences above the ovary and extends anteriorly. The metraterm is saccular and aspinose. The genital atrium is tubular, muscular and aspinose. Genital pore is in front of the acetabulum. The syncytium of genital atrium and metraterm closely lines the underlying musculature and is not folded.

Discussion

In the present study it has been observed that spines are present only in the cirrus. But Luhe (1906) described spines in the metraterm and the terminal portion of the hermaphroditic duct. Further the term hermaphroditic duct seems to be vague, as in the histological study it has been observed that the cirrus and the metraterm open separately into a common chamber, which is more appropriately called the genital atrium. Further the cirrus is spinose indicating its involvement during copulation. If we consider that the metraterm and cirrus unite to form a common hermaphroditic duct, it has to be considered that the terminal portion of the hermaphroditic duct as eversible.

It is not justifiable to think that both cirrus and hermaphroditic duct as eversible. Therefore it has been considered that the cirrus and the metraterm open into a long, tubular, weakly muscular, aspinose genital atrium. Whenever a hermaphroditic duct is present, it has been observed that the male genitalia lie free in the parenchyma. So it can be concluded that since the cirrus sac is also present in *Acanthocolpus*, it would seem more appropriate to consider that both cirrus and metraterm open into a common genital atrium rather than the hermaphroditic duct.

Yamaguti (1971) considered that if the seminal vesicle is bipartite in *Acanthocolpus liodorus* and *A. luhei*, it might serve to differentiate *Acanthocolpus* from *Tormopsolus*, in which the vesicle is definitely unipartite. In the present study it has been observed that the seminal vesicle is tripartite in *A. liodorus*.

3.3 *Stephanostomoides dorabi Mamaev and Oshmarin*, 1966 (figure 3)

This parasite has been collected from the intestine of *Chirocentrus dorab*.

Testes, two in number, situated in the posterior region of the body, post-acetabular, post-ovarian, intercaecal, median, tandem in position, smooth elongated and rod-like.

The anterior testis is smaller (0·814–0·820 × 0·220–0·224) than the posterior testis (0·952–0·958 × 0·179–0·182).

A conspicuous, saccular and tripartite seminal vesicle is present, occuping the basal region of the cirrus sac. Pars prostatica is covered by a syncytial tegument, the base of which is much folded. The interstitial tissue of pars prostatica is thick. Prostate gland cells are pear shaped. Nucleus is round with a single nucleolus. Each gland cell is 10 μm broad and the nucleus measures 3 μm. The cirrus is muscular, sinuous, and spiny. The base of syncytial tegument covering the cirrus is much folded. There are numerous spines on either sides at the inner surface of the cirrus, the base of the spine touches the base of syncytial tegument. The spines are rose thorn shaped. The cirrus leads into a tubular and broad genital atrium. The cirrus sac is sinuous and is thin-walled and commences above the ovary and measures 0·207–0·210 × 0·152–0·156. The metraterm is long, sinuous, broad and spinose. The spines of metraterm are similar to that of the cirrus spines. The musculature of the genital atrium is not very thick. The genital pore is in front of the acetabulum. The syncytium of metraterm and genital atrium is folded.

Discussion

It has been observed that the cirrus and metraterm are spiny and there are no spines in the genital atrium. This observation agrees with the description of Mamaev and Oshmarin (1966). But they have described the presence of a long hermaphroditic duct. In the histological study, it has been observed that cirrus and metraterm open separately into a common genital atrium as in *Acanthocolpus*.

It has been observed that the seminal vesicle is tripartite and not bipartite as reported by Mamaev and Oshmarin (1966).

3.4 *Rhynchocreadium singhia Pershad*, 1965 (figure 4)

This parasite has been collected from the intestine of *Macrognathus aculeatus*.

Testes, two in number, situated in the posterior region, post-acetabular, post-ovarian, intercaecal, tandem in position, smooth and oval in shape. Testes are unequal in size. The two testes are widely separated. The anterior testis measures 0·276–0·324 × 0·180–0·240 and posterior testis 0·252–0·360 × 0·192–0·300.

Seminal vesicle is conspicuous, saccular, tripartite and thin-walled. The partitions of the seminal vesicle are clearly demarcated. Pars prostatica is covered by a syncytial tegument the base of which is much folded. The interstitial tissue of pars prostatica is thick. The lumen of the duct is narrow. Prostate gland cells are pear shaped. Nucleus is round, with a single nucleolus. Each gland cell is big and broad (20–24 μm). The nucleus measures 7–10 μm. The cirrus is muscular. Both cirrus and cirrus sac are covered by a syncytial tegument. The cirrus sac is situated on the right side, starting in the lateral field just above the level of the acetabulum. It runs anteriorly up to a short distance and takes a bend towards the acetabulum in the middle of the body. The wall of the cirrus sac is relatively thin. The metraterm is muscular, tubular, leading into a muscular, small genital atrium. Genital papillae are present inside the genital atrium.

Discussion

Srivastava (1962) in his generic diagnosis of *Rhynchocreadium* reported that the seminal vesicle is bipartite. Pershad (1965) also observed a similar condition, but in the present histological study it has been observed that the seminal vesicle is tripartite. The cirrus is found to be eversible together with the terminal portion of the cirrus sac. The prostate gland cells are very big in size in this trematode.

3.5 *Prosorhynchus manteri* Srivastava, 1938 (figure 5)

This parasite has been collected from intestinal caeca of *Trichuris trichuris*.

Testes two, situated in the posterior region. Testes are posterior to the stomach, post-ovarian, situated in the lateral field on the right side. Tandem in arrangement, smooth and round in shape. Testes are unequal in size. The anterior testis measures 0·193–0·196 × 0·179–0·183 and the posterior testis is 0·166–0·172 × 0·190–0·193.

Seminal vesicle is prominent and bulb shaped. Below the epithelium of the seminal vesicle there is a slightly thick layer of interstitial tissue. Pars prostatica is covered by a syncytial tegument, the base of which is much folded. The interstitial tissue of pars prostatica is thick. The lumen of pars prostatica is narrow. Prostate gland cells are pear shaped. Nucleus is round with a single nucleolus. The gland cells are small in size, arranged in a few rows only and are 7 μm broad. Nucleus is also small and measures 3 μm. The cirrus and cirrus sac are muscular and covered by a syncytial tegument. The cirrus sac is prominent, it is vertical in position and directed posteriorly. It commences very close to the posterior testis. The base of the sac is slightly broader and it is in this region a bulb shaped seminal vesicle is seen. The cirrus sac measures 0·179–0·183 × 0·089–0·097. The seminal vesicle is 0·069–0·072 × 0·028–0·032.

The interstitial tissue of the cirrus sac is thick. The metraterm is narrow. The genital atrium is very conspicuous and highly muscular and very complicated in nature. Muscles are present throughout the genital atrium, there being no conspicuous space inside the genital atrium.

Discussion

In the members of the family Bucephalidae the genital atrium is highly muscular and very complicated. As the Bucephalidae lack powerful adhesive organs, the highly muscular genital atrium helps in powerful union during copulation and also aids in adhesion when needed. In this trematode the space inside the cirrus sac for the prostate gland cells is very narrow, whereas the pars prostatica is with a broad lumen.

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