



SCHISTOSOMA INFECTION IN VERTEBRATE

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ABSTRACT

Parasites are very primitive organisms and were residing from 512 million years. Parasitic infestation adversely affects the global livestock business and has harmful consequences on the country's growth. Schistosomiasis is a tropical disease of significant public health importance and can be observed both in humans and animals, resulting in morbidity and mortality in Asia and Africa. It also affects the economy of people and nations. The current manuscript provides us ephemeral knowledge about some vital features of Schistosomiasis like morphological character, general appearance, different species, pathogenesis, clinical sign, control and treatment of infection. It can be helpful to the end-user and may reduce human and animal infection.

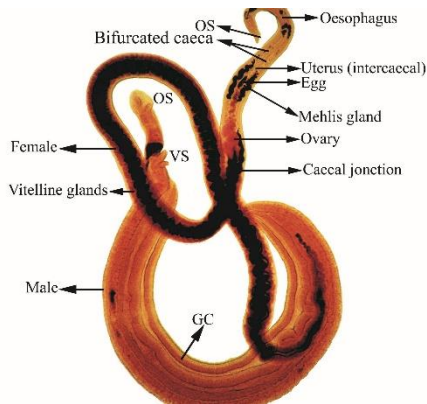
INTRODUCTION

According to a survey, on the whole, India has 535 million livestock population, out of which bovine, sheep and goat count is 302.3, 74.3 and 148.9 million, respectively (<https://www.nddb.coop/information/stats/pop>). Animal are mainly used for both milk and meat purposes and contribute to a large part of farmer and country economy. The health and productive status of these animals are affected by various parasites and out of which *Schistosoma* species infection play a vital role. The current popular article deals with various crucial aspects of *Schistosoma* such as morphology, general appearance, different species, pathogenesis, clinical sign, control and treatment.

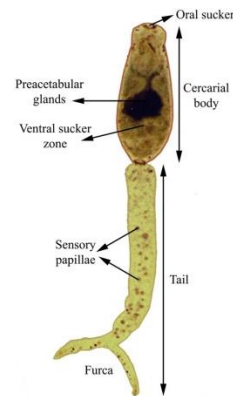
GENERAL STRUCTURE OF *SCHISTOSOMA* SPECIES

Schistosoma species, also known as “blood flukes”, mainly reside in their definitive host's blood vessels; they have elongated bodies and both sexes, i.e. male and female, are different individuals. The body of male is short, thick with turbeculated tegument, whereas the female body is long, thin with smooth tegument. Male has gutter like gynaecophoric canal, which is used to carry females during copulation. Organ of attachment i.e. oral and ventral sucker are positioned at anterior end. Digestive system is incomplete and starts from oral sucker followed by oesophagus and then intestine. Intestine divide in 2 caeca but at posterior end they join again. Circulatory system is absent whereas reproductive is well developed, male has 3-8 testes and are places near ventral sucker, and it is followed by vas efferentia and seminal vesicle. Female consist of ovary followed by oviduct, vitelline glands, ootype and uterus. Eggs come through genital pore and are non-operculated, thin shelled and are provide with terminal or sub terminal spine and they are voided in faeces, urine or nasal discharge (Soulsby 1982, Bhatia et al 2016).

APPEARANCE OF PARASITE



Male and female fluke*



Furcocercous cercariae*

*<https://www.waterpathogens.org/book/schistosoma>

Difference species along with their host and area of location

S. No	Species	Definitive host (DH)	Location in DH
1	<i>S. bovis</i>	Ruminants, equines, camels, rodents, man	Portal and mesenteric vein
2	<i>S. japonicum</i>	Ruminants, equines, dogs, cats, rodents, man	Portal and mesenteric vein
3	<i>S. mattheei</i>	Ruminants, equines, baboons, rodents, man	Portal and mesenteric vein and urinogenital tract veins
4	<i>S. spindale</i>	Ruminants, dogs	Mesenteric vein
5	<i>S. indicum</i>	Ruminants, equines, camels	Portal and mesenteric vein
6	<i>S. mansoni</i>	Man	Mesenteric vein
7	<i>S. haematobium</i>	Man, monkey, baboons, rodents, pigs	Mesenteric arteries, bladder, ureters and urethra
8	<i>S. nasale</i>	Ruminants, equines	Nasal mucosa veins
9	<i>S. incognitum</i>	Dog, pigs, sheep, goat	Mesenteric vein

LIFE CYCLE

At the time of laying eggs, an adult female goes deep inside the small blood vessels of the intestine mainly at mucosa or sub-mucosa level and ultimately lays a fertile egg in capillaries. Eggs mainly has spine and pierce the blood capillary and other structure along with intestinal wall thus reaching in the lumen of intestine. At the time of laying, the egg is not fully mature and its development continues until they are voided off in the faeces of the definitive host. Egg hatch as soon as it gets water and miracidium comes out. Hatching depends on other factors like temperature, light exposure and salinity of water. Miracidium swim with the help of cilia and after finding the appropriate intermediate host i.e. snail (*S. mattheei* infect *Bulinus*

sps, *S. japonicum* infect *Oncomelania* sps, *S. mansoni* infect *Biomphalaria*, *S. haematobium* infect *Bulinus* sps, *S. spindale* infect *Planorbis*, *Indoplanorbis*, *Lymnaea* sps) penetrate its tissue and form a sac like structure known as “mother sporocyst” after casting off its cilia. This mother sporocyst procedure daughter sporocyst and in the end cercariae is formed. Generally cercariae has forked tail so it is also known as “furcocercous cercariae”, it come out from snail body actively and swim in water body. With the help of secretion (hyaluronidase enzyme) from cephalic gland cercariae directly penetrate the body of DH. After penetration, the tail's cercaria cast forms globular structure also known as schistosomula. It is then carried away via circulation to lungs and at last liver. Pairing of male and female worms takes place in portal veins and reaches maturity in mesenteric veins and starts laying eggs (Soulsby 1982, Bhatia et al 2016).

PATHOGENESIS

Pathogenesis caused by *Schistosoma* sps is both mechanical and immunological and depends upon the parasite's location in DH. There are many form of pathogenesis which is given as under:

(1) *Intestinal form*- It mainly occurs in acute condition and develops due the presence of adult female and large number of egg in intestinal mucosa. Large number of haemorrhagic lesion is formed on mucosa of intestine mainly in posterior small intestine and caecum but it can also extend from fore-stomach to rectum of GIT. Haemorrhagic ulcers are seen on mucosa, oedematous exudate and blood stained mucous is also formed. Infiltration of immune cells such as eosinophil, lymphocytes, macrophages, and plasma cells occurs in lamina propria. These immune cells attack the eggs and thus eggs may be found free or micro abscess/granuloma can also form. In the last eggs are degenerated by immune cell and sometime fibrous tissue formation take place by action of epithelioid and fibroblast cells. Phlebitis can also occur in mesenteric vein by presence of adult parasite. In *S. indicum* pseudo-abscess are formed in intestinal wall and in equine these areas can be easily identified by the presence of black pigmentation.

(2) *Hepatic form* is mainly an immunological reaction against the parasitic egg. Egg shell has pores and through which soluble antigen is released and sensitizes the immune response in host. Mobilization of various immune cells such as eosinophil, macrophages and lymphocyte occur toward the egg, and inflammatory reaction starts along with the destruction of the egg. In later stages epithelioid cell, giant cells and fibroblast cells come into the place, fibrous tissue formation starts and ultimately lead to the formation of clay-pipe stem condition. Fibrous tissue formation sometime alters the flow of venous portal blood so there may be compensatory neovascularization and increase in blood flow.

(3) *Nasal form* is caused by *S. nasale* mainly in cattle whereas buffalo act as carriers. Parasitic eggs are found in mucosal gland of nasal cavity and result in the formation of military abscess (nasal granuloma) via cellular reaction. Sometime rupture of old abscess take place and again new abscess is formed; this can ultimately lead to fibrosis and cauliflower like growth. Mobilization of eosinophil, plasma cells, lymphocyte, macrophage, fibroblast and giant cells to infection site take place. Infected animal produce snoring sound and it can also lead to rhinitis, mucopurulent discharge, sneezing and dyspnoea.

(4) *Urinary form*- It is mainly caused by *S. haematobium* in the lower urinary tract and urinary bladder wall. Presence of egg lead to delayed type of hypersensitive reaction and formation of granuloma. Granuloma formation can also lead to obstruction in urinary bladder and ureter. Sometime ureteritis and appendicitis also develop.

(5) *Dermatitis form*- It is known as cercarial dermatitis, swimmer itch, dhobi itch, hunter itch, rice paddy itch. This is an occupational condition caused by penetration of avian origin cercariae into the skin of human

who usually work in pond, river side, ditch, rice paddy field or other water logged area. Skin penetration lead to mild erythema, oedema, pruritus, popular or pustular eruption followed by dermatitis.

CLINICAL SIGN

Acute infection leads to diarrhoea, dehydration, anorexia, anaemia, hypoalbuminemia and oedema. Chronic infection leads to emaciation, eosinophilia, anaemia, hypergammaglobulinemia (Soulsby 1982, Bhatia et al 2016).

DIAGNOSIS

Clinical sign, serological test such as miracidia immobilization test, cercarien hullen reaction test, circumoval precipitation test, haemagglutination test, complement fixation test, ELISA (Soulsby 1982, Bhatia et al 2016), molecular test such as PCR.

TREATMENT

Oxamniquine @ 15-20 mg/kg, trichlorophon @ 100-200 mg/kg in sheep, niridazole @ 25 mg/kg in pig, praziquantel 10 mg/kg in cattle, buffalo, sheep, goat. Tatar emetic @ 2 mg/kg and sodium antimony tartrate @ 1.5 mg/kg in case of nasal form (Soulsby 1982, Bhatia et al 2016).

CONTROL MEASURES

Destruction of IH by use of insecticide such as copper sulphate, sodium pentachlorophenate etc, rearing of snail eating ducts, use of spores of predacious fungi, use of larval stage of *Echinostoma* sps, use of *Nosema eurytremae*, segregation, treatment of infected animal, reduce contact of livestock and snail infested water bodies (Soulsby 1982, Bhatia et al 2016). Many vaccination agents had been tried to reduce *Schistosoma* infection. Sh28-GST (Bilhvax), Sm29, SmCD59, Sm200, Sj23, Sj62, Sj28, Sj14, SjCTPI, *S. mansoni*-TSP-2 and SmTOR had been used to produce immunity in the definitive host (Sumbria and Singla 2015). Control of snail can be achieved by three ways:

1. Physical: Net in water channel in farms/ flow of water, destruction of breeding ground.
2. Chemical: Copper sulphate (1:100000) or 10-35kg/hectare, N-tritylomorpholine (0. 45kg in 680litres/hectare), Cuprous chloride (5ppm), Niclosamide .
3. Biological: Duck and goose rearing, Fish (Black Carp), Nymphs of dragon fly, Predatory Prawn (*Macrobrachium vollenhoveni*), Water bugs (*Sphaerodema urinator*) and Plant extracts.

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