Schistosoma haematobium
Life Cycle and Pathogenicity

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OBJECTIVES

• The students will learn:
  • Geographical distribution, habitat & morphology of *Schistosoma haematobium*
  • Life cycle of *Schistosoma haematobium*
  • Pathogenicity, treatment and prophylaxis
INTRODUCTION

• *Schistosoma haematobium* is commonly known as the vesical blood fluke

• *Schistosoma* are parasitic blood dwelling fluke worms

• *Schistosoma* causes a disease called *Schistosomiasis*

• The genus *Schistosoma* contains different species that are of major pathological importance to man, *Schistosoma haematobium* (*S. haematobium*), *S. mansoni*, *S. japonicum*, *S. mekongi*, *S. intercalatum* etc.

• Habitat is urogenital veins (vesical plexus), hepatic portal system & mesenteric vessels of human beings
SYSTEMATIC POSITION

- Phylum: Platyhelminthes
- Class: Trematoda
- Order: Digenea
- Genus: Schistosoma
- Species: haematobium
GEOGRAPHICAL DISTRIBUTION:
Various parts of Africa and Middle East. Gadgil and Shah (1952) reported a few cases for India (Ratnagiri in Maharashtra State)
GEOGRAPHICAL DISTRIBUTION

- Human Schistosomiasis is endemic in large areas of (sub) tropics

- It has been estimated that over 700 million people in 74 countries are exposed to the risk of Schistosomal infection, and almost 200 million were estimated to be infected in 2003 (Ferwirch, 2006) of which 85% in sub Saharan Africa.
GEOGRAPHICAL DISTRIBUTION

• Natural streams, ponds and Lakes are typical sources of infections, but over the past few decades, man-made reservoirs and irrigation system, have contributed to the spread of Schistosomiasis.

• Prevalence of infection generally show a peak at the ages of 5-15 years and a decrease in adults.
**MORPHOLOGY**

- *Schistosomes* are not hermaphroditic, but have separate sexes.
- The adult worms are 1-2 cm long with a cylindrical body that features two terminal suckers, a complex tegument, a blind digestive tract and reproductive organs.
- *Schistosomes* are long-lived worms, having a life span of 20-30 years.
- Body is cylindrical, elongated and greyish or pinkish in colour.
• Both male and female worms are provided with oral and ventral suckers. Ventral suckers is large and powerful in male.
• Female is lodged in ventral **gynecophoric canal** of the male. It is formed by the infolding of the ventral body wall.
MORPHOLOGY

- Alimentary canal is simple and consists of mouth, oesophagus and forked (bifid) intestine. Pharynx is absent. Genital aperture lies immediately below the ventral sucker.
- Sexes are separate and sexual dimorphism is well marked.
- Male is shorter and has cylindrical and flattened body. It measures 8-16 mm in length.
- The male reproductive system consists of 4 to 5 testes, vas efferentia, a short vas deference and seminal vesicle.
- Female is longer and has more slender delicate cylindrical body with smooth surface.
MORPHOLOGY

• **Male**
  Size: 1-1.5 cm by 1 mm
  Cuticula: finely tuberculated
  Testes: 4-5, in groups

• **Female**
  Size: 2 cm by 0.025 mm

• **Ovary**: Behind the middle of the body

• **Uterus**: contains 20-30 eggs

• **Egg**: 150 by 50 micron
LIFE CYCLE

- **S. haematobium** passes its life cycle in two hosts

- **Definite host** - Man - Worms living in vesical and prostatic venous plexus

- **Intermediate host** - Fresh water snail (*Bulinus truncatus*)
LIFE CYCLE Contd

- Embryonated eggs pass with urine of definitive host and gain access to water.
- Eggs produced do not reach the vesical lumen and are carried away with the bloodstream and or trapped in the tissues, these eggs provoke a granulosmatous inflammatory response, which is the main cause of pathology in the human.
- Ciliated larvae (miracidia) hatch out of the eggs move freely in water in search of their intermediate host.
- The miracidium on entering its proper larval host, penetrates into the soft tissues of the snail and reaches the liver.
- Miracidium is transformed into a tubular sporocyst.
- Sporocysts multiplies and forms second generation of sporocysts they give rise to final larval forms, the fork-tailed Cercaria which are infective to man.
LIFE CYCLE

Mature adult worms in copula reaching vesical plexus (In 1 to 3 months)

Schistosomulae maturing into adult worms (In 3 weeks)

Carried to portal venous system (In 5 days)

Path of migration through the body

Schistosomulae in venules of skin

Cercaria penetrating unbroken skin of man (Within 1/2 hour)

Free-swimming cercaria

Sporocyst 2nd generation

Developmental phases in snail (4 to 8 weeks)

Sporocyst 1st generation

Miracidium liberated in water - enters snail

Eggs containing a ciliated embryo

Eggs escaping through urinary tract

Eggs in submucosa

Eggs in venule
• The Cercaria escapes from the snail into water
• Infection results when human beings bathing or wading in the water are infected
• They attach to skin and penetrate the human unbroken skin
• The cercaria lose their tail now known as *(schistosomulae)* and gain access to a peripheral venule
LIFE CYCLE
Route through which adult Schistosomes migrate to their sites of location

- From peripheral venule they are carried through the right heart into the pulmonary capillaries
- They are carried through the left heart into the systemic circulation
- The majority are shunted in the abdominal aorta and gain the access mesenteric artery pass through the capillary bed in the intestinal and enter portal circulation (taking 5 days to reach the liver).
• The larvae grows into adults.
• After becoming sexually differentiated they move out of liver into the inferior mesentric vein, rectal venous plexus, pelvic veins and eventually enter the vesical plexus of veins.
• The sexually mature worms copulate (the female are enclosed in the male) and the fertilized females lay eggs which are voided with the urine.
• The cycle is repeated.
LIFE CYCLE

1. Eggs shed from infected human: in feces, in urine
2. Eggs hatch and release miracidia
3. Miracidia penetrate snail tissue
4. Sporocysts develop in snail (successive generations)
5. Free-swimming cercariae released from snail into water
6. Cercariae penetrate skin
7. Cercariae lose tails during penetration and become schistosomulae
8. Circulation
9. Migration to portal blood in liver and maturation into adults
10. Paired adult worms migrate to:
   - Mesenteric venules of bowel/rectum (laying eggs that circulate to the liver and shed in stools)
   - Venous plexus of bladder; eggs shed in urine

Infective stage
Diagnostic stage

S. mansoni
S. japonicum
S. mekongi
S. haematobium
INFECTION

- Schistosoma infections follow direct contact with freshwater harbouring Cercariae
- Three major ways of infection
  i) Contamination of fresh water with excreta containing Schistosoma eggs
  ii) The presence of the snail intermediate host
  iii) Human contact with water-infested with Cercariae
PATHOGENECITY

- Bathing in infected pool
- Cercariae stick to the surface of the skin of bather
- **Infecting Agent**
  - Cercariae.
- **Portal of entry** - Skin
- **Site of location** - Vesical plexus of veins. (Urinary bladder)
PATHOGENESIS

• The terminal – spined eggs of *S. haematobium* may erode blood vessels and cause haemorrhages.

• Schistosoma eggs, deposited in the tissues, act like foreign protein and have an irritative effect leading to round cell infiltration and connective tissue hyperplasia.
CLINICAL FEATURES

• Disease caused is referred to as schitosomiasis haematobia (urinary schistosomiasis or bilharziasis)

Disease passes through 3 phases

➢ At the site of entrance by Cercariae local reaction (dermatitis)

➢ Toxic metabolites liberated during growth of schistosomulae fever, fatigue, weight loss, urticaria, enlarged tender liver and palpable spleen.

➢ Haematuria (terminal)
DIAGNOSIS

Based on the demonstration of eggs of *S. haematobium*

- A microscopical examination of urine. Sophisticated techniques give quantitative estimation of egg excretion
- Examination of stool: Concentration methods may detect the eggs
TREATMENT

• The drug having specific actions on the schistosomes are Praziquantel (40mg/kg/day in two divided doses for 1 day)
• Metrifonate (single dose of 7.5mg to 10mg/kg body weight, weekly for 3 weeks)
• Praziquantel is more effective drug than Metrifonate
PROPHYLAXIS

The preventive measures are-

• Eradication of the disease in man

• Prevention of pollution of water with human excreta

• Destruction of the snail vector in endemic areas

• Avoidance of swimming, bathing, wading or washing in infected water.
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THANK YOU