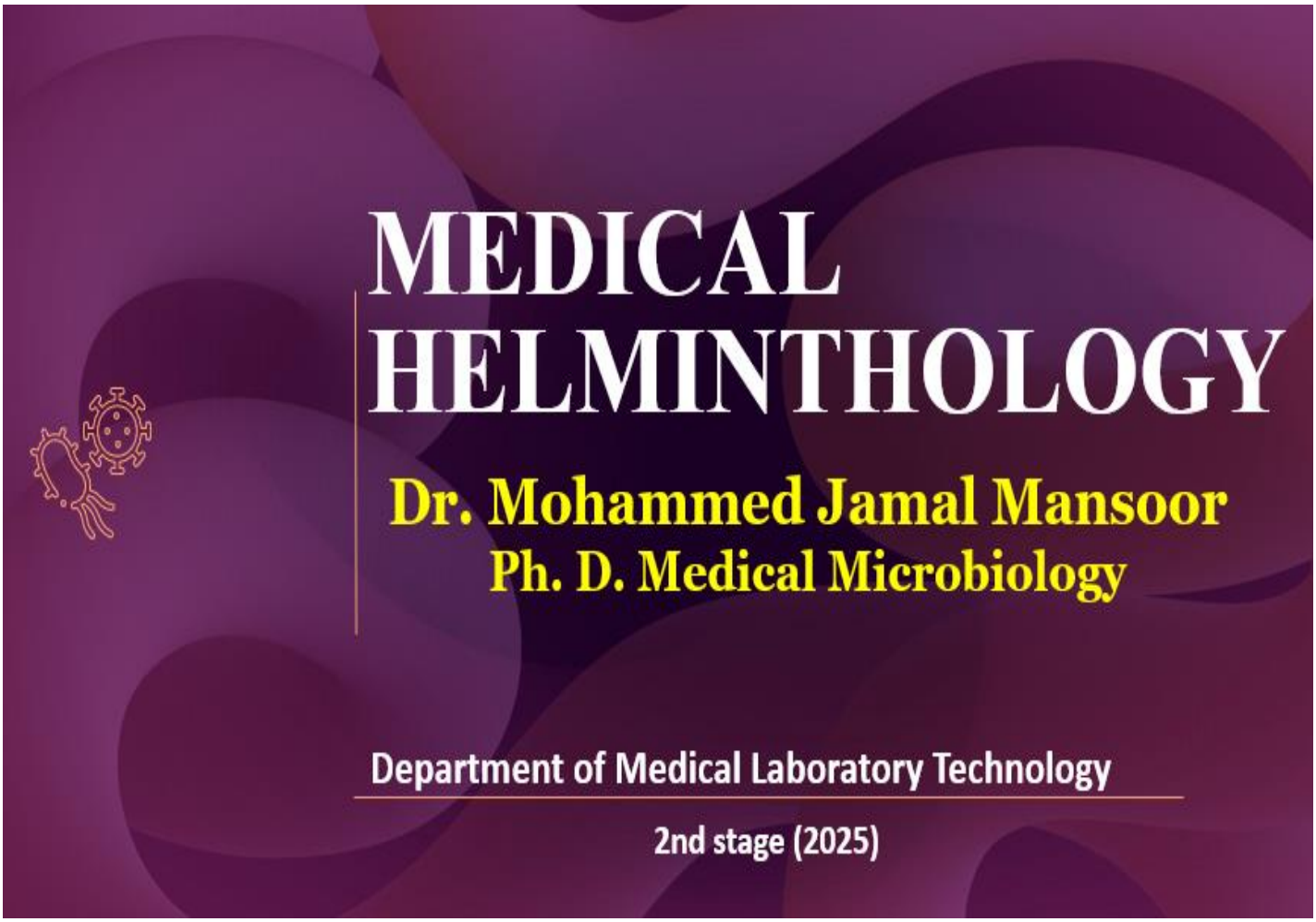
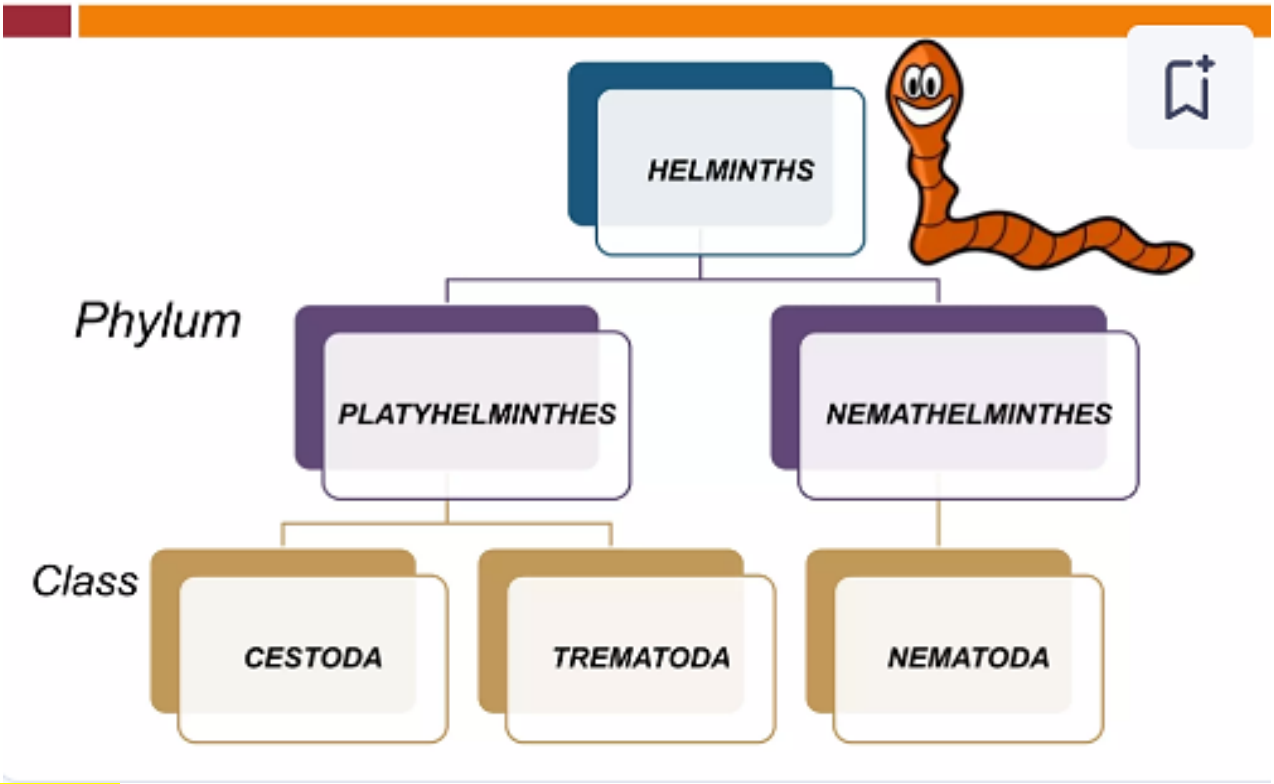

MEDICAL
HELMINTHOLOGY
Dr. Mohammed Jamal Mansoor
Ph. D. Medical Microbiology
Department of Medical Laboratory Technology
2nd stage (2025)

Lec.4 Trematodes: Flukes



Trematodes are **unsegmented** helminths, which are **flat and broad**, resembling the **leaf of a tree or a flatfish** (hence the name *Fluke*, from the *Anglo-saxon* word '*floc*' meaning '***flatfish***'). The name **Trematode** comes from their having **large prominent suckers** with a **hole in the middle** (Greek ***trema: hole***, *eidos*: *appearance*).

Classification Based on Habitat

Based on habitat, trematodes can be classified as

(1) **Blood flukes**

(2) **Liver flukes**

(3) **Intestinal flukes**

(4) **Lung flukes**

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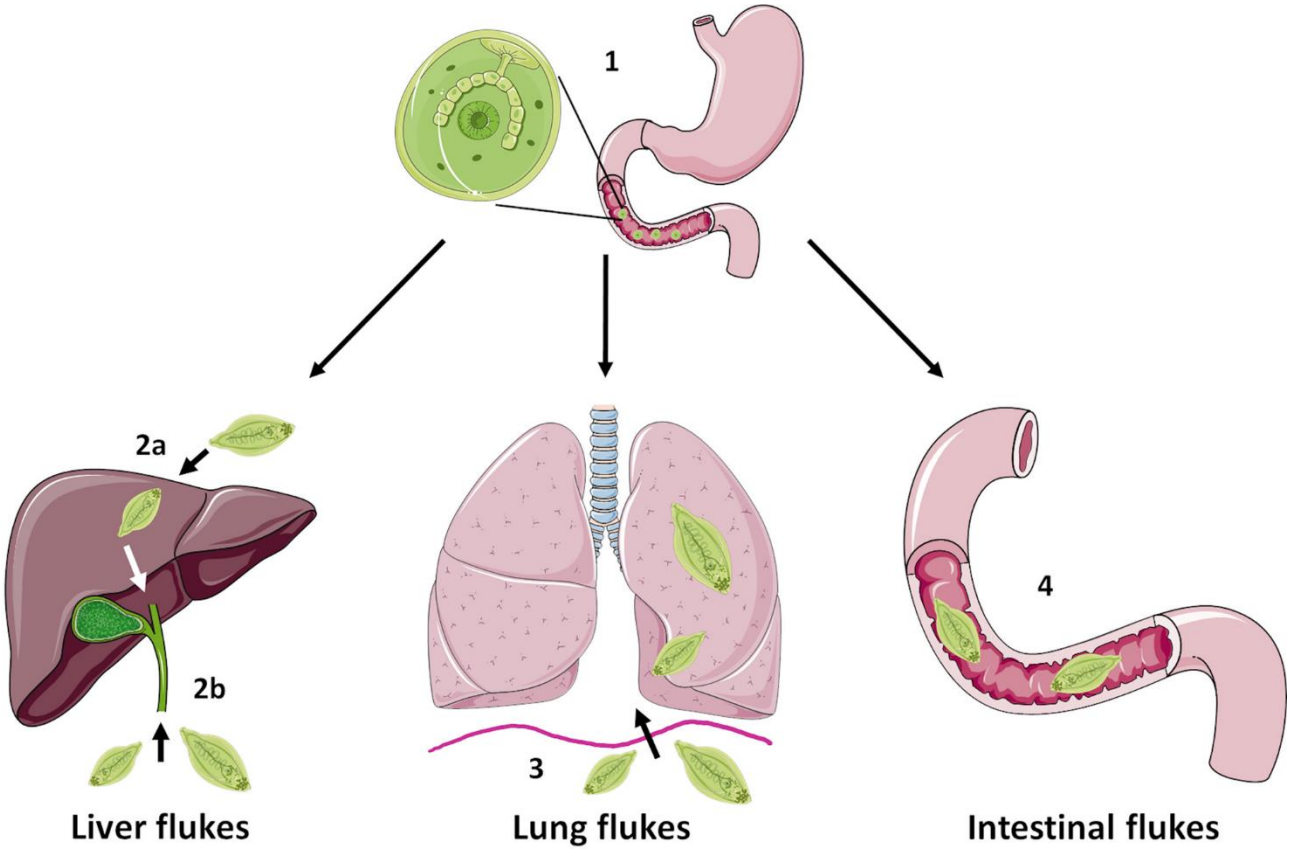


Flukes: General Characteristics

They vary in size from the species just visible to the naked eye, like *Heterophyes* to the large fleshy flukes, like *Fasciola* and *Fasciolopsis*.

- A prominent feature of flukes is the presence of **2 muscular cup-shaped suckers** (hence called **distomata**)— **the oral sucker** surrounding the mouth at the anterior end and the **ventral sucker or acetabulum** in the middle, ventrally.

The body is covered by an integument which often bears spines, papillae, or tubercles.

- They have **no body cavity**, **circulatory** and **respiratory organs**.
- The **alimentary system** consists of the mouth surrounded by the **oral sucker**, a muscular pharynx and the esophagus, which bifurcates anterior to the acetabulum to form **2 blind caeca**, that reunite in some species. **The alimentary canal, therefore appears like an inverted Y**. **The anus is absent.**
- The excretory system consists of flame cells and collecting tubules, which lead to a median bladder opening posteriorly.
- There is a primary nervous system consisting of paired ganglion cells.
- The reproductive system is well-developed. Flukes are **hermaphroditic** (**monoecious**) except for schistosomes, in which the sexes are separate (**dioecious**).

- The hermaphroditic flukes have both male and female structures, so that **self-fertilization** takes place, though in many species **cross-fertilization** also occurs.

In the schistosomes, the sexes are separate, but the male and female live in close apposition (***in copula***), the female fitting snugly into the folded ventral surface of the male, which forms the **gynecophoric canal**.

- Trematodes are **oviparous** and **lay eggs**, which are **operculated**, except in the case of schistosomes

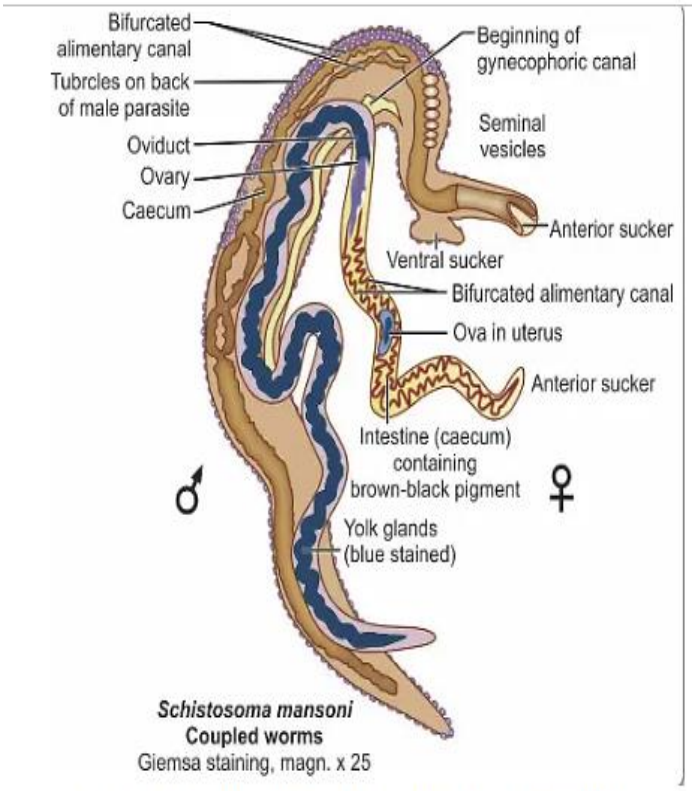
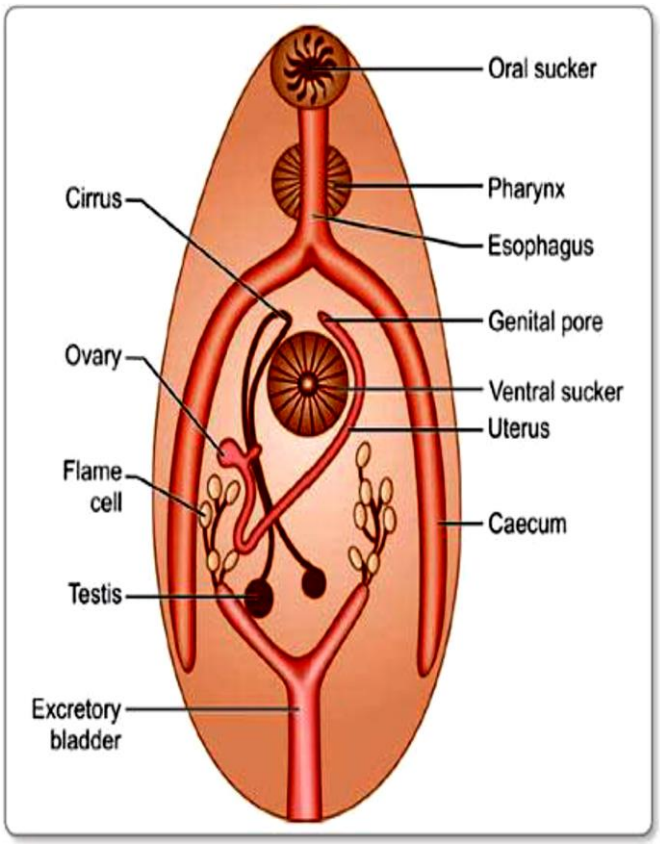


Fig: Schematic diagram showing structural details of Schistosoma (coupled)



Life Cycle

Medically important members of the class Trematoda belong to the subclass **Digenea**, as they are **digenetic**, i.e., **require 2 hosts** to complete their life cycle.

BLOOD FLUKES

Schistosomes

Schistosomes are **dioecious**, (sexes are separate) trematodes, which lead to **Schistosomiasis (bilharziasis).**

- Schistosomiasis is a water-borne disease constituting an important public health problem and affecting millions of persons in Africa, Asia, and Latin America.
- It is estimated that **over 100 million people** are infected with *S. haematobium*, *S. mansoni*, and *S. japonicum* each.
- The **male** worm is **broader** than the female and its lateral borders are **rolled ventrally into a cylindrical shape**, producing a long groove or trough called the **gynecophoric canal**, in which the female is held. It appears as though the body of the male is split longitudinally to produce this canal; hence the name schistosome (**Greek *schisto*: *split* and *soma*: *body***)
- Schistosomes were formerly called *Bilharzia* after **Theodor Bilharz** who in 1851, first observed the worm in the **mesenteric veins** of an Egyptian in Cairo.

Schistosomes differ from the hermaphroditic trematodes in many aspects.

- They are **unisexual (diecious)**.
- They **lack** a **muscular pharynx**.
- Their **intestinal caeca reunite after bifurcation to form a single canal**.
- They produce **non-operculated eggs**.
- They have **no redia stage** in larval development.
- The **cercariae** have **forked tails** and infect by penetrating the unbroken skin of definitive hosts.

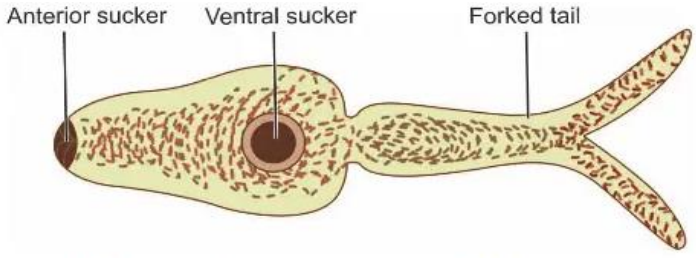


Fig: Schematic diagram to show cercaria larva of Schistosoma spp.

Schistosoma Haematobium

Habitat

The adult worms live in the vesical and pelvic plexuses of veins

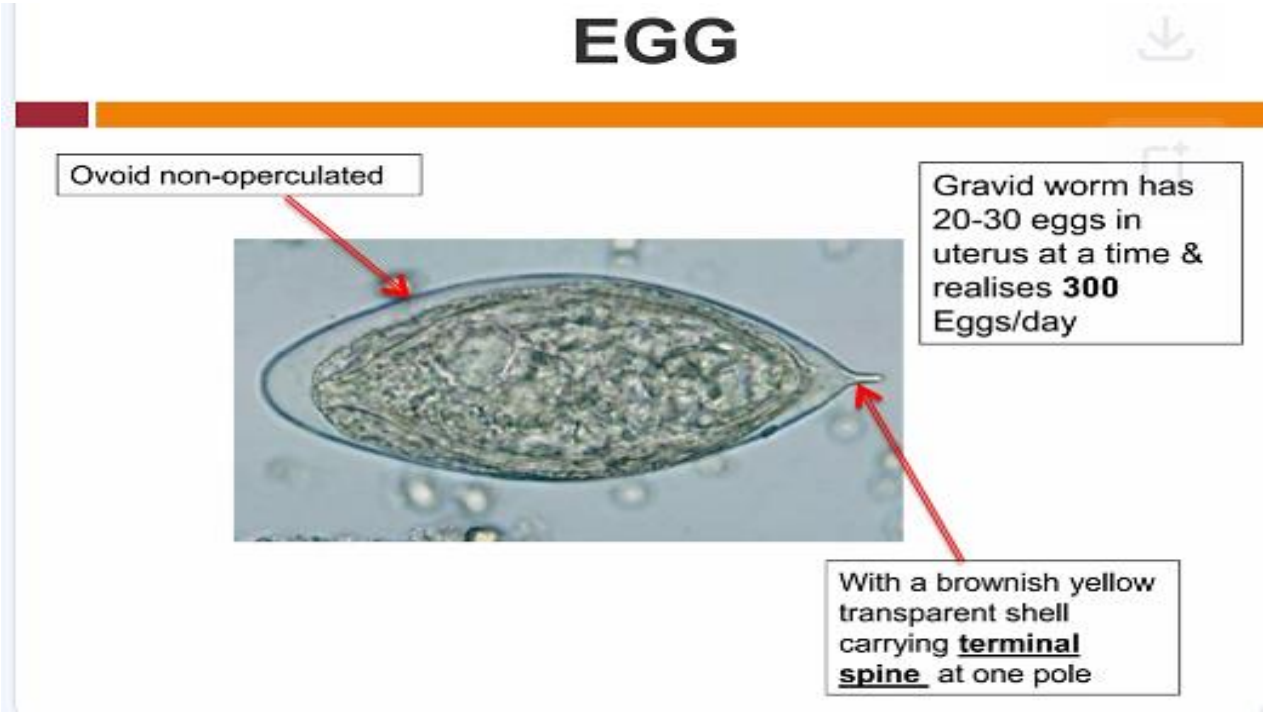
Morphology

Adult worm

- The male is 10–15 mm long by 1 mm thick and covered by a finely tuberculated cuticle.
- It has **2 muscular suckers**, the oral sucker being small and the ventral sucker large and prominent. Beginning immediately behind the ventral sucker and extending to the caudal end is the gynecophoric canal, in which the female worm is held.
- The adult female is long and slender, 20 mm by 0.25 mm with the cuticular tubercles confined to the two ends.
- The gravid worm contains 20–30 eggs in its uterus at one time and may pass up to 300 eggs a day.

Egg

The eggs are ovoid, about 150 µm by 50 µm, nonoperculated, with a brownish yellow transparent shell carrying a **terminal spine** at one pole; the terminal spine being



Life Cycle

S. haematobium passes its life cycle in 2 hosts.

Definitive host: Humans are the only natural definitive hosts. No animal reservoir is known.

Intermediate host: Fresh water snails.

Infective form: Cercaria larva

- The eggs that are passed in urine are embryonated and hatch in water under suitable conditions to release the free-living **ciliated miracidia**.
- Miracidia swim about in water and on encountering a suitable intermediate host, penetrate into its tissues and reach its liver. The intermediate hosts are snails of *Bulinus* species in Africa. In India, the intermediate host is the limpet, *Ferrisia tenuis*.

Development in Snail

Inside the snail, the miracidia lose their cilia and in about 4–8 weeks, successively pass through the stages of the **first and second generation sporocysts**.

- Large number of **cercariae** are produced by asexual reproduction within the second generation sporocyst.

The cercaria has an elongated ovoid body and forked tail (*furcocercous cercaria*)

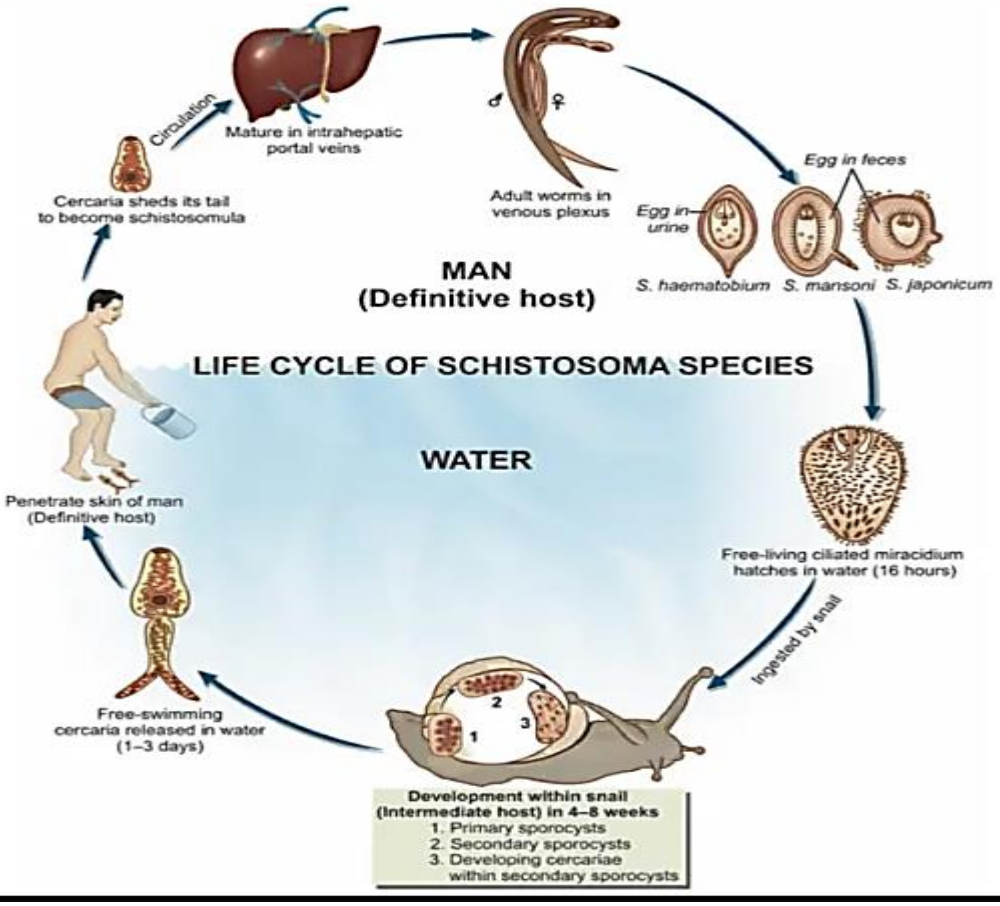
- **The cercariae escape from the snail.**
- **Swarms of cercariae swim about in water for 1–3 days.** If during that period they come into contact with persons bathing or wading in the water, they penetrate through their unbroken skin. **Skin penetration is facilitated by lytic substances secreted by penetration glands present in the cercaria.**

Development in Man

On entering the skin, **the cercariae shed their tails** and become **schistosomulae** which enter the peripheral venules.

- They then start a long migration, through the vena cava into the right side of the heart, the pulmonary circulation, the left side of the heart, and the systemic circulation, ultimately **reaching the liver**.
- In the **intrahepatic portal veins**, the schistosomulae grow and become **sexually differentiated adolescents** about 20 days after skin penetration.
- They then start migrating against the blood stream into the inferior mesenteric veins, ultimately reaching the **vesical** and **pelvic venous plexuses, where they mature, mate, and begin laying eggs**.
- **Eggs start appearing in urine usually 10–12 weeks after cercarial penetration**.
- **The adult worms may live for 20–30 years.**

Eggs hatch in water
↓
first stage larva
↓
Motile ciliated **MIRACIDIUM**
↓
Infects snail
↓
Cilia shed to become sporocyst
↓
Cell proliferation to form **germ balls**
↓
second generation sporocyst
↓
Cercariae formed by sexual reproduction → on maturity, escape from parent
↑
mature, mate, and lay eggs
↑
grow & is sexually differentiated
in 20 days in **intrahepatic portal veins**
↑
enters peripheral venules
↑
sheds tail - **schistosomulae**
↑
infection by direct skin penetration
↑
free living in water
↑
reaches vesical and pelvic venous plexus



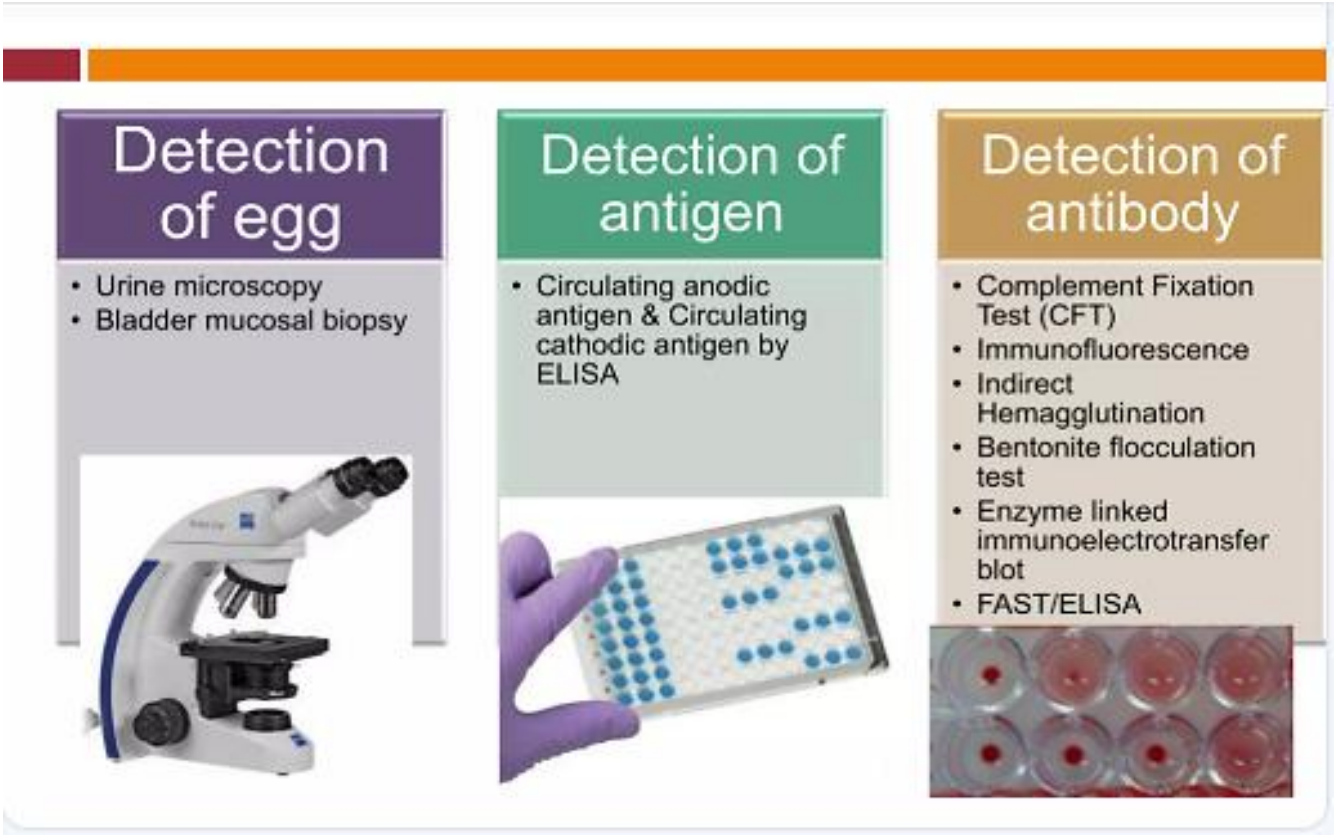
Pathogenicity and Clinical Features

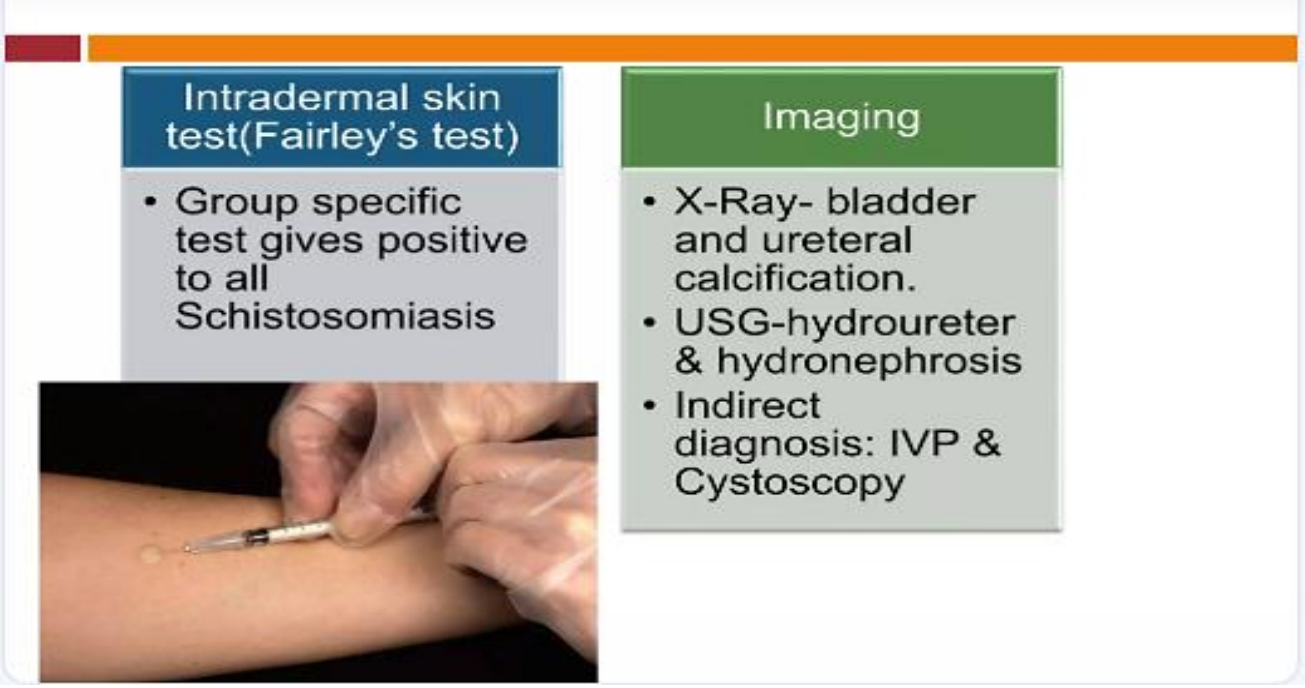
Clinical illness caused by schistosomes can be classified **depending on the stages** in the evolution of the infection, as follows:

- **Skin penetration and incubation period**
- **Egg deposition and extrusion**
- **Tissue proliferation and repair.**
- **The clinical features during the incubation period** may be **local cercarial dermatitis** or general **anaphylactic** or **toxic** symptoms.

- Cercarial dermatitis consists of transient itching and petechial lesions at the site of entry of the cercariae **(swimmer's itch).**
- It is particularly severe when infection occurs with cercariae of nonhuman schistosomes.
- Anaphylactic or toxic symptoms include fever, headache, malaise, and urticaria.
- This is accompanied by **leukocytosis**, **eosinophilia**, ⬆ enlarged tender liver, and a palpable spleen. This condition is more common in infection with *S. japonicum* (***Katayama fever***).

Laboratory Diagnosis of *Schistosoma haematobium*



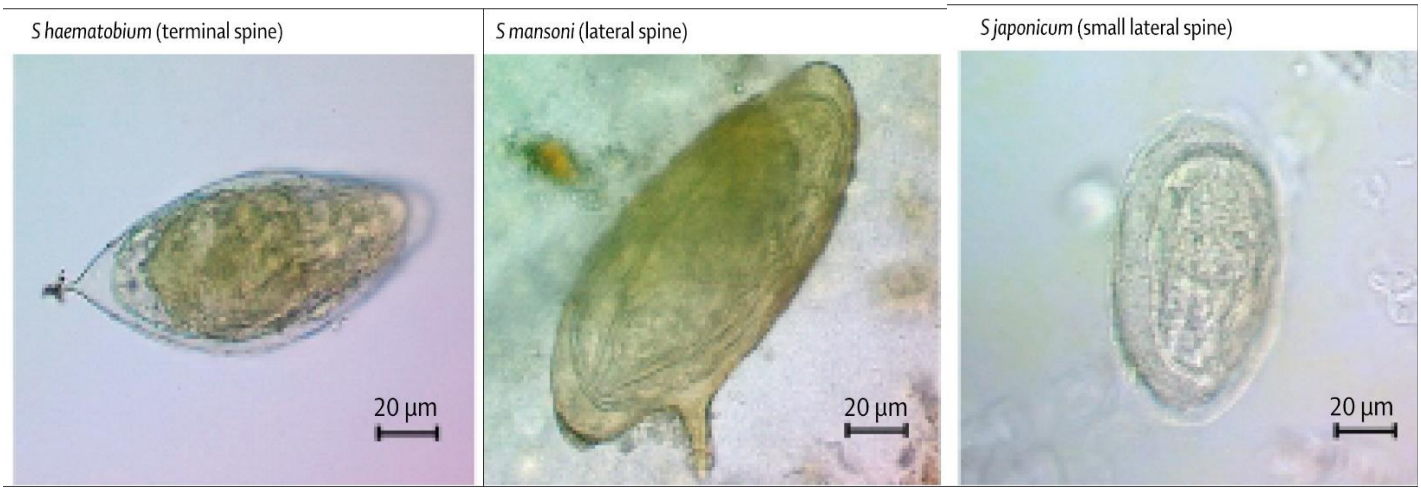


Intravenous pyelogram (IVP) is a type of X-ray used to diagnose conditions like stones and cysts in your kidneys, ureters and bladder. Dye is injected into your vein and travels to your kidneys, ureters and bladder where it's visible on X-ray.

Treatment

Praziquantel is the drug of choice (40mg/kg for 1 day).
Metriphonate is the alternative drug of choice.

	Schistosoma haematobium	*Schistosoma mansoni*	*Schistosoma japonicum*
Habitat	Veins of the vesical and pelvic plexuses, less commonly in portal vein and its mesenteric branches	Inferior mesenteric vein and its branches	Superior mesenteric vein and its branches
Morphology Size: Male Female Integument Number of testes Ovary Uterus	 • 1.5 cm x 1 mm • 2 cm x 0.22 mm • Finely tuberculated • 4–5 in groups • In the posterior one-third of the body • Contains 20–30 eggs	 • 1 cm x 1 mm • 1.4 cm x 0.25 mm • Grossly tuberculated • 8–9 in a zigzag row • In the anterior half of the body • 1–3 eggs	 • 1.2–2 cm x 0.5 mm • 2.6 cm x 0.3 mm • Nontubercular • 6–7 in a single file • In the middle of the body • 50 or more eggs
Egg	Elongated with terminal spine	Elongated with lateral spine	Round with small lateral knob
Cephalic glands in cercariae	Two pairs oxyphilic and three pairs basophilic	Two pairs oxyphilic and four pairs basophilic	Five pairs oxyphilic, no basophilic
Distribution	Africa, Near East, Middle East and India	Africa and South America	China, Japan and Far East (oriental)
Definitive host	Man	Man	Man (mainly) domestic animals and rodents (which act as reservoir of infection)
Intermediate host	Snail of genus *Bulinus*	Snail of genus *Biomphalaria*	Amphibian snail of genus *Oncomelania*



Q : How does a schistosome normally enter the body?
A- Through the urethra
B- Through the skin
C- Through the drinking water
D- Through the nose
E- Through the food
Q : The common name of Schistosoma
A- Protozoa
B- Bilharizia
C- Cestoda
D- None of the above
Q : For example sheep liver flukes
A- Fasciola hepatica
B- Toxoplasma gondii
C- Schistsoma haematobium
D- Teania saginata
E- Enteronuis vermicularis
Q : All species of trematode are hermaphrodite except
A- Fascialopsis
B- Paragonimus
C- Schistosomes
D- Toxoplasma
E- All of the above
Q : The eggs of trematodes hatch in
A- Colon
B- Water
C- Liver
D- Soil
E- Duodenum
Q : Terminal spined eggs are seen in
A- Schistosoma haematobium
B- Schistosoma mansoni
C- Schistosoma japonicum
D- Clonorchis sinensis
E- Diphyllobothrium

Q : Which of the parasites their eggs are operculated :
A- S. mansoni
B- S. japonicum
C- S. haematobium
D- Ascaris lambricoides
E- None of the above
Q : Cercaria larva is the infective form of :
A- Ascaris
B- Echinococcus granulosus
C- Taenia saginata
D- Taenia solium
E- Fasciola hepatica
Q : Nematoda residing in large intestine :
A- Schistsoma haematobium
B- Fasciola hepatica
C- Teania solium
D- Trichuris
E- Teania saginata
Q : All species of trematode are hermaphrodite except :
A- Fascialopsis
B- Paragonimus
C- Schistosomes
D- Toxoplasma
E- All of the above
Q : Snail is the intermediate hosts for :
A- Trichomonas vaginalis
B- Schistosoma haematobium
C- Taenia saginata
D- Toxoplasma gondit
E- Plasmodium malaria
Q : Diagnosis of schistosoma mansoni in human from
A- Urine analysis
B- Vaginal swab
C- Blood film
D- Sputum
E- None of the above

Q : Nematodes are differentiated from other worms by the following EXEPT :
A- Absent fragmentation
B- Flat or fleshy leaf-like worm
C- Separate sexes
D- Cylindrical body
E- None of them

What is the unique feature of the alimentary canal in flukes?
a) It resembles a straight line
b) It forms a loop
c) It appears like an inverted Y
d) It is absent in these organisms

Which of the following systems is absent in flukes?
a) Circulatory
b) Nervous
c) Respiratory
d) Excretory

What is the reproductive characteristic of most flukes?
a) They are dioecious
b) They reproduce asexually
c) They are viviparous
d) They are hermaphroditic

What is the estimated number of people infected with various Schistosoma species?
a) Less than 10 million
b) Approximately 50 million
c) Over 100 million
d) Around 500 million

What is the significance of the gynecophoric canal in male schistosomes?
a) It aids in reproduction
b) It functions as a respiratory organ
c) It is involved in excretion
d) It serves as a protective covering

How do cercariae infect definitive hosts?
a) By ingestion
b) By airborne transmission
c) By penetrating the skin
d) By entering through the respiratory system

What happens to cercariae upon entering the skin?
a) They immediately mature into adult worms
b) They shed their tails and become schistosomulae
c) They remain dormant in the dermis
d) They migrate to the lungs

Where do schistosomulae migrate to after entering the peripheral venules?
a) Lungs
b) Liver
c) Kidneys
d) Heart

When do schistosomulae become sexually differentiated adolescents?
a) Immediately after skin penetration
b) About 10 days after skin penetration
c) About 20 days after skin penetration
d) After reaching the liver

Q : Trematode which one ?
A- S. mansoni
B- Taenia solium
C- Ascaris lumbricoides
D- Hyminolipis nana
E- Echinococcus granulosus

Q : Which of the following is called blood fluke of man?
A- Taenia
B- Paragonium
C- Fasciola
D- Schistoma
E- None of the above

Q : Which one is trematode?

A- Enterobius vermicularis

B- Strongylaides stercoralis

C- Ascaris lumbricoides

D- Schistanama japonicumt

Please accept my sincere regards

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