Schistosomiasis and Fascioliasis

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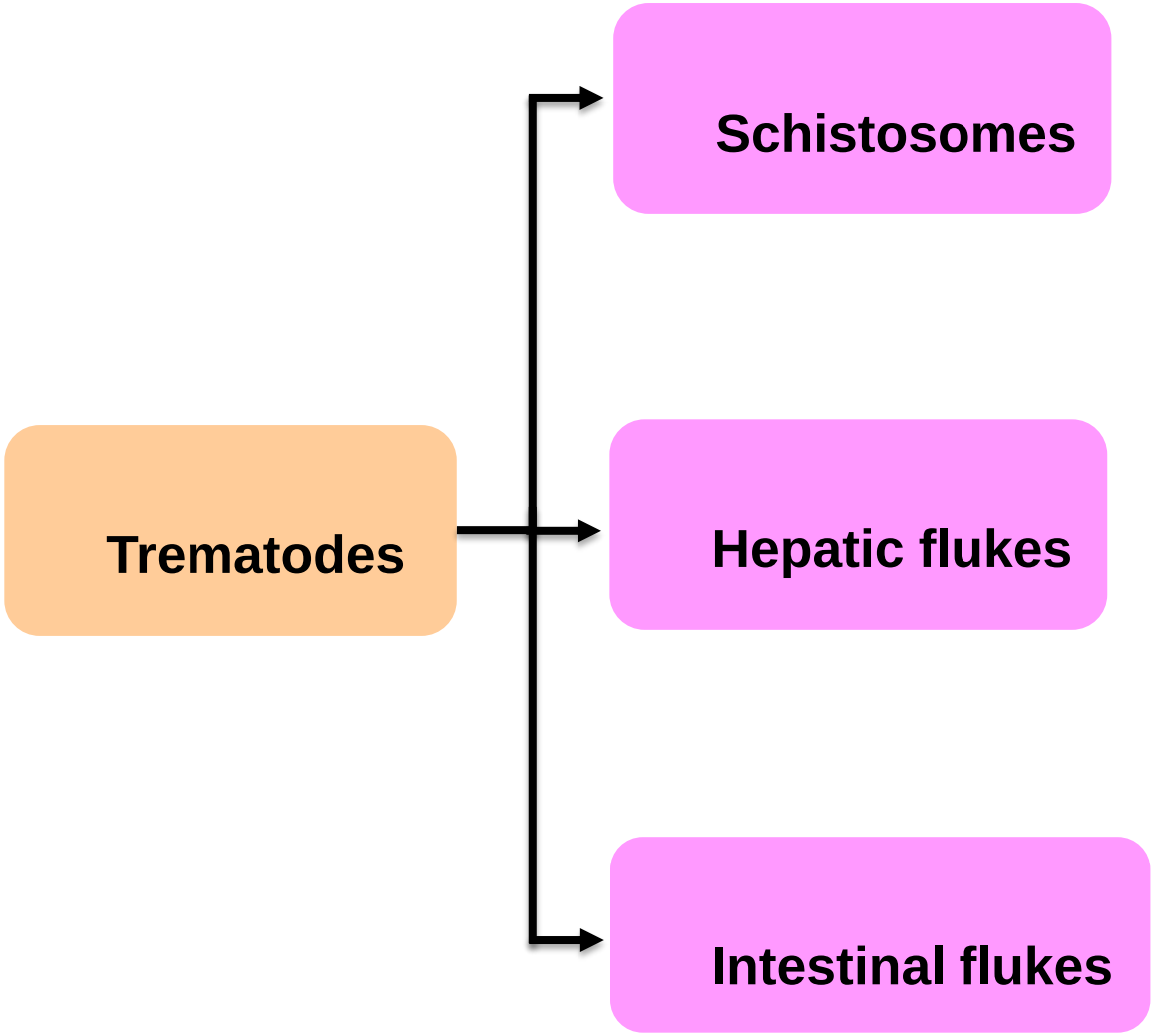
2 nd stage

Medical microbiology II (Parasitology)

University of Basra


Trematodes
Schistosomes
Hepatic flukes
Intestinal flukes

Schistosomiasis

Dr. Ayad almakki

Introduction

- Schistosomiasis is caused by helminth parasites of the genus Schistosoma
- The male has a ventral gynecophoric canal in which the female is held
- Intestinal Schistosomiasis ⇒ *S. mansoni & S. japonicum*
- Urinary Schistosomiasis ⇒ *S. heamatobium*
- Migrate to favoured sites:-
  - *S. mansoni* → mesenteric venules of large bowel and rectum
  - *S. japonicum* → mesenteric veins of the small intestine
  - *S. haematobium* → perivesical venous plexus surrounding the bladder

Connor (1997)

Introduction

- **Digenetic trematodes have a complicated life cycle in two or more hosts :**

  1- Definitive host (humans) 2- Intermediate host (fresh water snail)

- **Various animals, such as water buffalo, cows, dogs, cats, rodents, pigs, horses and goats, serve as reservoirs for S. japonicum.**

- **Infection occurs after contact with fresh water that contains the infective stage (Cercaria) of Schistosomes**

- **Etiology**

  Three Schistosomes most frequently associated with human disease are :

  1- *S. mansoni* (Schistosomiasis mansoni)
  2- *S. japonicum* (Schistosomiasis japonica)
  3- *S. haematobium* (Schistosomiasis haematobia)

Connor (1997)

Epidemiology

- Schistosomiasis is widespread in tropical and subtropical regions
- Schistosomiasis is most commonly found in Asia, Africa and South America
- *S. mansoni* is endemic throughout Africa, Middle East and South America.
- *S. japonicum* found in Asia only
- *S. haematobium* confined in Africa and Middle East.

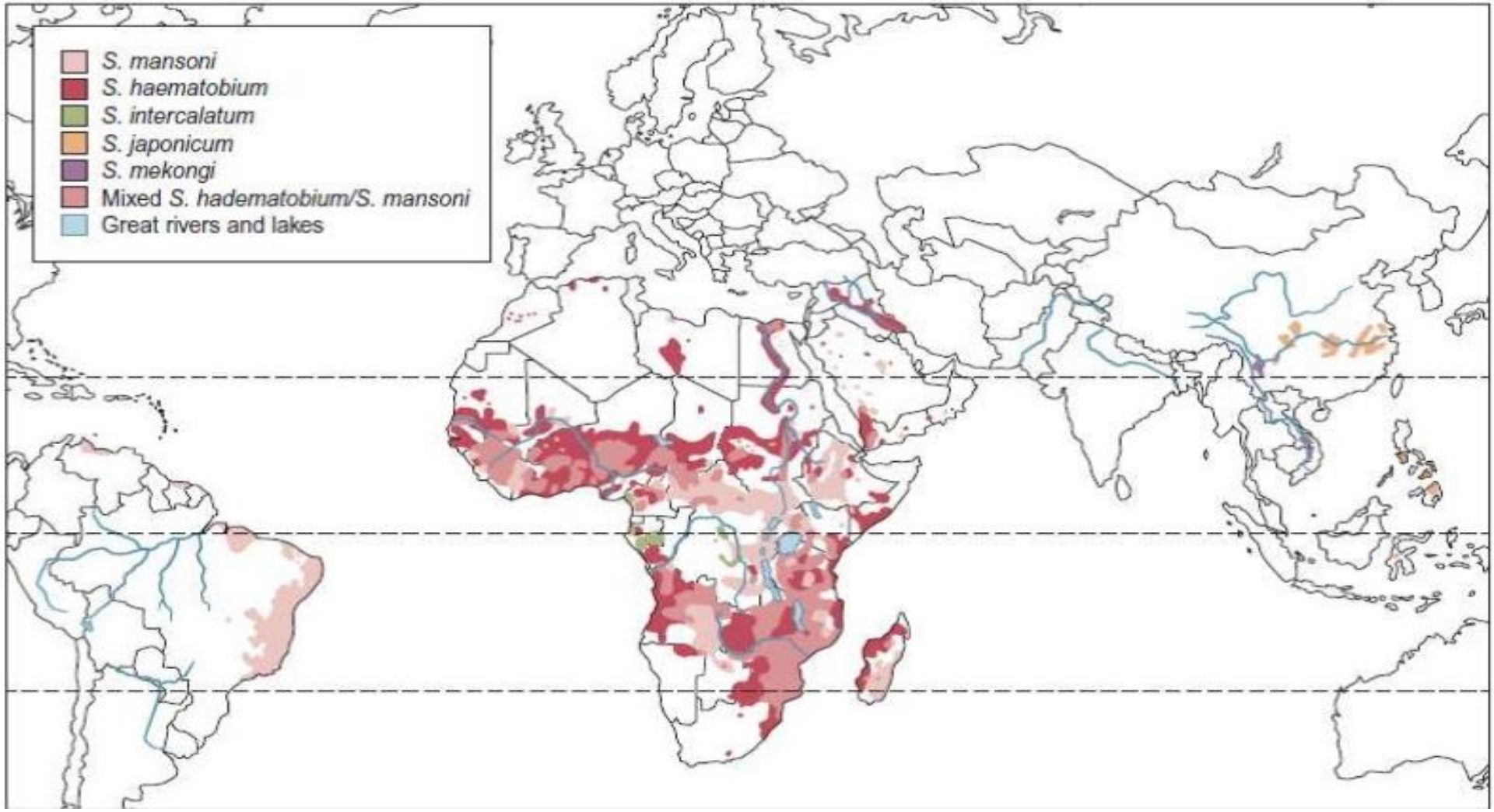
World Health Organization

Epidemiology

- **200 million persons infected with schistosomes in 74 countries**
- **120 million persons have symptoms, 20 million have severe disease and 100,000 die each year.**
- **Higher infection rate and infection burden in children**

World Health Organization

Epidemiology



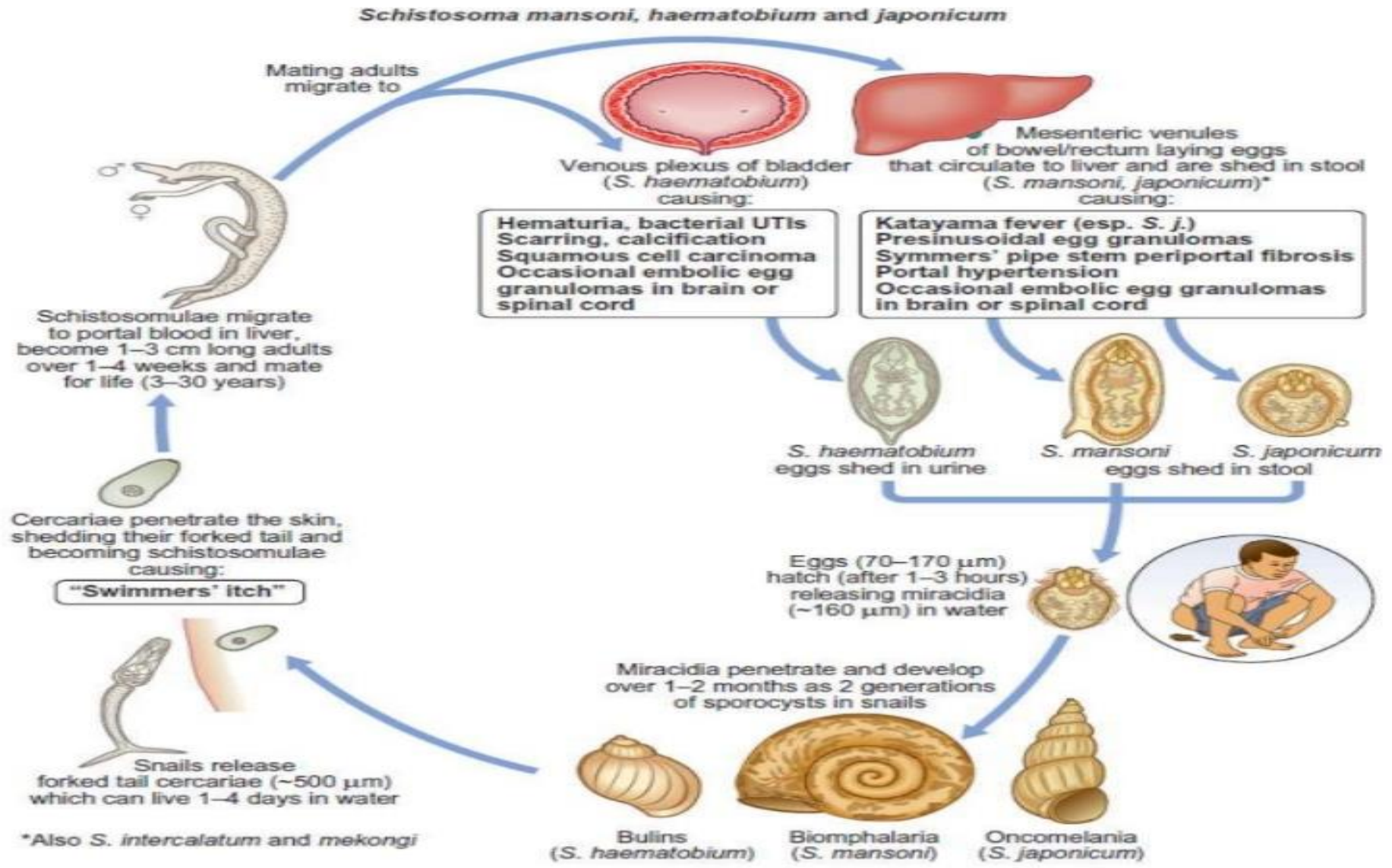
Map of worldwide distribution of Schistosomiasis

Life cycle

Eggs are eliminated in feces or urine. Under optimal conditions the eggs hatch and release **miracidia** , which swim and penetrate specific snail intermediate hosts . The stages in the snail include 2 generations of **sporocysts** and the production of **cercariae** . Upon release from the snail, the infective **cercariae** swim, penetrate the skin of the human host, and shed their forked tail, becoming schistosomulae . The schistosomulae migrate through several tissues and stages to their residence in the veins. Adult worms in humans reside in the mesenteric venules in various locations, depending on the species. For instance, ***S. japonicum*** is more frequently found in the superior mesenteric veins draining the small intestine, and ***S. mansoni*** occurs more often in the inferior mesenteric veins draining the large intestine. However, both species can occupy either location, and they are capable of moving between sites, so it is not possible to state unequivocally that one species only occurs in one location. ***S. haematobium*** most often occurs in the venous plexus of bladder, but it can also be found in the rectal venules. The females (size 7 to 20 mm; males slightly shorter) deposit eggs in the small venules of the portal and perivesical systems. The eggs are moved progressively toward the lumen of the intestine (***S. mansoni and S. japonicum***) and of the bladder and ureters (***S. haematobium***), and are eliminated in feces or urine, respectively. Human contact with water is thus necessary for infection by schistosomes.

Jones et al.,2011

Life cycle



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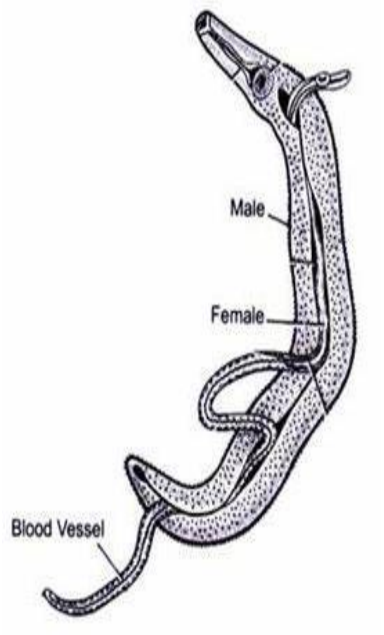
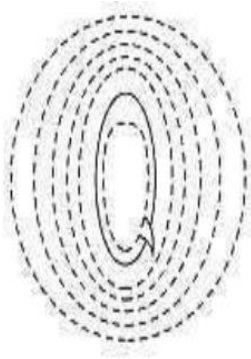
Pathogenesis

Origin	Stimulus	Response	Pathology



Adult Schistosomes in blood vessels around small or large intestine

Eggs laid by female are carried in blood vessels and trapped in liver



Hypersensitivity to antigens of larva inside egg cause formation of granuloma.

Liver sinusoids become blocked, impeding blood flow

Fibrosis of liver

Raised portal pressure perihepatic shunting of blood hepatomegaly splenomegaly formation of varices

Jones et al.,2011

Pathogenesis

- Adult worm evades host immune mechanisms

Alteration of the antigenic properties of their external surfaces. This is accomplished in part by incorporating host antigens into their external cuticular layer and allows the parasite to survive within the host for decades

- Most of the pathology is caused by host immune response to the eggs
- The course of infection is often divided into three phases:

1- Migratory or Immediate

- Occurs when cercariae penetrate and migrate through the skin
- In sensitized patients it may cause ; Cercarial dermatitis

Immediate and delayed hypersensitivity to parasite antigens

Jones et al.,2011

Question

How do helminthes, such as Schistosomes, avoid the host response?

Pathogenesis

Jones et al.,2011

2- Acute

- The onset of oviposition results in a symptom complex known as **Katayama syndrome**, which is marked by fever, chills, cough, urticaria , arthralgias, lymphadenopathy, splenomegaly and abdominal pain

- **Katayama syndrome** is typically seen 1 to 2 months after primary exposure and may persist for 3 months or more.

- Massive release of parasite antigens, with subsequent immune complex formation.

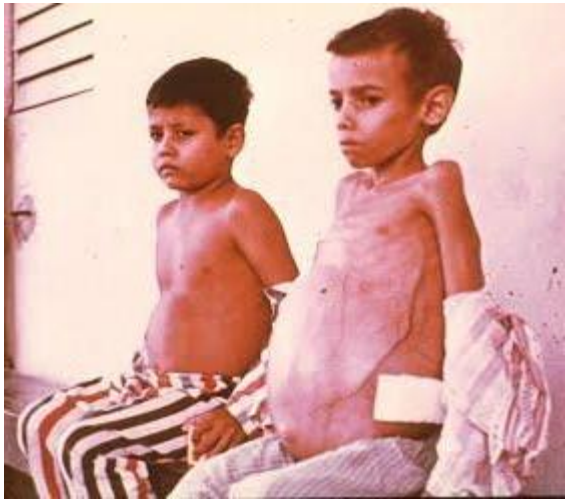
Laboratory abnormalities include leukocytosis, eosinophilia and polyclonal gammopathy (paraproteinemia)

Note: *S. haematobium* produces hematuria, dysuria and urinary frequency as early symptoms

Pathogenesis

3- Chronic

- Occurs in response to the cumulative deposition of eggs in various tissues and the host reactions that develop against them
- Not all the eggs successfully penetrate the gut or bladder walls into excreta, some trapped in organs where they elicit strong granulomatous responses
- *S. mansoni* ➡
  - Hepatosplenomegaly with large accumulations of ascetic fluid in the peritoneal cavity
  - Caly pipestem fibrosis



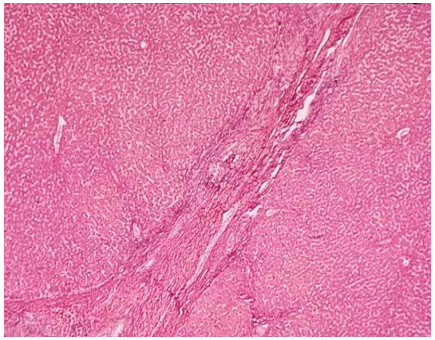
Jones et al.,2011

Pathogenesis

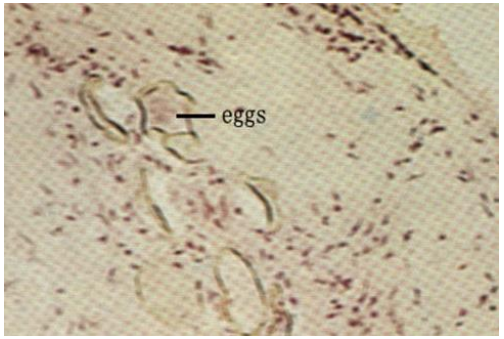
Jones et al.,2011

3- Chronic

- *S. japonicum*
  - Hepatosplenic disease, portal hypertension, bleeding esophageal varices, and accumulation of ascetic fluid are commonly seen
  - Granulomas that appear as pseudotubercles in and on the liver are common, along with the clay pipestem fibrosis
  - Cerebral infection when eggs reach the brain and granulomas develop around them. The neurologic manifestations include lethargy, speech impairment, visual defects and seizures.



clay pipestem fibrosis



Eggs of *S.japonicum* in the brain

Pathogenesis

3- Chronic

- *S. haematobium* ➡
  - Squamous cell carcinoma of the bladder (bladder cancer)
  - The granulomas and pseudotubercles seen in the bladder may also be present in the lungs.
  - Fibrosis of the pulmonary bed caused by egg deposition leads to dyspnea, cough and hemoptysis

Jones et al.,2011

Question

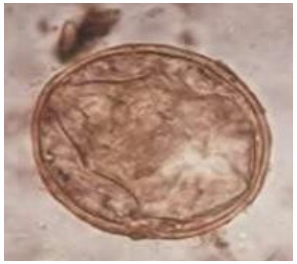
Why is *P. S. japonicum* more dangerous than other species of Schistosome ?

Diagnosis

❑ *Microscopic detection:*

- ✓ ***S. mansoni*** : Stool examination demonstrates the large, golden eggs with a sharp lateral spine

- ✓ ***S. japonicum*** : Stool examination demonstrates the small, golden eggs and almost spherical, has no spine but show a lateral knob.



- ✓ ***S. haematobium*** : Urine examination demonstrates the large, terminally spined eggs

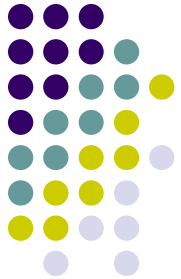
❑ *Biopsy*

❑ *Serologic tests*

Strickland (2000)

Treatment

Keiser et al.,2010



- ✓ Praziquantel most widely used drug.
- ***S. japonicum*** :Praziquantel 60 mg/kg divided into 3 doses for one day duration
- ***S. mansoni*** :Praziquantel 40 mg/kg divided into 1 or 2 doses for one day duration

  - Oxamniquine

- ***S. haematobium*** :Praziquantel 40 mg/kg divided into 1 or 2 doses for one day duration

  - Metrifonate

Mechanism of action

Praziquantel affects permeability to calcium ions , allowing a rapid influx

↓

Elevated intracellular calcium levels, tetanic muscular contraction and destruction of the tegument

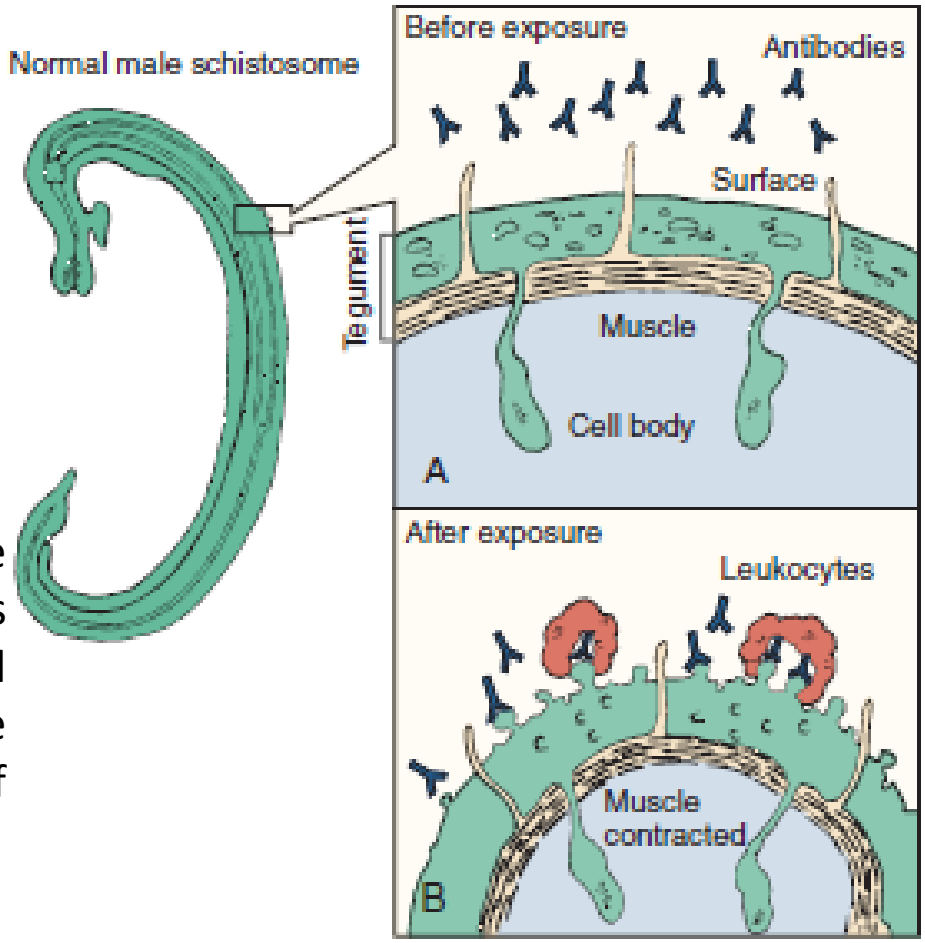
Treatment

Mechanism of action

Before exposure to praziquantel, the schistosome is capable of avoiding the numerous antibodies directed toward surface and internally located antigens.

(A) Cross-section of the dorsal surface of a normal male schistosome. Within 1 to 2 seconds after exposure to praziquantel, the muscles of the schistosome contract because of a druginduced influx of calcium ions into the schistosome tegument.

(B) The change in permeability of the schistosome surface toward external ions initiates the appearance of small holes and balloon-like structures, making the parasite vulnerable to antibody-mediated adherence of host leukocytes that kill the helminth.



Keiser et al.,2010

Question

What is the drug used for treating Katayama fever?

Prevention & Control

- Avoid contact with water known to contain cercariae
- Destroying snail intermediate host
- Treating water supply by using chlorine
- Waste disposal management, toilets and sanitation

Meltzer et al.,2006

Hepatic flukes

Fascioliasis

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Introduction

- Large and broadly-flat, measuring up to 30 mm X 13 mm
- The anterior end is conical projection
- Habitat : bile ducts and gallbladder
- Disease : Fascioliasis

Life cycle

Fasciola parasites develop into adult flukes in the bile ducts of infected mammals, which pass immature Fasciola eggs in their feces. The next part of the life cycle occurs in freshwater. After several weeks, the eggs hatch, producing a parasite form known as the miracidium, which then infects a snail host. Under optimal conditions, the development process in the snail may be completed in 5 to 7 weeks; cercariae are then shed in the water around the snail. The cercariae lose their tails when they encyst as **metacercariae (infective larvae)** on water plants. In contrast to cercariae, metacercariae have a hard outer cyst wall and can survive for prolonged periods in wet environments. Immature Fasciola eggs are discharged in the biliary ducts and in the stool. Eggs become embryonated in water; eggs release miracidia , which invade a suitable snail intermediate host, including the genera Galba, Fossaria, and Pseudosuccinea. In the snail the parasites undergo several developmental stages (sporocysts , rediae , and cercariae). The cercariae are released from the snail and encyst as metacercariaeon aquatic vegetation or other surfaces. Mammals acquire the infection by eating vegetation containing metacercariae. Humans can become infected by ingesting metacercariae-containing freshwater plants, especially watercress. After ingestion, the metacercariae excyst in the duodenum and migrate through the intestinal wall, the peritoneal cavity, and the liver parenchyma into the biliary ducts, where they develop into adult flukes. In humans, maturation from metacercariae into adult flukes takes approximately 3 to 4 months. The adult flukes (Fasciola hepatica: up to 30 mm by 13 mm; F. gigantica: up to 75 mm) reside in the large biliary ducts of the mammalian host. Fasciola hepatica infects various animal species, mostly herbivores (plant-eating animals).

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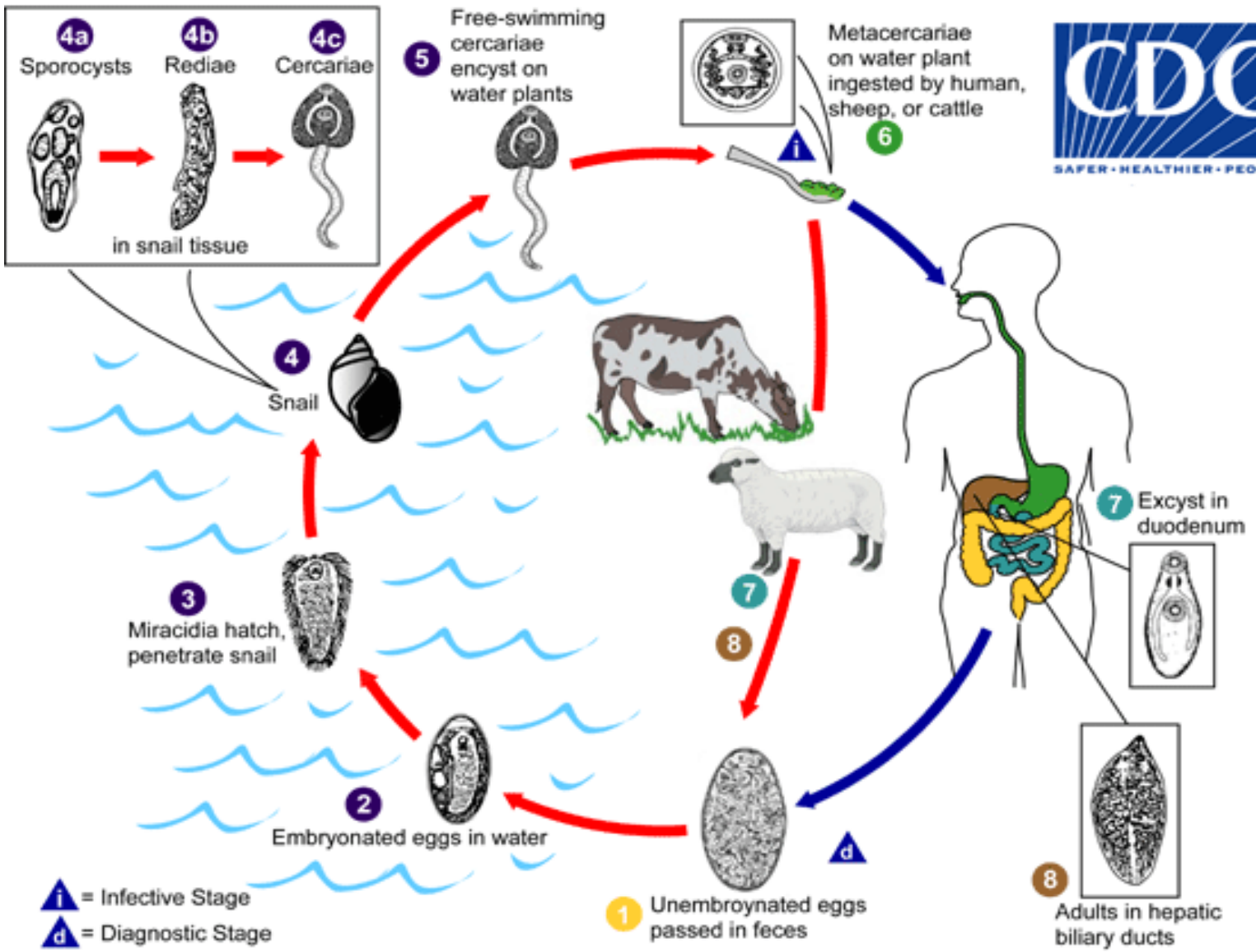
Life cycle



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Clinical syndromes

Acute/ Migratory phase

- In 6-12 weeks after infection : marked eosinophilia, abdominal pain, intermittent high fever, weight loss and urticaria
- Tender hepatomegaly, Jaundice and anemia

Chronic phase

- Eosinophilia
- Iiflammation and intermittent obstruction of bile ducts, cholecystitis and ascending cholangitis

Diagnosis

- **Finding eggs in stool**

Treatment

- ***Triclabendazole 10 mg/kg / 1 day***
- ***Bithionol***
- ***Nitazoxanide***


Thank you for
your attention