

## Helminthes Trematodes

### General characteristics

- Fluke is the common name for any member of the class *Trematoda*
- Trematodes are relatively simple, flatworms, soft-bodied, the fluke body is unsegmented and covered by a tough cuticular *tegument* for its protection from digestive enzymes of the host.
- Possess two suckers, one oral anterior in position and surrounding the mouth and the other the ventral lying on the ventral surface.
- They have a blind digestive system, i.e. without anus: the only opening is the mouth. waste products are regurgitated.
- Most are hermaphroditic and capable of self-fertilization. except for schistosoma, which have separate male and female.
- Have complicated life cycle occurring in two or more host, involving sexual reproduction in mammalian and other vertebrate (definitive hosts) and asexual reproduction in snail (intermediate hosts). Each species requires a certain species of snail as an intermediate host.
- Trematode eggs usually have a smooth, transparent, yellow-brown shell and may have spines
- Reproductive system: Uterus is the largest organ; a single ovary, testes and a series of glandular structures that produce egg. Uterus may be filled with thousands of eggs.
- Trematodes infect various organs of the human host (for example, intestinal veins, urinary bladder, liver, or lung).

### Types of Flukes

Flukes can be categorized into groups on the basis of the systems they infect:

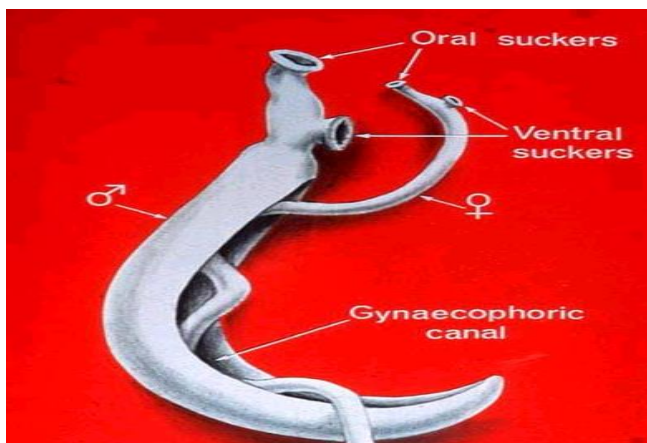
- (1) The hermaphroditic liver flukes which reside in the liver such as *Clonorchis sinensis*, *Fasciola hepatica*
- (2) The hermaphroditic intestinal fluke occur attached to the mucosa of the intestine such as *Fasciolopsis buski*, *Heterophyes*.
- (3) The hermaphroditic lung fluke which reside in the lung such as *Paragonimus*
- (4) The bisexual blood flukes such as *Schistosoma*, inhabits the blood in some stages of their life cycle which live in the intestinal or vesical (urinary bladder) venules

## Blood flukes: Schistosoma

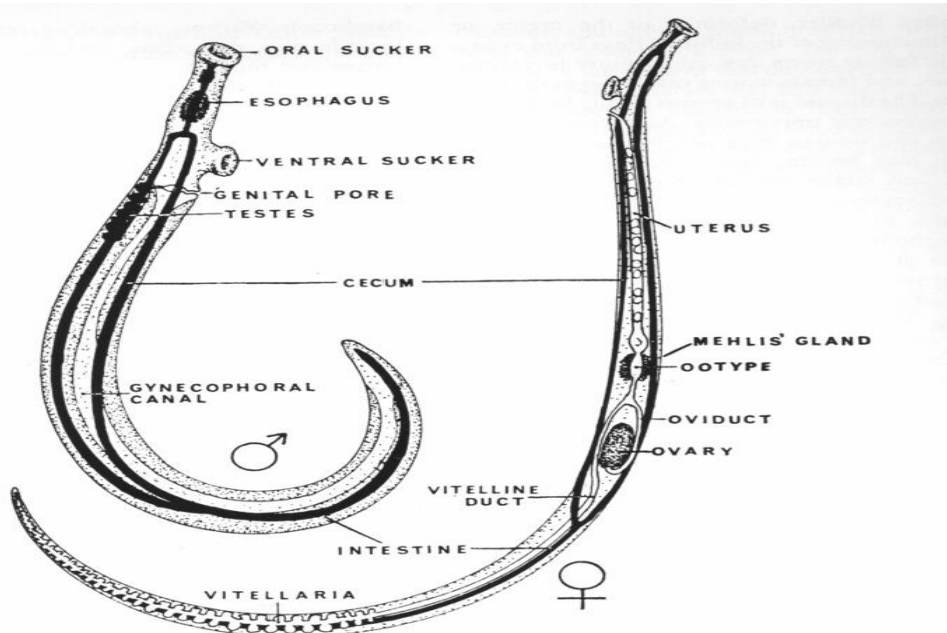
Schistosoma is by far the most important trematode parasite. It is flat worms live in the blood stream of warm-blooded hosts and undermine the health of the blood. They differ from other trematodes in that they have separate sexes. Adults exist as two sexes but are attached to each other. The female resides in a groove in the male, the gynecophoric canal (schist) where he continuously fertilizes her eggs. The male worms resemble a rolled leaf where they bear the longer and more slender female in a ventral canal (the gynaecophoric canal). Both sexes have two suckers, one anterior and one ventral, which are used to grip venule walls. They require definitive and intermediate hosts to complete their life cycle. Humans are definitive hosts, while snails are intermediate hosts. Dogs, cats, rodents, pigs, horses, and goats are reservoirs for *S. japonicum*.

Schistosoma is the only trematode that invades through the skin; all other trematodes infect only via ingestion. It causes schistosomiasis or Bilharzia disease and is the most important of helminth diseases. The source of infection is through swimming in infected water. There are three main species of schistosoma that infect humans, have similar life cycles:

- 1- *S. mansoni*: Adult worms live in the plexus of veins draining the rectum and colon, and in branches of the portal vein in the liver. Its cause intestinal disease.
- 2- *S. japonicum*: Adults worms live in the anterior mesenteric blood vessels and in the portal vein in the liver. Its cause intestinal disease.
- 3- *S. haematobium*: Adult worms live in the veins draining the urinary bladder. Its causes urinary tract disease.



**Schistosoma (blood flukes)**

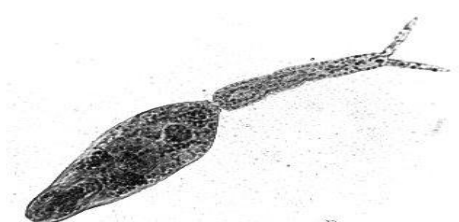


### ***Schistosoma japonicum* (blood flukes)**

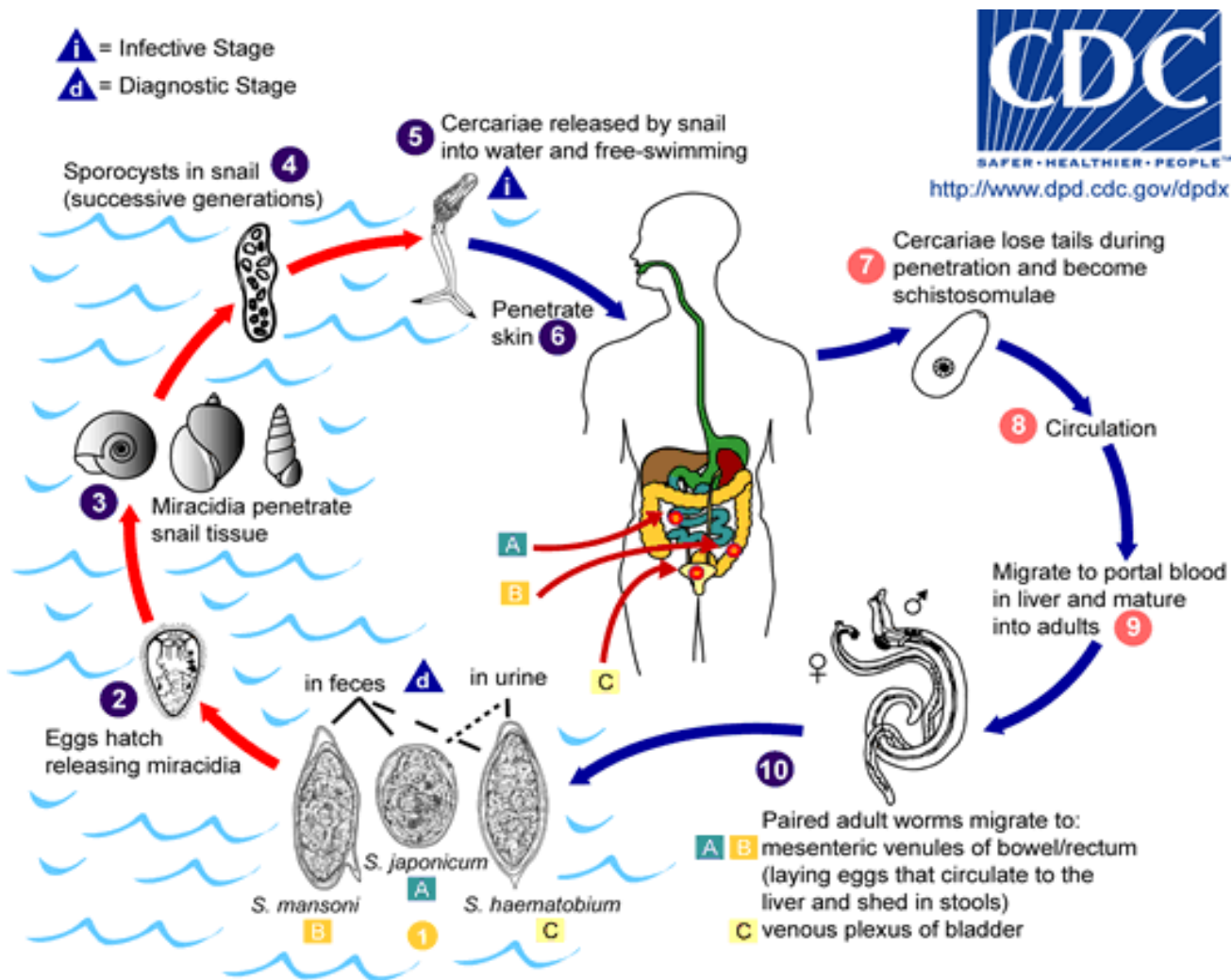
#### **Life cycle**

When human are swimming in contaminated water, the free-swimming fork-tailed cercariae penetrate the skin of human and infected its. They differentiate to larvae(schistosomula), enter the blood, and are carried via the veins into the arterial circulation. Those that enter the superior mesenteric artery pass into the portal circulation and reach the liver, where they mature into adult flukes. *S. mansoni* and *S. japonicum* adults migrate against the portal flow to reside in the mesenteric venules, while *S. haematobium* adults reach the bladder veins through the venous plexus between the rectum and the bladder.

In their definitive venous site, the female lays fertilized eggs, which penetrate the vascular endothelium and enter the gut (*S. mansoni* and *S. japonicum*) or bladder lumen (*S. haematobium*). The eggs are excreted in the stool or urine and must enter fresh water to hatch. Once hatched, the ciliate larvae (miracidia) penetrate snails and undergo asexual multiplication to produce many cercariae into the water (The three schistosomes use different species of snails as intermediate hosts). Cercariae leave the snails, cercariae actively swim and enter fresh water, and complete the cycle by penetrating human skin. Life span of the adults is about 20-30 years.



**Schistosome forked tail cercariae**



## Schistosoma species (Blood flukes) Life cycle for all specie

### Pathogenicity

Most important pathology is caused by the presence of eggs in the liver, spleen, or wall of the gut or bladder. Therefore, pathogenicity of flukes varies with the sites of their infection. Eggs in tissue induce inflammation, granulomas, fibrosis, and obstruction in tissue, especially in liver and spleen and causes hepatosplenomegaly. *S. mansoni* damages the colon (inferior mesenteric venules), while *S. japonicum* damages the small intestine (superior mesenteric venules). The damage is due both to digestion of tissue by photolytic enzymes produced by the egg and the host inflammatory response that forms granulomas in the venules. *S. haematobium* damages the bladder venules which can lead to carcinoma of the bladder.

### Clinical finding

Most infections are asymptomatic, but chronic infections may become symptomatic. The acute stage which begins shortly after cercariae penetration and consists of dermatitis, followed several weeks later by fever and chills, diarrhea, malaise, lymphadenopathy and abdominal pain resulting from enlargements of the liver and spleen. Eosinophilia (elevates the number of white blood cells) is seen in response to migrating larvae. This stage usually resolves spontaneously. Chronic symptoms vary with species but include bloody diarrhea (eg, with *S. mansoni* and *S. japonicum*) or (eg, with *S. haematobium*). Chronic stage causes significant mortality and morbidity.



**Advanced schistosomiasis patient with portal hypertension and ascites**

## Diagnosis

Diagnosis is based on a history of residence in an endemic area, swimmers' itch and other symptoms. Stool or urine is examined for eggs. Eggs are distinguished by spines and their difference according to the species:

- *Schistosoma mansoni* has **large lateral spine**
- *Schistosoma japonicum* has **small lateral spine**
- *Schistosoma haematobium* has **terminal spine**

If the clinical picture suggests schistosomiasis but no eggs are found after repeated examination of urine or feces, intestinal or bladder mucosa can be biopsied to check for eggs. Serologic tests may be sensitive and specific.



***S. japonicum***



***S. Mansoni***



***S. haematobium***

**Schistosome egg**

## **Treatment**

Praziquantel is the treatment of choice for all three species. The mode of action is not exactly known at present, but experimental evidence indicates that praziquantel increase the permeability of the membranes of schistosoma cells toward calcium ions. The drug thereby induces contraction of the parasites, resulting in schistosomes paralysis in the contracted state. Praziquantel also produces intense vacuolization at several sites in tegument of adult schistosomesthis is followed by phagocytic attachment to parasite and, ultimately, death. The effect is more marked on adult worms compared to young worms.

## **Prevention:**

- 1-Contaminated water and swimming in endemic areas should be avoided.
- 2- Proper disposal of human waste and destruction of snails.

## **Liver flukes**

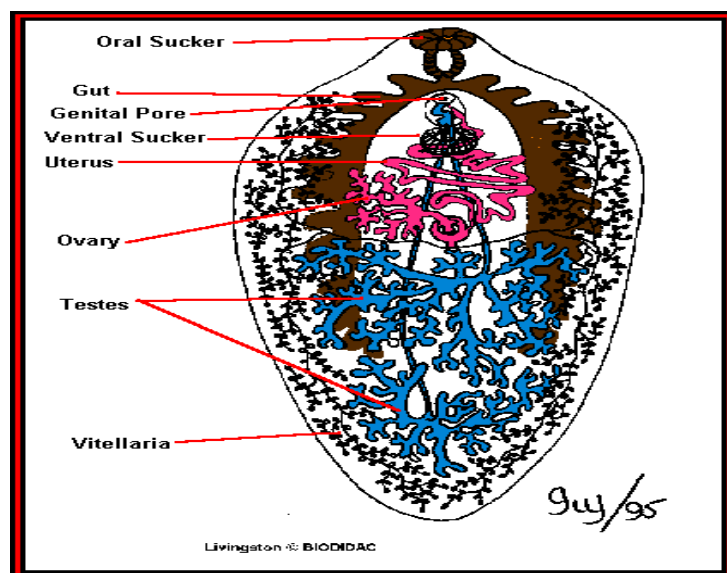


Liver flukes are parasites that are localized in the liver and biliary passage of various mammals. Human liver flukes belong to two families, the Opisthorchiidae and the Fasciolidae. Opisthorchiidae has three species (*Clonorchis sinensis*, *Op. viverrini*, *Op. felinus*). In the Fasciolidae (*F. gigantica* and *F. hepatica*).

## ***Fasciola***

*F. hepatica* (the sheep liver fluke) and *F. gigantica* (mainly of cattle) cause fascioliasis in humans. The parasites vary in adult and egg size and species of the snail host of the family Lymnaeidae. *Fasciola hepatica* was the largest and most common liver fluke found in humans, but its primary host is the sheep. It is worldwide in distribution, being found mainly in sheep-rearing areas. It causes the economically important disease 'liver rot' in sheep. Humans usually become infected by eating aquatic plants grown in water contaminated with feces from animals harbouring fasciola.

The adult worm lives in the biliary tract of the definitive host for many years, about 5 years in sheep and 10 years in humans. It is a large leaf-shaped fleshy fluke, 30 mm long and 15 mm broad, grey or brown in color. It has a conical projection anteriorly and is rounded posteriorly. The eggs are large, ovoid, operculated, bile stained. They are laid in the biliary passages and shed in feces.



A B



***F. hepatica*(A-adult,B-egg)**

## **Life cycle**

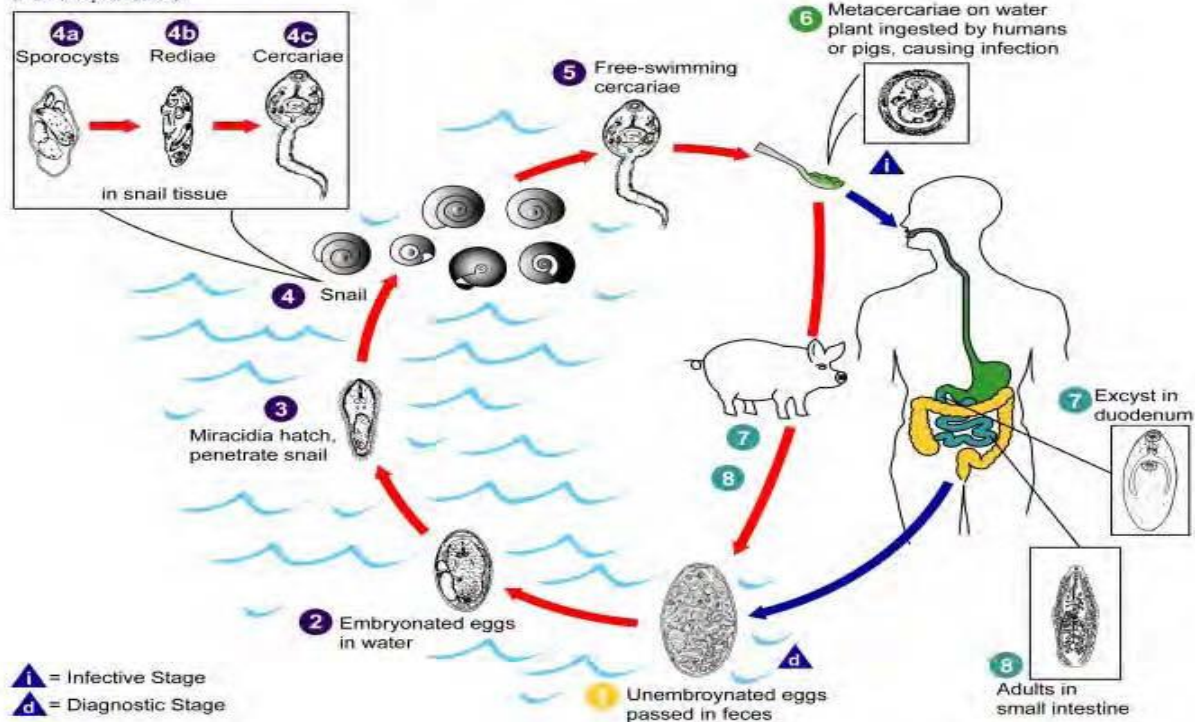
The adult worm lives in the bile duct of the final host and immature eggs discharged in the biliary ducts are excreted in the feces of the host. The embryo

matures in water in about 10 days and the miracidium escapes and invades a snail intermediate host of the genus *Lymnae*. In the snail the parasites undergo several developmental stages (sporocysts, rediae, and cercariae). The cercariae are released from the snail and encyst as metacercariae on aquatic vegetation or other surfaces. Sheep, cattle or humans eating water vegetation containing the metacercariae become infected. 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 adults. In humans, maturation from metacercariae into adult flukes takes approximately 3 to 4 months.

## Pathogenicity

These parasites cause considerable mortality in sheep, cattle and human. The acute phase occurs during migration of the immature flukes through the liver, it causes parenchymal injury, haemorrhage, inflammatory responses largely mediated by eosinophils. Some larvae penetrate through the liver and diaphragm ending up in the lung. Patients present initially with fever and hepatomegaly. Later they develop acute epigastric pain, obstructive jaundice and anaemia. Death is uncommon, but is caused by haemorrhaging in the bile duct.

### *Fasciolopsiasis* (*Fasciolopsis buski*)



### Life cycle of *F. hepatica*

### Clinical Features



Where cases are symptomatic, diarrhea, upper abdominal pain, malaise, weight loss, fever and night sweats may begin approximately 2 months following ingestion of metacercaria. The signs of this acute phase of infection are hepatomegaly, splenomegaly, anaemia, weakness and marked peripheral eosinophilia, up to 80%. Adult flukes in the bile ducts may be associated with cholangitis and calculous or acalculous cholecystitis.

### **Diagnosis**

- 1- Demonstration of eggs in feces or aspirated bile is the best method of diagnosis.
- 2- Eosinophilia is constantly present.
- 3- Serological tests by parasite-specific antibody such as immunofluorescence and immunoelectrophoresis may be helpful.

### **Treatment**

Oral bithionol is the treatment of choice. Intramuscular emetine has been used successfully.

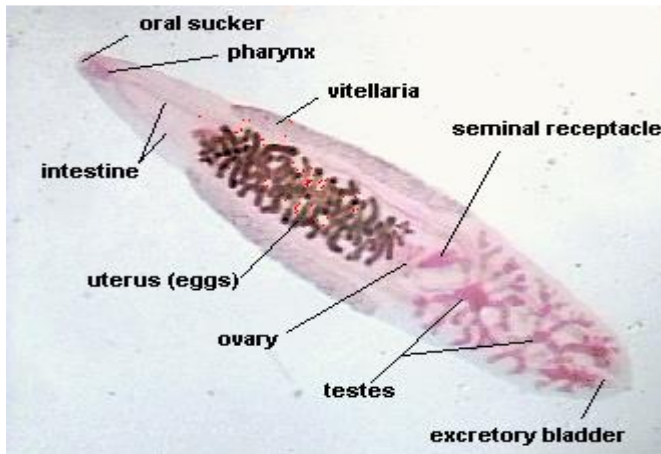
### **Prophylaxis**

Health education, preventing pollution of water courses with sheep, cattle and human feces, and proper disinfection of water cresses and other water vegetations before consumption can limit the infection.

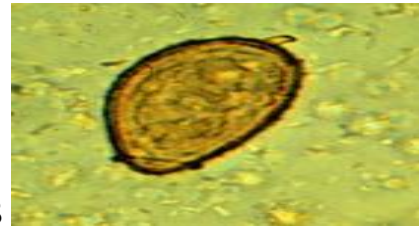
### **Clonorchis sinensis**

Commonly known as the Chinese (aka Oriental) liver fluke, *C. sinensis* was first described in the biliary tract of a Chinese in Calcutta. It belongs to the group of Oriental liver flukes where there are three main species which commonly infect man. These species are so similar in their morphology, life cycles and pathogenicity and its parasites of fish-eating mammals, particularly in Asia and Europe. Man is the definitive hosts and water snails and fish are the intermediate hosts. Dogs and cats are the most important reservoir hosts. Human clonorchiasis occurs in Japan, Korea, Taiwan, China and Vietnam affecting about ten million persons

The adult worm lives in the human biliary tract for 15 years or more. It has a flat, transparent, spatulate body and brownish in color; pointed anteriorly and rounded posteriorly, 10 to 25 mm long and 3 to 5 mm broad. They are all hermaphroditic and possess two suckers. The eggs are flask-shaped, and relatively smaller in size. They are yellow-brown (bile stained), containing a well-developed miracidium. It has an operculum at one pole and a small hook-like spine at the other.



A B



## Clonorchis sinensis (A-adult, B-egg)

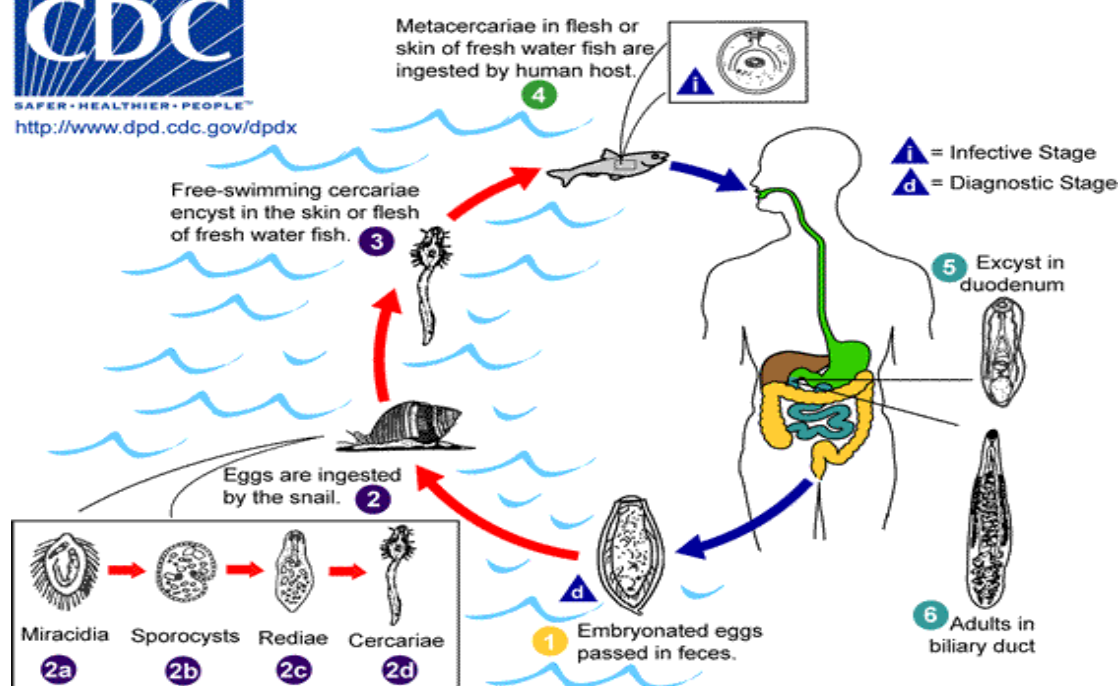
### Life Cycle

Humans are the principal definitive host, but dogs and other fish-eating canines act as reservoir hosts. Two intermediate hosts are required to complete its life cycle, the first being snail and the second fish.

The adult worm lives in the bile duct of the final host. Eggs contain the ciliated miracidia are discharged in the biliary ducts and passed in feces. They do not hatch in water, but only when ingested by species of snails, such as *Bulinus* or *Alocinma*. The miracidium develops through the (sporocyst, redia, cercaria with a large tail) in about 3 weeks. The cercariae escape from the snail and swim in water and attached to the second intermediate host, fresh-water fish of the carp family. The cercariae encyst under the scales or in the flesh of the fish to become, in about 3 weeks the metacercariae which are the infective stage for humans. Infection occurs when such fish are eaten raw or inadequately processed by human or other definitive hosts. Frozen, dried or pickled fish may act as source of infection. The metacercariae excyst in the duodenum of the definitive host. The adolescaria that come out enter the common bile duct where they mature in about a month and assume the adult form.

### Pathogenicity

Many millions of people become infected every year but only a minority suffers from any illness. The pathology is related to the number of parasites present. Light infections of up to 50 eggs or more are usually asymptomatic. A heavy infection of 500 or more eggs may cause serious illness. The migration of the larva up the bile duct induces desquamation, hyperplasia and sometimes adenomatous changes. The adult worm may cause obstruction of the bile duct leading to cholangitis. Acute infections may be characterized by fever, diarrhea, epigastric pain, enlargement and tenderness of liver and sometimes jaundice. The invasion by these worms in the gall bladder may cause cholecystitis. A few cases go on to biliary cirrhosis and portal hypertension.



## Life Cycle of *C. sinensis*

### Diagnosis

Diagnosis is made by observing ova in feces following an iodine stained. Several serological tests have been described including gel precipitation and indirect haemagglutination test sensitive and specific.

### Treatment

Chemotherapy has not been very successful. Chloroquine and praziquantel have been reported to be useful. Surgical intervention may become necessary in cases with obstructive jaundice.

### Prophylaxis

Infections can be easily avoided by man not eating raw fish. Health education, proper disposal of feces and snail control help to limit the infection in endemic areas