



Tikrit University
College of Veterinary Medicine

Subject name: Parasites

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Platyhelminthes

- 1) Bilaterally symmetrical.
- 2) Body having 3 layers of tissues with organs and organelles.
- 3) Body contains no internal cavity.
- 4) Possesses a blind gut (i.e. it has a mouth but no anus)
- 5) Has Protonephridial excretory organs instead of an anus.
- 6) Has normally a nervous system of longitudinal fibres rather than a net.
- 7) Generally dorsoventrally flattened.
- 8) Reproduction mostly sexual as hermaphrodites.
- 9) Mostly they feed on animals and other smaller life forms.
- 10) Some species occur in all major habitats, including many as parasites of other animals.

Phylum Platyhelminthes

Class Turbellaria

Class Monogenea

Class Trematoda

Class Cestoda

Class Digenea (Trematoda) - The Flukes

General characteristics:

A. The information on the Platyhelminthes provided in the previous section should be reviewed, as it still applies.

B. Adult trematodes are parasites of vertebrates. All have complex life cycles requiring one or more intermediate hosts. Most are hermaphroditic, many capable of self-fertilization.

C. Eggs shed by the adult worm within the vertebrate host pass outside to the environment, and a larva (called a miracidium) may hatch and swim away or (depending on species) the egg may have to be ingested by the next host.

D. Every species of trematode requires a certain species of molluscan (snail, clam, etc) as an intermediate host. A complex series of generations occurs in the mollusk, resulting ultimately in the liberation of large numbers of larvae known as cercariae.

E. To reach the vertebrate host, cercariae (depending on species):

1. Penetrate directly through skin and develop into adults.
2. Enter a second intermediate host, and wait to be ingested (they are now called metacercariae).
3. Attach to vegetation, secrete a resistant cyst wall, and wait to be eaten (now called metacercariae)

F. General adult's appearance

1. Body is non-segmented, flattened dorsal-ventrally, leaf-shaped, and covered with a cuticle which may be smooth or spiny.
2. Attachment organs are two cup-shaped suckers, two cup-shaped suckers, - oral and ventral. Tegument is metabolically active.
3. Oral cavity leads to muscular esophagus, from which intestines branch to form 2 caecae, which run parallel to each other ending blindly near the posterior end of the worm.
4. Simple digestive system, no anus - waste products are regurgitated
5. Reproductive system
 - a. Uterus is usually the largest organ with a single ovary, two testes & a series of glandular structures that produce shell material that covers the ovum.
 - b. Uterus may be filled with thousands of eggs.

6. Trematode eggs :

- a. Trematode eggs usually have a smooth, hard, transparent, yellow - brown shell and eggs may have "shoulders" and/or spines.
- b. Size varies greatly with species, ranging from less than 30 microns to nearly 175 microns.
- c. Most have an operculum (escape hatch for the miracidium).
- d. Trematode eggs cannot successfully be concentrated using flotation techniques (due to size and weight). The formalin-ether (ethyl-acetate) concentration procedure is recommended; although eggs may rupture (they are still recognizable).

***liver fluke**

Fasciola hepatica* and *Fasciola gigantica [causes hepatic fibrosis in ruminants and humans]

Main properties

These flatworms form seven different developmental stages: eggs, miracidia, sporocysts, rediae, cercariae, metacercariae, and adult flukes.

The eggs are operculate ('hatch' at one end), brown and ovoid (130-150µm in length by 65-90µm in width). **Miracidia** are pyriform motile larval stages (150-200µm long) covered with cilia. **Sporocysts** are pleomorphic sac-like bodies (0.3-1.5mm in diameter) containing germinal cells which give rise to **small rediae** (embryos). **Mature cercariae** (~0.5mm long) are free-swimming gymnocephalous stages with simple elongate club-shaped tails, which are subsequently shed when they encyst on vegetation to form membrane-bound metacercariae (~ 0.2mm in

diameter). **Mature flukes** are leaf-shaped (*F. hepatica* measure 20-30 mm x 13 mm; adult *F. gigantica* measure 25-75 mm x 12 mm) with a conical apex demarcated by wider 'shoulders'. They are dorsoventrally flattened, the tegument is covered with scaly spines, and they have two suckers (distome arrangement with the oral sucker and acetabulum close together). They have a bifurcate blind gut and each worm is hermaphroditic, possessing both male and female reproductive organs.

Host range

Liver fluke infections are distributed throughout many sheep and cattle producing areas around the world, particularly temperate regions with high rainfall or irrigated pastures where snail vectors are abundant. *F. hepatica* has been reported in sheep, cattle, goats, pigs, macropods, rats, rabbits and many other animals, and occasionally in humans

Site of infection

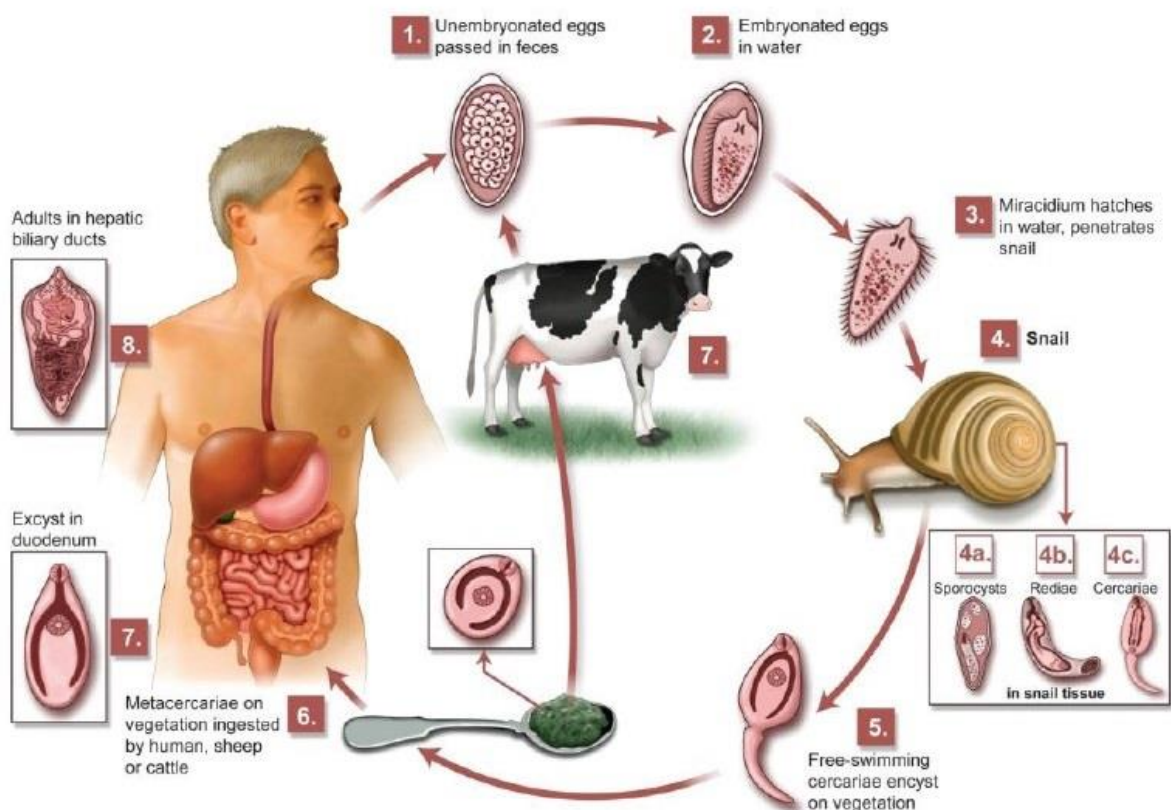
Immature flukes undergo transient migration through the liver parenchyma and then settle as mature flukes in the bile ducts of their definitive hosts. In some (uncommon) hosts, aberrant flukes may be found encapsulated in lungs, skin or other organs.

Life Cycle

Fasciola sp. parasites live as adult flukes in the bile duct and immature eggs go out through feces and grow in fresh water.

- The immature eggs hatch after several weeks in freshwater and develop into a parasite called the miracidium, which then infects a snail host.

- It takes about 5-7 weeks for the parasite to develop in the snail and develops into sporocysts, rediae and finally cercariae.
- Then the cercariae are released back to the water and encyst as infective larvae, metacercariae, in soil, on vegetation or other places as the water flows. The metacercariae have a hard outer cyst wall as compared to cercariae.
- Humans become infected when they ingest infected freshwater plants, especially watercress. Upon entering our system, the metacercariae excyst again in the duodenum and travel through the intestinal wall into the liver.
- It eats the liver and usually stays in liver for weeks. Then it moves to the biliary ducts and develop into adult flukes. It takes metacercariae 3-4 months to transform into adult flukes.
- When these adult flukes lay eggs and pass them out in feces, the whole new *Fasciola hepatica* life cycle begins.



Pathogenicity and clinical signs

Acute fasciolosis

There may be an outbreak of the disease following a massive but relatively short-term intake of metacercariae. Animals suffering from acute fasciolosis may not show any obvious symptoms. Some animals may show abdominal pain and may become jaundiced. Death is usually due to blood loss resulting from haemorrhage in the liver. The liver haemorrhage is the result of the immature fluke burrowing through the liver.

Subacute fasciolosis

Subacute fasciolosis is characterised by jaundice, some ill thrift and anaemia. The burrowing fluke causes extensive tissue damage, leading to haemorrhaging and liver damage. The outcome is severe anaemia, liver failure and death in 8–10 weeks.

Chronic fasciolosis

Chronic fasciolosis is the most common form of liver fluke infection in sheep, goats and cattle – and particularly in more resistant hosts, such as horses and pigs. **It occurs** when the parasites reach the bile ducts in the liver. The fluke ingests blood, which produces severe anaemia and chronic inflammation and enlargement of the bile ducts. The clinical signs develop slowly. The animals become increasingly anaemic, appetite is lowered, the mucous membranes of the mouth and eyes become pale and some animals develop oedema under the jaw ('bottle jaw'). Affected animals are reluctant to travel.

Differential diagnosis

Infections are conventionally diagnosed by coprological examination for fluke eggs in faecal samples, usually following their concentration by

sedimentation/flotation techniques. Blood biochemical tests can also be used to show elevated plasma levels of hepatic enzymes, notably glutamate dehydrogenase (GLDH) during acute stages and gamma glutamyl transpeptidase (GGT) during chronic stages. Immunoserological tests have also been developed to detect host antibodies against parasite excretory/secretory antigens in attempts to facilitate early diagnosis. Molecular studies are currently being used to examine parasite strain variation and host reactions to identify virulence factors and protective responses.

Treatment and control

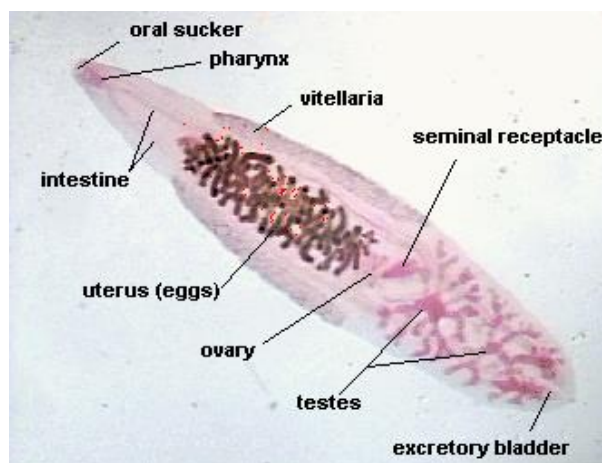
Subacute and chronic infections may be treated with triclabendazole or bithionol, which show excellent trematocidal activity with few side-effects. A range of other anthelmintics show variable activity, including carbon tetrachloride, rafoxanide, niclofolan, closantel and oxclozanide, but their use may be contra-indicated under certain conditions in certain animals. Preventive measures are based on breaking the cycle of transmission by reducing faecal contamination of water bodies, reducing snail populations using molluscicides (usually copper sulphate) or draining swampy fields, restricting access of livestock to aquatic vegetation, and avoiding watercress. Snail control is often difficult, particularly in high rainfall areas where even temporary pools may harbour large snail populations (they aestivate in the ground during dry conditions). Feral or wild animals (such as rabbits) may also continue to act as reservoirs of infection for domestic livestock.

***Clonorchis sinensis* (oriental liver fluke)**

Clonorchis sinensis, also known as the Chinese (aka Oriental) liver fluke is a narrow elongate liver fluke found in the Far East, mainly Japan, Korea, China, Taiwan and Vietnam

Main properties

C. sinensis is a very narrow fluke, 10-25 mm. in length, flattened dorsal-ventrally, with Trematode characteristics such as an oral/anterior sucker, a ventral sucker (also known as the acetabulum), no blood circulatory system, and no body cavity. The common genital pore is just anterior to the acetabulum. The fluke is tapered at the anterior end and rounded at the posterior end. The intestine is bifurcated and ends blindly. A thick and elastic cuticle lacks any kind of spines or scales and can either be a translucent gray color or yellow color (due to absorption of bile). When stained on a slide, its branched testes, lobed ovary, and follicular vitellaria are apparent as is the long and convoluted uterus. The pharynx and esophagus are also visible.



Host range

All members of this group are parasites of fish-eating mammals, particularly in Asia and Europe. Man is the definitive hosts and water snails and fish are the intermediate hosts. Infections can be easily avoided by man not eating raw fish since this is the only way that infection can be passed on.

Site of infection

Clonorchis is a liver fluke that can infect the liver, gallbladder and bile duct in humans.

Life cycle

The life cycle is a three host-system: a snail is always the first intermediate host, a freshwater fish is normally the second intermediate host, and there is a wide range of definitive hosts.

* *C. sinensis* is hermaphroditic therefore every single sexually mature fluke will produce eggs. The eggs are passed out with the feces of the definitive host. An egg will not hatch until it is ingested by a proper first intermediate host.

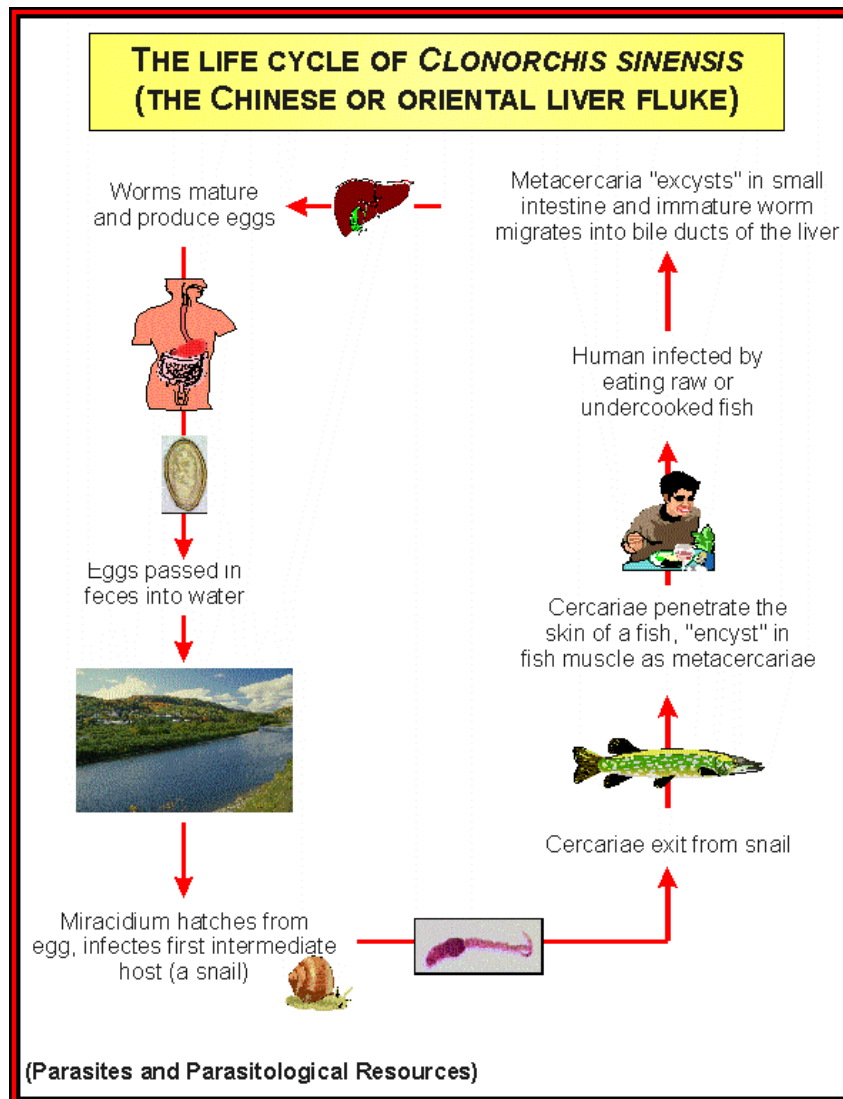
* A miracidium emerges from the egg. It remains in this stage for only about 4 hours, after which it becomes a sporocyst.

* The sporocyst is normally located in the wall of the first intermediate host's intestine. the sporocyst undergo asexual reproduction to produce a new "generation". Each new organism is a redia and they emerge when they are mature.

* Cercariae It travels to the hepatopancreas of the snail while the cercariae are developing within itself. The cercaria leaves its snail host one month after the initial infection of the snail by the eggs. Upon contact with the **second intermediate** host, it attaches with its oral sucker and penetrates the host. It loses its tail during this process of penetration. After 35 days of infection, the cercaria encysts under a scale or in a muscle.

* The metacercaria remains encysted in various tissues until the second intermediate host is ingested by a vertebrate. Excystation takes place in the duodenum and a juvenile adult fluke emerges.

* A juvenile adult reaches the bile ducts within 4-7 hours after ingestion of the intermediate host. From the duodenum, it penetrates the gut wall and is carried to the biliary system via the ampulla of Vater. After one month it matures enough to produce eggs.



Pathogenicity and clinical signs

When larvae of *C. sinensis* reach the biliary system and mature, the flukes provoke pathological changes, both as a result of local trauma and of toxic irritation.

- 1st phase, desquamation of epithelial cells.
- 2nd phase, hyperplasia and desquamation of epithelial cells.
- 3rd phase, hyperplasia and desquamation of epithelial cells, and adenomatous tissue formation.

- 4th phase, marked proliferation of the periductal connective tissue with scattered abortive acini of epithelial cells and fibrosis of the wall of the bile duct.

The onset of symptoms and signs is at times gradual, at times sudden. Chill and fever up to 40 degrees C occur during the acute stage,

The chronic stage follows with the classical clinical features. In general, symptoms and signs can be classified as follows: mild, essentially symptomless, progressive, with irregular appetite, gastrointestinal disturbances, oedema, hepatomegaly, etc., and severe, with a syndrome associated with portal cirrhosis and hypertension.

Diagnosis

The most practical diagnostic method is microscopic observation of eggs in feces, bile, or duodenal aspirates. Eggs are 27 to 35 μm by 11 to 20 μm . However, the eggs of a similar parasite (*Opisthorchis*) are identical to *C. sinensis* eggs. Serologic testing can also be helpful. Worms have been identified during surgery as well.

Treatment

The preferred treatment is Praziquantel. Praziquantel is an anthelmintic that alters ion flow across the worm membrane. This change in potential causes the worm to have muscle spasms and paralysis, helping a person's immune system attack and expel the worm. When administered at 25 mg/kg three times a day for one or two days, the cure rate is about 100 per cent.