TREMATODES

Classification

Phylum: Platyhelminthes
Class: Trematoda

- Intestinal species
  - Fasciolopsis buski
  - Heterophyes heterophyes
  - Metagonimus yokogawai

- Liver species
  - Fasciola hepatica / Fasciola gigantic
  - Clonorchis sinensis

- Lung species
  - Paragonimus wastermani

- Blood species
  - Schistosoma haematobium
  - Schistosoma mansoni
  - Schistosoma japonicum
General characteristics

1-Trematodes are unsegmented helminthes which are flat and broad resembling the leaf of a tree or flat fish.

2-they vary in size from the species just visible to the naked eye [like Heterophyes] to the large fleshy fluke [like Fasciola hepatica].

3-Flukes are hermaphroditic [monocious] except for Shistosomes in which the sexes are separated.

4-A conspicuous feature is the presence of muscular cup-shaped suckers [the structure by which the worm attached to the host]. *the oral sucker surrounding the mouth, [the oral or the anterior sucker] at the anterior end. *the ventral sucker [or Acetabulum] in the middle ventrally.

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

6- They have no body cavity, circulatory or respiratory organs.

7-The alimentary system consist of ; *Mouth surrounded by oral sucker. *A muscular pharynx and *esophagus which bifurcates anterior to the acetabulum to form two blind caeca [which reunite in some species], the alimentary canal therefore appears like inverted Y and the anus is absent.

8-The excretory system consist of flam cells and collecting tubules which lead to median bladder opening posteriorly.
9-There is a rudimentary nervous system consist of two lateral ganglion in the region of pharynx, connecting by dorsal commissures. From each ganglion arise anterior and posterior longitudinal nerve trunks connected by numerous commissures, [sense organs are almost lacking].

10- The reproductive system is well developed, the hermaphroditic flukes have both male and female structures so that self fertilization takes place [though in many species, cross fertilization also occur]. In the Schistosomes the sexes are separated but male and female live in close apposition [in copula], the female fitting snugly into the folded ventral surface of the male which form the gynaecophoric canal.

11-The trematodes are oviparous and lay eggs which are operculated, except in the case of Schistosomes.

12-The eggs hatch in water to form the first stage larvae, the motile ciliated Miracidium [Greec a little boy]. The miracidium infects the intermediate host Snail in which further development take place, the miracidium shed its cilia and becomes sac-like Sporocyst [meaning bladder containing seeds]. Within the sporocyst, certain cells proliferate to form the Germ balls which are responsible for asexual replication. In Schistosomes the sporocyst develops into second generation sporocyst in which infective larvae Cercariae are formed. But in the hermaphroditic trematodes, the sporocyst mature to more complex larval stage named Redia, which produce cercariae. Cercariae are tailed larvae;

-In schistosomes have a Forked tail and infect the definitive host by direct skin penetration [The cercaria].

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- In the hermaphroditic flukes, the cercariae have an unsplit tail, and they encyst on vegetable or within a second intermediated host, fish, or crab to form Metacercariae which are the infective forms.

13-Infection is acquired by ingestion metacercariae encysted on vegetables [Fasciola hepatica, fasciola gigantic and fasciolopsis buski], in fish [Clonorchis sinensis and Heterophyes heterophyes] or crabs [Paragonimus westermani]. The asexual replication during larval development is of great magnitude and in some species, a single miracidium may give rise to over half a million cercariae.

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**HERMAPHRODITIC FLUKES**

The adult form of all hermaphroditic flukes infecting humans live in the lumen of the biliary, intestinal or respiratory tracts. This location affords the parasites considerable protection from host defense mechanism and also facilitates dispersal of eggs to the environment. [Flukes inhabiting the human biliary tract are Fasciola hepatica/Fasciola gigantic, Clonorchis sinensis, less often opisthorchis species and rarely Dicrocoelium dendriticum]

**LIVER FLUKES;**

Fasciola gigantic, very rarely infects humans [reported cases are mainly from Africa]. The life cycle, transmission, morphology, clinical presentation and treatment of the F. gigantic trematode and its infection are very similar to those of F. hepatica.

**Fasciola hepatica [or sheep liver Fluke]**

Is the largest and most common liver fluke found in human, but its primary host is the sheep [and to less extent cattle].

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DISTRIBUTION ;

It is worldwide in distributions, being found mainly in sheep-raising area [it causes the economically important disease "Liver rot" in sheep]. In addition, the disease, Fascioliasis, now recognized as an emerging human disease.

MORPHOLOGY:

Adult worm:

1- It is a large leaf-shaped fleshy fluke 300 mm long, 15 mm broad.

2- Grey or brown in color.

3- The anterior end of the parasite forms a conical projection that broadens at the shoulders, then gradually narrows towards the posterior end. At the narrow tip of the conical projection is the **muscular oral sucker**, which surrounds the mouth of the parasite. The oral sucker is 1 mm in diameter and the ventral sucker which lies close behind it is about 1.6 mm.

4- Lives in the biliary tract of D.H for many years [about 5 years in sheep and to 10 years in human]

The eggs: Large, ovoid, operculated, bile stained and about 140 x 80 micro-meter in size.

Life cycle;

Eggs are laid in the biliary passage and shed in feces → water [in egg embryo mature in 10 days-formation of miracidium - ] **miracidium escape** from egg → miracidium penetrates tissues of I.H [snail of genus lymnaea in about 1-2 months] → **Sporocst** [in snail] miracidium progress through sporocyst to first and second generation of **redia** → **Cercariae** [in side redia] → **Cercariae**
escape [from snail] to water \(\rightarrow\) Cer. Encyst on aquatic vegetation [or blades of grass] \(\rightarrow\) Cercaria become Metacercaria [infective Stage, survive long period ] \(\rightarrow\)

Man or sheep [Eating water vegetation containing Metacercaria ] \(\rightarrow\)

\(\rightarrow\) Metacercaria excyst in duodenum pierce gut wall \(\rightarrow\) peritoneal cavity \(\rightarrow\) Liver travers liver parenchyma \(\rightarrow\) Biliary passage, where they mature into adult worm in 3-4 months [the adult flukes live in the large biliary ducts of the mammalian host ]

Clinical Features ;

The disease caused by the F. hepatica called Fascioliasis [also called Fasciolosis, Distomasis, Sheep liver rot ]. Most clinical manifestations are related to the migration of larva to and within liver until reaching the final and its dwelling place to live in .

With this disease, it is not abnormal to find some or all of the following clinical manifestations; Epigastric pain, fever, diarrhea, Jaundice, anemia, urticaria, Eosinophelia, arthralgia, vomiting, and nausea....etc.

* Eosinophelia is present with all infections at all stages and can be used as diagnostic feature in ectopic and early stage of infection when eggs are not be present in stool {fluke eggs are detectable in feces 8-12 weeks post infection, or even 4 months}.

Acute phase of infection.; Is rarely seen in humans and occur only when large number of metacercariae are ingested at once.

Symptoms {the most frequent} * Fever, * eosinophilia, * tender hepatomegaly and * abdominal pain. {The first three form a traid of symptoms of diagnostic importance in endemic area }.

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**Chronic phase:** Occurs when flukes gain access to the bile duct and cause *Obstruction and inflammation* of the bile duct.

**Symptoms:** Bilary cholic, abdominal pain, tender hepatomegaly, jaundice. And in children: severe anemia.

These symptoms reflect the biliary obstruction and inflammation caused by the presence of the large adult worms and their metabolic waste in the bile duct. *Inflammation of the bile duct eventually leads to Fibrosis and condition called* Pipestem Liver {a term describing the white appearance of the biliary ducts after fibrosis}. The final outcome of severe infection is Portal cirrhosis and even death.

**Halzoun:** The condition commonly known as halzoun is type of *F. hepatica* infection in which the worm settles in the Pharynx. {this occurs when an individual consumes infected raw liver, the young adult worms there attach themselves to the pharyngeal mucosa which cause; *Considerable pain*; *Edema* [may lead to dysphagia] and *Bleeding* [That can interfere with respiration causing "possibly" air way obstruction—rarely asphyxia].

**Ectopic Infections:**

Ectopic infections through normal transmission are infrequent but can occur in; The peritoneal cavity, Intestinal wall, Lung, Subcutaneous tissue and very rarely in other location.

**Complications** [of fasciolosis]
May be; Pancreatitis, Anemia [especially in children], Cholangiocarcinoma [occur rarely]. Cholelithiasis is a common late complication in Fascioliasis.

**Diagnosis:**

The definitive and most widely used form of diagnosis is the directly observed presence of F. hepatica eggs either in stool sample, duodenal aspirate or biliary aspirate [Fluke begin produce eggs until roughly 4 months from infection]

*Eosinophilia is constantly present.

*Serological test like FAST ELIZA [is useful]. Because the fluke eggs are detectable in feces 8-12 weeks post infection, it is preferable to use this fast serological test. Since specific antibodies are recognized, by this technic, from 2-4 weeks post infection. Fast Eliza can also used to confirm effective cure, as antibody levels return to normal level 6-12 months after the cessation of infection.

**False diagnosis:**

May be due to 1-Halzoun.

2-Ectopic infection.

3-Eggs of F. hepatica, F. gigantica and Fasciolopsis buski are indistinguishable.

**Treatment:**

Along with pharmaceutical therapy, surgery may be necessary in very extreme cases to clean the biliary tract.

**Prophylaxis:**
The following considerations can limit the infection:

1. Health education.
2. Preventing pollution of water sources with sheep, cattle, and human feces.
3. Proper disinfection of water grass and other water vegetation before consumption. Washing of water grown vegetables with 6% vinegar or potassium permanganate [5-10 minutes] which kill the encysted cercaria. Cooking water grown vegetables thoroughly before eating. Use of molluscicide is the most frequent public health intervention, as it prevents the transmission of many other trematodes. Treatment of animals to reduce the reservoir.

**Clonorchis sinensis** [Chinese Liver fluke]

**Epidemiology:**

Clonorchiasis [name of the disease] is endemic in far east especially in Korea, Japan, Taiwan, and South China. It has been reported in non-endemic areas [including the United States] in such cases, the infections found in Asian immigrants, or following ingestion of imported undercooked or pickled fresh water fish containing metacercaria.

**Inhabitancy:** The parasite lives in the liver of humans and is found in the common bile duct and gall bladder feeding on bile [believed to be the third most prevalent worm parasite in the world].

**Morphology and life cycle:**

The adult worm lives in the human biliary tract [for 15 years or more], it has a flat transparent body, spatulated, pointed anteriorly.
and rounded posteriorly. *Man is the principal D.H, but dog and other fish eating canines are reservoir.*

The eggs; are broadly ovoid 30 x 15 micrometers with a yellowish brown shell, it has an operculum at one pole and a small hook like spine at the other.

**Life cycle:**

**Eggs passed in feces** [containing the ciliated miracidium] → The miracidium not hatch in water. But only when ingested by snail → Ingested, by suitable I.H. [snail as bulimus, 1st I.H] → MIR develops through sporocyst → **Redia stages** [1st and 2nd generation] → 3 weeks → **Lophecerus cercaria** [with large fluted tail] → Escape from the snail [1st I.H.] → Suitable fresh water fish of the carp family [2nd I.H] where cercaria shed their tail and encyst under the scales of the fish or in the flesh. Cercaria become Metacercaria [infective stage] in 3 weeks on fish → **Man** [when fish eaten raw or inadequate processed] → Metacercaria → **Duodenum of D.H** [excystment] → **Common bile duct** → **Distal bile capillaries**, [where they become mature in one month-i.e. Adult].

**Pathogenicity**;

The disease is *Clonorchiasis*. Migration of larva and then dwelling in the bile duct induces an inflammatory reaction, epithelial hyperplasia and sometime even cholangiocarcinoma. -10-
The adult worm[or even its eggs] may cause obstruction of the bile duct leading to biliary obstruction and Cholangitis.

Patients in the early stage have; Fever, epigastric pain, diarrhea, tender hepatomegaly, nausea, vomiting. **this is followed by** ; Biliary colic, jaundice[skin and eyes], and progressive liver enlargement.

**Notes:** Many infections are asymptomatic, Chronic infection may result in calculus formation, A Few cases go on to biliary cirrhosis and portal hypertension, Some patients with chronic clonorchiasis tend to become biliary carriers of Typhoid baccilli

**Diagnosis:**
- The eggs may be demonstrated in feces or aspirated bile[ entero test is useful for duodenal aspirate]
- Eggs do not float in concentrated saline.
- Indirect haemagglutination with a saline extract of etherized worms is specific and sensitive.
- Intradermal allergic test.

**Prophylaxis:**
*Proper cooking of fish can prevent the infection,* Health education, *Proper disposal of feces,* *Snails control measurement* help to limit the infection in endemic areas.

**Note:** Infection may also occur through fingers or cooking utensil contaminated with metacercaria[Frozen, dried, or pickled fish may act as source of infection]
Intestinal Flukes;

A number of flukes parasite the human small intestine include Fasiolopsis buski[ the large intestinal fluke ]

Distribution;* Also called the giant intestinal fluke[ it is the largest trematode infecting man ].* It is a common parasite of man and pigs in china .* It is prevalent in Asia , mainly central and south Asia.

Morphology;* A large fleshy worm 20- 75 mm long, 8- 20 mm broad.* It is elongated, ovoid, Leaf-shaped, dorsa-ventrally flattend.* It is characterized by blunt anterior end, it has no cephalic cone as in Fasciola hepatica, with a small oral sucker and large acetabulum .* Undulating un branched ceca.* Dentritic testes, Branched ovary.* It has extensive vitelline follicles.* lives in the duodenum or jejunum and when abundant can be found in the lower areas of the intestine and stomach.

The eggs; *The typical;* Ovoid measures 130-140 micr.m X 78-85 mic .m.* Consist of an oblong undeveloped Miracidium, Equipped with a distinct operculum. It is indistinguishable from those of Fasciola hepatica and Fasciola gigantic.

The life cycle;

from snail  →  Cercaria encyst on lotus root [or other Aquatic vegetation]  →  Metacercaria eaten by man [with Aq. veg.]  →  Met. C. in duodenum  →  Excyst. in duodenum  →  Attached to the mucosa  →  Develops into adult [in about three months].

*The adult worm has life span of 6-12 months.
*Metacercaria may exist not only on aquatic plants but also on the surface of the water.

Pathogenicity: the disease called 'Fasciolopsiasis'.
The pathogenesis of Fasciolopsiasis is due to Traumatic, Mechanical, and Toxic effects.

*Most infected persons are asymptomatic.
*The initial symptoms are diarrhea and abdominal pain.
*Larva that attach to duodenal and jejunal mucosa cause inflammation and local ulceration.
*Adult worm, in heavy infection, cause partial obstruction of the bowel.
*Toxic and allergic symptoms appear usually as, edema, ascites, anemia, prostration, Persistent diarrhea, Sensitization [caused by absorption of worm allergenic metabolites which may eventually cause death of patients]

Diagnosis: History or residence in endemic area suggest the diagnosis which is confirmed by.*Demonstration of the eggs in feces* and/or demonstration of adult worms after administration of a purgative.

Prophylaxis:
*Adequate washing of water vegetables [preferably in hot water].
*Preventing contamination of ponds and other water with human and pigs excretion.*Sterilization of night-soil before use as fertilizer.* Antisnail measures helps in limiting the infection.

Notes:  

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* It has been found, in some countries, that the incidence of infection was prevalent in females and children ages of 10-14 years of age.*Disease predominantly occur in some countries of Asia, especially in areas where humans raise pigs and consume raw aquatic plant.

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**Heterophyes heterophyes**

**Morphology:** It is the smallest trematode parasite of man, 1.5 X 0.3 mm, it has an elongate ovoid shape and grayish in color. The tegument is covered by fine scale like spines, most numerous at the anterior end. The oral sucker is much smaller than the ventral sucker. *A genital sucker ‘gonotyl’* lies near the left posterior margin of the ventral sucker. The tubular excretory bladder lies in the posterior 5th of the body. Two ovoid testes lies side by side near the posterior end of the body. Adults attached to the wall of the jejunum and upper ileum.

**Eggs:** Are brown and of the size of 30 X 15 micr.m. These resemble the eggs of *Clonorchis sinensis*, except that the terminal knob is not distinct.

**Life cycle:** The minute operculated eggs are passed in feces and hatch after ingestion by I.H.[suitable water snail]. After passing through the sporocyst and one or two redial stages, the cercaria escape and encyst on suitable fishes, such as mullet and tilapia[or other various fresh water fishes].→ Fish eaten raw or inadequately cooked→ the definitive host become infected.

**Pathogenicity:** The disease called *Heterophyiasis*. -14-
Light infections are usually asymptomatic. In heavy infection, in the small intestine it can induce colicky pain and mucous diarrhea. *Occasionally*, the worm burrow into the gut mucosa, and their eggs are carried in the lymphatic and portal circulation to ectopic sites such as; Brain, Spinal cord, Myocardium. Where they induce granulomas [rarely the worms may be carried to these sites as emboli].

**Diagnosis:** Diagnosis done by stool examination is difficult when adult worms are not present because eggs are hard to distinguish from the eggs of Clonorchis sinensis.

**Lung flukes**

**Paragonimus westermani.**

**Distribution:** Most prominent in Asia and south America. It infects an estimated 22 million people worldwide.

**Morphology:**

* Adult worm of about 10X5mm and 4mm thickness, live in the lung [usually in pairs in cystic spaces that communicate with bronchi], with a life span of about 20 years. *Size, shape, and color resemble a coffee-bean when alive.* The skin of the worm [tegument] is heavily covered with scale-like spines [the oral and ventral sucker are similar in size]. *The lobed testes are adjacent from each other, located at the posterior end and the lobed ovaries are off-centered near the center of the worm [located anterior to the two branching testes]. *The uterus is located in a tight coil to the right of the acetabulum, which is connected to the vas deferens. *The vitelline glands, which produce the yolk for the eggs are wild spread in the lateral field from the pharynx to posterior end.
The eggs; are ovoid [or elongated], 100X50 micr.m, golden brown, operculated with a thick shell, the thickness is very clear on the site opposite to that of operculum.

Life cycle: Eggs escape into the bronchi and are coughed up and voided in sputum [or swallowed and pass in feces]

Water → Hatch Free swimming Miracidium → Penerteat Molluscan snail[1st IM.H] Several developmental stages Sporocyst, redia, [in snail] several weeks → Many Cercaria [Microcercus. I.e. having a short tail]

Drawn into The gill chambers of 2nd IM.H. {crabs, cray fish, others} encystment in gill or muscles as Metacercaria

Duodenum {D.H.} After eating of 2nd I.H. [raw] excyst in duodenum Adolescaria Penetrate gut wall Diaphragm → Lung → settle near the bronchi [where they encapsulated] and develop into adult in 2-3 months.

Notes: * The worm is hermaphroditic but usually it takes two for fertilization. * Sometimes the migrating larvae lose their way and going to ectopic sites as mesentry, groin or brain, striated muscles.

Pathogenecity: The disease called Paragonimiasis.

The clinical manifestation of the disease are associated with the organ invaded by the parasite, but most clinical manifestations are pulmonary as the lungs are the most commonly invaded [the parasite can produce lesions in the central nervous system, abdominal cavity, skin and few other locations]. Once in the lung or ectopic site, the worm stimulates an inflammatory response that allow it to cover itself in granulation tissue forming capsules. In the lung the worm lie in cystic spaces.
surrounded by a fibrous capsule formed by the host tissue [the cyst about 1 cm in diam., are usually in communication with a bronchus].

*Inflammatory reaction to the worms and their eggs lead to, Peribronchial granulomatous lesions, Cystic dilatation of the bronchi, Abscesses, Pneumoitis.

**Acute phase** of the disease [period of invasion and migration of larvae] may marked by: Pulmonary abnormality, Hepatosplenomegaly, Eosinophilia, Cough, Urticaria, abdominal pain, Diarrhea, Fever.

**Chronic phase** [pulmonary manifestation] include: Cough, Hemoptysis, Chest-radiographic abnormalities, Expectoration of discolored sputum [the color being caused by expectorated clusters of reddish brown eggs rather than blood]. *Cases may resemble "Pulmonary tuberculosis".*

*Paragonimiasis may also be extrapulmonary* But the clinical features varying with the site affected, examples: *In the abdominal type there may be abdominal pain and diarrhea.* *The cerebral type resembles Cysticercosis and may cause Jacksonian epilepsy.* *The glandular involvement causes fever and multiple Abscesses.*

**Diagnosis:** *Demonstration of the eggs in sputum or feces provide definitives evidence.* *Complement fixation test is positive only during and shortly after active infection.* *Intradermal test is useful because it remains positive for much longer period than C.F.T.*
**Prophylaxis:** *Adequate cooking of crabs and crayfish.* *Washing of hand after preparing them for food can prevent human infection.

**Some useful notes:** *Eggs are present in stool or sputum 2-3 months after infection.* *Many other species of paragonimus which normally live in animals can on occasion infect man.* *Paragonimiasis can commonly be misdiagnosed as Tuberculosis.*