Ministry of Higher Education and Scientific Research
Southern Technical University
Medical Technical Institute / Basra
Department of Medical Laboratory Techniques

Helminthes parasitic ((Worms))

Second Year

Lect. Sarah kamal naser

Helminthes (Metazoa)

Helminthes * Worms * Metazoa * Multicellular

•Helminths are multicellular (Metazoan) worms or wormlike animals.

•They may be parasitic or free living.

•Helminthes have complete systems like reproductive or digestive or excretory system.

•Since they are multicellular, most helminthes may be easily seen by naked eyes.

•Helminthes life cycle: egg, larval and adult stages.

•Helminthes have either direct life cycle or indirect life cycle (intermediate host or vector).

Classification of Helminthes

Helminths are found in two phyla of the subkingdom:

a. Phylum: Platy helminthes (flatworms)

Class I: Cestoda (Tapeworms).

Class II: Trematoda (Flukes).

b. Phylum: Aschelminthes or Nemathelminthes

Class: Nematoda (roundworms, threadworms.

1-Cestoda

*All cestoda are hermaphrodites. Both male and female reproductive organs at the same mature segment)

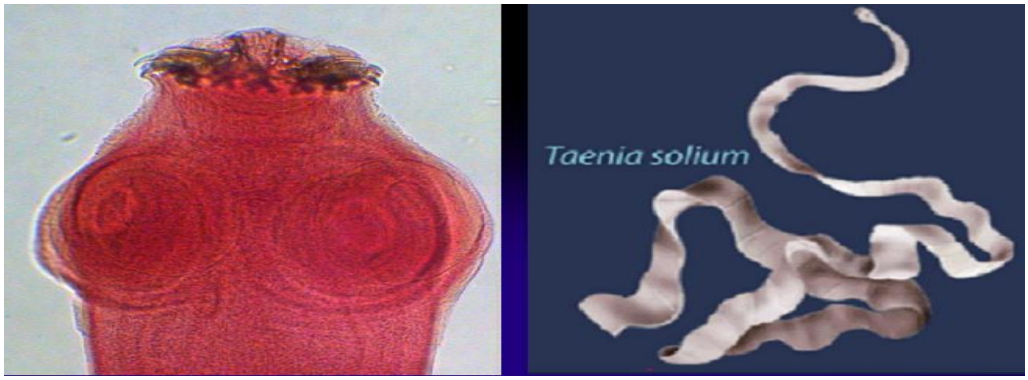
*All cestoda have stages: ovum, larva and adult. The length of an adult worm varies, according to the species, from 3-8 mm to 25 or 30 feet.

*The Cestodes main structure is divided into:-

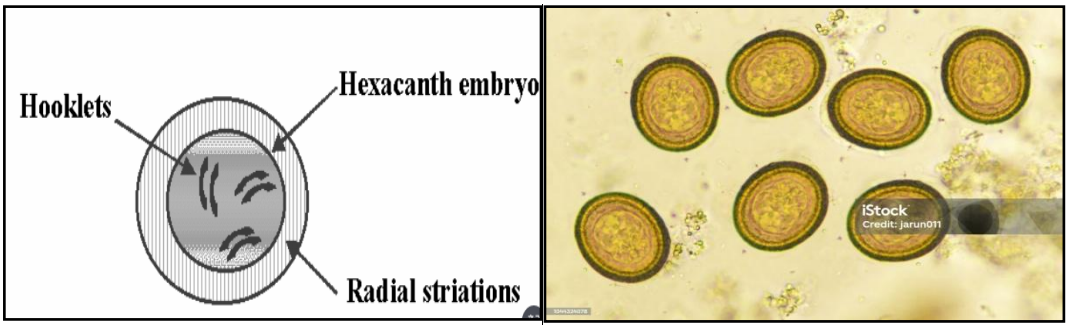
1-The scolex, or head, which bears the organs of attachment. it has either suckers with or without rostellum and hooks.

2-The neck that is the region of segment proliferation and production of segments.

3-The chain of fragments called proglottids or segments (totally are called strobila) or The strobila is made up of segments called proglottids.



Three types of segments A- Immature segments: the beginning of segments. B- Mature segment: has both male and female reproductive organs. C- Gravid segment: has uterus filled with ova (eggs). Full developed and mature egg has internal embryo is called oncospheres (hexacanth embryos) which contain three pairs of hooks (Six hooks).



Egg of Taenia Spp.

Cestoda tape worm

Taenia saginata called Beef tapeworm.

Taenia solium called Pork tapeworm.

Hymenoleps nana called Dwarf tapeworm.

Echinococus granulosus called Dog tapeworm.

Taenia saginata (Beef tapeworm).

• Common name: called the beef tapeworm.

• Disease: beef tapeworm infection or beef taeniasis.

• Infective stage to human is called : cysticercus bovis is taken by inadequate cooked meat of cows.

• Rout of infection: mouth.

• Habitat: adult worm in the small intestine of human.

• Cysticercus bovis larvae in the muscle of different organs of cows.

Symptoms: Tapeworms are usually asymptomatic. However heavy infection often results in weight loss, dizziness, abdominal pain, diarrhea, headaches, May be intestinal obstruction. Control Avoid taken uncooked beef meat containing infective stage in the muscles. Diagnosis find ova and gravid segment in stool. Treatment: Praziquantel drug of choice.

Taenia solium (Pork tapeworm).

•Common name: called pork tapeworm.

•Disease: Pork tapeworm infection or pork taeniasis or Cysticercosis.

•Infective stage: to human is called Cysticercus cellulosae is taken by inadequate cooked meat of pigs or ova by contamination of food and water.

•Intermediate host: human (accidently) and pigs.

•Final host is: human only.

•Habitat: adult worm in the small intestine of human.

•Cysticercus cellulosae larvae: in the muscle of different organs of pigs and human.

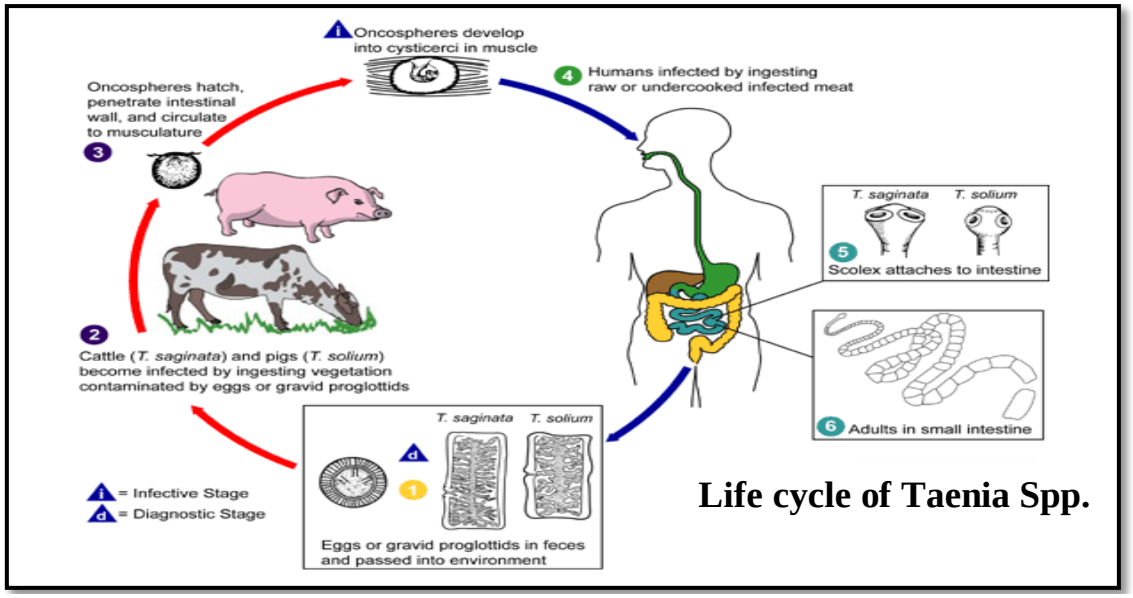
•Human may be as intermediate and final host.

It is more dangerous because of human is the intermediate host as well final host. In human larvae can cause serous symptoms if they localize in the brain, resulting in Neurocysticercosis.

Diagnosis: to find out ova and gravid segment in stool. in cysticercosis find out larvae in muscles and brain of human.

Control: Avoid to take undercooked meat of pork or keep away in contact with pigs.

Treatment: Albendazol appears to be more effective and a safe drug for Neurocysticercoses. Surgical intervention may be necessary to treat CNS lesions.



Hymenolepis nana (Dwarf Tapeworm)

- Common name: Dwarf tapeworm.
- Adult worm is small measures 10 cm to 40 cm in length
- Disease: Dwarf tapeworm infection or Hymenolepiasis .
- Widely distribution in children and most common.
- Infective stage to human is called: ova by food and water.
- Mode of infection: 1-contaminated food and water with ova or 2- Auto infection.
- Rout of infection: Mouth.
- Habitat: Adult worm in the small intestine of human.
- Life cycle is direct no intermediate host.
- Rare symptoms include anorexia, vomiting, nausea.
- Control Avoid taken contaminated food and water.
- Diagnosis: By finding ova and gravid segment in stool.

Morphology of Hymenolepis nana

Adult form

thread-like tapeworm

consists of a head (scolex), neck, and body (strobila)

lives for nearly two weeks

nearly 1000 to 5000 adults tapeworms may infect a man spontaneously

Scolex

globular with four suckers and a short rostellum

has 20 to 40 hooklets

the retractable rostellum always remains invaginated at the apex of the organ.



Hymenolepis nana scolex

Neck

long and is situated posterior to the scolex

Strobila

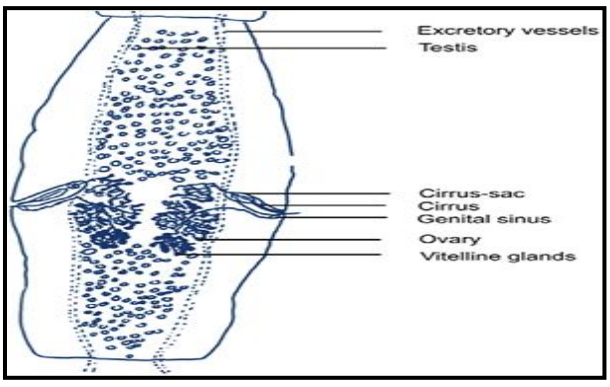
contains nearly 200 segments or proglottids

each mature segment measures 0.3mm in length and 0.9mm in breadth

as segments move away from the scolex, it develops and matures

genital pores are situated on the same side along the margin

gravid proglottids contain fertilized eggs.



Hymenolepis nana proglottid

Infective form (Egg)

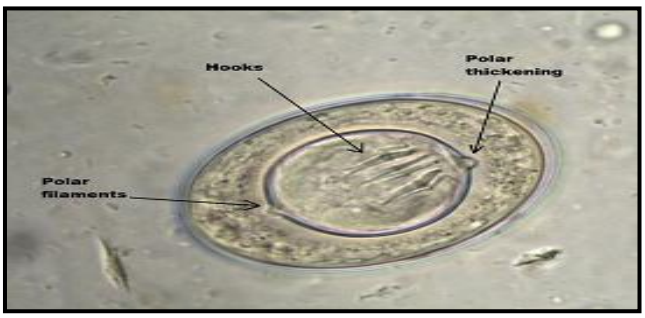
colorless and oval in shape

have two membranes separated by a clear space in between filled with yolk granules

outer membranes - thin, colorless

inner membranes (embryophore) – encloses an oncosphere with three pairs of hooklets

the inner membrane has two poles from where 4 to 8 thread-like polar filaments emerge and fill the space between the two membranes.



Hymenolepis nana egg

Life cycle

humans become infected after ingestion of Hymenolepis nana eggs

once in the small intestine, the embryo (oncosphere) is released from the egg

the oncosphere penetrates the small intestine and within 5 days, it develops into a small larval stage (cysticercoid)

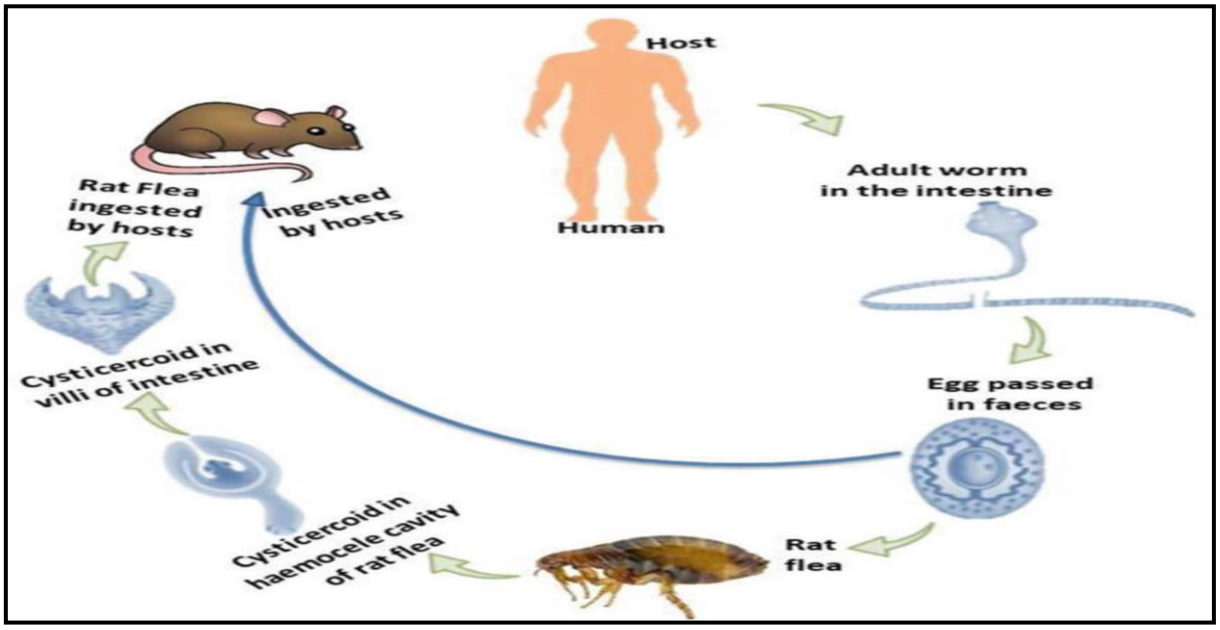
after fully maturing, the larva travels back to the small intestinal lumen where it attaches itself to the wall of the intestine with the help of suckers

within a month of infection, the tapeworm rapidly develops into an adult and the gravid proglottid breaks off and disintegrates to release fertilized eggs

these eggs are passed out along with the host feces which is the source of infection for new hosts (direct infection).

in some cases, the eggs hatch in the small intestine lumen of the original host to release embryos in the process called internal autoinfection

external autoinfection may also occur- which occurs when a person ingests eggs dispersed from their own body via the fecal-oral route and is mostly due to a lack of personal hygiene.



Hymenolepis spp. life cycle

Comparison of *Hymenolepis nana* and *Hymenolepis diminuta*

Feature	*Hymenolepis nana* (Dwarf Tapeworm)	*Hymenolepis diminuta* (Rat Tapeworm)
Size (Adult)	Small: 1.5–4 cm	Large: 10–60 cm
Common Name	Dwarf Tapeworm	Rat Tapeworm
Life Cycle	Direct (no intermediate host required); can have indirect	Indirect (requires flea/beetle intermediate host)
Transmission	Fecal-oral (person-to-person)	Ingestion of infected insect in grain/food
Autoinfection	Yes, common	No
Egg Size	Smaller: 30–47 μm	Larger: 60–85 μm
Egg Features	Polar filaments present (between shell and embryo)	No polar filaments; yellowish tint
Scolex Hooks	Present (on rostellum)	Absent

Echinococcus granulosus (Dog Tapeworm)

• Common name: is called the dog tapeworm or the hydatid worm

• Disease: Dog tapeworm infection or Echinococcosis and Hydatidosis.

• Infective stage to human and cattle is called: ova by food and water.

• Intermediate host: human, sheep cattle, camels all carry hydatid cyst and final host is only the dogs.

• Larval stage: is hydatid cyst in intermediate host.

• Habitat: adult worm in the small intestine of dogs.

Hydatid cyst structure

1-The outer (pericyst) layer: The outer layer is also called adventitia or ectocyst that encases the hydatid cyst, and this layer is produced by the host cells (modified dense fibrous protective tissue) as the host's response to the infection, this layer plays an important role in the development and survival of the cyst.

2-Laminatid layer (medial) layer: It plays a role in protecting the parasite from the immune response of host and providing the suitable environment for its continued growth**.**

3-Germinal layer Germinal (inner) layer: It acts to protect components of the cyst and controls the osmotic pressure of the cyst wall**.**

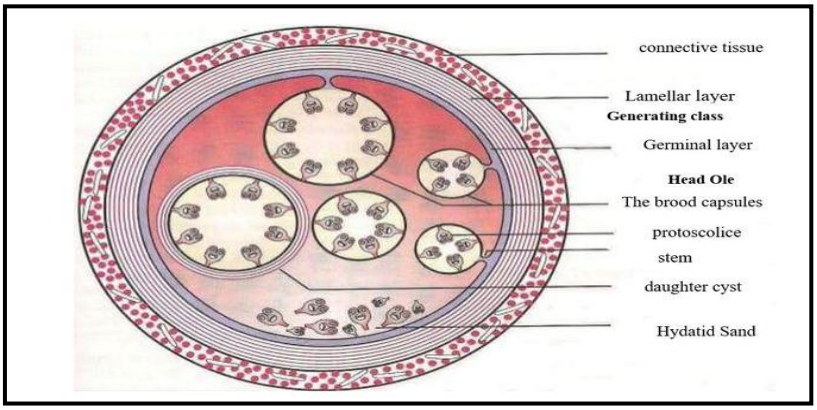
4-Daughter vesicles (brood capsules)

These capsules consist of the generated layer by several endogenous budding, which are small buds formed from the germinal layer toward the cavity of the cyst. These buds enlarge, and each capsule is connected to the germinal layer of the parental cyst by the stem, the process of budding is repeated, and each capsule contains large numbers of protoscolices, which have about 30-10 heads per capsule.

5-Hydatid sand

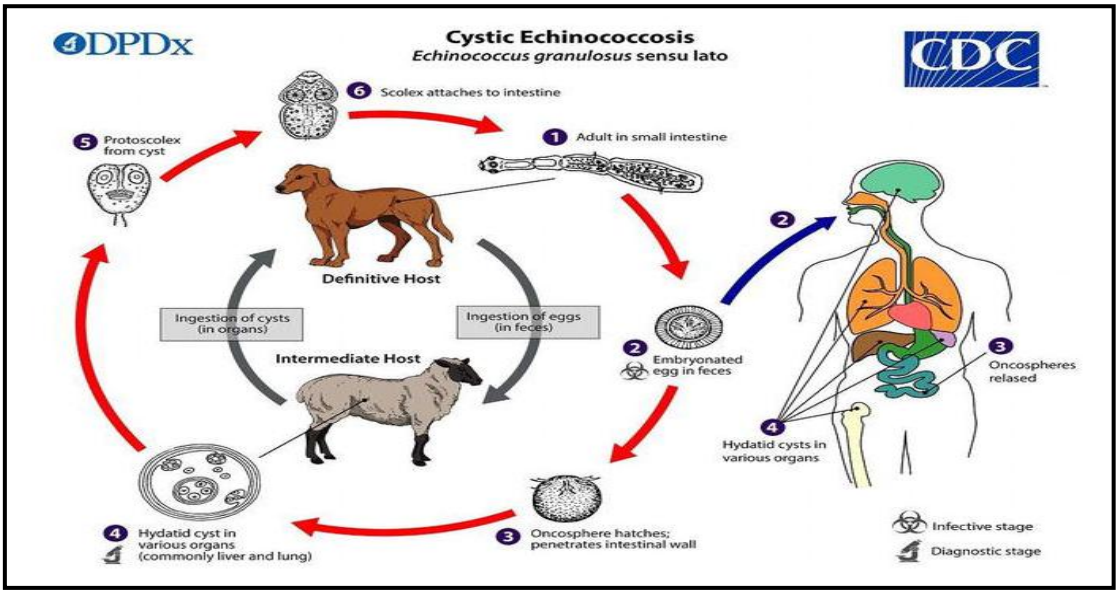
A term of hydatid sand refers to the contents of the hydatid cyst, which includes the daughter cysts, brood capsules, and protoscolices that present in the hydatid fluid of the E. granulosus.

6- Hydatid fluid: consist from different compounds for the activity and viability and pathogencity of the cyst. such as iron, chlorine, magnesium, sodium, calcium, cadmium, nickel, chromium,

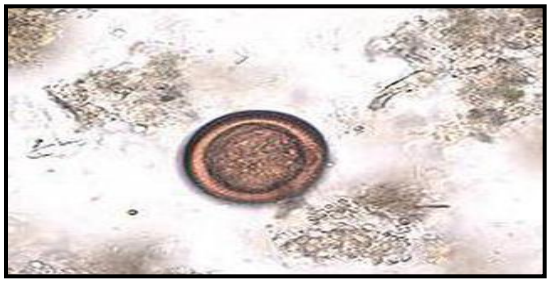


Life cycle

Egg is the infected stage comes from Ingested of water or vegetable polluted by infected dog feces, handling or caressing infected dog where the hairs usually contaminated with eggs. The ova hatch in duodenum or small intestine into embryos oncosphere, which penetrate wall enter portal veins migrate via portal blood supply to organs: lungs, liver, brain etc, thus causing extra intestinal infections. In these organs, larvae develop into hydatid cysts. The cyst may be large, filled with clear fluid and contain characteristic protoscolices (immature forms of the head of the parasite). These mature in to developed scolices, which are infected for doges.



*The eggs are spherical in shape and are similar in appearance to the eggs of other tapeworms, containing a hexacanth or oncosphere embryo because the embryo has sixth-hooks lets.



*Symptoms • Rare symptoms because the cyst grow slowly unless it rupture causing Anaphylactic shock due to release of protoscolices and toxins of hydatid cyst.

*Control: Avoid taken contaminated food and water. keep the dogs away with human contact.

*Diagnosis: Mostly X ray, CT scan or ultrasound to find the cyst.

*Treatment: surgical intervention most common(90%), Albendazole is used to treat infections caused by worms.

2-Class Trematoda:

*Trematodes are commonly referred to or commonly called as flukes. Flat and broad look like leaf of tree or flatfish (the name flukes comes from).

*All are hermaphrodite (monoecious) except Schistosoma in which sexes are separated (dioecious).

*According to the sites they inhabit, there are four groups of flukes (blood flukes, intestinal flukes, liver flukes and lung flukes).

*All of them are parasitic and pathogenic.

*No cavity, not segmented, Bilaterally flattened except genus Schistosoma is cylindrical.

*Body has 2 oral & ventral suckers (except some species have 3 rd genital sucker), oral suckers Situated anteriorly sometimes supported by hooks. Ventral sucker on ventral side for attachment and fixation.

*The all interior is occupied by the reproductive system; the organism is capable of producing huge numbers of eggs.

*Life cycle: all have indirect life cycle, so all trematodes are parasites of mollusks (snails) and vertebrates

Schistosomes (Blood flukes) Albilharzia

*They differ from other trematodes in that they have separate sexes.

* male worms resemble a rolled leaf where they bear the longer and more slender female in a ventral canal (the gynaecophoric canal).

*They require definitive and intermediate hosts to complete their life cycle.

*There are many species of Schistosomes responsible for human disease: S. mansoni, S. haematobium, S. japonicum, S. nasalis.

*Disease: Schistosomiasis or Bilharziasis.

Schistosoma mansoni

The intermediate host is snail of the geuns Biomphalaria. Man is the most common definitive host. The adult worms live in the lower colon.

Morphology: The male surrounding the female with his gynaecophoric canal, the male is actually flat but the sides roll up forming the groove. The cuticle of the **male** is covered with minute papillae. The **female** only posses these at the anterior and posterior end as the middle section being covered by the male body. Oral and ventral suckers are present, with the ventral one being lager serving to hold the worms in place.

Schistosoma japonicum

*Schistosoma japonicum is found in China, Japan, the Philippines and Indonesia.

*The intermediate hosts are from the subspecies Oncomelania, the worms desposit 1500 - 3500 eggs per day in the vessels of the intestinal wall.

Morphology: The adult worms are longer and narrower than the S. mansoni worms. The ova are oval with a minute lateral spine or knob.

Schistosoma haematobium

Schistosoma haematobium is different from the other two species previously mentioned in that it causes urinary schistosomiasis. It occurs in Africa, India and the Middle East. The intermediate host is the Bulinus snail. the females deposit their eggs in the walls of the bladder and finally making their way into the urine.

Morphology: The adult worms are longer than those of S. mansoni. The ova are relatively large. They have an elongated ellipsoid shape with a prominent terminal spine.

Eggs of three *Schistosoma* spp.



Schistosoma haematobium
(urine; eggs 115-170 x 45-65 micrometers)
(primates)



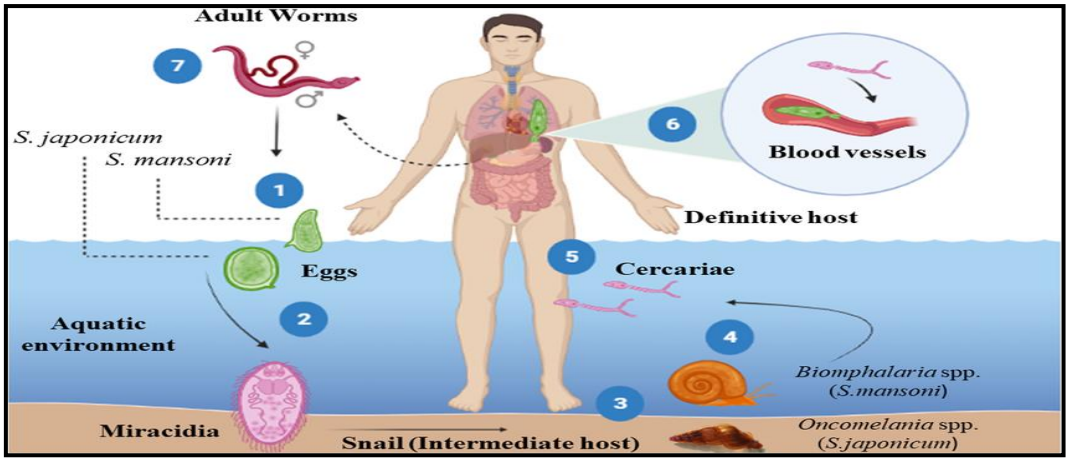
Schistosoma japonicum
(feces; eggs 75-95 x 45-65 micrometers)
(artiodactyla; carnivores; perissodactyla; primates; rodents)



Schistosoma mansoni
(feces; eggs 115-175 x 45-70 micrometers)
(primates and some rodents)

Life cycle

All have indirect needs so all trematodes are parasites of mollusks snails as (intermediate host) and vertebrates as final host, Show sexual stages or adult stages in the (definitive host) and asexual or larval stages in the (intermediate host). Require one or more intermediate host like snail or some fish. The habitat either in blood called blood flukes or in intestine called intestinal flukes or in the liver called hepatic or liver flukes. Egg from adult worm outside human body → miracidium (ciliated free swimming) → redia inside the snail sporocyst → many cercaria (free swimming with tailed) or encysted on vegetable forming metacercaria**.**



Clinical Presentation

Symptoms of schistosomiasis are not caused by the worms themselves but by the body's reaction to the eggs, *Schistosoma* infections may lead to central nervous system lesions. Cerebral granulomatous disease may be caused by *S. japonicum* eggs in the brain, and granulomatous lesions around ectopic eggs in the spinal cord may occur in *S. mansoni* and *S. haematobium* infections. Continuing infection may cause fibrosis in the affected organs (e.g., liver and spleen) with associated signs/symptoms.

Laboratory Diagnosis

- Microscopy Laboratory confirmation of S. mansoni infection can be made by finding the eggs in the feces or urine. When eggs cannot be found a rectal biopsy can be examined.

- Serology Serological tests are of value in the diagnosis of schistosomiasis when eggs cannot be found. An enzyme linked immunosorbent assay (ELISA) using soluble egg antigen.

Fasciola hepatica (Liver fluke)

*Common name: Sheep liver fluke.

*It is the largest and most common liver fluke found in humans, but its primary host is the sheep and to a less extent, cattle.

*It causes the economically-important disease, 'liver rot' in sheep.

*Habitat: The parasite resides in the liver and biliary passages of the definitive host.

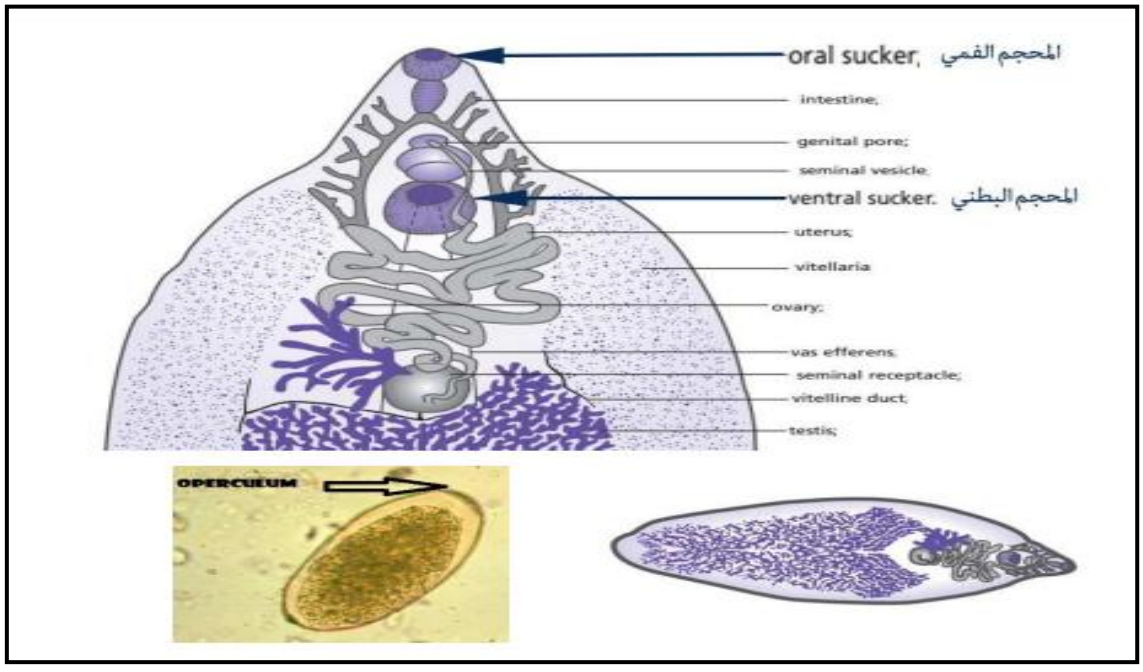
*Intermediate host: Freshwater snails (family Lymnaeidae), definitive hosts are ruminants, specifically sheep, cattle, and goats, and humans are accidental hosts.

*Adult Worm: It is a large leaf-shaped fleshy fluke grey or brown in color, it has a conical projection interiorly containing an oral sucker and is rounded posteriorly.

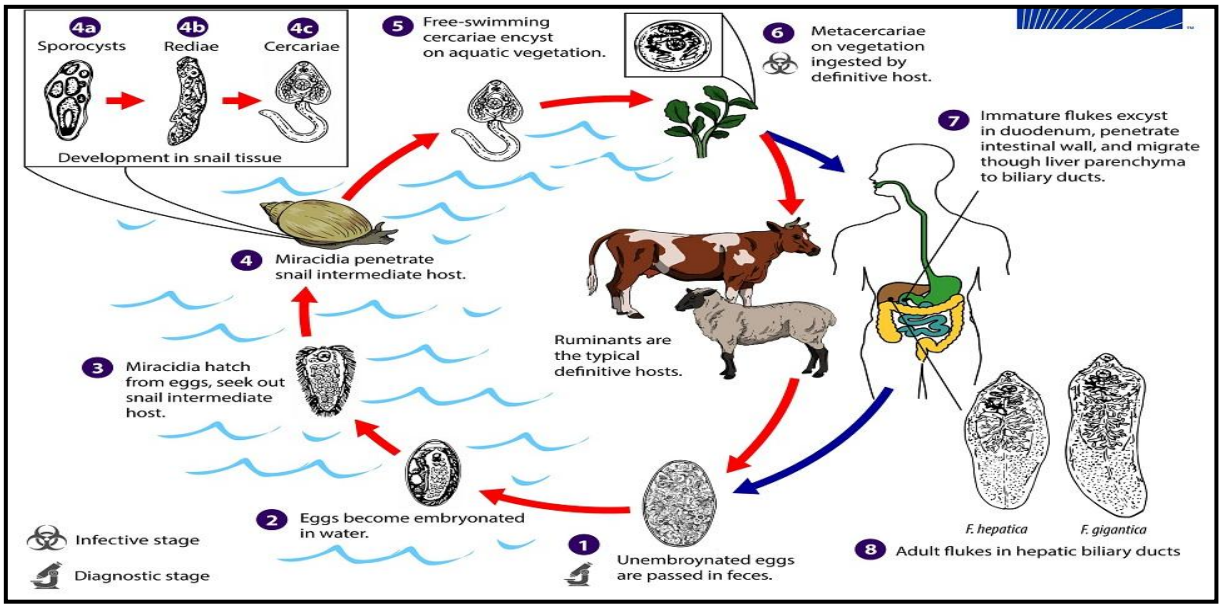
* The infective stage of Fasciola hepatica is the metacercaria.

Morphology:

1. Large fleshy worm inhabit the duodenum.
2. Tegument spinose.
3. Oral sucker is smaller than the acetabulum.
4. Testes are highly branched in the posterior 3/5 of the body.
5. Small branched ovary.
6. Short convoluted uterus.
7. Eggs are large, hen's egg shape with thin transparent shell operculum & unemberyonated.



Pathogenicity: Fascioliasis causes parenchymal injury. As humans are not its primary host, it causes more severe inflammatory response. Some larvae penetrate right through the liver and diaphragm ending up in the lung. In acute phase during the migration of the larva, patients present with fever, right upper quadrant pain, and tender hepatomegaly. In chronic phase, patients may develop biliary obstruction jaundice obstructive, cirrhosis biliary cholelithiasis.



Diagnosis: Stool Microscopy Demonstration of eggs in feces or aspirated bile from duodenum is the best method of diagnosis. Eggs of F. hepatica and F. buski are indistinguishable.

Fasciolopsis buski (Giant fluke, largest fluke)

*Disease: Fasciolopsiasis

*Habitat in human: Small intestine

*Definitive host: Humans and pigs

*2 Intermediate hosts: Snails and aquatic vegetation.

*Egg: eggs of F. hepatica and Fasciolopsis buski cannot be differentiated.

Fasciolopsis buski is commonly called the giant intestinal fluke is commonly called the giant intestinal fluke, being the largest known parasitic fluke is commonly called the giant intestinal fluke, being the largest known parasitic fluke in humans is commonly

called the giant intestinal fluke, being the largest known parasitic fluke in humans. The reason for its common name is due to the fact that it is one of the largest flukes is commonly called the giant intestinal fluke, being the largest known parasitic fluke in humans.

Heterophyes heterophyes (Minute fluke)

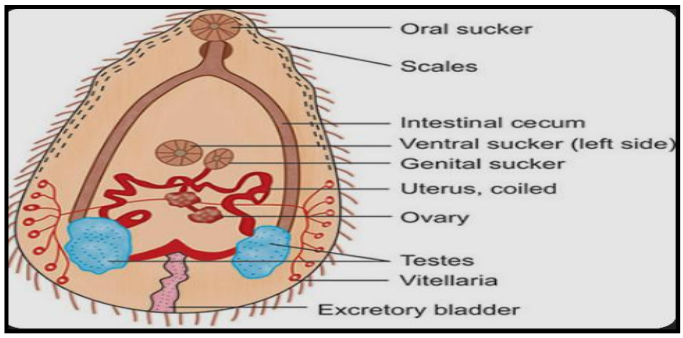
*Heterophyid flukes: is the smallest trematode parasite of man

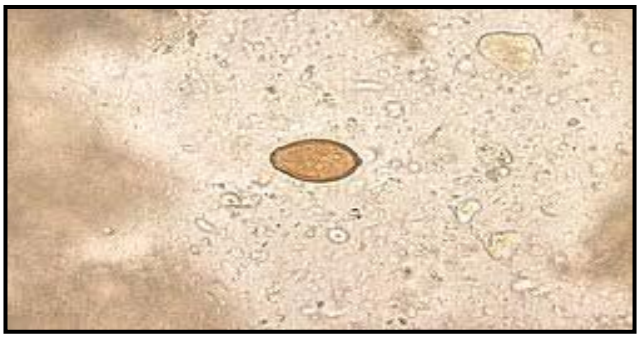
*Minute pyriform worm rounded posteriorly, inhabits the small intestines of its final hosts, which include humans and fish-eating mammals (such as cats, dogs, foxes), infections occur when these hosts consume raw or undercooked freshwater/brackish fish (intermediate host).

*Disease: Heterophyiasis, infective stage is metacercaria.

Morphology

Covered by minute spines. Oral sucker is very small and ventral sucker is large. Presence of genital sucker. Seminal vesicle lacks the cirral sac and organs. The eggs are small with conical operculum contain mature miricidium.





Life cycle: The life cycles of H. heterophyes are identical. Eggs are ingested by snails that are the first intermediate hosts. The eggs mature into cercariae and are passed by the host snail. The cercariae penetrate the skin of freshwater fish and migrate to the muscle where they mature into metacercariae. Infected raw fish are ingested by humans. The metacercariae mature into adult worms in the duodenum and jejunum.

Pathogenesis: The main symptoms are superficial irritation of the intestine mucosa with excess secretion of mucus, diarrhea and colicky abdominal pain. Migration of the eggs to the heart, resulting in potentially fatal myocardial and valvular damage.

Class: Nematodes

General characteristic

*Among the commonest of all parasites and responsible for diseases of major importance in humans.

*Non-segmented roundworms, cylindrical and slender.

*The sexes are usually separate (Dioecious), the male which is smaller than the female commonly has a curved posterior end.

*Sex-differentiated, bilaterally symmetrical

*The supporting body wall consists of cuticle layer, syncytial layer (subcutical layer) and longitudinal muscular layer.

*The alimentary tract is a simple tube extending from the mouth to the anus.

Ascaris Lumbricoides

common saying "round worm of man" is the largest of the intestinal nematodes parasitizing humans. It is the most common worm found in human (final host). Its completed within a single host. Infective stage is embryonated egg stage. Disease is Ascariasis

Morphology:

1-Adult: The adults are cylindrical in shape, creamy-white or pinkish in color, filled with irritating fluid ascarase or ascaron.

2-The female: averages 20-35cm in length, the largest 49cm, the male is smaller, and distinctly more slender than the female, the typical curled tail with a pair sickle like copulatory spines. On the tip of the head there are three lips, arranged as a Chinese word, each lip possesses a pair of sensory papillae.

3-type of eggs: 1. Fertilized eggs: broad oval in shape, brown in color. The shell is thicker and consists of ascaroside, chitinous layer, fertilizing membrane and mammillated albuminous coat stained brown by bile. The content is a fertilized ovum. There is a newmoon (crescent) shaped clear space at the each end inside the shell.

2.Unfertilized egg: Longer and slender than a fertilized egg. The chitinous layer and albuminous coat are thinner than those of the fertilized eggs without ascaroside and fertilizing membrane. The content is made of many refractable granules various in size.

3. Decorticated eggs: Both fertilized and unfertilized eggs sometimes may lack their outer albuminous coats and are colorless

Fertilized Ascaris Egg A fertilized Ascaris egg, still at the unicellular stage, as they are when passed in stool.

Symptoms: Early Phase (Lung Migration): As larvae travel through the lungs, symptoms can appear resembling asthma or pneumonia.

Later Phase (Intestinal Infection): Once adult worms settle in the intestines, they can cause digestive issues, particularly with a high worm burden: (Nausea and vomiting, Diarrhea and Visible worms in stool or vomit).

Severe Complications

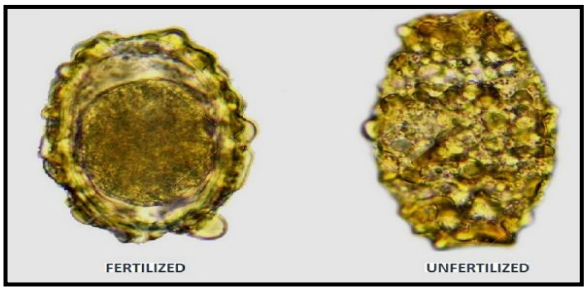
Intestinal Obstruction: Large masses of worms can block the intestines, requiring emergency care.

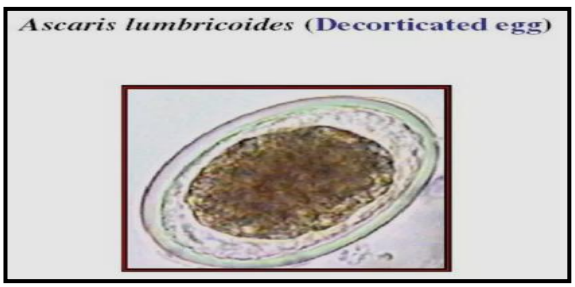
Biliary/Pancreatic Blockage: Worms may migrate into the bile or pancreatic ducts, causing severe abdominal pain, gallbladder inflammation (cholecystitis), or pancreatitis.

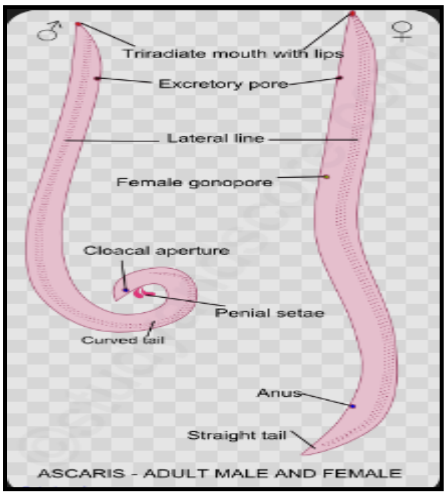
Nutritional Deficiencies: Chronic infection, especially in children, can lead to weight loss, poor growth.

Diagnosis: The confirmative diagnosis depends on the recovery and identification of the worm or its egg. Ascaris pneumonitis: examination of sputum for Ascaris larvae is sometimes successful. Intestinal ascariasis: feces are examined for the ascaris eggs. direct fecal film: it is simple and effective. The eggs are easily found using this way due

to a large number of the female oviposition, approximately 240,000 eggs per worm per day.







Trichuris trichiura

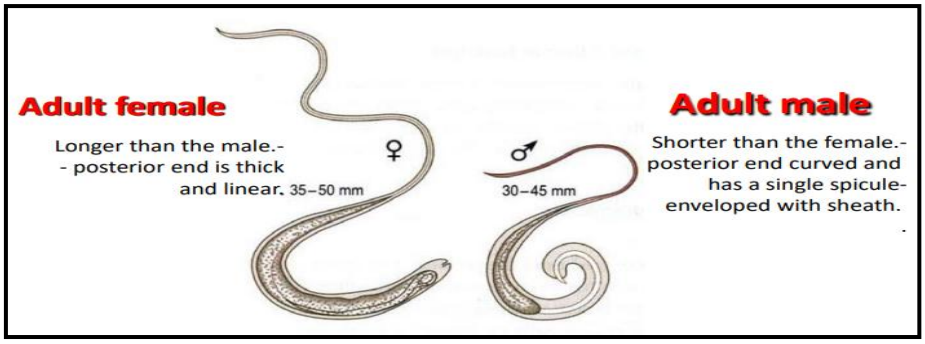
*Has a direct life cycle and no intermediate host. It requires only a single host, human.

*The larvae and adult worms live in the intestine of humans.

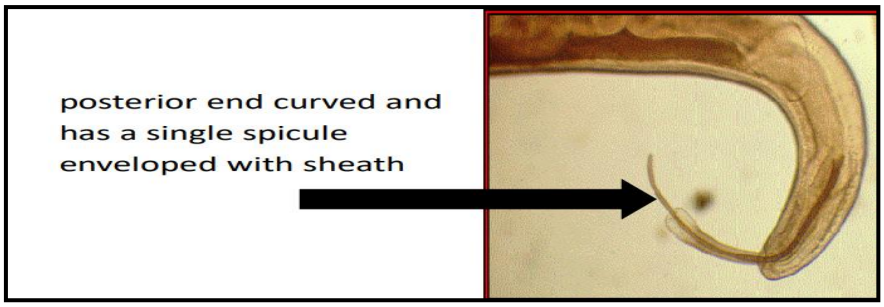
*The name is derived from the worm's distinctive whip-like shape.

*Disease: trichuriasis or Roundworm infection is caused by ingesting eggs. This can happen when hands or fingers that have contaminated dirt on them are put in the mouth, or by consuming vegetables or fruits that have not been carefully cooked, washed or peeled. Infective stage is embryonated eggs.

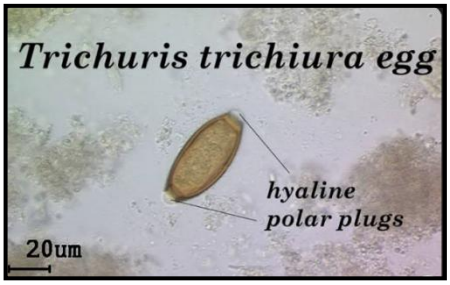
*Adult worm penetrates into and embed its whip-like anterior portion in the intestinal mucosa by small spear.

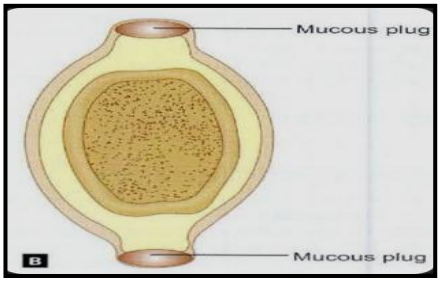


*The anterior end two-thirds of the body being very thin (looks like a whip).



Eggs: Shape: barrel shaped size: 50-55 x 25-30µm Shell: thick egg shell with 2 polar plugs Color: Yellow-brown Content: immature egg cells 3000-10000 eggs daily output





Clinial Signs

*Light infection with Trichiuris are asymptomatic

*Havier infections are characterized by diarrhea, anorexia, nausea, abdominal pain, anemia may be the result of hemorrhaging when the worms penetrate the intestinal wall.

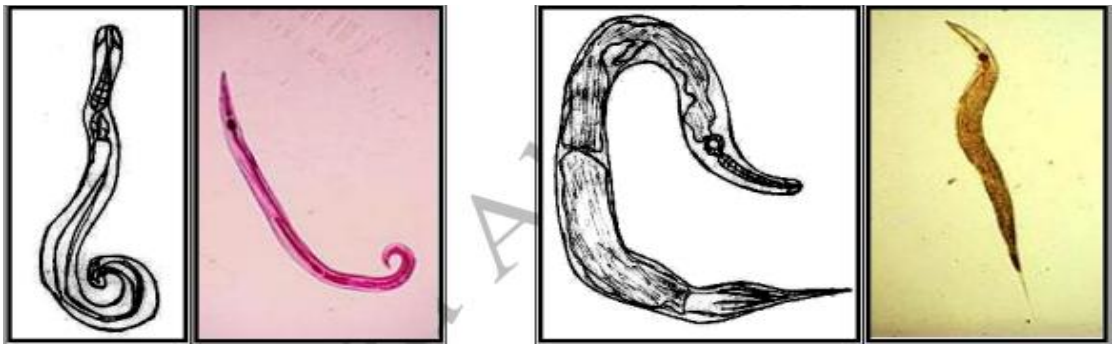
Laboratory diagnosis

1- Eggs or worm in feces. Eggs are oval, barrel shaped,
2- Eosinophilia may occur.
3- In heavy infection proctoscopy or sigmoidoscopy, can show the worms attached to the mucosa.
4- Visual detection of adult worms on prolapsed rectum.

Laboratory Diagnosis: The eggs are recovered from parietal skin by using the Scotch tape technique and can be observed microscopically . Unlike those of other intestinal nematodes, these eggs are not found in the stools. The small, whitish adult worms can be found in the stools or near the anus of diapered children.

Enterobius vermicularis

It is parasitic only to humans, commonly known as pinworm or seat worm. The worm is small and found in the large intestine of man, causes Enterobiasis. Adult worms characterized by its spindle shape, the mouth of the adult worm have 3 lips. The lateral view of the worm forms an inverted question mark. The male has strongly curved posterior end, has a copulatory spicule and caudal alae as well as the papillae. The female is considerably longer than male. The sharply pointed post anal portion is nearly a third of the total length and it is the cause of the name "pinworm", Infective stage: embryonated eggs.

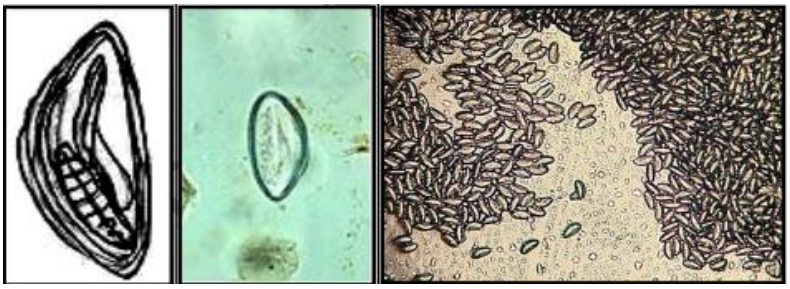


Enterobius vermicularis: male and female worm.

Life cycle

The characteristic habitat of these worms is the ileocecal region (cecum and appendix), but generally, they are crawling along the digestive tract from the stomach to the anus hanging on the mucosa where they are feeding on the epithelial cells and bacteria. After fertilization males die and detection of males become difficult and rare and must use a purgative for this purpose. When the female body become filled with eggs it become free in the intestine and migrates to the rectum and exits through the anus during the night (during 14 the host's sleep or relaxation), and lays-up its eggs on the skin of the perianal

region. More eggs released when the female's body ruptures, and sometimes the eggs exit with feces. The eggs are elongated, oval and flat from one side; it with a colorless double shell, an inner membrane and an outer albuminous layer that causes them to stick to each other and to clothing and other objects, each contains upon deposition an immature larva. The female lays-up 4000-16000 eggs then die after egg laying. The infective third-stage larva completes development within the egg several hours after leaving the body of the female worm.



Egg of Enterobius vermicularis (D shaped)

Mode of infections:

1.The most common method for infection is the direct infection or self-infection when the patient is re-infected by hand to mouth transmission from the anus to the mouth throughout the contaminated fingers, the migrant worms outside the anus causes pruritus over the perianal and sticks under nails and reach to the mouth. The infection also occurs through the contaminated beds and any other contaminated objects used from an infected person.

2.The inhalation of eggs. Its eggs are very light, so it is very simple to spread in the air during the cleaning of the beds and clothes of the infected individuals. Therefore, the inhalation of eggs found in the air with dust is another source of infection.

3.The retro infection, where the infection occur in the same individual. It occurs when the skin crypts of the perianal region is not clean for a long time. The aggregated eggs may hatch, and the larvae migrate back to the large intestine and grow to adult worms.

Pathology and Symptoms

Enterobiasis is frequently asymptomatic. The most typical symptom is perianal pruritus, especially at night, which may lead to excoriations and bacterial super infection.

Diagnosis

Specific diagnosis made on the recovery of the adult worms and/or eggs. Female worms emerge at night and are frequently visible in the perianal and perineal regions. Adult worms can often be observed in feces as well; however, eggs are found in feces in only about 5% of cases.

The cellophane tape technique it is doing by pressing transparent adhesive tape (cellulose-tape) on the perianal skin and then examining the tape placed on a slide. These preparations are more likely to be positive when perianal impression specimens are taken in the early morning before defecation or a shower or bath. Negative results from this protocol for seven consecutive days constitute confirmation that the patient is free of infection. Alternatively, anal swabs or "Swab tubes" (a paddle coated with adhesive material) can also be used. Eggs can also be found but less frequently in the stool and occasionally are encountered in the urine or vaginal smears. Adult worms are also diagnostic, when found in the perianal area, or during ano-rectal or vaginal examinations.

Ancylostoma duodenale (intestinal hookworm): These nematodes are called intestinal hookworms or known as the old world hookworm, and they are known for their voracious blood feeding habits. Two principal species infect around 900 million person a year. **Necator americanus** is known as the new world hookworm.

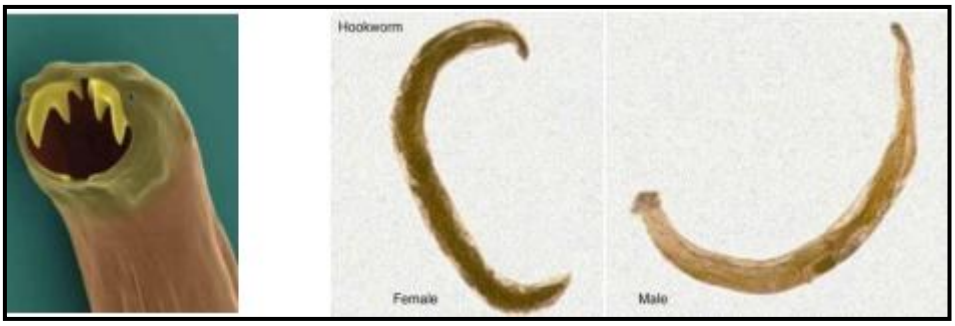
Morphology

*Adult worm appearance S-shaped worm with pinkish-white color.

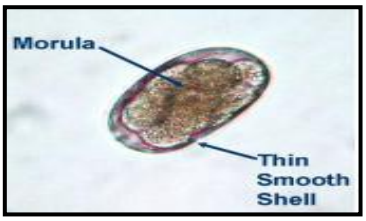
*Host: it infects only humans as the final hosts, no intermediate host is required.

*Size: female is 10-13 mm in length by 0.6 mm in diameter while males are 8-11 mm by 0.4 mm

*Shape: the posterior end has an umbrella shaped bursa with rib-like rays and two pairs of curved teeth on the ventral wall of its buccal capsule Egg.



*eggs are oval or elliptical, colorless, and with a thin transparent hyaline shell membrane.



Each egg contains a few cells grouped together "morula"
The eggs with single ovum develop in the intestine, then passed in feces having a segmented ovum with 4 to 8 blastomeres.
*Larva Eggs → hatch in the environment into larva L1 → L2 → L3 ready to penetrate human skin, the hatched rhabditiform (non-infective) larvae grow in the feces or soil for and mature into filariform (infective) larvae.

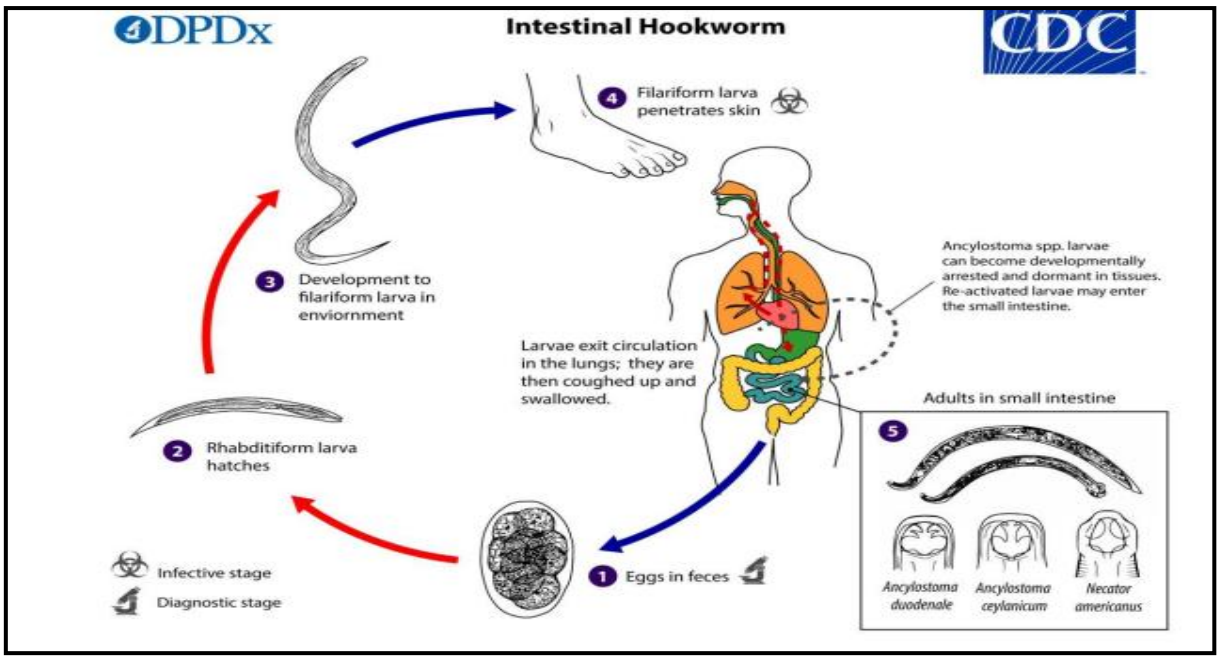
Mode of transmission: Penetration of the skin by larvae when they come in contact with the skin between the toes, the dorsum of the feet and the inner side of the soles. Another method of infection when drinking water contaminated with larva.

Pathogenesis and Clinical Feature

1.The larvae cause lesions on the skin at the site of penetration called Ancylostoma dermatitis (ground itch) and creeping eruption where the larva remain wandering in the skin for weeks and up to 2 years.



2.Lesions in the lung such as bronchitis and bronchopneumonia when the larva breaks the pulmonary capillaries.



Laboratory Diagnosis: 1. Examination of stool for detection of eggs. 2. Detection of larva in the sputum 3. Occult blood test is positive indicating intestinal bleeding.

Larva Migrans

Larva Migrans classified into cutaneous, ocular or visceral types depending on whether the larval migration takes place in the skin or in deeper tissues due to lose their way and wander around aimlessly when human infection with non-human species of nematodes:

1- Cutaneous Larva Migrans

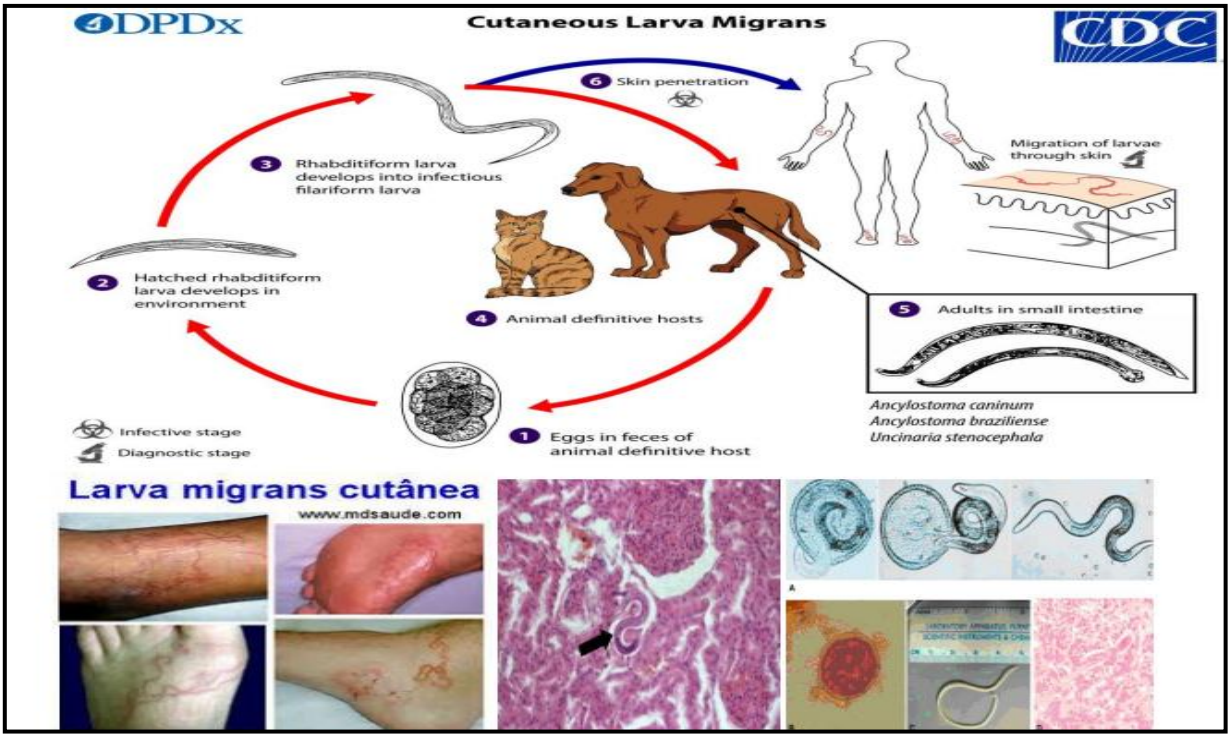
also known as creeping eruption (also called ground itch) which caused by burrowing larvae of animal hookworms. The larvae hatch from eggs passed in dog and cat feces and mature in the soil to larva stage(filariform larva) and penetrate the skin to cause infection, due to contact with contaminated soil in a human host is an accidental host for these parasites while in normal hosts such as dogs or cats develop normally in to adult in their intestine. The most common cause is non-human species of hookworm (Ancylostoma braziliense and A. caninum).

Pathogenesis: after larvae penetrate the skin erythematous lesions but the larvae are unable to penetrate the basement membrane to invade the dermis, so that the disease remains connected to the outer layers of the skin.

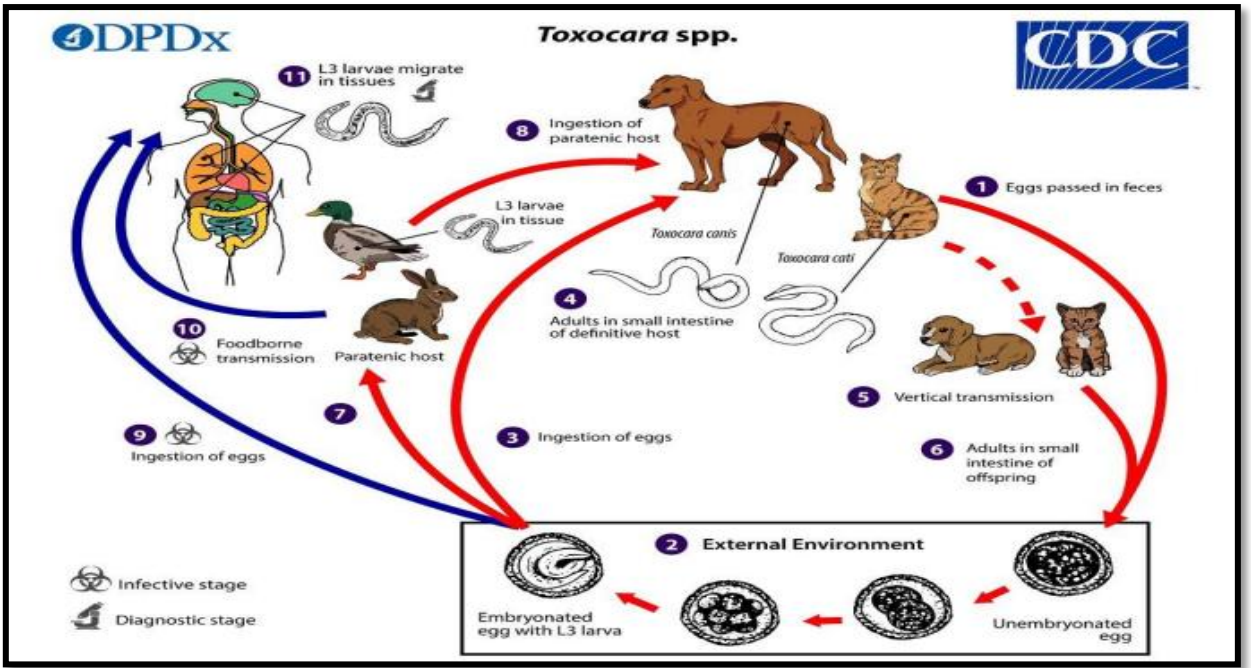
Clinical Features: The larvae produce itching papules, which develop into tunnels in the epidermis due to the movements of the larva in the skin, the lesion also shifts, hence the name „creeping eruption". Scratching may lead to secondary bacterial infection.

Transient creeping eruptions may be produced sometimes by the human hookworm, Necator americanus and Ancylostoma duodenale.

Prevention: Reduce contact with contaminated soil by wearing shoes and protective clothing and using barriers such as towels when seated on the ground.



2-Visceral Larva Migrans: caused by the migration of larvae of nonhuman species of nematodes that infect by the oral route. The cause is the dog ascarid, Toxocara canis and cat ascarid, Toxocara cati, these nematode larvae do not develop into adult worms, but instead, migrate through host tissues.



Pathogenesis

When the infective eggs present in the soil contaminated by dog and cat faces are ingested, the larvae hatch in the small intestine, penetrate the gut wall, and migrate to the liver, which may remain there or migrate to other organs such as the lungs, brain, or eyes. In humans, they do not develop into adults but induce granulomatous lesions, which cause local damage.

Clinical Features: Clinical manifestations depend on the sites acted and the degree and duration of infection. As children are more likely to swallow dirt, this condition is much more frequent in them. Fever, hepatomegaly, pneumonitis, hyperglobulinaemia, and patients may develop neurological disturbances (neural larva migrans) and endophthalmitis (ophthalmic larva migrans). Marked leukocytosis occurs with persistently high eosinophilia.

Diagnosis: Serological tests, to the diagnosis of toxocariasis (visceral larva migrans).