

Lecture :- 14 & 15

Phylum Platyhelminthes(Cestodes)

A- *Diphyllobothrium latum* is a flat tapeworm (Pseudophylidia, (Fish tape worm or board tape worm).

1-Definitive Host: Fish-eating carnivores, including dogs, bears, humans.

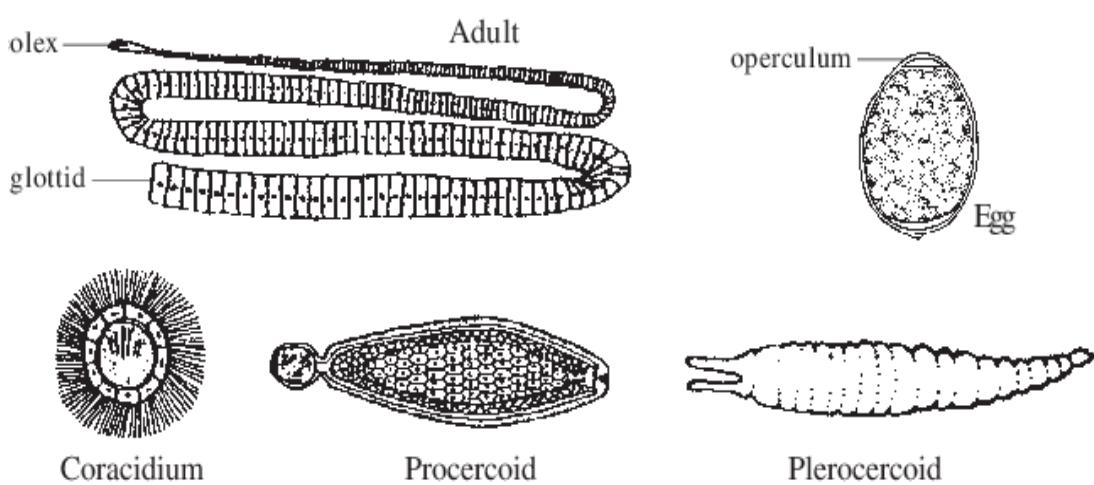
2-1-First Intermediate Host: Crustaceans, including copepods.

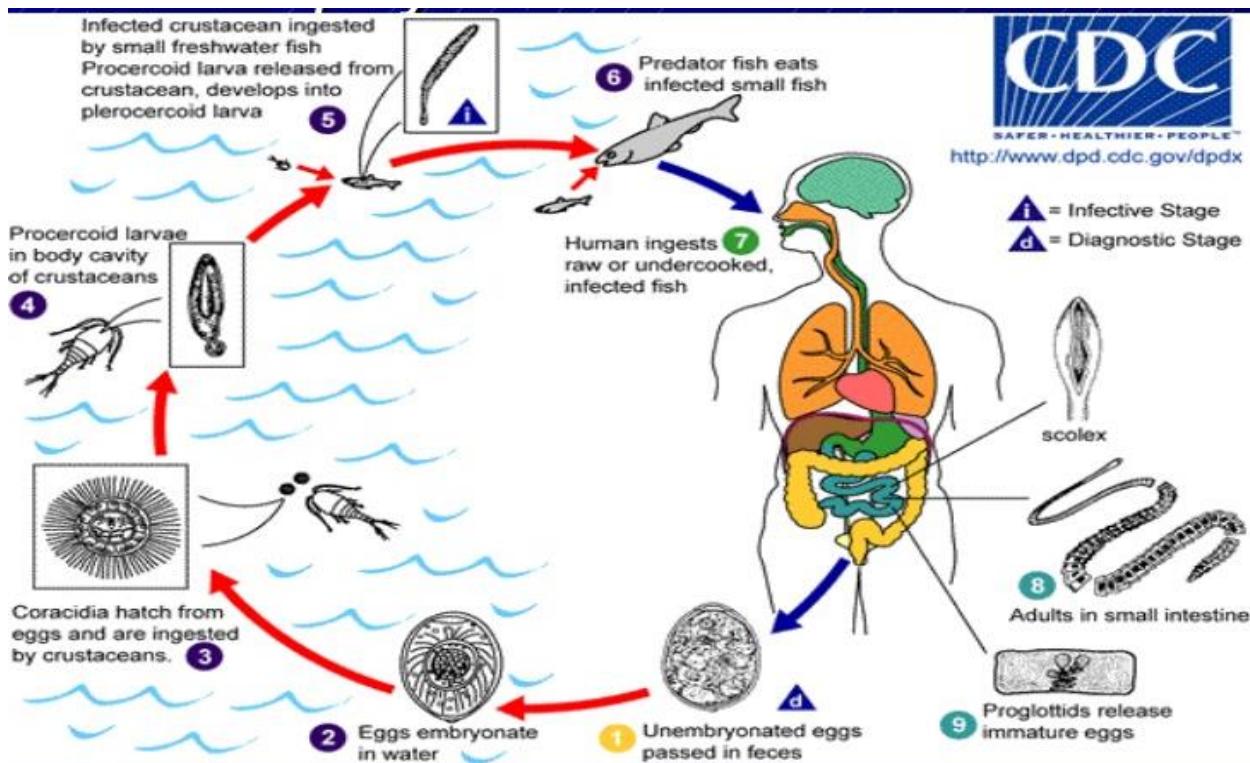
2-2-Second Intermediate Host: Fish, particularly pike and salmonids (trout, salmon).

- Fish eats copepod with procercoid larvae.

- Definitive Host : eats fish with plerocercoid.

-Embryonate egg: Coracidium: free in water.





Pathogenesis and symptoms

Obstruction of the bowel by large number of worm, decrease B12 vitamine.

B- Cycophyllidea

The body is divided into three main body regions; these are

Head (scolex): attachment organ and may have grooves, suckers, and rostellum armed with hooks.

Neck: growth region, proglottids proliferate from this region.

Strobila: varies in number, shape, size, and maturity. It is divided into three regions.

- a/ immature : sex organs are immature.
- b/ mature: sex organs are fully mature.
- c/ gravid : reduced or atrophied primary genital organs, uterus is filled with eggs

Taenia saginata (Beef tape worm)

Scolex of *T. saginata*



Geographical Distribution: World wide distribution

Habitat

Adult: In small intestine of man(4-8m).

Larvae: In muscular tissues of cattle.

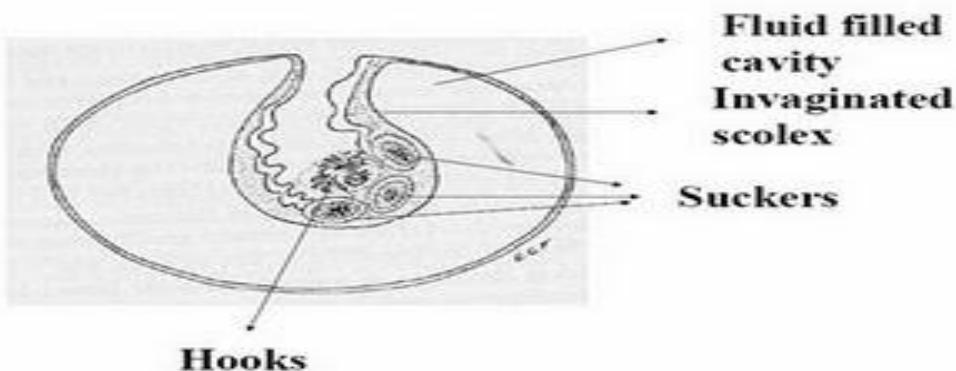
Eggs: In faeces of man or in gravid segments.

Life cycle

Requires two hosts to complete its life cycle. Man as a definitive host and cattle as intermediate host.

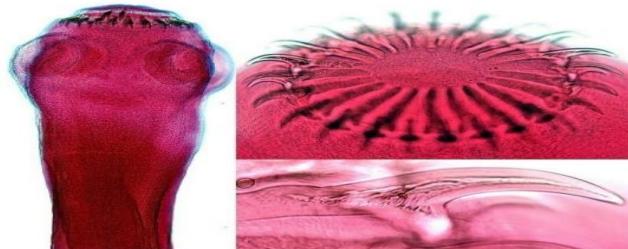
The larval cyst of *T. saginata*—the (*Cysticercus bovis*)—is a pea-sized, fluid-filled cyst, which develops in the muscles of the intermediate host. Within the cyst is a single inverted scolex, formed from a germinate portion of the inner cyst wall.

Diagrammatic representation of a cysticercus



Taenia solium, The Pork Tapeworm

Taenia solium



Geographical Distribution:- Widely distributed

Habitat:

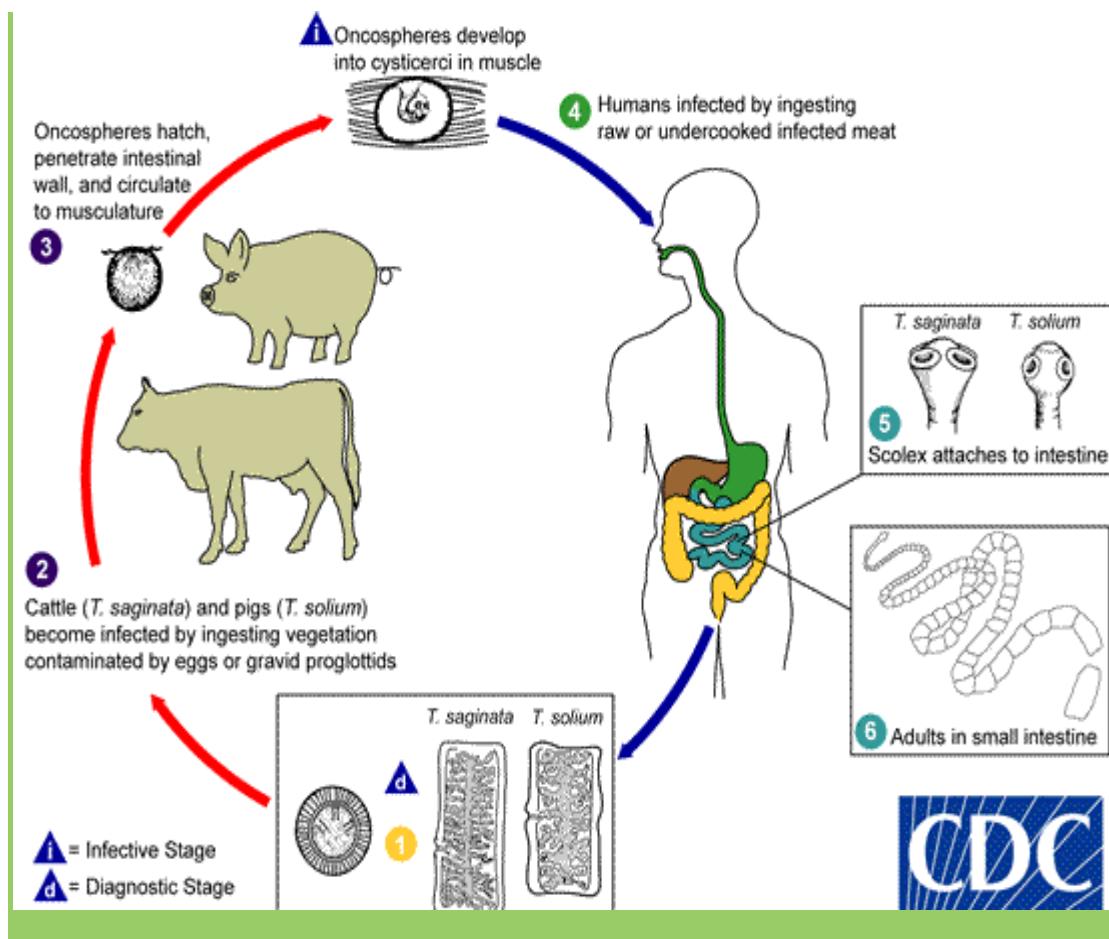
Adult: In the small intestine of man(2-4m).

Larva: In muscular tissues of pig

Egg: In the faeces of man and in gravid segment.

Life Cycle:

The life cycle of *T. solium* is similar to that of *T. saginata* except pigs serving as an intermediate host for the development of larvae known as (*Cysticercus cellulosae*).



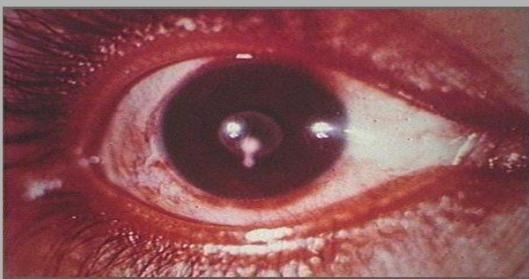
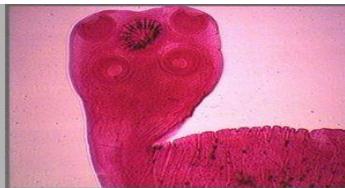
Pathogenesis

Causes taeniasis Major symptoms are loss of appetite, weight loss, hunger, acute intestinal obstruction, eosinophilia, and discomfort by the crawling of segments through the anus.

The hooked scolex of *T. solium* may cause greater intestinal disturbance, pain, and inflammatory response than that caused by *T. saginata*, but symptoms are still generally mild and the pathology minor. However, *T. solium* larval infection (cysticercosis) is a potentially dangerous systemic infection, the degree of damage depending on the site and number of *cysticercus (cysticercus cellulosae)* that develop.

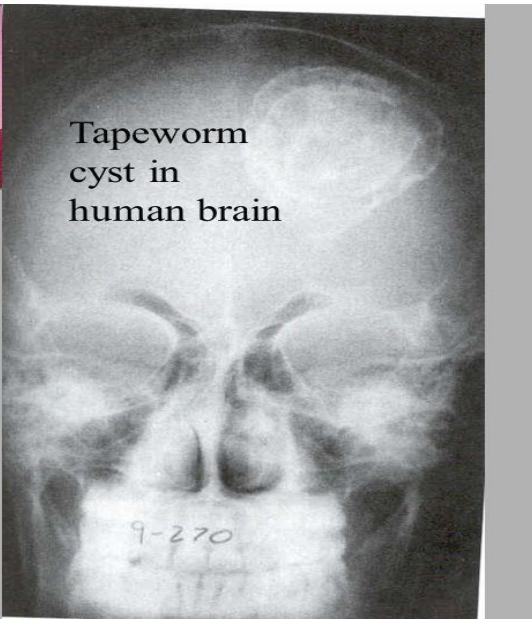
Infection most commonly occurs in the central nervous system (CNS). It is also frequently found in muscles and subcutaneous tissues. The globe of the eye is also a common site.

Taenia solium – scolex
(how it holds on in the gut)



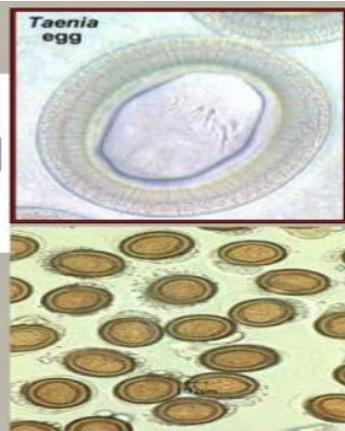
Taenia solium – cysts in human eye
(cysts can be just about anywhere in body)

Tapeworm cyst in human brain



Egg

- The eggs of *Taenia saginata* and *T. solium* are indistinguishable morphologically.
- The eggs are spherical, diameter 31 to 43 µm, with a thick radially striated brown embryophore.
- Inside each is an oncosphere with 6 hooklets.



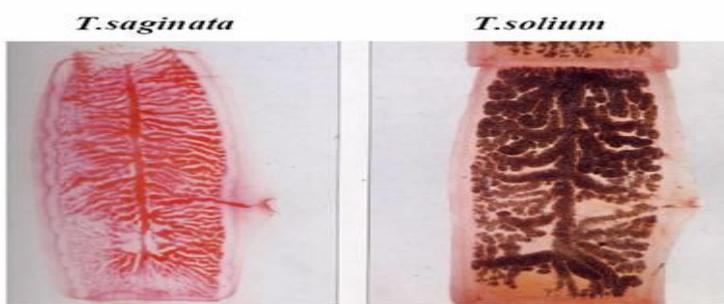
Differences between *T.solium* and *T.saginata*

Adult	<i>T. solium</i>	<i>T. saginata</i>
Length	2-4 meters	4-8 meters
Number of segment	700 to 1000	1000-2000
	thin and transparent	thick but opaque
Scolex	1mm in diameter with 4 suckers and hooklets	2mm in diameter, with 4 suckers but no hooklets
Mature proglottid	3 lobes of ovary	2 lobes of ovary
Gravid proglottid	7-13 uterine lateral branches each side	15-30 uterine lateral branches each side

Laboratory Diagnosis

1. Detecting eggs in the faeces which is morphologically indistinguishable from the egg of *Taenia saginata*.
2. Identifying gravid segments and scolex in the faeces after treatment.
3. Finding calcified larvae in histological or X-rays examination .

Stained gravid segments of *T.saginata* and *T.solium*



Note –
12 major
uterine
branches
with
T.solium
More than
13 in
T.saginata

measly meat

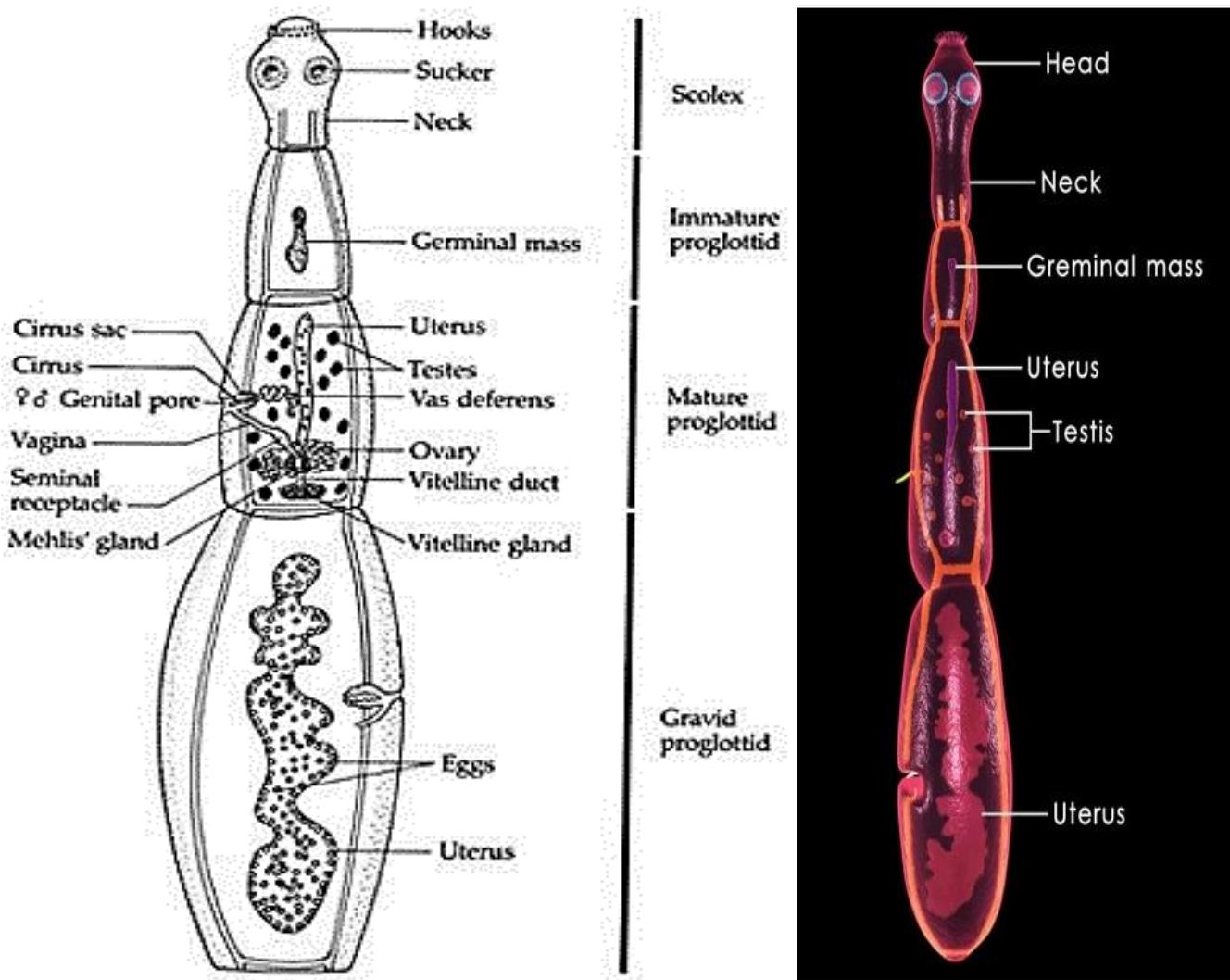


Prevention and Control:

1. Avoid eating raw or insufficiently cooked pork meat
2. Ensuring pigs do not have access to human faeces.
3. Inspecting meat for larvae
4. Treating infected person, providing health education and adequate sanitary facilities

**Compare with Pseudophyllidea (假叶目)
and Cycophyllidea (圆叶目)**

	Pseudophyllidea	Cycophyllidea
Scolex	2 slit-like sucking	4 cup-shaped suckers with or without hooks
Genital pore	on the flat surface of the segment	on the margin of the segment
Uterus	present open	absent
Vetelline glands	scattered all over the segment	condensed into a single gland

Echinococcus granulosus, Hydatid disease

Morphology

- **Size (adult):** Ranges in length from 2mm to 9mm
- **Segments:** Has 3 proglottids (segments) – immature, mature & a gravid link that is longer and wide.
- **Shape:** The scolex (head) has 4 suckers and a rostellum with hooks (25 – 50)hooks with a double crown at the tip of the scolex.

Echinococcus granulosus
(Hydatid Tapeworm)
Length: 3-9 mm

- **Location of adult:** small intestine of dogs
- **Location of hydatid cyst :** liver, lung, CNS and bone in man, cattle and sheep
- **Intermediate host:** cattle, sheep (man is an end stage intermediate host)
- **Infective stage (for human):** eggs in feces
- **Mode of transmission:** man is infected by ingestion of eggs in dog feces
- **Diagnosis:** identification of hydatid cyst by X-ray
- **Disease:** hydatid disease



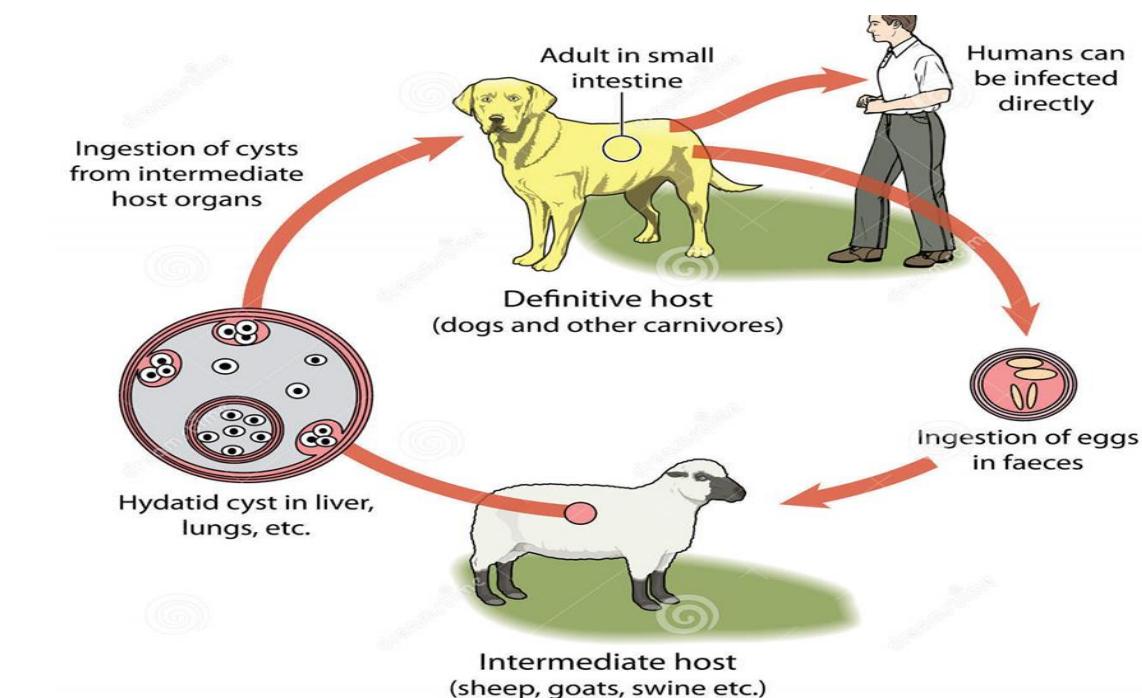
Geographical Distribution:- Common in sheep and cattle raising

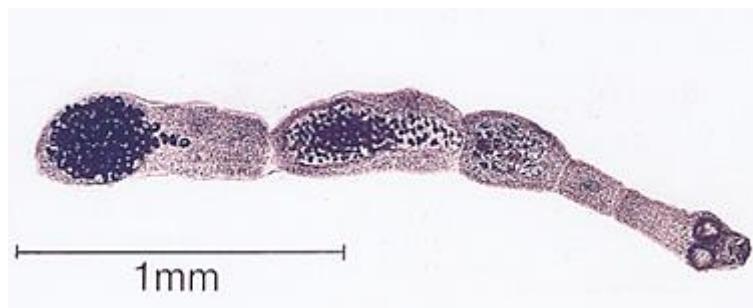
Habitat

Adult: mucus membrane of small intestine of carnivores such as dog, fox,

Hydatid cyst/larvae: in the different body parts (liver, lung, brain, etc) of man and herbivorous animals.

Egg: in the faeces of dog, fox, and jackals



Echinococcus multilocularis

The adult parasite is a small tapeworm that is 3- 6mm long, and lives in the small intestine of canines. The segmented worm contains a scolex with suckers and hooks that enable attachment to the mucosal wall.

Echinococcus multilocularis

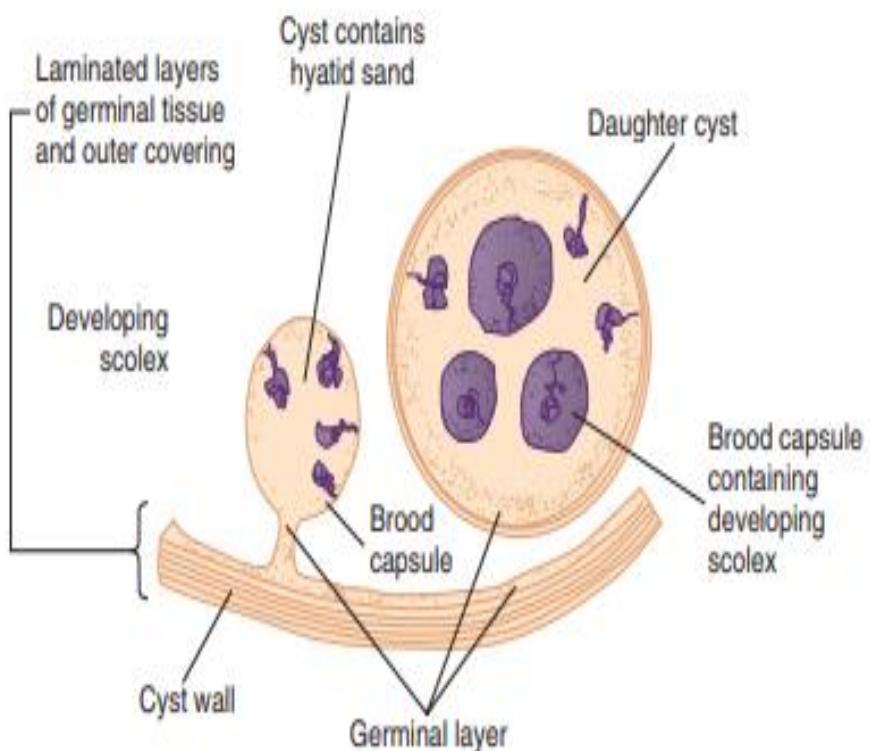
- This is a tapeworm, similar to *E. granulosus*, that also causes hydatid in northern parts of Asia and North America.
- It has a very similar morphology and life cycle except that rodents are its intermediate host.
- Humans, when infected with this worm, also develop hydatid cysts which produce symptoms similar to those caused by *E. granulosus*. However, the cysts are multilocular (many chambers).

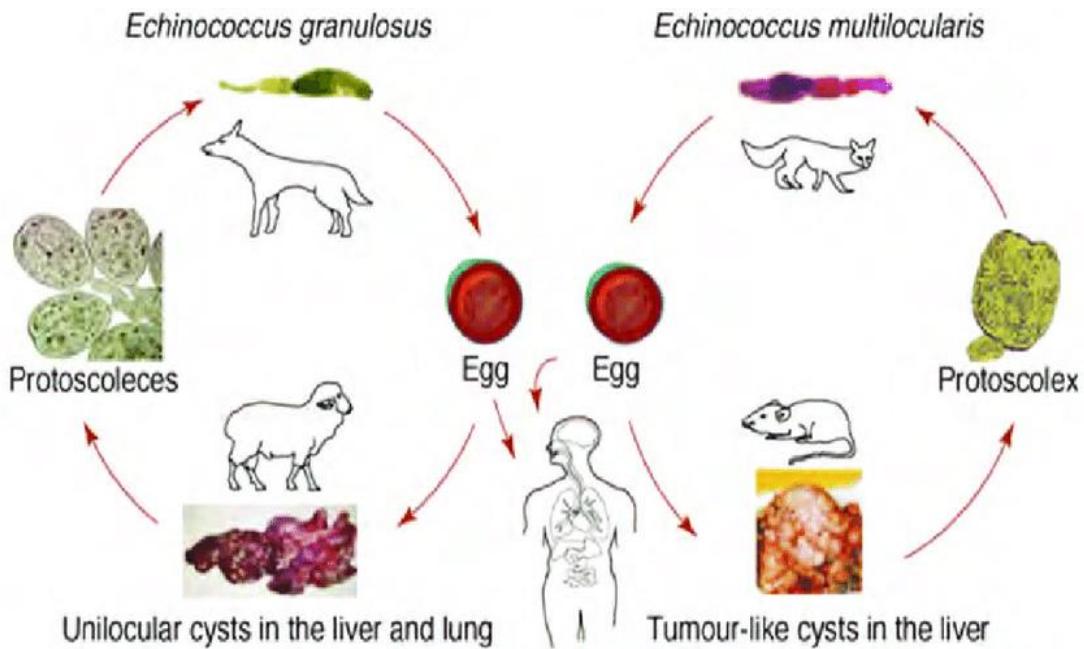
Pathogenesis

- ❖ **Sites of hydatid cyst:** liver, lungs, abdominal cavity, spleen, kidney, heart, bones, brain etc

- The pathology is primarily due to impairment as a result of pressure from the growing cyst, symptoms are subject to organs affected, size & number of the cyst.
- Pulmonary infection result into coughing & allergic responses.
- Seizures & comma may be a result of brain invasion.
- Rupture of the cyst release the protoscolices to the circulation, which may lead to secondary echinococcosis.

Causes hydatid disease. Major symptoms are obstruction and pressure on vital organs, anaphylactic shock due to rupture of the cyst, Jacksonian epilepsy, jaundice, erosion and fracture of bones.





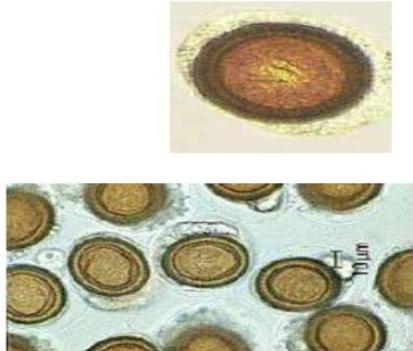
Laboratory Diagnosis

1. Histological examination to find cyst.
2. X-ray examination to find cyst.



- 3- Stool examination.

- Egg: Found in dog feces
- Infective stage
- These eggs are virtually indistinguishable from other closely related species of tapeworms such as Taenia

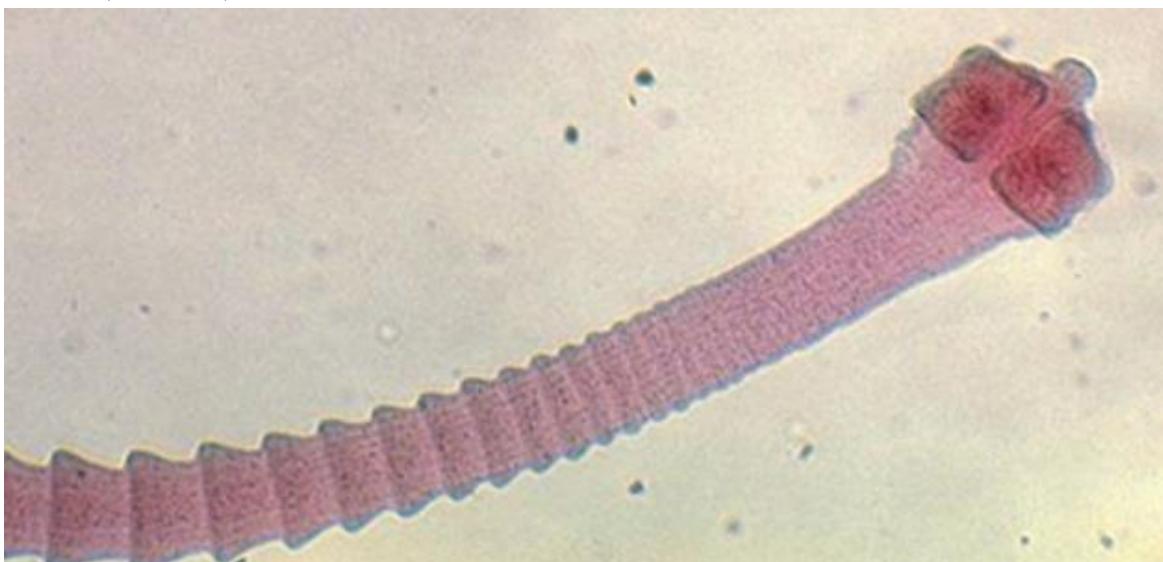


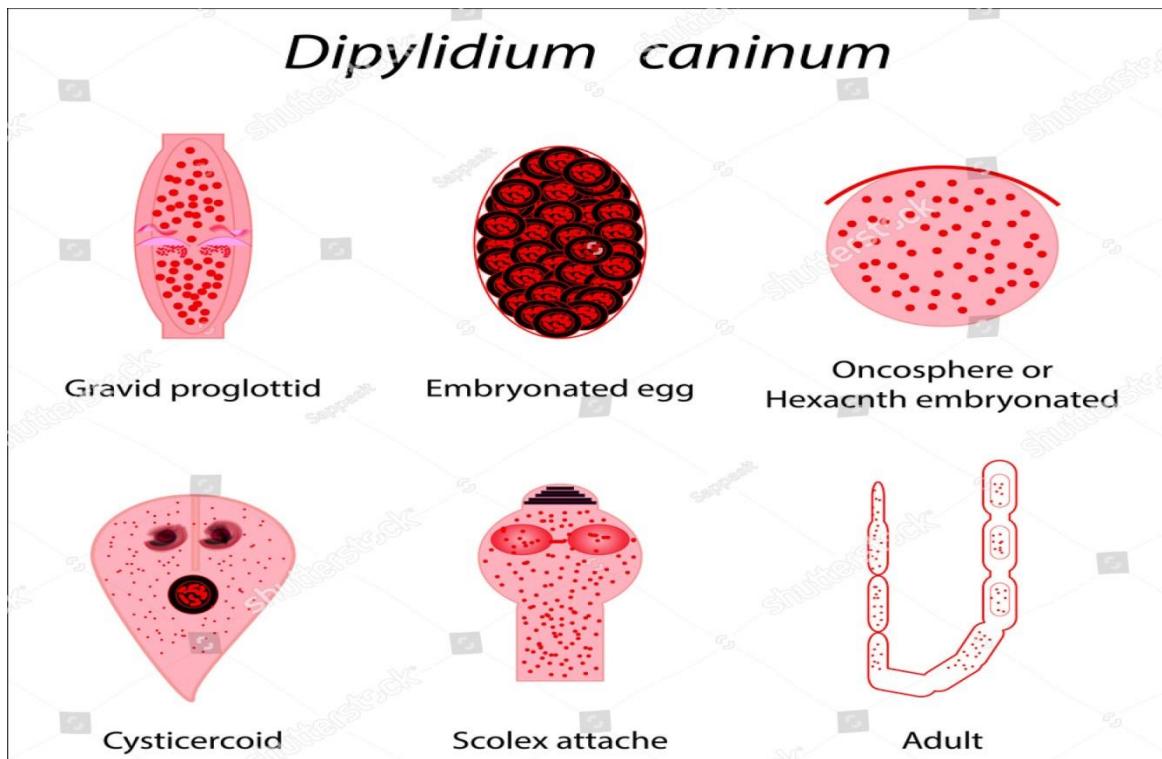
Prevention and Control:

1. Personal hygiene, washing of hands before eating
2. Avoid handling dogs
3. Avoiding eating uncooked food
4. Protection of food, and drink from contamination with faeces
5. Treatment and health education.

***Dipylidium caninum* (Dog Tapeworm)**

The scolex has a retractable rostellum with four rows of hooks, with the four suckers(10-20cm). .



**Habitat:**

Adult: mucus membrane of **small intestine** of carnivores :Dog, Cat, Man .

Cysticercoid larvae: In the body cavity of insects(fleas(ctenocephalides cains).

Egg: in the feces of dog, cat, man.

Life Cycle: -Requires two hosts to complete its life cycle. Carnivores such as dog, fox, and man are the definitive hosts, and fleas and other insects are intermediate host.

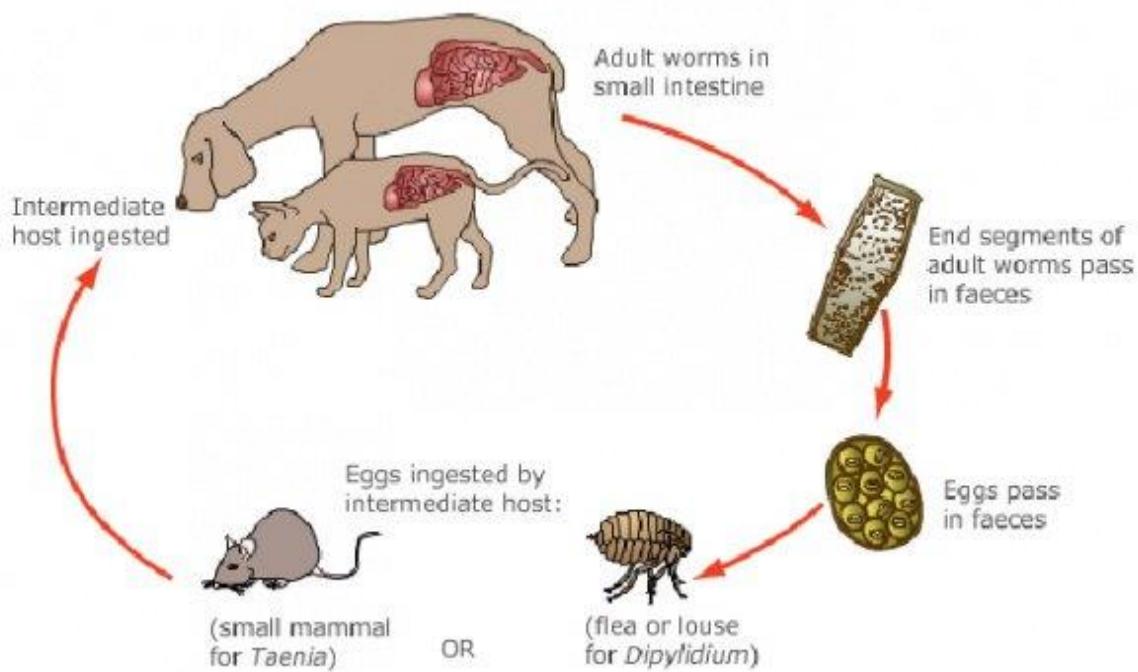
Pathogenesis: Causes dipylidiasis, abdominal pain, diarrhea, anorexia and lassitude.

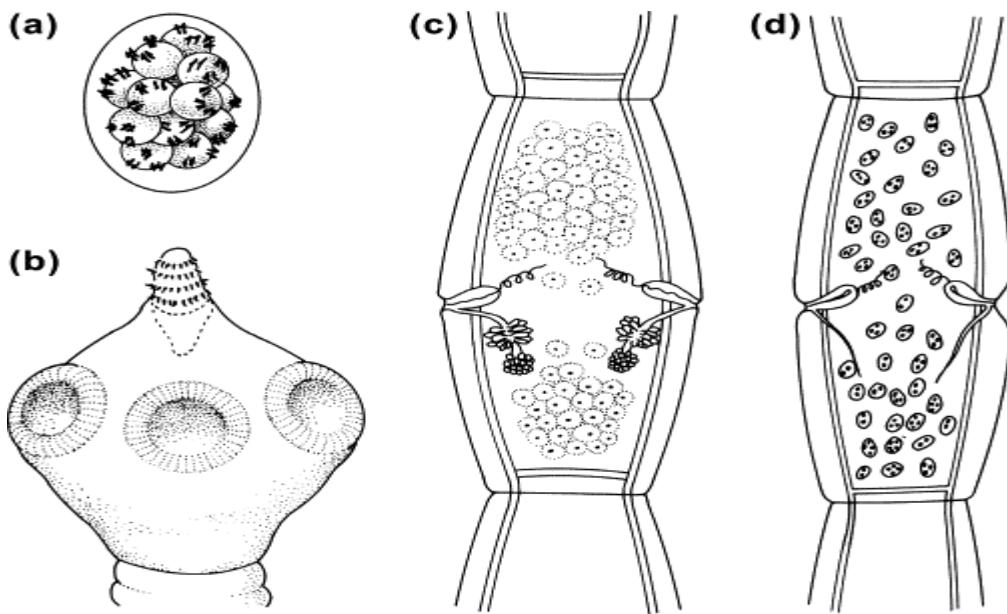
Laboratory Diagnosis:-Finding gravid segments and eggs in the feces

(Each side has a set of male and female reproductive organs. The uterus is paired with 16 to 20 radial branches each).



Figure 1. *D. caninum* proglottids.





- **Eggs**

Dipylidium caninum eggs are round to oval and contain an oncosphere that has 6 hooklets. And present as egg capsule contain 5 to 30 or more eggs .



- **segments**

Dipylidium caninum segments have two genital pores, one in the middle of each lateral margin. They are pumpkin seed-shaped.

Lecture :- 18

Hymenolepis nana (Dwarf Tape Worm)



Geographical Distribution:-

H.nana is widely distributed in countries with warm climates than in cold climates .

Children are more commonly infected than adults.

Habitat:

Adult: small intestine of man, rat and mice(25-40mm).

Cysticercoid larvae: in the intestinal villi of man, rat and mice.

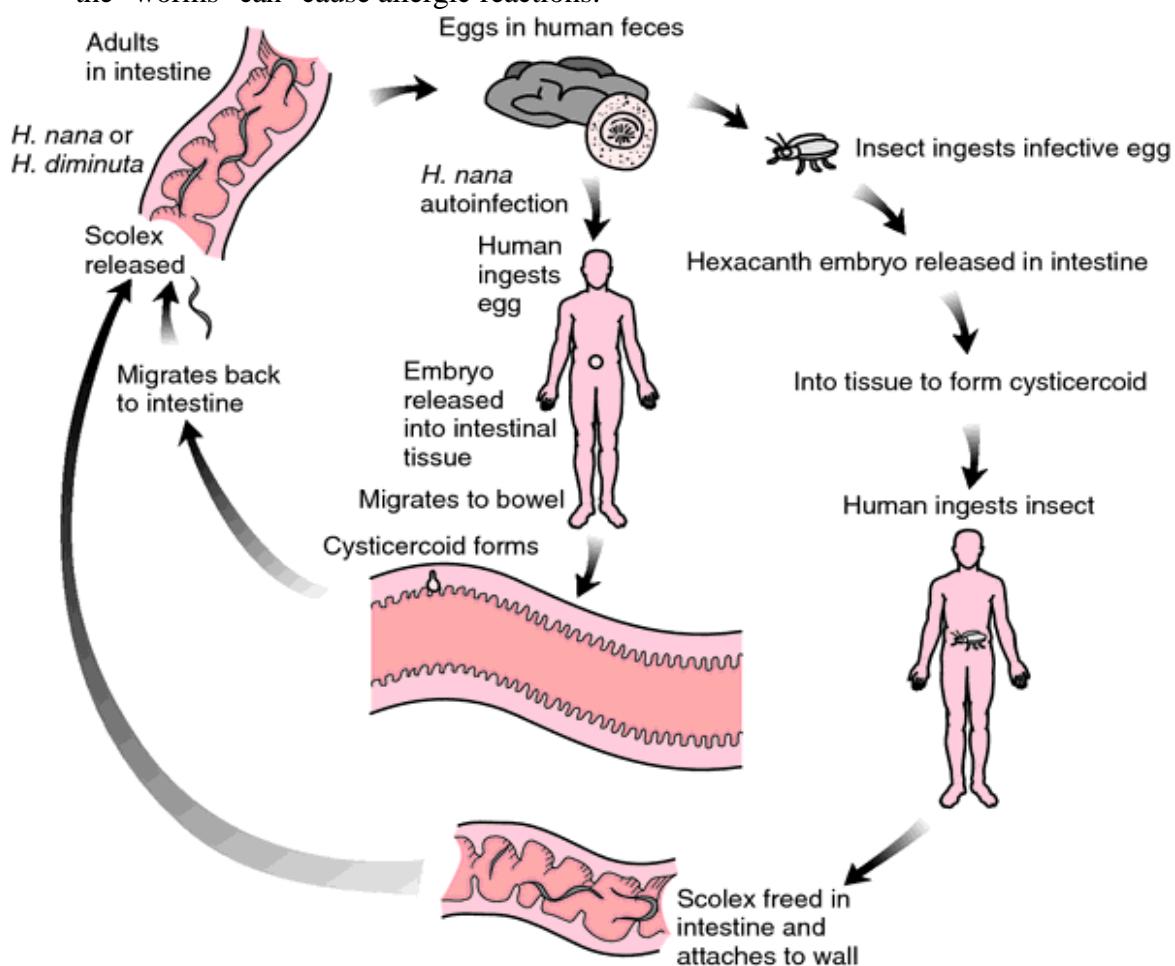
Eggs: In the faeces of man, rat and mice.

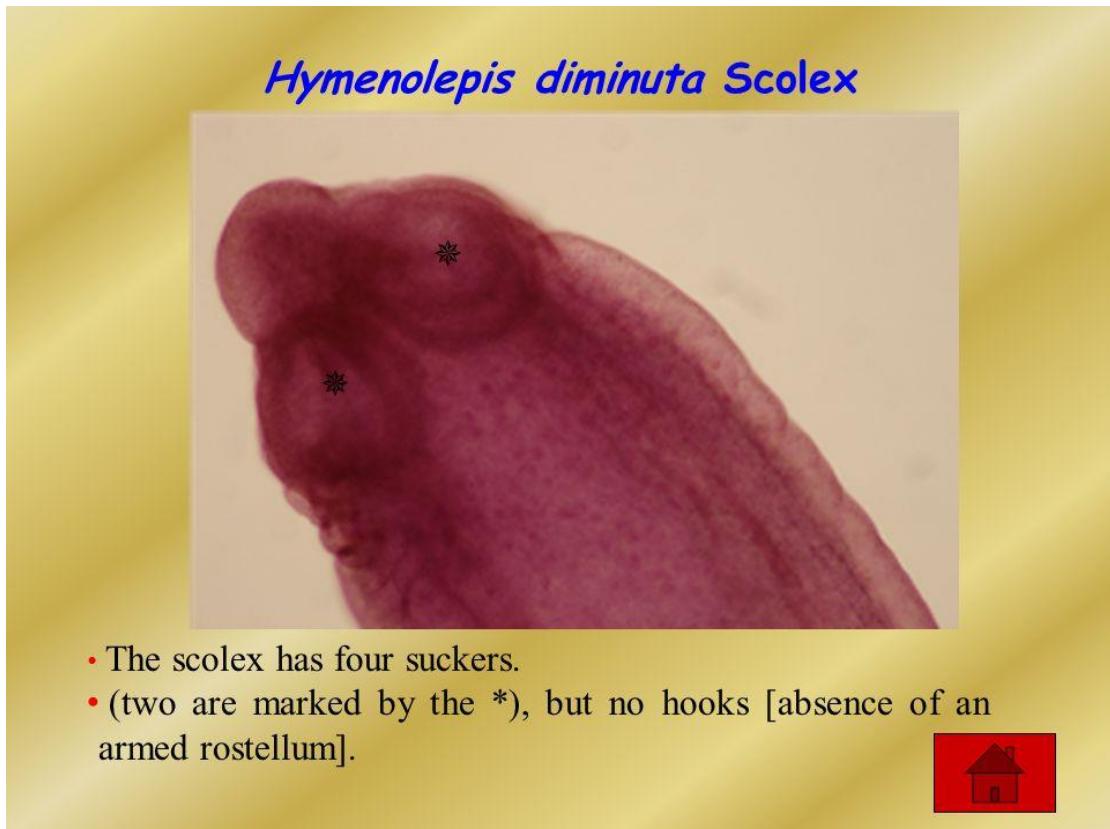
Life Cycle: *H. nana* has a direct life cycle with a human host serving as both definitive and intermediate host.

Egg(hexacanth embryo or oncosphere) → Cysticeroide larvae→ Adult

Pathogenesis: Although many *H.nana* tapeworms can be found in the same host due to autoinfection, the life span of the adult worm is only a few month.

Symptoms of infection are rarely detected except in children when many tapeworms may cause abdominal pain, diarrhea, anorexia and lassitude. Toxins released from the worms can cause allergic reactions.





Hymenolepis diminuta (Rat tape worm)

Geographical Distribution: Cosmopolitan with sporadic human infection in the world.

Habitat:

Adult: Ileum of rat, mice and rarely man.(20-60cm* 2.5mm)

Larva: body cavity of insects (fleas , beetles and cockroaches)

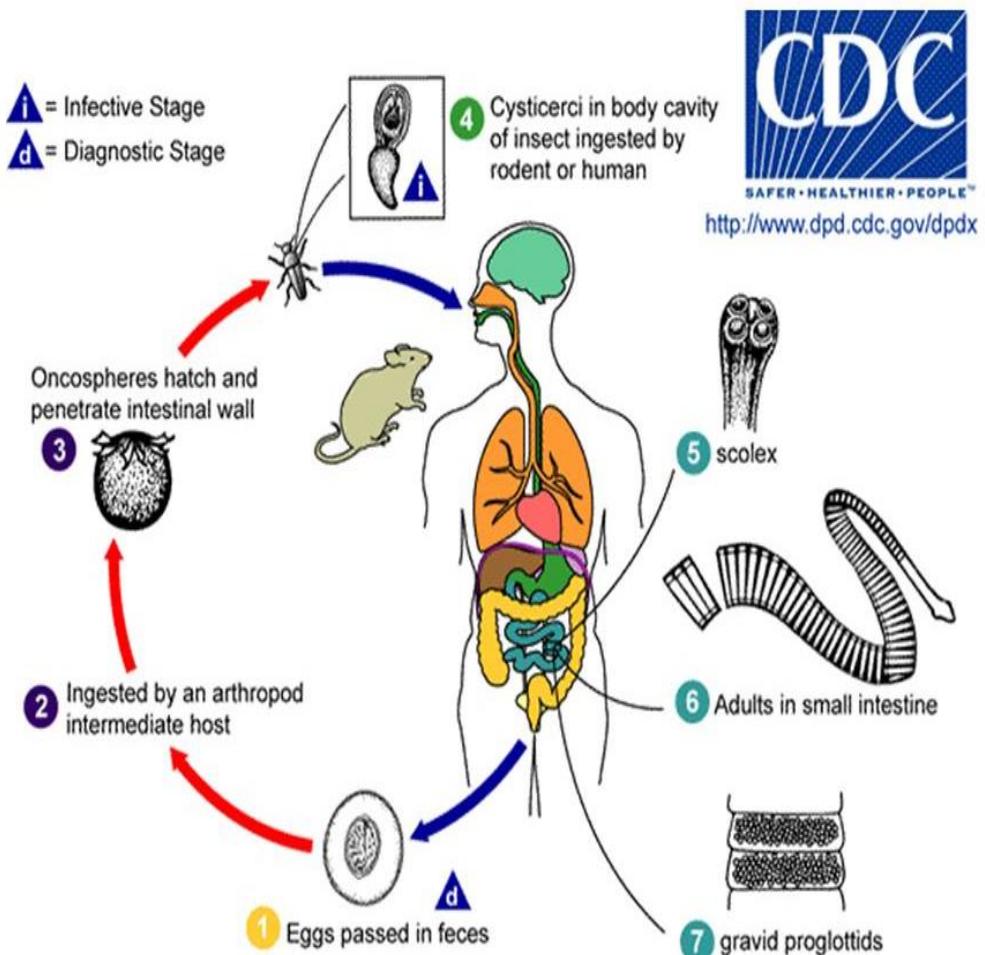
Egg: In the faeces of rat, mice and man.

Life Cycle:

Requires two hosts to complete its life cycle. Intermediate hosts are fleas, beetles, cockroaches. Definitive hosts are rat, mice and man.

Egg(hexacanth embryo or oncosphere) → Cysticeroide larvae→Adult

Hymenolepis diminuta life cycle



Mode of Transmission: -

1. Ingestion of egg with contaminated food, drink or finger.
2. Autoinfection. (*Hymenolepis nana*).

Laboratory Diagnosis

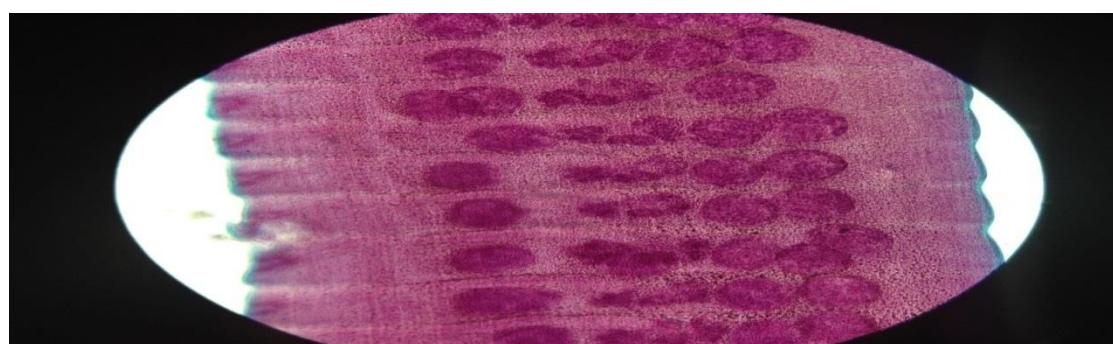
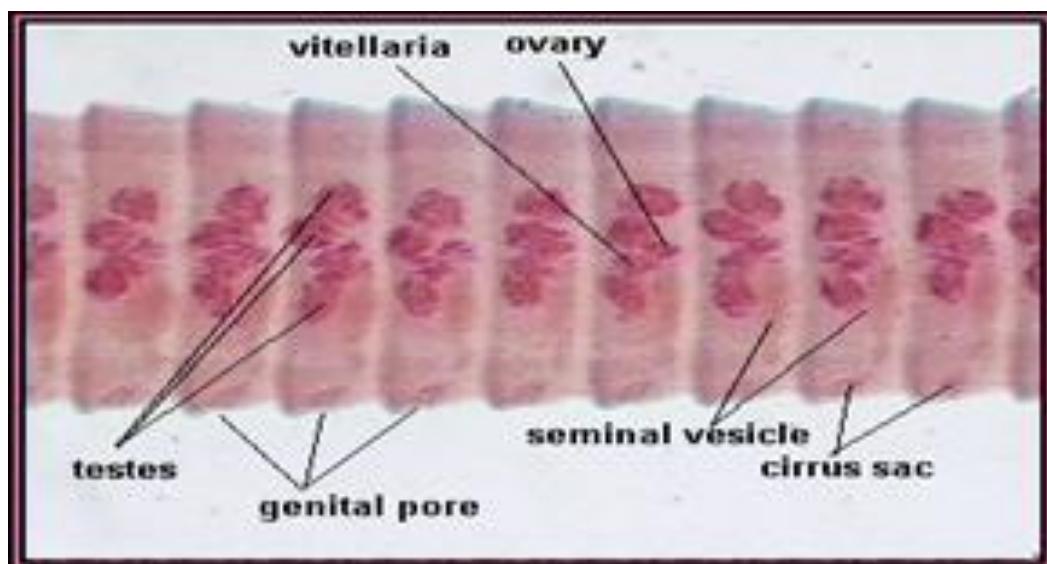
1. Usually eggs of the parasite in the faeces.
2. Some times adult worms in the faeces.

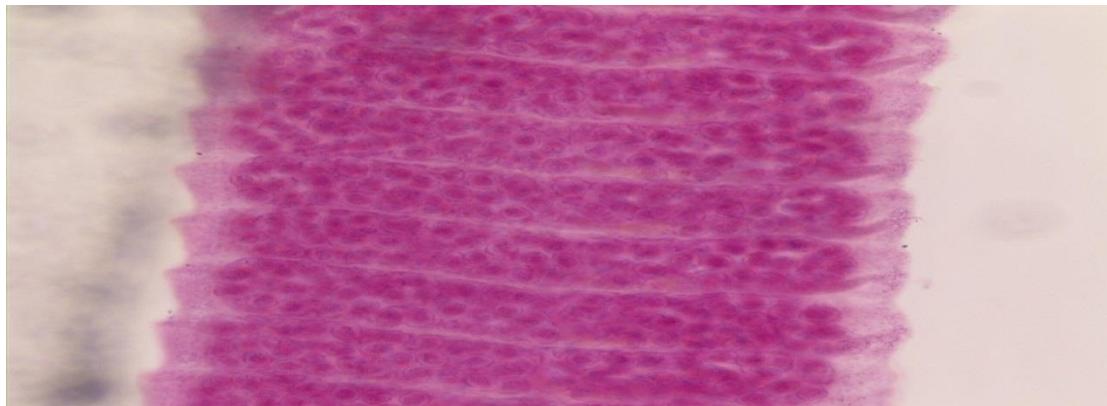


*Hymenolepis
diminuta*



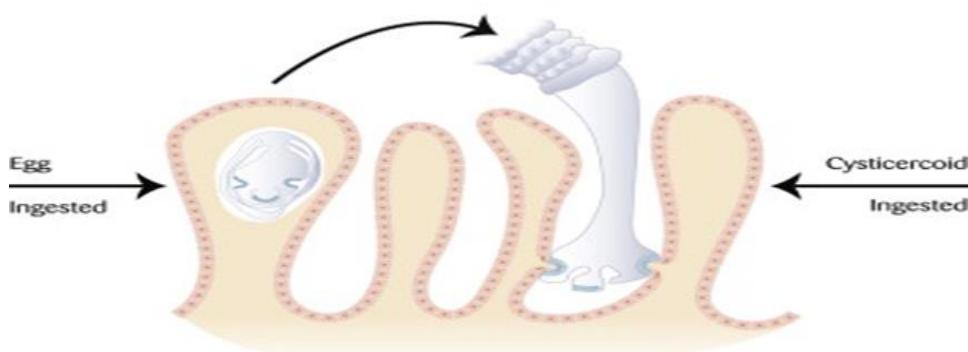
*Hymenolepis
nana*





Take home message & Summary

- *Taenia solium* – **Pork tapeworm**
- *Taenia saginata* – **Beef tapeworm**
- *Diphyllobothrium latum* – **Fish tapeworm**
- *Hymenolepis nana* – **Dwarf tapeworm**
- *Hymenolepis diminuta* – **Rat tapeworm**
- *Echinococcus granulosus* – **Dog tapeworm**



Prevention and Control:

1. Personal hygiene, washing of hands before eating and after Defecation.
2. Sanitary disposal of faeces into latrines.
3. Avoiding eating uncooked food.
4. Protection of food, and drink from contamination with faeces.
5. Treatment and health educations.

Lecture :- 19**Nematode**

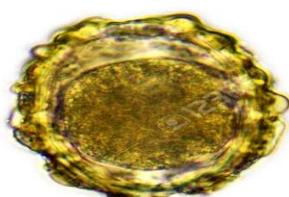
Sexes are separate with the male worms being smaller than the female.

1. In the male there is a testis at the distal end of a long tube which terminates in copulatory organs consisting of one or two projections called spicules.
2. Copulatory bursa, caudal rays.
3. Females are either viviparous (produce larvae) or oviparous (lay eggs).
4. Nematodes which infect humans live in the tissues or intestinal tract.

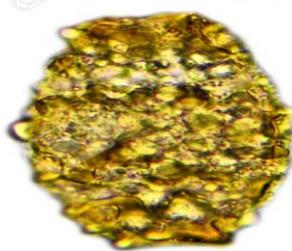
***Ascaris lumbricoides*(giant round worm)**

Ascaris lumbricoides, also known as round worm, is the largest and most prevalent of the human nematodes, and may have been the first human parasite ever described.

Adult females are 20 to 35 cm in length, and adult males 15 to 30 cm. Adult worms live in the lumen of the **small intestine**, a female may produce 200,000 eggs per day, which are passed with the feces, adult worms can live **1 to 2 years**.

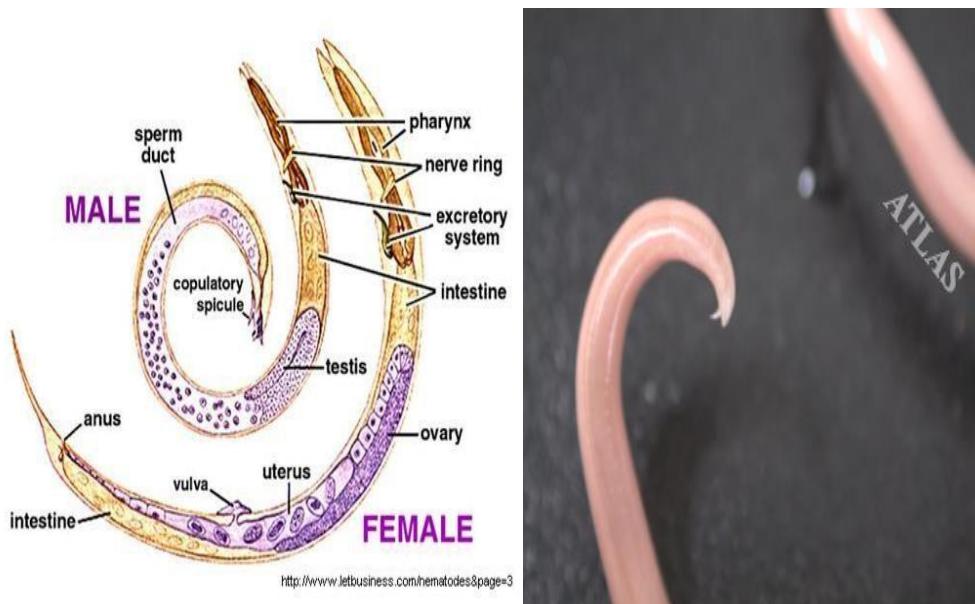
***Ascaris lumbricoides* (Eggs)**

Fertilised egg

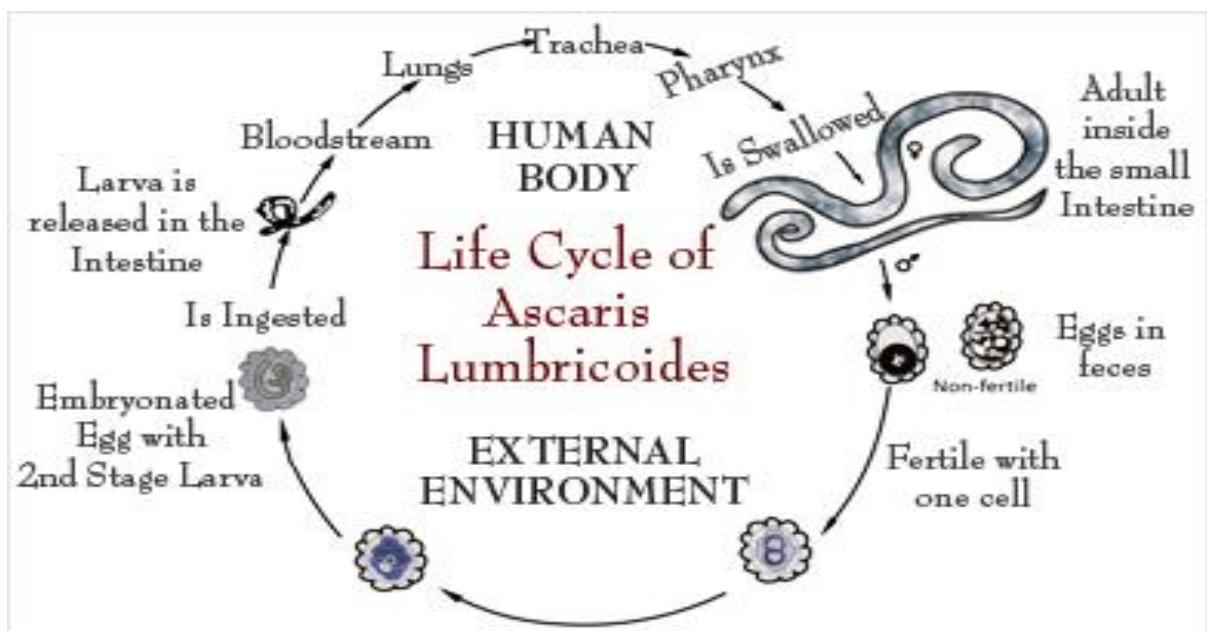


Unfertilised egg

Morphology



Life cycle:



Pathogenesis

The severity depends upon the number of invading organisms, the host's nutritional and immune status, migrating larvae may cause tissue reactions (inflammation) in the liver and lungs, with eosinophilic infiltration and granuloma formation, the reactions lead to pneumonitis, adult worms may cause **blockage** of the intestines.



Diagnosis of ascariasis is based on identification of ova or larva or adult stage of *Ascaris lumbricoides* by microscopic examination of stool. Radiological examinations are helpful for demonstrating adult worm. Eosinophilia is observed in *Ascaris* pneumonia.

Lecture :- 20

Enterobius vermicularis

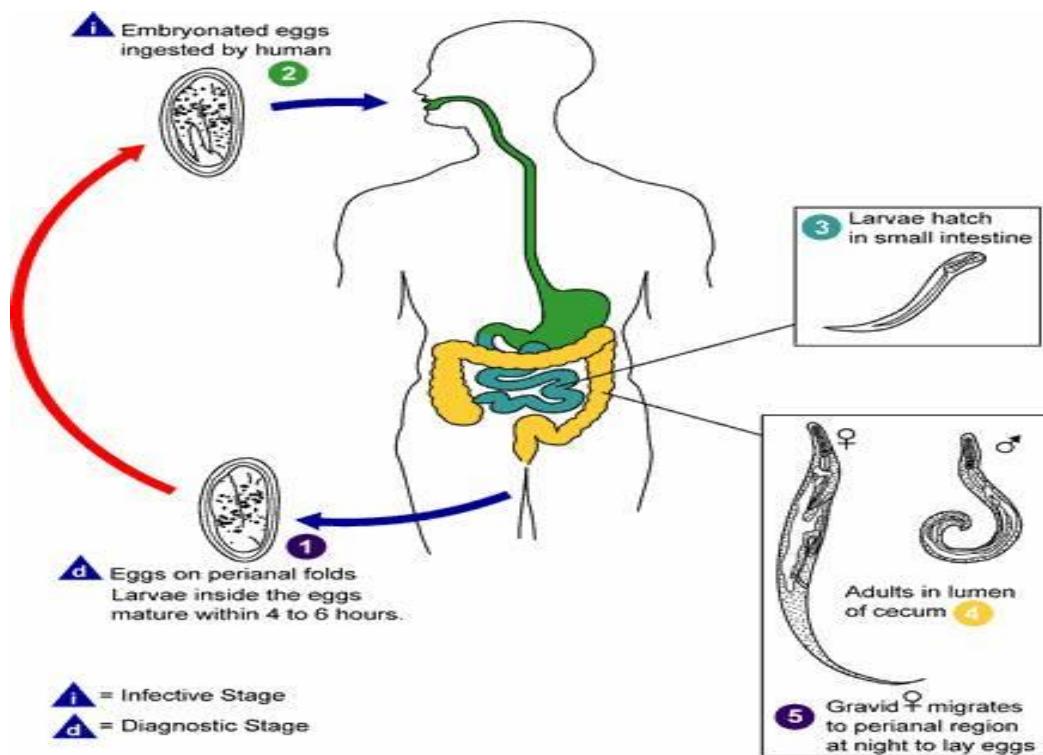
The pinworms(seat worm) are one of the most common intestinal nematodes. The adult worms inhabit the cecum and colon, right after mating, the male dies, therefore, the male worms are rarely seen, the female worms migrate out the anus depositing eggs on the anal skin, humans get this infection by mouth and by autoinfection.

Morphology

Adults: The adults look like a pin and are white in color, the female worm measures about 8 to 13 mm in size, the male adult is only 2-5mm. **Egg:** 50 to 60m by 25 μm , colorless and transparent, thick and asymmetric shell, content is a larva.



Life Cycle



Symptom

About one-third of pinworm-infected persons are asymptomatic, the adult worms may cause slight irritation of the intestinal mucosa, major symptom is anal pruritus(itch anal area), which associates with the migration of the gravid females from the anus and deposition of eggs in the anal folds of the skin.

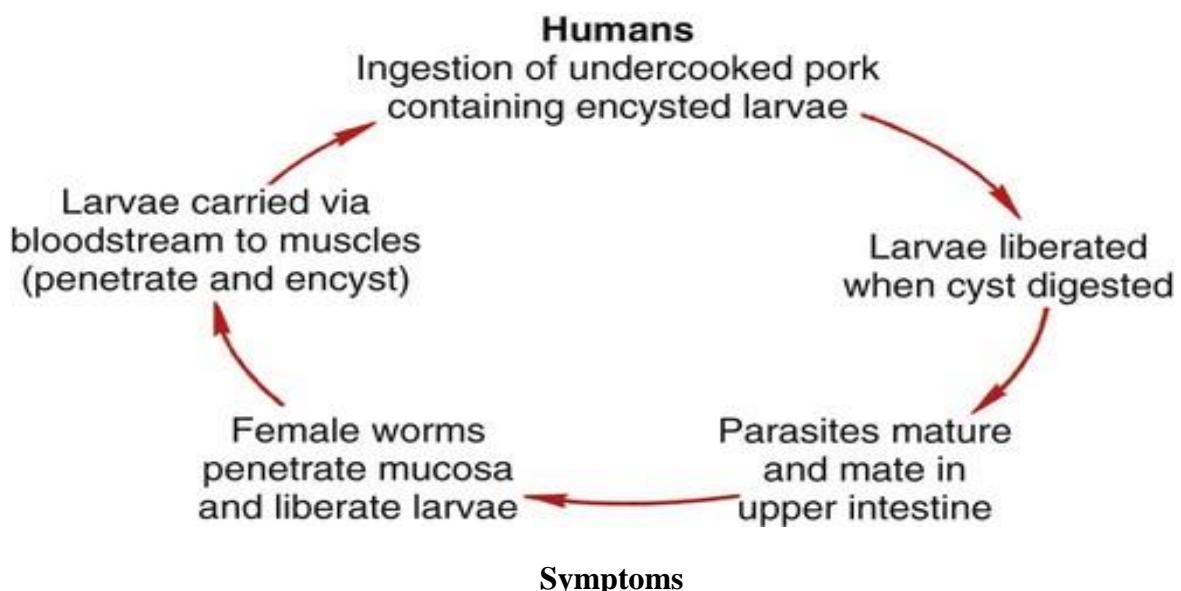
Diagnosis

1-Diagnosis depends on recovery of the characteristic eggs (**Scotch tape**).

2-The examination should be made in the morning, before the patient has washed or **defecated**.

Trichinella spiralis (Tissue Nematodes)

- Adult inhabit the **small intestine** of the rats, pigs(**pork worm**) and human.
- Fertilized female only penetrate the mucosa where the **larviparous**, they do not lay eggs.
- Larvae is the infective stage, live **encysted** in the tissue of the host, and they represent the diagnostic stage.
- Human infected by eating undercooked pork containing infective encysted larvae.
- **Human is dead end host.**



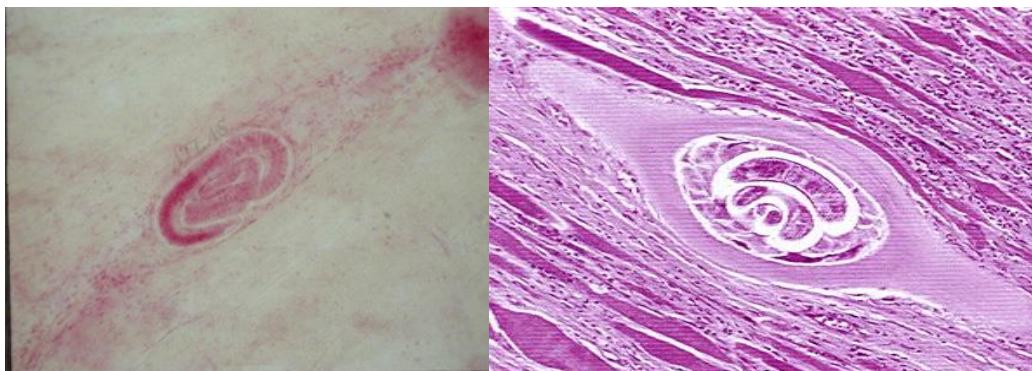
Symptoms

The first intestinal phase are diarrhea , nausea and abdominal pain beings with 1-3 days after ingestion, second phase (muscle) muscle aches, itching, fever , joint pain and chill begins 2-8 weeks after ingestion.

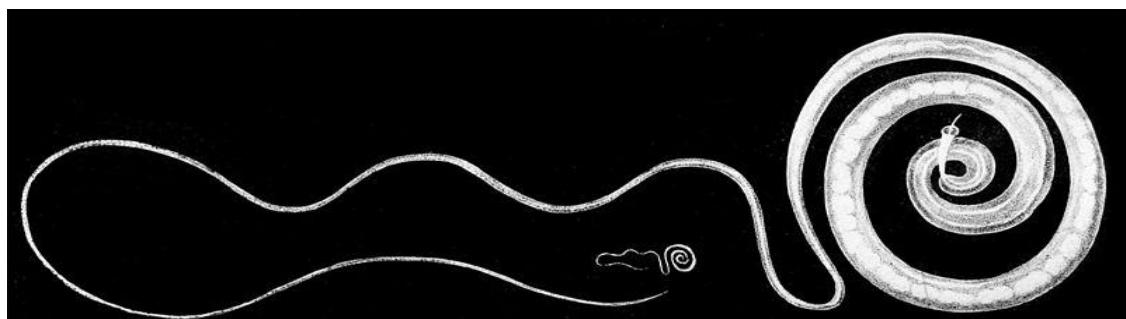
Diagnosis

- Finding larvae in the blood during migration or in muscle after encystation.
- Immunological tests.
- X-ray .
- PCR.

Trichinella spiralis larvae encysted in muscle

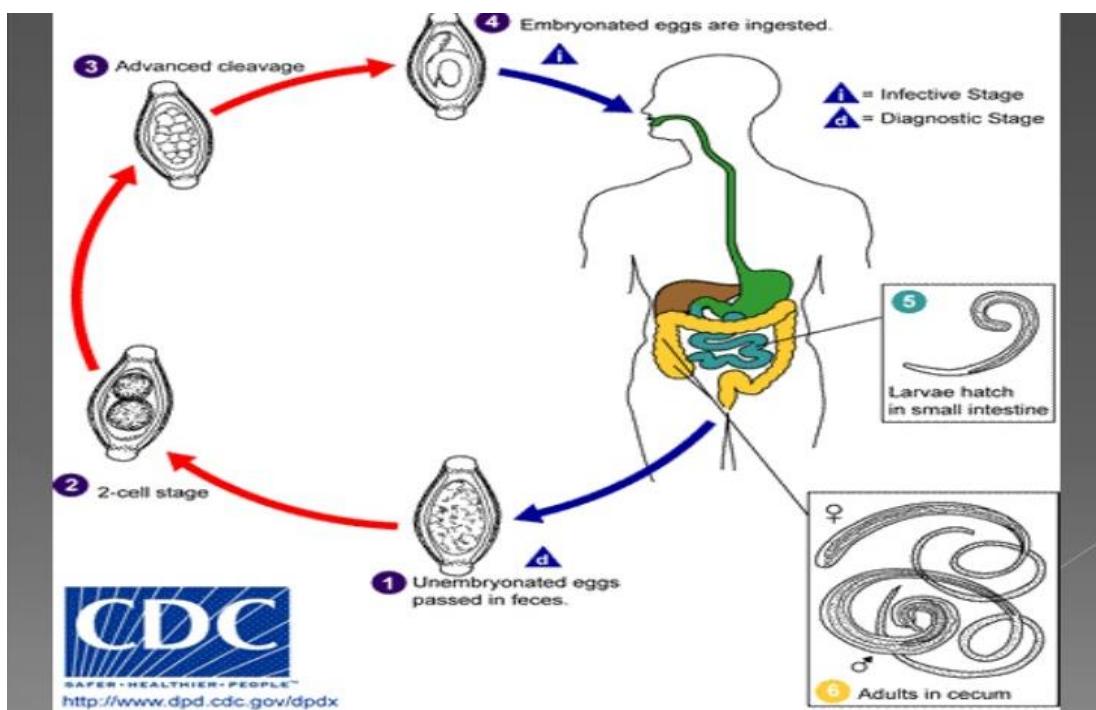
**Lecture :- 21*****Trichuris trichiura***

- Its commonly called whip worm because of the shape of this worm (anterior thin and posterior thick).
- Adult inhabit the **large intestine in the caecum of man**.
- The adult male smaller than female, male 3.4-4.5 cm, female 4-5 cm.
- *Trichuris trichiura* eggs have distinct shape(lemon or barrel shape)(oviparous) .



Clinical features and Pathogenesis

In young children , severe infection can cause chronic diarrhea, intestinal ulceration with blood and mucus being passed in the feces, iron deficiency anemia, failure to develop at the normal rate, weight loss and prolapse of the rectum.



Diagnosis: Stool examination to detect eggs



Lecture :- 22

Human hookworm

infections commonly cause public health problems, with 1 billion persons infected worldwide)**(5-10mm long of worm)**

Ancylostoma duodenale

(old world hookworm)

and

Necator americanus

(New world hookworm)

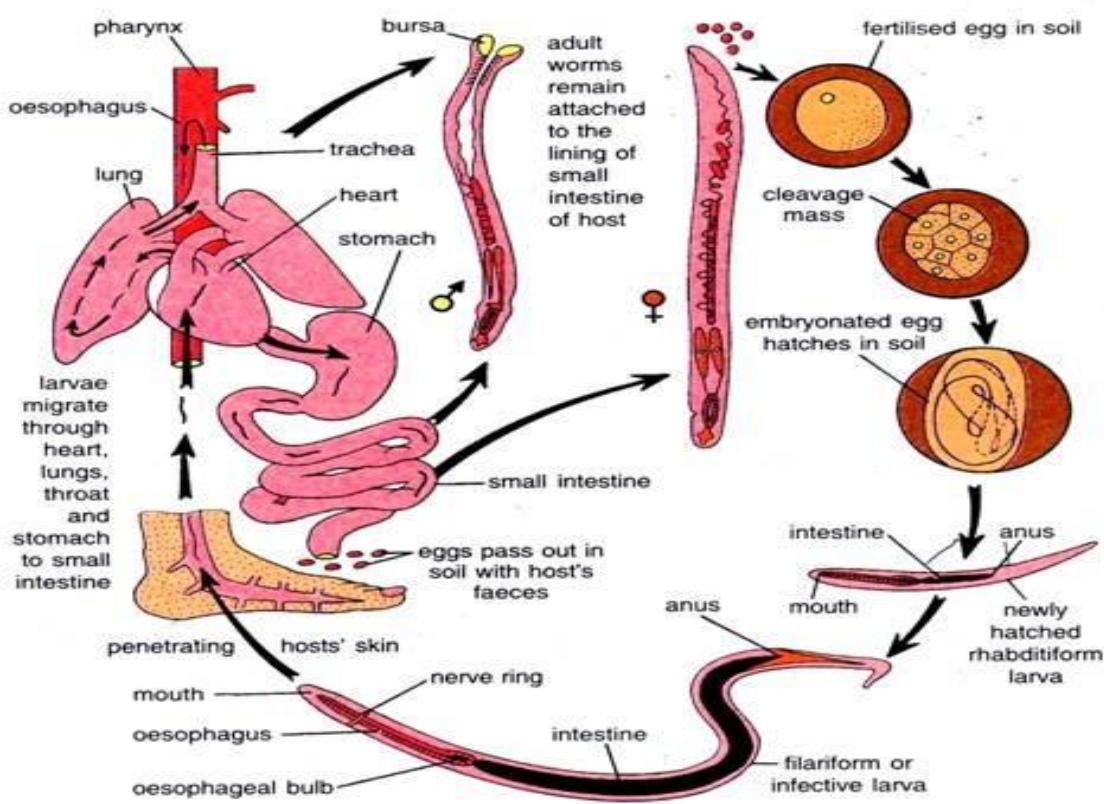
Habitat: Adult: Jejunum and less often in the duodenum of man.

Eggs: In the faeces(not infective to man).

Infective larvae: filariform (L3).

Life Cycle

The worms requires one host to complete their life cycle and the definitive host is man. Infection may occur in two ways: (1) through penetration of the skin and (2) ingesting **filariform** larvae(L3). The larvae penetrate the skin and enter small blood vessels and following a heart-lung migration. After migrating up the trachea, the larvae are swallowed. In the small intestine they develop and mate. The worm attach to the wall of the small intestine by sucking part of the mucus and blood from the host. Female worms lay eggs which are passed in the faeces. In the external environment the egg develop and hatch the **rhabditiform** larvae(L1). It feeds and moult twice to become infective larvae.



Symptoms and pathogenesis

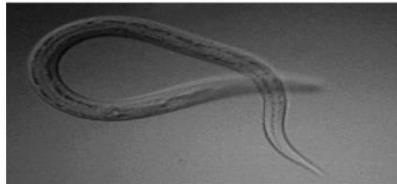
Pathogenesis: causes hookworm infection. Major symptoms are severe itching at the site of skin penetration known as "ground itch", mild pneumonia with cough, sore throat, bloody sputum, headache, weakness,

bloody diarrhea and anemia.

Hookworm infections cause iron deficiency anemia, *Ancylostoma duodenale* and *Necator americanus* are the 2 common species that cause human infections .

Adult hookworm cause chronic blood loss. It has been estimated that a single *A.duodenale* worm ingests about 0.15ml of blood/day and a *N.americanaus* worm about 0.03ml

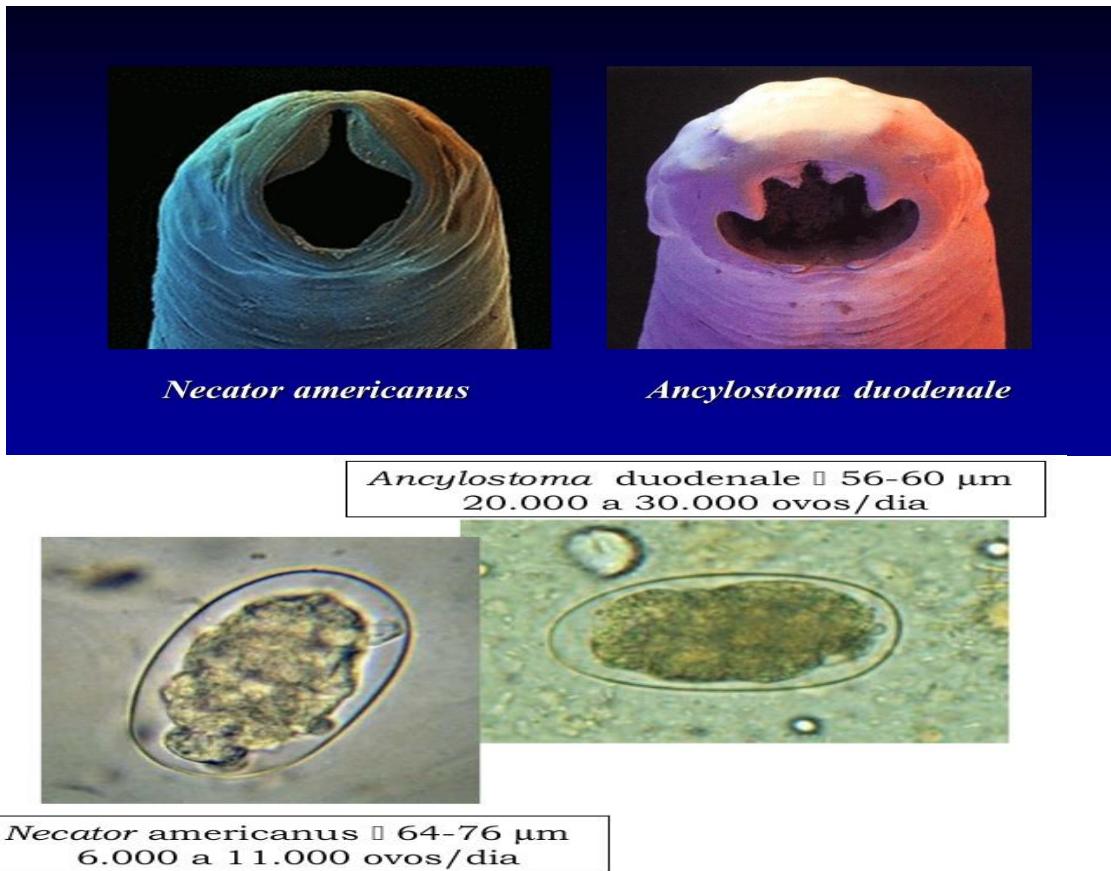
Transmission



- *Ancylostoma duodenale*
 - Fecal Oral Route
 - Penetration of filariform larvae upon human skin
 - Transplacentally and through mother's milk
- *Necator americanus*
 - Penetration of filariform larvae upon human skin

Diagnosis





Strongyloides stercoralis (The heard round worm)

Strongyloides is a 2 mm female longer than male, heterogenic life cycle and can autoinfection that make *Strongyloides* persistent parasite.

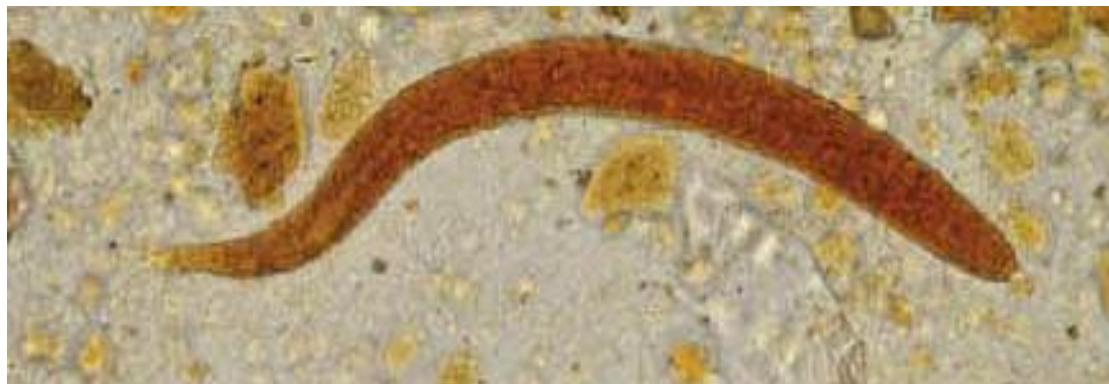
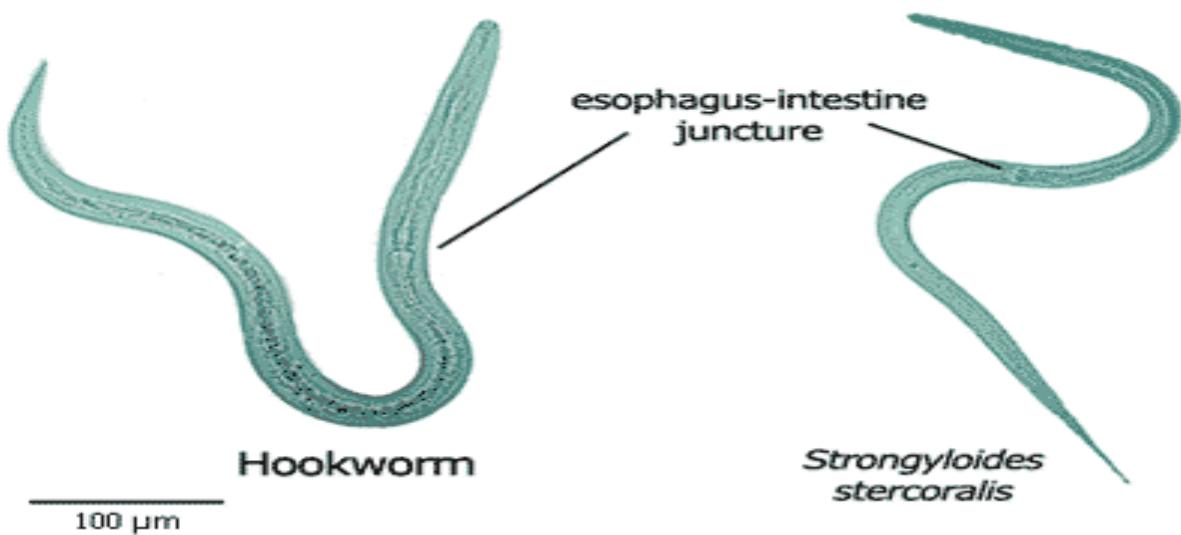
Strongyloides stercoralis

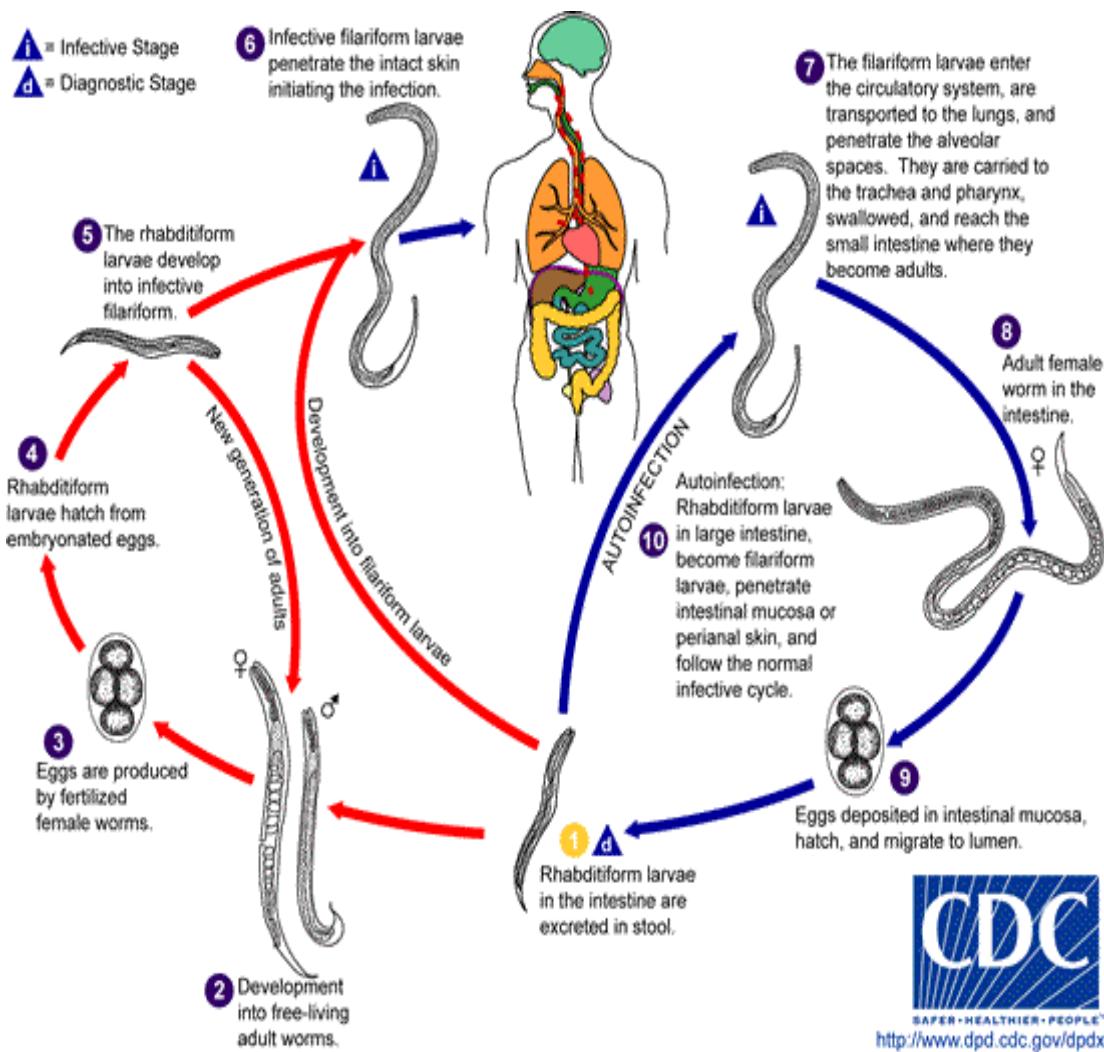
- **Common name:** Thread worm
- **Habitat:** Small intestine.
- **Definitive host:** Human.
- **Route of infection:** Filariform larvae penetrate the skin of human.
- **No Intermediate host.**
- **Infective stage:** Third stage larvae (filariform).
- **Diagnostic stage:** First stage larvae(Rhabditiform) in feces.
- **Disease:** Strongyloidiasis.

Symptoms

Diarrhea, abdominal pain, nausea, and vomiting ,dry cough, dyspnea, throat irritation ,Löffler syndrome eosinophilic pneumonia and asymptomatic ,rash. septicemia, shock and death.

diagnosis Larva seen via direct examination of stool

**Filariform (L3) Stage Comparison**



Treatment by ivermectin

Lecture :- 23

Filarial Nematodes (Filariasis)

(tissue ,lymph and blood nematodes)

White, slender roundworms - Creamy filariform female twice longer than male 2.5-4 cm, Three types:

1- *Wuchereria bancrofti*.

2- *Brugia malayi*.

3-*Loa loa*

Viviparous parasite , need intermediate host to complete their life cyle(mosquito).

Infected stages: (**filariform**) (microfilaria taken by mosquito to convert **filariform(L3)**)

1-Lymphatic filariasis is caused by the worms *Wuchereria bancrofti*.

2-Subcutaneous filariasis is caused by *Loa loa* (the eye worm).

Mode of Transmission & Incubation Period

- ◆ Lymphatic Filariasis is transmitted by the bite of Infected mosquito which harbour L₃ larva.
- ◆ L₁: 1-3 hours
- ◆ L₂: 3-4 days
- ◆ L₃: 5-6 days
- ◆ Pre-patent period: (L₃ to Mf) Not known
- ◆ Clinical Incubation period: 8-16 months .
- ◆ Adult worms mature over several months after human infection, and mature females release microfilariae into the circulation for many years.

Wuchereria bancrofti

Cause of filariasis , elephantiasis and Wucheriasis.

I.M.H: mosquito.

F.H: human.

Site of infection: lymphatic.

Infected stages: **filaria. (L3)**

The larvae become adult within 3-12 month.

Clinical Features

Symptoms include lymphadenitis and high fever due to inflammation response to the parasite , lodged in lymphatic channels and tissue , as the worm

die the reactions continue and produce a fibro proliferation granuloma which obstruction lymph channels and causes lymphedema and elephantiasis.

DIAGNOSIS

Diagnosis of filariasis is based of finding the microfilaria with specific morphologic features .

They have a gently curved body, and a tail that is tapered to a point.



(Source of larvae (specimen) used for laboratory **diagnosis** such as **blood, skin, nodule, urine, ulcer....**)

1-Nonspecific test abnormalities – Eosinophilia.

2— Blood examination for detection of microfilariae should be performed in all individuals in whom the diagnosis of filariasis is suspected.

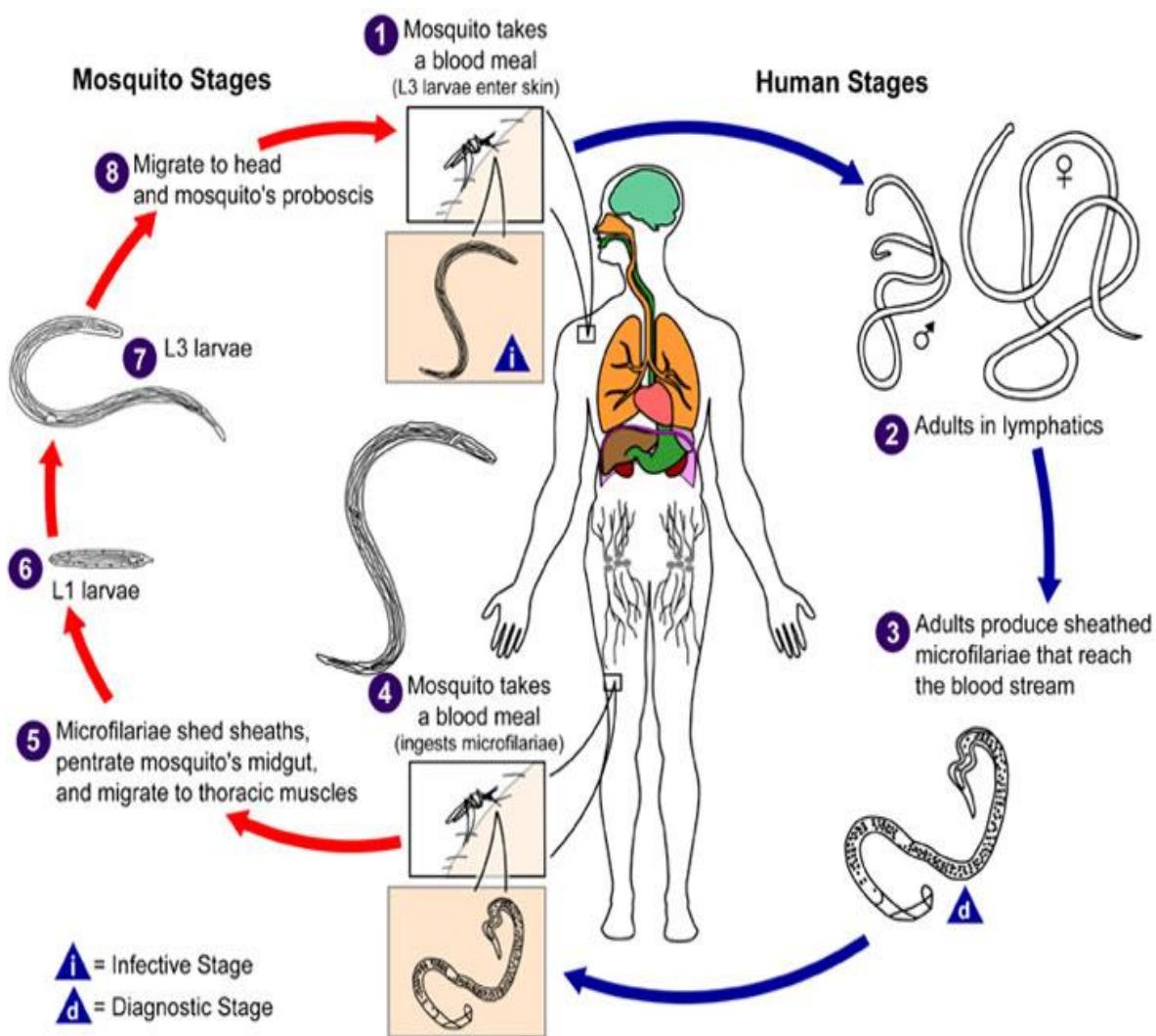
Bancroftian and *Brugian* filariasis tend to **show nocturnal periodicity**. Blood should be drawn between 10 p.m. and 2 a.m(night). because the greatest number of microfilariae can be found in blood during this peak biting time of the mosquito vectors.

3— Antibody tests : Serologic tests for filarial antibodies which detect elevated levels of IgG and IgE are available.

Filarial worms



- Primary cause of elephantiasis condition where parts of the body are swollen
- Requires arthropod intermediate host to complete life cycle



Prevention and Control:

1. Controlling mosquitoes vector
2. Avoid mosquitoes bite
3. Treating infected person
4. Giving health education.