الجامعة التقنية الشمالية
المعهد التقني / الموصل
قسم تقنيات المختبرات الطبية

الطفيليات

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2nd stage, 9th lecture

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Trypanosoma genus

- **Trypanosoma brucei gambiense**
- **Trypanosoma brucei rhodesiense**
- **Trypanosoma cruzi**

African trypanosomiasis (*sleeping sickness*)

[American trypanosomiasis(*chagas disease*)]

Habitat:

1. T.gambiense **2**. T.**rhodesiense**. Firstly in blood &tissue of reticuloendothelial system especially lymph nodes &spleen. In **chronic stage** of disease parasites involving C.N.S.

3. T.**Cruzi**: blood &tissue especially **cardiac muscle**.

Hosts:

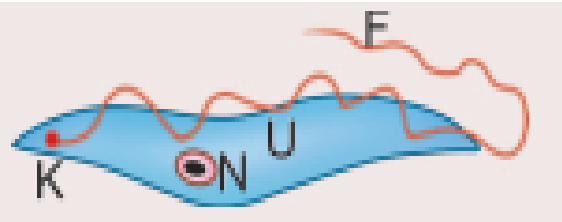
Final host: **human**: for all species of Trypanosoma.

Intermediate host: 1. Trypanosoma gambiense and 2. Trypanosoma rhodesiense

'**Tse-tse flies** genus glossina'

T. **Cruzi**: **reduvid bug** genus triatomine

Infective stage: **trypomastigote**



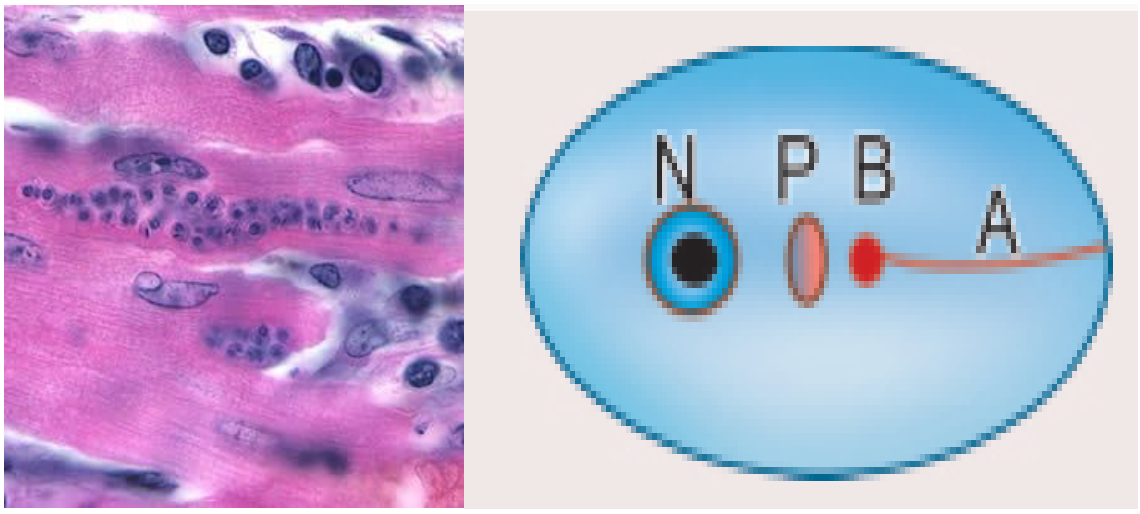
Trypomastigote

Mode of infection:

- Through the skin by biting **of infected** (insect vector of **Tse-tse fly)** for **T.brucei**
- Through the skin by **entering of parasite during rubbed of skin contaminated by feces of infected** (insect vector) **reduvid bug** (triatomine bug) for **T.Cruzi**.

Diagnostic stage: T.brucei: **Trypomastigote** only

T. cruzi: **trypomastigote in blood** and **amastigotes in tissue.**



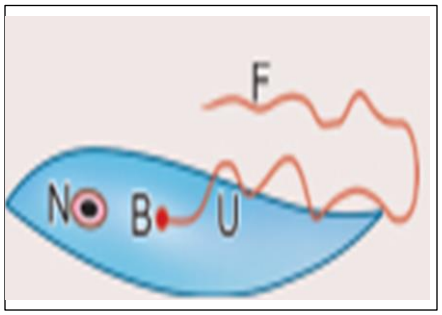
Amastigotes

Diagnostic sample:

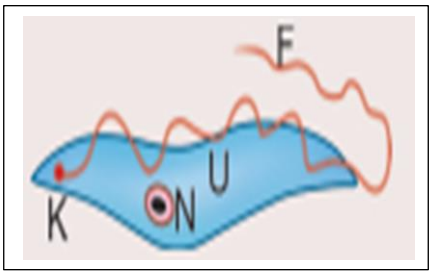
- In **early stage** of infection (disease) ------> the sample is **blood**
- In **acute stage** of disease ----------> the sample is **tissues**
- In **chronic stage** of sleeping sickness-----> the samples involving **C.S.F**.

Morphology

a. **Epimastigote stage** (crithedial form)
*body is elongated
*nucleus in the middle
*kinetoplast in just in front of the nucleus
*have a short undulating membrane
*free flagellum is usually present

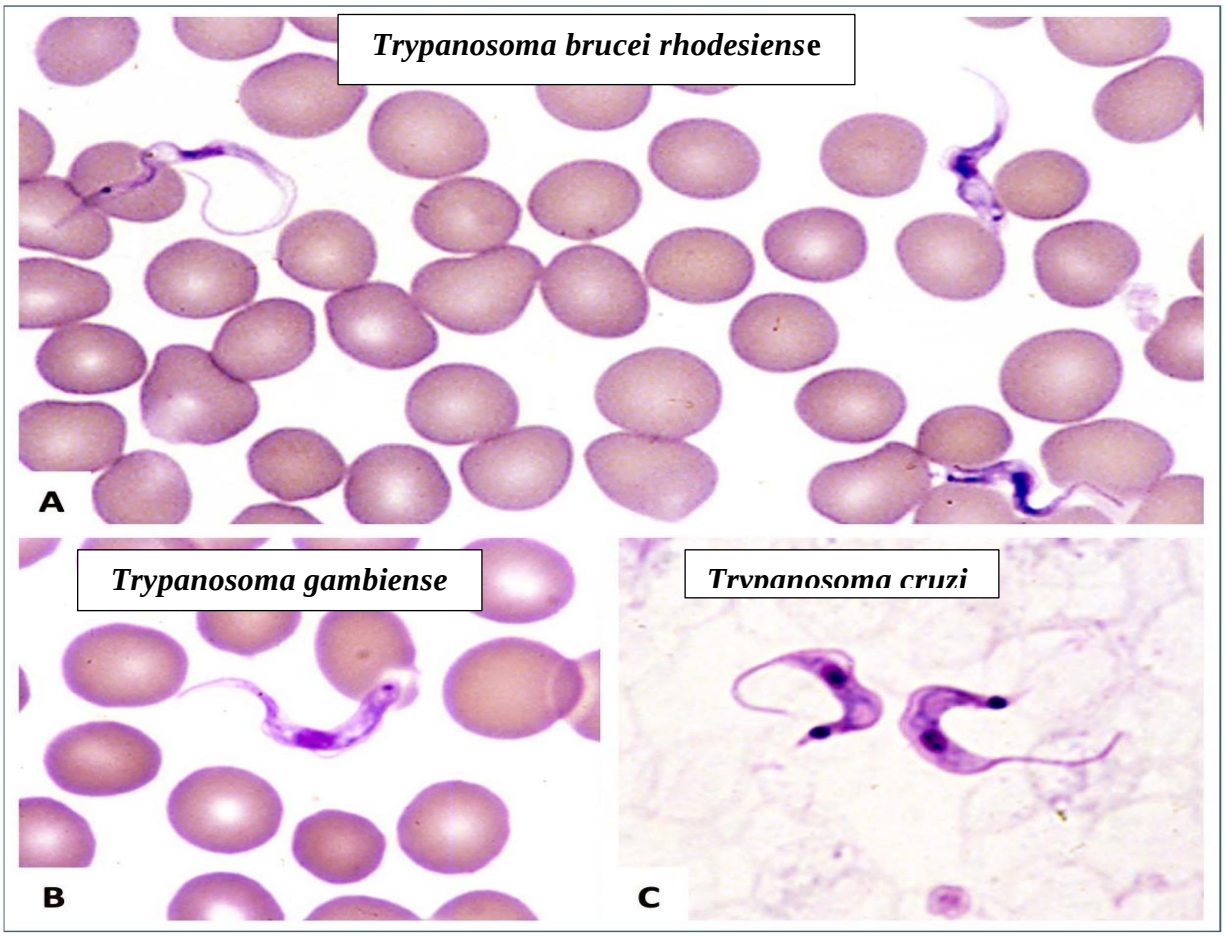


b. **Trypomastigote** (trypanosomal)
*body is elongated &flattened from side to side
*nucleus in the middle
*kinetoplast located near the posterior end.
Have long undulating membrane
*free flagellum may or may not be present
*volutin granules are present



Laboratory diagnosis:

- If sample is **blood** -----> blood film-------> stain by Leishman-------> microscopic exam. ----direct demonstration of **trypomastigote stage** for all species.
- If sample is **tissue** ------->smear---->stain by leishman ----->microscopic exam. ------->direct demonstration of **trypomastigote stage** for African spices and **amastigotes stage** for T. cruzi.
- If the sample **C.S.F**. ----->centrifugation ---->film ---->stain by leishman ----->microscopic exam. ----> Direct demonstration of trypomastigote stage for African species.
- **Xenodiagnoses**: this is a special diagnostic method for only (usually +ve results especially in acute phase of the disease).
- **Serological** methods (haemagglutination)"



Class: ciliate

General feature of parasitic ciliate:

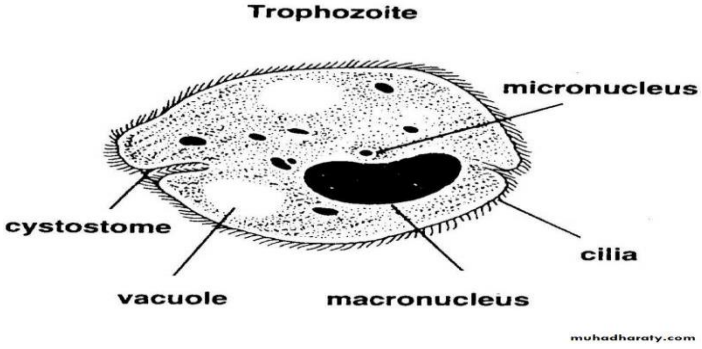
- Usually habitat in the large intestine
- Multiply asexually by simple binary fission
- They are requiring only one host (no intermediate host)
- Move by cilia : **Balantidium coli**
- Usually forming cyst stage

Balantidium coli

It causes balantidiasis or balantidial dysentery.
Habitat: lumen of large intestine especially in colon.
Host: final host----->human &pigs / Intermediate host ----->NO
Infective stage: cyst stage
Diagnostic sample: stool
Diagnostic stage: trophozoites & cyst
Treatment: Oxytetracycline 500mg ------>1 time daily ----> for 10 days
Mode of infection: oral route by ingestion of cyst with contaminated food &water
Morphology: have two stages:

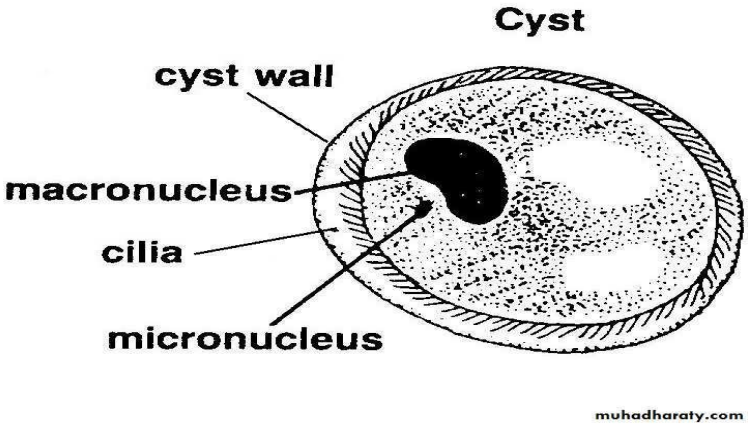
A. Trophozoite :

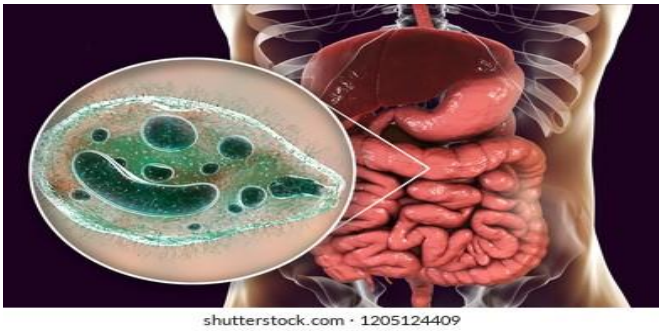
1. It is the largest intestinal protozoa of human
2. It is oval in shape
3. The body covers with longitudinal rows of cilia
4. Anteriorly end has a depression called peristome which leads to cytostome.
5. Posteriorly end has a small opening called cytopyge
6. There are 2 nuclei , one is large &kidney shape called macronucleus ,the second nucleus is small &rounded in shape called micronucleus
7. Have 2 contractile vacuoles
8. Have many food vacuoles that contain bacteria &some time RBCs.



B. <u>Cyst :</u>

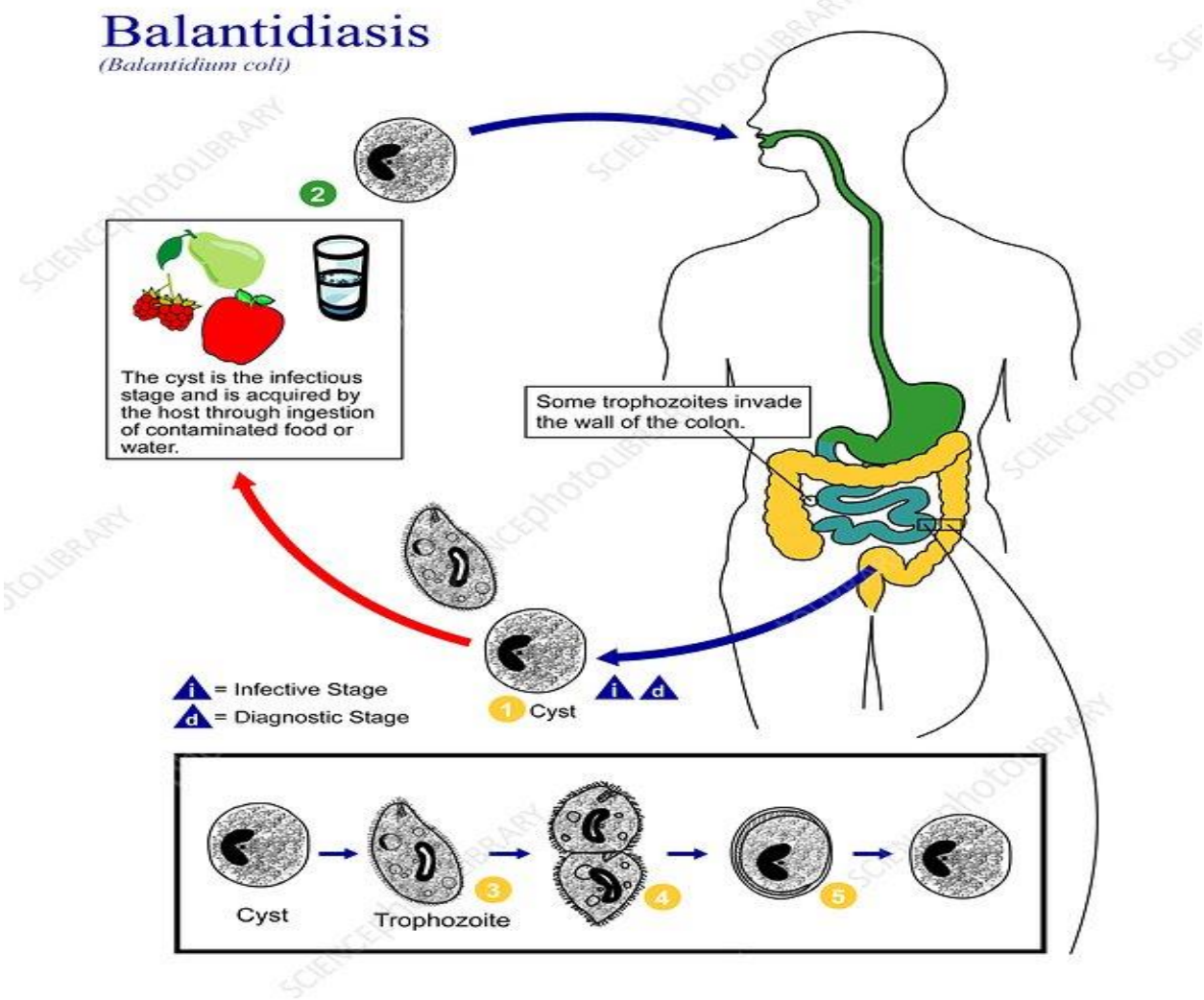
1. Contain 2 nuclei (micronucleus & macronucleus)
2. Have double layer cyst wall
3. No food vacuoles contain 2 contractile vacuoles.





Life cycle

Infected pigs or human----> cyst formed in the intestine -------> pass out with feces & ingested by new contaminated food & water -------> excystation occurs in the small intestine --------> multiple by simple fission in large intestine----->Trophozoite-------> (encystment) formation of cyst in the intestine.



Balantidium coli life cycle

Laboratory diagnosis

Stool examination------->direct smear ------>used iodine stain or normal saline ----> microscopic examination for trophozoites &cysts.

Introduction to helminthes

Helminthes is a general term for a parasitic worm and comprise a group of multi-cellular organisms known as the flatworms and the roundworms. They are found worldwide and are some of the most common parasites in poor, less developed countries in the tropical and subtropical regions, causing serious disease due to migration in the body. Worms are relatively large and have well developed organ systems and can be dioecious (different sexes) or have both sexes (hermaphrodites) in the same worm.

The life cycle of many helminthes is complex and may involve more than one host. The definitive host is the host in which the sexually mature adult helminthes lives. In order for the parasite to continue its life cycle, the larval (developmental) form(s) of the parasite may need to be passed from one intermediate host to another.

They belong to two major groups of animals:

A. Platyhelminths [flatworms]

a. Flat body covered with a plasma membrane
b. mainly hermaphrodites
c. There are two kinds of parasitic flatworms

i. Flukes (Trematodes)

Leaf-shaped
Ventral and oral suckers

ii. Tapeworms (Cestodes)

Long body
Scolex head with suckers and / or hooks
Proglottid: reproductive segments

B. Nematoda [roundworms]

a. cylindrical body covered with a cuticle
b. dioecious
c. Examples
    i. Roundworms [Ascaris]

ii. Hookworms [Ancylostoma]
iii. Strongyles [Stronglyloides]
iv. Whipworms [Trichuris]

Helminths

- Helminths is a polyphyletic group of morphologically similar organisms
- the helminths are worm-like parasites
- multicellular eukaryotic invertebrates
- with tube-like or flattened bodies
- bilaterally symmetrical

- Consisting of members of the following taxa:
- **Nemathelminthes** (Nematoda; roundworms)
- **Platyhelminthes** (flatworms):
  - Cestoda (tapeworms)
  - ´Trematoda (flukes):

Helminths


Roundworms (Nematodes)
- adult & larval roundworms are bisexual, cylindrical
- they inhabit intestinal & extraintestinal sites



Tapeworms (Cestodes)
- adults are elongated, segmented, hermaphroditic
- inhabit the intestinal lumen
- larval forms are cystic or solid
- larval forms inhabit extraintestinal tissues



Flukes (Trematodes)
- adult flukes are leaf-shaped
- prominent oral & ventral suckers help maintain position in situ
- hermaphroditic except for blood flukes: bisexual
- the life-cycle includes a snail intermediate host

Nematode cycle

- egg - larvae (L1-L4) - adult

Cestode cycle

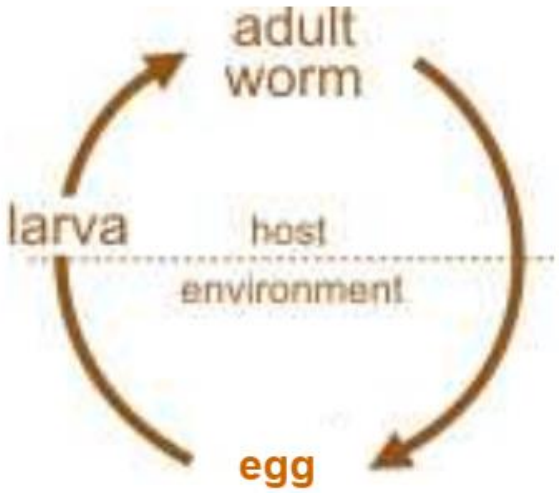
- egg - metacestode - adult

Trematode cycle

- egg-miracidium-sporocyst-redia-cercaria-(metacercaria)-adult

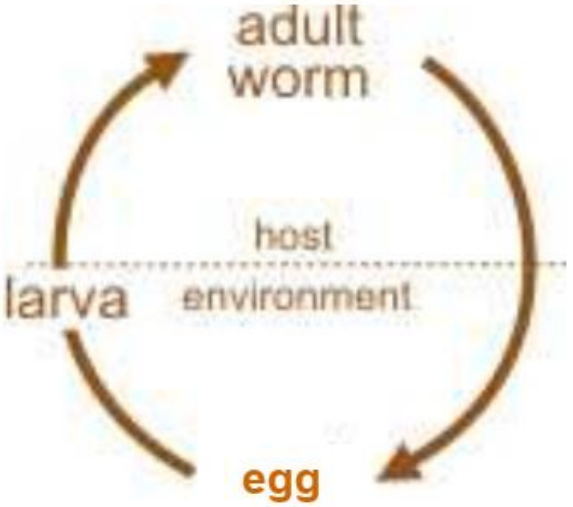
Faecal-oral transmission

- eggs or larvae passed in the faeces of one host & ingested with food/water by another
- ingestion of *Trichuris* eggs leads directly to gut infections in humans
- the ingestion of *Ascaris* eggs & *Strongyloides* larvae leads to a pulmonary migration phase before gut infection in humans



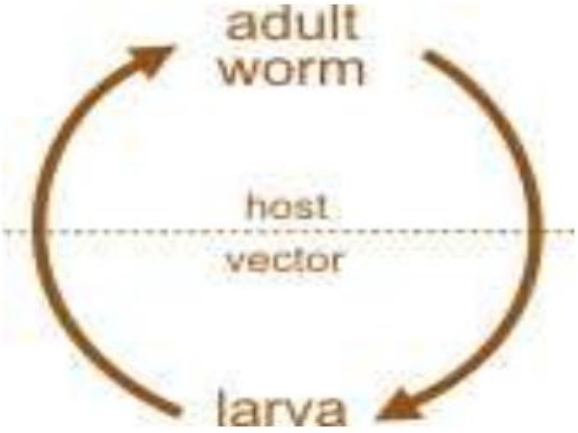
Transdermal transmission

- infective larvae in the soil (geo-helminths) actively penetrating the skin and migrating through the tissues to the gut
- In the gut adults develop and produce eggs that are released in host faeces
- larval hookworms penetrating the skin, undergoing pulmonary migration and infecting the gut where they feed on blood



Vector-borne transmission

- larval stages taken up by blood-sucking arthropods or undergoing amplification in aquatic molluscs
- *Onchocerca* microfilariae ingested by black fly and injected into new human hosts
- *Schistosoma* eggs release miracidia to infect snails where they multiply and form cercariae which are released to infect new hosts



Predator-prey transmission

- encysted larvae within prey animals (vertebrate or invertebrate) being eaten by predators where adult worms develop and produce eggs
- *Dracunculus* larvae in copepods ingested by humans leading to guinea worm infection
- *Taenia* cysticerci in beef and pork being eaten by humans
- *Echinococcus* hydatid cysts in offal being eaten by dogs

Infection

Transmission

· ingestion of infective eggs or larvae

· larval penetration of the skin

· intermediate host vector

- Bite

- Ingestion of meat

Pathogenesis

Many infections are asymptomatic. Pathological manifestations depend on size, activity, and metabolism of the worms. Immune and inflammatory responses can cause pathology.

I. Direct Damage from Worm Activity

a. Blockage of internal organs

1. Size
2. Migration
3. Immune response {granulomas}

b. Increased pressure from worm burden

c. Tissue Damage

1.Anticoagulants
2. Necrosis
3. Malabsorption / Maldigestion
4. Protein loss
5. Migration [skin, liver, lung]
6. Hyperplastic / metaplastic

II. Indirect Damage from Host Response

a. Hypersensitivity to antigen à granuloma
b. Inflammatory changes
c. Local allergic responses
d. Mucosal structural changes

III. Defenses Against Infection

A. Nonspecific

* Physical Barriers
* Secretions [HCl of stomach]
* Inflammation
* Complement activation
* Macrophages

B. Specific

- Antibodies: block enzymes secreted by worms
- Eosinophil's
- Cytotoxic T cells


Helminthes
cestodes
(Tapeworms)

Cestodes

Taenia saginata

Taenia solium

Hymenolepis nana

Echinococcus granulosus

NC STATE UNIVERSITY

Cestodes

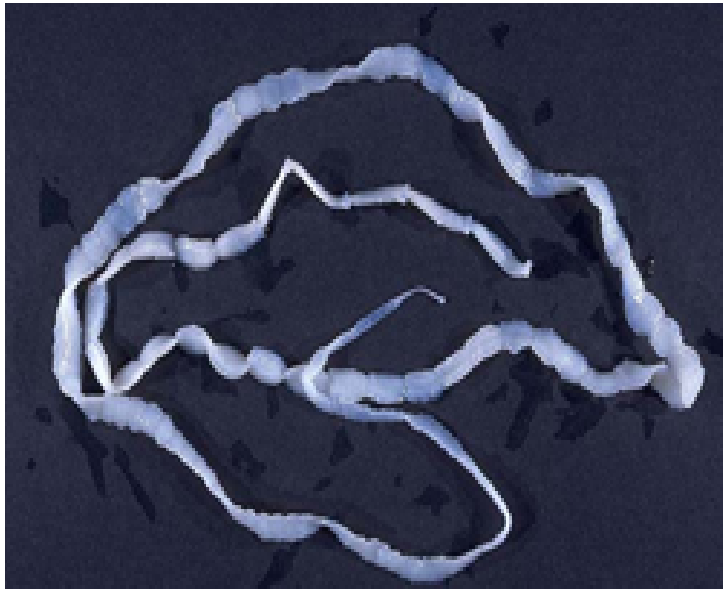
Tapeworms

General Flatworm Characteristics

- Except lacks Digestive Tract
- Absorbs food directly across Tegument

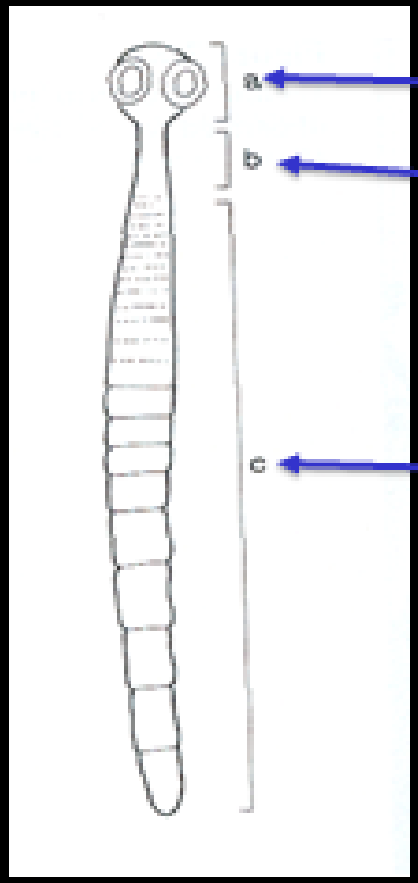
Adult Body

- Scolex => Holdfast organ
  - Usually has suckers, retractable or non-retractable rostellum of hooks
- Neck
  - Germinative region produces "segments", asexually
- Strobila
  - Series of Maturing "Segments" or Proglottids
  - Immature, mature, gravid proglottids in series
  - Each Proglottid is an individual reproductive unit



Morphology

Body is divided into three main regions

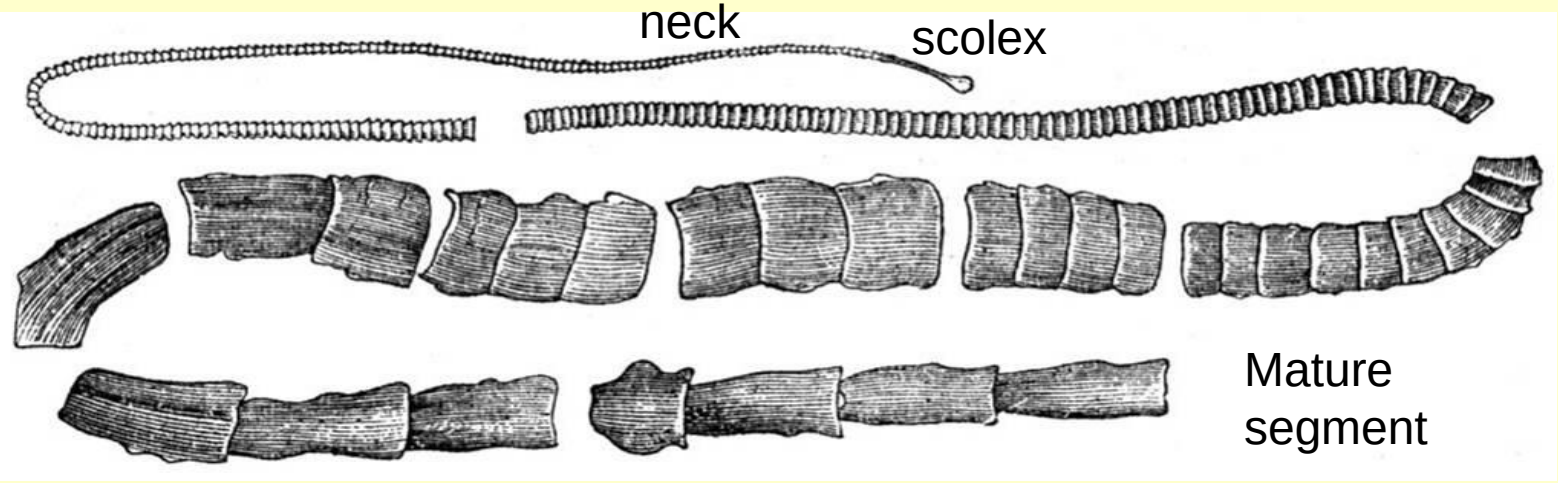


a. Scolex (head)

b. Neck

c. Strobila made up of proglottids

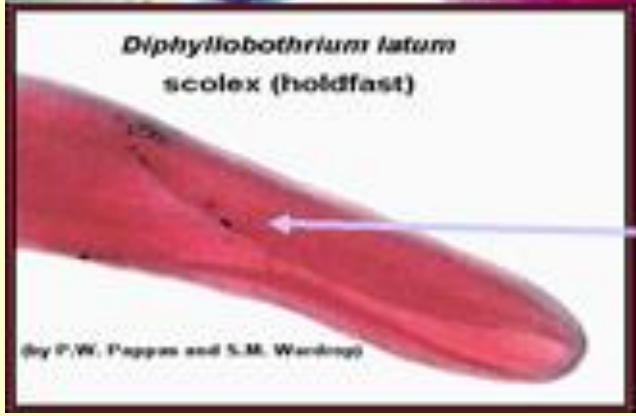
Teania worm



1. **Teania saginata**
2. **Teania solium**

Scolex

- "head" of the organism
- Has holdfast organs to keep the tapeworm in place
- Three main types of Scolex



- Three main types of Scolex

Cyclophyllidae

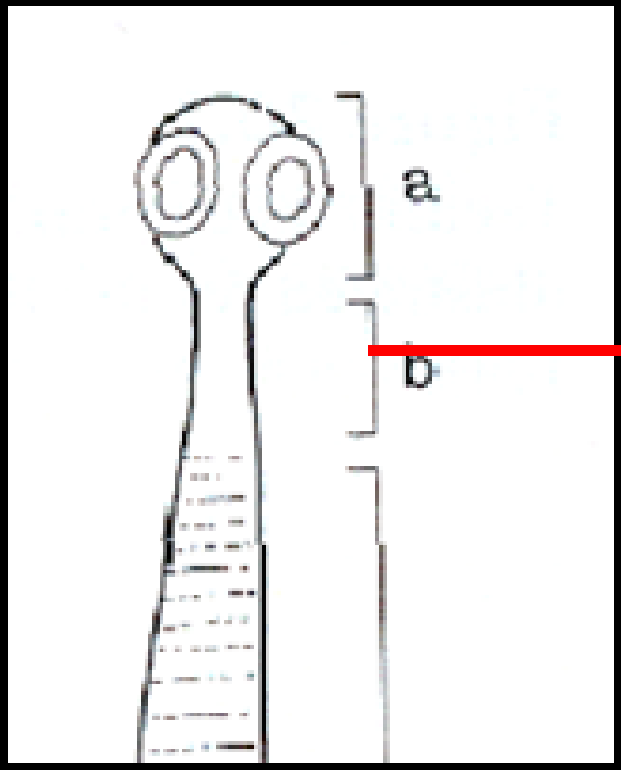
A-Globular head with 4 Muscular Sucker

B- 4 Sucker +Rostellum armed with hooks

Pseudohyllidea

Bothria-Shallow grooves or pits

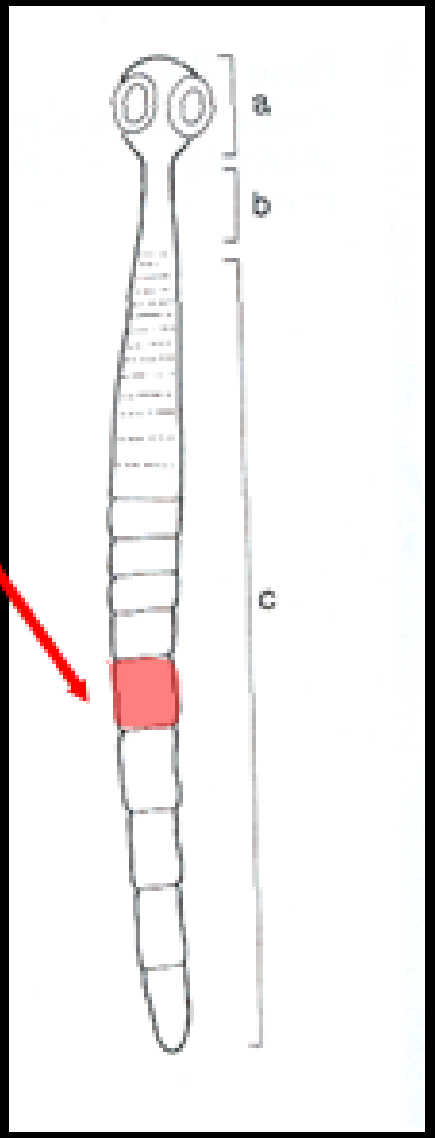
Neck



- Area where new segments are created
- Give rise to proglottids in strobila.

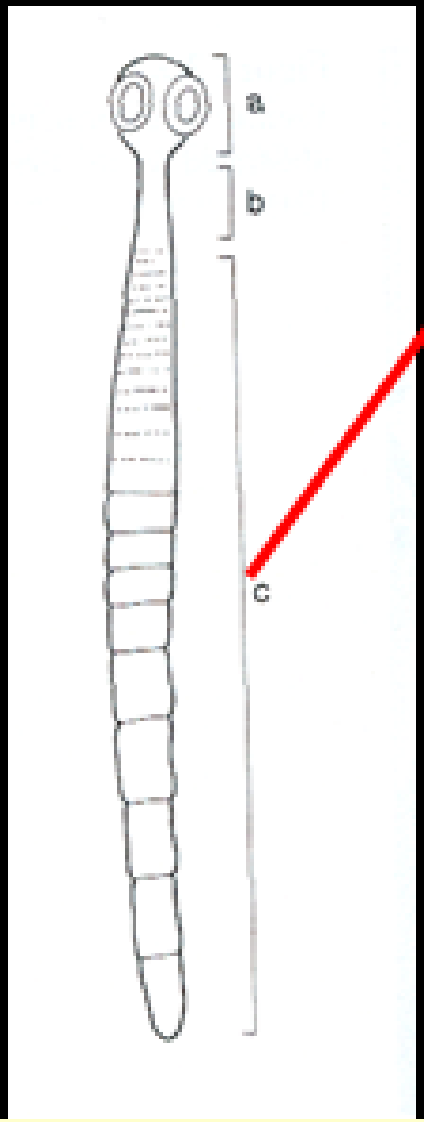
Proglottids/segment

- Proglottid
  - Set of reproductive organs
  - Includes male and female organs and genital pore
- Segment
  - Segments may have one or more proglottids
  - Body divisions
  - More mature as gets farther from neck
- **Size** and **shape** of segment along with **number of proglottids** and **location of genital pore** key to identification many of the tapeworms.



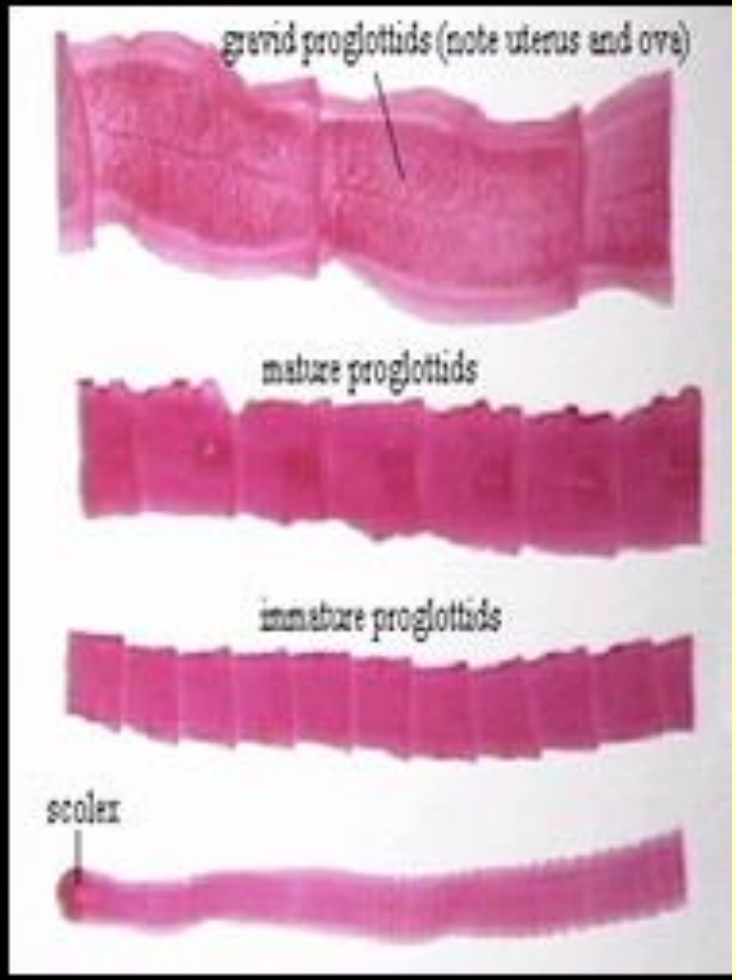
Strobila

- Is the entire chain of proglottids



Strobila is divided into three regions:

- **a/ Immature segment:**
  - near neck, sex organs are immature.
- **b/ mature segment:**
  - large segment, sex organs are fully mature.
- **c/ gravid segment:**
  - found at the tail end, uterus is filled with eggs



Egg: -

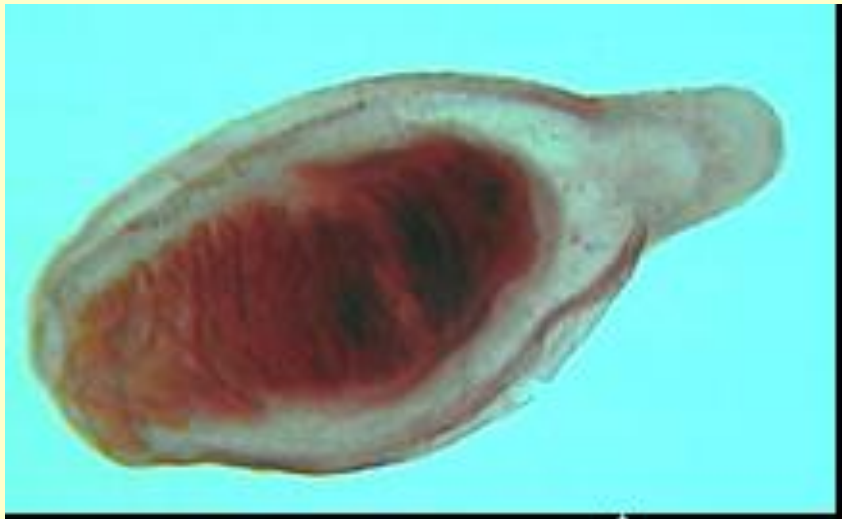
- Two type
  - Operculated, immature when voided to the external environment.
  - Non-operculated ,fully embryonated when voided to the external environment.

Larvae:

- Generally two types
  1. Solid :
     - eg. Procercoid, Plerocercoid, cysticercoid
  2. Cystic (true bladder) can be with:
     - Single scolex

       eg. Cysticercus;
     - Many scolexes and/or with daughter cyst

       eg. hydatid cyst, coenurus cyst, etc



Cysticercus ↑

↑ Coenurus

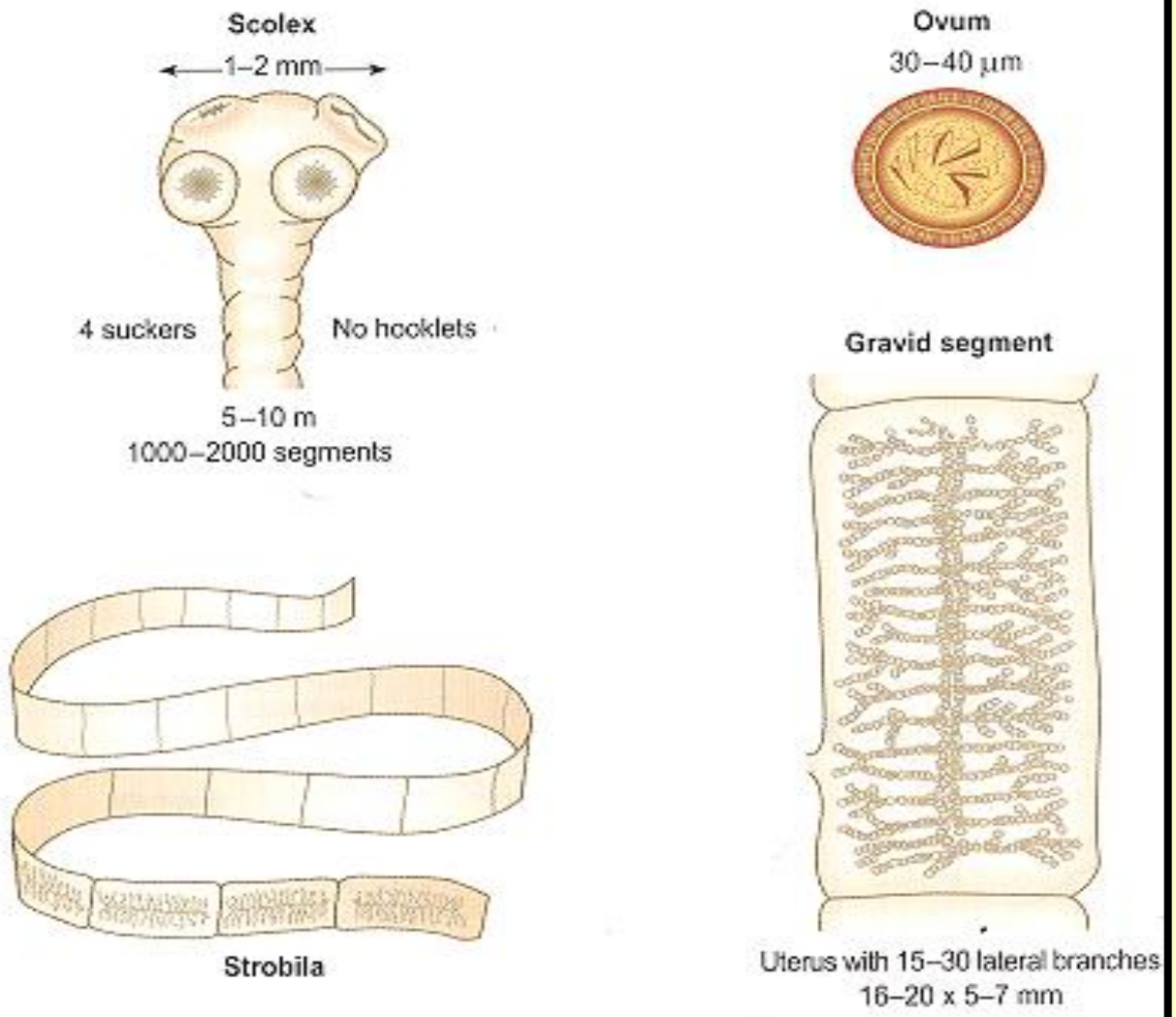
← Cysticercoid

Strobilocercus →

Reproduction

- Sex:- Hermaphrodites
  - Have well developed reproductive system.
- Reproduction
  - Sexual-Oviporous
  - Asexual-Sometimes multiplication with in larval forms

Teania saginata

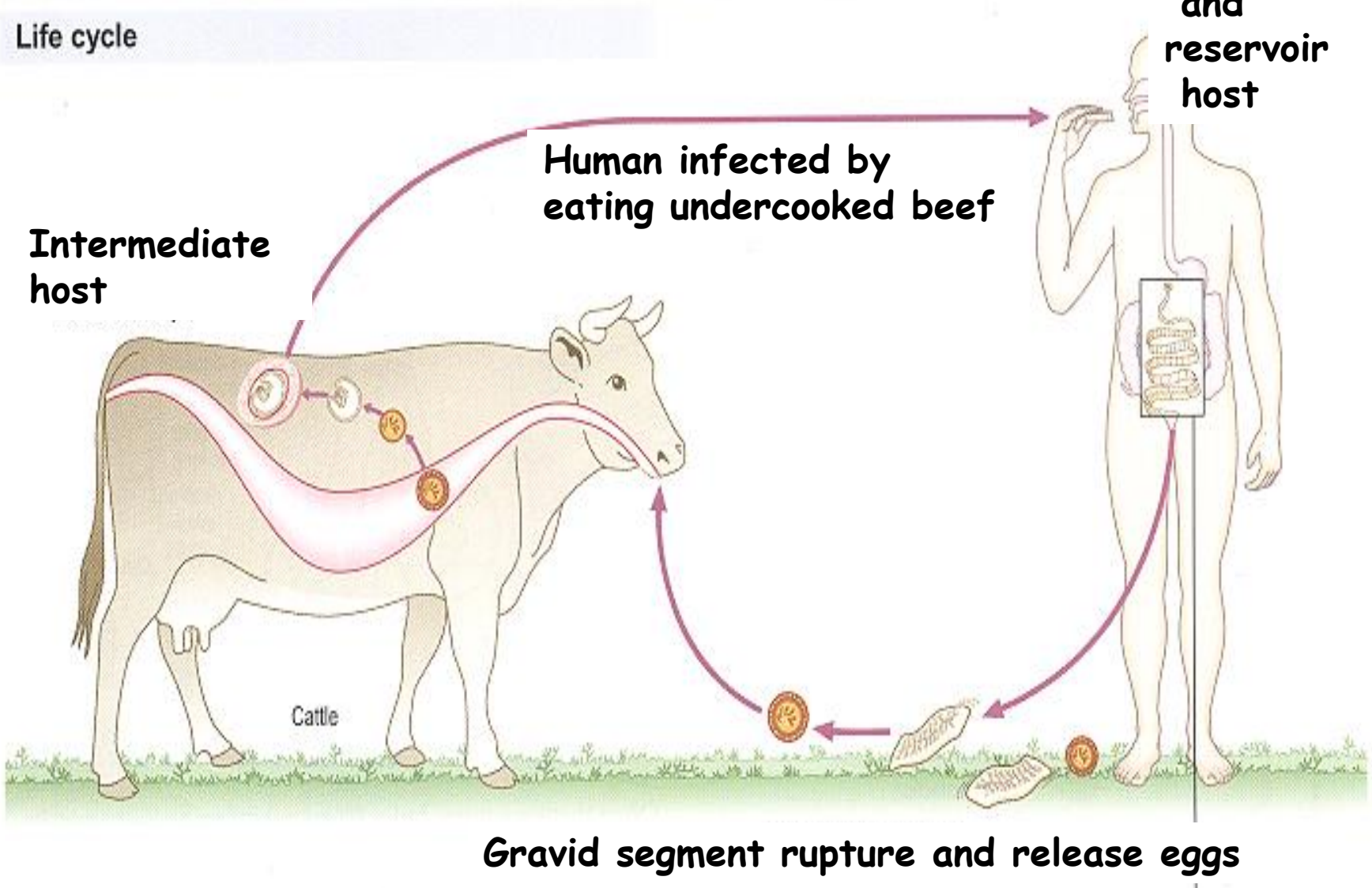


Taenia saginata (beef tape worm)

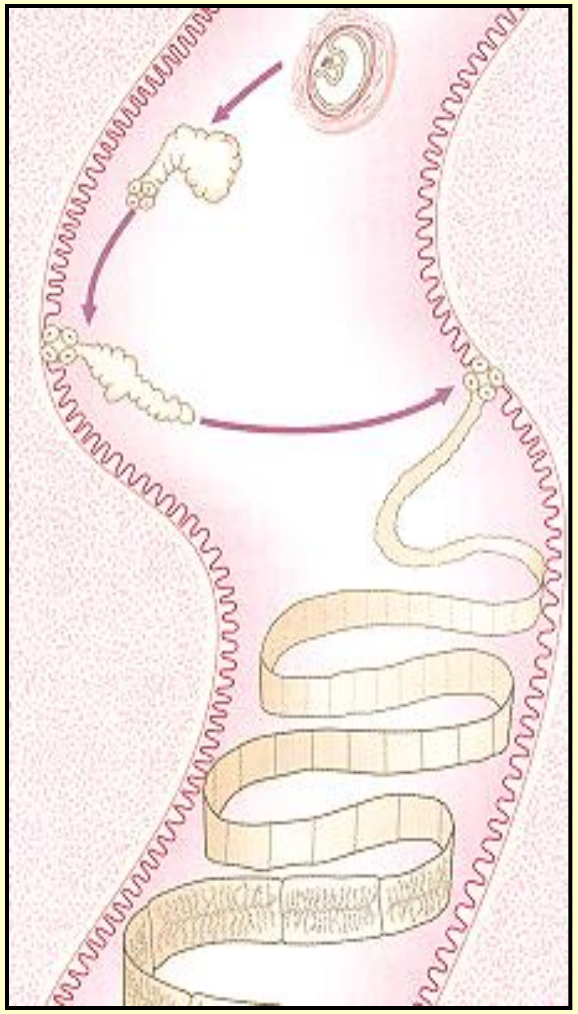
Double striated egg shell
Hexacanth embryo

More than 12 lateral uterine branch

Taenia saginata (beef tape worm)



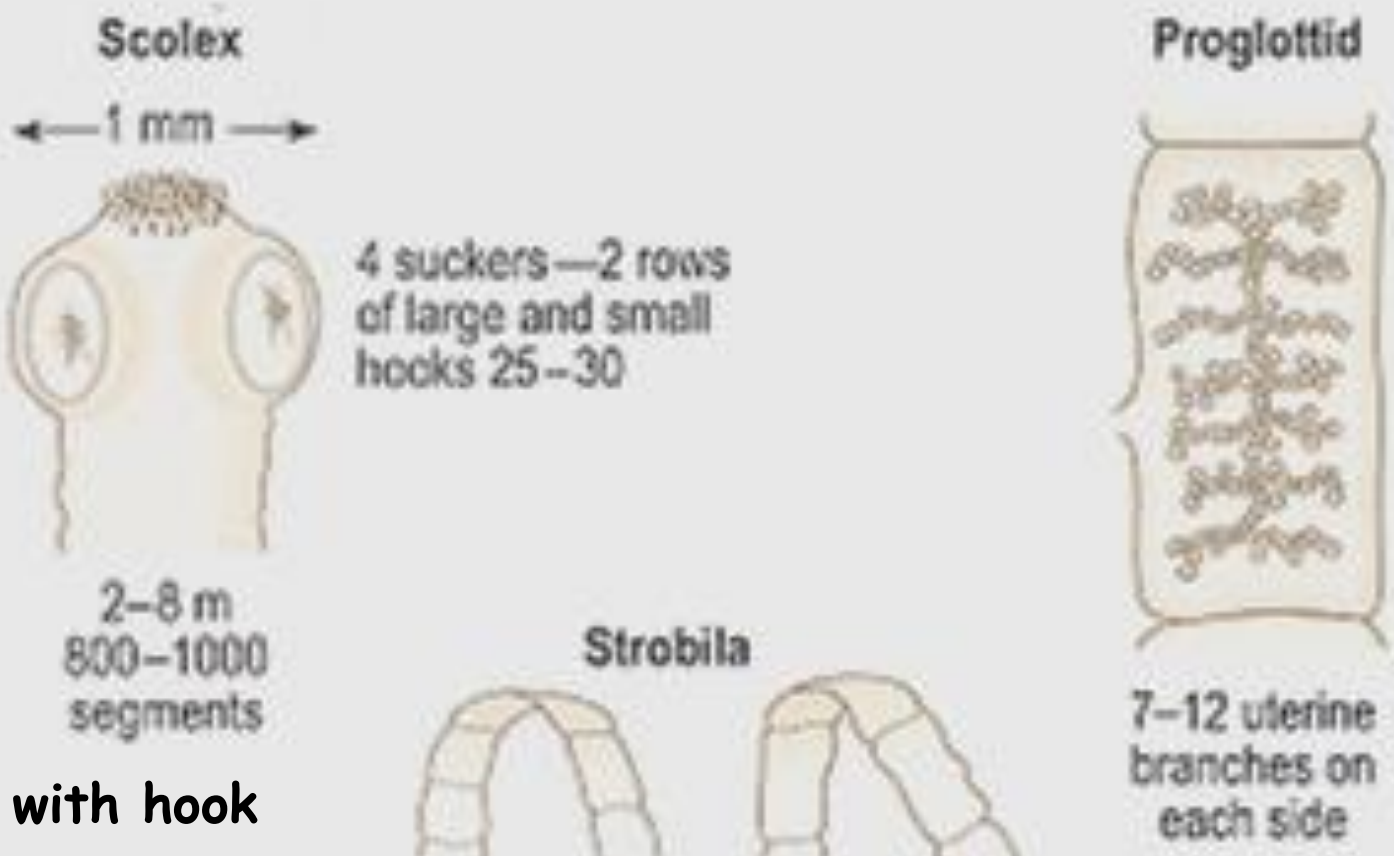
- Maturation time 8-10 weeks .
- Life span up to 25 years.
- Scolex evaginate in small intestine and attach it self to mucosa of intestine.



Clinical manifestation

- T saginata
  - Taeniasis.
    - Usually asymptomatic but may cause dizziness, abdominal pain, diarrhea, headache and nausea.
  - Proglottids obvious in feces.
  - Proglottides have a strong tendency to crawl from the anus during the day when its host is active

Taenia solium



-Scolex with hook

-Uterine lateral Branches less than 12

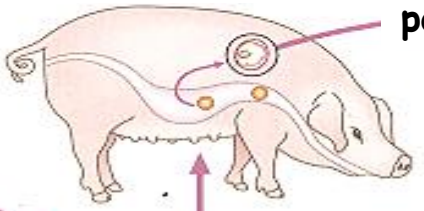
Taenia solium (pork tape worm)

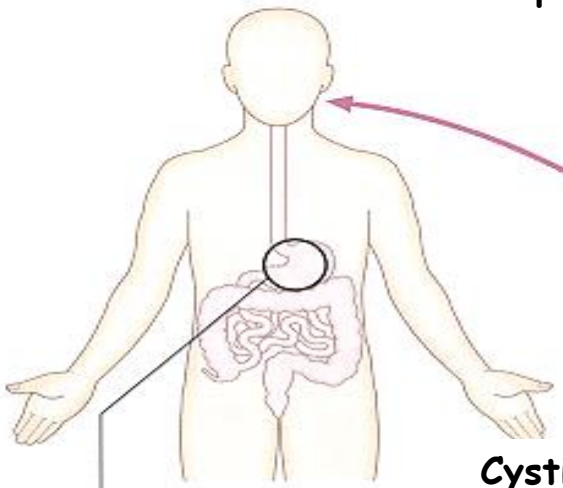
Life cycle

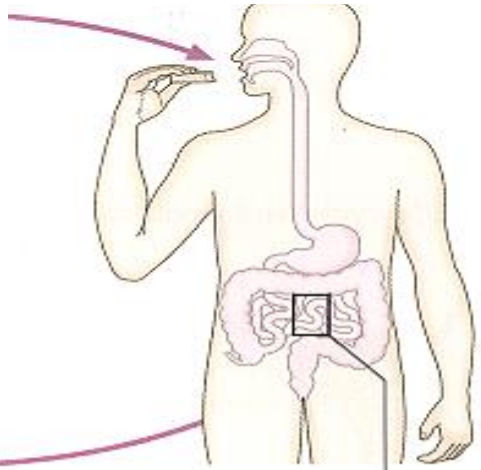
Usual Intermediate host liberated embryo,via bloodstream to tissue especially muscle

Measly pork

Definitive and reservoir hosts



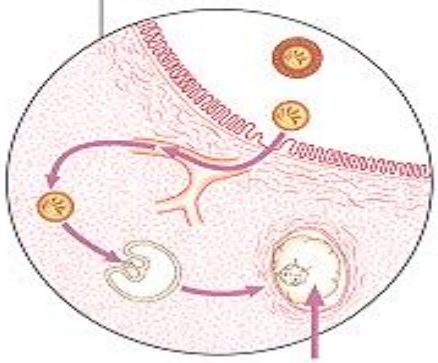




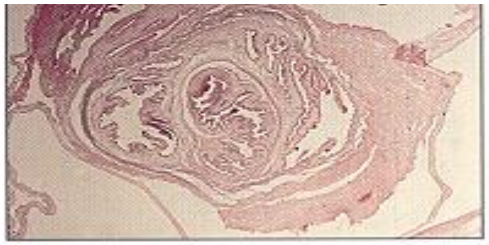
Ovum

Cysticercus is liberated, scolex evaginates, attaches itself to mucosa of small intestine. develops to adult. Maturation time 3months.Life span up to 25 years.

Human cysticercosis

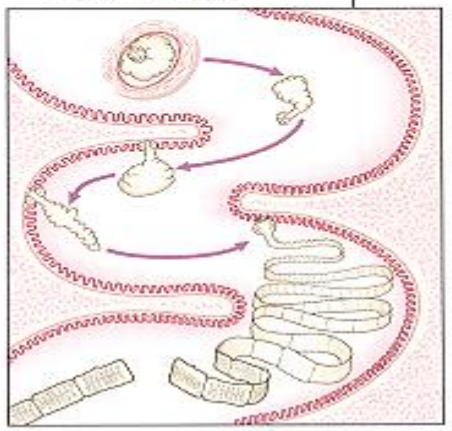


Development of cysticercus cellulosea-5x8-10mm



Section of human brain showing viable larva of *T. solium*

Infection with adult



Pathology

- **Adult**: may be abdominal pain with some abdominal disturbance.
- **Larvae of T.solium** produce cystic nodules **(cysticercosis)** in sub-cutaneous tissue and muscles with mild symptoms; except when present in **brain** it can cause major central nervous system sign.

- Cysticercosis can occur by autoinfection:
- Internal—antiprestalsis movement of intestine gets its contents back to the stomach
- External ova in stool of infected patient contaminate his own food or hands

Laboratory Diagnosis

- Detecting eggs in faeces .
- Identifying macroscopically
  - gravid segments in faeces
  - scolex recovered from clothing or passed in faeces.
- In addition
- T.saginata-
  - ova on perianal skin (cellotape slide)
- T.solium (cysticercosis)
  - Finding calcified larvae in histological or X-rays examination .

Egg : T.solium &T.saginata

- Size: - 33-40 μm
- Shape: -Round
- Colour: - Shell-dark yellowish-brown,
- Content: light yellowish gray.
- Shell:-Thick, Smooth, brown, radially straited (embryophore)
- Content: - A round granular mass enclosed by a fine membrane with six hooklets

Morphologically eggs of *T.saginata* and *T. solium* are indistinguishable unless stained by AFB

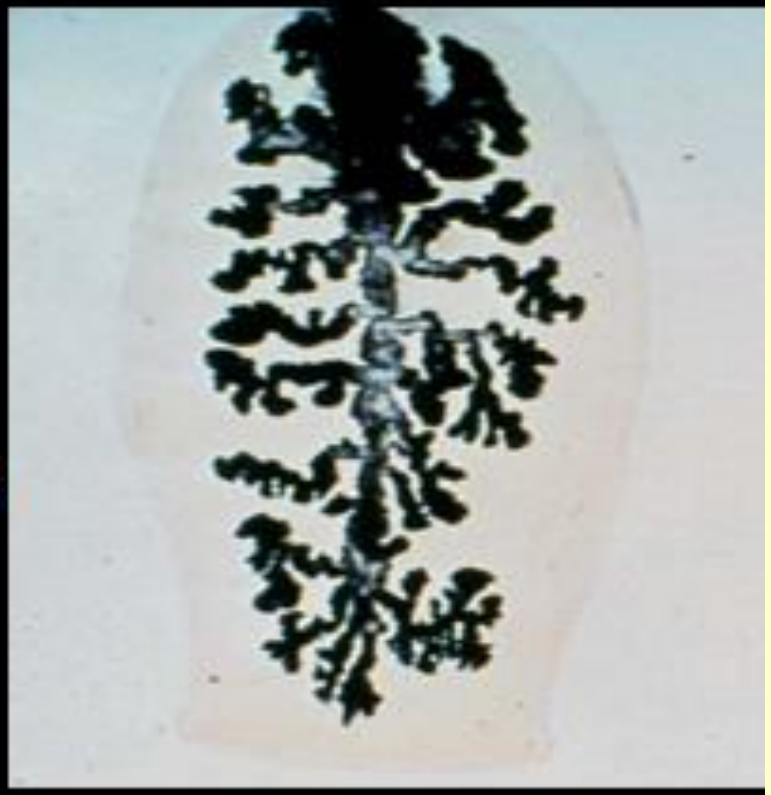
- T. saginata ova stains red (acid fast) in Ziehl-Neelsen stain
- this character helps to differentiate it from *T.solium* which do not have red color in such staining (not acid fast)

Taenia saginata

- **Gravid proglottide**
- Detach when fully develop and pass through the anus independently.
- Color- white and opaque
- Size- 20mmX6mm
- Uterus- > 13 main (15-30) lateral uterine branches.

Taenia solium

- **Gravid proglottides-**
- Grey-blue and transluscent
- Size-13mmX8m
- 7 to 12, on average 10 lateral compound uterine branches.
- Small chains of 3-4 rectangular segments found in the faeces



Morphology:

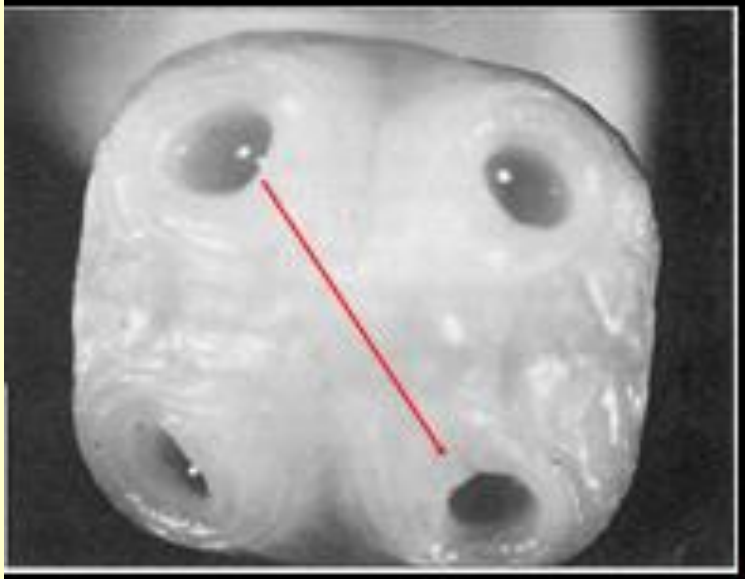
T. saginata

- ***Adult:***
  - Size: 4-10 m long (can reach up to 20 m)
  - Colour: ivory white
  - Strobila : 1000-2000 proglottides
  - Mature segment: 1-2cm long

T. solium

- ***Adult***
  - Size: 2-3m
  - Colour: pale blue
  - ***Strobila:*** 800-1000 Proglottides
  - Mature segment :0.5-1.5 cm

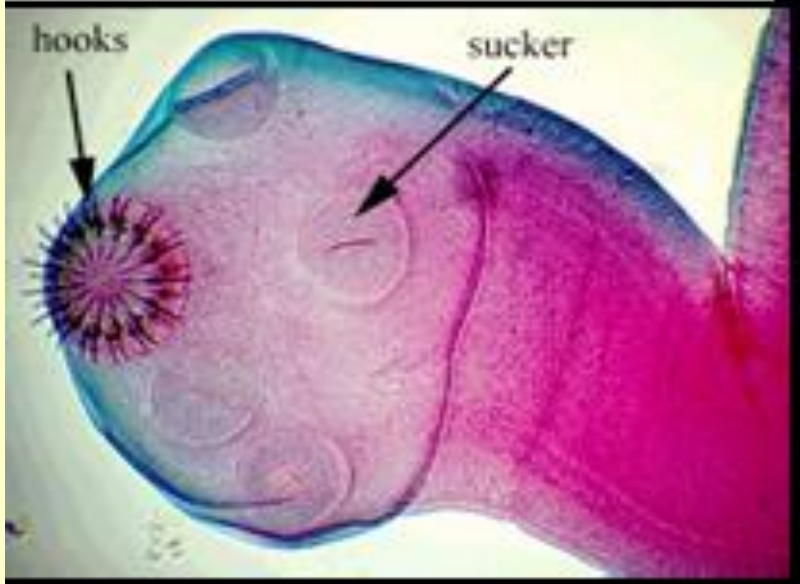
Taenia saginata



Scolex (head):

- Quadrate, with four suckers, no hooks, no rostellum on scolex
- Size-2mm across

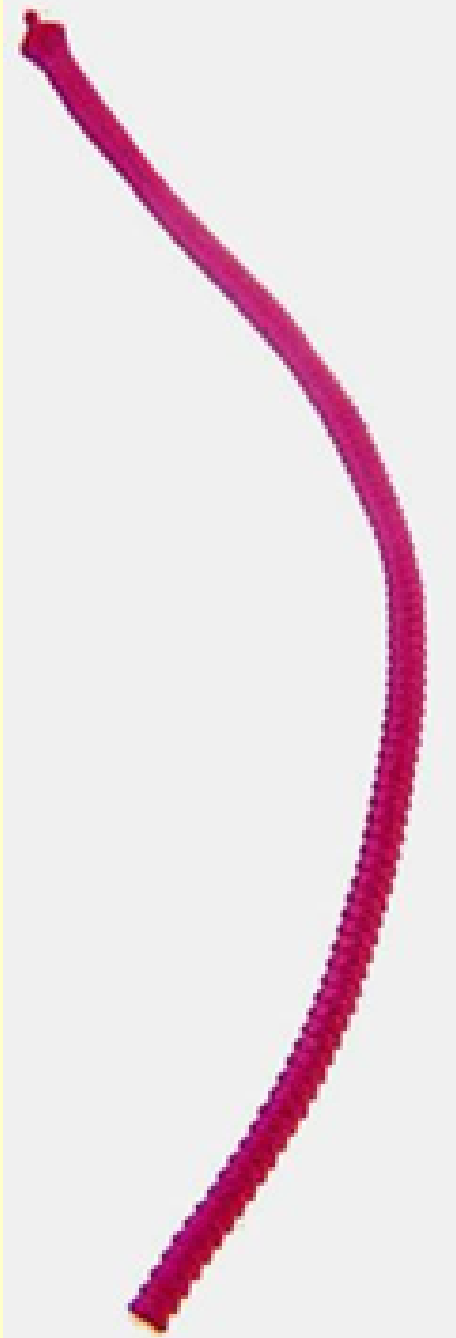
Taenia solium



Scolex has

- Four sucker
- two rows of hooks on a prominent rostellum

- *Hymenolepis nana*- Dwarf Tape Worm

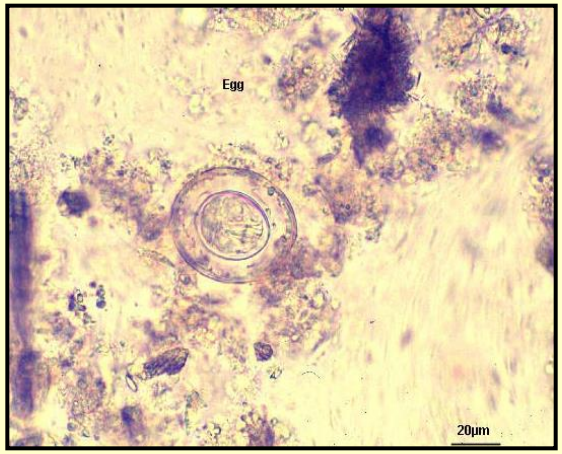


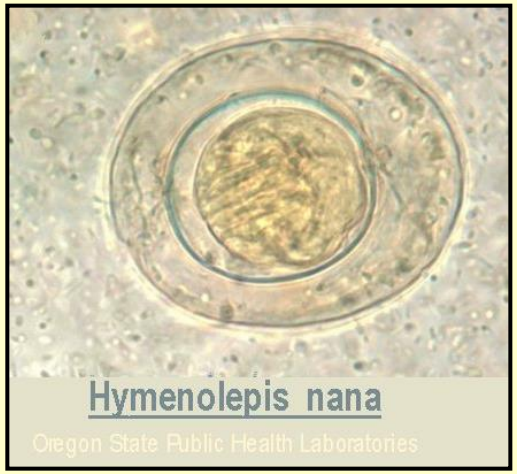
Hymenolepis nana

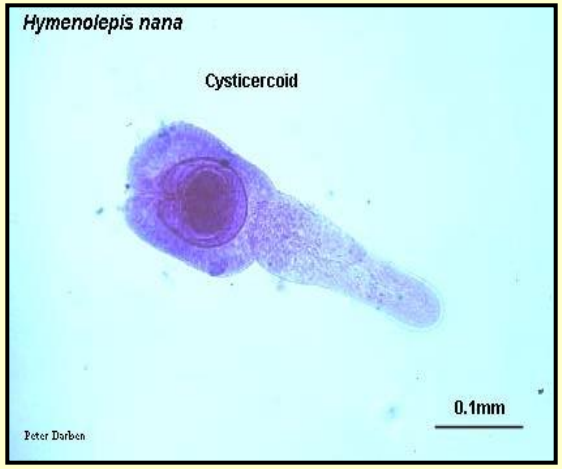
- Dwarf Tapeworm
  - *Vampirolepis nana*
- **Definitive Host:** Humans, rodents
  - Most common tapeworm of humans in the world
  - 1% rate of infection in the southern U.S.
  - 97.3% rate of infection in Moscow, Russia
- **Intermediate Host:** Larval and adult beetles (but optional)
  - Larval stage, cysticercoid, can develop in D.H. if it eats the eggs
    - Probably a recent evolutionary event

- Small tapeworm
- Scolex has rostellum with row of hooks
- Proglottids are wider than long with lateral genital pore

- **Mode of Transmisssion: -**
  - Ingestion of egg with contaminated food, drink or finger.
  - Autoinfection.
- **Life Cycle:** *H. nana* has a direct life cycle with a human host serving as both definitive and intermediate host.

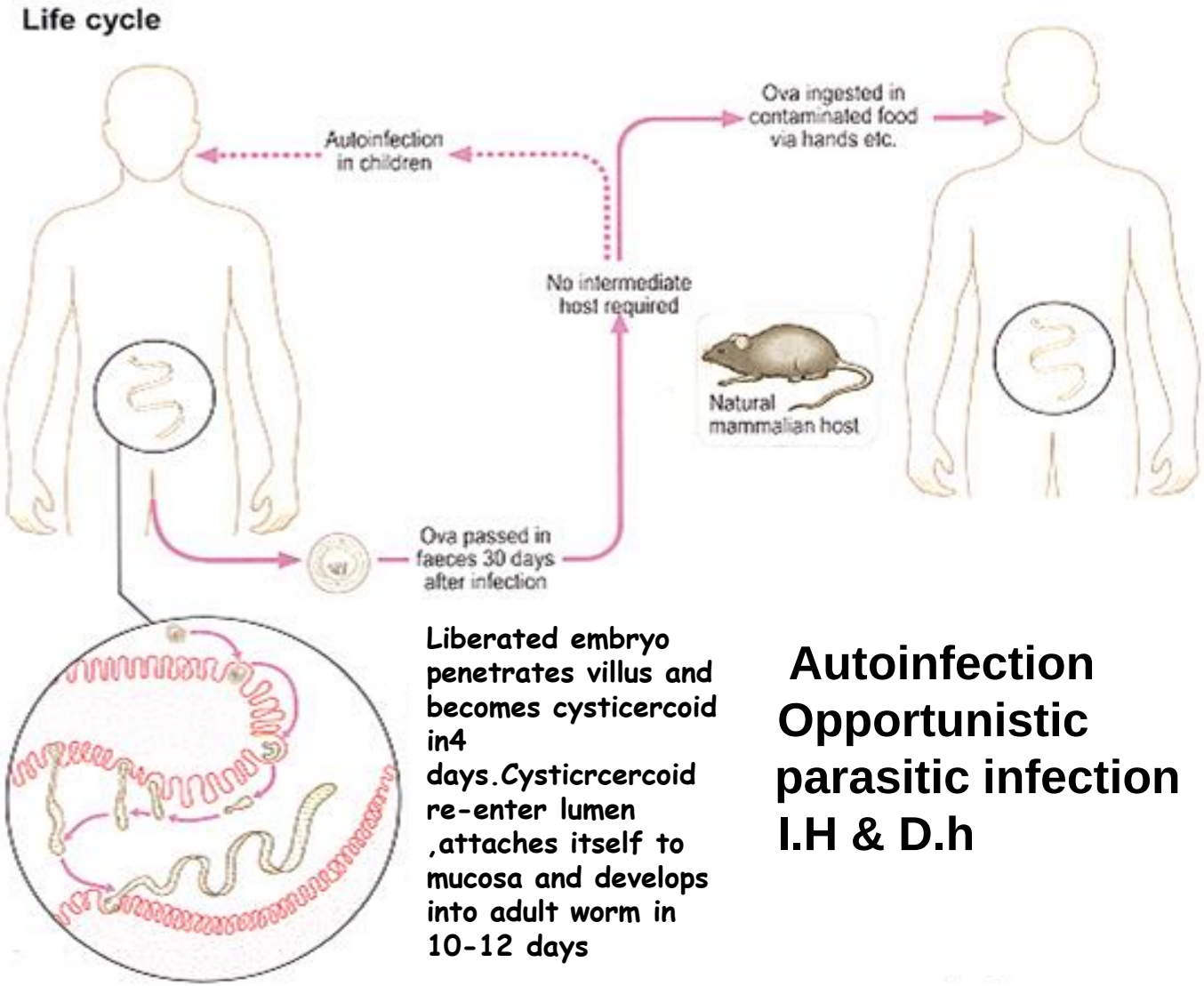

Egg
20µm


Hymenolepis nana
Oregon State Public Health Laboratories


Hymenolepis nana
Cysticercoid
0.1mm
Peter Darben

Dwarf tape worms

Hymenolepis nana



Liberated embryo penetrates villus and becomes cysticercoid in4 days.Cysticrcercoid re-enter lumen ,attaches itself to mucosa and develops into adult worm in 10-12 days

Autoinfection
Opportunistic parasitic infection
I.H & D.h

- Librated embryo penetrates villus and becomes cystocercoid in 4 days .
- cysticercoid re-enters lumen, attaches itself to mucosa and develops into adult worm in 10-12 days.

Diagnosis: Eggs in stools

Echinococcus granulosus

- Sheep Tapeworm
- **Definitive Host:** Carnivores including dogs, wolves, and coyotes
- **Intermediate Host:** Herbivores including sheep and mice.
- Occasionally infect humans.
- The hyatid cysts growin humans very slowly and can overcrowd organs
- **Geographic Distribution:** Most common in sheep raising countries
  - New Zealand and Australia highest incidence

3-8 mm in length

4 segments:

1-scolex with 4 sucker and hooks,

2- immature 3- mature 4- gravid segment.

- Definitive host is dog.
- Intermediate host is sheep, cattle , camel and human.

Echinococcus spp. - Hydatid Cyst DZ

Larval tapeworm in Humans

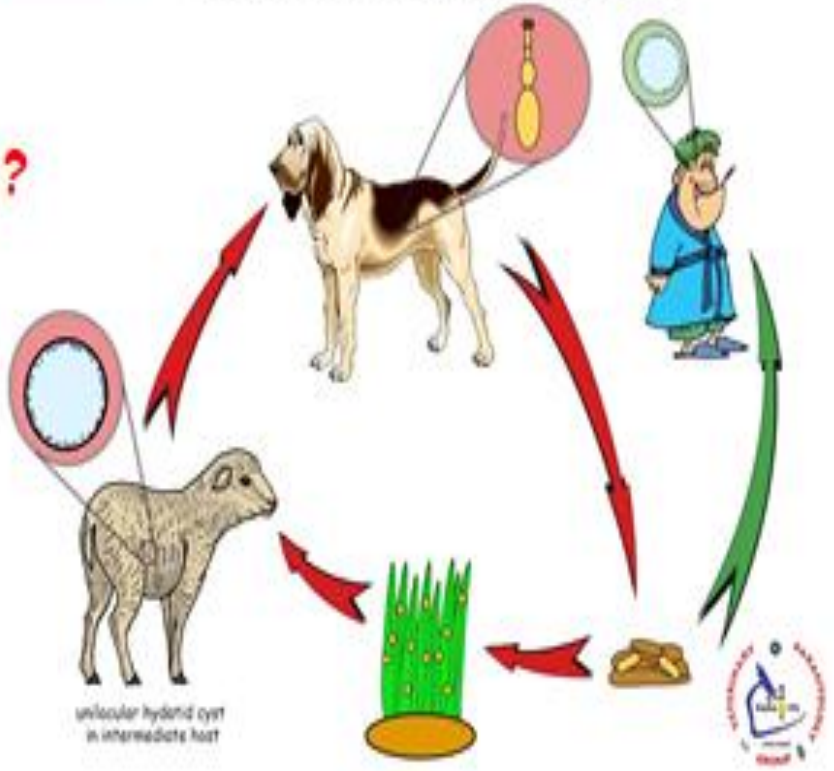
- Very Important Zoonotic DZ

Humans act as intermediate hosts. HOW ?

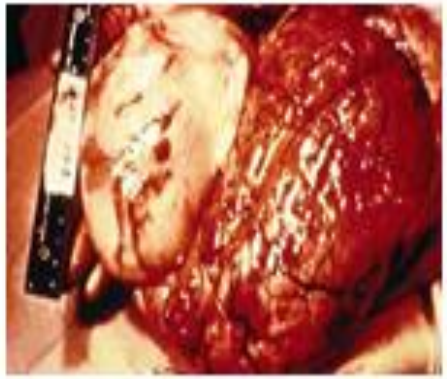
- Hydatid Cyst in Liver, Lungs, Brain.

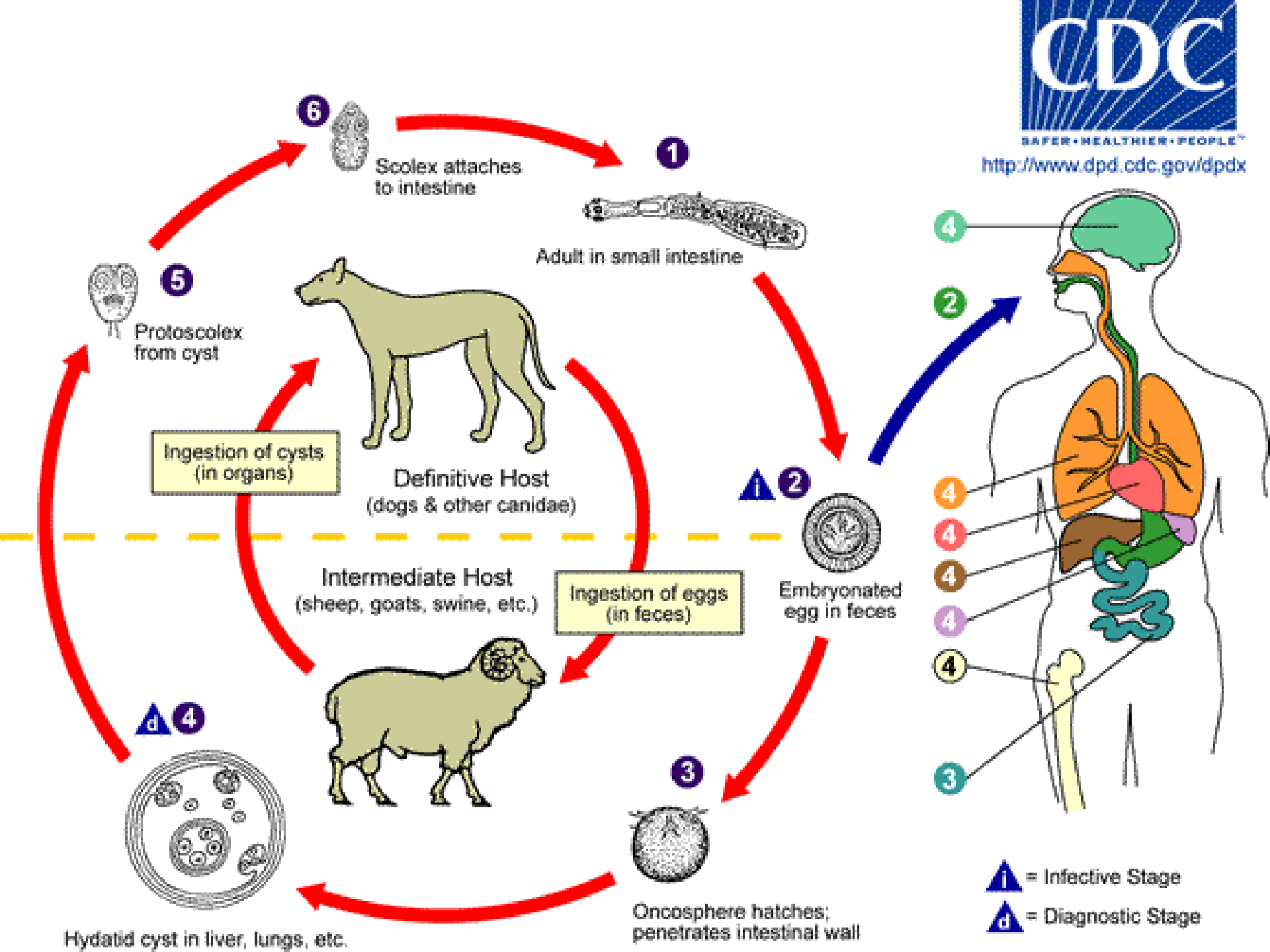
- If humans ingest *Echinococcus* ova from dog feces; then Hydatid Cyst DZ

Echinococcus granulosus



Hydatid Cyst DZ




CDC
SAFER·HEALTHIER·PEOPLE™
http://www.dpd.cdc.gov/dpdx
6
Scolex attaches to intestine
1
Adult in small intestine
5
Protoscolex from cyst
Ingestion of cysts (in organs)
Definitive Host
(dogs & other canidae)
i 2
Embryonated egg in feces
Intermediate Host
(sheep, goats, swine, etc.)
Ingestion of eggs (in feces)
d 4
Hydatid cyst in liver, lungs, etc.
3
Oncosphere hatches; penetrates intestinal wall
4
2
4
4
4
4
4
3
i = Infective Stage
d = Diagnostic Stage

(1) adult worms in bowels of definitive host.

(2) eggs passed in feces, ingested by humans or intermediate host.

(3) onchosphere penetrates intestinal wall, carried via blood to lodge in organs.

(4) hyatid cysts develop in liver, lungs, brain, heart.

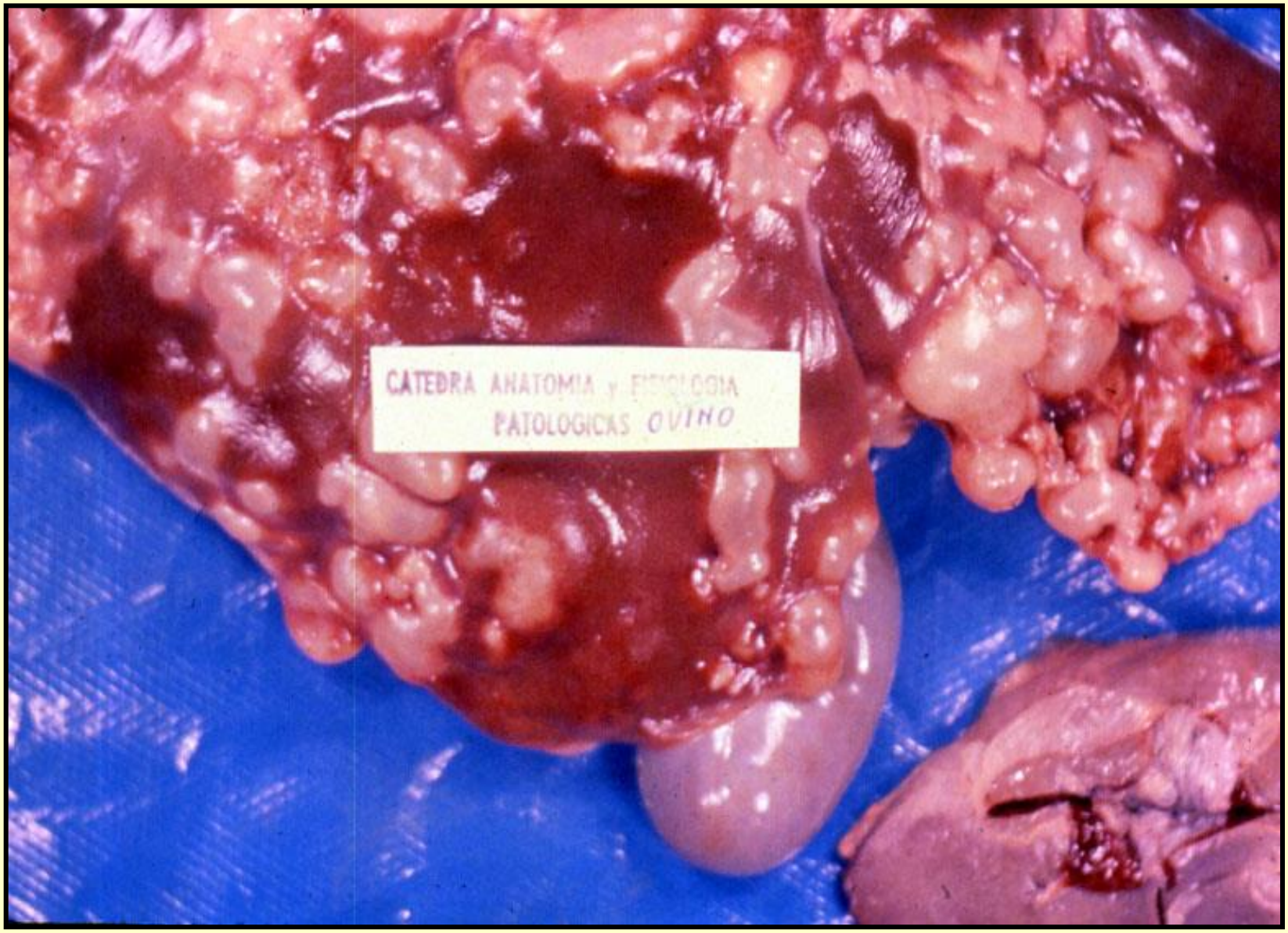
(5) protoscolices (hydatid sand) ingested by definitive host.

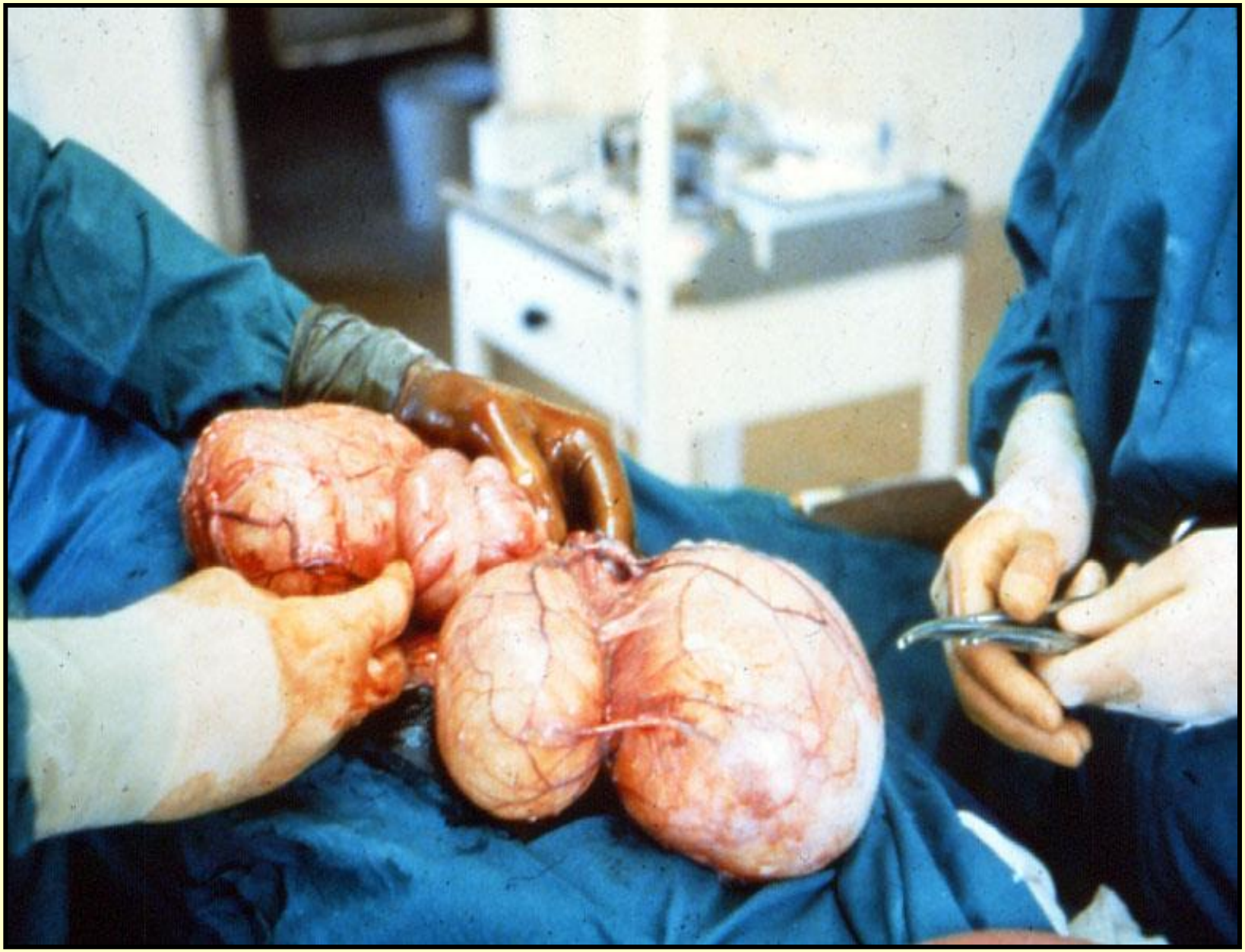
(6) attach to small intestine and grow to adult worm.

- **Infection**
- Human (I.H.), acceidental ingestion of dog feces containing eggs.
- Dogs (D.H.) ingest offal (farm feed of ground organs) containing cysts.

Clinical feature and Pathology:

- The symptoms, depend upon the location of the cyst.
- Large abdominal cysts produce increasing discomfort.
- Liver cysts cause obstructive jaundice.
- Peribronchial cysts may produce pulmonary abscesses.
- Brain cysts produce intracranial pressure and Jacksonian epilepsy.
- Kidney cysts cause renal dysfunction.
- The contents of a cyst may produce anaphylactic responses


CATEDRA ANATOMIA y
PATOLOGICAS OVINO



Laboratory Diagnosis

- Histological examination to find larvae
- X-ray examination to find larvae
- Examination of cystic fluid for brood capsules and protoscoleces
- Casoni's skin test

Phylum Platyhelminthes

Class: Trematode-Flukes

Blood flukes -- Schistosoma

Blood flukes

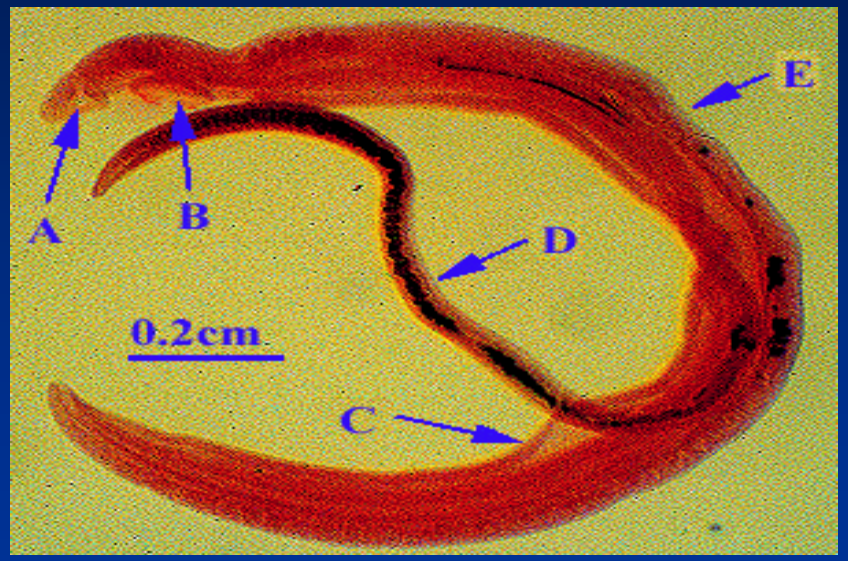
- Schistosoma haematobium –Vesical veins
- Schistosoma mansoni ----Intestinal veins
- Schistosoma japonicum---Intestinal veins

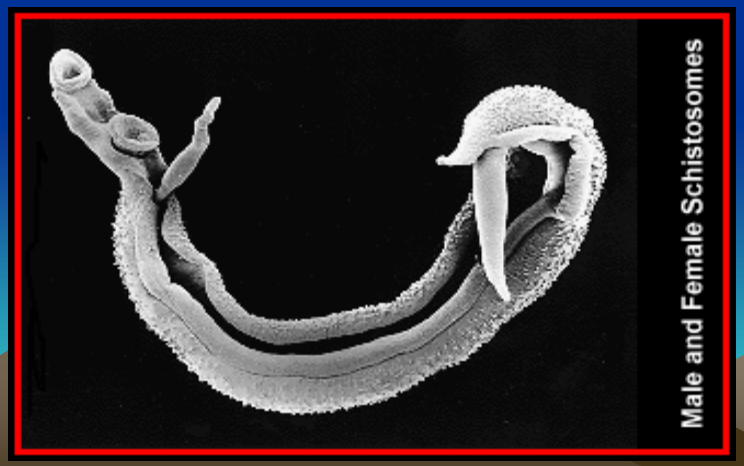
Disease types & Distribution

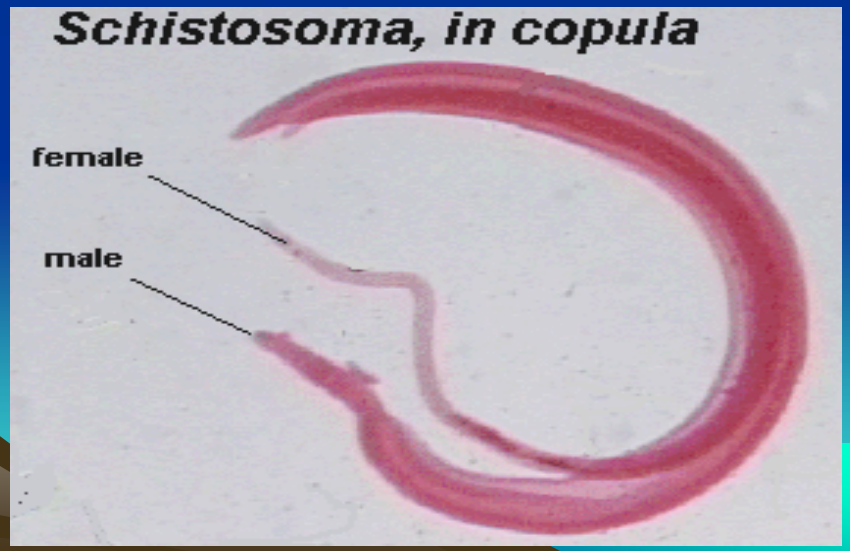
Type	Species	Geographical distribution
Urogenital	*S. haematobium*	Africa, Middle East
Intestinal	*S. mansoni*	Africa, Middle East, Caribbean, Brazil, Venezuela
	S. intercalatum	Rainforests of central Africa
	S. japonicum	China, Indonesia, Philippines
	S. mekongi	Cambodia, Lao

Schistosoma

- General character:
- Morphology
- Reproduction system
- Importance







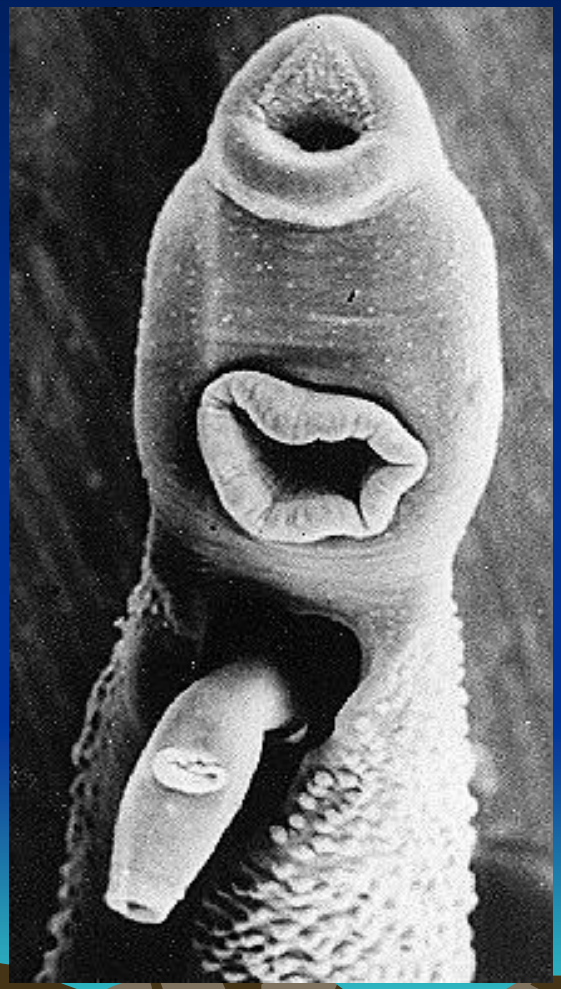
Morphology

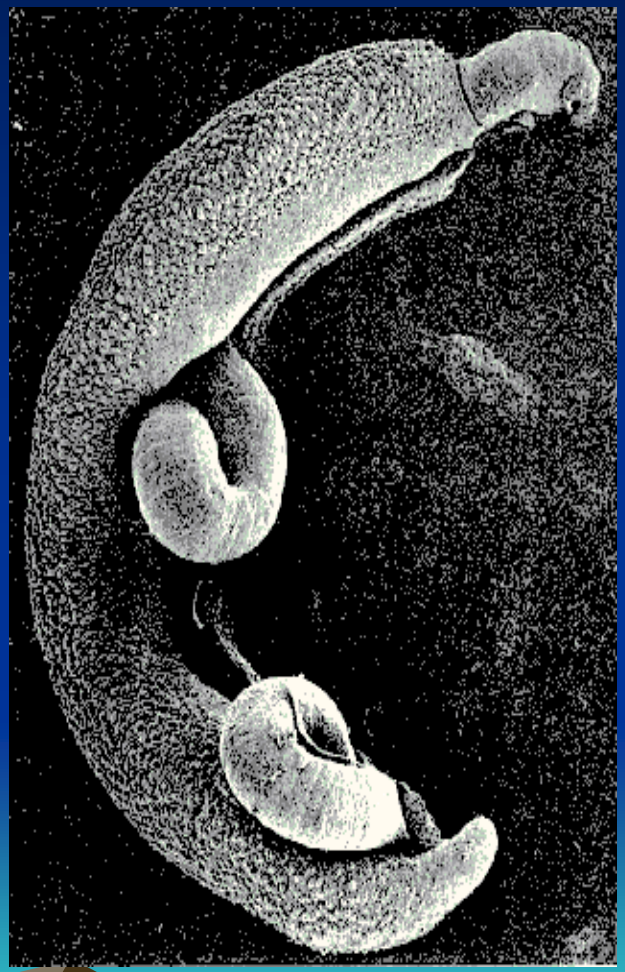
- Size: - Female 12 to 26 mm
  - Male 6 to 22 mm

The three main species infecting humans are
Schistosoma haematobium,
S. japonicum
,and S. mansoni .

Two other species, more localized geographically, are *S. mekongi* and *S. intercalatum*

Adult an larve of Sch.



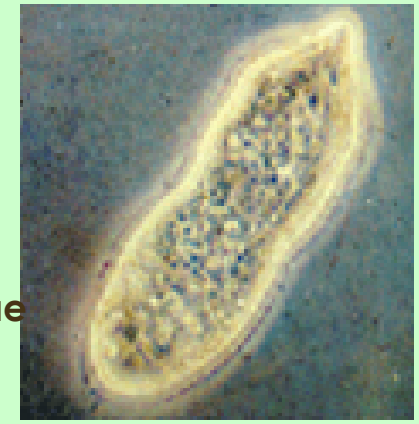


Schistosomulum

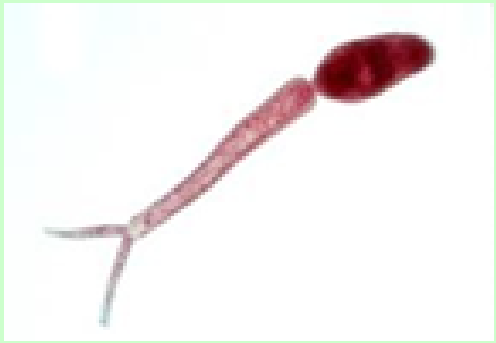
Life cycle

The life cycles of all human schistosomes are broadly similar:

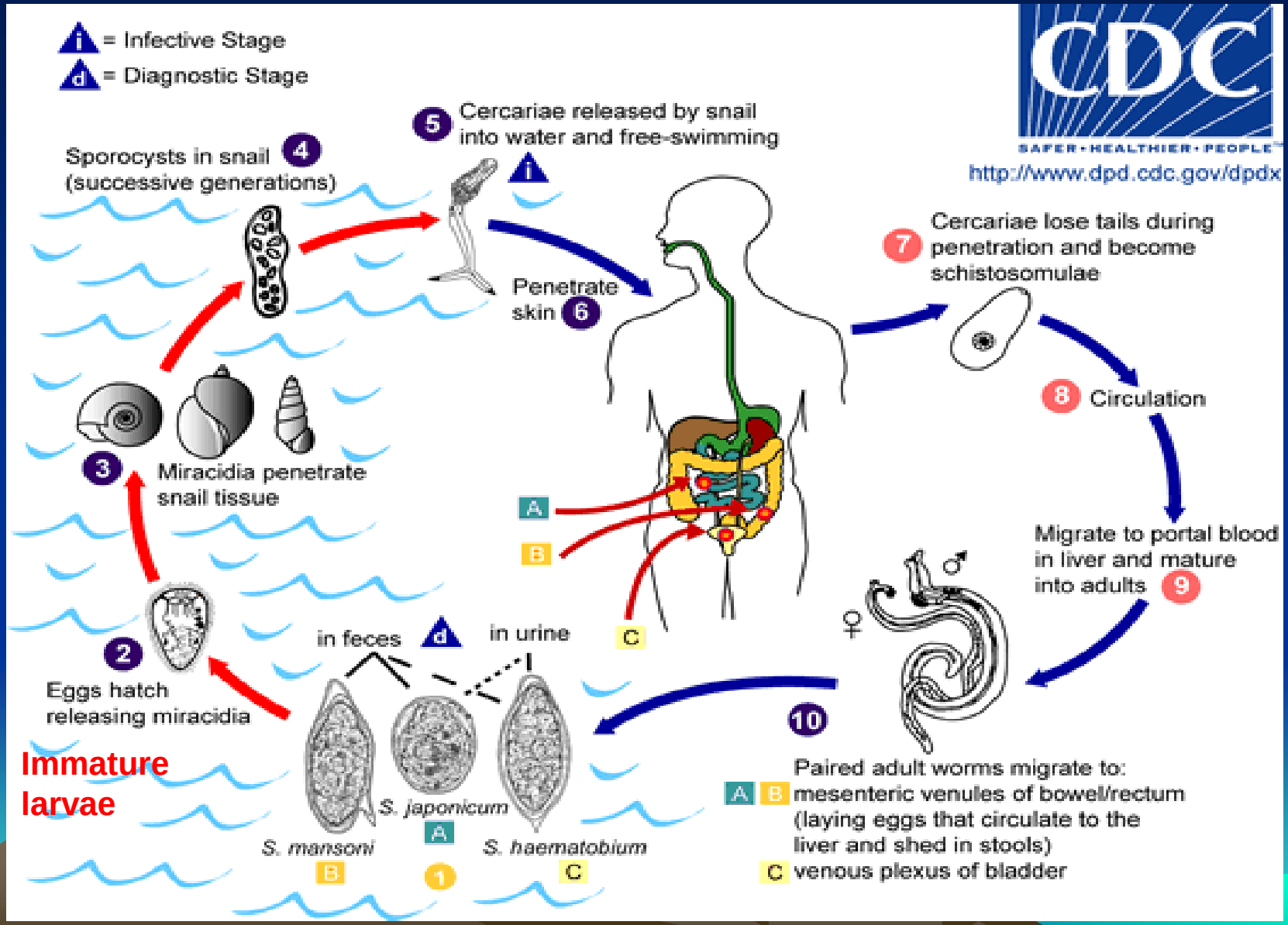
- parasite eggs are released into the environment from infected individuals, hatching on contact with fresh water to release the free-swimming miracidium.
- Miracidia infect fresh-water snails by penetrating the snail's foot. After infection, close to the site of penetration, the miracidium transforms at first into a primary (mother) sporocyst and then into secondary (daughter) sporocysts, which migrate to the snail's hepatopancreas.
- Once at the hepatopancreas the secondary sporocyst begin to divide again and producing thousands of new parasites, known as cercariae, which are the larvae capable of infecting mammals.



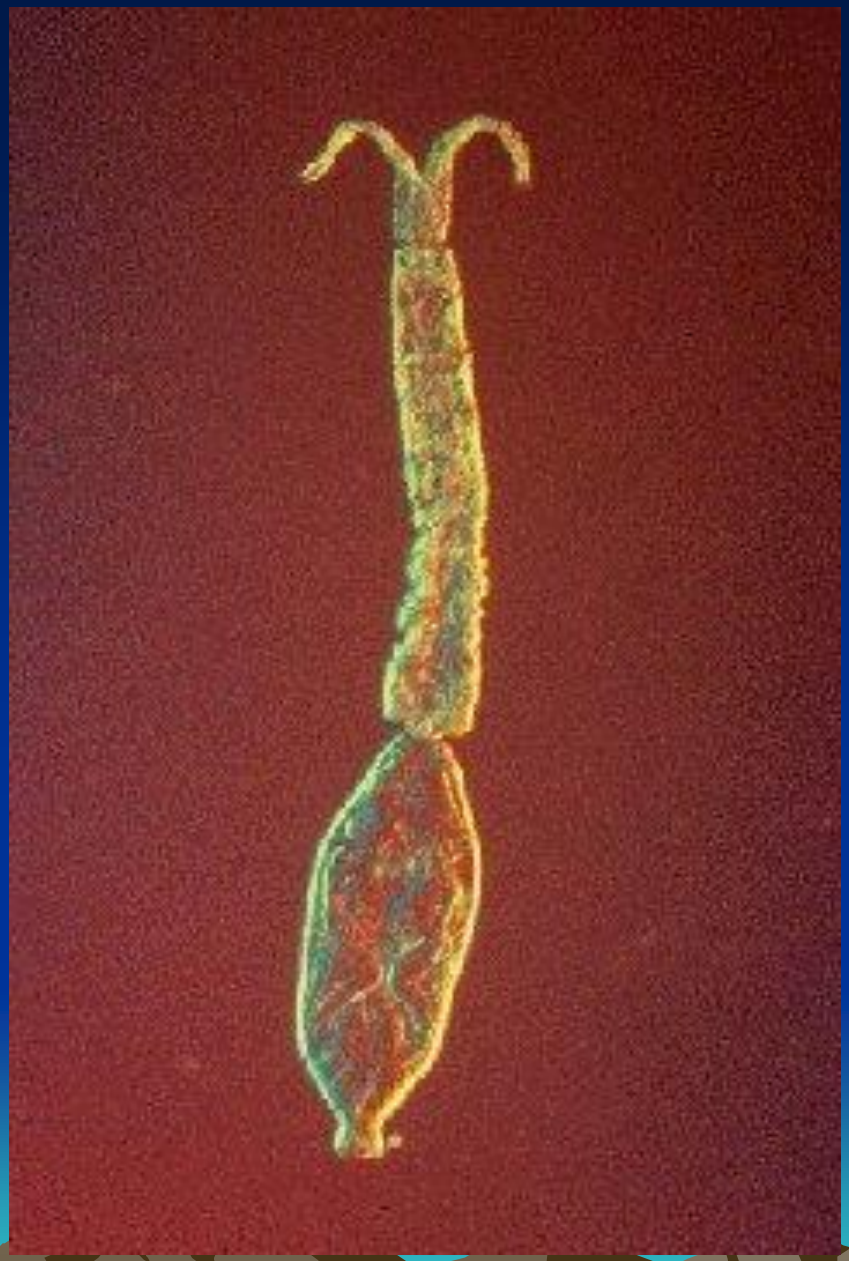
Immature larvae



Life Cycle


i = Infective Stage
d = Diagnostic Stage
CDC
SAFER·HEALTHIER·PEOPLE
http://www.dpd.cdc.gov/dpdx
5 Cercariae released by snail into water and free-swimming
Sporocysts in snail 4 (successive generations)
Penetrate skin 6
7 Cercariae lose tails during penetration and become schistosomulae
8 Circulation
3 Miracidia penetrate snail tissue
A
B
C
Migrate to portal blood in liver and mature into adults 9
in feces
d
in urine
2 Eggs hatch releasing miracidia
Immature larvae
10
Paired adult worms migrate to:
A B mesenteric venules of bowel/rectum (laying eggs that circulate to the liver and shed in stools)
C venous plexus of bladder
S. mansoni
B
S. japonicum
A
S. haematobium
C
1

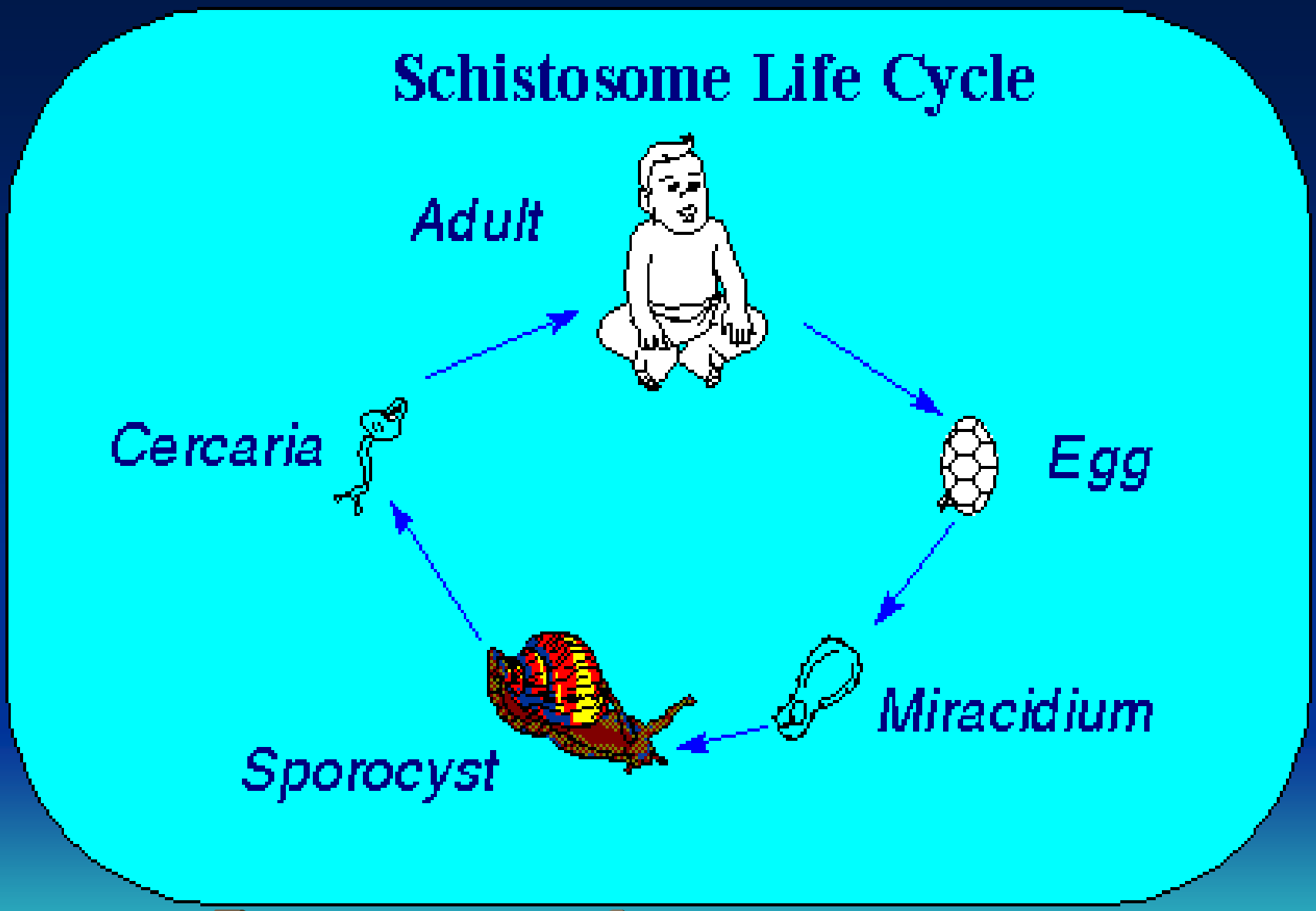
Schistosoma spp.: miracidium



Schistosoma spp. cercariae are the infective forms.

After encountering the skin, the cercariae penetrate and lose the tail transforming into schistosomulae

Schistosome Life Cycle



S. haematobium

Biomphalaria

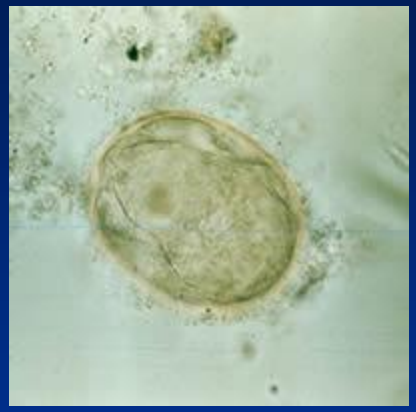
S. mansoni

Oncomelania


Schist. Japanicum
Gastropod snail
dreamstime.com
ID 201761679 © Maurociganotto

Schistosoma egg

Sch.mansoni egg



Sch. japonicum egg

Sch. Haematobium egg

Epidemiology of Schistomiasis

Clinical features

There are 4 stages

1. **STAGE OF INVASION: CERCARIAL DERMATITIS**
2. **STAGE OF MATURATION: ACUTE SCHISTOSOMIASIS**
3. **STAGE OF ESTABLISHED INFECTION**
4. **STAGE OF LATE INFECTION AND SEQUELAE**

STAGE OF INVASION: CERCARIAL DERMATITIS

- Penetration of the skin by cercariae, leads to occurrence of dermatitis (cercarial dermatitis or «swimmer's itch») and can be associated the death of cercariae in the skin.
- A transient immediate hypersensitivity reaction that occurs 10 to 15 min after exposure is followed by a more prolonged, delayed reaction, which develops after 12 to 24 h and may persist for up to 15 days.
- The lesion is characterized by a small, red, pruritic, macular rash, which progresses to papules, possibly accompanied by vesicle formation and oedema. Pustules may form if secondary infection occurs, and residual pigmentation may persist for months.
- The next symptoms develops a few days after exposure and can be associated with transient fever, cough and pulmonary infiltrates, as well as myalgia and abdominal pain.

STAGE OF MATURATION: ACUTE SCHISTOSOMIASIS

- fever,
- rigors,
- sweating,
- headache,
- malaise,
- muscular aches,
- profound weakness,
- an unproductive,
- irritating cough,
- abdominal pain or swelling,
- nausea, vomiting,
- diarrhoea, and loss of weight.
- pyrexia (intermittent or remittent with evening peaks),
- oedema,
- a generalized soft lymphadenopathy,
- a tender enlarged liver, enlarged and soft spleen, stuporose, or show visual impairment or papilloedema.
- Severe central-nervous manifestations
- Eggs become detectable in the faeces about 6 weeks after exposure.

STAGE OF ESTABLISHED INFECTION

S. haematobium infection:

- hypogastric discomfort,
- suprapubic pain,
- dysuria,
- haematuria, proteinuria and pyuria.

Figure 2 - Macroscopic appearance of the colon and distal ileum showing several sharply acute ulcers (arrows) extending deep into the bowel wall.

S. mansoni and S. japonicum infections is very frequently asymptomatic.

Classical symptoms include:

- hypogastric pain,
- diarrhoea, and the
- passage of blood or mucus in the stool.
- the liver may be enlarged and tender;
- the spleen may also be enlarged, but is usually soft.

STAGE OF LATE INFECTION AND SEQUELAE

Urinary schistosomiasis, in the bladder:

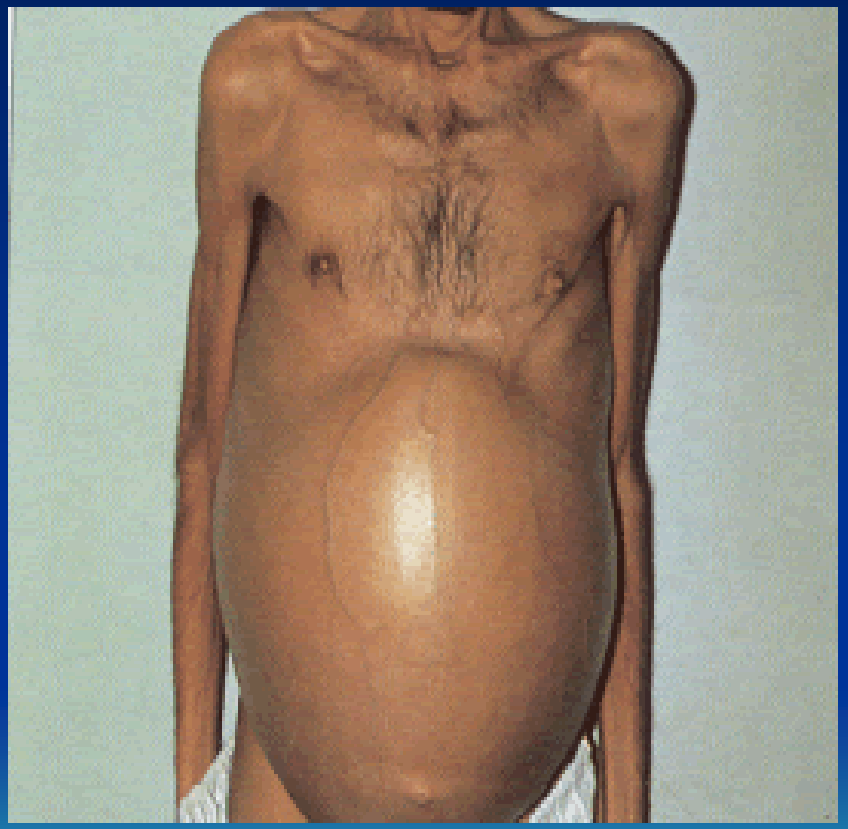
- calcification,
- ulceration,
- papillomas,
- nocturia,
- precipitancy,
- retention of urine,
- dribbling,
- severe pain.
- The ureteric pathology is usually asymptomatic, but may lead to ureteric colic.
- uraemia.

S. mansoni and S. japonicum infections, is associated with:

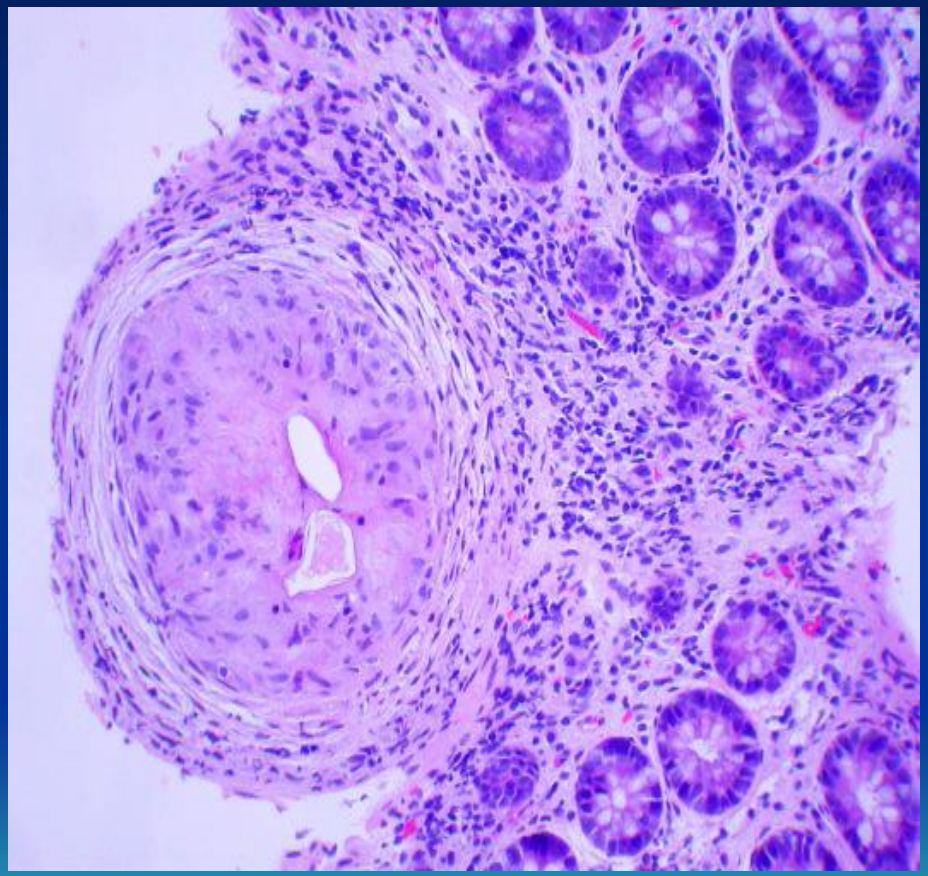
- intermittent diarrhoea, with or without the passage of blood or mucus;
- the colon may be tender.
- In between the episodes of diarrhoea, the stools are normal.
- bleeding from oesophageal varices
- haematemesis,
- melaena.
- Blood loss is frequently massive, and exsanguination is the usual cause of death rather than hepatic coma.

Cercarial Dermatitis

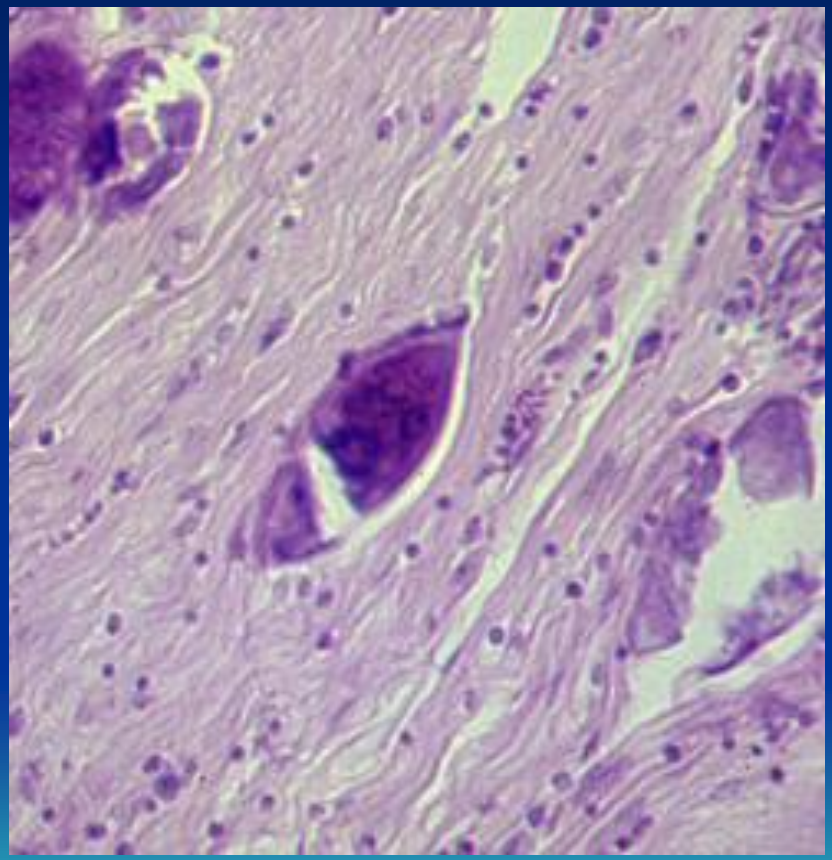
Hepatomegaly & splenomegaly

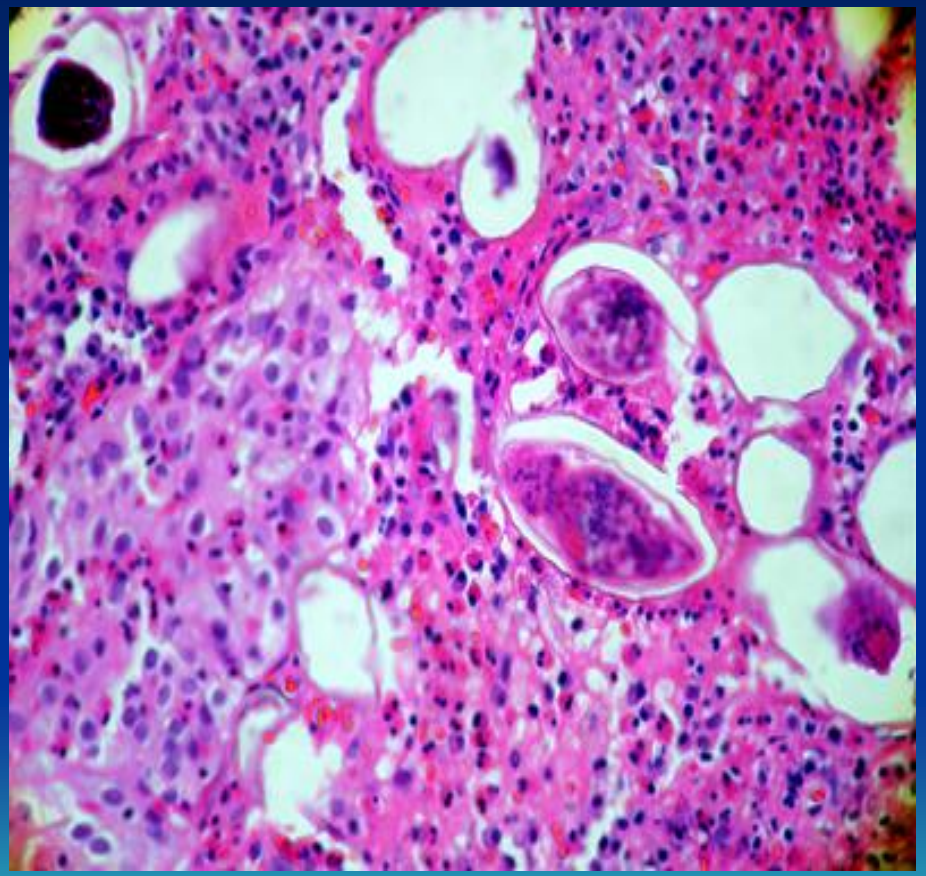


Granuloma
(Sch. japonicum egg)

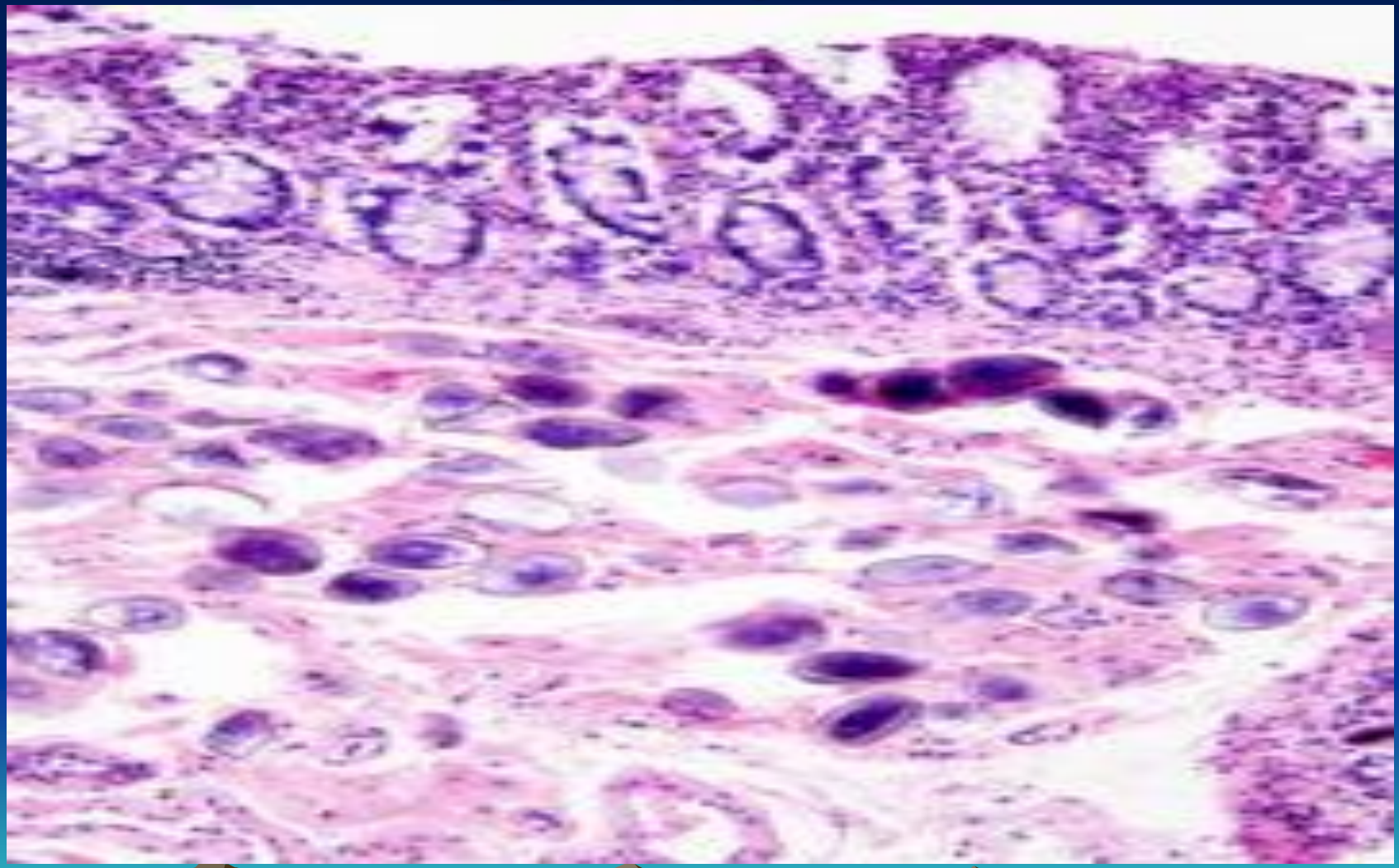


Granuloma
(Sch. hematobium egg)





Granuloma



Laboratory Diagnosis

- Microscopic identification of eggs in stool or urine is the most practical method for diagnosis.
-
- Stool examination should be performed when infection with *S. mansoni* or *S. japonicum* is suspected,
- and urine examination should be performed if *S. haematobium* is suspected.

Tissue biopsy (rectal biopsy for all species and biopsy of the bladder for *S. haematobium*) may demonstrate eggs when stool or urine examinations are negative .