Lecture (7)

Intestinal Helminths

Objectives:

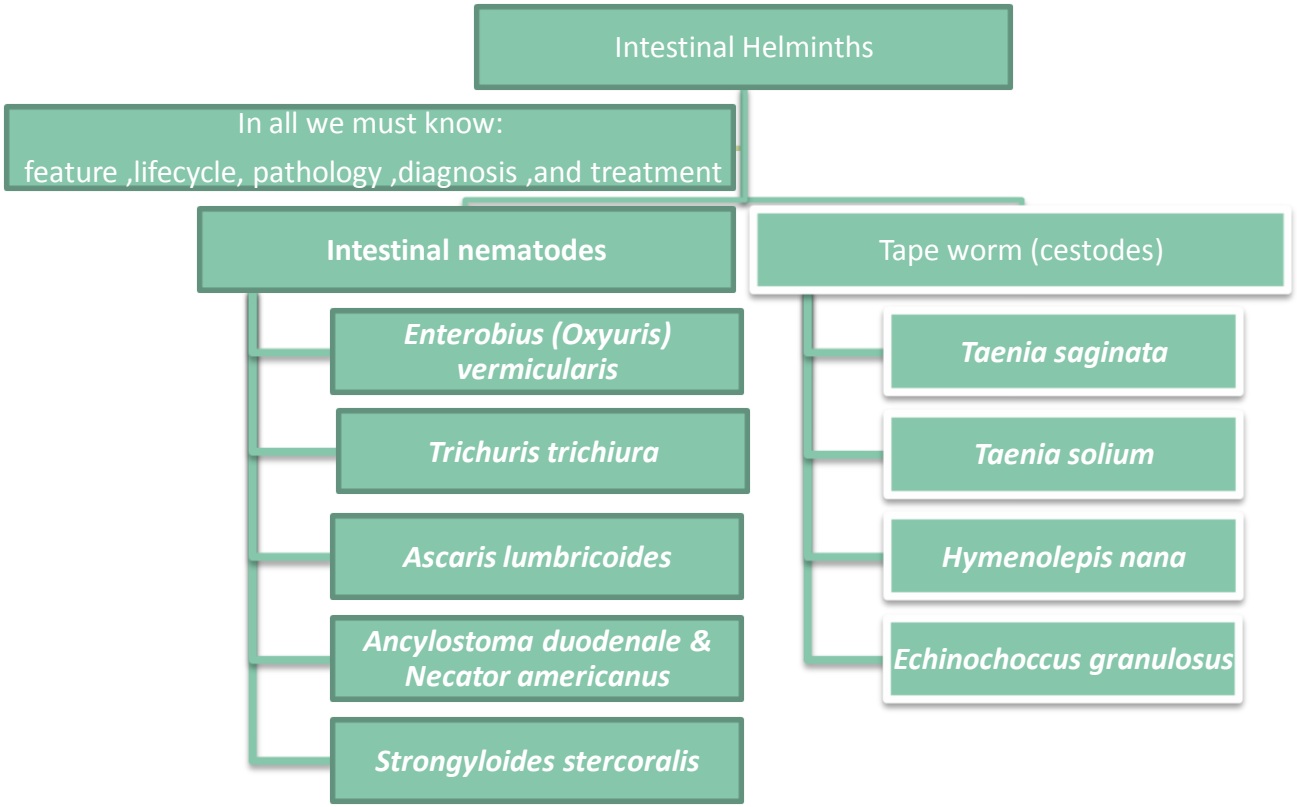
- Not given...
- .....
- ....

Note: since most of the explanation of lifecycles was in Arabic during the lecture, we took the explanation from http://dpd.cdc.gov/dpdx/Default.htm The information isn't extra ,its exactly proportionate to what the doctor said .

Done by: Lama-Al-Tawil and Bayan-Al-Amr **Reviewed by:** Khalid alosaimi

MIND MAP

Intestinal Helminths



Nematodes

Nematodes

General features

1. Elongated worm, cylindrical, unsegmented and tapering at both ends.
2. Variable in size, measure <1 cm to about 100cm.
3. Sex separate and male is smaller than female (in all nematodes)

Location in the human body

- Intestinal nematodes common infections:

1. Enterobius (Oxyuris) vermicularis (Pinworm,seatworm,threadworm)
2. Trichuris trichiura (whipworm)
3. Ascaris lumbricoides (roundworm)
4. Ancylostoma duodenale & Necator americanus (hookworms)
5. Strongyloides stercoralis

- Tissue nematodes

Enterobius vermicularis (Oxyuris)

Common names :Pin worm, seat worm, thread worm

Features :

- Found all over the world.
- adult in lumen of cecum and appendix from which adult female migrate to rectum.
- It can be seen by naked eye as white thread ± 1cm.
- Male is smaller than female ± 0.5cm, with coiled end.

Pathology and clinical features:

- Majority of infections are asymptomatic.
- Main clinical presentation **pruritus ani perianal excoriation (these are the most important)**
- Ectopic enterobiasis occurs in female when invade vulva and vagina result in **valvovagintis (important signs as well)**
- Usually accompanied by insomnia, anorexia, loss of weight and concentration (other Side effects)

Diagnosis : scotch tape preparation (1- eggs are usually in the peri –anal area meaning they wont be seen in the stool .you need to put the adhesive part of the tape around the anal to obtain sample then stick it to glass slide and examine under the microscope. 2- this test is best done in the morning)

Treatment :Albandazole , Mebendazole for whole family(there might be an asymptomatic carrier in the family)

Life cycle

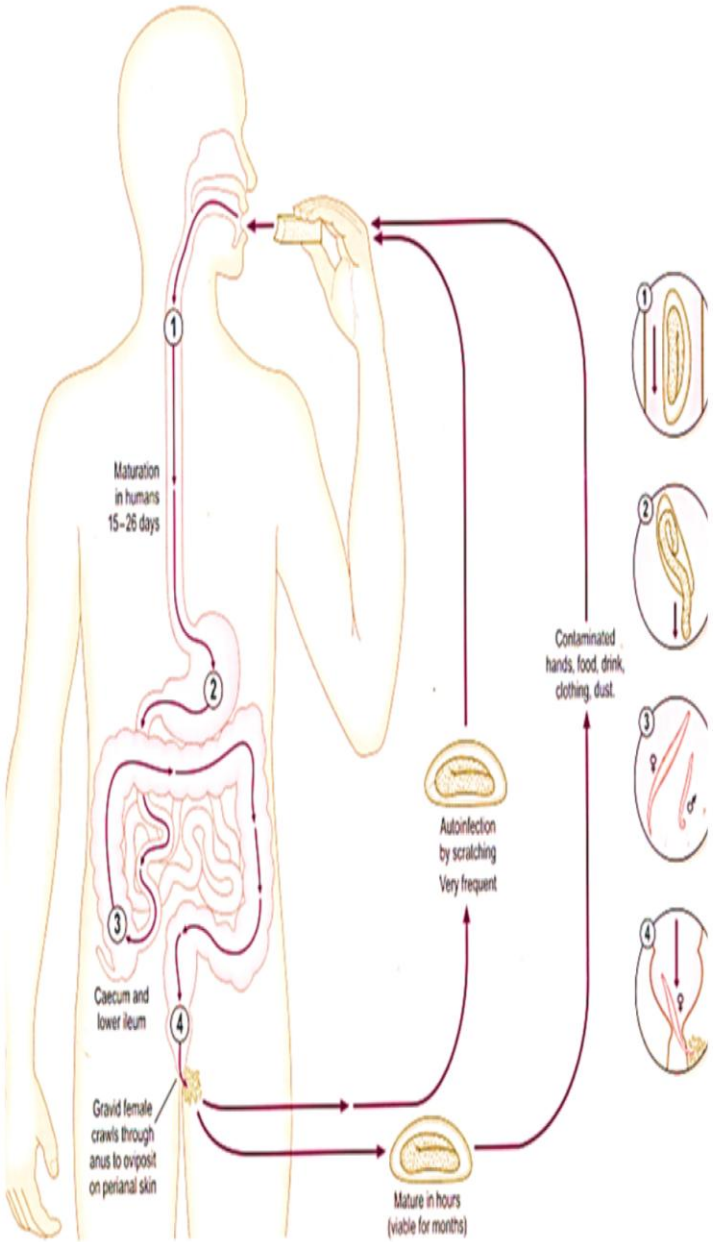
adult (male and female) are the in lumen of cecum and appendix =>Gravid females migrate outside the anus and deposits eggs on the skin of the perianal area => in 4 to 6 hours under optimal conditions , it becomes an embryonated egg (larvae contained inside the eggs)(the eggs become infective)=> Self-infection(auto-infecion) occurs by transferring infective eggs to the mouth with hands that have scratched the perianal area . Person-to-person transmission can also occur through handling of contaminated clothes or bed linens,air,food..etc=>larvae hatch in the small intestine and the adults establish themselves in the colon . Then the cycle repeats itself

N.b:

Infective stage =>embryoinated egg

Diagnostic stage=>egg within the anus

Transmission =>fecal-oral root



THE LIFE CYCLE OF *ENTEROBIUS VERMICULARIS* (THE HUMAN PINWORM) Additional

Humans are infected when they ingest eggs containing infective juveniles.

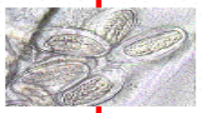
Eggs hatch in the small intestine and male and female worms migrate to the large intestine and reach sexual maturity.

Females crawl out of the anus (usually during the early morning hours) and deposit eggs on the perianal skin

RETROINFECTION

If eggs remain on the perianal skin long enough they will hatch, and the juveniles will crawl back into the anus and mature into adults.

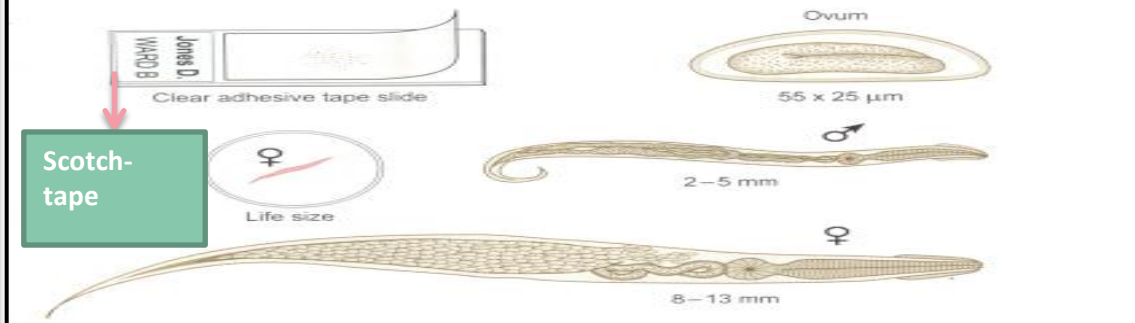
Eggs are deposited on the perianal skin.



Eggs become infective within six hours.

Hands, bed clothing, bed linens, floors, drapes, kitchen counters, clothing, school rooms, desk tops, etc.,are contaminated with infective eggs.

(Parasites and Parasitological Resources)



Ascaris lumbricoides

Common names : Roundworm

Features:

- The commonest human helminthes infection.
- Found in jejunum and upper part of ileum.
- Female ± 20 cm longer than male ± 10 cm
- Feed on semi digested food.

Pathology and clinical features:

Pathology:

1-Adult worm:

Light infection : asymptomatic.

Heavy infection : intestinal obstruction

Migrating adult : to bile duct -jaundice

2-Larvae: **Loeffler`s syndrome**

Pneumonia, cough with bloody sputum

Eosinophilia, urticaria (this happens during the migrating phase where the larva circulates to reach the lung (indirect root))

Diagnosis :

- eggs =>in stool.
- larvae =>in sputum.
- adult may pass with stool.

Treatment :Albandazole , Mebendazole

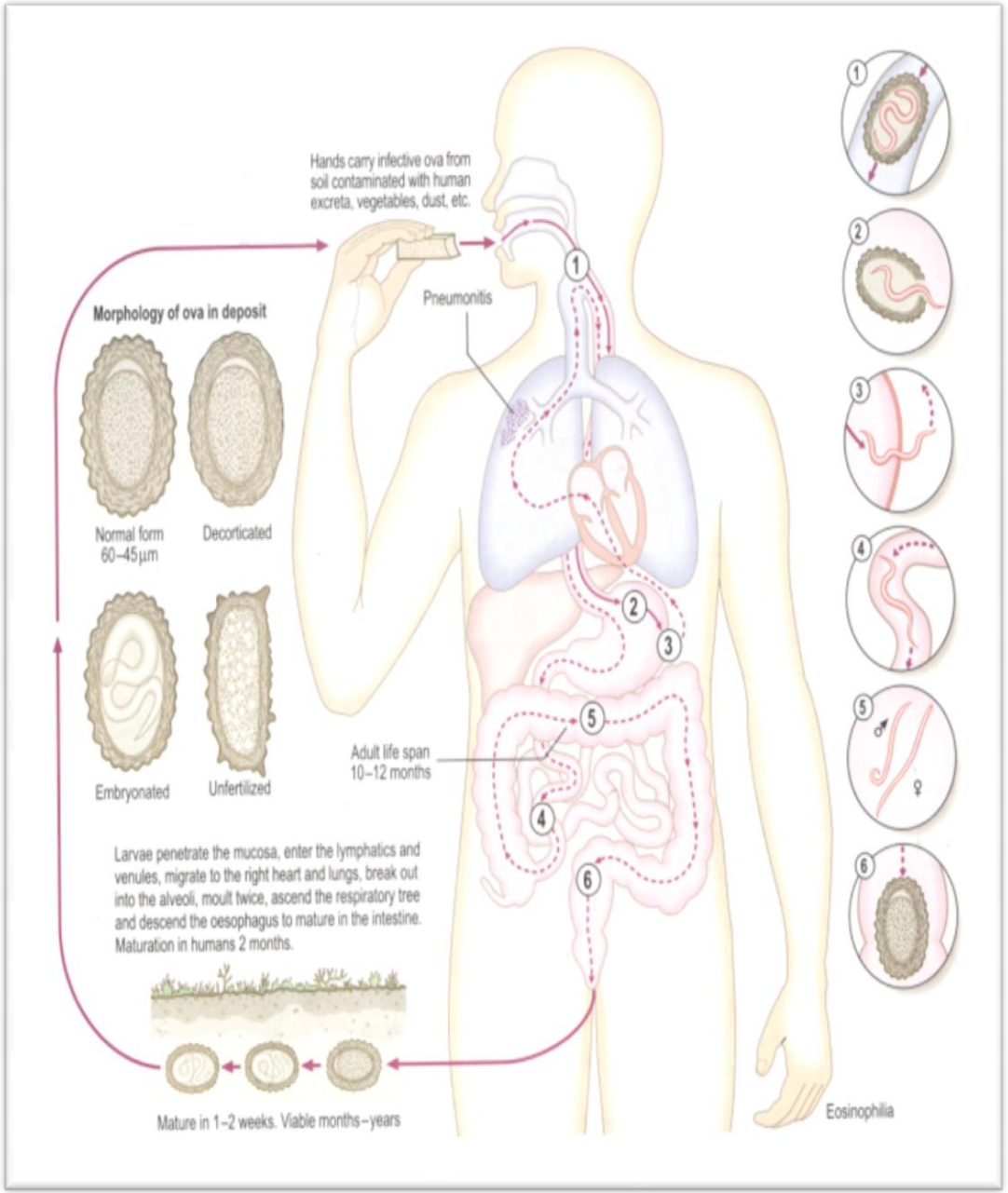
Life cycle:

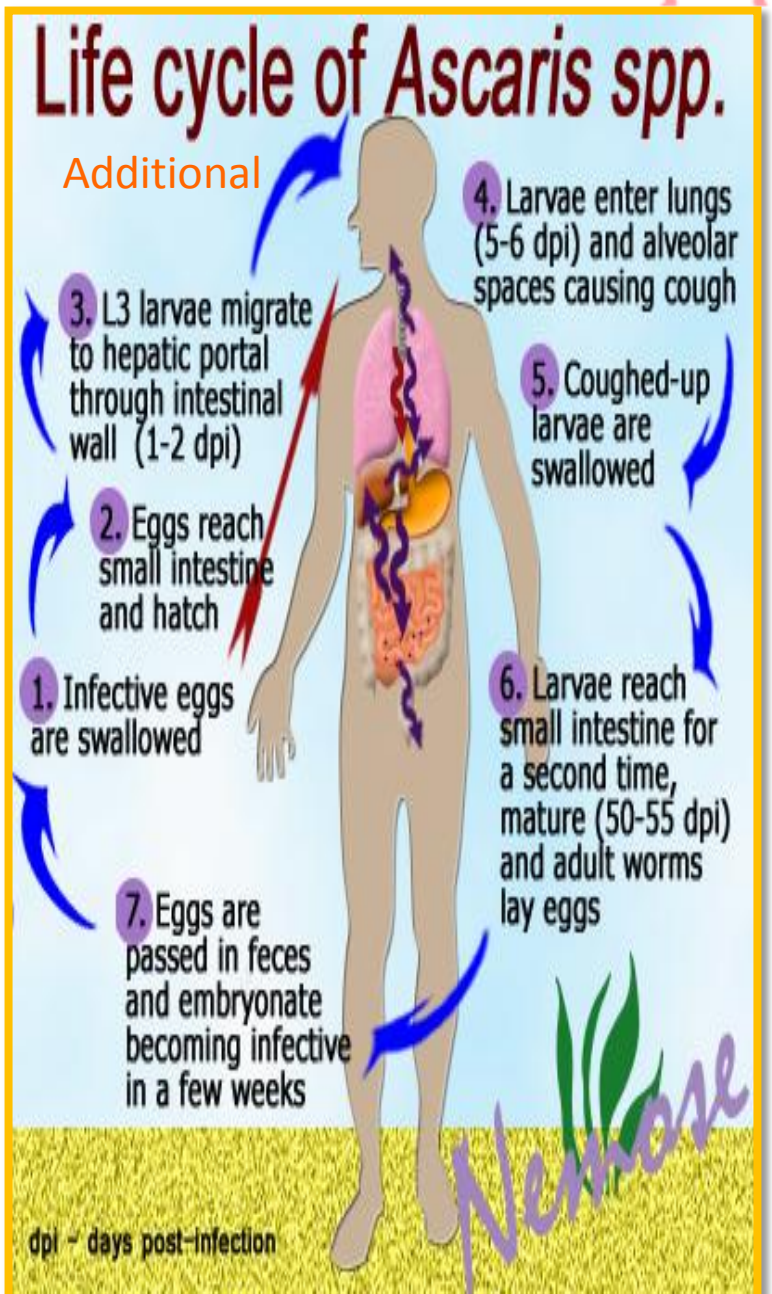
Adult worms live in the lumen of the small intestine. A female produces thousands of eggs per day=> which are passed with the feces =>Unfertilized eggs may be ingested but are not infective. Fertile eggs embryonate and become infective after days or weeks depending on the environmental conditions (optimum: moist, warm, shaded soil)=> After infective eggs are swallowed => the larvae hatch , invade the intestinal mucosa, and are carried via the portal, then systemic circulation to the lungs => penetrate the alveolar walls, ascend the bronchial tree to the throat, and are swallowed => Upon reaching the small intestine, they develop into adult worms . Then the cycle repeats its self again .

N.B

infective stage => embryonated egg

Diagnostic stage => egg in stool


Hands carry infective ova from soil contaminated with human excreta, vegetables, dust, etc.
Pneumonitis
Morphology of ova in deposit
Normal form 60–45µm
Decorticated
Embryonated
Unfertilized
Adult life span 10–12 months
Larvae penetrate the mucosa, enter the lymphatics and venules, migrate to the right heart and lungs, break out into the alveoli, moult twice, ascend the respiratory tree and descend the oesophagus to mature in the intestine. Maturation in humans 2 months.
Mature in 1–2 weeks. Viable months–years
Eosinophilia


Life cycle of Ascaris spp.
Additional
1. Infective eggs are swallowed
2. Eggs reach small intestine and hatch
3. L3 larvae migrate to hepatic portal through intestinal wall (1-2 dpi)
4. Larvae enter lungs (5-6 dpi) and alveolar spaces causing cough
5. Coughed-up larvae are swallowed
6. Larvae reach small intestine for a second time, mature (50-55 dpi) and adult worms lay eggs
7. Eggs are passed in feces and embryonate becoming infective in a few weeks
dpi = days post-infection
Nemose

Trichuris trichiura

Common names : whipworm

Features:

- World wide ,common in poor sanitation.
- It coexists with Ascaris because of similar requirement.
- Adult live in large intestine especially caecum and appendix –in heavy infection the whole length of large intestine affected.
- Male and female worm have narrow anterior portion penetrate the intestinal mucosa

Pathology and clinical features:

- light infection : asymptomatic
- heavy infection :abdominal pain ,bloody diarrhea. **Rectal prolapse** in **children** is a common complication.

Diagnosis :

- egg in stool characterized by its barrel shape (American football)with mucoid plugs at each pole .

Treatment : Albandazole

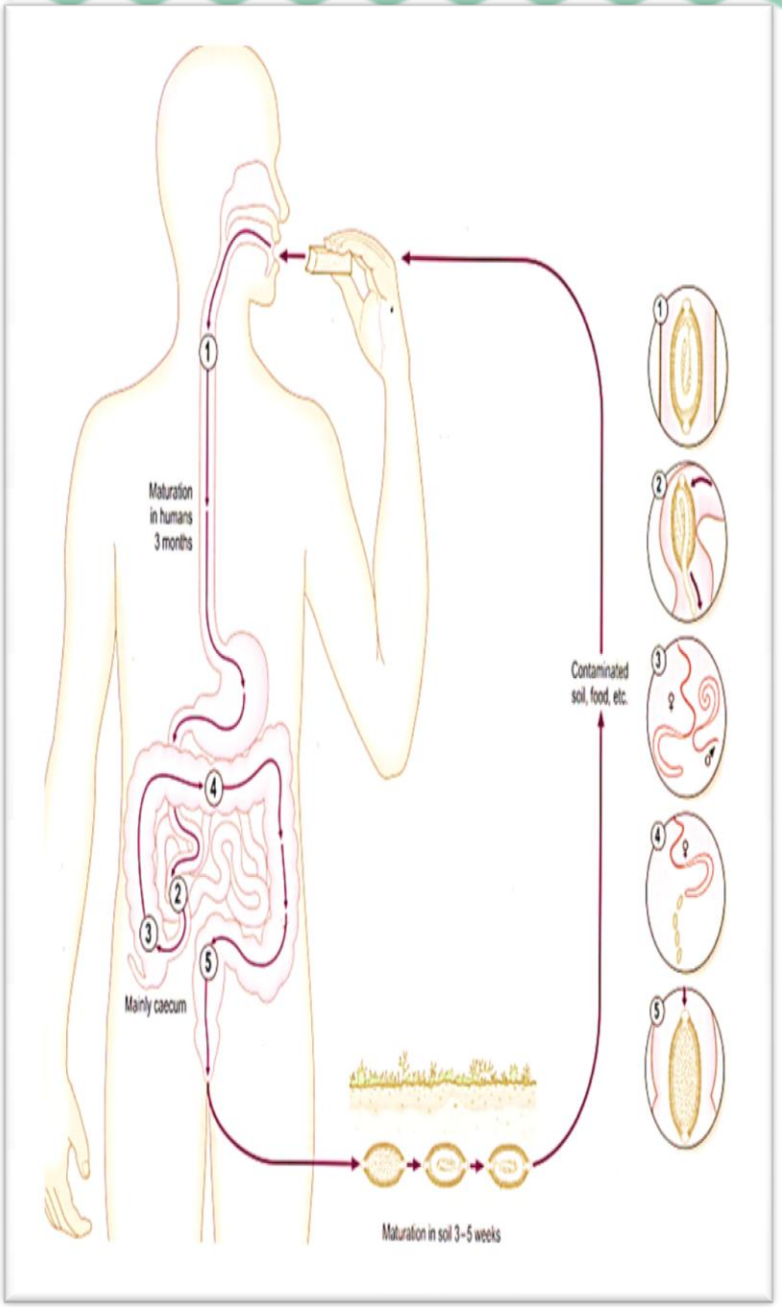
Life cycle (it's a simple life cycle)

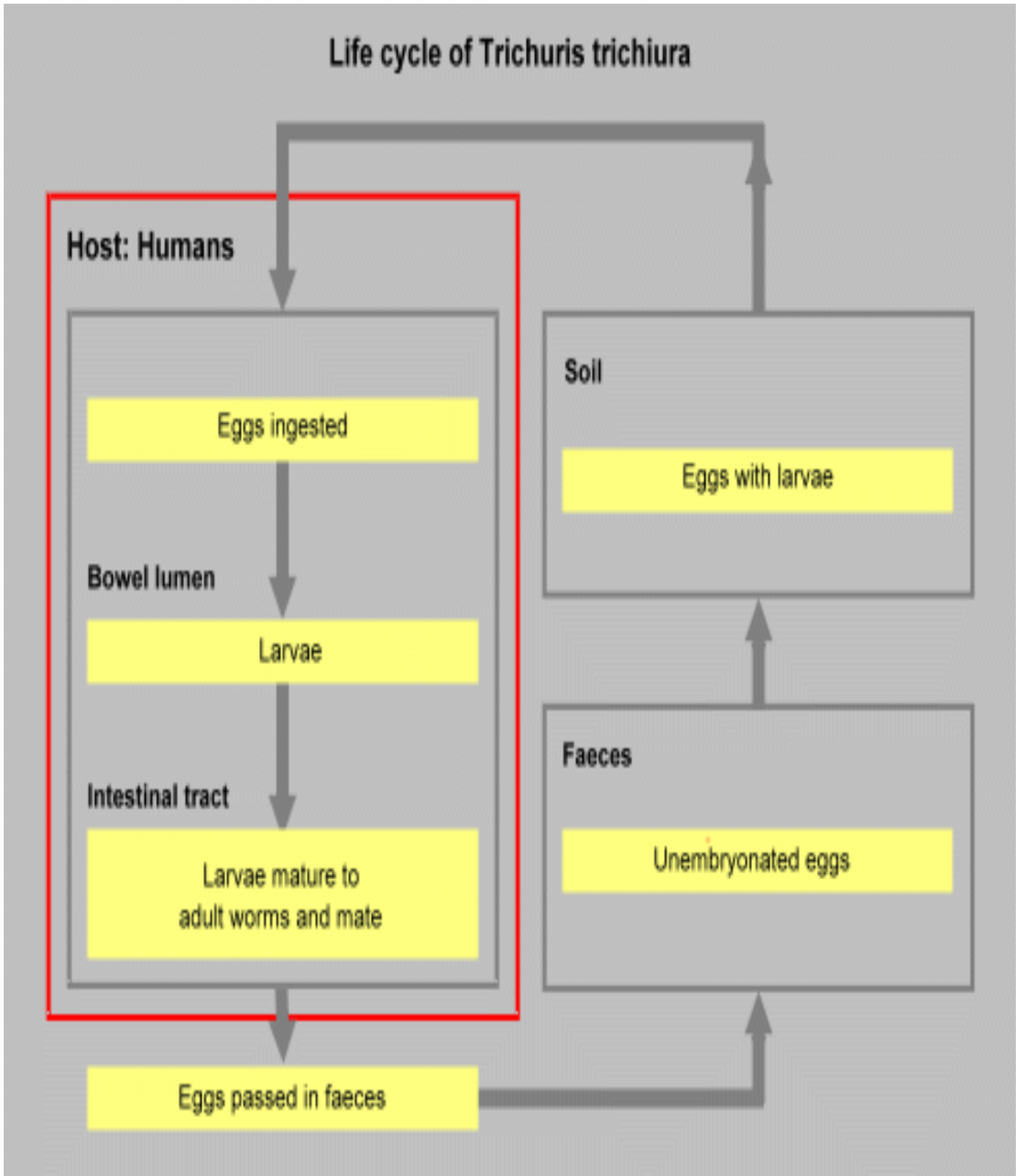
The unembryonated eggs are passed with the stool => In the soil, the eggs develop and then they embryonate => After ingestion (soil-contaminated hands or food), the eggs hatch in the small intestine=> release larvae that mature and establish themselves as adults in the colon The adult worms are fixed in that location, with the anterior portions threaded into the mucosa

N.B

infective stage => embryonated egg

Diagnostic stage => egg in stool


Maturation
in humans
3 months
Contaminated
soil, food, etc.
Mainly caecum
Maturation in soil 3–5 weeks


Life cycle of Trichuris trichiura
Host: Humans
Eggs ingested
Bowel lumen
Larvae
Intestinal tract
Larvae mature to
adult worms and mate
Eggs passed in faeces
Soil
Eggs with larvae
Faeces
Unembryonated eggs

Ancylostoma dudenale &Necator americanus


Hookworm

Common name : Hook worms

Features:

- A common cause of anemia.
- Found in small intestine mainly jejunum.
- Its buccal capsule (mouth) lined with hard hooks, triangular cutting plates and anticoagulant glands.

Pathology and clinical features:

Larvae:

1.At the site of entry of larvae **(ground itch).**

2.Migration phase:

cough with bloody sputum, pneumonia, eosinophilia,urticaria.

Adult worm:

1.Low worm burden: **no** symptoms.

2. Moderate to heavy burden:

Epigastric pain, vomiting , hemorrhagic enteritis.

Protein loss: hypoproteinaemia edema.

Anemia: due to withdrawal of blood by parasites and hemorrhage from punctured sites lead to **sever anemia** = microcytic hypochromic.

Diagnosis :

-Eggs in stools.

-occult blood (+).

Treatment : Albandazole, Mebendazole.

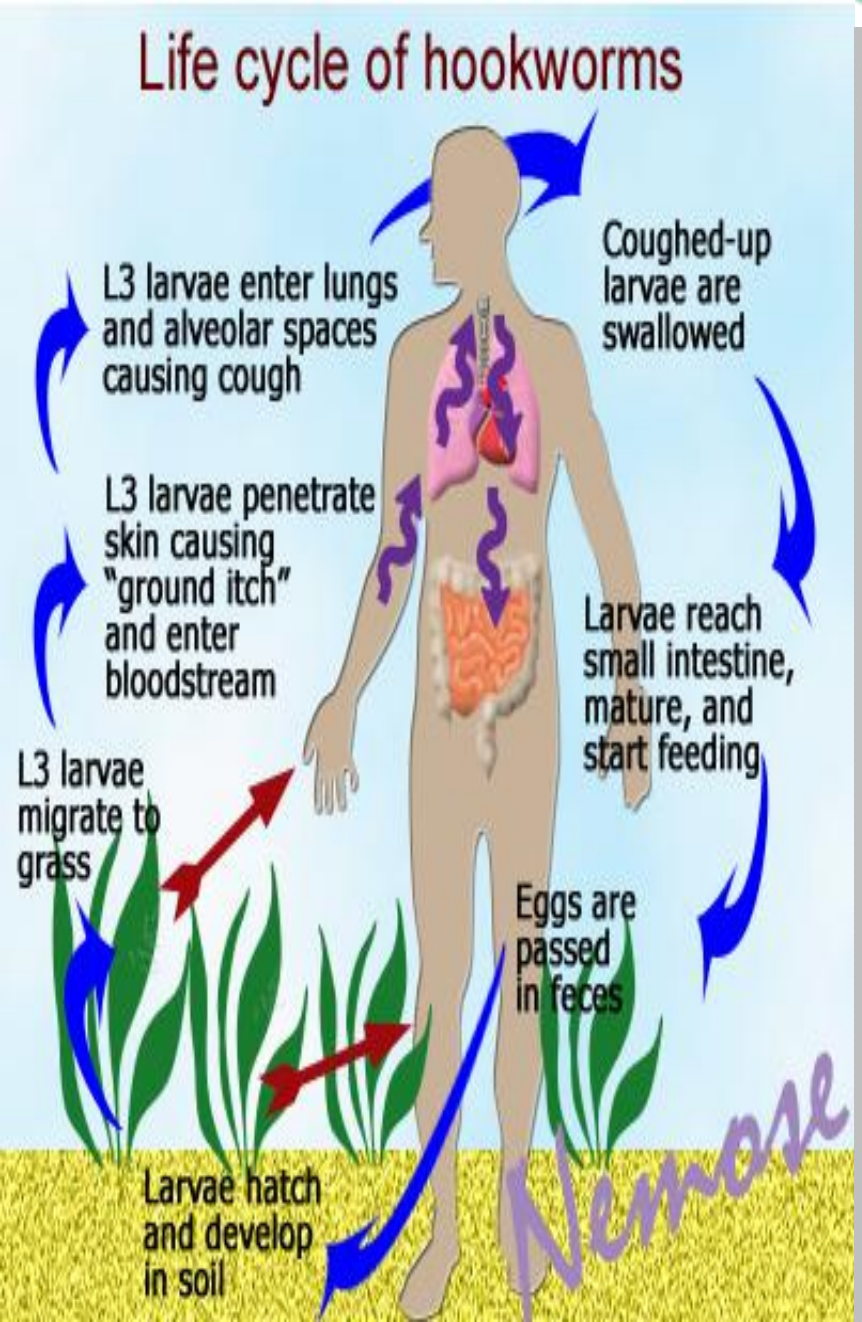
Life cycle

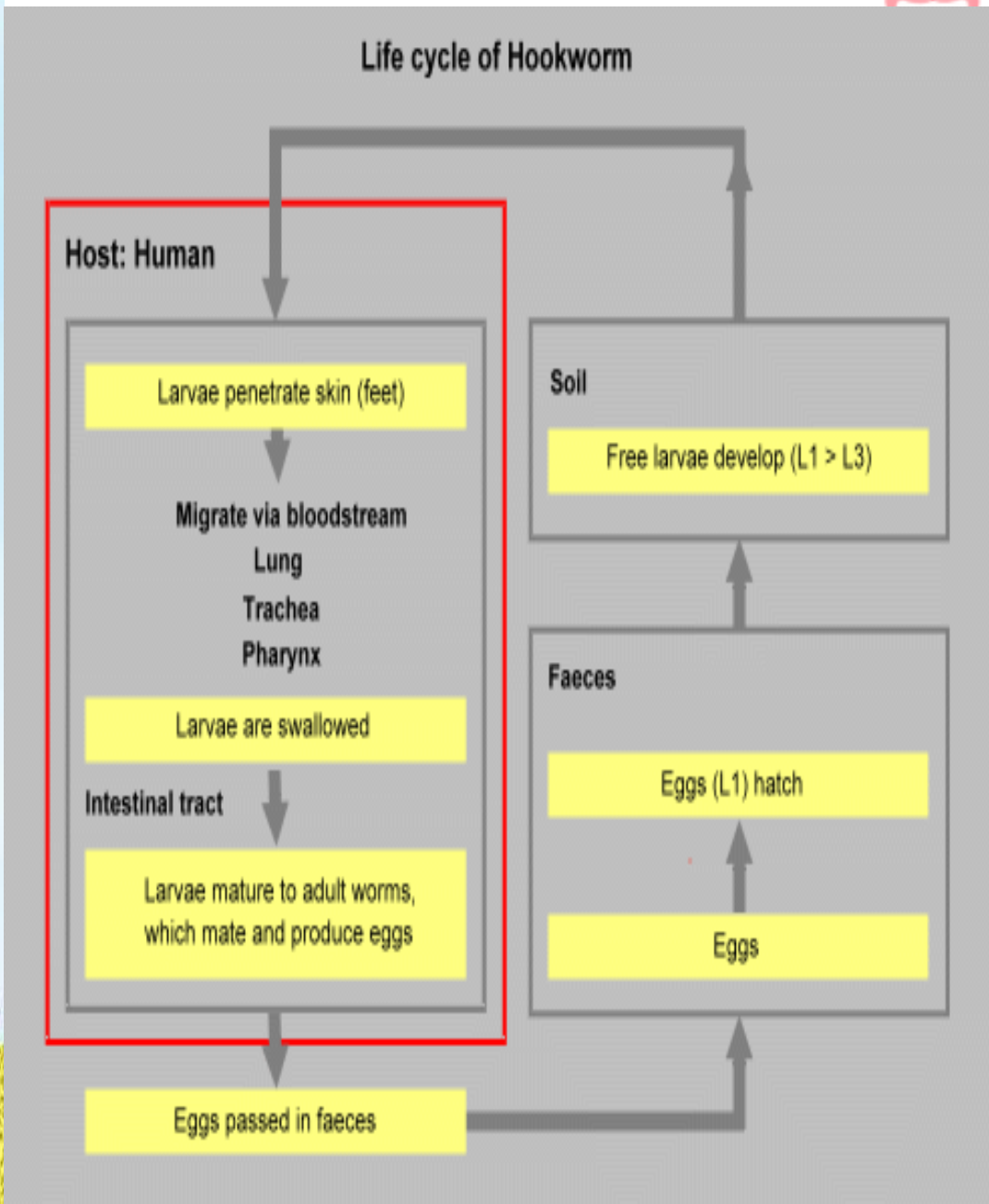
Eggs are passed in the stool and becomes mature within 1 week. The released rhabditiform larvae grow in the soil then they become filariform larvae that are infective. On contact with the human host, the larvae penetrate the skin and are carried through the blood vessels to the heart and then to the lungs. They penetrate into the pulmonary alveoli, ascend the bronchial tree to the pharynx, and are swallowed . The larvae reach the small intestine, where they mature into adults. Adult worms live in the lumen of the small intestine, where they attach to the intestinal wall with resultant blood loss by the host .

N.B

infective stage => Filariform larvae

Diagnostic stage => eggs in stool


Life cycle of hookworms
L3 larvae enter lungs and alveolar spaces causing cough
Coughed-up larvae are swallowed
L3 larvae penetrate skin causing "ground itch" and enter bloodstream
Larvae reach small intestine, mature, and start feeding
L3 larvae migrate to grass
Eggs are passed in feces
Larvae hatch and develop in soil
Nemose


Life cycle of Hookworm
Host: Human
Larvae penetrate skin (feet)
Migrate via bloodstream
Lung
Trachea
Pharynx
Larvae are swallowed
Intestinal tract
Larvae mature to adult worms, which mate and produce eggs
Eggs passed in faeces
Soil
Free larvae develop (L1 > L3)
Faeces
Eggs (L1) hatch
Eggs

Strongyloides stercoralis

Features:

- Widely distributed in tropical region worldwide.
- fetal opportunistic in immuno-compromised host.
- It is smallest pathogenic nematodes ± 2.5mm.
- adult live in mucous membrane of duodenum jejunum rarely m.m.of bronchus.

Pathology and clinical features:

Cuteneous : little reaction on penetration.
sever dermatitis at perianal region in case of external autoinfection.

Migration :same as hook worms .

Intestinal: inflammation of upper intestinal mucosa, diarrhea, upper abdominal pain clocky in nature.

Disseminated strongyloidiasis : in patient with **immunodeficiency** ,uncontrolled diarrhea –granulomatus changes –necrosis--perforation--peritonitis--death.

Diagnosis :

rhabditiform larvae diagnostic stage in:

-Stool examination
-Duodenal aspirate

Treatment : Albandazole, Mebendazole.

Life cycle

The *Strongyloides* life cycle is more complex than that of most nematodes with its alternation between free-living and parasitic cycles, and its potential for autoinfection and multiplication within the host. Two types of cycles exist:

Free-living cycle: The rhabditiform larvae passed in the stool can either molt twice and become infective filariform larvae (direct development) or molt four times and become free living adult males and females that mate and produce eggs from which rhabditiform larvae hatch . The filariform larvae penetrate the human host skin to initiate the parasitic cycle.

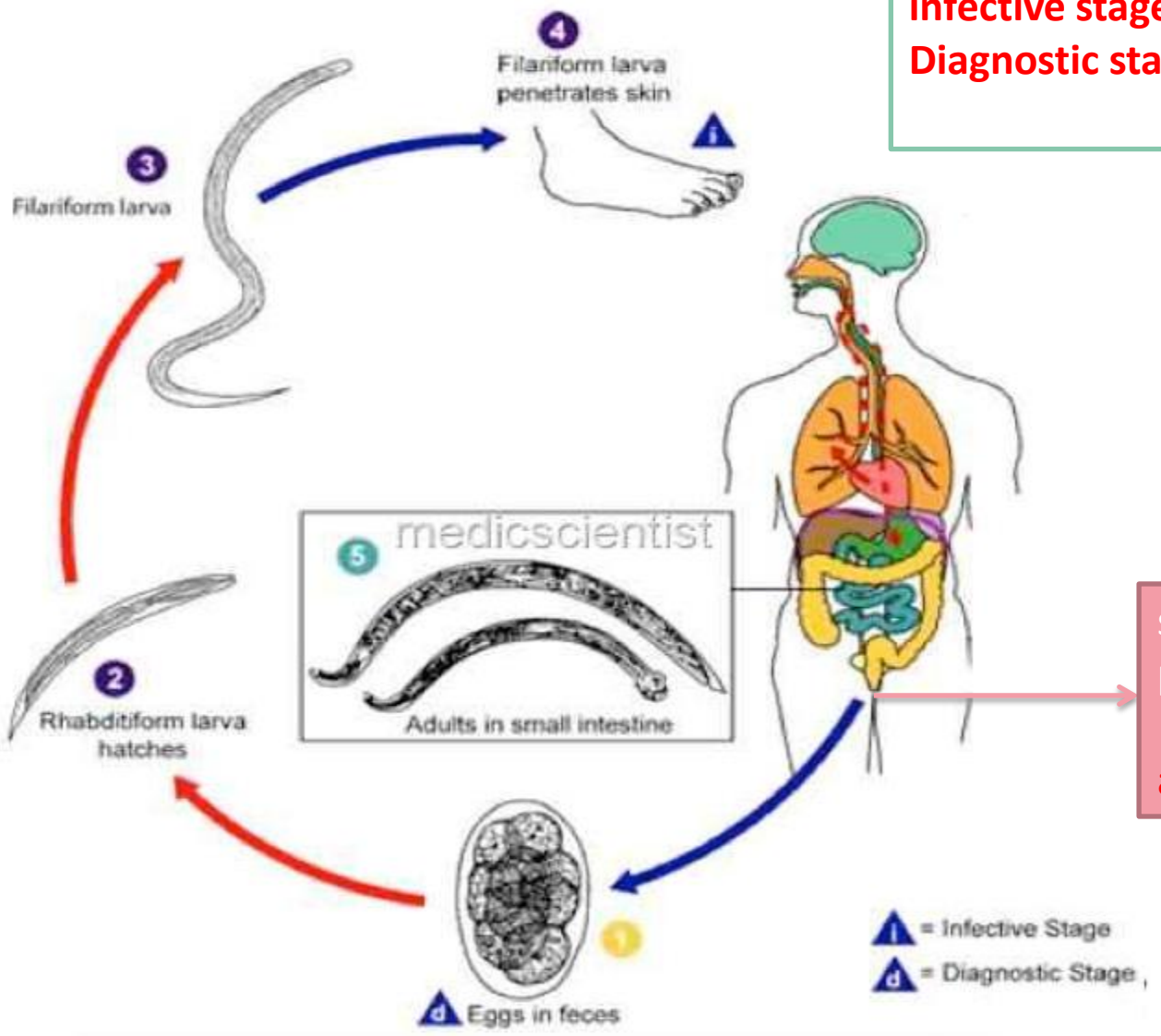
Parasitic cycle: Filariform larvae in contaminated soil penetrate the human skin , and are transported to the lungs then they are carried through the bronchial tree to the pharynx, are swallowed and then reach the small intestine . In the small intestine they molt twice and become adult female worms . The females live threaded in the epithelium of the small intestine and by parthenogenesis produce eggs , which yield rhabditiform larvae. The rhabditiform larvae can either be passed in the stool or can cause autoinfection . In autoinfection, the rhabditiform larvae become infective filariform larvae, which can penetrate either the intestinal mucosa (internal autoinfection) or the skin of the perianal area (external autoinfection).

N.B

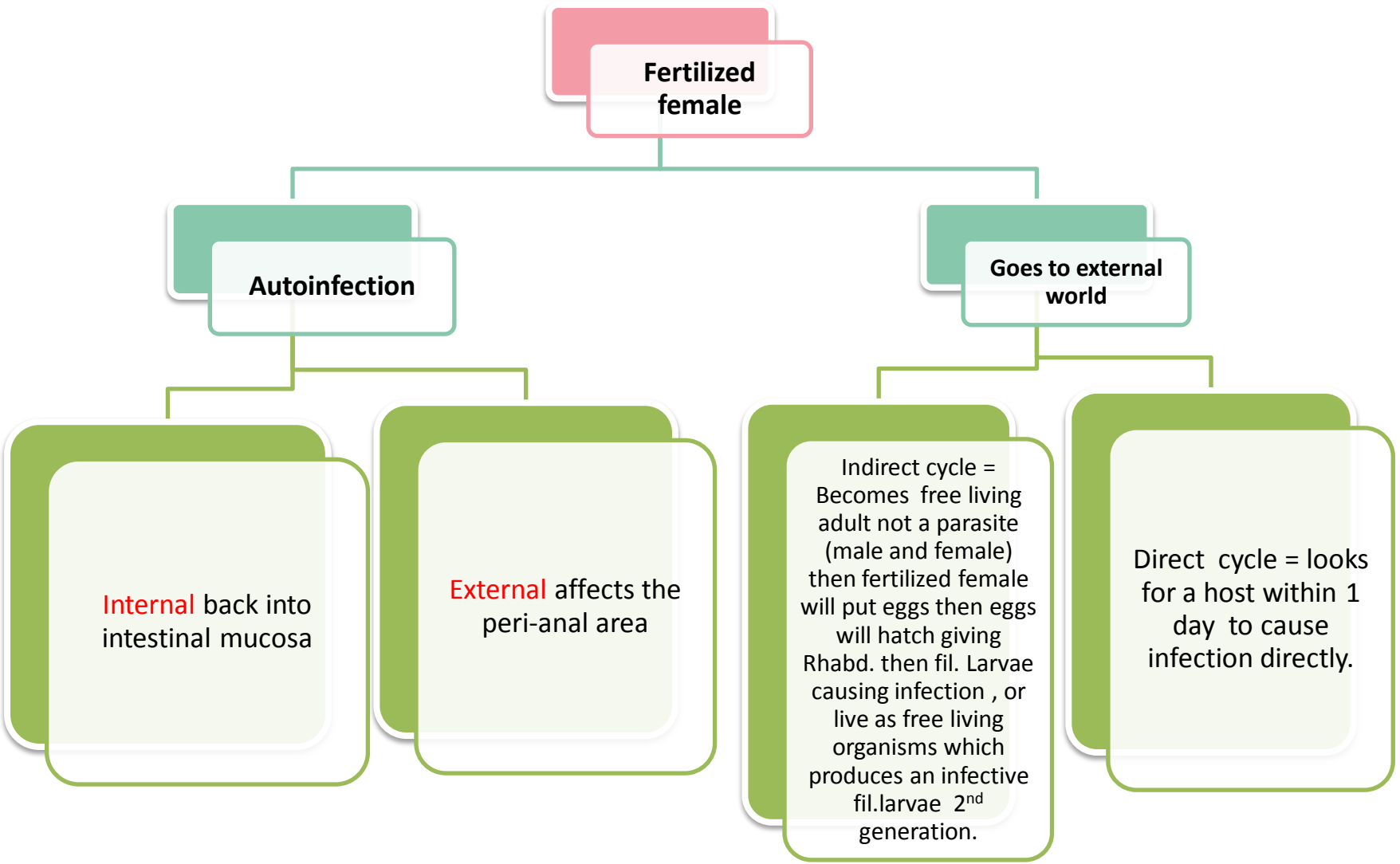
infective stage => Filariform larvae

Diagnostic stage => Rhabditiform larvae

infective stage => Filariform larvae
Diagnostic stage => Rhabditiform larvae



sever dermatitis at perianal region in case of external autoinfection


Fertilized female
Autoinfection
Goes to external world
Internal back into intestinal mucosa
External affects the peri-anal area
Indirect cycle = Becomes free living adult not a parasite (male and female) then fertilized female will put eggs then eggs will hatch giving Rhabd. then fil. Larvae causing infection , or live as free living organisms which produces an infective fil.larvae 2nd generation.
Direct cycle = looks for a host within 1 day to cause infection directly.

Cestodes

Taenia Saginata (beef tape wrom) and Taenia solium (Pork tape wrom)

Features:

- Solitary (الدودة الوحيدة) only one will cause the infection.
- Length : many meters.
- Attaches to the intestine by suckers.

Life cycle

Taeniasis is the infection of humans with the adult tapeworm of *Taenia saginata, T. solium*. Humans are the only definitive hosts for these species. Eggs or gravid proglottids are passed with feces ; the eggs can survive for days to months in the environment. Cattle (*T. saginata*) and pigs (*T. solium)* become infected by ingesting vegetation contaminated with eggs or gravid proglottids . In the animal's intestine, the oncospheres hatch , invade the intestinal wall, and migrate to the striated muscles, where they develop into cysticerci. Humans become infected by ingesting raw or undercooked infected meat .The adult tapeworms attach to the small intestine by their scolex and reside in the small intestine .The adults produce proglottids which mature, become gravid, detach from the tapeworm, and migrate to the anus or are passed in the stool .

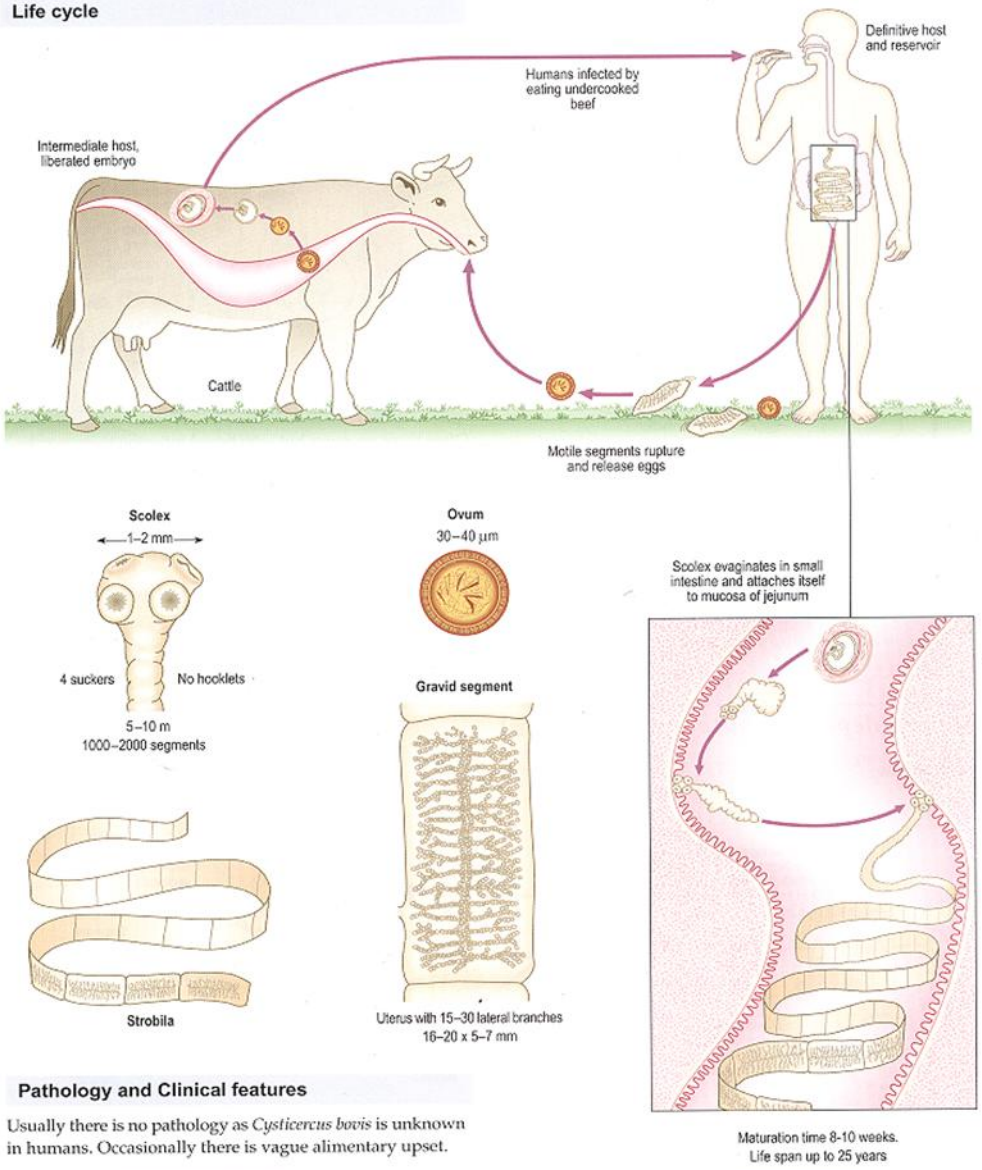
N.B

infective stage => When oncospheres become cysticerus.

Diagnostic stage => eggs alone or proglottid in stools (which is a segment of a tapeworm containing both male and female reproductive organs).

Taenia saginata (beef tape worm)

Life cycle



Pathology and Clinical features

Usually there is no pathology as *Cysticercus bovis* is unknown in humans. Occasionally there is vague alimentary upset.

Laboratory diagnosis

Gravid segments, ova and scolex can be found in faeces. Uterine branches of the mature segments may be seen in a crush preparation between two glass slides, or by Indian ink preparation, as in *T. solium*. Ova are also found on the perianal skin (on clear adhesive tape slides).

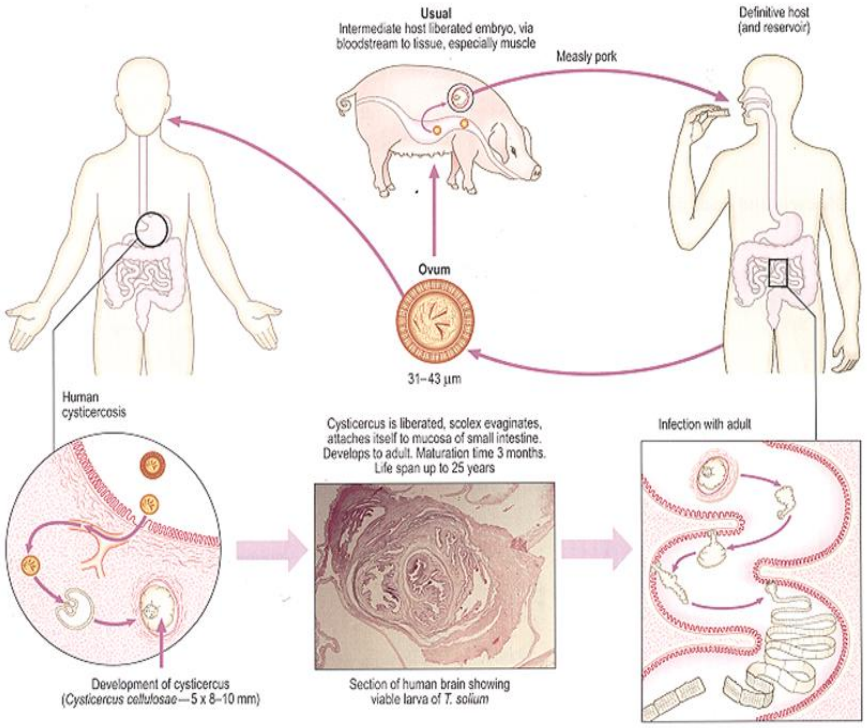
Distribution

Taenia saginata is found in beef-eating areas, especially in the tropics.

Cestode (tape) worms

Taenia solium (pork tape worm)

Life cycle



Pathology and Clinical features

Infection by larvae (cysticercosis). Cysticerci, generally multiple, may occur in any site but are more frequent in the brain and muscle. They excite reaction in the area, especially when they die, which manifests as inflammation, fibrosis and later some calcification. This leads to focal CNS syndromes, especially epilepsy.

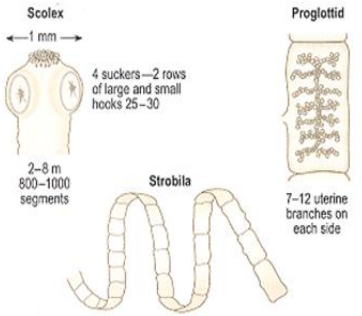
Infection with adults. Often there can be no pathology, but there might be mild irritation of intestinal mucosa.

Laboratory diagnosis

Eosinophilia.

Larval infections. There are several methods, including histological examination of biopsy material, serology (IFAT, ELISA, EITB) and radiology (CT or MRI scan of the brain, X-ray of the thigh muscles).

Pure infection with the adult. Gravid segments, ova and scolex can be found in faeces. The uterine branches of the mature segments can be demonstrated by injection of Indian ink through the uterine pore.



Distribution

5 million people infected worldwide. *Taenia solium* is endemic in pig-rearing areas of the world where hygiene and animal husbandry are poor.

Hymenolepis nana (dwarf worm)

DISEASE : hymenolepiais

TRANSMISSION OF INFECTION: ingestion of egg
LOCATION OF ADULT IN HUMANS: Small Intestine
LOCATION OF LARVA IN HUMANS: Intestinal Villi
CLINICAL PICTURE: Enteritis diarrhoea
LAB DIAGNOSIS: eggs in stool

Life cycle :

A- Eggs of *Hymenolepis nana* are immediately infective when passed with the stool -> eggs are ingested by an arthropod (beetles) intermediate host->they develop into cysticercoids, which can infect humans or rodents upon ingestion then->develop into adults in the small intestine.

B-When eggs are ingested (in contaminated food or water or from hands contaminated with feces)->the oncospheres contained in the eggs are released. The oncospheres (hexacanth larvae) penetrate the intestinal villus and develop into cysticercoid larvae ->Upon rupture of the villus, the cysticercoids return to the intestinal lumen, evaginate their scoleces , attach to the intestinal mucosa and develop into adults that reside in the ileal portion of the small intestine producing gravid proglottids . Eggs are passed in the stool when released from proglottids through its genital atrium or when proglottids disintegrate in the small intestine

C--An alternate mode of infection consists of internal autoinfection, where the eggs release their hexacanth embryo, which penetrates the villus continuing the infective cycle without passage through the external environment .

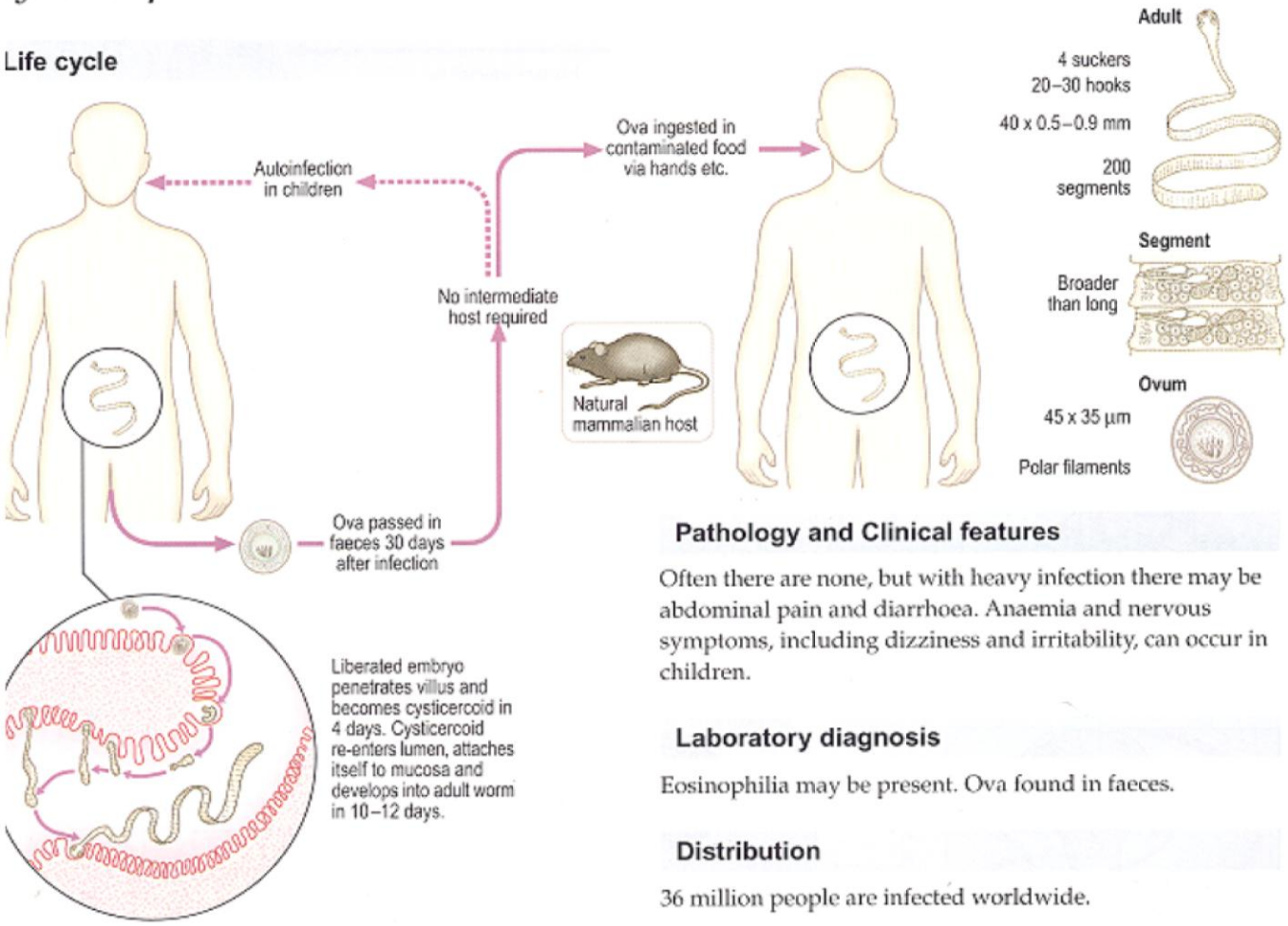
N.B

- Transmitted via fecal oral route
- The segments are broader than *Taenia*
- *Egg has filaments on both poles*
- *Causes abdominal pain , diarrhea and anemia*

Dwarf tape worms

Iymenolepis nana

Life cycle



Pathology and Clinical features

Often there are none, but with heavy infection there may be abdominal pain and diarrhoea. Anaemia and nervous symptoms, including dizziness and irritability, can occur in children.

Laboratory diagnosis

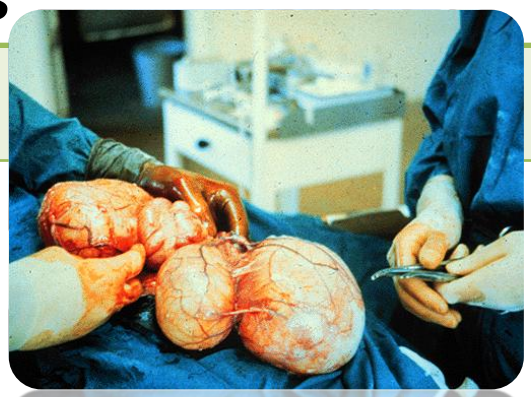
Eosinophilia may be present. Ova found in faeces.

Distribution

36 million people are infected worldwide.

Echinochoccus granulosus

DISEASE : hydatid disease



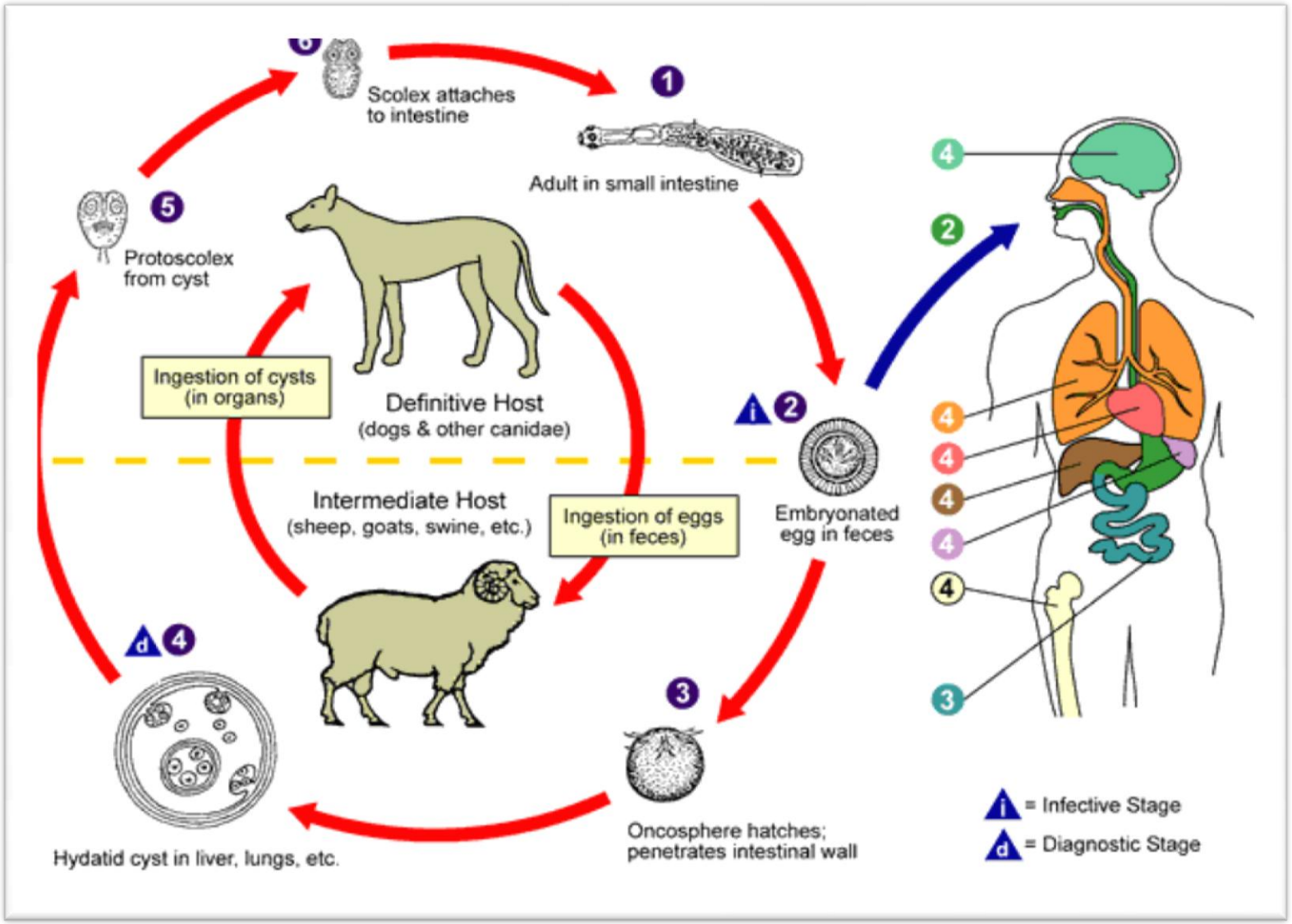
TRANSMISSION OF INFECTION: ingestion of egg
LOCATION OF ADULT IN HUMANS: none
LOCATION OF LARVA IN HUMANS: Liver, lungs,Bones etc
CLINICAL PICTURE:depending on locality
LAB DIAGNOSIS: X-ray,CT,US Serology ,Hydatid sand

Life cycle :

The adult *Echinococcus granulosus* resides in the small bowel of the definitive hosts(dogs or other canids)->Gravid proglottids release eggs that are passed in the feces ->After ingestion by a suitable intermediate host (under natural conditions: sheep, goat, swine, cattle, horses, camel)->the egg hatches in the small bowel and releases an oncosphere that penetrates the intestinal wall and migrates through the circulatory system into various organs, especially the liver and lungs ->In these organs, the oncosphere develops into a cyst that enlarges gradually, producing protoscolices and daughter cysts that fill the cyst interior ->The definitive host becomes infected by ingesting the cyst-containing organs of the infected intermediate host ->After ingestion, the protoscolices evaginate, attach to the intestinal mucosa , and develop into adult stages .

N.b:

- **The most important and common site of the hydatid is the liver**
- **The structure of an adult *Echinococcus granulosus is comprised of head (4 suckers) , and proglottids (3 segments: immautre, ,mature , and gravid)***
- ***Rarely affects humans its usually accidental. (usually between dogs and sheep or camels)***


Scolex attaches to intestine
1
Adult in small intestine
5
Protoscolex from cyst
Ingestion of cysts (in organs)
Definitive Host
(dogs & other canidae)
Intermediate Host
(sheep, goats, swine, etc.)
Ingestion of eggs (in feces)
i 2
Embryonated egg in feces
2
4
4
4
4
4
4
3
3
Oncosphere hatches; penetrates intestinal wall
d 4
Hydatid cyst in liver, lungs, etc.
i = Infective Stage
d = Diagnostic Stage

Treatment of Tapeworms	
Intestinal stages	Praziquantel
Tissue stages (Hydatid,cysticersosis)	Depends on clinical condition : Surgical and/or Albendazole

Summary (Nematodes)

Type	Infective stage	Diagnostic stage	Live in
Enterobius vermicularis	Embryonated eggs with larva inside	Eggs around anus opening	Caecum and appendix
Ascaris lumbricoides	Embryonated eggs with larva inside	Eggs in stool or larvae in sputum	Jejunum and upper part of ileum
Trichuris trichiura	Embryonated eggs with larva inside	Eggs in stool	Caecum and appendix . Severe cases the whole length of large intestine is affected
Hook worms	Filariform larvae	Eggs in stool	jejunum
Strongyloides stercoralis	Filariform larvae	Rhabditiform larvae	Adult lives in mucus membrane of duodenum and jejunum

- Ascaris lumbricoides infection is the commonest human helminthes infection.
- First three nematodes are transmitted by fecal-oral route.
- Always in nematodes female is longer than male.

Summary (Cestodes)

Tape worm	**DISEASE**	**TRANSMISSION** OF INFECTION	LOCATION OF ADULT IN HUMANS	**LOCATION OF LARVA IN HUMANS**	CLINICAL PICTURE	**LAB.** **DIAGNOSIS**
Taenia saginata	taeniasis	ingestion of larva in undercooked beef	Small Intestine	not present	vague digestive disturbance	**eggs or proglottids in stools**
Taenia solium- ADULT	taeniasis	ingestion of larva in undercooked pork	Small Intestine	not present	vague digestive disturbances	**eggs or proglottids in stools**
Taenia solium- LARVA (cysticercus cellulosae)	Cysticercosis	ingestion of egg	not present (except in autoinfection ,small intestine)	sub-cutaneous muscles brain,eyes	**depending on locality: from none to epilepsy**	**X - ray,CT,MRI Serology**
Hymenolepis nana	hymenolepiais	ingestion of egg	Small Intestine	Intestinal Villi	Enteritis diarrhoea	**eggs in stools**
Echinochoccus granulosus	hydatid disease	ingestion of egg	not present	Liver, lungs, Bones etc	depending on locality	X-ray,CT,US Serology Hydatid sand

QUESTIONS

Q-1 Which of the following intestinal Nematodes causes Loeffler`s syndrome?

A. Enterobius (Oxyuris)
B. Trichuris trichiura
C. Ascaris lumbricoides
D. Strongyloides stercoralis

Q-2 Regarding the examination of a stool sample Trichuris trichiura was identified due to the characteristic egg shape which is ?

A. Oval
B. Transparent with lobules
C. Barrel shaped

Q-3 Which of the following intestinal Nematodes causes anemia ?

A. Enterobius (Oxyuris)
B. Trichuris trichiura
C. Hook worms
D. Strongyloides stercoralis

QUESTIONS

Q-4 Which of the following intestinal Nematodes is the smallest pathogenic nematode?

A. Enterobius (Oxyuris)
B. Trichuris trichiura
C. Hook worms
D. Strongyloides stercoralis

Q-5 The most common site of the hydatid cyst is ?

A. Spleen
B. Lung
C. Bone
D. Liver

QUESTION	ANSWER
1	C
2	C
3	C
4	D
°	D

FOR ANY SUGGESTIONS AND PROBLEMS PLEASE CONTACT:
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