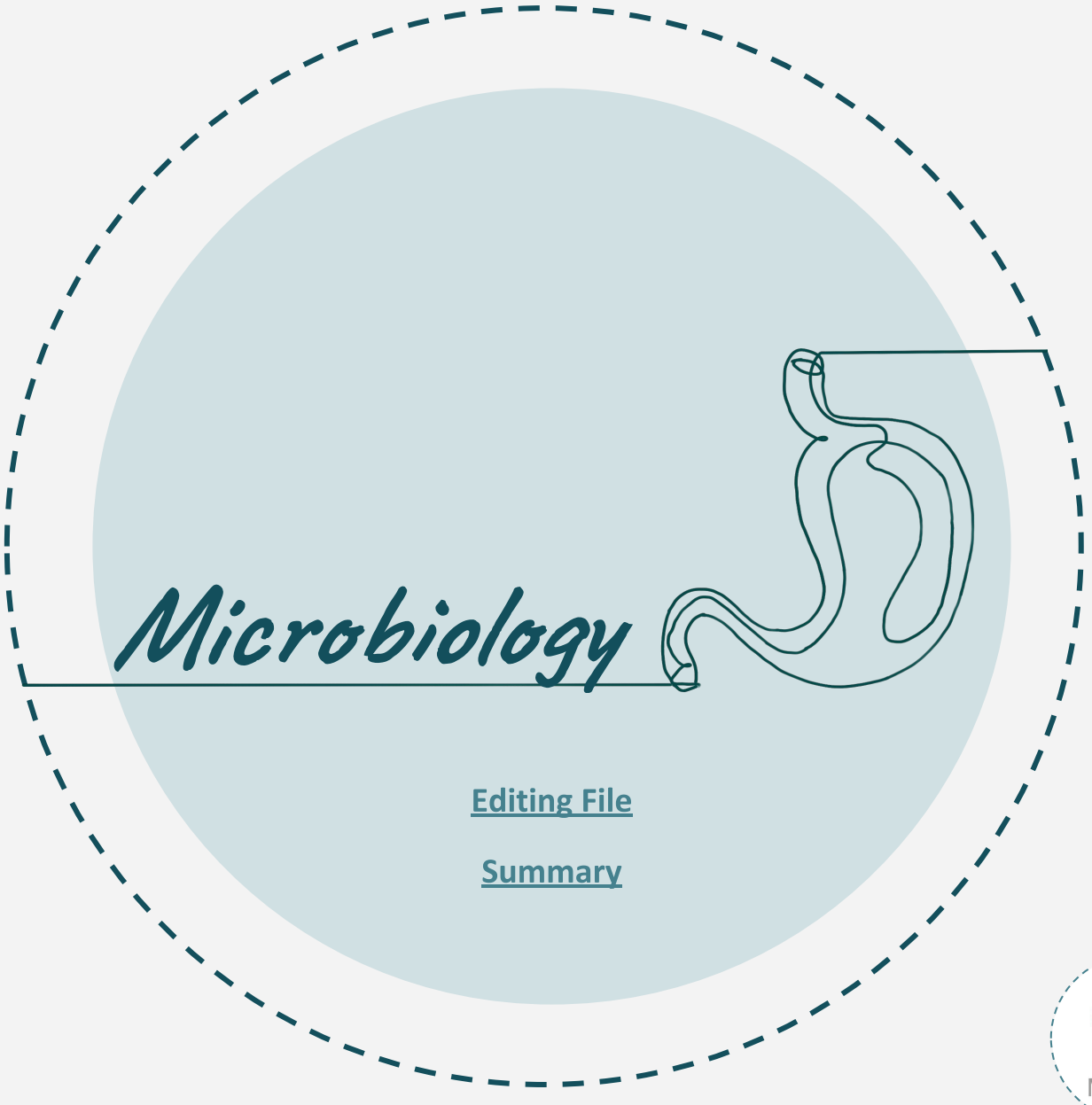
Intestinal Helminthes



Editing File

Summary

MED439
KING SAUD UNIVERSITY

MICROBIOLOGY
Team 439

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Color index

- Girls' slides
- Main content
- Important
- Boys' slides
- Extra
- Drs' notes

Objectives:

- Name the 3 main groups of parasitic helminths and their characteristic morphological features
- Know the 5 common examples of nematodes with their scientific and common names
- Describe the life cycle of these 5 examples of nematodes with pathology, diagnosis and treatment
- Describe the life cycle of taenia saginata and T. Solium and hymenolepis nana
- Describe the life cycle echinococcus granulosus and diagnosis know treatment of tapeworms

Introduction to Parasitology

(Extra page for better understanding)

Definition

the study of the invertebrate animals and the diseases they cause.

Human parasites' family tree

Parasites are classified as:

Protozoa

- **Complexity:** Single-celled.
- **Onset of symptoms:** days-weeks
- **Diagnostic forms:** Cysts and trophozoites
- **Elevated immune cells:** Typically Neutrophils

- Amebae
- Flagellates
- Apicomplexa (Sporozoa)
- Ciliates

Helminths (Metazoa) (ديدان)

- **Complexity:** Multi-cellular
- **Onset of symptoms**: >1 month
- **Diagnostic forms:** Eggs/Larvae
- **Elevated immune cells:** Eosinophils

- Roundworms (Nematodes)
- Flatworms (Platyhelminthes)
  - Cestodes
  - Trematodes

Introduction to Parasitology

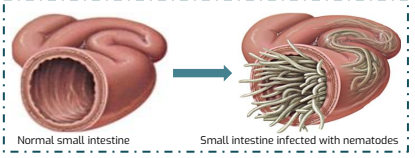
(Extra page for better understanding)

Important Terminology

Vectors Are living transmitters (e.g. a fly) of disease and my be:	**Mechanical**: transport parasite but there is no development of parasite in the vector	
	Biological: some stages of life cycle occur	
Life cycle forms	**Infectious**: the stage in the life cycle of an endoparasite in which it can initiate infection to its host e.g., cysts in protozoan	
	Diagnostic: e.g., trophozoite in protozoan infections, eggs/worm in helminth infection	
Others	**Obligatory**: They are always in contact with host and cannot survive without them.	**Free living:** They can live independently of their host, partially on soil.
	Direct life cycle: When parasite requires only one host to complete its life cycle.	**Indirect life cycle:** When two or more hosts are required to complete its life cycle
	Definitive host: It is the host in which the sexual reproduction (adult) takes place or most highly developed form exists (usually humans)	**Intermediate host:** It is the host in which asexual reproduction takes place.
	Reservoir: This is an animal host which serves as the source from which other animal are infected.	**Gravid worms:** Carrying eggs.
	Embryonated egg (Also called a "Larvated egg"): A nematode egg with a developed larva inside it. Most nematode eggs leave the host in the morula stage and develop in the environment to the embryonated stage (the stage just before hatching).A few nematode eggs are embryonated at the time they leave the host.	**Unembryonated egg:** Egg without an embryo, due to a lack of fertilization or to zygotic lethality.
		Larva migrans: Means that the larvae(يرقة)living in their abnormal hosts in which they can not grow into adults but can wander everywhere and cause the local and systemic pathological lesions of the hosts.
	Zoonosis: refers to animal's diseases which can be transmitted to humans.	**Life cycle:** Is the process of a parasite's growth, development and reproduction, which proceeds in one or more different hosts depending on the species of parasites.
	Sporozoite: a motile spore-like stage in the life cycle of some parasitic sporozoans.	**Trophozoites:** a growing stage in the life cycle of some sporozoan parasites, when they are absorbing nutrients from the host.
	Cysts: a stage in the life cycle of certain parasites, during which they are enveloped in a protective wall, facilitates their survival during unfavorable environmental conditions.	**Oocyst (كيسة بيض):** a cyst containing a zygote formed by a parasitic protozoan.

Introduction

Classification of Parasites	
Protozoa	**Helminths**
○ Unicellular ○ Single cell for all functions	○ Multicellular ○ Specialized cell
1. **Amoebae:** move by pseudopodia 2. **Flagellates:** move by flagella 3. **Ciliates:** move by cilia 4. **Apicomplexa (Sporozoa) tissue parasites**	1. **Round worms (Nematodes):** Elongated, cylindrical, unsegmented 2. **Flat worms:** - **Trematodes**: leaf-like, unsegmented - **Cestodes**: tape-like, segmented

Nematodes (الديدان الخيطية)		
General Features	**Location in the human body**	**Common intestinal infections**
○ Elongated worm ○ Cylindrical ○ Un-segmented ○ Tapering at both ends ○ Variable in size (measure < 1cm to about 100cm) ○ Sex separate ○ Male is smaller than female  	○ Intestinal nematodes ○ Tissue nematodes Extra pic 	1. **Enterobius (Oxyuris) Vermicularis** (Pinworm, seatworm, threadworm) 2. **Trichuris trichiura** (whipworm) 3. **Ascaris lumbricoides** (round worm) 4. **Ancylostoma duodenale & Necator americanus** (hookworms) 5. **Strongyloides stercoralis**

Enterobius Vermicularis (Oxyuris)

(Thread Worm) (الدودة الدبوسية " الخيطية ")

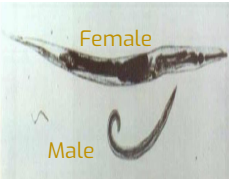
General information

- Common names: (Pinworm, Seat worm)
- Found all over the world but more common in temperate regions (المناخ المعتدل)
- Children are more often evolved than adults, it tends to occur in groups living together such as families, army camps or nursery.

★ Adult worms are located in lumen of cecum and the female migrate to rectum to **deposits her eggs on peri-anal area.**(1)

★ Direct human to human infections occurs mainly by Swallowing the eggs. In addition, **autoinfection** occurs by contamination of the fingers.(2)

- It can be seen by naked eye as white thread ± 1cm.
- Male is smaller than female ± 0.5 cm, with coiled end.



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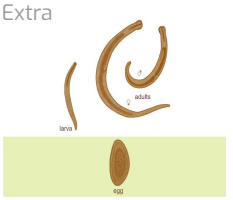
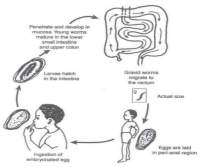
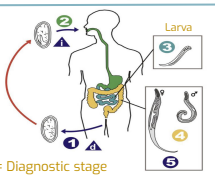


Life Cycle

- Diagnostic stage: Un-embryonated eggs
- Needs a few **hours** after the egg is released to become infective
- Infective stage: Embryonated egg
- What causes the disease: adult worms

Click here to check an extra helpful picture for Enterobius Vermicularis's life cycle





d= Diagnostic stage
i= Infective stage

Pathology

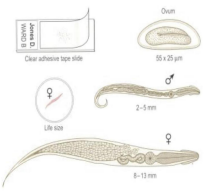
- Some of infections are asymptomatic (light infections)

★ Main clinical presentation **pruritus ani** *** which can be very troublesome and occurs more often during the **night**, persistent itching may lead to inflammation and secondary bacterial infection of the perianal region.

- Ectopic infection(fallopian tubes infection) occurs in women if the adult female parasite invade vulva and vagina result in vulvovaginitis, salpingitis
- Also adult worm can lodged in the lumen of appendix cause appendicitis.
- Infected children may suffer from:
  - Emotional disturbance
  - Insomnia
  - Anorexia
  - Loss of weight
  - Loss of concentration
  - Enuresis

Diagnosis

- Unlike other intestinal Nematodes, the eggs are not usually found in feces eggs tend to attach on the perianal area
- The best method is to look for them around the anus by
- taking an anal swab or by using CELLULOSE ADHESIVE TAPE,
- the examination should be done before defecation or bathing.



Treatment

Albendazole , Mebendazole for whole family because they might be asymptomatic

(1) main symptom is severe itching in peri-anal area
(2) Transfer from person: easy through contamination of fingers (itching) with eggs and sharing food or items. Autoinfection: also by contamination of fingers and self infection again.

Ascaris Lumbricoides

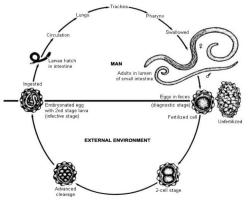
(Roundworm) (دودة الاسكارس الاسطوانية)

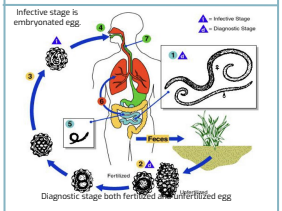
General information

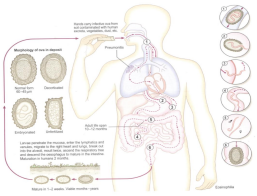
- The commonest human helminthes infection all over the world.
- Human is the only definitive host (primary host).
- The large roundworm is normally located in the small intestine.
- Found in **jejunum** and upper part of **ileum**.
- Female: **± 20** cm (longer than male).
- Male : **± 10** cm
- Feed on semi digested food

Life Cycle

- **It infect human only** ****
- when man ingest an Embryonated egg [1] (infective stage) contaminated with food or water, egg shell is dissolved by digestive juices and a Larva penetrate the wall of the **duodenum** to the portal circulation for (3 days) and then from right heart into the pulmonary circulation and stay in the **alveoli** ,where it grow and molts for (3 weeks), then Larva crawl up bronchi, trachea ,larynx and pharynx and be **coughed up** , then swallowed ,returned to the small intestine where it mature to adults male & female ,**fertilization take place producing fertilized eggs & unfertilized eggs** (diagnostic stage) which pass in stool.
- These eggs has to be in the soil for **three weeks** to become an embryonated eggs (infective stage).





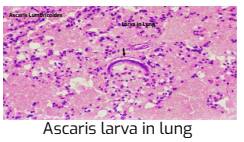


Ascaris larva emerging from egg hatch from small intestine to circulation go to the lungs causing LOEFFLER`S SYNDROM

Ascaris egg (embryonated egg infective stage enter the body with food contaminated in the soil)

Clinical Presentation

- Adult worm: (small intestine)
  A. Light infection : asymptotic
  B. Heavy infection : intestinal obstruction [2]
  C. Migrating adult : to bile duct - jaundice


Ascaris larva in lung

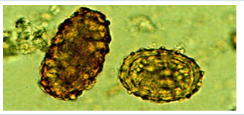
- Larvae
  Loeffler's syndrome: pneumonitis & bronchospasm, cough with bloody sputum ,eosinophilia, urticaria


Loeffler's syndrome: Larvae in lung

Diagnosis

- Eggs in stool (fertilized or unfertilized)
- Larvae in sputum
- Adult may pass with stool (rare)

Ascaris egg Diagnostic stage pass in the stool fertilized & unfertilized eggs



Treatment

Albendazole , Mebendazole

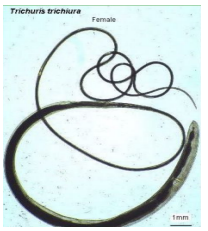
(1) The shell that surrounds the embryonated egg protects the larva from stomach acidity.
(2) because of its relative large size

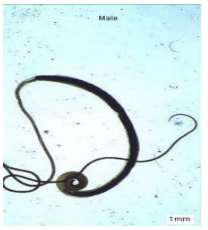
Trichuris trichiura

(Whipworm) (السوطية)

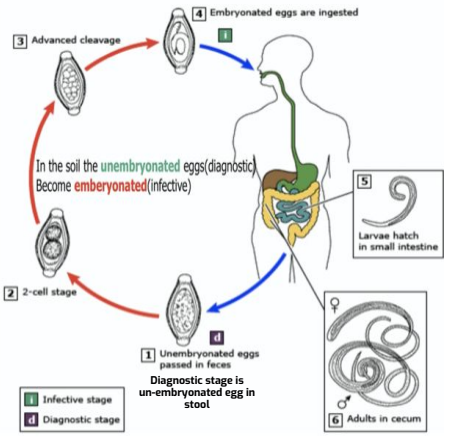
General information

- World wide ,common in poor sanitation.
- It coexists with Ascaris because of similar requirement (the eggs to be embryonated egg infective stage it needs to be 3 weeks in the **soil**).
- 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

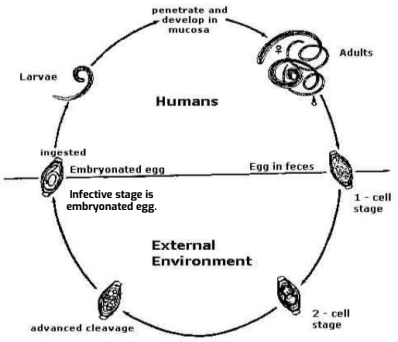




Life Cycle[1]



Click here to check an extra helpful picture for Trichuris trichura's life cycle



Pathology

- Light infection : asymptomatic

★ heavy infection : **rectal prolapse** in children is a common complication.

- abdominal pain , bloody diarrhea

Diagnosis

Fertilized egg (un-embryonated) in stool characterized by its barrel shape with mucoid plugs at each pole

Treatment

Albendazole

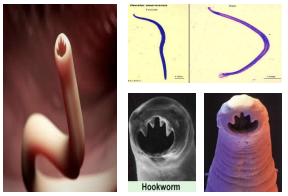
(1) Trichuris eggs need a few days to become infective

Ancylostoma duodenale & Necator americanus

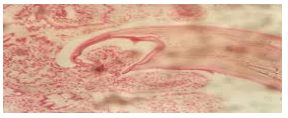
(Hookworm) (الخطافية)

General information

- A common cause of anemia in endemic areas
- Found in small intestine mainly jejunum

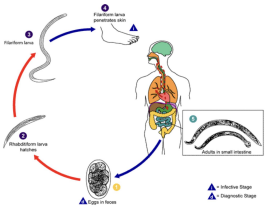


Buccal cavity attached to intestinal mucosa, Its buccal capsule (mouth) lined with hard hooks, **triangular cutting plates** and **anticoagulant glands** (1).



Life Cycle

- **Infective stage** is FILARIFORM LARVA penetrate the skin cause itching and dermatitis then larva go to the circulation (lungs causes slight pneumonitis and bronchitis) larva then swallowed and go to **small intestine** ,they attach to the mucous membrane where they mature into adult and the female starts laying **eggs** to be passed in stool (**not infective**)



- Filariform Larvae (**infective stage**) invasion of the **skin** can produce a skin disease called cutaneous larva migrans also known as creeping eruption, this is commonly caused by walking barefoot through areas contaminated with fecal matter. Larva migrate through the **vascular system** to the **lungs**, and from there up the **trachea**, and are swallowed. They then pass down the **esophagus** and enter the digestive system, finishing their journey in the **small intestine** where the larvae mature into adult worms. They mate inside the host, females laying up to 30,000 eggs per day, which pass out in feces (diagnostic stage). The eggs need to be in soil for about one week to become FILARIFORM LARVA

- The eggs need to be in soil for about one week to become FILARIFORM LARVA **INFECTIVE STAGE.**

Extra

Click here to check an extra helpful picture for Anclyostoma dudenale & Necator americanus's life cycle

Pathology

- There are no specific symptoms or signs of hookworm infection but they give rise to a combination of Intestinal inflammation, progressive iron-deficiency anemia & protein deficiency
- **Larvae:**
  1. At the site of entry larvae intense itching (ground itch) and dermatitis
  2. Migration phase:
     - Cough with bloody sputum
     - Pneumonitis and bronchitis but less severe than Ascaris & eosinophilia urticaria.
- **Adult worm:**
  1. Low worm burden (infection): **no** symptoms
  2. Moderate to heavy burden:
     - Epigastric pain, vomiting, hemorrhagic enteritis
     - Protein loss: hypo-proteinemia edema
  3. ★ **Anemia**: due to withdrawal of blood by parasites and hemorrhage from punctured sites lead to **severe anemia** = **microcytic hypochromic anemia**

Diagnosis

- Fertilized eggs in stools
- Occult blood (+)

شفافة ومفصصة من الداخل

Treatment

Albendazole , Mebendazole

(1) Anticoagulation glands help the worm feed on blood

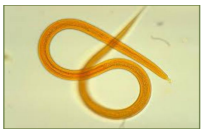
Strongyloides Stercoralis

(اسطوانية برازية)

General information

- Widely distributed in tropical area at Asia, Africa & South America .
- Fatal dissemination in **immunocompromised host.**
- It is smallest pathogenic nematodes ± **2.5**mm.
- Adult live in mucous membrane of duodenum, jejunum rarely mucous membrane of bronchus.
- ★ **Autoinfection** is a very important criteria.

Extra



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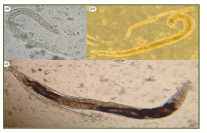
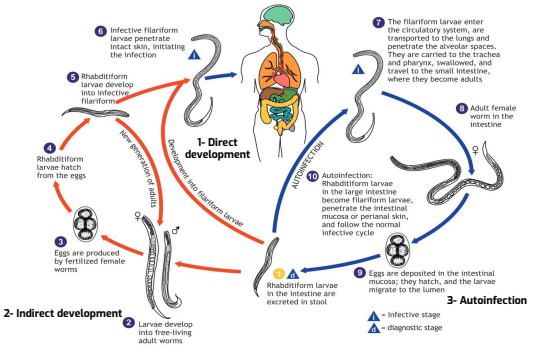
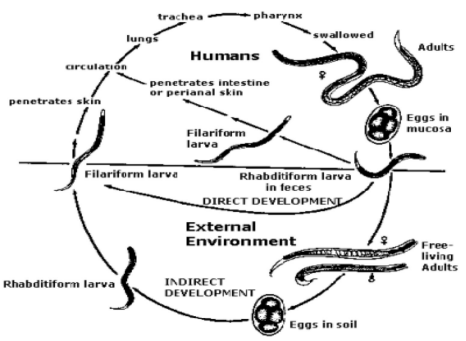


Life Cycle(1)

The parasite shows 3 different modes of development:

1. **Direct development:** The rhabditiform larva pass from stool and become directly a Filariform larva if the environment of the soil is suitable .directly from diagnostic stage to infective stage.
2. **Indirect development :** in external environment rhabditiform larva becomes free living adults, produce eggs,rhabditiform larvae and Filariform larva (Infective stage).
3. **Autoinfection:** mainly in immunocompromised patients
   - ★ **Internal-Autoinfection** (2)****: when the **rhabditiform larva become a filariform larva** in the intestine and penetrate the intestine
   - External-Autoinfection: fecal contamination of skin Rhabditiform larva → Filariform penetrates the skin





Pathology

Cutaneous: little reaction on penetration. Severe dermatitis at perianal region in case of external autoinfection.

Disseminated strongyloidiasis (3) :in patient with immunodeficiency, uncontrolled diarrhea, granulomatous changes , necrosis, perforation, peritonitis & death

Migration: pneumonitis during larval migration.

Intestinal: inflammation of upper intestinal mucosa, bloody diarrhea, upper abdominal pain in the colicky in nature

Diagnosis

Rhabditiform larvae (diagnostic stage) in:

- Stool examination
- Duodenal aspirate

Treatment

Albendazole , Mebendazole

(1) rhabditiform larvae excreted with stool **not eggs**.
(2) the only parasite in the lecture that does internal auto-infection.
(3) widespread dissemination of larvae (excessive number)

Common Intestinal Nematodes

All this slide was mentioned in the girls' slides

Parasite	Transmission	Location of adult in human	Infective stage	Diagnostic stage	Clinical picture
Enterobius vermicularis	- Swallowing the eggs, - external Autoinfection	Large intestine cecum	Eggs	- Adult pass in anus at midnight - Cellulose adhesive tape we detect adult worm	1- Pruritus ani during night 2-Persistent itching 3-Inflammation around the anus
Ascaris lumbricoides	Swallowing of Embryonated egg	Small intestine duodenum	Embryonated eggs food contaminated	- Fertilized & unfertilized egg in the stool. - Adult worm in stool. - larvae in sputum	Asymptomatic but can cause Intestinal obstruction in heavy infection pneumonitis &bloody sputum****** in larval stage.
Trichuris trichiura	Swallowing of Embryonated eggs	Large intestine	Embryonated eggs	Unembryonated eggs	- Asymptomatic in light infection - Rectal prolapse in children
Hookworm Ancylostoma Duodenale Necator Americanus	- Larval penetration of skin - Filariform larva the infective stage.	Small intestine	Filariform larva	Eggs in stool	- Itching & pruritus at sight of entry. - Cough and blood in the sputum at larval migration stage. - Loss of blood MICROCYTIC HYPOCHROMIC ANEMIA
Strongyloides Stercoralis	- Larval penetration of skin - internal and external Autoinfection	Small intestine	Filariform larva	Rhabditiform Larva	- Pruritus at the site of larval penetration. - Inflammation in the small intestine. - External autoinfection & INTERNAL****** AUTOINFECTION -Disseminated strongyloidiasis: in patient with immunodeficiency ,uncontrolled diarrhea ,granulomatous changes,necrosis, perforation ,peritonitis,death

Cestodes worms

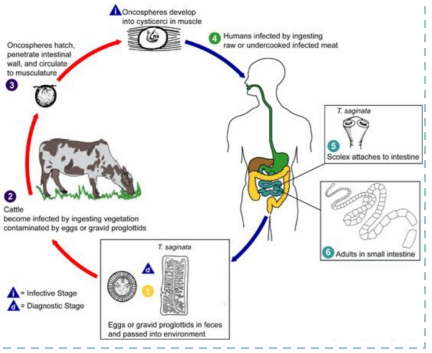
Cestodes tape like segmented parasite

- Taenia saginata — From cow
- Taenia solium — From pig
- Echinococcus granulosus

Taenia Saginata (Beef tapeworm)

General info

- Is an obligatory parasite of humans.
- Adult worm lives in the small intestine.
- Definitive host :Human
- intermediate host: cattle
- infective stage : cyst



Life Cycle

Cattle become infected by ingesting grass contaminated with eggs or gravid segments which passed from human faeces → In the cattle the oncosphere hatches out go to circulation and transformed to cysticercus stage in the muscle known as **cysticercus bovis** → Person becomes infected by eating undercooked(1) or improperly cooked beef , the adult worm lives in small intestine of man passing eggs and gravid proglottids segments, to the environment.

Clinical Findings

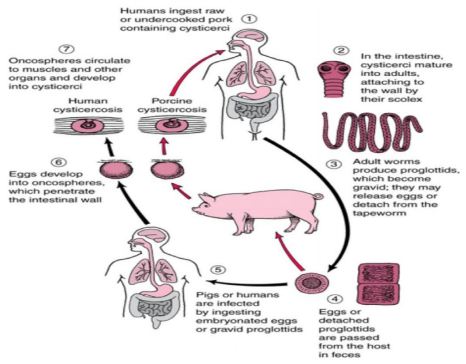
- The majority of cases are Asymptomatic
- Some patients have vague intestinal discomfort, vomiting and diarrhea.

- In *Taenia Saginata* infections there is usually only one worm in an infected person

(1)*Cysticercus Bovis* have heat protection which is why it can survive if it is undercooked

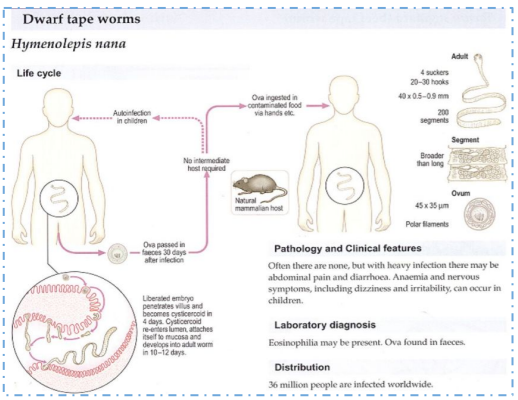
Taenia Solium & Hymenolepis nana

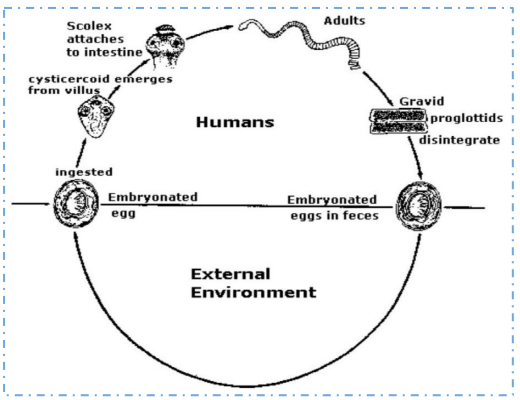
All this table was mentioned in girls slides except the pictures found in both

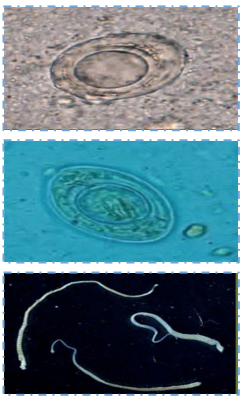
Taenia Solium (Pork tapeworm) Life Cycle	Human can be infected by 2 ways: **1-Eating eggs:** Cysts travel to various part of the body (cysticercosis) in eye & brain can be very dangerous. **2-Eating undercooked pork** contain cystocercus **:** Patient will have adult worm in the small intestine
	  
Clinical Findings	○ Taenia saginata(beef tapeworm) : most patient with adult T.saginata in the small intestine are asymptomatic, but some has malaise and some abdominal cramps. ○ Taenia solium (pig tapworm): Cysticercus of Taenia solium in brain ,eyes and skin ○ Can be very dangerous according to its location .
Laboratory diagnosis	○ Taenia infection is usually diagnosed by finding the typical segments (proglottids) and eggs in feces. ○ Clinical diagnosis of Taenia solium by C.T scan of the brain or abdomen according to the position of cysticerci in the human body.
Treatment	○ single dose of Praziquantel is usually successful in T.saginata but T.solium some time needs surgical intervention.

Hymenolepis nana

Only in boys slides







Echinococcus granulosus

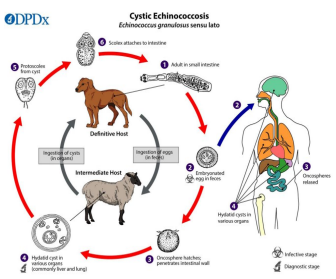
General information

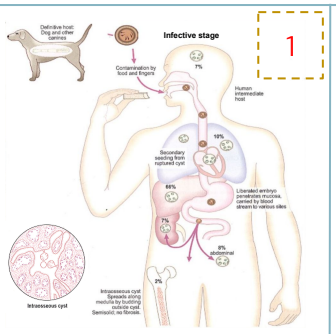
E. granulosus requires two host types:

1. Definitive host: Dogs
2. Intermediate host: most commonly sheep, cattle, pigs, goats, and camels and also Humans.

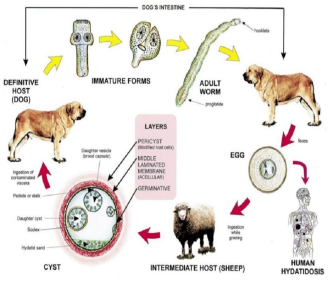
Life Cycle

- E. Granulosus cyst is ingested and attaches to the mucosa of the intestines in the definitive host and there the parasite will grow into the adult stages
- Dog become infected by eating sheep, cattle muscle having hydatid cyst which become in the intestine of the Dog as an adult and start releasing eggs witch excreted in the feces .
- Human become infected by ingestion of Echinococcus Granulosus eggs, usually by **hand-to-mouth contact with infected dog feces**
- The ingested eggs migrate to the various body tissues, and produce hydatid cysts. The life cycle is terminated at this point



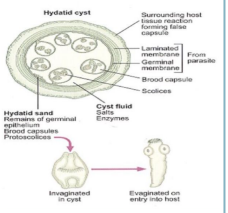


Location of hydatid cysts



Hydatid Cyst

Hydatid cyst, which may reach a large size, has laminated outer layer, and an inner layer of germinal tissues from which the daughter cysts and brood capsules (smaller cysts containing several developing inverted scolices) bud. The cyst also contains loose pieces of germinal tissue and scolices. This is known as hydatid sand. In addition, there is fluid inside the cyst can cause anaphylactic shock if the cyst rupture.



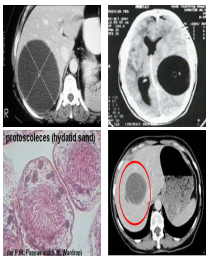
Symptoms

- Vary, depending on the location of the cyst in tissues.
- Although cysts may form in many areas of the body, the lung , the ★ **liver** followed by brain are most commonly affected.
- One serious complication of hydatid cyst disease is the **risk of anaphylactic shock,** following rupture of the ocyst.

Cerebral hydatidosis

Diagnosis

- Radiological examination: computed tomography (CT), magnetic resonance imaging (MRI) revealed a cystic swelling with smooth outline.
- Serological examination: to detect specific antibodies ELIZA,CFT.
- Casoni's test: it is an intradermal test used to detect immediate hypersensitivity in hydatid disease.
- Microscopical examination: hydatid sand
- Hydatid fluid may be withdrawn by the fine needle aspiration and examined under the microscope for scolices or hooklets. THIS IS A DANGEROUS PROCEDURE.



Treatment

- Intestinal stages: Praziquantel
- Tissue stages (hydatid & cysticercosis)
  - Depends on clinical condition: Surgical(2) and / or Albendazole

(1) most common site of hydatid cyst is the liver .
(2)removing the cyst without complications requires a very good surgical skills.

Common Tapeworm (Cestodes) Infections

TAPEWORM	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 disturbances	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 (Double infection), small intestine)	Subcutaneous 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**
Echinococcus granulosus	Hydatid disease	Ingestion of egg	Not present	LIVER***, lungs, Bones etc	Depending on locality	X-ray, CT, US Serology Hydatid sand

Drs' notes

Dr. Mona

★ Three parasites that needs soil: Ascaris Lumbricoides - Trichuris trichiura - Hookworm
★ Parasites causing autoinfection? Enterobius Vermicularis one and Strongyloides Stercoralis
★ Parasites causing **Internal** autoinfection? Strongyloides Stercoralis

- *Enterobius Vermicularis:*
  - Transfer from person: easy through contamination of fingers (itching) with eggs and sharing food or items.
  - Autoinfection: also by contamination of fingers and self infection again.
  - Embryonated egg (infective stage) → consumed with food → goes to large intestines where mating occurs (تزاوج) → adult female will deposit her eggs in peri-anal area.
  - Diagnosis is by using cellulose adhesive tape in the perianal area → wait until the morning (because it is more active at night) → place the tape on a microscope slide and examine → usually, we find female as it is the one that comes to place her eggs in this area.

- *Ascaris Lumbricoides*
  - Someone has Ascaris Lumbricoides → mating intercourse within body (that is why human is the only and primary host) → fertilized and unfertilized eggs are produced (diagnostic stage) → eggs pass in feces → residue in soil (طين) for three weeks and transform from fertilized egg to embryonated egg (infective stage) → contamination of plants and vegetables → human eats it → this egg (larva) will penetrate the small intestines and enter blood stream → goes to lungs and stays there for three weeks and gets bigger (as it needs good amount of oxygen) → bronchial irritation → coughing → enters esophagus → pass to stomach then small intestine again..

- *Trichuris trichiura*
  - Eating food contaminated with egg → goes to large intestine → grows to adult male or female → infects the secum and appendix (whole length)
  - Infective stage: embryonated eggs are ingest
  - Diagnostic stage: fertilized unembryonated eggs passing in feces
  - Difference from ascaris: no lung involvement and no larva migration
  - Light infection (asymptomatic) Heavy infection (rectal prolapse)

- *Hookworms*
  - Walking barefoot on soil → filariform larvae penetrates skin → circulation → lung (grows into bigger larvae) → coughed & swallowed again intestine.
  - Difference between hookworm and ascaris? its infective stage is larvae (to penetrate skin) unlike ascaris which was egg.
  - Infective stage: filariform larvae
  - Diagnostic stage: fertilized egg

- *Strongyloides Stercoralis*
  - Infective stage: Filariform larva
  - Diagnostic stage: Rhabditiform larvae
  - Development: either (1) directly if soil was suitable. (2) indirectly (3) Autoinfection in case of immunocompromised (internal & external)
  - The only parasite with **internal** autoinfection and it can cause disseminated strongyloidiasis in immunocompromised.

- *Taenia Saginata*
  - Adult worm is present in small intestine of human
  - infective stage: cyst acquired by by ingesting undercooked beef
  - Diagnostic stage: eggs and gravid segments (pieces of the worm) in stool.
  - How did the cow get the infection to begin with? By eating grass contaminated with eggs / infected human stool with eggs and gravid segments.
  - What if human consumed these eggs? Nothing will happen as the infective stage for human is the cyst NOT the eggs.

- *Taenia Solium*
  - Human eats undercooked pork containing cysticercosis → taenia solium in small intestine → gravid segment and eggs in human feces → (1) eaten by pig to repeat the cycle, or (2) contamination of food with eggs and developing cyst that goes to various sites including brain to cause parasitic tumor
  - Infective stage: cyst and eggs (unlike taenia saginata which was cyst only)
  - Diagnostic stage: eggs and gravid segments

- *Echinococcus granulosus*
  - Human is infected by hand-to-mouth contact with infected dog feces → develop cyst
  - Most common site for cyst? Liver
  - Definitive host: dog | intermediate host: human & cattle

Dr. Ibrahim

- It is difficult to distinguish between *Ancylostoma Duodenale* and *Necator Americanus.*
- *Necator Americanus* is in the Americas (new world) and *Ancylostoma Duodenale* Is in the old world (Asia Africa and Europe).
- *Enterobius* needs few hours after the egg is released before it becomes Infectious.
- *Enterobius* light infections: asymptomatic.
- *Enterobius* in large numbers (heavy infection): Abdominal pain.
- In *Enterobius* infection, treat the whole family because they might be asymptomatically affected.
- *Ascaris* needs few days or weeks before it becomes Infectious.
- *Ascaris* causes Obstruction because its relatively large.
- Adult *Ascaris* passing in stool is rare but it could happen.
- *Trichuris* eggs need a few days to become infective.
- Anticoagulant glands are useful because it helps the hookworm feed on blood.
- Hookworms do not spread through a fecal oral route.
- Hookworm eggs: شفافة ومفصصة من الداخل.
- *Strongyloides*: rhabditiform larvae excreted with stool not eggs.
- In *Taenia Saginata* infections there is usually only one worm in an infected person.
- *Cysticercus Bovis* has heat protection which is why it can survive if it was undercooked.
- *Echinococcus Granulosus* most commonly found in liver.

Quiz

MCQ

Q1: Which of the following can cause rectal prolapse in children?

A- Strongyloides stercoralis
B- Trichuris trichiura
C- Hookworm
D- Enterobius Vermicularis

Q2: Which parasite can cause microcytic hypochromic anemia?

A- Taenia saginata
B- Strongyloides stercoralis
C- Hymenolepis nana
D- Hookworms

Q3: Which parasite can cause an internal-autoinfection?

A- Strongyloides stercoralis
B- Ascaris lumbricoides
C- Trichuris trichiura
D- Enterobius Vermicularis

Q4: which of the following organism can affect the human by eating undercooked beef?

A- Echinococcus granulosus
B- Strongyloides stercoralis
C- Taenia saginata
D- Hymenolepis nana

Q5: which of the following organism can appear in 3 different modes of development?

A- Taenia Solium
B- Taenia Saginata
C- Strongyloides Stercoralis
D- Hookworm

Q6: In Taenia Solium the human is ?

A- intermediate host
B- Definitive host
C- Definitive and intermediate host .
D- non.

Answers: Q1:B | Q2:D | Q3:A | Q4:C | Q5:C| Q6:C

SAQ

Case: a kid comes to the hospital with his parents complaining of bacterial infection and inflammation of the perianal region and itching increasing during the night in further investigation the doctor ordered stool analysis trying to find any eggs the test came negative.

Q1: What is the most likely causative agent?

A:enterobius vermicularis

Q2: What are the best diagnostic methods for this case?

A: cellulose adhesive tape

Q3: mention both infective and diagnostic stages

A: infective stage : embryonated egg , Diagnostic stage : unembryonated egg

Q4: What is the prognosis and treatment in this case?

A: albendazole or mebendazole for **whole family**

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