Microbiology
437

MED437
KING SAUD UNIVERSITY

INTESTINAL HELMINTHS

PARASITIC INFECTION OF GIT

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Helminths

Multicellular
Specialized cells
Intestinal & tissue

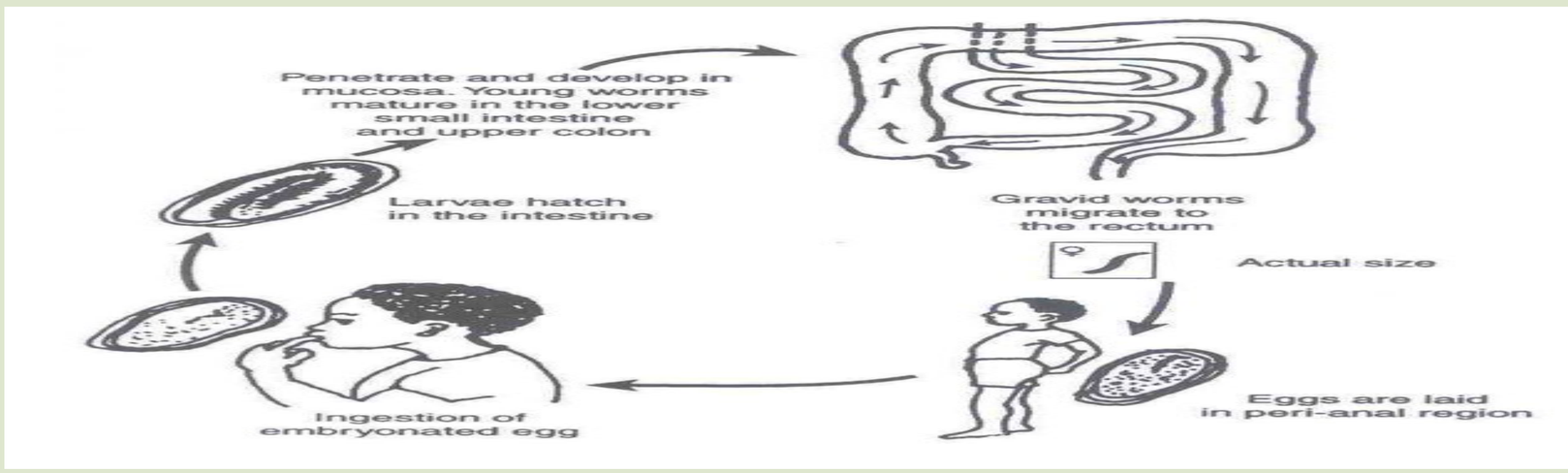
Roundworms (nematodes)	**Flatworms**
- Elongated, cylindrical, & unsegmented	- Trematodes: leaflike & unsegmented - Cestodes: tapelike & segmented

Nematodes

Location in the body	General Features	Common intestinal infections
Intestinal nematodes & tissue nematodes	★ Elongated worm, cylindrical, unsegmented and tapering at both ends. ★ Variable in size, measure <1 cm to about 100cm. ★ Sex separate and male is smaller than female	★ Enterobius (oxyuris) vermicularis (pinworm, seatworm & threadworm) ★ Trichuris trichiura (whipworm) ★ Ascaris lumbricoides (roundworm) ★ Ancylostoma duodenale & Necator americanus (hookworms) ★ Strongyloides stercoralis



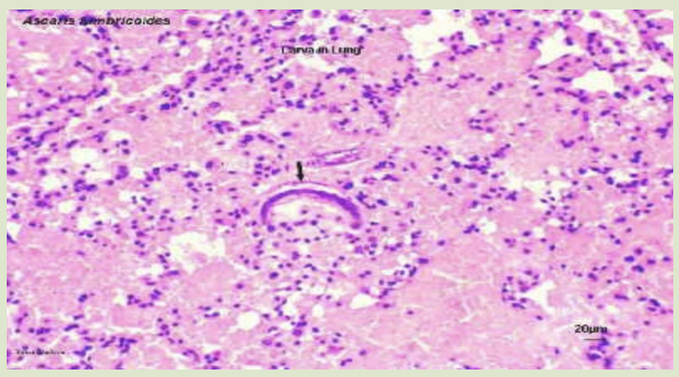

Enterobius Vermicularis (Thread Worm)

General Info.	- Common names; pinworm & seat worm - Found all over the world but more common in temperate regions, infects only human. - Children are more often evolved than adults , it tends to occur in groups living together such as families , army camps or nursery. - Adult worms live in the large intestine, mainly located in lumen of cecum and the female migrate to rectum to deposits her eggs on perianal skin. - Direct human to human infection occurs mainly by swallowing the eggs. - In addition, autoinfection occurs by contamination of the fingers.
Life cycle	
Clinical Presentation	- The most common symptom is perianal itching, also known as pruritus ani, which can be very troublesome - Occurs more often during the night. - Persistent itching may lead to inflammation and secondary bacterial infection of the perianal region. - Also adult worm can lodged in the lumen of appendix cause appendicitis. - Infected children may suffer from emotional disturbance ,insomnia ,anorexia , loss of weight and loss of concentration and enuresis. - Ectopic infection occurs in infected adult female when invade vulva and vagina result in valvo-vagintis & salpingitis.
Diagnosis	Unlike other intestinal Nematodes, the eggs are not usually found in feces. 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



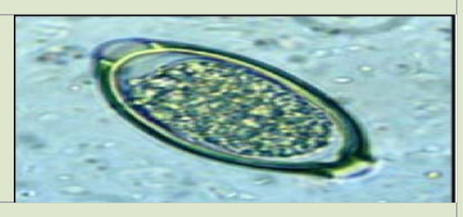

Ascaris Lumbricoides (Roundworm)

General Info.	- The commonest human helminthes infection all over the world - 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	- The Infection starts when a person ingest an embryonated egg contaminated with food or water (soil) - This embryonated egg become a Larva in the duodenum - Penetrate the wall of the duodenum & enter the bloodstream to the heart, liver and enter the pulmonary circulation and stay on the alveoli, where it grow for 3 weeks - Then larva passes from respiratory system to be coughed up, swallowed & returned back to the small intestine where it mature to adults male & female - Fertilization take place producing eggs which pass in stool as fertilized eggs or unfertilized eggs. - Only fertilized eggs can survive in the soil for 2 weeks to become an embryonated egg ready to infect human with contaminated food.
Pathogenicity	1. Migrating Larva : a. Ascaris pneumonia b. sometimes the Larva reaches aberrant sites like brain ,heart or spinal cord & cause unusual disturbance. 2. Adult Worm: a. The worm consumes proteins and vitamins from host's diet and leads to malnutrition. b. Can cause intussusception, intestinal ulcers and in massive infection can cause intestinal obstruction.
Clinical Picture	1. Adult worm: (small intestine) a. Light infection : asymptomatic. b. Heavy infection : intestinal obstruction c. Migrating adult : to bile duct -jaundice 2. Larvae: a. Loeffler's syndrome: pneumonitis & bronchospasm, cough with bloody sputum b. Eosinophilia, urticaria
Diagnosis	- Fertilized or unfertilized eggs in stool. - Larvae in sputum.
Treatment	Albendazole & Mebendazole

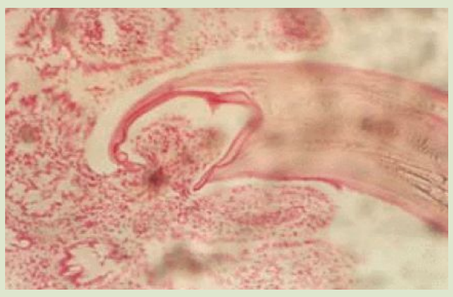


Loeffler's syndrome: Larvae in lung (pneumonia, cough & bloody sputum)

Trichuris Trichiura (Whipworm)

General Info.	- 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
Life Cycle	- Passage of unembryonated eggs (diagnostic stage) in the stool - In the soil, the eggs become embryonated and become infective in 15 to 30 days. - After ingestion of contaminated food or water with soil contains embryonated eggs (infective stage) - In the small intestine the larvae will hatch and become mature into adult worms, which become established in the cecum and ascending colon after 2-3 months. - The adults measure approximately 4 cm in length. - The females begin to produce eggs 60 to 70 days after infection and shed 3000 to 20,000 eggs per day. - The life span of the adults is one to three years.
Clinical Picture	1. light infection : asymptomatic 2. heavy infection :abdominal pain ,bloody diarrhea. Rectal prolapse in children is a common complication.
Diagnosis	Unembryonated eggs in stool characterized by its barrel shape with mucoid plugs at each pole 
Treatment	Albendazole

Hookworm

General Info. 	- It has two name: dr. mona said only memorize hookworm
	  - Ancylostoma duodenale (in the middle east)
	  - Necator americanus (in america)
	- A common cause of anemia, which is found in small intestine mainly jejunum.
	- Its buccal capsule (mouth) lined with hard hooks, triangular cutting plates and anticoagulant glands.
	 
	Buccal cavity attached to intestinal mucosa

Life Cycle	- Infection occurs by penetration of the larva to the human skin, In the soil eggs (diagnostic stage) become larva (infective stage) - its commonly caused by walking with barefoot

Pathology & Clinical Picture	1. Larva:
	  a. At the site of entry: larvae intense itching (ground itch) and dermatitis.
	  b. Migration phase:
	  i. Cough with bloody sputum
	  ii. Pneumonitis and bronchitis but less severe than Ascaris & eosinophilia urticaria.
	2. Adult worm:
	  a. low worm burden (infection): no symptoms
	  b. Moderate to heavy burden:
	  i. Epigastric pain, vomiting , hemorrhagic enteritis.
	  ii. Protein loss: hypoproteinemia & edema.
	  c. Anemia: due to withdrawal of blood by parasites and hemorrhage from punctured sites lead to severe anemia (microcytic hypochromic anemia)

Diagnosis	Eggs in stools & occult blood (+)
Treatment	Albendazole & Mebendazole




Strongyloides Stercoralis

General Info.	- Widely distributed in tropical area at Asia, Africa & South America . - Fatal dissemination in immunocompromised host. - It is smallest pathogenic nematodes ± 2.5mm. - Adult live in mucous membrane of duodenum jejunum rarely mucous membrane of bronchus. - Autoinfection is a very important criteria
Life Cycle	1. Rhabditiform larva (diagnostic stage) are excreted in the stool to the soil , to become adult male and female, where fertilization take place to produce eggs. 2. Larva hatch from the eggs in the soil and become Filariform larva (infective stage) 3. Infection take place by penetration of the Filariform larva to human skin → which enter the circulation to the lung → trachea → swallowed and reach the small intestine to become adult male and female 4. Starts to produce eggs, which become Rhabditiform larva and excreted in the stool to start another cycle in the soil. - Internal Autoinfection in immunocompromised patients: Rhabditiform larva in the intestine can be transferred to become filariform larva and penetrate the intestinal mucosa and peri-anal skin and produce infection. - It causes internal autoinfection
Pathology & Clinical Picture	- Cutaneous little reaction on penetration. Severe dermatitis at perianal region in case of external autoinfection. - Migration :pneumonitis during larval migration. - Intestinal: inflammation of upper intestinal mucosa, bloody diarrhea, upper abdominal pain in the colicky in nature. - Disseminated strongyloidiasis : in patient with immunodeficiency, uncontrolled diarrhea, necrosis, perforation, peritonitis & death.
Diagnosis	Rhabditiform larvae diagnostic stage in: - Stool examination - Duodenal aspirate
Treatment	Albendazole & Mebendazole




Common Tapeworm Infections

Tapeworm	Disease	Transmission of Infection	Location of Adult in Human	Location of Larva in Human	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)	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




Taenia Saginata

General Info.	- Is an obligatory parasite of man - Human (definitive host) infected by eating undercooked beef contains cysticercus in the muscle of the cattle (intermediate host). - Adult worm live in the small intestine.
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 - Man become infected by eating undercooked or improperly cooked beef , the adult worm lives in small intestine of man passing eggs and gravid proglottids to the environment.
Clinical Picture	- The majority of cases are Asymptomatic, some patients have vague intestinal discomfort, vomiting and diarrhoea. - T. Saginata infection is usually asymptomatic, but in heavy infection often result in weight loss, dizziness, ,abdominal pain, diarrhea and loss of appetite
Diagnosis	- Detection of eggs in stool or gravid segment.

Taenia Solium

General Info.	- Humans can be definitive or intermediate (reservoir) hosts
Life Cycle	- Humans can be infected by either eating undercooked pork containing cyst or by eating vegetables containing eggs or gravid segments → cyst could occur in any site but mostly muscles and brain → might develop epilepsy.

Echinococcus granulosus

General Info.	- The adult worm located in the small intestine of the dogs (definitive host). - Sheeps , goats, and humans are the intermediate host - If a human ingested the cyst they won't become infected.
Life Cycle	1. The adult worm located in the small intestine of the dogs (definitive host) 2. Eggs and gravid segments are then discharged in the feces of the infected dogs having oncosphere . 3. Eggs and gravid segments contain oncosphere are ingested by various animals e.g sheep goats and accidentally man. 4. These oncosphere hatches in the duodenum and penetrate the circulation and reach various organs mainly the liver and the brain causing Hydatid Cyst.
Diagnosis	Radiological examination & immunological tests.
Treatment	Intestinal stages: Praziquantel Tissue stages (hydatid & cysticercosis): Depends on clinical condition : Surgical and/or Albendazole




Dr's Notes

★ **The dr said don't memorize the treatment but in case just know Mebendazole**

Nematodes (Roundworms)

1. **Enterobius Vermicularis (pin/ thread worm)**
   a. More common in children
   b. Location? cecum (large intestine)
   c. Human is the definitive host
   d. How do we get the infection? Either by direct human to human by swallowing the eggs (fecal-oral route) or by autoinfection
      i. the kid would itch the area then would either touch his mouth (autoinfection) or touch other people (human to human infection)
   e. The only worm that its eggs doesn't go down with the stool but stay in the perianal area
   f. This worm likes to place its eggs during the night
   g. Diagnosis? Cellulose adhesive tape
   h. It has a direct infection (no need to be passed in the soil)
2. **Ascaris Lumbricoides (roundworm & looks like spaghetti)**
   a. Most common human helminths infection
   b. Location? small intestine
   c. Human is the definitive host
   d. Life cycle:
      i. When someone who's infected pass it stool in soil, the stool will has fertilized and unfertilized eggs. Fertilized will become embryonated eggs in 2 weeks & unfertilized will die.
      ii. Then someone who didn't know that the area is contaminated planted vegetables in the soil. So now what happened to the vegetables? They're contaminated with the embryonated eggs
      iii. Someone was walking by and decided to eat a piece of lettuce → reaches the intestine → lava penetrates it → reach the blood circulation → it likes O2 so it will go to the lungs (here the larva will grow) → when the person cough or vomit they will swallow it again → reaches small intestine and becomes and adult worm → pass it eggs in the stool
   e. Symptoms? in the lungs: cough & chest pain → in small intestine: diarrhea & abdominal discomfort
   f. Diagnostic stage? Unfertilized and fertilized eggs
   g. Infective stage? Embryonated eggs
   h. Microscopy is the gold standard method for diagnosis
3. **Trichuris trichiura (whipworm)**
   a. Location? Large intestine especially cecum and appendix
   b. Life cycle: same as Ascaris Lumbricoides but the only difference is:
      i. Doesn't have the extra-intestinal stage where it reaches the blood circulation
      ii. Embryonated eggs become larva in the small intestine → adults in the cecum
   c. Diagnostic stage? Unembryonated eggs
   d. Infective stage? Embryonated eggs




Dr's Notes

4. Hookworms

a. عندها مخالب فيها مادة تسيح الدم (anticoagulant)
b. فأول ما تمسك بالأمعاء وتبدأ تمص الدم هذي المادة بتخليها تاخذ كمية اكثر من الدم عشان كذا بتسبب ايش؟
   i. Iron-deficiency anemia (microcytic hypochromic anemia)
c. The life cycle of this one is different than the others so pay attention here:
   i. To get infected you have to be in a farm or somewhere in a soil while you're barefoot!
   ii. When someone who's infected pass his stool in the soil it will be contaminated with the eggs → after two weeks the larva got out of the egg and became free in the soil → then when someone is walking barefoot it will penetrate the intact skin → at the site of entry the larva will cause dermatitis (itching) → reaches the blood circulation → goes to the lungs and cause pneumonia → cough or vomit → swallow it back → small intestine → adult where it will start causing anemia
d. Diagnostic stage? Eggs in the stool
e. Infective stage? Larva
f. Definitive host? Human

5. Strongyloides Stercoralis

a. Most important thing about this is autoinfection in immunocompromised patients causing severe diarrhea and the patient might die (heavily infection)
b. Location? Small intestine
c. Life cycle? Very similar to the hookworm
   i. An infected person will pass larva in the stool to the soil where it will become filariform larva → penetrate the skin → blood circulation → lungs → cough → swallow it back → small intestine → adult → eggs → rhabditiform larva is passed in the stool
   ii. But in immunocompromised the rhabditiform will become filariform in the cecum and cause infection again (autoinfection)
d. Diagnostic stage? Rhabditiform larva
e. Infective stage? Filariform larva




Dr's Notes

Tapeworm (cestodes)

1. **Taenia saginata**
   a. Infected by eating undercooked beef (cow) cannot get infected by ingesting eggs & gravid segments
   b. Definitive host? Human only
   c. The cow eat grass containing eggs or gravid segments (it's a segment from the adult worm) → inside its body it became cyst in the muscles (cysticercus bovis) → human eating the meat containing cysticercus → cause diarrhea and abdominal discomfort
   d. Diagnostic stage? Eggs and gravid segments
   e. Infective stage? Undercooked beef containing cyst
2. **Taenia Solium**
   a. Infected by eating undercooked pork (pig) or by any vegetables contaminated by eggs or gravid segments, the larva itself can causes an infection
   b. Cyst in pigs like to go the muscles but in humans it goes to the brain and cause epilepsy
   c. Human can be definitive host and intermediate host
   d. Life cycle:
      i. Ingesting eggs or gravid segments → becomes cyst → penetrate intestinal wall → reaches other organs mainly brain
      ii. Eating undercooked pork containing cyst→ becomes adult → pass eggs and gravid segments in the stool

3. **Hymenolepis Nana**
   a. The dr said don't memorize this but in case it comes from the mouse

4. **Echinococcus granulosus**
   a. Definitive host? dogs
   b. The normal life cycle is when an infected dog has the adult worm and when passing stool it will contain eggs → when a sheep comes and eat from the grass which is contaminated → the eggs become cyst in the sheep → if later on the sheep was killed and we threw some of the meat away → then a passing dog ate the contaminated meat → cyst will become adult in the dog small intestine → pass eggs in the stool
   c. But if the infected dog is someone's pet and for whatever reason the human ingested the eggs → become cyst → penetrate the circulation → reaches the brain or liver → hydatid cyst




Summary

Enterobius vermicularis: (pin worn)					
Affect	Children	**Location**	Large intestine (lumen of cecum)		
Diagnosis	To look for egg around the anus by using cellulose adhesive tape	**Transmission**	1-Direct human to human. 2- Autoinfection by contamination of the fingers.		
Clinically	• Perianal itching (pruritus ani) • Adult worm can cause appendicitis, valvo-vagintis, salpingitis				
Ascaris lumbricoides					
Location	Small intestine (in jejunum and upper part of ileum)	**Life cycle**	Ingestion of Embryonated egg then it become a Larva→Enter the bloodstream→enter the pulmonary circulation→coughed up ,swallowed ,returned back to the small intestine where it become adult→pass in stool as Fertilized eggs or unfertilized eggs		
Infectious stage	Embryonated egg	**Diagnostic stage**	Unfertilizedor Fertilized eggs	**Definitive host**	Human
Pathogenicity	1-Migrating larva: pneumonia, cough bronchospasm. 2-Adult worm: malnutrition, intussusception, intestinal ulcers and intestinal obstruction.				
Trichuris trichiura					
Location	large intestine especially caecum and appendix	**Diagnostix stage**	Fertilized eggs or unfertilized eggs	**Infectious stage**	Embryonated egg
Hook worms					
Location	Small intestine mainly jejunum	**Diagnostic stage**	Egg in stool	**Infectious stage**	larva
Definitive host	Human	**Route of infection**	Infection occurs by penetration of the larva to the human skin	**Clinically**	Iron deficiency anemia(microcytic - hypo chromic): due to withdrawal of blood




Summary

Strongyloides stercoralis			
Affect	Internal autoinfection in immunocompromised patients: Rhabditiform larva in the intestine can be transferred to become filariform larva (which is in normal condition need soil to transferred)	**Infective stage**	Filariform larva
Route of infection	By penetration of the Filariform larva to human skin	**Definitive stage**	Rabditiform larva

Taenia saginata					
Definitive host	Human	**Intermediate host**	The cattle	**In the cattle the**	Oncosphere go to muscle and transformed to cysticercus bovis.
Location	Small intestine	**Definitive stage**	Eggs or gravid segments which passed from human faeces	**Infective stage**	Eating Under cooked beef contains cysticercus

Taenia Solium					
Definitive host	Human	**Intermediate host**	Human + pig	**Infective stage**	Eating Under cooked pork contains cyst
Human can be infected either by: 1-Eating vegetable contaminated with egg or gravid segments. 2-Eating Under cooked pork contains cyst.					

Echinococcus granulosus					
Definitive host	Dog	**Intermediate host**	human	**Clinically**	Onchosphere reach various organs mainly the liver and the brain causing hydatid cyst.




MCQs:

1-The Larva stage of Ascaris lumbricoides could cause?
A- Intestinal obstruction
B- Malnutrition.
C- Pneumonitis.
D-Intussusception

2-Which of the following does not cause extra-intestinal manifestation ?
A- Ascaris lumbricoides.
B- Hook worms.
C- Echinococcus granulosus.
D-Trichuris trichiura.

3- Microcytic-Hypochromic anemia is one of the manifestation of?
A- Enterobius vermicularis.
B- Taenia saginata.
C- Hook worm.
D-Echinococcus granulosus.

4- A patient has be Confirmed to have Echinococcus granulosus, if you perform more tests what do you expect to see?
A- enlarged heart.
B- Hydatid cyst.
C- Pneumonitis.
D-intestinal ulcers.

5-The most common symptom of Enterobius vermicularis?
A- Pneumonitis.
B- Pruritus ani.
C-diarrhea.
D- intestinal obstruction

6- In Taenia Solium the human is ?
A-intermediate host
B- Definitive host
C- Definitive and intermediate host .
D- non.

SAQ:

- A 20 years old female came to the ER. She presented with abdominal discomfort, cough and constipation. On history she told you she visited her grandparents in their farm 2 weeks age. CBC show high WBC, sputum Analysis shows larvae.
1- What is the most likely pathogen?

Ascaris lumbricoides

2-What is the diagnostic stage? And what is the Infectious stage?

Fertilized or unfertilized eggs in stool, Embryonated egg

2- What further test would you order ?

-Stools analysis looking for Fertilized or unfertilized eggs

3-what is the proper way to treat him?

Albendazole, Mebendazole

4- What are the complication of the pathogen?

Loeffler's syndrome, Pneumonitisand bronchospasm, cough with bloody sputum

intussusception, intestinal ulcers and in massive infection can cause intestinal obstruction.



1-C 4-B
2-D 5-B
3-C 6-C

THANK YOU!

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