الجهاز الهضمي

علم الأحياء الدقيقة

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Common Helminthic infections of the GI tract

Remember: parasites are divided into protozoa, Helminths- worms- (multicellular , macroscopic) and vectors .
Helminths further divided into nematodes (cylindrical in shaped) and cestodes.

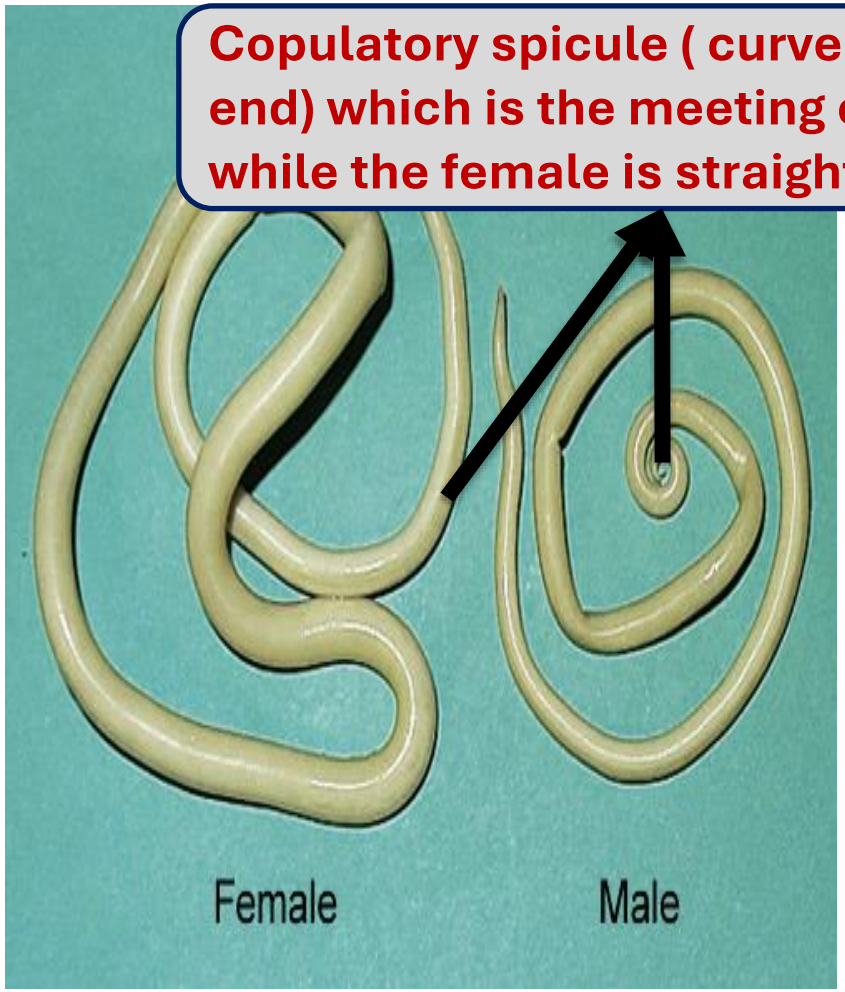
By : Nader Alaridah MD, PhD

ASCARIS LUMBRICOIDES

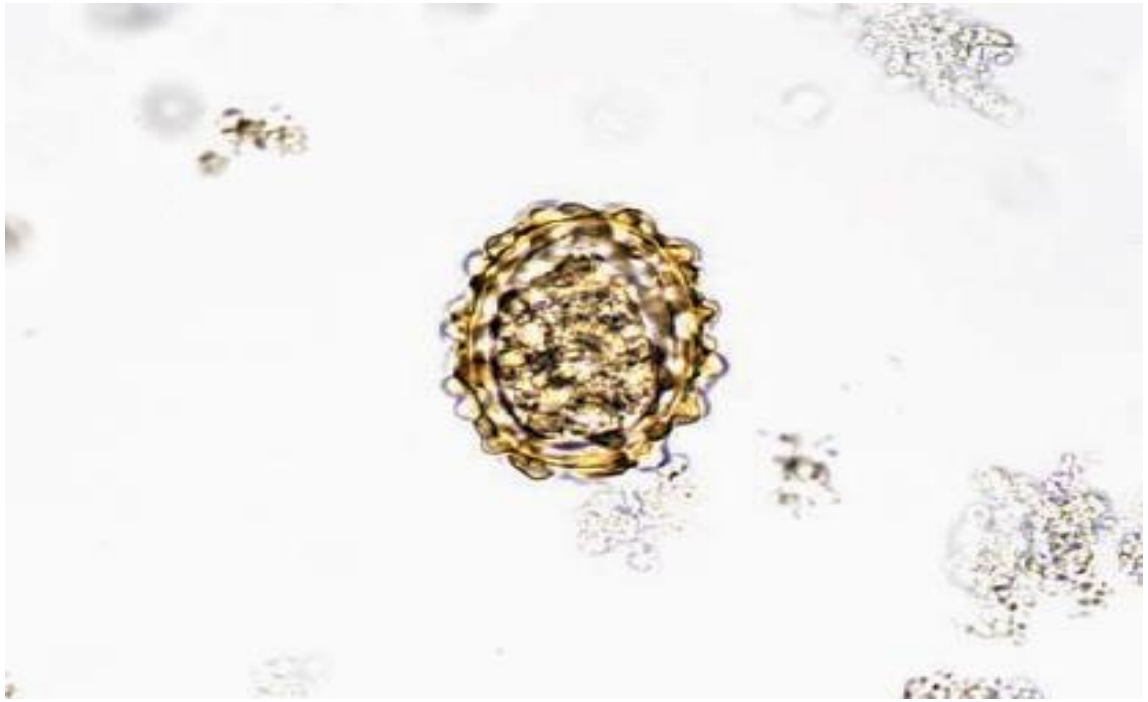
The disease called ascariasis

Morphology : Ascaris lumbricoides is the most common helminthic infection worldwide.

- Unsegmented helminthis
- Nematodes are dioecious, meaning they have separate sexes, with males and females being distinct individuals.
- Male adult worm measures 15-20 cm in length
- Female adult worm measures 20-40 cm in length (it is the longest nematodes).
- The posterior end of male adult worm is curved while the female adult worm is straight
- Estimated prevalence more than 1 billion .
- There is another worm with similar characteristics that’s found in the pigs/ swans called ascaris suum, also it can infect humans.



Copulatory spicule (curved posterior end) which is the meeting organ while the female is straight



Keep in mind that usually when we talk about helminthis female is larger than male. (Female =40 cm, while male =25 cm) .

The most common diagnostic stages to be found in the stool is Ascaris egg: (egg with bumps) which has thick wall and mammillated albuminous coat "corticated egg“ .
Usually brown in color as it’s habitat is the small intestine (bile stain).

Mode of transmission

- ❑ **Fecal – oral transmission**
- ❑ **Reinfection possible**

Habitat

- ❑ **small intestine**

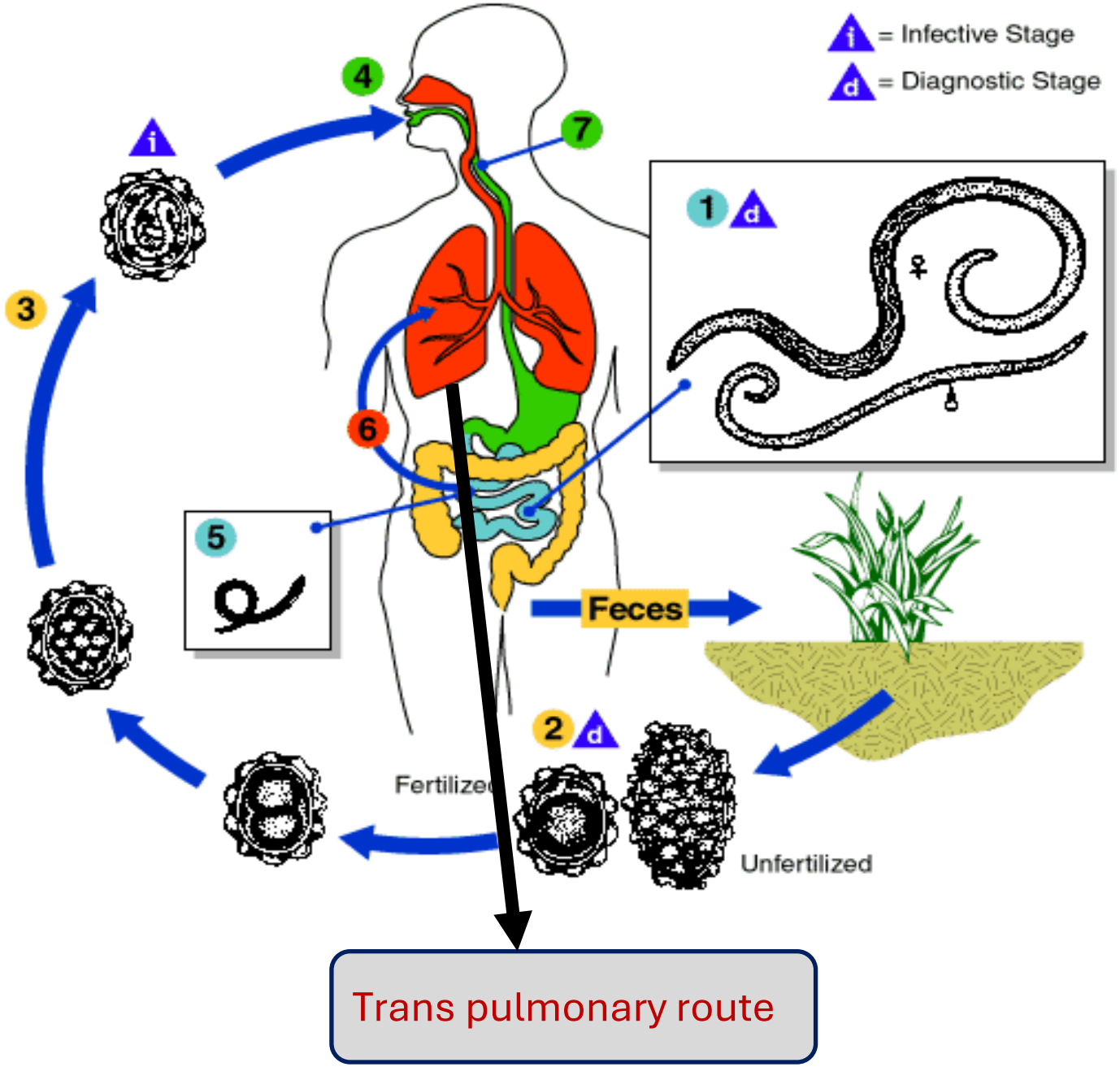
Infective stage

- ❑ **Embryonated egg**
- ❑ Each female produces 200,000 eggs a day
- ❑ Ascaris eggs are capable of survival within harsh environmental conditions, including dry or freezing temperatures.
- ❑ **When ingested they hatch in small intestine , migrate through the venous system to lungs where they break into the alveoli then to the bronchial tree before they are swallowed and develop into mature worm in the intestine.**

Ascariasis infection always associated with poor sanitation, poor personal hygiene, poverty and overcrowded.
Young adults and older children are more susceptible to be infected with ascariasis.

GENERAL RULE IN HELMINTHIS:
One egg —> one larva —> one adult.

Ascaris can indeed wander around, which means that they have the ability to move within the host's body (especially ovaries and fallopian tube in female) without a specific purpose or direction.


i = Infective Stage
d = Diagnostic Stage
1 d
2 d
3
4
5
6
7
Feces
Fertilized
Unfertilized
Trans pulmonary route

Patients with ascariasis have 2 types of egg in their stool:
-unfertilized eggs: don’t continue their life cycle

-Fertilized egg (diagnostics stage/soil phase): before being infective (embryonated eggs) they have to stay in the soil under favorable conditions (moisture and shade) transform from unfertilized to undominated (2-6 weeks, 3 weeks on average).
This infective eggs (embryonated eggs) once they get swallowed, they continue their life cycle.
They pass the stomach acidity, then they hatch in the small intestine—> Larvae.
The Larvae don’t stay in the small intestine, they penetrate mucosa and submucosa, reaching systemic circulation ascending to lungs, alveoli, bronchi, trachea then they get swallowed again (Trans pulmonary phase) (takes 3 weeks).
After they get swallowed again, they reach small intestine, but here they become adults rather than eggs.
The female adults lay eggs, and if female and male are present, they will lay fertilized eggs.

During trans pulmonary rout, patients may have respiratory symptoms, in addition to LOEFFLER'S SYNDROME (cough, eosinophilia, lymphadinitis , hemoptysis -coughing blood-).

SUMMARY :

fertilized eggs (21 days in soil) —> embryonated eggs —> infect human —> hatch in small intestine (becomes larvae) —> penetrate mucosa and submucosa —> reach systemic circulation—> trans pulmonary rout —> swallowed again as adult warms (موجودة في البلغم) —> lay eggs

Infective stage: embryonated eggs

Diagnostic stage: - eggs (fertilized and unfertilized) (the most common).

-the whole warm passing with stool

-larva from sputum sample during trans pulmonary rout.

Remember that fertilized eggs are not immediately infectious.

Pathogenesis and spectrum of disease

- **Disease is called Ascariasis (The most common helminthic infection worldwide, especially in developed countries)**
- **Children and young adolescents have higher infection rate**
- **Many A. lumbricoides infections are asymptomatic**
- Symptomatic:
  - **Pulmonary symptoms during migration (loeffler's syndrome which is respiratory symptoms, infiltrates and eosinophilia)**
  - **GI manifestations: malnutrition (due to complex nutritional requirements by the worm), anemia, malabsorption, steatorrhea (due to bile duct obstruction) and intestinal obstruction, biliary obstruction and jaundice**

The severity of infection depends on the health status of the host and the burden of worms (number of worms), one worm usually doesn't cause severe symptoms for the patient and might be asymptomatic. The burden of worms increase with reinfection. With reinfection, patients may have multiple generations of worm at the same time (eggs, larvae and adult worms).

Lab diagnosis

- **Eosinophilia** **(common with helminthic infections rather than protozoal infections).**
- **Microscopic examination (looking for eggs)**

  Direct smear (stool mixed with saline) identified for both (fertilized and infertile)eggs
- **Adult worm may also be identified in feces**
- **Larvae may be found in sputum or gastric aspirates**

THERAPY

oral Albendazole 400MG STAT (In the medical field, "STAT" is an abbreviation derived from the Latin phrase "statim," meaning immediately or at once.)

ENTEROBIUS VERMICULARIS
(pinworm) "seatworm"

- **Pinworm(because of its posterior end is this like pin head)**
- Small , thin and white worm
- **distributed worldwide and commonly identified in group settings of children ages 5 to 14 years. Females are more susceptible to be infected with E.Vermicularis.**
- The female worm measures 8 to 13 mm long with a pointed "pin" shaped tail (11000 ova and live for a month)
- **The males measure only 2 to 5 mm in length, die following fertilization, and may be passed in feces.**
- **Habitat : large intestine (Caecum)**

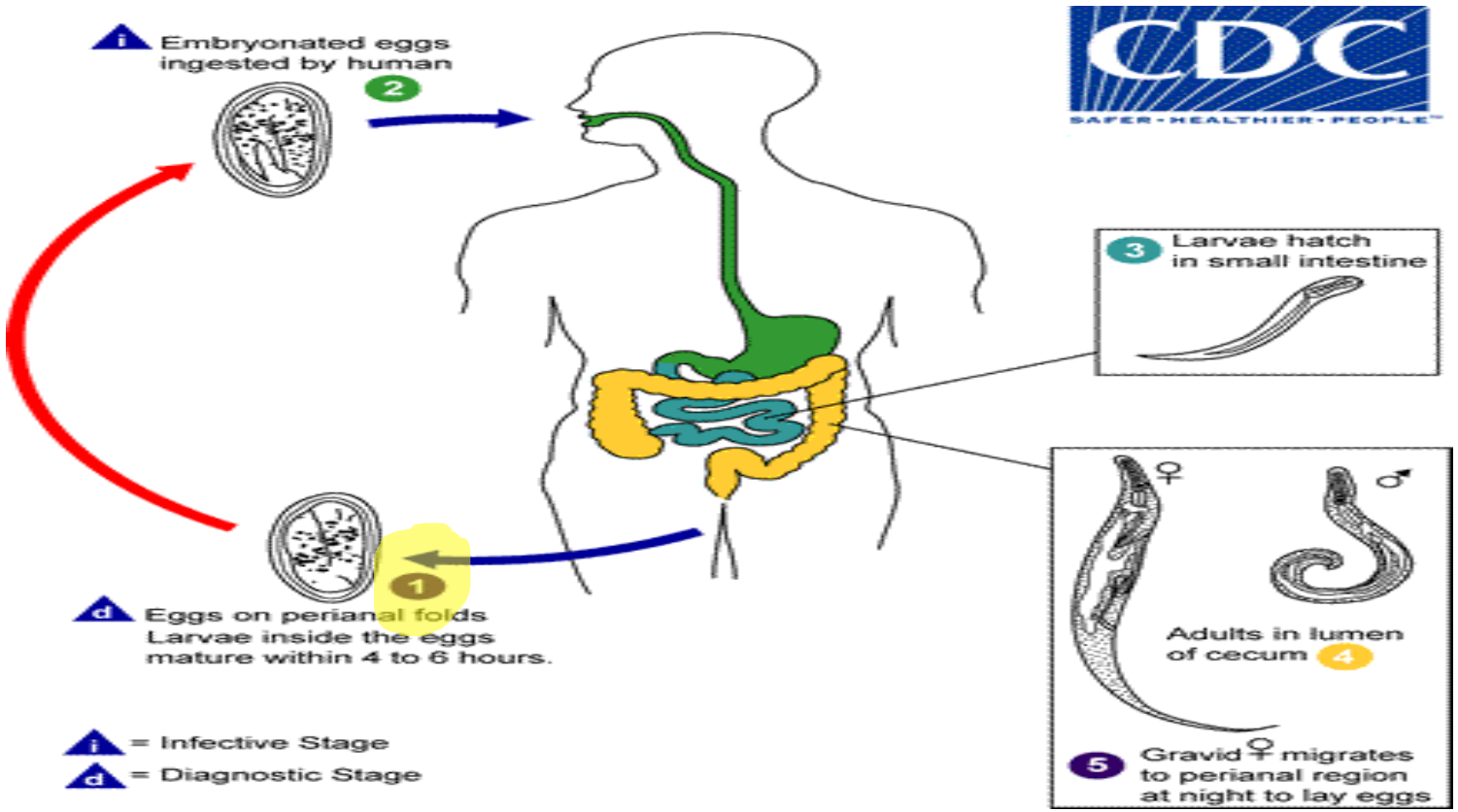
MALE (curved posterior end).

Mode of transmission

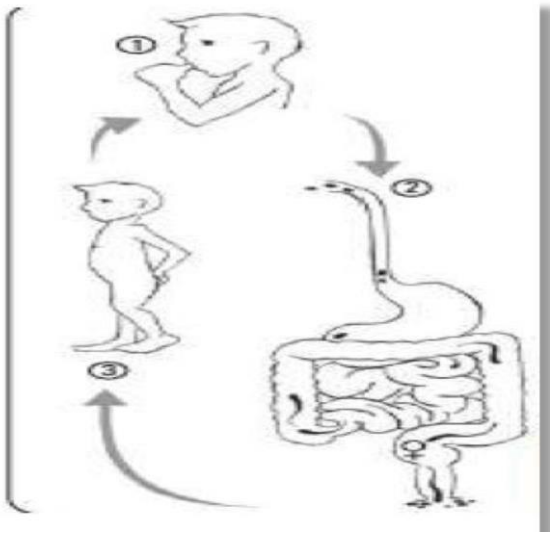
- **Fecal-oral or inhalation (autoinfection)**
- **Sexual transmission has been reported**
- **direct; transmission occurs from an infected host to another**
- **Infections are associated with institutional crowding and families**
- **They have liteweight, so they might be transmitted through inhalation.**

Life cycle

- **The female migrate at night (low cortisol level) to the perianal area where they deposit eggs. The eggs are immediately infectious.**
- Eggs embryonate within hours and transferred from their by above mentioned routes



Auto infection may occur as they are immediately infectious.



1) Infective and diagnostic stage, it doesn't need soil phase unlike ascaris, E.Vermicularis is immediately infectious. Also it doesn't have trans pulmonary route. Life span = 2-3 months.

Ascaris: not immediately infectious (needs 3 weeks) and has trans pulmonary route.
E. Vermicularis: immediately infectious and doesn't have trans pulmonary route.

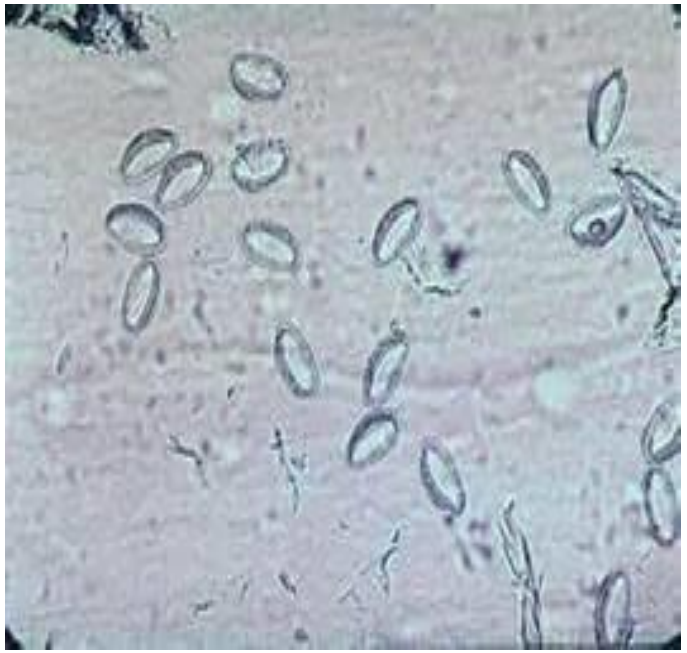
- **Clinically:**

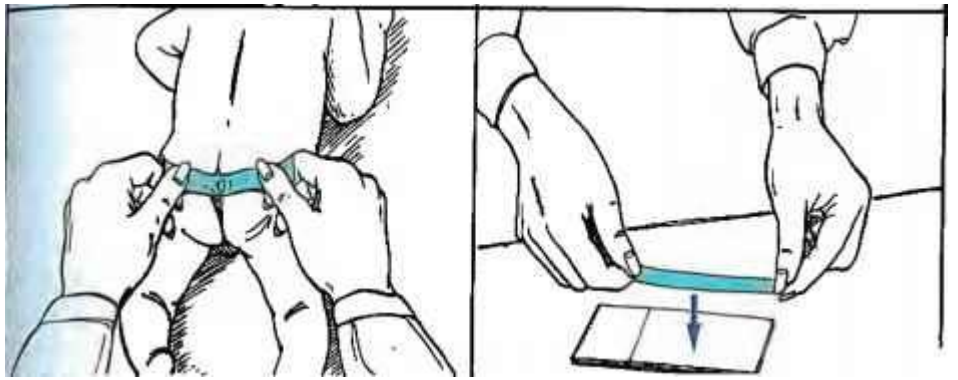
❑**Infections with E. vermicularis are typically asymptomatic**

❑**The most common complaint is perianal pruritus (itching)**

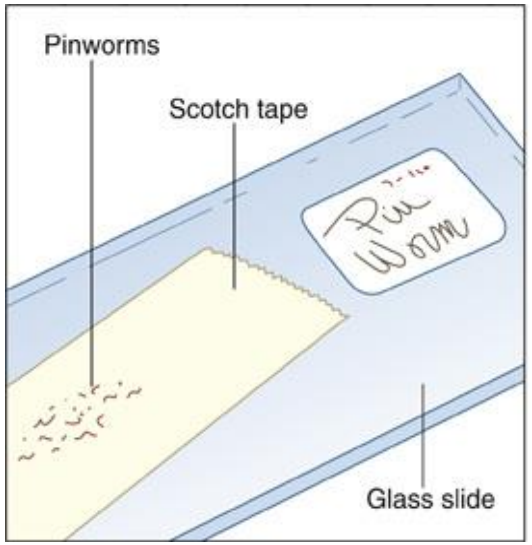
❑the parasite may migrate to other nearby tissues, causing appendicitis, oophoritis, ulcerative bowel lesions..

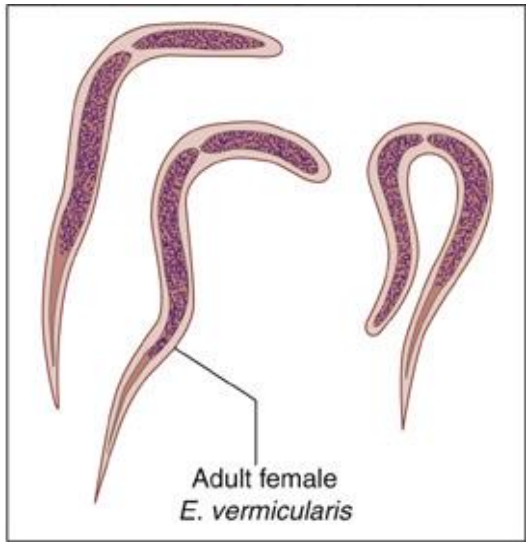
- **Diagnosis** is typically by microscopic identification of the characteristic flat-sided ovum
- the method that used for diagnosis of pinworm is a cellophane (Scotch) tape
- **Treatment: albendazole 400 mg stat repeated at 2w**





Enterobius vermicularis eggs (football (rugby) shaped eggs)
Also called D shaped eggs.





"Scotch tape test"
The test involves applying a piece of transparent adhesive tape to the perianal region, The tape is then examined under a microscope for the presence of pinworm eggs, which appear as small, oval-shaped structures.

Remember: female migrate at night to the perianal area where they deposit eggs. We rarely use stool sample in the diagnosis of E. Vermicularis.

Before we proceed to the remaining part of the lecture , let's revise some terms :

1) Definitive host : the host in which the mature stage and/or sexual multiplication take place
2) Intermediate host : the host in which the immature stage and/or asexual multiplication take place

The previously mentioned helminths (Ascaris lumbricoides & Enterobius vermicularis) are nematodes while the (Echinococcus granulosus) -that we are going to discuss in the next slide- is cestodes

- **Hydatid cysts (cystic echinococcosis)(*Echinococcus granulosus*):**

Segmented helminths

- Echinococcus is **the smallest** of all tapeworms (3 to 9 mm long)

- E. granulosus is a tapeworm found in the small intestine of the **definitive host**, the **canine**.
- Eggs are ingested by the **intermediate hosts** and include a variety of mammals including **sheep, cattle and humans.**
- **Humans** are typically **accidental hosts** and are **considered a dead - end since the life cycle of the organism is unable to continue in a human host leading** to **hydatid cysts**

Echinococcus granulosus is (platyhelminthis) , and remember that the platyhelminthis is subdivided into:
1) Flukes (leaf like worms) such as schistosomes
2) Tapeworms such as Taenia saginata (beef tapeworm) ,Taenia solium (pork tapeworm) ,and the broad fish tapeworm like (diphyllobothrium latum)

Note: these helminthis are the longest in general, diphyllobothrium latum is considered the largest & longest worm that can affect humans (up to 15 meters in length) while the Taenia saginata is up to 10 meters , Taenia solium is up to 8 meters

About the life cycle:
Normally, The definitive hosts are dogs or (carnivores in general) , the intermediate hosts are herbivores (especially sheep's and cattle's),the human can accidentally be an intermediate host (Apparent intermediate host) , apparent means that the life cycle isn't completed (dead end)

Humans infected with echinococcus granulosus by ingesting contaminated food with the eggs of echinococcus granulosus, then the ingested eggs will hatch inside the body and a larvae emerge, the larvae will encyst themselves in the liver or in the lung (maybe in the brain or in the muscles)

Note: the most common organ to be involved in cystic echinococcosis is the liver followed by the lung

- Hydatid cysts (*Echinococcus granulosus*):

The disease might be called cystic echinococcosis

- **Hydatid disease** in humans is potentially dangerous depending on the size and location of the cyst.
- **Majority occurs in liver and lungs and usually asymptomatic**
- **Some cysts may remain undetected for many years until they grow large enough to affect other organs.**

Our countries was endemic with hydatid disease

- **Diagnosis: incidentally by radiology , serology** (confirmatory)
- **Treatment: surgery, albendazole**

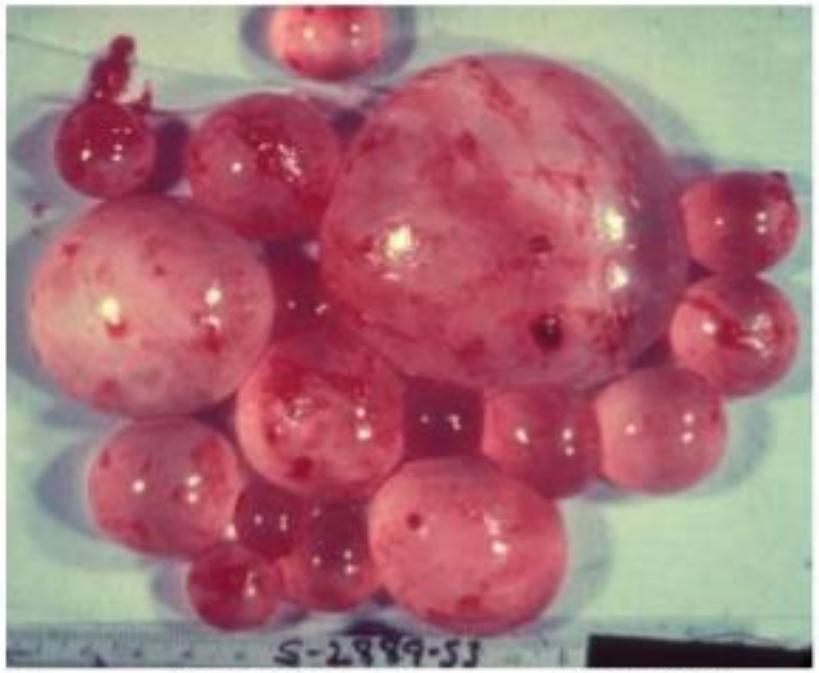
The surgeon is afraid to face a cyst of echinococcus granulosus, it needs a surgical removal but any leakage from the content of the cyst may cause anaphylactic shock

The hydatid disease is rare compared with other diseases caused by ascaris lumbricoides & enterobius vermicularis

Echinococcus granulosus is an exception of the rule (one egg—> one larva—> one adult) , because of the asexual multiplication inside the host, the cyst begins to increase in size (2cm....3cm) up to a size that is large enough to affect on other organs.....so the patient will come with symptoms related to that affected organ or accidentally diagnosed by imaging

Cyst structure

At gross examination, the vesicles resemble a bunch of grapes



- Sites of hydatid cyst: liver (65%), lungs(25%), muscle, spleen, kidney, heart, bones, brain etc

- Hydatid cysts – slow growing : 2-3cm/yr

The cyst is surrounded by three layers, each cyst is called (daughter cyst) , you can find that one of the cysts is basic and it is called (brood capsule).One of the diagnostic & infective stage for echinococcus granulosus is called (protoscoleces).
Cyst is filled with fluid called (hydatid sand) which is extremely immunogenic to the human's immune system, leakage of this hydatid sand can cause anaphylactic shock immediately

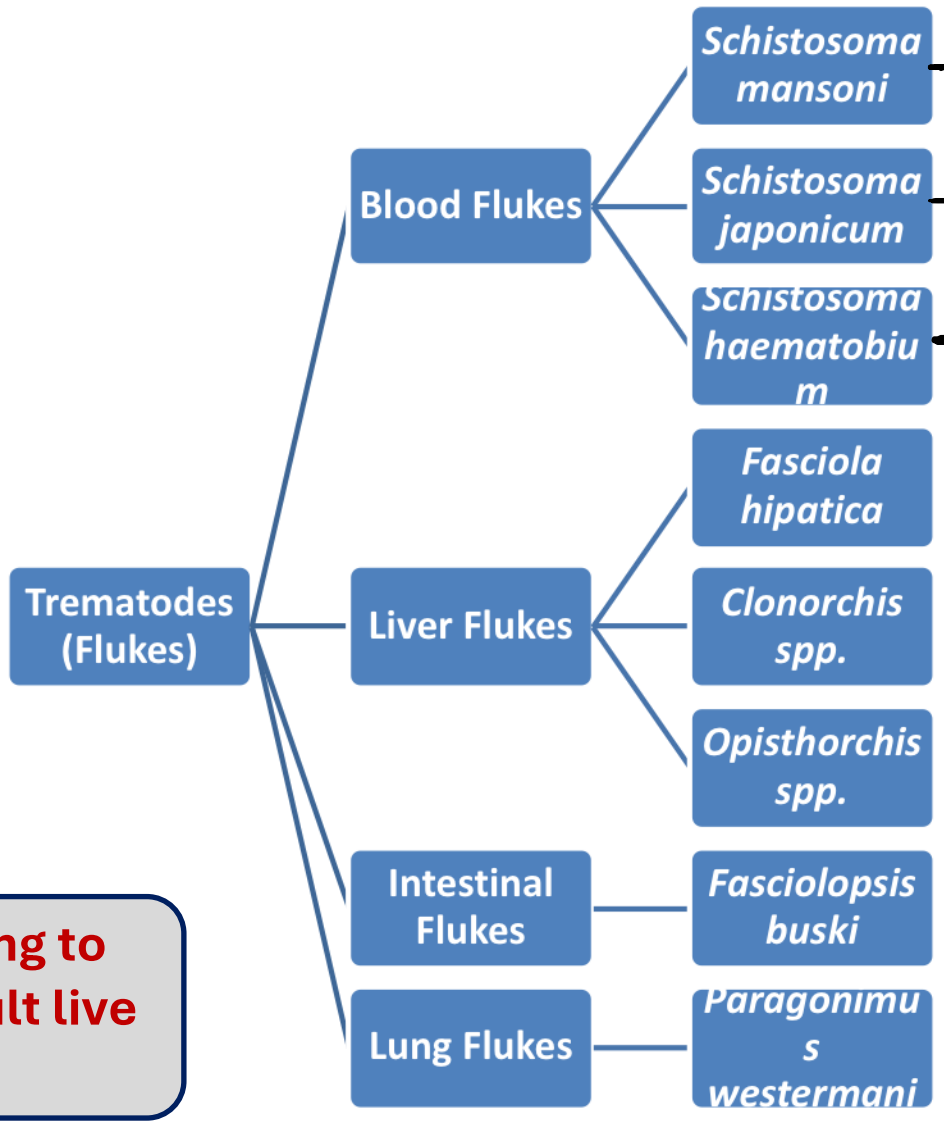
The best and internationally accepted treatment is albendazole in addition to what is called (PAIR Technique) which stands for:
P : Puncture
A : Aspirate
I : Injection of hypertonic saline or formalin
R : Re-aspirated

Trematodes classification based on the basis of their final habitats in humans:

Remember that the cestodes are monoecious (they don't have separate sexes) exception for schistosoma (they are dioecious) while the nematodes are dioecious (they have separate sexes) so we can call them (hermaphrodite)

Flukes are leaf like shape and they are flat

The Flukes are divided according to which organ (site) does the adult live inside the body



Causing abdominal schistosomiasis

Causing urinary bladder schistosomiasis

Liver,intestinal,and lung flukes....just know their names and be familiar with them

Fasciola gigantica is also a liver flukes

All Flukes, once they infect humans, the disease is related to where the adult worm live except schistosomes where the main pathogenesis is related to the eggs (the human’s immune system is extremely allergic to them) so , the immune system surrounds them by granuloma and fibrosis and here where the problem lies

SCHISTOSOMIASIS

Is a human disease syndrome due to infection by *Schistosoma*

Most human schistosomiasis is caused by

1. Schistosoma mansoni (**mainly GIT**).
2. Schistosoma japonicum (**mainly GIT**).
3. Schistosoma haematobium discovered by **Theodor Bilharz in Cairo** in 1861 (**mainly UTS**).

Endemic in far east

Very endemic in Egypt

The schistosomiasis is divided into:
GIT schistosomiasis
Urinary schistosomiasis

Schistosoma haematobium —> Adult worms live in the venous plexus of urinary bladder, once they lay their eggs, the eggs will lodge in urinary bladder which can cause dysuria, hematuria and can progress to carcinoma of the urinary bladder

Schistosoma (mansoni/japonicum) —> Adult worms live in mesenteric venous plexus and once they lay their eggs, the eggs get lodge with circulation and lodge in the liver and bile duct.....so they make granuloma and fibrosis in the liver which means that they can cause liver cirrhosis

There are also two species of Schistosoma in addition to the three mentioned above : Schistosoma Mekongi & Schistosoma Intercalatum and they are GI schistosomiasis

- It is estimated that than **200 million are infected all over the world & about 500-600 million are exposed to infection**..
- Adult worm inhabits the **portal venous system.**

Considered a significant helminthic disease worldwide

LIFE CYCLE

- **The ovum is passed in the faeces of infected individuals and gains access to fresh water where the ciliated miracidium inside it is liberated; it enters its intermediate host, a species of freshwater snail, in which it multiplies .**
- **Large numbers of tailed cercariae are then liberated into the water.**
- **Infectious cercariae penetrate human skin and migrate through the lung and the liver to reach portal venous system**

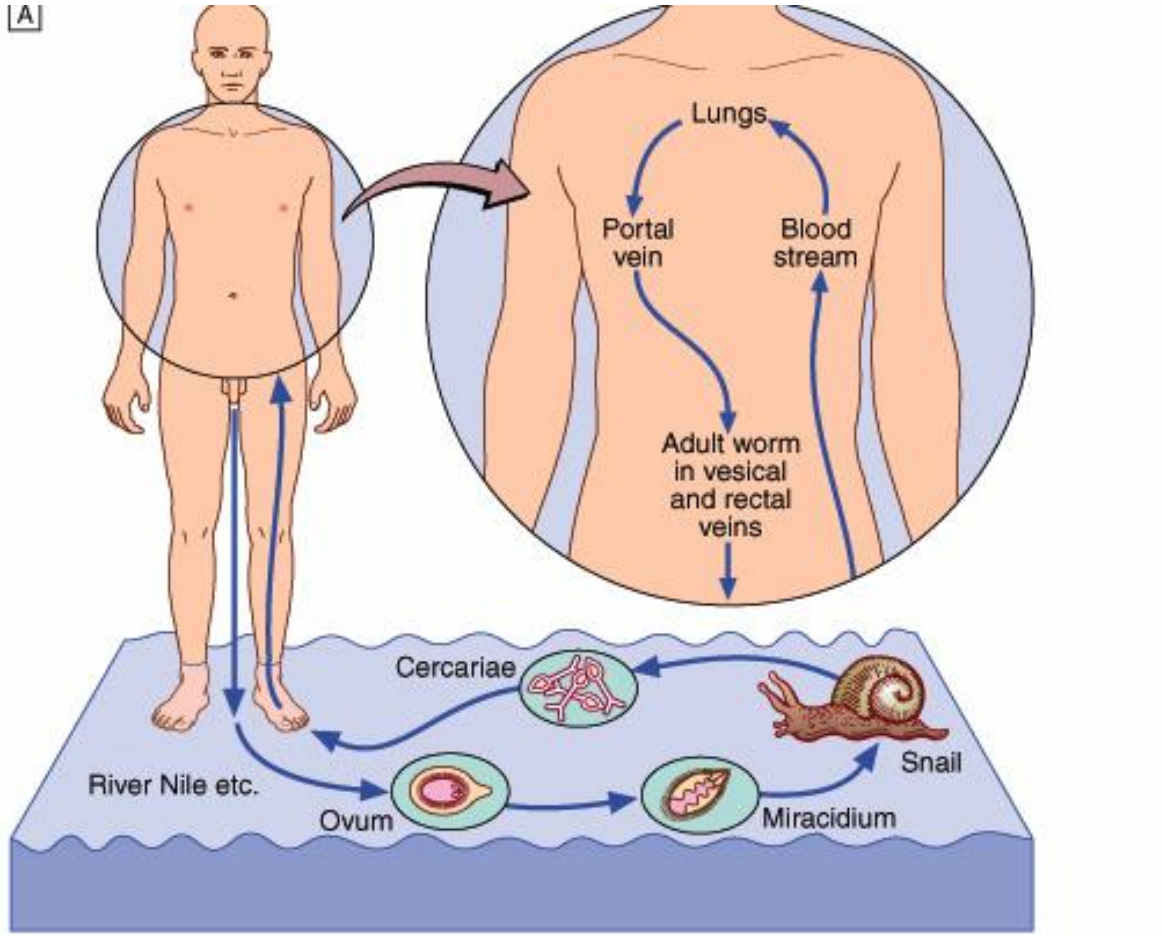
The transmission is through skin penetration rather than fecal-oral transmission

All Flukes requires at least one intermediate host and that host is the (snails) , so one of the name of schistosomiasis is (snail fever)

The ovum(eggs) will pass in the feces in case of GIT schistosomiasis while it will pass with urine in case of urinary schistosomiasis —> the eggs will hatch —> miracidium (the first stage)—> gain access to fresh water —> penetrate the snails—> they leave as cercariae (the infective stage)—> penetrate the skin—> circulate with systemic and portal circulation—> in the S.haematobium it will settle down in the venous plexus of urinary bladder while in case of S.mansoni it will settle down in mesenteric vein (usually in inferior mesenteric vein but it can be superior) and in S.japonecium it will settle down in mesenteric vein (usually in superior mesenteric vein but it can be inferior)

Look at the picture in the next slide....

LIFE CYCLE

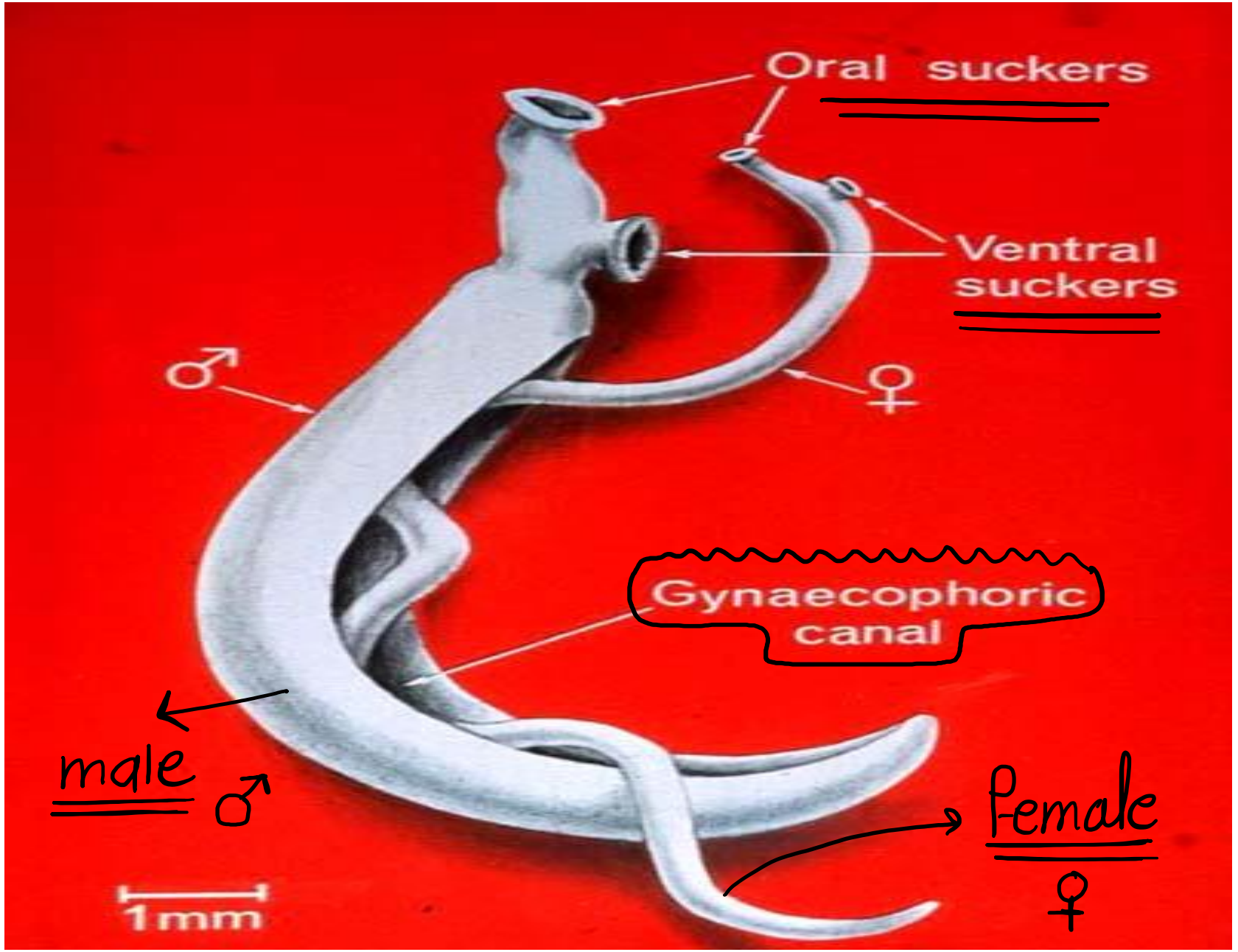

A
Lungs
Portal vein
Blood stream
Adult worm in vesical and rectal veins
Cercariae
Snail
River Nile etc.
Ovum
Miracidium

The skin penetration of Schistosoma can cause pruritus and itchy, but it isn't necessarily notified so , there is no acute manifestations

The typical picture of infection :
Egyptian person swimming in a swimming pool with contaminated water (contain snails) , this is the proper environment for infection

- ***Morphology***
- **Adult male & female have oral sucker surrounding the mouth anteriorly & ventral** Sucker on the ventral surface with which it attaches itself to the wall of the vessel in which it lives.
- **The male** worm is flat, leaf like &folded to form the **gynacophoric canal** which enfolds the slender female for almost its entire length.
- testes
- ovary

Remember that Schistosoma is dioecious and it is exception to the rule that (all flukes are monoecious)



Pathogenesis and manifestations

- **Skin penetration causing itchy rash**
- Travel via lung causing respiratory manifestations
- **Production of eggs causing granulomatous reaction and sclerosis in portal venous system to eggs deposited in tissues. This may lead to portal hypertention, esophageal varices, HSM and liver failure**

Katayama fever is associated with Schistosoma Japonecium

These manifestations for GIT schistosomiasis

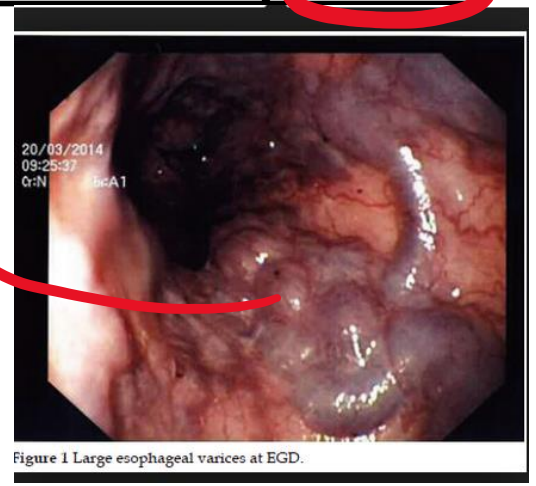


Figure 1 Large esophageal varices at EGD.

Hepato-spleno megaly

DIAGNOSIS

1. **CLINICAL**
2. HEMATOLOGICAL, BIOCHEMICAL
3. **CONFIRMED BY**

Detection of ova in STOOL or tissue biopsy

The confirmational diagnosis is by looking into the characteristic eggs in the patient's stool in (S.mansoni/S.japonecium) or in patient's urine in (S.haematobium)

Lateral Spine

S.mansoni

Treatment

Praziquantel 40mg /kg for all types and as a single dose is **treatment of choice**

All flukes have an operculated (بيضةلها غطاء) eggs, except for Schistosoma they don’t have

Schistosoma are characterised by having a spine :

S.Mansoni —> lateral spine
S.haematobium—> terminal spine
S.japonecium—> opioid in shape , nubby spine

Intestinal flukes

- Intestinal flukes include :
- **Fasciolopsis buski(the disease is called Fasciolopsiasis)**
- **Heterophyes heterophyes**
- **Metagonimus yokogawai**

Intestinal and liver flukes lives in the intestine, and the humans get infected with them either by ingestion of vegetation with infective stage or ingesting fish with infective stage

The infective stage is called (Metacercariae)

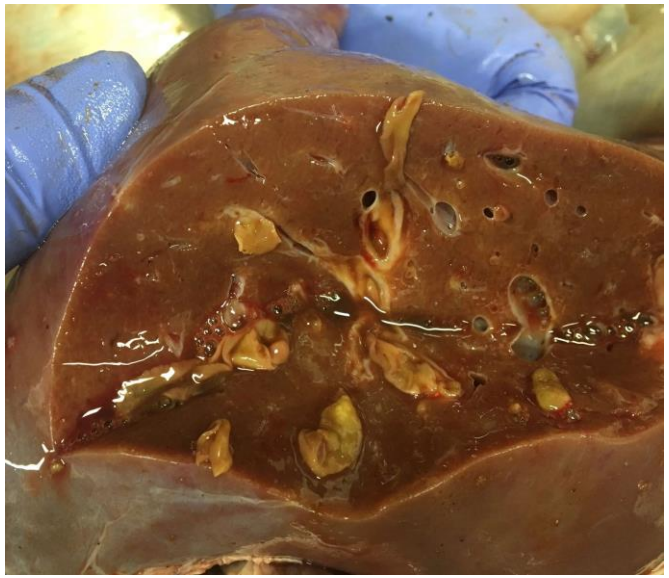
Liver flukes

- **Fasciola hepatica**
- **Fasciola gigantica**
- **Clonorchis sinensis**
- **Opisthorchis felineus/viverrini**
- **Dicrocoelium dendriticum**

Fasciola hepatica is the most common liver fluke , and the other names for it are (the common liver fluke) or (the sheep liver fluke)

Fasciola gigantica (the giant liver fluke) has a very large size

Fasciola sinesis causes (Chinese liver fluke or oriental liver fluke)



إذا كان لديك أي فكرة لتطوير عمل فريق طوفان الأقصى أو واجهت أي مشكلة، أكتبها هنا

اضغط هنا

The End

Thank you