

Introduction To Parasitology

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❖ **Medical Parasitology:** طفيليات

It is the science which deals with the parasites that infect man.

❖ **Parasite:**

Ectoparasite which causes infestation

Endoparasite which causes infection

Is an organism, which lives on or within another organism (**host**) for survival.

❖ **Host:**

Is a living organism that harbours the parasite.

• Parasitic kingdom include three phyla

multi cellular
metazoa

more complex → exoskeleton
jointed legs

• I- Protozoa. II- Helminths. III- Arthropods.

Parasitic kingdom includes three phyla

I- Protozoa (الأمراض نواقل) II- Helminths (الديدان) III- Arthropods (المفصليات)

classified
by →
two
ways

• **I- Protozoa:**

locomotion

sexual production

single cell

• Is a phylum of the animal kingdom consisting of unicellular parasites, divided into 4 classes according to the organ of locomotion:

also known as Rhizopoda

• **1- Class sarcodina:** Parasites that move by means of pseudopodia example Entamoeba histolytica.

الزحار الأميبي

AKA: Flagellates

• **2-Class mastigophora :** Parasites that move by means of flagella example Giardia lamblia causes Giardiasis (Beaver Fever in Canada) - intestinal disease.

سوط

• **3- Class ciliates :** parasites that move by means of cilia example Balantidium coli. causes Balantidiasis. The previously mentioned 3 classes reproduce only asexually.

شعيرات

• **4- Class Sporozoa :** parasites have both sexual and asexual reproductive organs, all these parasites are intracellular and they have no organ of locomotion example Plasmodium parasites causing malaria.

gliding
with no
organ of locomotion

Are obligate intracellular parasites, so one of their pathogenesis is cellular destruction.
e.g. (1) Plasmodium parasites causing malaria; they live in RBCs (anemia)
(2) cryptosporidium & (3) Cyclosporas.

- **II- Helminths:**

- They are metazoa (Multicellular parasite) wormlike parasite, divided into 3 classes:

- **1. Class Nematoda (Roundworms) :**

- a- Intestinal nematodes, e.g, *Ascaris lumbricoides* .

- b- Tissue nematodes, e.g, *Wuchereria bancrofti* .

Wuchereria bancrofti causes elephantiasis (patient's foot becomes like elephants). This class contains separate sexes male and female.

- **2- Class Cestoda (Tapeworms) :**

cestodes means segmented, so if we examine patient's stool, we'll find them segmented

- They are flattened and segmented worms e.g:

Taenia saginata .

Classes 2 and 3 (Cestoda and Trematoda) are known as Platyhelminthes (flatworms)

Flatworms have flat dorso-ventral cross sections

Flatworms are also called Hermaphrodites. Which means that the same parasite contains male and female reproductive organs.

Schistosoma (exception), have separate sexes although they are flatworms.

- **3- Class Trematoda (Flukes):**

- They are flattened leaf- shaped worms e.g:

Schistosoma heamatobium.

It causes Schistosomiasis (there are three members)

1. *Schistosoma mansonii*

2. *Schistosoma japonicum*

The first 2 cause Schistosomiasis in the intestines

3. *Schistosoma haematobium*; causes Schistosomiasis in urinary bladder (bilharzia).

↳ exception: has separate sexes

only for schistosomiasis of bladder (not intestine)

- **III- Arthropods :**

- These parasites having exoskeleton and jointed legs, divided into 2 classes:

- **1- Class Insecta** :e.g. Mosquitoes, lice and fleas .

- **2- Class Arachnida** :e.g. Ticks and mites .

Also, we can classify them into:

- Mechanical Arthropods: it only transfers the parasite from infected to another non-infected susceptible host.

- Biological Arthropods: it becomes part of the life cycle of transmitted parasite.

Mechanical vectors, such as flies, can pick up infectious agents on the outside of their bodies and transmit them through physical contact.

Biological vectors, such as mosquitoes and ticks may carry pathogens that can multiply within their bodies and be delivered to new hosts, usually by biting.

Vectors

Types of parasite

1- Ectoparasite: A parasite that lives on the surface of the host (**infestation**).

Ex : Lice) القمل

2- Endoparasite: A parasite that lives inside the body of its host (**infection**).

Entamoeba Histolytica

Survival

3- Obligatory parasite: A parasite that is completely dependent upon a host for its survival.

4- Facultative parasite: A parasite that is capable of living both freely and as a parasite.

Obligatory & Facultative Parasite: terms are related to survival of the parasite

Life
Cycle
of
Parasite

5- Permanent parasite: A parasite that spends its life cycle on or in the body of its host.

It can't complete its life cycle outside the host (note that here we are talking about life cycle too not just about survival).

6- Temporary or Intermittent parasite: A parasite that visits its host only for a short period of time for its meal.

It can complete its life cycle inside or outside the host (free living stages).

7- Opportunistic parasite: A parasite that causes disease **only in immunodeficient patients** (AIDS, cancer patients), while in **immunocompetent** individuals, the parasite may exist in a latent form producing ^{asymptomatic} no or mild symptoms.

8- Coprozoic or spurious parasite: An organism ^{living in feces.} ^{مزيف} that passes through the human intestine without causing any disease and is detected in the stool after ingestion. سيور

The most important are definitive host (D.H) and intermediate host (I.H).

Types of hosts

- **1- Definitive host (D.H):** It is the host which harbours the **mature adult stage** of the parasite or in which **sexual reproduction** of the parasite takes place.
(1)
(2)
or one of the two conditions is enough for the result (DH) to hold true
- Ex : man in case of Taenia
Cestoda
segmented
Tapeworm
- **2- Reservoir host (R.H):** The host which harbours the parasite and considered the source of human infection as
potential sources
- Dog in case of kala – azar (visceral leishmaniasis الحمى السوداء) (black fever) which is caused by the parasite (Leishmaniadonovani) .. It acts also as a source of infection to man and maintains the parasite in nature.
(potential source for the infection and we may also classify it DH or IH depending on the case).

Types of hosts

- **3- Intermediate host (I.H):** It is the host which harbours **larval stage** (immature or non-sexually reproducing forms of the parasites).

- **Ex : Snail in case of Bilharzia .**
- **القواقع** } immature stage / asexual reproduction
- } first & second intermediate host

- **4 Accidental host:** The host which harbours the parasite which is not normally found .

- **Ex : the Toxo cara (dog nematode))) الديدان الخيطية in man**

Normally, it affects dogs, but accidentally it might affect humans as well.

❖ The relationship between the organism and its host occurs in the following forms:-

Symbiosis: the relationship between two living organisms where they live and interact with each other. It contains the three following types:

1- Commensalism: It is a relationship between two living organisms where one gets benefit (commensal), while the other (host) is not harmed. (Entamoeba coli)

تطفل

2- Parasitism: It is a relationship between two living organisms where one gets benefit (parasite), while the other (host) is harmed.

تبادل

3- Mutualism: It is a beneficial relationship between two living organisms where both drive a benefit and can successfully live apart.



4- Symbiosis: It is a close and long term relationship between two living organisms

❖ Modes of transmission of parasitic infection:-

1- **Direct contact through the skin.**

2- **Penetration of the skin.** ^{urinary bladder} schistosomes can cause Schistosomiasis when people swim in contaminated water, it can penetrate the skin and cause the infection.

Fecal-Oral transmission; it is the most famous mode of all 10 modes, and it is the cause of intestinal parasitic infections.

3- **Ingestion of contaminated food or drinking water** containing the infective stage of the parasite.

4- **Inhalation of dust** carrying the infective stage of parasite.

5- **Congenital** from mother to foetus (transplacental) or may by **transmammary** ^{lactation} (mother's milk).

^{torch infection}

^{extra info:}
The term TORCH complex or TORCHes infection refers to the congenital infections of toxoplasmosis, others (Syphilis, Hepatitis B), rubella, Cytomegalovirus (CMV), and herpes simplex

such as Pinworm females migrate through the anus and go to the perineum (anal cleft) and lay their eggs there (it's considered outside the body); since it is itchy, the child will scratch it. Due to lack of hygiene, when they then put their hands in their mouth, the parasite reenters the body.

applies to one parasite only, namely *Strongyloides stercoralis* (human threadworm), which doesn't require to be transported outside the host to reinitiate the infection.

6- Sexual contact. *Trichomonas vaginalis* which causes Trichomoniasis.

7- Autoinfection (either external or internal).

is such a way that the complete life cycle of the parasite happens in a single organism without the involvement of another host.

8- Vectors, through bite or feces of infected vector or

by swallowing the vector.

Sand Fly can transfer *Leishmania Tropica/Major* which causes a disease called Cutaneous Leishmaniasis (In Jordan, we can see this in Aqaba).

↳ we don't have visceral leishmaniasis (kala azar)

9- Blood transfusion or through contaminated

syringes.

The modes 9 and 10 are mainly with Protozoa, eg. plasmodium; it causes Malaria. Also, *Trypanosoma*, *Toxoplasma*, and *Leishmania* are transmitted by 9 and 10.

10- Organ transplantation.

Terms used in parasitology

- **Habitat:** The natural site where the parasite lives.
- **Carrier:** A host in a state of equilibrium with parasite **without or with minimal symptoms** of the disease, but he is **infective to others**.
We must differentiate between carrier and a host in latency state
Latency state: no symptoms and not infective to others.

zoonotic diseases

- **Zoonosis:** Transmission of an infection from animal to man ^{*vector*} either **directly or indirectly via intermediate** host e.g. viruses transmitted by arthropod vectors (arbovirus).

viruses transmitted by arthropod vectors (arbovirus) causes a disease known as Viral Hemorrhagic Fever (النزفية الحمى)

rodents → humans

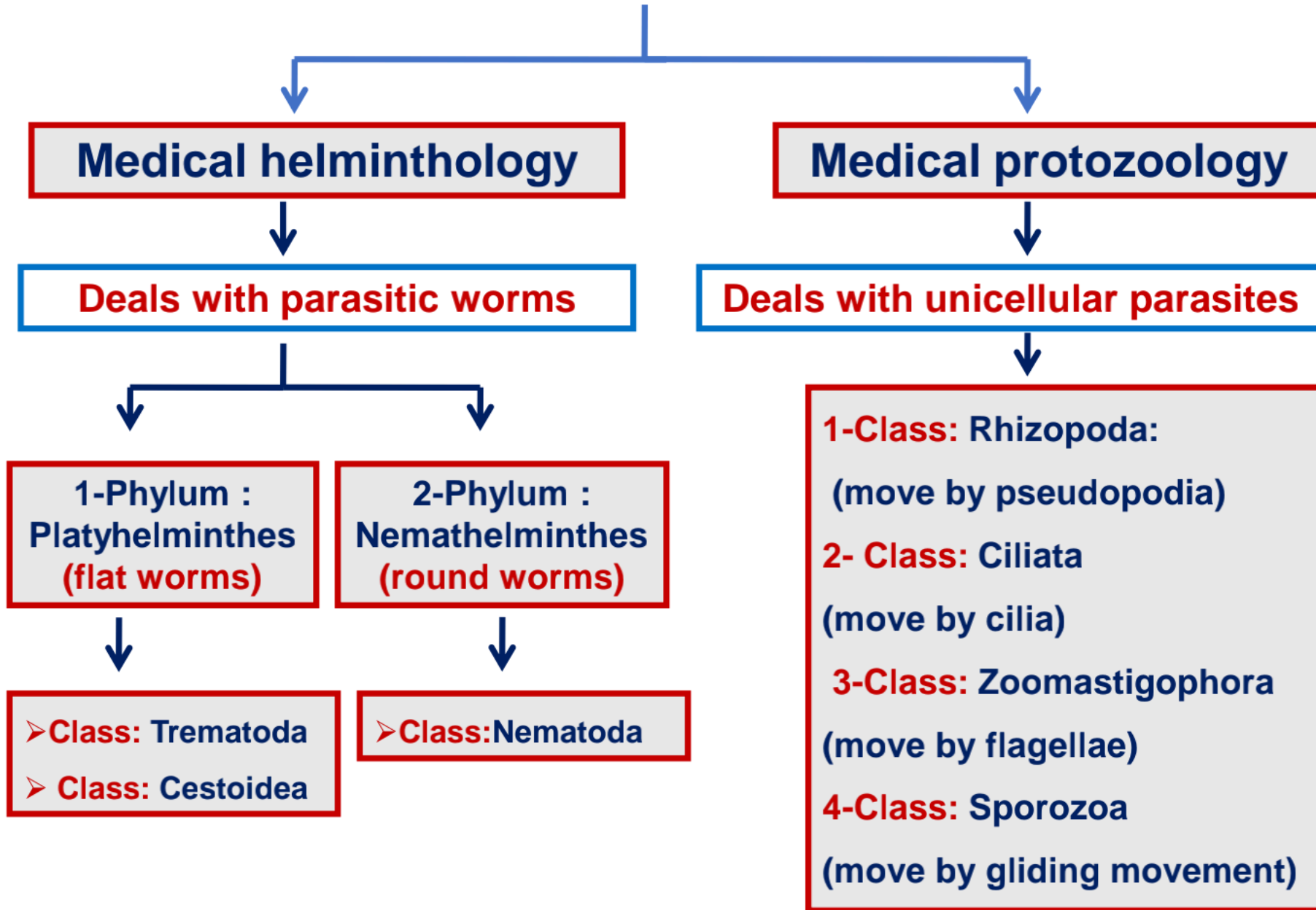
another definition *Alternatively, it is the developmental stage when the parasite enters the body.*

➤ **Infective stage (I.S):** The stage by which the infection takes place.

also is *Alternatively, it is the developmental stage when the parasite leaves the body.*

➤ **Diagnostic stage (D.S):** The stage by which we can diagnose the parasitic infection (disease).

Medical parasitology is classified into



Pathogenesis of parasitic infection

❖ Occurs through the following:-

1) Mechanical: The parasite may obstruct normal passage like intestine or bile tract. as large parasites (it's helminths' main pathogenesis) can cause obstruction in colon. *tube-like structure (can be obstructed)*

2) Traumatic :-

✓ **External due to invasion of the skin.**

As in Amebiasis (Entamoeba histolytica) in which the parasite lives only in the colon tube - Luminal Amebiasis. In other stages, there might be invasion into the mucosa & submucosa. Luminal Amebiasis causes diarrhea, but when invasion of the wall occurs, dysentery occurs (Blood + Mucus with diarrhea).

Trauma

✓ **Internal by attachment to intestinal mucosa by buccal capsule producing ulcers.**

3) Toxin production: Circulation of parasitic products (toxins and waste products).

4) Tissue damage and necrosis: Due to enzymes secreted by parasites.

specialty praziquantel → RBCs

As Plasmodium (lives intracellularly) in RBCs causing malaria.
✓ RES (reticuloendothelial system) damage.

5) Cellular destruction: As RBCs or RES damage.

6) Immune stimulation: Parasitic antigens produce

↳ how body responds

humoral /or cellular immune response → cellular

proliferation and infiltration → formation of fibrous

encapsulation around parasites (ex: hepatic granuloma

in *Schistosoma mansonia*).

In Helminths most diseases result from immune reaction to the present of adult stage, but not in all cases - in Schistosomiasis, the main pathology is immune reaction to the eggs of Schistosoma not the adult stage.

↳ clue when we do a CBC (complete blood count) → look at leukocyte numbers → leukocytosis → infection - usually -
→ extreme leukocytosis → cancer - leukemia -

7) Allergic reaction due to insect bites or parasitic toxins.

Lymphocytes → Viruses
Neutrophils → Bacteria
Eosinophil and IgE are the main mechanisms against Parasites

} clues not facts

□ The pathogenesis of the parasite **depends on** the number, size and morphology of the parasite, its activity (movement and migration), site (habitat), specific toxin and **host reaction.**

A lot of factors affecting pathogenesis of infection
(The Parasite itself, Immune Response & the environments factors)

Diagnosis of parasitic infection

I) Clinical diagnosis:-

Depends on the characteristic signs and symptoms related to the parasitic infection.

II) Laboratory diagnosis:-

❖ **Direct methods (to detect the diagnostic stage):-**

Microscopical examination of the tested samples (ex:

1- stool, 2- urine, 3- blood , 4- tissue biopsy, 5- sputum & 6-aspirates.

Aspirate (pronounced AS-pih-rayt) refers to the act of withdrawing the fluid, tissue, or other substance through a needle

1-Stool Examination

Mainly for intestinal infection.

1- Must collected in clean, dry, tight fitting lid containers.

2- Macroscopic examination: for consistency, composition, color and presence of adult parasites such as *Enterobius vermicularis*, *Taenia* segments & *Ascaris* worm.

(Proglottids)

can see the whole adult worm

Sometimes the patient will macroscopically notice something abnormal in the stool.

3- Microscopic examinations:

➤ **Direct saline smear or iodine smear:** when helminthic eggs & protozoa cyst are in large numbers.

➤ **Concentration techniques:** if the parasites is to increase your chance in spotting the parasites (eggs/cyst...) **scanty.** small quantity

➤ **Permanent stained smear :** for correct **identification of most protozoa.**

we fixed the slide (formalin fixed) for correct identification of most protozoa. It can be referred to later (it stays preserved)

should be in vagina but still can reach urethra

Ectopic infection within the pelvis: generally, refers to the occurrence of an infection in a location outside its normal or expected site, specifically within the pelvic region.

2- Urine examination

Mainly for genitourinary tract infections

The urine sample is examined macro& microscopically.

Certain parasites can be detected in urine as

Schistosoma haematobium eggs, *Trichomonas*

vaginalis trophozoites & eggs of *Enterobius*

vermicularis.

can be because of

Trophozoites of *Trichomonas vaginalis* (a sexually transmitted disease; presents in the vagina and can be detected in the urethra ectopic infection within the pelvis)

(parasite appears in stool macroscopically)

Eggs of *Enterobius vermicularis* (commonly known as the pinworm; here there is also an ectopic infection within the pelvis, these eggs should present in the intestine not in the urine, because it causes an intestinal infection.)

3- Blood examination

Blood droplet (directly to the slide) = thick
Swept (ممسوحة) (Blood droplet (over the slide
as well) = thin

Here the identification of the parasite can be done

- **Thin blood film:** to demonstrate the morphological
more detail

features of the parasites.

(Only for detecting the existing of the parasite or not)

- **Thick blood film:** to obtain large amount of blood which

increase possibility of detecting light infection. Parasites

detected in the blood are: **Malaria**, **Leishmania**, **Filaria** &

(affect mainly lymphatic system)

plasmodium

Trypanosomes.

Trypanosomiasis: one of the blood flagellate diseases, clinically has 2 types:

1- American Trypanosomiasis (Chagas Disease) → بالقلب مشاكل

2- African Trypanosomiasis (Sleeping Sickness) → CNS

4-Tissue biopsy

Tissue biopsy specimens are recommended for diagnosis of a number of parasitic infections

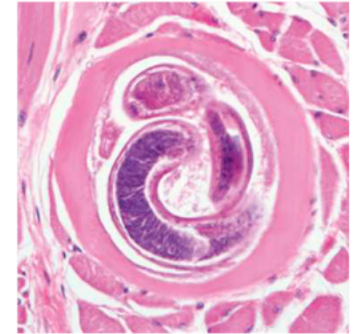
for example:

Muscle biopsy : In *Trichinella spiralis*.

*all helminths are extracellular except:-

(The only helminth that lives intracellularly) → in muscle fibers

Spirals in muscle



Rectal biopsy : In detecting *Schistosoma ova*.

remember:

It causes Schistosomiasis (there are three members)

1. *Schistosoma mansoni*
 2. *Schistosoma japonicum*
- > rectal biopsy

The first 2 cause Schistosomiasis in the intestines

3. *Schistosoma haematobium*; causes Schistosomiasis in urinary bladder (bilharzia).

not *Schistosoma haematobium* that affects urinary bladder.

5- Sputum examination

• Sputum is examined to detect parasites:

✓ **living in the lung.** target lungs
e.g. Paragonimus westermani

✓ **migrating through the lung.** larva migrans
Like some helminths, to complete their life cycle, they must be transported through the pulmonary system; they may then be swallowed back into the intestines

✓ **parasites which result from rupture of cysts in the lung.**

• **Parasites detected in the sputum are: Eggs of Paragonimus, trophozoites of *E. histolytica*, parts of ruptured hydatid cyst & migrating larvae of *Ascaris*, *Ancylostoma* & *Strongyloides*.**

why do they enter the lungs?
one possible explanation:
- has to do with evolution of
trying to prolong their stay
inside host → not to stay in
intestines & get flushed away →
travels to lungs & gets
reswallowed to colon as
mature helminths

Parts of ruptured hydatid cyst (very important in surgery) presents mainly in the lung and the liver. Its causative agent is a parasite known as *Echinococcus granulosus*.

Trophozoites of *Entamoeba histolytica* which causes Amebiasis, and it may cause extraintestinal amebiasis, they may migrate to several sites (skin, brain, liver, lung).

Migrating larvae of *Ascaris*, *Ancylostoma* (hookworm) & *Strongyloides*. Those parasites migrate through the lungs as part of their life cycle.

6- Aspirates examination

spp. = species of a certain genera.

sp. = one species that is not mentioned

- ❑ **Cerebrospinal fluid** may be used for detection of certain parasites of CNS as *Trypanosoma* spp & *Naeglaria*

like *Trypanosoma rhodesiense/gambiense*; cause African trypanosomiasis, also known as African sleeping sickness.

- ❑ **Duodenal aspirates (Enterotest):** for examination of duodenal contents.

(with helminths that affect GIT and live in the duodenum like *ancylostoma duodenale*)

- Parasites which can be present as *Giardia lamblia*, *Strongyloides larva* & *Cryptosporidium parvum*.

The End