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# Microbiology

Doctor 2018 | Medicine | JU

● Sheet

○ Slides

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This lecture is an introduction to parasitology, we will discuss some terms related to this branch of microbiology. Have FUN ^^

## Medical Parasitology:

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

### Parasite:

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

### Host:

Is a living organism that harbours the parasite .

### ❖ Parasitic kingdom include three phyla:

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

#### I- Protozoa:

Is a phylum of the animal kingdom consisting of **unicellular** parasites, and we distinguish them according to their **organ of locomotion** (how they move) and if there is **sexual reproduction**.

Firstly according to the **organ of locomotion** they divided into 4 classes:

**1- Class Sarcodina:** also known as **Rhizopoda**. Parasites that move by means of **pseudopodia**. Example, **Entamoeba histolytica** which cause **amebiasis** الزحار الأميبي.

**2-Class Mastigophore:** also known as **Flagellate**. Parasite that move by means of **flagella**. Example, **Giardia lamblia**.

*It causes Giardiasis ,Beaver Fever* in Canada, is an infection in your small intestine. It spreads through contact with infected people. And you can get giardiasis by eating contaminated food or drinking contaminated water.

**3- Class ciliates :** parasites that move by means of **cilia** example **Balantidium coli** .

It causes a disease known as **Balantidiasis** or balantidiosis which is defined as large-intestinal infection with Balantidium coli.

**4- Class Sporozoa :** parasites have both sexual and asexual reproductive organs, all these parasites are obligate intracellular so, one of its pathogenesis is cellular destruction. They have **no organ of locomotion**. Example, **Plasmodium** (causative agent of malaria and they live in RBC's), cryptosporidium & Cyclospora. They transport using Gliding Mechanism.

**According to the sexual reproduction:**

**Class Sarcodina, Mastigophore & ciliates** reproduce asexual. While **Sporozoa** can alternate between sexual and asexual.

## **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*** which cause a disease known as **elephantiasis**.

This class contains separate sexes male and female.

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

They are flattened and **segmented** worms and these segments play a role in the diagnosis (the same parasite get segmented into sections in the stool) e.g ***Taenia Saginata , Taenia Solium, Echinococcus Granulosus*** and ***Diphyllobothrium Latum***. “don't worry we will discuss them in details later on ^^ ”

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

They are flattened **leaf-shaped** worms e.g ***Schistosoma haematobium***.

It causes **Schistosomiasis**, also known as **snail fever** and **bilharzia**.

***Schistosoma mansoni***, and ***Schistosoma Japonicum*** cause **Schistosomiasis** in intestine while ***Schistosoma haematobium*** causes **Schistosomiasis in urinary bladder**.

>> **Class 2 and 3** known as **Platyhelminthes** (flatworm) and they don't contain separate sexes, we called them **Hermaphrodites**. Which means that the same parasite contains male and female reproductive organs. But, *Schistosoma* is an exception to this rule and it has separate sexes.

### III- Arthropods:

These parasites having exoskeleton and jointed legs and they are **vectors** of diseases, divided into **2 classes**:

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

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

**Also, we can classify it into:**

**Mechanical Arthropods:** it only transfers the parasites from infected to other non infected (susceptible).

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

#### ❖ Types of parasite:

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

Ex: Lice

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

Ex: Entamoeba Histolytica

**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 parasite & Facultative Parasite both are related to survival of the 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 .

**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 .

**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 no or mild symptoms.

**8- Coprozoic or spurious parasite:** An organism that passes through the human intestinal canal without causing any symptom or disease and is detected in the stool after ingestion.

## ❖ 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. Ex : man in case of Taenia

**2- Reservoir host (R.H):** The host which harbours the parasite and considered the source of human infection. Ex: Dog in case of **kala-azar** (visceral leishmaniasis), it means Black Fever, which is caused by the parasite (Leishmaniadonovani). It acts also as a potential source of infection to Human and maintains the parasite in nature.

**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.

**4- Accidental host:** The host which harbours the parasite which is not normally found. Ex: the Toxo cara الديدان الخيطية (dog nematode) in man. Normally it doesn't affect Humans but accidentally it might affect humans.

>> To find a parasite in others host rather than the normal one.

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

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

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

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

**4- Symbiosis:** the relationship between two living organisms. They just live and interact with each other. So, it contains the above three definitions (Commensalism, Parasitism & Mutualism).

"The doctor mentioned that the definition written in the slide related to symbiosis should be deleted"

## ❖ Modes of transmission of parasitic infection:

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

**2- Penetration of the skin:** For example: **schistosomes** can cause **Schistosomiasis** when people swim in contaminated water, it can penetrate the skin and cause the infection.

**3- Ingestion** of contaminated food or drinking water containing the infective stage of the parasite. The most famous one in intestinal parasite is Fecal-Oral transmission .

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

**5- Congenital:** from mother to fetus (transplacental) as Torch Syndrome, which is a cluster of symptoms caused by congenital **infection** with **toxoplasmosis**. And it maybe trans mammary through lactation (mother`s milk) like Ascaris .

**6- Sexual contact:** For example **Trichomonas vaginalis** which causes **Trichomoniasis**.

**7- Autoinfection:** is such a way that the complete life cycle of the parasite happens in a single organism without the involvement of another host. Either External as **Pinworm** which causes as **Enterobiasis** or **Oxyuriasis** (they penetrate the anus and go to perineum and lay their eggs there, since it is itchy the children will scratch it then put their hands to their mouth so the parasite reenter the body again) or Internal as **Human Threadworm**, doesn't require to be transported outside the host to reinitiate the infection.

**8- Vectors:** through bite or feces of infected vector or by swallowing the vector. For example Sand Fly can transfer **Tropica Leishmania** which causes **Cutaneous Leishmaniasis**.

**9- Blood transfusion or through contaminated syringes:** mainly protozoa.

Ex: **plasmodium** which causes Malaria, **Trypanosoma**, **Toxoplasma** and **Leishmania**.

**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**.

**Zoonosis:** is a term applied to **zoonotic diseases** which are diseases transmitted from animals to human either directly or indirectly via intermediate host (vector) e.g. viruses transmitted by arthropod vectors (arbovirus) causing a disease known as Viral Hemorrhagic Fever الحمى النزفية.

*Don't get confused with this term, we will discuss it in details in the next lectures.*

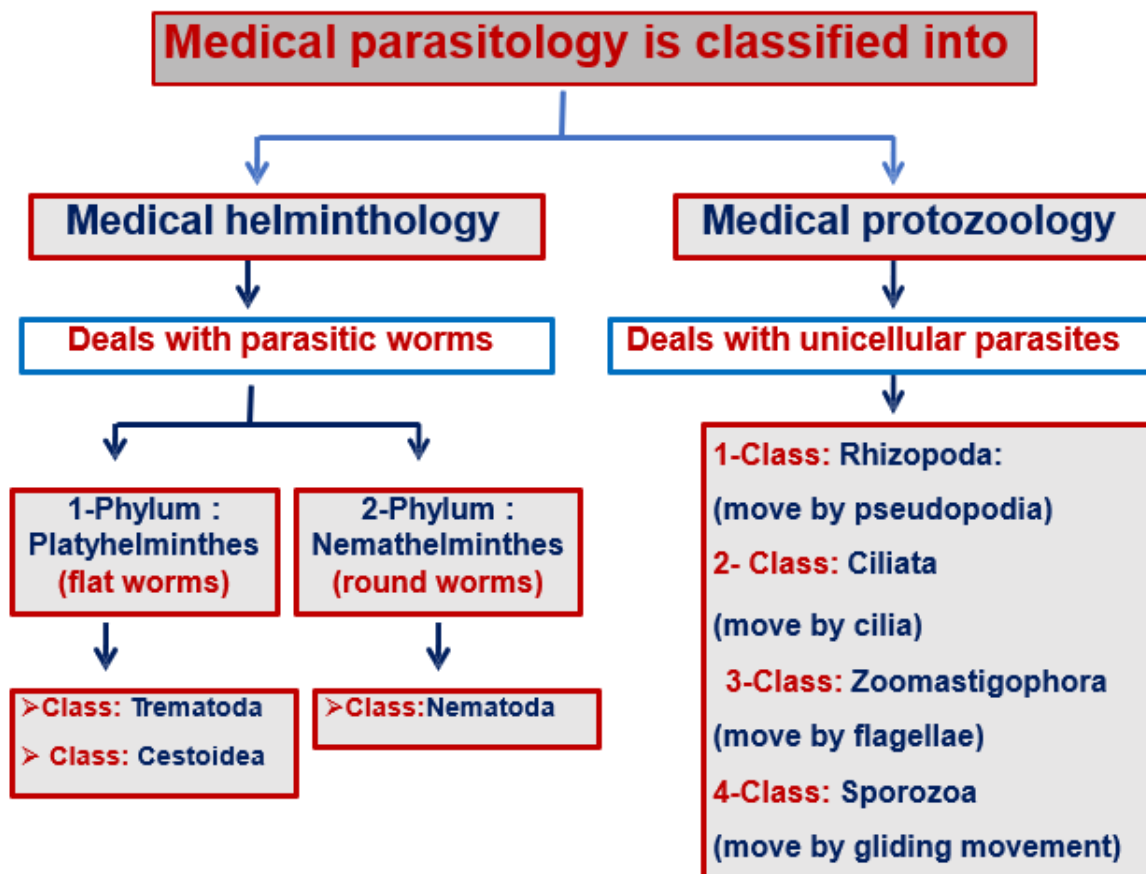
**Infective stage (I.S):** The stage by which the infection takes place.

>>The stage that the parasites **enter** the body.

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

>>The stage that the parasites **leave** the body.

These **two terms** are very important.



## Pathogenesis of parasitic infection:

Occurs through the following:-

**1) Mechanical:** The parasite may obstruct normal passage like intestine or bile tract as large parasites can cause obstruction in colon.

**2) Traumatic effect :** External due to invasion of the skin. Internal by attachment to intestinal mucosa by buccal capsule producing ulcers.

As in Amebiasis in which the Parasite lives only in the colon tube which we called **Luminal Amebiasis**, in other stage there might be invasion for mucosa & submucosa. So Luminal Amebiasis causes diarrhea but when invasion of the wall occurs here will be dysentery (Blood+Mucus with diarrhea).

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

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

**5) Cellular destruction:** As Plasmodium in RBCs or RES damage.

**6) Immune stimulation:** Parasitic antigens produce humoral /or cellular immune response → cellular proliferation and infiltration → formation of fibrous encapsulation around parasites (ex: hepatic granuloma in Schistosoma mansonia).

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

**Remember :**

**Lymphocyte → viruses**

**Neutrophils → Bacteria**

**Eosinophil → Parasites**

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.(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.

### 1-Stool Examination

- Mainly for intestinal infection.
- Must collected in clean, dry, tight fitting lid containers.
- Macroscopic examination: for consistency, composition, color and presence of adult parasites such as **Enterobius vermicularis**, **Taenia segments** & **Ascaris worm**.

>> The idea is sometimes the person might go to bathroom and feel that there is something with the feces that he can see it with his eyes.

- Microscopic examinations:

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

**Concentration techniques:** if the parasites is scanty.

**Permanent stained smear :** we fixed the slide (formalin fixed) for correct identification of most protozoa.

>> The idea here that you take 1-2 grams from feces then put it on slide with saline. So, if the number of parasites is little we do concentration in order to know whether there are parasites or not.

### 2- Urine examination

The urine sample is examined macro& microscopically.

Certain parasites can be detected in urine as **Schistosoma haematobium** eggs, **Trichomonas vaginalis** trophozoites (it presents in the vagina and can be detected in the urethra >> ectopic infection within the pelvis) & **eggs of Enterobius vermicularis** (here there is 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

**Thin blood film:** to demonstrate the morphological features of the parasites.

**Thick blood film:** droplet from the blood to obtain large amount of it which increase possibility of detecting light infection.

**Parasites detected in the blood are:** Malaria (plasmodium), Leishmania, Filaria & Trypanosomes.

### 4-Tissue biopsy

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

**For example:** Muscle biopsy in **Trichinella spiralis**. Rectal biopsy in detecting **Schistosoma ova**.

### 5- Sputum examination

- Sputum is examined to detect parasites that:
  - living in the lung. Ex: **Paragonimus westermani**.
  - migrating through the lung.
  - parasites which result from rupture of cysts in the lung.
- **Parasites detected in the sputum are:**
  - **Eggs of Paragonimus**
  - **Trophozoites of Entamoeba histolytica** which causes Amebiasis and it may cause extraintestinal amebiasis, they may migrate to several sites (skin, brain, liver, lung)
  - Parts of ruptured **hydatid cyst** presents mainly in the lung and the liver. Its causative agent is a parasite known as **Echinococcus granulosus**.
  - Migrating **larvae of Ascaris, Ancylostoma & Strongyloides**. Those parasites migrate through the lung as part of their life cycle.

### 6- Aspirates examination

- **Cerebrospinal fluid may be used for detection of certain parasites of CNS such as**
  - **Trypanosoma spp** (Trypanosoma rhodensiense) it causes African trypanosomiasis also known as sleeping sickness.
  - **Naeglaria**
- Duodenal aspirates (Enterotest): for examination of duodenal contents.
  - **Parasites which can be present as Giardia lamblia, Strongyloides larva & Cryptosporidium parvum.**

The end ^^