Lecture (1)

*Introduction to Parasitology and Classification

Parasitology : It is the science that specializes in studying all aspects of life in parasitic animals as movement ,nutrition ,reproduction ,respiration ,excretion ,secretion , sensation and even susceptibility to disease .

Host:

An organism which harbors the parasite and provides the nourishment and shelter to the latter.

***The importance of parasitology study**

Some parasites can cause death to humans such as malaria, or cause permanent diseases such as schistosomiasis also some of parasites can cause permanent disabilities such as *Wuchereria bancrofty* worms as well as some of the parasites infected animals of human and led to loses of these animals as chicken ,cows and sheep or domestic animals ,in addition there are parasites can infected plants and cause significant damage to agricultural production such as nematodes.

Parasite : A parasite is an organism that is entirely dependent on another organism (host) for all or part of its life cycle and metabolic requirements.

Parasite is of two types

1-**Microparasites**: small, unicellular and multiplies within its vertebrate host, often inside cells. Protozoa are microparasites

2-**Macroparasites**: large, multicellular and has not direct reproduction within its vertebrate host. This category include helminths

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Parasites can be divided according to the **habitat** into:

a-**Ectoparasite** :Parasite that is lives in or on the exterior surface of a host such as mites , lice. The infection by these parasites is known as *infestation*.

b-**Endoparasite :** Parasite that is lives inside body of host e.g. worms and protozoa . The invasion by endoparasite is known as *infection* **,** endoparasite can be further subdivided into following types:

1- Parasites can be divided according to **the nature of living** into:

a- **Obligatory** parasite : Parasite that cannot survive outside of a host e.g., *Toxoplasma gondi*).

b- **Facultative** parasite :Parasite that is capable of existing independently of a host *Acanthamoeba* spp.

***C* - Aberrant parasites:** Organisms that attack a host where they cannot live or develop further (e.g.)

Toxocara canis in man).

d-Accidental parasite : Organisms that attack an unusual host (e.g., *Echinococcus granulosus* in man).

e-Free-living: the nonparasitic stages existence which are lived independently of a host, e.g., hookworms have active freeliving stages in the soil.

2-Parasites can be divided according to **the length of time it spend with the**

They are parasites that visit their host only when feeding then it leave after it get the food like mosquitoes sucking human blood which is called **Temporar**y parasite While parasites that live a specific period of their life in or on their host are called **Stationary** parasites that can be divided into two groups one of them live a period of time with its host and then leave its host to live free which is called **periodic** parasites ,the another group which is called **permanent** parasites that spent all its life with its host .

3-Parasites can be divided according to **the number of hosts which parasite required**

a-Monoxenous parasite : which have one a host .

b-Heteroxenous parasite : which have more than one a host**.**

Kinds of Host:

Host is the organism that the parasite live on or in it and get its nutrients with protection from it, there are five type of host as follow:

1- **Definitive host** : is the host in which the adult sexual phase of parasite development occurs is the mammalian host. such like a human being for *Schistosoma* parasite.

2-**Intermediate host** : is the host in which the larval asexual phase of parasite development occurs Some parasites require two intermediate hosts for completion of their life cycle. These are referred to as first and second intermediate hosts like a human being for *Schistosoma* parasite.

3- **Reservoir host** : It is a host that harbors the parasite and serves as an important source of infection to other susceptible hosts like a snails being for *Schistosoma* parasite.

4- **Paratenic or Carrier host** : parasite-harboring host that is not exhibiting any clinical symptoms but can infect Others without any development for larval stage of parasite.

5- **Compromised host**

A compromised host is a host in which normal defence mechanisms are impaired such as AIDS, absent as congenital deficiencies, or by passed (e.g., penetration of skin barrier), this hosts are extremely susceptible to a variety of common as well as opportunistic pathogens.

Zoonosis

This term is used to describe an animal infection that is naturally transmissible to humans either directly or indirectly via a vector. Examples of parasitic diseases that are zoonosis include leishmaniosis, trypanosomiasis, hydatid disease.

Vector

A vector is an agent, usually an insect, that transmits an infection from one human host to another. It is of two types: **1. Mechanical vector**: is not essential in the life cycle of the parasite **2. Biological vector:** in which the pathogens undergo developmental changes with or without multiplication.

***Parasite-Host Relationship Terms**

Host-parasite relationships are of following types:

Symbiosis: Living together; An association in which both host and parasite are so dependent upon each other that one cannot live without the help of the other.

Commensalism: An association in which only parasite derives benefit without causing any injury to the host. A commensal lives on food residues or waste products of the body of host .

Mutualism: Association of two different species of organisms that is beneficial to both

Parasitism: An association of two different species of organisms that is beneficial to one and harm to other

Pathogenic: the ability of organism to cause disease

Phoresis: is the relationship in which one organism (a phoront) attaches itself to another (the host) for the travel with no physiological or biochemical dependence such as ticks and mites travels on cattle.

Predation: is a biological interaction where one organism (the predator) kills and eats another organism (its prey).

Sources of Infection

The source of infection are means a parasite become contact with its host to produces infection , these sources are :

1- **Contaminated soil and water:** Soil polluted with human feces acts as a source of infection with *Ascaris lumbricoides, Trichuris trichiura, Ancylostoma duodenale, Necator americanus* and *Strongyloides stercoralis.* Eggs of these parasites undergo certain development in the soil. These are known as **soil-transmitted helminths**.

Water also polluted with human feces may contain viable cysts of *Entamoeba histolytica, Giardia lamblia, Balantidium coli,* eggs of *Taenia solium, Hymenolepis nana,* and the infective cercarial stage of *Schistosoma haematobium, S. mansoni* and *S. japonicum.*, the diseases that transport by water which is named **waterborne diseases** while the diseases that transport by food which is named **food borne diseases**

2. **Fresh water fishes** constitute the source of *Diphyllobothrium latum* and *Clonorchis sinensis.*

3. **Crab and crayfishes** are the sources of *Paragonimus westermani*.

4. **Raw or undercooked pork** is the source of *Trichinella spiralis, Taenia solium and Sarcocystis suihominis*

5. **Raw or undercooked beef** is the source of *T. saginata, Toxoplasma gondii*
6. **Water cress** is the source of *Fasciola hepatica.*
7. **Blood-sucking insects** transmit *Plasmodium spp*., *Wuchereria bancrofti*, *Trypanosoma spp., Leishmania spp.* and *Babesia spp.*
8. **Housefly** (mechanical carrier) is the source of *E.histolytica*.
9. **Dog** is the source of *Echinococcus granulosus* (hydatid cyst), and *Toxocara canis* (visceral larva migrans).
10. **Cat** is the source of *Toxoplasma gondii.*
11. **Man** is the source of *E. histolytica, Giardia lamblia and Enterobius vermicularis* .
12. **Autoinfection** may occur with *Enterobius vermicularis and Strongiloides stercoralis* leading to **hyperinfection**.

Portal of Entry into the Body

1-Mouth

through contaminated food, water, soiled fingers or fomites can enter host. e.g., *E. histolytica,G. lamblia, Balantidium coli.*

2-Skin

The entry of parasites by skin. *A. duodenale, N. americanus* and *S. stercoralis,* filariform larvae are penetrates the unbroken skin by walking over faecally soil. *S. haematobium,S. mansoni* and *S. japonicum* cercaria larvae, in water, penetrate the skin. *Plasmodium* spp. *Leishmania* spp. are infected host by bloodsucking arthropods for skin.

3-Sexual contact

Trichomonas vaginalis is transmitted by sexual contact

4-Kissing

E. gingivalis is transmitted from person-to-person by kissing

5-**Congenital**

Infection with *T. gondii* and *Plasmodium* spp. may be transmitted from mother to fetus transplacentally .

6-Inhalation

Airborne eggs of *E. vermicularis* may be inhaled into pharynx leading to infection.

7-Iatrogenic infection

Malaria parasites may be transmitted by transfusion of blood from the donor with malaria .

***Infective Stages**

It refers to the stage of the life cycle of the parasite if the parasite comes into contact with the host's body it causes infection to the patient, these stage are :

1-Egg or ovum:

Its infective stages for many worms, Some of eggs directly causes infection after releasing as *Hymenolepis nana* eggs while another eggs requires a time to become infected as *Ascaris lumbricoides* eggs

2-Larva:

it the infective stages for many worms, it is may be living free in the soil and penetrate the skin as *Ancylostoma duodenale* larvae or swimming in water and penetrate skin as *Schistosoma* spp. larvae, or swimming in human blood as *Wuchereria bancrofti* larvae and infected human by insect bite . Some larvae are cystic in animal meat such as *Taenia* spp. or on plants as metacercaria of *Faciola hepatica* .

3-Cyst: is cyst stage in protozoa , transmitted by contaminated water and food,it resistant for environmental conditions **also some worm larvae are cystic as *Taenia sp*.**

4-Adult: protozoa that have only trophozoite stage, **this stage represents the adult stage and the** infective stages **as *Trichomonas* vaginalis**

***Effects of parasite on host**

Parasites trigger varying changes within their hosts

1-Tissue Damage:

a-Albuminous degeneration: swollen cells packed with albuminous

b- Fatty degeneration: the deposition of abnormal amounts of fat in cells

c- Necrosis : continuous cell degeneration causes death of cells or tissues

2-Tissue Changes :

1-Hyperplasia : increase the cell division led to increase in host body repair activity that follows inflammation

2- Hypertrophy :An increase in cell or organ size

3- Metaplasia : tissue may be converted into another tissue.

4-Neoplasia: Abnormal cell growth producing an entirely new entity as a tumor

***Classification:**

Classification of animal parasite and vectors:

Phylum- Subphylum-Class- Order -Family -Genus – Species. All of these names must be of Greek or Latin origin or have a classical termination.

Species: it designates a population, the members of which have the same genetic characters and are capable of continued reproduction of their kind, but cannot interbreed with individuals of other species.

Genus: is a group of closely related species. The scientific designation of a species is a combination of the genus and species name. This is referred to as binomial nomenclature. Ex. *Entamoeba histolytica.*

The parasites of humans in the kingdom **Protozoa** are now classified under three **phyla**:
1-**Phylum: Sarcomastigophora** (containing the flagellates and amoeba),
2- **Phylum :Apicomplexa** (containing the sporozoans)
3- **Phylum :Ciliophora** (containing the ciliates).

1-**Phylum: Sarcomastigophora**
The important human parasites, listed as **subphyla**:
(1) Subphylum: Mastigophora, the flagellates, have one or more whip-like flagella (e.g, Trypanosomes).
These include intestinal and genitourinary flagellates (*Giardia, Trichomonas Dientamoeba, Chilomastix*) and blood and tissue flagellates (*Trypanosoma, Leishmania*).
(2) Subphylum :Sarcodina are ameboid which include species of *Entamoeba, Endolimax, Iodamoeba*.
2- **Phylum :Apicomplexa**
(1) Subphylum :Sporozoa undergo alternating sexual and asexual reproductive phases, usually involving two different hosts (eg, arthropod and vertebrate, as Malaria).
a-The class Coccidia: contains the human parasites *Toxoplasma, Cryptosporidium*.
b-The class Haematozoa: (blood sporozoans) are the malarial parasites (*Plasmodium* species) and members of the order **Piroplasmida**, which includes *Babesia* species.
3- **Phylum :Ciliophora**
(1) Subphylum: Ciliophora: are protozoa bearing cilia, with two kinds of nuclei as *Balantidium coli*
A distinctive group, formerly listed with the Protozoa, often within the Sporozoa, is now considered a separate phylum, the **Microspora.** It includes the microsporidians, which opportunistic parasites.

The parasitic **worms, or helminths**, of human beings belong to two phyla:
(1) Phylum: Platyhelminthes (flatworms) lack a true body cavity (celom) .All medically important species belong to the classes **Cestoda** (tapeworms) and **Trematoda** (flukes). The **tapeworms** of humans are band-like and segmented; the **flukes** are leaf-shaped, separate-sexed .
The important **tissue and intestinal cestodes** of humans belong to the genera *Taenia, Echinococcus, Hymenolepis.* Medically important **trematode** genera include *Schistosoma, Paragonimus, Clonorchis,*
(2) Nemathelminthes (worm-like, separate-sexed, roundworms) include many parasitic species that infect humans.

*Important Note:
All students are required to rely on these references and also the lectures of another pharmacy college in another Iraqi university.
1. Animal agents& vectors of human disease 5th edition by Beaver& Jung

2. -Medical Parasitology by Arora (2010)
3. Medical Microbiology 24th ed. (2007) by Jawetz.