Medical Parasitology

Parasitology: A scientific study of parasites, their hosts, and the relationship between the parasite and the host.

- **Medical parasitology**: is the science that deals with organisms living in the human body (the host) and the medical significance of this host-parasite relationship.

- **Parasite**: is an animal that is dependent on another animal (host) for its survival. It is simple unicellular protozoa e.g. *Plasmodium* (malaria) or complex multicellular metazoan e.g. helminths (worms) and arthropods (ticks, lice). All parasitic organisms are eukaryotes.

- **Zoonosis**: "a parasitic disease in which an animal is normally the host but which also that can be transmitted to people and infects man"
- **Vector**: "a living carrier (e.g.an arthropod) that transports a pathogenic organism from an infected to a non-infected host". A typical example is the female *Anopheles* mosquito that transmits malaria

Relationships

In biology, the relationship between the two different species of organisms live closely together for an extended period of time, is called symbiosis (symbiotic relationships).

The common symbiotic relationships between two organisms:

1- **Commensalism** : both partners are able to lead independent lives, but one may gain advantage from the association when they are together and least not damage to the other.

2- **Prey-predator relationship**- In this relationship, the predator which is normally bigger in size, hunts, kills and feeds on the smaller, hunted animals called prey. Generally, the predator population is smaller than the prey population. For example: Lions (predators) hunting deer (prey) for food.

3- **Mutualism**: An association which is beneficial to both living things.

4- **Parasitism** : An association which is beneficial to one partner and harmful to the other partner. The former that is beneficial to is called parasite, the latter that is harmful to is called host.

The type of parasites

1-**Endoparasite and ectoparasite**: A parasite which lives in or on the body of the host is called endoparasite (protozoa and helminths) or ectoparasite (arthropod e.g. lice, ticks).

2-**Temporary or intermittent parasite**: visits the host from time to time for food.

3-**Permanent parasite**: remains on or in the body of the host for its entire life.

4-**Facultative parasite**: organism that can exist in a free-living state or as a parasite.

5-**Obligatory parasite**: cannot survive without a host i.e. completely adapted for parasitic existence.

6-**Opportunistic parasite**: produces disease only in immunodeficient or immuno-suppressed patients (AIDS). In immunocompetent individuals the organisms may exist in latent form producing no symptoms.

7- **Erratic parasite** - is one that wanders in to an organ in which it is not usually found. E.g. *Entamoeba histolytica* in the liver or lung of humans.

8- **Accidental parasite** – when a parasite attacks an unnatural host and survives. E.g. *Hymenolepis diminuta* (rat tapeworm).

Host and type of host

•**Host:** the organism in, or on, which the parasite lives and causes harm , harbors the parasite usually larger than the parasite.

1- **Intermediate host**: The host harboring the larvae or asexual stage of parasite.

2- **Final host (Definitive host)** : The host harboring adult or sexual stage of parasite.

3-**Reservoir host**: Animals harboring the same species of parasites as man.

Type of life cycle

Life cycle: The whole process of parasite growing and developing.

A- **The direct life-cycle**: Only one host (no intermediate host).

B-**The indirect life cycle**: Life cycle with more than one host (intermediate host and final host).

Effect of parasites on the host:

The damage which pathogenic parasites produce in the tissues of the host may be described in the following two ways;

(a) **Direct effects of the parasite on the host**

1- **Mechanical injury** - may be inflicted by a parasite by means of pressure as it grows larger, e.g. Hydatid cyst causes blockage of ducts such as blood vessels producing infraction.

2- **Deleterious effect of toxic substances**- in *Plasmodium falciparum* production of toxic substances may cause rigors and other symptoms.

3- **Deprivation of nutrients**, fluids and metabolites -parasite may produce disease by competing with the host for nutrients.

(b) Indirect effects of the parasite on the host:

1- **Immunological reaction**: Tissue damage may be caused by immunological response of the host, e.g. nephritic syndrome following Plasmodium infections.

2- Excessive proliferation of certain tissues due to invasion by some parasites can also cause tissue damage in man, e.g. fibrosis of liver after deposition of the ova of Schistosoma.

Effects of the host on the parasites

The host can produce certain degree resistance to parasites in human body. The resistance (Immunity) is not very strong. In general, it don't wipe out parasites completely, but may limit the number of parasites and establish balance with parasites.

1- Innate immunity

a- **Barrier**: Prevent parasites to invade in certain degree. Skin/Mucous membrance/Placenta.

b- **Acid** in skin or stomach can cause damage of the parasites.

c- Phagocytosis of phagocyte.

2-Acquired immunity Mechanism:

a- cellular and humoral immunity.

b- Sterilizing immunity: Wipe out the parasites completely; meanwhile get a long-term specific resistance to re-infection.

The basic factor of transmission of parasitic diseases

1- The source of the infection

2- The routes of transmission

3- The susceptible host

The combined effect of those factors determine the prevalence of the parasites at a given time and place and regulate the incidence of the parasitic diseases in certain local population.

The source of the infection

a- **Patient**: Persons who have parasites in their body and show clinical symptoms.

b- **Carrier**: Persons, who have parasites in their body, not show symptoms.

c- **Reservoir host**: Animals that harbors the same species of parasites as man. Sometimes, the parasites in animals can transmit into human.

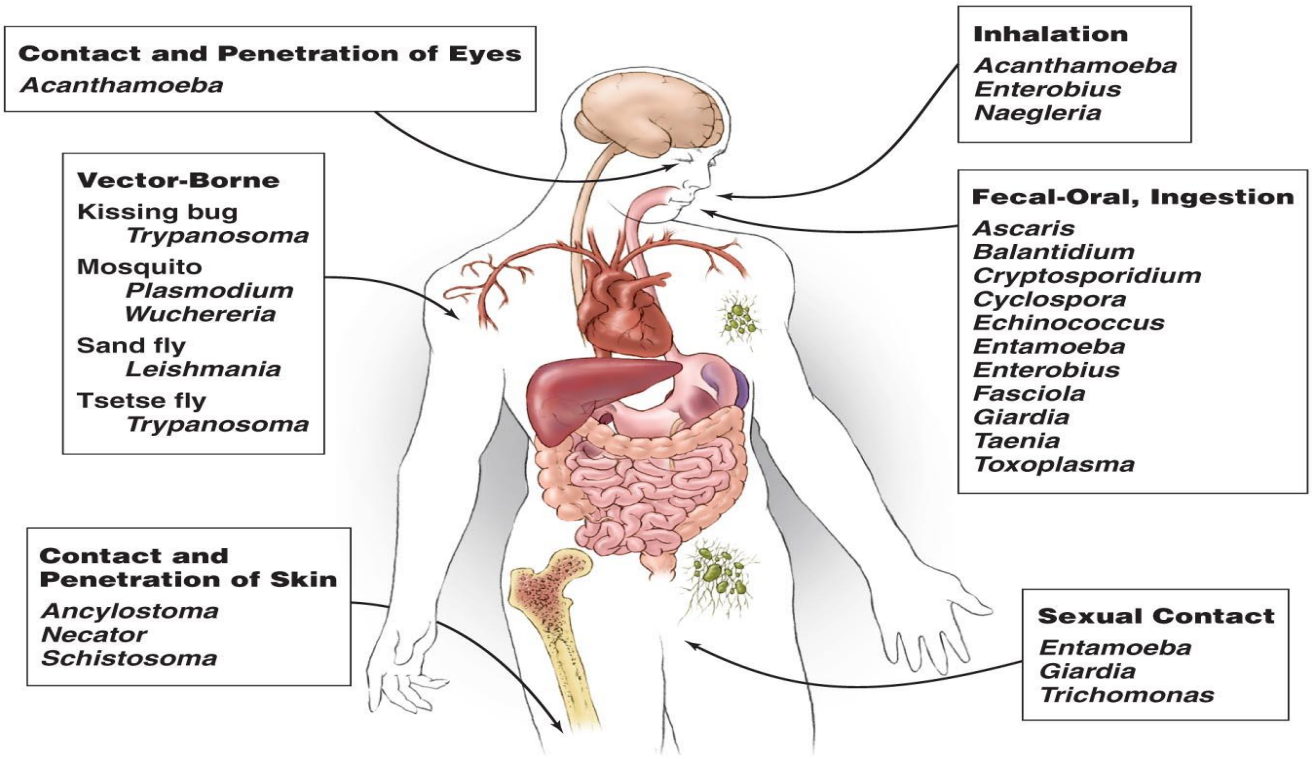
The routes of transmission

1- **Congenital transmission**: From mother to infant. Toxoplasmosis

2- **Contact transmission**: Direct contact---*Trichomonas vaginalis*; indirect contact---*Ascaris lumbricodes*

3- **Food transmission**: The infectious stage of parasites contaminated food/ the meat of the intermediate hosts containing infectious stage of parasites.

4- **Water transmission**: Drink or contact the water contaminated the infectious stage of parasites.
5- **Soil transmission**: Contamination of the soil by feces containing the certain stage of parasites and this stage can develop into other stage.
6- **Arthropod transmission**: Vectors of certain parasitic diseases.



<u>Distribution of parasites depends upon</u>:

a. The presence and food habits of a suitable host:

• Host specificity, for example, *Ancylostoma duodenale* requires man as a host where *Ancylostoma caninum* requires a dog.

• Food habits, e.g. consumption of raw or undercooked meat or vegetables predisposes to Taeniasis.

b. Easy escape of the parasite from the host- the different developmental stages of a par asite which are released from the body along with faces and urine are widely distributed in many parts of the world as compared to those parasites which require a vector or direct body fluid contact for transmission.

c. **Environmental conditions favoring survival outside the body of the host**, i.e. temperature, the presence of water, humidity etc.

d. **The presence of an appropriate vector or intermediate host** – parasites that do not require an intermediate host (vector) for transmission are more widely distributed than those that do require vectors.

Laboratory diagnosis – depending on the nature of the parasitic infections, the following specimens are selected for laboratory diagnosis:

a) Blood – in those parasitic infections where the parasite itself in any stage of its development circulates in the blood stream, examination of blood film forms one of the main procedures for specific diagnosis. For example, in malaria the parasites are found inside the red blood cells. In Bancroftian and Malayan filariasis, microfilariae are found in the blood plasma.

b) Stool – examination of the stool forms an important part in the diagnosis of intestinal parasitic infections and also for those helminthic parasites that localize in the biliary tract and discharge their eggs into the intestine. In protozoan infections, either trophozoites or cystic forms may be detected; the former during the active phase and the latter during the chronic phase. Example, Amoebiasis, Giardiasis, etc. In the case of helmithic infections, the adult worms, their eggs, or larvae are found in the stool.

c) Urine – when the parasite localizes in the urinary tract, examination of the urine will be of help in establishing the parasitological diagnosis. For example in urinary Schistosomiasis, eggs of Schistosoma haematobium are found in the urine. In cases of chyluria caused by *Wuchereria bancrofti*, microfilariae are found in the urine.

d) Sputum – examination of the sputum is useful in the following:

• In cases where the habitat of the parasite is in the respiratory tract, as in Paragonimiasis, the eggs of *Paragonimus westermani* are found.

• In amoebic abscess of lung or in the case of amoebic liver abscess bursting into the lungs, the trophozoites of *E. histolytica* are detected in the sputum.

e) Biopsy material - varies with different parasitic infections. For example spleen punctures in cases of kala-azar, muscle biopsy in cases of Cysticercosis, Trichinelliasis, and Chagas' disease, Skin snip for Onchocerciasis.

f) Urethral or vaginal discharge – for *Trichomonas vaginalis*

Indirect evidences – changes indicative of intestinal parasitic infections are:

a. Cytological changes in the blood – eosiniphilia often gives an indication of tissue invasion by helminthes, a reduction in white blood cell count is an indication of kala-azar, and anemia is a feature of hookworm infestation and malaria

b. Serological tests – are carried out only in laboratories where special antigens are available.

Treatment – many parasitic infections can be cured by specific chemotherapy. The greatest advances have been made in the treatment of protozoal diseases. For the treatment of intestinal helminthiasis, drugs are given orally for direct action on the helminthes. To obtain maximum parasiticidal effect, it is desirable that the drugs administered should not be absorbed and the drugs should also have minimum toxic effect on the host.

Prevention and control

measures may be taken against every parasite infective humans. Such measures include:

1- Reduction of the source of infection- the parasite is attacked within the host, thereby preventing the dissemination of the infecting agent. Therefore, a prompt diagnosis and treatment of parasitic diseases is an important component in the prevention of dissemination.
2- Sanitary control of drinking water and food.
3- Proper waste disposal – through establishing safe sewage systems.
4- The use of insecticides and other chemicals used to control the vector population.
5- Protective clothing that would prevent vectors from resting in the surface of the body and inoculate pathogens during their blood meal.
6- Good personal hygiene.
7- Avoidance of unprotected sexual practices.