

Introduction to Parasitology (PMB 271)

Parasitology is the study of parasites, their hosts and the relationship between them. It is a scientific discipline concerned with the study of the biology, ecology and relationships which parasites are involved in with other organisms known as the host.

There are different fields of parasitology and some of these include Medical parasitology, Structural parasitology, Malariology, Helminthology, Parasite Immunology, Quantitative parasitology etc.

Medical Parasitology

Medical Parasitology is the branch of medical sciences dealing with organisms (parasites) which live temporarily or permanently, on or within the human body (host) and the medical significance of host-parasite relationship. Medical parasitology focus mostly on the disease causing (pathogenic) parasites. Also, parasite which do not ordinarily produce disease in healthy (immunocompetent) individuals but do cause illness in individuals with impaired defense mechanism (opportunistic parasites) is becoming of paramount importance.

It's also concerned with the various methods of their diagnosis, treatment and finally their prevention and control.

Medical Parasitology is generally classified into:

- **Medical Protozoology** - Deals with the study of medically important protozoa.
- **Medical Helminthology** - Deals with the study of helminthes (worms) that affect man.
- **Medical Entomology** - Deals with the study of arthropods which cause or transmit disease to man.

Note: Parasites of medical importance come under the kingdom called Protista and Animalia. Protista includes the microscopic single-celled eukaryotes known as Protozoa.

In contrast, Helminthes are macroscopic, multicellular worms possessing well differentiated tissues and complex organs belonging to the kingdom Animalia

Malariology

This is an aspect of parasitology which focuses mainly on the study of Protozoan parasite, *Plasmodium*, its species, their biology, pathogenicity, epidemiology and management of the parasitic infection.

Parasite Immunology

This is an aspect which deals with parasite survival in host as well as host susceptibility. This aspect is particularly important when formulating concentrations of chemotherapeutic agents and vaccines.

Structural parasitology

This is the study of structures of proteins from parasites. Determination of parasitic protein structures may help to better understand how these proteins function differently from homologous proteins in humans. In addition, protein structures may inform the process of drug discovery.

Helminthology

“Helminth” means worms. Hence as the name implies it is the study of vermiform parasites ranging from trematodes to Cestodans, Nematodans and leeches.

What are parasites?

Parasites are living things which harm others(host) by becoming metabolically dependent on them. Its dependence is mainly for nutrition and support. A parasite is defined as an organism which has a detrimental effect on the intrinsic growth rate of its host population.

Parasites' Life Cycles

Life cycles of parasites can be **Monoxenous** or **Heteroxenous**

Monoxenous can be described as be Simple/ Direct life cycle.

A simple or direct life cycle have only one host involved. The parasite generally spends most of its life in or on the host, and may reproduce within the host. Because offspring must be transmitted to other hosts, however, the parasite or its **progeny** must have some way of leaving the host, surviving in the external environment for some period, and locating and infecting a new host. Parasites with simple life cycles have both parasitic and free living life stages. The proportion of the total life cycle spent in each stage varies according to the parasite. Example is the life cycle of *Ascaris lumbricoides*. Most Nematodes, trypanosomatids and Crystosporidium have Direct life cycle

Heteroxenous life cycle: Is a Complex or Indirect life cycle.

Parasites with complex life cycles involve multiple hosts. E.g. life cycle of *Fasciola* spp. The primary or definitive host of a heteroxenous species is the one in which adult parasites live and reproduce sexually. The secondary or intermediate host is the host where immature life stages of the parasite live and reproduce asexually.

In many cases, the parasite passes through critical developmental stages in the intermediate host. The intermediate host may also aid in transmitting parasites to their final host as well as disease transmission in the form of vectors, such as mosquitoes which pass immature parasite through their proboscis directly into the blood stream of a definitive host. Some Filarial nematodes, Plasmodium and Leishmania are examples of parasites with indirect life cycles

Parasites can be Classified: -

According to their habitat:

- ❖ . Ectoparasites: parasites living on or affecting the skin surface of the host. E.g. lice, tick, etc.
- ❖ Endoparasites: Parasites living within the body of the host. E.g. *Leishmania* species, *Ascaris lumbricoides*, etc

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II. According to their dependence on the host:

- ❖ Permanent (obligate) parasites: The parasite depends completely upon its host for metabolites, shelter, and transportation. This parasite cannot live outside its host. E.g. *Plasmodium* species, hookworms, *Trichomonas vaginalis*, etc.
- ❖ Temporary (facultative) parasite: The parasite is capable of independent existence in addition to parasitic life. E.g. *Strongyloids stercoralis*, *Naegleria fowleri*, etc.

III. According to their Pathogenicity:

- ❖ Pathogenic parasites: - It causes disease in the host. E.g., *E. histolytica*
- ❖ Non-Pathogenic (commensal) parasite:-The parasite derives food and protection from the host without causing harm to the host. E.g. *Entamoeba coli*

- ❖ **Opportunistic parasites:-** Parasites which cause mild disease in immunologically healthy individuals, but they cause severe disease in immuno-deficient hosts. An opportunistic parasite that is capable of producing disease in an immune deficient host (like AIDS and cancer patients). In the immuno-competent host, it is either found in a latent form or causes a self-limiting disease e.g. *Toxoplasma gondii*, *Pneumocystis carinii*, *Isospora belli*

Types of Hosts

Hosts are organism which harbors the parasite. They are classified according to their role in the life cycle of the parasite.

- **Definitive or Primary host** that - harbors the adult or sexually mature stages of the parasite (or in whom sexual reproduction occurs) e.g. man is DH for *Schistosoma Haematobium* (urinary blood fluke), while female *Anopheles* mosquito is DH for *Plasmodium* species (malaria parasites).
- **Intermediate or Secondary host** - harbors larval or sexually immature stages of the parasite (or in whom asexual reproduction occurs) e.g. man is IH of malaria parasites. Two intermediate hosts termed 1st and 2nd IH may be needed for completion of a parasite's life cycle, e.g. *Pirenella conica* snail is the 1st IH, while *Tilapia* (Bolt) fish is the 2nd IH for *Heterophyes heterophyes* (a minute intestinal fluke)
- **Reservoir /Asymptomatic host** harbors any of the stages of the parasite and shows no ill effect. It maintains the life cycle of the parasite in nature and is therefore, a reservoir source of infection for man. e.g. sheep are RH for *Fasciola hepatica*.
- **Paratenic or transport host** in whom the parasite does not undergo any development but remains alive and infective to another host. Paratenic hosts bridge gap between the intermediate and definitive hosts. It serves as “dumps” for non-mature stages of parasites which they can accumulate in high numbers, For example, dogs and pigs may carry hookworm eggs from one place to another, but the eggs do not hatch or pass through any development in these animals.
- **Accidental/Incidental host** one that accidentally harbors an organism that is not ordinarily parasitic in the particular species e.g is Tick which can feed on human as accidental host, rather than their normal deer or forest animal host.

Host- Parasite relationship

Infection is the result of entry and development within the body of any injurious organism regardless of its size. Once the infecting organism is introduced into the body of the host, it reacts in different ways and this could result in:

- Carrier state** - a perfect host parasite relationship where tissue destruction by a parasite is balanced with the host's tissue repair. At this point the parasite and the host live harmoniously, i.e. they are at equilibrium.
- Disease state** - this is due to an imperfect host parasite relationship where the parasite dominates. It can result either from lower resistance of the host or a higher pathogenicity of the parasite.
- Parasite destruction** – occurs when the host takes the upper hand. In this case, the host could no longer resist or withstand the parasite dependency on it thereby leading to the death of the 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•

- ✓ 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.

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

- ✓ 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:

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

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.