

Introduction to medical Parasitology

- **Parasitology** is the study of parasitism; a subject covering many topics including morphology, taxonomy, biology, behaviour, life-cycles, pathogenesis, epidemiology, ecology, physiology, biochemistry, genetics and molecular biology, as well as the diagnosis, immunology and treatment of infections.
- **Parasite**-A living organism which receives nourishment and shelter from another organism where it lives.
- **Host**-An organism which harbours the parasite.
- **Symbiosis**-It is an association in which both are so dependent upon each other that one cannot live without the help of the other. None of the partner suffers any harm from the association.
- **Commensalism**-An association in which the parasite only is deriving benefit without causing injury to its host. A commensal is capable of leading an independent life.
- **Parasitism**-An association in which the parasite derives benefit and the host gets nothing in return but always suffers some injury. A parasite has lost its power of independent life.
- **Zoonosis**-It means a disease of animals. Leishmaniasis, trypanosomiasis, trichinelliasis and echinococcosis.
- **Mutualism** is a permanent association between two different organisms that life apart is impossible, two partners benefit each other, such as termites and flagellates. The mutuals are metabolically dependent on one another; one cannot survive in the absence of the other.

Classes of parasites

- **Ecto-parasite(Ectozoa)**:Lives outside on the surface of the body of the host. ex. mosquito, fleas, flies, scabies, lice and other haematophagous arthropods. They are important as vector transmitting pathogenic microbes. The term infestation is often employed for parasitisation with ectoparasite in place of the term infection used with reference to endoparasite.

Endoparasite-lives inside the body of the host, in the blood, tissues, body cavities, digestive tract and other organs. ex. Malarial parasite ,Ascaris, Taenia saginata, Hydatid cyst

Temporary parasite-Visits its host for a short period to obtain nutrition and leaves away ex. Mosquito, flies. .

Permanent parasite-leads a parasitic life throughout the whole period of its life. ex. Taenia saginata which may live inside the body for long period may reach to 10 years or more

Facultative parasite-Lives a parasitic life when opportunity arises.

ex. Larval stage of house fly inside the ear ,this occur due to the discharge inflammatory pus which attracts flies to feed on and the latter may accidentally lay their eggs in the ear.

Obligatory parasite-Cannot exist without a parasitic life. such as malaria, Taenia saginata and other helminthes.

Occasional or Accidental Parasite-Attacks an unusual host.

Wandering or Aberrant parasite-Happens to reach a place where it cannot live.

Free living-The term free living describes the nonparasitic stages of existence which are lived independently of a host. E.g. hookworm have active free living stages in the soil.

Pseudoparasite :- a false parasite may be either commensal or temporary parasite in which accidentally ingested and leaves the host without causing any harmful effect.

Classes of Hosts

- **Definitive Host**-Either harbours the adult stage of the parasite Or Where the parasite utilizes the external method of reproduction. In majority of human parasitic infections, man is the definitive host.
- **Intermediate host** :- the host in which larval stage of the parasite lives or the asexual multiplication takes place for continue their life cycle ,so some parasite need intermediate host while others not ex. cow for T. saginata and snails for schistosomal parasites. Some parasites require tow intermediate hosts for complete their life cycle such as P. westermani and D. latum.
- **Reservior host** :-the host in which the parasite can be found or develops an asymptomatic infestation until it travels to its own intermediate or final host . Ex. dogs and rodents in human leishmaniasis.

- **Transport host or vector** :- an organism that transmit the parasite by mechanical process without development of the parasite inside it ex. House fly. Also named as **paratenic host**. The larval stages of some parasites can also be transmitted from smaller to larger intermediate hosts through the food chain, without any significant morphological changes occurring. Such hosts accumulate the larvae, and their insertion in the life cycle facilitates transmission of these larvae to the definitive host.
- **Carrier**: A person who harbors parasite has no clinical symptoms, is an important source of infection in epidemiology. (transmission)
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Parasites classification

Protozoa: Over 10,000 species of single-celled protozoa have been described in the gut, blood or tissues of vertebrate and invertebrate hosts. Parasitic flagellates cause enteric diseases such as giardiasis, urogenital diseases such as trichomoniasis, systemic diseases such as sleeping sickness, and tissue diseases such as Chaga's disease and kala azar. Parasitic amoebae cause dysentery, meningoencephalitis and corneal lesions. Spore-forming sporozoa cause many serious diseases: Apicomplexa cause coccidiosis, malaria and tick fevers;.

Helminths: Around 50,000 species of multicellular helminths (worms) have been described from a wide range of hosts. Roundworms (nematodes) cause much morbidity and mortality in humans and animals throughout the world. Serious infections include filariases, hookworm and threadworm diseases. Larval and adult tapeworms (cestodes) may be found in many vertebrate hosts.

Arthropods: Thousands of arthropods are parasitic at some stage in their life-cycles. Many cause serious diseases and limit agricultural productivity. Parasitic insects include biting and sucking lice which may cause skin lesions or anaemia, fleas which may cause allergic dermatitis, and various flies which suck blood as adults or produce larvae which feed on host tissues. Parasitic arachnids include ticks which feed on blood and may cause anaemia or paralysis and mites which feed on skin and may cause mild itching, hair loss or severe mange.

Modes of Transmission

Direct contact through contact with the skin, such as in mites or lice One special case of contact infection is sexual transmission, as in the case of infections caused by *Trichomonas vaginalis*.

oral infection: the intake of infective stages via the mouth. Intake can occur via the food chain and foodstuff – a process known as alimentary infection.

fecal-oral contamination occurs when infective stages derived from feces (e.g., amoeba cysts, coccidia oocysts, and nematode eggs) are ingested orally.

Air (air borne transmission): like inhalation egg of *Ascaris* and *Enterobius*

Percutaneous infection or skin penetration: plays an important role, particularly in helminth infections. In these cases, infective stages in the soil or water actively bore into the skin of the final or intermediate host(e.g., the cercariae of schistosomes and other digeneans, the infective larvae of the hookworm *Ancylostoma duodenale*).

Sources of infection-:

Parasitic infection originate from various sources and are transmitted by various routes, the major sources of infection are-:

Soil -: Embryonated eggs which are presented in soil may be ingested ex. Round worm , whipworm .Infective larva present in soil may enter by penetrating exposed skin, ex. Hook worms.

Water-: Infective forms of some parasite present in the water may be swallowed ex. cyst of amoeba and giardia.Water containing the intermediate host for some parasite and may be swallowed ex. Infection with Guinea worm occur by drinking the water containing the Cyclops which is the intermediate host for this parasite. Infective larva in water may enter by penetrating exposed skin ex. Cercariae of schistosoma. Free-living parasite in the water may enter through vulnerable sites ex. *Naegleria* may enter through nasopharynx and cause meningoencephalitis.

Food-: Contamination with human or animal feces ex. Amoebic cysts, eggs of helminthes. Meat containing infective larva ex. Taenia saginata and Trichinella spiralis.

Insect vectors:-if the transmitter is not essential in the life cycle , called mechanical vector whereas if it's essential in the life cycle, it is a biological vector . Biological vector, ex. Mosquito in the life cycle of malaria and sand flies in the life cycle of leishmania donovani. Mechanical vector, ex. house fly in the transmittion of amoebiasis.

Animals-:

- Cow in the life cycle of beef tapeworm.
- Dog in the life cycle of hydatid disease.
- Cat in the toxoplasmosis.
- Mollusks in the life cycle of liver fluks.

Effects of Parasites on the hosts

Traumatic damage

•Physical damage is produced by entry of filariform larvae of *S.stercoralis*, *A.duodenale* and *N.americanus* and cercarial larvae of *S.haematobium*, *S.mansoni* and *S.japonicum* into the skin.

Migration of several helminthic larvae through traumatic damage of pulmonary capillaries leading to extravasation of blood into the lung.

- Eggs of *S.haematobium* and *S.mansoni* cause extensive damage with haemorrhage as they escape from vesical and mesenteric venules, respectively, into the lumen of the urinary bladder and the intestinal canal.
- Attachment of hookworms to the intestinal wall results in traumatic damage of the villi and oozing of blood at the site of attachment.
- Large worms, such as *A.lumbricoides* and *T.saginata* may produce intestinal obstruction.

Lytic necrosis

E. histolytica : secretes lytic enzyme which lyses tissues for its nutritional needs.

Inflammatory reaction: Most of the parasites provoke cellular proliferation and infiltration at the site of their location.

Allergic manifestations: In certain helminthic infections, the normal secretions and excretions of the growing larvae and the products liberated from dead parasites may give rise to various allergic manifestations.

Life cycle

Life cycle is the process of a parasite's growth, development and reproduction, which proceeds in one or more different hosts depending on the species of parasites.

Direct life cycle : life cycle which accomplished in one host

Indirect life cycle: life cycle that need more than hosts.

In life cycles of some parasites, there are the regular alternations of sexual and asexual reproductions , this phenomenon is called **alternation of generation**, such as the life cycle of *Plasmodium* spp.

Infective Stage is a stage when a parasite can invade human body and live in it .

Diagnostic stage the diagnostic stage of nematodes is the stage which leaves the definitive host in order to continue its development and which can be detected by sampling appropriate tissues in a live, infected animal

Immune response

The protective immune response to parasitic infections has four arms:

Cytotoxic T(Tc) cells, Natural killer (NK) cells, Activated macrophages , Antibody (Produced by B-cells).

- The main classes of antibodies (Immunoglobulins) produced are IgM, IgG, and IgE.
- IgM appears first and denotes recent infection.
- IgG antibodies are usually the most abundant type in parasitic infections.

- Helminths and ectoparasites also provoke high titres of IgE antibodies.

Laboratory Diagnosis

Laboratory diagnosis of parasitic infections can be carried out by:

- Demonstration of parasite
- Immunodiagnosis
- Molecular biological methods