Lecture No. One PARASITOLOGY DR.Raad H.H.

 **Introduction**

**Medical parasitology** : the study of the parasites of man and their medical consequences.

**Parasite**

It is an a organism of varying complexity from a unicellular protozoa to a complex multicellular helminthes live on the expense of an a large organism (Host) causing different degrees of harm or disease ended by death some times.

**Symbiosis**

It is an a relationships between two dissimilar organisms that are adapted together ,symbiosis may be beneficial or harmful to the associates.

**Symbiont**

It is a dissimilar associate organism that lives with other associate.

**Types of Symbiosis**

1. Mutualism

The symbiotic association which is benefit to both associates .e.g. Ciliates in ruminant assist in cellulose digestion.flagellates produce cellulose in gut of termites

1. Commensalism

The symbiotic association of two different species or organism in which one is benefited and the other is neither benefited nor harmed. e.g. *Entmoamoeba coli* in the human intestine can digest bacterial flora which might be mutate to a pathogenic bacteria

3.Parasitism

 The symbiotic association in which one of the associates (Parasite) lives in ,or ,on the other associate (Host).e.g. *Taenia saginata* lives in the human intestine.

**Host**

It is an organism harboring a parasite..e.g. human is the host of *Taenia saginata* (Cestoda).

**Life cycle**:

The sequence of morphologic and environmental stages. (for survival and reproduction reasons many parasites evolve through a number of morphologic stages and several environments or different hosts.)

**Types of parasites**

It is divided to various types ; depending on :-

1. Habitat
2. Ectoparasite. e.g. Ticks ,Mites.
3. Endoparasite. e.g. Helminthes ,Protozoa .
4. Number of hosts required
5. Monoxenous = 1 host (Seen in direct life cycle) .e.g. *Isospora belli*.
6. Heteroxenous = more than 1 host (Seen in indirect life cycle).e.g. *Shistosoma heamatobium* has Man as a final host and Snails as an intermediate host.
7. Specificity of parasite

1. Facultative parasite.(A parasite that not need living tissues). e.g*. Strongyloides stercolaris* or the larvae of Sarcophaga flies.

2. obligatory parasite.( A parasite that Need living tissues ).e.g. *Shistosoma mansoni* (Bilharzia) in Man.

3. Permanent parasite.(A parasite that Which lives entire its life in ,or ,on a host .e.g*. Ascaris lumbricoides* , Mites(*Sarcoptes scabiei*).

4. Temporary parasite.(A parasite that Which lives as intermittent periods on the host) e.g. Mosquitoes.

5 Incidental parasite .(A parasite that Which lives in uncommon host) e.g. *Dipylidium Caninum* a parasite of dog that infect Man.

6. Aberrant parasite . (A parasite that Which enter a tissue not adapted to it during it’s migration inside the host) e.g. Larvae of *Osterus ovis* (nasal fly of sheep enter the brain tissue).

7. Host specific parasite . (A parasite that lives on a specific host and organ tissue during their life.)e.g. *Taenia saginata* parasitize Man intestine in the adult stage but it’s larval stage *Cysticercus bovis* parasitize the cattle muscles tissues.

8. Accidental parasite . (An free organism that act as a parasite when enter host accidentally).e.g. Fruit fly larvae enter human gut accidentally.

**Types of host**

1.Deffinitive or Final host

 The host (animal ; man) harboring the adult or sexually mature stage of the parasite. e.g. Man when infected by *Heterophyes heterophyes* (Fluke) and Mosquitoes (insects)when infected by *Plasmodium malariae* (Protozoa of Malaria).

2.Intermediate host

The host harboring the immature stage of parasite **(** often asexual stages**)**  ,e.g. Heterophyes (fluke) needs a snail Pirnella as 1st. Intermediate host and a Fish as 2nd intermediate host.

 3.Carrier host

A host that harbors a parasite but clinical signs or symptoms not exhibits due to the immunity against the parasite which still exist e g. Man infected by *Plasmodium falciprem*( Malaria).

4.Reservior host

An animalin which the parasite can be found or developed as asymptomatic infection until it infect it’s final or intermediate host e.g. Mice as in intestinal Bilharzia infection of Man ,Dogs and Jackals as in Leishmania infection of Man ,Dears and Mice as in Trypanosome infection of Man.

5.Vector host

an arthropod or other living carrier that transports a pathogenic organism from an infected to a non-infected host. This can be passive transport(MECHANICAL VECTOR ) or as an essential host in the life cycle of the pathogenic organism (i.e. a biologic vector) e.g. Mosquitoes as in Malariasis or Filariasis human infections.

6.Paratenic host

The host in which no development could be occurred but has the ability to transmit the parasite to anther host. e.g., Earth worm reserve the worm *Ascaridia galli* which infect chicken ; pseudophyllidean tapeworm larvae in fish.

 **Modes of infection**

1. Dermal infection (skin)

E.g. Insect bites ,mites ,larvae of Ancylostoma and Shistosomes.

1. Orally infection

E.g. Swallowing Ascaris egg.

1. Urogenetal infection

E.g*. Trichomonas vaginalis*

1. Placental infection

E.g. *Toxoplasma gondii*

1. Transfusion of blood

E.g. African trypanosomiasis.

**Determinant factors against Parasitic diseases**

1. No. of parasites.
2. Species of parasites.
3. Strain of parasites.
4. Virulence of parasites.
5. Age of host.
6. Sex of host.
7. Status of host
8. Nutritional ( dietary deficiency)
9. Physiological (e.g. pregnancy)
10. Genetically ( e.g. Breed)
11. Immunological (if it is intact ,suppressed , deficiency, co-infection )

**Some typical characteristics of parasitism** (Reference ; K- state)

* 1. High reproductive potential i.e. multiple fission in Apicomplexa.
	2. Parthenogenesis in *Strongyloides* spp. ,Aphids ;
	3. Strobilation of tapeworms for high ova output;
	4. Overall high ova/larval output of many worms.
	5. Often unique morphological or physiological specializations,
		1. loss of structures, etc. e.g. loss of digestive tract of tapeworms
		2. loss of wings of fleas and lice
		3. loss of many sensory structures of nematodes
		4. development and refinement of a TEGUMENT; a living external layer of digenes, cestodes and acanthocephalan that allows digestion and other functions across body surface
		5. development of special holdfast organs, including hooks, suckers, teeth, clamps, cutting plates, spines
		6. production of anti-coagulants in leeches and hookworms
	6. Often special site specificity
	7. Usually, but not always, non-lethal to host
	8. Generally more numerous than hosts
	9. Generally much smaller than host (if larger, then termed a predator)
	10. Production of resistant stage (e.g. cyst or egg) for transferred to new hosts.
	11. Hermaphroditism of trematodes.
	12. Often have evolved methods to Overcome Host Defenses immune system ; Mechanisms include host:
		1. Antigenic variation of trypanosomes .
		2. Tough tegument of acanthocephalans .
		3. Intracellular habitat of coccidian and *Trichinella* larvae .
		4. Antigen acquisition of Shistosomes .
		5. Suppression eosinophil or neutrophil migration to the site of the parasite .
		6. Encystment .
		7. Ability to cleave antibodies or consume complement.
		8. Ability to trigger certain arms of the immune response, which may in turn damage host tissue enough to facilitate parasite invasion.
	13. Many parasites are now being shown to change host behavior ; Growing number of scientists believe that many ecological studies need to include parasitology as component as much animal behavior can be explained by level of parasitism,

**Parasite pathology:**

Level of pathology due to parasites is highly varied:

1. Physical trauma [cell-tissue destruction; i.e. migration of nematodes through tissues; ulceration of intestinal wall and liver by cysteine proteases of *Entamoeba histolytica*; displacement of tissue or structures by hydatids; protease digestion of epithelial cells by *Trichomonas vaginalis*; ulceration due to insertion of hooks, spines, etc. into intestinal wall, Obstruction of lymphatic vessels due to Wucheraria filarae human infection.
2. Nutritional diversion [i.e. Giardiasis results in diarrhea and malabsorption; *Diphyllobothrium* absorbs vitamin B12]
3. Competition on food e.g. Ascaris.
4. Toxins/Excretory products/Immune complexes [i.e. African trypanosomes slough antigen/Ab complexes that are absorbed by RBC's → complement activated → massive RBC lysis ; excretory products of some trematodes and cestodes causing anaphylaxis i.e. fibrosis and inflammation around Shistosoma eggs i.e. granulomas, fibrosis, edema against adult filarids ; Lytic enzymes secreted by parasites to invade host tissues e.g. *Entamoeba histolytica* in large intestine.
5. Teratogenic e.g. Schistosomiasis causing Urinary bladder cancer.
6. Sterility e.g. *Trichomonas vaginalis*.
7. Allergic e.g. Insects , Ticks ,Mites.
8. Blood loss [i.e. hookworms and anemia]
9. Mechanical irritation e.g. Intestinal worms.

**Classification**

 Animalia kingdom

 Protozoa a phylum

 Nemathelminthes thes =

 Nematoda da class

 Rhabditida ida order

 Strongylina ina suborder

 Strongyloidea oidea super family

 Strongylidae idea family

 Strongyinae inae sub family

 Strongylus genus *Strongylus vulgaris*  species

**Nomenclature**

The Swedish scientist Carolus von Linnaeus (1707-1778) developed the binomial system of nomenclature.

The scientific name of organism Genus and Species are derived from a **Latin word** ,and it may be:

1. Host :*Trichomonas hominis* (Man).
2. Scientist : *Chabertia ovina* (chabert).
3. Organ target :*Fasciola hepatica* (liver).
4. Geographical area :*Ancylostoma braziliensis*.
5. Name or adjective :*Oxyuris equi* (oxy=pointed ,Uris =tail ).

**Epidemiology**

The study of factors that determined the prevalence of infection and incidence of parasitic diseases.

1. Anthroponoses : human diseases that can be transmitted to animals.
2. Endemic : common in a community.
3. Epidemic : high prevalence with rapid transmission.
4. Epizootic :disease that affects a large number of non-human animals and spreads rapidly)
5. Hyper endemic : high Prevalence.
6. Incidence : Rate or Frequency of infection.
7. Outbreak : An unusual increasing no. of disease not transmitted from man to man e.g. Trichinosis from eating pork sausage .
8. Prevalence : No. of infected people in certain time and same area.
9. Sporadic : irregular occurrence.
10. Zoonosis : animal diseases that may be transmitted from animals to humans.

\*\*As in general the infective parasitic diseases as a cause of death based on civil registration in Iraq had recorded 13% 1n 1970 and 13.5% in 1971 as example.

**World annual rates of morbiditv and mortality**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **Infections (millions)** | **Disease (millions)** | **Deaths (thousands)** |
| **Protozoa** |   malaria  | 800 | 150 | 1500 |
|  |   amoeba | 480 | 50 | 100 |
|  |   toxoplasma |  | 40 | 10 |
|  |   trypanosoma | 24 | 1.2 | 60 |
| **Nematodes** |   intestinal nematodes | 2400 | 2.6 | 80 |
|  |   filaria | 250 | 3 | <1 |
|  |   onchocerca | 30 | 5 | 50 |
| **Trematodes** |   schistosoma | 200 | 20 | 1000 |
| **Cestodes** |   tapeworms | 2.5 |  |  |

**Taxonomy**

Depending on morphology and structure :

1.
2. Phylum Sarcomastigophora
3. = Apicomplexa Protozoa
4. = Microspora
5. = Ciliophora
6. Phylum Platyhelminths Flat worm, Flukes.
7. Phylum Aschelminthes Nematoda ,Round worm.
8. Phylum Acanthocephala Thorny headed worms.
9. Phylum Arthropoda.

**References**
The **best** reference text available in **clinical parasitology** is :

 Beaver, Jung and Cupp. Clinical Parasitology, 9th ed., Lea and Febiger, Philadelphia, 1984.

The **best Tropical Disease texts** are ; 1) Manson's Tropical Tropical Diseases ed GC Cook et al. 21st ed ,2003 WB Saunders Co., London

2) Hunter's Tropical Medicine and Emerging Infectious Diseases ed Strictland GT 8th ed, 2000 WB Saunders Co., Philadelphia

3) Tropical Infectious Diseases, Principles,Pathogens & Practice. ed RL Guerrant et al. Churchill Livingstone, Philadelphia  2006

**Other texts** or reference sources of a **more condensed nature** are :

1) **Markell and Voges. Medical Parasitology. 6th ed. 1991. Saunders Co.**
2) Brown and Neva. Basic Clinical Parasitology. Appleton-Century-Crofts. Norfolk Connecticut.

3) Urquhart GM, Annour J, Duncan JL, Dunn AM, Jennings. FW. 1996.Veterinary Parasitology 2 edition 307 pages. Wiley-Blackwell.

 4) Soulsby E. J. L. Immunity to animal parasites. 1972.Edited by Soulsby E. J. L. 472 pp. Academic Press, New York.

5) Soulsby, E.J.L., 1982. Helminths, Arthropods and Protozoa of Domesticated Animals. (7th edition) 809 pp.,.London: Bailliere Tindall, Lea and Febiger, Philadelphia.

6) Soulsby, E.J.L. 1965. Textbook of Veterinary Clinical Parasitology, vol. 1. , Helminths .1120 pages .Oxford Blackwell Scientific Publications.

7) Dunn M. Angus. 1978.Veterinary helminthology. vii, 323 p. Heinemann Medical, London .