

Introduction to Medical Parasitology

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Objective of the lecture.

- To introduce the students to principles of Medical Parasitology.

Format of the lecture.

- 1. Definition**
- 2. Symbiosis**
- 3. Ecology of Parasites**
- 4. Evolution of Parasitism**
- 5. Host-parasite relationship**
- 6. Examples of parasites**
- 7. Laboratory/non laboratory examinations of parasitic infections.**

Parasitology:

- Is the study of **Parasites** and their relationships to their **hosts (man or animals)**.
- A **parasite**: can be either a **microorganism** or a **macroorganism** that lives **in** or **on** and obtains its nourishment from a **living** host.

Relevance of Medical Parasitology.

- Some parasites cause a class of diseases called **Neglected Tropical Diseases (NTDs)**.
- **NTDs** are defined as diseases of poverty found in developing countries.
- **NTDs** are characterized by the following: May **debilitate, deform, blind**, and cause **death**.
- There are **20** diseases classified as NTDs by the World Health Organization (WHO).

Parasitology is:

Interdisciplinary and encompasses aspects of:

Systematic and phylogeny, Ecology, Morphology,
Embryology, Physiology, Biochemistry,
Immunology, Pharmacology, Nutrition,
among many disciplines.

Parasitology includes study of:

- i) **Protozoa** (single celled organisms-parasites-Kingdom: **Protista**),
- ii) **Helminths** (also called **metazoa**, many celled organisms or worms-parasites)-Kingdom: **Animalia**).
- iii) **Arthropods**.
- iv) **Species of arthropods** that serve as **vectors** (carriers) of parasites (Kingdom: **Animalia**).

- Thus parasitology encompasses elements of
 - i. Protozoology
 - ii. Helminthology,
 - iii. Entomology (insects),
 - iv. Acarology (ticks, mites).
- Parasites are eukaryotes* .

Symbiosis.

- **Parasitism** falls under a relationship called **Symbiosis**.
- **Symbiosis** is defined as: A relationship in which one **living** organism spends a portion or all of its life **intimately** associated with another **living** organism of a **different** species (called a ***symbiont***).
- The original meaning of symbiosis or “**living together**”

There are 4 types of symbiotic relationships:

1. Commensalism

2. Phoresis

3. Mutualism

4. Parasitism.

Commensalism.

- There is **NO physiologic** interaction or dependency between the **two symbionts**, the **host** (bigger organism) and the **commensal** (smaller organism).
- The term means “**eating at the same table**”
- Here **spatial proximity** allows the commensal to feed on substances **captured** or **ingested** by the host.
- The two parties can survive **independently**.
- **E.g***.

Phoresis.

- Means “**to carry**”.
- The **phoront**, usually the smaller organism, is mechanically **carried** by the other, usually larger, organism, the **host**.
- There is **NO** physiologic interaction or dependency involved.
- e.g.*

Mutualism.

- The mutualist (smaller) and the host depend on each other physiologically.
- e.g*.

Parasitism.

- The parasite (usually the smaller of the two) is physiologically dependent upon the host.
- Host does not benefit from relationship
- Relationship categorized as:
 1. Obligatory.
 2. Facultative.

Obligatory parasite.

- **Physiologically** dependent upon host and usually **cannot** survive if kept isolated from it.
- Relationship may be:
 1. **Permanent** (e.g. tape worm in intestine, blood parasites) or
 2. **Temporary** (e.g. ticks on the host).

Facultative parasite.

- Free living organism
- Capable of becoming **parasitic** if placed in situations conducive to such a mode.

- **Parasites** obtain **essential** nutrients **directly** from the **living** host e.g. *blood, red blood cells, red blood cell contents such haemoglobin, lymph, cytoplasm, tissue fluids, host digested food.*

- **Overlap between symbiotic relationships in nature.**

A Venn diagram with three overlapping circles. The top circle is labeled Phoresis / /commensalism. The bottom-left circle is labeled Parasitism. The bottom-right circle is labeled Mutualism. The circles overlap in various regions, representing combinations of these relationships.

Phoresis
/commensalism

Parasitism

Mutualism

Ecology of parasitism.

- **Body** of a host is the **environment** on or in which the parasite spends some or all of its life.
- **Host's environment** affects the parasite.
- Certain biological, chemical, and physical factors, dictate the **geographic distribution** of a parasite.

- Survival of a parasite depends upon the **availability** of **all hosts** needed to complete its **life cycle***
- **Factors** governing survival of the hosts **indirectly** determine the presence of parasites.

Host specificity.

Defn*

- A factor determining **distribution** of a parasite.
- **Degree** of specificity varies from species to species of parasite (determined by **genetic, immunologic, physiological, and/or ecological** factors).

- Many **ecological factors** play important roles in defining the **epidemiology** of a **disease-producing** parasite.

Evolution of parasitism.

- When and how did parasites arise?
- No **definitive** answer.
- Parasites evolved among very diverse groups of **free-living progenitors**.
- An initially **casual association** with another organism.
- Later, due to **preadaptation***, developed a gradually increasing **dependency** on the other.

Host-parasite relationship

Described in terms of:

1. Location
2. Host
3. Vector
4. Reservoir host
5. Zoonosis
6. Effects of parasite on host (parasitic infection)

Location.

- a) **Endoparasites:-** live within the body of the **host** e.g, intestines, liver, lungs, blood, brain, spleen, heart etc.
- b) **Ectoparasites :-** attached to the outer surface of the **host** or are superficially embedded in the body surface.

Host.

- Depending on the **role** of the host in relation to the **parasite stage** in the life cycle, the host may be classified as:
 - a) **Definitive:** the parasite attains sexual maturity therein.
 - b) **Intermediate:** temporary but essential environment for the **development** of the parasite and/or its **metamorphosis**, **short** of sexual maturity.

c) Transfer (Paratenic): not necessary for the completion of the life cycle but utilized as a **temporary refuge** and **vehicle** for reaching the **definitive** host in the cycle.

Vector.

- An **arthropod** or other **invertebrate** that serves as a **host** as well as a **carrier** for a parasite.
- **Essential** for the completion of the life cycle of a **vector-borne** parasite.

Reservoir host.

- An **infected vertebrate** animal that serves as **source** of parasites for humans.
- Often the reservoir host **tolerates** the parasite better than the human host does.
- Shares the **same** stage of the parasite with humans.

Zoonosis.

- Disease of humans caused by a parasite **normally** found in **wild** and **domestic** **vertebrate** animals.

Effects of parasites on hosts

- Parasitic infections
- Parasites cause **varying** degrees of change within their hosts (man/vertebrate animals).
- Although **not** inevitable, **disease** often results.
- Parasitic diseases, especially by **worms**, usually functions of **parasitic density**.

**Factors in general that commonly influence
the onset of recognizable disease :**

- 1. Number of parasites.**
- 2. Physiological state of the host.**

The conditions resulting from parasitic infections:

1. Tissue damage
2. Tissue change

- Lead to **disease**

Tissue damage*:

1. **Erosion:** caused by **ingestion** or by **mechanical disruption** of cells by the parasite (**ulcers resulting**).
2. **Cell damage::**
 - a) **Parenchymatous/ albuminous degeneration**
 - b) **Fatty degeneration**
 - c) **Necrosis.**

Tissue change*:

- Changes in the growth pattern of the affected tissue:
 - i. Hyperplasia.
 - ii. Hypertrophy.
 - iii. Metaplasia .
 - iv. Neoplasia. (Benign/malignant)

Examples of human parasites

A. Protozoa:

- Malaria parasite
- Trypanosomes

B. Helminths.

- Ascaris
- Bilharzia

C. Ectoparasites.

- Lice
- Tick
- Flea
- Mite
- Bed bugs

Examples of Vectors.

- Mosquitoes
- Tsetse flies
- Snails
- Ticks

Laboratory tests (investigations) for human parasitic infections.

Examples:

- i. Macroscopic examinations
- ii. Light Microscopic examinations
- iii. Immunological tests (serological)
- iv. Molecular Biology techniques
- v. Artificial Intelligence (AI)**

Non-laboratory tests (investigations) for parasitic infections.

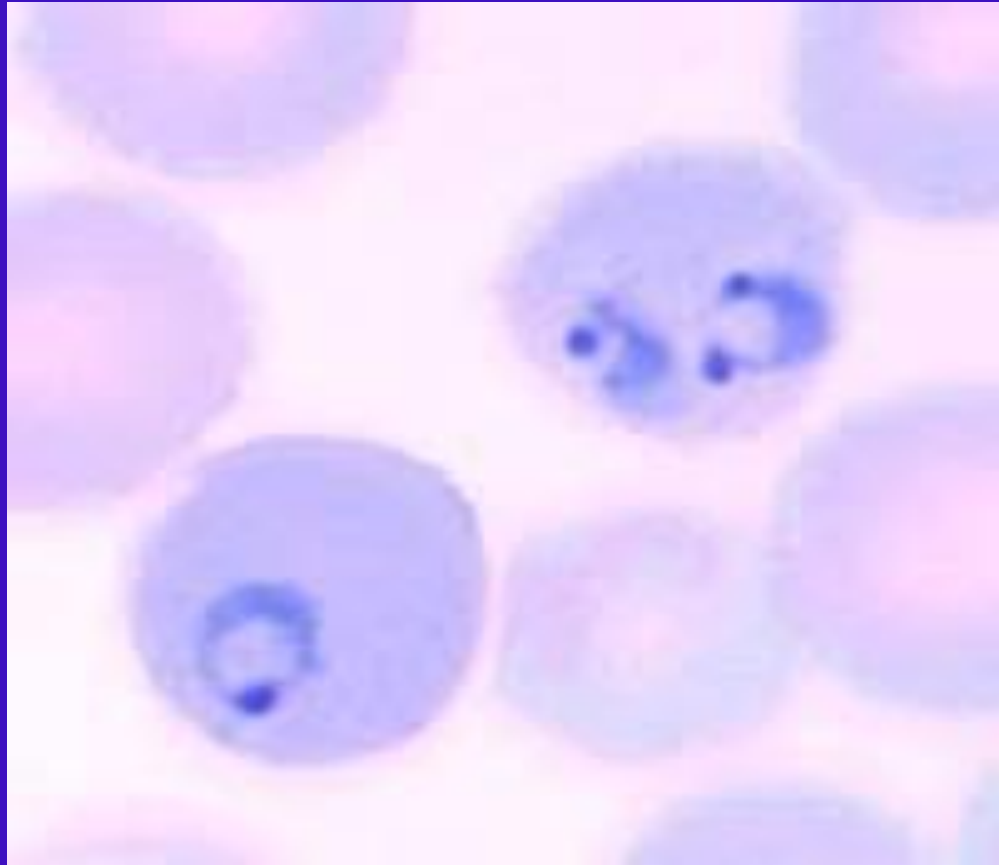
- Radiological imaging:
 - i. X-ray
 - ii. Ultra sound

Some parasites of medical importance:

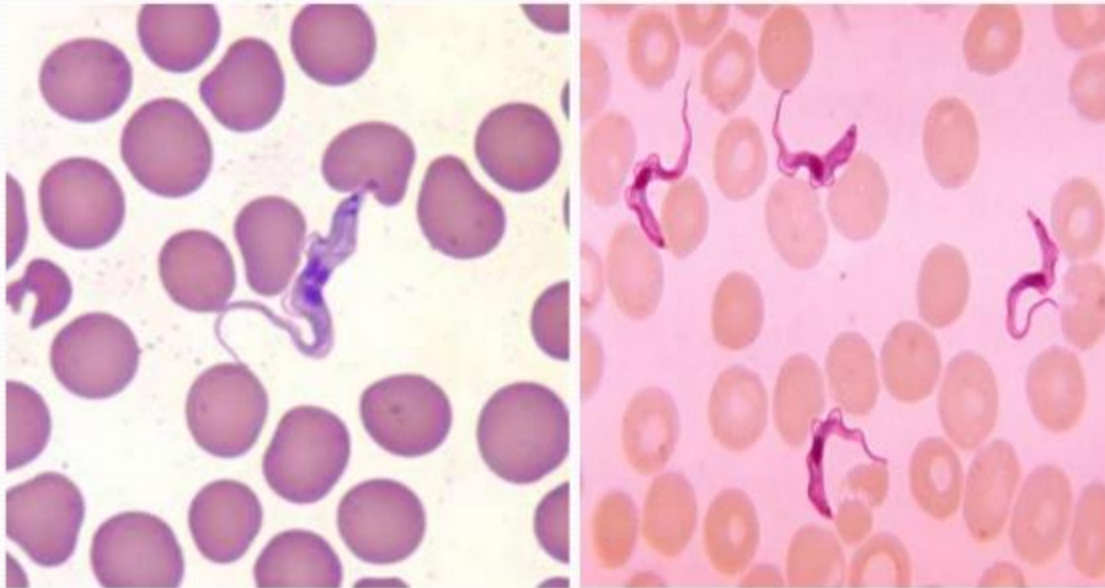


Ascaris lumbricoides
fertilised egg





Trypanosoma in blood





Adult Taenia

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