Human Parasitology

- The study of organisms which are parasitic to humans.
- In the broadest sense of "parasitology"—which is anything parasitic to humans—therefore, it includes study of:
  - Viruses
  - Bacteria
  - Fungi
  - Protozoa
  - Metazoa—Metazoans are multicellular organisms such as:
    - Helminths (Worms)
- However, pathogenic viruses, bacteria, and fungi are incorporated in the science of Microbiology.

Scope of Human Parasitology

- Parasitology claims the Protozoans, Arthropods, and Helminths.
  - Mnemnonic: "Human parasitology includes PAHrasites."
- PAH’s existence depends on the availability of host animals.
- Insects are arthropods.
  - Although insects, as a group, are studied in Entomology, parasitologists are interested in insects that are vectors of several parasitic infections.

Human Parasitology

- Protozoology
  - Phyla:
    - Lobosea
    - Zoomastigophora
    - Sporozoa
    - Ciliophora

- Arthropodology
  - Phyla:
    - Crustacea
    - Insecta
    - Arachnida
    - Chilopoda

- Helminthology
  - Phyla:
    - Nematoda
    - Trematoda
    - Cestoda
    - Metacanthocephala

Types of Feeding

Animals can either be:

- Predatory
  - Predation—eating live prey
    - Predator—the aggressor
    - Prey—the animal under attack
→ Scavenging—the eating of dead animals

Animals can be:
→ Pure predatory
→ Pure scavengers
→ Facultative—both predatory and scavengers
  o However, other animals, despite the predatory and scavenging modes of feeding have been so modified that they can only obtain food except in conditions with **intimate association**, either continuously or at intervals, with other species.

→ This association of two species is called **symbiosis**
  o Living together in such intimate association may involve protection or other advantages to one or both partners.
  o Symbiosis is mainly for **food getting** on either one organism’s part or both of the partners involved.
  o Different forms of symbiosis may be distinguished on the basis of whether or not the association is detrimental to one of the two partners:
    ▪ **Commensalism**
      1 One benefits, the other receives no harm NOR benefits.
    ▪ **Mutualism**
      1 Both partners benefit
      2 This biological relationship is so good, both mutuals CANNOT exist in the absence of the other.
      3 Example: Termites and flagellates
    ▪ **Parasitism**
      1 Two components:
        a **Parasite**—the one that benefits
        b **Host**—the one that is harmed
      2 Parasitism is a way of life for some animals. As such, they can be:
        a **Obligate parasites**—parasites that REALLY REALLY need a host or otherwise, they will die
        b **Facultative parasites**—animals that can either be:
          i **Planktonic** or **Free-living**—they CAN exist without a host
          ii **Parasitic**—when opportunity presents itself (example: when a facultative parasite lodges in the human body where there is abundant nutrition,) it can become parasitic
        c **Temporary parasites**—parasites are animals. And as such they have a life cycle. The life cycle of a temporary parasite is that during one or more points of its life cycle, it becomes an **obligatory parasite**. But at other points in its life cycle, the organism is **planktonic**.
        d **Ectoparasites**—parasites that live on the surface of the host’s body (integument)
        e **Endoparasites**—parasite that live within the host
        f **Intermittent parasites**
          i Example: Mosquitoes
Definition of Terms

**Host**—In parasitism, it supplies the nutrients for the parasite. It is the partner the is harmed.

- **Definitive Host**—Harbors the adult form (sexual reproductive stage) of the parasite.
- **Intermediate Host**—Harbors larval form (asexual reproductive stage) stage of the parasite.
- **Reservoir Host**—The vertebrate host which harbors the same species of parasite at same stage as a human host.
  - Important source of infection such as Zoonosis.
    - Zoonotic disease are diseases of animals passed on to man.
- **Paratenic/Transport Host**—An abnormal host in which some parasitic larvae can survive cannot develop into adults.
  - If these larvae enter appropriate host, they can continue to develop into adult forms.
- **Carrier**—A host which does not present with any clinical symptoms. Carriers are important sources of infections in epidemiology.

**Life Cycle**—The process of a parasite’s growth, development and reproduction.

- The life cycle of a particular parasite can occur in many environments:
  - Planktonically
  - On the host
  - In the host
- **Types of Parasitic Life Cycles:**
  - **Simple**—No intermediate host
    - Example of parasites with simple life cycles:
      - *Trichuris trichiura*
      - *Ascaris lumbricoides*
      - *Necator americanus*
  - **Complex**—Parasites with 1 or more intermediate host
    - Example of a parasite with a complex life cycle:
      - *Schistosoma japonicum*
        - Intermediate host—the snail called *Oncomelania quadrasi*
- **Components of the Parasitic Life Cycle:**
  - **Infecive stage**—A stage when a parasite can invade the human body and live in it.

Other Terms

- **Larva Migrans**—The larvae living in their abnormal hosts (Paratenic/Transport Hosts) in which they cannot grow into adults but can wander everywhere in the body causing local and systemic lesions through inducing Eosinophilia.
- **Infective Route**—The specific entrance through which the parasite invades the human body.

- They periodically seek out other and larger animals to nourish themselves.
Lecture 1: Overview of Medical Parasitology #AsturiaNOTES
Parasitology: Introduction to Parasitology

- **Infective Mode**—Mechanisms of action of a parasite to be able to cause a successful infection
- **Alternation of Generation**—In life cycles of some parasites, there are the regular alternations of sexual and asexual reproductions.
  - Example: *Plasmodium vivax*—agent for malaria
- **Vectors**—Any agent (human, animal, microorganism) that carries and can transmit pathogenic organisms into another living organisms:
  - **Mechanical Vectors**
    - A vector (usually arthropods) that simply transmits the infectious agents due to contact.
      - Example:
        - Flies
          - Typhoid bacilli
          - Ascarid eggs
          - Amoebic cysts
  - **Biological Vectors**
    - A vector (usually arthropods) that is essential in the growth and development of the pathogen. And once the parasite (pathogen) matures, the same biological vector can transmit the pathogen to humans:
      - Examples:
        - *Aedes aegypti*—dengue virus
        - *Anopheles gambiae*—*Plasmodium falciparum*
        - *Culex*—Arbovirus

**EFFECTS OF THE PARASITE ON THE HOST**

Injury to the host may be brought about in many ways. Some of these mechanisms are common to all parasites (viruses and bacteria included). The most widespread type of injury is that brought about by interference with vital processes of the host through the action of secretions, excretions or other parasite products.

- The interference is probably largely or exclusively on the level of the host’s enzyme systems
  - Parasites that produce these effects may be in the:
    - Tissues
    - Organs
    - Bloodstream
    - Within the GIT
    - Ectoparasitic

*Fasciolopsis buski*—Giant Intestinal Fluke
- When this parasite is present in large numbers, toxic symptoms are seen
- May damage the intestinal wall due to its powerful suckers

*Entamoeba histolytica*
- Causes amebiasis
- Erodes the intestinal wall, destroying the tissues locally by means of a proteolytic enzyme

Malarial parasites—*Plasmodium* species
In invade and multiply in RBC which are destroyed in the process
- May attach to the walls of smaller blood vessels in the brain → occluding these blood vessels → producing a local brain ischemia

**Ascaris lumbricoides**
- May perforate the bowel wall
- Cause intestinal obstruction if present in large numbers
- Can invade the:
  - Appendix
  - Bile Duct
  - Other organs

**Hookworms (Necator americanus and Ancylostoma duodenale)**
- Suck blood and can deprive the host of iron
  - Can produce an anemia

**Diphyllobothrium latum (Fish Tapeworm)**
- Selectively removes Vitamin B12 from the alimentary tract
  - Producing a megaloblastic anemia

**EFFECTS OF THE HOST TO THE PARASITE**

The genetic constitution of the host may profoundly influence the host-parasite relationship.
- There are racial variations in resistance to *Plasmodium vivax*, which are related to the presence or absence of the Duffy blood group.
- Among African people, there is prevalence of genetic abnormality resulting in Sickle Cell Disease causing the RBCs to assume the shape of a sickle.
  - The sickling of the RBCs results in increased resistance against the malarial agent *Plasmodium falciparum*.

The diet or nutritional status of the host may be of major importance in determining the outcome of a parasitic infection.
- **High-protein diet**
  - Unfavorable to:
    - The development of intestinal protozoa
      - However, **low-protein diet** favors the appearance of the symptoms of amebiasis and the complications of this disease.
- **High-carbohydrate diet**
  - Favorable to:
    - The development of certain tapeworms

The general nutritional status of the host may be of considerable importance both in determining whether a particular parasitic infection will be accompanied by symptoms and in influence their severity, if present. Major nutritional disturbances may influence resistance through their effects on the immune mechanisms of the host.

Unlike the medical knowledge about bacterial infections, there is still much to discover about parasitic infections.
In bacterial and viral infections, the **acquired immunity** is higher compared to that produced by protozoal/helminthic infections.

In bacterial and viral infections, the **resistance** against **reinfection** is evident.

- Unlike in protozoal infections where there is only **little resistance**.
- And to helminthic infections, maybe **no resistance** at all to a **reinfection**.

There are **NO vaccines** yet for protozoal/helminthic infections.

There NO long-lasting immunity after protozoal/helminthic infections subside.

- However, they seem to stimulate resistance while the parasite is still in the body.
  - Thus, there is resistance to **hyperinfection** and is termed as **premunition**.

Infants born to a semi-immune parent in an endemic area has a great immunity against these parasites because of the **maternal antibodies** acquired **transplacentally**.

If these babies are infected, the symptoms are not severe and repeated infections over the years keep the immunity at a high level and symptoms correspondingly mild.

- However, when these babies who spent a relatively long time in an endemic area and leaves it for protracted period and then return, they will be as susceptible as the first timers in the area.

The role of cytokines, and particularly of **Tumor Necrosis Factor (TNF)** or **cachectin** has been the subject of much research activity.

**Cachectin**—a major secretory product of **activated macrophages**

- In low doses, it is protective against experimental malaria in mice
- It stimulates the killing of **schistosomules** by **eosinophils in vitro**
- However, can bring about the state of **cachexia** in **Trypanosomiasis**
  - **Cachexia**—general physical wasting and malnutrition in chronic diseases

**PARASITES AND THE COMPROMISED HOST**

Factors that can make the host **immunocompromised**:

- Surgery
- Transfusion
- Intubation
- Prolonged hospitalization
- Corticosteroids
- Immunosuppressive agents
- Antimetabolites
- HIV/AIDS

- AIDS patients are particularly susceptible to the following conditions:
  - **Toxoplasmosis**
  - **Cyclosporiasis**
  - **Cryptosporidiosis**
  - **Isosporiasis**
  - **Strongyloidiasis**
  - Other bacterial, fungal, and bacterial disease
  - Malignancies—**Kaposi’s Sarcoma**
LIFE CYCLES OF PROTOZOA AND HELMINTHS

Many parasitic organisms have but a single host, being transferred from one individual to another of the same species either through direct physical contact or by means of resistant or semiresistant forms that are able to survive a period outside or away from the host.

→ *Entamoeba gingivalis*
  - A commensal organism that inhabits the mouth
  - No cyst stage or other means of being able to survive outside the host
  - Transferred through direct contact

→ *Trichomonas hominis*
  - Unable to form cysts
  - But can survive short periods of time outside a host
  - Therefore, direct contact is NOT necessary

Though these two are unable to produce cysts, many protozoa and helminths have cyst stages or eggs that survive away from the host and is the means by which new hosts become infected.

**WHO Priority Infectious Diseases**
1. Schistosomiasis
2. Malaria
3. Filariasis
4. Trypanosomiasis
5. Leishmaniasis
6. Leprosy (replaced by HIV/AIDS)

Mnemonic: **SM Faranaque is TaLL, HA!**

**Geographic Distribution Factors for Endemicity**
1. Presence of a suitable host
2. Habits of the host
3. Escape from the host
4. Favorable conditions outside the host
5. Economic and social conditions

**Presence of Diseases in a Population (Prevalence)**
→ Factors
  - Sources
    - Infected persons
    - Carriers
    - Animals
  - Mode of transmission
    - Direct
    - Indirect
    - Vectors
Susceptible host
- Immune status

Three Key Links of Disease Transmission
- **Source of Infection**
  - Excrement
  - Secretion
  - Blood
  - Focus of infection
- **Route of Transmission**
  - Food
  - Water
  - Finger
  - Direct or indirect contact
  - Blood transfusion
  - Injection
  - Intermediate host
  - Insects sucking blood
  - Touching soil, water, and grass
- **Susceptible hosts**
  - Mouth with oral lacerations
  - Wounded skin
  - Contact with mucous membranes
  - Placenta

Diagnosis of Parasitic Infections
- **Clinical diagnosis**
  - Includes symptomatology of the disease
- **Laboratory diagnosis**
  - Indicates eosinophilia

Treatment of Parasitic Infections
- Medical and Surgical
- Chemotherapy
- Adequate Nutrition

Prevention and Control
- Reduction in sources
- Health education
- Destruction and control of reservoir hosts and vectors

Some notes:
- Hookworm infection is DIFFERENT from Hookworm Disease
  - Distinction is made on the basis of the presence or absence of clinical symptoms.
 Humans are **INTERMEDIATE HOSTS** (not definitive hosts) of the malarial parasite *Plasmodium*

-end-

**References**

1. Markell and Voge’s Medical Parasitology  (9th edition)
2. Lecture notes by RAsturiano from the lecturer

Downloadable for free at: [www.theelusivedoktora.wordpress.com](http://www.theelusivedoktora.wordpress.com)
For any corrections you may find, content or otherwise, email me at: ram.ustmedicine@gmail.com

-THANKS-

**AsturiaNOTES**
By RAsturiano
#TheElusiveDoktora