

INTRODUCTION TO PARASITOLOGY

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OBJECTIVES:

1. Be familiar with the key characteristics that identify protozoa, nematodes, trematodes, and cestodes.
2. Be familiar with the major parasites
 - a. whether the organism is a protozoan, nematode, trematode, or cestode
 - b. aspects of the parasite life cycle, including
 - i. how the parasite is acquired by humans
 - ii. the organ systems involved in infection
 - iii. how the parasite is transmitted (the vector)
 - iv. how diagnosed
3. Be familiar with the drugs used to treat each infection.
4. Even though many of these parasites are endemic to the tropics, they still represent important health problems for the American physician and physician assistant. Therefore, know why parasites are significant health problems in the United States.

PARASITOLOGY LECTURE OUTLINE:

I. INTRODUCTION

Perhaps the most outstanding feature of parasitic infections in humans is their extraordinary number. Infection levels are staggering - literally one in every two human beings worldwide harbors a parasite of some sort, and many people are infected with multiple species of parasite. One in every five people carries the 8" *Ascaris* worms, nearly as many carry hookworms or whipworms. Blood flukes and malaria afflict significant proportions of the population in Africa, as well as other countries outside of Africa. Although parasites are unfamiliar to most Americans, people of the tropical and subtropical regions of the world are well acquainted with parasites and the diseases they cause.

By and large, parasites infect humans without consequential symptomatology, although they have a huge impact due to the immense number of individuals affected. For example, minimally 200,000,000 people are infested with the protozoan parasite *Entamoeba histolytica*, although only 10% of these individuals suffer from amoebic dysentery. Malaria infects even more individuals, yet only 2-3 million people, mostly children, die from malaria each year.

Parasites are remarkably adept at parasitizing every niche (organ) within the human body, rarely, however, destroying their human habitat, thereby maximizing their potential for propagation and long term survival. As a group, parasites seize every opportunity to exploit human behavior, food habits, dwelling sites, and lifestyle. Poverty, overcrowding, impure water, contaminated food, and inadequate sewage are the parasite's benefactors.

Why should OHSU physician assistant students be interested in parasites?

1. HUGE numbers of humans infected.
2. Fascinating and complex life cycles.
3. Correlation between environmental circumstances and the human condition with the spread of infection.
4. Extended rapid travel, international interest, military involvement abroad, and AIDS pose increased risks to Americans.

II. BASIC INFORMATION

- DEFINITIONS:** Parasite, host, symbiosis, commensalism, mutualism.
- LIFE CYCLES:** Vary from simple to complex. Concepts of definitive, intermediate, reservoir host, vector.
- PATHOGENESIS:** Parasites may cause damage in a variety of ways including: mechanical, lytic, necrosis, toxic effects, allergic, secondary bacterial infections.
- SYMPTOMS:** Parasitic infections are often asymptomatic or mild; usually non-specific. Acute: high fever, inflammation, pain, tenderness. Host nutrition and immune status are important factors. Chronic: gradual weight loss, anemia, eosinophilia.
- DIAGNOSIS:**
1. Detect the organism in the host (feces, sputum, tissues, etc.). Note: the laboratory report is only as reliable as the person who makes it.
 2. Understanding life cycle may help in diagnosis; know where to look for the parasite.
 3. Immunodiagnosis, DNA diagnostics
- TREATMENT:** Often specific chemotherapies are available. Some diseases, e.g., malaria or schistosomiasis, present especially difficult treatment problems, such as drug resistance or reinfection.
- EPIDEMIOLOGY:** Portal of entry is often the mouth or the skin.
- IMMUNITY:** Many parasitic infections are chronic in the normal host. Elaborate methods to evade immunity.
- PREVENTION:** Problems at the individual, community, and national levels. Control: insecticides, Molluscicides, sanitation, vaccines (none available), chemotherapy. All have inherent problems
- NUMBERS:**

Top Ten Human Parasites (based on WHO estimates)	Infections	Deaths (thousands per year)
Ascaris	1,400,000	200
Hookworms	1,200,000	55
Trichuris	950,000	-
Plasmodia	500,000	2000-3000
Entamoeba	480,000	75
Filarias	280,000	-
Schistosoma	200,000	750
Giardia	200,000	-
Trypanosoma	25,000	65
Leishmania	12,000	30

III. CHARACTERISTICS OF THE MAJOR GROUPS OF PARASITES: PROTOZOA, ROUNDWORMS, TAPEWORMS, FLUKES, ARTHROPODS

A. PROTOZOA

Single-celled eukaryotes: One or more characteristic nuclei, cytoplasm, cell membranes; Can be intracellular and/or extracellular; Unusual organelles, life cycles, and tissue tropism; *Plasmodia*, *Leishmania*, *Trypanosoma* species all have insect vectors.

1. *Plasmodia spp.* - malaria
2. *Trypanosoma brucei/cruzi* - African sleeping sickness, Chagas disease
3. *Leishmania spp.* - leishmaniasis
4. *Trichomonas vaginalis* - trichomoniasis
5. *Giardia lamblia* - giardiasis
6. *Entamoeba histolytica* - amoebiasis or amoebic dysentery
7. *Toxoplasma gondii* - toxoplasmosis (opportunistic pathogen in AIDS patients)
8. *Cryptosporidium parvum* - cryptosporidiosis (opportunistic pathogen in AIDS patients)
9. *Pneumocystis carinii* - pneumocystosis (opportunistic pathogen in AIDS patients)
- this organism displays characteristics of both protozoa and fungi

B. HELMINTHS (WORMS)

1. **Roundworms (Nematodes):** Adults are cylindrical, elongate, and unsegmented and possess a complete digestive tract. Separate sexes, females larger. All nematodes have the same fundamental complex life cycle: adult worms, eggs, several successive cylindrical larval stages. Roundworms are the most common parasitic worms; usually species specific. Most are intestinal.
 - a. *Enterobius vermicularis* - enterobiasis or pinworms
 - b. *Trichuris trichiura* - whipworm disease
 - c. *Necator americanus* and *Ancylostoma duodenale* - hookworm disease
 - d. *Strongyloides stercoralis* - strongyloidiasis
 - e. *Trichinella spiralis* - trichinosis
 - f. *Ascaris lumbricoides* - ascariasis
 - g. *Wuchereria bancrofti* and *Brugia malayi* - filariasis or elephantiasis
 - h. *Onchocerca volvulus* - onchocerciasis or river blindness
 - i. *Loa loa* - loiasis
 - j. *Dracunculus medinensis* (Guinea fire worm) - dracunculiasis
2. **Tapeworms (Cestodes):** Segmented. Adult worms live in the intestinal tract of vertebrates. Scolex, proglottids. Eggs produced in proglottids, excreted, develop into larval forms in intermediate host. When the larva reaches the intestinal tract of a definitive host, it develops into a scolex which gives rise to a complete worm.
 - a. *Taenia saginata*
 - b. *Taenia solium*
 - c. *Diphyllobothrium latum*
 - d. Larval Tapeworms
3. **Flukes (Trematodes):** Adults flat and leaflike (exception: the schistosomes). Those that parasitize humans are digenetic (asexual reproduction in snails). Adults vary in size from 1 mm to several cm and have two suckers, one anterior and one ventral. Most trematodes of humans are hermaphroditic (exception: the schistosomes) and produce eggs of distinctive size and shape (useful diagnostically). Humans acquire trematodes either by ingesting larval forms on animals or plants, or when these forms penetrate the skin.

- a. *Schistosoma spp.* - schistosomiasis or bilharzia
- b. *Clonorchis sinensis* - clonorchiasis
- c. *Fasciola hepatica* - fascioliasis
- d. *Paragonimus westermani* - paragonimiasis

C. ARTHROPODS

Have jointed appendages, an exoskeleton, bilateral symmetry, and a complete digestive tract. These include ticks, mites, lice, bugs, fleas, mosquitoes. Arthropods may cause disease on their own (e.g., by sucking blood) or may serve as vectors and transmit other disease agents to humans.