Unit 11 (Part 1)

Symbiotic relationships. Medical Protozoology.

Symbiotic relationships

The word ***symbiosis*** literally means 'living together, ' but when we use the word *symbiosis* in biology, what we are really talking about is a *close, long-term interaction between two different species.*

There are several kinds of symbiosis.

Mutualism is a type of relationship when two organisms of different species "work together" each benefiting from the relationship.

Example: The bacteria and the human. A certain kind of bacteria lives in the intestines of humans and many other animals. The human cannot digest all of the food that it eats. The bacteria eat the food that the human cannot digest and partially digest it, allowing the human to finish the job. The bacteria benefit by getting food, and the human benefits by being able to digest the food it eats.

Commensalism is a type of relationship between individuals of two species in which one species obtains food or other benefits from the other without either harming or benefiting from the latter.

Example 1: Bacteria (Acetobacter oxydans) make fructose by oxidizing mannitol. Other species can metabolise fructose, but cannot metabolise mannitol. A hermit crab taking up residence in an empty seashell.

Example 2: Mites will attach to wasps, flies or beetles for transportation.

Parasitism is a type of relationship when one partner uses another one as a source of supply (habitat or shelter) doing harm but not killing it.

Example 1: Fleas and mosquitoes feed on blood from other organisms.

Example 2: Tapeworms do more damage to their hosts because they eat partially digested food and that deprives the host of some food and nourishment.

Components of "parasite – host" system

A parasite is a living organism, which derives its nourishment and satisfies other needs at the expense of a host.

An obligate parasite is a parasite which is completely dependent on the host during a segment or all of its life cycle.

A facultative parasite is an organism that exhibits both parasitic and non-parasitic modes of living and hence does not absolutely depend on the parasitic way of life, but is capable of adapting to it if placed on a host.

An ectoparasite is a parasitic organism that lives on the outer surface of its host.

An endoparasiet is a parasitic organism that lives inside the body of their host.

A temporary parasite is a parasite that lives upon or within the host only during mealtime.

A permanent parasite is parasite that lives upon or within the host throughout its life cycle.

A host is an organism in or on which the parasite lives and causes harm.

A definitive host i**s** a host that harbors a parasite at the adult stage or a parasite which reproduces sexually.

An intermediate host harbors the larval stages of the parasite or an asexual cycle of development takes place. (In some cases, larval development is completed in two different intermediate hosts, referred to as the first and second intermediate hosts).

A reservoir host is a host that makes the parasite available for the transmission to another host and is usually not affected by the infection.

An accidental host is a host that is not infected with the parasite under normal circumstances.

A vector is a carier that transports a parasite to a host or a pathogenic organism from an infected to a non-infected host.

Ways of adaptation to a parasitic mode of life

Morphological adaptation (attachment organs of parasitic worms, specialized mouth parts in insects, thick external outer cover to prevent digestion).

Biochemical mechanisms for entry (proteolytic enzymes to facilitate tissue penetration).

Complex life cycle and transmission opportunities (direct and indirect life cycles with one or more than one (two or three) intermediate hosts; ability to adapt to physiology and behavior of the host).

Mechanisms of immune evasion (ability to quickly change antigens, adjust to the antigenic structure of host).

Highly developed reproductive system (many parasites have a complex reproductive system, hermaphroditism is possible).

Ways of host adaptation

The defense to a parasitic infection involves both non-immune and acquired mechanisms:

Protective outer covering

Acidic medium of stomach

Biochemical changes

Immune response

Effect of parasites on the host

The damage which pathogenic parasites produce in the tissues of the host may be described in the following two ways;

Direct effects of the parasite on the host:

Mechanical injury (by means attachment organs, proteolytic enzymes)

Deleterious effect of toxic substances

Deprivation of nutrients

Indirect effects of the parasite on the host:

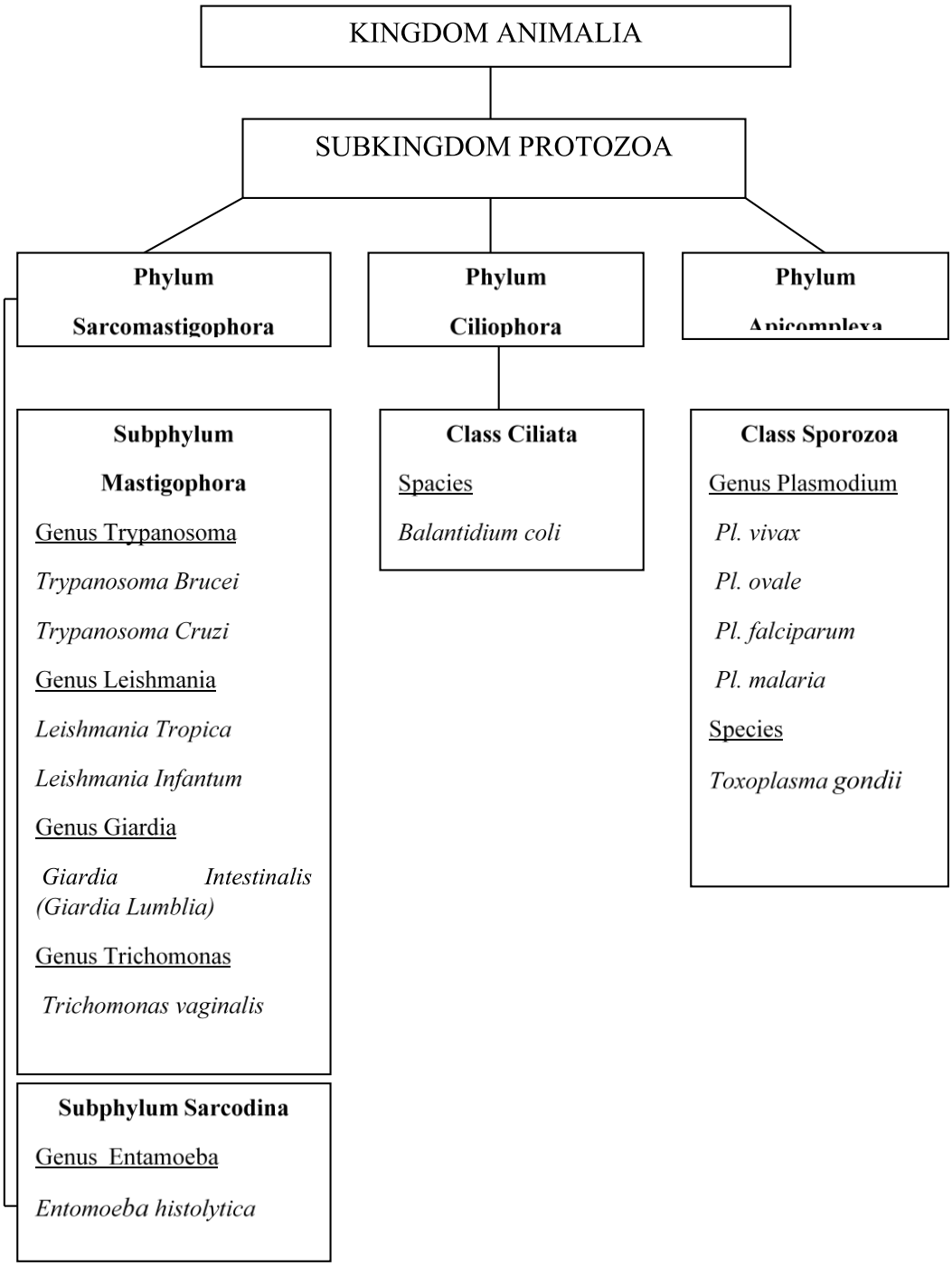
Immunological reaction (tissue damage may be caused by immunological response of the host)

Excessive proliferation of certain tissues due to invasion by some parasites can also cause tissue damage in man.

Subkingdom Protozoa. General characteristics. Medical significance.

Medical protozoology studies the unicellular organisms of Subkingdom Protozoa that are parasites of human beings.

Classification of the Protozoa into four of their major groups is based upon their characteristically different methods of locomotion:



SUBKINGDOM PROTOZOA

The Protozoa are considered to be a subkingdom of the kingdom Protista, although in the classical system they were placed in the kingdom Animalia. More than 50, 000 species have been described, most of which are free-living organisms; protozoa are found in almost every possible habitat. These are ubiquitous or cosmopolitan. Free living protozoans are usually aquatic (marine or fresh water). Several protozoans are commensal, symbiotic and parasitic species. Parasitic protozoans are internal or external.

General characteristics Protozoans are single-celled eukaryotes;

1. The protozoon is made of a mass of protoplasm differentiated into cytoplasm and nucleoplasm;
2. Nucleus: there may be one or more nuclei, and in some taxa the nuclei are of two types: larger - macronucleus and smaller - micronucleus;
3. The cytoplasm consists of outer thin hyaline ectoplasm and inner voluminous granular endoplasm;
4. The ectoplasm functions consist in: protection, locomotion, ingestion of food, excretion and respiration;
5. The endoplasm is involved in metabolism. It encloses: food vacuoles: containing food during digestion; excretory vacuoles: collecting waste products and discharging them outside the body by bursting through the ectoplasm or by an anal opening;
6. Nutrition: by absorption of liquid food through the body surface, or ingestion of solid particles with the help of pseudopodia or through the cytostome;
7. Excretion: by diffusion through the body surface, or excretory vacuoles.
8. Secretions: by digestive enzymes, toxins, and material for cyst wall, enzyme to liquefy tissues;
9. Respiration : aerobic or anaerobic;
10. Locomotion: by pseudopodia, flagella (whip-like) and cilia (hair-like) or organs absent;
11. Cyst formation: encystment of some protozoa is essential for their survival outside the body of the host and during transmission from host to host;
12. Reproduction: asexual reproduction - by amitosis, binary fission,

multiple fissions; sexual reproduction – copulation, conjugation.

Entamoeba histolytica: morphology, mode of transmission, life cycle, diagnosis prevention and control.

Entamoeba histolytica is a common parasite living in the large intestine of humans, certain primates, and some other animals.

*Disease**:*** Amebiasis, Amoebic dysentery.

Geographic distribution: cosmopolitan.

Localization in human body: colon, cecum, liver, lung, brain.

Morphology: there are 3 forms: small vegetative (forma minuta), large vegetative (forma magna) and and cyst (containы 4 nuclei). Locomotion by pseudopodia, excretion by contractile vacuole, multiplication by amithosis.

Mode of transmission: ingestion of mature cysts through contaminated food or water, by dirty hands, by direct contact with an asymptomatic carrier.

Life cycle: Parasite turns out in the human body in form of cyst. From the cyst in the lumen of the intestine, 4 small forma minuta are formed. They can exist for a long time and this case human becomes cyst-carrier. With the weakening of the host organism, the forma minuta transforms into forma magna (pathogenic form). This transformation is facilitated by a number of factors: violation of the function of the digestive system (consumption of spicy food, starvation), weakening of the host body by infections, hypothermia, etc. The forma magna destroys the epithelium of the colon mucosa. Then it can turn out in the liver, brain and other organs through blood vessels, causing inflammatory processes.

The attenuation of disease pathogenic forms in the lumen of the small intestine are converted into forma minuta, and then in the cysts.

Diagnosis: **s**tool examination by direct smear unstained or stained with iodine. Stools may contain cysts with 4 nuclei (**!** it is necessary to distinguish from the cysts of a non-pathogenic intestinal amoeba, whose cysts contain 8 nuclei).

Prevention and control: prevention of contamination of food and drink with cysts by improvement of sanitaryconditions; examination and treatment of food handlers; treatment of cases and asymptomatic cyst passers;control of flies and other insects as cockroaches; personal prophylaxis.

Genus Trypanosoma. Morphology, mode of transmission, life cycle, diagnosis prevention and control.

Genus TRYPANOSOMA

Some species of Trypanosoma are human parasites. They are:

T. brucei gambiense

T. brucei rhodesiense.

T. Cruzi

Disease: Sleeping sickness.

Trypanosoma brucei rhodesiense causes East African trypanosomiasis,

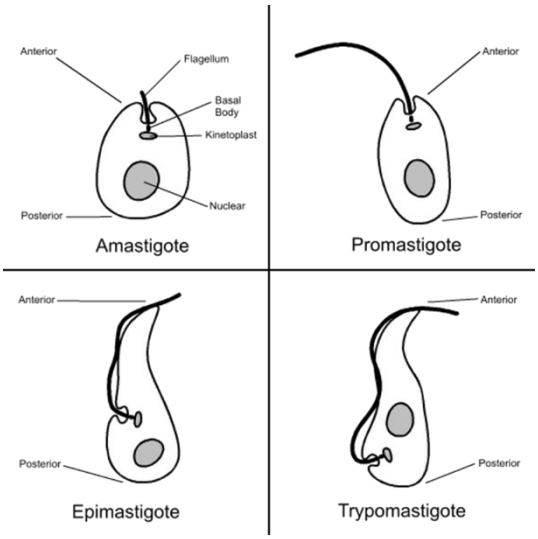
Trypanosoma brucei gambiense causes West African trypanosomiasis.

T. Cruzi causes American Sleeping sickness or Chagas disease.

Geographic distribution: T. b. rhodesiense is found in eastern and southeastern Africa. T. b. gambiense is found predominately in central Africa and in some areas of West Africa. T. Cruzi - South America.

Localization in the human body: blood, lymphatic or spinal fluid, may be found in brain, heart, kidney, liver.

Morphology. Moving by flagella, reproduce by longitudinal binary fission. There are four morphs: epimastigote, trypomastigote, promastigote, amastigote.



Mode of transmission:

T. brucei gambiense and T. brucei rhodesiense through a bite of tse-tse flies (Glossina genus). A tse-tse fly contains trypanosomes in its proboscis and salivary glands.

T. Cruzi through a bite of triatomine insect vector (or "kissing" bug).

Life cycle: pathogens of African trypanosomiasis go through 2 stages of development: trypomastigote and epimastigote. The first part of the life cycle takes place in the digestive tract

of a specific vector – the tse-tse fly (R. Glossina). When a fly sucks the blood of a sick person, trypomastigotes enter its stomach. Here they turn into epimastigotes, multiply and then accumulate in the salivary glands (the duration of development is 20 days). Through the bites of flies parasite turns out in human body. The second part of the life cycle of parasites takes place in humans and reservoir hosts (for the gambian trypanosoma – pigs, and for the rhodesian-antelopes and cattle). The first 9-10 days of trypomastigotes live in the subcutaneous tissue, then gradually accumulate in the lymphatic system, multiply and after 20-25 days enter the blood and spread to all tissues and organs. The predominant localization of trypanosomes is the cerebrospinal fluid, from where they enter the brain and spinal cord.

T. cruzi goes through the stages of development: trypomastigote, epimastigote and amastigote. When sucking the blood of a sick person or animal, trypomastigotes enter the intestines of kissing bug, transform into epimastigotes, multiply, turn into trypomastigotes and after a while are excreted with its excrement. Infection of a person (transmissible pathway) occurs when excrement with pathogens gets on damaged skin (wounds from bites, combs). After 1-2 weeks, inside the affected cells, amastigotes turn into trypomastigotes and enter the bloodstream, circulate through the body, invade cells of various organs (heart and skeletal muscles, nervous system, etc.), where the cycle repeats.

Laboratory diagnostics: detection of trypanosomes in blood smears, cerebrospinal fluid, punctates of lymph nodes, spleen, bone marrow. Immunological reactions are used (determination of antibodies in the blood serum of patients).

Prevention: protection from tse-tse fly and kissing bug bites.

Genus Leishmania. Morphology, mode of transmission, life cycle, diagnosis prevention and control.

Leischmania donovani is the causative agent of *visceral leishmaniasis*,

Leischmania tropica is the causative agent of *cutaneous leishmaniasis*,

Leischmania brasiliensis is the causative agent of *cutaneous* and *mucous leishmaniasis*.

Morphology: there are 2 forms – promastigota (has a flagellum) and amastigota (without flagella). All pathogens of leishmaniasis are morphologically similar, but have biochemical and antigenic differences.

Life cycle: specific vectors of leishmania are sand fly of *Phlebotomus*, in which parasites multiply in the digestive tract and accumulate in the proboscis. In the body of the carrier is

formed flagellate stage promastigote. Human becomes infected by means of bite sand fly. In humans and other vertebrates (reptiles, mammals) leishmania lose the flagellum, turn into amastigotes and multiply intensively inside the cell.

The pathogenic effect of:

Mechanical (destruction of skin cells and mucous membranes and even cartilage).

Toxic-allergic (poisoning of the body with waste products).

Symptoms: ulcers that increase in size and gradually destroy all soft tissues. Overgrowth of the tissues of the nose, lips, pharynx, larynx.

Laboratory diagnostics: detection of leishmania in smears from the contents of ulcers.

Prevention: individual protection from sand fly bites (reppelents, nets).

Fill in the table

Name of Parasite (in Latin)	Name of *Disease*	*Mode of transmission*	Invasive stage for Human	Localization in Human body	*Laboratory diagnostics*	*Prevantion*