

PART II

PROTOZOOLOGY

Chapter 3

Introduction to Protozoa

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Protozoa are unicellular eukaryotic organisms that do not undergo tissue formation through the process of embryological layering, including about 65,000 species. Most of them are free-living and some are parasitic in human or other animals. Medical protozoa refer to the protozoa that are parasitic in the lumen, body fluid, tissue or intracellular of the human. There are approximately 40 species, which can be classified into pathogenic protozoa and non-pathogenic protozoa. The size of protozoa is 2-200 μm . All of them have the usual cellular structure, including the plasmalemma, the cytoplasm and the nucleus and can complete all the functions of life activities. The body is bounded by plasmalemma and may possess a glycoprotein surface coat. There exist complicated receptors, ligands, enzymes, and other kinds of antigen components on the plasmalemma, so plasmalemma involves a serial of activities including invasion, excretion, intaking of nutrients, mobility, and evasion of host immunity and so on. Usually, there are three ways for intaking nutrients: permeation, pinocytosis, and phagocytosis. The cytoplasm of protozoa is composed with the substrate, organelle, and some special vacuoles. Locomotory organelles are unique to protozoa, and the flagellum, cilium, pseudopodium and sucking disk are their unique locomotory organelles. The protozoa can be classified into amoeba, flagellate, ciliate and sporozoa based on the types of locomotory organelles. The Nuclei of protozoa may be of two types: vesicular nucleus and compact nucleus. Most species of the protozoa are of vesicular nucleus.

Reproduction in protozoa includes either asexual production or sexual production, or both asexual and sexual. The most common type of asexual multiplication is binary fission which split the individual into two, and other types including multiple fission and budding. The sexual reproduction involves gametogony and conjugation. The reproduction can be an alternation of generation in some protozoa, such as in *Plasmodium* and *Toxoplasma gondii*. Nevertheless,

the sexual reproduction only can happen in definitive host. The felines are the definitive host for *Toxoplasma gondii*, and the gametogony for *Plasmodium* happens in the mosquitoes.

The life cycle of protozoa consists of several developmental stages differing in structure and activity: trophozoites, cyst formation, and sexual phase. The reproduction and feeding stages and trophozoites are active and associated with the pathogenesis of human diseases. The cysts are major infective sources with a protective membrane or wall which enable the parasite to persist and “wait” for transmission to a new host. The cyst formation happens when the protozoa are in the unfavorable circumstances. According to the transmission characteristics, the transfer can be classified into three modes: person to person transfer mode in which no intermediate host is needed and the transmission is only from person to person, circulation transfer mode in which protozoa passes through more than one vertebrate with sexual and asexual reproduction to finish its life cycle, and vector transfer mode in which the protozoa need insects as host to develop to an infective stage.

The pathogenesis of protozoa is associated with species/strains, location, virulence and proliferation of the protozoa and the state of the host immunity. There are three typical characteristics of pathogenesis including multiplication, diffusion and invasion, and opportunistic pathogen. Opportunistic protozoa are somewhat symbiotic and nonpathogenic, causing only limited clinical symptoms in immunocompetent host called suppressed infection, but severe symptoms may appear in the immunodeficient persons. For example, there are no clinical symptoms in immunocompetent after infected with *Toxoplasma gondii*. However, there can be serious *Toxoplasma* encephalitis in persons with AIDS.

There are four phyla for medical protozoa: Phylum Sarcomastigophora, Phylum Apicomplexa,

Phylum Microsporidia and Phylum Ciliophora. A number of protozoan pathogens are human parasites, causing diseases such as amoebic dysentery (by *E. histolytica*), trichomoniasis (by *Trichomonas vaginalis*), giardiasis (by *Giardia intestinalis*), kala-azar (by *Leishmania donovani*,

malaria (by *Plasmodium falciparum*), toxoplasmosis (by *Toxoplasma gondii*), cryptosporidiosis (by *Cryptosporidium*), etc.

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