**I Lecture : Medical microbiology and immunology, aims and objectives, historical stages. The role of microbiology in the activity of the pharmacist. Classification of microorganisms. Classification of bacteria**

**The purpose of the lecture.** To emphasize the subject, subject, sections, goals and objectives of medical microbiology and immunology, its place in medical education, the role of microbiology in the activities of pharmacists. To acquaint students with the history and stages of development of microbiology, to explain to them the principles of classification of microorganisms.

Lecture plan:

1. Introduction to medical microbiology and immunology, its position in medical education, its importance for medical practice.

2. Subject,+ sections, goals and objectives of the subject.

3. History and stages of development.

 first ideas about microorganisms (period of hypotheses).

 Preliminary evidence of the existence of microorganisms, the discovery of the microscope (morphological period).

 Study of the vital activity of microorganisms, works of L. Pasteur and R. Cox (physiological period).

 Research of protective factors of an organism, works of II Mechnikov and P. Erlich (immunological period).

 modern stage of development of microbiology (molecular-genetic period).

 Development of microbiology in Azerbaijan.

4. The role of microbiology in the activities of pharmacists.

5. Modern principles of classification of microorganisms. The main groups of microorganisms. Prokaryotes (bacteria, spirochetes, actinomycetes, rickettsiae, chlamydia, mycoplasmas), eukaryotes (primates and fungi) and viruses.

6. Taxonomy and taxonomic categories: world, department, class, group, season, genus, species, subspecies. Type as the main taxonomic category. The concept of the categories of subspecies: biovar, serovar, phagovar. Concepts of culture, strain, clone.

7. Bergi classification of prokaryotes.

 Lecture equipment: Computer, projector, electronic slides related to the lecture.

 Literature: p.1

***Microbiology*** (Gk. *mikros* small, *bios* life, *logos* science) is the science of minute organisms, invisible to the naked eye, named microbes. It is the study of the laws of the life and development of micro-organisms, and also of the changes which they bring about in animal and plant organisms and in non-living matter.

Modern medical microbiology has become an extensive science. It is subdivided into *bacteriology* — the science of bacteria, the causative agents of a number of infectious diseases; *virology —* the science of viruses, non-cellular living systems capable of causing infectious diseases in man; *immunology —* the science which is concerned with the mechanisms of body protection against pathogenic micro-organisms and foreign cells and substances; *mycology* — the study of fungi pathogenie for man, and *protozoology* which deals with pathogenic, unicellular animal organisms. In addition, medical microbiology includes the study of the mechanisms of infection and the methods of specific therapy and prophylaxis of infectious diseases.

According to application fields special microbiology is divided to branches : medical microbiology , sаnitary microbiology , clinical microbiology , industrial microbiology , biotechnology , veterinary microbiology, agromicrobiology , cosmic microbiology

*Medical microbiology* : Learns features of disease causing microorganisms and pathological processes developing in microorganism during diseases. Main objectives of medical microbiology aredevelopment of laboratory diagnostics, specific prevention and treatment methods of diseases caused by microorganisms.

*Sаnitary microbiology* : Learns microorganism living in environment (air, water, soil etc.) and processes caused by them. The main aim of sanitary microbiology is to detect causative agents of infectious diseases from environment and conduct measures to prevent contamination of environment by microorganisms, thus preventing development of infectious diseases.

*Clinical microbiology* : A branch of medical microbiology learning diseases of human organ and systems caused by microbes and priciples and of microbiological diagnostics.

*Industrial microbiology* : Studies microorganisms used in production of food, organic molecules such as antibiotics, enzymes, vitamins, alcohol etc. Industrial microbiology is in close relationship with biotechnology learning producers of biologically active substances.

*Biotechnology* : Learns living organisms especially microorganisms, animal and plant cells used in industry. Its aim is to obtain metabolic products of living cells. Sometimes it is possible through bioeffects which are usually do not exist in nature.

*Veterinary microbiology :* Learns microorganisms causing diseases in animals and develops diagnostic, specific prevention and treatment methods used in diseases caused by them. Veterinary microbiology is related to medical microbiology- many microorganisms causing animal diseases are pathological for human as well.

*Agromicrobiology* : Studies microflora of soil, role of microorganism in plant nutrition and soil fertility, Studies phytopathogen microorganisms causing plant diseases and develops methods used in struggle with them.

*Space microbiology :* Studies effect of Space factors on microorganisms and human microflora, develops methods to prevent spread of microorganisms from Earth surface to space.

*Immunology* : Immunology is a science evolved together with microbiology and developed based on microbiology. Learns structure and function of immune systemsupporting inner homeostasis of organism. Immune competent cells of immune system produce protective reactions called immune reactions thus supporting inner stability of organism against genetically foreign substances called antigens by removing them from organism.

***Aims:*** The study of pathogens for humans microorganisms and also diseases which are caused by them, pathogenesis of those illnesses, their laboratory diagnosis, treatment and prevention.

***Objectives:*** Further study of roles of particular species of pathogen microbes in the etiology and in the pathogenesis of different human diseases, study of mechanisms of immunity formulation, development of diagnostics methods and method development of specific prevention and treatment.

***The role of microbiology in the activity of the pharmacist:*** Understanding the principles of microbiology and human cell mechanisms allows **pharmacists** to discover antimicrobial drugs that would prevent an escalating number of communicable diseases. Pharmacists and microbiologists work synergistically to ensure that drug therapies target the opportunistic microbes without harming its human host

Microbiology began to develop as a science from the second half of the 19th century. The history of the development of microbiology is divided into several stages:

***Theoretical stage:***  Hippocrates played an important role in formation of knowledge about infectious diseases in antic age medicine (IV-III b.c). He thought that epidemics are caused by rotting organic matter called miasma also called night air. Hippocrates theory existed until renaissance - ХIV century when a new theory of infectious diseases had emerged. In 1374 in Venice people suspected in plague were isolated for 40 days (quаrаntinа). In ХV-ХVI G.Fracastoro (1476-1553) suggested that diseases are caused by «living pathogenic agents» - cоntаgium vivum. He thought that these agents are nonvisible and live in environment, spread by air and environmental objects.

***Mоrphological stage:***  The first prove of microorganisms existence was given by datch scientist Antonie van Leeuwenhoek(1632-1723). Antonie van Leeuwenhoek produced microscope lenses. His handcrafted microscope could magnify object 160-200 times. He discovered living organisms in dental plaque, faeces and other objects and called them «wild animals» - «аnimаlculа vivа». He sent his observation to London Royal Society.

 

***Physiological stage:*** From ХIХ century middle scientists begun intensively learn bacterial physiology. This stage continuing to develop up to our days is called physiological stage. Researches of *Louis Pasteur* (1822-1895) played an important role in development of physiological stage. He studied the crystals of wine acid in the microscope, proved microbiological nature of alcoholic, lactic and butyric fermentation, demonstrated a new type of respiration – anaerobic – in some of microbes. Then he presented and proved his famous theory that there is no self-origin of life (microbes). He proved that spontaneous generation of living substases does not exist. Also he discovered the nature of rabies and developed the method of producing of antirabies vaccines and began to use this vaccine to treatment (prophylaxis). In 1798 the English physician *E. Jenner* published his results of vaccinations against smallpox. He proved that vaccination of human with cowpox protects them from infections with smallpox. Those discoveries played important role for further development theoretical and practical problems of prophylaxis and struggle against infectious deceases.



**Based on L.Pаstеur researches an English surgeon J.Listеr developed antiseptic principles playing an important role in prevention of postsurgical complications**



**In ХVIII English physician Е.Jenner (1749-1823) proposed a protective vaccine against natural pox**

*Robert Koch* made a great progress of medical microbiology. He discovered a solid nutrient media (gelatin, coagulated serum, meat peptone agar (MPA) and applied them to isolating of pure cultures of microbes. He also introduced aniline dyes and immersion system in practice of microscopy. Koch proved the bacterial nature(etiology) of anthrax. He discovered choleric agent, tuberculosis agent and obtained tuberculin from tuberculoid bacterium. In 1892 Russian scientist *D.I.Ivаnоvsкi* learned tobacco mosaic disease discovered small microorganisms passing through bacterial filters and causing specific pathological processes – viruses. In the middle of ХХ century– virology formed as a distinct independent science learning viruses.

 

 **Edward Jenner Louis Pasteur**

***İmmunological stage:*** Great role of understanding of inflammation nature was made by *I.E. Mechnikov* – all basic ideas of immunology: immune status, immune resistance, specific and non-specific factors of defense.The classic works of Mechnikov on the biological theory of immunity opened a new stage in the development of medicine. He discovered and studied the process of intracellular digestion as a mechanism of defense against pathogenic microbes which have penetrated into the body. He discovered that some cells of mesoderma, leykocytes possess a defense mechanism against pathogenic microbes. Those cells were named phagocytes. That is why we now Mechnikov as a founder of cellular theory of immunity, in 1908 he was awarded Nobel prize.

***Molecular-genetic stage:*** Discovery of DNA mоlеcule structure by J.Watsоn and F.Crick in 1953 is the beginning of new stage in development of microbiology and immunology. In addition, study of genomic and antigenic structure of microorganisms, molecular structure of immune globulins, immune response mechanism, immune systеm mеdiаtоrs, discovery of cytokines and application of new diagnostic methods - gеnеtic methods were stuied.

 **Classification of microorganisms.**

***The modern classification***

There are 2 upper kingdom of living mater: procariotes and eucariotes.

Procariotes contain: Cianibacterium, Archebacterium, Eubacterium (true bacteria).

Eucariotes contain: animals, plants, fungi (micota).

In this group for microbiology are important:

From animals - class Protozoa

From plants – unicellular water-plants – Algae

From fungi – all microscopical representatives.

Main classification of bacteria is **Bergey’s Manual**, which include two divisions:

1. Cyanobacteria (cyanophyta)
2. True bacteria which include 19 parts.

Main of them represents:

* Bacteria (rod-like, cocci), (aerobic and anaerobic), (endospore forming or no);
* Spirochetes and spiriles;
* Vibrions;
* Actinomycetes (important as producents of antibiotics);
* Obligate intracellular parasites (Ricketsia and Chlamidia).

Viruses are grouped in an independent kingdom:

* Are genetic parasites
* No cell structures and protein synthesis systems
* On animals, insects, plants, bacteria (phages) and human
* Contain DNA or RNA
* Are not visible with the light microscope.

 Each microorganism in systematics has its own taxonomy (greek, taxis – place, row). Taxonomy learns classification, identification and nomenclature of microorganisms.



**Classification categories**: Classification categories of microorganisms is the same as in other organisms : dоmеn - kingdom –class– order - family – genus – species. Some categories are changed depending on microorganism representatives. For exp., in animals «family» category is used, while in plants and microbes «order» is used.

The main classificarion category – species consists of microorganisms with the same origin and similar morpho-biological features

Species have:

• Strains with different morphological features - mоrphоvаrs,

• Strains with different biological features– biоvаrs,

• Strains with different antigenic features– sеrоvаrs,

• Strains with different susceptibility to phages– phagоvаrs etc.

• One species of microorganisms consists of manyn strains.

• Strain –microorganism related to one species obtained from different sources or from the same source in different time.

Modern classification divides microorganisms to 2 groups: **cellular and acellular.**

 • Acellular(akaryotes) microorganisms belong to a special кingdоm.

 • Cellular microorganisms belong to 3 domains: bacteria, archebacteria, and eukarya.

• Bacteria domain consists of true bacteria (eubacteria, greek, еu - true), archebacteria domain consists archebacteria (both domains - prokaryotes),

• Domain Euкаryа consists of eukaryotic microorganisms.



**Acellular microorganisms(акаryоtes**)

• Unlike prokaryotes and eukaryotes they do not have cellular elements – cell wall, cytoplasm, and other subcellular structures.

• Includes of viruses, virоids and priоns

**Cellular microorganisms**

• Divided to prokaryotes and eukaryotes.

• Prokaryotes modern classification is based on Bergey classification. This classification first introduced by American bacteriologist Bergey in 1923, is annually updated by International Committee on Classification of Bacteria

• According to last update – 9 th edition all prokaryotes depending on cell wall structure divided to 4 categories.

• Each category consists of many groups.

**Bergey classification of prokaryotes**:

• Gram negative eubacteria with cell wall

• Gram positive eubacteria with cell wall

• Eubacteria lacking cell wall

• Archebacteria

**Classification of Еuкаryotic microorganisms**

• Еuкаryotic microorganism are included in «еuкаriyа» dоmain.

• Unlike Prokaryotes they have formed nucleus which is separated from cytoplasm by special membrane.

• Eukaryotic microorganisms include Fungi and protozoans

 **Principles of the bacterial classification.**

All bacteria have binary nomenclature:

**Genus and Species:**

– pool of microorganisms with common origin, similar genotype (>60% of DNA homology) and maximum adjacent phenotypic signs and properties.

Additional terms:

**Clone** – a population of microorganisms descended from a single individual by asexual reproduction.

**Strain** – clones that are presumed or known to be genetically different. (it is specimen of microbic culture the same species, which was isolated from different places or from one place in different times.

**Cocci**: monococci, diplococcic (gonococci, meningococci, pneumococci), streptococci, staphiococci, tetracocci, sarcines (8-16 cells).

**Rod-like**: mono, strepto, diplo; with or without spores.

**Spirals** forms: vibrio, spirillae.