UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Basic Pathology

1819-2-H4102D011

Aims

Pathology and Medicine

The course aims to introduce the student to the knowledge of the causes of human diseases, the students will be able to understand the fundamental pathogenetic and pathophysiological mechanisms. During the course, topics for in-depth knowledge on the molecular mechanisms underlying the disease pathogenesis to identify potential therapeutic targets will be developed.

Immunology I

The Immunology I course provides students with the fundamentals of modern cellular and molecular immunology.

The course deals with the investigation of pathological mechanisms of immunology common to all pathologies, functional alterations and clinical significance. It focuses on the immunological aspects of various diseases. The course allows students to understand how and why the immune system protects us, its cells, what are the clinical manifestations that appear following the body's immune reaction. At the end of the course the student will be able to understand the immunological basis of alterations in human health and associated clinical manifestations and to clarify the physio-pathological principles underlying immunology and therefore of treatment.

Immunology II

The Immunology II course provides students with the knowledge of some basic cell and molecular immunology laboratory techniques.

The course will provide skills on sample preparation to be analyzed as well as basic immunology techniques. At the end of the course the student will be able to understand how the main immunological tests can be applied both to the diagnosis of diseases and to the translational research laboratory.

Microbiology and Virology

The course aims to provide the students with knowledge on the fundamental principles of the microbial etiology and pathogenesis of the major human infectious diseases.

Contents

Pathology and Medicine:

Introduction to General pathology

Physical, chemical and biological agents as a cause of illness

Tissue changes in response to chronic and acute pathological stimuli

The inflammatory process

The healing and repair process

Cardiovascular Disorders

The body's response to infection

Neoplastic growth

Environmental and Nutritional Diseases

Immunology I

• Immune response.

• Cells, tissues and organs of the immune system.

• Antibodies and antibody response.

• Major Histocompatibility Complex (MHC I and MHC II or HLA; Human Leukocyte Antigens) and antigen Presentation.

• Regulation of the immune response.

• Tolerance.

• Immediate hypersensitivity reactions.

• Delayed hypersensitivity reactions.

• Autoimmunity.

• Primary and Acquired Immunodeficiencies.

• Transplant immunology.

• Principles of immunosuppressive therapy.

Immunology II

• Cell culture techniques.

• Preparation of blood sample leukocytes

• Antibody production. Monoclonal antibodies and their applications.

• Antigen-antibody interaction, direct and indirect immunofluorescence. Immunohistochemistry.

• Immunoassay: immunoblotting, immunoprecipitation. ELISA test.

Microbiology and Virology

General characteristics of microbial pathogens.

Microbial genetics.

Microbial pathogenesis.

General characteristics of bacterial pathogens.

Virulence factors and mechanisms of bacterial pathogenesis.

Bacterial pathogens and associated diseases.

Viral pathogens and associated diseases and viral-induced oncogenesis.

Major fungal and protozoal human pathogens.

Principles of laboratory diagnosis of infectious diseases.

Antimicrobial agents and resistance.

Strategies for infectious diseases prevention and control.

Health Care Associated Infections.

Detailed program

Pathology and Medicine

Concepts of health, pathological process and disease. Etiology, pathogenesis, evolution, course, outcomes. Intrinsic and extrinsic pathogenic factors: causes of physical, chemical, biological nature. Alterations of DNA, RNA, proteins.

Cellular pathology. Alterations of cell growth and differentiation. Atrophy, hypertrophy, hyperplasia, metaplasia, dysplasia. Cell Aging. Cellular bases of aging; Reduction of cell replication; Accumulation of metabolic and genetic damage; Premature aging syndromes: Werner's syndrome, Hugthinson-Gilford syndrome, Bloom's syndrome, Xeroderma pigmentosum, Cockayne's syndrome;

Molecular mechanisms of cell damage. Oxidative stress: origin of free radicals, lipid peroxidation, oxidation of proteins and DNA. Antioxidant defenses of the cell. Hypoxic damage. Reperfusion damage.

Necrosis. Causes of necrosis. Types of necrosis: simple, coagulative, colliquative. Apoptosis. Causes of apoptosis. Morphological, biochemical and molecular aspects of necrosis, apoptosis. Other types of cell death: ferroptosis, pyroptosis, autophagy. Reaction to damage: inflammatory processes. Acute inflammation and chronic inflammation: phenomena (hyperemia, inflammatory exudate, leukocyte migration, infiltrate, tissue damage), mechanisms, cells, mediators, types, evolution. Inflammatory lesions: abscesses, ulcers, granulomas. Defects and excesses of the inflammatory response. Reaction to damage: the reparative process and its alterations. Fibrosis.

Molecular pathology. Neurodegenerative diseases: Amyloidosis; Alzheimer's disease; Prion diseases; Parkinson's disease; Multiple Sclerosis.

The response to infections. The main transmission pathways of infections. Structural defenses against infection. Escape mechanisms. The susceptibility to infections. Antibiotic resistance and bacterial resistance prevention strategies. How viral agents develop resistance to antiviral agents.

Cardiovascular disorders. Vascular occlusion and thrombosis. Atherosclerosis and hypertension. Circulatory failure.

Oncology: Introduction, nomenclature, epidemiology. Molecular oncology: cell cycle and related control mechanisms; protooncogenes, oncogenes and oncoproteins; tumor suppressor genes and their products; alterations of DNA repair mechanisms; altered genetic control of apoptosis. Etiological factors: chemical carcinogenesis, carcinogenesis by physical agents, DNA and RNA oncogenic viruses, presence of carcinogens in the environment, tumor heredity. Immuno-surveillance mechanisms. Tumor-host interaction. Environmental and nutritional disorders. Environmental effects, climate change and environmental pollution on health. Occupational health risks. Effects of alcohol and drugs. Nutritional disorders

Immunology I

- **Immune response. General properties of the immune system. Innate immunity and acquired immunity. The cells of the immune system. Soluble mediators. Antigens. The immune response. Inflammation. Defence mechanisms against intra- and extra-cellular pathogens. Humoral immunity. Cell mediated immunity.**

- **Cells, tissues and organs of the immune system. Cells of innate immunity, phagocytes: polymorphonuclear cells- Neutrophils, Basophils, Eosinophils; Monocytes and Macrophages. Platelets and Natural Killer Cells. Cells of acquired immunity: Antigen Presenting Cells; T lymphocytes - differentiation, activation and functions, B lymphocytes - differentiation, activation and functions. Primary lymphoid organs and tissues: Bone marrow; Thymus. Secondary lymphoid organs and tissues: Lymph nodes, Spleen, mucous associated Lymphoid tissue (MALT). Leukocyte trafficking.**

- **Antibodies and antibody response. Structure and functions. Antigen-Antibody Interaction. Fc receptors. Antibody response. Generation of antibody diversity. The cooperation of cells in the antibody response.**

• Major Histocompatibility Complex (MHC I and MHC II or HLA; Human Leukocyte Antigens) and antigen Presentation. T Cell Receptor: structure and functions. MHC I and II: gene organization and expression; structure and function; interaction with the antigen. Antigen presentation. Costimulatory molecules. cell-mediated cytotoxicity.

• Regulation of the immune response. Regulation due to: antigens, antibodies, lymphocytes, NK cells. Idiotype modulation. Neuroendocrine modulation. Genetic control.

• Tolerance. Experimental induction of tolerance. Thymic tolerance to self antigens. Selection and Development of T Cells. Post-thymic (peripheral) tolerance to self antigens. Privileged sites. Role of T cells and Dendritic cells. Tolerance of B cells to self antigens.

• Immediate hypersensitivity reactions. Hypersensitivity reactions Type I. IgE. Allergens. Role of T Cells, Mast cells and Basophils. Genetics of allergies. Type II hypersensitivity reactions I. Mechanism of damage. Reactions against platelets and blood cells. ABO system. Reactions against tissue antigens.

• Delayed hypersensitivity reactions. Immune complex diseases. Formation, persistence and deposition of immune complexes in tissues. Delayed hypersensitivity reactions. Hypersensitivity reactions Type IV. Contact hypersensitivity. Cellular reactions: Granulomas.

• Autoimmunity. Genetic factors. Aetiology and Pathogenesis of autoimmune diseases. Immune response in infectious diseases. Immunity to viruses, bacteria and fungi. Evasion of immune defences. Mechanisms of the response to LPS.

• Primary and Acquired Immunodeficiencies. Deficiency of Innate and Acquired Immune. Acquired or secondary immunodeficiencies (AIDS, malnutrition, etc.).

• Transplant immunology. Immunological barriers to transplantation. Histocompatibility antigens. The rejection. Role of lymphocytes in rejection. Prevention of rejection.

• Principles of immunosuppressive therapy

Immunology II

• Cell culture techniques.

• Preparation of blood sample leukocytes

• Antibody production. Monoclonal antibodies and their applications.

• Antigen-antibody interaction, direct and indirect immunofluorescence. Immunohistochemistry.

• Immunoassay: immunoblotting, immunoprecipitation. ELISA test.

Microbiology and Virology

General characteristics of human microbial pathogens.

General characteristics of bacterial pathogens.

Bacterial genetics and mechanisms of horizontal gene transfer in bacteria.

Virulence factors and mechanisms of pathogenesis of bacterial infections.

Bacterial pathogens: *Staphylococcus* spp., *Streptococcus* spp., *Enterococcus* spp., *Bacillus* spp., *Clostridium* spp., *Neisseria* spp., *Haemophilus* spp., Enterobacteriaceae, *Pseudomonas* spp., *Acinetobacter* spp. *Mycobacteria* spp. and other bacterial pathogens such as *Legionella* spp., *Vibrio* spp., *Campylobacter* spp., *Helicobacter* spp., *Listeria* spp., *Mycoplasma* spp., *Chlamydia* and *Rickettsia*.

Viral genetics and pathogenesis of viral infections.

Pathogenic viruses: Herpesviruses, Adenovirus, Human Papilloma Virus, Hepatitis viruses, Influenza, Parainfluenza, Respiratory Syncytial Virus, Viruses of Mumps, Measles and Rubella, Enteroviruses, Viruses associated with diarrhoea, Retroviruses.

Main fungal and protozoal human pathogens.

Antimicrobial agents: mechanisms of action, methods to evaluate their in vitro antimicrobial activity and acquisition of resistance.

Laboratory methods for the diagnosis of infectious diseases: direct and indirect methods.

Molecular diagnostics applied to Medical Microbiology.

Strategies for infectious diseases prevention: vaccines and protocols for infection control.

Health Care Associated Infections.

Prerequisites

Pathology and Medicine

Knowledge of the introductory courses indicated in the regulation of the degree.

Immunology I

Knowledge of the introductory courses indicated in the regulation of the degree course

Immunology II

Knowledge relating to the theoretical course of Immunology I.

Microbiology and Virology

Knowledge on the principles of Cell Biology, Genetics and Anatomy as acquired during the first year of the degree course.

Teaching form

Pathology and Medicine

Frontal lectures and support videos. Interactive lessons based on computer simulations of pathological clinical questions.

Immunology I

Lectures with the help of power point presentations - interactive lessons based on clinical questions.

Immunology II

Exercises

Microbiology and Virology

Lessons and interactive discussion of clinical cases.

Textbook and teaching resource

Pathology and Medicine

Robbins and Cotran, “Basic Pathology”, 10th Edition, Elsevier.

Immunology I

Abul Abbas Andrew H. Lichtman Shiv Pillai- "Basic Immunology"-ed. Elsevier

Casey Weaver, Kenneth Murphy-Janeway "Immunobiology" - ed. Garland Science

Microbiology and Virology

Sherris “Medical Microbiology”, McGraw Hill Education.

Patrick R. Murray, Ken S. Rosenthal, Michael A. Pfaller “Medical Microbiology”, Elsevier.

Semester

1st semester of the second year of the Degree Course

Assessment method

Pathology and Medicine

The exam includes a written test with multiple choice questions on topics of General Pathology. The questions will assess the degree of depth achieved by the student. In the specific case of GENERAL PATHOLOGY, questions are asked on all the fundamental aspects of the individual parts of the Program above. The test will also include an open-ended question that will assess the ability to link the different topics covered.

The exam is considered passed only if at least 60% of the questions including exactly the open question are answered

Immunology I

The exam includes a written test with multiple choice questions on subjects of Immunology. The questions will assess the degree of depth of knowledge achieved by the student. In the specific case of Immunology, questions are asked on all the fundamental aspects of the individual parts of the Program above. The test will also include an open-ended question that will assess the ability to link the different topics covered.

The exam is considered passed only if at least 60% of the questions including the open-ended question are answered.

Immunology II

The exam includes a written test with multiple choice questions on the topics covered during the exercises.

Microbiology and Virology

The exam will include an initial written evaluation made up of 20 multiple choice questions and of 2 open questions on any of the topics illustrated and discussed as part of the Medical Microbiology module. The written exam will subsequently be integrated with an oral discussion aimed at evaluating the student’s degree of comprehension of the topics part of the Medical Microbiology module.

Office hours

See specific modules