



HUMANITAS MEDICAL SCHOOL

Course: PHARMACOLOGY

Year: 3rd

Period: annual

Credits: 8

Objectives

The Pharmacology course aims at providing a comprehensive understanding of the principles and applications of pharmacology in clinical medicine. In the first part, the course will provide solid foundations of the principles related to pharmacodynamics and pharmacokinetics processes, which represent the main pillars in pharmacology. In the second part, the course will be focused on the rational and evidence-based use of drugs in treating various diseases. This includes learning about the main class of pharmacological tools available for different conditions, understanding drug selection criteria, and evaluating the efficacy and safety profiles of drugs. These objectives collectively aim to equip medical students with a solid foundation in pharmacology, enabling them to face the subsequent courses with a proper background about the therapeutic strategies in clinical practice.

Prerequisites

A solid understanding of anatomy is essential since pharmacology often involves knowledge of the body's structures and how drugs interact with them. Proficiency in cellular and systemic physiology is crucial as pharmacological agents often affect physiological processes at the cellular and systemic levels. Knowledge of the principles of pathology is necessary to comprehend how diseases and conditions can alter the pharmacokinetics and pharmacodynamics of drugs. Familiarity with biochemistry is important, as it helps in understanding the biochemical mechanisms of drug actions and metabolism. Basic knowledge of chemistry is necessary to understand the chemical properties of drugs and their interactions in the body. Eventually, Microbiology and Immunology are also relevant because some drugs target microorganisms (e.g., antibiotics) or modulate the immune system.

Contents

The course of Pharmacology covers a wide range of topics divided in two semesters.

SEMESTER I

INTRODUCTION TO MEDICAL PHARMACOLOGY

Faculty member: prof. Michela Matteoli

Number of lessons: 1 (2 hours)

Programme:

Introduction to the course of Pharmacology, history of pharmacology, principles and foundations of clinical and preclinical pharmacological science.

PRINCIPLE OF PHARMACOKINETICS

Faculty member: prof. Maurizio D'Incalci

Number of lessons: 6 (12 hours)

Programme:

- General aspects of pharmacokinetics. Description of the main pharmacokinetic parameters. Mathematical representation of drug absorption, distribution and elimination. Clinical application of pharmacokinetics.
- ADME processes: Absorption - routes of drug administration and main physical/chemical factors regulating absorption; Distribution - main physical/chemical factors regulating distribution; Metabolism - phase I and phase II reactions of drug metabolism; Elimination - different ways of drug elimination.
- Personalisation of the therapeutic regimen, drug-drug interactions, pharmacokinetics of biologicals. Pharmacogenetics.
- Adverse effects of drugs.

PRINCIPLES OF PHARMACODYNAMICS

Faculty member: prof. Davide Pozzi

Number of lessons: 3 (6 hours)

Programme:

- General concepts of pharmacodynamics: brief history of pharmacology, main principles in pharmacodynamics, the concept of receptor.
- Class of receptors fundamental in pharmacology: nuclear receptors, G-coupled receptors, ion channels (including ligand- voltage-gated channels), membrane transporters and enzymes.
- Dose-response relationship: occupancy theory, the concept of agonist (including full and partial agonist) and antagonist (including competitive, non-competitive antagonist and inverse agonist) drugs. Concepts of tolerance, dependence, sensitization, hormesis and synergism. Kinetics properties of drug-receptor relationship and interactions with agonist and antagonist drugs (examples of dose-response relationships).



DRUGS ACTING ON THE AUTONOMIC NERVOUS SYSTEM

Faculty member: prof. Michela Matteoli

Number of lessons: 2 (4 hours)

Programme:

- Structure and function of central and peripheral synapses.
- The sympathetic and parasympathetic systems: a general overview.
- The cholinergic synapse and the drugs affecting cholinergic neurotransmission.
- The catecholaminergic synapses and the drugs affecting adrenergic neurotransmission.

DRUGS ACTING ON CARDIOVASCULAR SYSTEM

Faculty member: prof. Riccardo Fesce

Number of lessons: 6 (12 hours)

Programme:

- Drugs affecting renal excretory function
- Antiarrhythmic drugs.
- Heart failure and CHF drugs.
- Heart ischemia and anti-angina drugs.
- Atherosclerosis, antidiabetic, anticoagulant, antiplatelet drugs.
- Hypertension and antihypertensive drugs

MECHANISMS OF PULMONARY PHARMACOLOGY AND ANTI-INFLAMMATORY DRUGS

Faculty member: prof. Maurizio D'Incalci

Number of lessons: 1 (2 hour)

Programme:

- Introduction to the main classes of drugs used to treat asthma, chronic obstructive pulmonary disease, and cystic fibrosis.
- Introduction to the main classes of anti-inflammatory agents: nonsteroidal anti-inflammatory drugs (NSAIDs), cytokine inhibitors.

DRUGS AGAINST ENDOCRINE DISEASES

Faculty member: prof. Davide Pozzi

Number of lessons: 3 (6 hours)

Programme:

- Introduction to pharmacology of the hypothalamic-pituitary axis.
- Pharmacology of the reproductive tract: estrogens, progestins, and androgens.
- Adrenocorticotrophic hormone: adrenal cortex and steroids.
- Pharmacology of prolactin- and GH- secreting diseases.
- Pharmacotherapy of diabetes (type I and type II diabetes).

GASTROINTESTINAL PHARMACOLOGY

Faculty member: prof. Michela Matteoli

Number of lessons: 2 (4 hours)

Programme:

- Pharmacotherapy for gastrointestinal disorders.
- Pharmacology of IBD.

SEMESTER II

NEUROPHARMACOLOGY

Faculty member: prof. Michela Matteoli

Number of lessons: 13 (26 hours)

Programme:

- General principles of neuropharmacology: synapse as a drug targets.
- Pharmacology of neurodegenerative disorders (Alzheimer's disease and Parkinson's disease)
- Anxiolytics and hypnotic drugs.
- Pharmacology of mood disorders (antipsychotic drugs).
- Pharmacology of abnormal electrical neurotransmission (antiepileptic drugs).
- Addiction and drugs of abuse.
- Analgesic drugs and pain therapy.
- Pharmacology of the blood-brain-barrier and multiple sclerosis.
- General and local anaesthetics and therapeutic gases.
- New frontiers in neuropharmacology: the gut-brain axis

CHEMOTHERAPY OF INFECTIOUS DISEASES AND ANTI-INFLAMMATORY DRUGS

Faculty member: prof. Maurizio D'Incalci

Number of lessons: 5 (10 hours)

Programme:

- Introduction to antibacterial agents: classification and mechanisms of action of antibacterials. Therapeutic choice. Pharmacokinetic aspects. Antibiotic toxicity, antibiotic resistance.
- Classes of antibacterial agents: drugs targeting folic acid metabolism, inhibitors of cell wall synthesis, inhibitors of nucleic acid synthesis, inhibitors of protein synthesis.
- Antibiotics against tuberculosis.
- Antiprotozoal agents, with a focus on antimalarial agents.
- Introduction to antifungal agents and anthelmintic agents.



- Antiviral agents: drugs against Herpes viruses, Influenza viruses, HIV, Hepatitis viruses, SARS-CoV-2.

ANTICANCER DRUGS

Faculty member: prof. Maurizio D'Incalci

Number of lessons: 6 (12 hours)

Programme:

- General aspects of antitumor therapy and its limits.
- General principles of personalized therapy.
- Main classes of chemotherapeutic drugs: alkylating agents, platinum coordination complexes, antimetabolites, natural products, miscellaneous.
- Targets and mechanisms of action of conventional chemotherapy.
- Hormones and their antagonists as antitumor agents.
- Conventional chemotherapy and targeted therapy.
- Main classes of small molecules inhibitors, their targets and mechanisms of action.
- General principles of cell therapy against cancers.
- Combinations of drugs and their association with other therapeutic modalities (immunotherapy, surgery, radiotherapy).

Assessment

The exam will be organized as multiple choice questions. The questions will cover all the topics discussed during the course, with a number of questions proportional to the number of lessons dedicated to each topic. For each right answer will be assigned 1 point, whereas no negative score will be given to wrong answers.

In total the test will include 66 questions and to pass the exam the student will have to answer to at least 40 questions correctly. Time allotted: 90 minutes.

There will be also an intermediate test at the end of the first semester (IT 1st semester exam), that it is not mandatory. Students who will not take or will not pass the 1st semester exam will have to take the Full exam. Students who passed the IT 1st semester exam will be able to take a second test at the end of the second semester (IT 2nd semester exam), to complete the exam. This option can be seized only till the September session, after that students will have to pass the Full exam.

IT 1st semester exam

33 questions (each right answer 1 point) about the contents addressed in the lessons of 1st semester. To pass the exam, the student will have to answer to at least 20 questions correctly. Time allotted: 50 minutes.

IT 2nd semester exam

33 questions (each right answer 1 point) about the contents addressed in the lessons of 2nd semester. To pass the exam, the student will have to answer to at least 20 questions correctly. Time allotted: 45 minutes.



Full exam

66 questions (each right answer 1 point) about the whole program of the course. To pass the exam, the student will have to answer to at least 40 questions correctly. Time allotted: 100 minutes.

Scores of the Full exam or IT exams (1st semester + 2nd semester) will be based on the number of questions answered correctly as indicated in the table below:

IT Exam	
Score	Grade
20	18
21	19
22	20
23	21
24	22
25	23
26	24
27	25
28	26
29	27
30	28
31	29
32	30
33	30 LODE

Full Exam	
Score	Grade
40	18
41	19
42	19
43	20
44	20
45	21
46	21
47	22
48	22
49	23
50	23
51	24
52	24
53	25
54	25
55	26
56	26
57	27
58	27
59	28
60	28
61	29
62	29
63	30
64	30
65	30 LODE
66	30 LODE



Texts

- *“Basic & Clinical Pharmacology” (15e) Authors: Bertram G. Katzung Anthony J. Trevor*
- *“Goodman and Gilman's The Pharmacological Basis of Therapeutics” (13e) Authors: Laurence Brunton, Bjorn Knollmann*
- *“Pharmacology” Authors: Rang and Dale*
- *“General and Molecular Pharmacology: Principles of Drug Action” Authors: Clementi and Fumagalli*