



MEDTEC SCHOOL

Course: Pharmacology

Year (1st-2nd-3rd-4th-5th-6th): 4th

Period (1st-2nd semester - annual): annual

Credits: 8

Objectives

Pharmacology is the scientific study of drugs and their action on biological systems, ranging from genes and cells up to tissues and human populations. The Pharmacology course aims to provide the student with the fundamental knowledge for understanding the activity of drugs in relation to their interaction with targets at the cellular and systemic levels. The course describes the mode of action and main features of the most frequently used drug classes; their application in the clinical setting - required to develop prescribing competences - will be detailed during the following courses of the MEDTEC school committed to specific organ system diseases.

At the end of the Pharmacology course, the student will be able to:

Knowledge and insight

- describe the basic scientific concepts and principles underpinning the pharmacological sciences including pharmacokinetics, pharmacodynamics, and main factors affecting drug response.
- explain how these fundamental pharmacological properties can influence route of administration; drug levels in the body; drug action; drug efficacy and potency; drug toxicity; potential for drug interactions; and the appropriate choice of drugs for pharmacotherapy in a given patient.
- elucidate how the determination of the pharmacological parameters can be used to design, monitor, and modify appropriate dosing regimens in specific patient populations.
- list the major drugs and drug classes currently used in medical practice for infectious diseases, cardiovascular and kidney diseases, endocrine diseases, pulmonary diseases, gastrointestinal diseases, diseases affecting the autonomic nervous system and the central nervous system, and cancers.
- describe the main pharmacological features of the described drugs, including their indications, pharmacokinetic and pharmacodynamic properties, major adverse effects, with a specific focus on their mechanism(s) of action.
- give a general overview about the main classes of anti-inflammatory agents.
- describe how targeting the pathophysiological mechanisms with the appropriate drug(s) can act to effectively treat, cure, or mitigate the underlying disease causes and/or symptoms.
- demonstrate the ability to link the acquired knowledge on pharmacokinetics and pharmacodynamics with the toxic and therapeutic effects of the various described drugs.



- describe the process by which new drugs are discovered, developed, tested, and finally approved by the regulatory agencies for use in the clinic; understand the scientific rigor and methodological approach underlying the development of new drugs.

Applying knowledge and insight

- calculate drug-specific and patient-specific pharmacokinetic and pharmacodynamic parameters in relation to the physiochemical properties that influence drug response.
- keep up to date by critically reading and understanding scientific articles published in reviewed international journals, and by performing on-line search queries on reference web sites.

Communication

- articulate ideas and questions and respond to the ideas and questions from the teacher, and/or from other learners.
- demonstrate the ability to effectively communicate and work collaboratively together with other learners in the small group setting to successfully address problems of pharmacological significance.
- use the correct English terminology relative to the field of Pharmacology.

Learning skills

- demonstrate the learning capacity required to continue training in MEDTEC school, particularly concerning organ system diseases.

Prerequisites

To attend the Pharmacology course, the student should be familiar with the molecular, cellular and physiological mechanisms underlying normal cell/organ functions and the pathophysiological changes that occur in the aetiology of the most common disease states, as well as the clinical presentations associated with these diseases. Namely, a deep understanding of the main concepts of anatomy, physiology, biochemistry, cell biology, genetics, physiology and patho-physiology is required.

As a general prerequisite, the student must have passed all the exams of the academic years 1st and 2nd of the MEDTEC school.



Contents

PRINCIPLE OF PHARMACOKINETICS

Faculty member: prof. Maurizio D'Incalci

Number of lessons: 5 (9 hours)

Semester: 1st

Programme:

- Topics covered by clinical pharmacology.
- 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.

PRINCIPLES OF PHARMACODYNAMICS

Faculty member: prof. Davide Pozzi

Number of lessons: 3 (6 hours)

Semester: 1st

Programme:

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

DRUG DEVELOPMENT

Faculty member: prof. Maurizio D'Incalci

Number of lessons: 2 (4 hours)

Semester: 1st

Programme:

- Processes of drug development: target discovery and validation, hit discovery, lead identification and optimization, preclinical development, clinical studies.

- Adverse effects of drugs.

DRUGS ACTING ON THE AUTONOMIC NERVOUS SYSTEM

Faculty member: prof. Michela Matteoli

Number of lessons: 3 (6 hours)

Semester: 1st

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 TO TREAT CARDIOVASCULAR DISEASES

Faculty member: prof. Gianluigi Condorelli, prof. Giulio Stefanini, dr Giuseppe Ferrante, dr Cristina Panico, dr Davide Cao, dr Mauro Chiarito

Number of lessons: 5 (10 hours)

Semester: 1st

Programme:

- Anticoagulant, Fibrinolytic, and Antiplatelet Drugs
- Drug Therapy for Dyslipidemias
- Treatment of Hypertension
- Antiarrhythmic Drugs
- Treatment of Ischemic Heart Disease

DRUGS AGAINST INFECTIOUS DISEASES

Faculty member: prof. Maurizio D'Incalci

Number of lessons: 5 (9 hours)

Semester: 1st

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 particular focus on antimalarial agents.
- Antiviral agents: drugs against Herpes viruses, Influenza viruses, HIV, Hepatitis viruses, SARS-CoV-2.
- Introduction to antifungal agents: classification, resistance.



- Introduction to antihelmintic agents.

MECHANISMS OF ANTI-INFLAMMATORY DRUGS

Faculty member: prof. Maurizio D'Incalci

Number of lessons: 1 (1 hour)

Semester: 1st

Programme:

- Introduction to some classes of anti-inflammatory agents: nonsteroidal anti-inflammatory drugs (NSAIDs), cytokine inhibitors.

NEUROPHARMACOLOGY

Faculty member: prof. Davide Pozzi, prof. Maurizio D'Incalci, dr. Erica Tagliatti

Number of lessons: 11 (22 hours)

Semester: 2nd

Programme:

- General principles of neuropharmacology: synapse as a drug target.
- Pharmacology of neurodegenerative disorders.
- Anxiolytics and Hypnotic drugs.
- Pharmacology of Mood disorders.
- Pharmacology of abnormal electrical neurotransmission.
- Addiction and Drugs of abuse.
- Analgesic drugs and Pain Therapy.
- Pharmacology of the Blood-Brain-Barrier and Multiple Sclerosis.
- New frontiers in Neuropharmacology.

DRUGS AGAINST GASTROINTESTINAL DISEASES

Faculty member: prof. Maurizio D'Incalci, dr. Alessandro Armuzzi

Number of lessons: 2 (4 hours)

Semester: 2nd

Programme:

- Pharmacotherapy for Gastric Acidity, Peptic Ulcers, and Gastroesophageal Reflux Disease.
- Gastrointestinal Motility and Water Flux, Emesis, and Biliary and Pancreatic Disease.
- Pharmacotherapy of Inflammatory Bowel Disease.

DRUGS AGAINST ENDOCRINE DISEASES

Faculty member: prof. Davide Pozzi

Number of lessons: 3 (6 hours)

Semester: 2nd



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 adenomas.
- Pharmacology of endocrine pancreas (Type I and Type II diabetes).

ANTICANCER DRUGS

Faculty member: prof. Maurizio D'Incalci

Number of lessons: 7 (14 hours)

Semester: 2nd

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).

MECHANISMS OF DRUGS TO TREAT KIDNEY DISEASES

Faculty member: prof. Maurizio D'Incalci

Number of lessons: 1 (2 hours)

Semester: 2nd

Programme:

- Introduction to pharmacology of kidney diseases, with a focus on kidney transplantation medication.

MECHANISMS OF PULMONARY PHARMACOLOGY

Faculty member: prof. Maurizio D'Incalci

Number of lessons: 1 (1 hour)

Semester: 2nd

Programme:



- Introduction to the main classes of drugs used to treat asthma, chronic obstructive pulmonary disease, cystic fibrosis, and anti-tussive agents.

OVERVIEW OF DRUG AGAINST RARE DISEASES

Faculty member: prof. Maurizio D’Incalci

Number of lessons: 1 (2 hour)

Semester: 2nd

Programme:

- Introduction to the main classes of drugs used to treat rare diseases.

Teaching Methods

The synchronous sessions are organized mainly as lectures (on campus and TEAMS). Students are encouraged to actively participate to the lectures with questions and comments. Interactive discussions and collaborative activities for medium sized groups are planned. Guest lecturers enrich the course through the inclusion of relevant, specialized knowledge on specific issues.

The asynchronous sessions (off campus) are characterized by in-depth articles and investigations related to specific topics.

Assessment

The final test consists of multiple choice questions, with only one correct answer. Questions will include the whole program of the course. The final mark will be proportional to the number of correct answers.

Texts

Title: “Basic & Clinical Pharmacology”

Author: Bertram G. Katzung, Todd W. Vanderah

Title: “Goodman and Gilman's The Pharmacological Basis of Therapeutics”

Author: Laurence Brunton, Bjorn Knollmann

Title: “Rang & Dale's Pharmacology”

Author: James Ritter, Rod Flower, Graeme Henderson, Yoon Kong Loke, David MacEwan, Humphrey Rang

Title: “General and Molecular Pharmacology: Principles of Drug Action”

Author: Francesco Clementi, Guido Fumagalli