Universitat Autònoma de Barcelona

2023/2024

Pharmacology

Code: 101911
ECTS Credits: 6

Degree	Type	Year	Semester
2501230 Biomedical Sciences	OB	3	2

Contact

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Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject. Please note that this information is provisional until 30 November 2023.

Teachers

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Prerequisites

It is necessary to have acquired sufficient knowledge of Physiology, Biochemistry and Cell Biology.

Objectives and Contextualisation

The subject is programmed in the third year of the degree in Biomedical Sciences, when both the knowledge of Physiology, Biochemistry, Cell Biology and the study of the clinical bases have already been acquired.

The training objectives of the subject are to show the preclinical scientific basis of drugs, by studying the different processes to which a medication is subjected since it is administered until it has its effect, as well as the possible undesired effects and pharmacological interactions that may occur with drug administration. In addition, the pharmacological characteristics of the main groups of drugs are studied.

Competences

- Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.

- Describe biomedical problems in terms of causes, mechanisms and treatments.
- Display knowledge of the bases and elements applicable to the development and validation of diagnostic and therapeutic techniques.
- Display knowledge of the concepts and language of biomedical sciences in order to follow biomedical literature correctly.
- Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
- Read and critically analyse original and review papers on biomedical issues and assess and choose the appropriate methodological descriptions for biomedical laboratory research work.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
- Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
- Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
- Use bioinformatic tools, databases and methods for analysing experimental data.
- Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.

Learning Outcomes

1. Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
2. Analyse information from experimental studies and clinical trials.
3. Define the concept of pharmacodynamics, action and effect, and describe the different general action mechanisms of drugs.
4. Define the principles of anti-infective and antineoplasic chemotherapy.
5. Describe the basic principles of drug kinetics in the organism (absorption, distribution, metabolism and elimination) and the mathematical principles that describe it.
6. Discern the most important aspects of neurotransmission in the central and peripheral nervous system, and the potential for pharmacological intervention.
7. Discern the potential for pharmacological intervention in the endocrine system.
8. Identify commonly-used terminology in a clinical laboratory.
9. Identify commonly-used terminology in the field of pharmacology and therapeutics.
10. Identify the drugs that act on the principal organs and systems.
11. Identify the principal cellular chemical mediators and the potential for pharmacological intervention.
12. Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
13. Obtain information from pharmacological databases.
14. Select the principal experimental techniques in basic and clinical pharmacology basic.
15. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
16. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
17. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
18. Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
19. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.

20. Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
21. Understand and critique scientific articles on pharmacology.
22. Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.

Content

I.GENERALITIES

Unit 1. Introduction to pharmacology. Pharmacology concept. Historical evolution. Parts of Pharmacology. Relationship with other biological disciplines.

Unit 2. Transport and absorption of drugs through the membranes. General cycle of drugs in the body. Physicochemical characteristics of drugs and their behavior in aqueous solutions. Main transport mechanisms through membranes: passive diffusion, facilitated diffusion, active transport, endocytosis and exocytosis. Routes of administration: topical and systemic. Concepts of bioavailability. Factors that influence the absorption of drugs.

Unit 3. Distribution of drugs in the body. Factors that influence the distribution of drugs in the body. Union to plasma proteins. Accumulation of drugs in tissues and organs. Natural barriers: hematoencephalic and placental. Concept of volume of distribution.

Unit 4. Biotransformation of drugs. Structural modification of drugs in the body. Place of metabolic transformation of drugs. Enzymatic biotransformation. Concepts of liver clearance. Synthetic and non-synthetic metabolic pathways. Modifications in the metabolism of drugs: pharmacological, dependent on sex, age, species and diet.

Unit 5. Excretion of drugs. Physiology of renal function. Elimination of drugs by the kidney: glomerular filtration, reabsorption and tubular secretion. Pharmacological modifications of renal excretion processes. Kidney clearance concept. Biliary excretion. Other routes of excretion: pulmonary, mammary, salivary and sweaty.

Unit 6. Pharmacokinetics. General concepts. Pharmacokinetic parameters: absorption kinetics, distribution and elimination. Concept of semi life time, distribution volume and depuration. Calculation of pharmacokinetic parameters.

Unit 7. General principles of the mechanism of action of drugs. Concepts of pharmacodynamics. Concepts of action and effect. Levels of action of the drugs: systemic, tissue, cellular and molecular. Concentration-response relationship and parameters that characterize this relationship. Drug inherent properties: affinity and efficacy.

Unit 8. Pharmacological actions mediated by receptors. Definition of receptor. Analysis of the drug-receptor interaction: receptor binding and concentration-effect curves. Quantitative aspects of the drug-receptor interaction. Concepts of total agonist, partial, inverse and antagonist. Types of receptors. Receptors coupled to channels. Receptors coupled to G proteins. Receptors that control gene transcription.

Unit 9. Pharmacological actions not mediated by receptors. Actions on ion channels: voltage dependent channels. Pharmacological modulation of channel functioning. Actions on enzymatic systems. Alterations of the cell membrane. Modifications in the transportation system. Alteration in the synthesis of proteins. Pharmacological modulation of genes.

Unit 10. Pharmacological interactions. Concept. Pharmacokinetic interactions. Pharmacodynamic interactions. Synergy and antagonist concept. Importance of pharmacological interactions. Criticism of polypharmacy.

Unit 11. Undesirable effects. General concepts and terminology. Classification according to their origin: type A, B, C, D and E reactions. Concept of therapeutic risk.

II. PHARMACOLOGY OF CHEMICAL MEDIATORS: PERIPHERAL NERVOUS SYSTEM.

Unit 12. Pharmacology of cholinergic transmission. Colinoceptors and their classification. Muscarinic agonists: concept, mechanism of action and classification. Direct agonists: Choline esters, natural and synthetic alkaloids. Indirect agonists: reversible and irreversible anticholinesterase. Antagonists of the colinoceptors: antimuscarinic and neuromuscular blockers.

Unit 13. Pharmacology of adrenergic transmission. Adrenoreceptor concept and its classification. Agonists and antagonists of the different adrenoreceptors: concept, mechanism of action and classification. Modulators of noradrenergic transmission: inhibitors of synthesis, accumulation of noradrenaline release; facilitators of liberation; blockers of neuronal reuptake mechanisms.

Unit 14. Pharmacology of other chemical mediators. Serotonin: types of receptors, main places of action. Purines (ATP, ADP and Adenosine). Angiotensin Nitric oxide.

III. PHARMACOLOGY OF CHEMICAL MEDIATORS: CENTRAL NERVOUS SYSTEM

Unit 15. Pharmacology of the noradrenergic and serotonergic system. Characteristics and functions of noradrenergic and serotonergic neurotransmission. Neurochemical bases of depression: antidepressant drugs.

Unit 16. Pharmacology of the cholinergic system. Characteristics and functions of cholinergic neurotransmission. Alzheimer's disease: anticholinesterase drugs, muscarinic agonists and nicotinic agonists.

Unit 17. Pharmacology of the dopaminergic system. Characteristics, functions and alterations of dopaminergic neurotransmission. Parkinson's disease: levodopa, inhibitors of MAOB, dopamine agonists and muscarinic antagonists. Schizophrenia: antipsychotic drugs (phenothiazines, thioxanthenes, butyrophenones) and other chemical groups.

Unit 18. Pharmacology of the GABAergic system. GABAergic transmission and benzodiazepine receptors. Classification of anxiolytic and hypnotic drugs: benzodiazepines, 5-HT1A agonists and barbiturates.

Unit 19. Pharmacology of other central mediators: opioid peptides. The opioid system: opioid receptors and endogenous opioid peptides. Opioid analgesic concept. Total agonists, agonists-antagonists and pure antagonists. Mechanism of action.Pharmaceutical effects and undesired effects.

IV. PHARMACOLOGY OF CHEMICAL MEDIATORS: ANTI-INFLAMMATORIES AND IMMUNODEPRESSORS

Unit 20. Immune response and immunomodulation. Cells and molecules of the immune response. Pharmacological targets for immunomodulation. Immunosuppressive drugs: drugs that bind to immunophilins (e.g. cyclosporin A), glucocorticoids and new immunosuppressive drugs. Immunopotentiating drugs.

Unit 21. Nonsteroidal anti-inflammatory drugs (NSAIDs). Concepts of inflammation. Mediators of inflammation: mechanism of action. Biological targets to obtain an anti-inflammatory effect. Prostaglandins: biosynthesis (Cox-1 and Cox-2) and function. NSAID concept. Classification. Pharmacological characteristics of NSAID families (salicylates, paraaminophenols, etc ...). Therapeutic utility.

Unit 22. Glucocorticoids. Endogenous regulation of glucocorticoids. Adverse effects. Mechanism of anti-inflammatory action, main glucocorticoid drugs: general differences.

Unit 23. Pharmacological blocking of other mediators of inflammation. Histamine: histamine receptors, antagonists of the H1 receptors: action pharmacological effect. Inhibitors of histamine release. Antagonists of leukotriene receptors, blockage of PAF activity. Modulation of the activity of proinflammatory cytokines.

V. ENDOCRINOLOGICAL PHARMACOLOGY

Unit 24. General principles of endocrinological pharmacology. Introduction. Mechanism of hormonal action. Regulation of hormonal secretion. Chemical classification of hormones. Hormonal Therapeutics: pharmacokinetic characteristics, specialty and types of treatment. Present and future of hormone treatments: insulin.

VI.FARMACOLOGY OF APPLIANCES AND SYSTEMS

Unit 25. Pharmacology of the heart. Pathophysiological basis of heartfailure. Cardiotonic drugs: cardiac glycosides and others.Pharmacological properties and mechanisms of action. Electrophysiological bases of cardiac arrhythmias. Classification of antiarrhythmics.

Unit 26. Antianginal and vasodilatory drugs. Physiopathological bases of angina. Antianginal drugs: classification. Nitrates: mechanisms of action and pharmacological effects. Calcium antagonists: types of calcium channels, mechanism of action and pharmacological effects. Vasodilators. Main groups. The renin-angiotensin system and its pharmacological modulation.

Unit 27. Diuretics. Diuresis concept. Anatomy and physiology of the kidney. Place of action of diuretics. Classification. Loop diuretics. Benzothiadiazides, potassium-sparing diuretics. Osmotic diuretics. Other diuretics.

Unit 28 General pharmacology of the digestive system. Neuropharmacological mechanisms of vomiting. Pharmacological modulation of gastric secretion: antisecretory, protective and antacid. Pharmacology of motility and intestinal secretion: laxatives and antidiarrheals.

VII. ANTINFECTIOUS PHARMACOLOGY.

Unit 29. General principles of anti-infectious pharmacology.
General concepts and terminology: antibiotics: chemotherapeutic, anti-infectious. Mechanism of action: interference with nucleic acids, protein synthesis, cell membrane, formation of the bacterial wall. Resistance to antibiotics as the main mechanism of therapeutic limitation. Classification of anti-infective drugs. General characteristics of antibacterial drugs. General aspects of antiviral drugs. Modern trends in the search for new antibiotics.

VIII. ANTINEOPLASTIC CHEMOTHERAPY

Unit 30. Antineoplastic chemotherapy. Objectives of antineoplastic chemotherapy. Mechanism of action and adverse reactions to cytotoxic drugs. Tumor sensitivity to cytotoxic drugs. Pharmacological groups.

IX. MISCELLANY

Unit 31. Biotechnological drugs. Biological versus biotechnological drugs. In biotechnology the process is the product. Pharmacological profile of biotechnological drugs: concept of immunogenicity. Biological medicines similar or biosimilar: a regulatory concept of the EMA. Biosimilar versus generic.

Methodology

The subject of Pharmacology consists of several activities:

Theoretical lessons:
The student must acquire the scientific-technical knowledge of this subject attending classes and complementing them with personal work. At the beginning of the academic year, the student will be given a detailed calendar of the topics that will be dealt with throughout the course, as well as the bibliography that will have to consult to prepare each theoretical lesson. The teaching of each subject will be based on theoretical lessons. Some of the topics will be prepared autonomously by the students and discussed later in the lectures, if any.

Laboratory practices:
Sessions of observation and practical learning of techniques that are used in the study of drugs. Group working and self-learning will be encouraged. To attend lab sessions, it is necessary that pass the biosafety and security tests.

Problem Based Learning sessions:
This activity consists in: i) exposure of relevant pharmacological issues in the social field, which are not included in the theoretical program, and interactive explanation teacher-student to learn how to perform scientific reasoning and where to find bibliographic sources; and ii) discussion of cases based on a pharmacological issue that has not necessarily been exposed in the theoretical classes.

Virtual practices:
The students will use virtual models of animal experimentation to learn to work on methodological aspects that are used in pharmacology laboratories, as well as to reinforce the understanding of some knowledge exposed in the theoretical classes.

Supervised activities:
The students will use virtual animal experimentation models to learn working on methodological aspects that are used in pharmacology laboratories, as well as to reinforce understanding of some knowledge exposed in theoretical lectures.

Autonomous activities:
Preparation and presentation in written format of results of laboratory practices following the basic principles of a scientific manuscript. This activity includes bibliography search. Preparation of cases that are presented and discussed in Problem Based Learning sessions. Completion of problems presented in one of the practice activities and personalized tutorials.

The attendance to the practical sessions is mandatory, the students will obtain the grade of "NOT Evaluable" when the absence is superior to 20% of the programmed sessions.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Laboratory practices	14	0.56	2, 9, 14, 22
Seminars	10	0.4	2, 21, 9, 13, 22
Theoretical lessons	31	1.24	3, 4, 5, 6, 7, 10, 11, 9
Type: Supervised			
Problem solving	9	0.36	2, 13, 22
Type: Autonomous			
Problem solving	10.5	0.42	3, 5
Study	40	1.6	3, 4, 5, 6, 7, 11, 9
Virtual practices	10	0.4	2, 3, 5, 6
Writting of a scientific paper	20	0.8	2

Assessment

The competences of this subject will be evaluated by means of:

Continuous assessment: Periodically and without prior notice, at the beginning / end of a theoretical lecture the student will have to answer a questionnaire / exercises related to the subject explained until that moment. In addition, the student will have to present a summary in the form of oral presentation about Problem Based Learning sessions. Participation in classroom and laboratory practices will also be evaluated. The value of the average mark of all these exercises will score 10% of the final mark.

Partial assessments: A theoretical and practical knowledge exam will consist of 2 tests per year: a) proof of knowledge; and b) proof of relationship capacity. Each test will count 20% of the final mark, that is, the assessment of each one of these tests will represent 80% of the final mark.
Each of these tests will be scored on 10 points and then the corresponding percentages will be applied as explained below:

20% (1st proof of knowledge) + 20% (1st test of relationship) + 20% (2nd proof of knowledge) + 20% (2nd test of relationship) + 10% (continuous assessment) + 10% of the evaluation of the work = FINAL MARK

This sum must give a minimum of 5 points in order to pass the subject and each mark from each section must have a value equal or greater than 4 points out of 10 to score in a section. To pass the subject, the student must participate in at least 67% of activities.

To participate in the recovery exam, the students must have been previously evaluated in a series of activities whose weight equals to a minimum of two thirds of the total grade of the subject. Therefore, the students will obtain the "Non-evaluable" qualification when the evaluation activities carried out have a weighting of less than 67%.

Evidence of recovery: If the student wants to participate in the recovery exam having passed the subject, in other words, the student wants to raise marks, he/she renounces to their previous marks (80% corresponding to exams) and will retain the mark of the recovery exam. The whole subject (1st + 2on proofs) will be evaluated in the recovery test.

The subject does not include a single assessment.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Continuous evaluation	10%	1.5	0.06	1, 20, 2, 21, 3, 4, 5, 6, 7, 10, 11, 8, 9, 12, 13, 19, 18, 17, 15, 16, 14, 22
Evaluation of a scientific paper	10%	1	0.04	2, 21, 9, 13
Partial evaluations	40% (proof of knowledge) + 40% (test of reationship) of the final mark	3	0.12	3, 4, 5, 6, 7, 10, 11, 9

Bibliography

Recommended bibliography by alphabetical order:

1. BAÑOS JE, FARRE M. Principios de Farmacologia clínica: bases científicas de la utilización de medicamentos. Ediciones Masson, 2002

2. BRUNTON L, PARKER K, BLUMENTAHL D, BUXTON I. Goodman and Gilman's. Manual of Pharmacological Therapeutics,
Editorial McGraw-Hill, 13ª ed, 2018

3. FLOREZ J, ARMIJO JA, MEDIAVILLA A. Farmacología Humana. Ediciones Elsevier España, 6ª ed, 2013

4. HARVEY RA, CLARK MA, FINKEL R, REY JA, WHALEN K. Lippincot's Illustrated Reviews: Farmacología, Philadelphia, Lippincot,

Williams and Wilkins, 5ª edición, 2012

5. HITNER H, NAGLE B. Introducción a la Farmacología. Editorial Mc-Graw-Hill Interamericana, 5ª ed, 2007

6. KATZUNG BG, MASTERS SB,TREVOR AJ. Farmacología básica y clínica. Editorial McGraw-Hill Interamericana, 11a ed, 2010

7. LORENZO P, MORENO A, LEZA JC, LIZASOAIN I, MORO MA. Velázquez. Farmacología básica y clínica. Editorial Médica Panamericana, 17ª ed, 2005

8. PAGE C, CURTIS M, SUTTER M, WALKER M, HOFFMAN B. Farmacología integrada.
Ediciones Harcourt Brace, 1998

9. RANG H, RITTER JM, FLOWER RJ, HENDERSON G. Rang & Dale Pharmacology. Elsevier, 9ª ed, 2020

10. SEIFERT R. Basic Knowledge of Pharmacology. Springer, 2018. https://link.springer.com/content/pdf/10.1007%2F978-3-030-18899-3.pdf

Software

no need for specific software