

DEPARTMENT OF PHARMACOLOGY, JNMC, AMU, ALIGARH

PROSPECTUS & SYLLABUS - M. D. (PHARMACOLOGY)

(Revised on 04.8.2014)

Objectives :

At the end of the 3 years training in pharmacology, the PG student should be able to :

1. Acquire sound knowledge of general pharmacological principles, systemic pharmacology and rational use of drugs.
2. Plan and conduct lecture, practical demonstration and tutorial classes for students of medical and allied disciplines.
3. Carry out screening of drugs for pharmacological and toxicological profile.
4. Critically review and comment on research papers.
5. Monitor adverse drug reactions, therapeutic drug monitoring and able to provide drug information service to needy places.
6. Preparation of protocols to conduct experimental studies in animals and human drug trials independently.

The following self-learning sessions for PG students will be held

Post graduate lectures in systemic pharmacology to update various aspects of basic pharmacology and applied therapeutics.

Therapeutic club : To critically analyze the day to day development in therapeutics and new drug.

Journal club : To familiarize with research methodologies and analysis of results.

Seminars : To update newer developments in pharmacology/emerging trends/novel mechanisms of drug action etc.

Practical exercise : Once in a week, under the supervision of a faculty, with/without the help of animals, various principles/mode of drug action/screening of drugs/drug analysis using various techniques should be performed to develop practical skills to conduct similar experiments in future.

Thesis : Each PG student will carry out research work under the supervision of faculty member of the Pharmacology Department, JNMC, AMU, University as prerequisite for the candidate to be allowed to appear in the final examination.

M.D. EXAMINATION

Theory Examination

Paper - I

General Pharmacological principles and allied sciences (Section - I)

Paper - II

Systemic pharmacology, chemotherapy and therapeutics (Section - 2)

Paper - III

Experimental pharmacology, screening of drugs and statistics (Section -3)

Paper - IV

Clinical pharmacology and recent advances in pharmacology (section-4)

Practical Examination (2days)

1. One experimental pharmacology exercise on intact animal**
2. One experimental pharmacology exercise on isolated organ**
3. One chemical pharmacology exercise.
4. One clinical pharmacology exercise.

Oral Examination

1. Microteaching session.
2. Thesis presentation and discussion
3. General viva voce.

Section 1

1a. General pharmacological principles and Applied sciences

1b. Toxicology

Basis of principles of diagnosis and treatment of human poisoning. Clinical feature of common poisoning Antidotes in the management of poisoning. Principles of clinical toxicology. Applied analytical toxicology and toxicovigilance.

1c. Molecular Biology in Pharmacology

Gene expression, pharmacogenomics, proteomics, techniques involved in studying receptor dynamics. PCR, Northern blot, Southern blot and Western blot. Protein purification. Mono, polyclonal antibodies. Molecular biology in receptor identification. Antisense oligonucleotides, molecular targets of drug action.

1d. Isolation of compounds from Herbal sources

Basic constituents of plants (chemical classification). Isolation of active constituent from plant materials. Percolation and maceration. Qualitative constituent characterisation techniques. Utilisation of HPTLC for the constituent analysis. Estimation of marker compound in biological fluid after crude plant material administration.

1e. Wonder Discoveries in Pharmacology

Nobel laureates in Pharmacology and their revolutionary discoveries.

1f. Teaching and communication skills

Delivering lectures, conducting practical/demonstrations for undergraduate and post graduate students.

Maintenance of records of practical exercise. Techniques to retrieve relevant information from various sources. Methodology of preparing research manuscripts. Research presentation in scientific deliberations.

Practical skill : Post graduate teaching of recent developments in pharmacology and therapeutics.

SECTION - 2

2a. Systemic pharmacology, chemotherapy and therapeutics

Autonomic nervous system

Central nervous system

Autacoids

Drugs affecting kidney function and cardiovascular system

Drugs affecting gastrointestinal and respiratory system

Drugs affecting uterine motility

Chemotherapy of parasite infections

Chemotherapy of microbial diseases

Antineoplastic agents

Immunomodulators

Drugs acting on blood and blood forming organs.

Hormones

Miscellaneous

SECTION - 3

3a. Experimental pharmacology, Bioassay And Statistics.

Experimental methodologies involved in the discovery of drugs (in vivo, in vitro, ex vivo). Animal handling and animal care. Methods of anaesthetising animals and methods of euthanasia. Restraining and blood collecting methods. Drug screening methods involved in the evaluation of anti-ulcer, antidepressant, antianginal, antihypertensive, antiarrhythmic, antidiabetics, anticataract, anti-platelet, anticancer, anti-inflammatory, antidiarrhoeal, antiepileptics, analgesic, antithyroid, antipyretic, antiglaucoma, antihyperlipidemic, antiasthmatic drugs and cough suppressants. Drug screening methods used in screening antifungal, anthelmintic, antibacterial, antiviral agents, drugs for heart failure, posterior pituitary, adrenal steroid (gluco & mineralo corticoids), testicular, parathyroid, ovarian, thyroid hormones, methods involved in testing teratogenicity, carcinogenicity and organ toxicities in animals.

*Practical Skills***: Effect of anti-inflammatory agents on carrageenan induced rat paw edema. Evaluation of analgesic activity of morphine using tail flick latency test. Evaluation of Cardiotonic drugs on isolated rabbit heart (Langendorff isolated heart preparation). Demonstration of Dale's vasomotor reversal and nicotinic effect of acetylcholine on dog blood pressure. Effect of autonomic drugs on rabbit intestine. Demonstration of bronchodilation on guinea pig tracheal chain. Effect of sedatives on rodents (rotarod test.).

Four point assay of histamine and acetylcholine on guinea pig ileum. Four point assay of 5HT rat uterus. Estimation of PA2 value of atropine. Identification of unknown by evaluating its action haemodynamic parameters. Assay of acetylcholine using rat fundus. Estimation of pressor agents on rat blood pressure.

3b. Instrumentation in Drug analysis

Qualitative testing, titrimetric analysis. Beer and Lambert's law. Basis and working principle of colorimeter, ultraviolet, atomic absorption spectrometers, fluorescence spectroscopy, NMR and Mass Spectroscopy. Basics of chromatography. Partition, adsorption and ionexchange chromatography, Column chromatography, thin layer chromatography, paper chromatography, immunoabsorbant chromatography, high performance thin layer chromatography. High performance liquid chromatography and Gas chromatography. Radio immunoassay. Processing of biological materials for drug analysis. Calculations drug analysis. Good laboratory practice. Validation of analytical procedure.

Practical skills : Spectrophotometric & fluorimetric estimations of drugs in biological fluids.

3c. Biostatistics

Calculation of basic statistical parameters (mean, median, mode. Standard deviation standard error etc.) Null hypothesis, parametric and non parametric tests (Student 't' test, Wilcoxon, ANOVA etc) Metaanalysis.

Practical skills: Calculation for statistical significance in the given data for student paired and unpaired 't' test. Applying ANOVA to the given set of concentration vs time data of two drug formulations to comment about their bio-equivalence.

SECTION - 4

4A. Clinical Pharmacology and Recent Advances

Pharmacokinetics

Basics of Pharmacokinetics, calculation of pharmacokinetic estimates (C-max, T_{max}, T_{1/2}, AU, AUC(0-x), V_d, K_e, K_a etc.) Compartment models used in pharmacokinetics (Oral and intravenous Compartment fitting (one comp & Two comp). Pharmacodynamic/pharmacokinetic (PK/PD) correlation.

Practical skills : Calculation of Pharmacokinetics estimates from given concentration vs time data.

Drug Regulations

Drug and cosmetics act, drug price control order, application for investigational new drug (IND), application for New Drug Discovery (NDD) according to Indian control Authority & USFDA guide Conducting bio equivalence studies. Ethical considerations in utilizing human subjects for drug development process. Helsinki's declaration. ICH-GCP Guidelines. Ethical guidelines in utilising animals for experimental purposes.

Practical skills : Draft an IND and NDD application for the approval of a numbered compound.

Drug development process

Methods involved in the development of new drugs. Preclinical toxicological studies. Calculation of LD₅₀ & ED₅₀. Acute, subacute and chronic toxicity studies. Irwin profile test, Preclinical pharmacokinetics and dynamic

studies. Lipinski's rule for drug like molecule, high throughput screening (invitro and invivo) for pre clinical pharmacokinetic and pharmacodynamic studies.

4b. Clinical Trials

Types of clinical trials, clinical trial for a new investigational drug in India. Methods involved in the assessment of drugs in human volunteers and bio-equivalence studies. Key points in drafting protocol for a large scale multicentric drug trial in India.

Practical skills : Draft protocol to conduct phase II clinical trial for a newly discovered non-steroidal anti-inflammatory drug.

4c. Therapeutic drug Monitoring (TDM)

Basic principles of TDM. Therapeutic index. Through level monitoring and dosage adjustments.

Practical skills: Calculation of the next dosage of drug to the patient whose plasma drug level has been estimated.

Therapeutic audit : Drug utilisation studies, essential medicine concept, rational prescribing.

Drug delivery systems: Sustained release. Enteric coated formulations and liposome etc. Pharmacovigilance, pharmacoconomics, Pharmacogenetics and drug information.

BOOKS RECOMMENDED

1. Goodman Gillman's The Pharmacological basis of therapeutics. (2011) Ed. Hardman JG, Limbird LE (Tenth Edition) McGraw Hill press New York.
2. Applied biopharmaceutics and pharmacokinetics Ed. Srgel L. (latest Edition) Prentice-Hall International, London.
3. Fundamentals of experimental Pharmacology. latest Ed. Ghosh MN. Scientific book agency, Calcutta.
4. Text book of receptor pharmacology, Eds. Forman JC, Johansen TJ CRC Press, New York 1996.
5. Drug Discovery and Evaluation-Pharmacological assays. (1997) Ed. Vogel HG & Vogel WH. Springer-New York.

JOURNALS TO BE REFERRED

Trends in Pharmacological Sciences, Annual Review of Pharmacology, Pharmacological Reviews, Indian Journal of Pharmacology, Indian Journal of Physiology and Pharmacology, annals of Pharmacotherapy, Pharmacology and Experimental Therapeutics, Journals of Ethnopharmacology, Nature, Science, European Journal of Clinical Pharmacology, BJCP and other pharmacology related journals.

**Practical Exercise using Animal Experiments is subject to Ethical Approval.

Department of Pharmacology, J.N.M.C., AMU, Aligarh

List of Experiments for M.D. (Pharmacology) as per Board of studies held on 04.8.2014

General Techniques

1. Animal handling and animal care.
2. Drug administration using different routes (oral, IP, IM, IV and SC)
3. Anaesthesia in animals.
4. Euthanasia
5. Methods of blood collection in animals.

ANS Experiments

6. To study the effect of autonomic drugs on isolated frog heart preparation.
7. To study the effects of autonomic drugs on isolated rabbit ileum.
8. To study the effects of Autonomic drugs on isolated frog rectus muscle.
9. To study the effects of autonomic drugs on rabbit eye.
10. To study the effects of autonomic drugs on blood pressure and respiration in the experimental animals.

Screening Methods

11. Evaluation of drugs having Anti-convulsant activity.
12. Evaluation of drugs having sedative & hypnotic activity.
13. Evaluation of drugs having anti-depressant activity
14. Evaluation of drugs affecting motor coordination.
15. Evaluation of drugs having anti-pyretic activity.
16. Evaluation of drugs having analgesic activity.
17. Evaluation of drugs having anti-inflammatory activity
18. Evaluation of drugs having Anti-arthritis activity.
19. Evaluation of drugs having Anti-ulcer activity.
20. Evaluation of drugs having Bronchodilator activity.
21. Evaluation of drugs having diuretic activity.
22. Evaluation of drugs having Antidiabetic activity.
23. Evaluation of drugs having Local Anaesthetic activity.

Bioassay

24. Bioassay – Direct end point assay, Graded & quantal response assay, dose response curve, cumulative dose response curve, efficacy & potency, Competitive & non competitive antagonist response, LD50, ED 50, therapeutic index, PA2.
25. *4 point assay*: Acetylcholine using frog rectus muscle & guinea pig ileum; d-tubocurarine using frog rectus muscle; 5-HT using rat uterus; Histamine using guinea pig ileum; Prostaglandin (Misoprostol) using rat stomach fundus; Noradrenaline using rat vas deference.

Biostatistics

26. Calculation of basic statistical parameters (mean, median, mode, Standard deviation, standard error etc). Null hypothesis, parametric and non parametric tests (Student 't' test, Wilcoxon, ANOVA etc) Metaanalysis.
27. Calculation for statistical significance in the given data for student paired and unpaired 't' test. Applying ANOVA to the given set of concentration vs time data of two drug formulations to comment about their bio-equivalence.