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MICROBIOLOGY

Goal

The main objective of this course is to train students of Medicine in the field of medical Microbiology. Theoretical and practical training is imparted to the candidate's in subspecialties viz., Bacteriology, Virology, Parasitology, Immunology and Mycology so that they can participate in good patient care and prevention of infectious diseases in the community. They are introduced to basic research methodology so that they can plan and conduct fundamental and applied research.

They are also imparted training in teaching methods in the subject which may enable them to take up teaching assignments in medical colleges/institutes

Objectives

To impart training to post graduates:

1. To acquire knowledge and skills in various branches of Microbiology, so as to enable them to become a competent Medical Microbiologist.
2. To apply their training in patient care for early diagnosis of the disease
3. To utilize knowledge acquired for preparation of guidelines regarding infection control and implementation of infection control methods.
4. To plan and carry out fundamental and specialized research.
5. To operate routine and sophisticated instruments in the laboratory

At the end of the course, the students should be able to:

1. Establish good clinical microbiological services in a hospital and in the community in the fields of bacteriology, virology, parasitology, immunology and mycology.
2. Plan, execute and evaluate teaching assignments in medical microbiology.
3. Plan, execute, analyse and present the research work in medical microbiology.

2.COURSE OVERVIEW:

Cognitive domain:

- A. To have knowledge about the clinical features, aetiology, pathogenesis and laboratory diagnosis of communicable diseases caused by micro-organisms and apply that knowledge in the treatment, prevention and control of such diseases.
- B. To know the principles of immune mechanism which help to understand the pathogenesis and laboratory diagnosis of infectious and non-infectious diseases.
- C. To become a competent Microbiologist and to establish diagnostic Microbiology laboratory in hospitals and community for patient care
- D. To have sound knowledge of skills in microbiological laboratory methods
- E. To acquire teaching ability and to handle classes for undergraduates
- F. To prepare the student for fundamental and applied research

Psychomotor domain:

- A. To give guidelines for proper collection, transport and processing of clinical specimen
- B. To have a sound knowledge of techniques of sterilization, preparation of media, disposal of biomedical waste and implementation of infection control measures
- C. To learn serological and immunological techniques for diagnosis of infectious diseases

Affective domain:

- A. To acquire competency in teaching and diagnostic work
- B. To develop team spirit in organizing academic activities
- C. To follow ethics in routine and research activities

Course content (Syllabus)

Paper I: General Microbiology and Immunology

Paper II: Systematic Bacteriology and Mycology

Paper III: Virology and Parasitology

Paper IV: Applied microbiology and recent advances

COGNITIVE SKILL

General Microbiology

1. History and pioneers in Microbiology
2. Microscopy
3. Bio-medical waste management including universal precautions
4. Morphology of bacteria and other microorganisms

5. Nomenclature and classification of microbes
6. Growth and nutrition of bacteria
7. Bacterial metabolism
8. Sterilization and disinfection
9. Bacterial toxins
10. Bacterial antagonism: Bacteriocins
11. Bacterial genetics and bacteriophages
12. Molecular genetics relevant for medical microbiology including gene cloning
13. Antibacterial substances used in the treatment of infections and drug resistance in bacteria
14. Bacterial ecology - Normal flora of the human body - Hospital environment
- Air, water and milk
15. Host parasite relationship
16. Quality assurance, quality control and accreditation in microbiology

IMMUNOLOGY

1. The immune system
2. Innate and acquired immunity
3. Cells involved in immune response
4. Antigens
5. Immunoglobulins
6. Complement
7. Antigen and antibody reactions
8. Hypersensitivity
9. Cell mediated immunity
10. Immunodeficiency
11. Autoimmunity
12. Immune tolerance
13. Transplantation immunity
14. Tumour immunity
15. Prophylaxis and immunotherapy
16. Measurement of immunity
17. Immunological techniques

18. Immunopotential and immunomodulation

SYSTEMATIC BACTERIOLOGY

1. Isolation, description and identification of bacteria
2. Gram positive cocci of medical importance including Staphylococcus, Micrococcus, Streptococcus, anaerobic cocci, etc.
3. Gram negative cocci of medical importance including Neisseria, Branhamella, Moraxella, etc.
4. Gram positive bacilli of medical importance including Lactobacillus, Coryneform organisms, Bacillus & aerobic bacilli, Actinomyces, Nocardia, Actinobacillus and other Actinomycetales, Erysipelothrix, Listeria, Clostridium and other spore bearing anaerobic bacilli.
5. Gram negative bacilli of medical importance including Vibrio, Aeromonas, Pleisiomonas, Haemophilus, Bordetella, Brucella, Gardnerella, Pseudomonas & other non-fermenters, Pasturella, Francisella, Bacteroides, Fusobacterium, Leptotrichia, and other anaerobic Gram negative bacilli, etc.
6. Helicobacter, Campylobacter and Spirillum
7. Mycobacteria
8. The Enterobacteriaceae
9. The Spirochaetes
10. Chlamydiae
11. Rickettsia, Coxiella, Bartonella
12. Mycoplasmatales: Mycoplasma, Ureaplasma, Acholeplasma
13. Miscellaneous bacteria

VIROLOGY

1. The nature of viruses
2. Classification of viruses
3. Morphology: virus structure
4. Virus replication
5. The genetics of viruses
6. The pathogenicity of viruses
7. Epidemiology of viral infections
8. Laboratory diagnosis of viral infections
9. Vaccines and anti-viral drugs
10. Bacteriophages

11. RNA viruses of medical importance including, Enteroviruses, Togaviridae, Flaviviruses, Orthomyxoviruses, Paramyxoviruses, Reoviridae, Rhabdoviridae, Arenaviridae, Bunyaviridae, Retroviridae, Filoviruses, Human immunodeficiency virus, Arboviruses, Coronaviridae, Calciviruses, etc.
12. DNA viruses of medical importance including Poxviridae, Herpesviridae, Adenoviridae, Hepadnavirus, Papova and Parvoviruses, etc.
13. Slow viruses and Prions
14. Human immunodeficiency viruses
15. Oncogenic viruses
16. Viruses of gastroenteritis
17. Miscellaneous and newer viruses
18. Viroids

PARASITOLOGY

1. General characteristics and classification of parasites
2. Pathogenesis and pathology of parasitic infections.
3. Protozoan parasites of medical importance including Entamoeba, Giardia, Balantidium coli, Trichomonas, intestinal coccidian parasites, Toxoplasma, Sarcocystis, blood parasites including Plasmodium, Leishmania, Trypanosoma.
4. Cestodes and Trematodes of medical importance including, Diphylobothrium latum, Spirometra, Taenia, Echinococcus, Hymenolepis, Dipylidium caninum, Schistosoma, Fasciola, Fasciolopsis buski, Paragonimus, Clonorchis, other trematodes.
5. Nematodes of medical importance including, nematodes such as Trichuris, Trichinella, Capillaria, Strongyloides, Ancylostoma, Necator, Enterobius, Ascaris, Toxocara, agents causing larva migrans, tissue nematodes including, Filarial worms, Dracunculus medinensis.
6. Ectoparasites: Common arthropods and other vectors viz. Mosquito, Sandfly, Ticks, Mite, Cyclops
7. Common laboratory methods including common culture methods in Parasitology.
8. Antiparasitic agents.
9. Immunity mechanisms in parasitic infections.

MYCOLOGY

1. The morphology and reproduction of fungi and antimycotic agents
2. Classification of fungi

3. Contaminant and opportunistic fungi including Candida, Cryptococcus, Pneumocystis, Aspergillus, Zygomycetes, Penicillium marneffeii.
4. Superficial mycotic fungi including Dermatophytes.
5. Fungi causing subcutaneous mycoses including mycetoma and rhinosporidiosis.
6. Fungi causing systemic infections including Histoplasma, Blastomyces, Coccidioides, Paracoccidioides, Sporothrix.
7. Keratomycosis and otomycosis.
8. Fungal toxicosis.
9. Antifungal agents and in-vitro antifungal susceptibility testing.

APPLIED MICROBIOLOGY

1. Epidemiology of infectious diseases
2. Hospital acquired infections
3. Hospital waste management
4. Molecular genetics as applicable to Microbiology
5. Vaccinology: principle, methods of preparation, administration of vaccines
6. Investigation of an infectious outbreak including infections of various organs and systems of human body viz. sexually transmitted diseases, respiratory tract infections, urinary tract infections, central nervous system infections, congenital infections, reproductive tract infections, gastrointestinal infections, hepatitis, pyrexia of unknown origin, infections of eye, ear & nose, septicaemia, endocarditis, haemorrhagic fever, etc.
7. Emerging and re-emerging infections.
8. Automation in microbiology.
9. Statistical analysis of microbiological data and research methodology.
10. Care & handling of animals and ethics

PSYCHOMOTOR SKILLS

Bacteriology-

Must Acquire

1. Preparation and pouring of media-nutrient agar, blood agar, MacConkey agar, sugars, serum sugars, Kligler Iron agar, Robertson's cooked meat, Lowenstein Jensen's, Sabouraud's dextrose
2. Operation of autoclave, hot air oven, distillation plant, filters like Seitz and membrane and sterility tests
3. Washing and sterilization of glass wares (plugging and packing)

4. Preparation of reagents-oxidase, Kovac's, etc
5. Disposal of contaminated materials like cultures
6. Testing of disinfectants-phenol coefficient and "in use" tests
7. Quality control of media, reagents, etc
8. Aseptic practices in laboratory and safety precautions
9. Care and maintenance of common laboratory equipments like water bath, centrifuge, refrigerator, incubator, thermocycler, automated BACTEC system, microcentrifuge, ELISA system etc.
10. Preparation of antibiotic discs: performance antibiotic sensitivity tests by Kirby Bauer, Stokes method, etc. Estimation of minimal inhibitory/bactericidal concentration by tube/plate dilution methods
11. Tests for β -lactamases, ESBL, AmpC, Metallobetalactamases
12. Collection of specimens for microbiological investigations on blood, urine, throat swab, rectal swab, stool, pus (swabs), OT specimens
13. Identification of bacteria of medical importance up to species level (except anaerobes which could be up to generic level)
14. Techniques of anaerobiosis, anaerobic jars, evacuation and filling with CO₂ and H₂, automated anaerobic system.
15. Preparation of stains viz. Grams, Albert, capsule, spores, Ziehl-Neelsen etc. and performance of staining
16. Care and operation of microscopes viz. light, dark ground, phase contrast and fluorescence microscopes
17. Care and breeding of laboratory animals viz. mice, rats, guinea pigs and rabbits
18. Bleeding techniques from animals including sheep
19. Inoculation of infective material by different routes in the animals
20. Preparation, examination and interpretation of direct smears from clinical specimens viz. sputum for AFB-ZN, auramine O, slit smears for M. leprae for ZN staining, conjunctival smears for Chlamydia by Giemsa/Iodine
21. Quantitative analysis of urine by pour plate method and semi quantitative analysis by standard loop test for finding significant bacteriuria
22. Plating of clinical specimens on media for isolation, purification, identification and quantification purposes

23. Tests for motility: hanging drop, Craigie's tube, dark ground examination for spirochaetes-
Treponema and Leptospira
24. In-vitro toxicity tests-Elek's test, Nagler's reaction
25. Skin tests like Mantoux, Lepromin etc.
26. Special tests-bile solubility, chick cell agglutination, sheep cell haemolysis, niacin and catalase tests for Mycobacterium, satellitism, CAMP test, catalase, slide agglutination tests
27. Bacteriological test for air, water and milk.
28. Maintenance and preservation of bacterial cultures.

Bacteriology-

Desirable to acquire

1. Conjugation experiments for drug resistance
2. Serum antibiotic assays e.g. Gentamicin
3. Phage typing for Staphylococcus, S. typhi etc.
4. Bacteriocin typing viz. Proteocin, etc.
5. Enterotoxigenicity tests like rabbit ileal loop, intragastric inoculation of infant mouse, Sereny's test
6. Performance of autopsy on the animals
7. Animal pathogenicity / toxigenicity tests for C. diphtheriae, C. tetani, S. pneumoniae, S. typhimurium, K. pneumoniae etc.
8. Serological grouping of Streptococcus
9. Antibiotic susceptibility tests for Mycobacteria
10. Molecular typing methods.
11. Special staining techniques for Mycoplasma, Treponemes, Gardnerella.

Immunology-

Must acquire

1. Collection of blood by venepuncture, separation of serum and preservation of serum for short and long periods
2. Preparation of antigens from bacteria or tissues like Widal, Weil-Felix, VDRL, etc and their standardization
3. Raising of antisera in laboratory animals
4. Performance of serological tests viz. Widal, Brucella tube agglutination, Weil-Felix, Cold agglutination, VDRL, Paul-Bunnell, ASO, IFA

5. Enzyme linked immunosorbent assay
6. Latex and Staphylococcal Co-agglutination tests

Immunology

Desirable to acquire

1. Radial immunodiffusion for estimation of serum immunoglobulins
2. Immunoelectrophoresis
3. Crossed immunoelectrophoresis
4. Immunodiffusion in gels, (Ouchterlony) counter immunoelectrophoresis
5. Haemolysis and complement fixation.
6. Immunoblotting
7. Leukocyte migration test
8. T-cell resetting
9. Separation of lymphocytes by centrifugation, gravity sedimentation, etc

Mycology-

Must acquire

1. Collection and transport of specimens
2. Direct examination of specimens by KOH, Gram's, Kinyoun's, Giemsa, Lactophenol cotton blue stains
3. Calcofluor staining and examination under fluorescent microscope.
4. Examination of histopathology slides for fungal infections
5. Isolation and identification of common laboratory contaminants, dermatophytes and others of medical importance (yeast, dematiaceous fungi)
6. Special techniques like Wood's lamp examination, hair baiting, hair perforation, paraffin baiting and slide culture
7. Maintenance of stock cultures

Mycology-

Desirable to acquire

1. Animal pathogenicity tests viz. intracerebral and intraperitoneal inoculation of mice for Cryptococcus
2. Antigen and antibody based serological test in fungal diseases including Candida, Cryptococcosis, Aspergillus, etc.

Parasitology-

Must Acquire

1. Examination of feces for parasitic ova and cysts etc. by direct and concentration methods (salt floatation and formal-ether methods)
2. Egg counting techniques for helminthes
3. Examination of blood for protozoa and helminthes by wet mount and thin and thick stained smears
4. Examination of other specimens e.g. urine, CSF, bone marrow etc. for parasites
5. Histopathology sections-examination and identification of parasites
6. Performance of stains- Leishman, Giemsa
7. In-vitro culture of parasites like Entamoeba, Leishmania, etc.
8. Preparation of media-NIH, NNN, etc.
9. Copro-culture of larva of hookworms
10. Antigen preparation-viz. Entamoeba, filarial, hydatid for serological tests like IHA and skin tests like Casoni's test
11. Identification of common arthropods and other vectors viz., mosquito, sandfly, tick, mite, Cyclops
12. Collection of specimens
13. Preservation of parasites- mounting, fixing, staining, etc.
14. QBC for malaria.

Parasitology-

Desirable to Acquire

1. Permanent staining techniques like iron haematoxylin
2. In-vitro culture of Plasmodium falciparum
3. Maintenance of Toxoplasma gondii in mice
4. Antigen based and antibody based serological diagnostic tests such as IHA, ELISA, Western blot, etc for cysticercosis, amoebiasis, hydatid disease, filariasis, etc.

Virology-

Must acquire

1. Preparation of glass wares for tissue cultures (washing, sterilization)
2. Preparation of media like Hanks, MEM
3. Preparation of clinical specimens for isolation of viruses

4. Maintenance of continuous cell lines by subcultures. Preservation in -70°C and liquid nitrogen
5. Recognition of CPE producing viruses
6. Serological tests-ELISA for HIV, ELISA for HBsAg, HCV, Hepatitis virus, serological tests for arboviruses.
7. Chick embryo techniques-inoculation and harvesting
8. Handling of mice, rat, guinea pigs for collection of blood, pathogenicity tests, etc.

Virology-

Desirable to acquire

1. Performance of haemadsorption for Parainfluenza, Haemagglutination for Influenza, Immunofluorescence, neutralization for Enteroviruses and Respiratory viruses, identification tests on tissue cultures and supernatants, etc.

Molecular biology-Must acquire

1. Extraction of DNA, routine PCR protocols, gel documentation, RFLP, RAPD.
2. SDS PAGE
3. Western blot

APPLIED MICROBIOLOGY

1. Planning and execution of investigations during an epidemic
2. Segregation and disposal of biological and hospital wastes
3. Handling automated systems
4. Performance of molecular techniques
5. Computer applications

Time frame for minimum skill acquisition by PG residents of Microbiology Department

General Microbiology and Bacteriology

First year

1. Media and reagent preparation
2. Operation of autoclave, hot air oven
3. Washing and sterilization of glass wares
4. Laboratory waste management
5. Aseptic practices in laboratory and safety precautions
6. Care and maintenance of common laboratory equipments

7. Preparation and performance of common bacterial stains
8. Collection of specimens for microbiological investigations
9. Care and operation of microscopes
10. Preparation, examination and interpretation of direct smears from clinical specimens
11. Motility testing of bacteria
12. Plating of clinical specimens on media

Second year

1. Quality control of media and reagents
2. Quantitative and semi-quantitative analysis of urine
3. Skin tests
4. Preparation of antibiotic discs
5. Estimation of MIC, MBC, and tests for β -lactamases
6. Identification of bacteria of medical importance up to species level
7. Care and breeding of laboratory animals

Third year

1. Techniques of anaerobiosis
2. Bleeding techniques from animals
3. Inoculation of infective material by different routes in the animals
4. Performance of autopsy on the animals
5. Animal pathogenicity / toxigenicity tests and in-vitro toxicity tests
6. Special tests

Immunology

First year

1. Collection of blood by venepuncture
2. Separation of serum and preservation of serum for short and long periods
3. Preparation of antigens from bacteria or tissues like Widal, VDRL, etc and their standardization
4. Latex and Staphylococcal Co-agglutination tests
5. Preparation of adjuvants like Freund's adjuvant

Second year

1. Performance of serological tests viz. Widal, Brucella tube agglutination, WeilFelix,
2. Cold agglutination, VDRL, Paul-Bunnell, Rose-Waaler, IF

3. Raising of antisera in laboratory animals
4. Enzyme linked immunosorbent assay
5. Separation of lymphocytes by centrifugation, gravity sedimentation

Third year

1. Counter immunoelectrophoresis
2. Haemolysin and complement titration
3. Leukocyte migration test
4. T-cell resetting
5. Radial immunodiffusion for estimation of serum immunoglobulins
6. Immunoelectrophoresis
7. Crossed immunoelectrophoresis
8. Neutrophil phagocytosis

Mycology

First year

1. Collection of specimens
2. Direct examination of specimens by KOH, Gram's, Kinyoun's, Giemsa,
3. Lactophenol cotton blue stains

Second year

1. Isolation and identification of common laboratory contaminants, dermatophytes and others of medical importance (yeast, dematiaceous fungi)
2. Maintenance of stock cultures

Third year

1. Examination of histopathology slides for fungal infections
2. Special techniques like Wood's lamp examination, hair baiting, hair perforation, paraffin baiting and slide culture
3. Animal pathogenicity tests viz. intracerebral and intraperitoneal inoculation of mice for Cryptococcus

Parasitology

First year

1. Collection of specimens
2. Examination of feces for parasitic ova and cysts etc. by direct and concentration methods (salt floatation and formal-ether methods)

3. Examination of blood for protozoa and helminthes by wet mount and thin and thick stained smears
4. Performance of stains- Leishman, Giemsa
5. Preservation of parasites- mounting, fixing, staining, etc.
6. Preparation of media-NIH, NNN, etc.

Second year

1. Egg counting techniques for helminthes
2. Examination of other specimens eg. urine, CSF, bone marrow etc. for parasites
3. In-vitro culture of parasites like Entamoeba, Leishmania, etc.
4. Copro-culture of larva of hookworms
5. Antigen preparation-viz. Entamoeba, filarial, hydatid for serological tests like IHA and skin tests like Casoni's test
6. Serological tests like IHA, ELISA, Co-A

Third year

1. Histopathology sections-examination and identification of parasites
2. Identification of common arthropods and other vectors viz., mosquito, sandfly, tick, mite, Cyclops
3. Permanent staining techniques like iron haematoxylin

Virology

First year

1. Preparation of glass wares for tissue cultures (washing, sterilization)
2. Preparation of media like Hanks, Eagle's MEM
3. Preparation of clinical specimens for isolation of viruses
4. Serological tests-ELISA for HIV, RPHA for HBsAg

Second year

1. Maintenance of continuous cell lines by subcultures.
2. Preservation in -70°C and liquid nitrogen
3. Handling of mice, rat, guinea pigs for collection of blood, pathogenicity tests, etc.

Third year

1. Recognition of CPE producing viruses
2. Performance of viz. haemadsorption for Parainfluenza

3. Haemagglutination for Influenza
4. Immunofluorescence
5. Neutralization for Enteroviruses and Respiratory viruses
6. Identification tests on tissue cultures and supernatants, etc.

MD Microbiology Examination Format

Theory Examination (Multiple Choice Questions-200 per paper)

Each paper 3 hours

Paper I : General Microbiology and Immunology

Paper II : Systematic Bacteriology and Mycology

Paper III : Virology and Parasitology

Paper IV : Applied microbiology and recent advances

Practical Examination(Objective Structured Practical Examination)

Duration: two days

The examination will consist of the following exercises conjointly conducted and evaluated by four examiners, two internals and two externals.

1. Exercise in Clinical Bacteriology Isolation

and identification of bacteria from clinical specimen

2. Exercise in Bacteriological Techniques Isolation and identification of bacteria given in pure culture

3. Animal experiment

Any one of bleeding of rabbit/guinea pig/mouse/rat

1. Post mortem examination of laboratory infected animal

2. Inoculation of infective material into laboratory animal and isolation of the pathogen

4. Exercise in Virology

Egg inoculation, or identification of unknown virus serological tests

5. Identification of fungi

6. Exercise in Parasitology

Examination of stool for ova and cysts by direct and concentration techniques

7. Histopathology- identification of slides

8. Exercise in Immunology

Any one of the serological techniques used in clinical medicine

9. Pedagogy

Oral examination: The oral examination consists of questioning on the dissertation and overall subject matter. It will be conducted by all the four examiners as in the case of the practical examination