

Paper II: Technical Subject

1. Hematology

20 %

- Identification and rectification of different types of errors in hematology laboratory
- Concept of laboratory audit and accreditation
- Quality assurance in hematology, concept of NEQAS, EQAS
- Reference preparation of hemoglobin and blood cells, preparation of quality control material for autoanalysers
- Principle, function and maintenance of automated hematology analysers and other instruments used in hematology laboratory
- Biomedical waste management relevant to hematology laboratory
- Standardization of instruments in hematology laboratory
- Hematopoiesis (erythro, leuco as well as thrombopoiesis) – origin, development, function and fate of blood cells, regulation of hematopoiesis
- Structure and function of normal hemoglobin
- Anemia: definition, classification (morphological as well as etiological), and clinical features and causes of various types, laboratory investigation
- Classification of acute and chronic leukemia, including the WHO classification, laboratory investigation of leukemia
- Collection and preservation of blood for various hematological investigations, mechanism of action, advantages and disadvantages of various anticoagulants
- Principle and procedure of common hematological tests by different methods, errors involved and their rectification
- Different stains used in hematology, their preparation, storage, uses, advantages, disadvantages
- Examination of blood films for parasites
- Blood cell morphology in health and disease, effect of storage on blood cell morphology
- Indication, sites and procedure of bone marrow aspiration and biopsy
- Definition of pancytopenia, causes, laboratory approach to a case of pancytopenia
- Molecular basis of hemoglobinopathies and thalassemias, clinical manifestation and laboratory diagnosis of abnormal hemoglobins and thalassemias, reagents preparation, principle and procedure of test used in their diagnosis
- Leukocyte abnormalities and pathological variations of white cell values
- Leukemoid reactions and its importance
- Definition, classification and laboratory investigation of hemolytic anemia
- Hemostatic mechanism and theories of blood coagulation, physico-chemical properties of coagulation factors
- Etiopathogenesis, classification and investigation of bleeding disorders, including various factor assays, platelet function tests and test for Von willebrand factor
- Disseminated intravascular coagulation: definition, pathophysiology, clinical features, laboratory investigation
- Thrombotic disorders – classification, pathogenesis, clinical features and laboratory investigations, investigation of antiphospholipid antibody syndrome, principle and procedure of tests for lupus anticoagulants
- Classification of plasma cell disorders, Laboratory investigation of multiple myeloma
- Principle, preparation of stain and staining procedure of various cytochemical stains for leucocytes: Myeloperoxidase, Periodic acid Schiff, Sudan Black B (SBB), neutrophilic alkaline phosphatase, alpha naphthol acetate esterase, naphthol AS acetate esterase,

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- Use of flow cytometry in hematology, procedure of immunophenotyping on blood and bone marrow samples in leukemia and lymphoma
- Processing blood and bone marrow samples for cytogenetic study, molecular biology and detection of philadelphia chromosome
- Principles of various Molecular methods used in hematology
- Haematological tests and their Principle and procedure of:
 - Reticulocyte count, reticulocyte production index
 - Sickling test, HbS solubility test
 - Osmotic fragility test
 - Coomb's test
 - Kleihauer acid Elution test, Alkali denaturation test
 - Ham's test, Sucrose lysis Test
 - Electrophoresis – HbF & Hb A2 estimation
 - Demonstration of HbH
 - Test for G6PD deficiency
 - Serum iron, TIBC, ferritin
 - Plasma hemoglobin, serum haptoglobin, urine for hemosiderin, urine myoglobin
 - BT, CT, PT, APTT
 - Platelet function test, Ristocetin co factor assay
 - Urine Bence Jones protein
 - Mixing study, Factor VIII, IX assay, urea solubility test, fibrinogen assay, Factor VIII: C inhibitor study, Test for D dimer
 - Antithrombin III, protein C and protein S assay
 - Serum Vitamin B12, serum folate, red cell folate estimation
 - Iron and reticulin stain in bone marrow

2. Blood Banking

10%

- History of transfusion medicine
- Indications for blood and component transfusion
- Donor registration, donor selection, blood collection from donors, adverse donor reaction, pre-donation counselling, bleeding of the donor, post donation care, post donation counseling
- Blood collection room equipment, their principles, and use, emergency medicines
- Preservation of donated blood, mechanism of action and composition of blood preservation solution and additive solutions, changes during storage
- Blood components – indications, preparation, storage, transport
- Principles of immune system, central to transfusion medicine, immunology of red blood cells
 - Major and minor blood groups, clinical significance and methods of identification in laboratory
- Red cell allo and autoantibody formation and function, platelets and leucocytes antigen and antibodies
- Blood grouping and compatibility testing – major, minor, Coomb's cross match, factors influencing the results of blood grouping
- Coomb's test (direct, indirect) – application, procedure, Rh antibody titre
- Gel testing for antibody screening and identification
- Hazards of blood transfusion
- Hemolytic transfusion reaction: immediate and delayed; immune and non-immune, their pathophysiology, clinical signs and symptoms and laboratory

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investigation; strategies to prevent transfusion reactions

- Management of Blood Bank Issue Counter
- Screening of blood units for TTI, ELISA, rapid and other tests for diagnosis of transfusion transmitted infections, nucleic acid testing
- Hemapheresis - definition, types of pheresis, machines and techniques
- Stem cell processing and storage for transplantation
- Procedure of HLA matching for bone marrow transplant
- Procedure of chimerism testing/engraftment analysis after bone marrow transplant
- Basics of tissue banking and cord blood banking
- Preparation of antisera and their quality control
- Plasma fractionation and preparation of component of clinical use (albumin,, immunoglobulin and coagulation factors)
- Factors preparation by recombinant DNA technology
- Disposal of wastes and biologically hazardous substance in the blood bank
- Medico legal aspects of blood transfusion
- Quality control of blood grouping reagents, QC of anti-human globulin reagent, bovine albumin, normal saline, blood bags and different blood products
- Calibration, validation and maintenance of blood bank equipment, QC of blood bank techniques, external and internal quality assessment
- Hemovigilance in blood banking
- Use of automation in blood banking

3. Microbiology

30%

Historical development of microbiology with reference to Anton Van Leuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Edward Jenner

- Bacterial Classification, Morphology and Cell structure
- Laboratory contamination, and infection; Disposal of infectious material, laboratory safety measure, laboratory discipline and practices.
- Different ways of sterilization by Physical, chemical, radiation and filtration and its applications. Relationship between disinfectants and antiseptics, disinfection rate of microorganisms; and uses of ethylene oxide sterilizer
- Mechanism, functions, uses and the quality control of the laboratory equipments.
- Classify the types of antigen antibody reactions, hypersensitivity, immediate and delayed.
- Morphology, staining property, cultural characteristics, Biochemical reaction, Antigenic Characters, Pathogenicity, Laboratory diagnosis and the diseases caused by the followings:
 - Gram positive cocci: Staphylococci, streptococci, Pneumococci, Micrococci
 - Gram Positive bacilli: Corynebacteria, bacillus; clostridia
 - Gram negative bacilli (Enterobacteriaceae): Escherichia coli, Klebsiella, Enterobacter, Citrobacter, Proteus, Providencia, Yersinia, Salmonella, Shigella etc.
 - Gram negative cocci: Neiseria
 - Curve Gram negative bacilli: Vibrio, Campylobacter, helicobacter
 - Mycobacteria: Typical and Atypical mycobacteria, Leprosy
 - Haemophilus: H. Influenzae and other species

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- Non fermentative Gram negative bacilli: Pseudomonas, Acinetobacter, Moraxella
- Spirochaete; Treponema, Borrelia, Leptospira
- Miscellaneous fastidious organisms: Mycoplasma, Chlamydia, Rickettsia

Antigen Antibody reaction; agglutination, precipitation flocculation, complement fixation and ELISA.

Procedure of:

- Laboratory diagnosis of common Bacterial infection; Pyogenic Infection; Respiratory tract infection, urinary tract infection, sexually transmitted diseases, food poisoning, enteric fever, gastroenteritis, meningitis, diphtheria, tuberculosis, leprosy.

Diagnostic procedure immunological/serological test; Widal tests; ASO titer; CRP, Rose – Walter test; Brucella agglutination; cold agglutination; VDRL, RPR, TPHA, ELISA, CFT.

Methods of separation of T and B Cells

Bacteriology (procedure):

- Collection of specimens for bacteriological specimens
- Methods of culture techniques and organisms encountered in CSF, Blood culture, Sputum, Pus, Urine, Stool, Body fluid aspirate etc.
- Quality control in procedure, culture media, equipments
- Hospitals infection, Laboratory infection
- Infectious waste management

General Virology:

- General properties of viruses and interferon
- Principle of viral isolation, embryonated egg and tissue culture
- Immunology of viral infection

Mycology:

- Identification of superficial, deep and systemic mycosis
- Opportunistic mycosis
- Examination and identification by different method and culture

Parasitology

- Classification of human and vectors
- General characteristics of Protozoa, Helminthes, trematodes/ cestodes
- Methods of collection, transportation and storage of different types of specimens
- Methods of identification parasites from different types of clinical materials

Systematic Bacteriology

Properties, epidemiology, methods of isolation, differentiation, pathogenesis and Laboratory diagnosis of following bacterial infections:

Staphylococcus, Streptococcus, Pneumococcus, Neisseria, Corynebacteria, Bacillus, Clostridium, nonsporing anaerobes, Enterobacteriaceae, Vibrio, Pseudomonas, Yersinia, Pasteurella, Francisella, Haemophilus, Bordetella, Mycobacterium, Spirochaetes, Mycoplasma, Actinomycetes, Rickettsia, Chlamydiae.

4. Biochemistry

20%

Structure and function of cells

Principle of Biochemistry

- Buffer: definition, types, composition of buffer present in body fluids
- Photometric measurement of light, Beer's law and Lambert's law and their limitations
- Automation in biochemistry; wet and dry chemistry analyzer
- Principles and applications of: Photometry, Spectrophotometry (UV, visible, IR), Fluorimetry, spectroscopy, turbidimetry, nephelometry, spectrofluorimetry, atomic emission, reflectometry, mass spectrometry, nuclear magnetic resonance, dry and wet chemistry analyzer, CLIA
- Collection, handling and storage of sample, influence of temperature, nutrition, drugs, posture
- Separation techniques including various chromatography techniques and electrophoresis
- Use of radioisotopes in biochemical analysis
- Recent advances in clinical biochemistry

Chemistry of Amino acids and Proteins

- Structure, function and metabolism of protein
- Biochemical basis and investigation of amino acid metabolism disorder
- Methods to determine the amino acid sequence of proteins
- Procedures and application of:
Electrophoresis: paper, polyacrylamide gel, agarose gel and cellulose acetate
Chromatography : principle, types, uses
Ultra centrifugation, ultrafiltration
Estimation of proteins by various methods

Chemistry of Carbohydrates

- Carbohydrates - introduction, classification, properties (physical, chemical), metabolism, hormones influencing metabolism, isomers, uses, carbohydrate derivatives, medicinally important carbohydrates
- Inborn errors associated with carbohydrate metabolisms
- Diabetes mellitus
diagnostic and monitoring criteria for diabetes
Glucose tolerance test procedure
Principle and procedure of estimation of glucose and hemoglobin A1c by various methods

Chemistry of Lipids

- Lipids: definition, classification, uses, digestion and absorption, transport and storage and metabolism of lipids and hormonal regulation
- Lipoprotein: Introduction, classification, definition and types

Liver Function Test

- Hemoglobin and bilirubin metabolism
- Liver function test : principle and procedures
- Biochemical investigation in acute and chronic liver disease
- Important plasma proteins and their laboratory estimation

Kidney Function Test

- Renal function test: principle, and procedure
- Biochemical investigation in acute and kidney disease

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- Glomerular filtration rate and clearance
- Estimation of GFR and creatinine clearance
- Activity and effects of diuretics on different laboratory tests
- Urine analysis for different diseases and methods used

pH, Acid Base Balance

- Concept of pH and buffers. Handerson-Hasselbalch equation
- Acid base regulation and its disorders, assessment of acid base status
- Measurement of electrolytes by various methods
- Blood gas analysis

Pancreatic Function Test

- Pancreatic function test and their list

Cardiac Function Test

- Biochemical basis and investigation of myocardial infarction
- Estimation of LDH, CPK, GOT, Troponin, CPK MB

Endocrinology

- Formation, regulation, function and laboratory estimation of various clinically important hormones, effect of hypo and hyperfunction
- Biochemical investigation of endocrine disorders
- Metabolism and laboratory investigation of excess and deficiency of calcium, phosphate and magnesium
- Hormones of pancreas and gastro intestinal tract, their formation, uses, excess and deficiency states and relevant laboratory tests
- Principle and procedure of estimation of various hormones in infertility

Tumor Marker

Technical details of methods of estimation of AFP, B-hCG, CEA, CA-125, CA 19-9, CA 15-3, PSA and other tumor markers

Drugs

Theory of drug absorption, metabolism, excretion, pharmacokinetics, pharmacodynamics and pharmacogenetics
Monitoring therapeutic levels of drugs
Individual determinations for important drugs
Drugs of abuse and modalities of DAU testing

Enzymes : Definition, classification and properties of enzyme, regulation of enzymatic activity, Method of estimation of clinically important enzymes

Vitamins, Minerals, Nutrition

Chemistry, source, requirements, absorption, metabolism, biochemical role, excess and deficiency manifestations of various vitamins and minerals, Lab. estimation of the clinically important vitamins and minerals

5. Histopathology and Cytology

10%

Fixatives and preservatives, their types, composition and methods of preparations
Different types of decalcifying agents, their principle and mode of decalcification
Special histological stains, their composition and principle of Haematoxylin, eosin and special stain for connective tissue, protein, amyloid, carbohydrate, lipid and pigments
Principle and application of immunohistochemistry
Immunofluorescence technique
Electron Microscopic and its applications
Safety measures and quality assurance in Histopathology laboratory
Cytology of the respiratory tract: Introduction to respiratory tract, various methods of sample collection, different methods of staining the collected samples and special stains used in the diagnosis

of the diseases.

Gynecological cytology: Introduction to the female genital tract, various methods of sample collection and different methods of staining. Features of various malignant, benign and infective specimens, stains and special stains used.

Cytology of body fluids and urine: Introduction, methods of sample collection, various methods of staining body fluid samples and urinary cytology.

Cerebrospinal fluid (CSF): Introduction, staining, cytological study and its applications.

Role of automation in cytology

Sex chromatin, Chromosomal Analysis and Karyotyping: Introduction, methods of staining and its applications.

Uses of Cytogenetics, Flowcytometry, and Polarized microscopy in cytological study

6. Immunology

5%

History of immunology, innate and acquired immunity, mechanisms of innate immunity inflammation-inflammatory cells, mediators, inflammatory responses, antigens, cells and organs of immune system, evolution of immunity.

Immunoglobulin: structure and function; regulation of immune response

Advances in the development of vaccines

Theory of hypersensitivity reactions, their types, mechanism, examples

Complement system and its roles in disease

Autoimmune diseases: mechanism of common diseases, principle and procedure for test for autoimmune diseases

Transplantation Immunology

Major histocompatibility complex, their types, genetics, role of MHC in organ transplant, MHC association with diseases, principle of transplantation, graft rejection

Preparation, preservation and titration of complement

Monoclonal and polyclonal antibodies preparation, application in biomedical research, clinical diagnosis and treatment

Diagnostic procedure of common immunological/serological tests

Immunological reaction and their various types, agglutination, precipitation, flocculation, complement fixation, ELISA

Quality control and evaluation of kits used in laboratory

Immunological methods in clinical laboratories: Method and application of the following:

Double diffusion in agar, Single radial immunodiffusion, Electrophoresis and immunoelectrophoresis, Chromatography, Ion exchange, Affinity (gel), RIA, Elisa,

Western blotting, Detection of immune complexes, nephelometry, Immunofluorescence,

Agglutination test direct and indirect, Haemagglutination and haemagglutination

inhibition, Complement assays-CFT, Detection of cellular immunity-delayed

hypersensitivity skin test, Assays for lymphocytes-T and B cells, Flow cytometry, Mixed lymphocyte culture, NK cells neutrophil function test and Histocompatibility testing for

organ transplant

7. Molecular Biology

5%

Chromosomes structure, chromosomal abnormalities, mutations and important genetic diseases

Procedure of karyotyping and other methods of chromosomal analysis in various specimens

Collection, storage & processing of tissues, including bone marrow for karyotyping

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Recombinant DNA technology: necessary elements

Separation of DNA and RNA

Application of genetics in medicine

Poymerase chain reaction: principle, types, procedure, uses in medicine

Insitu hybridization: principle, types, procedure, uses in medicine

Gel electrophoresis: principle, procedure, uses

Recent advances in molecular biology relevant to medicine

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