

Paper II: Technical Subject

1. Basic Hematology

- 1.1 Morphology, physiology and biochemistry of blood, marrow, lymphatic tissue and spleen
- 1.2 Basic morphology and basic concepts of hematopoiesis
- 1.3 Normal hemostatic mechanism, pathophysiology of blood coagulation and thrombosis
- 1.4 Development of Immune system
- 1.5 Cell Cycle and Carcinogenesis
- 1.6 Principles of chemotherapy
- 1.7 Effects of other systemic disorders on the blood, blood-forming organs and lymphatic tissue
- 1.8 Genetic aspects of hematology
- 1.9 Relevant drugs, their mechanisms of actions, pharmacokinetics and clinical indications and limitations, including effects, toxicity, and interactions
- 1.10 Infections and hematological problems
- 1.11 Cluster of differentiation antigens (CD markers) relevant to hematological diseases, their distribution, detection and use in diagnosis
- 1.12 Use of radioisotopes in hematology

2. Clinical Hematology and Hematopathology

2.1 Erythrocytes:

- 2.1.1 Production, composition, destruction of erythrocytes
- 2.1.2 Clinical manifestations and classification of erythrocyte disorders
- 2.1.3 Definition and classification of anemia
- 2.1.4 Iron metabolism. Vitamin B12 and folic acid metabolism
- 2.1.5 Causes, clinical features laboratory diagnosis of iron deficiency anemia, megaloblastic anemia, anemia resulting from other nutritional deficiencies, anemia of chronic diseases
- 2.1.6 Etiopathogenesis, clinical features, diagnosis and treatment of congenital dyserythropoetic anemia
- 2.1.7 Etiopathogenesis, clinical features, diagnosis and treatment of congenital paroxysmal nocturnal hemoglobinuria
- 2.1.8 Acquired and inherited aplastic anemia and pure red cell aplasia: etiopathogenesis, clinical and laboratory findings, diagnosis, management
- 2.1.9 Anemia in systemic disorders, endocrine disease and associated with marrow infiltration
- 2.1.10 Red blood cell membrane disorders: hereditary spherocytosis, elliptocytosis and related disorders
- 2.1.11 Disorders of red cell resulting from enzyme abnormalities
- 2.1.12 Thalassemia and hemoglobinopathies: epidemiology, etiopathogenesis, classification, genetic mechanism, clinical and hematological features, complications, laboratory diagnosis, antenatal diagnosis, management

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- 2.1.13 Sickle cell anemia and related abnormalities; epidemiology, etiopathogenesis, classification, genetic mechanism, clinical and hematological features, complications, laboratory diagnosis, management
- 2.1.14 Classification, etiology, clinical and laboratory diagnosis of hemolytic anemias and Hemolytic anemias due to physical, chemical, microbial causes and immune mechanisms
- 2.1.15 Red cell disorders in the newborn
- 2.1.16 Hemolytic disease of newborn: Basis, diagnosis, clinical and laboratory features
- 2.1.17 Porphyrrias: types, etiopathogenesis, diagnosis, clinical and laboratory features
- 2.1.18 Hereditary and acquired sideroblastic anemias; etiopathogenesis, diagnosis, clinical and laboratory features, management
- 2.1.19 Primary and secondary polycythemias: etiopathogenesis, clinical and hematological features, complications, laboratory diagnosis, management
- 2.1.20 Red cell disorders in pregnancy

2.2 Leucocytes:

- 2.2.1 Morphology, composition, production, function, distribution and fate of different WBCs
- 2.2.2 Classification, clinical manifestations and diagnosis of qualitative and quantitative disorders of neutrophils
- 2.2.3 Production, function, morphology and disorders of eosinophils, mast cells and basophils,
- 2.2.4 Classification, clinical manifestations and diagnosis of monocytes and macrophages, Inflammatory and malignant histiocytosis, etiopathogenesis, clinical and laboratory features, diagnosis
- 2.2.5 Lipid storage disorders; Types, genetic basis, etiopathogenesis, clinical and laboratory features, complications, management
- 2.2.6 Hematological manifestation of AIDS
- 2.2.7 Production, morphology and functions of lymphocytes. Lymphocytosis and lymphocytopenia.
- 2.2.8 Etiopathogenesis, classification, clinical features, diagnosis, treatment, genetic and molecular evaluation, prognostic markers and complications of acute and chronic myeloid and lymphoid leukemias
- 2.2.9 Leucocyte cytochemistry
- 2.2.10 Etiopathogenesis, classification, clinical features, diagnosis, treatment, genetic and molecular evaluation, prognostic markers and complications of various Myeloproliferative disorders and Molecular diagnosis, Treatment of CML, Monitoring response to therapy in CML
- 2.2.11 Hodgkin and Non Hodgkin Lymphomas: pathophysiology, classification, clinical and laboratory findings, diagnosis, management, complications, prognosis
- 2.2.12 Plasma cell disorders : Etiopathogenesis, classification, clinical features, diagnosis, treatment
- 2.2.13 Amyloidosis, heavy chain diseases, macroglobulinemia

2.3 Hemostasis and Thrombosis :

- 2.3.1 Overview of megakaryopoiesis
- 2.3.2 Biochemistry, morphology and function of platelets
- 2.3.3 Various coagulation factors, their molecular biology and biochemistry
- 2.3.4 Pathophysiology of blood coagulation and thrombosis, pathways of hemostasis
- 2.3.5 Classification, clinical manifestation, evaluation, treatment of disorders of hemostats
- 2.3.6 Etiopathogenesis, clinical and laboratory features, treatment and prognosis of Hereditary and acquired qualitative disorders of platelets, effect of drugs on platelet function.
- 2.3.7 Hematological and systemic disorders associated with abnormal platelet function
- 2.3.8 Thrombocytopenia, their causes, clinical and laboratory features, diagnosis and treatment, pathophysiology of ITP, neonatal thrombocytopenia, spurious thrombocytopenia
- 2.3.9 Thrombocytosis, causes, clinical and laboratory features, reactive thrombocytosis
- 2.3.10 The vascular purpuras: etiopathogenesis, clinical and laboratory features, diagnostic approach
- 2.3.11 Hemophilia A & B: etiopathogenesis, genetics, clinical and laboratory features, complications, management, course and prognosis
- 2.3.12 Etiopathogenesis, clinical and laboratory features, complications, management of inherited deficiency of other coagulation factors, combined deficiency of factors
- 2.3.13 Hemostatic dysfunction related to liver disease
- 2.3.14 Von willebrand disease; : etiopathogenesis, genetics, types, clinical and laboratory features, complications, management, course and prognosis
- 2.3.15 Disseminated intravascular coagulation: Etiopathogenesis, clinical and laboratory features, complications, management
- 2.3.16 Hereditary Thrombophilia: Etiopathogenesis, major types, clinical and laboratory features, management
- 2.3.17 The antiphospholipid antibody syndrome: Etiopathogenesis, clinical and laboratory features, complications, management
- 2.3.18 Venous thrombosis: Causes, approach to diagnosis, management
- 2.3.19 Fibrinolysis and thrombolysis: concept of fibrinolytic system, fibrinolytic agents, inhibitors, thrombolytic therapy, antifibrinolytic agents and their clinical use
- 2.3.20 Pediatric issues in thrombosis
- 2.3.21 Thrombosis and pregnancy
- 2.3.22 Thrombotic thrombocytopenic purpura and Heparin induced thrombocytopenia: Etiopathogenesis, clinical and laboratory features, complications, management
- 2.3.23 Anticoagulant monitoring

3. Laboratory Hematology

- 3.1 Proper use and care of common instruments such as light microscope, centrifuge, water baths, freezers, weighing balance, etc. used in hematology laboratory

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- 3.2 Blood collection, different methods, sample collection, anticoagulants, containers, effects of delay in processing and storage
- 3.3 Preparation of blood films and CSF, staining of peripheral/blood films and CSF cytospin slides with Ramanowsky and other dyes
- 3.4 Determination of peripheral blood counts (Hemoglobin, Hematocrit, RBC, Total WBC and platelets) manually and calculation of red cell indices
- 3.5 Use of automated blood cell counters including principles and practice
- 3.6 Interpretation of peripheral blood counts and abnormal flags
- 3.7 Performance of WBC differential counts; subjective assessment of platelet counts and diagnostic interpretation of abnormal counts
- 3.8 Review of normal and abnormal blood films with emphasis on morphology of red cells, white cells and platelets
- 3.9 Supravital staining of reticulocytes, counting of reticulocytes
- 3.10 Limitations and uses of automated WBC differentials
- 3.11 Interpretation of RBC indices to characterize anemias
- 3.12 Preparation and staining of thick and thin blood films for Hemoparasites
- 3.13 Identification of different hemoparasites in blood and marrow
- 3.14 Measurement and significance of ESR and plasma viscosity
- 3.15 Indication, instruments, procedure of bone marrow aspiration; trephine needle biopsy, splenic aspiration
- 3.16 Preparation of smear of bone marrow aspirates and biopsy (touch) imprints. Staining and diagnostic evaluation of bone marrow aspirates in adult as well as pediatric patients
- 3.17 Interpretation of iron profile, indications and interpretation of ferrokinetic studies
- 3.18 Principle and procedure of serum vitamin B12, serum folate and red cell folate testing
- 3.19 Principle, procedure and interpretation of sickling test, HbS solubility test, osmotic fragility test, HAMS test, G6PD deficiency
- 3.20 Screening for unstable hemoglobin, supravital staining of Hb H inclusions
- 3.21 Principles, procedure and practice of separation and identification of normal and abnormal hemoglobins by electrophoresis and chromatography, interpretation of electrophoresis and HPLC data
- 3.22 Quantitation of HbF by alkali denaturation and cellular distribution of HbF
- 3.23 by Kleihauer acid elution technique,
- 3.24 Heinz body preparation and identification screening for G6PD deficiency and quantitative estimation of G6PD and other red cell enzymes
- 3.25 Direct and indirect Coomb's test, warm and cold autoantibody titres
- 3.26 Miscellaneous biochemical test on red cell, plasma and urine for diagnosis of hemolytic anemias: plasma bilirubin and Haptoglobin, methaemalbumin, methaemoglobin and sulphahemoglobin; urine for Hb, red cells, hemosiderin, urobilinogen and bilirubin
- 3.27 Screening for cryoglobins, principles of immunoglobulin estimation and immune electrophoresis,
- 3.28 Different Enzyme cytochemical stains, their principle, uses and interpretation: Myeloperoxidase, specific and non-specific esterases, acid phosphatase. Periodic acid Schiff and iron staining, Leucocyte alkaline phosphatase

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- 3.29 Interpretation of quantitative immunoglobulin levels, serum protein electrophoretic strips and immunoelectrophoresis patterns
- 3.30 Principle, procedure and interpretation of routine tests : PT, PTT, thrombin time, reptilase time, bleeding time, platelet count
- 3.31 Workup of abnormal PTT and PT results
- 3.32 Understanding of platelet kinetics, study of platelet morphology
- 3.33 Principles, practice and interpretation of platelet aggregometry tests
- 3.34 Study of Platelet associated immunoglobulin (PAIgG) and circulating antiplatelet antibodies
- 3.35 Laboratory approach to inherited and acquired coagulation factor deficiencies
- 3.36 Correction studies with normal plasma, adsorbed plasma, aged serum and factor deficiency plasmas.
- 3.37 Principle, procedure and interpretation of tests for FDP and D-Dimers
- 3.38 Assays of clotting factors particularly factors VIII and IX
- 3.39 Urea solubility test for factor XIII, Euglobulin lysis time and other relevant tests of plasma fibrinolytic activity, laboratory work up of DIC
- 3.40 Thrombophilia work up: Assays of plasma AT III, protein C, protein S, Factor V Leiden
- 3.41 Screening for lupus anticoagulant and activated protein C resistance ; principles of screening tests and interpretation of results
- 3.42 Anticoagulant monitoring in laboratory
- 4. Immunophenotyping**
 - 4.1 Principle and practice of flow cytometry
 - 4.2 Interpretation and clinical significance of flow cytometry data in leukemias, lymphomas and other hematological disorders
- 5. Histopathology**
 - 5.1 Tissue processing techniques
 - 5.2 Different stains used in bone marrow trephine biopsies and lymph node biopsies
 - 5.3 Interpretation of bone marrow trephine biopsies and lymph node biopsies
 - 5.4 Use of immunohistochemistry in bone marrow and lymph nodes for diagnosis of leukemias and lymphomas and other disorders
- 6. Cytogenetics, Molecular Pathology and Immunopathology**
 - 6.1 Methods, procedures, and interpretation of standard karyotyping analysis
 - 6.2 Principle and use of fluorescent in situ hybridization and more specialized techniques
 - 6.3 Cytogenetics of myeloid, lymphoid and plasma cell disorders, their use in prognosis and therapy monitoring
 - 6.4 Basic concepts in molecular biology and pathology
 - 6.5 Basic gene structure and function
 - 6.6 Principle, brief procedure and interpretation of Molecular pathology tests pertinent to hematopathology: Southern blot, PCR and its different types, restriction fragment length polymorphism, Real-time PCR
 - 6.7 DNA & RNA extraction techniques
 - 6.8 Separation of lymphocytes using density gradient and centrifugation
 - 6.9 HLA typing, microlymphocytotoxicity test and its application in HLA typing, cross-matching and antibody screening

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6.10 Recent advances and Other emerging techniques and technologies in hematopathology

7. Transfusion Medicine

7.1 History of Transfusion Medicine

7.2 indications for blood and component transfusion

7.3 Donor registration, donor selection, blood collection from donors, adverse donor reaction, pre donation counselling, Bleeding of the donor, post donation care, post donation counseling

7.4 Blood collection room equipment, their principles, and use, emergency medicines,

7.5 Details of Anticoagulants used to store blood, their mechanism of action and composition, preservation of donated blood, types of blood bag, mechanism of action and composition of blood preservation solution & additive solutions, changes occurring in the stored blood

7.6 Blood components – Indications, preparation of blood components, Selection of blood bags for component preparation, preparation of red Cell concentrate, Fresh Frozen plasma, platelet concentrate, cryoprecipitate, washed red cells, Frozen red cells . Component Testing, Labeling, Transportation and storage of blood components, Metabolic changes in blood components during storage

7.7 Blood groups and genetics, Principles of immune system central to transfusion medicine, Immunology of red blood cells, Different major and minor blood groups and their importance

7.8 Red cell allo- and autoantibody formation and function

7.9 Platelets and leucocytes antigen and antibodies, their importance

7.10 Blood grouping and Compatibility testing – Major, minor, Coomb's cross match, Factors influencing the results of blood grouping

7.11 Coomb's test – application – DCT, ICT, Rh antibody titre

7.12 Gel testing for antibody screening and identification

7.13 Hazards of blood transfusion, Strategies to prevent transfusion reactions

7.14 Pathophysiology, clinical signs and symptoms, and Laboratory Investigation for hemolytic transfusion reactions

7.15 Investigation of ABO, Rh and other immunohaemolytic diseases of the newborn

7.16 Practical aspects in the selection of blood for neonatal exchange transfusion, Hemolytic disease of the new born and exchange transfusion

7.17 Management of Blood Bank Issue Counter, Criteria for acceptance of requisition form, inspection of blood component prior to issue

7.18 Screening of blood units for TTI, ELISA, rapid and other tests for diagnosis of transfusion transmitted infections

7.19 Nucleic acid testing

7.20 Hemapheresis- definition, types of pheresis, machines and techniques

7.21 Basics of Tissue banking & Cord blood banking

7.22 Disposal of wastes and biologically hazardous substance in the blood bank

7.23 Medico legal aspects of blood transfusion

7.24 Quality control of blood grouping reagents, QC of anti-human globulin reagent, bovine albumin, Normal saline

7.25 Quality control in blood banking, Quality control of bags and different blood bank components, sterility test on component

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- 7.26 Calibration, validation and maintenance of blood bank equipment, QC of blood bank techniques, external and internal quality assessment
- 7.27 Hemovigilance in blood banking
- 7.28 Automation in Blood Banking
- 8. Bone marrow Transplant:**
 - 8.1 Donor selection, HLA typing and, screening of Donor
 - 8.2 Conditioning regimens, principles of their use in different disorders and complications
 - 8.3 Harvesting and manipulation of the bone marrow. Bone marrow collection, red cell or plasma reduction, peripheral blood stem cell, mobilization and collection, cryopreservation, Transfusion of marrow. Purgine of marrow – T cell depletion
 - 8.4 Stem cell processing and storage for transplantation
 - 8.5 Classes of MHC, different methods of HLA typing, Procedure of HLA matching for bone marrow transplant
 - 8.6 Procedure of chimerism testing/engraftment analysis after bone marrow transplant
 - 8.7 Transplantation immunology, Histocompatibility, graft versus host disease – diagnosis and management, Immune reconstitution following transplantation
 - 8.8 Management of post transplant patient
- 9. Medical oncology, radiotherapy and Nuclear medicine**
 - 9.1 Principles of management of different solid tumors, other hematological malignancies such as NHL, Hodgkins disease, multiple myeloma
 - 9.2 Basics of high dose chemotherapy and newer modalities of treatment, principles of radiotherapy, the use of various radioisotopes
 - 9.3 Radiotherapy in management of NHL, hodgkins disease, multiple myeloma, CNS prophylaxis in acute leukemias
 - 9.4 Basic knowledge of use of nuclear medicine in diagnosis of both oncologic and non-oncological hematological disorders
- 10. Laboratory Management**
 - 10.1 Fundamental of Total Quality management
 - 10.2 Statistical process in quality control
 - 10.3 Element of quality assurance program
 - 10.4 Concept of Evidence based medical practice.
 - 10.5 Concept of critical values and alert values in laboratory practice
 - 10.6 Laboratory information system
 - 10.7 Concept of reference laboratory
 - 10.8 Implementation of reference system in laboratory medicine
 - 10.9 Standard operating procedure and their preparation
 - 10.10 Errors and identification of the source of error in hematology laboratory
 - 10.11 Internal and External quality control and proficiency testing
 - 10.12 Preparation of quality policy manual
 - 10.13 Laboratory Accreditation, Key component of accreditation, ISO 15189 and others laboratory related accrediting bodies
 - 10.14 Quality control in procedure, equipments, NEQAS, EQAS
 - 10.15 Ethics in medicine
 - 10.16 Health and Safety measures (Physical/Chemical/Biological/Radiation)
 - 10.17 Waste disposal
 - 10.18 Management of under resourced laboratory