

1) Intermediary metabolism and Associated disorders

Carbohydrates: Glycolysis, kreb's cycle, Pentose Phosphate pathway, Glycogen metabolism

Disorders of galactose metabolism, glycogen storage diseases

Lipids: Biosynthesis and degradation of lipids, Ketone bodies, Cholesterol and Lipoproteins

Lipoprotein associated disorders, Atherosclerosis

Nucleic acids: Biosynthesis, degradation and regulation of purines and pyrimidine metabolism

Pathology of Gout, Enzyme disorders of purine metabolism (Lesh-Nyhan syndrome and Orotic aciduria)

Proteins: Amino acids – structure, classification and properties, Hierarchy of protein structure, amino acid metabolism and its regulation

Disorders of plasma proteins, Acute phase proteins, cystic fibrosis, Inborn errors of amino acid metabolism, Protein folding disorders: Amyloids, Prions

2) Enzymes and diagnostic enzymology

Enzymes as catalysts, Mechanism of enzyme action

Enzyme kinetics and its regulatory mechanisms

Enzyme Inhibition – Reversible and Irreversible

Allosteric enzyme and Isoenzymes

Factors affecting enzyme levels in blood

Principle, Assay, and clinical significance of transaminases, creatine kinase, lactate dehydrogenase, phosphatases, isocitrate dehydrogenase, amylase, lipase, choline esterase, glutamate dehydrogenase, and glucose-6-phosphate dehydrogenase

3) Molecular diagnostics

Scope of clinical biochemistry in diagnosis, Collection and preservation of biological fluids (blood, urine & CSF)

Normal values of important constituents of blood, CSF and urine

Requirements of setting up of clinical laboratory

Collection, preparation, preservation, and handling of clinical samples

Quality control, Safety measures in clinical laboratory

Importance of molecular diagnostics in present diagnostic era

Benefits of molecular diagnostics over serological diagnostic tests

Ethical issues related to molecular diagnostics, Basic techniques used in molecular diagnostics

Molecular diagnostics of HIV, SARS-COV-2, Tuberculosis, cholera and pathogenic *E. Coli*

4) Applied molecular biology and biochemical methods

Protein sequencing methods, detection of post-translation modification of proteins
DNA sequencing methods, strategies for genome sequencing
Methods for analysis of gene expression at RNA and protein level, large scale expression analysis such as Dot-blotting and micro array based techniques
RFLP, RFLP in DNA fingerprinting
PCR and types (Reverse transcriptase RT-PCR, Real time/quantitative PCR, inverse PCR, nested PCR, multiplex PCR, anchored PCR and asymmetric PCR), RAPD and AFLP techniques
Blotting techniques (Southern blotting, northern-blotting and western-blotting)
FISH, Flow cytometry
Mass spectroscopy, Cell culture methods
Light, electron, phase contrast and fluorescent microscopy, Freeze fracture techniques

5) Cell signalling and disorders

Signal transduction through cell-surface receptors (GPCR signalling pathway, IP3 pathway, Receptor Tyrosine Kinase pathway, Non receptor TK pathway, Receptor Ser/Thr kinase pathway)
Signal transduction through intracellular receptors, Signal transduction pathways that control gene expression
JAK-STAT and MAPK pathway, Hormone response elements, CRE and CREB
Secondary messengers (cAMP, cGMP, NO, Ca, IP3, DAG)
Disorders of cell surface receptors; Insulin receptor, Growth factor receptors, LDL-receptors, dopamine receptors
Antibodies to receptors: Ab to insulin receptor, TSH receptor, acetylcholine receptor
G-protein defects: inactivated (pseudo hypo-parathyroidism); activated (cholera)
Disorders of Intracellular receptors: androgen receptors, estrogen and progesterone receptors

6) Fluid and electrolyte imbalance

Regulation of water and electrolyte balance; Role of Na^+ and K^+
Hyper-natremia, hypo-natremia; (SIADH), hypo-kalemia, hyper-kalemia.
Acid-Base balance; regulation by kidney and hormones. Acid-base disorders
Diffusion of gases through respiratory membranes, role of transferrin, oxygen, CO , CO_2 in respiration
Chronic respiratory failure, Clinical features and laboratory findings in COPD, Cystic fibrosis, asthma and pneumonia
Tests of kidney function and their Clinical co-relations
Tests of glomerular functions, measurement of GFR
Clearance tests (creatinine and inulin clearance), Plasma creatinine, urea, β_2 -microglobulin.
Glomerulonephritis, acute glomerulonephritis, progressive glomerulonephritis, nephritic syndrome. Nephrotic syndrome, acute renal failure/chronic renal failure, renal calculi

7) Gastrointestinal and Hepatobiliary system disorders

Mechanism of gastric secretion - HCl production, Gastrointestinal hormones

Clinical features and laboratory findings in diseases of the stomach: peptic ulcer, neoplastic disease. Assessment of pancreatic function. Pancreatic enzymes; Secretin and CCK-PZ tests

Assessment of intestinal function; Small bowel malabsorption tests; Xylose, Lactose and other disaccharides). Clinical features and laboratory findings in: Malabsorption, Malabsorption syndromes - gluten intolerance, inflammatory bowel disease, Crohn's disease

Biochemical indices of hepatobiliary disorders, Liver function assessment and Cholangiography

Diseases of hepatobiliary system - acute liver diseases: viral hepatitis, Toxic hepatitis (hepatotoxic drugs), chronic liver diseases – liver cirrhosis

8) Endocrine and cardiovascular system disorders

Diabetes, type I and type II, Gestational diabetes

General characters and classification of hormones; Hypothalamus & pituitary gland; Structure, biosynthesis, secretion, transport metabolism, and function of the hormones secreted by pituitary gland, Hypo and hyper secretions of pituitary hormones

Thyroid gland: Structure, biosynthesis, secretion, transport metabolism, and function. Proteolysis of thyroglobulin and secretion of thyroxine and triiodothyronine, storage and transport of iodine, Regulation of thyroid hormone synthesis. Parathyroid gland: Structure, biosynthesis, secretion, transport metabolism and function of the hormones. Hypo and hyper- thyroidism

Adrenal gland hormones: Adrenal medulla- Epinephrine and nor-epinephrine, their biosynthesis, metabolism of Epinephrine and nor-epinephrine, biological actions of Epinephrine and nor-epinephrine and their regulation. Adrenal cortex- synthesis of adrenal cortical steroids, biological actions and transport of cortical steroids. Mechanism of action of adrenal steroid hormones. Adrenal disorders- Addison's, Cushing's Syndrome

Gonadal hyper and hypo secretions. Infertility, Hirsutism, PCOS, Feto-Placental disorders

9) Nervous and Musculo-skeletal system disorders

Physiology of muscle, Skeletal muscle - Ultrastructure, Molecular mechanism of its contraction; Smooth muscle - Ultra structure, contraction and its control

Joints- Physiology, Types of Joints – fibrous, cartilage and synovial; Synovial fluid and its properties; Pathophysiology and laboratory findings of joint disorders - Osteoarthritis and Rheumatoid Arthritis; Bone metabolism- Biochemical markers of bone turnover. Significance of urinary cyclic AMP, Clinical features and laboratory findings in the disorders like Tetany, Osteoporosis

Structure of nervous system; CNS, peripheral nervous system

Neurotransmitters; Excitatory and Inhibitory neurotransmitters, Pre-synaptic and post-synaptic events of neuromuscular junctions

Disorders of neurotransmission: cholinergic systems (Alzheimer's disease, myasthenia gravis); aminergic systems (Parkinson's disease) Epilepsy, Huntington's disease, Multiple sclerosis, Psychiatric disorders; mood disorders, depressive disorders

10) Lab diagnosis and Automation

Clinical Significance and Principle of various laboratory tests - Lipid Profile (TG, Cholesterol, HDL, and LDL), Blood Glucose (Fasting, Post prandial, and GTT), Kidney Function Test (Urea, Creatinine, Uric Acid), Liver Function Test (AST, ALT, Total protein, Albumin); Thyroid function test (TSH, T3, T4) PTH, Calcitonin, Cortisol, Testosterone, hCG screen (pregnancy test), quantitative hCG, Insulin tolerance test, Bilirubin - total, conjugated (direct), Hepatitis A, B and C serology Cardiac Markers; CK-2 (CKMB), troponins, myoglobin, Creatinine kinase, allergen specific IgE Hemoglobins, Urine analysis (including microscopy)

Automation in Clinical Biochemistry: Types of Automation, Individual steps in the analytical processes, Reagent handling and storage, reagent delivery, Chemical reaction phase, Development of standards for laboratory automation - Urine and Biochemical analyzers, hematology cell counters and Immune analysers

Fundamentals of total quality management, elements of quality assurance program. External quality assessment- Identifying the source of analytical errors

Methods for determining the reference values and presentation of an observed value in relation to reference value