

MD PHYSIOLOGY

General Physiology

Introduction to Physiology
Principles of Homeostasis
Structure of cell membrane, Intercellular communications
Mechanisms of Transport across cell membrane
Body Fluid compartments
Blood volume
Apoptosis and aging

Hematology

Blood - Functions, composition, Properties
Plasma proteins
Red Blood Cells
Morphology, composition, functions, normal RBC count and variations, properties
Haemoglobin – structure, normal content, functions, types, abnormal Hb
Erythropoiesis – sites (intra and extrauterine) different stages,
Factors influencing and regulating Erythropoiesis
Life Span of RBC and its destruction, jaundice
Anaemias – definition, classifications (etiological, morphological), physiological basis of anaemias, investigations
Bone marrow study – Importance, myeloid: erythroid ratio
White Blood Cells:
Classification, morphology, lifespan
Properties and functions
Normal total and differential count, variations
Leucopoiesis
Immunity
Definition, Types – innate and acquired, Humoral and cellular
Mechanisms of immune response, plasma cell, immunoglobins,
Autoimmune disorders, AIDS
Platelets:
Morphology, properties and functions, normal count, variations, thrombopoiesis, and factors influencing this Reticuloendothelial system
Haemostasis
Primary (vasospasm, platelet plug formation) and
Secondary (extrinsic and intrinsic mechanisms of coagulation of blood)

Clot retraction
Anticlotting mechanisms in vivo
Anticoagulants - used in lab and in vivo
Bleeding disorders
Tests for bleeding disorders
Thrombosis and Embolism
Blood groups
ABO and Rh systems, inheritance, differences, Bombay group,
Landsteiner's laws I and II
Other minor blood groups, bombay blood group
Blood grouping and cross matching, concept of universal donor and recipient
ABO and Rh incompatibility
Management and preventive measures, Medicolegal and clinical importance
Blood banking and transfusion
Blood transfusion – indications, precautions and complications
Blood Banking – anticoagulants used, storage, changes during storage
Transfusion of blood components – with special reference to recent advances
Lymph – formation, circulation, functions
Tissue fluid – formation, circulation and functions
Starling's hypothesis – edema formation

Cardiovascular system

Functional anatomy of heart and blood vessels
Properties of cardiac muscle
Conducting system of heart
Parts of conducting system, origin and spread of cardiac impulse,
Abnormal pacemakers, conduction defects
Cardiac cycle:
Definition, phases, events of cardiac cycle
Volume and Pressure changes – in different chambers and major vessels
Heart sounds – causes, character, murmur (definition, physiological basis)
Arterial Pulse - genesis, characters of normal pulse, common abnormalities
Venous blood flow- Venous tone, valves, factors affecting

Correlation between different events of cardiac cycle
Non invasive investigations in cardiology
ECG
Definition, Principles of recording of ECG
Leads
Normal tracings in all leads
In Lead II – normal waves, intervals and segments, how HR is determined, correlation with action potential and phases of cardiac cycle
Clinical uses of ECG
Abnormal ECG pattern in myocardial infarction, cardiac arrhythmias
Effect of changes in ECF K⁺, Ca⁺⁺ and Na⁺
Conduction defects
Cardiac output:
Definition, normal values, variations
Method of measurement
Regulation of cardiac output
Correlation of normal ECG pattern with events of cardiac cycle in a diagram
Haemodynamics
Functional organisation correlated with structure of vascular system
General principles including physical laws governing flow of blood in heart and blood vessels
Pressure – resistance - flow relationship
Laminar flow, turbulent flow, Reynold's number, critical closing volume
Importance of peripheral resistance, venous circulation, venous tone
Regulation of blood flow – local and general
Arterial Blood pressure
Systolic and diastolic pressures– definition, normal values, variations
Define end pressure and lateral pressure, Bernoulli's principle
Pulse pressure, Mean arterial pressure
Determinants of Systolic and diastolic pressures - Measurement
Regulation - neural and humoral (short term, intermediate and long term)

Cardiovascular reflexes

Local regulation including auto regulation of blood flow, vasoconstrictors and vasodilators, substances secreted by endothelium
Effects of gravity, Posture and Exercise on B.P
Hypertension & hypotension
Regional circulations
Circulatory shock
Types, pathophysiology, stages, compensatory mechanisms
Cardio-vascular adjustments in health and disease
Respiratory System
Introduction
Organisation and functional anatomy of respiratory system
Functions of different parts of respiratory system including non-respiratory functions
Mechanics of respiration
Surfactant
Law of laplace – application
Measurement of pulmonary ventilation

Lung volumes and capacities
Ventilation – pulmonary and alveolar
Dead space – Anatomical & Physiological
Pressure – volume relationship
Elastic behaviour of lungs, total and lung compliance
Airway resistance, work of breathing, factors affecting bronchial tone,
Pulmonary blood flow
Volume, pressure, factors influencing, unique features.
Ventilation – perfusion ratio and its importance
Pulmonary gas exchange
Composition of inspired air, alveolar and expired air, partial pressures gas composition of arterial and venous blood
Mechanism of gas exchange
Structure of blood gas barrier, factors affecting diffusion across respiratory
Membrane diffusion capacity
O₂ transport in blood
O₂ dissociation curves
CO₂ transport in blood
CO₂ dissociation curve

Regulation of respiration

Neural control
Chemical control
Interactions between these chemical stimuli
Hypoxia
Definition, types, clinical features, differences
Oxygen therapy
Cyanosis, asphyxia and dyspnoea
Definition, CO poisoning
Periodic breathing
Cheyne – stokes and biots breathing, voluntary hyperventilation
Environmental Physiology
High altitude, rapid ascent, mountain sickness, acclimatization
Effects of UV rays, dysbarism
Effects of increased barometric pressure
Nitrogen narcosis, High pressure nervous syndrome, Oxygen toxicity
Decompression sickness (Caissons disease)
Pulmonary function tests
Artificial respiration
Mouth to mouth, Holger-Neilson method, mechanical methods, ventilators
Gastrointestinal System
Introduction to G.I. Physiology
General organization of G.I. tract
Neural control of G.I function, enteric nervous system
Mechanism of enzyme secretion by glands in general
Salivary glands
Functional anatomy (types and location) with relevant histology
Saliva
Composition, functions, control of secretion

Conditioned and unconditioned reflexes
Disturbances in salivary secretion
Gastric secretion
Functional anatomy of stomach and different gastric glands
Gastric juice: Composition, functions, phases of secretion and regulation
Gastric HCl secretion - mechanism and regulation of secretion
Gastrin – functions and regulation of secretion
Mucosal barrier, pathophysiology of peptic ulcer
Pancreatic secretion -- exocrine Pancreas
Functional anatomy with relevant histology
Pancreatic juice: Composition, function, and regulation of secretion
Applied importance
Liver and gall bladder
Functions of Liver, Functional anatomy with relevant histology
Composition and functions of bile, control of secretion
Functions of gall bladder
Enterohepatic circulation, Jaundice
Small intestine
Functional anatomy with relevant histology
Composition, regulation of secretion, and functions of intestinal juice
Small intestine – Functions
Movements of G.I. tract
Electrophysiology of smooth muscle in the GIT
Peristalsis
Mastication
Deglutition
Gastric motility – types, regulation, abnormal movements (vomiting, diarrhoea)
Gastric emptying – duration, factors affecting
Movements of small intestine
Large intestine
Functions – secretory, motor, absorptive, synthesis of short chain fatty acids
Defecation reflex
Role of dietary fibre, bacterial flora
Renal Physiology
Introduction
Functions of kidney – homeostasis, as an endocrine organ
Functional anatomy of Kidney
Renal circulation
Juxtaglomerular apparatus
Glomerular filtration
Clearance values
Tubular functions
Tubular reabsorption
Water, Sodium, glucose, water, urea, electrolytes - sites, mechanisms involved
Tubular secretion
Filtered load, Tubular maximum, glomerulo tubular feed back, and renal threshold
Acidification of urine
Concentration of urine
Counter current system – multiplier, exchanger
Cortico medullary gradient, Osmotic gradient along renal tubules

Diuresis
Micturition
Functional anatomy of bladder and innervation of bladder,
Filling and emptying of bladder, Cystometrogram
Micturition reflex and its higher control, voluntary control
Abnormalities of micturition
Urine
Normal volume, constituents
Abnormal constituents – albuminuria, glucosuria
Polyuria, Oliguria, Anuria
Dialysis – artificial kidney
Renal function tests
Skin and Temperature regulation
Structure and function of skin
Methods of heat conservation and loss in human body
Regulation of body temperature
Hyperthermia, Fever, Heat stroke, hypothermia, cold injuries (frost bite)
Nerve – Muscle Physiology
Excitable tissue
Definition, properties
Neuron
Structure of a typical neuron, types, properties, functions
Stimulus
Definition, types – threshold, subthreshold, suprathreshold
Nerve fibres
Types, classification, and functions
Resting membrane potential
Nerve action potential
Transmission of nerve impulses
Peripheral nerve injury
Neuromuscular junction
Functional anatomy, transmission of impulses across neuromuscular junction
Neuromuscular blocking drugs
Applied clinical aspects
Muscles
Classification
Skeletal muscle
Structure including molecular details
Action potential
Molecular basis of muscle contraction
Types of muscle contraction
Muscle types – fast and slow
Energy sources and metabolism in muscle at rest and during contraction
Muscular changes during exercise
Length –tension relationship
EMG
Fasciculation, fibrillation
Cardiac muscle
Structure, properties
Action potential

Pacemaker potential
Mechanism of contraction
Length – tension relationship
Smooth muscle
Types, Structure, innervation and neuromuscular junction
Potentials
Mechanism of contraction - Excitation – contraction coupling
Plasticity
Length – tension relationship
Nervous system
Organisation of nervous system
General organisation
Functional anatomy of brain and spinal cord
Brain – lobes, functions, Brodmann's areas
Neuron, neuroglia – functions
Spinal cord – Functional anatomy -
Cross section with location of sensory, motor and autonomic neurons and tracts
Cerebro spinal fluid
Ventricles of brain, Blood-brain barrier- importance
CSF – formation, circulation, composition, functions, Lumbar puncture
Synapse
Types
Functional anatomy of typical chemical synapse and synaptic transmission
Synaptic potentials
Properties of synapses
Synaptic inhibition
Neurotransmitters and neuromodulators
Reflex action
Definition, reflex arc - components
Classification with examples
Sensory receptors
Classification (recent view), types (phasic and tonic), properties - adaptation
Receptor potential, comparison with action potential
Sensations
Classification
Sensory tracts
Organisation of sensory pathways
Tracing of pathways from body and face
Pain Sensation – details
Different types of pain
Modulation of pain - Spinal level, supra spinal level
Visceral pain, referred pain, radiating pain, - clinical correlates
Altered pain sensations
Thalamus
Functional anatomy, nuclei – classification, connections, Functions of thalamus
Thalamic syndrome
Sensory Cortex
Location – primary area, secondary area, association areas
Salient histological features, Sensory homunculus
Lesions

Motor system
Introduction, levels of motor control
Reflex action
Definition, Reflex arc
Classification of reflexes with examples
Stretch reflex, inverse stretch reflex, reciprocal innervation, withdrawal reflex
Motor Cortex
Motor system
Introduction, levels of motor control
Reflex action
Definition, Reflex arc
Classification of reflexes with examples
Stretch reflex, inverse stretch reflex, reciprocal innervation, withdrawal reflex

Motor Cortex
Motor areas
Motor homonculus
Descending tracts
General organisation, Pyramidal and extra pyramidal tracts, their functions
Upper motor neurons and lower motor neurons, their lesions
Effects of lesions at various levels - hemiplegia, paraplegia, monoplegia
Spinal cord injuries
Injuries of spinal cord: complete transection, incomplete transection, hemisection, section of anterior and posterior roots, injury to motor nerve
Basal ganglia
Organisation, Connections, Functions
Disorders
Cerebellum
Functional anatomy, Functional and evolutionary divisions, functions
Deep cerebellar nuclei, connections in relation to functions, functions
Neuronal circuit
Cerebellar lesion
Reticular formation
ARAS, descending reticular system –explain control of muscle tone
Functions
Limbic system
Organisation, connections and functions
EEG and sleep
Define EEG, principle of recording,
Normal waves , Clinical uses (
Vestibular apparatus
Functional anatomy
Connections and Vestibular pathway, Functions
Muscle tone, posture, equilibrium
Basis of maintenance – stretch reflex, higher control,
Postural reflexes – mention with levels of integration (details not required)
Regulation of muscle tone and posture

Hypothalamus

Functional anatomy, Nuclei, connections and functions

Higher functions of the brain

Learning

Memory

Speech

Autonomic nervous system

Organisation and functions

Special Senses

Olfaction

Receptor, pathway, lesions

Taste

Taste buds, receptor, primary taste sensations, pathway, lesions

Vision

Functional anatomy of eye

Chambers of the eye, intraocular fluids,

Lens - characteristics, changes with age, aphakia, cataract

Retina – Histology, Macula lutea, fovea centralis

Basic optics

Optical system of the eye

Refractive media of eye

Concepts of reduced eye, Image formation on retina

Emmetropic eye, Far and near points

Accommodation and accommodation reflex (Near response) –

Errors of refraction, Presbyopia

Contact lenses

Visual receptors (cones and rods)

Structure in detail

Visual pigments, role of vitamin A

Phototransduction

Adaptations of visual receptors - Dark adaptation and light adaptation

Electrophysiology of receptors, receptor potential, lateral inhibition

Electroretinogram

Duplicity theory of vision, photopic and scotopic vision

Muscles of eye

Names, nerve supply and movements of eyeball

Corresponding points, double vision and squint

Colour vision

Primary, secondary and complementary colours

Hue, brightness and saturation

Receptors

Trichromatic and Opponent Process Theories

Colour blobs – location and function

Colour blindness

Afterimages, contrasts

Visual pathway

Mono ocular and binocular vision

Visual signals - Processing in the Retina

Pathway -Important features to be specified at all levels

Effects of lesion at different levels

Macular sparing (recent views)

Visual cortex – all areas and functions
Visual reflexes
Papillary light reflex (direct and indirect) - pathway, lesion)
Accommodation reflex – pathways, lesions
Corneal reflex - pathway
Tests of Vision -Field of vision, Visual acuity, Color vision
Audition
Acoustics – frequency, amplitude of sound, pitch, intensity, and quality of sound
Functional anatomy of the ear
Functions of external, middle and inner ear
Cochlea
Structure, Organ of corti,
Hair cell physiology, Mechano-electrical transduction by hair cells
Endocochlear potential
Discrimination of pitch (travelling wave theory) and intensity of sound
Auditory pathway
Sound localisation, pitch discrimination, masking of sounds
Deafness
Audiometry
Endocrinology
General endocrinology
Names and organisation of Endocrine glands in human body
Hormone – definition, and classification
Mechanism of action of hormones.
Control of secretion of hormones in general – the + ve and –ve feed back
Abnormalities of hormone function
Hormonal assay
Hypothalamus
Functional anatomy, Hormones, their physiological actions
Interrelationship between hypothalamus and pituitary glands –
Infundibulum -hypothalmo –pituitary tract and portal system
Pituitary gland
Functional anatomy, cell types
Hormones of anterior and posterior pituitary
Growth hormone - physiological actions and regulation of secretion, Hyper and
hypofunction
Other hormones to be dealt with the target glands,
Mention intermediate lobe hormones - – pro opiomelanocortin and MSH
Thyroid gland
Hormones- biosynthesis, transport, physiological actions (physiologic,
pharmacologic and pathologic) and regulation of secretion (H-P-T axis)
Thyroid function tests
Hyper and hypofunction in children and adults
Pancreas – endocrine
Functional anatomy, Hormones- physiological actions and regulation of secretion
Hyper and hypofunction
Insulin - receptors and insulin resistance
Glucagon, Somatostatin, Pancreatic polypeptide
Adrenal gland
Adrenal Cortex

Functional anatomy
Hormones of adrenal cortex - glucocorticoids, mineralocorticoids, sex steroids
Biosynthesis, transport, physiological actions and regulation of secretion
Hyper and hypofunction
Adrenal medulla
Hormones (catecholamines) , regulation of secretion, clinical aspects
Calcium homeostasis
Normal calcium metabolism
PTH, calcitonin and vitamin D - target organs and physiological actions
Hypocalcemia and tetany
Other endocrine glands
Kidney, Pineal body, Thymus, White adipose tissue, Heart, endothelium
Local hormones
Sources and physiological actions
Physiology of growth and development
Correlation of actions of different hormones from infancy, childhood, puberty and adulthood
Physiology of Reproduction
Introduction
Sex organs, genetic basis of sex
Sex differentiation and development of Reproductive system
Factors influencing development of genitalia
Aberrant sexual differentiation
Chromosomal developmental
Puberty – normal, precocious and delayed puberty
Male reproductive system
Functional anatomy
Functions of testis – endocrine, Spermatogenesis
Abnormalities of testicular function
Erection, ejaculation, composition of semen, sterility
Female reproductive system
Functional anatomy
Ovary - oogenesis, ovulation, corpus luteum,
Ovarian hormones, Control of ovarian functions by H- P- Gonadal axis
Pituitary gonadotropins (FSH, LH)
Menstrual cycle
Phases, Ovarian, uterine and vaginal changes during menstrual cycle
Hormonal regulation
Abnormalities of ovarian function
Menarche, menopause, Castration before and after puberty
Pregnancy
Fertilisation, implantation, Corpus luteum of pregnancy
Placenta – functions, Placental hormones
Foetoplacental unit
Pregnancy tests
Parturition – physiology of labour
Lactation
Hormones influencing and their actions
Contraception
Temporary and permanent methods in males and females, and their physiological basis