

Objectives: The student shall know the facts, understand the concepts, and be able to deduce the consequences for each of the following:

PAIN

Nociceptor characteristics

Adequate stimuli for pain and stimulus-response mechanisms

Subtypes: "fast" and "slow" pain

Localization acuity for pain

Localization errors: Projection and Referred pain

Pain intensity modulation; opioid peptides and opioid receptors; peripheral and central modulation

Adaptation and sensitization

Pain-induced reflexes utility; mechanisms of chronic pain

AUDITION (HEARING)

Sound parameters, loudness units, masking

Hearing frequency range, audiogram, hearing loss

Sequence for sound wave transmission to the cochlea; role of the external auditory meatus, tympanic membrane, middle ear ossicles, tympanic reflex, Eustachian tube

Normal conduction, air conduction, and bone conduction; classification and diagnosis of deafness

Cochlear structure: basilar membrane, organ of Corti, hair cells, tectorial membrane, fluid compartments, auditory (cochlear) nerve axons

Basilar membrane vibration and traveling waves; inner and outer hair cell function

Mechanism of hair cell stimulation, role of the stria vascularis

Determination of pitch and loudness

Auditory cortex, location and organization

Cochlear efferent nerve innervation and functions

VESTIBULAR SYSTEM

Structures: utricle, saccule, semicircular canals, innervation

Mechanism of hair cell stimulation

Utricle and Saccule: otolith adequate stimuli and function

Semicircular canals: adequate stimuli and function

Nystagmus: define, causes, normal function, abnormal response

Pathophysiology

MOTOR SYSTEMS

Definitions of motor terms

Involuntary motor function: reflexes, pattern generators

Upper and lower motoneurons; flaccid and spastic paralysis

Primary motor cortex: role, location, organization, descending motor pathways, pathophysiology

Premotor cortex and supplementary motor cortex: role and location

Basal ganglia; location

Input and output

Functions; associated movements, unwanted movements

Pathophysiology: hyperkinetic and hypokinetic abnormalities; Huntington's Disease and Parkinson's disease

Cerebellum; location

Input and output

Functions

Pathophysiology

CARDIAC EXCITATION

Ventricular myocardium action and resting potentials

Resting potential

Action potential shape, phases, relation to muscle contraction; refractory period

Ionic basis of the action potential: channels, sequence of activation

Comparison with atrial myocardium and nerve-skeletal muscle action potentials

Nodal action and resting potentials

Resting potential and autorhythmic property

Action potential shape, channels, prepotentials, ionic basis

Excitation conduction: mechanism and conduction velocity; role of the SA and AV nodes;
location and role of the rapid conduction system

Mechanical contraction

Molecular basis and excitation-contraction coupling

Comparison with skeletal muscle

Cardiac activation

Normal sequence of heart activation

Basis of the electrocardiogram (ECG)

ECG waves and identification with cardiac events

CARDIAC CYCLE

Heart as a pump

- Cardiac chambers and anatomical arrangement
- Cardiac valves and valve function; valve defects
- Pumping action of the cardiac chambers; role of the papillary muscles

Cardiac cycle

- Phases of the cardiac cycle: relation to electrical activation and the ECG, pressures in the ventricle & atria & aorta, volume of the ventricles, AV valve and semilunar valve opening and closure, relation to heart sounds
- Comparison of left heart with right heart; systolic and diastolic pressures
- Cycle timing at rest and in exercise

Heart sounds

- Causes of heart sounds
- Normal heart sounds

Cardiac output

- Define terms and typical values for CO, SV, HR, EDV, ESV, Ejection fraction

PERIPHERAL CIRCULATION

Functions of the circulation and its components

- Relation between pressure, flow, resistance, and blood cell velocity; definition of cardiac output

- General determinants of resistance; role of vessel diameter, viscosity (and hematocrit), flow pattern (streamline and turbulent); Poiseuille's Law

- Arteries: functional anatomy; roles; resistance, shape of pressure wave; systolic, diastolic and mean pressures; typical values

Arterioles and related vessels

- Functional anatomy
- Resistance
- Vasomotion
- Control of resistance: nervous (and receptors, response of various organs), metabolic, paracrines, myogenic, temperature

- Venules and Veins: functional anatomy, roles

CAPILLARY EXCHANGE

Capillary functional anatomy and relation to role

Exchange of solutes (dissolved substances) between blood and interstitial fluid

Capillary permeability and selectivity

Composition of interstitial fluid

Water movement

Forces: hydrostatic and osmotic

Hydrostatic pressure distribution

Osmotic pressure: basis, action, values

Starling's law of the capillaries

Role of the lymphatics

Response to reduced capillary hydrostatic pressure

Edema: definition and causes