Physiology
Submitted by Marie Havlová on 12. January 2010 - 0:00

Syllabus of Physiology

Cellular membrane physiology

  Ion distribution in the cell membrane

  Transmembrane transport mechanisms

  Ion membrane channels

  Ion transport in excitatory cells

Mechanisms of membrane transport

  Ion distribution in epithelial cells

  Transport mechanisms in epithelial cells

  Mechanisms of secretion in epithelial cells

Physiology of body fluids

  Definition of water and solutes intake and output

  Body fluid compartments

  Development of body fluid compartments

  Measurement of body fluid compartments

  Regulation of body fluids
    composition
    volume

  Thirst

Renal physiology
Functional morphology of nephron

Renal blood flow
  measurement
  regulation

Glomerular filtration
  functional properties of glomerular membrane
    factors determining transport
  glomerular filtrate
    composition
    volume
  glomerular filtration rate
  measurement of GFR
  filtration fraction

Tubular transport mechanisms
  Proximal tubule
  Distal tubule
    transport of solutes
    transport of urea
    transport of amino acids
    transport of glucose
  measurement of tubular transport mechanisms
  regulation of tubular transport mechanisms

Glomerulotubular balance
Concentration of urine

- function of loop of Henle
- concentration gradient in medulla
- function of the collecting duct
- regulation of concentration and dilution mechanisms
- measurements

Urine

- composition
- diuresis

Kidney and regulation of body fluids

Role of kidney in regulation of acid base status

- tubular mechanism of transport of
  - proton
  - bicarbonate
- buffer mechanisms in urine

Function of urinary bladder

- transport of urine in the urethra
- intrinsic mechanism of regulation of SM in urinary bladder
- neural control of urinary bladder
- mechanism and regulation of micturition
Circulation

Transport function of circulation

Physical basis of blood flow

Function of the heart

Mechanism of heart contraction

isometric, isotonic contraction

series and parallel elasticity

homeometric, heterometric regulation

preload, afterload

pressure volume diagram

volume - velocity curve, dP/dt

Mechanism of heart excitation

action potential in the heart muscle

ion fluxes, channels

sinus potential

ion fluxes

generation of rhythm

spreading of stimulus

relative and absolute refractory period

heart rate

regulation

ECG - origins

measurement
Cardiac output

regulation

measurement

Fick principle
dilution methods
electromagnetic flowmeter

Heart sounds

Heart work

Heart metabolism

utilization of oxygen

factors determining oxygen delivery
coronary blood flow

Peripheral blood vessels

Physical concept of resistance

blood viscosity

resistance ? blood flow ? pressure

concept of closing pressure

compliance of vessels

arteriole

regulation

autoregulation
shear stress of endothelium
nerves
local factors
endothelial cells
local blood flow and metabolic needs

Blood pressure
systolic, diastolic, mean
determining factors
pressure curves
driving, intravascular and transmural pressures
effect of hydrostatic pressure
syphon effect
function of veins
measurement of blood pressure, catheterization

Capillaries
regulation of blood flow through capillaries
transport of solutes
balance between the capillary and interstitium
edema
lymph flow

Regulation of blood pressure (Prof. Herget)
Blood pressure and regional distribution of blood flow

volume of fluid compartments and

blood pressure

cardiac output

concept of Guyton

kidney ? fluid balance ? blood pressure

ANF

renin ? angiotensin ? aldosterone

baroreceptors

blood pressure and vascular morphology

Lung function

Lung ventilation

partial pressure of gas

measurement

gradients of respiratory gases

concept of alveolar ventilation

composition of alveolar air

dead spaces

Bohr equation

Lung volumes

spirometer

measurement of FRC
Mechanism of inspiration and expiration

interpleural pressure

lung compliance

pressure volume diagram

surfactant

concept of measurement

compliance of thorax wall

lung resistance

alveolar pressure

bronchial resistance

mucus secretion

regulation of bronchial smooth muscle

nerves

local factors

larynx

concept of measurement of lung resistance

resistance of thorax

Regional pulmonary resistance and compliance

distribution of inspired gas

measurement

regional lung blood flow

matching the blood flow and ventilation

hypoxic pulmonary vasoconstriction

concept of alveolar dead space and venous admixture
Fehn and Rahn diagram

regional lung distribution of V/Q

effect of gravity

Function of pulmonary capillary

lung diffusion of gases

transfer factor

relation of lung diffusion and V/Q

limitation of diffusion

limitation perfusion

metabolic function of pulmonary capillary

ion and water transport in lungs

Control of breathing

Neural

origin of rhythmicity

regulation of inspiration and expiration

feedback from the lung tissue

feedback from the chest wall

cortical influences

speech

Chemical

carotid and aortic bodies

mechanism of oxygen sensing

effect of hypoxia on lung ventilation

on lung volumes
central chemoreceptors
mechanism of CO2 sensing in central chemoreceptors
interaction of CO2 and O2 in control of breathing
breathing and acid base status
breathing in sleep
breathing in exercise
breathing at high altitude
voluntary apnoe
diving

Reflexes from the lungs
caugh

Pulmonary circulation
blood pressures
measurement
compliance of pulmonary blood vessels
causes of low pulmonary vascular resistance
critical closing pressure of lung vessels
effect of gravity
mechanical interaction of breathing and lung blood flow
regulation of pulmonary vascular resistance

Foetal circulation
reconstruction of circulation after the birth
Heart & lung interactions

Physiology of Blood

Red blood cells

production

formation of haemoglobin

destruction of red blood cells

Neutrophils and macrophages

general characteristics

defensive properties

adhesion, adhesive molecules

fagocytosis

mechanism of activation

production of

ROS

enzymes and cytotoxic factors

physiology of inflammation

Blood groups

0 ? A ? B

Rh

transfusion

Hemostasis and blood coagulation

hemostasis

vasoconstricton
formation of platelet plug

coaugulation

conversion of prothrombin \to thrombin

conversion of fibrinogen \to fibrin

formation of prothrombin activator complex

lysis of blood clot, plasmin

concept of procoagulation and anticoagulation balance

Transport of blood gases

Transport of oxygen

amount of oxygen in blood

function of hemoglobin

saturation, partial pressure

hemoglobin dissociation curve

adult

foetal

factors influencing oxygen dissociation curve

Types of hypoxia

Transport of carbon dioxide

Henderson - Hasselbalch equation

effects of carbonic anhydrase

forms of CO2 transport in the blood

Interaction of O2 and CO2 transport mechanisms
Endocrinology

autocrine, paracrine and endocrine regulations
hormones, types, structure
physiology receptors for hormones

Thyroid gland
hormones
iodine metabolism, trapping
transport of thyroid hormones
metabolism of thyroid hormones
effect of thyroid hormones
ontogenesis
regulation of thyroid secretion

Pancreas
insulin, secretion, metabolism
blood transport
receptors
effects
regulation
glucagon
effects
regulation

Endocrine regulation of carbohydrate metabolism

Adrenal gland
medulla

structure and metabolism of hormones
regulation of secretion
cortex

structure and metabolism of hormones
transport

ACTH
effects of glucocorticoids
role in inflammation
effects of mineralocorticoids
adrenalectomy
concept of stress

Regulation of calcium metabolism

metabolism of Ca and P
physiology of bone
calcitonin
parathormon
regulation of secretion
Vitamin D

Pituitary gland (hypophysis)

overview of pituitary hormones
hormones of the middle lobe

STH
structure, metabolism, regulation
receptors
somatomedins
physiology of growth

Gonads
ontogenetic development
puberty
hypophysial gonadotropins

System renin-angiotensin
erythropoetin
ANP
epiphysis

Physiology of sexual activity
function of male sexual organs
regulation
function of female sexual organs
regulation
menstruation
central regulation of sexual behaviour
physiology of coitus
contraception

Physiology of energy metabolism and nutrition
energy metabolism
measurement, RQ
energetic balance
physiology of nutrition
vitamins
minerals

Physiology of gastrointestinal tract
Mechanisms of digestion
Regulation of gastrointestinal tract
gastrointestinal hormones
mechanism of swallowing
function of the stomach
secretion of pepsin
secretion of HCl
motility
regulation of secretion and motility
exocrine secretion of pancreas

csmall intestine
secretion
regulation of secretion
types of motility
regulation of motility
large intestine
resorption mechanisms
regulation of motility

defecation

physiology of intestinal immunologic mechanisms

Metabolic function of liver

Bile function and secretion

Metabolism and excretion of bilirubin

Function and regulation of gallbladder

Neurophysiology

Introduction to neurophysiology.

Review of anatomical and histological principles of neurophysiology.

General neurophysiology

The neuron and the glial cell; the blood?brain barrier

Metabolism and nutrition of the neural tissue

Types of neurons (Golgi I and II) and neural circuits

Basic functions of synapses

Review of neurotransmitters and neuromodulators

Ionotropic and metabotropic mechanisms of synaptic transmission

G protein and second messengers

Electrophysiology of the neuron

The resting membrane potential: Ionic and electric gradients

Action potentials: Properties of excitable membranes

The absolute and relative refractory periods

Myelinated nerves ? saltatory conduction

Postsynaptic potentials, excitation and inhibition
Generator potentials in receptors

Accommodation of the nerve fibre and adaptation of the receptor

Recording and stimulation of neural cells

Electrical properties of a volume conductor, extracellular recording and stimulation.

EEG, event related potentials, chronaxy, the Pflüger's law.

Reflex and non-reflex activity

Learning and memory

Systemic neurophysiology

General design of the nervous system

The peripheral nervous system

Organization of the central nervous system

Principles of development of the central nervous system

Functions of the spinal cord

Physiology of the brain stem: the medulla, the pons, the mesencephalon

Functions of the thalamus and physiology of pain

Hypothalamus and the autonomic nervous system

Motor functions: The cerebral cortex, the basal ganglia and the cerebellum. Pyramidal and extrapyramidal systems.

The cerebral cortex and intellectual brain functions

Sleep and wakefulness, modulatory systems of the brain.

Motivation and emotions.

Neurophysiology of vision and hearing.

The chemical senses of taste and hearing