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

carrotil 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
cough

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
Hemostasis and blood coagulation

hemostasis

vasoconstriction

formation of platelet plug

coagulation

conversion of prothrombin - thrombin

conversion of fibrinogen - 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

erthropoetin

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

small 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

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