Endocrine system

- system of glands and groups of cells
- maintenance of homeostasis
- slower and more diffuse response than nervous system

• Hormeo = to stir up, influence
Endocrine glands

- no ducts, richly supplied by blood vessels
- pour (secret) their secretions (hormones) directly into blood stream

- thyroid gland
- parathyroid gland
- adrenal (suprarenal) gland
- islets of Langerhans of pancreas
- pineal gland (epiphysis)
- hypophysis (pituitary gland)
- ovary, testis

gastroenteroendocrine cells, kidney cells, thymus, placenta, heart, adipous tissue, brain...
Hypothalamo-hypophyseal system

Hypophysis (pineal gland)

anterior lobe, adenohypophysis:

posterior lobe, neurohypophysis:

TSH, LH, FSH, GH, prolactin,
ACTH (MSH, LPH)

vasopresin (ADH), oxytocin

Neurosecretory cells

Median eminence

Nerve fibres transporting vasopressin and oxytocin

Hypothalamic releasing and inhibitory factors secreted at nerve endings

Portal vessels transporting
ACTH
MSH
TSH
FSH
LH
GH

Prolactin inhibitory factor

ANTEROIOR PITUITARY

POSTERIOR PITUITARY

OXYTOCIN

VASOPRESSIN

ACTH
MSH
TSH
FSH
LH
GH
PROLACTIN
Hormonal excess
- primary gland overproduction
- secondary to excess production of trophic (releasing, stimulating) substance (hormone)

Hormonal deficiency
- primary gland failure
- secondary to lack of stimulation by trophic (releasing, stimulating) substance (hormone)
- target organ resistance
**Thyroid gland** – štítná žláza

**H shape** (2 lobes, narrow isthmus)
- isthmus – level of 2-4 tracheal ring
- pyramidal lobe
- surrounded by sheath derived from pretracheal
- pear shaped lobes, 5-8 cm
- 30-40 g (20-60g)

- **Relations of the gland**
  - posterolat.: infrahyoid mm., CCA, IJV, CN X.
  - posteromed.: larynx, trachea, pharynx, esophagus
  - caud.: manubrium sterni (rarely)
Relations of the gland
posterolat.: infrahyoid mm., CCA, IJV, CN X.
posteromed.: larynx, trachea, pharynx, esophagus
ant.: infrahyoid mm.
Blood supply of thyroid

Arteries
• superior thyroid a. (from external carotid a.)
• inferior thyroid a. (from subclavian a.)
• thyroidea ima
Veins

- superior et middle thyroid vv. (→ IJV)
- inferior thyroid vv. (impaired thyroid plexus) (→ brachiocephalic vv).
• thyroid follicle (*follicular cells*)
• cavity of the thyroid follicle, filled with colloid
• blood vessel
• parafollicular cells
follicular cells

- trijodthyronine T3, tetrajodthyronine T4 (thyroxine)
- thyroglobulin in follicles (storage protein)
- thyroxine –binding globulin (TBG) in plasma (carrier protein)
- under control of TSH
- increases basal metabolic rate (heat generation….)
- essential to proper development and differentiation of all cells of the human body incl. neurons (- cretinism)

Cretinism is a condition of severely stunted physical and mental growth due to untreated congenital deficiency of thyroid hormones or from prolonged nutritional deficiency of iodine (Endemic cretinism was especially common in areas of southern Europe around the Alps from Roman times till 20th cent. )
parafollicular cells (C – cells)

• Calcitonin
• reduces blood calcium (Ca\textsuperscript{2+}) (opposing the effects of parathyroid hormone - PTH).
  - Inhibits Ca\textsuperscript{2+} absorption by the intestines
  - Inhibits osteoclast activity in bones
  - Inhibits Ca\textsuperscript{2+} reabsorption by the kidney tubules
• Hypothyroidism x Hyperthyroidism

• Goitre
• Cretinism
Parathyroid gland - příštitná tělíska

- usually **2 pairs** of small glands located on the posterior surface (back side) of thyroid gland (4x2 mm)
- superior et inferior parathyroid gland
  
  - At close relationship to laryngeus recurrens and inferior thyroid a.
• **Parathormone (PTH)**
  • increases blood calcium (Ca²⁺) (opposing the effects of calcitonin).

- increases Ca²⁺ absorption by the intestines
- stimulates osteoclast activity in bones
- increases Ca²⁺ reabsorption by the kidney tubules

**Hypoparathyroidism**

**Hyperparathyroididm**
th.gland
parath.gland
reccurent laryngeal n.
Th. gland
Parath. gland
inferior th. a.
recurrrent laryngeal n.
Alfred Kohn (1867–1959)
head of the Institute of Histology at the Medical Faculty of German University in Prague for 26 years.
twice the dean of German Medical Faculty in Prague

1880 – I. V. Sandström – described gl. parathyroidea

1895 – A. Kohn – demonstrated its independent function and independent developmental origin (1898)
Adrenal (suprarenal) glands - nadledviny
Adrenal (suprarenal) glands

- level Th 11-12, 6-12g
- Medulla – catecholamine hormones (adrenaline, noradrenaline), dopamine
- Cortex – 3 zones – 3 distinct groups of hormones
  - Zona glomerulosa - mineralocorticoids (aldosterone) – Na/K homeostasis (secretion of K, conservation of Na – increased water retention and blood pressure; renin-angiotensin system)
  - Zona fasciculata – glucocorticoids (cortisol) - counteracts insulin, weakens immunity, lowers bone formation…
  - Zona reticularis – androgens (dehydroepiandrosteron-DHEA) – prohormone of sex steroids
Hypercortisolism x Hypocorticolism
Paraganglia

– pea sized bodies (several mm to 1-2cm) – at close relationship to vessels (aorta), autonomous nerves and symp. ggl.

- tissue similar to adrenal gland medulla – catecholamines (affecting circulation)

paraganglion aorticum abdominale paraganglion (glomus) caroticum
Inappropriate activation of the stress response in modern humans (when physical action is inappropriate and/or unnecessary) can cause negative effects.
Blood supply of adrenal gland

**Arteries:**
- 1. superior suprarenal a. (from inf. phrenic a.)
- 2. middle suprarenal a. (from aorta abdominalis)
- 3. inferior suprarenal a. (from renal a.)

**Veins:**
- coming from hilus (central v.), then as suprarenal v. opens into:
  - R side – IVC
  - L side – renal v.
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