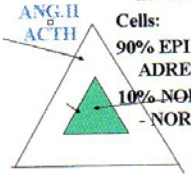
Adrenal gland

SUPRARENAL GLAND

- ADRENAL CORTEX essential for life - steroids
- Zona glomerulosa
  Mineralocortikois
  ALDOSTERONE
- Z. fasciculata
  Glucocorticoids
  CORTISOL
- Z. reticularis
  Androgens
  DEHYDROEPIANDROSTERONE

ANG.II
ACTH



- ADRENAL MEDULLA not essential

Cells:
90% EPINEPHRINE - ADRENALIN
10% NOREPINEPHRINE - NORADRENALIN

„sympathetic ggl"
SPLANCHNIC NN

BIOSYNTHESIS OF STEROIDS

- **Liver and steroid glands – cholesterol from acetate (C27)**
- **Progesteron C21**

Adrenal cortex	Androgens	Estrogens
C21	C19	C18
Hydroxilation of C	TESTOSTERONE	ESTRADIOL
17,21,11 CORTISOL		
21,11 ALDOSTERONE		

TRANSPORT OF GLUCOCORTICOIDS

- **Bound to proteins <=> free**

dynamic balance

Specific binding protein - α globulin „Transcortine"
= corticosteroids binding globulin CBG (changes of its conformation near inflammation release cortisol)

no excess or deficiency

CBG ↑ pregnancy ↓cirrhosis
↓free ↑free
↑ACTH ↓ACTH
(pigmentation)

+ estrogens

Metabolisation in liver ketosteroids tetrahydrocortisole, cortisone **conjugation - glucuronids, sulfates**

Excretion - urine and bile **(15%)**

EFFECT ON INTERMEDIAL METABOLISMS

- DIRECT

↑ GLYCEMIA

DIABETOGENES = ANTI-INSULIN (steroid diabetes)

Provides glukose for  and brain
from  gluconeogenesis

- lipolysis (↑ lipemia and cetosis)
- protein breakdown in periphery (neg N balance), but proteosynthesis in liver (angiotensinogen), formatio of erythrocytes, thrombocytes, neutrophil granulocytes

ANTIINFLAMMATORY EFFECT

IMMFLAMATION – response to noxa

- VASCULAR REACTIVITY
  ↑responsiveness to catecholamins (↑BP)
  ↓release of histamine (↓permeability)
- BLOOD CELLS
  ↓eosinofils, T lymfocytes, monocytes, basophil granulocytes
- ↓FIBROBLATIC ACTIVITY
  ↓scars, keloid, adhesis
- INHIBITION OF SYNTHESIS AND RELEASE OF prostaglandins, tromboxan, IL1(pyrogen)

red
BP decrease
swelling
Response to microb.
walling
↑ temperature

DANGER DURING THERAPY BY GLUCOCORTICOIDS, NEGATIVE EFFECTS

- ↑RISK OF INFECTION (TBC)
- Feedback - ↓ACTH → relative insufficiency when therapy is stopped
- Weekened protection of gastric mucose - danger of peptic ulcer
- PERMISIVE for catecholamins
- MINERALOCORTICOID EFFECT in high doses

CUSHING´S SYNDROME

- ↑ plasma GLUCOCORTICOIDS
- Caused by **exogenous administration; prim – sec – tercial... adrenal hyperplasia or tumor ...immunoglobulins; hypersecretion of ACTH, CRH**
- Symptoms: Gluconeogenesis –**hyperglycemia, insulin-resistent diabetes, hyperlipemia;** protein depleted **(thin skin, muscles, wounds heal poorly);** fat redistribution **(thin extremities, abdominal wall + striae – rupture of the subdermal tissue, moon face);** mineralocorticod action **(K depletion, weakness);** osteoporosis; gastric ulcus **↑ HCl + ↓mucus cescretion**

ADDISON´S DISEASE

- ADRENOCORTICAL INSUFICIENCY
- Cause – autoimmune, TBC,..
- Total insuficiency – rapidly fatal
- Incomplete - pigmentation (↑ACTH), hypotension – loss of Na(↓aldosteron), hypoglycemia (↓glucocorticoids), stress leads to a collaps (addisonian crisis)

CONN´S SYNDROME

- HYPERALDOSTERINISM
- K depletion, Na retention

HYPERTENSION + HYPERVOLEMIE

polyuria, weakness, tetany

CORTICAL ANDROGENS

- DEHYDROEPIANDROSTERON
- SECRETION IN MAN = WOMEN (20% activity of testosteron), physiol - protein anabolism, masculinising effect when secreated in excess - Precoucious pseudopuberty in boys, pseudohermafroditism in female,
- adrenogenital syndrome

↓cortisol→↑ACTH (pigmentation) →↑androgens therapy glucocorticoides

Adrenal medulla

„= sympathetic gangl. – nn. lost axons“

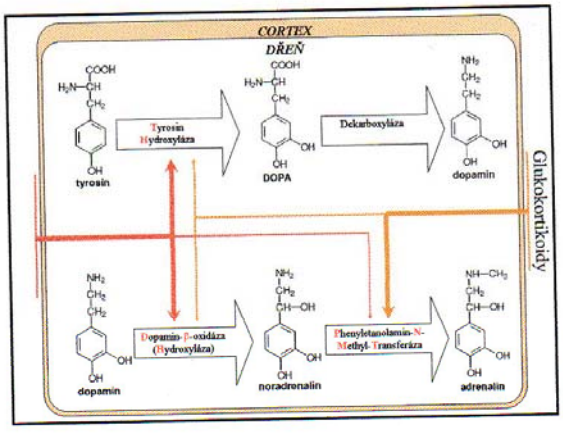
1. 90% cells - epinefrin (adrenalin)
2. 10% cells - norepinefrin (noradrenalin)
3. (dopamin?, transmitter in CNS, peptides – NPY, enkefalin)

Paraganglia

Groups of cells near thoracic and abdominal sympathetic ganglia

Adrenalectomy – plasma level of A: 0 (it later occur), NA: unchanged

Adrenal medullar hormones are not essential for life



Two classes of ADRENERGIC RECEPTORS

α Affinity - NA, blocker fentolamin
α1 IP3→ release of Ca++ from SR
vasoconstriction, glycogenolysis, contraction of m. –
dil pupillae, uterus, bronchioli, sphincters of digestive s, urinary bl
α2 ↓ cAMP → opening of K+ channel (hyperpolarisation).
Closing of voltage gated Ca2+ channel
praesynaptic membrane of sy nn., aggregation of trombocytes

β Affinity - A, Isoproterenol resp., blocker propranolol
β1 cAMP → phosphorylation of Ca++ channel →
influx of Ca++... + inotropic, + chronotropic,
lipolytic effect, secretion of insulin
β2 cAMP → activation of SR →uptake of Ca++
relaxation of bronchi, vasodilation (skeletal muscles),
uterus during pregnancy
β3 in brown fat↑ production of heat

Relationship between secretion of A and NA

Different species:
cats – NA predominates
dogs – A predominates
Human – relationship is regulated by sympathetic stimulation - NA
glucocorticoids ... A (methylation of NA)

STRESS is an answer of organism to physical and mental load (1936 – Selye), activation of sympatho-adrenal system (emergency function – „fight-or-flight" responses)

- ↑ ACTH (hypothalamus)
- ↑ glucocorticoids (adrenal cortex)
- ↑ adrenalin (adrenal medulla)
- ↑ noradrenalin (adrenal medulla, sympathetic n.)

Effect on system:
- cardiovascular
- energy producing
- immune

Stimuli activating sympathoadrenal system - cold, heat, hemorrhage, hypoxia, hypoglycemia, infectious d.)

Plasma level of NA (sympathetic activity), A (medullary secretion)

Orthostasis - ↑ NA
- ↑ A – the individual does not know what to expect
- ↑ NA – stresses with which the individual is familiar
- Beta blockers ↓ tachycardia, tremor

Pheochromocytoma

Adrenal medullary tumor (chromafin cells)

Episodic or sustained hypertension
Tachycardia
Hypermetabolism
Hyperglycemia, glycosuria
Redden, sweating