Adenohypophysis
Adenohypophyseal hormones

- adenohypophyseal hormones and their targets:
  - GH (STH), PRL – growth, lactation
  - FSH, LH (ICSH) – gonads
  - ACTH – cortex of the adrenal gland
  - TSH – thyroid gland
- hormones are produced in dedicated cells, but some cells produce both FSH and LH
- production and secretion of these trophormones are regulated by small neurosecretory neurons in the ventral hypothalamus through the portal circulation of the hypophysis – axons terminate in the eminentia mediana
- window on the blood-brain-barrier factors emptied by neurosecretion enter the capillaries – they are released in the adenohypophysis through the wall of sinusoid capillaries
- releasing and inhibiting hormones/factors exist
- these hormones are mainly peptides, but dopamine serves as PIF
- release is pulsating to ensure receptor sensitivity (internalization) – frequency and amplitude modulation

Descending effects

- light
- SCN
- limbic system
- sensory systems
- pain
- feeding
- psychic factors
- hypophyseotrop cells
- PIF
- SRIF
- PRL
- GHRH
- hGH
- GnRH
- ACTH
- FSH+LH
- TRH
- CRH
- TSH
Negative feedback

ACTH

- Corticotrope cells produce proopiomelanocortin (POMC) - this peptide is cleaved to give ACTH (39 amino acids) and β-LPH (91 amino acids)
- In other cells, MSH and endorphin is cleaved from POMC
- ACTH increases glucocorticoid (cortisol) and androgen hormone production in the adrenal gland
- The most important regulator of ACTH is CRH - cortisol decreases CRH sensitivity and POMC transcription
- ACTH and cortisol peak around awakening, then decreases
- Stress strongly increases ACTH secretion
Glycoprotein hormones I.

- TSH, FSH and LH are glycoproteins built up of the same α- (92 amino acids), and a unique β-subunit
- The placenta produces during pregnancy a similar glycoprotein hormone with LH effect: chorionic gonadotropin (hCG)
- TSH (110 amino acids)
  - Production is regulated by the TRH tripeptide (transcription + secretion) - in most mammals cold environment induces TRH secretion
  - Thyroid hormones (T<sub>3</sub>/T<sub>4</sub>) effect TRH secretion, TRH sensitivity of TSH cells and TSH transcription
  - TSH production is pulsating and shows daily rhythm: low in the morning, increases during the day, high during the night

Glycoprotein hormones II.

- FSH (115 amino acids) - stimulates production of germ cells
- LH (115 amino acids) - stimulates hormone production
- FSH and LH production is increased by GnRH (LHRH)
  - Pulsated secretion - short, high amplitude pulses
  - In men gonadal hormones inhibit GnRH, inhibin produced by Sertoli-cells inhibits FSH secretion
  - In females complicated cyclic functioning, ovarian hormones can stimulate or inhibit depending on concentration
  - Large changes in the functioning of the system from birth to adulthood
  - In adults, pulsated secretion of GnRH with a period of 90-minute during the whole day
PRL/GH family

- similar sequence, similar receptors
- PRL (199 amino acids)
  - many cells have receptors; only known effects are preparation of breasts for lactation and stimulation of milk production
  - PRL production does not depend on releasing hormones
    - it is under continuous inhibition (PIF = dopamine)
  - pulsating secretion, minimum at noon, maximum in the second half of the night
  - inhibits GnRH production - breast feeding as natural contraception - do not trust it!
- GH or STH (191 amino acids)
  - half of adenohypophyseal cells are somatotropes
  - GHRH stimulates both transcription and secretion, somatostatin only inhibits secretion
  - pulsating secretion, during SWS strong increase, even during a nap, both negative (somatostatin or SRIF) and positive (GHRH) regulation
  - GHRH and SRIF secretion change in opposite ways

Effects of GH

- GH receptor is a glycoprotein with one transmembrane region
- partly direct effect, partly through IGF I (insulin-like growth factor I) produced by various tissues
- secretion is stimulated by hypoglycemia and high amino acid (arginine) levels
- GH inhibits insulin effects and stimulates effects of hormones acting through cAMP – thus it increases lipolysis
- increases longitudinal growth of bones acting on the epiphysis; stimulates growth in other tissues as well
- its effect depends on T3/T4-re and insulin
- during puberty, androgens (from the adrenal gland, in boys also from the testis) also stimulate growth, but close epiphysis as well
- GH deficiency: dwarfism – proportional
- GH overproduction: gigantism, or acromegaly
Portal circulation of hypophysis

Eckert: Animal Physiology, W.H. Freeman and Co., N.Y., 2000, Fig. 9-5.