Adenohypophysis

Endocrine regulation

- there are many hormones that are under direct homeostatic regulation:
  - ADH, aldosterone, ANP
  - insulin, glucagon
  - secretin, gastrin, CCK, GIP
  - erythropoietin
- others are regulated by the hypothalamo-hypophyseal system
- hypophysis is located on the base of the brain below the hypothalamus – connection is provided by the stalk of the hypophysis
- the anterior part (adenohypophysis) ectodermal, the posterior (neurohypophysis) neuroectodermal by origin
- adenohypophysis is divided into pars tuberalis, distalis and intermedia; the latter was called intermediate lobe earlier; rudimentary in humans

Adenohypophyseal hormones

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- 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 emptyied 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

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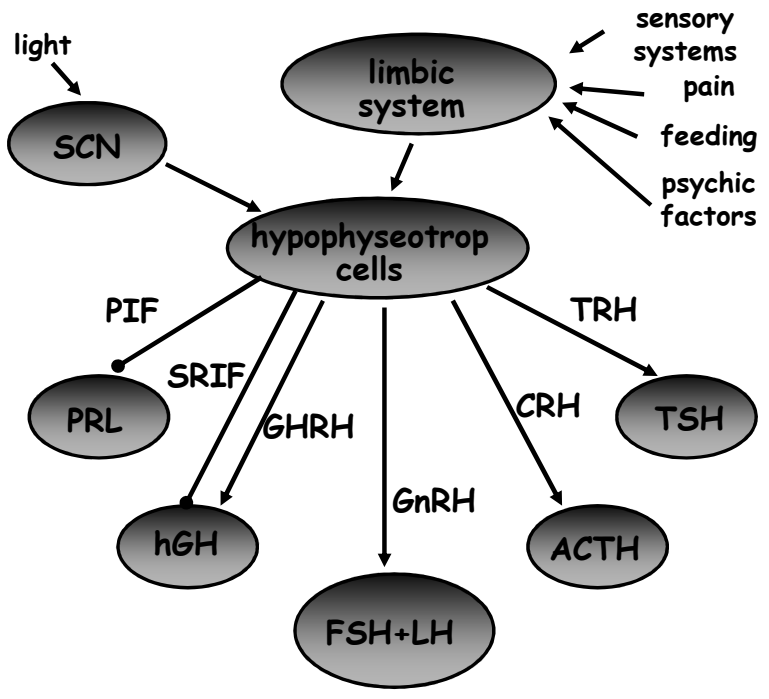

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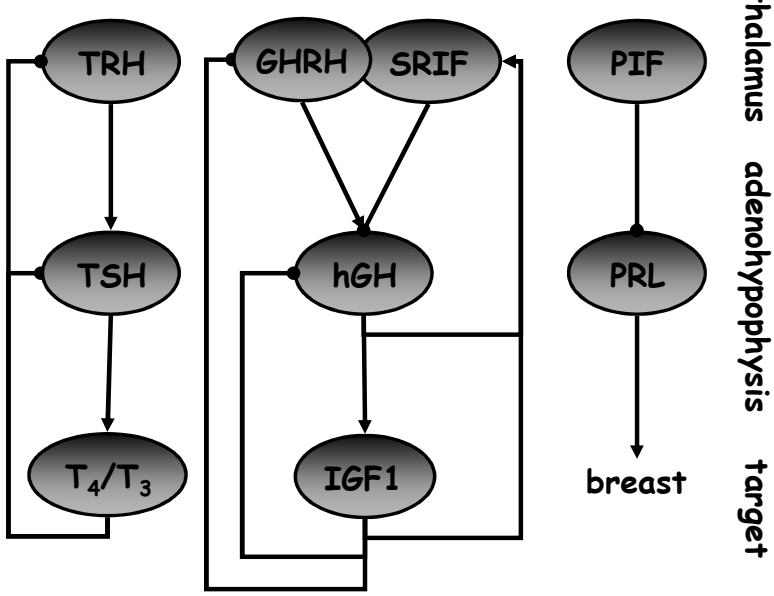
Negative feedback



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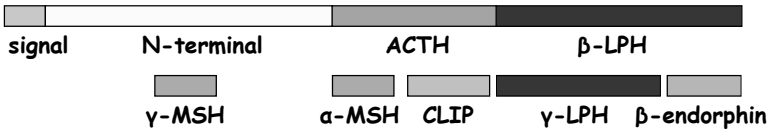
ACTH

- corticotrope cells produce proopiomelanocortin (POMC) – this peptid 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.

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- 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_3/T_4) 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.

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- 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

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- 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 soamtotropes
  - 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

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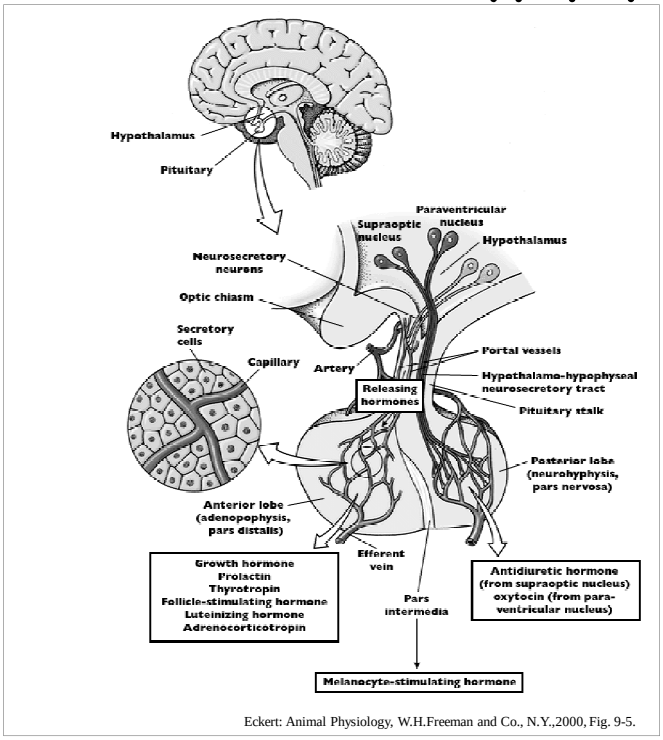
- GH receptor is a glycoprotein with one transmembrane region
- partly direct effect, partly through IGF I (insulin-like growth factor I) produced by various tissues
- secretion is stimulated by hypoglycemia and high amino acid (arginine) levels
- GH inhibits insulin effects and stimulates effects of 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 T_3/T_4-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.