

The hypothalamo-pituitary axes

describe and illustrate the structural connections between the hypothalamus, anterior and posterior lobes of the pituitary gland

list the hormonal products secreted from the posterior pituitary gland

list the major cell types present in the anterior pituitary gland and the protein hormones produced in and secreted from each of these cell types

explain how the synthesis and secretion of anterior pituitary hormones is controlled by specific hypothalamic releasing hormones and inhibitory factors

outline the negative feedback loops within the hypothalamo-pituitary axes that control the thyroid gland, gonads, adrenal glands and growth
explain the unique control of prolactin secretion

describe the role for neural reflexes in the control of oxytocin secretion

The Hypothalamo-Pituitary Axis: Structural Connections

The hypothalamus is connected to the pituitary gland by the pituitary stalk, located at the brain's base, protected by the sphenoid bone.

Posterior Pituitary (Neurohypophysis):

- Hormones (e.g., oxytocin, vasopressin) are synthesized in hypothalamic neurons (paraventricular nucleus, PVN, and supraoptic nucleus, SON).
- Transported via axons to the posterior pituitary for secretion.

Anterior Pituitary (Adenohypophysis):

- Linked to the hypothalamus via the hypophyseal portal system, allowing hypothalamic hormones to regulate anterior pituitary functions.

Posterior pituitary hormones

Posterior pituitary releases ADH (vasopressin/AVP) and oxytocin (OT)

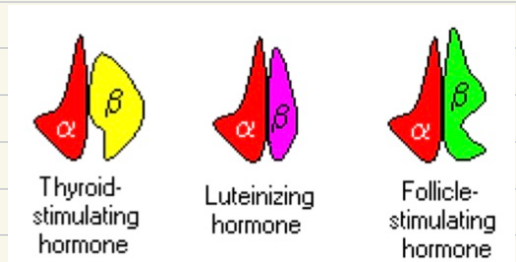
- Hormones synthesised in cell bodies of magnocellular neurones (PVN & SON) (in the hypothalamic neurones)
- Transported from hypothalamus to posterior pituitary through axon

Anterior Pituitary Cell Types and Secreted Hormones

- **Thyrotrophs:** Secrete **TSH** (Thyroid-Stimulating Hormone) → Stimulates thyroid hormone production
- **Gonadotrophs:** Secrete **LH and FSH** (Luteinising and Follicle-Stimulating Hormones) → Regulate gonadal function
- **Corticotrophs:** Secrete **ACTH** (Adrenocorticotrophic Hormone) → Stimulates adrenal cortex to produce corticosteroids
- **Somatotrophs:** Secrete **GH** (Growth Hormone) → Stimulates growth via IGF-1
- **Lactotrophs:** Secrete **prolactin** → Stimulates lactation

TSH, LH & FSH:

- Heterodimeric glycoproteins
- Common α -subunit
- Specific β -subunits (TSH β , LH β & FSH β)



GH & PRL:

- 190aa peptides - internal di-S bonds
- homologous receptors
- Must be IV injected as broken down in stomach

Control of anterior pituitary

Hormones need to be stimulated/inhibited

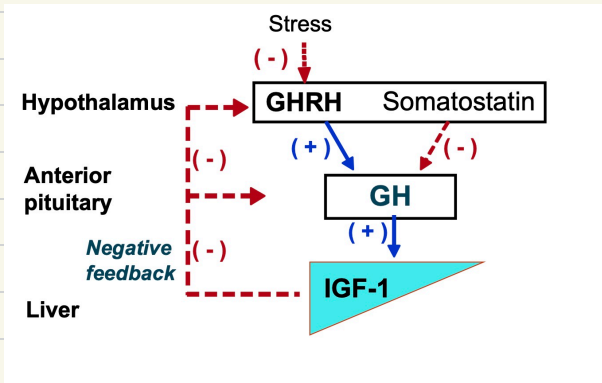
- TRH (3aa) - stimulates thyrotrophin (TSH)
- GnRH (10aa) - stimulates gonadotrophins (LH & FSH)
- CRH (41aa) - stimulates corticotrophin (ACTH)
- GHRH (44aa) - stimulates GH

Dual control of GH secretion

Negative feedback model:

- Make hormone, release it, stimulate factor to prevent overproduction

Most GH released at night in 3hr pulses



Prolactin exception

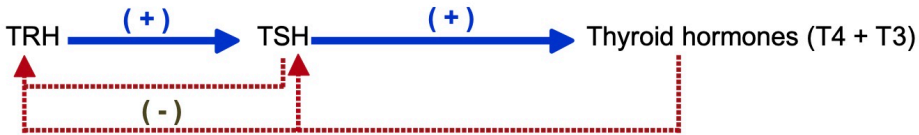
Prolactin appears to be under dominant negative control by dopamine (from arcuate nucleus)

—> (as prolactin is usually turned off except for specific circumstances e.g. lactation)

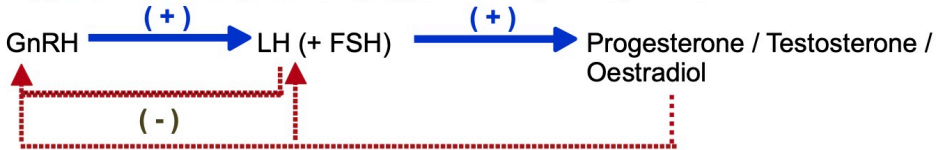
—> so stimulus = less inhibition

Negative feedback loops

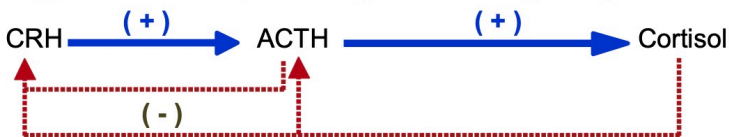
Hypothalamo-pituitary-thyroid (HPT) axis



Hypothalamo-pituitary-gonadal (HPG) axis



Hypothalamo-pituitary-adrenal (HPA) axis

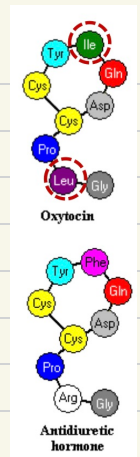


Higher centres of brain can override hypothalamic-pituitary drive to endocrine axes
e.g. chronic stress:

- overrides negative feedback on CRH and ACTH - hyperactivity in adrenal axis
- Loss of GnRH and GHRH

Oxytocin and positive feedback

Oxytocin (9aa) - similar structure to ADH. Both hormones produced in hypothalamic neurones and packaged into granules and secreted along with carrier proteins (neurophysins)

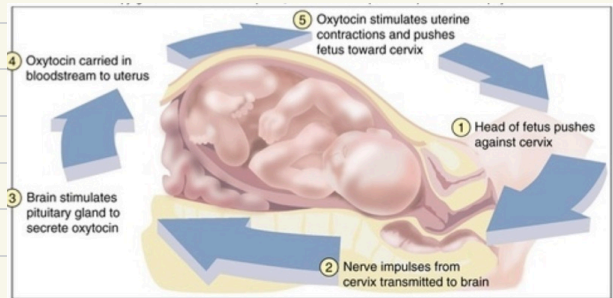


Suckling Reflex:

- Nursing triggers a spinal reflex arc, stimulating oxytocin release.
- Oxytocin causes milk ejection by contracting myoepithelial cells in the mammary glands.

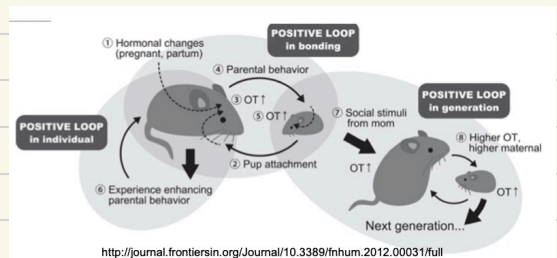
Fergusson Reflex:

- Cervical and vaginal stimulation during labor increases oxytocin secretion.
- Oxytocin enhances uterine contractions, forming a feedback loop to aid delivery.



Maternal Behavior:

- Elevated oxytocin in the brain during birth promotes maternal bonding and caregiving.



Positive Feedback:

- Oxytocin secretion amplifies until the stimulus (e.g., suckling or labor) ends, ensuring effective physiological responses.