Hormon Hipotalamus dan Hipofisis

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**Tropic vs Nontropic Hormones**

**Tropic hormones** - stimulate the production and secretion of hormones by other endocrine glands; ex. TSH

**Nontropic hormones** - stimulates cellular growth, metabolism, or other functions; ex. thyroxine
Pineal Gland

Produces **melatonin** (synthesized from serotonin, a derivative of tryptophan)

- Secreted directly in CSF to blood
- High levels at night make us sleepy; low level during day
- Pineal gland is stimulated by darkness and inhibited by light
- Function in regulating circadian rhythms (sleep, body temp, appetite) → biological clock
• FEED BACK MECHANISM

* the characteristic of the endocrine system
* homeostatic feedback mechanism
→ determine the synthesis rate of hormone
* did not work on all hormones
**Feedback Mechanism**

![Diagram showing the feedback mechanism involving TRH, TSH, and thyroid gland.]

- TRH travels to the hypothalamus via the hypothalamic-hypophyseal portal circulation.
- TSH travels to the specific cells in the anterior pituitary to stimulate synthesis and secretion of trophic hormones.

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**Hypothalamic releasing factors for anterior pituitary hormones**

- Travel to adenohypophysis via hypothalamic-portal circulation
- Travel to specific cells in anterior pituitary to stimulate synthesis and secretion of trophic hormones
Hypothalamic releasing hormones

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Characteristics of hypothalamic releasing hormones

- Secretion in pulses
- Act on specific membrane receptors
- Transduce signals via second messengers
- Stimulate release of stored pituitary hormones
- Stimulate synthesis of pituitary hormones
- Stimulates hyperplasia and hypertrophy of target cells
- Regulates its own receptor
Hypothalamus and anterior pituitary

Hypothalamus-pituitary axis

- Hypothalamus
- Hormone 1
- Anterior Pituitary
- Hormone 2
- Peripheral Endocrine Gland
- Hormone 3
- Effector Cells
Hipofisis

1. **The “master gland”**— controls three other endocrine glands

2. **Better to think of the pituitary gland as the relay center**—

3. **Its function covers both endocrine target glands and nonendocrine target glands**

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The Pituitary Gland

- A sort of master gland
- It is a cherry-sized endocrine gland
- The hormones it secretes affect the growth and secretion of other endocrine glands
- The real boss is the hypothalamus
Pituitary Gland (Hypophysis)

- Suspended from hypothalamus by stalk (infundibulum)
- Location and size
  - housed in **sella turcica** of sphenoid bone
  - 1.3 cm diameter
- **Adenohypophysis** (________ pituitary)
  - arises from hypophyseal (Rathke's) pouch (outgrowth of pharynx); Fig. 2.1 and x
- **Neurohypophysis** (________ pituitary)
  - arises from brain;
  - Magnocellular neurons— supraoptic and paraventricular nuclei; Nerve endings?
Hypothalamic-hypophyseal portal system--1

1. (Anatomy) Hypothalamic hormones travel in portal system from hypothalamus to anterior pituitary (Fig. 2.2 and x+y)
   - Primary capillaries (plexus)--?
   - Secondary capillaries (plexus)--?

2. (Physiology) Hypothalamic hormones regulate hormones secretion by anterior pituitary
   - Example— Gonadotropin-releasing hormone (GnRH) regulates FSH & LH secretion
Axons to primary capillaries

Primary capillaries
Superior hypophyseal artery

- Gonadotropin-releasing hormone
- Thyrotropin-releasing hormone
- Corticotropin-releasing hormone
- Prolactin-releasing hormone
- Prolactin-inhibiting hormone
- Growth hormone
- Somatostatin

Secondary capillaries

- Follicle-stimulating hormone
- Luteinizing hormone
- Thyroid-stimulating hormone (thyrotropin)
- Adrenocorticotropic hormone
- Prolactin
- Growth hormone
Hypothalamic-hypophyseal portal system--2

3. **Advantages (of this portal system)—**
   - Almost all the blood supplied to the anterior pituitary must first drain through the 
     ________________________________________________________________
   - Releasing/inhibiting hormones then can directly deliver to the anterior pituitary **in what fashion**?
     ________________________________________________________________
   - Therefore, only **minute** amounts of neural secretions are needed to achieve biologically effective concentrations in pituitary blood.
Check Point Questions--

A. Besides hormones, give another way for intercellular communication.

B. Give an example of a hormone. Why does your example qualify as a hormone? (hint: definition of hormone)

C. Give an example of a hypothalamic hormone.

D. What is the target tissue of a hypothalamic hormone secreted into the hypothalamic-hypophyseal portal system?

The Posterior Pituitary
Posterior Pituitary Hormones

• OT (oxytocin) and ADH
  – produced in hypothalamus
  – transported by hypothalamo-hypophyseal tract to posterior lobe
  (stores/releases hormones)

Hormone Actions: Posterior Lobe

• ADH (Antidiuretic Hormone)
  – Target organ/tissue-- ?
    • ↑ water retention, reduce urine
  – also functions as neurotransmitter

• Oxytocin
  – labor contractions, lactation (milk ejection)
  – possible role in
    • sperm transport . . .
    • emotional bonding
Regulation of Posterior Pituitary

• Posterior lobe control - neuroendocrine reflexes
  – hormone release in response to nervous system signals
    • suckling infant → stimulates nerve endings
      → hypothalamus → posterior lobe → oxytocin → milk ejection

  – hormone release in response to higher brain centers
    • milk ejection reflex can be triggered by a baby's cry

Physiology of the anterior pituitary gland
1. **FSH** (follicle stimulating hormone)
2. **LH** (luteinizing hormone)
   The above two are called **gonadotropins**
3. **TSH** (thyroid stimulating hormone, thyrotropin)
4. **ACTH** (adrenocorticotropic hormone)
5. **GH** (growth hormone; somatotropin or somatotropic hormone)
6. **PRL** (prolactin)

**Tropic (trophic) hormones**—target other endocrine glands to release their own hormones; which ones above?
Glycoprotein hormone family– TSH, FSH, LH

1. **TSH**– to stimulate the secretion of thyroid hormone

2. **FSH & LH**– important for the function of the testes and the ovaries
   - **FSH**– growth of ovarian follicles and formation of sperm
   - **LH (in women)**– induce ovulation and the formation of the corpus luteum; stimulate the ovarian production of estrogen and progesterone
   - **LH (in men)**– stimulates the production of Testosterone; **what cells?**

Glycoprotein hormone family (continued)

1. 2 peptide subunits– alpha + beta

2. The three glycoprotein hormones and **hCG** (Human chorionic gonadotropin; a placental hormone) all share the same **alpha subunit**. Fig. 2.3

3. Both subunits need to be present to be functional.

4. **Beta subunits** are encoded in separate genes located on different chromosomes.
4 Glycoproteins— all of them share a common alpha subunit

Growth hormone and prolactin

1. **Growth hormone (GH)** is required for proper adult stature.
   - Species specificity: primates for primate GH
   - Metabolic effects

2. **Prolactin (PRL)** is required for milk production in post-partum women.
   - In men or nonlactating women— not clear; however, evidence suggests it may have to do with the immune function.

3. **Human prancental lactogen (HPL) = human chorionic somatomammotropin**
3 single-stranded peptides are similar in their structures and functions

2 GH & 3 human placental lactogen genes

Adrenocorticotropic hormone family

1. **ACTH** (adrenal corticotropic hormone) regulates hormone secretion by the **cortex of the adrenal glands**.

2. The gene produces ACTH is called POMC (pro-opiomelanocortin) in **corticotropes** and **other cells** by prohormone convertases.
   - (Corticotropes) ACTH is the only one has an established physiological role in humans
   - (melanocytes and keratinocytes)– pigmentation by MSH
   - (Melanotrope in arcuate neurons)– food intake
Pro-opiomelanocortin (POMC), a gene, products

1. P. convertases
   - Corticotrope
     - NH2-Terminal Peptide
     - JIP
     - ACTH
     - β-lipotropin
   - γ-lipotropin
   - β-Endorphin

2. Melanotrope
   - Arcuate neurons
     - γ-MSH
     - α-MSH
     - CLIP
     - β-MSH
     - β-Endorphin

3. Melanocyte-stimulating hormone (MSH)
   Corticotropin-like intermediate lobe peptide (CLIP)

Regulation of anterior pituitary function
Regulation of anterior pituitary function

1. **Primarily by the CNS**— All pituitary hormones except PRL would decline in the absence of the hypothalamus
   - **Experiment**— Pituitary gland is removed . . . and in vitro . . .

2. **By hormones produced in peripheral target glands**—
   - Example— inhibin secreted from gonads

3. All anterior pituitary hormones secreted in a diurnal pattern.
1. Hypophysiotropic hormones (Neuro-secretions) into the hypothalamo-hypophyseal portal system

2. Include TRH (Thyrotropin-releasing hormone), GnRH (Gonadotropin releasing hormone) etc.

3. These hormones are clustered in discrete hypothalamic nuclei
Hypothalamus and pituitary

(b)
Thyrotropin-releasing hormone (TRH)

1. Tripeptide

2. Is synthesized primarily in parvocellular neurons in the **paraventricular nuclei** of the hypothalamus, and stored in the nerve terminals in the median eminence.

3. Function– regulate **TSH** secretion and thyroid function
Gonadotropin releasing hormone (GnRH)

1. A decapeptide
2. Is synthesized primarily in the arcuate nucleus in the hypothalamus and secondary in the preoptic area
   - GnRH gene is also expressed in the placenta
3. Function—GnRH regulates FSH and LH secretion
   - How? Pulses of GnRH release determines the ratio of FSH and LH Secreted
   - Secretions (Examples: Testosterone and inhibin) of the FSH/LH target organs regulate FSH/LH output

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Control of GH secretion

1. By both **Growth hormone releasing hormone** (GHRH; from arcuate nuclei mainly); its gene is expressed in the GI tract and the pancreas
2. and by **somatostatin** (Growth hormone release inhibiting hormone) (from preoptic periventricular and paraventricular nuclei); its gene is expressed in GI tract and the pancreas
3. **Ghrelin** (a peptide from the Arcuate Nuclei) also increase GH secretion via GHRH
   - Ghrelin is also synthesized in the stomach and is thought to signal feeding behavior
Corticotropin releasing hormone (CRH)

1. Containing 41 amino acids
2. Synthesized mainly in the **paraventricular nuclei** whose axons project to the median eminence. CRH-containing neurons in the CNS is wide distributed. What does this suggest?

   – Also produced in the placenta

3. CRH stimulates secretion of ACTH
## Dopamine and control of prolactin secretion

1. **Dopamin** (an amine) is a prolactin inhibitory factor which can inhibit PRL secretion

2. Dopamine is synthesized in tuberohypophyseal neurons

3. PRL releasing hormone’s existence is unclear

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## Secretion and actions of hypophysiotropic hormones

1. **(ONE to ONE)** In general, the hypophysiotropic hormones affect the secretion of one or another pituitary hormone specifically; not always this way
   - Example: TRH increases PRL and TSH secretion; suckling at the breast increases both PRL and TSH secretion

2. Many factors impact neurons that secrete hypophysiotropic hormones—internal and external environment

3. **(Action Mechanism on pituitary hormones)**—all appear to act through G-protein
Feedback control of anterior pituitary function

Feedback regulation of anterior pituitary hormone secretion

Interplay of the following two:

• Stimulatory effects of releasing hormones

• Inhibitory effects of target gland hormone
Physiology of the posterior pituitary gland
The Posterior Pituitary

- OT (oxytocin—rapid birth; mainly from paraventricular nuclei) and ADH (vasopressin—contraction of blood pressure-to _______ blood pressure; mainly from supraoptic nuclei)
- These two are from a single ancestral gene; both are nonapeptides and differ by only two amino acids
- Neurophysins—cosecreted with AVP or oxytocin but no known hormonal actions.
Hormones of the neurohypophysis and their prohormone precursors.

Hormone Actions: Posterior Lobe

- **ADH (Antidiuretic Hormone; i.e. vasopressin)**– through different G-proteins
  - Reabsorption of water– through cAMP
  - Vascular muscular contraction– through inositol tris-phosphate/diacylglycerol

- **Oxytocin**
  - labor contractions, lactation (milk ejection)
  - Through a single class of G-protein– through the inositol trisphosphate/diacylglycerol
Regulation of posterior pituitary function