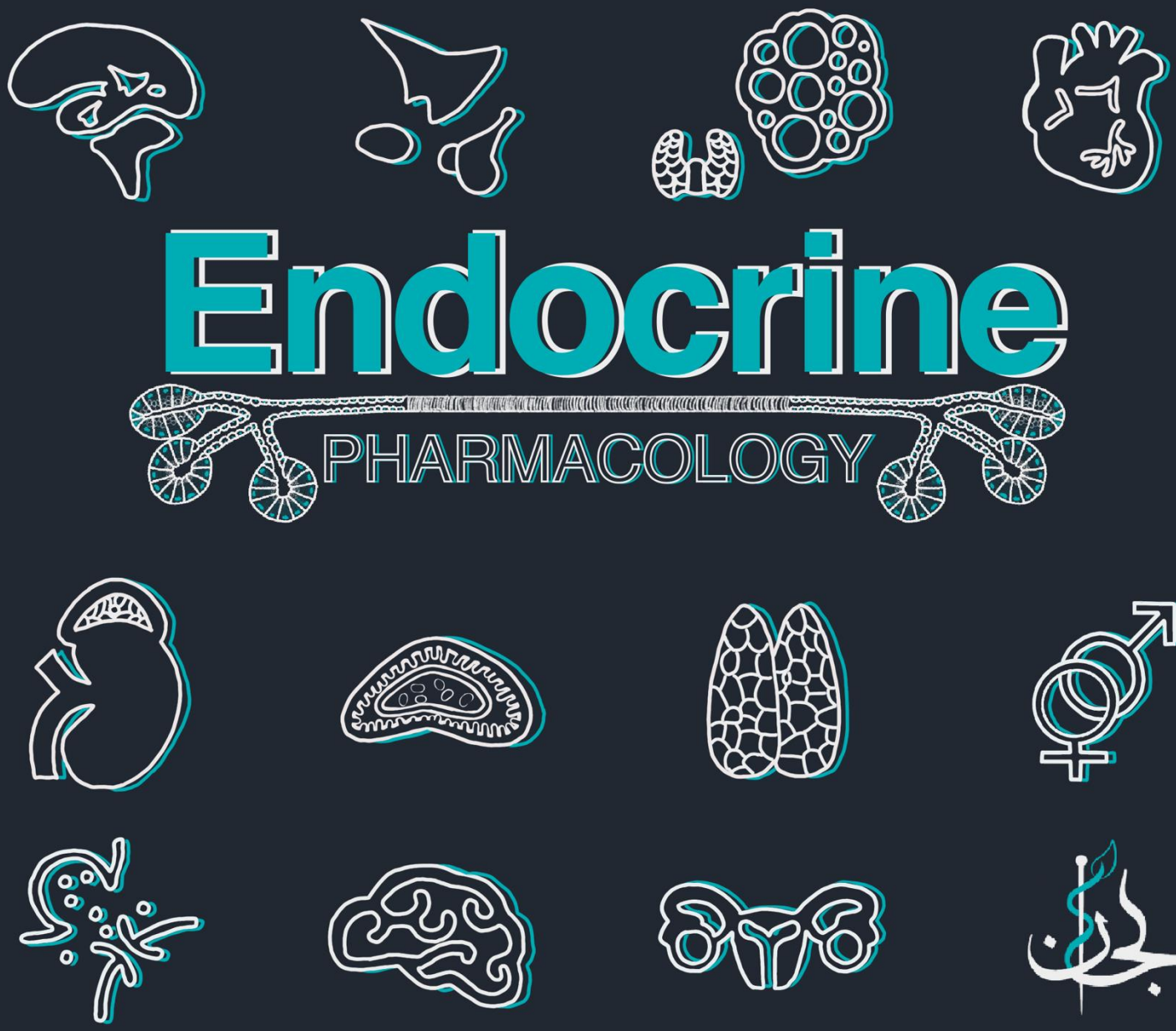

Title: Sheet 1 - Hypothalamus & Pituitary

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The Hypothalamus and Pituitary Gland (00:00)

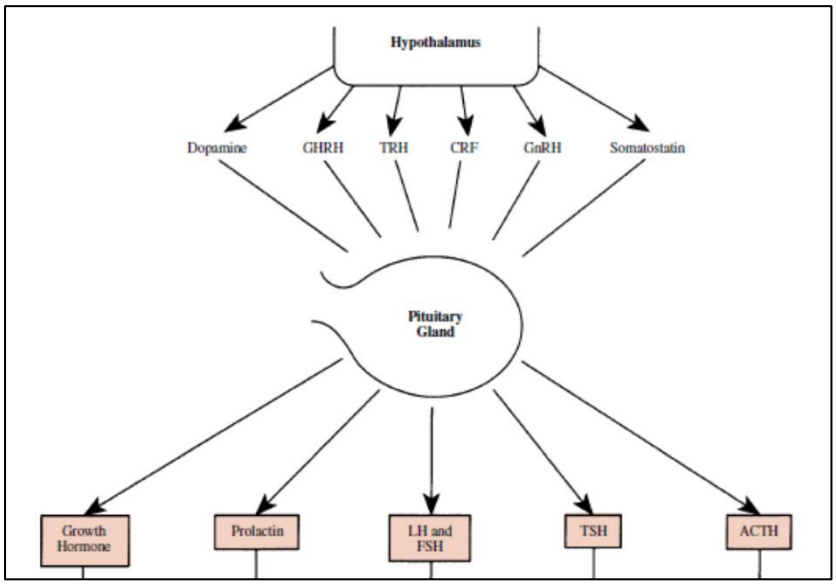
- *The hypothalamus-pituitary unit is the most dominant portion of the entire endocrine system.*
- *The importance of the hypothalamus and the pituitary gland is due to the fact that they work together as one unit.*

- Together, they control the ***Endocrine System*** (by regulating the function of endocrine glands).
- *including the thyroid, adrenal and reproductive glands.*

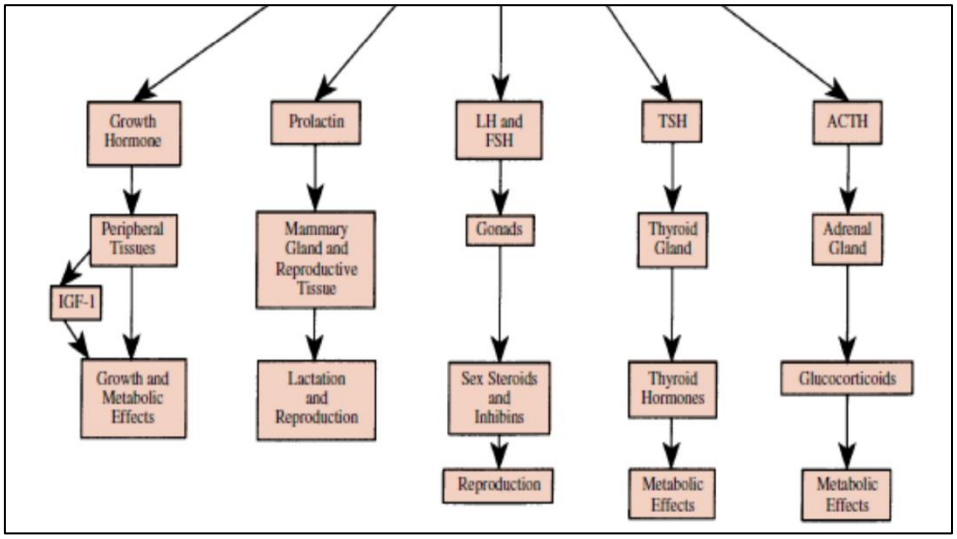
- They also control ***somatic growth, lactation, milk secretion and water metabolism*** (by controlling all the glands that do these jobs).
- The function of the pituitary gland depends on the hypothalamus.
- The anatomical organization/design which connects the hypothalamus and the pituitary gland reflects the relationship between them.

The **pituitary gland** lies in a pocket of bone, at the base of the brain, just below the hypothalamus. It is *connected to the hypothalamus* by a stalk containing **nerve fibers and blood vessels.**
The pituitary gland is composed of *two lobes*: **anterior and posterior lobes**. Each lobe is responsible for secreting certain types of hormones.

The diagram on the right shows the connection between the hypothalamus and the pituitary gland*, the anterior pituitary gland,* to be exact. This connection is emphasized by the hormones secreted from the hypothalamus. These hormones affect the pituitary gland and regulate/induce the release of pituitary hormones. With regards to the anterior pituitary gland, **the hormones are six in number** – which control and regulate the endocrine gland secretions.



The diagram *on the right illustrates what we've said before. There are six hormones secreted by the anterior pituitary gland. (You'll have to refer back to this diagram every time we talk about a specific hormone).*



Example 1: ***The Growth Hormone***

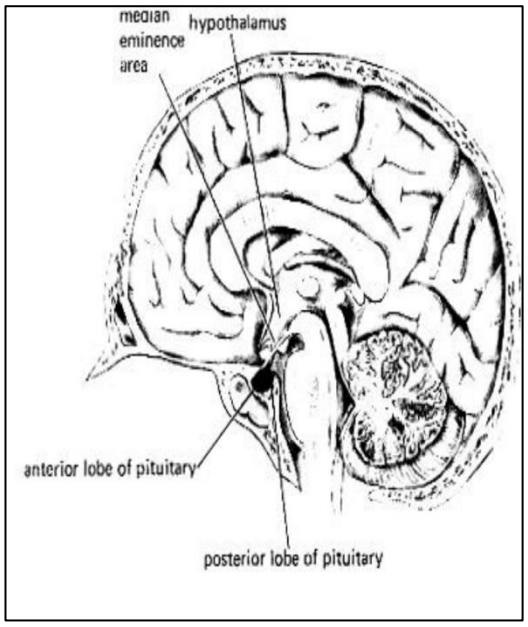
- One of the most important anterior pituitary hormones.
- Controls peripheral tissues.
- Controls growth and metabolism depending on the person's age.

Example 2: Prolactin

- Controls the ***Mammary Gland*** and ***Reproductive Tissues***, controlling lactation and reproduction.

Throughout this lecture, we'll be talking about the rest of the hormones that are shown in this diagram, further explaining the relationship between the pituitary gland hormones and the glands to be controlled by these hormones.

This is a cross section of the brain, *which shows the hypothalamus and the pituitary gland (ant and post parts). It shows the median eminence, where the connection between the hypothalamus and pituitary gland is formed.*



The anterior pituitary is connected to the hypothalamus by the hypothalmoanterior pituitary portal vessels. It is responsible for secreting the six peptide hormones that we mentioned before, including:

1. Prolactin
2. Growth hormone (GH)
3. Thyroid stimulating hormone (TSH)
4. Adrenocorticotropic hormone (ACTH)
5. Follicle-stimulating hormone (FSH)
6. Luteinizing hormone (LH)

The posterior pituitary (neurohypophysis) is an outgrowth or protrusion of the hypothalamus, composed of neural tissue. The neurons of the hypothalamus pass through the neural stalk, and end in the posterior pituitary.

The median eminence is the area that connects the hypothalamus to the pituitary gland. *It is the upper portion of the neural stalk.*

Specific hormones are secreted from the hypothalamus. These hypothalamic releasing hormones travel to specific cells in the anterior pituitary gland, in order to stimulate the secretion or synthesis of certain hormones from the pituitary gland.

Hypothalamic releasing hormone	Effect on pituitary
Corticotropin releasing hormone (CRH)	Stimulates ACTH secretion
Thyrotropin releasing hormone (TRH)	Stimulates TSH and Prolactin secretion
Growth hormone releasing hormone (GHRH)	Stimulates GH secretion
Somatostatin	Inhibits GH (and other hormone) secretion
Gonadotropin releasing hormone (GnRH)	Stimulates LH and FSH secretion
Prolactin releasing hormone (PRH)	Stimulates PRL secretion
Prolactin inhibiting hormone (dopamine)	Inhibits PRL secretion

↳ *TABLE: You're required to know the names of the hypothalamic hormones and the corresponding stimulated pituitary hormones that are released as a result of this hypothalamic control.*

Anterior Pituitary Hormones (08:00)

The following table shows:

- *Anterior pituitary gland cell types*
- *The hormones that are released from each type of cell*
- *The hypothalamic factors (stimulatory/inhibitory hormones) which regulate the release of these anterior pituitary hormones.*
- *The major target organ, and target gland hormones (hormones released from the affected/stimulated target organ)*

Notes:

ANTERIOR PITUITARY GLAND CELL TYPE	STIMULATORY HYPOTHALAMIC FACTORS	INHIBITORY HYPOTHALAMIC FACTORS	PITUITARY HORMONES RELEASED	MAJOR TARGET ORGAN	TARGET GLAND HORMONES
Somatotroph	GHRH, Ghrelin	Somatostatin	GH	Liver	Insulin-like growth factors
Lactotroph	TRH	Dopamine, Somatostatin	Prolactin	Mammary gland	None
Gonadotroph	GnRH	None known	LH and FSH	Gonads	Estrogen, progesterone, and testosterone
Thyrotroph	TRH	Somatostatin	TSH	Thyroid gland	Thyroxine and triiodothyronine
Corticotroph	CRH	None known	ACTH	Adrenal cortex	Cortisol, adrenal androgens

GHRH (Growth Hormone Releasing Hormone), is released from the hypothalamus. It stimulates the release of GH from the anterior pituitary gland (from Somatotrophs). On the other hand, Somatostatin is released from the hypothalamus, inhibiting GH release. The GH targets the LIVER and affects the release of Insulin-like growth factors.

The column "Target Gland Hormones" indicates the hormones released by the target gland that is affected by the hormones released by the anterior pituitary gland.

Prolactin is released from the Lactotrophs of the anterior pituitary gland in response to stimulation by hypothalamic TRH (Thyroid Releasing Hormone). It is inhibited by Somatostatin and Dopamine.

Growth Hormone (11:15)

- *Growth hormone, or somatotropin is a protein hormone. It has two major effects (depending on age):*

1. **In children**: Stimulates linear body growth and regulates cellular metabolism.
2. **In adults**: Regulates cellular metabolism.

Other major effects:

- **Stimulates lipolysis**, enhances the production of free fatty acids, elevates blood glucose level.
- **Enhances the production of an Insulin-like Growth Factor (IGF-1) –** Has an effect on linear body growth in children and regulates cellular metabolism in adults and children.

Growth hormone is released during sleep, with maximal release occurring an hour after onset of sleep. (that's why we stress on the importance of sleep for children, in order to keep their growth patterns within the appropriate/healthy limits/range).

Prolactin (13:00)

In women, prolactin, along with other hormones, acts on the mammary gland:

- **During pregnancy:** To develop lactation
- **After birth/delivery**: To induce the start of and maintain lactation.

Pathological Conditions:

Hyperprolactinemia (*Increased Prolactin levels*) causes:

- **Impotence** in men
- **Amenorrhea and infertility** in women

Treatment:

- Dopaminergic agonist **Bromocriptine** (**Parodel**)

↳ If you refer to the table, you will notice that Dopamine (released from the hypothalamus) **INHIBITS the release of Prolactin**. So, a dopaminergic agonist would be effective in lowering prolactin levels.

*Approximately one-third of women who need treatment for **infertility** have high serum prolactin levels (Remember that infertility may occur due to hyperprolactinemia). In some cases, the only reason for infertility is hyperprolactinemia, so the treatment will be aimed at lowering the hormone level.*

Diagnosis:

- Prolactin **serum levels** are measured to diagnose hyperprolactinemia.

There is no known therapeutic use for prolactin (it isn't used clinically).

Prolactin serum levels increase during:

1. Pregnancy
2. Breast-feeding
3. After birth/delivery (Increases almost immediately, the increase is very clear)
4. Increases markedly during stress (Over-stress could lead to hyperprolactinemia → Infertility)

We've already stated that the anterior pituitary hormones are released from certain types of cells in the pituitary gland.

Lactotrophs (16:30)

↳ *Site of production of prolactin.*

- **Lactogenesis** (milk synthesis) requires prolactin.
- **Dopamine** inhibits prolactin production → Dopaminergic agonists are used to treat hyperprolactinemia.
- **TRH** is the **main prolactin-releasing hormone**
- **Other hormones:**
  1. Oxytocin stimulates prolactin release.
  2. Estradiol enhances prolactin synthesis.

ACTH (17:35) & (22:45)

- *Adrenocorticotropic hormone (corticotropin) is produced in corticotropes in the anterior pituitary gland.*
- *It is made up of 39 AA's*
- *It is produced in the anterior pituitary gland by the proteolytic processing of the precursor compound Prepro-opiomelanocortin (POMC).*

Function:

1. **Regulates adrenal glands (adrenal cortex)** → Induces the synthesis of adreno-corticosteroids.
2. **An increase in ACTH** leads to an increase in the following:
   a) **Adreno-corticosteroid** level.
   b) **α-MSH** (a-melanocyte-stimulating hormone) → Increased melanin production → Overproduction may lead to increased pigmentation of areas of the skin.
   c) **β and γ lipotropin**
   d) **β endorphin**
   Examples b-d are other neuropeptide products of POMC.

- ACTH can be used to measure the level of stress, **since it's is a key regulator of the stress response.**

Over stress is also reflected by an increase in MSH → overproduction of melanin

TSH (19:20)

- *TSH, or thyrotropin, is a glycosylated protein made up of two subunits.*
- *Its main function is to stimulate the thyroid gland to produce thyroid hormones.*

- **Deficiencies (including Hypothyroidism)**:

Are treated by giving **thyroxine** itself rather than **TSH** (even though it stimulates the thyroid gland, it is NOT used to treat hypothyroidism)

- **TSH is available for diagnostic purposes**: To differentiate between pituitary and thyroid gland failure as causes of hypothyroidism.

Thyrotropes (20:35)

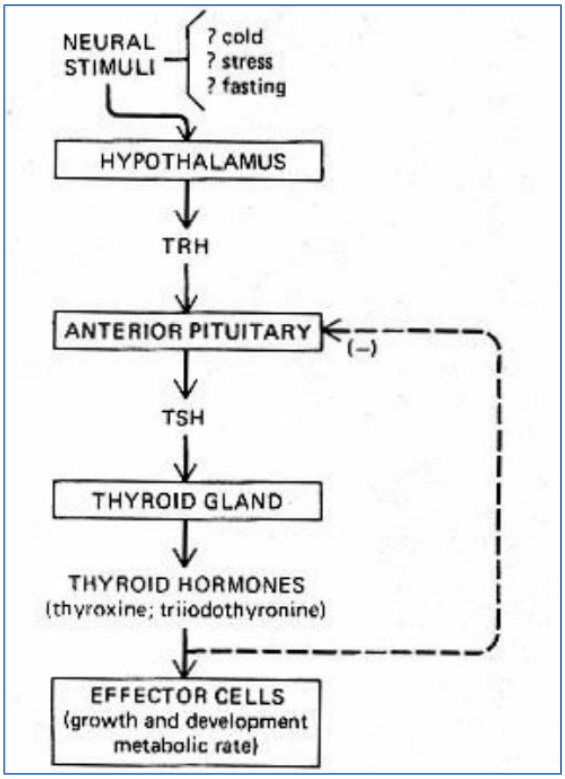
↳ *Site of production of TSH in the pituitary gland.*

- **Pattern of secretion** of TSH is relatively **steady.**
- TSH secretion is stimulated by the **hypothalamic TRH.**
- The thyroid gland produces the **thyroid hormone (T3),** which is a part of **feedback control**.

Feedback Control of Thyroid Function (21:40)

The diagram on the right shows how the ***hypothalamus*** *stimulates the anterior pituitary gland by* ***TRH*** *→* ***Anterior pituitary gland*** *releases* ***TSH*** *→ Stimulates the* ***thyroid gland*** *→ The* ***thyroid gland*** *secretes thyroid hormones (Such as* ***Thyroxine and Triiodothyronine****).*

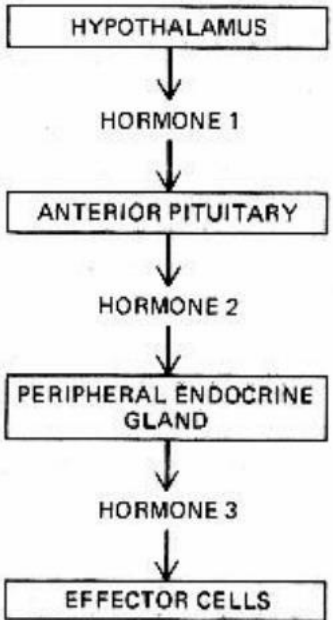
The accumulation of thyroid hormones will bring about negative feedback → This stops the anterior pituitary gland from releasing TSH → Thyroid gland isn't stimulated → No production of thyroid hormones (THIS PREVENTS THE ACCUMULATION OF THYROID HORMONES).



IMPORTANT: After the professor discussed the feedback control of thyroid function, she talked about ACTH again → refer back to page 6 (I added all the information there, along with the information that was already mentioned)

Feedback Control of the Hypothalamus and Pituitary Gland (24:30)

This diagram shows the feedback regulation of the hypothalamus and the pituitary gland by the final product/hormone, which is a prominent feature of each of the hormonal sequences initiated by the hypothalamic releasing hormones. This is exerted upon the hypothalamic-pituitary system ***by the hormones whose production are stimulated in the sequence.***



The hypothalamus releases **HORMONE 1**, which simulates the release of **HORMONE 2** from the anterior pituitary

- ➔ **HORMONE 2** then stimulates the release of the final product **HORMONE 3** from the Peripheral endocrine gland that is stimulated.
- ➔ **HORMONE 3** accumulates → Inhibits the anterior pituitary gland.
- ➔ This stops/inhibits the anterior pituitary gland from further stimulating the peripheral endocrine gland.