

Endocrine Block

- Text
- Only in Females' slide
- Only in Males' slides
- Important
- Numbers
- Doctor notes
- Extra Notes

المحاضرة مبنية بشكل أساسي على نوات الدكتورز + قايتون ولندا، نظرا لأن السلايدات اغلبها صور !

المحاضرة بتكرر بالمحاضرة الجاية فاحرصوا تفهمون كل شيء 😊

"إن الله لا يُعطي
أصعب المعارك، إلا
لأقوى جنوده"

Hypothalamo-Pituitary axis and regulatory mechanisms

By the end of this lecture, students should be able to describe:

1. Structure of pituitary gland (hypophysis):

- Anterior pituitary (adenohypophysis) cell types and hormones
- Posterior pituitary (neurohypophysis) cell types and hormones

2. Control of pituitary gland by hypothalamus:

Hypothalamo-hypophysial portal blood vessels (Hypothalamic releasing and inhibiting hormones and median eminence).

Hypothalamo-hypophysial tract.

3. Feedback mechanisms: positive and negative feedback.

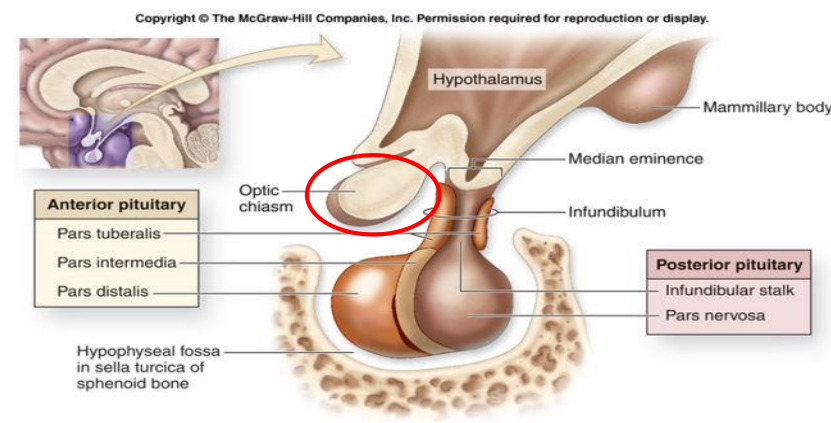
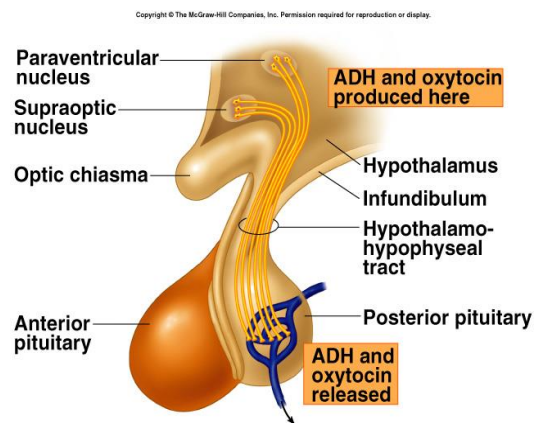
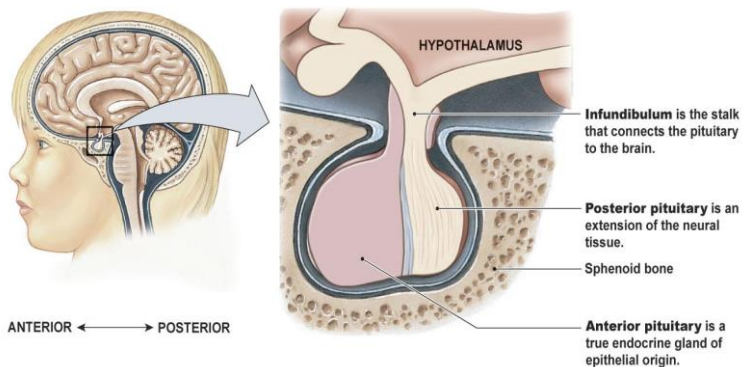


Hypothalamus

- ▶ Hypothalamus is located at the base of the brain & Composed of number of nerve cells.
- ▶ It is part of the limbic system, which controls the autonomic nervous system and the endocrine systems.
- ▶ Control pituitary gland secretion by:
 1. Secretes releasing hormones to cause the pituitary to release hormones.
 2. Secretes inhibiting hormones to turn off secretion of pituitary hormones.
- ▶ One of the most important functions of the hypothalamus is to link the nervous system to the endocrine system via the pituitary gland (hypophysis).
- ▶ Hypothalamic-pituitary relationships:
 1. hypothalamus/anterior lobe: hypophyseal portal system.
 2. hypothalamus/posterior lobe: hypothalamo-hypophyseal tract.
- ▶ The hypothalamus and pituitary gland function in a coordinated fashion to orchestrate many of the endocrine systems. The hypothalamic-pituitary unit regulates the functions of the thyroid, adrenal, and reproductive glands and also controls growth, milk production and ejection, & osmoregulation.
- ▶ It is important to visualize the anatomic relationships between the hypothalamus and the pituitary because these relationships underlie the functional connections between the glands.

Pituitary Gland

Pituitary Gland			
Structure	Anterior lobe (Adenohypophysis)	Posterior lobe (Neurohypophysis)	Infundibulum
Histology	Originates from Rathke's pouch (pharyngeal epithelium).	Originates from hypothalamus (glial-type cells) → neural tissue.	
Structure of pituitary gland (relation to optic chiasm) It's important to know that there is a relation between optic chiasm and anterior pituitary gland, any tumor in the anterior pituitary gland could affect optic chiasm, so it will affect the vision.	<ul style="list-style-type: none"> ✓ Pars tuberalis. ✓ Pars intermedia. ✓ Pars distalis. 	<ul style="list-style-type: none"> ✓ Infundibular stalk. ✓ Pars nervosa 	
How to control of secretion	Hormonal secretion of hypothalamus.	Nervous signals from hypothalamus	
Weight & dimeter	0.5-1 gram & 1cm.		



Relationship of the hypothalamus to the pituitary gland

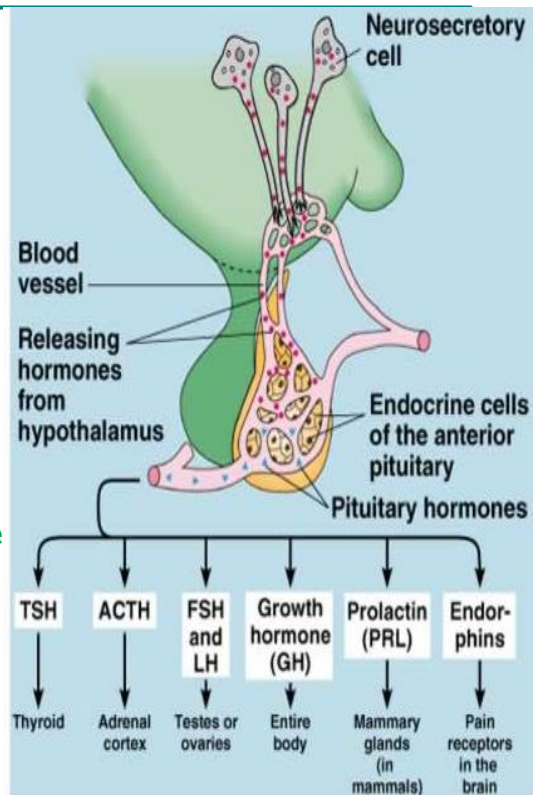
- ✓ It is important to visualize the anatomic relationships between the hypothalamus and the pituitary because these relationships underlie the functional connections between the glands.

Relationship of the hypothalamus to the Anterior pituitary

Collection of endocrine glands:

1. TSH
2. FSH
3. LH
4. GH
5. Prolactin
6. ACTH.

When we do a blood test to assess thyroid function, we can only detect the TSH and T4, but we cannot detect TRH b/c of its less amount and it also got diffused. In addition, it didn't reach the bloodstream.



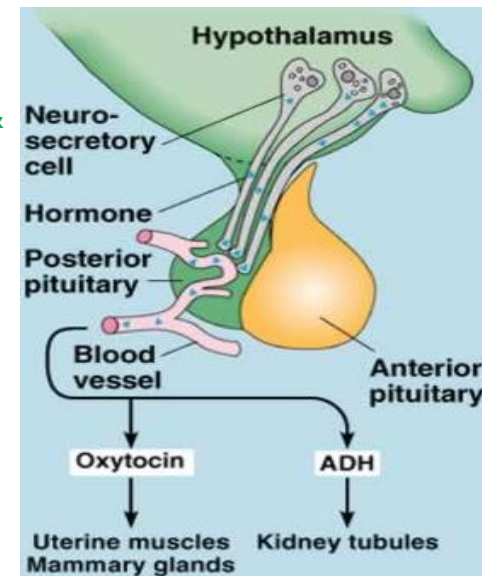
Relationship of the hypothalamus to the posterior pituitary

Collection of nerve axons + supporting cells (Straight forward neural relationship).

1. Antidiuretic hormone (ADH) (vasopressin) → For water regulation:
Supraoptic nuclei.

2. Oxytocin → For production of milk & contraction of uterus:
Paraventricular nuclei.

Hormones released from the posterior pituitary are synthesized in the hypothalamus and travel through the infundibular stalk to the posterior pituitary, where they are released into the bloodstream.



Anterior Pituitary (Adenohypophysis¹)

- ▶ Special neurons in the hypothalamus synthesize and secrete the hypothalamic releasing and inhibitory hormones that control secretion of anterior pituitary.
- ▶ Neurons send their nerve fibers to the median eminence (extension of hypothalamic tissue into the pituitary stalk).
- ▶ **There is NO direct neural contact to anterior pituitary.**
- ▶ Hormones are secreted to the tissue fluids, absorbed into the hypothalamic-hypophysial portal system and transported to the sinuses of the anterior pituitary (Anterior pituitary gland is connected to hypothalamus by portal system: “**hypothalamic-hypophysial portal vessels²**”).

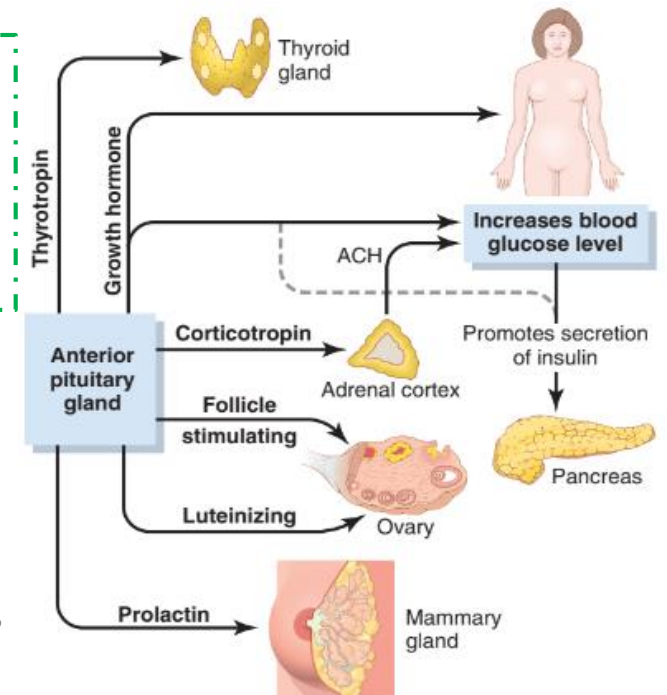
Adenohypophyseal Hormones³:

1. Growth hormone (GH).
2. Thyroid-stimulating hormone (TSH).
3. Adrenocorticotrophic hormone (ACTH).
4. Follicle-stimulating hormone (FSH).
5. Luteinizing hormone (LH) also known as lutropin.
6. Prolactin (PRL).

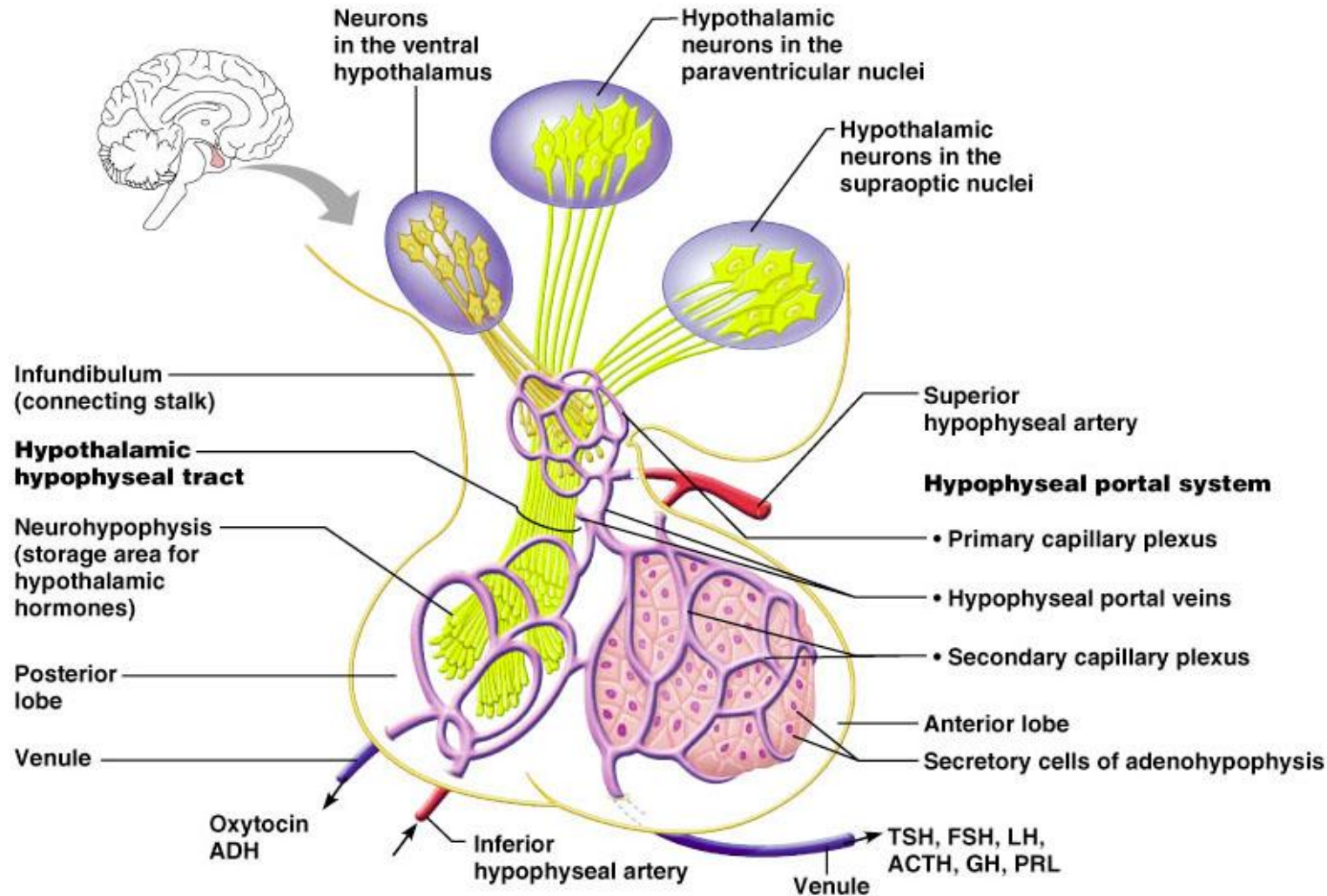
¹= Adenohypophysis = Epithelial cells secrete a lot of different secretions.
²= portal system → Connection between two capillaries.
³= Anterior pituitary gland usually secrete 6 hormones:
 4 of them is known to stimulate other endocrine gland like prolactin stimulate the mammary gland. **The only hormone which is acting on all body cell is growth hormone.**

- ▶ These six hormones secreted from 5 types of cells are called trophes, Ex: somatotrophes & it regulate the activity of other endocrine glands.

- ▶ In addition, pro-opiomelanocortin (POMC): Has been isolated from the pituitary. Is enzymatically split into ACTH, opiates, and melanocyte-stimulating hormone (MSH).



Hypothalamic-hypophysial portal system



- ✓ The artery will branched and give this primary capillaries or plexus.
- ✓ The end of the neurons “the yellow” will secret the hormones coming from hypothalamus in the interstitial fluid, & immediately it absorbed by primary plexus, the primary plexus will union with each other and give venules ”portal venules” which take the hormones to secondary capillary “which is sinusoid blood vessels منتشرة inside anterior pituitary” than finally the hormones of anterior pituitary will go to the circulation.

Anterior Pituitary (Adenohypophysis)

Anterior pituitary contains 5 cell types:

Cell: Somatotrops.
Hormone its secret:
growth factor (GH)

40%

Cell: Corticotrops
Hormone its secret:
Adrenocorticotropic
hormone (ACTH)

20%

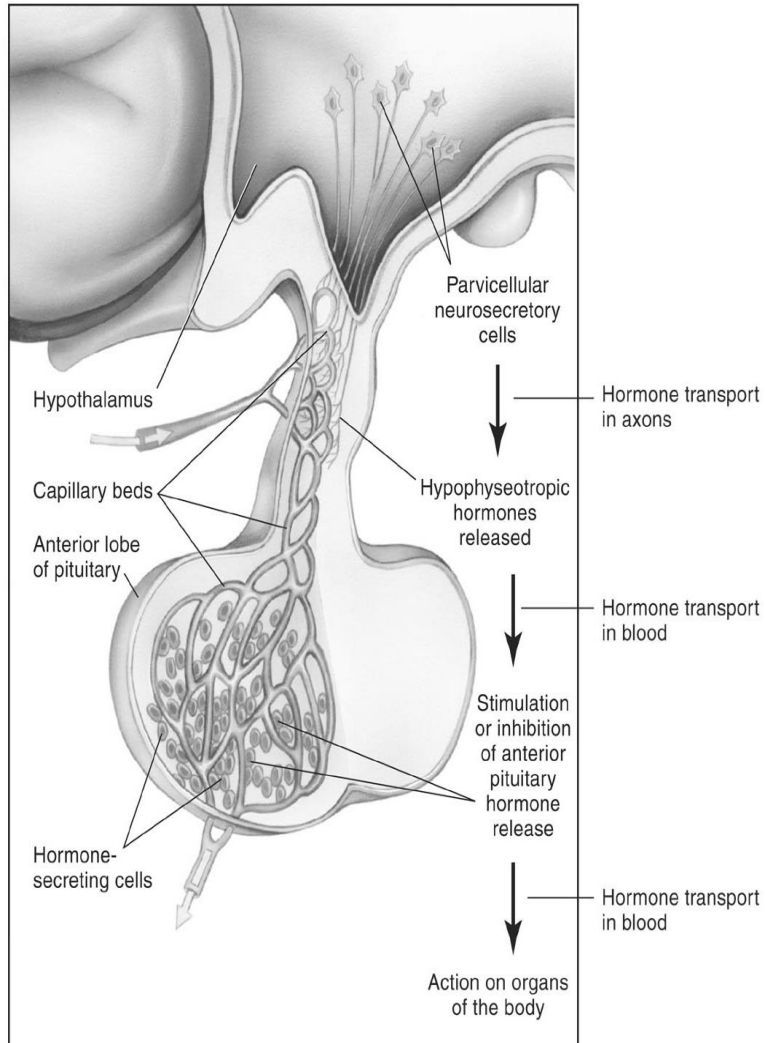
Cell: Thyrotropes
Hormone its secret:
thyroid–stimulating
hormone (TSH)

Cell: Gonadotropes.
Hormone its secret:
luteinizing hormone
& Follicle-stimulating
hormone (LH & FSH)

Anterior pituitary gland
contains 5 cell types

Cell: Lactotrops
Hormone its secret:
PRL

Control of anterior pituitary by hypothalamus (Hormonal control)



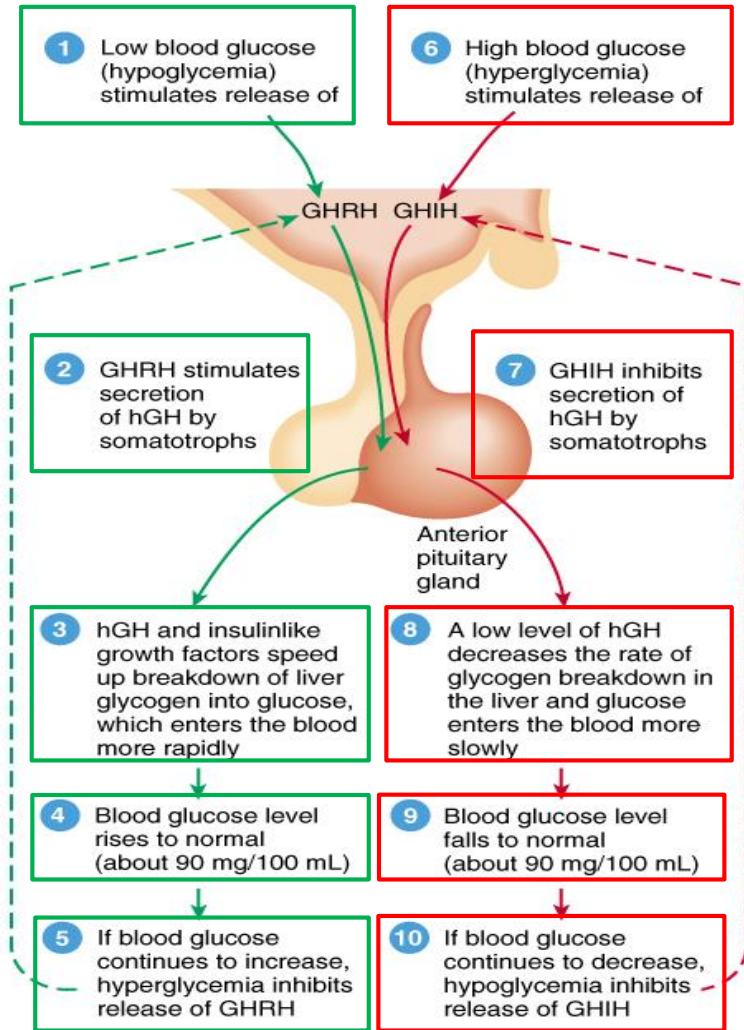
- ▶ As we said before: There are two types of special neurons in the hypothalamus these have either:
 1. Releasing hormones.
 2. Inhibitory hormones.
- ▶ These special neurons send their axon to the median eminence which is an extension of the hypothalamic tissue into the pituitary stalk.
- ▶ The hormones secreted by these neurons will reach the anterior pituitary cells by a way of hypothalamic-hypophysial portal vessels.

Other picture

Relationship between hypothalamus/anterior pituitary:

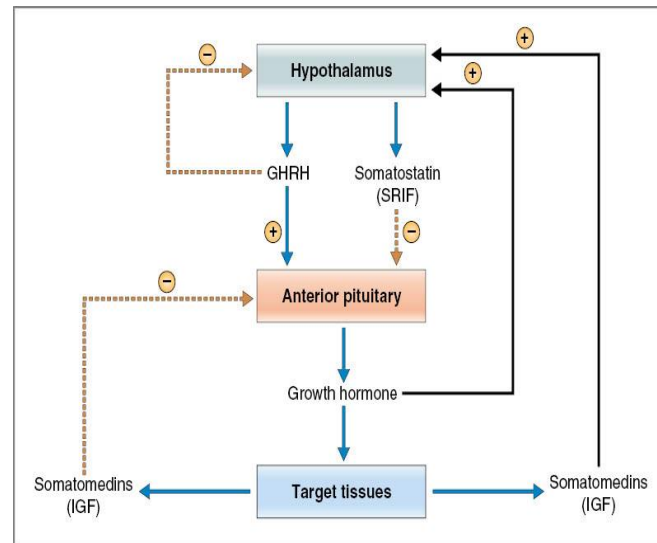
- ✓ Hypothalamus will release hormones and dump it in the median eminence. From there it will enter the following respectively:
 - primary capillary plexus, hypophyseal portal vessel, secondary capillary plexus (anterior pituitary), hypophyseal veins. And finally enter the bloodstream.
- ✓ The pituitary is connected to the hypothalamus by infundibulum (neural stalk).
- ✓ Its protected by sella turcica of the body of sphenoid.
- ✓ It lie between optic chiasma (anteriorly) and mammillary bodies (posteriorly).

Hypothalamic releasing and inhibiting hormones



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GHRH & GHIH	
Growth hormone releasing hormone (GHRH)	Growth hormone inhibiting hormone (GHIH) also called Somatostatin
<ul style="list-style-type: none"> ✓ GHRH it self stimulated by low blood glucose "hypoglycemia". ✓ Stimulates release of growth hormone. ✓ It's antagonize the action of insulin, act like glucagon. 	<ul style="list-style-type: none"> ✓ GHIH it self stimulated by high blood glucose "hyperglycemia". ✓ Inhibits release of growth hormone.
<p>These two hormones have an antagonist action</p> <p>عشان كذا دائما نقول الأطفال ما ينفع يكثروا حلويات، لأنه إذا كان سكر الدم عالي هيكون في تثبيط لـ GH. الصيام يحفز GH release؛ كيف؟ فترة الصيام يكون سكر الدم منخفض يالتالي يتحفز الـ GH.</p>	

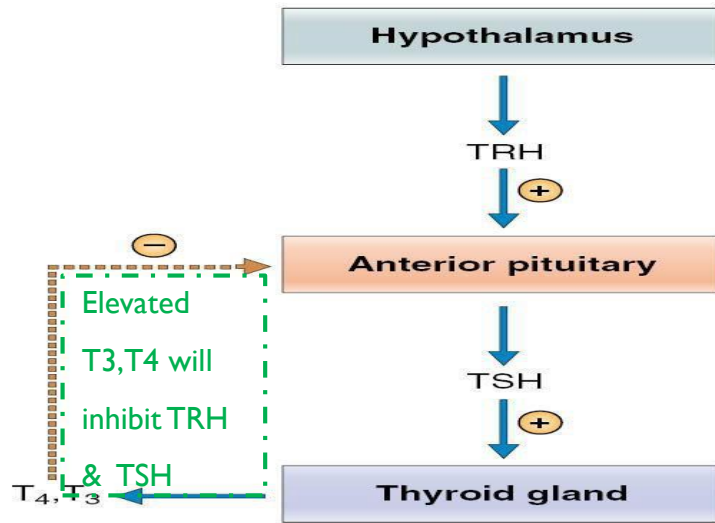


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GHRH and somatostatin will act on the anterior pituitary. One will stimulate and the other will inhibit the release of growth hormone.

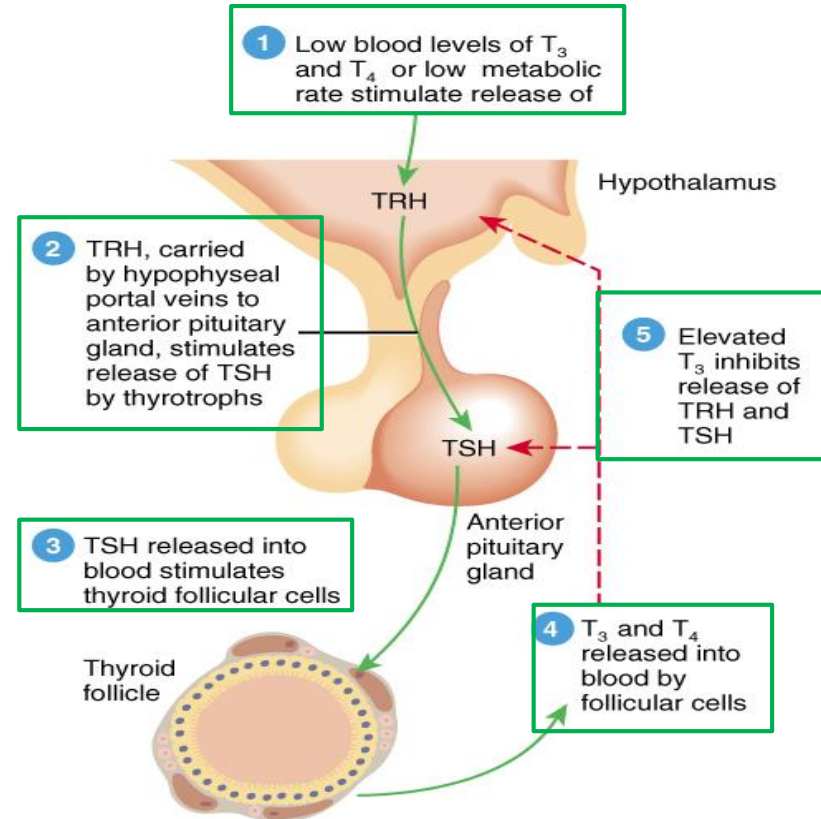
These positive and negative processes will give a final outcome of inhibiting the hypothalamus where less growth hormone is released.

Cont. Hypothalamic releasing and inhibiting hormones



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- ✓ Not enough thyroid hormones will stimulate hypothalamus to secrete TRH which will secrete TSH that will go to the thyroid gland and stimulate the secretion of hormones.
- ✓ If there was over stimulation on thyroid gland, this can cause a trophic effect (change in size)- goiter effect – abnormal enlargement of thyroid gland.

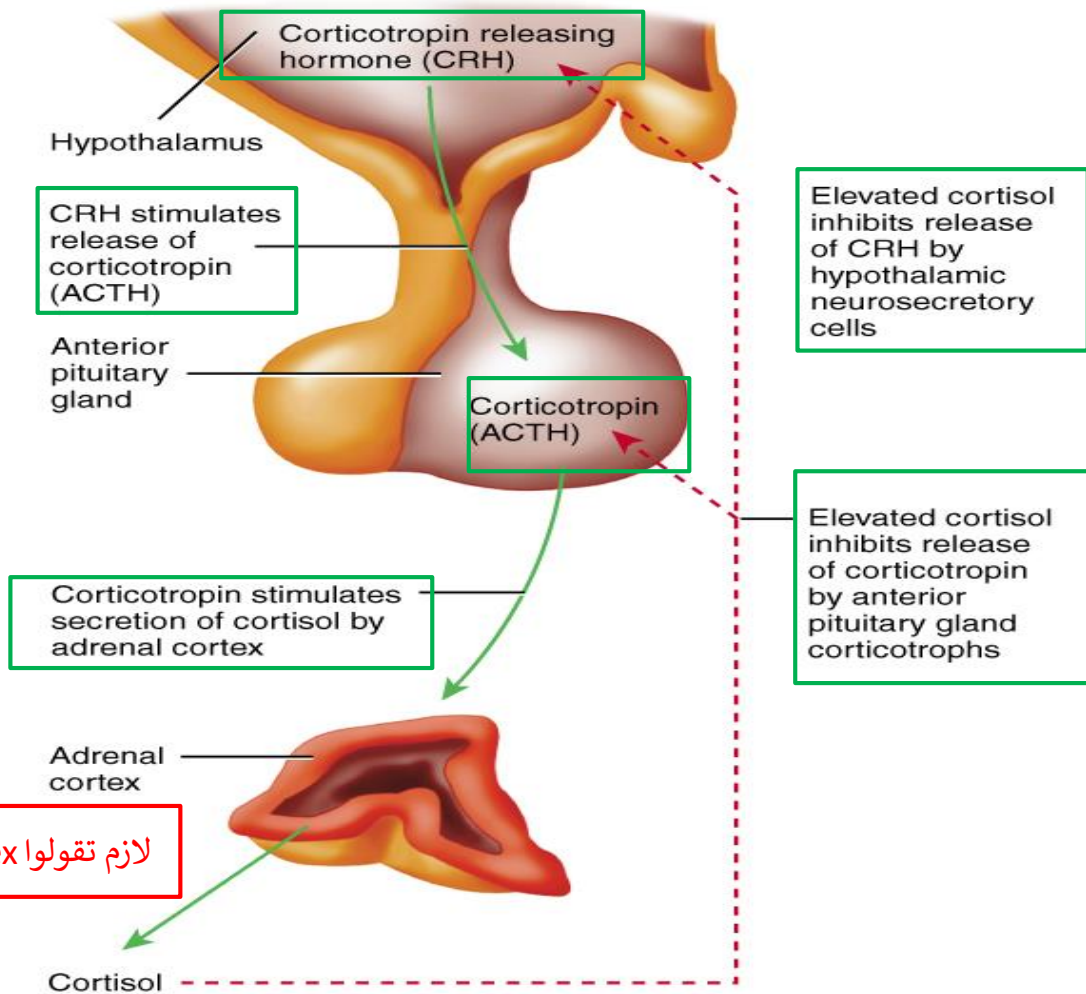


Key:
 TRH = Thyrotropin releasing hormone
 TSH = Thyroid-stimulating hormone
 T₃ = Triiodothyronine
 T₄ = Thyroxine (Tetraiodothyronine)

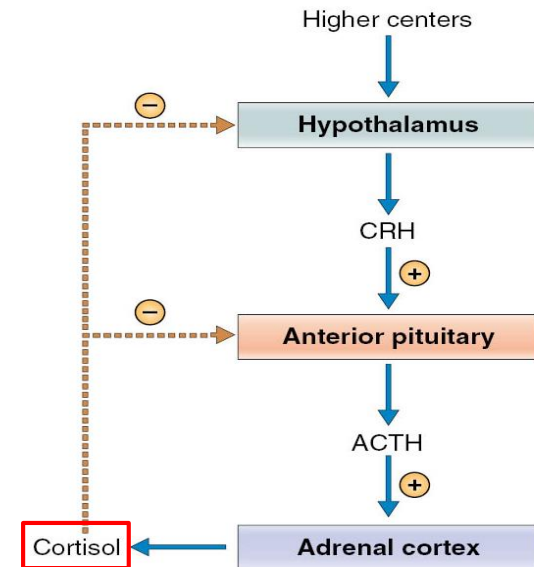
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(TRH)
Thyrotropin-releasing hormone
Stimulates release of thyroid stimulating hormone (TSH)

Cont. Hypothalamic releasing and inhibiting hormones

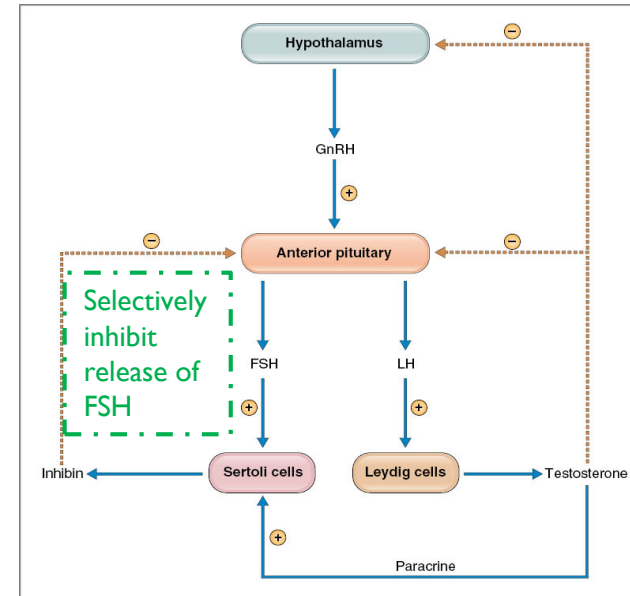
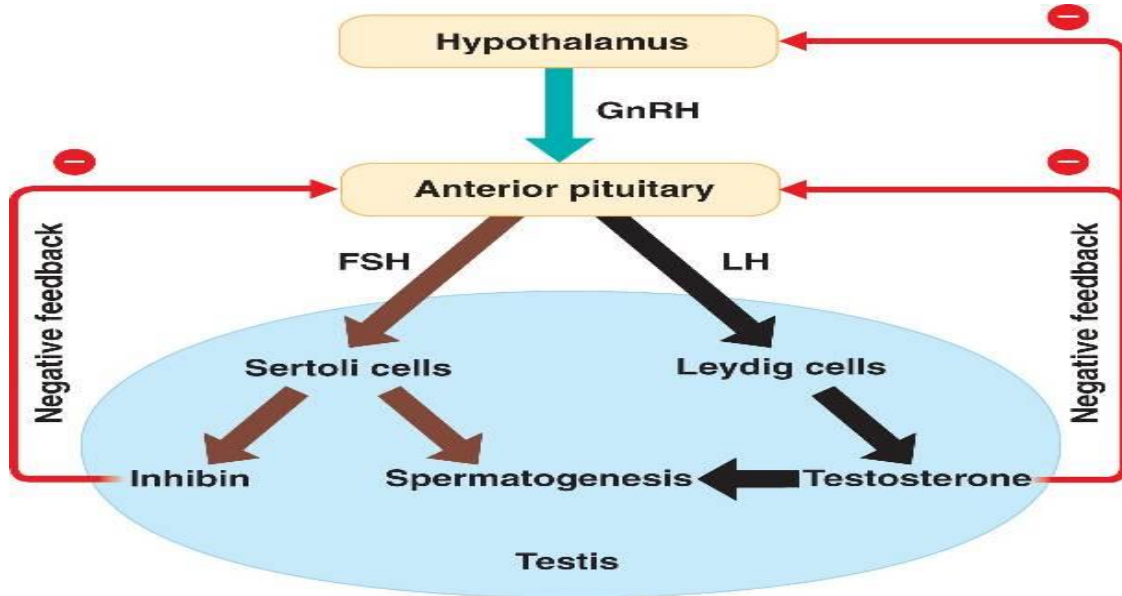


(CRH)
Corticotropin-releasing hormone
<ul style="list-style-type: none"> ✓ Stimulates release of adrenocorticotropin hormone (ACTH). ✓ This hormone stimulated when the level of cortisol decreased.



Elevated cortisol will inhibit release of CRH by hypothalamic neurosecretory cells and ACTH by anterior pituitary corticotrophs.

Cont. Hypothalamic releasing and inhibiting hormones

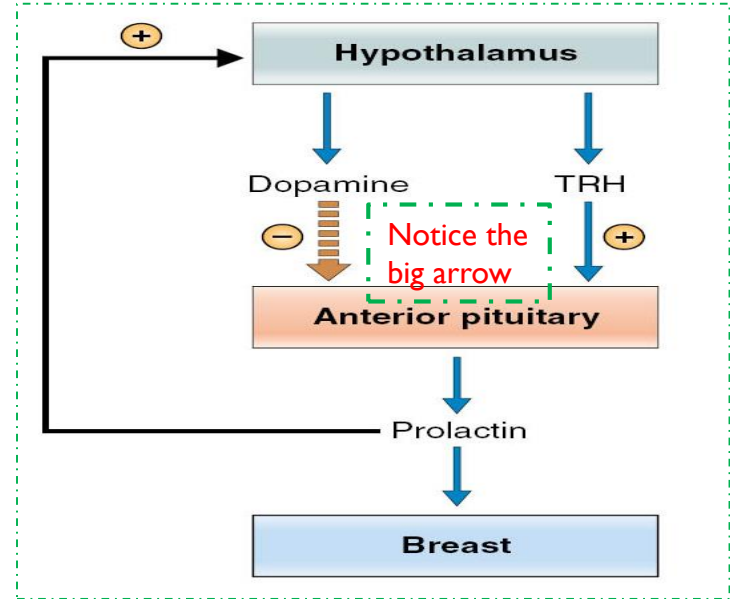
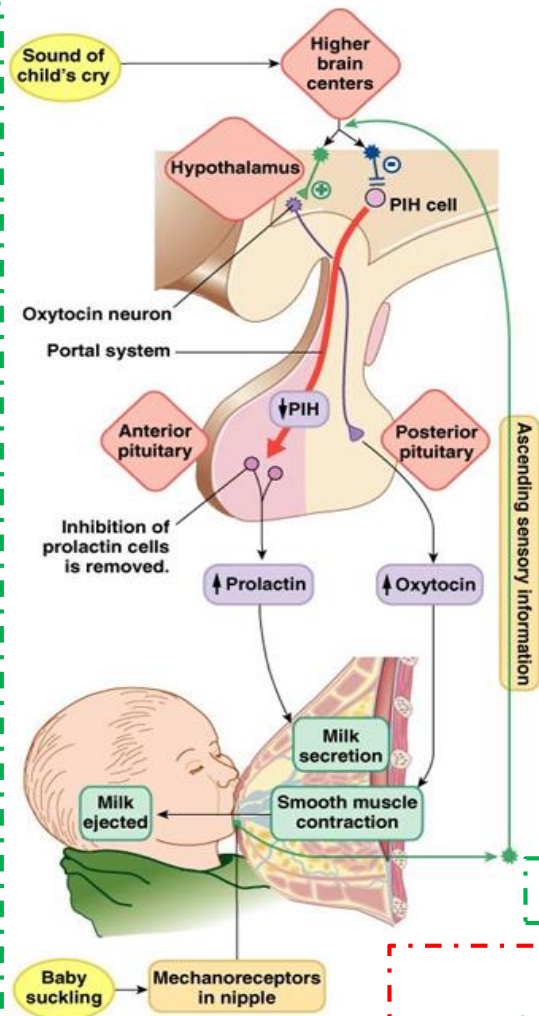


(GnRH)
Gonadotropin releasing hormone
causes release of the 2 gonadotropic hormones:
1. Luteinizing (LH).
2. follicle-stimulating hormone FSH.

- ✓ LH and FSH In female will act on ovary and stimulate release of estrogen and progesterone, when their level elevated in blood they will do negative feedback.
- ✓ But there is exception in day 12-14 the time of ovulation in the cycle when estrogen reach certain level and became high and stimulate hypothalamus to release more of LH which cause weakness in the membrane of follicle and rupture, this is a positive feedback mechanism.
- ✓ In male, FSH & LH have different function. FSH cause growth to sperm "spermatogenesis", LH work in interstitial cells called leyding cells causes release of testosterone. When testosterone elevate it will cause negative feedback, also there is another hormones from sterol cells called inhibin causes negative feedback.

Cont. Hypothalamic releasing and inhibiting hormones

- ✓ How prolactin release ?
When there is sucking from baby to the nipple, the mechanoreceptors in nipple will send sensory neural impulses that reach the brain in hypothalamus, this impulse has two action:
- ✓ 1- inhibitory to cells that release PIH so the prolactin will release from anterior pituitary and go to breast to synthesis milk.
- ✓ 2- stimulation to release of Oxytocin from posterior pituitary. oxytocin work in myoepithelial cells around الحويصلات to eject the milk.



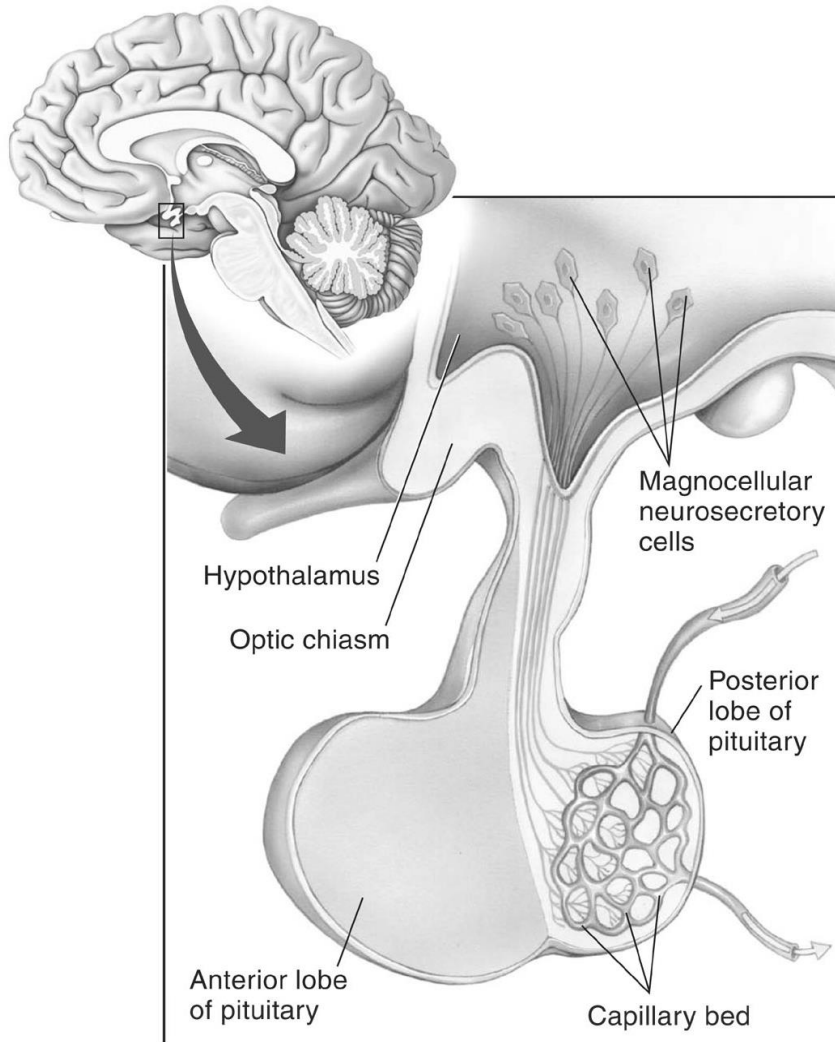
(PIH)
Prolactin inhibitory hormone also known as Dopamine
<ul style="list-style-type: none"> ✓ Inhibits prolactin secretion. ✓ The hormone that always make inhibition.

Ascending sensory information to release more prolactin when the baby is sucking the nipple (mechanoreceptor in nipple).
The release of prolactin is inhibited by dopamine. Even though TRH is stimulated to release prolactin, dopamine inhibit the release b/c its much more stronger.

Only during lactation prolactin is released TRH is stimulated and PIF is inhibited.

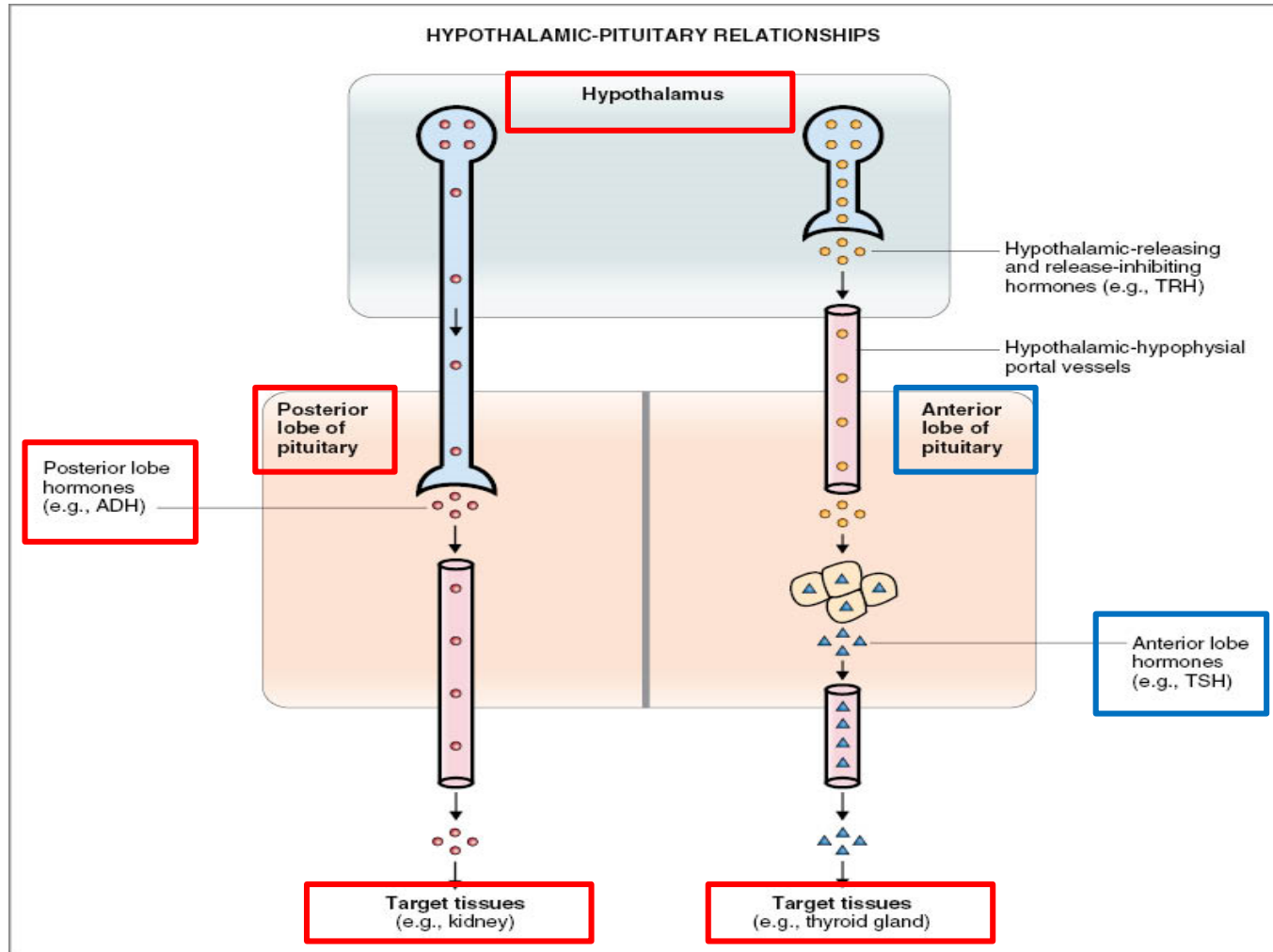
بروكلاتين ما عنده هرمون محفز، فقط مثبّط. ليه؟
لأننا ما نحتاج هذا الهرمون طول حياتنا، نحتاجه فقط لفترة محدودة، (فترة ما بعد الولادة) لتحفيز breast لإفراز الحليب.

Control of posterior pituitary



- ▶ Magnocellular neurons in paraventricular and supraoptic nuclei secrete oxytocin and vasopressin directly into capillaries in the posterior lobe.
- ▶ Here there is **no** primary and secondary capillary, just one capillary in posterior pituitary.

neural & endocrine (posterior & anterior)



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Means the relationship between:

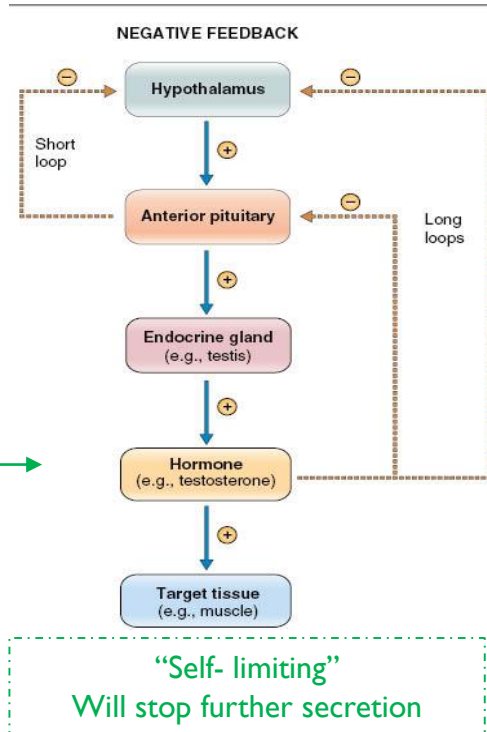
1. Hypothalamus/anterior pituitary: both neural and endocrine.
2. Hypothalamus /posterior pituitary: straight forward neural relationship.

Feedback mechanism
(The level of the hormone will stimulate/inhibit its own release)

Negative feedback

negative feedback means that some feature of hormone action, directly or indirectly, inhibits further secretion of the hormone.
 Release of hormone A stimulates the release of hormone B → Hormone B inhibits the release of hormone A.
 for example, LH from pituitary stimulates the testes to produce testosterone which in turn feeds back and inhibits LH secretion.
 Guyton Explanation:
 ✓ Negative Feedback Prevents Overactivity of Hormone Systems. Although the plasma concentrations of many hormones fluctuate in response to various stimuli that occur throughout the day, all hormones studied thus far appear to be closely controlled. In most instances, this control is exerted through negative feedback mechanisms that ensure a proper level of hormone activity at the target tissue.
 ✓ After a stimulus causes release of the hormone, conditions or products resulting from the action of the hormone tend to suppress its further release. In other words, the hormone has a negative feedback effect to prevent over secretion of the hormone or over activity at the target tissue.
 ✓ The controlled variable is sometimes not the secretory rate of the hormone but the degree of activity of the target tissue. Therefore, only when the target tissue activity rises to an appropriate level will feedback signals to the endocrine gland become powerful enough to slow further secretion of the hormone.

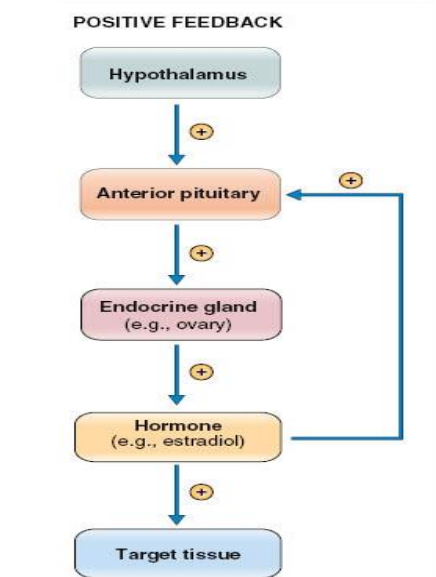
- ✓ Short loop: the feedback is directly on the chief gland secreting it
- ✓ Long loop: when the feed back is all the way back to the hypothalamus
- ✓ Ultra-short loop: the gland secretes hormone and that'll directly act on it "autocrine"



Positive feedback

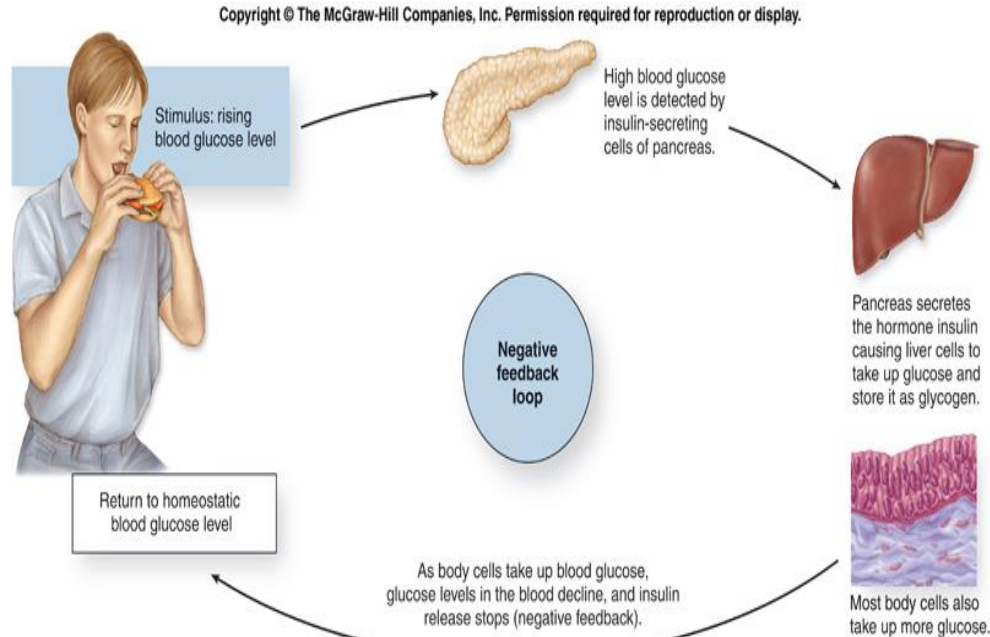
means that some feature of hormone action causes more secretion of the hormone.
 Release of hormone A stimulates the release of hormone B → Hormone B stimulates further release of hormone A.
 For examples: include LH stimulation of estrogen which stimulates LH surge at ovulation.

"Self- augmenting"
Hormone release will further increase its secretion
 E.g. oxytocin will cause uterus contraction and lead to cervix expansion which will further increase oxytocin release



Cont.

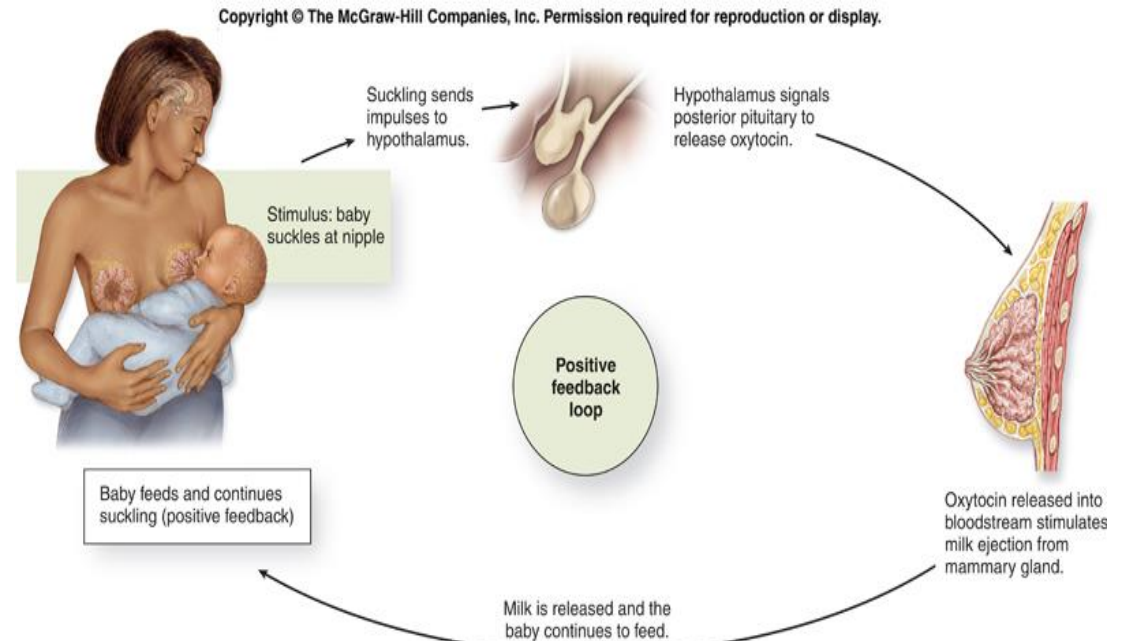
Negative feedback



(a) Negative feedback

This man is eating, so for sure the blood glucose level will elevate, this will stimulate B cells in pancreas to release insulin → take the glucose inside the liver and stores it as glycogen. also other tissue will open the channels responsible for glucose transport take up more glucose, Then the glucose blood level drop, so I don't need insulin any more → it will inhibited.

Positive feedback



(b) Positive feedback

- ✓ Baby sucking will stimulate the nipple receptors which send impulses to brain that stimulate the release of prolactin and oxytocin, oxytocin cause contraction so the milk released and the baby do more sucking and more positive feedback.
- ✓ Also the operation of labor consider as positive feed back

Summary

Anterior (Adenohypophysis):

originates from Rathke's pouch (pharyngeal epithelium)

Anterior pituitary gland is connected to hypothalamus by portal system: hypothalamic-hypophysial portal vessels.

Anterior pituitary contains 5 cell types: (Somatotrops: GH 40%, Corticotrops:ACTH 20%, Thyrotrops:TSH, Gonadotropes: LH & FSH, Lactotropes: PRL)

Posterior (Neurohypophysis):

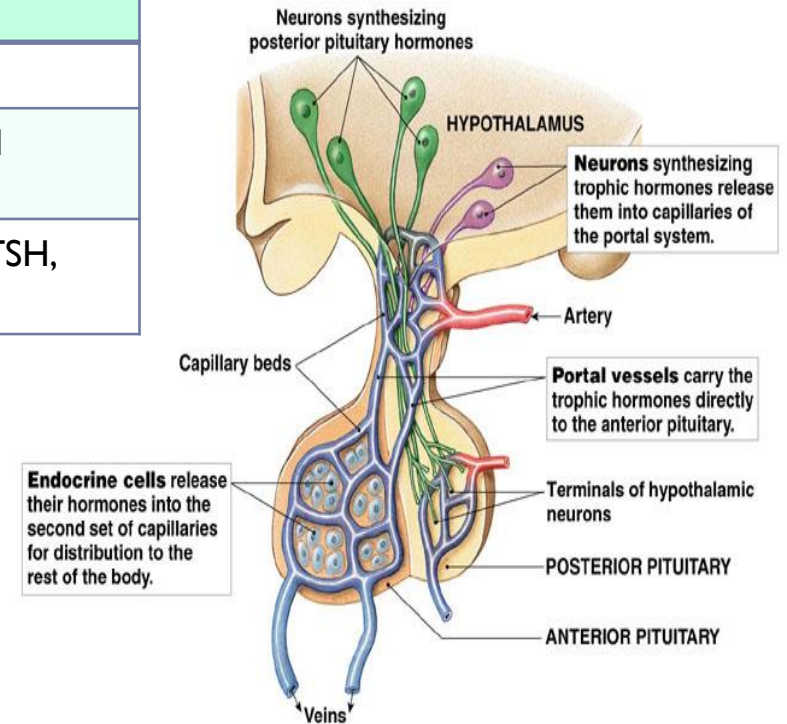
Originates from hypothalamus (glial-type cells)

Hormones synthesized in the supraoptic and paraventricular nuclei of the hypothalamus and released in posterior pituitary

Secrete oxytocin and vasopressin

Hypothalamic control of pituitary secretions

Hormonal	secretion of hypothalamus (The anterior pituitary)
Nervous	signals from hypothalamus (Posterior pituitary)



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Fig. 7-16

Summary

Hypothalamic releasing and inhibiting hormones

Growth hormone releasing hormone (GHRH)	Stimulates release of growth hormone
Growth hormone inhibiting hormone (GHIH) also called Somatostatin	Inhibits release of growth hormone
Thyrotropin-releasing hormone (TRH)	Stimulates release of thyroid stimulating hormone (TSH)
Corticotropin-releasing hormone (CRH)	Stimulates release of adrenocorticotropin hormone (ACTH)
Gonadotropin releasing hormone (GnRH)	causes release of the 2 gonadotropic hormones: <ul style="list-style-type: none"> ✓ Luteinizing (LH) ✓ follicle-stimulating hormone FSH
Prolactin inhibitory hormone (PIH) also known as Dopamine	Inhibits prolactin secretion

Feedback mechanism

Positive feedback	Negative feedback
<ul style="list-style-type: none"> -Release of hormone A stimulates the release of hormone B -Hormone B stimulates further release of hormone A 	<ul style="list-style-type: none"> -Release of hormone A stimulates the release of hormone B -Hormone B inhibits the release of hormone A

Thank you for checking our work!

اعمل لترسم بسمة، اعمل لتمسح دمة، اعمل و أنت تعلم أن الله لا يضيع أجر من أحسن عملا.

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شروق الصومالي



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