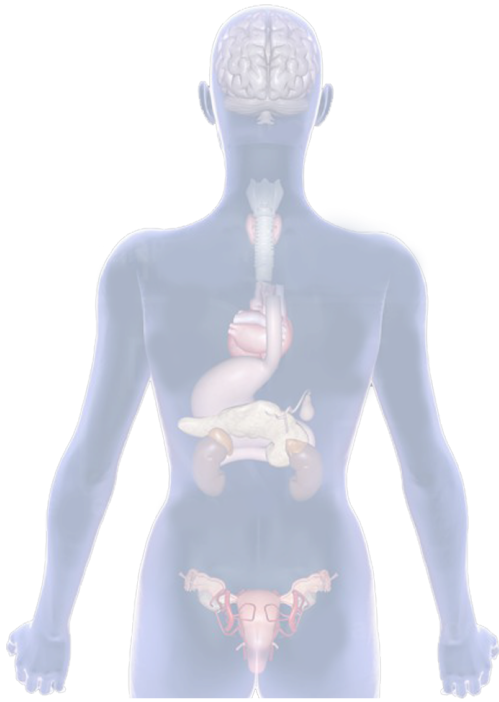
435 team

#2,3,4&5 Physiology of Pituitary Gland

Objectives:



- List the functional parts (lobes) of the pituitary gland.
- Describe the relationships of the hypothalamus to the anterior and posterior pituitary glands.
- Describe the hypothalamo-hypophyseal portal system.
- Explain the physiological significance of the hypothalamo-hypophyseal portal system in regulating anterior pituitary functions.
- List the hypothalamic hormones and their target cells in the anterior pituitary.
- List the anterior pituitary hormones and their target tissues.
- Summarize the functions of the anterior pituitary hormones.
- Outline the different feedback loops regulating secretion of anterior pituitary hormones.
- Summarize the direct and indirect physiological actions of growth hormone.
- Outline neuroendocrine control of growth hormone secretion
- List stimuli that increase and decrease growth hormone secretion
- Describe the role of prolactin in milk secretion.
- Discuss regulation of prolactin secretion.
- ADH: Physiological functions & Control of secretion
- Oxytocin:Physiological functions& Control of secretion

We recommend u to study anatomy and histology of pituitary gland first.

Important
Male's notes
Female's notes
Extra

Revised by
خولة العماري & هشام الغفيلي

Resources: 435 male's & female's slides + guyton
Editing file: click Here

Overview of Hypothalamus

Hypothalamus:

- *Hypothalamus* is located at the base of the brain. It is part of the limbic system, which controls the autonomic nervous system and the endocrine systems.
- One of the most important functions of the *hypothalamus* is to link the nervous system to the endocrine system via the *pituitary gland* (hypophysis).
- Secretes **releasing hormones** to cause *the pituitary* to release hormones
- Secretes **inhibiting hormones** to turn off secretion of pituitary hormones

Hypothalamic control over the Endocrine System:

1. Secretion of regulatory hormones to control activity of *anterior pituitary gland* → *Anterior pituitary gland* → Hormones secreted by *anterior pituitary gland* control other endocrine organs.
2. Production of ADH and oxytocin → *Posterior pituitary gland* → Release of ADH and oxytocin.
3. Control of sympathetic output to *adrenal medullae* → *Adrenal medulla* → Secretion of epinephrine and norepinephrine.

Overview of Pituitary Gland

The pituitary gland is composed of two distinct components:

(1) The *anterior pituitary gland,* or ***adenohypophysis***, made up of glandular tissue, which is derived embryologically from an upward invagination of cells from the oral cavity (Rathke's pouch).

(2) The *posterior pituitary gland,* or ***neurohypophysis***, which is derived from a down-growth of cells from the third ventricle of the brain.The hypothalamus is connected to the pituitary gland by a thin stalk called the **infundibulum**.

In the posterior lobe of pituitary gland, the hormones are synthesized in the hypothalamus, travel through the nerves and then secreted into the posterior pituitary gland. That means that the hormones are synthesized outside the posterior gland and stored and secreted from the posterior pituitary gland.

BUT the anterior pituitary gland is a real gland that has different types of cells and is regulated by hormones (not nerves) that are secreted by the hypothalamus which are released in the portal system and goes to the anterior pituitary and affect different types of cells and each of them has its own hormones.

if there's any tumor in the anterior pituitary gland and this tumor enlarges to a certain size > it will cause pressure on the optic chiasma and will disturb the lateral vision (Bilateral loss of vision)

Almost all secretions by the pituitary are controlled by either:

-Hormonal secretion of hypothalamus(The anterior pituitary)

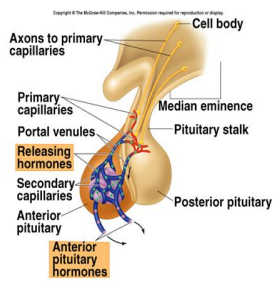
or

- Nervous signals from hypothalamus(Posterior pituitary).

The hypothalamus control the anterior pituitary gland through regulatory hormones. And control the posterior pituitary gland through nervous control.

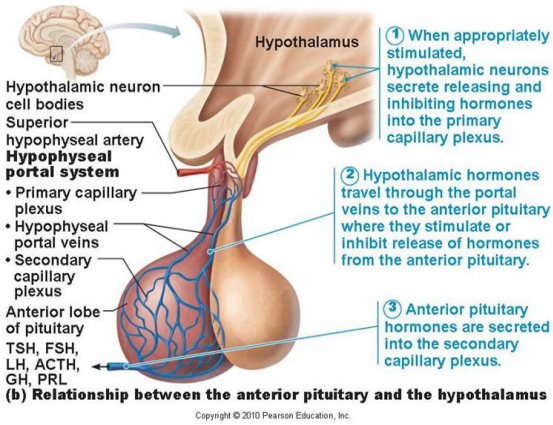
Anterior Pituitary(Adenohypophysis)

Relation of the hypothalamus to anterior pituitary:



- 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 vessels")

Special types of cells (neurons) in the hypothalamus secretes different types of hormones they are either stimulatory or inhibitory, these neurons sends axons to median eminence "the lower part of the hypothalamus just above the pituitary gland, part of it is in the infundibulum or stalk" here, the hormones will be absorbed through blood capillaries which are called the primary capillaries. (neuroendocrine type because the hormones are from nervous system to the blood)Hormones are released from the axons coming from the hypothalamus into the primary capillaries. Then these regulatory hormones will go to the secondary capillaries and will then go to portal veins.



Adenohypophyseal Hormones:

- The six hormones of the *adenohypophysis*:

Growth hormone**(GH),**Thyroid-stimulating hormone **(TSH),** Adrenocorticotropic hormone **(ACTH) , FSH, LH,** and Prolactin **(PRL),**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 releasing and inhibiting hormones:

Growth hormone releasing hormone (GHRH): Stimulates release of growth hormone	**Thyrotropin-releasing hormone (TRH):** Stimulates release of thyroid stimulating hormone (TSH) and prolactin (PL).	**Corticotropin-releasing hormone (CRH):** Stimulates release of adrenocorticotropin hormone (ACTH).	**Gonadotropin releasing hormone (GnRH):** causes release of the 2 gonadotropic hormones: (LH) & (FSH).	**Prolactin inhibitory hormone (PIH)** also known as Dopamine: Inhibits prolactin secretion.
Growth hormone inhibiting hormone (GHIH) also called Somatostatin: inhibits release of growth hormone				**Prolactin releasing factor or hormone (PRH)?* :** Stimulates prolactin secretion.

* The main control is inhibitory but TRH stimulate PRL indirectly.

Adenohypophyseal Cells & Hormones: (5 Cell types & 6 Hormones)

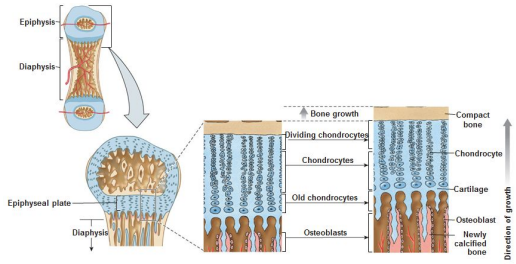
Cell	Hormone	Physiologic Actions
Corticotropes	Adrenocorticotropic hormone (ACTH) *(20% of anterior pituitary secretions)*	Stimulates production of glucocorticoids and androgens by the adrenal cortex maintains size of zona fasciculata and zona reticularis of cortex) ACTH is very important for stimulation of the cortex of adrenal glands. The cortex releases vital hormones, any problem in these hormones will lead to a shock and the patient may die in a very short period of time. Shutdown of adrenal gland> they might die immediately if not treated by electrolytes of hormones.
Thyrotropes	Thyroid-stimulating hormone (TSH)	Stimulates production of thyroid hormones, T4 and T3, by thyroid follicular cells;maintains size of follicular cells
Gonadotropes	1)Follicle-stimulating hormone (FSH) 2) Luteinizing hormone (LH)	Stimulates development of ovarian follicles; regulates spermatogenesis in the testis. Causes ovulation and formation of corpus luteum in the ovary; stimulates production of estrogen and progesterone by the ovary; stimulates testosterone production by the testis. In females: GnRH stimulates the anterior pituitary gland to release LH and FSH which will acts on the ovaries >> the ovaries will secrete in response Estrogen and progesterone.Normally estrogen and progesterone are like other hormones when their level rises in the blood they will cause a negative feedback BUT there's an exception here, ESTROGEN at certain time in the cycle (day 12-14) it causes positive feedback, why? Because of ovulation. Rising estrogen level will stimulates LH to be released. LH ترتفع بشكل عالي جدا وتسوي الاوفيوليشن. In males: FSH works on sertoli cells to stimulate spermatogenesis, at the same time the sertoli cells will secrete a hormone called inhibin which will cause negative feedback to anterior pituitary and inhibits FSH secretion. LH stimulates Leydig cells which are responsible for secreting testosterone >> when high it can produce its negative feedback.FSH and testosterone are important for spermatogenesis.
Mammotropes, Lactotropes	Prolactin (PRL)	Essential for milk production by lactating mammary gland
Somatotropes	Growth hormone (GH) *(40% of anterior pituitary secretions)*	See the next page to understand better Stimulates postnatal body growth; stimulates secretion of **IGF-1**; stimulates triglyceride lipolysis; inhibits actions of insulin on carbohydrate and lipid metabolism Somatotrophs are the most abundant type of cells. Why is it called somato? Because it secretes growth hormone and this GH goes to all the body. Somato=body.

Growth Hormone(GH):

Functions of growth hormone:

1)**Growth Action(long term):**Promotes Growth of Many Body tissues(↑cellular sizes,↑ mitosis, ↑ tissue growth &↑ organ size) except the brain.

Growth actions are not direct, but they are indirectly mediated via the generation of polypeptides called **somatomedins** or insulin-like growth factors (IGFs). Somatomedins are secreted by the liver.



- ***HOW GH promotes the growth of bone & Cartilage????***

Before epiphyseal closure *in childhood* → *Promotion of linear growth.*	after epiphyseal closure in late adolescence → increase bones thicken and total bone mass.
Under the influence of GH, the *chondrocytes* in the growth plate are stimulated → Increases amino acids uptake by chondrocytes → Stimulates protein synthesis by chondrocytes → Stimulates mitosis of chondrocytes → This effect causes an increase in number of chondrocytes (i.e., hyperplasia) → Stimulates expansion in size of the chondrocytes (i.e., hypertrophy). Thus, IGF-1 leads to elongation of the bones. • Chondrocytes cultured outside the body fails to proliferate or enlarge in response to growth hormone.cuz GH needs thyroid hormones as permissiveness.	when there is no remaining epiphyseal cartilage and the shafts have fused with the epiphyses , GH can no longer cause lengthening of the long bones. Because GH also stimulates osteoblasts, which deposit new bone → bones thicken and total bone mass is increased by GH even after epiphyseal closure.

2)Metabolic actions(short term): Metabolic actions of growth hormone are directly induced by the GH through its receptor.

1- Promotion of protein deposition in tissues:	2- Promotion of fat utilization for energy:	3- Impairment of carbohydrate utilization for energy:
BY: •enhancement of amino acid transport through the cell membrane. • enhancement of RNA translation to cause protein synthesis by the ribosomes. •Increased nuclear transcription of DNA to form RNA. •Decreased catabolism of protein and amino acids"protein sparer". SUMMARY:Growth hormone enhances almost all facets of amino acid uptake and protein synthesis by cells, while at the same time reducing the breakdown of proteins	•release of fatty acids from adipose tissue →increasing the FFA in the body fluids →conversion of FFA to acetyl coenzyme A. •High GH levels might cause excessive fat mobilization leading to acetoacetic acid formation by the liver → causing ketosis → fatty liver. GH causes lipolysis via inhibition of lipoprotein lipase	•GH decreases the uptake and utilization of glucose by many insulin-sensitive cells, such as muscle and adipose tissue ,Also it increases the synthesis of glucose by the liver→ As a result, blood glucose concentration tends to rise and insulin secretion increases to compensate for the GH-induced insulin resistance. •Excess secretion of growth hormone =metabolic disturbances very similar to patients with type II diabetes (diabetogenic effect).

3)Other functions:

- Increases calcium absorption from GIT.
- Strengthens and increases the mineralization of bone.
- Retention of Na+ and K+.
- Increases muscle mass.
- Stimulates the growth of all internal organs excluding the brain.
- Contributes to the maintenance and function of pancreatic islets.
- Stimulates the immune system.

Necessity of insulin and carbohydrate for the growth promoting action of growth hormone: *boy's slides only*

- Animal + lacks of pancreas → no growth hormone effect
- Animal + diet without carbohydrate → no growth hormone effect
- Carbohydrate and insulin → production of energy
- Insulin : transport of amino acids into cells and glucose transport stimulation.

Control of Growth Hormone Secretion:

The precise mechanisms that control secretion of growth hormone are not fully understood, but several factors related to a person's state of nutrition or stress are known to stimulate secretion

Stimulate Growth hormone secretion	inhibit Growth hormone secretion
Growth hormone releasing hormone(GHRH)	Growth hormone Inhibitory hormone(GHIH)(somatostatin)
Decrease blood glucose:**hypoglycemia**,fasting لان هرمون النمو يزيد مستوى السكر بالدم فكتعويض عند انخفاض السكر يفرز	increase blood glucose: **hyperglycemia** عشان كذا نحرص على الاطفال مايأكلون سكر كثير لكي ينمو جيدا
Decrease Blood free fatty acid لان هرمون النمو يزيد مستوى الدهون بالدم فكتعويض عند انخفاض مستوى الدهون بالدم يفرز	increase Blood free fatty acid
Intake of protein or amino acids (Arginine) After a protein meal, increased plasma levels of GH would favor the utilization of amino acids for protein synthesis.	IGF-1
starvation, especially with severe *protein deficiency* Clearly, the increase in GH during fasting would be beneficial because GH enhances lipolysis and decreases peripheral utilization of glucose	Senescence الشيخوخة
during the first 2 hours of ***deep*** *sleep (more in children)* GH peak at night and most of its action at the 1st hour of sleep	
Ghrelin (stomach)(hunger hormone)	
Stress conditions: e.g. trauma or emotions	
Muscular exercise	
Puberty	
Androgen & estrogens	

الستميوليترس نفسها ما تفرز الGH، اللي يصير إنه:

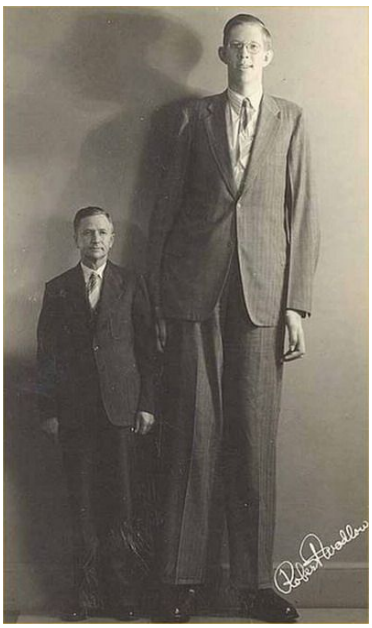
Stimulus (eg. low glucose) → detected by Hypothalamus → GHRH → Ant. Pituitary → GH

GH is measured by Radioimmunoassay & ELISA, GH goes up and down through the day, so better to see IGF-1.

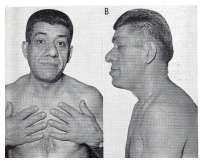
Abnormalities of GH secretion:

<table>
<tr><th colspan="2">Due to increase GH secretion</th><th>Due to decrease GH secretion</th></tr>
<tr><th>In children “ Gigantism” العملقة</th><th>In adult “Acromegaly”ضخامة الأطراف</th><th>pituitary dwarfismالتقزم</th></tr>
<tr>
<td>as all body tissues grow rapidly, including bones.Height as it occurs before epiphyseal fusion of long bones with their shafts. The person will develop Hyperglycemia (diabetes).

•Cause:Excessive production of GH from a GH-secreting pituitary tumour (somatotropes tumours)in childhood

  </td>
<td>person can’t grow taller, BUT soft tissue continue to grow in thickness (skin, tongue, liver, kidney, …).

 
•Cause:Excessive production of GH from a GH-secreting pituitary tumour (somatotropes tumours)in adulthood.

 
•Clinical features:
- Excessive soft tissue growth.
- Enlargement of bones of hands(spade like) & feet.
- Enlargement of membranous bones including cranium, nose, forehead bones, supraorbital ridges.
 
- Protrusion of lower jaw.
- Ride-spaced teeth (widening of incisor spaces).تباعد المسافه بين الاسنان
- Hunched back (kyphosis) (enlargement of vertebrae).
-Deepening voice.
- Macroglossia.ضخامة اللسان</td>
<td>Dwarfism means failure in growth (i.e., growth retardation).

•Causes:
-It is caused usually by defective GH axis (hypothalamic-anterior pituitary-liver-target organs axis)such as decreased secretion of:
GHRH,human growth hormone (HGH) or insulin-like growth factors (IGF-I). There may be a defect in the GH receptors.

-other cause :deficiency of thyroid hormones in childhood.because Thyroid hormone have permissive effect on growth hormone action.</td>
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</table>

Prolactin(PL):

Functions	**Major function is milk production, Effect on the breast:** • Increases mRNA to increase production of casein and lactalbumin These proteins are commonly found in mammalian milk. •Inhibits the effects of gonadotropins → inhibits the actions of FSH and LH thus ovulation is often inhibited by breast feeding عشان كذا المرضع تنقطع عنها الدوره **Other effects:** • Stimulates the secretion of dopamine in median eminence (inhibits its own secretion) •In males, PL is involved in testicular function.
Control of secretion	**Inhibition of PL secretion:** By prolactin inhibitory hormone(PIH) **(Dopamine)** (Hypothalamic control of PL secretion is performed primarily by dopamine. Thus, pituitary stalk lesions cause hyperprolactinemia.Because of the absence of the inhibitory path way (dopamine or PIH) coming from the hypothalamus.) **Stimulation of PL secretion:** Exercise ,Surgical, psychological stress , Stimulation of the nipple(Suckling response inhibits PIH release), Sleep, Pregnancy and TRH[1].

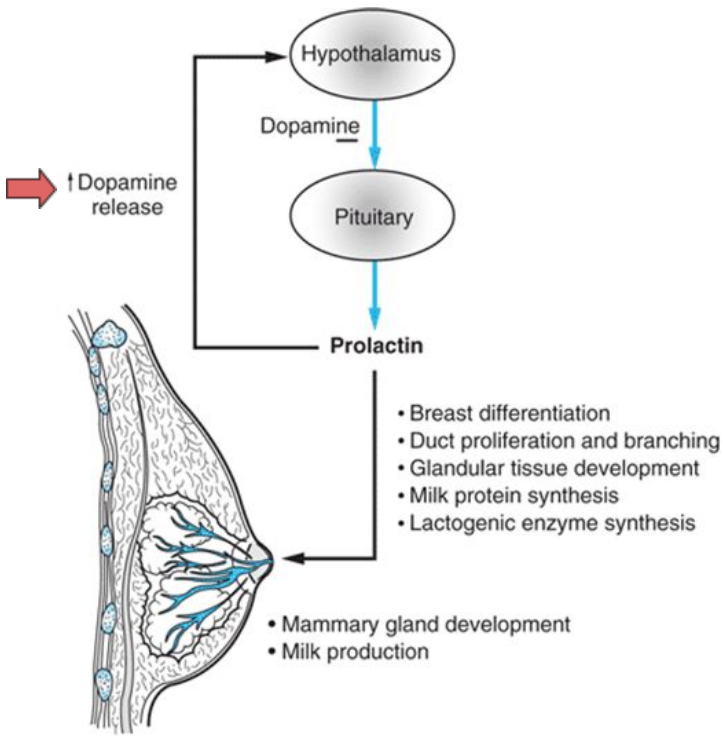
Prolactin is the only hormone that is always inhibited, why? Because we don't need it most of the time. "needed only in lactating mothers"

Prolactin can be elevated by stress. Stress can affect the CNS ويلخبط كل الهرمونات الموجودة بالهايبوثالامس

Increased level of prolactin may cause infertility (reversible infertility) so they give them dopamine to suppress the release of prolactin.

High PL could cause infertility in both male and female (by inhibiting GnRH)

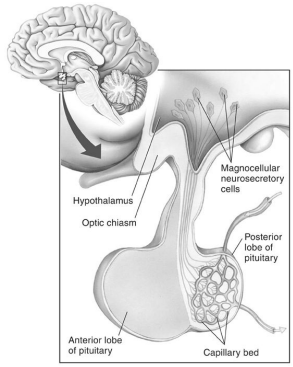
dopamine inhibits PL بيجيكم سؤال



[1] Thyrotropin-releasing hormone (**TRH**), also called thyrotropin-releasing factor (TRF) or thyroliberin, is a releasing hormone, produced by the hypothalamus, that stimulates the release of thyrotropin (thyroid-stimulating hormone or TSH) and prolactin from the anterior pituitary

Posterior Pituitary (Neurohypophysis)

Relation of the hypothalamus to posterior pituitary:



- The posterior lobe is a downgrowth of hypothalamic neural tissue.
- Has a neural connection with the hypothalamus *(hypothalamic-hypophyseal tract).*
- Posterior pituitary Does not synthesize hormones & Consists of axon terminals of hypothalamic neurons.
- Magnocellular neurons in **paraventricular and supraoptic** nuclei of the hypothalamus secrete **oxytocin** and **ADH** also known as Vasopressin ,They are then transported in secretion granules down axons to nerve terminals in the posterior pituitary gland.These endings lie on the surfaces of capillaries.

The hypothalamic control of posterior pituitary is nervous.Supraoptic nuclei secrete ADH mainly.Paraventricular nuclei secrete oxytocin mainly.They travel through nerve axons until they reach to posterior pituitary, they are stored in the ending of the nerves until there's a stimulus coming through the nervous system>>stimulates the release of these hormones to blood vessels to do the action.

Antidiuretic hormone(Vasopressin):

the major hormone concerned with regulation of body fluid osmolarity.

Synthesis of ADH :

- It is synthesized as pre-prohormone and processed into a nonapeptide
- ADH synthesized in the cell bodies of hypothalamic neurons(supraoptic nucleus)
- ADH is stored in the posterior pituitary

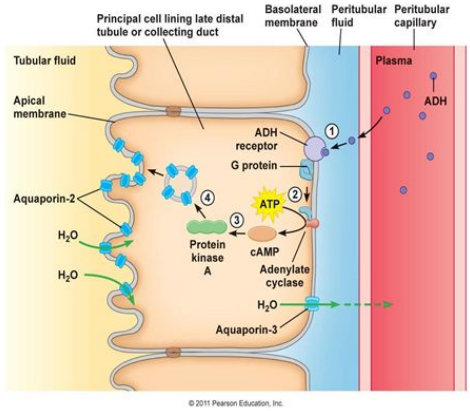
Receptors of ADH: " V from vasopressin "

- **V1A receptors** mediate vasoconstriction يفرز لما يكون فيه هايبوتنشن ونحتاج نرفع ضغط الدم,V1A receptors also found in the liver glycogenolysis.
- **V1B receptors** are unique to anterior pituitary and mediate increased adrenocorticotropic hormone(ACTH) secretion.
- **V2 receptors** are located in the principle cells in distal convoluted tubule and collecting ducts in the kidneys.

V2 receptors absorb water from urine مثلا لما تكونين صايمه وعندك جفاف فهو يحافظ على الماء الين ا الشخص يلقى مويه

Mechanism of action of ADH:Antidiuresis

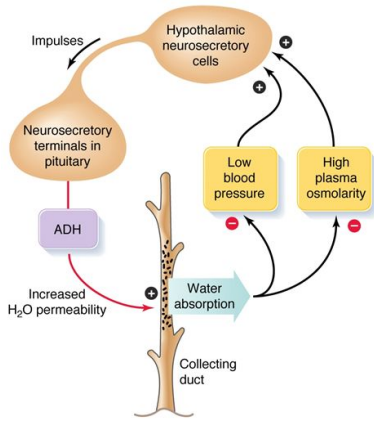
ADH binds to V2 receptors on the *principle cells* of the distal convoluted tubules and collecting ducts → Via adenylate cyclase/cAMP induces production and insertion of **aquaporin2** into the luminal membrane and enhances permeability of cell to water → Increased membrane permeability to water permits back diffusion of free water, resulting in increased urine osmolality (concentrates urine).



Control of ADH Release:

•Osmotic pressure(Osmoreceptor mediated):

(Osmoreceptors located in the hypothalamus)



•If plasma osmolality is directly increased by administration of solutes, only those solutes that do not freely or rapidly penetrate cell membranes, such as sodium, cause ADH release.

•Conversely, substances that enter cells rapidly, such as urea, do not change osmotic equilibrium and thus do not stimulate ADH release.

•ADH secretion is very sensitive to changes in osmolality thus Changes of 1-2% result in increased ADH secretion.

•**To sum up:**

↑osmolality → ↑ADH secretion

↓osmolality → ↓ADH secretion

•Blood volume (baroreceptors mediated (vagus nerve)):

•Hypovolemia is perceived by *"pressure receptors"* (carotid and aortic baroreceptors, and stretch receptors in left atrium and pulmonary veins).

•Normally, pressure receptors tonically inhibit ADH release.

•Decrease in blood pressure induces ADH secretion by reducing input from pressure receptors →The reduced neural input to baroreceptors relieves the source of tonic inhibition on hypothalamic cells that secrete ADH.

•Sensitivity to baroreceptors is less than osmoreceptors senses 5 to 10% change in volume.

•**To sum up:**

↑blood pressure → ↓ADH secretion

↓blood pressure → ↑ADH secretion

Other stimuli that affect ADH secretion:

•**Stimuli that increase ADH secretion:** Pain_ Nausea_Surgical stress_Emotional stress

•**Stimuli that decrease ADH secretion:**Alcohol intake . اللي يشربون كحول كثير يصير لهم تبول لا ارادي

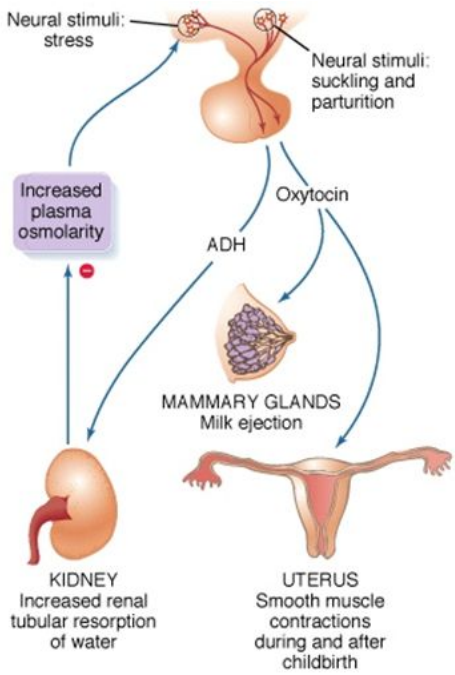
Table summarizes the major characteristics of osmoreceptors and baroreceptors:

Receptors	Osmoreceptors	Baroreceptors
Location	Anterolateral hypothalamus	Carotid sinus & aortic arch
Value Measured	Plasma osmolality	Circulating volume
ADH Release Stimulated By	Activation of receptor	Suppression of receptor
Change Required for Action	1% above 280 mosm/kg	10-15% decrease
Resulting Amount of ADH	Small	Large (vasoconstriction)
Override Other?	no	yes

Oxytocin:

Synthesis of Oxytocin	Oxytocin is synthesized in the cell bodies of hypothalamic neurons(paraventricular nucleus) → stored in the posterior pituitary
Functions	•**Suckling during breast-feeding :**Contracts the ***myoepithelial cells*** that lie outside the alveoli of the mammary glands. Some of the female will secrete Oxytocin in response to crying baby so this will increase the milk secretion or even lake of the milk if the breast is full already •**Childbirth (Parturition):** In late pregnancy, ***uterine smooth muscle*** (myometrium) becomes sensitive to oxytocin (positive feedback).Oxytocin Causes Contraction of the Pregnant UterusBreast-feeding and birth are always **POSITIVE** feedback.
Other stimuli	•In humans, oxytocin is thought to be released during(hugging, touching, and orgasm in both sexes) that's why it called LOVE hormone. •Release increased during stress. •Release inhibited by alcohol. •In males secretion increases at time of ejaculation (contraction of smooth muscle of vas deferens).
Autism	Autistic people have significant low plasma conc of Oxytocin. Its found quite elevated in those whom are socially successful.

Summary of posterior pituitary hormones actions



Important questions

الي بتجاوب عليها بعطيها هديه :)

Q1): suppose that we cut the connection between the hypothalamus and the posterior pituitary glands, what will happen to ADH and oxytocin? And why?

a) ADH and oxytocin will be secreted immediately.

b) ADH and oxytocin will not be secreted at all.

c) ADH and oxytocin will be secreted BUT after a while (few days)

The answer is C, why? The signals come from the brain and stimulates the cells In hypothalamus that synthesize these hormones, when we cut the pituitary glands, signals won't reach there and the stored hormones will stay and won't be secreted because there's no signals.

When a stimulus comes, the hormones will be synthesized again and this will take time (few days), then it will be secreted from the nerve ending المقطوعة through the blood.

Q2) What will happen if we moved the pituitary gland to another position (away from hypothalamus) ?

Its secretion rates of the different hormones (except for prolactin) fall to very low levels , why ? because Almost all secretion by the pituitary is controlled by either hormonal or nervous signals come from the *hypothalamus.*

SUMMARY

General comparison between Anterior and posterior pituitary glands

Taken from 434Team

Pituitary	Anterior (Adenohypophysis)	Posterior (Neurohypophysis)
Origin	Rathke's pouch (oral cavity)	Down growth of hypothalamic neural tissue
Hormones released	GH, TSH, FSH, LH, ACTH, PRL	Oxytocin, ADH
Hormones synthesis	Hormones are synthesized in anterior pituitary	Synthesized in hypothalamus and stored in posterior pituitary
Blood supply	Superior hypophyseal	Inferior hypophyseal
Hypothalamic control	Hormonal signals (releasing and inhibitory hormones)	Neural signals

Anterior pituitary hormones:

Prolactin	
Functions	**Major function is milk production, Effect on the breast:** - Increases production of casein and lactalbumin - Inhibits the effects of gonadotropins. **Other effects:** - Stimulates the secretion of dopamine in median eminence (inhibits its own secretion)
Control of secretion	**Inhibition of PL secretion:** PIH (Dopamine) **Stimulation of PL secretion:** Exercise ,Surgical, psychological stress , Stimulation of the nipple, Sleep, Pregnancy and TRH.

SUMMARY

Growth Hormone

<table>
<tr><td>MOA</td><td colspan="2">-Direct (short term effect): on its own receptors.

- Indirect(long term effect): by IGF (insulin like growth hormone).
Mechanism of Bone growth:
Before epiphyseal closure in childhood → Promotion of linear growth.
after epiphyseal closure in late adolescence → increase bones thicken and total bone mass,in membranous bones like jaw & skul.</td></tr>
<tr><td rowspan="4">Functions</td><td colspan="2">A. Long term effect: promotion of growth (↑cellular sizes, ↑mitosis, ↑ tissue growth & organ size).</td></tr>
<tr><td rowspan="3">B. Short term effect: metabolic effects:</td><td>• Protein metabolism: Anabolic.
- ↑ rate of protein synthesis in all cells</td></tr>
<tr><td>• CHO metabolism: Hyperglycemic
- ↑glucose production by the liver (↑gluconeogenesis)
- ↓ glucose uptake by tissues</td></tr>
<tr><td>• Fat metabolism: Catabolic.
- ↑mobilization of FFAs from adipose tissue stores. Conversion of FFT to acetyl CoA to provide energy</td></tr>
<tr><td>Other effects</td><td colspan="2">- Increases calcium absorption -> Strengthens of bones.
- Retention of Na+ and K +
- Increases muscle mass
- Stimulates the immune system
- Stimulates the growth of all internal organs excluding the brain</td></tr>
<tr><td>Control of GH secretion</td><td>Increase GH secretion:
-GHRH
-.Hypoglycemia
-FFAs ↓
- Muscular exercise.
- During sleep
- Intake of protein or amino acids
- Starvation & protein deficiency</td><td>Decrease GH secretion:
-GHIH
-glucose intake
-FFAs ↑</td></tr>
<tr><td>Abnormalities of GH secretion</td><td>↑ GH secretion:
”In children “ Gigantism
In adult “Acromegally</td><td>↓ GH secretion:
pituitary dwarfism</td></tr>
</table>

SUMMARY

Posterior pituitary hormones:

ADH (Vasopressin)	
synthesis	•It is synthesized as pre-prohormone and processed into a nonapeptide. •ADH synthesized in the cell bodies of hypothalamic neurons(supraoptic nucleus). •ADH is stored in the posterior pituitary.
Receptors	**-V1a**: Vasoconstriction & liver glycogenolysis **-V1b**: are unique to anterior pituitary (↑ Adrenocorticotropics release) **-V2**: in main cells of distal convoluted tubules & collecting ducts
MOA (V2)	binds to its receptor in kidney →triggers cAMP system to synthesize aquaporin Protein →the Protein is released into lumen & causes massive change in cells permeability to H2O, allowing huge amount of H2O into the circulation, resulting in concentrated Urine.
Control of ADH release	• **osmotic pressure:-**by osmoreceptors ↑ osmolality→ ↑ ADH secretion ↓ osmolality→ ↓ ADH secretion • **Blood volume:-**By baroreceptors in ICA/aortic arch & stretch receptors in left atrium ↑ blood pressure→ ↓ ADH secretion ↓ blood pressure → ↑ ADH secretion
Other factor that affect ADH secretion	**Stimulants:-** Pain_ Nausea_Surgical stress_Emotional stress **Inhibitors:-** Alcohol intake .

Oxytocin	
Synthesis of Oxytocin	Oxytocin is synthesized in the cell bodies of hypothalamic neurons(paraventricular nucleus) → stored in the posterior pituitary
Functions	-very strong uterine contraction (delivery) -triggers milk ejection (control of myoepithelial cells of milk alveoli)
Other stimuli	•In humans, oxytocin is thought to be released during(hugging, touching, and orgasm in both sexes) •Release increased during stress •Release inhibited by alcohol •In males secretion increases at time of ejaculation (contraction of smooth muscle of vas deferens)
Autism	Autistic people have significant low plasma conc of Oxytocin. Its found quite elevated in those whom are socially successful

MCQs

1.Oxytocin is secreted by:
A- para optic nuclei
B- para ventricular nuclei
C- posterior pituitary
D- paraventricular

2. Excess secretion of which hormone have type II diabetes like metabolic disturbance:
A- GH
B- TSH
C- ACTH
D- PL

3. It is indispensable for the ovulation to occur:
A- FSH
B- LH
C- Prolactin
D- Estrogen

4. Which one of the following is wrong regarding the short term effect of GH:
A- ↑ rate of glucose utilization throughout the body
B- ↑ mobilization of FFAs from adipose tissue stores
C- ↓ protein catabolism
D- ↑ insulin resistance (↑FFA)

5. What's the effect of Ghrelin on Growth hormone:
A- ↑GH secretion
B- ↓ GH secretion
C- No effect

6. The cause of Gigantism is:
A- Decrease of GH during childhood
B- Increase of Prolactin during childhood
C- Decrease of GH during adulthood
D- Increase of GH during childhood

7.Patient came to the hospital with enlarged hands and nose,wide supraorbital ridge and Protruded lower jaw and his length is normal. The patient most likely has:
A- Gigantism
B- Prolactinoma
C- Acromegally
D- cushing's

8.Regarding to previous question what is the cause of your answer:
A- Decrease of GH during childhood
B- Increase of Prolactine during childhood
C- Decrease of GH during adulthood
D- Increase of GH during adulthood

9. Which one of the following is NOT a function of prolactin hormone:
A- Stimulates the secretion of dopamine in median eminence
B- Enhance the effects of gonadotropins
C- Increases production of casein and lactalbumin

10. Man presented with galactorrhea, gynecomastia and he's infertile. Which one of the following this patient most likely has:
A- Gigantism
B- Prolactinoma
C- Acromegaly
D- cushing's

11. The anterior pituitary secretes:
A- Oxytocin
B- Endorphins
C- ADH
D- TRH

12. The pituitary gland secretes its hormones into:
A- Arteriole
B- Venule
C- Axons
D- Lymphatic

13.The most abundant cell type in anterior pituitary lobe is:
A- Somatotrope
B- Corticotrope
C- Thyrotrope

14.Which of the following hormone is enzymatically spilt into MSH and ACTH:
A- CRH
B- GnRH
C- pro-opiomelanocortin

Answer key:

1 (B) | 2 (A) | 3 (B) | 4 (A) | 5 (A) | 6 (D) | 7 (C) | 8 (D) | 9 (B) | 10 (B) | 11 (D)| 12 (B)| 13 (A)| 14(C)

Physiology 435 team

Thanks to this amazing team!

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