لا حول ولا قوة إلا بالله ويتبعه بلا إله إلا الله

Endocrine System

The endocrine system has a endocrine glands or secretory cells or organs

Endocrine glands are 2 types

- Exocrine glands
- Endocrine glands

Exocrine glands

Slivary glands → exocrine glands

What is the function of slivary glands?!

They release sliva through duct to release it in to the oral cavity

We have also the exocrine gland of the pancreas that has a duct which empties in the Gastrointestinal tract

We have also sweat glands which has a duct and releases their content on the surface

of the body.

So this is how exocrine glands work and they produce a massive amounts.

طول الوقت قاعدين بنبلع في ريقنا ليش؟! لإنه
↳ there is a release of slive from the slivary g
all the time. عشان هيك دايماً في كمية

Exocrine glands → ① Slivary glands
② exocrine glands of pancreas
③ Sweat gland

Endocrine glands

Endocrine glands of the pancreas that release the Insulin.

pancreas is 2 glands

endocrine gland → secretes Insulin, Glucagon into blood.

exocrine gland → releases enzymes, bicarbonate and fluids

So exocrine release their contents into a cavity or to the surface of the body where the endocrine release chemicals called hormones directly to the blood.

Hormones →

we have some chemicals that are produced and they aren't secreating through ducts and not also into the blood but still they are in the way similar to the hormones, these chemicals are 3 types

① Autocrines ② paracrines ③ phermones

Autocrines → it means that a chemical compound that is released from one cell affecting the same cell of the body (its not affecting the neighboring). In other words, it has its own receptors located on the same cell that secreated this chemical).

paracrines → they are chemicals that are released from one single cell but affecting the neighboring cell. One cell release the chemicals and the receptors are in the neighboring cells around it

pheromones → chemicals released from one individual to affect the other individuals from the same species (هدول شركات العطور بدفعوا عليه بالاوي عشانه النساء يطوهم على حالهم فيجذبوا الرجال أو العكس . بس هما لهلأ مش قادرين بالاقوهم فعشانه هيك بطوا بالعطور أشياء غريبة مثل في عطور الرجال بطوا روائح التوباكو وعرقة الرجال في عطور النساء بطوا منة روائح الدورة الشهرية) .

Characteristics of Hormones →

- Example to a distant target tissue receptor is if we have from pituitary gland we have a hormone that is released to affect the kidneys it has to be at a distance.

The pituitary gland Locate in the brain → plays a major role in regulating vital body functions and general wellbeing. its called a master gland because it controls the activity of most other hormone-secreting glands.

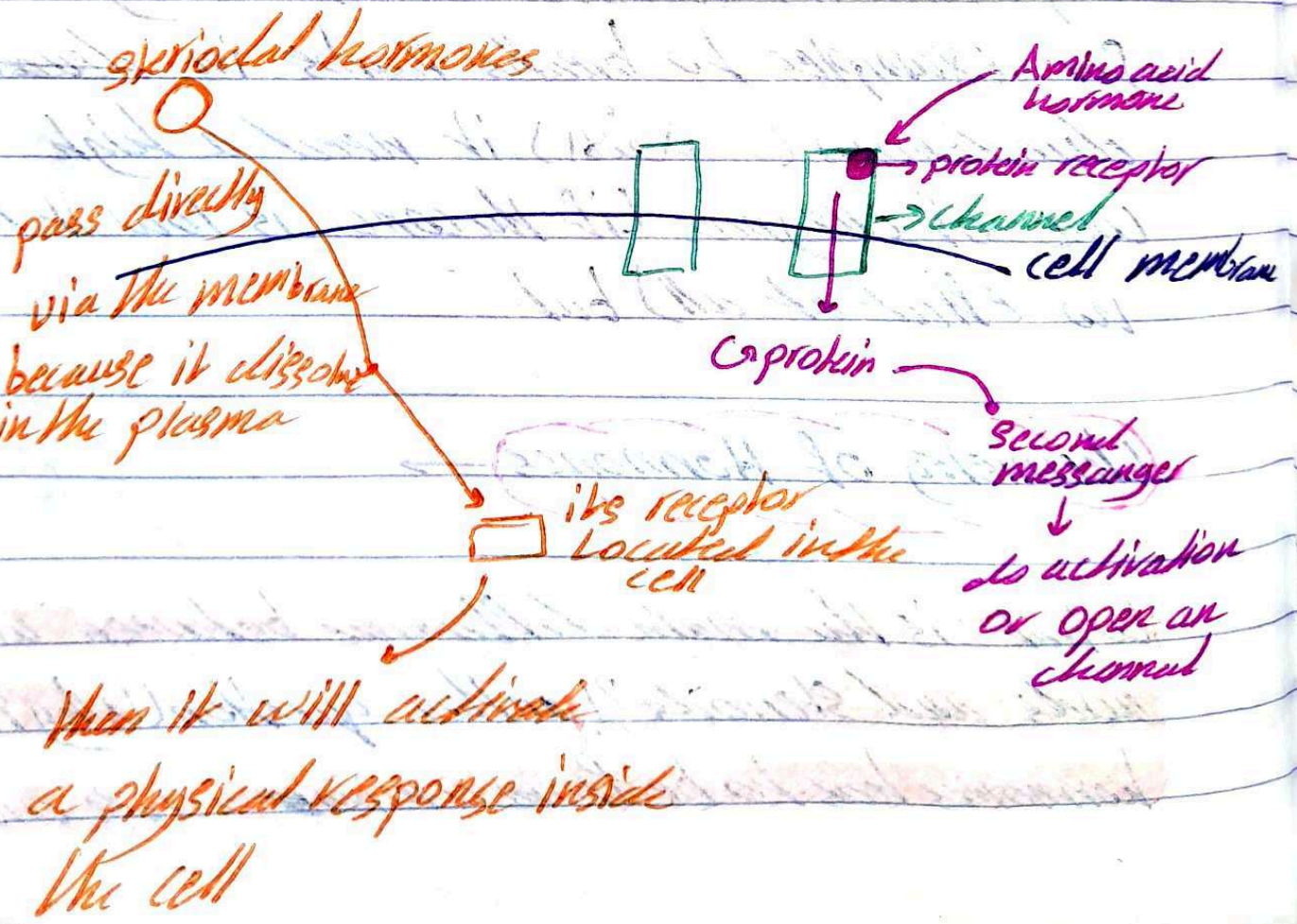
Why it has to be in a very low conc.?!
Their receptors are so sensitive to the very low conc. The receptor is very sensitive even to 1 or 2 molecules to perform it's function but the enzymes for examples to breaks bonds in duodenum (الاثنى عشر) it need a high conc of enzymes (if the conc. is low it has no effect at all)

Chemistry of Hormones →

What is the main difference between amino acids and steriods?! another question (Why there's hormones has to be from amino acids and

hormones has to be from steriods (not all of them from amino acids or steriods)?)

amino acids isn't soluble in Lipid, in order to enter the cell it has to pass the cell membrane which is hydrophobic so the amino acids has to be hydrophobic to enter but its a hydrophilic so the receptor of the steroidal hormones are located inside the cell however the amino acids based hormones receptors are located on the surface of the cell (on the cell membrane



The Discussion of the previous picture →
Amino acids hormone →
There a protein which is a receptor for an amino acid hormone only. the amino acid hormone will come and bind to the Protein which will activate G protein and make a second messenger finally it will do an activation or open channel

Steriodal hormone →
It passes directly into the cell because it dissolves in the plasma this means that its receptor is located inside the cell. then the receptor will activate and the activation of this receptor may activate a physiological response inside the cell

So the amino acid didn't enter and i don't want it to enter through channel, it will do an activation to a receptor Look in the cell membrane While steriods receptor Locate

inside the cell

another difference ⇒ amino acids don't need a transporter protein while the steriodal hormone need because it didn't dissolve in blood.

another difference ⇒ Steriodal hormone can't be stored in the cell because it can pass from the cell to the blood directly while the amino acid we can store it in vessicales and keep it in the cell. Steriodal hormone will be synthesised when it needed while the amino acid can be synthesized and stored in vesicals and when i need it we open the vesicales (important difference).

Primary endocrine organs →

endocrine organs releases hormones, Sometimes these hormones are considered to be what is known a Tropic hormones which means the hormones that will affect the release of

other hormones

Blood connection to anterior pituitary

Anterior pituitary has a complicated system that its hormones are released upon the release of other hormone from the hypothalamus.

how the anterior work?!

we have certain cells in the hypothalamus that releases hormones into the blood and the blood has to circulate until it gets to the anterior pituitary and then it affects the cells of the anterior to release its content.

we have ⇒

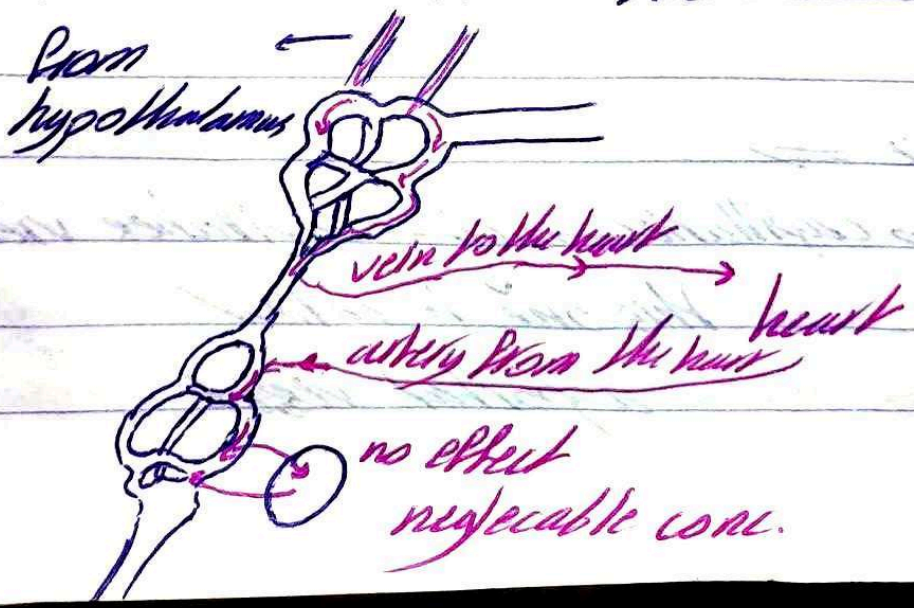
artery → capillaries → vein → capilaries vien

↓

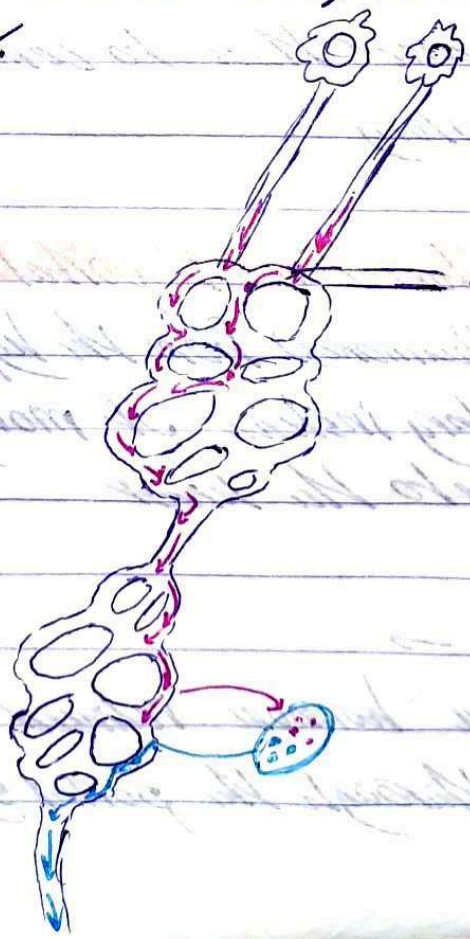
this one is called a portal vessel

the portal vessel is important because it moves blood from one section to another section before it passes to heart because we have a very low conc. of the hormones that are released from the hypothalamus

Because the hormones that are released from the hypothalamus are in a very very low conc (even lower than the hormones conc.) It means that if they are going to be secreted in the capillaries of the hypothalamus and then sent to the HEART by a vein then from the heart to return back to arteries to come to anterior pituitary, its conc. will be negligible and will not affect the anterior cells



That's why the hormone is secreted by the neurosecretory cells at the hypothalamus. They release blood to the capillaries and the capillaries carry hormone through the portal vein to another capillary beds located in the anterior pituitary before it's distributed to the rest of the body anterior has one capillary bed connected to another capillary bed before it goes to the heart while the posterior has one capillary bed.



portal system is not going to يغذي the organs so it doesn't have a relationship with the oxygenation pituitary system has another system to يغذيها (systemic circulation).

The hormones released from the hypothalamus they only affect the hormones in the pituitary (their target receptors are located in cells that are found in anterior pituitary) so they don't need to circulate in blood everywhere and then to come back to the anterior pituitary

What is the function of portal veins??
moves blood (hormones) from the hypothalamus to the anterior pituitary instead of moving blood from hypothalamus to the heart

For example →
GnRH is a hormone released from the hypothalamus it will go through the portal system until it

reach the anterior pituitary which make it release another hormones called LH and FSH which will go to the blood. then to the heart then to the Gonads (ovaries for females or testines for males) (target tissue). which will cause a release of testeron in the males. So

GnRH → tropic hormone

LH → tropic hormone

portal system is used in order to save the very low conc. of hormones in the blood it consist of portal vein connected to 2 capillaries, one in the hypothalamus and one in the anterior pituitary.

We have another portal system that is located near the small intestines. We have blood absorbes nutrients they then go directly to a capillary surrounding the small intestines. From small intestines we have a hepatic portal vein that gets everything

from small intestines to the liver because liver need to ~~det~~ detoxify and remove toxic metals from what we have absorbed before it's being circulated to the rest of the body. thats why we have a portal system (it's similar in structure but different in function) ⟹ in liver ⟶ to detoxify absorbed nutrients

hypophyseal portal system ⟶ to reduce the loss of the very low conc. hormone

pituitary gland is also called hypophysis

Hormones of the thyroid gland ⟶

What effect would you expect to have if we have:-

① hypothyroidism
② hypoparathyroidism
③ hyper thyroidism
④ hyperparathyroidism

EXPLAIN →

hypothyroidism, the thyroid doesn't create and release enough thyroid hormone into your bloodstream and your metabolism slows down and difficult time to deal with the cold and ~~low~~ high levels of Ca^{2} in blood. (hypercalcemia)

hypoparathyroidism → a condition in which your body produces slow levels of parathyroid hormone and low levels of Ca^{+2} in blood.

hyperthyroidism → a condition in which your body produces a high levels of

oids hormone and your metabolism speed up and difficult time to deal with heat and high levels of Ca^{+2} in the blood.

hyperparathyroidism → a condition where your parathyroid glands create too much parathyroid hormone in the bloodstream, Ca^{+2} levels will rise too high in the blood

~~calcitonin and PTH are additive hormones that increase the Ca^{+2} levels in the blood.~~

3 types of stimuli that control hormone release
- hormonal, neural, humoral stimuli.

Which type of hormones stays in the blood longer?!
Lipid-soluble hormones. (steroids)

Adrenal gland →

The adrenal cortex has a different layers of cells

Female body builders takes testosterone to increase the muscles mass but because the conc. of testosterone is high in their body this will cause →

① frontal baldling (صلع جبهي) ② acne (حب الشباب) ③ enlarged clitoris

④ infertility (العقم)

higher conc. of hormone will lead to increase in its negativity

Cortisol → affect the bone growth and immunity and water retention
→ its the master in the autoimmune diseases.
→ any diseases we don't find a medicine to it we give the patient cortisol
→ for (أجزما)

cortisol increase the appetite which increase the release of glucose from liver (تفتح الشهية).

في نقل الأعضاء ، بستخدموا الـ cortisol عشان يثبط المناعة.

aldosterone → we have a system called And Angiotensin renel aldosteron this is a group of 3 hormones that works together to increase the pressure.

aldosteron → reabsorb sodium which lead to increase the pressure in the body

high levels of aldosterone cause a →

① high blood pressure ② low potassium levels

(The body will hold too much water so increase the blood volume)

low potassium levels cause weakness, tingling, muscle spasms and periods of temporary paralysis.

الضعف والوخز والتشنجات العضلية وفترات الشلل المؤقت

Low levels of aldosterone cause a →
① Low blood pressure ② high levels of K^+ in blood
weight loss and decreased apetite, darking of the skin, salt carving, fainting, Nausea, diarrhea or vomiting, Abdominal pain
فقد شديد، فقدان الوزن وانخفاض الشهية، اغمقة البشرة، اشتهاء الملح، الإغماء، غثيان، إسهال أو القيء، وجع بطنه.

high levels of cortisol cause a →
cause some marks of cushing syndrome
- a fatty hump between your shoulders, a rounded face, pink or purple stretch marks on your skin, also high blood pressure, bone loss, type 2 diabetes

Low levels of cortisol cause a →
primary adrenal insufficiency or addison disease (auto immune disease that causes a damage to the adrenal glands)

قصور الغدة الكظرية أو مرض أديسون.

High levels of androgens in males → increased risk of cardiovascular disease

Low levels of androgens in males → decreased sex drive, erectile dysfunction and fatigue

إنخفاض الدافع الجنسي وضعف الإنتصاب والإرهاقة.

Adrenal medulla →

Sympathetic system →

preganglionic nerve → ganglion → postganglionic nerve → then it release ach

but in adrenal ~~cortex~~ medulla we get only the preganglionic nerve (we don't have the ganglion and the postganglionic nerve)

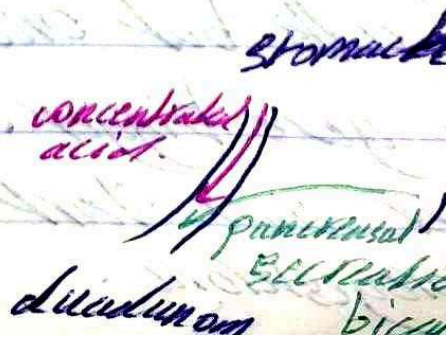
~~the~~ Sympathetic release a neurotransmitter which called Ach on the adrenal

medulla and its binds to the receptor there which are a nicotinic receptor on the secretory cells which produce the epinephrine and norepinephrine.

Anatomy of the pancreas →

pancreas is a combination of both endocrine and exocrine gland

Duct cells produces bicarbonate. the bicarbonate there is very critical because it actually dump its content (the pancreatic content) in the duodenum. So the duodenum will receive the input from the stomach and what comes from the stomach is very concentrated acid so we need to neutralize the acid by the secretion that comes from the pancreas



a problem in the duct cells will cause a problem in releasing the bicarbonate so there won't be neutralization which cause ... to duodenum.

acinar cells produces the digestive enzymes.

Gonads →

the testosterone that produced from adrenal gland is very low conc, in testes is very high conc. • still at very low conc but higher than the adrenal gland.

In the unpregnant female you will find that we have the estrogens and progesterone produced by the ovaries. by the cells that are surrounding the oocyte. they are called either granulosa cells or theca cells but once it gets pregnant and placenta gets bigger. the placenta will took over and start to produce the estrogens and progesterone.

The empryo also does produce hormone in the beginning that is called HCG (human chronic gonadotropin hormone)
لما يفحصوا إذا المرة حامل بشوفوا إذا موجود بالبول هاد الهرمونه أولا وصح إذا موجود بالدم.

Why the empryo release it?!
To make the cells know that its exist
, the hormone goes to the corpus luteum cells to make it know the empryo is exist so the corpus luteum will continue release the progesterone to save the pregnancy,

إذا الجنينه ما فرز هذا الهرمونه مش راح يقدر يحافظ عا الـ corpus luteum وإذا ما حافظ عليه راح يموت الـ corpus luteum وإذا مات رح تنخفض نسبة البروجسترونه والإستروجينه رح تنخفض كتير فرح يموت الـ empryo.

protein and polypeptide hormones →

Hormones in general if they are amino acids based hormones (polypeptide) how they are going to be produced ?! Like insulin, What is the main organelle that we need to find inside the cell that produces insulin?!

What kind of organelle you need to find in the beta cells that produces insulin?!

① Ribosomes attached to the endoplasmic reticulum

What is the different between attached ribosomes and free ribosomes?!

free ribosomes → produces protein that are required inside the cell

attached ribosomes → produces protein that will be a part of the membrane or stored in a vesicles and moved outside the cell.

Discussion to the picture in the slide →

① First, the m.RNA came from inside the cell because it was transcripted from the DNA (from nucleus) and go to the attached ribosome.

② In attached ribosomes, the hormone will be built

③ then the hormone will go through the endoplasmic reticulum until it goes out at a vesicle

④ the vesicle moves to the Golgi apparatus

⑤ Golgi apparatus will do a modification and the modified hormone will go by a vesicle to do the exocytosis by adhere (تلتحم) with the cell membrane and go to the blood.

So the hormone has to be synthesized in the

rough endoplasmic reticulum (ribosomes attached to it).

The production and synthesis of hormones will be in the form of what is known as preprohormone so it has more than one part attached to it. The preprohormone while it produced to the rough ER a small piece as a signal sequence will be cut off and this signal will produce what is known as prohormone. The prohormone will be in a vesicle and go toward the golgi apparatus and adhere with it. Golgi will do a modification in it and the hormone will go via a vesicle and will be active and the vesicle will contain also a peptide fragments and then the both fragments (active hormone and peptide fragment) will go to the blood.

Sometimes when we look to a diapetes patient, we don't only examine how much insulin it has. Sometimes we are afraid that the insulin is active or inactive so they also look to the fragment called c-fragment. We look at the conc. of c fragment in the blood this will give us an indiction of how much active insulin we have in the blood.

protein and polypeptide hormone receptor →

Discussion for the pic in the slide →

① The hormone will come and attached to a receptor that is present on the cell membrane

② Then the transduction occur, how does it happen? either its a part of a channel directly so its open the channel or it activates a G protein that this protein will open the channel or activates a G protein that will activate

a second messenger and the second messenger will increase product or response in the cell

Examples of second messengers ⇒ Ca^{+2}

cAMP

↓

cyclic Amp

③ Second messenger produces or phosphorylate a protein or activate a cascade of reactions Leads to phosphorylation for a certain protein that will produce a cellular response

Steroid hormones are derived from cholesterol

In ovaries, Once female ovulates. What is left from the cells like the granulosa cells, they actually change their function and start to store cholesterol at much as they can and once they store it, they are in process in producing the progestron and estrogen.

عشان هيك دايماً متوقع أنه الخلايا إلي بتعمل estradiol يكون فيها الكوليسترول عالي.

What organelles are expected in those cells that produce steroide hormones?!
∴ smooth endoplasmic reticulum because its the one that produces lipides or the hydrophobic components.

∴ Steroid hormone action →

Dissecussion of the pic in the slide →
① Steroid hormone they enter the cell
② either they have the cytoplasmic receptor to activate the second messenger or they have the nuclear receptor and its target is directly the DNA to do the transcription and translation to produce the protein.

① Steroid hormone isn't released all the time because once it synthesised it will leave the cell because they dissolve in the plasma membrane and get out

② At soon as they get out of the cells and go through the blood stream, they are carried by a carrier protein

③ Once the protein is binded with the hormone, their function will stop, they are not active any more and only they are released from the protein carrier if they get the signal that says we want a higher con of this hormone (unbound from the protein carrier).

Endocrine reflex pathways: Overview →

Whenever we have an increase in the blood suger, a receptor will get stimulated (stimulus) and send an afferent signal to the integration center which is the pancreas, then the pancreas will order B cells that produces the insulin (Efferent signal (the hormone)). The insulin is in vesicales once the signal of increasing glucose in the blood reached, They exocytose and remove the insulin from vesicales to the blood (physiological action) So the insulin will increase in the blood and the blood suger (glucose) will decrease (Negative Feedback).

{ When the doctor ask us this question: Why the insulin is a good example of the Negative feedback? answer is the whole paragraph in the top of the page. with this → }

Then a signal will come to do inhibition

for the first signal which was the stimulation of the receptor. So the receptor stopped, the efferent signal stopped and the integration center stopped.

كلام بنكرر أسماء ال

in pancreas ← receptors.

where the stimulus occurs

the integration center

insulin opens channels for the glucose to enter directly to the cell (Ligand-gated transport) it only needs insulin, it doesn't need ATP. (direct flow).

A simple endocrine reflex: parathyroid hormone

① When we have a low level of Ca^{+2} in blood directly the parathyroid cells will produce the PTH (parathyroid hormone)

② The PTH will gets in the blood stream and directly works in the bone and kidneys

③ Which lead to increase in the calcium reabsorbation of kidney and release Ca^{+2} from bones and gets more Ca^{+2} in the blood steam

④ Once we get an increased level of Ca^{+2} in plasma, this will produce a negative feedback to inhibit the original signal

To say that there is a negative feedback we need to make a stimulus that is opposite for the first stimulus

Negative Feedback Loops

For negative feedback we have 2 kinds of Loops :-

- Short Loop reflexs → which is similar to the simple reflex

- Long Loop reflex

Discussion →

hypothalamus produces a hormone → this hormone is called a tropic hormone → the tropic hormone will affect the anterior pituitary gland → to produce a second tropic hormone → The second tropic hormone affects an endocrine gland in the body → to produce a hormone

When the Hormone 3 secretion (like estrogen) affect the release of Tropic hormone 1 (Like GnRH) from the hypothalamus this is called the long Loop reflex

When the Hormone 3 secretion (like estrogen) affect the release of Tropic hormone 2 (like LH) from the anterior pituitary this is called short Loop reflex

يعني لما يرتفع تركيز Est بعمل negative feedback على ال GnRH انو تنزلوا تركيز ال GnRH وبعمل negative feedback على ال LH انو تنزلوا تركيز ال LH

When the Tropic hormone ↓ secretion (Like LH) affect the release of the Tropic hormone ↓ (Like GnRH) from the hypothalamus. This is called. Short Loop reflux

Long Loop reflux → قفزتين
Short Loop reflux → قفزة

Testosterone has a receptors in the anterior pituitary and on the hypothalamus

Kidney get rid of the excess hormones.

When the target cell takes it needs from the hormones, the hormones will go to the anterior and also goes to the hypothalamus and inhibit their function.

FSH → development and production of sperms and eggs

we have 2 kinds of hormones

regular hormone
↓
effect directly our body

tropic hormone
↓
hormone affect the release or inhibition of release of another hormone
ما بأثر على الجسم كمان بأثر بس على غدة ثانية.

anterior pituitary released
→ directly-called hormone → FSH
→ tropic hormone → LH

increase insulin level to decrease Sugar level
to decrease insulin → Short Loop direct
Loop negative feedback

increase testosterone level to negatively affect
the anterior pituitary gland to reduce the
release of LH and FSH → Short Loop direct
Loop negative feedback

We have also another pathway that testosterone
also affect the release of GnRH from the
hypothalamus and this is the long Loop increase
testosterone will decrease the GnRH we are
going to the first level we are going to
the second level.

Endocrine reflex pathways: Multiple Stimuli

Discussion for the pic in the slide →
we can stimulate the pancreas because of
the increase of the blood glucose which lead to

directly attack the pancreas and the pancreas release the insulin and this to reduce the blood glucose level

But also when we eat a meal, it means that we are stretching the stomach, the stretch in the stomach will send sensory information to the central nervous system, the CNS will directly predict that glucose is going to increase because we are ~~inde~~ increasing the stretching of the stomach due to the food and this will affect directly, will sent an efferent neuron to the pancreas to order it to release insulin.

So we have 2 methods

① Blood glucose level increase

② Through the nervous system

Neurohormones secreted into the blood by Neurons

Discussion for the pic on the slide :-

the vesicle of hormone is produced in the hypothalamus, the vesicle will move through the axon. then the axon will cause the release of hormone to the posterior pituitary Example :- ADH is a neurohormone because it was released by a nerve cell.

Endocrine gland →

The X hormone that is being released from one single gland, it was released because of a stimulus like Low level of Ca^{+2} will release the calcitonin and pTH so we call it a humeral stimulus which is a electrolyte level affected the release of hormone from the gland., the 2 hormones will lead to release hormone from the bone and lead

to the kidneys reabsorbtion of Ca^{+2}, so the Ca^{+2} will increase, this will cause to a negative feedback which will stop the release of hormones from the pituitary gland (this is a control

PRH → prolactin releasing hormone
TRH → Tyrosin releasing hormone
CRH → cortisol releasing hormone
GHRH → Growth hormone releasing hormone
GHIH → Growth hormone inhibiting hormone
GnRH → Gonadotropic releasing hormone

Endocrine control: 3 levels of integration

Level 1 →
Hypothalamic hormones are being release from hypothalamus to control the release or inhibition of release of hormones from anther gland - (anterior pituitary)

Level 2 →

We have group of hormones released from the anterior pituitary but they are waiting and - their release is controlled from hormones that are released from hypothalamus