



# ENDOCRINE BLOCK

## LECTURE 3

### Anterior Pituitary Gland



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# OBJECTIVES

## ❖ Anterior pituitary gland Hormone :

- TSH - FSH – LH - Growth Hormone – PROLACTIN - ACTH

### 1) Growth Hormone

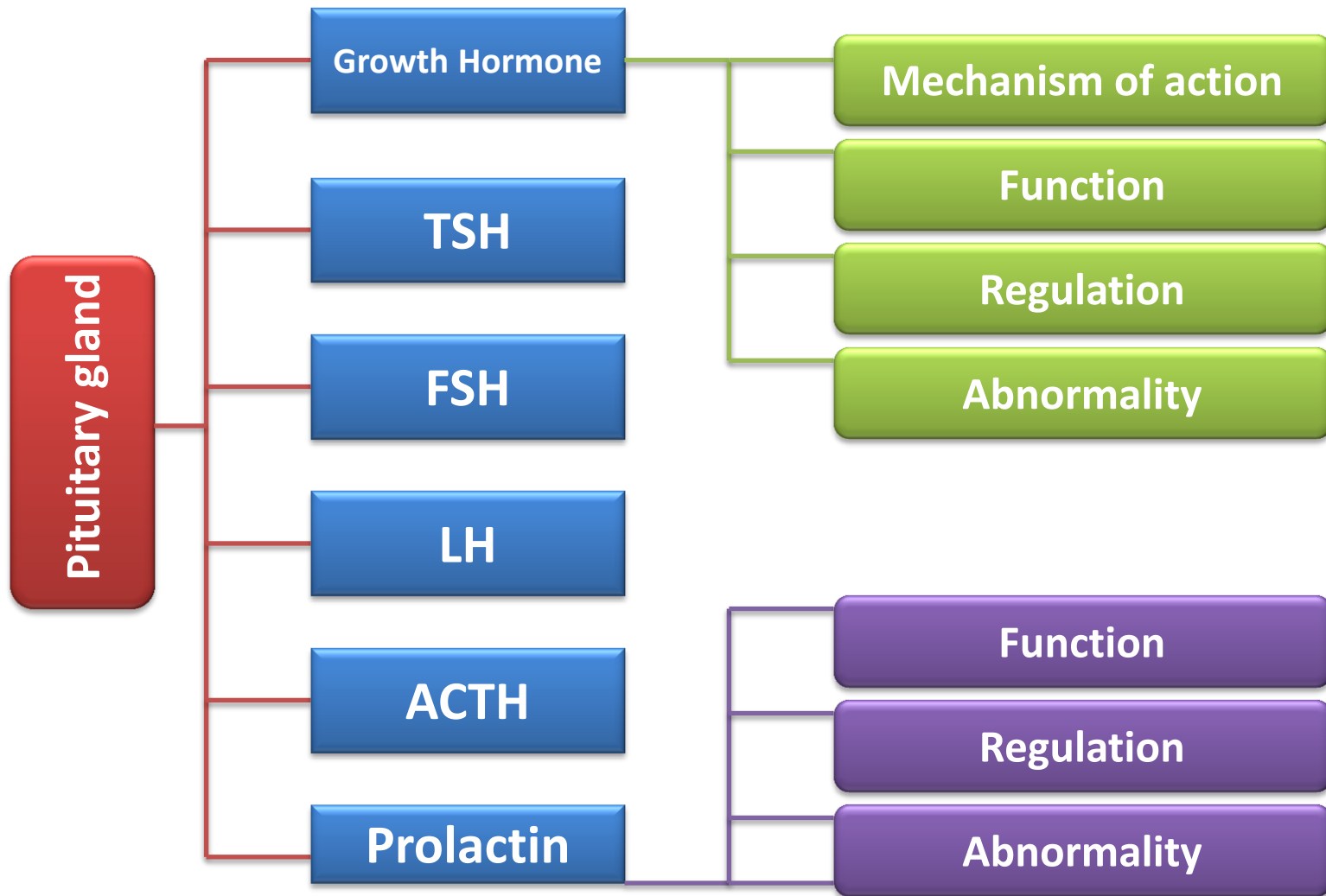
- a. Physiological functions
- b. Regulation of GH secretion
- c. Feedback mechanism
- d. Factors controlling secretion

### 2) Prolactin

- a. Physiological functions
- b. Regulation of prolactin secretion



# MIND MAP



■ Slides

■ Important

■ Females' Notes

■ Explanation

■ Males' Notes



## Endocrine gland stimuli may be :

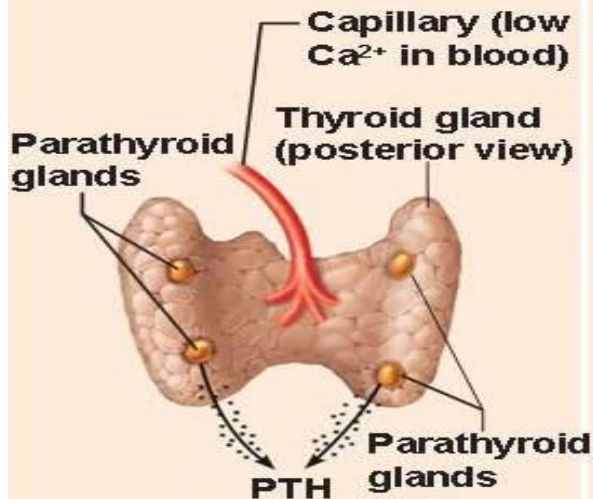
Humoral

neural

hormonal

### (a) Humoral Stimulus

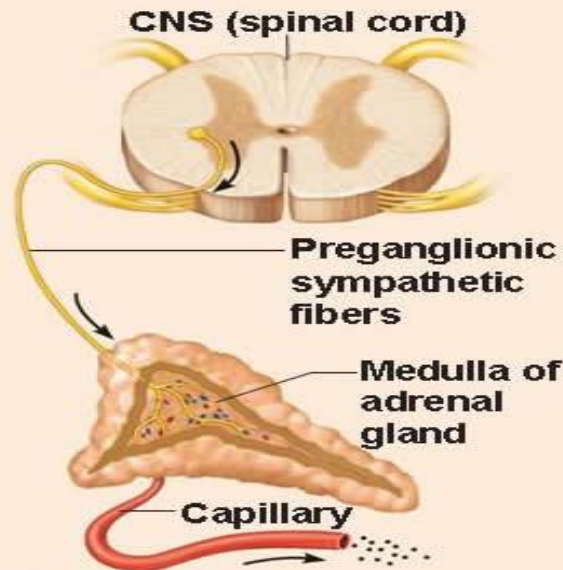
① Capillary blood contains low concentration of  $Ca^{2+}$ , which stimulates...



② ...secretion of parathyroid hormone (PTH) by parathyroid glands\*

### (b) Neural Stimulus

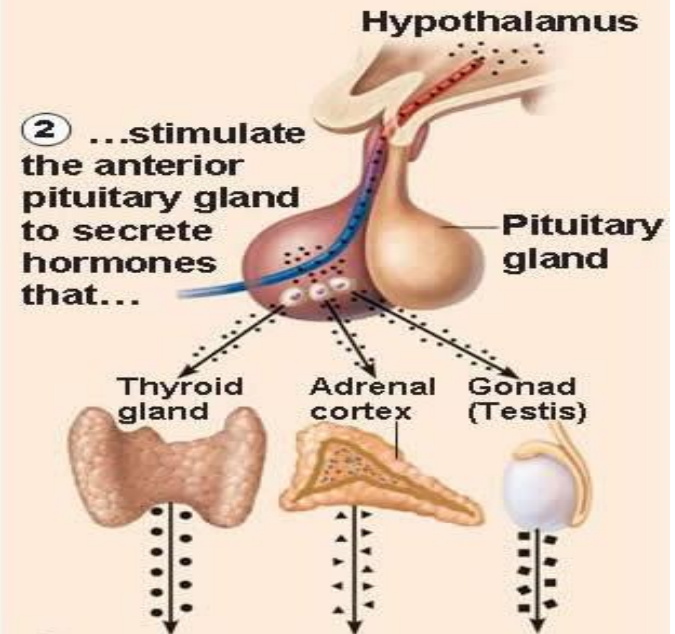
① Preganglionic sympathetic fibers stimulate adrenal medulla cells...



② ...to secrete catecholamines (epinephrine and norepinephrine)

### (c) Hormonal Stimulus

① The hypothalamus secretes hormones that...



② ...stimulate the anterior pituitary gland to secrete hormones that...

③ ...stimulate other endocrine glands to secrete hormones

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■ Slides

■ Important

■ Females' Notes

■ Explanation

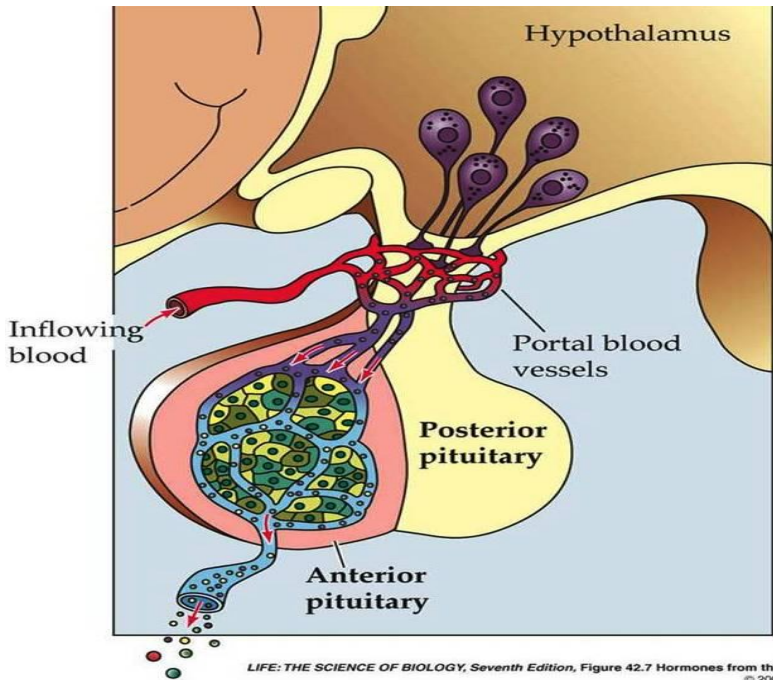
■ Males' Notes



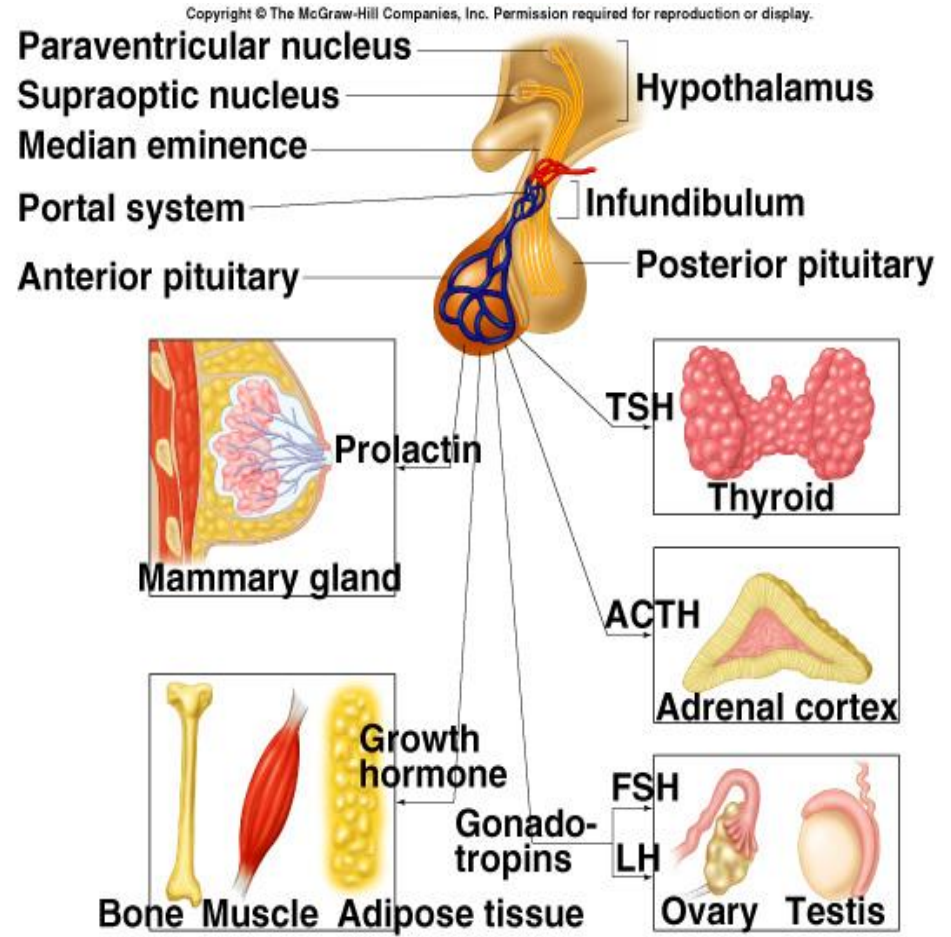
# (Adenohypophysis)

- Anterior pituitary gland (adenohypophysis):

is connected to hypothalamus by portal system: **“hypothalamic-hypophysial portal vessels”**.



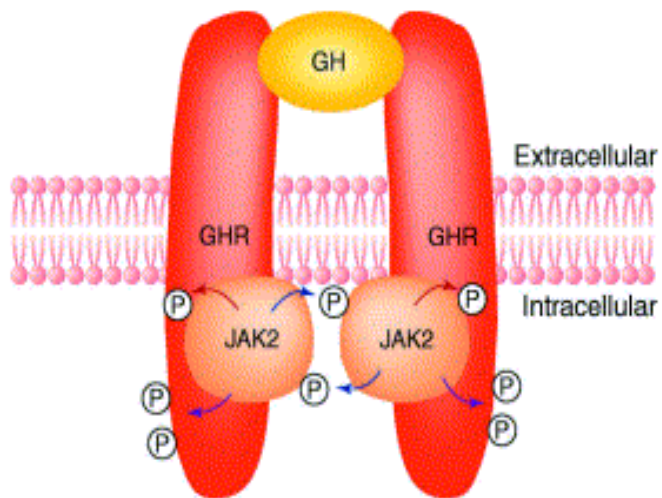
- Anterior pituitary hormones:





• **Mechanism of action:**

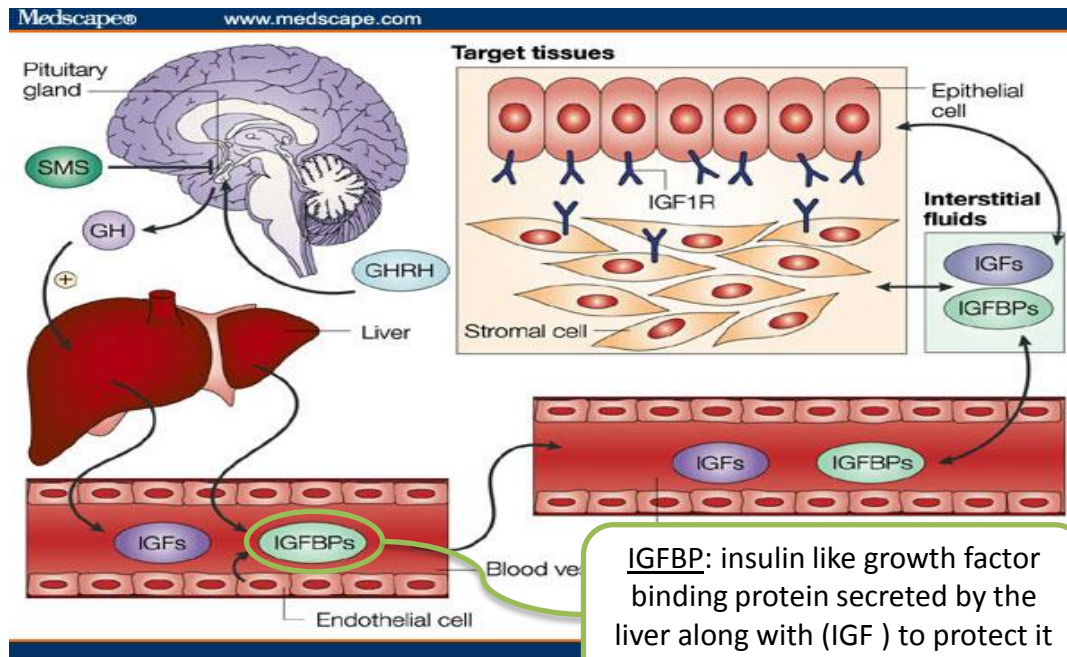
1. Direct effect:



TRENDS in Endocrinology & Metabolism

- GH is a protein hormone , so it will act directly on the receptors which located on the cell membrane .

2. Indirect effect (somatomedins ) :



**IGFBP:** insulin like growth factor binding protein secreted by the liver along with (IGF ) to protect it in the blood stream .

Indirect effect :

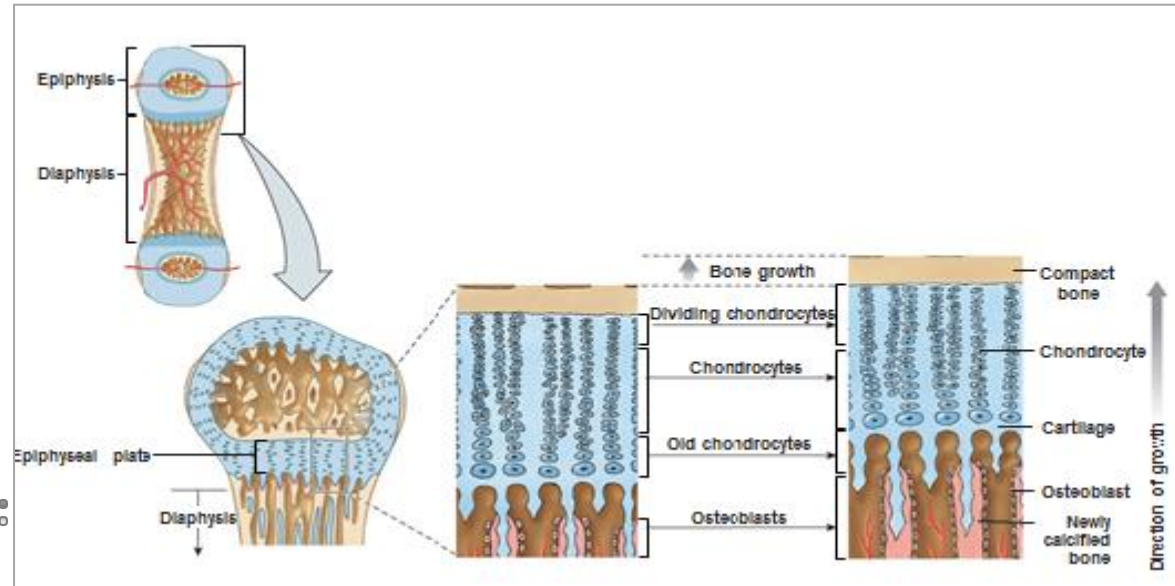
Depends on somatomedin 'insulin– like growth factor **[IGF-I& II]** secreted by the **liver**, which is responsible for effect of GH on **bone & cartilage growth** and increase the synthesis of protein in skeletal muscles.



## 1. Long term effect:

### Promotion of growth:

- ↑ cellular sizes & ↑ mitosis
- tissue growth & organ size
- Chondrocyte are the cells which Has the reveptor for IGF binding



## \* Mechanisms of bone growth :

### 1. Linear growth of long bones:

- ↑ Long bones grow in length at **epiphyseal cartilages**, causing **deposition of New Cartilage** (collagen synthesis) followed by its conversion into bone.
- When bony fusion occurs between shaft & epiphysis at each end, NO further lengthening of long bone occur.

### 2. **Deposition of New Bone** (↑ cell proliferation) on surfaces of older bone & in some bone cavities, ↑ **thickness of bone**.

- Occurs in membranous bones, e.g. jaw, & skull bones.



## 2. Short term effect:

### Metabolic effects:

#### \* Protein metabolism (**Anabolic**)

↑ rate of protein synthesis in all cells through:

- ↑ amino acids transport into cells
- ↑ DNA transcription= RNA synthesis
- ↑ RNA translation= protein synthesis
- ↓ protein catabolism “protein sparer”

#### \* Fat metabolism: (**Catabolic**)

- ↑ mobilization of FFAs from adipose tissue stores
- Conversion of FFA to acetyl CoA to **provide energy** >> for protein synthesis when excess

GH is secreted

#### \* CHO metabolism: (**catabolic**) Hyperglycemic

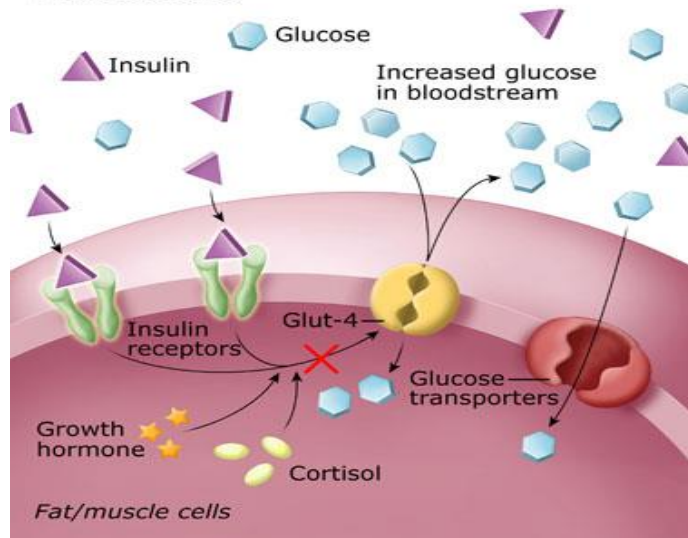
- ↓ glucose uptake by tissues (skeletal muscles and fat).
  - ↓ rate of glucose utilization throughout the body
  - ↑ glucose production by the liver (↑ **gluconeogenesis**)
  - ↑ insulin resistance (↑ FFA)
- this effect called (**diabetogenic**) or anti-insulin effect of GH.

- Metabolic effects mainly occur on the level of protein, fat and carbohydrate.
- The function of GH after puberty mainly: Metabolic & regenerative functions.





## Glucose Counter-regulatory Hormones: Effect on Fat and Muscle Cells



- Not important to know it now because we will study it later inshallah 😊.
- Just for your information: Glucose counter regulatory hormones means the relation between the hormones which increase the glucose level and the only hormone which decrease it ( insulin )

## Other effects of growth hormone:

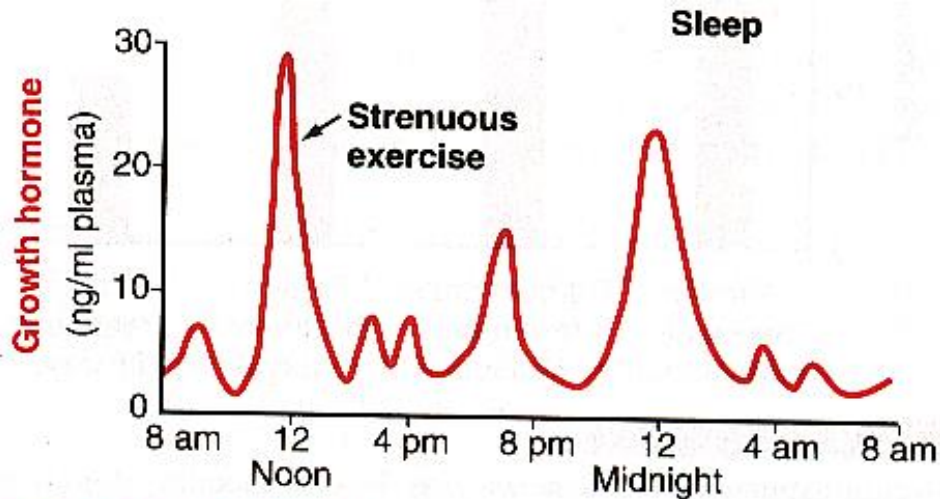
- ❑ Increases **calcium** absorption from GIT ( because we need calcium for bone growing ) .
- ❑ Strengthens and increases the **mineralization of bone** .
- ❑ Retention of **Na<sup>+</sup>** and **K<sup>+</sup>** ( by acting on the renal tubules and this may increase the blood pressure ) .
- ❑ Increases **muscle** mass .
- ❑ Stimulates the growth of all internal organs **excluding the brain** ( there is no direct action of GH on the brain )
- ❑ Contributes to the maintenance and function of **pancreatic islets** .
- ❑ Stimulates the **immune system** .



Factors INCREASE GH secretions	Factors DECREASE GH secretions
<ul style="list-style-type: none"><li>• The hypothalamus : GHRH*</li><li>• Hypoglycemia (fasting)</li><li>• Muscular exercise</li><li>• Intake of protein or amino acids (after meals)</li><li>• During sleep &gt;&gt;See the next slide ( more in children )</li><li>• Stress conditions (trauma or emotions)</li><li>• Grelin (hormone from stomach)</li><li>• Hormones of puberty (Estrogen + testosterone)</li><li>• Arginine</li><li>• <math>\alpha</math>-adrenergic agonists</li></ul>	<ul style="list-style-type: none"><li>• The hypothalamus : GHIH**</li><li>• Glucose intake</li><li>• Increase FFAs concentration</li><li>• Aging</li><li>• Growth hormone &amp; Somatomedin (Negative feedback)</li><li>• Pregnancy.</li></ul>

\* Growth hormone releasing hormone

\*\* Growth hormone inhibitory hormone  $\rightarrow$  which also known as somatostatin (SRIF)



**FIGURE 75 - 6**

Typical variations in growth hormone secretion throughout the day, demonstrating the especially powerful effect of strenuous exercise and also the high rate of growth hormone secretion that occurs during the first few hours of deep sleep.

- Growth Hormone have 2 peaks : at noon & at midnight
- Pulsatile every 2H → the secretion resembles Pulse, every 2 hours it increase then decrease ...

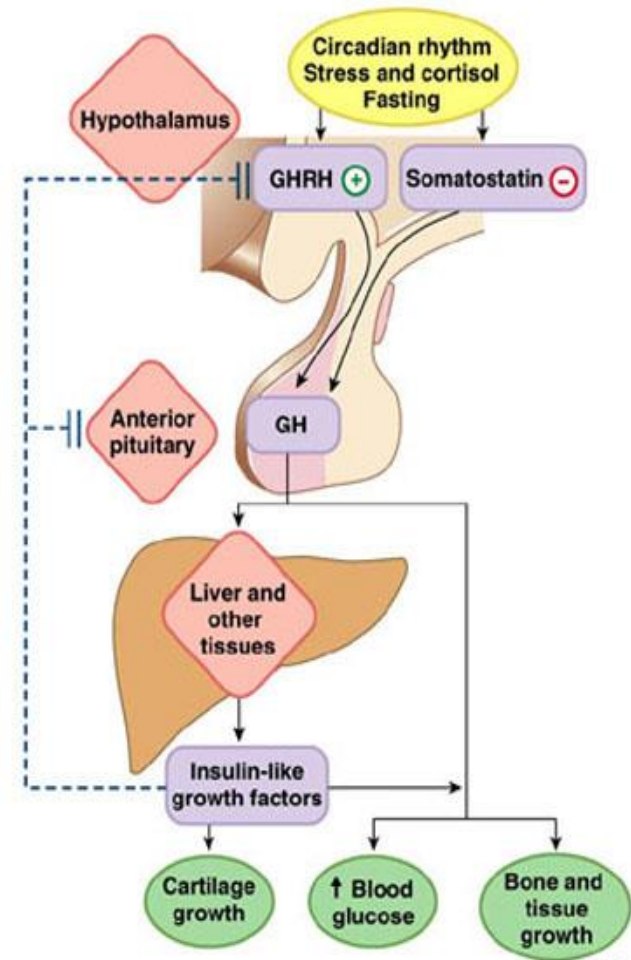


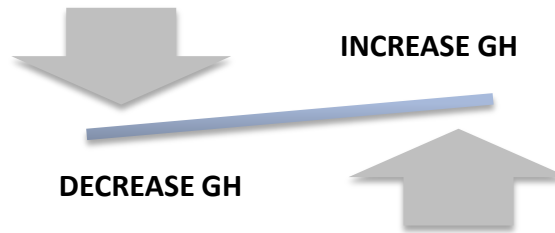
Fig. 23-16

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	Before Puberty	After Puberty
<b>INCREASE GH</b>	<p><b>Gigantism</b> (<a href="#">image</a>) all body tissues grow rapidly, including bones.</p> <p>Height ↑ as it occurs before epiphyseal fusion of long bones with their shafts.</p>	<p><b>Acromegaly</b> (<a href="#">image</a>) person can't grow taller, BUT soft tissue continue to grow in thickness (skin, tongue, liver, kidney, ...)</p> <ul style="list-style-type: none"> <li>- Enlargement of bones of hands &amp; feet.</li> <li>- Enlargement of membranous bones including cranium, nose, forehead bones, supraorbital ridges.</li> <li>- Protrusion of lower jaw.</li> <li>- Hunched back (kyphosis) (enlargement of vertebrae) + <b>Scoliosis</b></li> <li>- <b>Organomegally</b></li> </ul>
	Both cases will result in <b>Hyperglycemia (diabetes)</b> & patient will suffer of <u>headache</u> because this increase of GH probably caused by GH tumor secreting cells of anterior pituitary gland .	
	Both treat with: ( <a href="#">Octreotide</a> )	





	Before Puberty	After Puberty
DECREASE GH	<p><b>Pituitary Dwarfism</b></p> 	<p>No prominent effect. Only slight changes in metabolic functions.</p>

• Why GH is needed for us as adult although we are not growing ?  
Because it is important for the **cell regeneration** and repair. Also, for metabolic functions e.g. "Protein anabolism"

• Deficiency of thyroid hormone may cause Dwarfism but with mental retardation unlike dwarfism due to GH, they have a normal brain.



- Growth hormone get secreted from **(Somatotrophs)** cells which represent **20%** from the cells in anterior pituitary gland.
- 191 Amino Acid.
- 22000 molecular weight , while somatomedin 4500-7500 molecular weight.

➤ **Mechanism of secretion:**

- GHRH receptor Gs protein → Adenylyl cyclase and phospholipase C → cAMP and IP3/Ca → ↑ secretion + synthesis.
- Somatostatin (SRIF) → receptor Gi → inhibit generation of cAMP → Decrease secretion.



- The major function of prolactin is **milk production** .
- Release is **inhibited by PIH** “Prolactin inhibiting hormone” (dopamine) .
- **Suckling** response inhibits PIH release .
- Prolactin get secreted from (lactotrophs) cells which represent 15% from the cells in anterior pituitary gland.
- 198 Amino Acid.
- Related to growth hormone (the same family).

## Functions of Prolactin:

### 1) Effect on the **breast development** :

- Increases mRNA.
- Increases production of casein and lactalbumin .
- Inhibits the effects of gonadotropins ( inhibition of ovulation ).

### 2) Other effects :

Stimulates the secretion of dopamine in median eminence (**inhibits its own secretion**) .

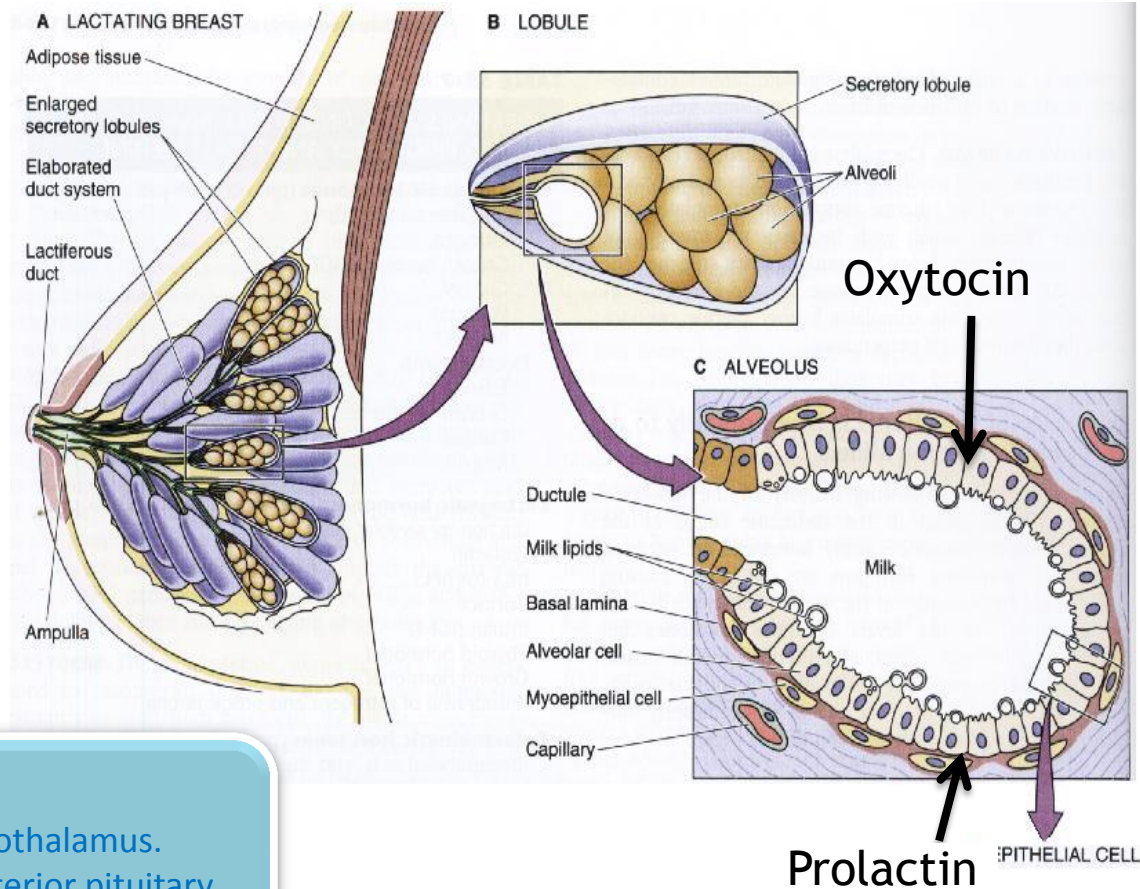


## ➤ Increase PRL secretion :

- Exercise
- Surgical & psychological stress
- Stimulation of the nipple (Suckling)  
“mechanical stimulus”
- sleep
- Pregnancy (estrogen)
- TRH “thyroid releasing H”
- Dopamine antagonist

## ➤ Decrease PRL secretion :

- PIH (Dopamine)



## • Sources of Dopamine :

1. Dopaminergic neurons in the hypothalamus.
2. Dopaminergic neurons in the posterior pituitary.
3. Non-Lactotrophs cells of the anterior pituitary.



## ➤ Prolactin deficiency:

- Failure to lactate.

## ➤ Prolactin excess:

- Galactorrhea
- Infertility
- Treat with → **Bromocriptine** ( dopamine agonist )

- PRL has an effect on the ovary and compete with Gonadotropins (FSH & LH).
- Under pathologic conditions, when PRL exceeds its limit, it will stop the ovulation and cause infertility.
- Prolactinoma is tumor causing excessive secretion of PRL. Patient present with “Galactorrhea & infertility” (either male or female). Men will suffer from Gynecomastia while women suffer from amenorrhea.
- Tx :- 1) surgical excision.      2) Bromocriptin “DRUG”.

Important

- Prolactin stimulates the mammary glands to produce milk (lactation) so increased serum concentrations of prolactin during pregnancy cause enlargement of the mammary glands of the breasts and prepare for the production of milk.
- Normally, Milk production starts when the levels of progesterone fall by the end of pregnancy and a suckling stimulus is present.
- Progesterone is an inhibitory factor while Estrogen is a stimulatory factor.
- Also when prolactin get released > it inhibits the effect of gonadotropins > no pregnancy while breastfeeding.



- TSH get secreted from **(Thyrotrophs)** cells which represent **5%** from the cells in anterior pituitary gland.
  - Glycoproteins.
  - Have  $\alpha$  and  $\beta$  parts. (change in  $\beta$  part give us TSH or FSH or LH)
  - Related to FSH and LH. (the same family)
- **Regulation of secretion:**
- Thyrotropin releasing hormone → stimulate it secretion.
  - Thyroid gland hormone ( T4 – T3 ) → inhibit it secretion (negative feedback).
- **Effect:**
- Increase synthesis and secretion of thyroid hormones.
  - Trophic effect → (increase the size of cells and it's secretion)
- **Abnormalities:**
- Hyperthyroidism.
  - Hypothyroidism.



### ➤ **FSH and LH:**

- They get secreted from (**Gonadotrophs**) cells which represent **15%** from the cells in anterior pituitary gland.
- Glycoproteins.
- Have  $\alpha$  and  $\beta$  parts. (change in  $\beta$  part give us TSH or FSH or LH)
- Related to TSH. (the same family)

### ➤ **Regulation of secretion:**

- GnRH  $\rightarrow$  stimulate it secretion.
- Inhibin + testosterone  $\rightarrow$  inhibit it secretion (negative feedback).

### ➤ **ACTH:**



- **adrenocorticotrophic hormone** get secreted from (**cortictrophs**) cells which represent **15%** from the cells in anterior pituitary.
- Pro-opiomelanocortin (POMC) is a precursor polypeptide that will give us:
  1. ACHT
  2. MSH (melanocyte-stimulating hormones)
  3. B-endorphin

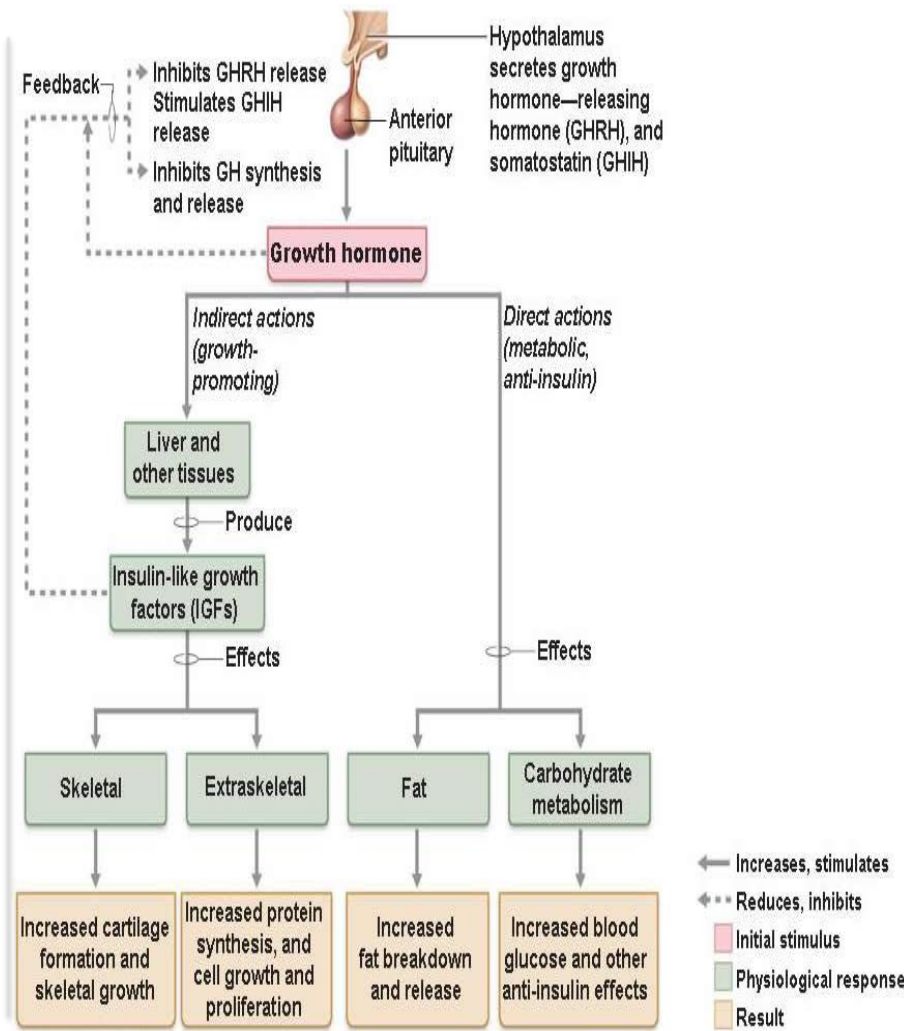
### ➤ **Regulation of secretion:**

- Corticotropin releasing hormone  $\rightarrow$  stimulate it secretion.
- Adrenal cortex secretion ( **Cortisol** )  $\rightarrow$  inhibit it secretion (negative feedback).



# SUMMARY

HORMONE (CHEMICAL STRUCTURE AND CELL TYPE)	REGULATION OF RELEASE	TARGET ORGAN AND EFFECTS	EFFECTS OF HYPOSECRETION ↓ AND HYPERSECRETION ↑
 <b>Anterior Pituitary Hormones</b>  <b>Growth hormone (GH)</b> (Protein, somatotroph)	Stimulated by GHRH* release, which is triggered by low blood levels of GH as well as by a number of secondary triggers including hypoglycemia, increases in blood levels of amino acids, low levels of fatty acids, exercise, other types of stressors, and estrogens  Inhibited by feedback inhibition exerted by GH and IGFs, and by hyperglycemia, hyperlipidemia, obesity, and emotional deprivation via either increased GHIH* (somatostatin) or decreased GHRH* release	 Liver, muscle, bone, cartilage, and other tissues: anabolic hormone; stimulates somatic growth; mobilizes fats; spares glucose  Growth-promoting effects mediated indirectly by IGFs	↓ Pituitary dwarfism in children ↑ Gigantism in children; acromegaly in adults



\*Indicates hypothalamic releasing and inhibiting hormones:  
 GHRH = growth hormone-releasing hormone; GHIH = growth hormone-inhibiting hormone

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# SUMMARY

Dr.njeeb

- **Anterior pituitary gland** is connected to hypothalamus by “**hypothalamic-hypophysial portal vessels**”.

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- Somatotrophs cells secrete **Growth hormone** and have a **direct + indirect action**.
- GH have **two effect**: **growth effect (long term)** and **metabolic effect (short term)**
- **GH metabolic effect is**: protein **anabolism** – fat **catabolism** – CHO **catabolism**
  - **Increase** in GH will cause either **Gigantism (before puberty)** or **acromegaly (after puberty)**
  - **Decrease** in GH will cause **dwarfism**

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- (lactotrophs) cells secrete **Prolactin** which major function is **milk production** .
- Dopamine **inhibit** prolactin secretion (**always**) but **suckling** stop dopamine release.
  - Increase in prolactin will cause ( Galactorrhea – Infertility )

1<sup>st</sup>  
vid.



2nd  
vid.



3rd  
vid.



From 431

Read  
More

## • **Panhypopituitarism:**

This term means decreased secretion of all the anterior pituitary hormones. The decrease in secretion may be congenital (present from birth), or it may occur suddenly or slowly at any time during life, most often resulting from a pituitary tumor that destroys the pituitary gland.

Click here



# SUMMARY

## Male's Slide

Hormone	Target Tissue	Principal Actions	Regulation of Secretion
ACTH (adrenocorticotrophic hormone)	Adrenal cortex	Stimulates secretion of glucocorticoids	Stimulated by CRH (corticotropin-releasing hormone); inhibited by glucocorticoids
TSH (thyroid-stimulating hormone)	Thyroid gland	Stimulates secretion of thyroid hormones	Stimulated by TRH (thyrotropin-releasing hormone); inhibited by thyroid hormones
GH (growth hormone)	Most tissue	Promotes protein synthesis and growth; lipolysis and increased blood glucose	Inhibited by somatostatin; stimulated by growth hormone-releasing hormone
FSH (follicle-stimulating hormone)	Gonads	Promotes gamete production and stimulates estrogen production in females	Stimulated by GnRH (gonadotropin-releasing hormone); inhibited by sex steroids and inhibin
PRL (prolactin)	Mammary glands and other sex accessory organs	Promotes milk production in lactating females; additional actions in other organs	Inhibited by PIH (prolactin-inhibiting hormone)
LH (luteinizing hormone)	Gonads	Stimulates sex hormone secretion; ovulation and corpus luteum formation in females; stimulates testosterone secretion in males	Stimulated by GnRH; inhibited by sex steroids

■ [Slides](#)

■ [Important](#)

■ [Females' Notes](#)

■ [Explanation](#)

■ [Males' Notes](#)



# SUMMARY

**Table 75-3. Factors That Stimulate or Inhibit Secretion of Growth Hormone**

Stimulate Growth Hormone Secretion	Inhibit Growth Hormone Secretion
<p>Decreased blood glucose            Decreased blood free fatty acids            Increased blood amino acids (arginine)            Starvation or fasting, protein deficiency            Trauma, stress, excitement            Exercise            Testosterone, estrogen            Deep sleep (stages II and IV)            Growth hormone-releasing hormone            Ghrelin</p>	<p>Increased blood glucose            Increased blood free fatty acids            Aging            Obesity            Growth hormone inhibitory hormone (somatostatin)            Growth hormone (exogenous)            Somatomedins (insulin-like growth factors)</p>





# QUESTIONS

**1. Short-term effect of GH :**

- A) Increase cell size
- B) Increase organ size
- C) Increase Glucose production
- D) Increase Glucose uptake

**2. Increase the GH secretion at childhood result in ..... While decrease it result in .....**

- A) Acromegaly, gigantism
- B) Gigantism, dwarfism
- C) No effect, dwarfism

**3. Which one induce the GH secretion:**

- A) Glucose intake
- B) Exercise
- C) Aging

**4. Which one of the following is a metabolic effect caused by GH:**

- A) Increase fat breakdown
- B) Decrease blood glucose level
- C) Protein catabolism

**5. The mediator that needed for GH function:**

- A) IGFBP
- B) IGF
- C) Calcium
- D) Thyroxin

**6. Which one of the following is the result of mechanical stimulation of the nipple "suckling":**

- A) Dopamine secretion
- B) Prolactin secretion
- C) Both of them

1	C
2	B
3	B
4	A
5	B
6	B



# THE END

If there are any Problems or Suggestions,  
Feel free to contact us:

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# THANK YOU



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