

ENDOCRINE PHYSIOLOGY

PROF. ABDULMAJEED AL-DREES

ANTERIOR PITUITARY GLAND

OBJECTIVES

- **By the end of this lecture, students should be able to :**
- **List Anterior Pituitary Hormones**
 - **Chemical structure Secretion**
- **Describe actions of Anterior Pituitary hormones**
- **Mechanism of action of hormones**
 - **Hormone receptors, down-regulation and up-regulation**
 - **Intracellular signaling**
 - **Second messenger mechanism**
 - **Know conditions related to hypo or hyper secretion of Anterior Pituitary hormones**

ANTERIOR PITUITARY GLAND

- **Hormones:**

1- TSH

2- FSH

3- LH

4- GH

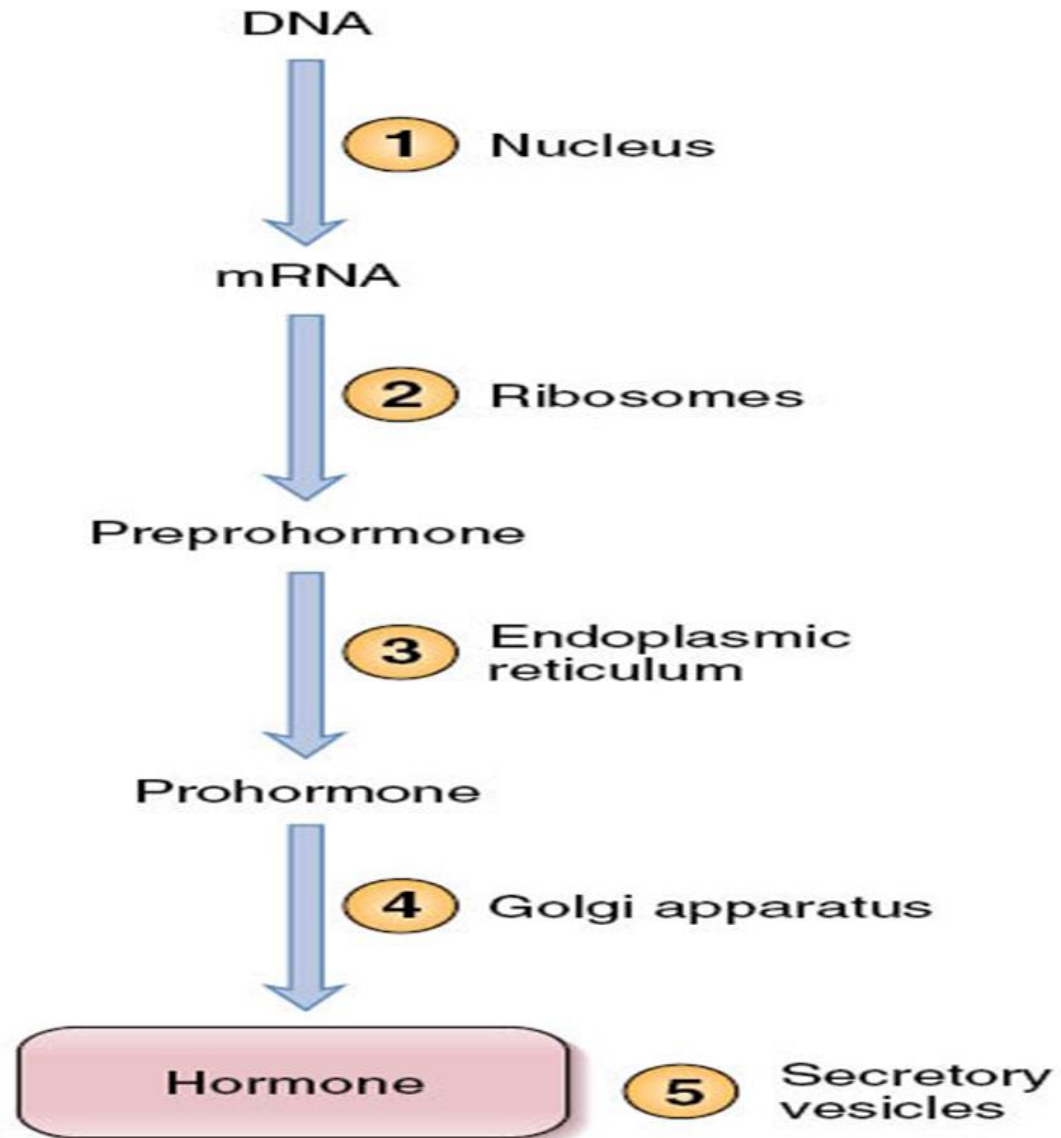
5- PROLACTIN

6- ACTH.

Table 11.6 | Anterior Pituitary Hormones

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

PEPTIDE HORMONE SYNTHESIS



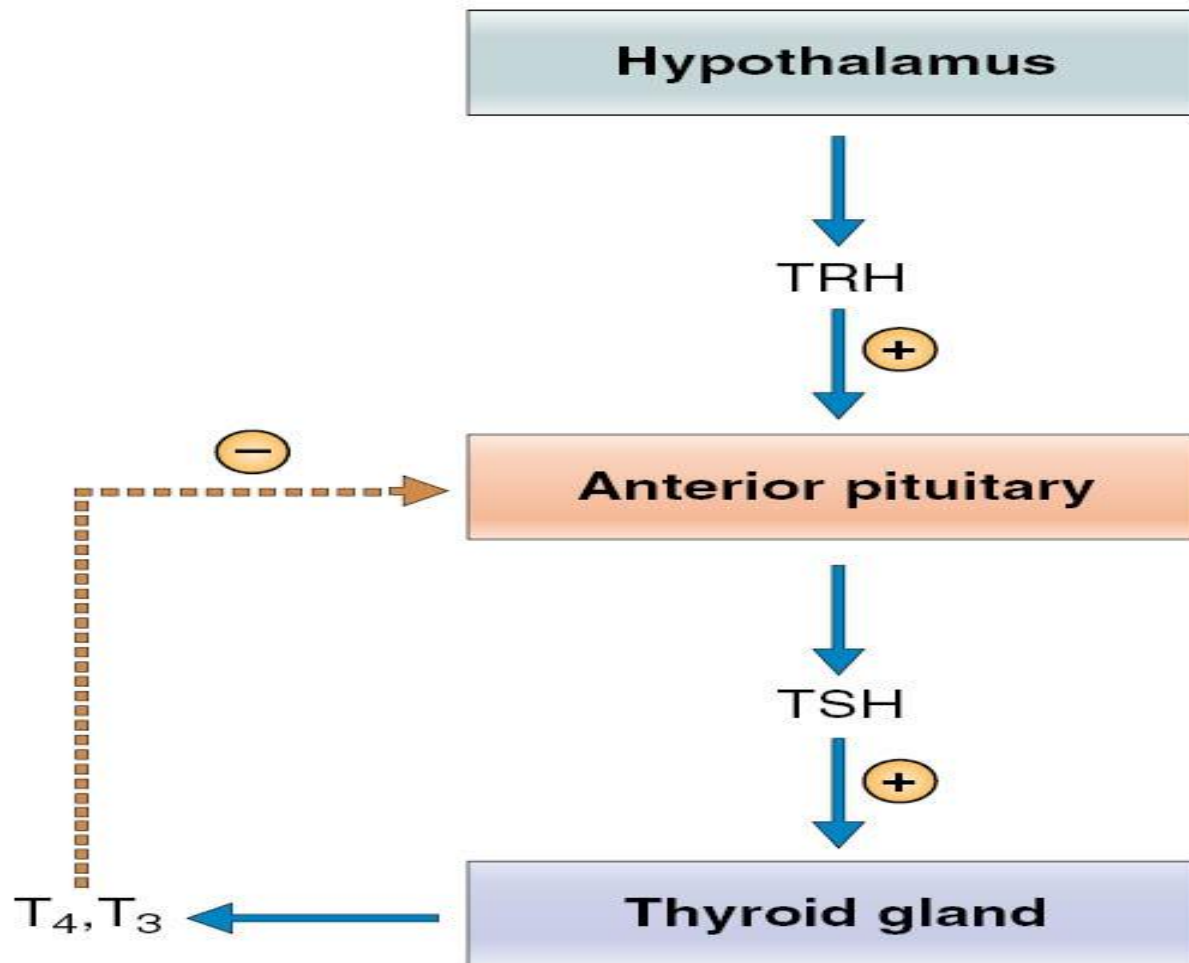
TSH

- Thyrotrophs. (5%)
- Glycoproteins.
- α and β .
- Related to FSH and LH.

ABNORMALITIES

- **Hyperthyroidism.**
- **Hypothyroidism.**

REGULATION OF SECRETION

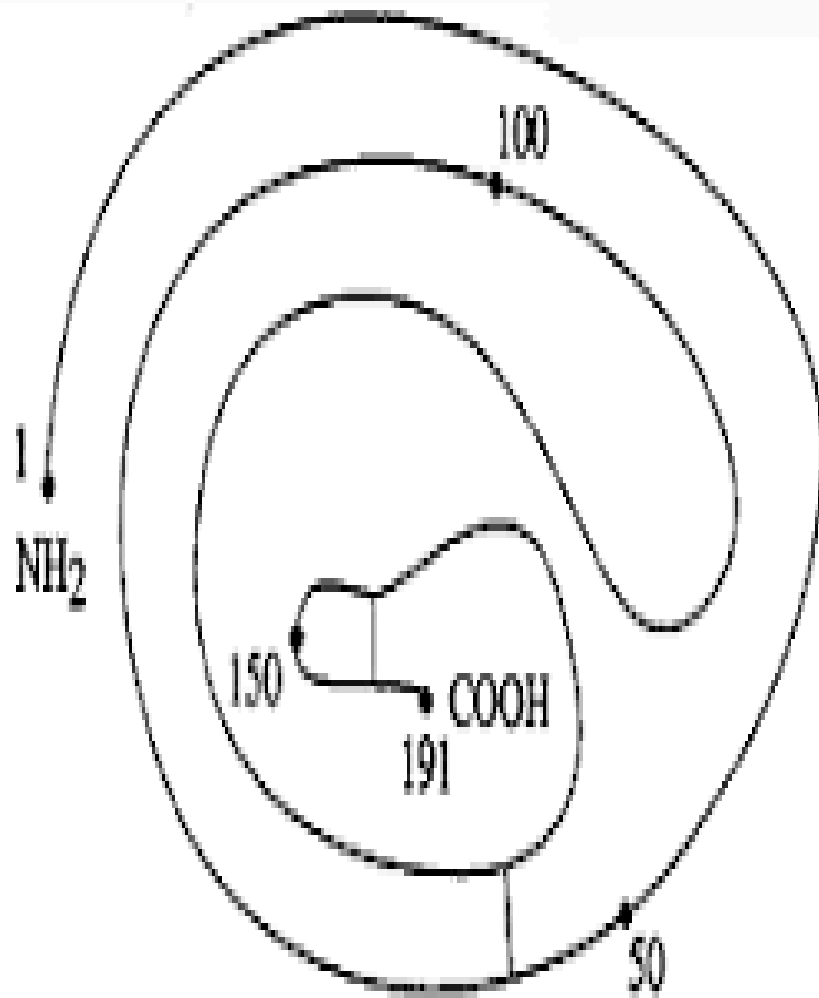


ACTION

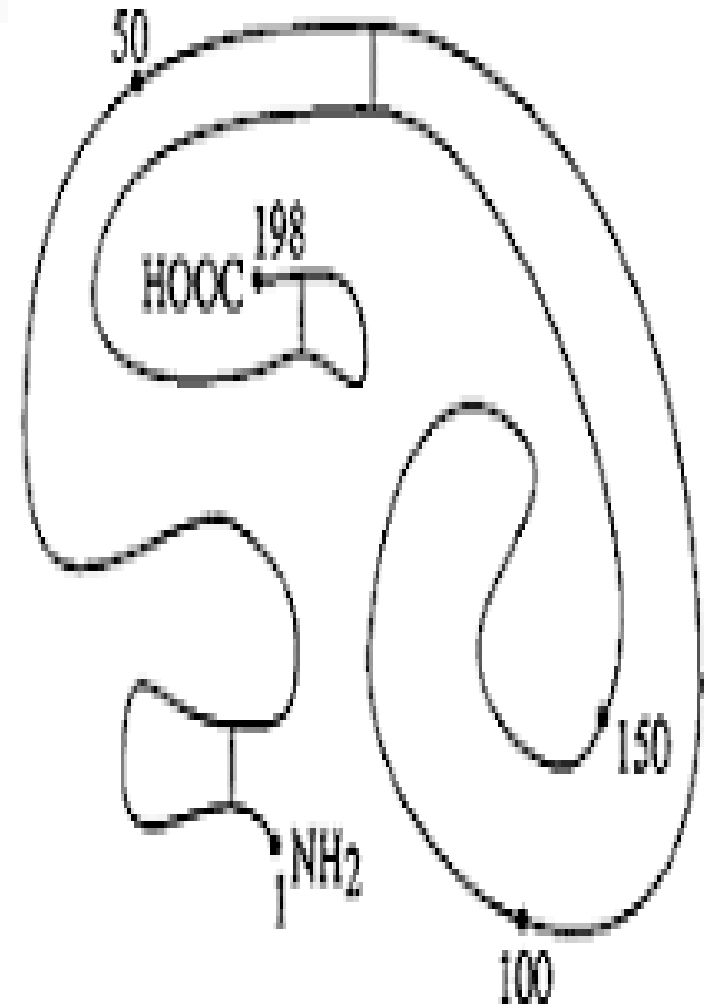
- 1- Increase synthesis and secretion of thyroid hormones.**
- 2- Trophic effect.**

GROWTH HORMONE

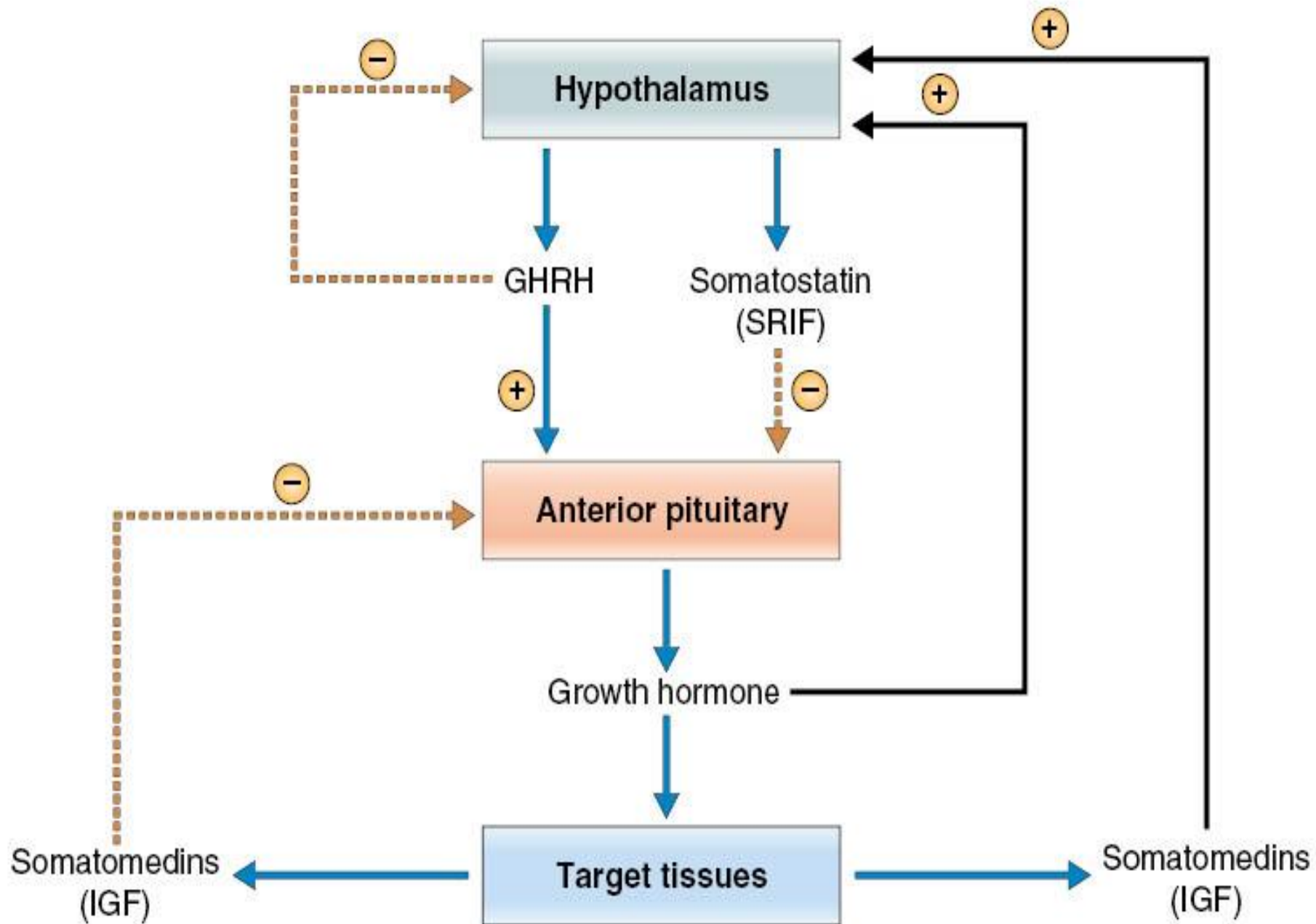
- Somatotropic hormone, somatotropin.
- Somatotrophs.(20%)
- 191 AA.
- MW 22000 kD.
- GHRH .



Human growth hormone



Prolactin



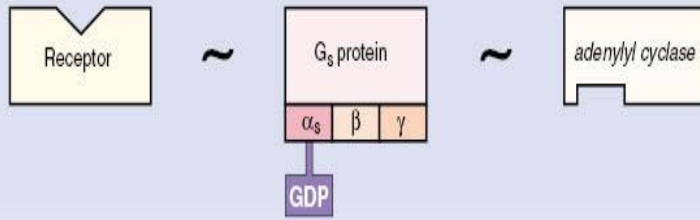
• **GHRH** → **receptor** → **Gs protein** →

Adenylyl cyclase and phospholipase C →

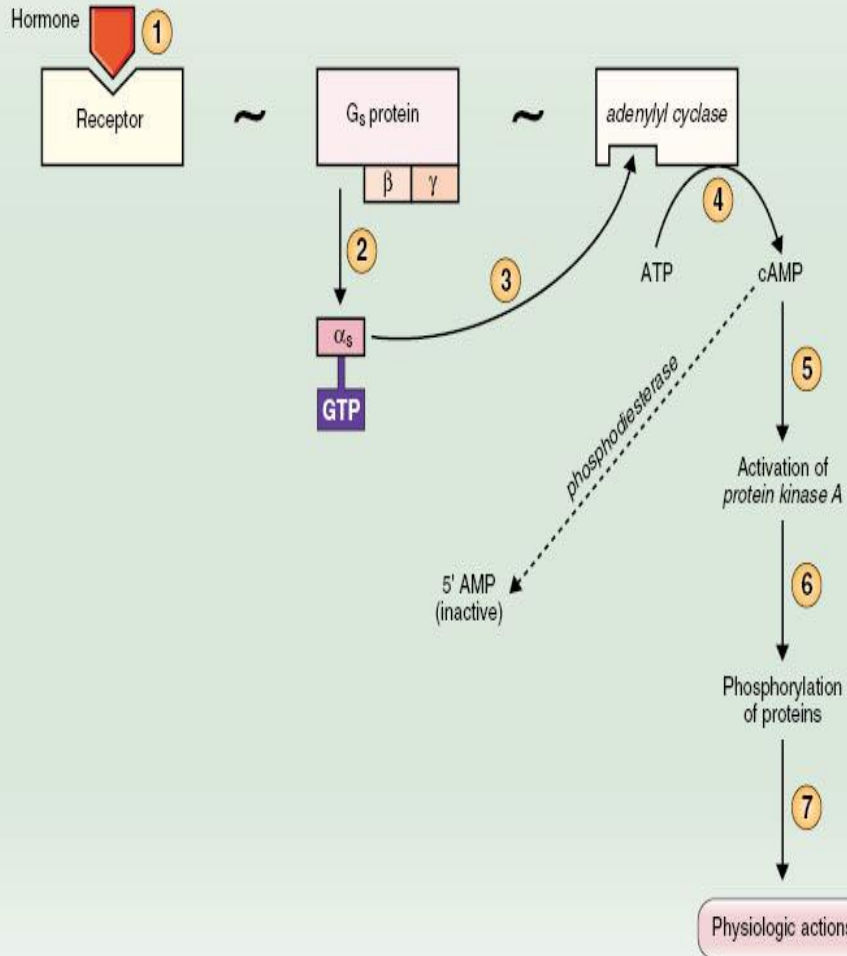
cAMP and IP3/Ca → **secretion +
synthesis.**

ADENYLYL CYCLASE MECHANISM

Inactive

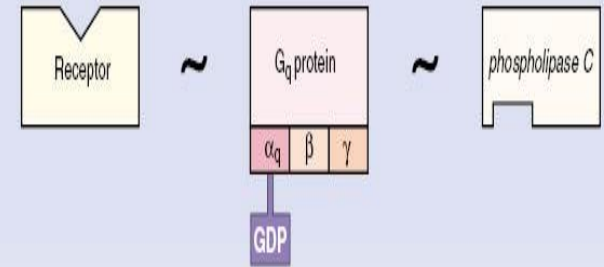


Active

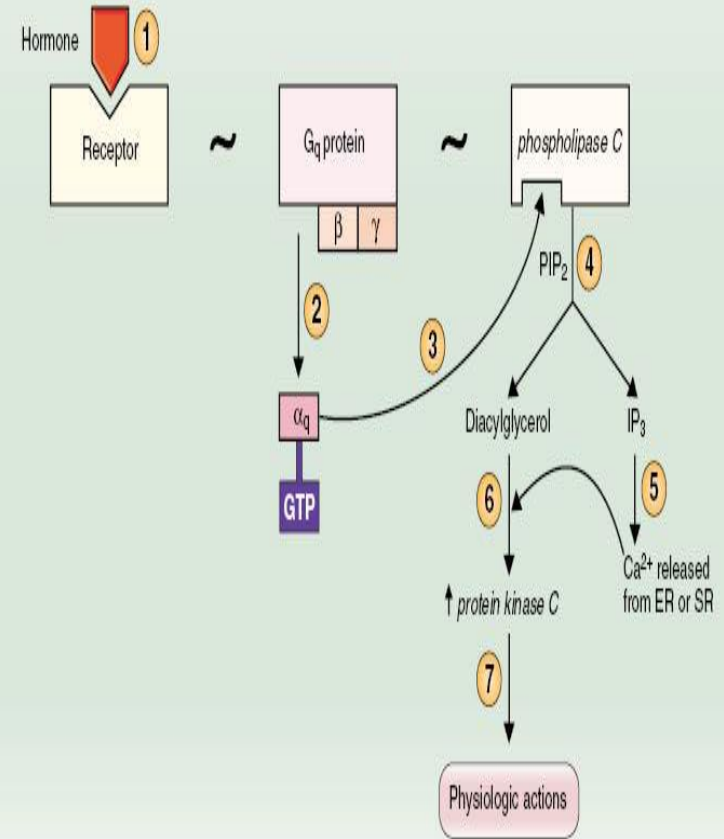


PHOSPHOLIPASE C MECHANISM

Inactive



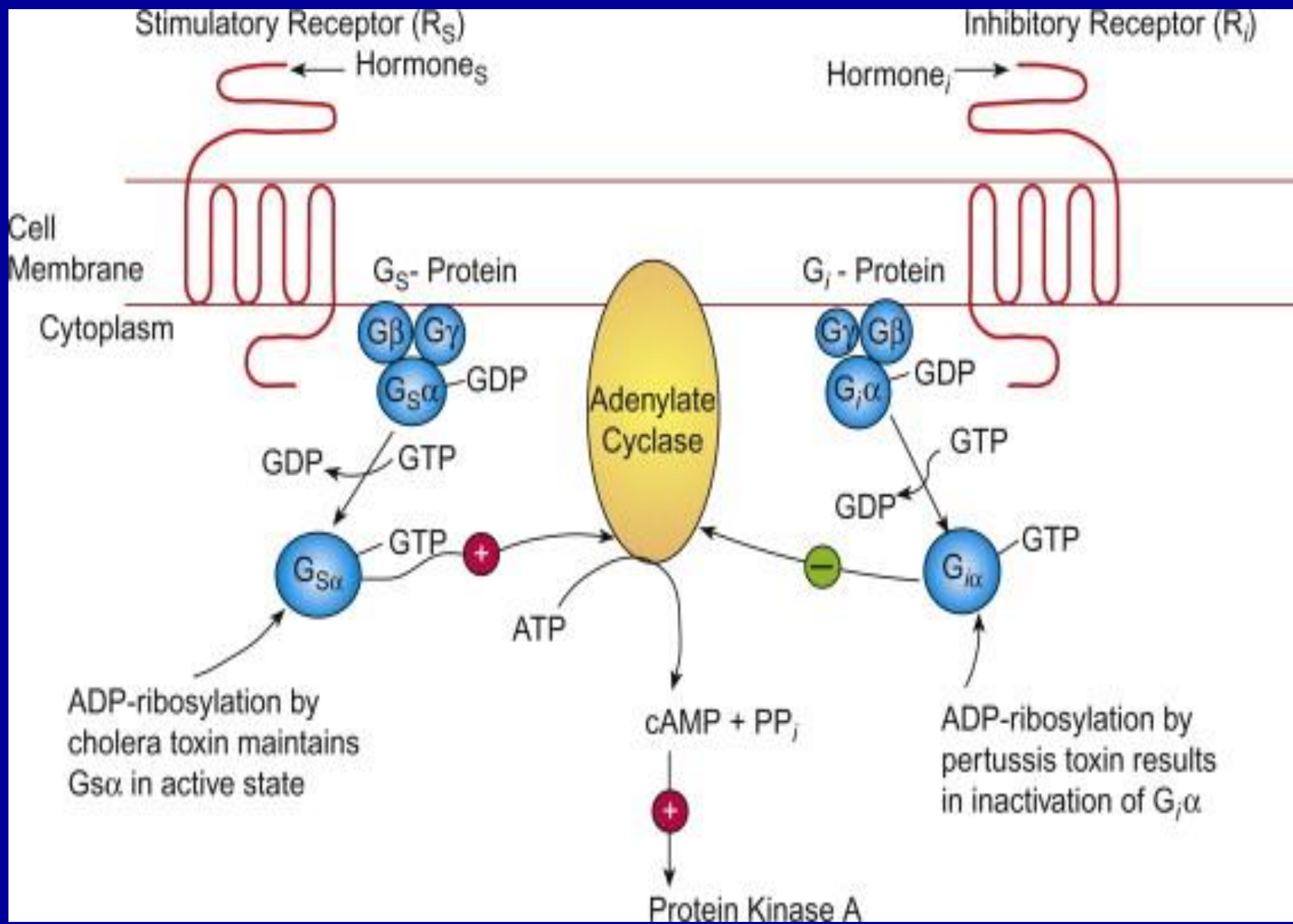
Active



• **Somatostatin (SRIF) → receptor**

Gi → inhibit generation of cAMP →

Decrease secretion.



SECRETION

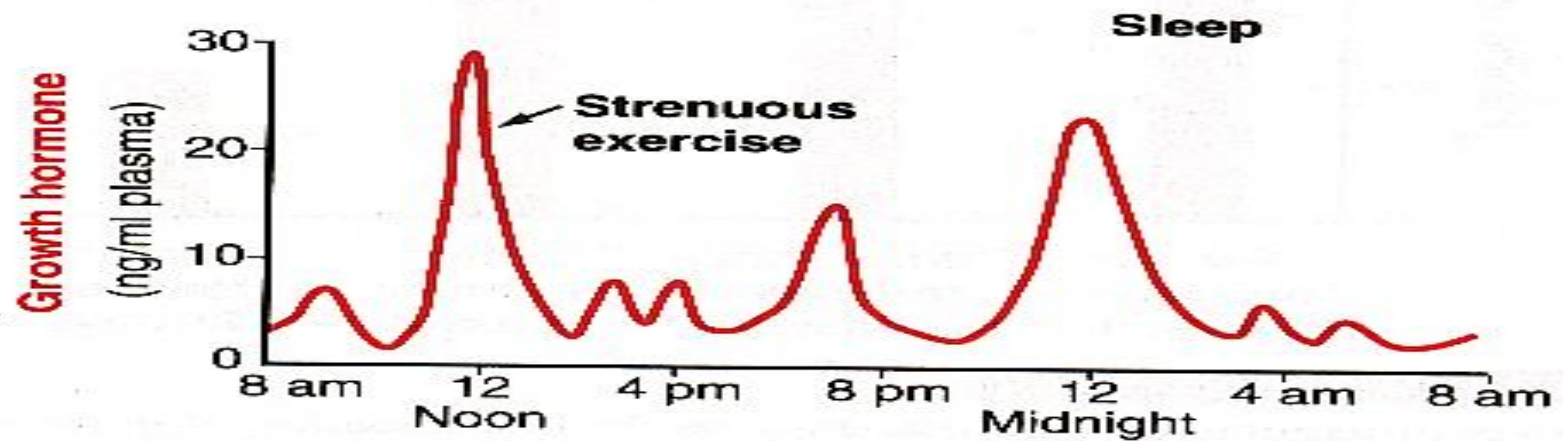


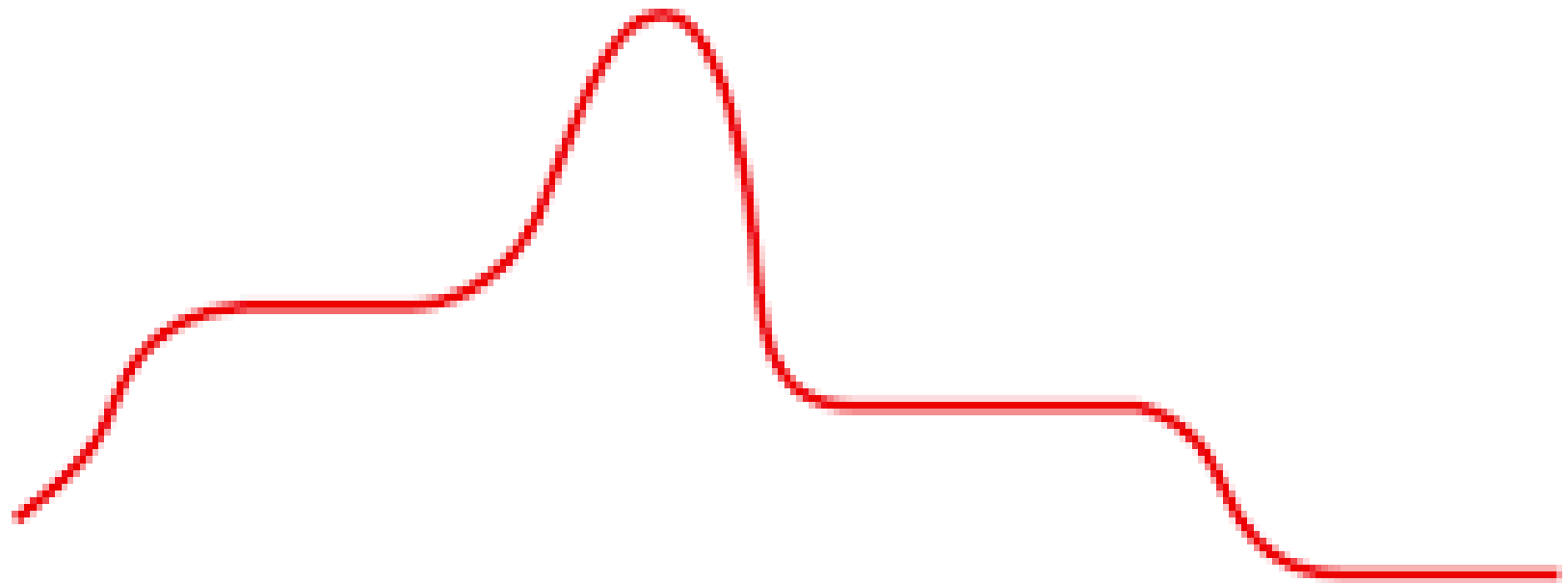
FIGURE 75-6

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.

- Pulsatile every 2H.

Growth hormone secretion

F M



Birth

Childhood

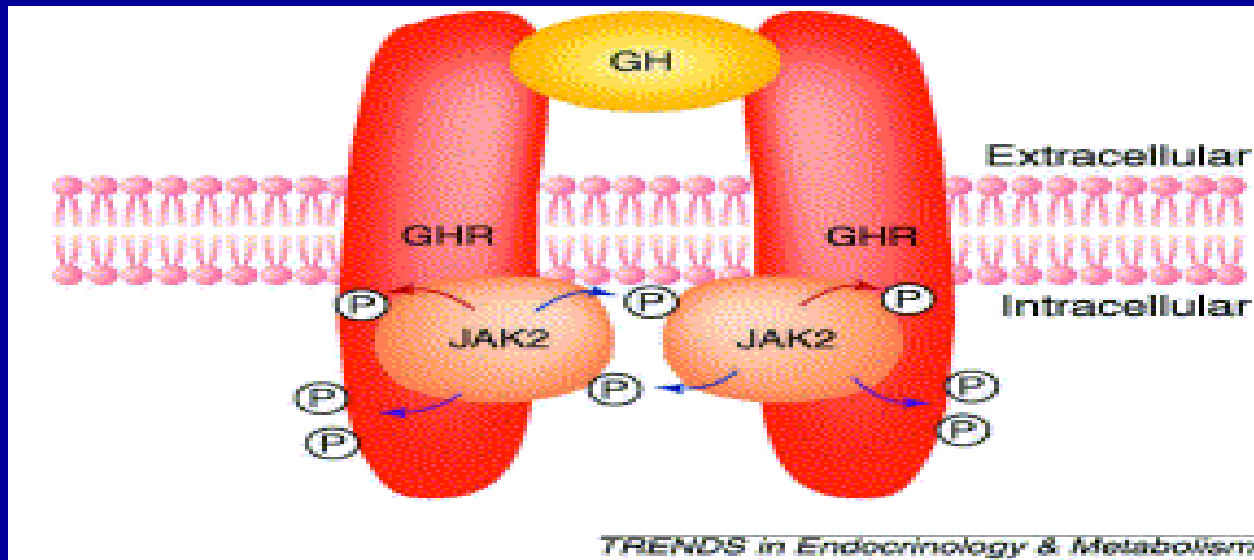
Puberty

Adult life

Senescence

ACTION OF GROWTH HORMONE

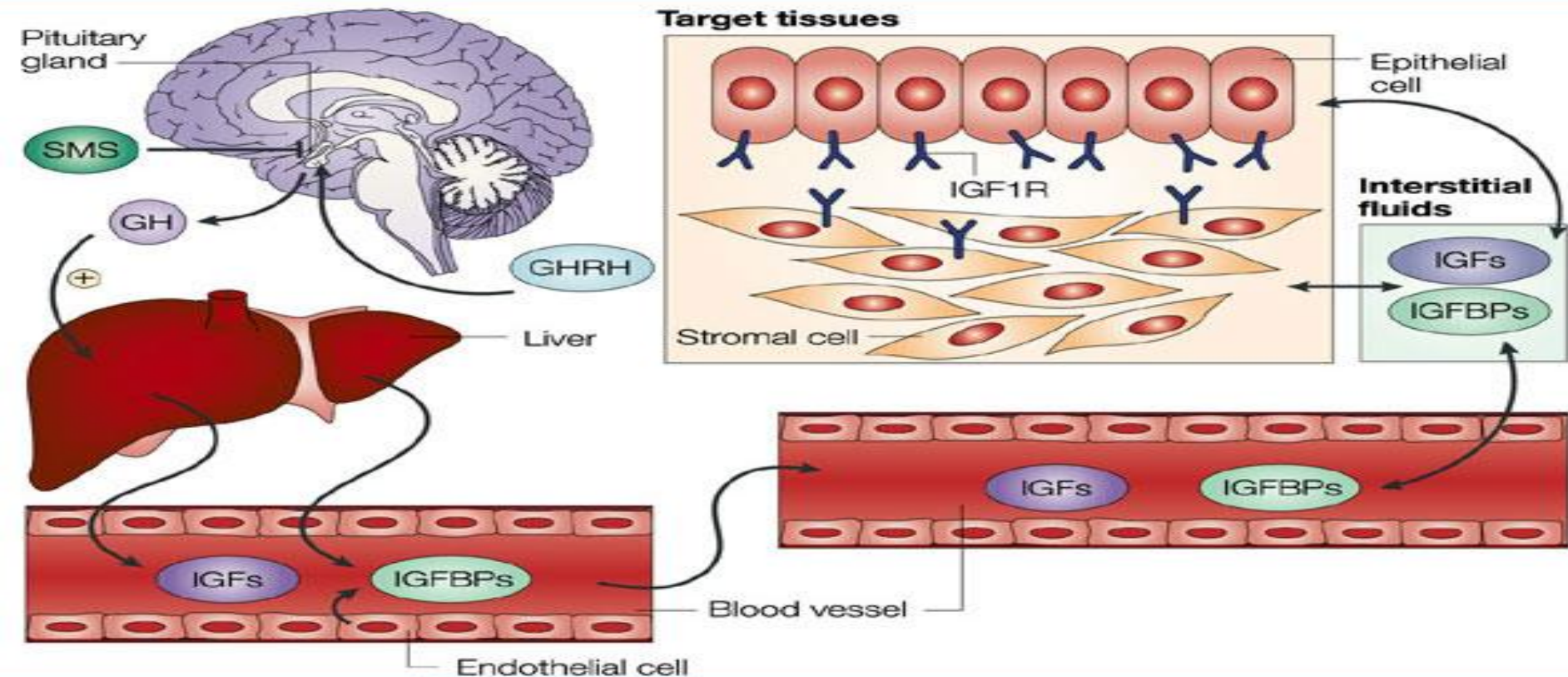
- **Direct.**
- **Skeletal muscles, liver and adipose.**



- **Indirect** (somatomedine IGF).
- 4500-7500 MW.
- Somatomedine C.

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EFFECT ON CARBOHYDRATE

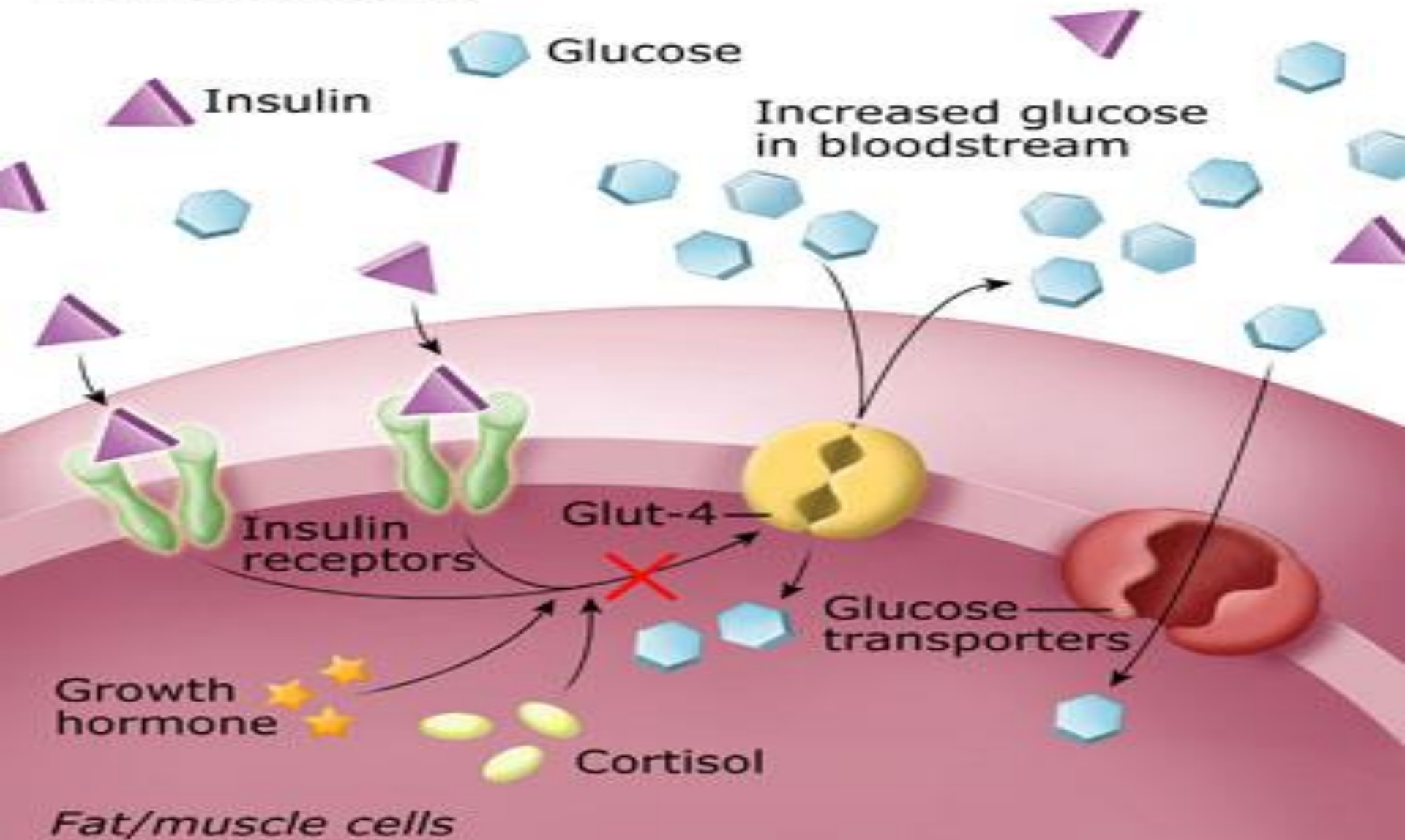
- Increase blood glucose.(**Diabetogenic effect.**)

(↑ gluconeogenesis)

Decrease glucose utilization in energy.

- Increase in insulin.

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



EFFECT ON PROTEIN

- Increase protein synthesis.
 - a- Increase AA uptake.
 - b- Increase DNA synthesis.
 - c- Increase RNA synthesis.
- Decrease protein catabolism.

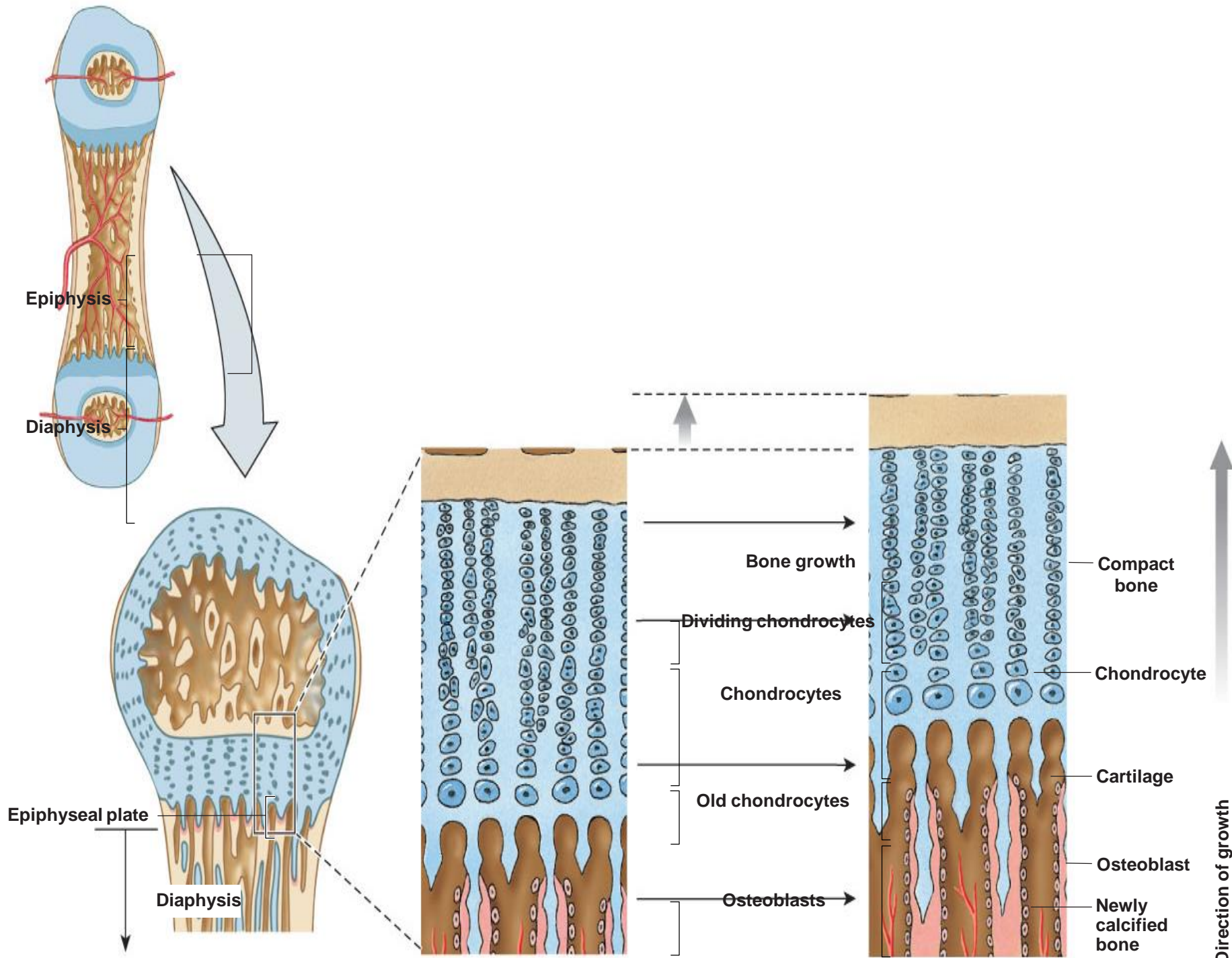
EFFECT IN FAT

1- Increase FFA.

2- FFA \longrightarrow Acetyl-CoA \longrightarrow energy

EFFECT IN BONE AND CARTILAGE

- 1- Increase linear growth.**
- 2- Increase metabolism in cartilage forming cells.**
- 3- Increase proliferation of chondrocytes.**
- 4- Widening of the epiphyseal plate.**



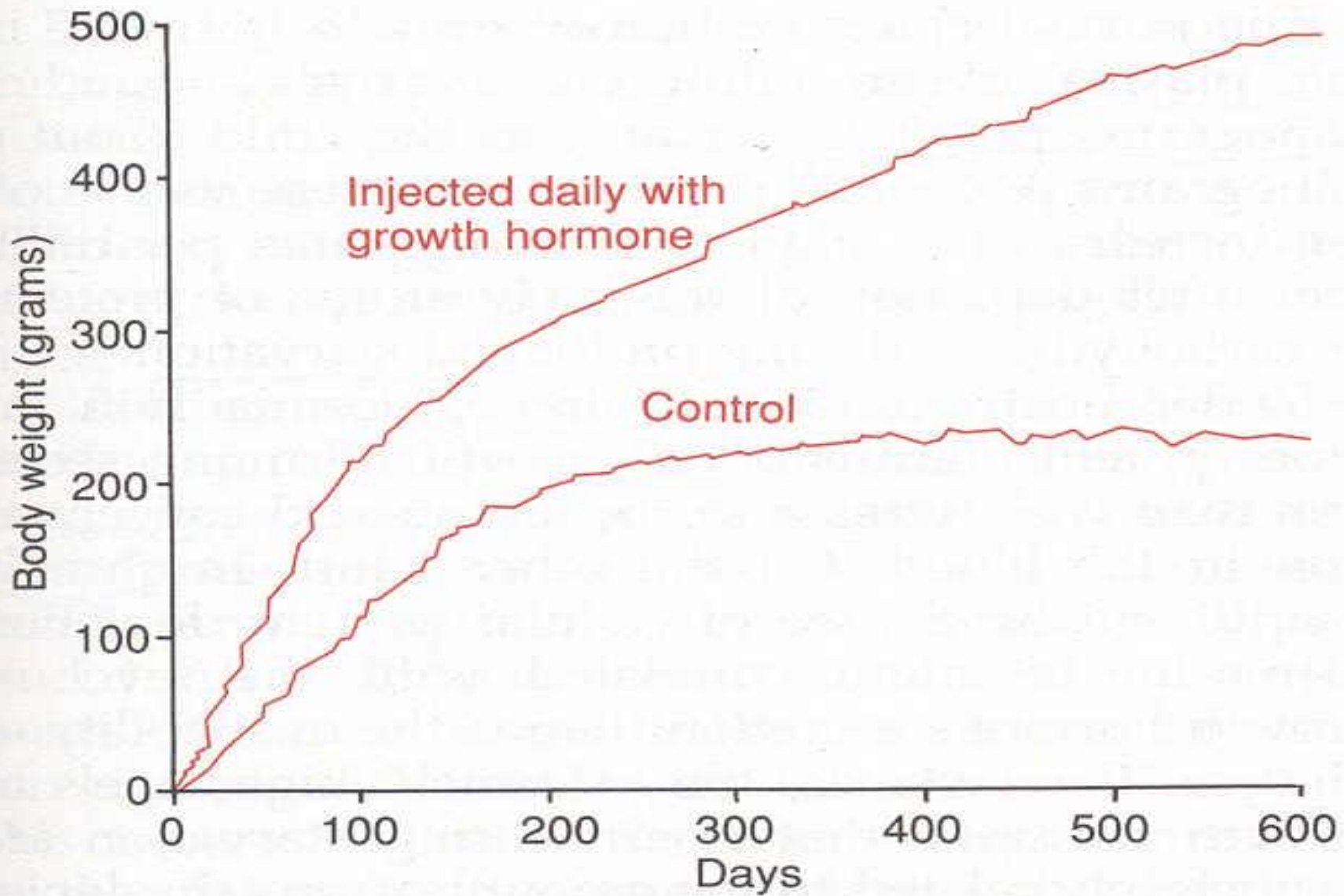


Figure 49-7 Comparison of weight gain of a rat injected daily with growth hormone with that of a normal rat.

Table 9-4 Factors Affecting Growth Hormone Secretion

Stimulatory Factors	Inhibitory Factors
Decreased glucose concentration	Increased glucose concentration
Decreased free fatty acid concentration	Increased free fatty acid concentration
Arginine	Obesity
Fasting or starvation	Senescence
Hormones of puberty (estrogen, testosterone)	Somatostatin
Exercise	Somatomedins
Stress	Growth hormone
Stage III and IV sleep	β -Adrenergic agonists
α -Adrenergic agonists	Pregnancy

TABLE 16.1 Pituitary Hormones: Summary of Regulation and Effects

HORMONE (CHEMICAL STRUCTURE AND CELL TYPE)	REGULATION OF RELEASE	TARGET ORGAN AND EFFECTS	EFFECTS OF HYPOSECRETION ↓ AND HYPERSECRETION ↑
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Anterior Pituitary Hormones

Growth hormone (GH)
(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

ABNORMALITIES

1- Hyposecretion of GH.

Dwarfism.

Causes?.

where?



2- Hypersecretion.

- Often associated with tumor.
- Gigantism.
- Acromegaly.
- Octreotide.



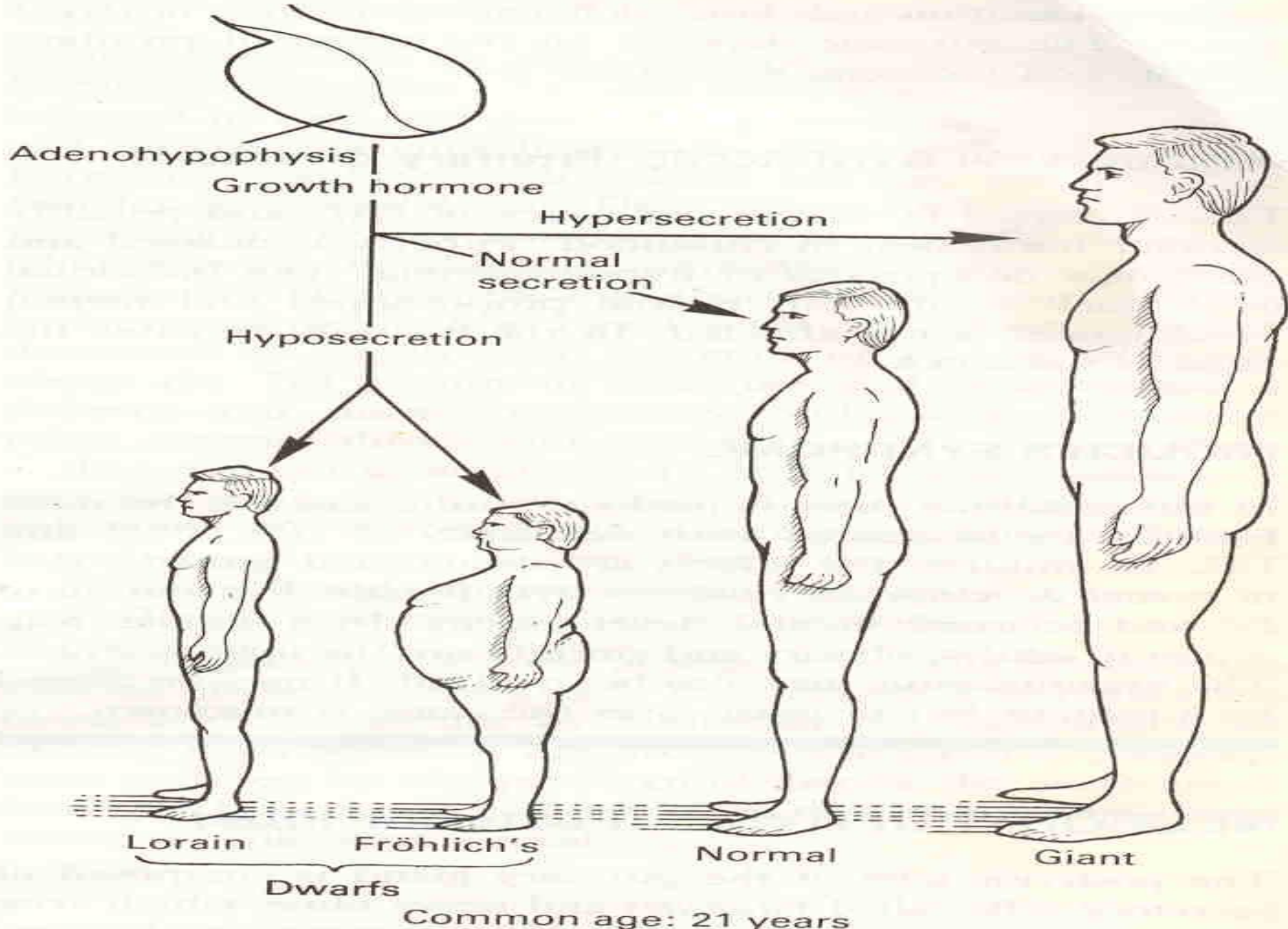


Figure 14:5 Effects of normal and abnormal growth hormone secretion.

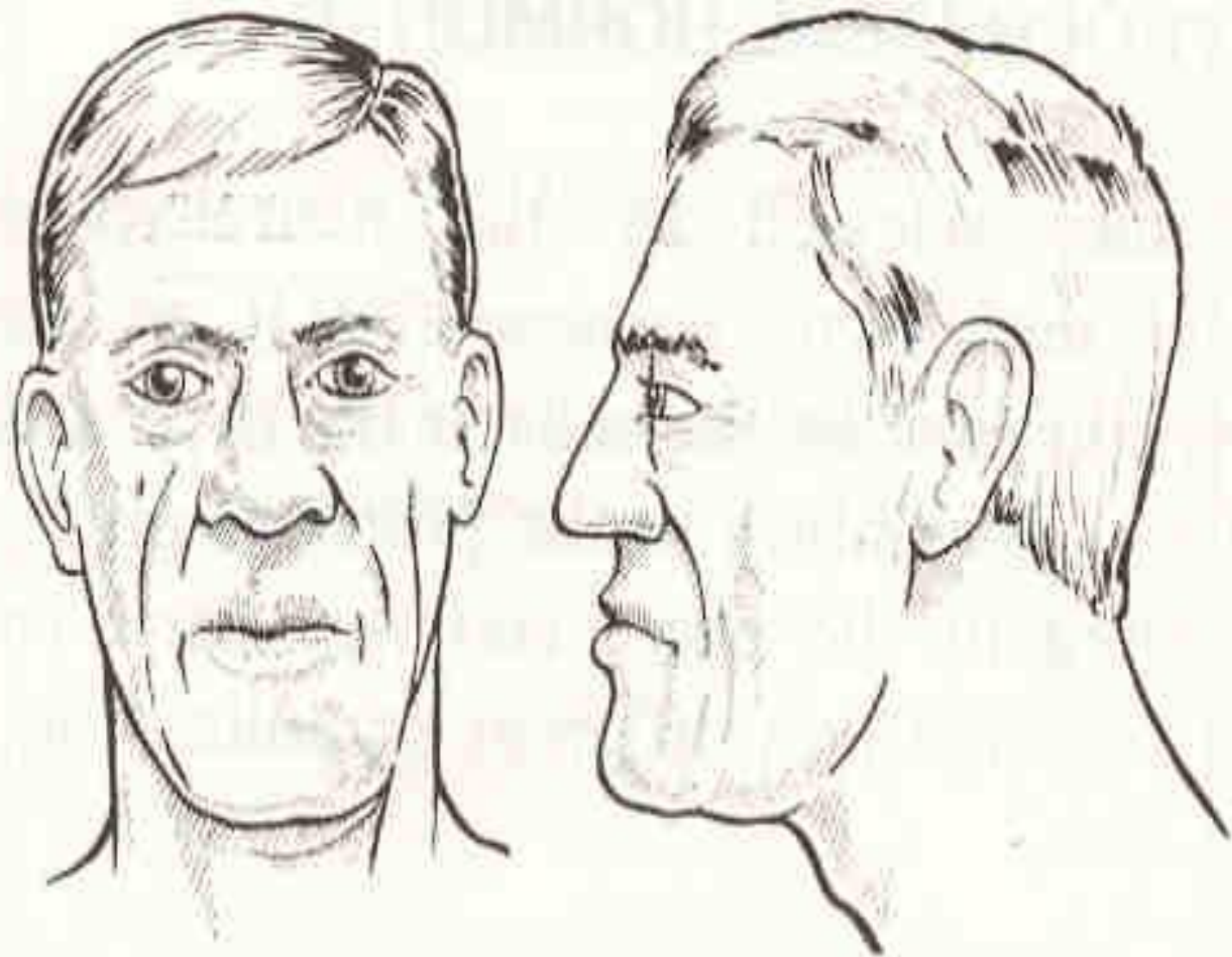
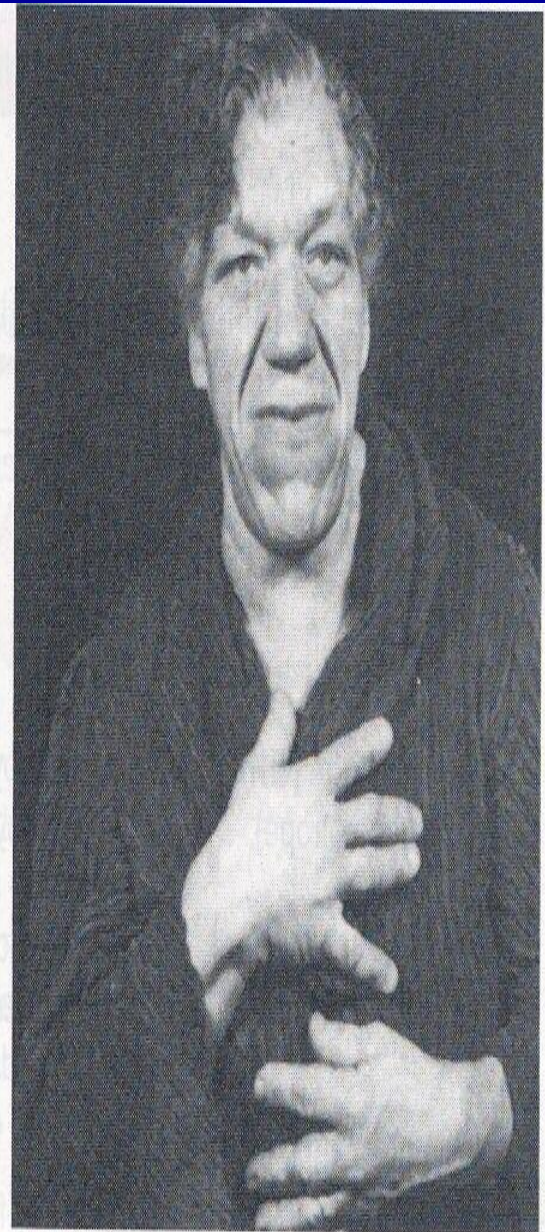


Figure 14:6 Acromegaly.



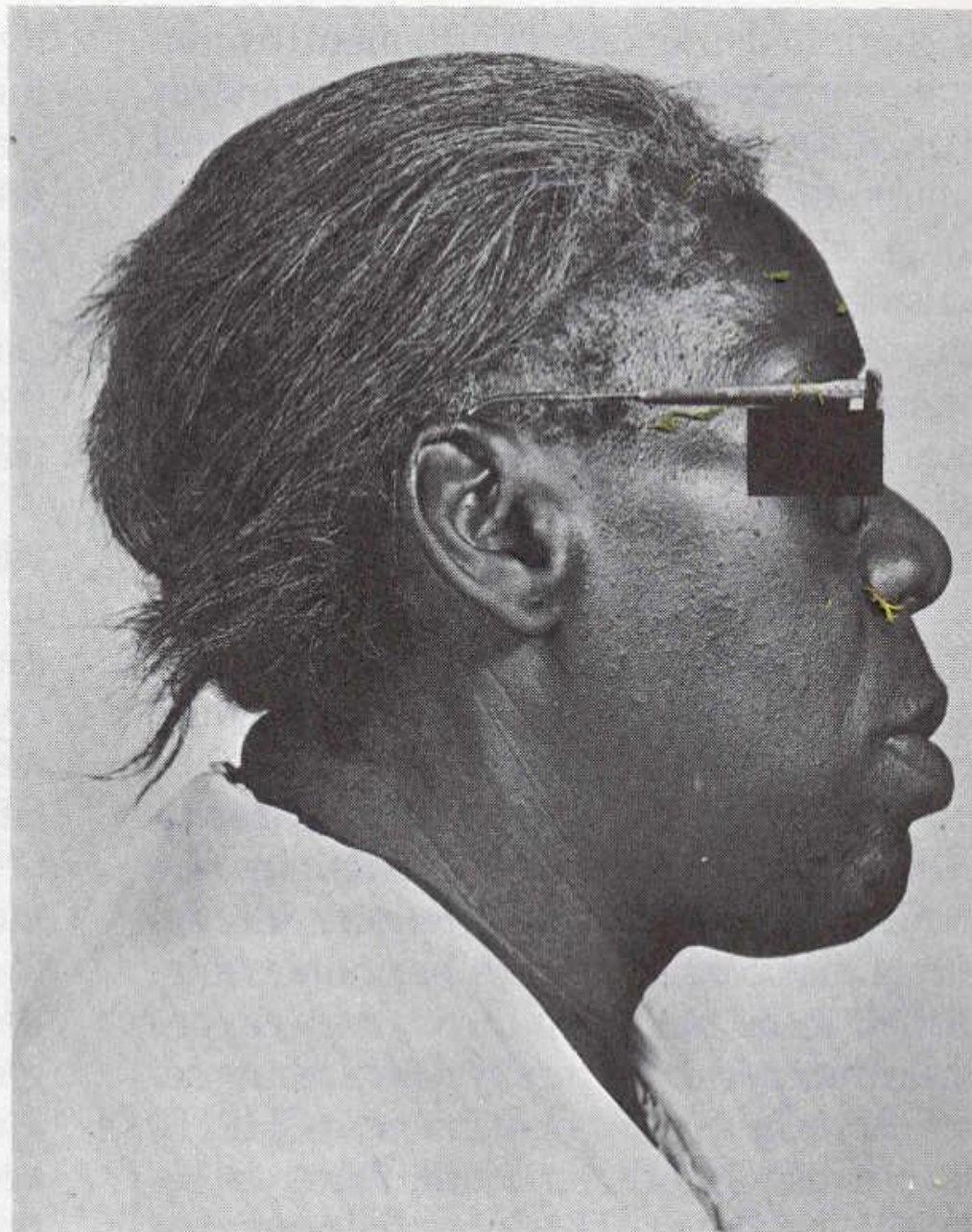
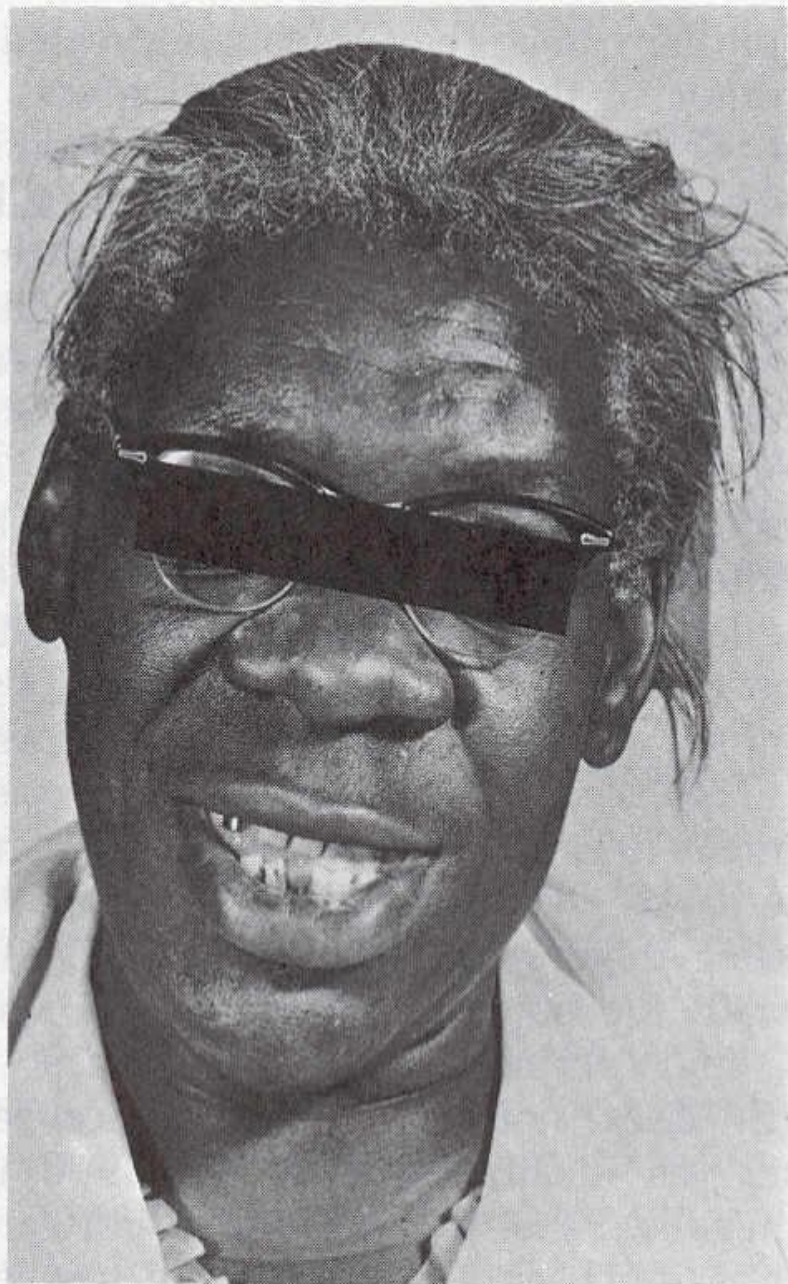
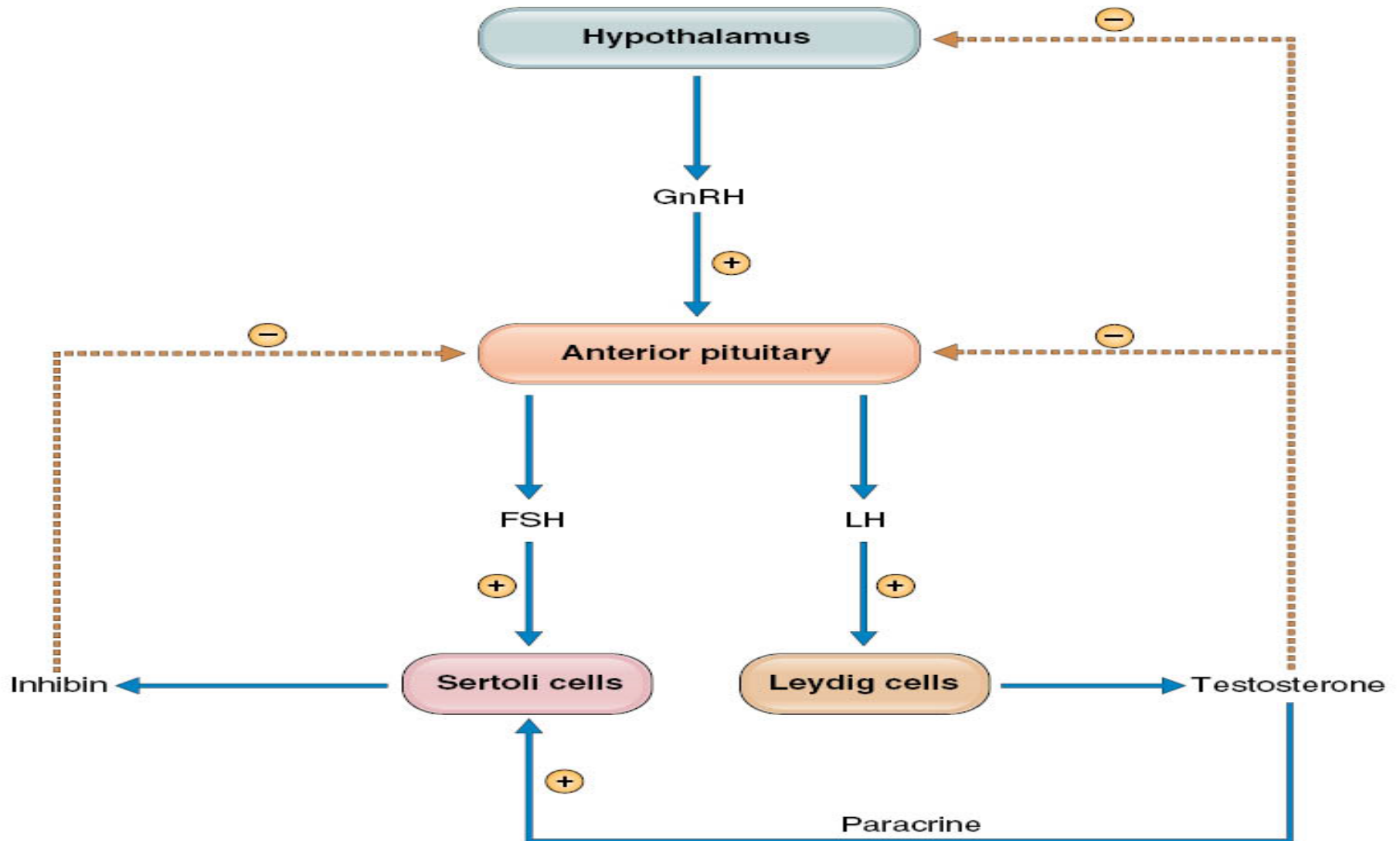


Figure 49-8 An acromegalic patient. (Courtesy of Dr. Herbert Langford.)

FSH AND LH

- **Glycoproteins.**
- **Gonadotrophs (15%)**
- **α and β .**
- **Related to TSH.**

SECRETION



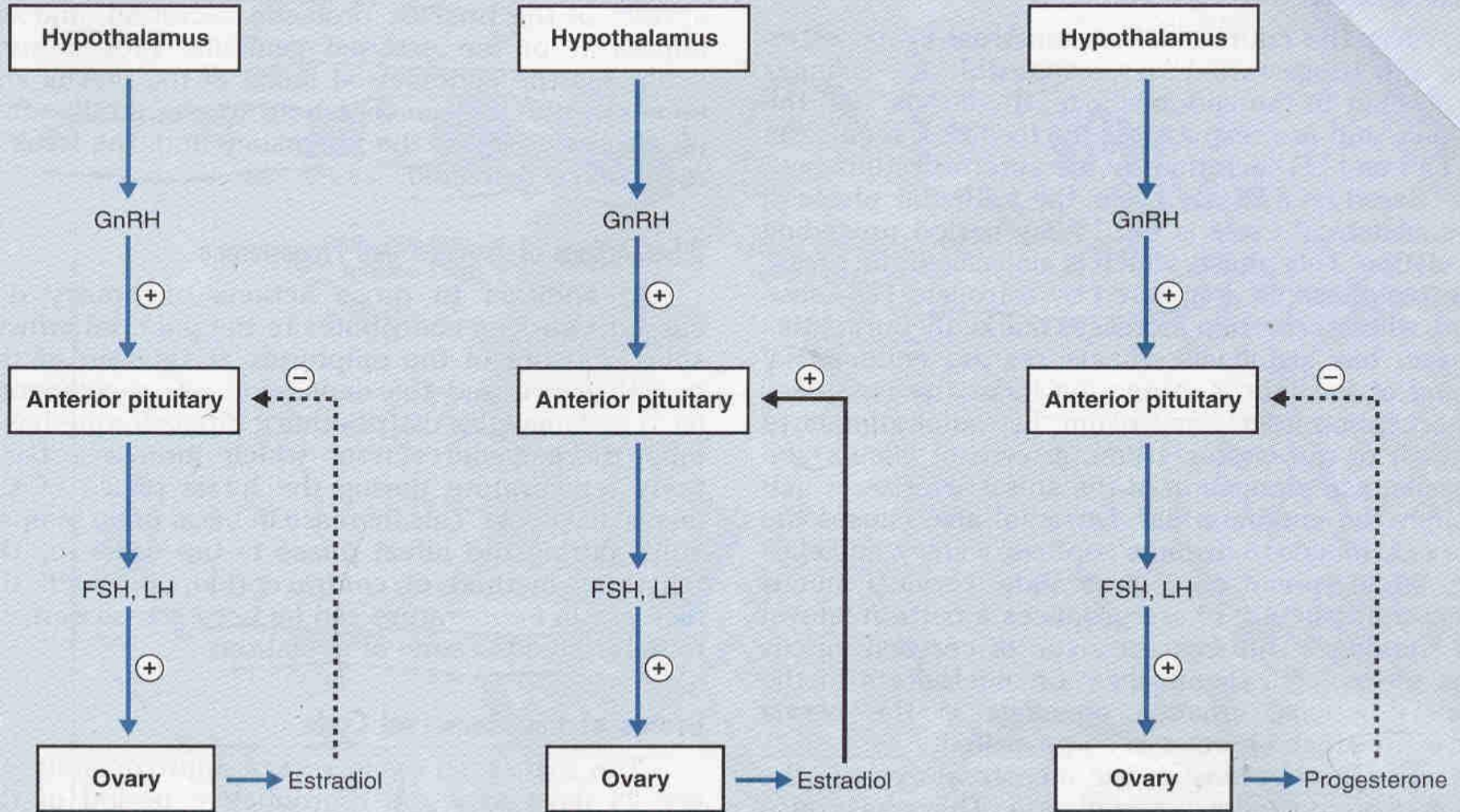
FOLLICULAR PHASE**MIDCYCLE****LUTEAL PHASE**

FIGURE 10-9. Control of follicle-stimulating hormone (FSH) and luteinizing hormone (LH) secretion in females during the menstrual cycle. The follicular and luteal phases are characterized by negative feedback of estradiol and progesterone, respectively, on the anterior pituitary. Midcycle is characterized by positive feedback of estradiol on the anterior pituitary. GnRH, gonadotropin-releasing hormone.

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Thank you