ENDOCRINE PHYSIOLOGY

PROF. ABDULMAJEED AL-DREES

ANTERIOR PITUITARY GLAND

ANTERIOR PITUITARY GLAND

- **Hormones:**

1- TSH

2- FSH

3- LH

4- GH

5- PROLACTIN

6- ACTH.

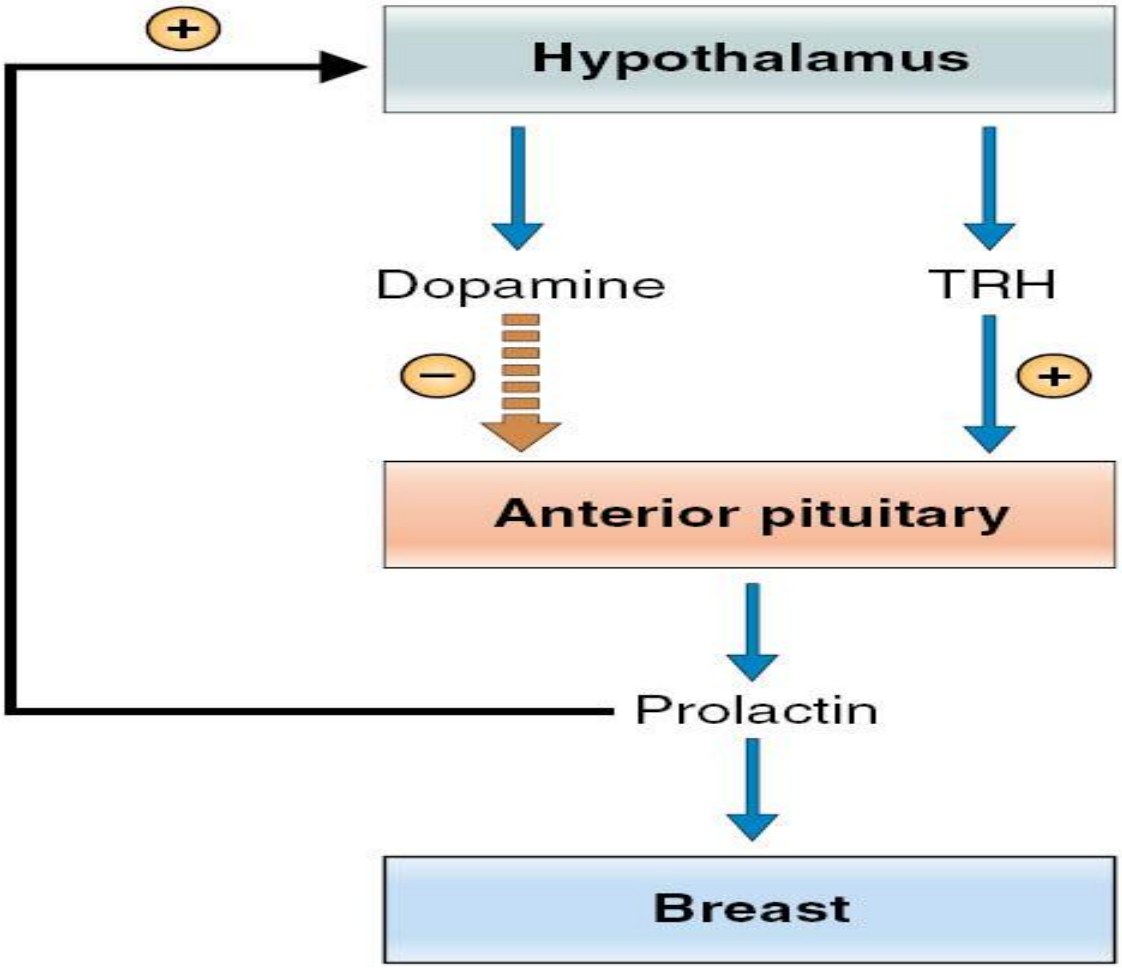
Table 11.6 | Anterior Pituitary Hormones

Hormone	Target Tissue	Principal Actions	Regulation of Secretion
ACTH (adrenocorticotropic 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

PROLACTIN

- Lactotrophs.(15%)
- 198 AA.
- Related to GH.

REGULATION OF SECRETION



SOURCES OF DOPAMINE

1- Dopaminergic neurons in the hypothalamus.

2- Dopaminergic neurons in the posterior pituitary.

3- Nonlactotrophs cells of the anterior pituitary.

Table 9-5 Factors Affecting Prolactin Secretion

Stimulatory Factors	Inhibitory Factors
Pregnancy (estrogen)	Dopamine
Breast-feeding	Bromocriptine (dopamine agonist)
Sleep	Somatostatin
Stress	Prolactin (negative feedback)
TRH	
Dopamine antagonists	

ACTION

1- Breast development.

2- Lactogenesis.
(Lactose, lipid, casein)
Parturition.

3- Inhibition of ovulation.
GnRH

ABNORMALITIES

1- Prolactin deficiency.

Failure to lactate.

2- Prolactin excess.

Galactorrhea.

Infertility.

Bromocriptine.

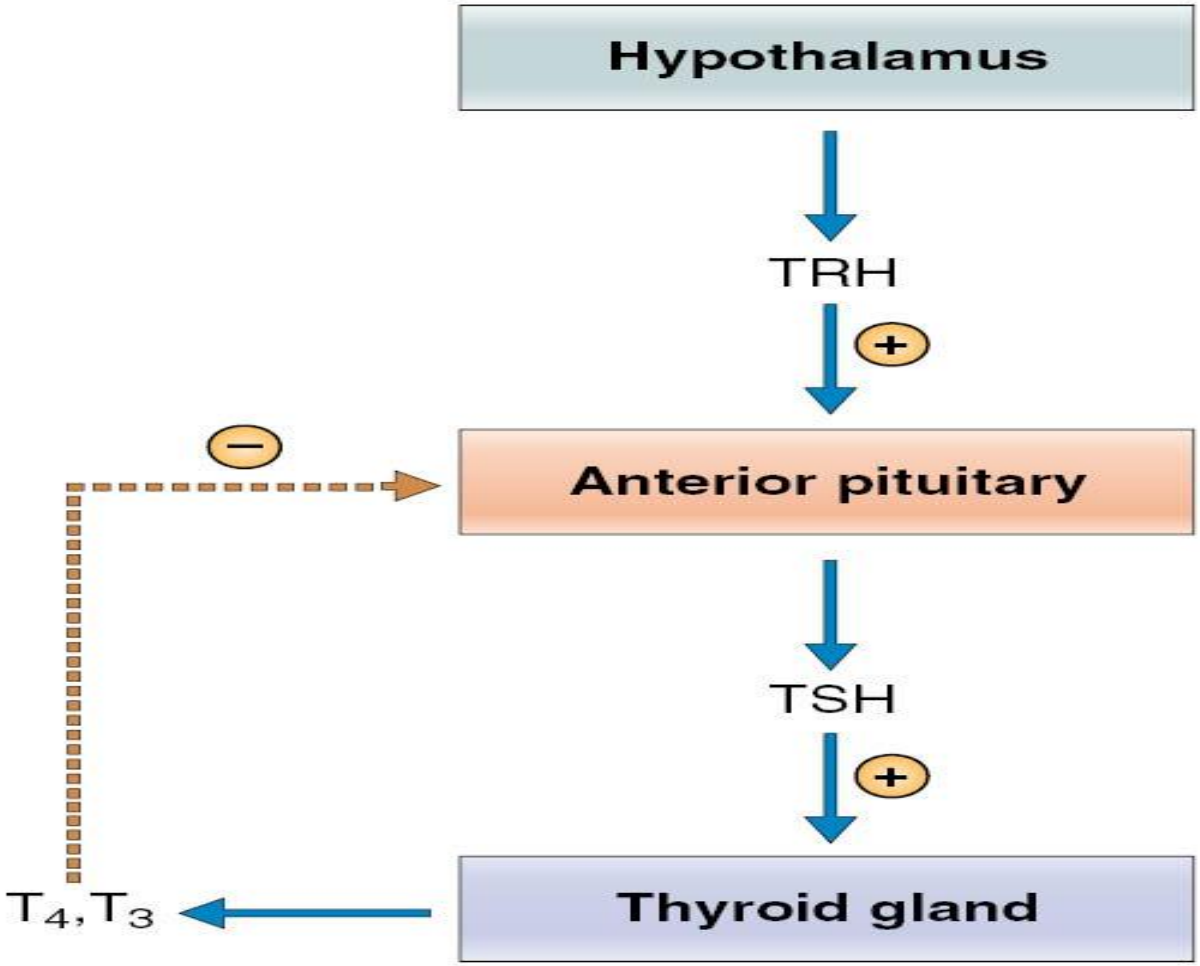
TSH

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

ABNORMALITIES

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

REGULATION OF SECRETION



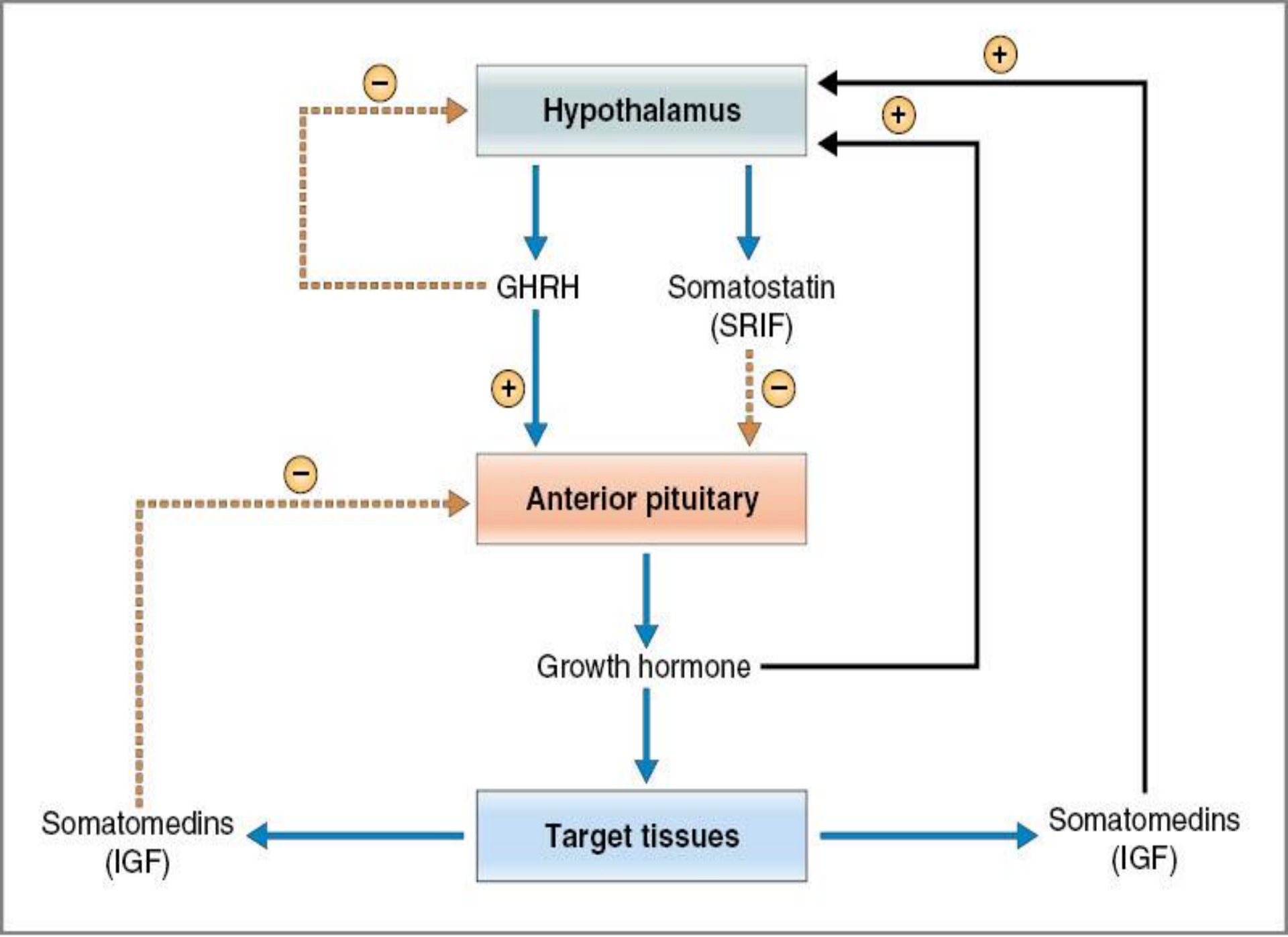
ACTION

1- Increase synthesis and secretion of thyroid hormones.

2- Trophic effect.

GROWTH HORMONE

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



- GHRH → receptor → Gs protein →

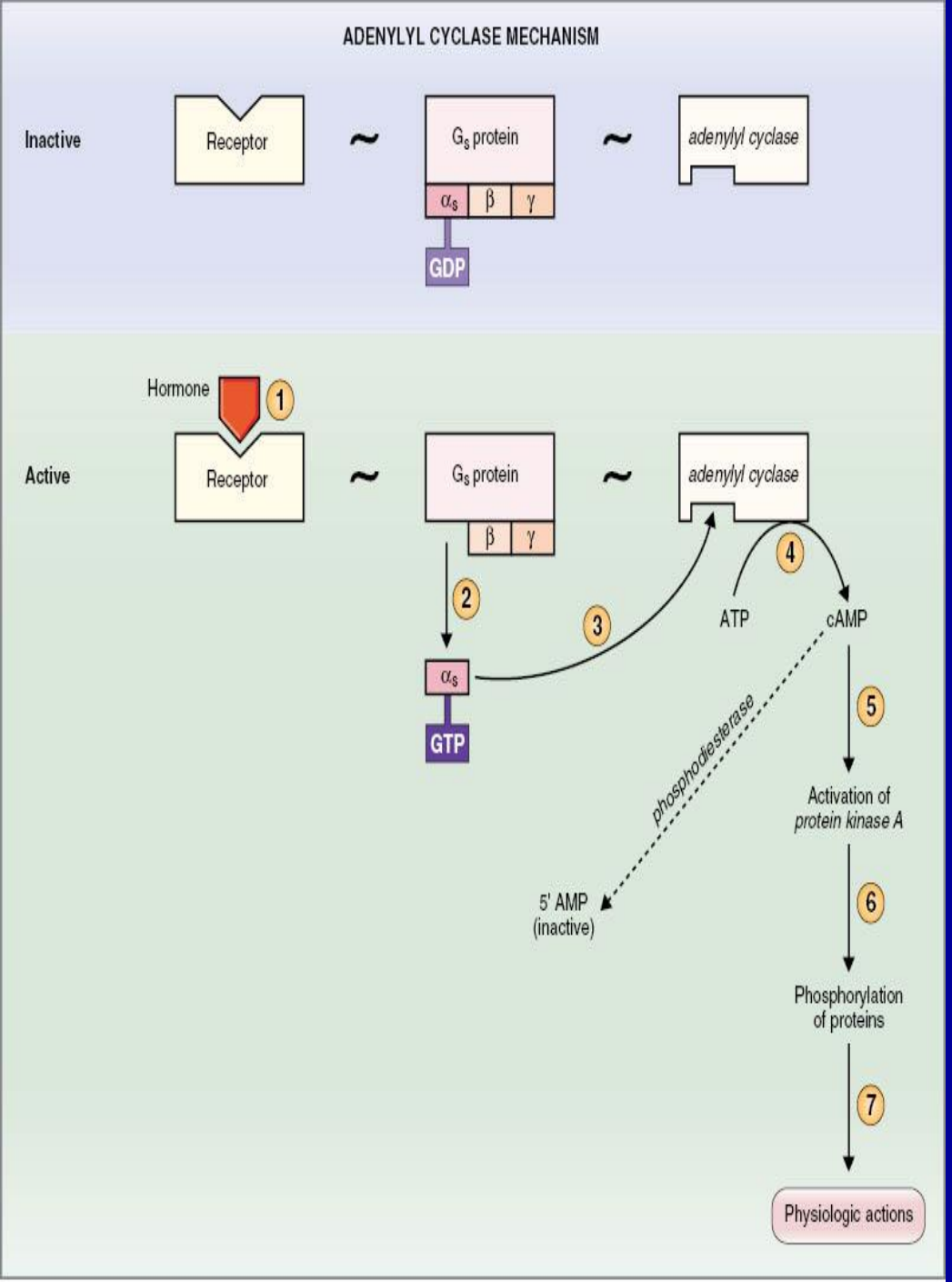
Adenylyl cyclase and phospholipase C →

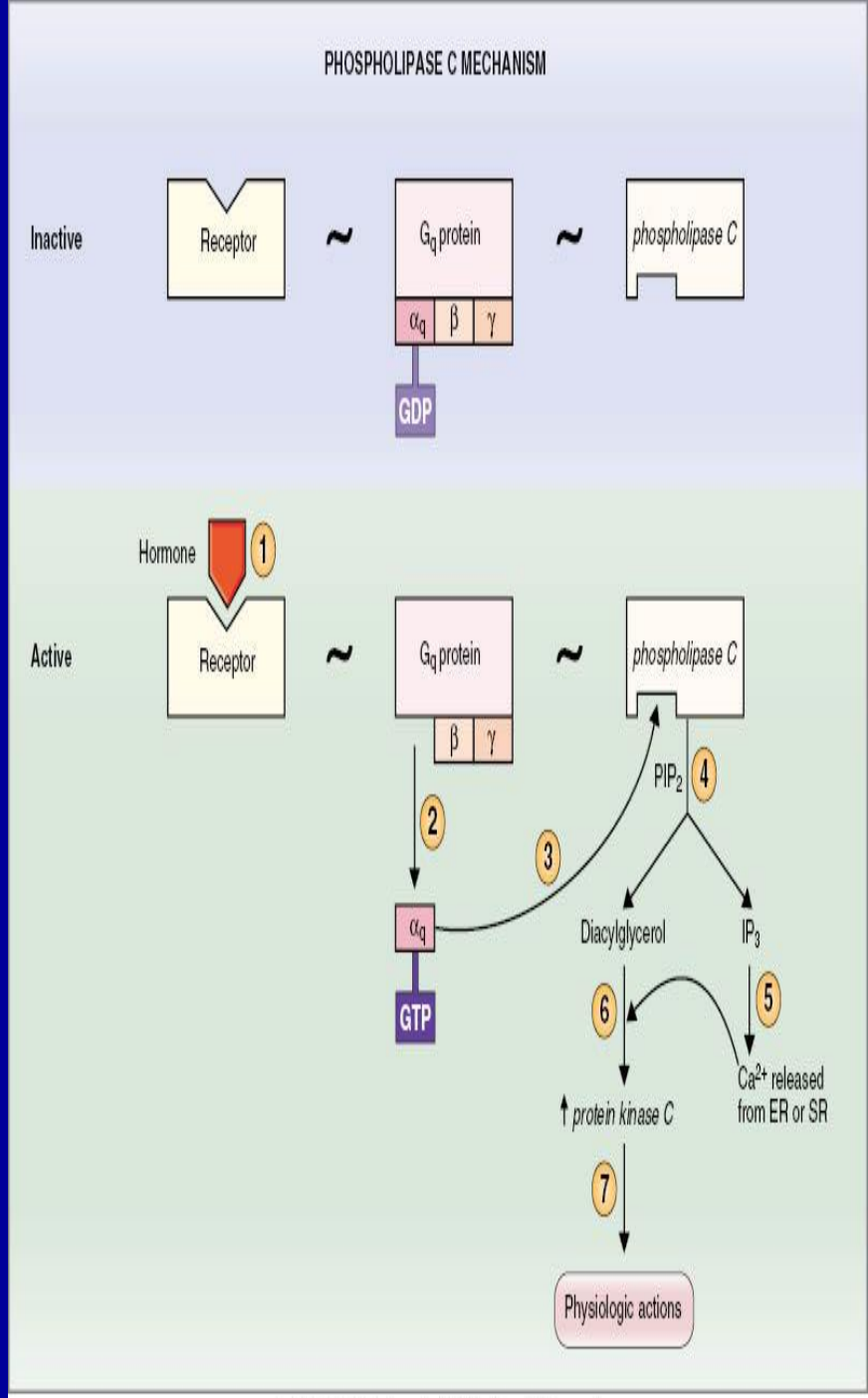
cAMP and IP3/Ca → secretion + synthesis.

- **Somatostatin (SRIF) → receptor**

Gi → inhibit generation of cAMP →

Decrease secretion.





SECRETION

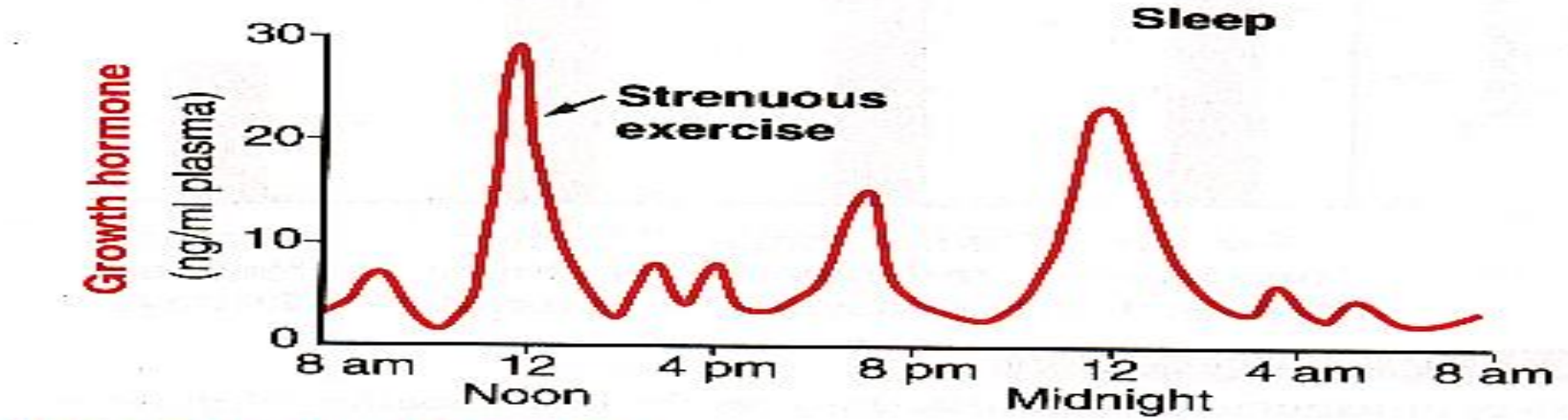


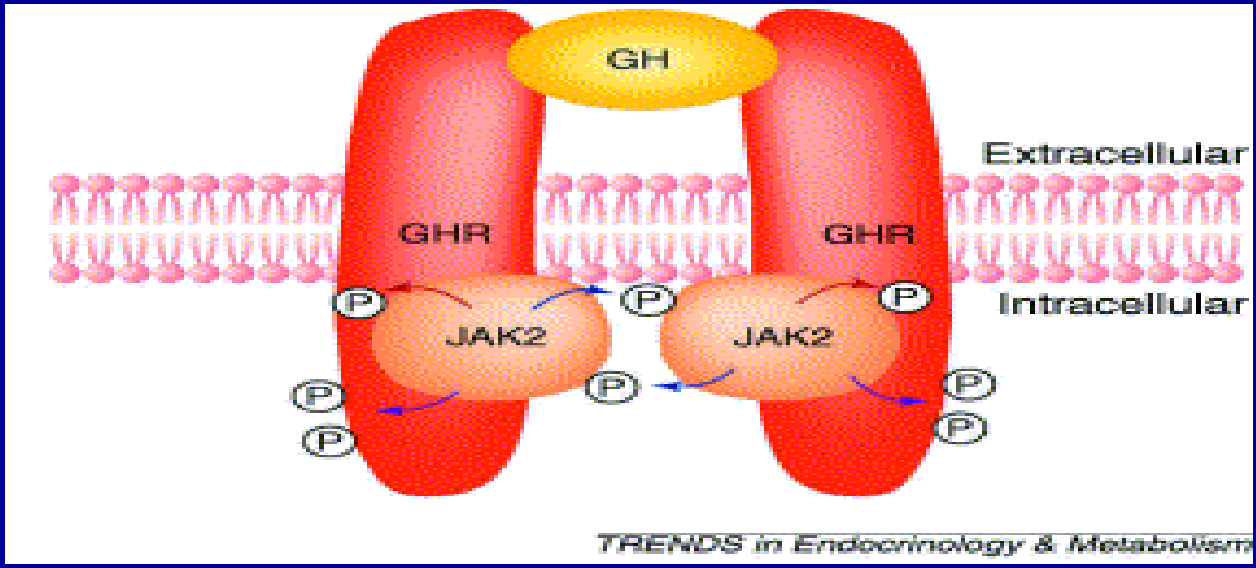
FIGURE 75–6

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.

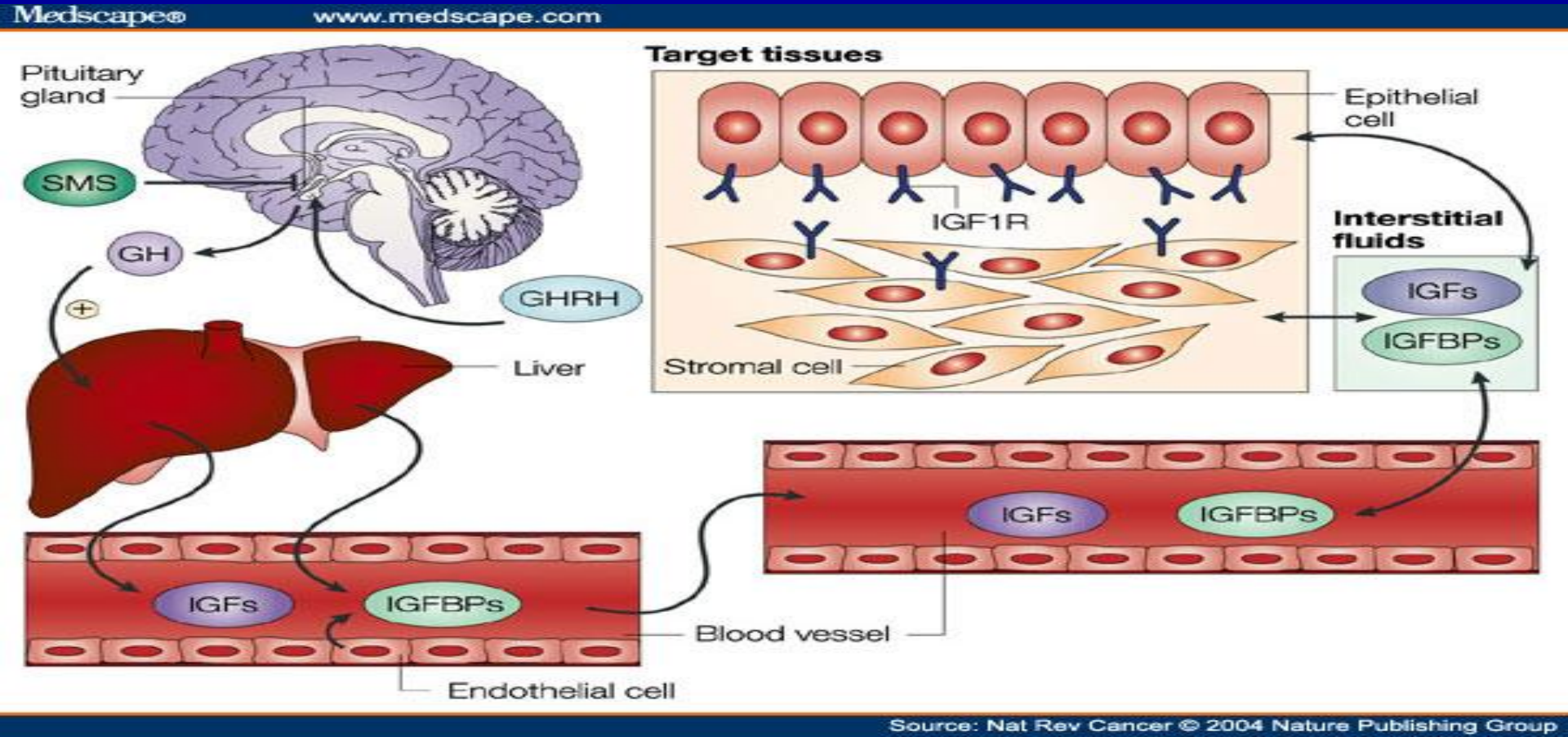
- Pulsatile every 2H.

ACTION OF GROWTH HORMONE

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



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



EFFECT ON CARBOHYDRATE

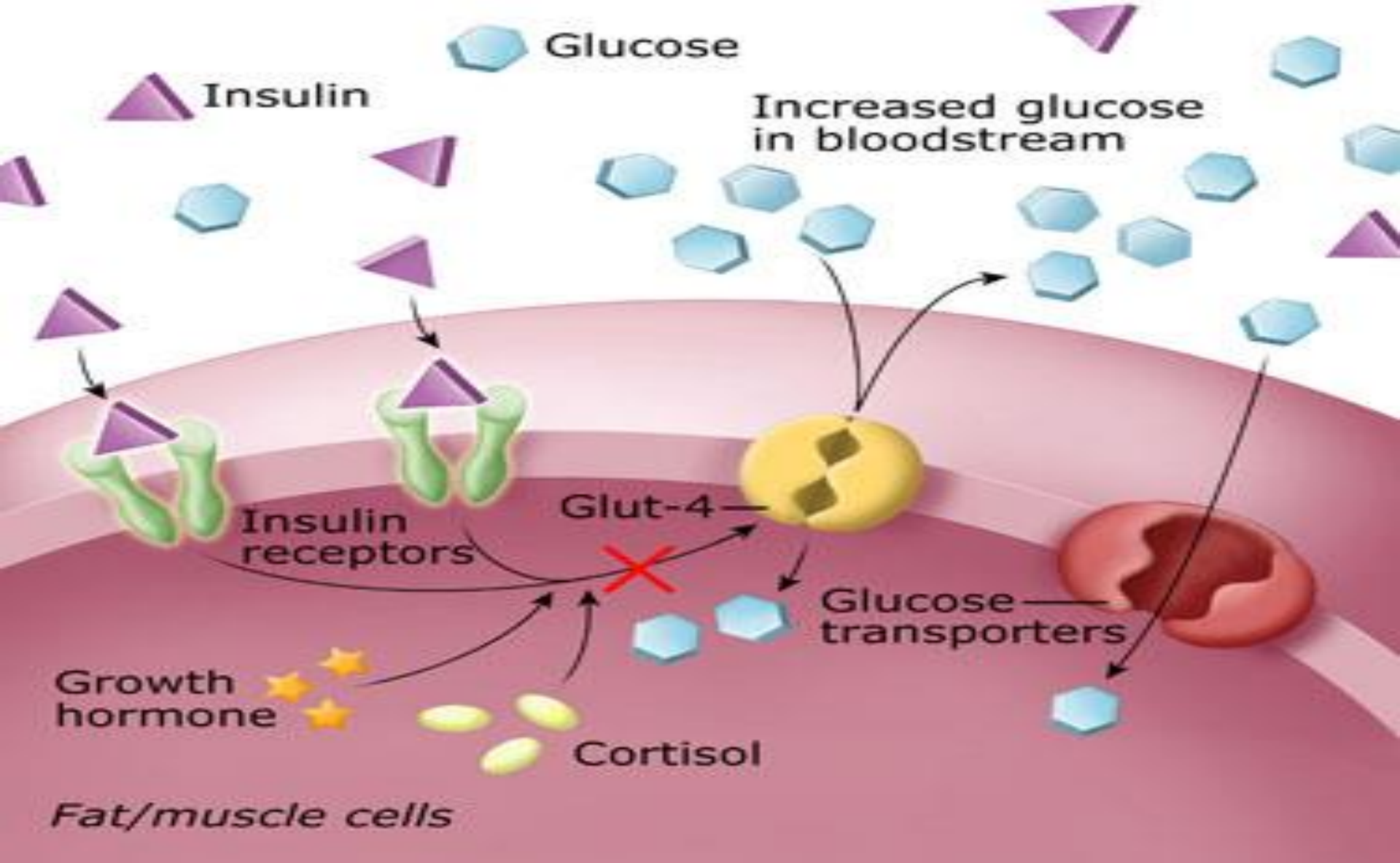
- **Increase blood glucose.(Diabetogenic effect.)**

(↑ 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 ⟶ Acetyl-CoA ⟶ energy

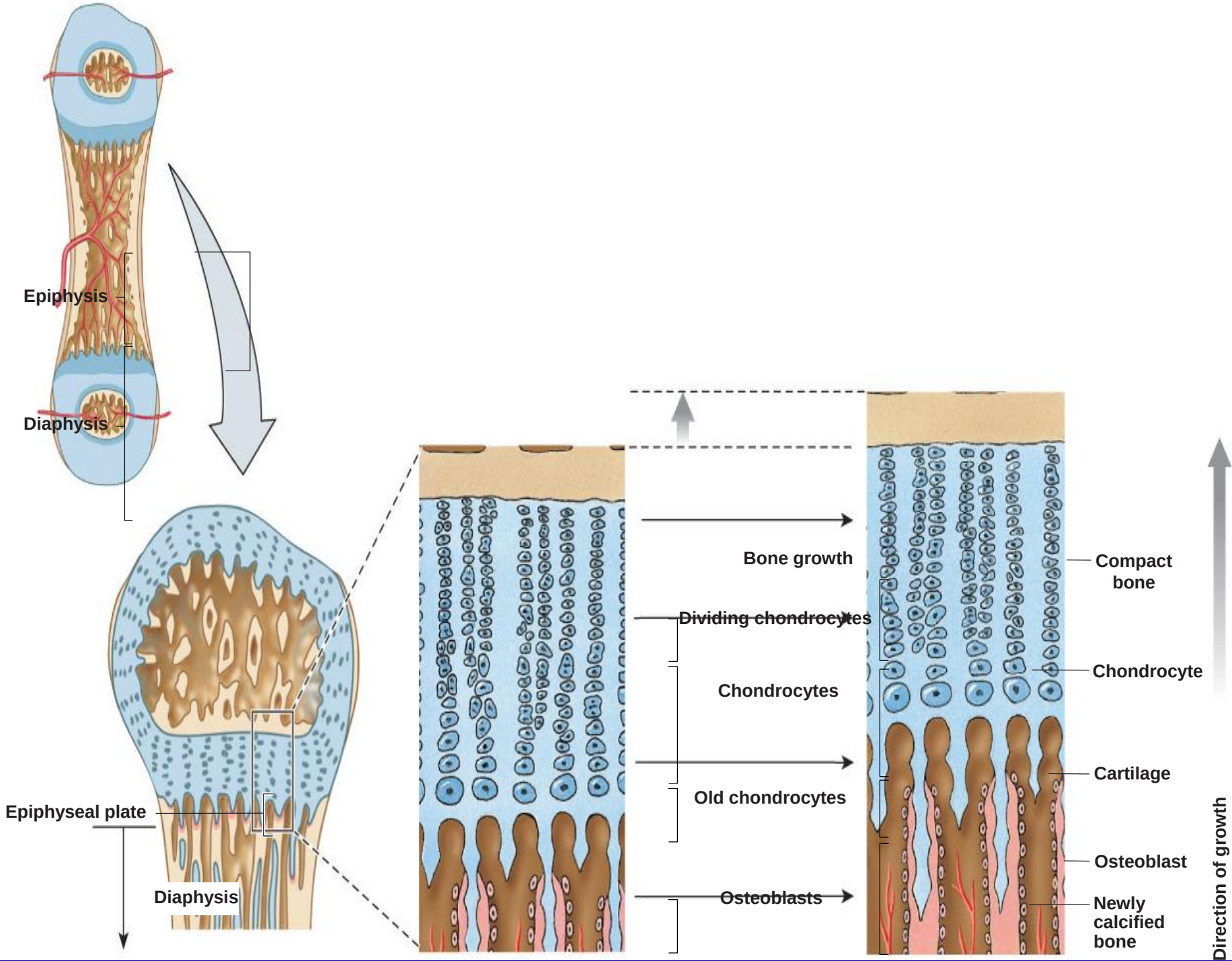
EFFECT IN BONE AND CARTILAGE

1- Increase liner growth.

2- Increase metabolism in cartilage forming cells.

3- Increase proliferation of condrocytes.

4- Widening of the epiphyseal plate.


Epiphysis
Diaphysis
Epiphyseal plate
Diaphysis
Bone growth
Dividing chondrocytes
Chondrocytes
Old chondrocytes
Osteoblasts
Compact bone
Chondrocyte
Cartilage
Osteoblast
Newly calcified bone
Direction of growth

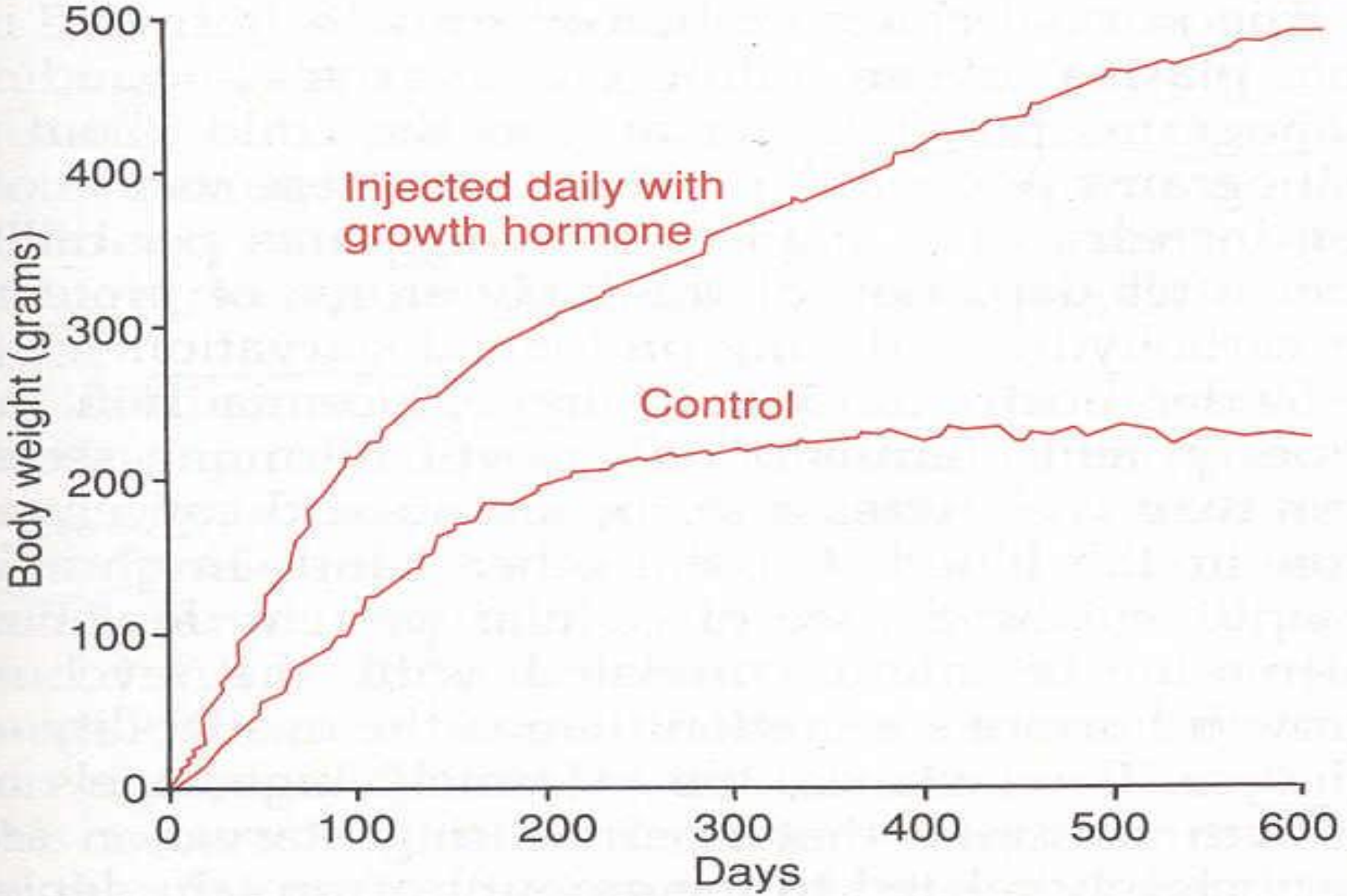


Figure 49–7 Comparison of weight gain of a rat injected daily with growth hormone with that of a normal rat.

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
	Somatomedins
Exercise	Growth hormone
Stress	β-Adrenergic agonists
Stage III and IV sleep	Pregnancy
α-Adrenergic agonists	

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 ↑
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.
- Giganitsm.
- Acromegaly.

- Octreotide.

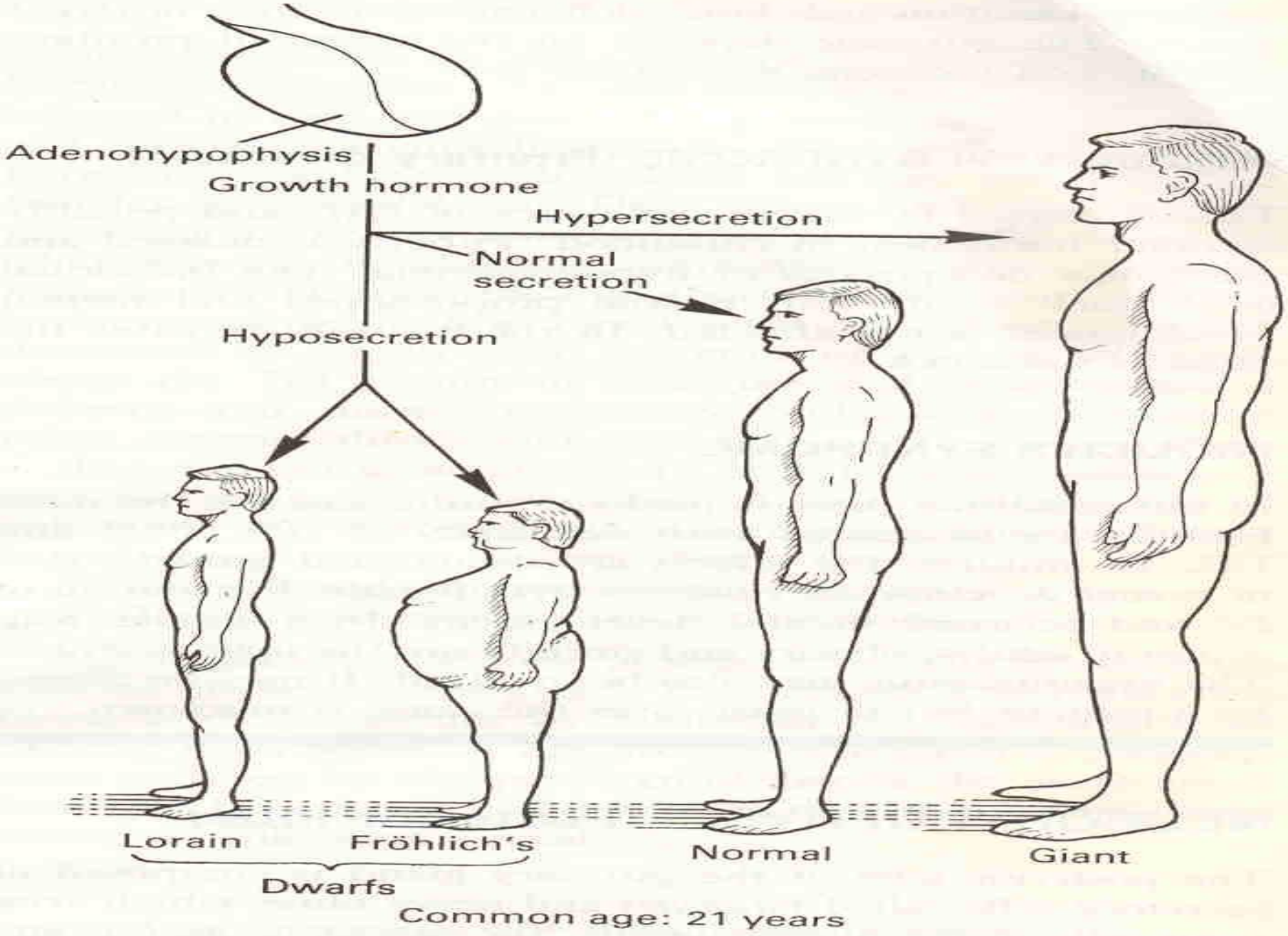


Figure 14:5 Effects of normal and abnormal growth hormone secretion.

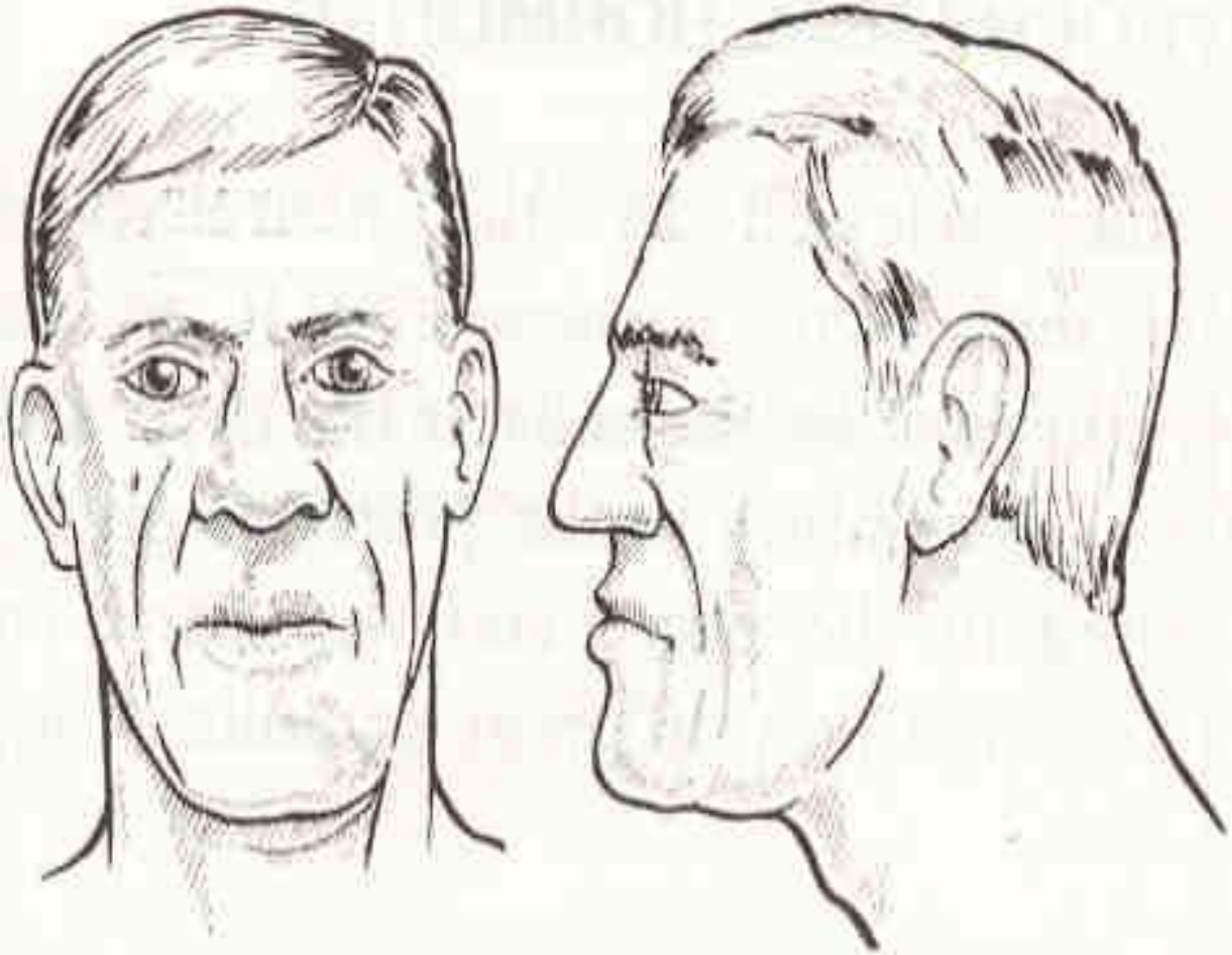


Figure 14:6 Acromegaly.



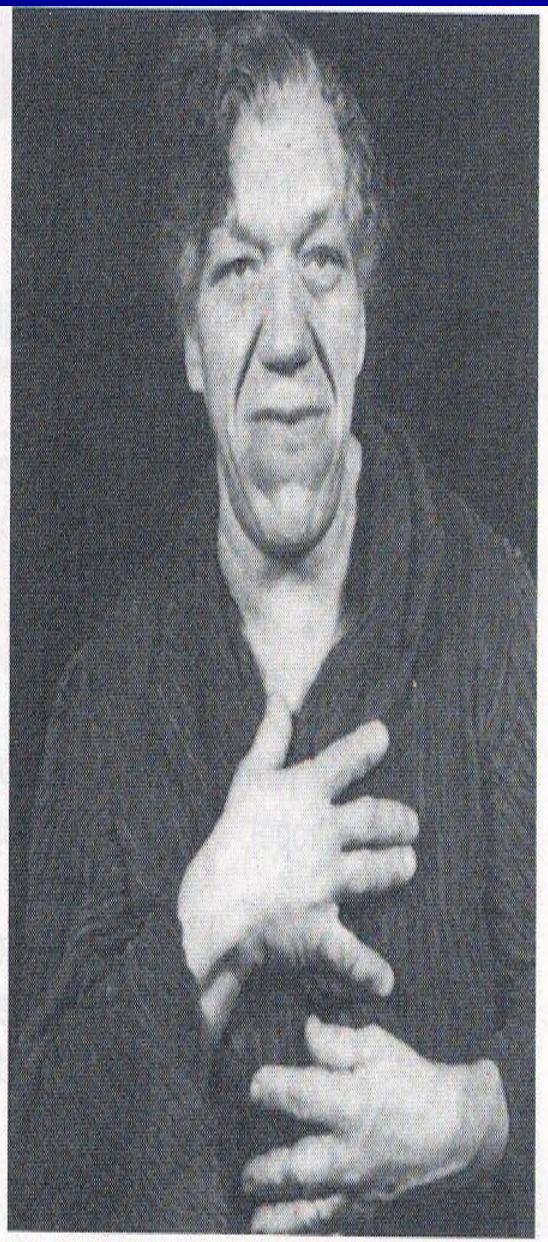
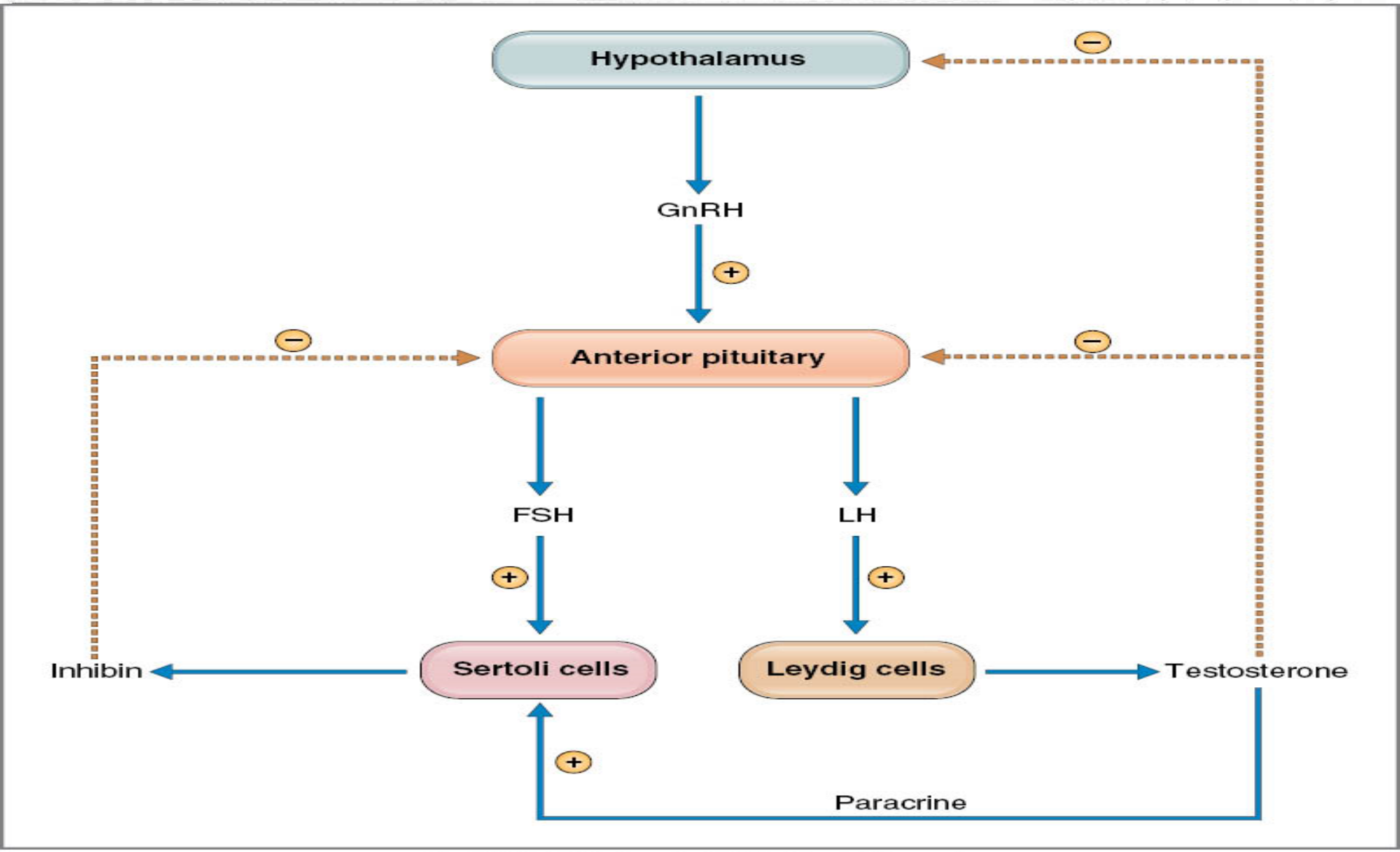


Figure 49–8 An acromegalic patient. (Courtesy of Dr. Herbert Langford.)

FSH AND LH

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

SECRETION



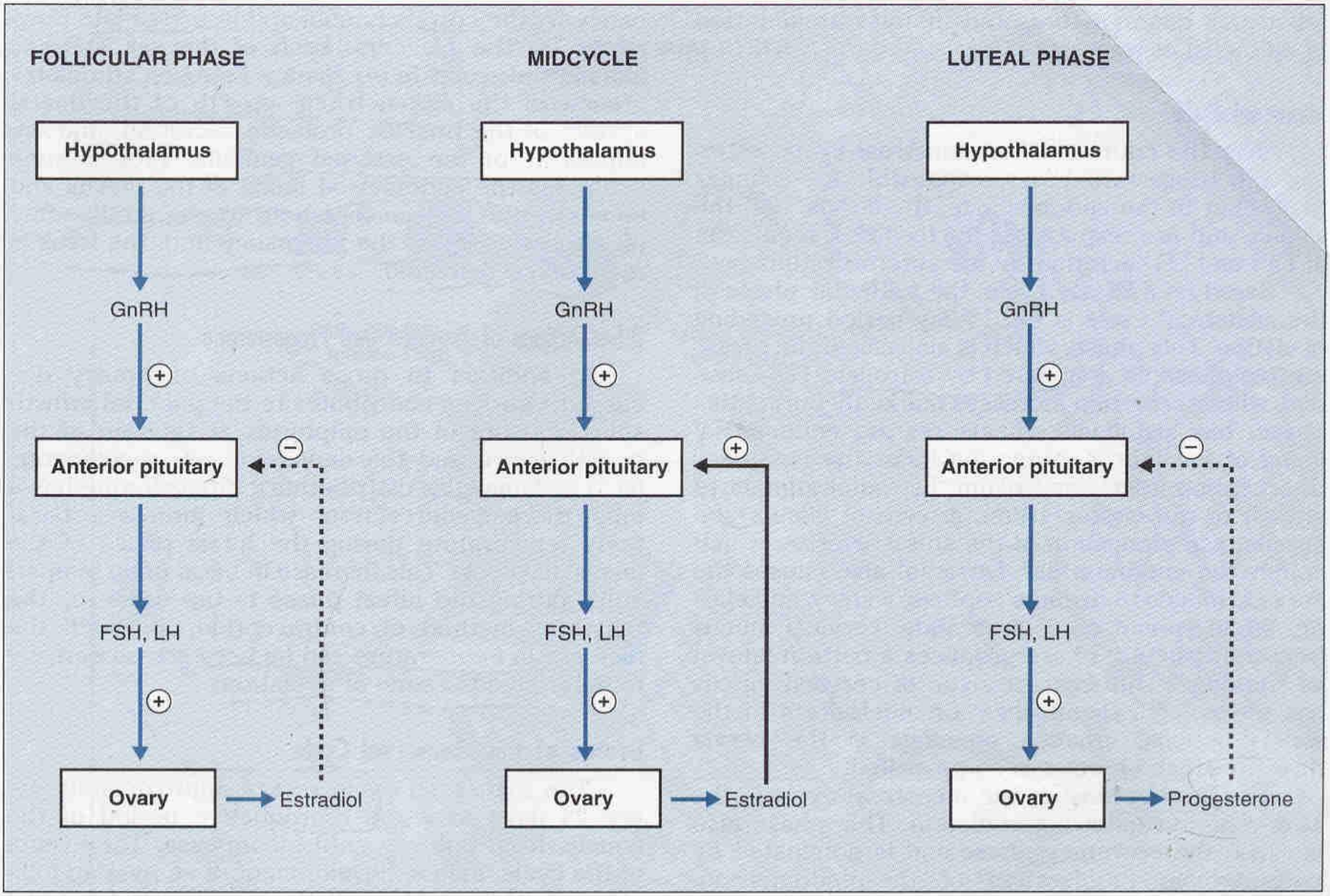
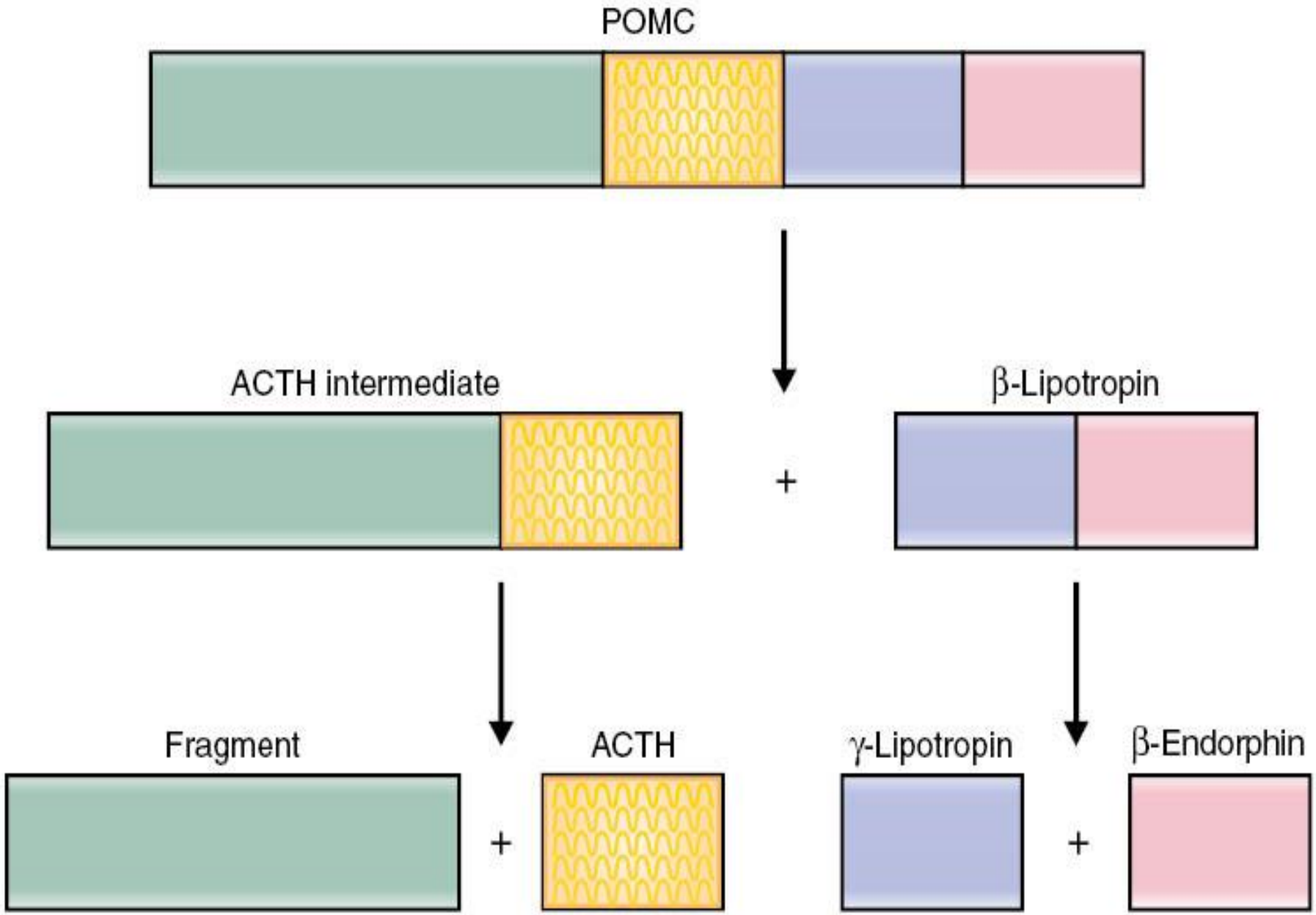


FIGURE 10–9. Control of follicle-stimulating hormone (FSH) and luteinizing hormone (LH) secretion in females during the menstrual cycle. The follicular and luteal phases are characterized by negative feedback of estradiol and progesterone, respectively, on the anterior pituitary. Midcycle is characterized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

ACTH

- Cortictrophs.(15%)
- ACTH, MSH, β-endorphin.
- Preproopiomelanocortin (POMC).



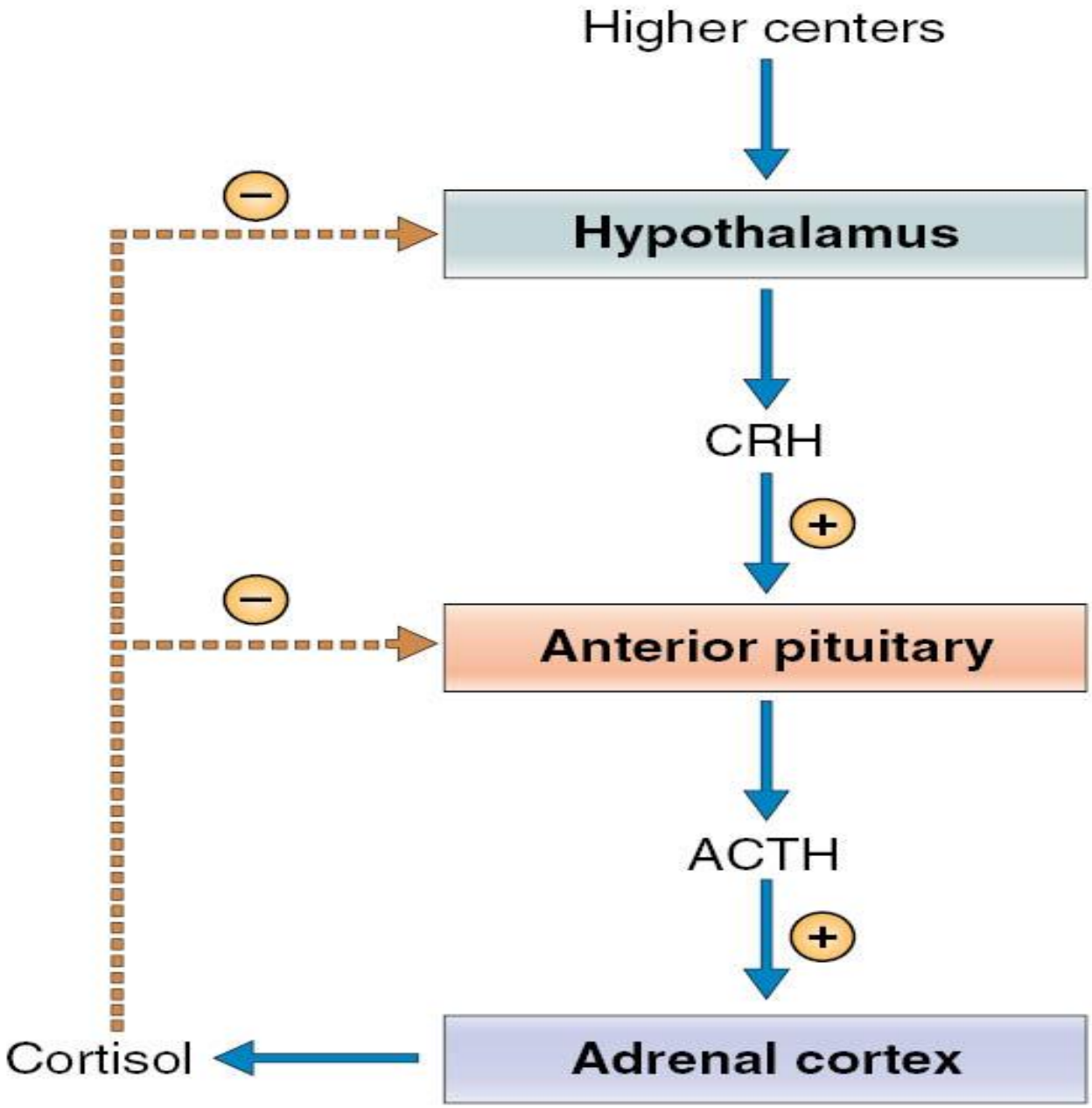


Table 9-10 Factors Affecting ACTH Secretion

Stimulatory Factors	Inhibitory Factors
Decreased blood cortisol levels	Increased blood cortisol levels
Sleep-wake transition	Opioids
Stress; hypoglycemia; surgery; trauma	Somatostatin
Psychiatric disturbances	
ADH	
α-Adrenergic agonists	
β-Adrenergic antagonists	
Serotonin	

ACTION

- **Stimulate synthesis and secretion of adrenal cortical hormones.**

Thank you