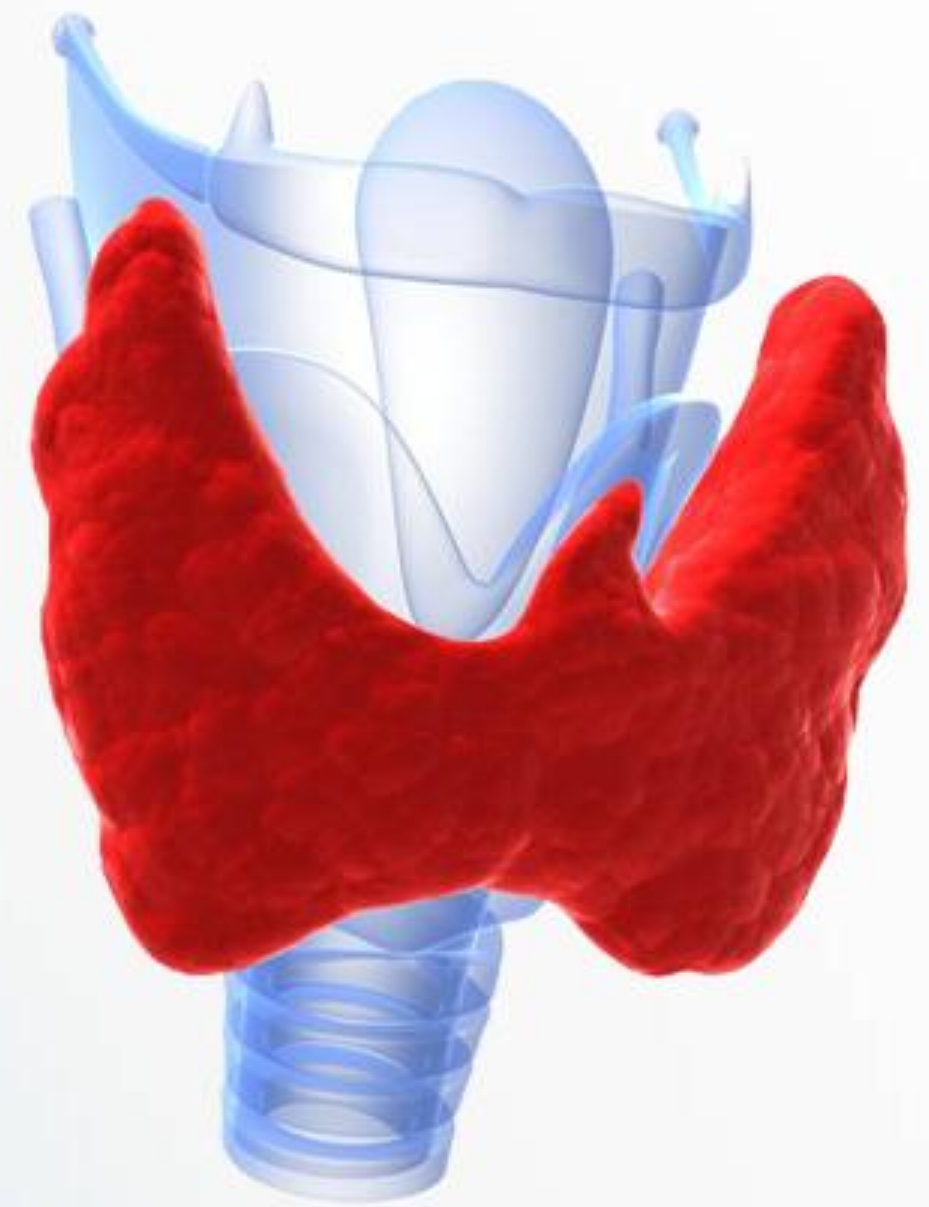




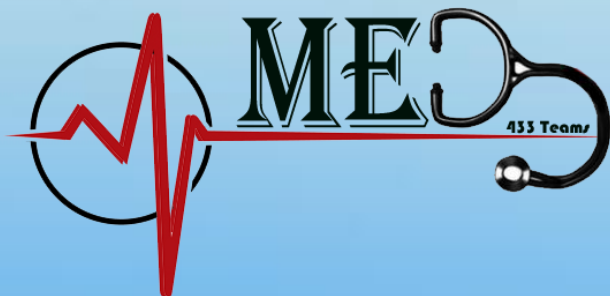
Physiology team



3 Anterior pituitary hormones

Sources:

- Female slides**
- BRS physiology**



Objectives

-Anterior pituitary hormones

➤ GH

- Physiological functions
- Regulation of GH secretion
- Feedback mechanism
- Factors controlling secretion

➤ Prolactin

- Physiological functions
- Regulation of prolactin secretion

Pituitary glands

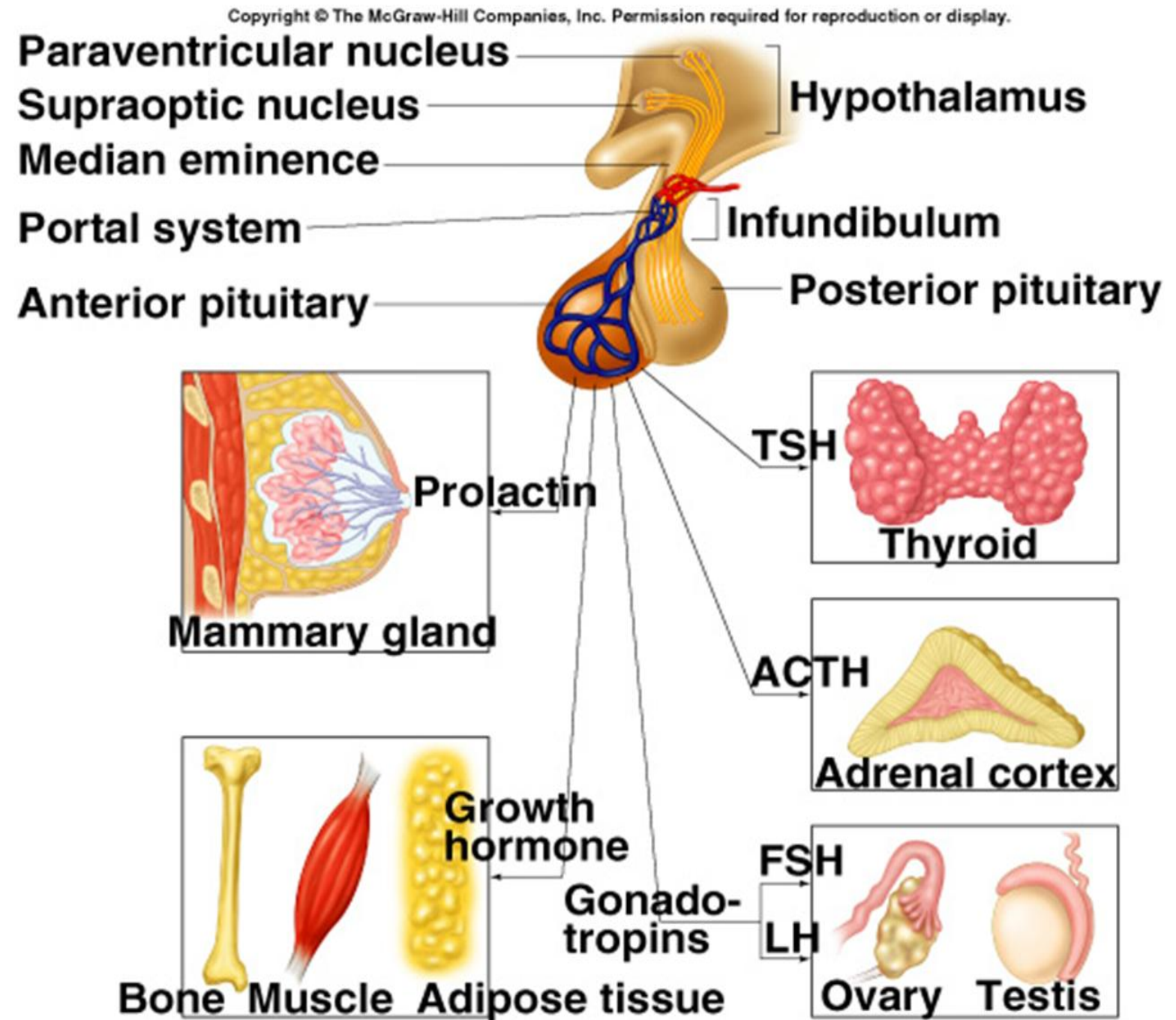
Anterior pituitary hormones

- GH
- Prolactin

Posterior pituitary hormones

- ADH
- Oxytocine

Anterior pituitary hormones



Growth Hormone (Somatotropin)

Structure and Source of Growth Hormone:

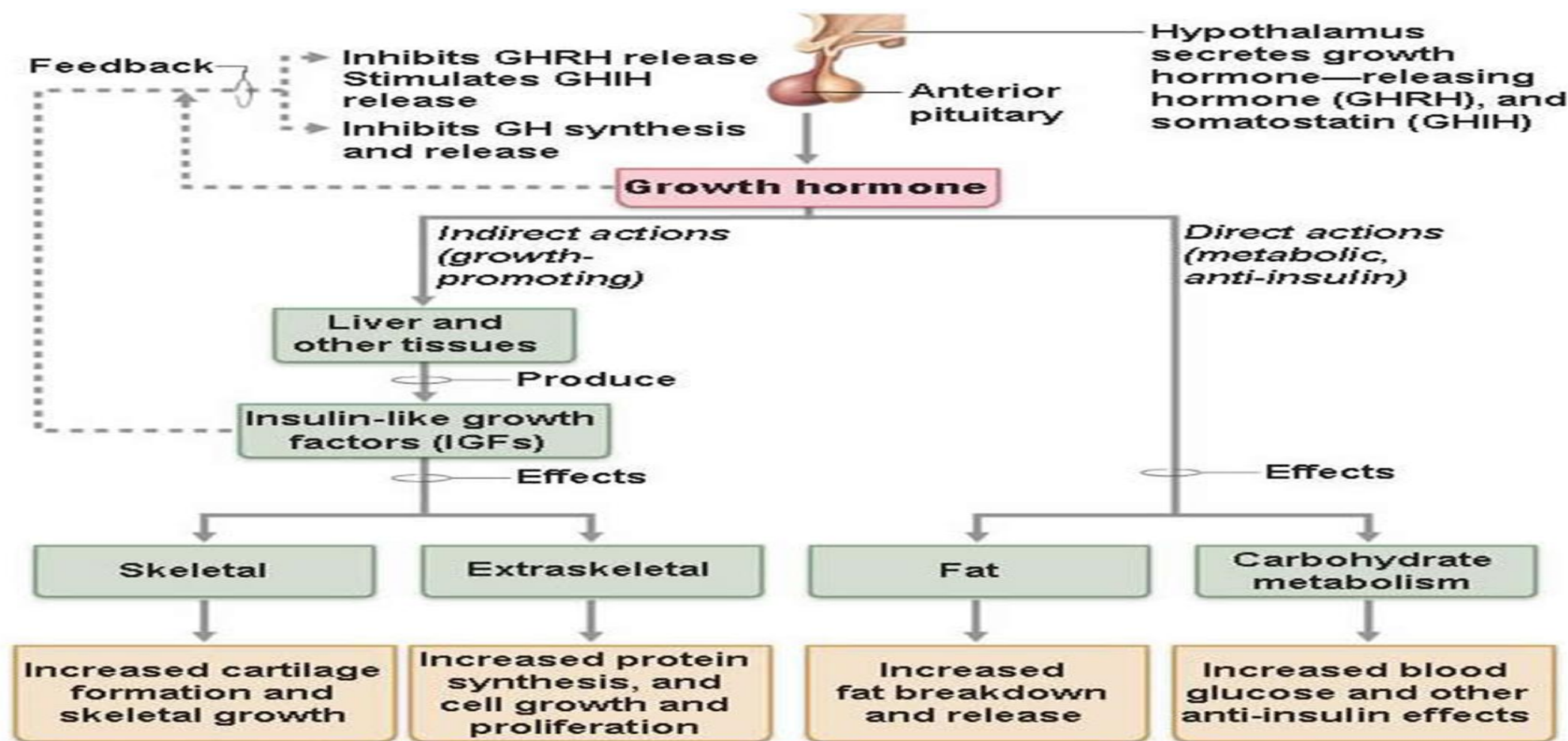
- GH is a large peptide hormone, with 191 amino acids
- GH is produced by somatotroph cells of the anterior pituitary

Transport of GH in the Blood

- About 50% of GH is found in the blood bound to a Growth Hormone-Binding Protein (GHBP).
- GHBP **increases** the half-life of GH, but **decreases** biological activity (bound GH is not biologically available).
- The GHBP is identical to the ligand binding domain of the GH receptor, and may be derived from alternative splicing of the GH receptor RNA

Growth Hormone (GH; Somatotropin)

- ✓ The major hormone regulating growth in the body.
- ✓ Actions of Growth Hormone:
 - increases skeletal growth
 - increases muscular growth
 - increases amino acid uptake and protein synthesis by the cells.
 - increased use of lipids for energy
 - decrease glucose re-uptake by the cells & increases blood sugar level.
 - decreased storage of carbohydrates



Note:

Growth Hormone is

1. Anabolic to amino acids.
2. Lipolytic to fat.
3. Hyperglycemic to glucose.

(2 & 3 are the anti-insulin actions of GH)

Role of Somatomedins in GH Actions – the GH/IGF Axis

The effects of GH on skeletal and muscular growth appear to be due to the activity of **somatomedins**, or insulin-like growth factors (IGF-1 and IGF-2) – processed in the **liver**.

GH acts on the liver, and some other tissues, to increase the production of IGFs

IGFs then enter the circulation and act on target tissues to enhance growth.

They **increase** protein synthesis in skeletal muscles.

Control of GH secretion

Factors INCREASE GH secretions

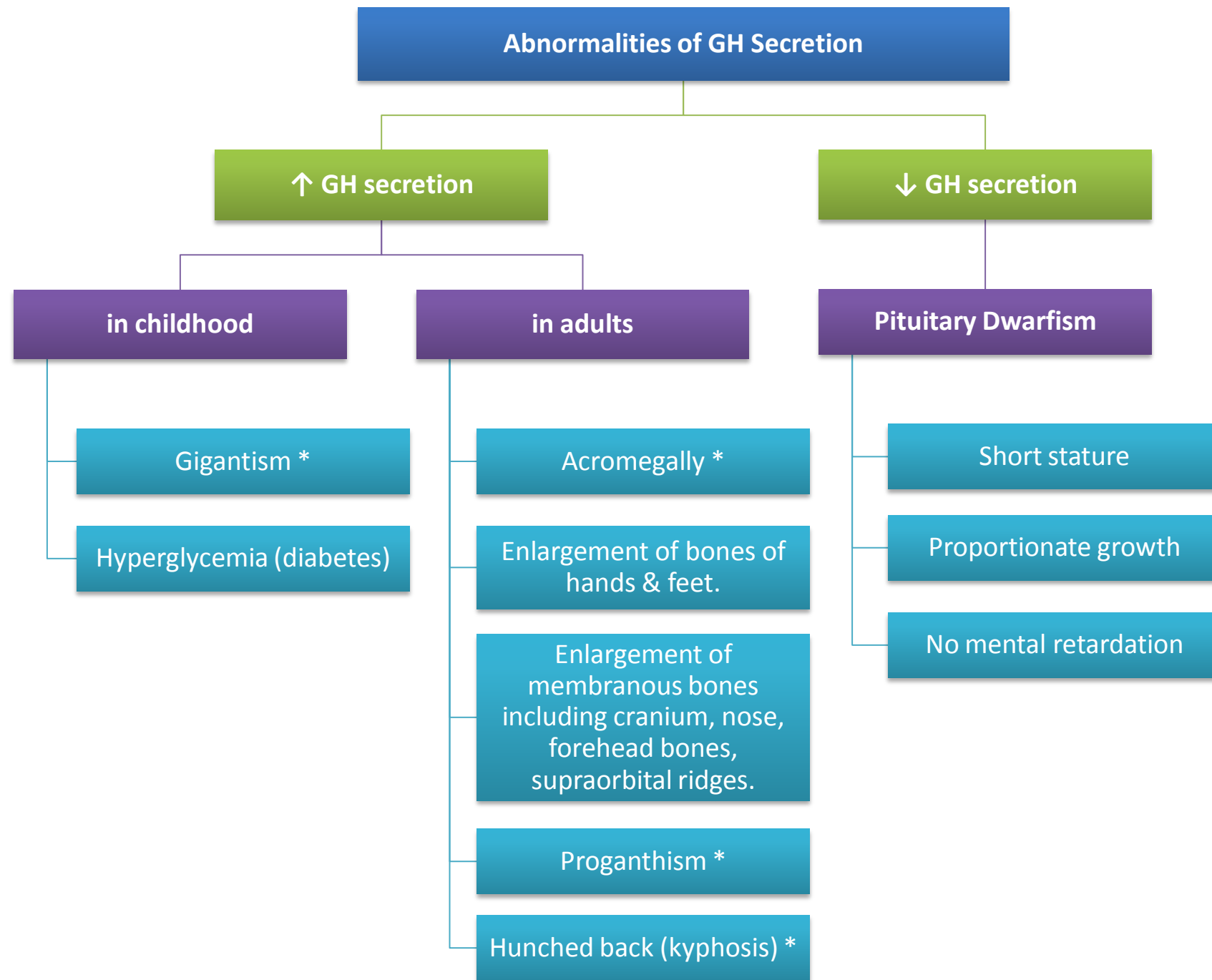
- The hypothalamus : GHRH*
- Hypoglycemia (fasting)
- Muscular exercise
- Intake of protein or amino acids (after meals)
- During sleep
- Stress conditions

* Growth hormone releasing hormone

Factors DECREASE GH secretions

- The hypothalamus: (somatostatin) GHIH*
- Glucose intake
- Increase free fatty acids concentration

* Growth hormone inhibitory hormone



Gigantism: all body tissues grow rapidly, including bones. (Height □ as it occurs before epiphyseal fusion of long bones w their shafts).

Acromegally: person can't grow taller, soft tissue continue to grow in thickness (skin, tongue, liver, kidney, ...) = organomegally.

Prognathism: protrusion of lower jaw.

Hunched Back (kyphosis): enlargement of vertebrae.

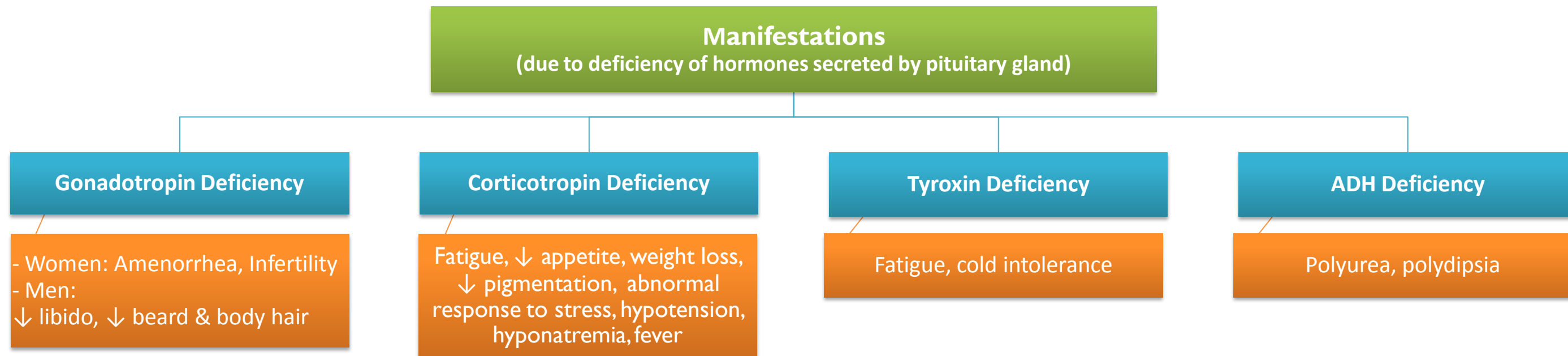
Hypopituitarism / Panhypopituitarism

Hypopituitarism

- It is hypofunction of the pituitary gland.
- It results from disease of the pituitary gland itself (destruction of the anterior lobe) or of the hypothalamus.

Panhypopituitarism

- It is **total** absence of all pituitary secretions and is rare.
- Postpartum pituitary necrosis is more likely to occur in women with severe blood loss, hypovolemia, and hypotension at the time of delivery.
- It can be a complication of radiation therapy.
- The total destruction of the pituitary gland results in extreme weight loss, emaciation, atrophy of all endocrine glands and organs, hair loss, impotence, amenorrhea, hypometabolism, and hypoglycemia. Coma and death may occur.



Libido: sexual desire.

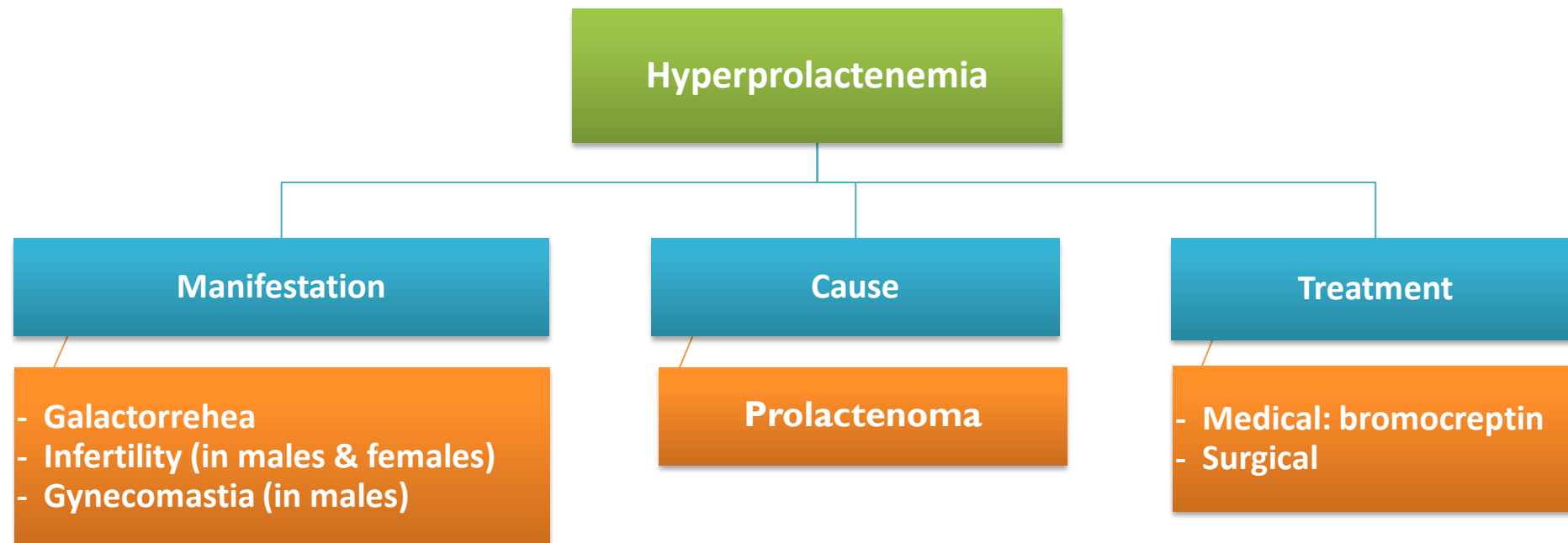
Polydipsia: excessive or abnormal thirst.

Prolactin (PRL) known as luteotropin

- A Protein hormone that in humans is best known for its milk production effect.
- It is secreted from the pituitary gland in response to mating, estrogen treatment, ovulation, and nursing.
- It is secreted in a **pulsatile fashion** in between these events.
- It also plays an essential role in metabolism, regulation of the immune system.

Functions:

- The major function of prolactin is milk production (synthesis).
- Release is inhibited by **PIH (dopamine)** secreted by the hypothalamus.
- **Suckling** response inhibits PIH release & stimulates prolactin secretion.



Galactorrehea: milk secretion in non-lactating female.

Gynecomastia: overdevelopment of the male breast.

* Infertility as it competes with **FSH** at receptor site (ovaries/testis).

Summary

- ✓ Growth hormone produced by somatotroph cells of the anterior pituitary gland
- ✓ GH is anabolic, lipolytic and hyperglycemic hormone
- ✓ GH acts on the liver to increase the production of IGFs (somatomedins) so, it affects muscles and bones growth Indirectly
- ✓ Regulation of GH by hypothalamus: GHRH (stimulatory) & Somatostatin (inhibitory)
- ✓ Increase GH secretion: GHRH, hypoglycemia (fasting), muscular exercise, intake of protein, during sleep, stress
- ✓ Decrease GH secretion: increase FFAs, Somatostatin, glucose intake.
- ✓ Abnormalities: increased GH secretion: Gigantism (childhood), Acromegally (adults)
- ✓ Decreased GH : pituitary dwarfism (Short stature, no mental retardation)
- ✓ Hypopituitarism results from disease of the pituitary gland itself or of the hypothalamus
- ✓ Manifestations are due to deficiency of hormones (Depends on which hormone is deficient)
- ✓ Panhypopituitarism is total absence of all pituitary secretions and is rare
- ✓ Prolactin is secreted from the pituitary gland in response to mating, estrogen treatment, ovulation, and nursing
- ✓ The major function of prolactin is milk production
- ✓ Release is inhibited by PIH (dopamine) secreted by the hypothalamus
- ✓ Suckling response stimulates prolactin secretion (inhibits PIH release)
- ✓ Hyperprolactenemia: galactorrhea, infertility, gynecomastia, Caused by Prolactenoma
- ✓ Both GH and Prolactin released from the pituitary in a pulsatile manner

Summary

3. Growth hormone (somatotropin)

- is the most important hormone for normal growth to adult size.
- is a single-chain polypeptide that is **homologous with prolactin** and human placental lactogen.

a. Regulation of growth hormone secretion (Figure 7-6)

- Growth hormone is released in **pulsatile** fashion.
- **Secretion is increased** by sleep, stress, hormones related to puberty, starvation, exercise, and hypoglycemia.
- **Secretion is decreased** by somatostatin, somatomedins, obesity, hyperglycemia, and pregnancy.

(1) Hypothalamic control—GHRH and somatostatin

- **GHRH** stimulates the synthesis and secretion of growth hormone.
- **Somatostatin** inhibits secretion of growth hormone by blocking the response of the anterior pituitary to GHRH.

(2) Negative feedback control by somatomedins

- Somatomedins are produced when growth hormone acts on target tissues.
- Somatomedins **inhibit the secretion of growth hormone** by acting directly on the anterior pituitary and by stimulating the secretion of somatostatin from the hypothalamus.

(3) Negative feedback control by GHRH and growth hormone

- **GHRH** inhibits its own secretion from the hypothalamus.
- **Growth hormone** also inhibits its own secretion by stimulating the secretion of somatostatin from the hypothalamus.

b. Actions of growth hormone

- In the liver, growth hormone generates the production of **somatomedins [insulin-like growth factors (IGF)]**, which serve as the intermediaries of several physiologic actions.
- The **IGF receptor** has **tyrosine kinase activity**, similar to the insulin receptor.

(1) Direct actions of growth hormone

- (a) ↓ glucose uptake into cells (**diabetogenic**)
- (b) ↑ lipolysis
- (c) ↑ protein synthesis in muscle and ↑ lean body mass
- (d) ↑ production of **IGF**

(2) Actions of growth hormone via IGF

- (a) ↑ protein synthesis in chondrocytes and ↑ **linear growth (pubertal growth spurt)**
- (b) ↑ protein synthesis in muscle and ↑ **lean body mass**
- (c) ↑ protein synthesis in most organs and ↑ **organ size**

c. Pathophysiology of growth hormone

(1) Growth hormone deficiency

- in children causes failure to grow, short stature, mild obesity, and delayed puberty.
- can be caused by:

- (a) Lack of anterior pituitary growth hormone
- (b) Hypothalamic dysfunction (↓ GHRH)
- (c) Failure to generate IGF in the liver
- (d) Growth hormone receptor deficiency

(2) Growth hormone excess

- can be treated with **somatostatin analogs (e.g., octreotide)**, which inhibit growth hormone secretion.
- Hypersecretion of growth hormone causes **acromegaly**.

- (a) **Before puberty**, excess growth hormone causes increased linear growth (**gigantism**).
- (b) **After puberty**, excess growth hormone causes increased periosteal bone growth, increased organ size, and glucose intolerance.

Summary

4. Prolactin

- is the major hormone responsible for **lactogenesis**.
- participates, with estrogen, in breast development.
- is structurally **homologous to growth hormone**.

a. Regulation of prolactin secretion (Figure 7-7 and Table 7-3)

(1) Hypothalamic control by dopamine- and thyrotropin-releasing hormone (TRH)

- Prolactin secretion is **tonically inhibited by dopamine** [prolactin-inhibiting factor (PIF)] secreted by the hypothalamus. Thus, interruption of the hypothalamic-pituitary tract causes increased secretion of prolactin and sustained lactation.
- TRH increases prolactin secretion.

(2) Negative feedback control

- Prolactin inhibits its own secretion by stimulating the hypothalamic release of dopamine.

b. Actions of prolactin

- (1) Stimulates **milk production** in the breast (casein, lactalbumin)
- (2) Stimulates **breast development** (in a supportive role with estrogen)
- (3) **Inhibits ovulation** by decreasing synthesis and release of gonadotropin-releasing hormone (GnRH)
- (4) Inhibits spermatogenesis (by decreasing GnRH)

c. Pathophysiology of prolactin

(1) Prolactin deficiency (destruction of the anterior pituitary)

- results in the **failure to lactate**.

(2) Prolactin excess

- **results from hypothalamic destruction** (due to loss of the tonic “inhibitory” control by dopamine), or from prolactin-secreting tumors (**prolactinomas**).
- causes **galactorrhea** and decreased libido.
- causes **failure to ovulate** and **amenorrhea** because it inhibits GnRH secretion.
- can be treated with **bromocriptine**, which reduces prolactin secretion by acting as a **dopamine agonist**.

t a b l e

7-3

Regulation of Prolactin Secretion

Factors that Increase Prolactin Secretion

Estrogen (pregnancy)
Breast-feeding
Sleep
Stress
TRH
Dopamine antagonists

Factors that Decrease Prolactin Secretion

Dopamine
Bromocriptine (dopamine agonist)
Somatostatin
Prolactin (by negative feedback)

TRH = thyrotropin-releasing hormone.

MCQs

1-Which one of these hormones is not secreted by anterior pituitary:

- A. ACTH
- B. Prolactin
- C. ADH
- D. TSH

2- What decreases GH secretion:

- A. Muscular exercise
- B. Somatostatin
- C. Fasting
- D. Intake of protein

3-Increased GH secretion in adult known as:

- A. Acromegally
- B. Gigantism
- C. Dwarfism
- D. a and b

4-Features of pituitary dwarfism include:

- A. Short stature
- B. Mental retardation
- C. Diabetes
- D. A and B

5-Release of prolactin is inhibited by:

- A. Dopamine
- B. Suckling
- C. Both

6-Features of hyperprolactinemia:

- A. Galactorrhea
- B. Infertility
- C. Gynecomastia
- D. All of the above

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



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