

Pituitary Gland

Introduction:

- Pituitary gland / hypophysis → Diameter = 1cm
Wt = 0.5 - 1g.
 - Connected with hypothalamus by pituitary stalk or hypophyseal stalk.
- } situated in Sella turcica in Sphenoid bone.

Divisions:

- (a) Anterior pituitary / Adenohypophysis
- (b) Posterior pituitary / Neurohypophysis
- Pars intermedia (avascular structure between two divisions) - Part of Ant. Pituitary.

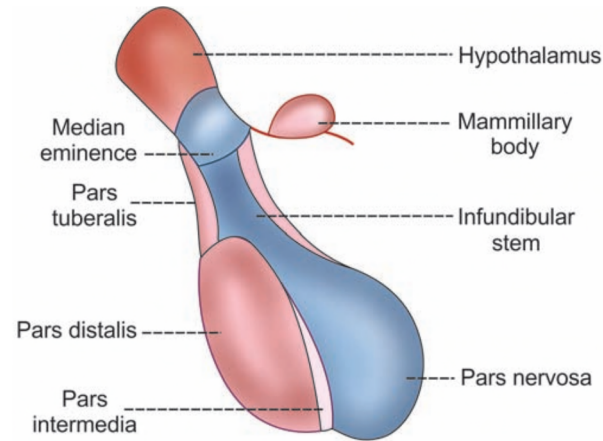
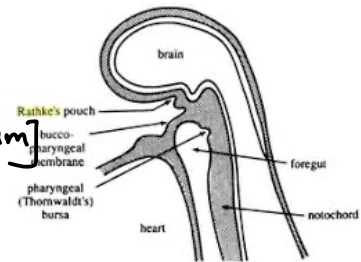


FIGURE 66.1: Parts of pituitary gland
■ Adenohypophysis ■ Neurohypophysis

Development:

- Anterior pituitary = Ectodermal [Pharyngeal Epithelium as an upward growth as Rathke pouch]
- Posterior pituitary = Neuroectodermal [Arises from hypothalamus as downward diverticulum]

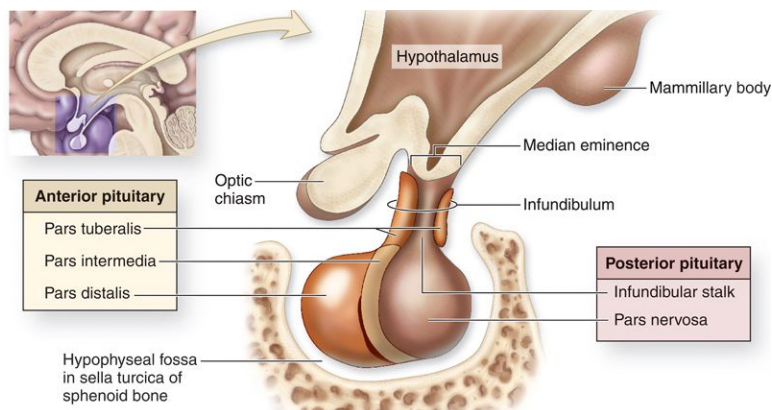


Anterior Pituitary

- Also known as the master gland.
- Parts - (a) Pars distalis
(b) Pars tuberalis
(c) Pars intermedia

Histology

- Two types of cells:
 - (1) Chromophobe cells
 - (2) Chromophil cells



- **Chromophobe Cells** : - No granules
- Stain poorly
- 50% of all cells
- Not secretory.

- **Chromophil Cells** : - Large no. granules
- Darkly stained

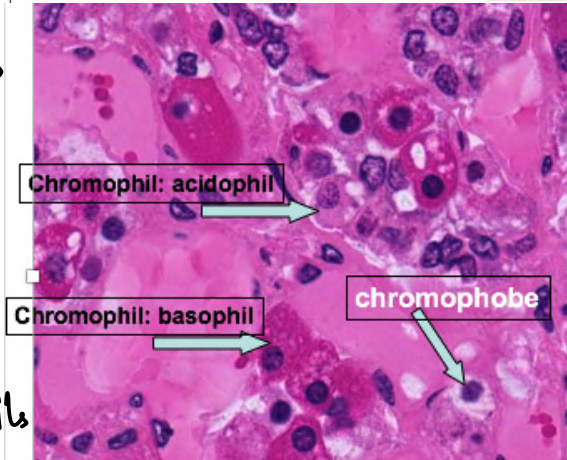
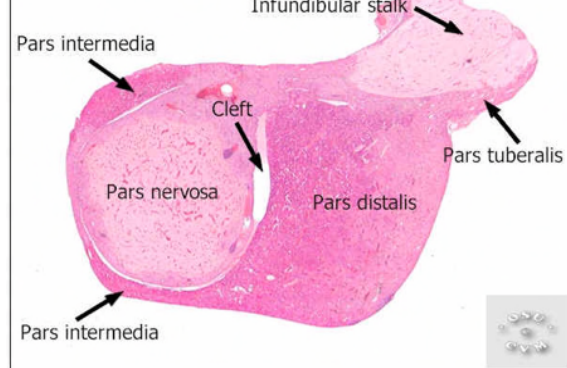
Types of Chromophil

(1) On basis of Staining

- Acidophilic / α -cells - 35% of all cells
- Basophilic / β -cells - 15%

(2) On Basis of Secretory nature:

- Somatotropes - Growth hormones
- Corticotropes - Adrenocorticotrophic
- Thyrotropes - TSH
- Gonadotropes - FSH & LH
- Lactotropes - Prolactin.



Cell Type	Percentage of Total Secretory Cells
Somatotrope	50
Lactotrope	10-30
Corticotrope	10
Thyrotrope	5
Gonadotrope	20

Hormones Secreted By Anterior Pituitary :

(1) **Growth hormone** :

- It is secreted by somatotropes which are the acidophilic cells of anterior pituitary.
- GH = 191 AAs with 21,500 da
- Blood concentration = 300 ng/dL (adult) , 500 ng/dL (children)
- It daily output is 0.5 to 1.0 mg.
- Growth hormone is transported in blood by GH-binding proteins (GHBP) with Half-life = 20 mins.

- It is degraded in Liver & Kidney.

Actions of Growth Hormone:

- Responsible for the growth of all tissues of body.
- It increases size & no. of cells and also causes specific differentiation.
- GH also acts as metabolism of all three major types of food :-

(a) Protein

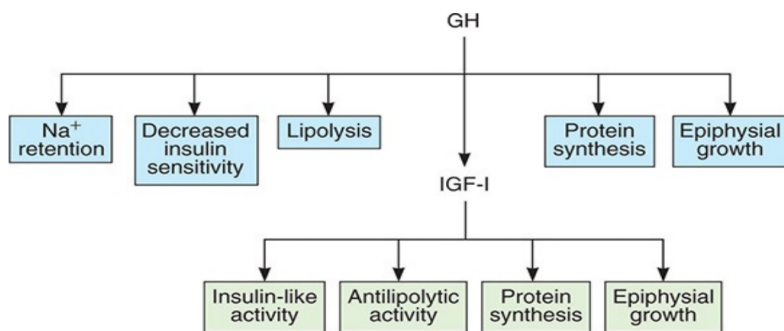
- AAs transport ↑
- RNA translation ↑
- Transcription ↑
- Catabolism of Protein ↓
- Anabolism of Protein ↑

(b) Lipids

- Cont. of Fat ↑
in body fluids

(c) Carbohydrates

- Peripheral utilization of Glucose ↓
- Glycogen deposition ↑
- Glucose uptake ↓
- Glucose level ↑ in blood (Diabetogenic effect)



- In embryogenic stage, GH is responsible for Bone cell development & differentiation.
- In bones, GH increases :
 - (i) Synthesis & deposition of proteins by chondrocytes & osteogenic cells.
 - (ii) Multiplication of cells
 - (iii) New bones formation [Chondrocytes → Osteogenic cells]
 - (iv) Calcium ↑ for mineralization.
- GH increases length of bone until epiphysis fuses with shaft, which occurs at puberty, then only thickness increases.

Mode of Action of GH - Somatomedin

- GH acts on bones, growth & protein metabolism through somatomedin secreted by liver.
- GH stimulates the liver to secrete somatomedin.

↓

- mol. wt = 7500
- Two types :-
 - (i) Insulin-like growth factor-I (IGF-I) (Somatomedin C) :
acts on bones & protein metabolism.
 - (ii) Insulin-like growth factor - II : Imp. for foetus growth.
- The action of Somatomedin C lasts for about 20 hrs.
- It acts through second messenger (cyclic AMP).
- GH receptor is called Growth hormone secretagogue (GHS)
- GH binds with receptor situated mainly in liver cell.^{receptor.}
- As Hormone-receptor complex forms, various intracellular enzyme pathways, resulting in somatomedin secretion.

	Insulin	IGF-I	IGF-II
Other names	—	Somatomedin C	Multiplication-stimulating activity (MSA)
Number of amino acids	51	70	67
Source	Pancreatic β cells	Liver and other tissues	Diverse tissues
Level regulated by	Glucose	Growth hormone after birth, nutritional status	Unknown
Plasma levels	0.3–2 ng/mL	10–700 ng/mL; peaks at puberty	300–800 ng/mL
Plasma-binding proteins	No	Yes	Yes
Major physiologic role	Control of metabolism	Skeletal and cartilage growth	Growth during fetal development

Regulation of GH Secretion:

- Hypothalamus regulates GH via three hormones:

(a) Growth hormone-releasing hormone (GHRH) → GH secretion ↑

(b) Growth hormone-releasing polypeptide (GHRP) → GHRH ↑
GH ↑

(c) Growth hormone-inhibitory hormone (GHIH)
or Somatostatin: GH secretion ↓

- GH secretion is also stimulated by:

(a) Hypoglycemia

(b) Fasting

(c) Starvation

(d) Exercise

(e) Stress & trauma

(f) Initial stages of sleep.

Inhibited by:

(a) Hyperglycemia

(b) Increase in Free fatty acids (FFAs) in blood.

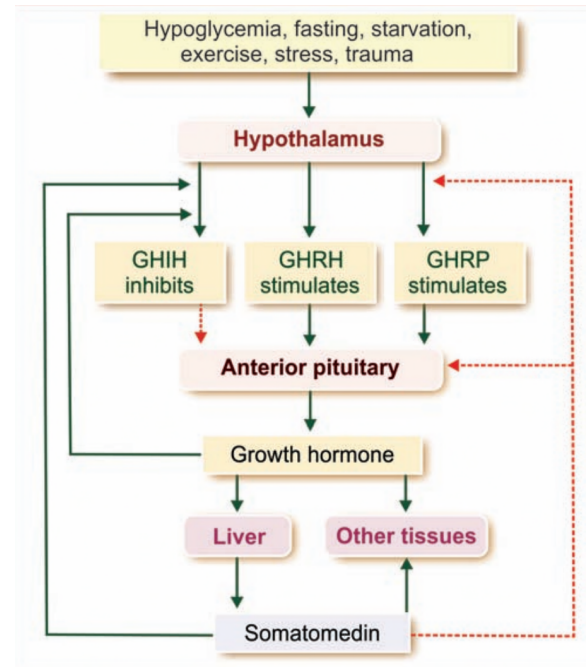
(c) Later stages of sleep.

Gigantism & Acromegaly

Tumors of the somatotropes of the anterior pituitary (pituitary adenomas) secrete large amounts of growth hormone, leading to **gigantism** in children and to **acromegaly** in adults. If the tumor arises before puberty, the individual may grow to an extraordinary height. After linear growth is no longer possible, on the other hand, the characteristic features of acromegaly arise, including greatly enlarged hands and feet, vertebral changes attributable to osteoarthritis, soft tissue swelling, hirsutism, and protrusion of the brow and jaw. Abnormal growth of internal organs may eventually impair their function such that the condition, which has an insidious onset, can prove fatal if left untreated. Hypersecretion of growth hormone is accompanied by hypersecretion of prolactin in 20–40% of patients with acromegaly. About 25% of patients have abnormal glucose tolerance tests, and 4% develop lactation in the absence of pregnancy. Acromegaly can be caused by extrapituitary as well as intrapituitary growth hormone-secreting tumors and by hypothalamic tumors that secrete GHRH, but the latter are rare.

THERAPEUTIC HIGHLIGHTS

The mainstay of therapy for acromegaly remains the use of somatostatin analogues that inhibit the secretion of growth hormone. A growth hormone receptor antagonist has become available and has been found to produce clinical improvement in cases of acromegaly that do not respond to other treatments. Surgical removal of the pituitary tumor is also helpful in both acromegaly and gigantism, but sometimes challenging to perform due to the tumor's often invasive nature. In any case, adjuvant pharmacologic therapy must often be continued after surgery to control ongoing symptoms.



Other hormones of Anterior Pituitary:

(2) **Thyroid-stimulating Hormone (TSH)** - TSH is necessary for the growth & secretory activity of thyroid gland.

(3) **Adrenocorticotrophic Hormone (ACTH)** - ACTH is necessary for structural integrity and the secretory activity of adrenal cortex.

(4) **Follicle-stimulating Hormone (FSH)** - It is a glycoprotein made up of one α -subunit and a β -subunit.

$\underbrace{\hspace{1cm}}_{92 \text{ AAs}} \qquad \underbrace{\hspace{1cm}}_{118 \text{ AAs}}$

- Half-life = 3-4 hrs.
- In male, it induces spermeogenesis.
- In female, it induces graafian follicle development.
 - Stimulates theca cells to secrete estrogen.
 - Promotes aromatase activity in granulosa cells, resulting in conversion of androgens into estrogen.

(5) **LH (Luteinizing Hormone)** - It is a glycoprotein.

One α -subunit = 92 AAs

One β -subunit = 141 AAs

- Half-life = 60 mins
- In males, LH is known as Interstitial cell-stimulating hormone (ICSH) as it stimulates Leydig cells.
 - $\downarrow$ Testosterone.
- In females:
 - (1) Causes maturation of vesicular follicle into graafian follicle along FSH
 - (2) Ovulation (LH surge)
 - (3) Formation of Corpus Luteum & activates its secretory functions.

(6) **Prolactin** — It is a single chain polypeptide with 199 AAs.

- Half-life = 20 mins
- Prolactin is necessary for final preparation of mammary glands for production & Secretion of milk.
- It causes alveolar hyperplasia.

(7) **β -lipotropin** — It is a polypeptide with 31 AAs.

- It mobilizes fat from adipose tissue & promote lipolysis.
- It also forms the precursor of Endorphins.
- It acts via messenger (adenyl cyclase).

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