

The Pituitary Gland

Objective:

To study the anterior pituitary hormone secretion regarding chemistry, their control by the hypothalamus, effects and pathophysiology.

The Pituitary Gland

It is the master endocrine gland , consists of 3 lobes (anterior, intermediate and posterior) which are more or less separated endocrine glands.

The intermediate lobe is rudimentary in humans.

The anterior and posterior lobes are entirely distinct physiologically.

The Anterior pituitary (Adenohypophysis)

It synthesizes and secretes the following Hormones:

1. Growth hormone “ GH”
2. Adrenocorticotrophic hormone “ACTH”
3. Follicle – Stimulating hormone “FSH”
4. Luteinizing hormone “LH”
5. Thyroid – Stimulating hormone “ TSH”
6. Prolactin “ PRL”
7. γ -Melanocyte – Stimulating hormone “ γ -MSH”
8. β - Lipotropin “ β -LPH”

Growth hormone “ GH”

GH secretion is controlled by 2 hypothalamic hormones:

1. *GHRH* (growth hormone releasing hormone)
2. *GHRH* (growth hormone release inhibitory hormone ,”Somatostatin”).

GH is a single poly peptide synthesized by the somatotropes (anterior pituitary acidophilic cells).

• *Effects of GH:*

1. *Protein metabolism:-*

GH is protein anabolic H. It increases the transport of amino acids into muscle cells.

2. *Carbohydrate metabolism :-*

GH antagonizes the effects of insulin, it decreases the peripheral glucose utilization, and increases hepatic glucose production via gluconeogenesis.

GH also increases liver glycogen.

3. *Lipid metabolism :-*

GH promotes the release of fatty acids and glycerol from adipose tissues and increases circulating fatty acids. It also increases fatty acid oxidation in the liver.

4. *Mineral metabolism :-*

It promotes positive Ca,Mg, and P balance, and causes retention of Na, K and Cl. It promotes the growth of long bones at the epiphyseal plate in growing in children and acral growth in adults.

It also enhances cartilage formation in children.

5. *PRL – like effects:-*

It bind to lactogenic receptors, and has many of PRL effects such as stimulation of mammary gland and lactogenesis.

Pathophysiology:

GH deficiency

1. GH deficiency in childhood result in short stature, a condition called ***Dwarfism***
2. GH deficiency in adulthood result in lethargy, muscle weakness and increased fat mass

GH excess

1. If occurs before the closure of epiphyseal plate leads to an increase in the growth of long bones, a condition called “Gigantism”.
2. If it occurs after epiphyseal plate closure, then it results in “Acromegaly” in which there is an increased acral bone growth causing the characteristic appearance (protruding jaw, enlarged nose, and also enlargement of hands, feet and skull).

Prolactin “ PRL”

Is a peptide hormone secreted by the lactotropes (Pituitary acidophilic cells). PRL secretion is under ***predominantly inhibitory control by Dopamine*** which is secreted by hypothalamus.

However, **TRH** (Thyrotropin releasing hormone), secreted by hypothalamus may , in some instances, ***stimulate PRL secretion.***

Effects

Women:- Initiation and maintenance of lactation .

Men:- not clearly known yet.

HOWEVER, Hyperprolactinaemic men have an impaired gonadal response to gonadotropins.

Pathophysiology

Women:-

Excessive PRL (hyperprolactinaemia) causes amenorrhoea and galactorrhoea

Men:-

Excessive PRL results in erectile dysfunction, impotence and gynaecomastia. Also, it may result in oligospermia.

Thyroid – Stimulating hormone “ TSH”

Is a glycoprotein hormone. It’s secretion is controlled by the hypothalamic TRH. It is synthesized by the thyrotropes (basophilic pituitary cells).

Effects:-

Stimulate the growth of thyroid gland, and the synthesis and release of thyroid hormones (T₄ & T₃).

Follicle – Stimulating hormone “FSH” and Luteinizing hormone “LH”

Interestingly, although there is only one releasing H. for both FSH and LH called LH and FSH releasing H “ GnRH” (LHRH, FSHRH) secreted by the hypothalamus, however, LH and FSH can be secreted independently.

FSH and LH are glycoproteins secreted by the gonadotropes (basophilic pituitary cells).

- **Effects of LH**

Women: Induces ovulation stimulate progesterone production by the corpus luteum , and also, is required for the early maintenance of corpus luteum.

Men: Stimulate testosterone production by the Leydig cells of the testis.

- **Effects of FSH**

Women:- Stimulate the maturation of ovarian follicle causing an increase in estradiol production by the granulosa cells of the follicle.

Men:- FSH is essential for maintenance of spermatogenesis. FSH bind to sertoli cells of Testis, promotes synthesis of **ABP** “ androgen binding protein” which bind to testosterone and transport it to the lumen of seminiferous tubules (the site of spermatogenesis).

Adrenocorticotrophic hormone “ACTH”

- **Is a single poly peptide secreted by the corticotrops basophilic pituitary cells under the control of the hypothalamic CRH (corticotrophin-releasing H.)**

Effects:-

It regulate the growth and function of adrenal cortex, and enhances the production of adrenal steroids (glucocorticoids, mineralocorticoids & dehydroepiandrosterone). However, in physiological concentrations, the contribution of ACTH to mineralocorticoids & dehydroepiandrosterone secretion is minimal.

ACTH also has considerable MSH activity.

β - Lipotropin " β -LPH"

It is found only in the pituitary since it is rapidly converted to γ -LPH and β -endorphin in other tissues.

Effects:- causes lipolysis and fatty acids mobilization, but its physiological role is minimal. It probably serves only as the precursor of β -Endorphin which in turn behaves as the precursor of δ -endorphin and γ -endorphin.

Endorphins : acts inside the CNS as neurotransmitters and are involved in endogenous pain perception.

γ -Melanocyte – Stimulating hormone " γ -MSH"

They increase pigmentation of the skin and mucous membrane by stimulating melanin synthesis in the melanocytes, and also, causes dispersion of the intracellular melanin granules resulting in skin darkening.

The pituitary in mammals contains 3 MSHs:-

- 1. δ -MSH**
- 2. β -MSH**
- 3. γ -MSH**

γ -MSH is present in high concentration in the intermediate lobe, but is also present in the anterior pituitary. In adults, it appears that neither δ -MSH nor β -MSH are secreted.