PITUITARY GLAND HORMONES

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The pituitary gland hormones and its relation to the hypothalamus: The pituitary gland also called the hypophysis, is a small gland about 1 cm in diameter and 0.5-1 gm in wt., that is in the sellaturcica, a bony cavity at the base of the brain and is connected to the hypothalamus by the pituitary or hypophysial stalk physiologically the pituitary gland is divided into two distinct portion.

The anterior pituitary also called as adenohypophysis

The posterior pituitary also called as neurohypophysis

Between these is a small relatively a vascular zone called the par's intermedia which is almost absent in the human beings but it is much more functional in some lower animals.

Six important peptide hormones plus several less important ones are secreted by the anterior pituitary and two important peptide hormones are secreted by the posterior pituitary.

The hormones of the anterior pituitary play major roles in the control of metabolic functions throughout the body.

Like growth hormone (GH) promote growth of the entire body by affecting protein formation cell multiplication and cell differentiation.

Adrenocortico hormones controls secretion of the corticotrophins which in turn affect the metabolism of glucose, proteins and fats.

Thyroid stimulating hormone (TSH) or thyrotropin controls the rate of secretion of thyroxine, and tri-iodo thyroxine by the thyroid gland and these hormones in turn control the rate of most intracellular chemical reactions of the entire body.

Prolactin promotes mammary gland development and milk production.

Two separate gonadotropic hormones follicle stimulating hormone (FSH) and leutinising hormone control growth of the ovaries and testes as well as their hormonal and reproductive activities.

The two hormones secreted by the posterior pituitary play other roles.

Anti diuretic hormone (ADH) also called as vasopressin controls the rate of water excretion into the urine and in this way helps, control the concentration of water in body fluids.

Oxytocin helps express milk from the glands of the breast to the nipples during suckling and possibly helps in the delivery of the baby.

The anterior pituitary gland contains several different cell types:

Usually there is one cell type for each major hormone formed in the anterior pituitary gland with special stains attach to high affinity Antibodies that bind with the distinctive hormones. At least 5 cell types can be differentiated one from another.

i. **Somatotropes : AGH (Human Growth Hormone).**
ii. **Corticotropes : Adreno corticotrophin hormone (ACTH).**
iii. **Thyrotropes : Thyroid stimulating hormone (TSH_)**
iv. **Gonadotropes : Gonatrophics hormone like follicle stimulating (FSH) and leutinising hormones (LH)**
v. **Lactoropes : Prolactin.**

About 30-40% of the anterior pituitary cells are somatotropes that secrete growth hormone and about 20% are corticotropes that secrete ACTH.

The other cell types only 3-5% that secrete powerful hormones for controlling thyroid function, sexual functions and milk secretion by the breast.

The cell bodies of the cells that secrete the posterior pituitary hormone are not located in the posterior are not located in the posterior pituitary gland but are large neurons celled magnocellular neurons.

The hormones are then transported to the posterior pituitary gland in the exoplasm of neurons, nerve fibres passing from the hypothalamus to the posterior pituitary gland.

The hypothalamus controls the pituitary secretions.

Almost all secretion by the pituitary is controlled by either hormonal or nervous signals from the hypothalamus.

Indeed, when the pituitary gland is removed from its normal position beneath the hypothalamus and transplanted to some other parts of the body its rates of secretion of the different hormones falls to very low level.

Secretion from the posterior pituitary are controlled by nerve signal that originate in the hypothalamus and terminate in the posterior pituitary. In contrast secretion by the anterior pituitary is controlled by hormones called hypothalamic releasing and hypothalamic inhibitory hormones secreted within the hypothalamus itself. The major hypothalamic releasing and inhibitory hormones are the following. :

Thyrotropin Releasing Hormone (TRH) : which causes the release of TSH (Thyroids Stimulating Hormone).

Cartico tropin Releasing Hormone (CRH): which causes the release of Adrenon corticotropins.

Growth hormone releasing hormone (GHRH) : which causes release of growth hormone and growth hormone inhibitory GHIH). This is also called as somatostatin, which inhibits release of growth hormone.

Gonadotropin Releasing Hormone (GRH) : which causes release of two gonadotropic hormones. Luteinizing hormone (LH) and follicle stimulating hormone (FSH).

Prolactin inhibitory hormone (PIH) : which causes inhibition of prolactin secretions.

GROWTH HORMONE (GH)

GH also called as somatotropic hormone or somatotropin. It is small protein molecule that contains Amino acids in a single chain and has a mol. Wt. 22005 Daltons. It causes growth of almost all tissues of the body that are capable of growing. It promotes increased sizes of cells and increases. Mitosis with development in number of cells. Apart from its general effect on growth, GH has multiple specific metabolic effects.

1. Incd. Rate of protein synthesis in most cells of body. This has pronounced incd. In nitrogen and phosphorus retention.
2. Incd. Mobilization of fatty acids from adipose tissue, incd. Free fatty acids in the blood and incd. Use of the fatty acid for energy.
3. Decd. Rate of glucose utilization throughout the body.
4. Incs. Intestinal absorption of calcium and also plays important role in the retention of sodium, potassium, magnesium phosphate and chloride ions.

Growth hormone deficiency in children result in dwarfism. Since it increase total growth, incd. Levels of GH may lead to gigantism in children.

Acromegaly, results when the person cannot grow taller but the soft tissues can continue to growth and the bones can grow in thickness. Enlargement is specially marked in the bone of the hands and the feet and in the membranous bones including the cranium, nose, bosses on the forehead, lower jaw bone and portions of the vertebrae.

Many soft tissue organs such as tongue, liver and specially the kidneys become specially enlarged.

Normal value	**5-20 years**	**:**	**6 ng/ml**
	20-40 years	**:**	**3 ng/ml**
	40-70 years	**:**	**1.6 ng/ml.**

PROLACTIN

Also called as lactogenic hormone. It is a protein with a mol. wt. of about 23000. It activates the corpus leuteum and stimulates continued progesterone production by the developed corpus leuteum. Prolactin incs. during pregnancy and may stimulate mammary development and also show growth hormone like metabolic charges.

In women tumours of prolactin secreting cells cause galactorrhea (breast discharge) and also causes amenorrhea (ceasation of menses).

In men, excessive prolactin is associated with breast enlargement and impotence (infertility).

The determination of prolactin is imp. In the diagnosis and management of patient with tumours of the hypothalamus or the pituitary and in the case of women with galactorrhea and amenorrhea.

Normal range :

In males	**5-18 ng/ml**
In Females	**6-22 ng/ml**

GONADOTROPINS

Follicle stimulating Hormone (FSH) Luteinizing Hormone (LH)

They are glycoproteins with mol. wt. of FSH, 25000 and that of LH, 40000. They influence the function and maturation of the testes and the ovary. The secretion of LH and FSH is regulated by a single hypothealomic releasing factor LH/FSH releasing hormone.

Follicle Stimulating Hormone (FSH)

This hormone promotes follicular growth, prefers the follicle for the action of LH and induces release of LH to enhance the release of estrogens.

In the males, FSH stimulates seminal tubule and testicular growth. It plays an imp. role in the early stages of spermatogenesis. Plasma FSH concentration incs. through puberty.

In the females, high values with order of 10 fold or more are observed slightly before the time of ovulation. Incd. values of FSH are found in menopause, male climatric and in seminiferous tubule failure.

Normal Value :

Male	**: 2-25 mIU/ml**
Female	**: 4-30 mIU/ml**
Post Menopausal	**: 40-250 mIU/ml**

Luteinizing Hormone (LH)

In the females, LH stimulates final maturation of the graffian follicle, ovulation and the development corpus lutes. Progesterone and estrogen levels are also stimulated by LH. In the ovary LH can stimulate the non-germinal elements which contain the interstitial cells. These cells produce androgens such as testosterone and dehydro epiandosterone (DHEAS).

In the males, LH stimulates testosterone production by the tests. The assay of LH is of value in evaluation of gonadal failure in males. High values are associated with primary dysfunction and low values are associated with secondary failure of hypothalamus or pituitary. Women with amenorrhea caused by ovarian failure have elevated LH values.

Normal Range

Men - 7-24 μIU/ml

Women - 6-30μIU/ml

Human Placental Lactogen (HPL) :

The determination of this gives the obstetrician, a valuable parameter in the management of difficult pregnancies.

HPL is detectable at about 5 weeks of pregnancy with concentration increasing until term.

The decrease in plasma HPL levels preceedes abortion form 5-10 days.

Normal value

Weeks of pregnancy	HPL Concentration in µg/ml
5-27	Below 4.6
28-31	2.4-6.1
32-35	3.7-7.7
36 Term	5.8-8.6

THYROID STIMULATING HORMONE

Thyrotropic Hormone

TSH is a glycoprotein with mol. wt. 30,000.

Functions :

(a) It incs. thyroid growth and general metabolic activity.
(b) Glucose oxidation
(c) Oxygen consumption
(d) Synthesis of phospholipids and RNA
(e) Iodine uptake and thyroxine metabolism.

The release of TSH or thyrotropin is controlled by the hypothalamic factor, the thyrotropic releasing hormone (TRH). TRH causes and incs. in thyrotropin with in one min. and this action calcium dependent.

High TSH levels are observed in primary hypothyroidism low TSH levels are observed mainly in primary hyperthyroidism. The determination of TSH is of valuable aid in avoiding under treatment of primary hypothyroidism and over treatment of hyperthyroidism.

Normal Range :

Adults : 0.39-4.89 µIU/ml

Neonates : less than 25 µIU/ml by 3rd day after birth.

ADRENO CORTICO TROPIC HORMONE (ACTH)

It is a straight chain polypeptide with mol. wt. 45,000. Adrenal function is regulated by ACTH it incs synthesis of cortico and stimulate their release from the gland. It also incs. total protein synthesis.

ACTH stimulating results in an inc. in mineralo corticoids, glucocroticoids and androgens. ACTH mobilizes some prostaglandins in the adrenals. Excess production of ACTH produce Cushing's syndrome.

HORMONES OF NEUROHYPOPHYSIS OR POSTERIOR LOBE OF THE PITUITARY GLAND

The hormones release by the neurohypophysis one oxytocin and antidiuretic hormonal (ADH). They are synthesized by the cells of the hypothalamus and migrate along the nerve fibres to the posterior pituitary where they are stored in the nerve endings. Each hormone is released in response to a different stimulus. Both oxytocin and ADH are polypeptides each containing of amino acids.

OXYTOCIN

It promotes contraction f uterine muscle and contraction of myoepithelial cells of the lactating breast. Due to this action squeezing of milk take place into the large ducts behind the nipple. Thus, it helps in milk ejection in late pregnancy the uterus becomes very sensitive to oxytocin.

ANTI DIURETIC HORMONE (ADH)

It acts on the distal convoluted and collection tubules of the nephrons of the kidneys. As a result due to increasing permeability reabsorption of water from the glomerular filterate increases. The amount of ADH secreted influence by the Osmotic pressure of the blood circulating to the hypothalamus. The increased osmotic pressure rises the secretion of ADH and more water in reabsorbed. Similarly when the osmotic pressure of the blood is low the secretion of ADH decreased by water reabsorption and more urine is produced.

The release of anterior pituitary hormones follow stimulation of the gland by the hormones or hormone releasing hormones produced by the hypothalamus. Releasing hormones reach pituitary gland through the pituitary portal system of the blood vessels. When there is a low level of target gland hormone, the hypothalamus release appropriate releasing hormone. The releasing hormone stimulates release of hormone by the anterior pituitary and this in turn stimulates the target gland to produce & release its hormone. When blood level of the target gland hormone increased it inhibit the secretion of releasing hormone by the hypothalamus. This is called the *negative feed back mechanism*.