PITUITARY GLAND

Hypophysis

An endocrine gland, about the size of a pea, whose secretions control the other endocrine glands and influence growth, metabolism, and maturation.

About Pituitary gland

Function

Hormones secreted from the pituitary gland help control the following body processes:

- growth
- blood pressure
- some aspects of pregnancy and childbirth including stimulation of uterine contractions
- during childbirth
- breast milk production
- sex organ functions in both males and females
- thyroid gland function
- the conversion of food into energy (metabolism)
- water and osmolarity regulation in the body
- water balance via the control of reabsorption of water by the kidneys
- temperature regulation
- pain relief
- sleeping patterns

Anterior

The anterior pituitary synthesizes and secretes hormones. All releasing
hormones (-RH) referred to, can also be referred to as releasing factors (-RF). These hormones are released from the anterior pituitary under the influence of the hypothalamus. Hypothalamic hormones are secreted to the anterior lobe by way of a special capillary system, called the hypothalamic-hypophysial portal system (Pic. 1).

**Somatotrophins:**

- Human growth hormone (HGH), also referred to as 'growth hormone' (GH), and also as somatotropin, is released under the influence of hypothalamic growth hormone-releasing hormone (GHRH), and is inhibited by hypothalamic somatostatin. Its primary function is anabolic; it promotes protein synthesis and tissue building through direct and indirect mechanisms (Pic. 2). GH levels are controlled by the release of GHRH and GHIH (also known as somatostatin) from the hypothalamus.

**Thyrotrophins:**

- Thyroid-stimulating hormone (TSH), is released under the influence of hypothalamic thyrotropin-releasing hormone (TRH) and is inhibited by somatostatin. It stimulates the thyroid gland to produce thyroxine (T4), and then triiodothyronine (T3), which stimulates the metabolism of almost every tissue in the body.

**Corticotropins:**

- Adrenocorticotropic hormone (ACTH) and Beta-endorphin are released under the influence of hypothalamic corticotropin-releasing hormone (CRH). ACTH stimulates secretion of glucocorticoid steroid hormones from adrenal cortex cells, especially in the zona fasciculata of the adrenal glands.

**Lactotrophins:**

- Prolactin (PRL), also known as 'Luteotropic' hormone (LTH), whose release is inconsistently stimulated by hypothalamic TRH, oxytocin, vasopressin, vasoactive intestinal peptide, angiotensin II, neuropeptide Y, galanin, substance P, bombesin-like peptides (gastrin-releasing peptide, neuromedin B and C), and neurotensin, and inhibited by hypothalamic dopamine. It stimulates growth of the mammary glands and lactation in females.

**Gonadotropins:**

- Luteinizing hormone (also referred to as 'Lutropin' or 'LH'). In both males and females, LH is essential for reproduction (Pic. 3).
  - **Effect in females** - LH supports theca cells in the ovaries that provide androgens and hormonal precursors for estradiol production. At the time of menstruation, FSH initiates follicular growth, specifically
affecting granulosa cells. With the rise in estrogens, LH receptors are also expressed on the maturing follicle, which causes it to produce more estradiol.

- **Effect in males** - LH acts upon the Leydig cells of the testis and is regulated by GnRH. The Leydig cells produce testosterone (T) under the control of LH, which regulates the expression of the enzyme 17-\[\beta\] hydroxysteroid dehydrogenase that is used to convert androstenedione, the hormone produced by the gonads, to testosterone, an androgen that exerts both endocrine activity and intratesticular activity on spermatogenesis.

- Follicle-stimulating hormone (FSH), both released under influence of Gonadotropin-Releasing Hormone (GnRH). It stimulates the growth of ovarian follicles in female mammals, and induces spermatogenesis in male mammals.

**Intermediate**

The intermediate lobe synthesizes and secretes the following important endocrine hormone:

- Melanocyte–stimulating hormone (MSH). This is also produced in the anterior lobe. When produced in the intermediate lobe, MSHs are sometimes called "intermedins". MSH stimulate the production and release of melanin (a process referred to as melanogenesis) by melanocytes in skin and hair. MSH actions in the brain have effects on appetite and sexual arousal.

**Posterior**

The posterior pituitary is actually an extension of the neurons of the paraventricular and supraoptic nuclei of the hypothalamus. The cell bodies of these regions rest in the hypothalamus, but their axons descend as the hypothalamic–hypophyseal tract within the infundibulum, and end in axon terminals that comprise the posterior pituitary (Pic. 4). The posterior pituitary stores and secretes (but does not synthesize) the following important endocrine hormones:

**Magnocellular Neurons:**

- Antidiuretic hormone (ADH), also known as vasopressin and arginine vasopressin AVP), the majority of which is released from the supraoptic nucleus in the hypothalamus. It regulates the amount of water excreted by the kidneys.

- Oxytocin, most of which is released from the paraventricular nucleus in the hypothalamus. Oxytocin is one of the few hormones to create a positive feedback loop. For example, uterine contractions stimulate the release of oxytocin from the posterior pituitary, which, in turn, increases uterine contractions. This positive feedback loop continues
Development

The anterior pituitary is derived from the ectoderm, more specifically from that of Rathke’s pouch, part of the developing hard palate in the embryo. The pouch eventually loses its connection with the pharynx, giving rise to the anterior pituitary. The anterior wall of Rathke's pouch proliferates, filling most of the pouch to form the pars distalis and the pars tuberalis. The posterior wall of the anterior pituitary forms the pars intermedia. Its formation from the soft tissues of the upper palate contrasts with the posterior pituitary, which originates from neuroectoderm.

Anatomical structure

The pituitary gland is an endocrine gland about the size of a pea and weighing 0.5 grams in humans. It is a protrusion off the bottom of the hypothalamus at the base of the brain. The hypophysis rests upon the hypophysial fossa of the sphenoid bone in the center of the middle cranial fossa and is surrounded by a small bony cavity (sella turcica) covered by a dural fold (diaphragma sellae) (Pic. 5 and Pic. 6).

It consists of two lobes that arise from distinct parts of embryonic tissue:

- the anterior pituitary (adenohypophysis) is glandular tissue
- the posterior pituitary (neurohypophysis) is neural tissue

Anterior

The anterior pituitary is composed of three regions:

- Pars distalis

Microanatomy of the pars distalis showing chromophobes, basophils and acidophils The pars distalis, (distal part), comprises the majority of the anterior pituitary and is where the bulk of pituitary hormone production occurs.

The pars distalis contains two types of cells including:

- chromophobe cells
- chromophil cells - can be further divided into acidophils (alpha cells) and basophils (beta cells) (Pic. 7)

These cells all together produce hormones of the anterior pituitary, and release them into the blood stream.

- Pars tuberalis
The pars tuberalis, (tubular part), forms a part of the sheath extending up from the pars distalis which joins with the pituitary stalk (also known as the infundibular stalk or infundibulum), arising from the posterior lobe. The function of the pars tuberalis is poorly understood. However it has been seen to be important in receiving the endocrine signal in the form of TSHB (a β subunit of TSH) informing the pars tuberalis of the photoperiod (length of day).

The expression of this subunit is regulated by the secretion of melatonin in response to light information transmitted to the pineal gland.

- Pars intermedia

The pars intermedia, (intermediate part), sits between the pars distalis and the posterior pituitary, forming the boundary between the anterior and posterior pituitaries. It is very small and indistinct in humans.

**Posterior**

The posterior pituitary gland does not produce hormones, but rather stores and secretes hormones produced by the hypothalamus. The paraventricular nuclei produce the hormone oxytocin, whereas the supraoptic nuclei produce ADH. These hormones travel along the axons into storage sites in the axon terminals of the posterior pituitary. In response to signals from the same hypothalamic neurons, the hormones are released from the axon terminals into the bloodstream.

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**Diagnoses**

**Amenorrhoea**
The absence of a menstrual period in women of reproductive age.
Learn more at: [www.fertilitypedia.org/therapy/diag/amenorrhoea](http://www.fertilitypedia.org/therapy/diag/amenorrhoea)

**Anorexia Nervosa**
An eating disorder characterized by the maintenance of a body weight below average, fear of gaining weight, and a distorted body image.
Learn more at: [www.fertilitypedia.org/therapy/diag/anorexia-nervosa](http://www.fertilitypedia.org/therapy/diag/anorexia-nervosa)
**Anovulation**  
Failure of the ovaries to release an oocyte over a period of time generally exceeding 3 months.  
Learn more at: [www.fertilitypedia.org/therapy/diag/anovulation](http://www.fertilitypedia.org/therapy/diag/anovulation)

**Azoospermia**  
Complete absence of sperm in the ejaculate of a man.  
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**Delayed ejaculation**  
A man’s inability for or persistent difficulty in achieving orgasm, despite typical sexual desire and sexual stimulation.  
Learn more at: [www.fertilitypedia.org/therapy/diag/delayed-ejaculation](http://www.fertilitypedia.org/therapy/diag/delayed-ejaculation)

**Erectile dysfunction**  
The inability (that lasts more than 6 months) to develop or maintain an erection of the penis during sexual activity.  
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**Hyperprolactinemia**  
The presence of abnormally high levels of prolactin in the blood.  
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**Hypogonadism**  
A medical term which describes a diminished functional activity of the gonads – the testes and ovaries.  
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**Hypopituitarism**  
Partial or complete loss of production of one or more of the pituitary gland hormones.  
Learn more at: [www.fertilitypedia.org/therapy/diag/hypopituitarism](http://www.fertilitypedia.org/therapy/diag/hypopituitarism)

**Kallmann syndrome**  
A genetic condition where the primary symptom is a failure to start puberty or a failure to fully complete puberty.  
Learn more at: [www.fertilitypedia.org/therapy/diag/kallmann-syndrome](http://www.fertilitypedia.org/therapy/diag/kallmann-syndrome)
**Klinefelter syndrome**
The set of symptoms that result from two or more X chromosome in males.
Learn more at: www.fertilitypedia.org/therapy/diag/klinefelter-syndrome

**Menopause**
The time in most women’s lives when menstrual periods stop permanently, and the woman is no longer able to have children.
Learn more at: www.fertilitypedia.org/therapy/diag/menopause

**Menstrual cycle disorders**
An abnormal condition in a woman's menstrual cycle.
Learn more at: www.fertilitypedia.org/therapy/diag/menstrual-cycle-disorders

**Non-obstructive azoospermia**
Complete absence of sperm in the ejaculate due to testicular failure.
Learn more at: www.fertilitypedia.org/therapy/diag/non-obstructive-azoospermia

**Oligozoospermia**
Semen with a low concentration of sperm and is a common finding in male infertility.
Learn more at: www.fertilitypedia.org/therapy/diag/oligozoospermia

**Polycystic ovary syndrome**
Polycystic ovary syndrome is a condition in which a woman has an imbalance of female sex hormones and cysts in the ovaries.
Learn more at: www.fertilitypedia.org/therapy/diag/polycystic-ovary-syndrome

**Testicular torsion**
Emergency medical condition occurring when the spermatic cord twists and cuts off the testicle's blood supply.
Learn more at: www.fertilitypedia.org/therapy/diag/testicular-torsion

**Thyroid disorders**
A medical condition impairing the function of the thyroid.
Learn more at: www.fertilitypedia.org/therapy/diag/thyroid-disorders

**Undescended testes**
In the case of cryptorchidism one or both testes are absent from the scrotum. It is is the most common etiologic factor of azoospermy in the adult.
Learn more at: www.fertilitypedia.org/therapy/diag/undescended-testes
Biological control

**Follicle-stimulating hormone**
FSH is a hormone secreted by the anterior pituitary gland. It regulates the development, growth, pubertal matur and reproductive functions of the body.
Learn more at: [www.fertilitypedia.org/edu/biological-control/follicle-stimulating-hormone](http://www.fertilitypedia.org/edu/biological-control/follicle-stimulating-hormone)

Symptoms

**Absence of ovulation**
An anovulatory cycle is a menstrual cycle during which the ovaries do not release an oocyte.
Learn more at: [www.fertilitypedia.org/edu/symptoms/absence-of-ovulation-1](http://www.fertilitypedia.org/edu/symptoms/absence-of-ovulation-1)

**Increased level of FSH**
A condition with high serum follicle–stimulating hormone (FSH) concentration.
Learn more at: [www.fertilitypedia.org/edu/symptoms/increased-level-of-fsh](http://www.fertilitypedia.org/edu/symptoms/increased-level-of-fsh)

**Infertility**
The failure to achieve a clinical pregnancy after 12 months or more of regular unprotected sexual intercourse.
Learn more at: [www.fertilitypedia.org/edu/symptoms/infertility](http://www.fertilitypedia.org/edu/symptoms/infertility)

**Irregular menstruation**
Irregular menstruation is a menstrual disorder whose manifestations include irregular cycle lengths as well as metrorrhagia.
Learn more at: [www.fertilitypedia.org/edu/symptoms/irregular-menstruation](http://www.fertilitypedia.org/edu/symptoms/irregular-menstruation)

Gallery

*Pic*
Located at the base of the brain, the pituitary gland is protected by a bony structure called the sella turcica of the sphenoid bone.

*Pic*
Location of the pituitary gland in the human brain.
Microanatomy of the pars distalis showing chromophobes, basophils and acidophils.

Hypothalamic hormones are secreted by neurons, but enter the anterior pituitary through blood vessels.

Growth hormone (GH) directly accelerates the rate of protein synthesis in skeletal muscle and bones.

In both males and females, LH is essential for reproduction.
The posterior pituitary gland does not produce hormones, but rather stores and secretes hormones produced by the hypothalamus.

Sources

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