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Pituitary Gland part-11

ANATOMY

The pituitary gland is responsible for maintaining vertebrate homeostasis, regulating processes as varied as somatic growth, response to stress, reproduction, flux through metabolic pathways and lactation. It is composed of two parts, the adenohypophysis and the neurohypophysis. The adenohypophysis forms the bulk of the gland and is composed of three parts: the *pars distalis*, *pars intermedia and pars tuberalis*. The neurohypophysis is composed of nerve fibres projecting from hypothalamic nuclei to the median eminence. The pituitary gland is located in the sella turcica, a bony cavity in the sphenoid bone that is roofed by the diaphragma sellae; defective development of which results in the 'empty sella syndrome'.

Nerve supply

The anterior pituitary has no direct nerve supply other than autonomic nerves. The posterior lobe, in contrast, is composed almost exclusively of hypothalamic nerve fibres. Hypothalamic projections release hormones and trophic factors by neurosecretion into the median eminence and portal system. There aretwo principal tracts; the hypothalamo-hypophyseal tract arises in the magnocellular neurones of the supraoptic and paraventricular nuclei and releases vasopressin and oxytocin into the posterior pituitary, the parvocellular neurones of the tubero-infundibular tract originate in multiple hypothalamic nuclei and project to the median eminence.

Circulatory supply

The adenohypophysis and hypothalamus share a complex portal blood supply carrying trophic and inhibitory hormones from the hypothalamus, thus regulating systemic release of anterior pituitary hormones. The anterior pituitary has no direct arterial supply. Branches of the superior, middle and inferior hypophyseal arteries supply the median eminence and posterior pituitary. The superior hypophyseal arteries branch into an internal and external plexus. The internal plexus forms glomeruloid structures known as gomitoli. Gomitoli regulate the flow of regulatory hormones in the pituitary paracrine 'biological network' and are the presumed origin of sellar glomangiomas. The inferior arteries supply the pituitary capsule, the neural lobe and the pituitary stalk. The venous drainage of the pituitary gland is to the inferior petrosal sinuses via the cavernous sinus. The capacity of the venous drainage is exceeded by the volume of blood entering the gland, thus forming a reservoir. Reversal of blood flow here results in secretory products from the adenohypophysis entering the neurohypophysis and median eminence. This vascular anatomy is important in the pathophysiology of apoplexy.

adenohypophysis may be deposited along the migration route of Rathke's pouch, the most common site being the roof of the nasopharynx.

PATHOLOGY

Pituitary deficiency disorders

Aplasia of the pituitary gland is usually associated with severe congenital malformations. One form, associated with septo-optic dysplasia (SOD), has been attributed to mutation of *RPX1/HESX1* or the *SOX2* gene, but it is clear that other genes remain to be identified. *LHX3* is

defective in hypopituitary patients associated with a rigid cervical spine and *LHX4* mutations are associated with combined pituitary hormone deficits in association with Chiari-type malformations.

Pituitary adenomas

Specific immunochemical stains permit differentiation of anterior pituitary cells into somatotrophs (growth hormone; GH), lactotrophs (prolactin; see Figure 2), thyrotrophs (thyrotrophin; TSH), gonadotrophs (luteinising hormone and follicle-stimulating hormone; LH and FSH) and adrenocorticotrophs (adrenocorticotrophin; ACTH). Any of these cell types can give rise to functional or silent adenomas. Mutations in the *Ikaros* gene and cell cycle proteins are implicated in pituitary tumorigenesis. Pituitary adenomas can be differentiated from normal pituitary tissue by the loss of the nodular reticulin framework and uniform immunohistochemical staining with a single pituitary hormone. Adenomas may be hormonally inactive, presenting particularly with visual field defects, headaches, nausea and vomiting. Tumours that secrete hormones often produce clinical symptoms corresponding to the systemic effects of the hormone concerned. Adenomas often maintain some degree of hormonal regulation and pituitary carcinomas are rare, supporting the concept of 'reversible plasticity' in pituitary adenomas. Aggressive behaviour in pituitary adenomas can be predicted by increased expression of the cell proliferation marker Ki67 (Mib-1) or increased expression of the p53 protein.

Diagnosis

Details of individual pituitary adenomas are described elsewhere, but our approach to tumour diagnosis is considered. There is little application for intraoperative smears in pituitary pathology, especially with modern imaging techniques. The exception is where the surgeon suspects hypophysitis, where confirmation of inflammation may limit the extent of surgery. Our approach is to fix a small fragment for electron microscopy; the remainder being processed for embedding in paraffin. Paraffin sections are stained using haematoxylin/eosin and reticulin. An immunohistochemical panel, composed of synaptophysin, chromogranin A, Cam 5.2, Mib-1, p53, GH, prolactin, ACTH, LHβ, FSHβ, TSHβ and the common α-subunit of the glycoprotein hormones, is then applied. Tissue culture techniques, flow cytometry and molecular analysis have no diagnostic application at this time.

IN CONCLUSION

The pituitary gland is an anatomically unique organ with complex developmental biology and physiology. Defects in differentiation can lead to aplasia or combined pituitary hormone deficiency. Abnormalities in cell cycle regulation result in cell proliferation resulting in hyperplasia, adenoma or carcinoma. Inflammatory and vascular diseases are also encountered. Detailed understanding of pituitary physiology is of vital importance in the management of endocrine disorders.

Hormone Anterior - Front Part	Target	Function
Adrenocorticotrophic Hormone (ACTH)	Adrenals	Stimulates the adrenal glands to produce a hormone called cortisol. ACTH is also known as corticotrophin. Cortisol promotes normal metabolism, maintains blood sugar levels and blood pressure. It provides resistance to stress and acts as an inflammatory agent. Cortisol also helps to regulate fluid balance in the body.
Thyroid Stimulating Hormone(TSH)	Thyroid	Stimulates the thyroid gland to secrete its own hormone called thyroxine (T4). TSH is also known as thyrotropin. Another hormone produced from the thyroid is called tri-iodothyronine or T3. Thyroxine controls many bodily functions, including heart rate, temperature and metabolism. It also helps metabolise calcium in the body.
Lutenising Hormone (LH) and Follicle-Stimulating Hormone (FSH)	Ovaries (females) Testes (males)	Control reproduction and sexual characteristics. Stimulate the ovaries to produce oestrogen and progesterone and the testes to produce testosterone and sperm. LH and FSH are also known collectively as gonadatrophins. **Oestrogen** helps with growth of tissue of the sex organs and reproductive parts. It also strengthens bones and has a positive effect on the heart. **Testosterone** is responsible for the masculine characteristics including hair growth on the face and body and muscle development. It is essential for producing sperm and strengthening the bones.
Prolactin	Breasts	Stimulates the breasts to produce milk and is secreted in large amounts during pregnancy and breastfeeding. It is however present at all times in both males and females
Growth Hormone (GH)	All cells in the body	In children this hormone is essential for a normal rate of growth. In adults it controls energy levels and well-being. It is important for maintaining muscle and bone mass and appropriate fat distribution in the body.
Hormone Posterior - Back Part	**Target**	**Function**
Anti-diuretic Hormone (ADH)	Kidneys	Controls the blood fluid and mineral levels in the body by affecting water retention by the kidneys. This hormone is also known as vasopressin.
Oxytocin	Uterus Breasts	Affects the uterine contractions in childbirth and the subsequent release of milk for breast feeding.

Pituitary hormone and their Functions