Pituitary disease and anaesthesia

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Abstract

Patients with pituitary gland tumours comprise a significant proportion of the neurosurgical population, making transsphenoidal pituitary surgery a relatively common procedure. Such patients present anaesthetists with unique challenges resulting from hormone hypersecretion, pituitary hypofunction or tumour mass effect. To understand this pathophysiology requires a good working knowledge of normal pituitary anatomy and physiology. An appreciation of the respiratory and cardiovascular comorbidities associated with pituitary tumours is also essential to the anaesthetist. We aim to review the key principles involved in the preoperative assessment, intraoperative management and postoperative care of these patients.

Keywords Acromegaly; anaesthesia; Cushing's disease; pituitary; prolactinoma; transsphenoidal surgery

Royal College of Anaesthetists CPD Matrix: 1A01, 2A03, 3F00

Learning objectives

After reading this article, you should be able to:

- understand the anatomy and physiological function of the pituitary gland
- describe the clinical presentations of different types of pituitary tumours
- understand the anaesthetic challenges caused by hormonal hypersecretion and mass effect of pituitary tumours
- outline the postoperative complications of transsphenoidal pituitary surgery.

Pituitary tumours make up 10–20% of all primary intracranial tumours, with incidental pituitary tumours affecting up to 11% of the population. Surgery is the first-line treatment for many of these patients who can pose an anaesthetic challenge due to complications of hormonal hypersecretion and mass effect. An understanding of pituitary anatomy, physiology as well as pathophysiology is therefore essential to the neuroanaesthetist.

Anatomy

The pituitary gland measures approximately 15 × 10 × 6 mm in the adult and lies within the sella turcica, a saddle-shaped depression of the sphenoid bone that is lined with dura mater. The gland is situated outside the blood–brain barrier and consists of two lobes with very separate functions. The larger anterior lobe (or adenohypophysis), develops embryologically from Rathke's pouch and accounts for two-thirds of the gland by volume. The posterior lobe (or neurohypophysis) is smaller and anatomically connected to the hypothalamus via the pituitary stalk. The stalk predominantly contains the axons of hypothalamic neurones terminating at the posterior pituitary, creating a hypothalamo-hypophyseal nerve tract.

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Physiology

The anterior pituitary secretes several important hormones that affect specific target organs and tissues (Table 1). Most of the anterior pituitary hormones are secreted phasically with diurnal variation. This physiological process is controlled by hypothalamic peptide hormones that reach the anterior pituitary via the hypophyseal portal system. In turn, the hypothalamic hormones stimulate or inhibit the synthesis and secretion of their corresponding anterior pituitary hormones. Anterior pituitary hormones are also under negative feedback control, with hormones secreted by target organs exerting an inhibitory effect at the pituitary and hypothalamic level (Figure 1).

The posterior pituitary is mainly composed of glia-like cells called pituicytes and the terminal nerve endings of neurones originating in the paraventricular and supraoptic nuclei of the hypothalamus. These neurones are responsible for the storage and release of oxytocin and vasopressin respectively.

The pituitary is functionally complex and, in addition to secreting the nine 'classical' hormones also secretes substance P, vasoactive intestinal peptide, renin and chorionic gonadotrophin.

Pituitary tumours

Clinical presentation

The majority of pituitary tumours are benign adenomas that arise from the anterior part of the gland. Their clinical presentation is largely determined by tumour type and size (Figure 2). Macroadenomas (>10 mm diameter) present with symptoms and signs attributed to local mass effect. These include visual disturbance (classically bitemporal hemianopia), headaches and, rarely, a third cranial nerve palsy. Hormone hypersecretion syndromes are seen more commonly with microadenomas, and present with the sequelae of hormone overproduction. Pituitary tumours can also present with non-specific symptoms such as epilepsy, infertility or pituitary hypofunction. Hormonal under-activity can follow compression of functioning pituitary tissue by a non-functioning adenoma, or rarely following pituitary apoplexy, an acute condition that occurs when a macroadenoma outgrows its blood supply and infarcts.

With the use of increasingly sensitive radiographic imaging, there has been a resultant increase in pituitary tumours

Pituitary hormones and their site of action

Hormone	Target organ/Site of action	Effects
Anterior pituitary		
Adrenocorticotrophic hormone (ACTH)	Adrenal cortex	Stimulates cortisol release
Growth hormone (GH)	Musculoskeletal system	Anabolic effect on bone and muscle. Impairs glucose utilisation and promotes lipolysis
Thyroid stimulating hormone (TSH)	Thyroid gland	Stimulates iodine binding by the thyroid gland and stimulates thyroxine release
Follicle-stimulating hormone (FSH)	Female ovaries	Stimulates oestrogen production and egg maturation.
	Male testes	Stimulates sperm production
Luteinising hormone (LH)	Female ovaries	Stimulates ovulation and progesterone production.
	Male testes	Stimulates testosterone production
Prolactin	Mammary glands	Stimulates milk production
Melanocyte stimulating hormone (MSH)	Skin	Increases skin pigmentation
Beta – endorphins	Brain and immune system	Inhibits pain sensation
Posterior pituitary		
Oxytocin	Uterus and mammary glands	Stimulates uterine contractions in labour Stimulates contractions of mammary milk ducts
Antidiuretic hormone (ADH)	Kidneys	Promotes renal retention of water

Table 1

Negative feedback control of hypothalamo-pituitary axis

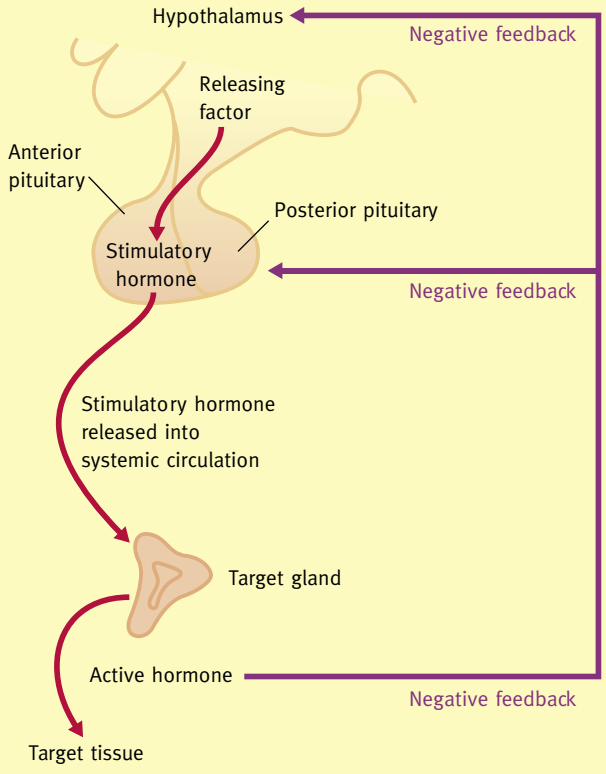

Figure 1

diagnosed 'incidentally' during the investigation of unconnected conditions.

Hormone hypersecretion syndromes

Prolactinomas

Prolactinomas account for up to 30% of all functioning pituitary adenomas and predominantly occur in women; they are often diagnosed during investigation of infertility. Common clinical presentations include secondary amenorrhoea and galactorrhoea. Prolactinomas in men present with relatively non-specific symptoms including decreased libido, hypogonadism and erectile dysfunction. Due to their earlier diagnosis, prolactinomas in women are overwhelmingly microadenomas, whereas in men macroadenomas are more common.

Symptomatic prolactinomas are treated with the dopamine agonist cabergoline as the drug of choice. Surgery is reserved for patients whose symptoms are refractory to medical therapy.

Acromegaly

Acromegaly is caused by the hypersecretion of growth hormone after epiphyseal plate closure at puberty. Patients characteristically present with enlargement of the hands, feet, mandible and soft tissues. These symptoms develop insidiously and often precede diagnosis by several years.

Acromegaly is associated with numerous airway challenges. Macrognathia and macroglossia coupled with soft tissue hypertrophy of the pharynx and larynx can render the acromegalic airway unpredictable. This can be complicated further by an enlarged thyroid that may cause tracheal compression and/or deviation. Unsurprisingly therefore, standard airway assessment tools may fail to predict difficult tracheal intubations. As such,