Pituitary disease and anaesthesia

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Abstract

Patients with pituitary gland tumours comprise a significant proportion of the neurosurgical population, making transphenoidal pituitary surgery a relatively common procedure. These patients present unique anaesthetic challenges resulting from hormone hypersecretion, pituitary hypofunction or tumour mass effect. To understand this pathophysiology requires knowledge of normal pituitary anatomy and physiology. Respiratory and cardiovascular sequelae of pituitary tumours also pose anaesthetic challenges. 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; transphenoidal surgery

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

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 (with approximately 1300 operations taking place in the UK per year), who can pose an anaesthetic challenge due to complications of hormonal hypo- or 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 lined with dura mater. The gland is situated outside the blood–brain barrier and consists of two lobes with very different 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 hypothalamo–hypophyseal nerve tract, axons of hypothalamic neurones terminating at the posterior pituitary.

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Physiology

The anterior pituitary secretes several important hormones that target specific organs and tissues (Table 1). In health most anterior pituitary hormones are secreted phasically with diurnal variation, controlled by hypothalamic peptide hormones that reach the anterior pituitary via the hypophyseal portal system blood supply. The hypothalamic hormones either stimulate or inhibit the synthesis and secretion of their corresponding anterior pituitary hormones. Anterior pituitary hormones are regulated by negative feedback control by hormones secreted by target organs exerting an inhibitory effect at both pituitary and hypothalamic level (Figure 1). This negative feedback control can be lost with hormone-secreting tumours constantly 'switched on'.

The posterior pituitary is mainly composed of glia-like cells call 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 with the clinical presentation determined by tumour type and size (Figure 2). Macroadenomas (>10 mm diameter) present with symptoms and signs attributed to mass effect, including visual disturbance (classical bitemporal hemianopia), headaches and, rarely, a third cranial nerve palsy. Hormone hypersecretion syndromes are more common with microadenomas, presenting with the sequelae of hormone overproduction. Pituitary tumours can also present with non-specific symptoms such as infertility, pituitary hypofunction or even seizures if the tumour is large enough to extend into the temporal lobe. Hormonal under-activity can follow compression of functioning pituitary tissue by a non-functioning adenoma, or rarely following pituitary apoplexy, an acute neurosurgical emergency that occurs when a macroadenoma outgrows its blood supply and infarcts requiring consideration of urgent sphenoidal decompression. Patients will complain of headache, vomiting and visual disturbance including hemianopias, diplopia, and occasionally third nerve palsy or even blindness. An absolute lack of adrenocorticotrophic hormone (ACTH) can precipitate Addisonian crises, followed by panhypopituitarism.

Increasingly sensitive radiographic imaging has resulted in an increase in pituitary tumours diagnosed 'incidentally' during investigation of other conditions.

Hormone hypersecretion syndromes

Prolactinomas

Prolactinomas account for up to 30% of all functioning pituitary adenomas, predominantly 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

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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 utilization 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
Luteinizing 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
β-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

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 to utilize the negative feedback pathway. 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 which develop insidiously and often precede diagnosis by several years.

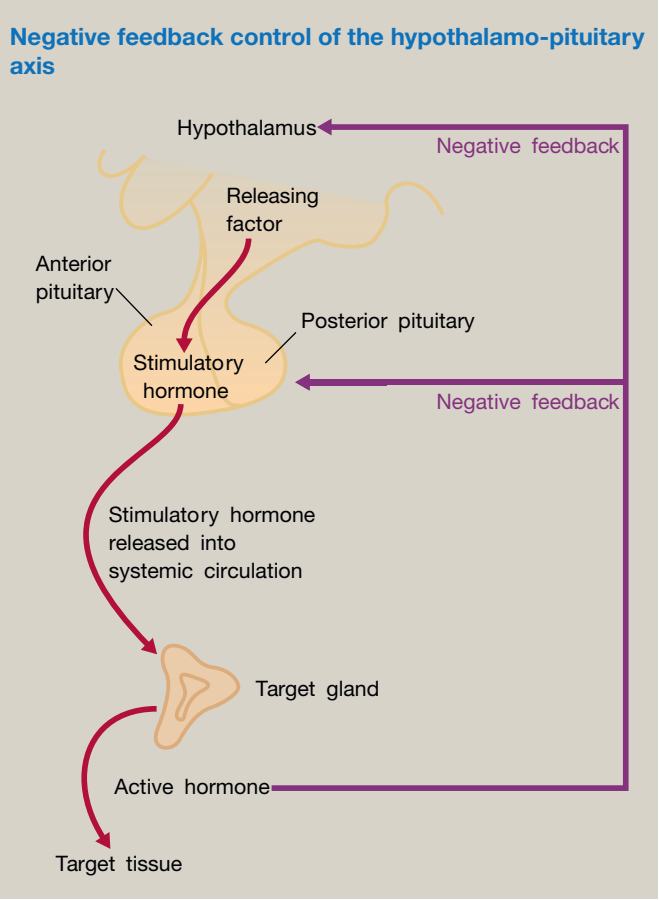

Figure 1

Patients with acromegaly present 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 tracheal compression and/or deviation from thyroid enlargement which may not be evident from standard airway assessment resulting in an unpredicted difficult tracheal intubation. As such, airway adjuncts should be readily available during induction of anaesthesia, and awake fibreoptic intubation may be appropriate for selected patients.

Both obstructive and central sleep apnoea can complicate acromegaly, which in turn increases the risk of perioperative airway compromise; opiates and benzodiazepines should be given with caution in these patients. A restrictive lung disease secondary to kyphoscoliosis may also be present.

Hypertension occurs in 30% of patients with acromegaly and evidence of left ventricular hypertrophy even in normotensive patients. There is an increased incidence of arrhythmias, ischaemic heart disease and cardiomyopathy. Preoperative echocardiography is useful to determine left ventricular function and size. Glucose intolerance is frequently seen in patients with acromegaly and established diabetes is present in 25% of patients.

First-line treatment for growth hormone-secreting tumours is surgery, with or without additional radiotherapy. A minority of patients can, however, normalize growth hormone and insulin-like growth factor-1 (IGF-1) plasma levels by dopamine agonists alone.

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