Imaging of the Pituitary

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• Pituitary • MR imaging • Adenoma • Cushing syndrome • Sella turcica

Since the advent of magnetic resonance (MR) imaging, imaging has become an integral part of the evaluation of patients with endocrinological abnormalities suspected to be of pituitary etiology. This article discusses normal development and anatomy of the pituitary gland, indications for imaging, and imaging techniques. In addition, imaging characteristics of common pituitary/infundibular lesions are discussed in detail. Juxtasellar/suprasellar pathologies that may mimic primary pituitary lesions are briefly reviewed. The postoperative appearance of sellar and suprasellar contents may be a source of misinterpretation, and this is discussed along with other errors in image interpretation.

DEVELOPMENT AND NORMAL ANATOMY

The pituitary gland is composed of anterior and posterior lobes. The anterior pituitary (adenohypophysis) is the larger part and arises from Rathke's pouch within the fetal nasopharynx. It produces numerous hormones: growth hormone (GH), thyroid-stimulating hormone, adrenocorticotropic hormone (ACTH), prolactin, luteinizing hormone, and follicle-stimulating hormone. The anterior pituitary receives its ample blood supply from the hypophyseal-portal system; blood flows within the infundibulum, which lacks a blood-brain barrier. The posterior pituitary (neurohypophysis) and the median eminence of the hypothalamus arise from neuroectoderm in the floor of the forebrain; the infundibular stalk arises from ventromedial hypothalamus. The pars intermedia separates the anterior gland from the posterior gland; the pars intermedia often contains small colloid cysts. The posterior gland contains two modified glial cell types, the tanycyte and the pituicyte, both of which support the axons of the neurons that produce vasopressin and oxytocin. These hormones are transported directly through the hypophyseal portal system.

The pituitary gland sits within the sella turcica, a cup-shaped bony depression within the basisphenoid. Above the sella is the dural covering known as the diaphragma sellae, and above that lies the suprasellar cistern, the optic chiasm, and the hypothalamus. Posteriorly, the sella is bound by the dorsum sella. The cavernous sinuses form the lateral borders of the pituitary fossa. The gland can be considered to sit within a dural "bag," a thin sheath separating it from the cavernous sinus. The lateral wall is not always a rigid sagittal fold of dura as commonly depicted in anatomic drawings, but may have a more undulating shape, allowing for normal lateral extension of the gland, especially superolaterally over the cavernous carotid.[1] Cranial nerves III, IV, V1, V2, and VI travel through or adjacent to the cavernous sinus, as do the cavernous internal carotid artery (ICA) and venous structures.

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The size and shape of the pituitary gland is dependent on age and gender. The pituitary gland of a neonate is larger than in later childhood. Similarly, the gland is generally larger in women than in men. In pubertal girls and peripartum women, the gland may appear enlarged with a convex upper border. The gland can also become enlarged if exogenous estrogens are present, if there is excess or ectopic hypothalamic releasing factors, and in cases of end-organ failure. The infundibulum tapers normally from superior to inferior. Deviation or tilting of the infundibulum is common and does not always suggest underlying pathology; it may simply reflect a sloping sellar floor. In general, the size of the pituitary gland decreases with age.

In normal adults, the anterior pituitary is isointense to gray matter on T1-weighted and T2-weighted sequences. The posterior pituitary, on the other hand, is typically inherently T1 hyperintense; hyperintensity accounts for the so-called pituitary bright spot, attributed to an antidiuretic hormone neurosecretory granular complex present within the posterior pituitary. In neonates up to 2 months of age and in pregnant women, the anterior pituitary may be as or more hyperintense on T1 as the posterior pituitary. The posterior pituitary generally enhances before the anterior pituitary during dynamic contrast-enhanced imaging. The infundibulum enhances earlier than the remaining gland. Enhancement of the pituitary tuft (the junction of the stalk and gland) follows. Centrifugal enhancement of the remaining gland then occurs (**Fig. 1**). Contrast enhancement varies depending on microscopic anatomy: areas of densely compacted cellularity and/or increased cellular granularity are intermixed with areas of less compacted cellularity and diminished granularity.[2] The normal gland may also appear very heterogeneous because of natural asymmetries of the position of anterior and posterior gland and pars intermedia colloid cyst variability.

INDICATIONS FOR IMAGING

Pituitary imaging is indicated in patients who present with signs and symptoms of either excess or deficiency of pituitary hormone. Imaging is also indicated if a patient presents with symptoms suggestive of a pituitary mass, such as a visual field deficit and/or headaches.

Any disturbance in the hormones that are produced by the adenohypophysis or are a part of the pituitary-hypothalamic axis may cause symptoms that prompt endocrinologic testing. Confirmation of pituitary hormone abnormalities using biochemical testing should be performed before imaging (**Table 1**).

Prolactinoma

One of the most common pituitary hormone abnormalities is hyperprolactinemia, which is caused by an adenoma that secretes excess prolactin. Approximately 40% of all functional adenomas are prolactinomas.[3] Women with hyperprolactinemia will present with galactorrhea and menstrual irregularities whereas men will present with hypogonadism. Stalk compression by a supra- or parasellar lesion may cause hyperprolactinemia as well, although prolactin levels in these patients are usually less than 150 ng/mL, whereas patients with functional prolactinomas usually have prolactin levels greater than 150 ng/mL.[4]

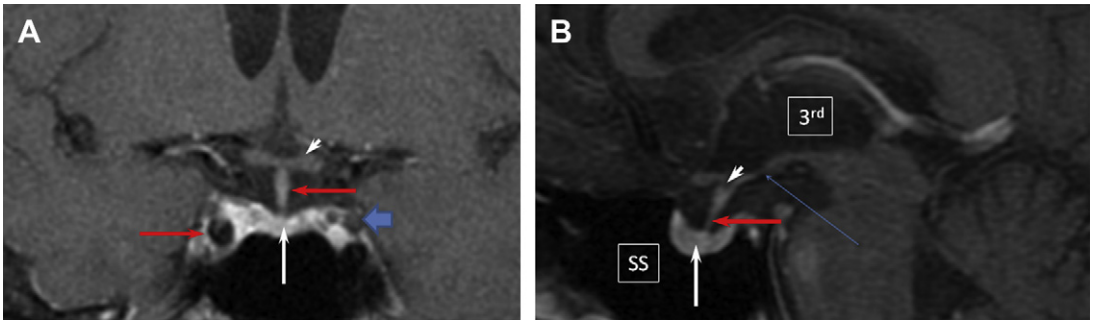

Fig. 1. Normal pituitary anatomy. (*A*) Coronal postcontrast image through the pituitary gland shows the normal position and appearance of the optic chiasm (*white arrowhead*), the infundibulum in the midline (*red arrow*), the homogeneously enhancing pituitary gland (*white arrow*), and the intracavernous ICA flow void (*red arrow*). Note that cranial nerve III is well visualized in the upper outer corner of the cavernous sinus (*blue arrow*). (*B*) Sagittal anatomy. The normal pituitary gland enhances homogeneously (*white arrow*), the infundibulum is wider superiorly and tapers inferiorly (*red arrow*), and the white arrowhead points to the infundibular recess. Behind the infundibulum recess and anterior to the mammillary bodies is the tuber cinereum (*thin blue arrow*), which is the inferior hypothalamus. Note the marked third ventricle (3^{rd}) and sphenoid sinus (SS).