21 Pituitary Apoplexy

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INTRODUCTION

Pituitary apoplexy (PA) is a rare clinical condition presenting most commonly with acute headache as well as vomiting, visual impairment, ophthalmoplegia, altered mental state, and potentially panhypopituitarism. Occasionally it may be fatal. The syndrome is caused by hemorrhage into and/or infarction of the pituitary gland. PA is most commonly caused by hemorrhage into a preexisting macroadenoma. Asymptomatic pituitary hemorrhage without clinically defined apoplexy syndrome can occur and should not be termed PA.

Accurate and early diagnosis of PA on initial imaging is important, given the potential need for urgent surgical decompression, intensive care unit (ICU) monitoring, and/or hormone replacement therapy. Although the computed tomography (CT) appearance can overlap with other sellar and parasellar lesions, some patterns of disease progression are highly specific in the appropriate clinical setting. Importantly, urgent magnetic resonance imaging (MRI) can confirm hemorrhage, exclude mimicking diagnoses, and provide additional information about potential optic nerve compression.

DISCUSSION

The pathogenesis underlying PA is unknown. Some have suggested that excessive growth of an adenoma may cause it to outgrow its blood supply, thereby leading to ischemic necrosis and hemorrhage (Fig. 21.1). Another hypothesis is that a gradually enlarging macroadenoma becomes impacted at the diaphragmatic notch, compressing the hypophyseal stalk and its vascular supply.

However, these theories do not explain hemorrhages into microadenomas. A third hypothesis is that some pituitary tumors are characterized by an intrinsic vasculopathy that can lead to spontaneous infarction and hemorrhage. Many risk factors that predispose patients to symptomatic infarction of the pituitary gland have been described; these include hypertension, diabetes mellitus, and dynamic tests of pituitary function as well as the administration of anticoagulants, bromocriptine, estrogens, or radiotherapy.

PA occurs in a small number of patients with macroadenomas. It is more frequent in males (gender ratio 2:1) and the mean age of onset is 57 years. In many cases this clinical syndrome represents the first sign of a previously undetected adenoma. A relatively small number of cases of apoplexy have been reported in patients without underlying pituitary pathology. This typically occurs as Sheehan syndrome, a condition characterized by pituitary infarction occurring in post- or peripartum females due to hypervolemia.

Many authors attribute disturbance of pituitary function to the sudden enlargement of a preexisting adenoma due to hemorrhage and local mass effect on surrounding structures. Headache symptoms may relate to sudden increases in intracranial pressure or meningeal irritation. Ophthalmoplegia is attributed to compression of the cavernous sinuses, and decreased visual acuity is attributed to compression of the optic chiasm.

IMAGING APPEARANCE

Computed Tomography

Most patients with symptoms related to PA first undergo nonenhanced CT in an emergency setting. The differential diagnosis for acute headache includes more common diagnoses, such as subarachnoid hemorrhage, venous sinus thrombosis, or cervical arterial dissection. Because of the hemorrhagic component in most instances of apoplexy, CT at presentation may show patchy or confluent areas of hyperdensity within the sella (Fig. 21.2, *top row*). Reported low sensitivity of CT for the evaluation of PA can be explained by the evolution of blood degradation products on CT, which gradually decrease in density and conspicuity in the days following hemorrhage.

Although a hypesrdense lesion inside the sella turcica tends to represent PA in the proper clinical setting, diseases other than PA may lead to similar imaging appearances. Other hyperdense lesions in the pituitary region include aneurysm, meningioma, Rathke cleft cyst (RCC), craniopharyngioma, germinoma, and

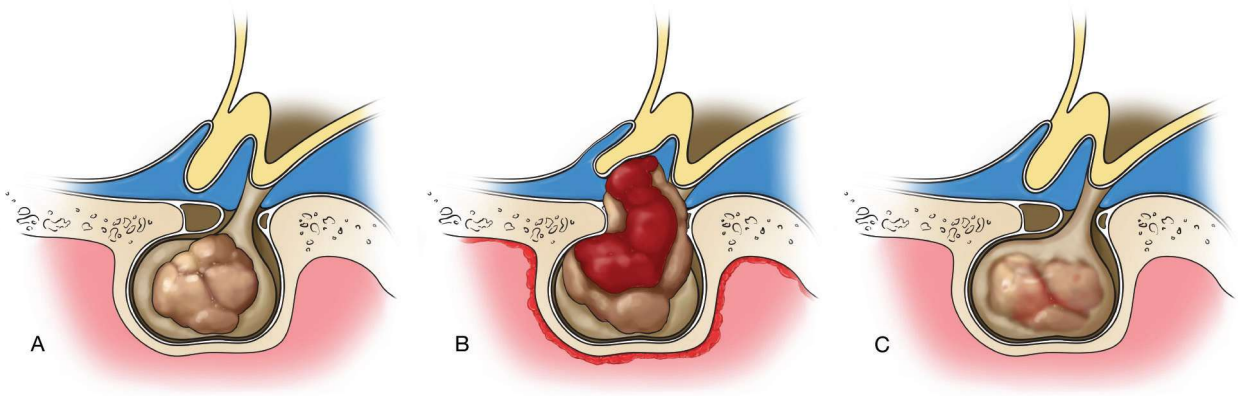

Figure 21.1. Evolution of pituitary apoplexy. (A) Preexisting adenoma. (B) Hemorrhage into adenoma with mass effect, including elevation of the optic chiasm. Hemorrhage is presumed to related to ischemic necrosis of adenoma. (C) Gradual resorption of hemorrhage with resolution of mass effect. Residual tumor may or may not be present at follow-up.

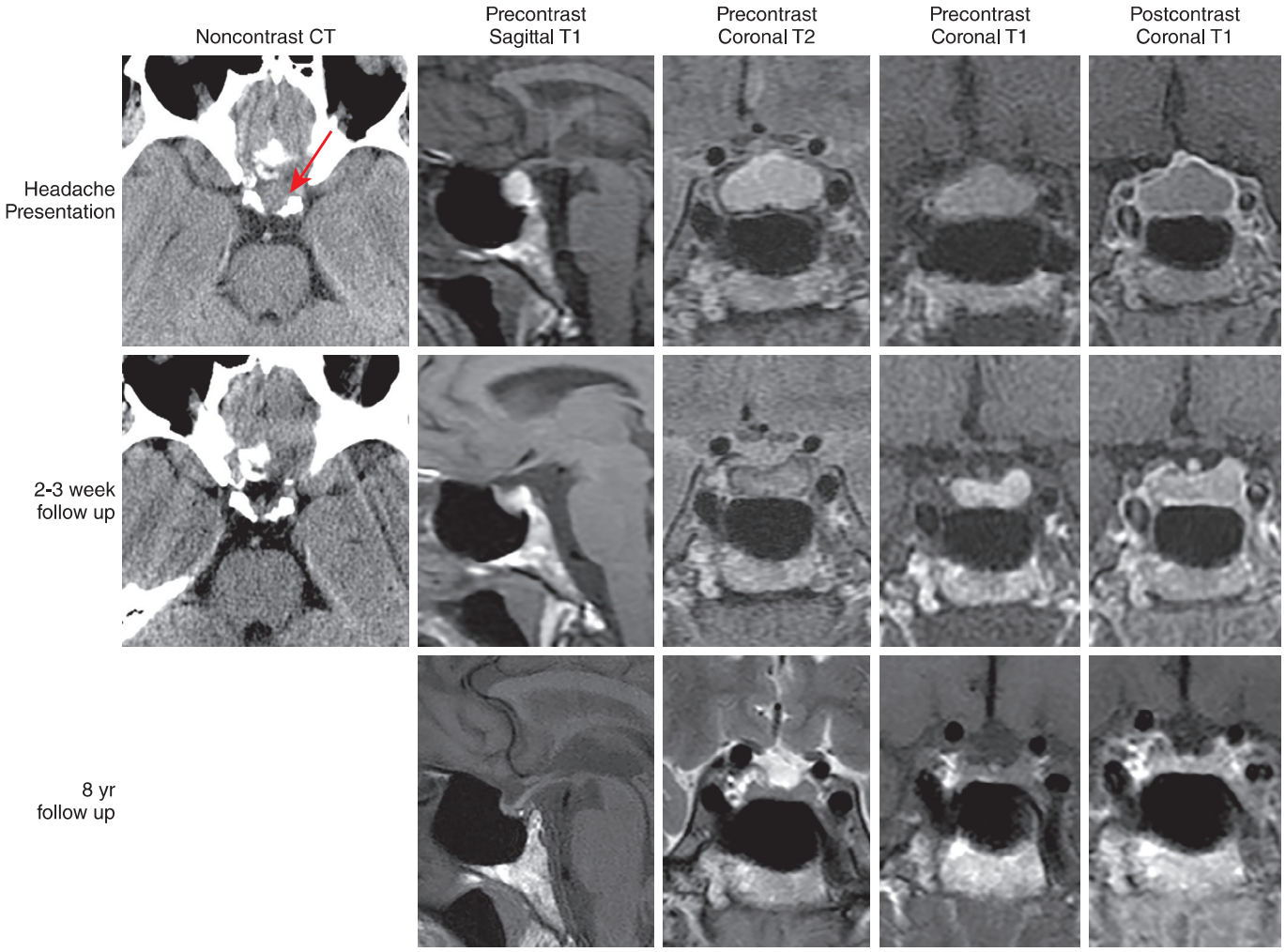

Figure 21.2. Hemorrhagic pituitary apoplexy. A 59-year-old type 2 diabetic presenting with headache. *Top Row*, Noncontrast computed tomography *(CT)* at presentation demonstrates hyperdense sellar lesion *(red arrow)*, which corresponds to a nonenhancing mildly T1 and T2 hyperintense lesion suggestive of pituitary hemorrhage. There is linear enhancement of the pituitary gland surrounding the hemorrhage on postcontrast coronal T1. *Middle Row*, Follow-up CT at 2 weeks and magnetic resonance imaging (MRI) at 3 weeks demonstrate diminished size of the hyperdense sellar lesion on CT and also of the nonenhancing lesion on MRI. Note the increased degree of precontrast T1 hyperintensity in the sella, compatible with evolving subacute blood products (methemoglobin). *Bottom Row*, At 8 years, the sellar hemorrhage has completely resolved, with normal enhancing pituitary tissue seen along the floor of the sella (previously compressed by hemorrhage). No adenoma was identified. Pituitary function testing was normal.

lymphoma. MRI can be used to distinguish hemorrhage from these other lesions. (See differential diagnosis section later.)

The less common occurrence of nonhemorrhagic PA in a patient with an adenoma may be effectively visualized by noncontrast CT due to the associated bone remodeling and enlargement of the sella. A change in CT density of a previously imaged pituitary lesion—both hyperdensity (hemorrhage) and hypodensity (ischemia)—should raise concern for apoplexy in the appropriate clinical setting (Fig. 21.3).

Magnetic Resonance Imaging

Variable MR signal of hemorrhage has been well described. To review, acute hemorrhage (1 to 7 days) is typically iso- to hyperintense on T1 with variable T2 signal ranging from hyperintense to hypointense. Subacute hemorrhage (7 to 21 days) results in the accumulation of methemoglobin, which causes T1 shortening effects resulting in T1 hyperintensity. As blood products break down in the subacute phase, T2 hyperintensity predominates. In the chronic phase (>21 days), hemosiderin and ferritin blood degradation products cause hypointensity on both T1 and T2 sequences. It should be specifically noted that T1 hyperintensity within the neurohypophysis (also known as the "posterior pituitary bright spot") due to the accumulation of neurohypophysial peptide hormone (vasopressin) is a normal finding and should not be mistaken for hemorrhage.

After administration of contrast medium, a rim of enhancement may surround a predominantly hemorrhagic lesion. Alternatively, in large macroadenomas, inhomogeneous enhancement in the areas of residual viable tumor may be identified with more peripheral areas of T1 hyperintense hemorrhage. A hemorrhagic fluid level may be identified in some lesions, with a T1 hyperintense upper fluid level representing free extracellular methemoglobin and T1 hypointense lower fluid level representing sediment of red blood cells. Less common and poorly described nonhemorrhagic infarcted macroadenoma demonstrates a nonenhancing pituitary mass, which is T1 hypointense on both pre- and postcontrast studies.

One MRI finding that has been uniquely associated with the acute phase of PA is thickening of the sphenoid sinus mucosa. This has been postulated to result from venous engorgement and

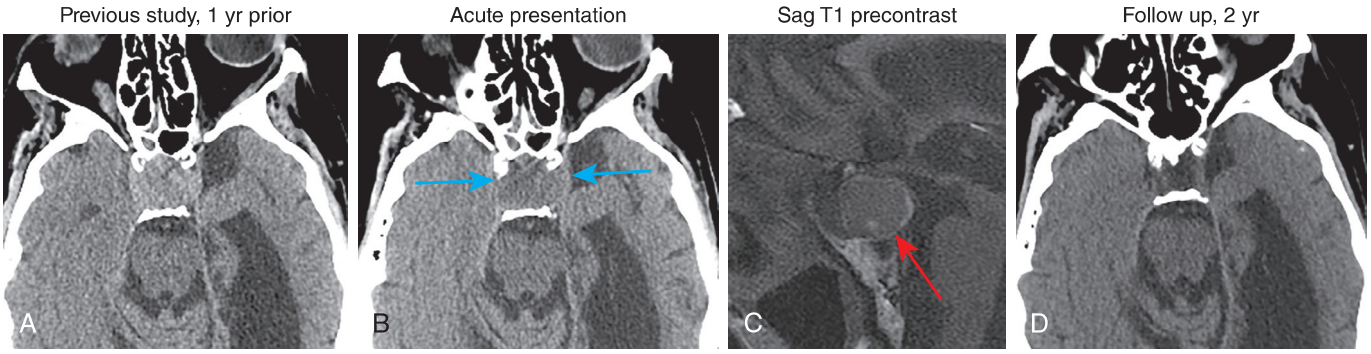

Figure 21.3. Ischemic pituitary apoplexy. A 71-year-old man with type 2 diabetes and a preexisting macroadenoma presented with acute lethargy, visual disturbance, and adrenal insufficiency. (A) Previous computed tomography (CT) performed 1 year prior demonstrates a mildly hyperdense pituitary macroadenoma expanding the sella. (B) Acute presentation CT demonstrates interval decrease in density of the macroadenoma compatible with nonhemorrhagic infarction *(blue arrows)*. (C) Sagittal T1 precontrast magnetic resonance imaging demonstrates a small focus of T1 hyperintensity within the macroadenoma, consistent with a small amount of internal hemorrhage *(red arrow)*. (The patient was unable to tolerate postcontrast imaging.) (D) Two-year follow-up study after transsphenoidal resection due to progressive visual disturbance during the acute episode demonstrates cerebrospinal fluid density within the expanded sella. The pathology was consistent with necrotic adenoma. The patient continues to receive hormone replacement therapy.

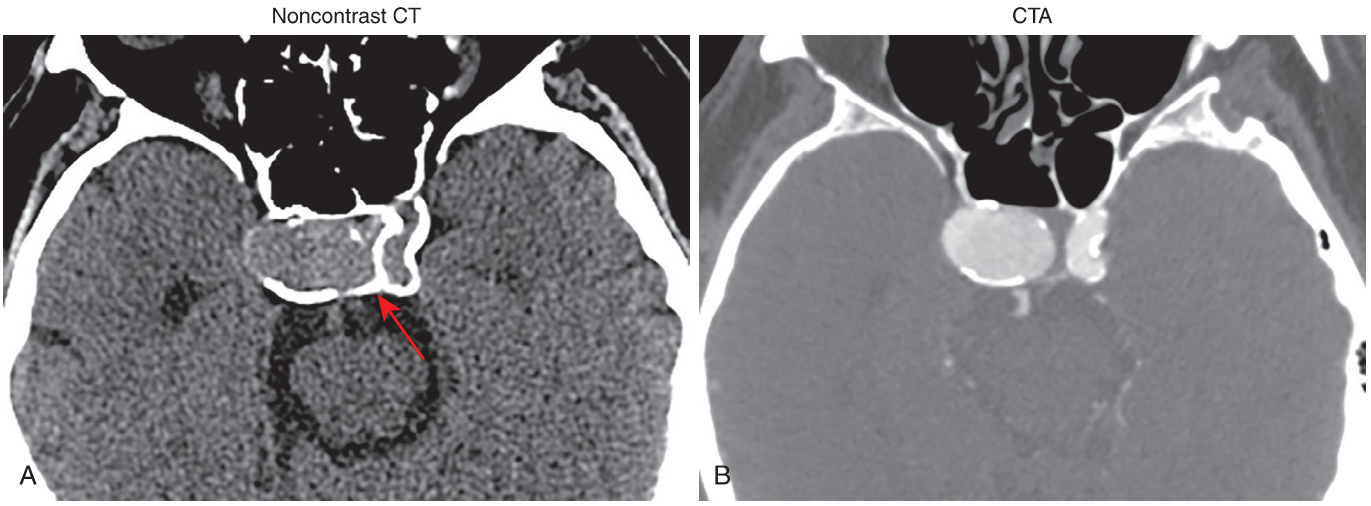

Figure 21.4. Carotid aneurysm. A 70-year-old man presented with altered mental status. (A) Noncontrast axial computed tomography *(CT)* demonstrates a slightly hyperdense sellar lesion with peripheral calcification and sellar expansion *(red arrow)*. Differential considerations included adenoma and carotid aneurysm. (B) Axial CT angiography *(CTA)* image confirmed a right cavernous internal carotid artery aneurysm.

typically resolves on follow-up imaging. This finding can be used in the determination of acuity of apoplexy in conjunction with the MR signal of the blood products.

Although the diagnosis of apoplexy can be made clinically and can be supported by CT, compression of the chiasm is potentially the most important indication of MRI in PA. Chiasm compression may favor the need for surgical decompression, especially in patients who are unable to participate in visual field assessment. If conservative management is undertaken, continued MRI follow-up can be used to exclude growth of or rehemorrhage into a presumed residual adenoma.

On follow-up, the hemorrhagic cavity will gradually decrease in size until resolution. There may be a remnant of hemosiderin, which is markedly T2 hypointense and blooms on gradient echo (T2*) or susceptibility weighted imaging. Occasionally a hemorrhagic focus will increase in size due to rehemorrhage; however, the hemorrhage should eventually resolve spontaneously. Of note, rehemorrhage may occur with or without any deterioration of symptoms.

MIMICS AND DIFFERENTIAL DIAGNOSIS

The CT differential diagnosis for a hyperdense lesion in the sellar and suprasellar regions includes aneurysm, meningioma, RCC, craniopharyngioma, germinoma, lymphoma, and metastasis. MRI can often distinguish enhancing mass lesions from hemorrhagic lesions based on the typical MRI hemorrhage signal patterns discussed previously.

Aneurysms arising from the carotid siphon and anterior communicating artery can appear as rounded hyperdense lesions, mimicking hemorrhage on CT. Furthermore, partially thrombosed aneurysms can have a variable MRI signal that can mimic a hemorrhagic mass (Fig. 21.4). Recognizing the arterial origin of the lesion is critical. Distinguishing factors are peripheral calcification, very low T2 signal, and pulsation artifacts due to flow.

Meningiomas of the sellar region are typically T1 isointense and demonstrate mild to moderate enhancement following contrast administration (Fig. 21.5). The T2 signal of meningiomas can be variable due to the fibrous nature of these lesions. Completely calcified meningiomas may show little to no enhancement, but the noncontrast CT appearance is usually diagnostic. Other distinguishing features are a dural tail, lack of sellar expansion when a meningioma is suprasellar, and encasement with narrowing of the internal carotid artery (Fig. 21.6).

RCCs are nonneoplastic sellar or suprasellar cystic lesions arising from embryologic remnants of the Rathke pouch. The vast majority are asymptomatic; however, if large, these lesions may present

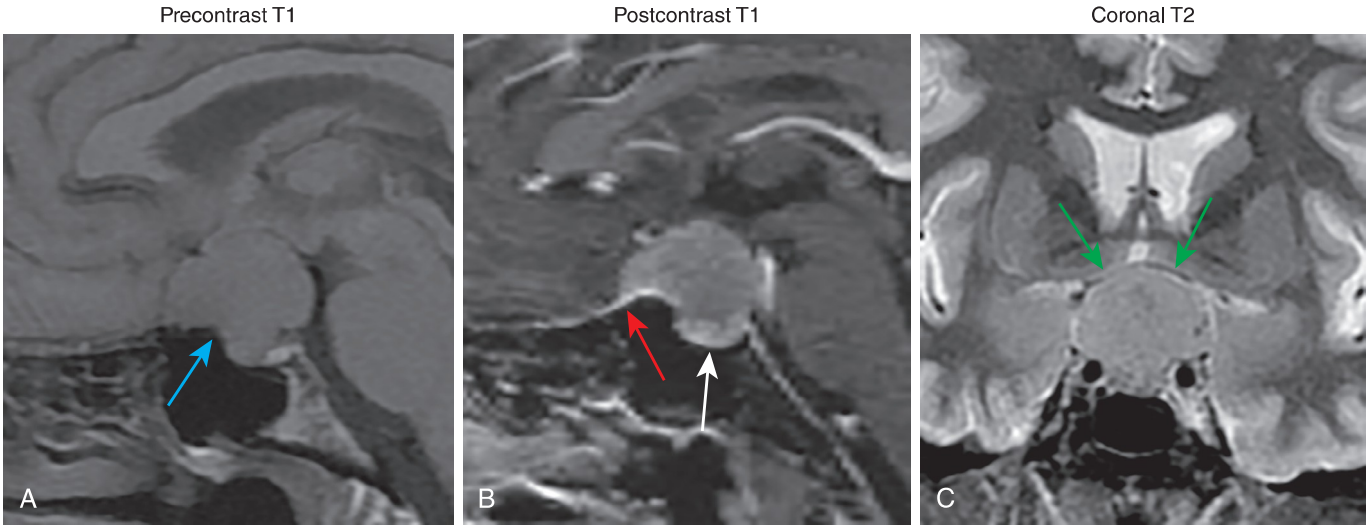

Figure 21.5. Suprasellar meningioma. A 50-year-old woman with headache. (A) Sagittal T1 precontrast magnetic resonance imaging (MRI) demonstrates a T1 isointense lesion *(blue arrow)* elevating the optic chiasm. Note: No expansion of the sella and normally positioned posterior pituitary bright spot. (B) Sagittal T1 postcontrast MRI demonstrates moderate lesion and dural tail enhancement over the planum sphenoidale *(red arrow)*. Note normal enhancement of the anterior pituitary gland below the meningioma *(white arrow)*. (C) Coronal T2 MRI demonstrates elevation and compression of the optic chiasm *(green arrows)*.

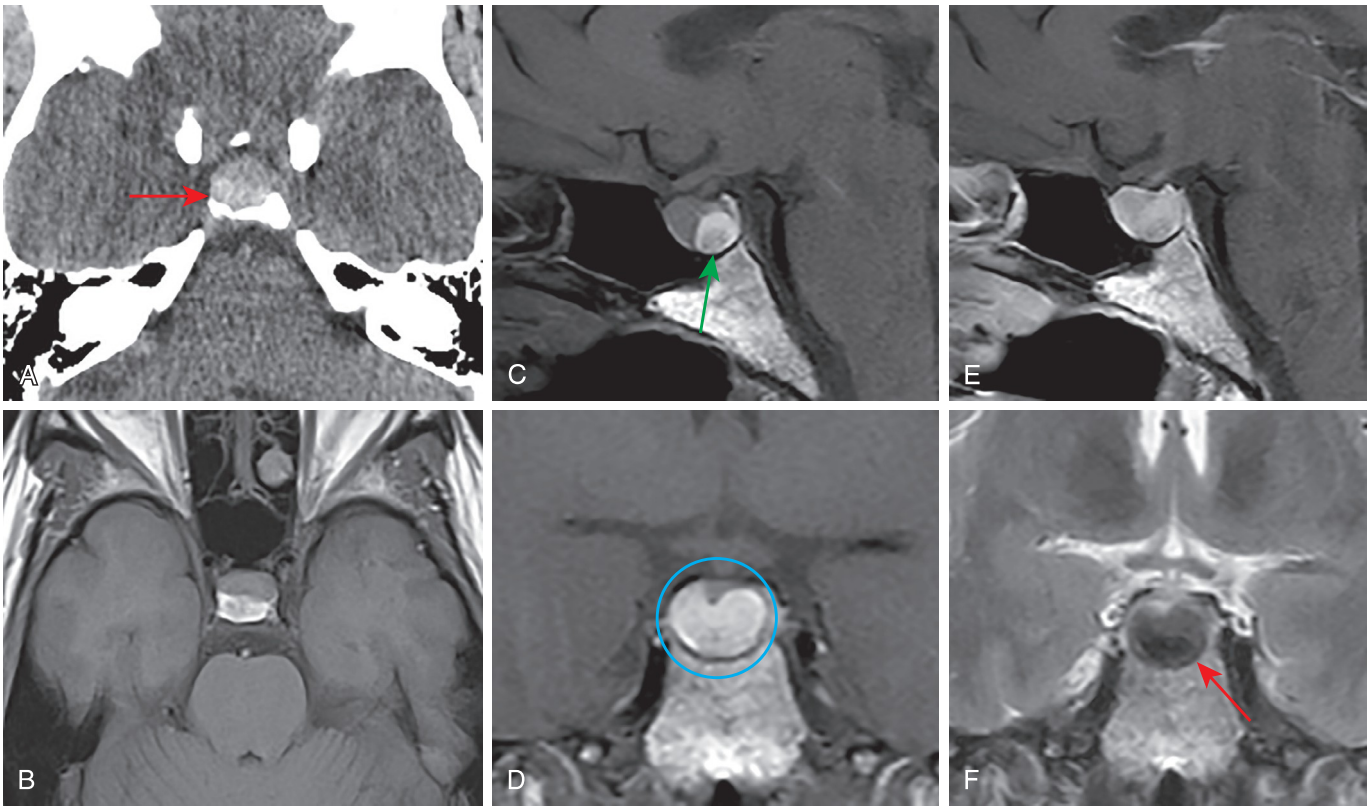

Figure 21.6. Rathke's cleft cyst. A 48-year-old woman with headache. (A) Hyperdense lesion within the middle and posterior pituitary gland *(red arrow)*. (B–D) Precontrast axial, sagittal, and coronal T1 magnetic resonance imaging (MRI) demonstrates a T1 hyperintense lesion within the middle and posterior sella. (The lesion is too large to represent the normal neurohypophysis—the posterior pituitary bright spot.) (E) Postcontrast sagittal MRI T1 demonstrates normal enhancement of the adenohypophysis (anterior pituitary gland). (F) Coronal T2 demonstrates hypointense region corresponding to area of T1 hyperintensity in D *(blue circle)*, consistent with a high-protein-content cyst. Hypointense intracystic nodule typical of Rathke cleft cyst is also identified on multiple sequences (*green arrow* in C) and (*red arrow* in F). The intracystic nodule is felt to represent a concretion of protein within the proteinaceous cyst. (This lesion did not change over 3 years of follow-up.)

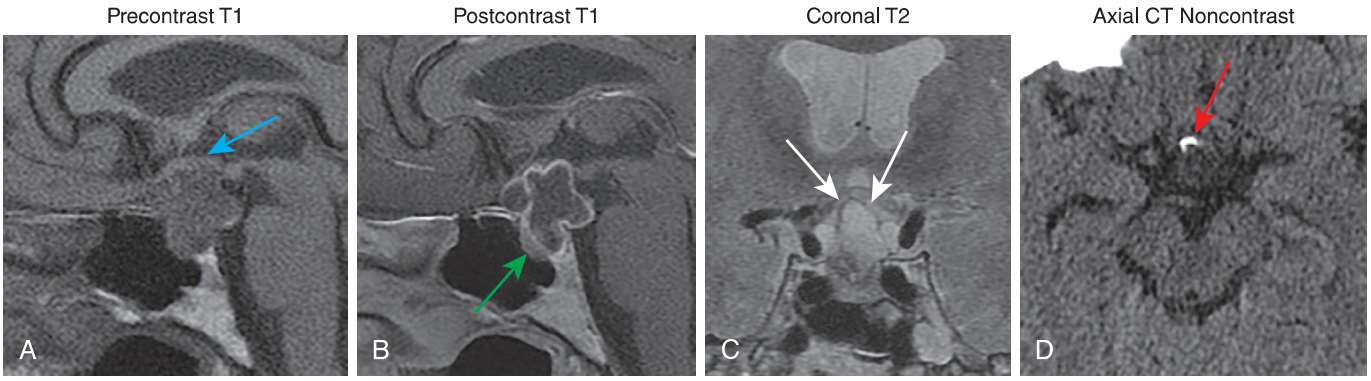

Figure 21.7. Craniopharyngioma. (A) Sagittal T1 precontrast magnetic resonance imaging (MRI) demonstrates a T1 hypointense lobulated sellar and suprasellar lesion elevating the optic chiasm *(blue arrow)*. (B) Sagittal T1 postcontrast MRI demonstrates smooth peripheral enhancement of the predominantly cystic lesion. (Note the normally enhancing pituitary gland along the anterior floor of the sella *[green arrow]*.) (C) Coronal T2 MRI demonstrates a predominantly hyperintense cystic sellar and suprasellar lesion *(white arrows)*. (D) Axial noncontrast computed tomography confirmed the presence of peripheral calcification *(red arrow)*, most typical of an adamantinomatous type craniopharyngioma.

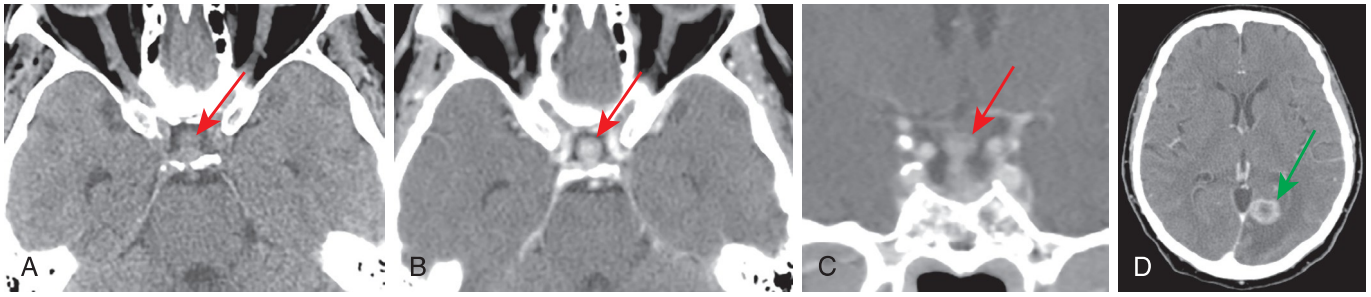

Figure 21.8. Metastasis. A 74-year-old woman with a history of breast carcinoma presenting with vertigo. (A) Noncontrast axial computed tomography (CT) demonstrates a hyperdense suprasellar lesion *(red arrow)* and edema in the left occipital lobe (not included). (B and C) Postcontrast axial and coronal CT demonstrate homogeneous enhancement of the suprasellar lesion *(red arrows)*, which involves the pituitary stalk. (D) Postcontrast axial CT demonstrates a rim-enhancing lesion in the left occipital lobe *(green arrow)* consistent with metastatic disease.

with headache, pituitary dysfunction, or visual disturbances due to compression of the pituitary stalk or optic chiasm. Internal cyst fluid has variable protein concentrations, which allow for a wide range in T1 signal. A hallmark of RCC is a small nonenhancing intracystic nodule, typically hypointense on T2, which represents a concretion of proteinaceous material. Occasionally internal fluid levels may occur within an RCC, which suggests prior hemorrhage. These lesions may grow or fluctuate in size over time, but they do not spontaneously resolve as expected with hemorrhagic PA (see Fig. 21.6).

Craniopharyngiomas are low-grade neoplasms typically occurring along the course of the pituitary stalk, although they may also involve the sella. Two pathologic types are recognized, adamantinomatous (more common in the pediatric age group) and papillary (more common in adults), although the histology may be mixed. Craniopharyngiomas often have both cystic and solid components, with calcifications. Internal fluid can have variable signal on T1 and T2 sequences due to variable protein content, mimicking hemorrhage. Also, rare lesions that demonstrate a predominant intrasellar component may expand the sella, similar to macroadenomas (Fig. 21.7).

Germinomas, lymphomas, and metastatic lesions of the parasellar region typically involve the pituitary stalk and do not expand the sella, as would be expected with macroadenomas. Other sites of involvement may also be present, including a metachronous pineal region lesion in germinomas, or brain parenchymal or leptomeningeal lesions in lymphoma and metastatic disease (Fig. 21.8).

SUGGESTED READINGS

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