Diagnostic significance of T2W hypointensity of the sella

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Abstract

Normal anatomical structures and lesions characterized by low T2W signal intensity are reviewed in this pictorial essay. The purpose is to demonstrate how evaluation of the appearance, shape and exact anatomical location of the T2W hypointense sellar region structure, correlated with its T1W signal intensity, can based on the clinical context lead to an appropriate differential diagnosis.

Key words: Sellar region. Parasellar region. Pituitary gland. MRI. T2W hypointensity.

M RI is the imaging modality of choice to assess the sellar and parasellar regions because of its high spatial and contrast resolution for optimal lesion characterization (1). The most frequent lesions, such as adenoma, cystic lesions or meningioma, usually are T2W hyper/isointense and T1W hypo/isointense. Lesions that are entirely or partly T2W hypointense are less frequent. Detection and careful analysis of this T2W hypointensity may thus be of diagnostic value. The diagnostic value of T1W hyperintensity in and around the sella has been reported (2), however, little attention has been given to the diagnostic impact of T2W hypointensity.

After first briefly reviewing the normal anatomical structures and associated variants that may appear T2W hypointense, the variety of sellar and parasellar lesions that may be T2W hypointense will be illustrated. We will demonstrate how detailed analysis of the location, shape, number and nature of the T2W hypointense signal, usually correlated with the corresponding appearance on T1W images, may provide a confident diagnosis. Tables listing each of the criteria for T2W hypointensity, demonstrating its diagnostic value, will be presented as well.

Causes of T2W hypointensity in the sellar and parasellar regions

Except for special circumstances (neonate, pregnancy, post-partum or after surgery), the signal intensity of the anterior pituitary gland is isointense to cerebral white matter on conventional spin echo (SE) T1W and turbo spin echo (TSE) T2W images (fig. 1) (3). For the purpose of this review, a T2W hypointense structure is defined as a structure with lower T2W signal intensity than normal cerebral white matter.

Normal T2W hypointense structures and variants of normal

Cortical bone

The cortical margins of the sphenoid bone are markedly T1W and T2W hypointense, and difficult to differentiate from air within the sinus (fig. 1). Based on the degree of sphenoid pneumatization, the cortex at the floor of the sella and clinoïd processes may appear as linear T2W hypointense structures outlining the T1W and T2W hyperintense fat-containing bone marrow. The sellar spine is an intrasellar anatomical variant that may be T2W hypointense (fig. 2). The sellar spine is a very rare
anatomical variant, with an incidence between 1/5000 and 1/8000. At the time of development of the posterior pituitary gland, the cranial end of the notochord involutes. The sellar spine would correspond to ossification of a remnant of the most cranial aspect of the notochord secondary to incomplete involution (4). It is of variable size, but when thin, has the characteristic MRI appearance of a T1W and T2W hypointense midline spur of cortical bone that projects anteriorly from the dorsum sellae. When larger, it may contain bone marrow and be T1W and T2W hyperintense (2).

Proton-poor structures

Air within the sphenoid sinus is hypointense on all pulse sequences, thus T1W and T2W hypointense. A magnetic susceptibility at the bone/air interface may cause artifactual enlargement of the air-containing structure; this artifact at the inferior margin of the pituitary gland is T2W hypointense, but T1W hyperintense. The artifact is more prominent at 3T imaging.

The lateral dural margin of the cavernous sinus and diaphragm sellae appear as thin T1W and T2W hypointense linear structures, best depicted on T2W images due to the presence of hyperintense CSF (fig. 1) (5). On the other hand, depiction of the medial margin of the cavernous sinus, composed of a single dural reflection, is inconsistently visualized (5, 6). Visualization may be improved at 3T with reported depiction rate of 72% (7).

Vascular structures

Internal carotid arteries and circle of Willis

The internal carotid arteries and components of the circle of Willis appear on T2W (fig. 1) and T1W as well-defined rounded areas of signal void continuous from one image to the next, outlining the carotid siphon and circle of Willis.

Persistent trigeminal artery

Several anastomoses exist between carotid and basilar artery during fetal development: the trigeminal artery, the otic artery and the hypoglossal artery. These arteries typically disappear after the posterior communicating artery is formed. Persistent trigeminal artery is the most common variant (0.1 to 0.2%) (8). Two types are described: the medial-type or intrasellar persistent trigeminal artery (50-59% of cases) and the lateral-type persistent trigeminal artery (41-49% of cases). On coronal T2W images, this persistent artery appears as a rounded or oval-shaped well-defined area of signal void originating from the cavernous segment of the internal carotid artery extending to the basilar artery, either intrasellar through the posterior wall of the sella (fig. 3), or parasellar in location.

Paramedian or “kissing” carotid arteries

This is characterized by medial positioning of the cavernous internal carotid arteries at the level of the sphenoid sinus or sella. These dolichoectatic arteries are sometimes observed in elderly hypertensive patients or more frequently in patients with acromegaly (9). On sagittal images, this rounded well-defined hypointense structure could be misdiagnosed as a pituitary microadenoma. An accurate diagnosis should easily be achieved by correlating with coronal and axial images by confirming the symmetry of and continuity with the cavernous internal carotid arteries. Presence of this variant should be recognized and reported since it may lead to serious complications at the time of trans-sphenoidal surgery (10).
Cavernous sinus veins
The venous structures of the cavernous sinuses are arranged in plexus. Flow is slow with corresponding fluid-like T2W hyperintensity and T1W hypointensity. Small veins of the cavernous sinus also show slow flow, but on occasion, sometimes physiological and sometimes pathological as will be described later, these may become large enough and/or show flow of sufficient velocity to appear as areas of signal void with low T2W and T1W signal, similar to arteries. Rarely, this may even occur at the level of the inferior intercavernous sinus (fig. 4).

Partial volume
Based on the plane of section, partial volume effects with normally T2W hypointense structures are not unusual in the sellar region (cortical bone of the clinoid processes and dorsum sellae, air within the sphenoid sinus, flow void of the carotid siphon). Correlation of findings on multiple section planes usually resolves this potential pitfall.

CSF flow artifacts
On spin echo T2W images, CSF flow artifacts may be observed in the opticochiasmatic cistern resulting in the presence of a pseudo mass or pseudo enlargement of the pituitary stalk, without corresponding abnormality on T1W images. Such artifacts are more frequent and pronounced at 3T imaging (fig. 1). Because they occur frequently, knowledge of their imaging features is important.

T2W hypointense lesions or with T2W hypointense component
Lesions with high protein content
Rathke’s cleft cyst (RCC)
These are frequent (13-22% of normal pituitary glands on autopsy series (11)) benign cystic lesions of the sellar region, usually small and asymptomatic. RCC are classically considered as originating from epithelial remnants of Rathke’s pouch. Persistence during embryogenesis of a residual lumen within the pouch lined by a single layer of mucous producing cuboidal respiratory type epithelium explains the formation of a cyst due to accumulation of secretions. RCC are midline in position, between the anterior and posterior pituitary glands (hence the value of axial images for accurate detection and localization) (fig. 5), but they may also be suprasellar in location, ventral to the stalk (developing from the pars tuberalis at the anterior wall of Rathke’s pouch located above the diaphragm sellae) (fig. 6) (12). RCC have sharp regular margins and show no enhancement after gadolinium. Mean size is less than 10 mm, but size ranges from a few mm to 50 mm. The signal intensity of RCC on MRI is variable and depends on their biochemical content, especially their protein content (13). All combinations of T1W and T2W signal intensity are possible based on the degree of hydration and protein concentration. RCC with serous and fluid content are T2W hyperintense and T1W hypointense whereas RCC with thick mucoid content are T2W hypointense and T1W hyperintense. Signal is homogeneous, without fluid-fluid level. RCC may contain small intracystic nodules corresponding to inspissated protein and cholesterol rich mucus. These are more intense on T1W images and more hypointense on T2W images, surrounded by the more hyperintense fluid component of the cyst (fig. 7). Identification of these small rounded nodules is of diagnostic significance because these T2W hypointense nodules are nearly pathognomonic for RCC (14).

Craniopharyngioma
Craniopharyngiomas are benign tumors that are supra- and intrasellar (60%), suprasellar (30%) or intrasellar (10%) in location (15). They are composed of multiple layers of squamous epithelium and develop from Rathke’s pouch. They occur more frequently in children (peak incidence between 5 and 10 years) with a second smaller peak between 40-50 years. They...
are generally symptomatic due to their size (> 20 mm) and presence of adhesions to surrounding structures (16). These tumors may have three different components: cystic component, solid component and calcifications (70% of cases, and the imaging features of calcifications will be reviewed later). The signal intensity of the cystic component may vary based on its content, similar to RCC. Typically it is heterogeneous and T2W hyperintense. The cystic component usually contains only a moderate concentration of proteins with signal intensity close to CSF. With higher protein concentration, the cystic component may appear T1W hyperintense and T2W hypointense. This is generally less T2W hypointense than RCC, and it is adjacent to a solid enhancing component that may itself contain punctuate T2W hypointense foci due to calcifications (fig. 8). A pseudo fluid level (non-dependent) is sometimes observed either due to leveling of secretions or fortuitous appearance at the interface between solid and cystic components (2).

**Mucocele**

Sphenoid mucoceles result from chronic obstruction of the sinus ostium with subsequent accumulation and desiccation of protein containing secretions. A prior history of fracture, surgery, osteoma, polyp

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**Fig. 5:** *Incidental detection of a large inferior intercavernous sinus with upward convexity of the pituitary tissue.*

The inferior intercavernous sinus, with flow void on T1W and T2W images (arrowheads) extends between the cavernous sinuses, under the pituitary tissue. This venous structure, parallel to the floor of the sella shows enhancement after gadolinium injection. The enlarged venous structure could in part be the cause of elevation and upward convexity of the pituitary tissue (arrow).

- **a** Coronal T2W image.
- **b** Sagittal T1W image.
- **c** Coronal T1W image after gadolinium injection.

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**Fig. 6:** *Incidental suprasellar RCC in a patient with amenorrhea.*

This typical egg-shaped non-enhancing (not shown) mucoid RCC is homogeneously T2W hypointense and T1W hyperintense (arrows). It is midline in location, cranial to the anterior pituitary gland and ventral to the infundibulum.

- **a** Coronal T2W image.
- **b** Sagittal T1W image.

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**Fig. 7:** *RCC with intracystic nodules.*

Coronal T2W image showing 2 nodular T2W hypointense (arrowheads) within the T2W hyperintense cyst. This imaging feature is considered nearly pathognomonic for RCC.
or chronic sinusitis is frequent. Mucocles appear as well defined intra-sinus masses with homogeneous signal, sometimes T2W hypointense and T1W hyperintense (17). When large, mucocles may enlarge the sinus and cause bone erosions and become symptomatic.

Aspergillosis – Tuberculosis

Sphenoid sinus or intrasellar aspergillosis and pituitary tuberculoma are very rare.

Aspergillosis may present as a sinus mycetoma, or as a more invasive lesion in immunodeficient patients, often from sinus origin, with bone destruction and widening of the sella. Tuberculoma is generally better-defined, intrasellar, with mass effect. Both may be hyperdense on CT. Their signal characteristics on MRI, mostly heterogeneous with large T2W hypointense components and iso- to hyperintense T1W signal may suggest the diagnosis (18, 19). The T1 and T2 relaxation times of mycetoma are very short because the contain proteins, calcium salts and heavy metals (iron, manganese, copper, lead). The T2W hypointensity is mainly due to dehydration, similar to desiccated mucocles. The presence of paramagnetic substances further decreases the relaxation times. For invasive disease, MRI shows a heterogeneous lesion with zones of very low T2W signal corresponding to fungal elements (20). For tuberculosis, and based on the stage of the disease, T2W hypointense areas may be due to tuberculomas (composed of macrophages containing free radicals and fibrosis) or caseous necrosis (composed to proteins, free radicals, and cellular debris). At the mature stage, the fibrous capsule of the tuberculoma also appears T2W hypointense (21). After gadolinium injection, tuberculomas and aggressive aspergillosis only show peripheral enhancement because of necrosis in the heterogeneous center. There also is local meningeal enhancement due to the local inflammatory reaction.

Adenoma

Adenomas are benign tumors and are the most frequent pituitary pathology. Microadenomas (< 10 mm) are small rounded or oval-shaped tumors of the anterior pituitary tissue, frequently located off midline, but they sometimes are flattened or triangular shaped. The T2W signal characteristics are more variable on T2W images than on T1W images, in part due to the type of secretion. While most microprolactinomas (80%) are T2W hyperintense (may involve only part of the tumor), two thirds of GH secreting adenomas are T2W iso- to hypointense (fig. 9) (22). The reason for this T2W hypointense signal in pituitary adenoma is unknown. It could relate to the presence of protein-rich intracytoplasmic granules. For similar tumor volumes, a T2W hypointense prolactinoma would secrete more than a T2W hyperintense prolactinoma (22); non-secreting adenomas rarely are T2W hypointense; and GH secreting adenomas, known for their high density of intracytoplasmic granules, are frequently T2W hypointense (23). These imaging features only offer partial correlation with histological subtypes and do not explain the typical T2W hyperintensity of ACTH secreting adenomas which are generally very secreting (24). The T2W
Hemorrhage and clot

Detection of blood products in a sellar region lesion is important since these are exceptionally rare in lesions other than pituitary adenomas and thrombosed aneurysms.

Hemorrhagic adenoma, apoplexy, and Sheehan’s syndrome

Hemorrhage within a pituitary adenoma is not rare. Recent data on gradient-echo T2*W imaging with histological correlation suggest that about 50% of adenomas show stigmata from hemorrhage (26). Intra-tumoral hemorrhage is most frequently asymptomatic. The term apoplexy is used to describe symptomatic hemorrhage. It is an acute clinical syndrome characterized by headache, ophthalmoplegia and visual symptoms, secondary to acute tumor enlargement from hemorrhage.

The signal intensity of the hematoma varies as a function of its age. An additional diagnostic imaging feature would be the change of signal and size over time due to partial resorption of the hematoma.

At the acute phase, the hemorrhagic adenoma is usually composed of intra-cellular methemoglobin with a little deoxyhemoglobin and shows heterogeneous T2W hypointensity and T1W iso/hyperintensity.

At the subacute phase, the hematoma may become organized and layer within the adenoma. The hemorrhagic adenoma appears as a lesion with well defined cystic component with dependent fluid-fluid level (well depicted on sagittal and axial images). Accurate recognition of this hemorrhagic fluid-fluid level is important because it almost formally indicates the presence of an underlying adenoma. On T2W images, a dependent hypointense layer composed of brown hemorrhagic fluid (with deoxyhemoglobin and intra-cellular methemoglobin) and a supernatant hyperintense layer composed of xanthochromic fluid (with free extracellular methemoglobin) (fig. 10). The contrast is better appreciated on T2W images, and the lesion appears hyperintense and heterogeneous on T1W images. The hematoma and fluid-fluid level are trapped within the adenoma and may persist for a long time, longer than the theoretical length of the subacute phase. A fluid-fluid level is not always present, and would be more likely in the presence of hemorrhagic necrosis or recurrent hemorrhage (27). This fluid-fluid level should not be confused with the pseudo fluid level that may sometimes be observed as in the protein-rich cystic component of craniopharyngiomas.

At the chronic phase, the hematoma may appear liquefied with signal characteristics close to water. A T2W hypointense halo at the periphery of the cyst may be present as a stigmata of remote hemorrhage with peripheral hemosiderin staining. This finding is rare in clinical practice, probably due to the absence of blood-brain barrier within the pituitary tissue. The use of gradient-echo T2*W imaging could increase the detection of remote hemorrhage within adenomas (26).

At the acute phase of pituitary apoplexy, dural enhancement in the sellar region may be present along with sphenoid sinus mucosal thickening. These would be the result of venous congestion in the sellar region. Similar findings have also been described in patients with Sheehan’s syndrome. Sheehan’s syndrome is characterized by anterior pituitary necrosis from hemorrhage or hypotension during the peripartum period. Necrosis often is followed by hemorrhage, and MRI shows an enlarged heterogeneous pituitary gland, with iso- to hyperintense T1W and hypointense T2W signal, without gland enhancement but with loco-regional reactive inflammatory changes at the acute phase (fig. 11) (28). Over time, the necrotic pituitary gland decreases in size with empty sella appearance at 3 months (29).

Thrombosed aneurysm

Aneurysms of the intracavernous ICA and circle of Willis will be discussed in more details in the section on flow voids. However, these may at times be partially thrombosed, especially larger aneurysms. The possibility of aneurysm should always be raised in the presence of a rounded, well-defined, T2W hypointense lesion in the sellar region. Mural thrombus is heterogeneous and T2W hypointense and T1W hyperintense. Sometimes, mural thrombus may have a more organized concentric appearance corresponding to thrombus layers of different ages (fig. 12) (30).

Bone and calcifications

Fibrous dysplasia

Fibrous dysplasia is a benign non hereditary congenital disorder of bone where...
normal bone is replaced by pseudo fibrous tissue with immature osteogenesis. The skull base is affected in 50% of cases with cranial involvement and it is one of the most frequent benign disorder of the sphenoid bone (31). It is generally diagnosed in teenagers or young adults. It can be monostotic or polyostotic, unilateral or bilateral. Irrespective of the imaging modality, it always presents as a slightly expansile lesion, without cortical disruption or periosteal reaction. The MRI signal characteristics depend on the composition of the lesion. Sclerotic type lesions are T1W and T2W hypointense, frequently heterogeneous, with ground-glass appearance on CT. Lesion heterogeneity is due to the presence of more cellular regions considered active. Cystic type lesions are T2W hyperintense (32). On MRI, the diagnostic differential with mucoceles is based on the more heterogeneous and more marked T2W hypointensity as well as heterogeneous enhancement of the fibrocellular components of fibrous dysplasia.

### Chordoma and chondrosarcoma

Chordoma is a benign but locally aggressive tumor of the skull base. Midline, arising from notochordal remnants and near the sphenoid bone destruction by the tumor, are mostly small, speckled and irregular (fig. 13). It may be difficult to distinguish calcifications from other causes.

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**Fig. 11:** Sheehan's syndrome in a 34 year old patient with headache in the immediate postpartum period.

The pituitary gland is enlarged, heterogeneous with T2W hypointense halo (arrows). The appearance after gadolinium injection with only peripheral enhancement is very suggestive of the diagnosis in this clinical setting (black arrowheads). There is minor reactive mucosal thickening in the sphenoid sinus next to the sella (white arrowheads).

*Coronal T2W image.*

*Coronal T1W image after gadolinium injection.*

**Fig. 12:** Thrombosed suprasellar aneurysm in a 47 year old patient presenting with reduced visual acuity for 48 hours.

Coronal T2W image. The mural thrombus is heterogeneous with concentric T2W hypointense areas suggesting the diagnosis.

**Fig. 13:** Chordoma in a 62 year old patient with headache and bilateral III and IV cranial nerve palsy.

Heterogeneous lytic mass of the clivus with superior and posterior extension. The large mass contains speckled T2W hypointense and T1W hyperintense calcifications.

*Coronal T2W image.*

*Sagittal T1W image without gadolinium injection.*
Calcifications are present in 70 to 90% of craniopharyngioma of the diaphragm sellae. Calcifications are rare and occur from the inferior surface of purely intrasellar meningiomas. They are cavernous sinus and planum sphenoidale. Calcifications are invasive extra-dural lesions. Diffuse curvilinear, sometimes confluent, chordroid matrix calcifications are present in 50% of cases. On MRI, these calcifications are scattered within a T2W hyperintense chordroid matrix and appear T2W hypointense; their T1W signal varies with the degree of mineralization. Some calcifications may also correspond to bone sequestra. The administration of gadolinium may also be helpful by demonstrating heterogeneous patchy enhancement.

Meningioma
Meningiomas are frequent tumors and 20% occur in the sellar region. They can involve the tuberculum sellae, clinoid processes, greater or lesser sphenoid wing, cavernous sinus and planum sphenoidale. Purely intrasellar meningiomas are very rare and occur from the inferior surface of the diaphragm sellae. Calcifications are present in about 25% of cases. They may be entirely calcified and be homogeneously T2W hypointense. The hemispheric or rounded shape, the smooth and regular margins and the location are suggestive of the diagnosis. Hyperostosis along their dural margin is present in 34% of sellar region meningiomas. The hyperostosis is more easily depicted when in contains T1W and T2W hyperintense marrow. Pneumosinus dilatans of the sphenoid sinus may occur with planum sphenoidale meningiomas. Dural thickening next to the meningioma may be prominent and appear T1W and T2W hypointense. Exceptionally, hemorrhagic transformation of a meningioma may occur with signal characteristics that vary based on the stage of blood degradation products, and possibility of T2W hypointensity.

Craniopharyngioma
Calcifications are present in 70 to 90% of craniopharyngiomas. They are usually peripheral in location, and generally within the solid component of the tumor (fig. 8), curvilinear or micro-nodular in shape, and T1W and T2W hypointense (36). The presence of calcifications within a cystic mass of the sellar region is a strong argument in favor of a diagnosis of craniopharyngioma. Cyst wall calcifications are thin and curvilinear (eggshell), and are difficult to detect on MRI; CT remains the imaging modality of choice to demonstrate their presence.

Adenoma
Calcifications are rarely present in pituitary adenomas, with estimated incidence of 1.7% on imaging series and 6.75% on autopsy series (26). MRI is poorly sensitive and can only detect macro-calcifications. Procliniomas calcify most frequently (37).

Lesions with vascular flow voids
Aneurysm
Aneurysm of the intracavernous ICA is the most frequent cavernous sinus lesion. It also is the most frequent site for giant aneurysms (38). These lesions must be detected. As previously stated, MRI is helpful to identify mural thrombus, but additional findings may also be identified. The aneurysm is usually rounded and well-defined with intraluminal signal void on all sequences. The presence of turbulence may cause heterogeneous signal. Therefore, the possibility of aneurysm should always be raised in the presence of a well-defined rounded lesion with marked T2W hypointensity in the sellar region (fig. 15). It should also be determined if the lesion is contiguous with an artery of the circle of Willis, also with signal void. Another imaging feature of aneurysm is the presence of a pulsation artifact along the phase encoding direction, best depicted on T1W images (2). Diagnosis can be confirmed on MRA. This will also further characterize the exact location of the aneurysm and potentially detect additional aneurysms.

Hypervascular tumors: meningioma, juvenile angiofibroma, metastases
Meningiomas are hypervascular tumors and abnormal vessels are demonstrated in 65% of sellar region meningiomas on angiogram (39). In addition to T2W hypointense calcifications discussed previously, small serpentine intratumoral or peritumoral vascular structures with flow void may be visible on all sequences, best depicted on T2W sequences. These should be differentiated from the cavernous ICA that may show reduced caliber of its flow void secondary to cavernous sinus invasion by a meningioma. The cali-
ber reduction or carotid compression may suggest a diagnosis of meningioma since it is generally not observed with macroadenameas (40).

Juvenile angiofibroma is a benign fibrovascular tumor that occurs almost exclusively in adolescent males. It originates in the region of the sphenopalatine foramen at the posterior portion of the nasal cavity and is locally invasive with frequent extension to the pterygopalatine fossa, skull base and even the cavernous sinus. It is characteristically hypervascular and MRI shows a T2W hyperintense destructive lesion of the posterior nasal cavity with serpentine intratumoral vascular flow voids (41).

Malignant tumors most frequently metastasizing to the pituitary gland and sellar region are breast, thyroid and lung cancers (42). Metastases are typically T2W and T1W isointense. Enhancement is variable, but hypervascular metastases from renal cancer usually show intense enhancement and intratumoral vascular flow voids may be present (43).

Carotid-cavernous fistula (CCF)

Direct CCF corresponds to an arteriovenous shunt between the cavernous ICA and the cavernous sinus venous plexus. It is clinically suspected in the presence of pulsatile exophthalmos, chemosis and ptosis. CCF is typically post-traumatic or secondary to the rupture of an aneurysm of the cavernous ICA. On MRI, the cavernous sinuses are asymmetrical in size, with enlargement of the cavernous sinus on the affected side, containing multiple serpentine vascular flow voids corresponding to dilated veins with fast flow (fig. 16) (44). This CCF of the cavernous sinus interferes with pituitary venous drainage resulting in upward convexity of the pituitary tissue. MRI is not the imaging modality of choice for diagnosis of CCF since it may be normal in cases of indirect or slow flow CCF. Angiography is performed for confirmation in suspicious cases, for complete characterization and/or treatment.

Distension of intracavernous veins in association with intracranial hypotension

Distension of intracavernous veins in patients with intracranial hypotension is explained by the relationship between the volumes of the different intracranial compartments. The Monroe-Kelly hypothesis states that the cranial compartment is incompressible, and the volume inside the cranium is a fixed volume: The volume of brain tissue + blood + CSF = constant. Therefore, with intracranial hypotension due to CSF loss, there is compensatory distension of intracranial vessels. The negative hydrostatic pressure also may increase the transcapillary pressure gradient with increase in the volume of brain tissue, but this phenomenon is limited by the blood-brain barrier.

On MRI, intracavernous veins may appear distended, with rapid flow, and vascular flow voids (fig. 17). Distension of the inferior intercavernous sinus, inferior to the pituitary gland and joining both cavernous sinuses, associated with dural thickening at the floor of the sella, may elevate the pituitary gland with upward convexity. This sinus, usually with slow flow and T2W hypointensity, may become enlarged with vascular flow void on T1W and T2W images.

Diffuse meningeal enhancement after Gadolinium administration also indicates the presence of diffuse compensatory dural venous distension (45). Congestion of the venous drainage of the pituitary would explain the enlarged size and upward convexity of the gland under these circumstances (46).
Fat-containing lesion:
Dermoid cyst

Dermoid cyst is a benign congenital epithelial inclusion cyst, of ectodermic origin, that occurs at the time of neural tube closure (47). It is extra-axial in location, and generally located near midline. It is frequently suprasellar in location, but may also be parasellar in location with middle cranial fossa or cerebellopontine angle extension. It is well defined and of variable content: it may be purely cystic, contain desquamated cells, fat in the form of sebum or hair. It the lesion is a teratoma, calcifications may also be present. Presence of a fat-fluid level, characteristic of the diagnosis, creates an interface with chemical shift artifact with T1W and T2W hypointense band of signal along the frequency encoding direction (fig. 18).

Miscellaneous

Hemochromatosis

Hemochromatosis, primary or secondary, leads to the accumulation of iron (in the forms of ferritin and hemosiderin) in the reticuloendothelial system (liver, spleen, bone marrow) and other organs such as the heart, endocrine glands including the anterior pituitary, gonads and skin. On MRI, the anterior pituitary gland is of normal morphology, but is small and diffusely markedly T2W hypointense (fig. 19). It may also show decreased T1W signal in cases of severe iron overload, prior to and following administration of Gadolinium (48). The physiologic T1W hyperintensity of the posterior pituitary gland is preserved. The signal abnormalities are due to iron accumulation in the anterior pituitary tissue. In the presence of diffuse signal abnormality involving the anterior pituitary gland without contour modification, a focal process is unlikely (49).

Melanin containing lesions

Primary or secondary melanin containing intrasellar lesions are very rare. These lesions characteristically appear as soft tissue masses invading the sella, with low T2W and heterogeneous high T1W signal. The paramagnetic effect is due to the presence of multiple free radicals with several unpaired electrons, chelated metallic ions melanin and/or microbleeds (50). They show heterogeneous enhance-ment after contrast administration. This combination of peculiar signal intensities on T1W and T2W images (enhanced on gradient-echo T2*W images) is more frequent with metastatic melanoma compared to other metastatic tumors and is very suggestive of the diagnosis. The imaging features are not specific since metastases from colic cancer may also be T2W hypointense (51). Also, while the presence of spontaneous T1W hyperintensity is suggestive of melanin, it may also be due to hemorrhage. Because melanin containing lesions of the sella are so rare, the diagnosis initially suggested usually is that of a hemorrhagic adenoma. Differentiating points to consider are that blood products are generally heterogeneous on T2W...
Fig. 19: **Pituitary hemochromatosis in a 32 year old patient with secondary amenorrhea.**
The anterior pituitary gland is small with preserved shape and contour. It is markedly hypointense on T2W images and hypointense on T1W images as well (white arrows). The physiologic T1W hyperintensity of the posterior pituitary gland is preserved (black arrow). The skull is thickened with marked T1W hypointensity of the marrow (arrowheads) suggesting an underlying marrow disorder (thalassemia major in this case). The reduced marrow signal is secondary to iron overload (asterisk).

a) Coronal T2W image.

b) Sagittal T1W image.

**Table I**

Diagnostic approach of a T2W hypointense intrasellar lesion.

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<td>Tubular</td>
<td>Signal void</td>
<td>3D TOF</td>
<td>Intrasellar persistent trigeminal artery</td>
</tr>
<tr>
<td>Entire anterior pituitary</td>
<td>Preserved gland margins</td>
<td>Homogeneous</td>
<td>T2*W: marked loss of signal of the anterior pituitary</td>
<td>Hemochromatosis</td>
</tr>
</tbody>
</table>

*RCC: Rathke’s cleft cyst; **GH: Growth Hormone.

images and that the hemorrhagic component does not enhance after gadolinium—whereas a metastasis enhances more than an adenoma.

**Diagnostic approach**

After this review of potential causes of T2W hypointense lesions in the sellar and parasellar region, a diagnostic approach is proposed in table format. The approach combines the location of the T2W hypointense signal (intrasellar (table I), suprasellar (table II) or parasellar (table III)), with shape and imaging characteristics, and provides significant imaging findings on complementary sequences to reach the diagnosis.

All authors contributed significantly to this manuscript, with no conflict of interest to disclose.
Table II
Diagnostic approach of a T2W hypointense suprasellar lesion.

<table>
<thead>
<tr>
<th>Location</th>
<th>Shape</th>
<th>Imaging characteristics</th>
<th>Additional imaging features</th>
<th>Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midline, anterior to the infundibulum</td>
<td>Rounded</td>
<td>Homogeneous</td>
<td>Lack of enhancement</td>
<td>RCC*</td>
</tr>
<tr>
<td>Midline, possible intrasellar extension</td>
<td>Variable</td>
<td>Heterogeneous, within a mass</td>
<td>Enhancing mass</td>
<td>Cranioopharyngioma</td>
</tr>
<tr>
<td>Median or paramedian, of sellar origin</td>
<td>Rounded</td>
<td>Heterogeneous, or fluid-fluid level</td>
<td>T1W: hyperintense (level)</td>
<td>Hemorrhagic adenoma</td>
</tr>
<tr>
<td>Midline, above the diaphragm or lateral, abutting the circle of Willis</td>
<td>Rounded</td>
<td>Homogeneous signal void</td>
<td>3D TOF</td>
<td>Aneurysm</td>
</tr>
<tr>
<td>Lateral, abutting the circle of Willis</td>
<td>Rounded or curved</td>
<td>Heterogeneous, concentric layers</td>
<td>3D TOF</td>
<td>Thrombosed aneurysm</td>
</tr>
<tr>
<td>Next to the diaphragm sellae, planum sphenoidale or dorsum sellae</td>
<td>Variable</td>
<td>Punctate or multiple signal voids within a hemispheric shaped mass</td>
<td>Diffuse enhancement with dural tail</td>
<td>Meningioma</td>
</tr>
</tbody>
</table>

* RCC: Rathke’s cleft cyst

Table III
Diagnostic approach of a T2W hypointense parasellar lesion

<table>
<thead>
<tr>
<th>Location</th>
<th>Shape</th>
<th>Imaging characteristics</th>
<th>Additional imaging features</th>
<th>Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intracavernous, abutting the carotid siphon</td>
<td>Rounded</td>
<td>Single, signal void</td>
<td>3D TOF</td>
<td>Aneurysm</td>
</tr>
<tr>
<td>Intracavernous, abutting the carotid siphon</td>
<td>Tubular</td>
<td>Elongated, signal void</td>
<td>3D TOF</td>
<td>Parasellar persistent trigeminal artery</td>
</tr>
<tr>
<td>Intracavernous, abutting the carotid siphon</td>
<td>Rounded or curved</td>
<td>Heterogeneous, concentric layers</td>
<td>3D TOF</td>
<td>Thrombosed aneurysm</td>
</tr>
<tr>
<td>Intracavernous, unilateral</td>
<td>Serpentine</td>
<td>Multiple, signal void</td>
<td>Coronal T1W: signal voids, Enlarged superior orbital vein</td>
<td>Carotid-cavernous fistula</td>
</tr>
<tr>
<td>Lateral margin of the cavernous sinus</td>
<td>Rounded</td>
<td>Single, signal void</td>
<td>Dural enhancement</td>
<td>Intracranial hypotension</td>
</tr>
<tr>
<td>Within a paramedian mass originating from the sphenopetrosal synchondrosis</td>
<td>Speckled or curvilinear</td>
<td>Multiple</td>
<td>T2W hyperintense chondroid matrix tumor</td>
<td>Chondrosarcoma</td>
</tr>
</tbody>
</table>

References


