The parasellar region: Normal Anatomic and Pathologic Appearances

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Learning objectives

1/To review the complex anatomic, relationship between structures in the parasellar regions.

2/To understand the main patterns and radiological characterization, mainly by MR, of the lesion that alter the structures of parasellar region.

Background

The parasellar region is an anatomically complex area that represents a critical junction for important contiguous structures. A wide range of neoplastic, inflammatory, infectious, developmental and vascular diseases may embroil vital structures in this region.

The most frequently involved are the brain parenchyma, meninges, the optic pathways and cranial oculomotor nerves (III, IV, VI) and the V1 and V2 branches of the trigeminal nerve, major blood vessels, hypothalamo-pituitary system, tuber cinereum, and bone compartments. Presently MR is the method of choice for diagnosis and characterization of this disease[1].

Findings and procedure details

The cavernous sinus (CS) contains vital neurovascular structures that may be affected by vascular, neoplastic, infective, and infiltrative lesions arising in the CS proper or via extension from adjacent intra- and extracranial regions. Patients with CS syndrome usually present with paresis of 1 or more cranial nerves (III–VI), which may be associated with painful ophthalmoplegia. The clinician needs to know the type of CS lesion, its relationship to crucial neurovascular structures, and its extension into the surrounding tissues.
MR is enormously valuable, in the study of parasellar region, CT or nuclear studies can also provide relevant information.

**Normal Anatomy**

The parasellar region is considered a cranial area around the sella turcica. The anatomical definition of the parasellar region, includes all the structures that border the sella turcica.

The parasellar region includes, laterally, the dural walls of the cavernous sinus.

The relationships of the cavernous sinus are: inferiorly with the basisphenoid and sphenoid sinus, superiorly and above the diaphragm sellae, with the suprasellar subarachnoid spaces containing the optic nerves and chiasm, the polygon of Willis, hypothalamus, tuber cinereum and anterior third ventricle. The gasserian ganglion region, though it is not anatomically related to the sellar region, can be considered as a parasellar structure. Nasopharynx and the medial aspects of the temporal lobes are closely related to the parasellar region, and pathological processes in this region can be disclosed by symptoms related to intrinsic parasellar structures[3].

![Fig. 1: A Coronal schematic drawing of the parasellar region with reference to the main structures found in this area. References: farhat hached - Sousse/TN](image)

References: farhat hached - Sousse/TN
Pathologic Conditions

Pathological conditions that affect the parasellar region can arise from the pituitary gland, meninges, vessels, cranial nerves and nasopharynx. Pathological processes are represented by primary and secondary neoplasms, inflammatory/ granulomatous and vascular lesions[3].

Fig. 2
References: farhat hached - Sousse/TN

Imaging Protocol

**CT Scan**: CT better delineates primary or secondary bony changes and intraliesional or perilesional calcifications and still represents a quite good approach for the detection and characterization of lesions. CT Angiography can be used to evaluate the cavernous part of the internal carotid arteries.
MRI: provides detailed information about the contents of the para-sellar regions. Multiplanar views are possible and the different MR sequences help to reach accurate diagnosis in case of diagnostic dilemma. Post-gadolinium enhanced MR sequences obtained with fat suppression are helpful to obtain contrast between pathology and surrounding structures.

Current MRI protocols for the correct imaging of the sellar and parasellar regions are based on sagittal and coronal T1-weighted images (T1WIs) without and with contrast enhancement. Other pulse sequences generating T2-weighted, FLAIR and FE images are complementary for characterisation of some specific processes. Magnetic resonance (MR) spectroscopy is rarely used in this region.

Digital subtraction angiography is helpful for vascular lesions and tumoral vascularisation for therapeutical Planning [3].

I. Vascular Lesions:

Carotid Cavernous Fistula Fig. 3 on page 9 Fig. 4 on page 10 Carotid cavernous fistula (CCF) is an abnormal connection between the carotid arterial system and the CS, which may be classified into 4 types. Direct CCF (type A) is a high-flow communication between the ICA and the CS that occurs after trauma or secondary to a ruptured aneurysm of the cavernous ICA. These lesions present acutely with pulsating exophthalmos, chemosis, and CS syndrome. Dural CCFs (types B_D) are low-flow fistulas occurring between meningeal branches of the carotid artery and CS, which tend to have milder symptoms than direct fistulas. MR imaging findings of CCFs include a dilated CS with multiple signal-intensity void structures that are associated with proptosis and an enlarged superior ophthalmic vein. On gradient-echo images, these flow voids shows high signal intensity. The presence of flow related enhancement in the CS on MR angiography suggests the diagnosis in the right clinical setting [4].

Normal 0 21 false false false FR X-NONE AR-SA

Anevrysms: Cavernous carotid anevrysms may produce CS syndrome by virtue of mass effect, inflammation, or rupture into the CS, with subsequent development of a CCF. Most are idiopathic, but they may occasionally be traumatic or mycotic in nature. A patent aneurysm shows signal-intensity void on spin-echo MR imaging sequences[5].

Thrombosis Fig. 5 on page 11 CS thrombosis may be secondary to infection of the sinonasal cavities, orbits, and/or the middle third of the face. MR imaging signs of CS thrombosis include changes in signal intensity and/or in the size and contour of the CS.
Indirect signs that help to suggest the diagnosis are dilation of the superior ophthalmic veins, exophthalmos, and increased dural enhancement along the lateral border of CS and ipsilateral tentorium[6].

II. Neoplastic Lesions

**Adenomas Fig. 6 on page 12:** Large adenomas are the most frequent tumours involving the cavernous sinus [7]. The extent of the adenomas invading or infiltrating the cavernous sinus is an important feature, to be diagnosed or excluded by imaging studies in order to define not only the way to approach surgically, but also to show whether the tumour can be completely or partially removed [3].

**Meningiomas Fig. 7 on page 13:** represent, after adenomas, the most frequent intracranial tumours, a great majority of them localized in the surroundings of the sella turcica, arising from the tuberculum sellae, jugum sphenoidal, floor of the frontal fossa, greater and lesser wing of the sphenoid or in the dural wall of the cavernous sinus. Meningiomas are generally isointense with cortical grey matter on T1- and T2-weighted images and enhances intensely. A dural tail frequently can be seen extending away from the edge of the tumor and often into the ipsilateral tentorium[8].

**Cavernous Hemangioma:** CS hemangioma is more commonly seen during the fifth decade of life in female patients. This tumor is formed by sinusoidal spaces with endothelial lining that contain slow-flowing or stagnant blood. A preoperative diagnosis is important because of its propensity to bleed at the time of resection. These tumors are nearly hyperintense on T1- and T2-weighted images and are attached to the outer wall of the CS, and their diagnosis may be suggested when they show progressive "filling in" after contrast administration[9].

**Schwannomas:** infiltrating or invading the cavernous sinus come from the trigeminal nerve and affect its cisternal portion, the ganglion or one of its terminal branches. They can be found isolated or in the context of NF-1. Schwannomas are isointense-to-hypointense masses on T1 images, mostly T2 hyperintense, and show contrast enhancement. They may have an appearance very similar to meningiomas[10].

**Chordoma and chondrosarcoma:** are rare neoplasms developing within the clivus [11] and affecting the parasellar region. Although pathologically distinct, they have similar imaging features. Chordomas are slow-growing neoplasms developed from notocord
remnants, while chondrosarcomas are malignant bone tumours whose cells produce hyaline cartilage. Both lesions have prolonged T1 and T2 relaxation times and enhance intensely by contrast media. CT is very useful for demonstrating the structure and bone destruction as well as the pattern of intratumoral calcifications.

Differential diagnosis has to be made with infiltrative adenomas as well as metastases from lung, breast or prostatic carcinomas, which affect the sphenoid sinus and clivus[3].

**Metastases :** Metastases to the CS can be hematogenous or perineural in nature. Distant tumors with hematogenous spread to the CS are generally renal, gastric, thyroid, lung, and breast cancers. MR imaging shows CS enlargement, outward bowing of its lateral wall, and replacement of the Meckel cave with soft tissue that homogeneously enhances. Perineural tumor spread is commonly seen along branches of cranial nerve V. Perineural spread is most commonly seen with adenoid cystic or squamous cell carcinoma but may also be seen with lymphoma, melanoma, basal cell carcinoma, rhabdomyosarcoma, neurogenic tumors, and juvenile angiofibroma. MR imaging features of perineural tumor spread include nerve enlargement and enhancement and foraminal enlargement and destruction [12].

**Lymphoma and Leukemia** Fig. 8 on page 14

As with metastases, lymphoma and leukemia reach the CS by direct extension from a primary lesion or from hematogenous spread. MR imaging may show infiltrative lesions of the skull base invading the CS without arterial narrowing[13]

**Nasopharyngeal Carcinoma** Nasopharyngeal carcinoma is the most common primary malignant extracranial neoplasm to invade the CS. Intracranial extension may occur directly via the skull base erosion or by perineural spread along branches of the trigeminal nerve. Tumor can extend through the petro-occipital synchondrosis and foramen lacerum into the inferior CS or via the carotid canal to gain access to the CS without destroying bone.

Once the CS is invaded, bulky masses are present in the nasopharynx. The tumor is generally hypointense to isointense (relative to muscles) on T1-weighted images and T2 hypointense and shows moderate-to-intense contrast enhancement[14].

**Other tumors:** Case reports described a lot of other tumors arising in the parasellar region: hemangioblastomas [15], hemangiopericytomas[16], fibrosarcomas[17], rhabdomyosarcomas of the sphenoid sinus[18], solitary fibrous tumors [19]...
III. Inflammatory, Infectious, and Granulomatous Lesions:

**Tolosa-Hunt Syndrome:** Tolosa-Hunt syndrome is a term applied to a retro-orbital pseudotumor extending to the CS. Its clinical triad includes unilateral ophthalmoplegia, cranial nerve palsies, and a dramatic response to systemic corticosteroids. The process is usually unilateral but may be bilateral. MRI shows a mild asymmetry of the affected sinus, together with an asymmetric hypersignal on proton density (PD) images and some degree of narrowing of the intracavernous carotid artery[20].

**Tuberculous Pachymeningitis:** Tuberculosis is, in some parts of the world, a relatively common cause of pachymeningitis that produces diffuse or focal extra-axial masses along the surfaces of the CS[21].

**Sarcoidosis Fig. 10 on page 16:** Dural involvement can occur with sarcoidosis and extend to the CS. The presence of multiple dural-based lesions, pachymeningitis or leptomeningeal enhancement, thickened cranial nerves, thickened hypothalamus, multiple scattered brain lesions, and periventricular multifocal white matter lesions should raise the possibility of the diagnosis of sarcoidosis[21].

**Wegener Granulomatosis:** Wegener granulomatosis is a rare disorder of unknown etiology associated with necrotizing granulomas in the paranasal sinuses, nasal cavities, and/or orbits. CS involvement is rare. MR imaging shows meningeal thickening and enhancement that may extend to the CS[22].

Images for this section:
Fig. 1: A Coronal schematic drawing of the parasellar region with reference to the main structures found in this area.

Lesions of the parasellar region

Vascular lesions
- Carotid Cavernous Fistula
- Cavernous carotid aneurysms
- CS thrombosis

Neoplastic Lesions
- Pituitary adenomas
- Meningiomas
- Schwannomas
- Metastasis
- Lymphomas
- Chordoma/chondrosarcoma
- Hemangiomas
- Nasopharynx carcinomas
- Glioma
- Hemangiopericytoma
- Plasmacytoma
- Craniopharyngioma

Inflammatory, Infectious, and Granulomatous Lesions
- Tuberculosis
- Sarcoidosis
- Tolosa-Hunt Syndrome
- Wegener

Fig. 2
Fig. 3: Contrast-enhanced computed tomography, arterial phase. Female 73-year-old patient with diagnosis of Direct Carotid Cavernous Fistula. Early contrast enhancement shows proptosis and an enlarged superior left ophthalmic vein. Orbital Doppler ultrasonography: Exuberant shows blood flow at color Doppler study and is arterialized at spectral Doppler study.
Fig. 4: Female 45-year-old patient with a diagnosis of Dural Carotid cavernous fistula
**Fig. 5:** CS thrombosis. Coronal postcontrast T1-weighted image shows an enlarged and inhomogeneous-appearing left CS that contains areas of low signal intensity compatible with clot.
**Fig. 6:** Large adenomas tumours involving the cavernous sinus. Coronal T1,T2 and postcontrast T1-weighted image shows a large inhomogeneous-appearing mass involving the CS, sella, supra-sellar region.
Fig. 7: Meningiomas. T1 and T1 post contrast weighted image shows a meningioma that is isoattenuated to white matter with homogeneously enhancing involving the left CS.
Fig. 8: Lymphoma: Coronal T1, T2 and postcontrast T1-weighted image shows diffuse enlargement and enhancement of the CS.
Fig. 9: nasopharyngeal fibroma involving the CS
Fig. 10: hypothalamic pituitary SARCOIDOSIS
Conclusion

Profound understanding and knowledge of the anatomy, clinical dysfunctions and all possible pathological processes that may arise in the parasellar region are necessary to diagnose correctly the pathological processes. MRI is the modality of choice to assess the complete information needed for patient management.

Personal information

References


Radiology 215:463-469


