Olfactory groove meningioma
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Patient: 56 years, female

Clinical History:
Subacute clinical symptoms of headache, gait disturbance (with falls at home) and apathy/confusion. Worsening 1 week before neuroimaging studies/diagnosis. Anosmia (since along time ago) was noted in hindsight. No complaints of nasal obstruction, rhinorrhea and/or epistaxis. Personal history of depressive syndrome.

Imaging Findings:
Middle-aged female developed clinical symptoms of headache, gait disturbance and apathy/confusion. Those symptoms began some weeks ago and worsened one week before neuroimaging studies. The patient suffered from anosmia for a long time. On neurological examination, bilateral anosmia was diagnosed. A CT scan showed a volumous extra-axial lesion of the midline occupying the anterior level of the skull base, with evident extension into the superior portion of the nasal cavity and eroding the cribiform plate. The lesion is spontaneously hyperdense and enhance homogeneously and intensely after contrast. MR confirmed this volumous extra-axial lesion, in a fronto-etmoidal location, centered on the midline (with larger dimensions on the left side), extending into the superior portion of the nasal fossa and with discrete orbital extension, reaching no further than the plane of the medial rectus muscle. Posteriorly, it extends into the suprassellar cistern and it has a cleavage plane with the pituitary gland. The lesion is globally homogenous, with small central punctiform areas with hyposignal on all pulse sequences. It presents mildly hyposignal on T1- weighted images, isosignal/discrete hypersignal on long TR sequences and moderate enhancement after gadolinium, with small uncaptured areas. There is bilateral digitiform edema, obliteration of the adjacent cerebral cortical sulci, marked effect of mass on the encephalic structures and subfalcine herniation. Study of the area of the lesion by means of spectroscopy (MRS) with intermediate echo time (135 ms) revealed absence of the N-acetylaspartate peak (NAA), elevation of the choline (Cho) and doublet inverted peak at 1.48 ppm that points to alanine.

Discussion:
The description of the volumous extra-axial lesion at the anterior level of the skull and nasal-etmoidal areas leads to the following possible diagnoses of meningioma or esthesioneuroblastoma. Bearing in mind the characteristics of the described lesion (MR and MRS), the most probable diagnosis is meningioma. The appearance of Olfactory Groove Meningiomas (OGMs) on imaging studies (CT, MR) is similar to meningiomas situated elsewhere. CT scanning is particularly useful for defining the osseous anatomy, including areas of erosion (as seen in that case) supporting/assisting the diagnosis. Meningiomas typically are hyperdense relative to brain parenquima on noncontrast CT scans and enhance homogeneously and brightly after contrast. Paranasal sinuses extension through the floor of the anterior cranial fossa is well demonstrated on CT scans. On MRI they usually appear isointense or mildly hypointense to gray matter on T1WI and iso or hyperintense on T2WI. It contrasts with other intracranial tumours (usually moderately hypointense on the T1-weighted images and often more hyperintense on
the T2-weighted images) because of the high cellularity and low water content of most meningiomas. They usually 
enhance intense and homogeneously after gadolinium. OGMs arise over the cribiform plate and frontosphenoid 
suture and can reach very large sizes before clinical presentation. Although they arise in the midline, they can 
extend predominantly to one side. Extension into the ethmoid sinuses has been reported to occur in 15% of cases. 
Further extension into the nasal cavity and orbit occur in some (less) cases. They must be differentiated from other 
anterior cranial fossa meningiomas (including those of the tuberculum sella and clinoidal meningiomas) and other 
tumours (like esthesioneuroblastomas). OGMs arise more anteriorly in the skull base and displace the optic nerve 
and chiasm inferiorly rather than superiorly. Esthesioneuroblastoma (olfactory neuroblastoma) is a rare tumour 
 uprising from the olfactory epithelium of the nasal vault which frequently invades the cranial base, cranial vault and 
orbit. It has a bimodal bimodal peak seen both in males 11 to 20 year olds and in middle-aged adults (sixth decade 
of life). Patients present with a history of nasal obstruction, epistaxis or decrease in olfactory function. A calcified 
malignancy high in the nasal cavity or ethmoid vault is usually an esthesioneuroblastoma. As with squamous cell 
carcinoma, esthesioneuroblastomas typically have low signal intensity on T2WI. Intracranial cysts associated with 
this tumour have been described and are virtually pathognomonic for this malignancy. Esthesioneuroblastomas 
have a particular propensity to cross the cribiform plate and enter into the intracranial compartment (Kadish, stage 
C) or into the paranasal sinuses or orbit (Kadish, stage B). It was considered in differential diagnosis in this case. 
The spectral pattern of meningiomas typically demonstrates markedly elevated Cho and reduced Cr. It should not 
contain NAA. The presence of an alanine peak (a doublet at 1.48 ppm), when present, is fairly characteristic and 
helps to differentiate a meningioma from a glial tumor. The alanine doublet behaves similarly to lactate (doublet at 
1.33 ppm) and inverts at intermediate echo time (135ms) due to J-coupling effects.

**Differential Diagnosis List:** Olfactory groove Meningioma

**Final Diagnosis:** Olfactory groove Meningioma

**References:**

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Orrison W. Neuroimaging, 2000, Saunders.

Law M. Perfusion and MRS for Brain Tumor Diagnosis. Clinical MRI, 2005, Elsevier.
Description: Presence of voluminous extra-axial lesion of the midline occupying the anterior level of the skull base, with evident extension into the superior portion of the nasal cavity and eroding the cribiform plate.

The lesion is spontaneously hyperdense. It causes an accentuated effect of mass and there are extensive edema in the parenchyma, with predominance on the left, and displaces brain across midline and forced under the inferior margin of the falx cerebri to the right (subfalcine herniation). Posteriorly, the lesion extends to the suprasellar cistern, causing posterior deviation of the branches of both internal carotid arteries; the anterior cerebral arteries seem to “hug it” from both sides. There are no signs of hydrocephaly. In the nasal cavity, the lesion occupies approximately the upper half of the lumen; the sphenoidal cores are filled, seemingly due only to inflammatory phenomenon. There are discrete components of the lesion in the extra-conical spaces of both orbits. Origin:
Figure 2

**Description:** The lesion enhance homogeneously and intensely after contrast administration. **Origin:**
Description: Coronal CT reformatations allow a better anatomical delimitation.

The intracranial portion of the lesion is cupuliform, with larger dimensions of approximately 28mm in height, 47 mm in width and 59 mm in depth.

Paranasal sinuses extension through the floor of the anterior cranial fossa is well demonstrated on CT scans, particularly on coronal views. **Origin:**
**Figure 4**

**Description:** The lesion is globally homogenous, with small central punctiform areas with hyposignal in all pulse sequences. It has isosignal/discrete hypersignal in long TR sequences. Linear vascular structures surrounding the lesion may also be observed as well as small more central vessels. **Origin:**
Description: The tumour has isosignal/discrete hypersignal in long TR sequences (DP, T2-WI, FLAIR). A marked effect on mass is caused by the tumour and digitaliform edema in bilateral frontal-nuclear-capsular location (with larger dimensions to the left). Origin:
Description: The lesion is mildly hypointense on T1-weighted images. A marked effect on mass is brought about on the encephalic structures, including the ventricular system, with edema and obliteration of the cerebral cortical sulci with predominance in the bilateral frontal-parietal cerebral high convexity, and deviation to the right of the median line – subfalcine herniation. Origin:
Figure 7

Description: The tumour has isosignal/discrete hypersignal in long TR sequences (DP, T2-WI, FLAIR).
Origin:
Figure 8

**Description:** Extra-axial lesion isointense / mildly hypointense to normal gray matter in T1-weighted images

**Origin:**
Figure 9

Description: Origin:
Description: The lesion has moderate enhancement after gadolinium, with small uncaptured areas. The approximate anterior-posterior dimension of the lesion is 5.83 cm (endocranial location). Posteriorly, it extends into the suprasellar cistern and it has a cleavage plane with the pituitary gland (better identified after c.l.v.). Origin:
Description: The approximate maximum dimensions of the lesion are 5.83 x 5.34cm (anterior/posterior x transverse) with vertical dimensions of 6.45cm (endocranial location and extension into the nasal fossa, on the median line) and 3.41cm (endocranial location). Origin:
Description: Hyperdense lesion on T2 echo gradient. Small hypointense areas. Origin:
Description: Coronal T2WI shows a voluminous antero-posterior lesion with discrete hypersignal and extensive surrounding edema. Origin:
Description: Observing NAA (small quantity in this spectrum) in a meningioma MRS is not uncommon due to voxel contamination by metabolites outside the margins of a chosen voxel. Atypical meningiomas truly show NAA because they invade the brain parenchyma, being difficult to differentiate from glial tumours. There are elevation of the choline (Cho) and alanine peak (see figure 14b). Origin:
Description: Study of the area of the lesion by means of MRS with intermediate echo time (135 milliseconds) revealed absence of the N-acetylaspartate peak (NAA), elevation of the choline (Cho) and doublet inverted peak at 1.48 ppm that points to alanine. MRS support the diagnosis of a non neuronal tumour. The presence of an alanine peak (a doublet at 1.48 ppm), when present, is fairly characteristic and helps to differentiate a meningioma from a glial tumour. In these case MRS helps pre-operative diagnosis of meningioma. Origin:
Description: MRS demonstrated elevated choline (Cho). The striking elevation in Cho is likely due to higher cell turnover and cellularity. Origin:
Description: Spectrum of an brain area without lesion, in the same patient. Cho/Cr and Cho/NAA ratios help to identify neoplastic versus non-neoplastic tissue. MRS is also useful to evaluate lesions after treatment. Origin: