Sellar region masses: Tips and Traps

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Learning objectives

1. To review MRI most typical and remarkable imaging findings in sellar masses.

2. To remember the importance of complete anatomical delimitation and correct description of invasive sellar masses.

3. To identify most common pitfalls and to be able to remember most important differential diagnosis.

Background

We performed a retrospective analysis of patients with remarkable findings in sellar region in our institution with MR 1,5T and 3 T between the years 2016 and 2018, correlating imaging characteristics and histopathological findings.

Findings and procedure details

• Anatomy of the sellar and parasellar region.

• MRI sellar protocol.

• WHO classification of pituitary tumors.

• MRI features: Tumor shape, extension, characteristics and enhancement patterns.

• Knosp's and Hardys radiological classification.

• MRI evidence of macroscopic invasion of surrounding tissues and structures.

Introduction:

The sellar region is a central nervous system complex anatomical area composed by relevant anatomical structures. The region is surrounded by suprasellar and parasellar structures. This makes it essential to became familiar with all anatomical components. (Fig. 1).

The pituitary gland develops by day 24 of gestation from the primitive oral stomodeus involving the diencephalon and it is later composed by two lobes (neuro and adenohypophysis).

Although the embryological development is complex, the spectrum of most common pathologies that affect the region can be grouped into adenomas, craniopharyngiomas, meningiomas and less common entities such as hypothalamic gliomas or vascular anomalies. A very useful mnemonic tool is often used: SATCHMO, in order to remember most common pathologies in this area.

When studying the region it is important to include high resolution sequences and intravenous contrast protocols in order to achieve an accurate diagnosis. We pretend with this review to give diagnostic tools that will help radiologist to achieve a correct diagnosis with subsequent treatment and follow-up.

PITUITARY MACROADENOMA:

It is the most frequent suprasellar mass in adults, it arises from the pituitary gland and later it can extend to the suprasellar region, invade parasellar structures and less frequently invade other anatomical regions.

Usually, it presents as an isointense solid mass compared with gray matter in T1 and T2 sequences, although hyperintense cystic / necrotic areas, as well as the hemorrhagic foci, are relatively frequent. (Fig. 2).

After gadolinium injection these lesions usually enhace but with less intensity than normal glandular parenchyma.

Cranial extension can compress the optic chiasma and gland suprasellar growth is responsible for the typical "snowman" morphology or the "eight shape" look, due to the diaphragm membrane effect. (Fig. 3).

The so-called "invasive" pituitary adenomas may show invasion signs of the dural membrane, bone and / or surrounding anatomical structures but truly malignant pituitary tumors (pituitary carcinomas) are only defined by the presence of metastases and are extremely rare, with more aggressive clinical behavior, resistance tendency to conventional treatments and early postoperative recurrence.

If we assess Hardy's classification (Fig. 4), only grade III (focal bone erosion) and grade IV tumors (extensive bone erosion, including the skull base) are considered invasive.

If we analyze Knosp's classification (Fig. 5), only III and IV grade adenomas are considered truly invasive (as they invade cavernous sinuses).

A sellar tumor should be defined as an aggressive type when it has macroscopic characteristics, an unusually rapid tumor growth rate, or clinically relevant tumor growth despite optimal standard therapies (surgery, radiotherapy, and conventional medical treatments). (Fig. 6-7).

For tumor dimensions, invasion and growth quantification, MRI represents the best imaging method as it provides tools that help the radiologist to differentiate benign (typical) pituitary tumors from aggressive and potentially malignant pituitary tumors.

Some reports indicate that cavernous or sphenoid sinus invasion imaging findings may be more sensitive in invasive tumors identification compared to histology.

The most common aggressive pituitary tumors clinical presentation is early recurrence after initial pituitary surgery and rapid local growth as well as tumor extension.

Cavernous sinus invasion MRI signs:

· Loss of normal boundaries between sellar parenchyma and cavernous sinus

· Venous compartments status in cavernous sinus.

· Cavernous sinus size.

· Cavernous sinus medial wall bulging

· Intracavernous internal carotid artery displacement.

· Knosp-Steiner parasellar extension degree.

· ICA enclosure percentage (Greater than 25%).

(Fig. 8-9).

NON-ADENOMATOUS SELLAR LESIONS

Craniopharyngioma:

Location: Sella Turcica and suprasellar cistern. Along the pituitary stalk.

Age range: Childhood / adolescence (adamantinomatous type).

Elderly, sixth decade (papillary type).

Although benign, craniopharyngiomas tend to recur and invade adjacent structures. Tumor adherence to surrounding vascular structures represent the most common cause of incomplete resection.

Adamantinomatous type: Shows solid and cystic components. There is extensive surrounding inflammation and fibrosis.

MRI findings: Heterogeneous appearance, hyperintense cystic components in T1W and T2W sequences. The solid component shows moderate enhancement and calcifications may be present.

Papillary type: Occurs in adult patients. They are solid, without calcifications.

(Fig. 10).

Meningioma:

Location: Sella Turcica, clinoid process, lesser wing of sphenoid bone, cavernous sinus.

MR image: T1W sequence - isointense.

T2W Sequence - 50% isointense, 40% hyperintense.

Intense homogeneous contrast enhancement.

Other diagnostic clues:

-Dural thickening (Dural tail sign).

-Identification of normal pituitary gland.

-Peripheric vasogenic edema.

-Associated hyperostosis.

-Vascular encapsulation pattern.

(Fig. 11-12-13).

Germinoma:

Location: Suprasellar cistern or pituitary fossa, pineal gland, posterior third ventricle.

Age group: Children and young adults, with a higher prevalence in females.

They are infiltrating lesions.

MR image: Loss of normal signal intensity of the posterior pituitary gland.

Homogeneous and rarely cystic.

Sequence T1W- midly hypointense.

T2W sequence - isointense to grey matter.

Marked contrast enhancement present.

MR spectroscopy - prominent lipid peaks.

Teratomas - Heterogeneous signal, with fat or calcifications.

Epidermoid and Dermoid Cysts:

Benign lesions, slow expansive growth is characteristic, they tend to insinuate within and around adjacent neural structures, usually they don't invade adjacent spaces.

They become symptomatic due to compression of adjacent neurovascular structures.

Epidermoid - Age group - Adulthood (2-4 decade).

Location - Basal cisterns and lateral situation.

MR Imaging: Slightly Hyperintense to CSF on T1W and T2W sequences.

DP and FLAIR - Epidermoid are hyperintense to brain and CSF whereas arachnoid cysts remain isointense to CSF.

DWI - epidermoid cysts show restricted diffusion, whereas arachnoid cysts show facilitated diffusion.

Usually do not show any contrast enhancement, calcifications rare.

Dermoids - Age group -Pedriatic age.

MR Imaging - Fatty components -Hyperintense on T1W sequence.

Areas of dense calcifications.

Chiasmatic and Hypothalamic Gliomas:

Age group - childhood, (first decade).

Association with neurofibromatosis.

MR imaging findings: isointense on T1W sequence and hyperintense on T2W sequence.

Calcification and hemorrhage are uncommon, contrast enhancement is variable. They invade the brain along the path of the optic radiations.

Condrosarcoma:

Chondrosarcomas are cartilaginous, off midline skull base tumors that occur in the middle cranial fossa. Chondrosarcomas affect the cavernous sinuses because of their preponderance for petro occipital synchondrosis. The tumor may displace the cavernous sinuses superiorly, narrow them, or invade them directly because of the inferiosuperior vector of growth. On imaging, chondrosarcoma is seen as a lytic-appearing lesion on CT, which demonstrates rings and arcs of calcification. On MR, the tumor appears markedly hyperintense on T2WI, shows chondroid matrix, is locally aggressive, and demonstrates variable enhancement. (Fig. 14).

Chordomas:

Derived from remnants of the primitive notochord.

Age group: commonly third decade. More frequent in men.

Location: In relation to clivus. They are locally invasive and destructive.

MR Imaging: T1W sequence iso-hypointense.

T2W sequence extremely hyperintense.

(Fig. 15).

Metastasis:

Metastasis in pituitary gland are extremely rare, seen in disseminated malignancies of breast and bronchogenic carcinomas.

They present with pituitary gland enlargement, but without enlargement of the pituitary fossa.

Aneurysms:

Origin: cavernous portion of the internal carotid artery or its supra-clinoid segment, occasionally anterior and posterior communicating arteries, basilar artery tip aneurysm.

MR Imaging: usually well-defined lesions with signal void in T2 sequences.

If there is a clot inside the aneurysm it appears multilamellated high signal on T1W sequences.

MR Angiography can be done for accurate characterization.

Pitfall: Clinoid process pneumatization. (Fig. 16).

Images for this section:

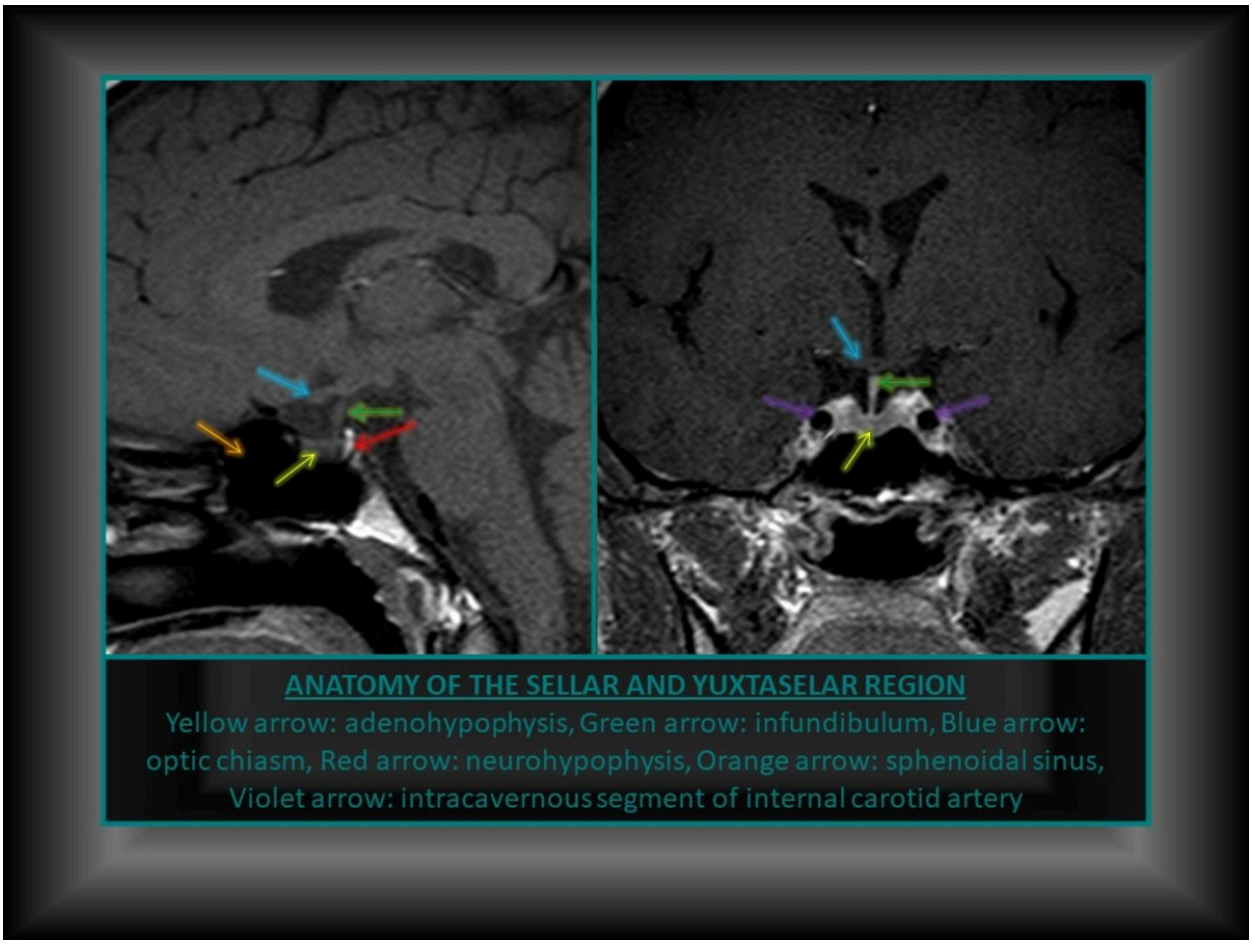

Fig. 1: ANATOMY OF THE SELLAR AND YUXTASELAR REGION. Sagittal T1 MRI (a) and coronal T1 MRI (b) with overdrawn scheme of the main anatomical relations.

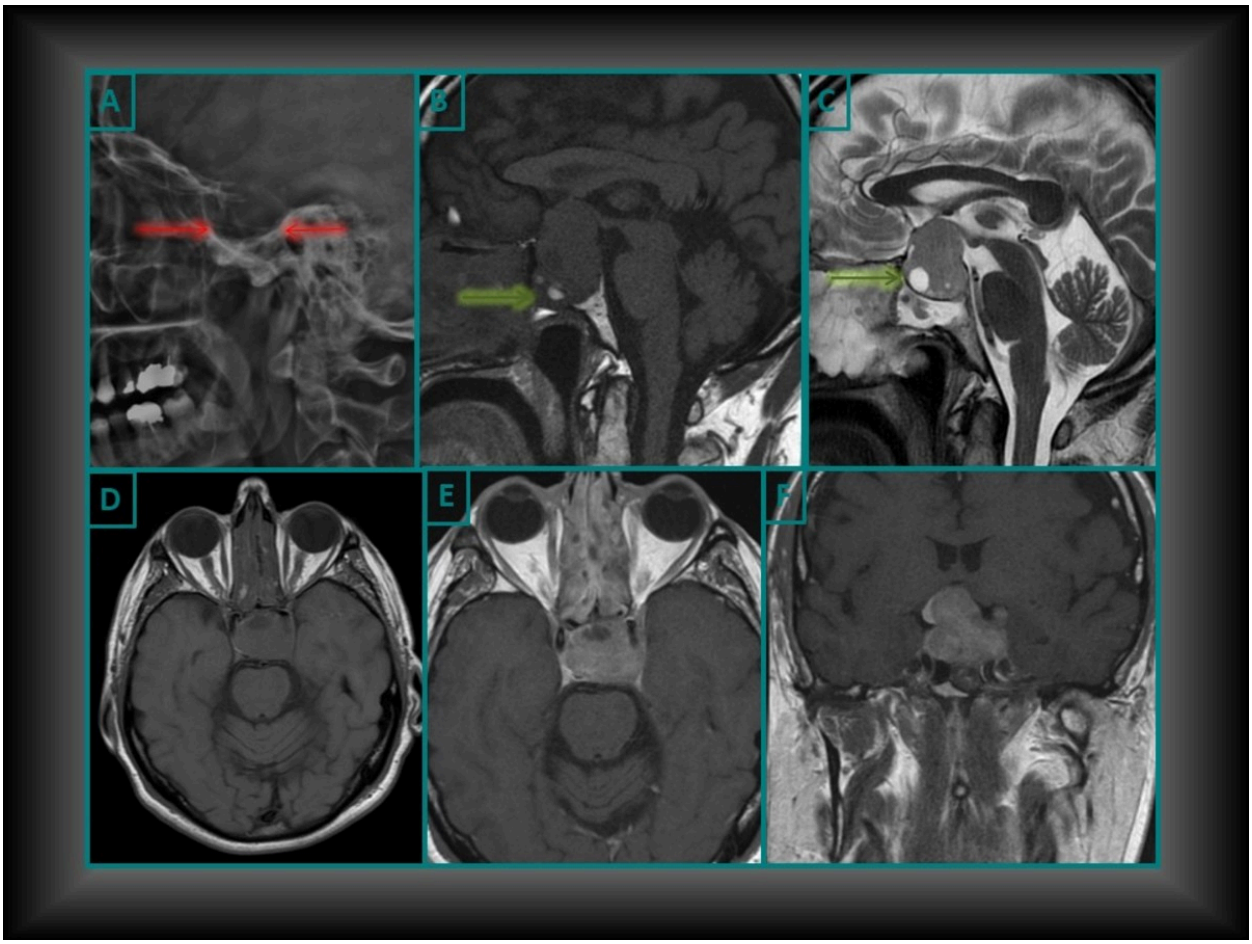

Fig. 2: Pituitary Macroadenoma with areas of necrosis or hemorrhage. X-ray (A) reveal the expand the sella turcica (Red arrows), this generally only occurs with pituitary lesions that originate in the sella. Sagittal T1-W (B), Sagittal T2-W (C), Axial T1-W (D) and T1-W-postcontrast (E), Coronal T1-W-postcontrast (F). There is suprasellar extension with elevation and compression of the optic chiasm. They tend to be soft, solid lesions, often with areas of necrosis or hemorrhage as they get bigger (Green arrow). The lesión show intense but heterogeneous enhancement after contrast administration.

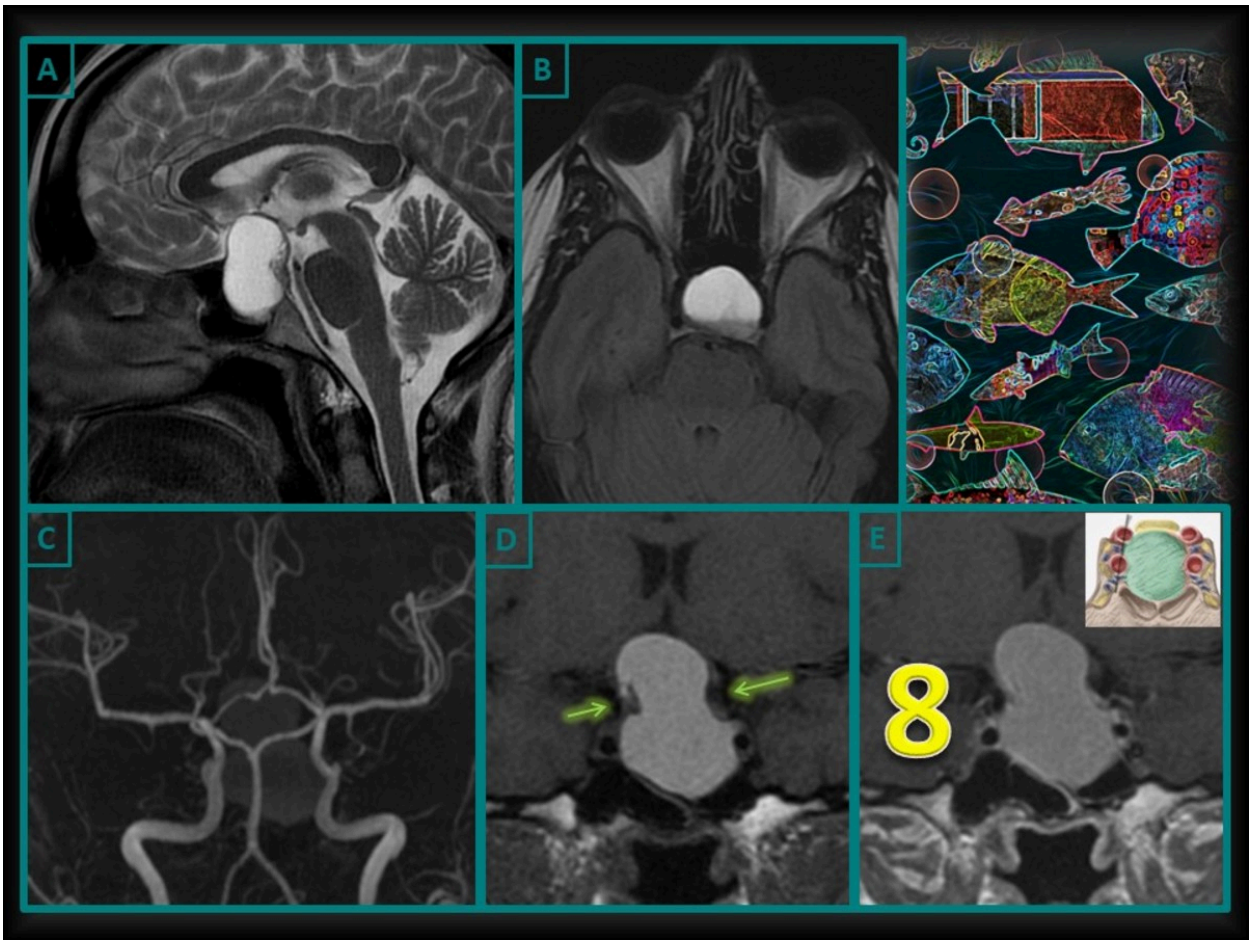

Fig. 3: Pituitary Macroadenoma Sagital T2-W sequence (A), axial T1-W (B), MR angiography (C), Coronal T1-W (D) and T1-W-postcontrast (E). Images reveal a hyperintense mass in sellar and suprasellar location. Because they are soft tumors, they usually indent at the diaphragma sellae (Green arrows), giving them a 'snowman' or "eigth"configuration.

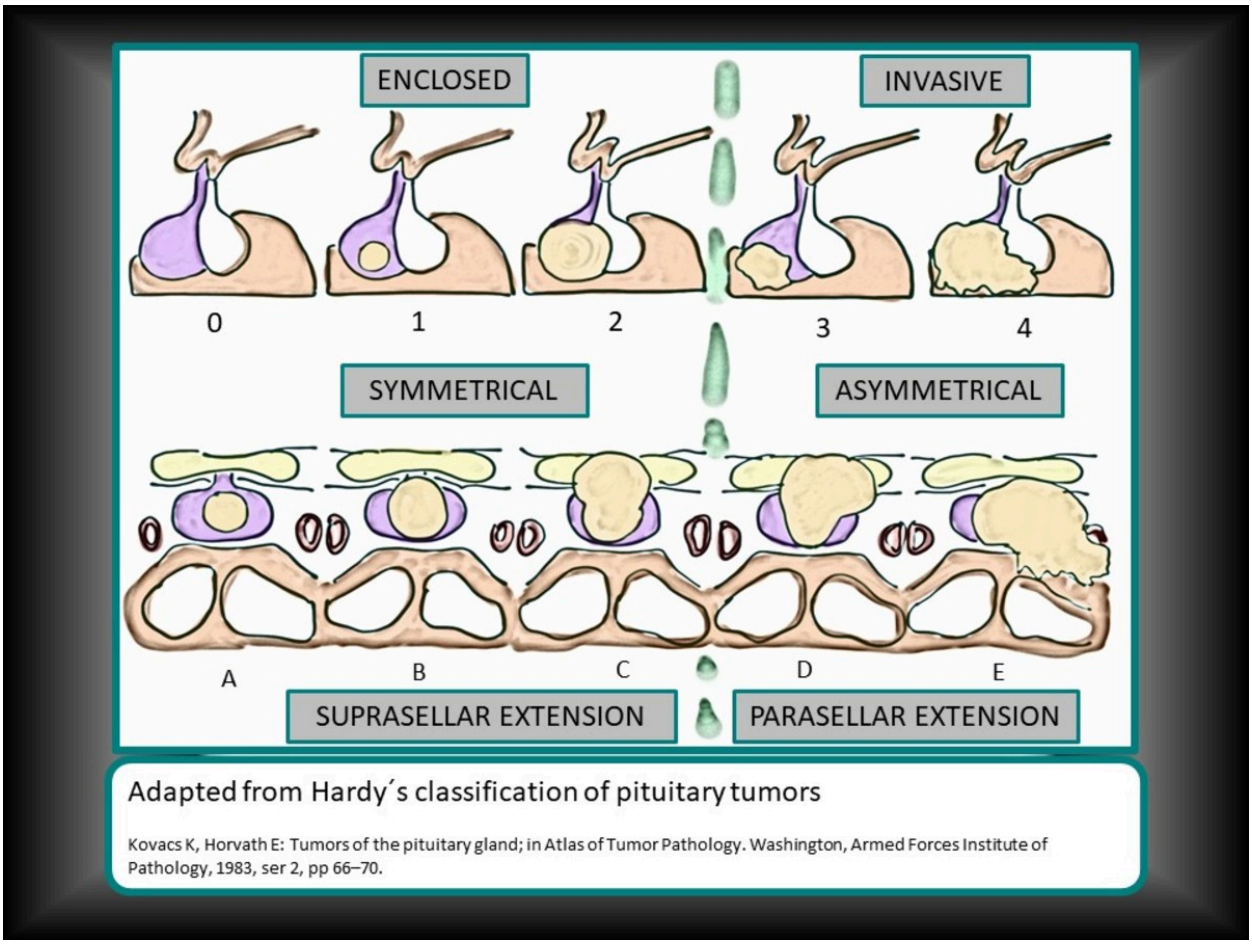

Fig. 4: ADAPTED FROM HARDY´S CLASSIFICATION OF PITUITARY TUMORS Grades I and II are enclosed within the sella. Grades III and IV are invasive. Extrasellar classifications A, B, and C are increasing amounts of direct suprasellar adenomas. D is asymmetric extension, and E is lateral extension into the cavernous sinus. References: Kovacs K, Horvath E: Tumors of the pituitary gland; in Atlas of Tumor Pathology. Washington, Armed Forces Institute of Pathology, 1983, ser 2, pp 66-70.

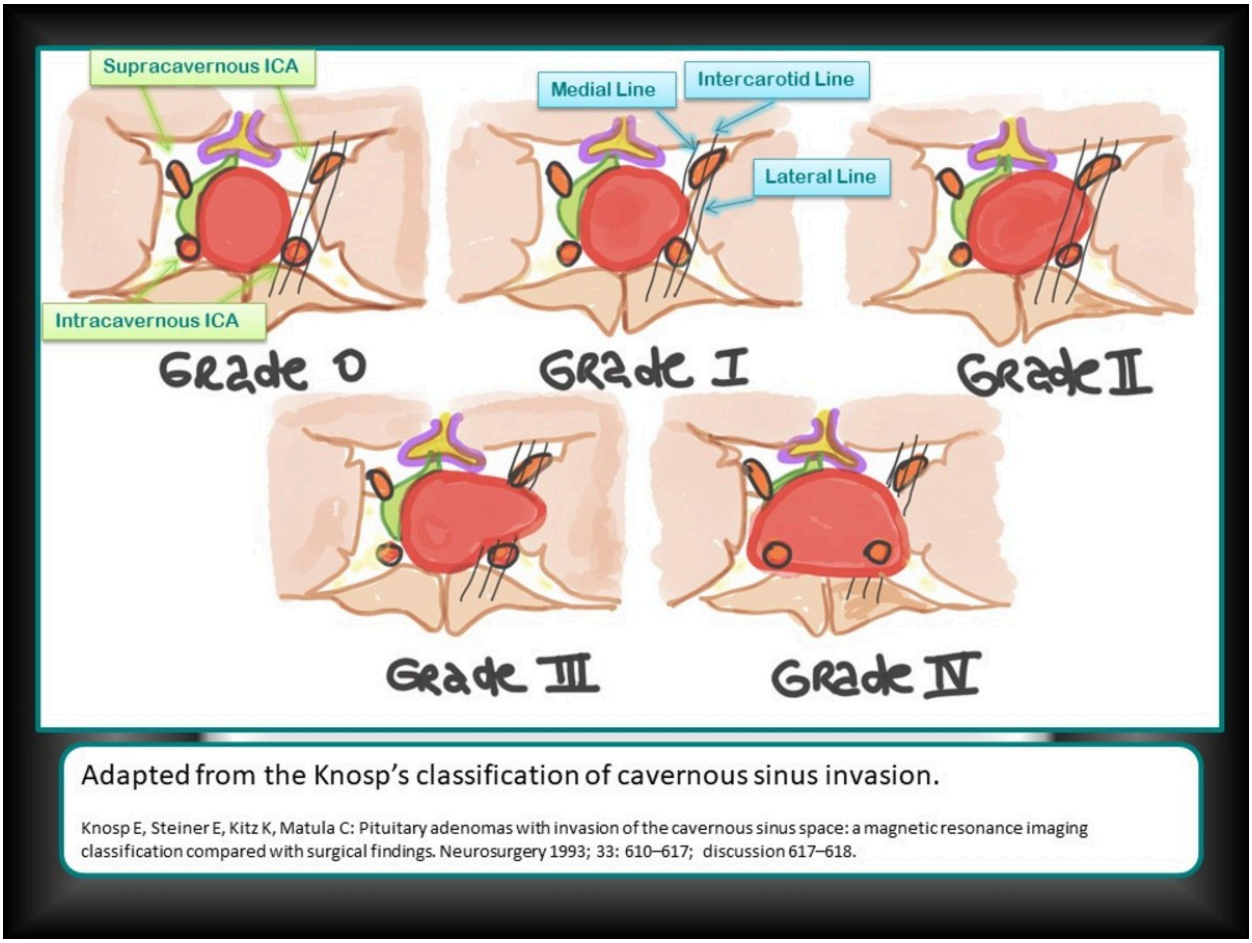

Fig. 5: ADAPTED FROM THE KNOSP'S CLASSIFICATION OF CAVERNOUS SINUS INVASION. Knosp et al. offered a grading system for predicting invasion of the cavernous sinus by pituitary macroadenoma on the basis of MRI. This represents the parasellar extension of the tumor. Reference: Knosp E, Steiner E, Kitz K, Matula C: Pituitary adenomas with invasion of the cavernous sinus space: a magnetic resonance imaging classification compared with surgical findings. Neurosurgery 1993; 33: 610-617; discussion 617-618.

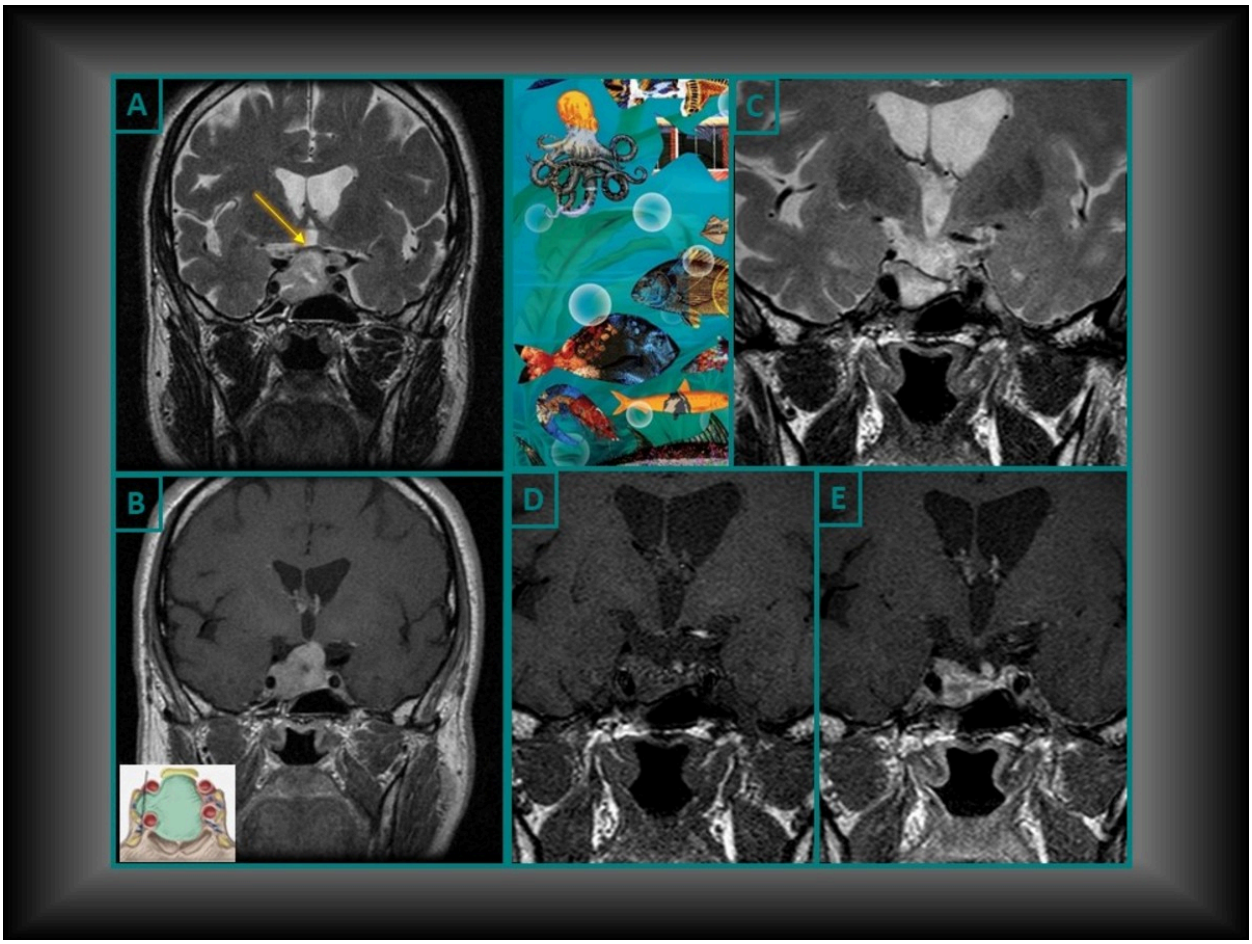

Fig. 6: Pituitary Macroadenoma Pre surgical: Grade 3A: the tumor extends lateral to the lateral tangent of the intracavernous ICAs into the superior cavernous sinus compartment A)Coronal T2-W, show the mass encases the cavernous segment of the right internal carotid artery by 55% (arrow) consistent with cavernous sinus invasion. Yellow arrow denotes the mass effect on the optic chiasm. B)Contrast-enhanced coronal T1WI image demonstrates a homogenous enhancing sellar mass. Post surgical: Coronal T2WI image (C), Coronal T1WI image (D) and Contrast-enhanced coronal T1-WI (E) demonstrates a heterogeneous reinforcing seal that demonstrates contact with the cavernous segment of the right internal carotid artery.

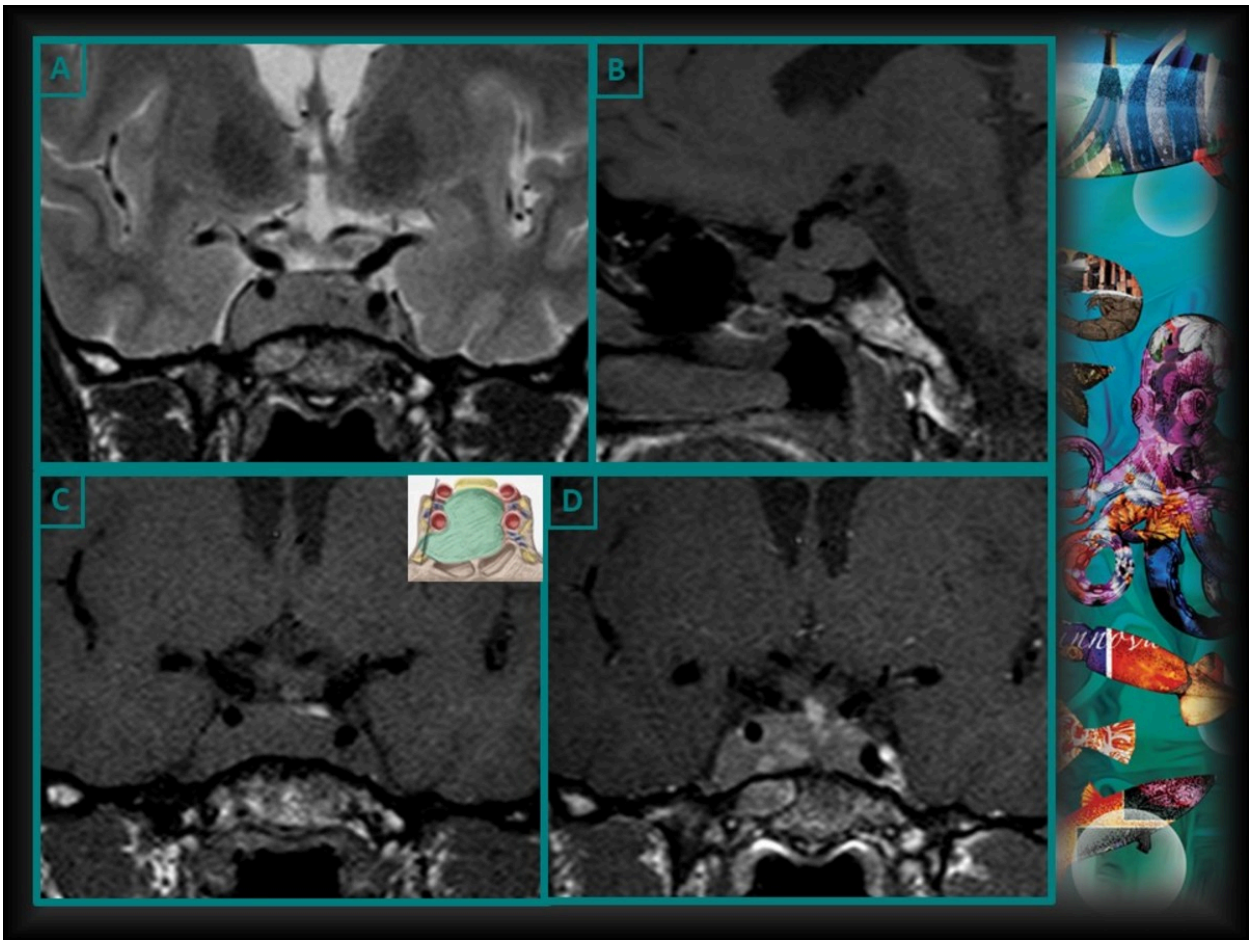

Fig. 7: Pituitary Macroadenoma Grade 3B: the tumor extends lateral to the lateral tangent of the intracavernous and supracavernous ICAs into the superior cavernous sinus compartment. Coronal T2-W (A), Saggital T1-W, Coronal T1-W and T1-W-postcontrast. Show the mass encases the cavernous segment of the right internal carotid artery consistent with cavernous sinus invasion. Contrast-enhanced coronal T1WI image demonstrates a heterogenously enhancing sellar mass and extends to the meckel cavum.

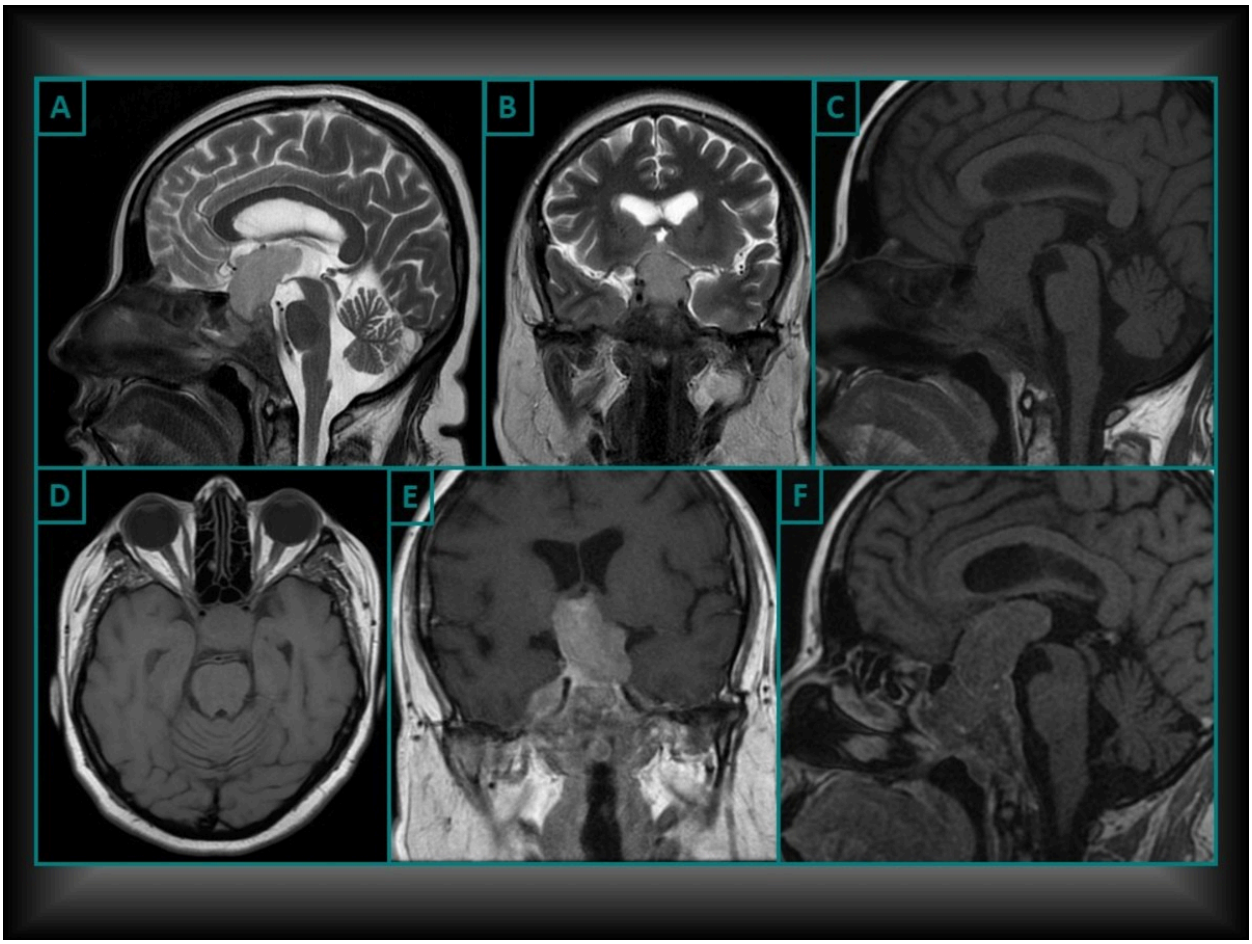

Fig. 8: Pituitary Macroadenoma Coronal T1-W (A) and T1-W post contrast (B), Axial FLAIR (C) and sagittal T2-W images demonstrate an heterogenous enhancing mass lesion in sellar and important suprasellar location with compromise of a extension into paranasal sinuses.

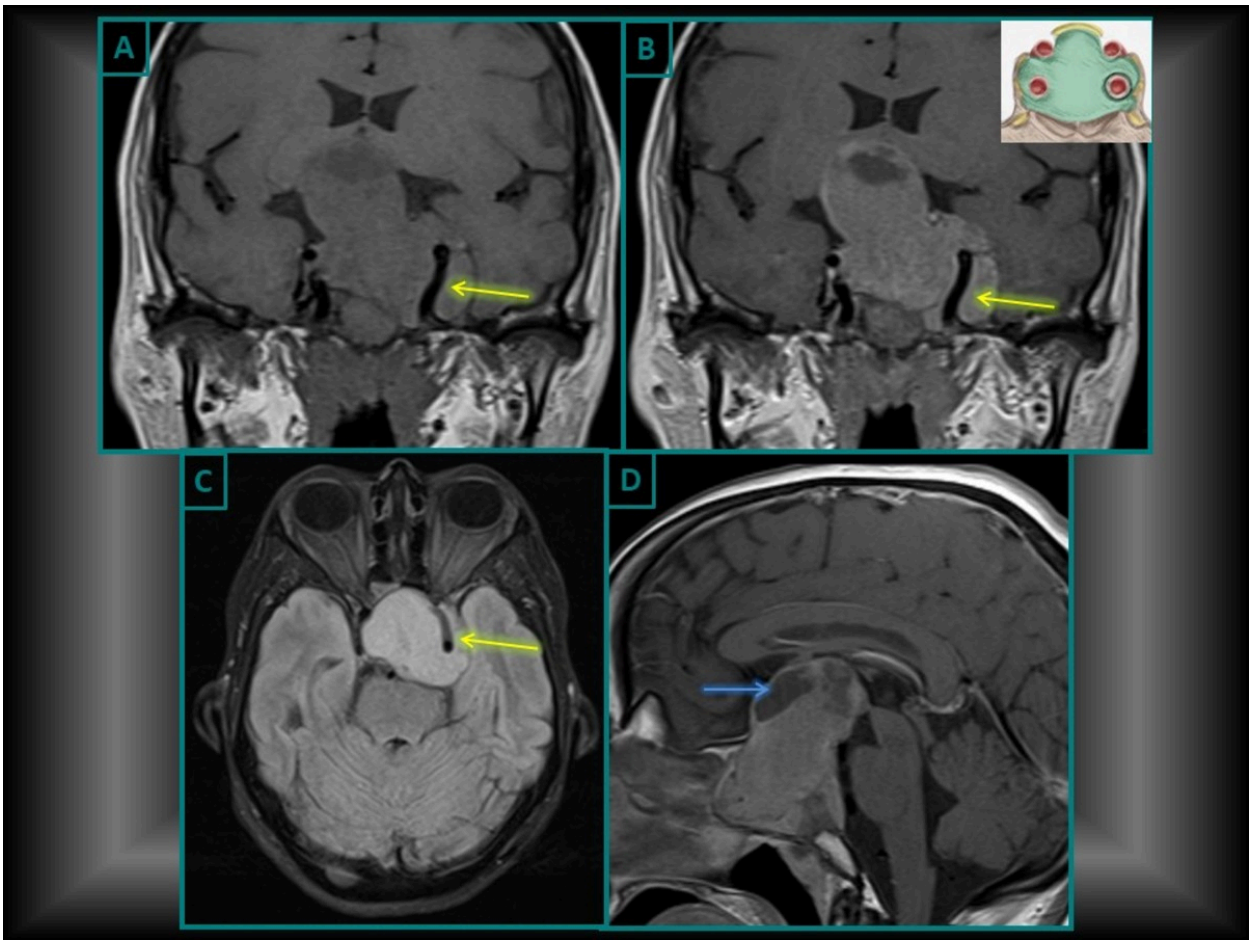

Fig. 9: GIANT PITUITARY MACROADENOMA Grade 4: there is total encasement of the intracavernous carotid artery. Coronal T1-W (A) and T1-W post-contrast (B), Axial FLAIR (C) and sagittal T2-W images show an intensely enhancing mass lesion with peripheral cystic component (Blue arrow) in sellar and suprasellar location with a parasellar component on left side completely encasing the cavernous ICA (Yellow arrow) and extension into paranasal sinuses.

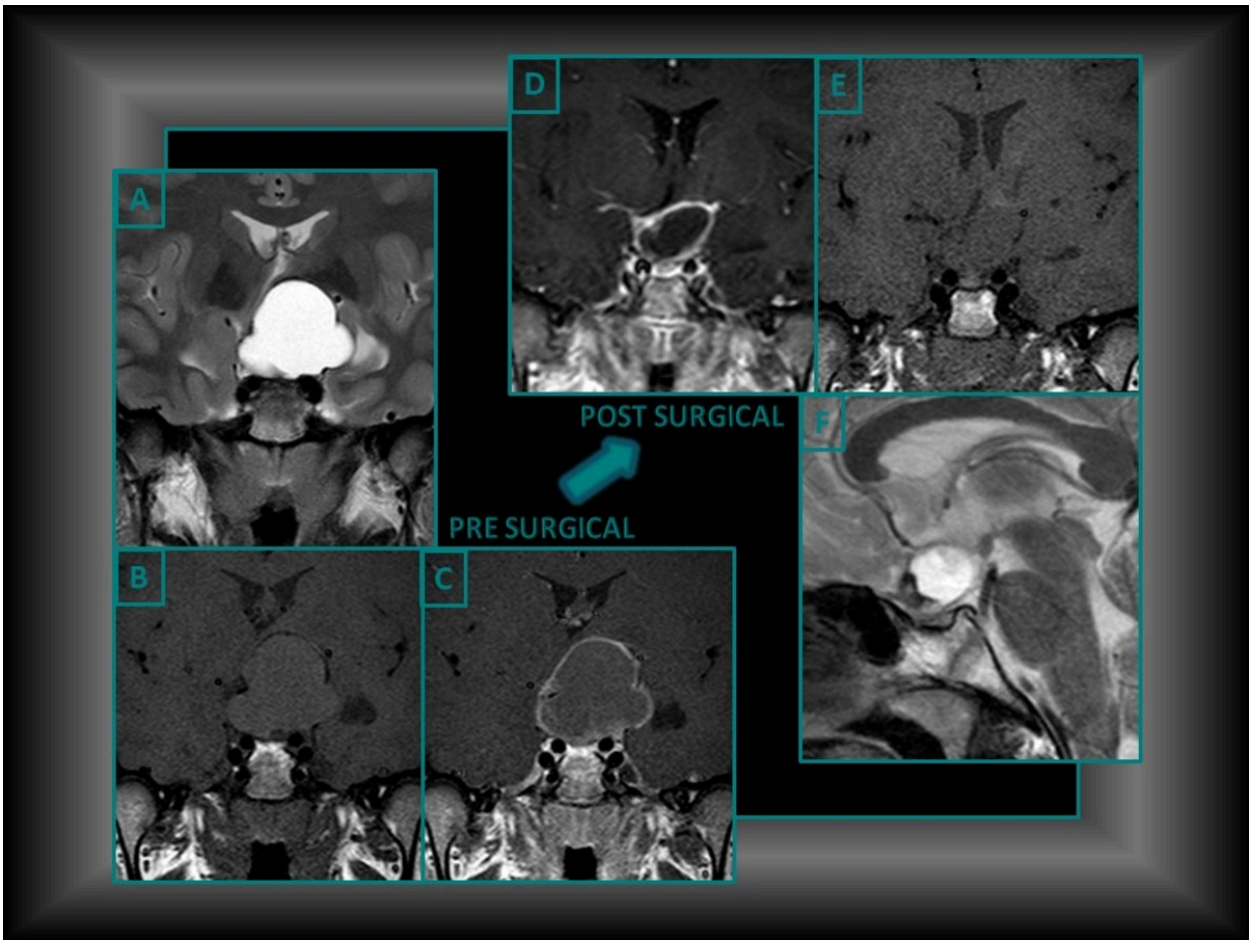

Fig. 10: CRANIOPHARYNGIOMA Pre surgical: Coronal T2-W (A), T1-W (B) and post-contrast T1-W (C) images showing craniopharyngioma in adult. The images show a predominantly cystic mass in the sellar and suprasellar locations. The cystic portion is hyperintense on T2-W and isointense on T1-W. On post contrast images the cystic component shows thin peripheral enhancement. Post surgical: Coronal post-contrast T1-W (D), T1-W (E) and sagital T2W (F) images showing recurrence of craniopharyngioma post-surgical in the same patient.

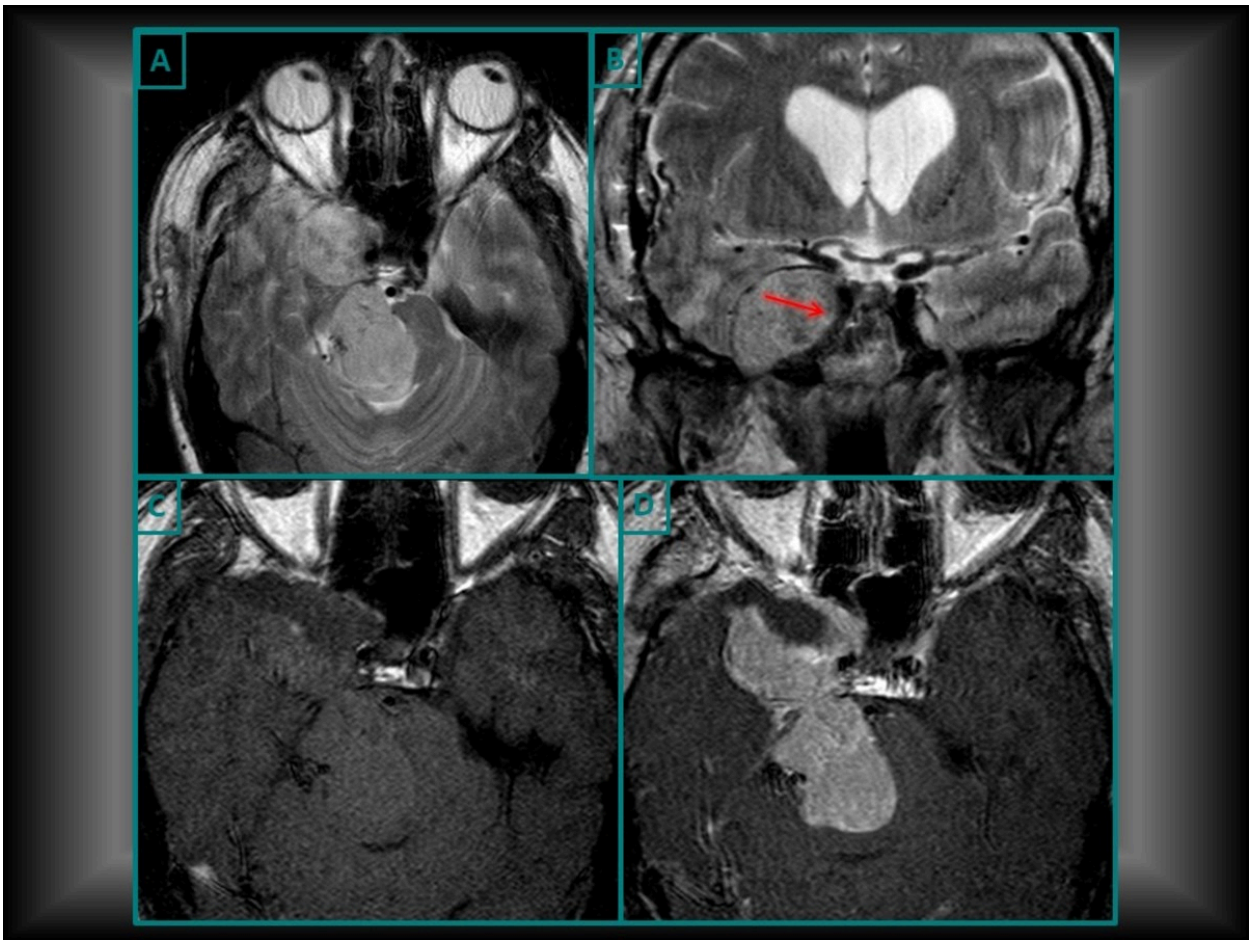

Fig. 11: PARASELLAR MENINGIOMA. Axial T2-W (A), Coronal T2-W (B), Axial T1-W (C) and post-contrast T1-W (D). Demonstrates a well-defined, lobulated, heterogenous mass involving the right cavernous sinus region extending posteriorly to involve the Meckel's cave and medially to extend into the sella turcica and sphenoid sinus. Note posterior displacement of the right cavernous internal carotid artery flow void (Red arrow). Post-contrast T1-W demonstrates a moderately enhancing mass.

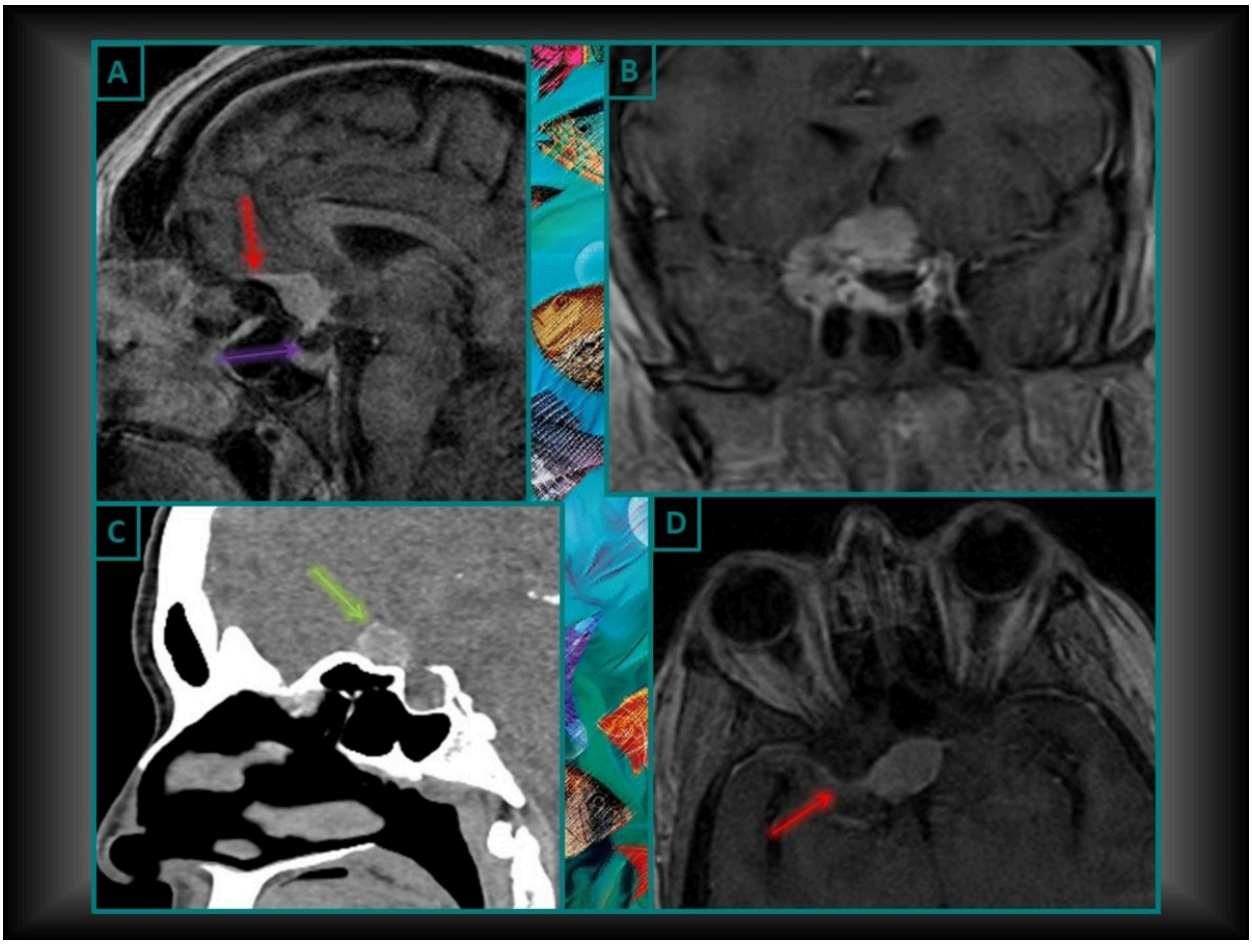

Fig. 12: SUPRASELLAR MENINGIOMA Sagittal post-contrast T1-W (A), Coronal post-contrast T1-W (B) and Axial post-contrast T1-W (D) showing an intensely enhancing homogenous mass in suprasellar location with separately visualized pituitary gland (violet arrow). Sagittal CT Scan (C) reveals a spontaneously hyperdense image in suprasellar location . The red arrow indicates the spread of the lesion along the meninges, dural tail sign.

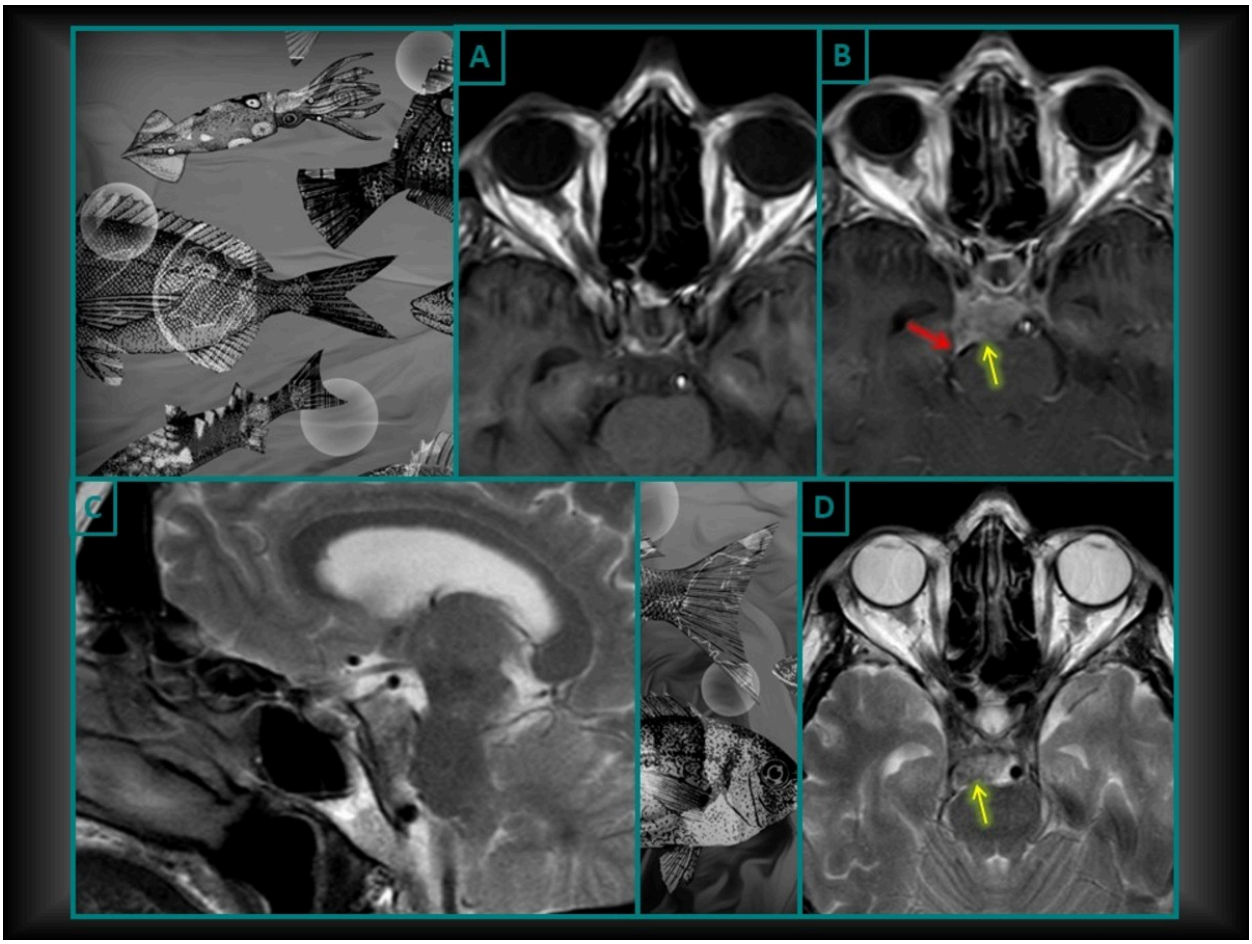

Fig. 13: CLIVAL MENINGIOMA Axial T1-W (A) and Axial post-contrast T1-W (B). Sagittal T2-W and Axial T2-W. Yellow arrows indicates a well defined homogenously enhancing extra-axial lesion arising from the upper aspect of the rigth side of the clivus. This extends into the pre-pontine space with mild mass effect on the ventral aspect of the pons. The red arrow indicates the spread of the lesion along the meninges, dural tail sign.

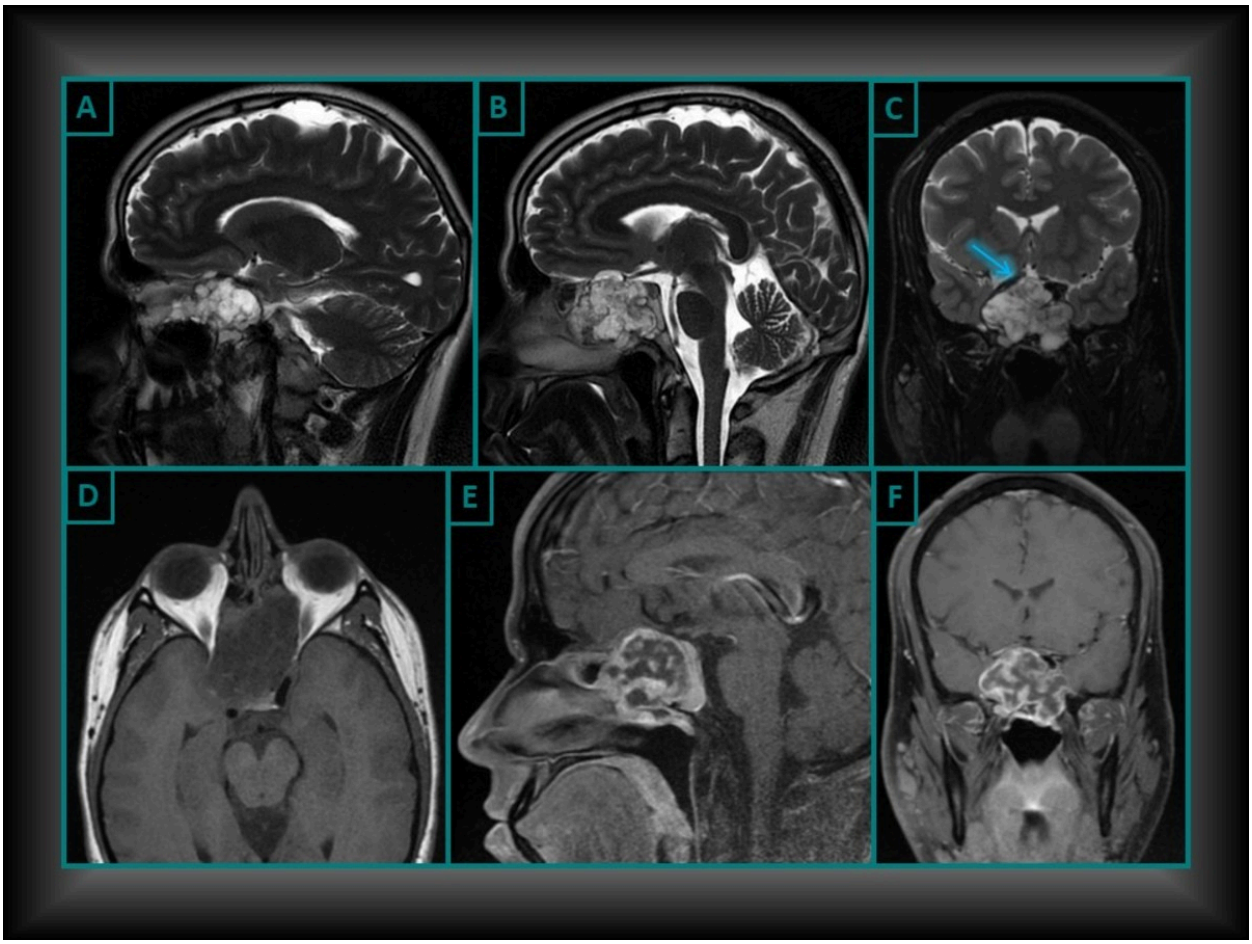

Fig. 14: Rare case of chondrosarcoma grade I (well differentiated) mimicking a sellar and suprasellar mass with parasellar extension Sagittal T2-W (A,B), Coronal T2-W (C), Axial T1-W (D), Sagittal post-contrast T1-W (E) and coronal post-contrast T1-W (F). Demonstrates an expansible lytic appearing lesion, involving the floor of the anterior and middle cranial fossa. Axial T2WI demonstrates a well-defined lobulated, predominantly hyperintense mass, which abuts and narrow the cavernous internal carotid artery. Post-contrast T1-WI demonstrates significant contrast enhancement of the lesion.

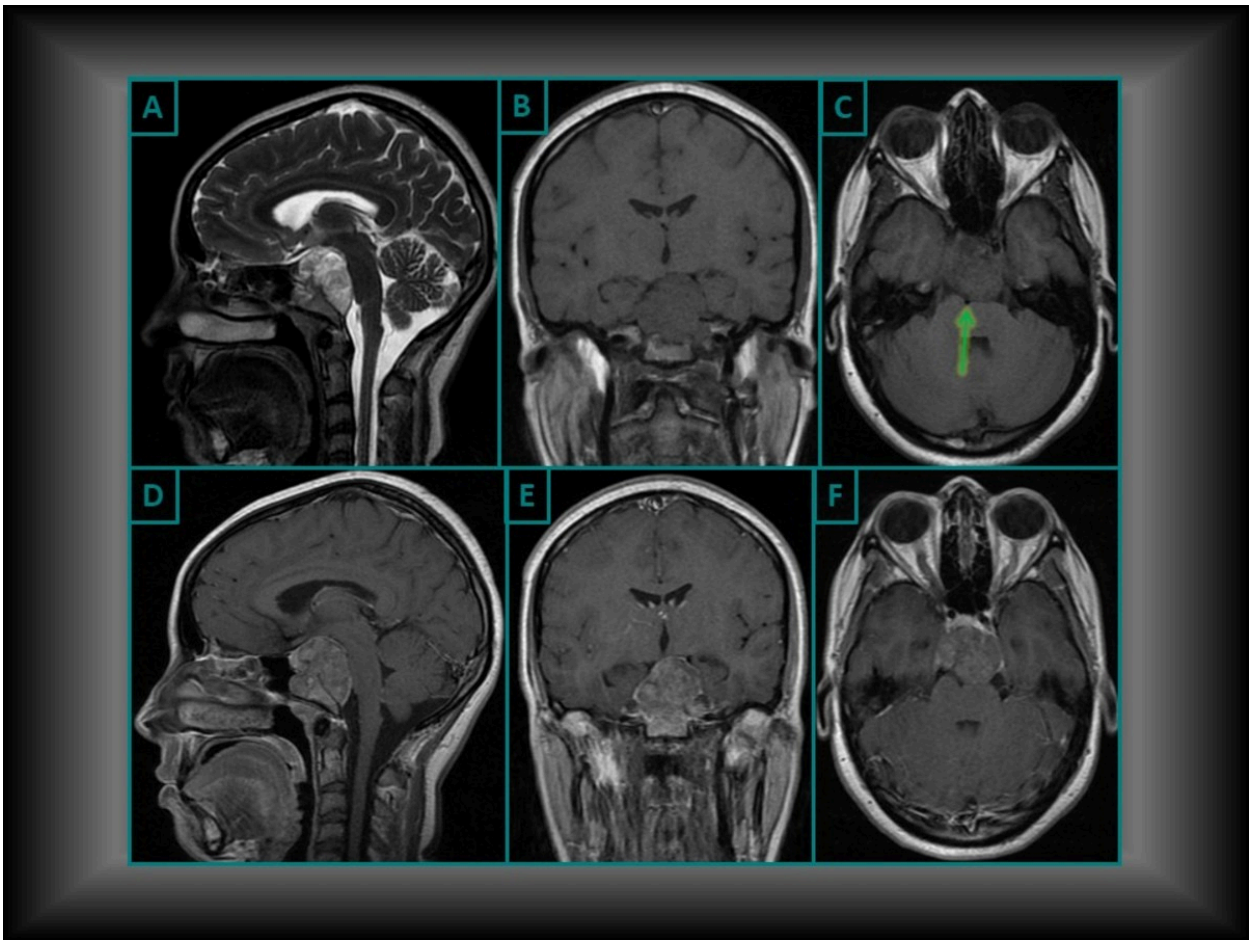

Fig. 15: CHORDOMA Sagittal T2-W (A), Coronal T1-W (B), Axial T1-W (C), Sagittal post-contrast T1-W (D), coronal post-contrast T1-W (E) and Axial post-contrast T1-W (F). Images showing the chordoma involving the clivus. The lesion is heterogeneous and hyperintense in T2-weighted sequences, slightly hypointense in T1, and with heterogeneous enhancement. The mass occupies the prepontine cistern with compression on the anterior margin of the protuberance and displacement of the basilar artery (Green arrow).

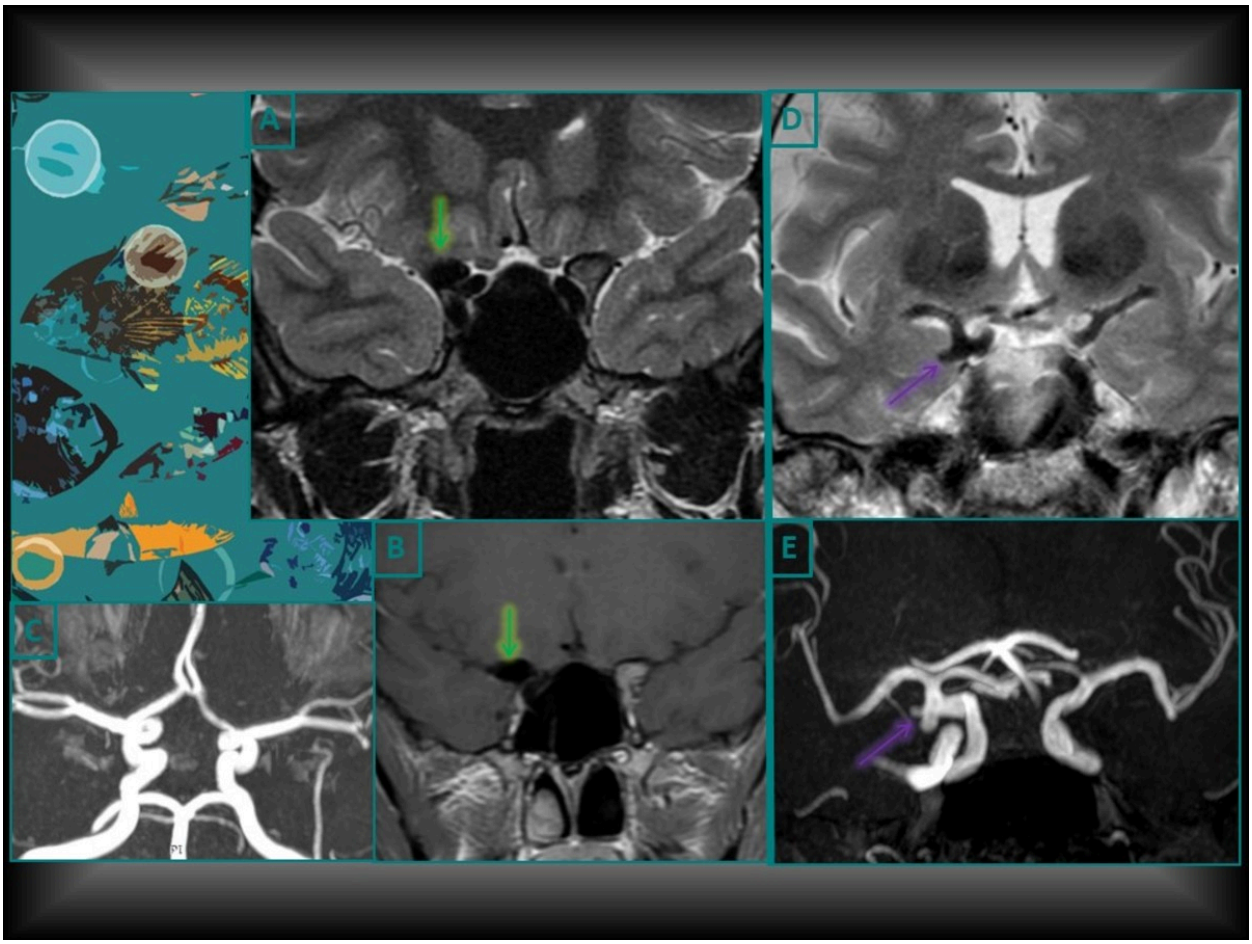

Fig. 16: Pneumatization of clinoid apophysis - aneurysmatic dilation. Coronal T2-W (A), coronal T1 (B) and MR angiography (C). Yellow arrows indicate unilateral pneumatization of clinoid apophysis and shows normal MR angiography. Coronal T2 (D) and MR angiography (E). Purple arrows indicate aneurysmatic dilatation that compromises C6 portion of the right internal carotid.

Conclusion

Masses of the sella turcica can exhibit an aggressive behavior, characterized by invasion of surrounding tissues and anatomical structures. That may leads to resistance to conventional treatment and in consequence frequent recurrences.

A correct interpretation of the most typical imaging findings is important to accurately diagnose and classify pituitary tumors according to their prognostic potential.

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References

1. S C-Z, M G-L, Ae V-G, Vh R-P, L M-A, Gm G-A. Lesiones de la región selar que pueden simular macroadenomas. 2016;15(4):251-260. http://www.medigraphic.com/pdfs/anaradmex/arm-2016/arm164b.pdf.

2. Liu Y, Qi ST, Wang CH, et al. Pathological Relationship Between Adamantinomatous Craniopharyngioma and Adjacent Structures Based on QST Classification. J Neuropathol Exp Neurol. 2018;77(11):1017-1023. doi:10.1093/jnen/nly083

3. Exhibit E, Bakare VN, Taori K, et al. Role of MRI in evaluation of various Sellar and Para-sellar. 2013:1-30.

4. Exhibit E, Sahni S, Saggar K, Gupta K, Kakkar C, Banerjee A. Sellar and Parasellar pathologies : a comprehensive review on MRI. 2016.

5. Dworakowska D, Grossman AB. Aggressive and malignant pituitary tumours: state-of-the-art. Endocr Relat Cancer. 2018;25(11):1-46. doi:10.1530/ERC-18-0228

6. Chatzellis E, Alexandraki KI, Androulakis II, Kaltsas G. Aggressive pituitary tumors. Neuroendocrinology. 2015;101(2):87-104. doi:10.1159/000371806

7. Ahmadi J, North CM, Segall HD, Zee CS, Weiss MH. Cavernous sinus invasion by pituitary adenomas. Am J Roentgenol. 1986;146(2):257-262. doi:10.2214/ajr.146.2.257

8. Kucharczyk W, Truwit CL. Diseases of the sella and parasellar region. Dis Brain, Head Neck, Spine 2012-2015 Diagnostic Imaging Interv Tech. 2012;48(1):115-121. doi:10.1007/978-88-470-2628-5_17

9. Vieira JO, Cukiert A, Liberman B. Evaluation of magnetic resonance imaging criteria for cavernous sinus invasion in patients with pituitary adenomas: Logistic regression analysis and correlation with surgical findings. Surg Neurol. 2006;65(2):130-135. doi:10.1016/j.surneu.2005.05.021

10. H. I, K. I, T. M, et al. Giant invasive pituitary adenoma extending into the sphenoid sinus and nasopharynx: Report of a case with intraoperative cytologic diagnosis. Acta Cytol. 2005;49(4):452-456. http://content.karger.com/ProdukteDB/produkte.asp?Aktion=JournalHome&ProduktNr=254338&ContentOnly=false%5Cnhttp://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emed10&NEWS=N&AN=41008843.

11. Micko ASG, Wöhrer A, Wolfsberger S, Knosp E. Invasion of the cavernous sinus space in pituitary adenomas: endoscopic verification and its correlation with an MRI-based classification. J Neurosurg. 2015;122(4):803-811. doi:10.3171/2014.12.JNS141083