ANTERIOR CLINOID MENINGIOMA, SURGICAL NOTES

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RÉSUMÉ : La stratégie chirurgicale des méningiomes de la clinoïde antérieure, doit prendre en considération les rapports intimes de cette tumeur bénigne avec les structures nerveuses et vasculaires de la région clinoidienne. L'abord chirurgical est guidé par différentes étapes afin de respecter l'intégrité anatomique des structures neurovasculaires avoisinantes tout en assurant l'exérèse la plus complète. Dans cet article nous vous résumons la stratégie chirurgicale de l'exérèse des méningiomes clinoïdiens à travers un cas clinique, au niveau du service de neurochirurgie de Bab El Oued.

***Mots clés** : Méningiome, Clinoïde antérieure, Nerf optique, Tige pituitaire.*

ABSTRACT : The surgical strategy of meningiomas arising from the clinoidal region may take into consideration the intimate relationship of this benign tumor with surrounding structures. The surgical approach is guided by various steps in order to respect the anatomical integrity of neighboring neurovascular structures while ensuring the most complete excision. In this article we summarize the surgical strategy of clinoid meningiomas through a clinical case, in the Bab El Oued neurosurgery department.

***Key words** : Meningioma, Anterior clinoid, Optic nerve, Pituitary stalk.*

INTRODUCTION

Meningiomas of the anterior clinoid process are uncommon benign tumors, acknowledged by most experienced surgeons to be among the most challenging meningiomas to completely remove due to their propensity to encase important vessels like the internal carotid artery (ICA) and its branches, and invade the cavernous sinus and the optic canal, rendering complete tumor removal difficult and most of the time impossible, even in experienced surgeon's hands.

While some skull base meningiomas present as a localized mass, others present as a diffuse mass, infiltrating the cavernous sinus, encasing vessels, and invading cranial nerve foramina. Most skull base surgeons are well aware that not all clinoid meningiomas are the same. However, the literature to date has generally not analyzed outcomes for clinoidal meningiomas in the same way that skull base surgeons think of them when they are planning an operation.

In this article, we summarize our institutional experience removing these uncommon and challenging skull base meningiomas. with a specific emphasis on the different steps to acheive a total removal with the best clinical outcomes.

MATERIEL AND METHODS

In neurosurgery department of Bab El Oued hospital, we operated 64 clinoid meningiomas from 2002 to 2018, to report the different steps through a case report.

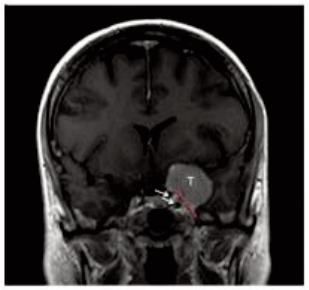
1. Case report:

Female Patient of 47 years old, with past medical history of blood hypertension, unstable diabetes under treatment, Crohn's Disease, Dyslipidaemia, she had hysterectomy years ago

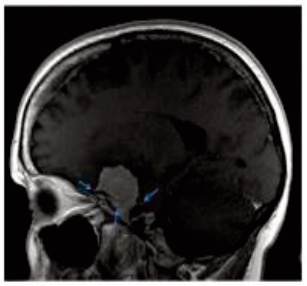
She was complaining of some subjective vision changes in her left eye without visual loss, for Dizziness and generalized feeling of not doing well, she was transferred to our care, evaluated with an MRI and found a left clinoidal region meningioma with compression of the surrounding brain, the visual field showed an early inferior arcuate defect in her left eye.

After She underwent a medical work up, stabilisation of her diabetes, she had surgery.

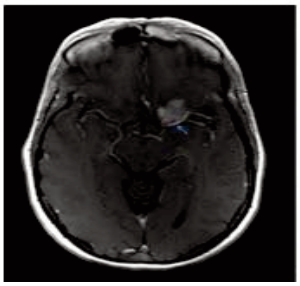
2. Work up:



Pic 1: Coronal brain MRI on T1, shows a hyper-intense extra-axial tumor, involving the region of the left anterior clinoid and the lateral wall (red dotted line) of the cavernous sinus (left), the internal carotid is encased (white arrow). This tumor put pressure on the frontal and temporal lobes



Pic 2: Sagittal brain MRI on T1, shows the posterior extension of the tumor, And its probable vascularization (Blue arrows) from, the posterior ethmoidal artery in front, medal meningeal artery laterally and Bernasconi casinarii artey posteriorly



Pic 3: Axial brain MRI, shows the relationship of the upper part of the tumor with the middle cerebral artery (Blue arrow) which has been raised.

3. Surgical technic:

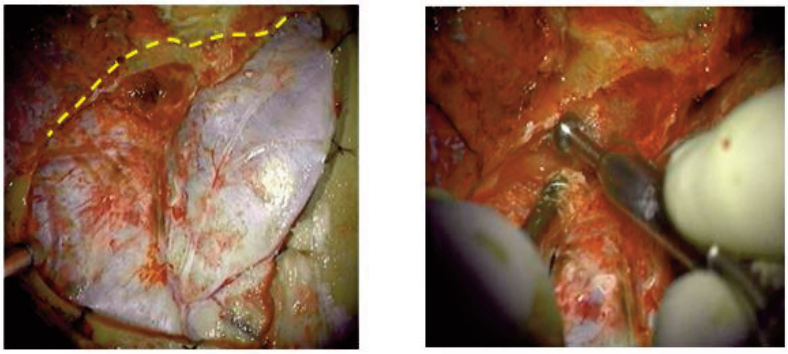
The meningioma is a benign extra-axial tumor originating from the dura matter, its clinoid localization is vascularized by the posterior ethmoidal artery, medial meningeal artery and can also be the Bernasconi Casinarii artery.

The purpose of this surgery is to perform a complete resection while preserving neighboring neuro-vascular structures, for this the strategy is:

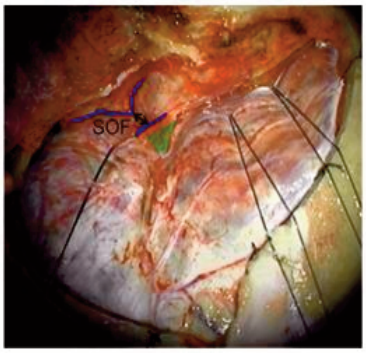
1. Pterional flap is performed with drilling of the sphenoidal wing including the clinoid and optic strut, opening of the superior orbital fissure and unroofing the optic canal; By this way we avoid retraction on the brain parenchyma.
2. Proceed with the extradural devascularization first of the tumor by the coagulation of its feeding arteries, as the posterior ethmoidal artery beneath the frontal lobe, and the middle meningeal artery at its exit from the foramen spinosum.
3. The proximal opening of the dura mater and dural ring of the internal carotid artery, as well as the dura mater of the optic canal and excision of the tumor surrounding and invading these two structures.
4. Opening of the dura mater in front of the sylvian valley, dissection and excision of the tumor from the arterial axis in a retrograde way from the internal carotid to the ACM and its bifurcation.
5. The previous dissection allows the tumor to be divided into two parts according to the arterial plane; The frontal part which is to be dissected, according to the arachnoid plan, of the parenchyma as well as the anterior cerebral arteries on their A1 segment, and the departure of the heubner artery and the fronto-orbital one.

Then the second part which is temporal sided, must be dissected from the deep sylvian veins and branches of the ACM.

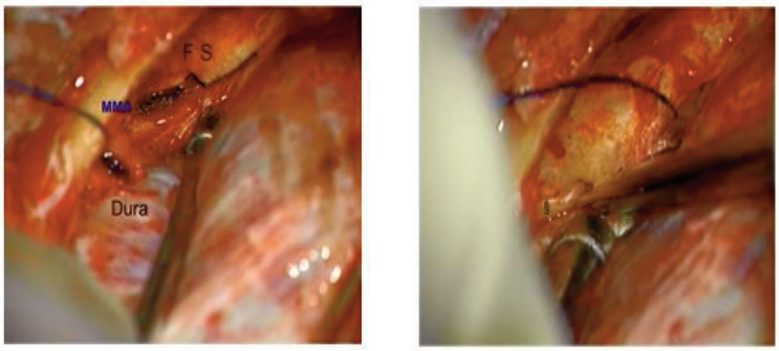
At the end of the operation, a perfect hemostasis and closure of the dura matter with placement of a fat graft taken from the abdomen.



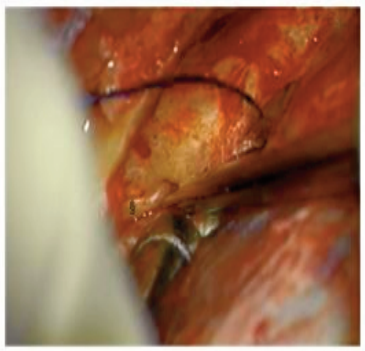
Pic 4. Left pterional approach, A: the yellow dashed line shows the bone to drill, B: Drilling of the sphenoid wing



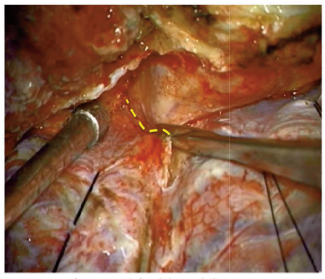
Pic 5: Opening the lateral wall of the Orbit, and the Superior Orbital Fissure (SOF). Anterior Clinoidal Process (Green)



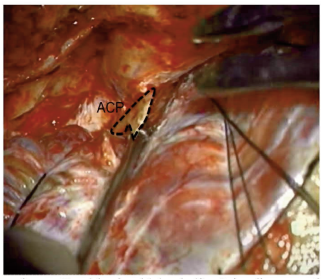
Pic 6: Extra-dural sub-temporal dissection of the Foramen Spinosum (FS)(A), Coagulation and division of the middle meningeal artery (MMA, §) (B)



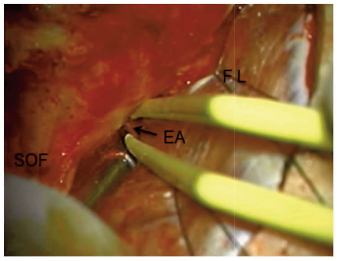
Pic 7: The lateral Orbital fissure bone (temporal side) is opened first, then the Coagulation of the Orbito meningeal band in which runs the Orbito meningeal artery.



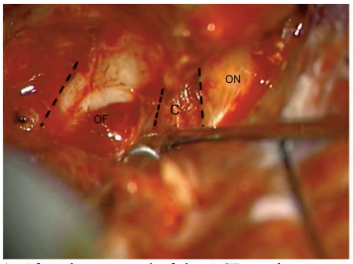
Pic 8: meningo-orbital band () was transected following the dashed yellow line, facilitating access to the ACP.



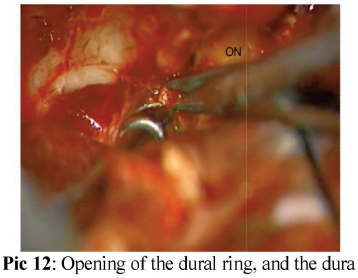
Pic 9: The ACP (dashed black line) is dissected from the Dura covering the frontal lobe, and Removed with a ronger instrument



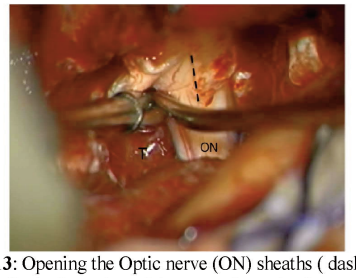
Pic 10: Coagulation of the ethmoïdal artery (**EA**), the second feeding artery.
SOF: Superior orbital Fissure
FL: Frontal Lobe.



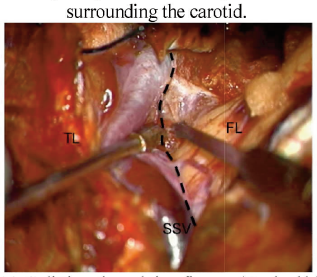
Pic 11: After the removal of the ACP, optic strut, and unroofing of the optic canal, Three neuro-vascular compartments are highlighted:
ON: Optic nerve - **C**: Carotid
OF: the contents of the orbital fissure



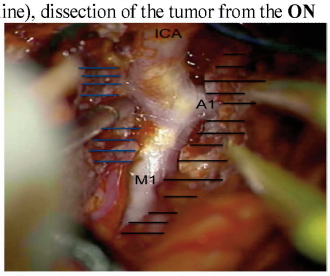
Pic 12: Opening of the dural ring, and the dura surrounding the carotid.



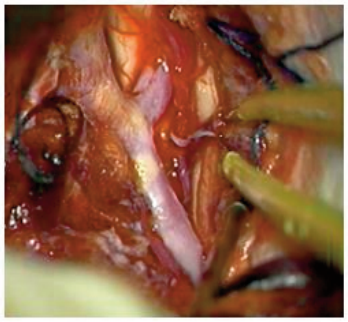
Pic 13: Opening the Optic nerve (ON) sheaths (dashed black line), dissection of the tumor from the **ON**



Pic 14: Splitting the sylvian fissure (Dashed black line), medial of the superficial sylvian vein (SSV),
TL: Temporal lobe - **FL**: Frontal lobe

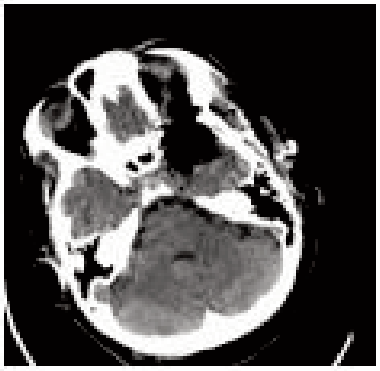


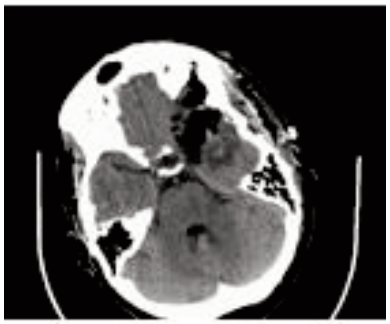
Pic 15: dissection and removal of the tumor from Internal carotid artery (ICA) until its bifurcation, segments M1 and A1
The tumor had also being split on two parts relative to the middle cerebral artery plan, the frontal part (black lines), temporal part (bleu lines)



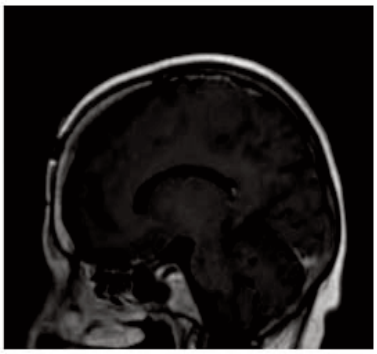
Pic16: Removal of the Frontal Part of the Tumor

RESULTS

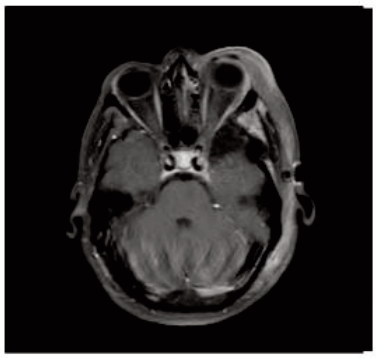




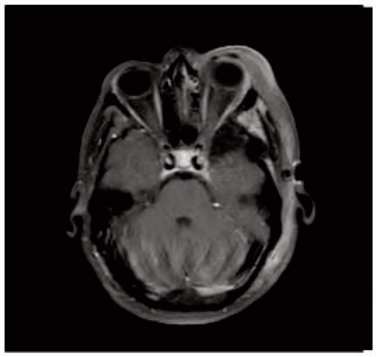
Pic 17: Brain TC scan , showing the bone removal (sphenoid wing)



Pic 18: Sagittal T1 brain MRI,showing a total removal of the tumor.



Pic 19: Axial brain MRI, showing the optic nerve and the carotid of the right side freed from the tumor.



Pic 20: coronal brain MRI, shows a total removal of the tumor from all the left clinoidal region

DETAILS OF THE SURGICAL TECHNIC:

Under general endo- tracheal anaesthesia, the patient was put in supine and the head fixed in 3 points mayfield head holder and tilted to the right side. The left fronto temporal region was shaved, scrubbed, and draped in the usual sterile manner.

The neuronavigation was calibre and used during the intervention.

A curvilinear incision was made in the fronto temporal region and the flap reflected anteriorly. The temporalis muscle was then cut from its attachment to the superior temporal line and away from the posterior aspect of the junction of the zygoma and the orbital rim and reflected inferiorly and posteriorly.

Then the perforator and the craniotome were used to establish the bone flap in the fronto-temporal region.

The rest of the surgery was done under the microscope using microdissection technique.

The high-speed drill was used to drill the sphenoid wing flat with the orbital roof, down to the level of the anterior clinoïde process.

The orbital roof was removed in its posterior third as well as the anterior clinoïde process which was quite enlarged and hyperostotic with evidence of bone compression to the optic canal which was compressed as well.

Following this, the epidural haemostasis, was established in the pre-temporal and upper temporal region along the middle fossa where the anterior aspect of the cavernous sinus was exposed also, the right sub-fontal region was elevated well and there were several feeders coming to the

clinoidal region which were providing blood to the tumor including branches from middle meningeal artery as well as branches from the intracavernous internal carotid artery.

There was a large branch arising from the meningo-hypophyseal artery going through Parkinson's triangle and providing the temporal dura with blood supply to the tumor as well. This allowed the tumor to become much less vascular.

At this stage the dura was opened along the intentation of the sphenoid wing and then followed laterally towards the medial aspect of the optic nerve.

The base of the cut extended from just above the optic nerve medially and going laterally over the region of the dural ring and the entry site of the third nerve of the occulomotor trigon and further laterally to the sub-temporal region. This was the whole extent of the base of the aneurysm and the blood supply region

The dura was then reflected exposing the tumor which was significantly impinging into the brain both in the frontal and temporal region and over the proximal aspect of the sylvian fissure.

The initial-dissection was carried over the optic nerve and the carotid artery, opening the falciform ligament decompressed the optic nerve.

The tumor was extending under optic nerve and over the carotid artery medially towards the region of the tuberculum sellae. This part of the tumor was coagulated and removed and the extension of the tumor over the carotid artery was followed along the dural ring region.

The dural ring itself was involved with tumor and it was cut all the way from the optic nerve and the carotid toward the third nerve.

The tumor was then debulked over the carotid artery and followed distally and the debulking was carried then to its lateral extension into the temporal fossa.

The most lateral edge of the tumor was reached and the dural cut was beyond that point to remove a safe margin.

It was then followed posteriorly to its most posterior extension along the edge of the tentorium.

This part was further debulked and then the medial part of the tumor over the optic nerve was also debulked as it pushed against the frontal orbital gyrus.

Once this proximal aspect of the carotid was exposed all the way to the level of the bifurcation, then from the distal aspect, the sylvian fissure was opened starting from the level of the limen insulae and followed proximally to the level of M1 segment.

At this stage the tumor was followed from the M1 segment to the carotid artery by debulking the tumor above it and paying attention to all the different branches including temporal branches and the area where the perforators run medially.

Once the whole span of the middle cerebral artery and the carotid artery was exposed, the tumor was divided into two compartments, one medial impinging into the fronto orbital gyrus, and one lateral pushing against the temporal operculum.

Attention was then concentrated towards the frontal tumor component which was debulked and followed to its most deep part where it became clear that the pia arachnoid layer vas violated in that region and the tumor had to be undermined through the plane between the violated pia arachnoid and the tumor capsule.

This necessitated removing part of the pia arachnoid in that region.

Once the tumor was removed haemostasis was established.

The attention was directed to the temporal region where the tumor was dissected away from its attachment to the pia arachnoid.

On that side, the attachment to the arachnoid was not as adherent as it was of the frontal side. This was carefully dissected and separated away from the pia surface until the whole piece was removed a way from the brain.

There several branches from the temporal middle cerebral artery branches that were very adherent to the capsule of the tumor which were carefully dissected using the microscope with magnification and microdissection technic.

Once gross total resection was achieved, then the dural closure was done and a fat graft taken from the abdomen is placed in the drilled zone.