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Clinoidal Type 1 - A Case Report

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ABSTRACT

The clinoidal region, situated at the skull base near the clinoid processes of the sphenoid bone, involves critical anatomical structures. Clinoidal Type 1 variation refers to the prominence or enlargement of the anterior clinoid process, a relatively rare condition with a prevalence ranging from 10% to 30%. This variation poses significant medical challenges due to its complex anatomy and the need for careful surgical approaches to avoid complications.

Symptoms associated with Clinoidal Type 1 include severe headaches, visual disturbances, hormonal dysregulation, and neurological impairments. The etiology is multifactorial, involving genetic predisposition, environmental triggers, and hormonal dysregulation. Diagnosis typically involves advanced imaging techniques such as CT and MRI, 3D reconstructions, neurological testing, endocrine evaluation, and cerebrospinal fluid analysis.

A case report of a 56-year-old female with a right sphenoid meningioma demonstrates the complexities involved in managing Clinoidal Type 1 variations. The patient presented with status epilepticus and a large tumor encroaching on critical neurovascular structures. Surgical intervention included a right fronto-temporal craniotomy and partial excision of the tumor, with some residual tumor left to avoid vascular injury. Despite achieving a Simpson grade-1 excision, the decision to leave residual tumor underscores the delicate balance between complete tumor resection and preservation of neurological function.

This case highlights the intricate decision-making process in neurosurgical interventions, the importance of intraoperative judgment and the need for advancements in surgical techniques and imaging modalities. It underscores the necessity for comprehensive postoperative care and long-term follow-up to monitor for tumor recurrence and neurological deficits. Further research is warranted to refine surgical approaches and adjuvant therapies, aiming to minimize morbidity and improve long-term survival and quality of life for patients with complex meningiomas involving critical neurovascular structures.

INTRODUCTION

The clinoidal region refers to a part of the skull base located near the clinoid processes, which are small bony protuberances found at the base of the skull. There are two types of clinoidal processes: Type 1 and Type 2 [1]. Clinoidal Type 1 typically refers to an anatomical variation where there is a prominence or enlargement of the anterior clinoid process. These processes are located at the anterior tip of the lesser wing of the sphenoid bone, forming a bony ridge. The clinoidal processes play crucial roles in anchoring the tentorium cerebelli (a membrane separating the cerebrum from the cerebellum) and serving as attachment points for various structures within the skull [2].Clinoidal Type 1, while relatively rare, presents a significant medical challenge due to its complex and varied manifestations. Studies have reported varying prevalence rates of Clinoidal Type 1 variations, ranging from around 10% to 30% of examined cases. The prevalence may vary across different populations and ethnic groups.Surgeons may need to modify their surgical approach and techniques when dealing with patients with Clinoidal Type 1 variations. Careful dissection and preservation of important structures around the anterior clinoid process are essential to minimize the risk of intraoperative complications. Limited studies have investigated the impact of Clinoidal Type 1 variations on postoperative outcomes and complications following skull base surgeries. Further research is needed to better understand the long-term effects of these variations on surgical outcomes and patient prognosis [3,4].

SYMPTOMS

Clinoidal Type 1 presents a diverse array of symptoms, reflective of its intricate involvement of multiple organ systems and structures. Among the cardinal manifestations are severe headaches, often described as throbbing or pulsating and resistant to conventional pain management strategies. These headaches may be accompanied by visual disturbances, including blurry vision, visual field defects, and in severe cases, partial or complete vision loss. Additionally, individuals may experience hormonal dysregulation, leading to manifestations such as menstrual irregularities, infertility, and alterations in libido [5]. Neurological symptoms are prevalent in Clinoidal Type 1, encompassing cognitive impairments such as memory loss, difficulty concentrating, and executive dysfunction. Mood disturbances, including depression and anxiety, further compound the clinical burden. Moreover, individuals may present with symptoms related to compression of adjacent structures, such as facial pain, numbness, and cranial nerve deficits [6].

Etiology

The etiology of Clinoidal Type 1 is multifactorial,

- Genetic predisposition- Genetic factors play a significant role, with certain gene mutations predisposing individuals to the development of pituitary adenomas or other lesions within the cavernous sinus.
- Environmental triggers- Environmental influences, such as exposure to radiation, toxins, or infectious agents, may act as precipitating factors in susceptible individuals.
- Hormonal dysregulation- particularly involving the hypothalamic-pituitary axis, is central to the pathogenesis of Clinoidal Type 1. Dysfunction in hormonal signaling pathways can lead to aberrant growth and function of the pituitary gland, contributing to the development of adenomas or other lesions [7].

DIAGNOSIS

Computed Tomography (CT) Scan: CT imaging provides detailed cross-sectional images of the skull and can detect bony abnormalities, including variations in the shape or size of the anterior clinoid process. CT scans may be performed with or without contrast enhancement.

Magnetic Resonance Imaging (MRI): MRI imaging offers excellent soft tissue contrast and is particularly useful for visualizing structures such as the optic nerve, pituitary gland, and surrounding tissues. MRI can help identify any associated lesions or abnormalities, such as pituitary adenomas, meningiomas, or vascular anomalies.

3D Reconstruction: Three-dimensional reconstructions of CT or MRI images can provide additional insights into the spatial relationships and anatomical variations of the clinoidal region, aiding in surgical planning and decision-making.

Neurological Testing: Depending on the clinical presentation, additional tests may be warranted to evaluate specific neurological functions, such as visual field testing, electroretinography (ERG), or electrophysiological studies of cranial nerves.

Endocrine Evaluation: If pituitary gland abnormalities are suspected, hormonal assays and endocrine testing may be performed to assess pituitary hormone levels and function.

Cerebrospinal Fluid (CSF) Analysis: In cases of suspected increased intracranial pressure or intracranial pathology, lumbar puncture (spinal tap) may be indicated to analyze CSF composition and pressure [8].

CASE REPORT

A 56 years female patient of height 158cm, weight 70kgs, BMI 28kg/sqm was brought to tertiary care hospital with known case of status epilepticus for which she was on TAB LEVEPIL 750MG BD. She had one episode of acute seizures followed by unresponsiveness for which she was intubated for 1 day in another hospital and extubated. Radiological imaging was suggestive of right sphenoid meningoma. She was managed conservatively and counselled regarding the need of surgery in view of right sphenoid wing meningoma.

MRI report: Right sided middle sphenoid wing meningoma. Tumor was quite large in size and was involving right ICA, M1, A1, A2 Acom artery and optic apparatus, so the family and patient were counselled that the surgery is advisable to prevent visual and neurological deterioration as the tumor was in close vicinity of optic apparatus and major vessels. Safe maximal removal of tumor will be attempted. The family and the patient agreed and she Underwent Right Fronto-Temporal Craniotomy and Excision of Anterior Clinoidal Meningoma on 08/04/2024. Pre-OP evaluation was suggestive Iron Deficiency Anemia (severe). Reports showed her Hb was 6g/dL, so she received 2 units PRBC transfusion and injectable iron forms.

SURGERY PROCEDURE

Right pterional craniotomy. Dura was tense upon craniotomy. Sphenoid ridge was drilled. C-shaped durotomy. Sylvian fissure was dissected. Lateral sub-frontal approach. Extra-axial well encapsulated tumor noted following frontal lobe retraction with ill-defined arachnoid plain between brain and the tumor and epicenture of tumor at anterior clinoid process. Dilated tumor vessels noted on supero-lateral surface of the tumor which were coagulated. Internal decompression of the tumor done. Tumor was firm in consistency, non suckable, pearly white in colour and moderately vascular. Right ICA, M1, A1, A2 and Acom artery were noted inside the tumor which were separated. However, some part of the tumor which was adherent with right ACA-Acom was left behind because of pure arachnoid plane and to prevent vessel injury. Opposite side A2 visualized. Both sides optic nerves and chiasma visualized and preserved. Bleeding from Acom complex noted while separating the tumor which was controlled using bipolar, surgical and fibrin glue. Intra-operative ICG showed good flow in both the ACA and Acom. Simpson grade-1 excision of the tumor done. Hemostasis achieved. Primary dual closure done. Bone flap replaced back.

Before the Surgical Procedure the Patient was Given Dexamethasone 8mg, Inj Solumetrol- 250mg Iv As a Stat Medication & Inj Ceftriaxone 1gm Iv Bd For Infection Prophylaxis. Tab Nemodipine 60mg Every 6 Hourly was Given to Prevent Vasospasm. After the Procedure Dexamethasone 2mg Iv Tid was Given. Inj Tamin 1gm Iv Tid As Analagesic, Syp Duphalac 25ml Hs as Laxative.

DISCUSSION

The present case describes a 56-year-old female with status epilepticus secondary to a large right-sided middle sphenoid wing meningioma, encroaching upon critical neurovascular structures. Despite the surgical intervention of right fronto-temporal craniotomy and excision of the anterior clinoidal meningioma, some residual tumor remained due to adherence with the right ACA-Acom artery complex. The decision to leave behind this portion of the tumor was made to mitigate the risk of vascular injury and preserve neurological function.

While the surgery achieved a Simpson grade-1 excision of the tumor, the decision not to remove the residual portion may raise concerns regarding the possibility of tumor regrowth and its associated complications.

CONCLUSION

This case underscores the complex decision-making process involved in neurosurgical interventions, balancing the goals of maximal tumor resection with the preservation of vital neurovascular structures. The decision to leave residual tumor near critical neurovascular structures prompts ongoing discussions regarding optimal surgical strategies and the need for further research to refine treatment protocols. It also highlights the importance of intraoperative judgment and the complexities involved in achieving complete tumor excision while minimizing the risk of postoperative complications. Despite advancements in neurosurgical techniques, cases like this highlight the ongoing challenges in achieving complete tumor resection while preserving neurological function. This case serves as a reminder of the ongoing need for advancements in surgical techniques, imaging modalities, and adjuvant therapies to improve outcomes and quality of life for patients with

complex meningiomas. Long-term follow-up and surveillance are essential to monitor for tumor recurrence and neurological deficits, emphasizing the importance of comprehensive postoperative care in patients undergoing meningioma resection. Further research is warranted to elucidate the optimal surgical approaches and adjuvant therapies for meningiomas involving critical neurovascular structures, with the goal of minimizing morbidity and maximizing long-term survival for affected patients.

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