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Endoscopic Transsphenoidal Resection of a Non-Functioning Ectopic Pituitary Adenoma Located in the Clivus: A Case Report and Literature Review

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1. Abstract

We successfully removed a rare ectopic pituitary adenoma from a 64-year-old female patient initially misdiagnosed with a chordoma. The tumor was located in the slope region and posed a challenge due to its rarity and location. Using neuro-navigation and neuro-endoscopic techniques, we performed a transnasal transsphenoidal resection and confirmed postoperatively that the tumor was a non- functional pituitary adenoma. Although the patient experienced temporary cortisol deficiency after surgery, she recovered well.

To accurately diagnose ectopic pituitary adenomas of clivus, doctors must carefully evaluate the patient's imaging results and hormone levels. If necessary, nuclear medicine scans can also aid in diagnosis. Endoscopic transnasal- transsphenoidal surgery is the preferred treatment method, and preoperative multimodal imaging evaluation and intraoperative neuro-navigation technology are essential for a successful surgery.

2. Keywords:
Ectopic pituitary adenoma, Endoscopic transnasal-transsphenoidal resection, Neuro-navigation, Imaging evaluation

3. Introduction

Upper slope region mass is usually associated with chordoma or bone metastases.Pituitary tumors in this area that do not occupy the sella are uncommon. The anterior pituitary lobe develops from finger-like tissue outside the cranial invagination derivedfrom the ectoderm during early embryonic development. This tissue then invaginates into the stomodeal opening area of the oral cavity and migrates upward to form the anterior pituitary lobe [1] . During embryonic development, some pharyngeal pouch andtube cells disappear, but a small amount of residual tissue remains in the top front of the pharynx. This residual embryonic tissue may be the origin of ectopic pituitary adenomas (EPAs), which are not histologically related to pituitary adenomas within thesella [2]. To accurately diagnose EPAs, we must carefully evaluate imaging results and hormonal levels, and we can treat them effectively with endoscopic transnasal transsphenoidal surgery. Preoperative multimodal imaging evaluation and intraoperative neuro-navigation technology are crucial for successfully performing thissurgical approach.

EPAs are rare tumors that are typically found in the region of the sphenoid sinus [2,3] , with only a few cases reported in the slope region [4]. We report a case of a patientwith an EPA in the slope region, initially misdiagnosed as a chordoma. This highlights the diagnostic challenges associated with EPAs. Accurate diagnosis is crucial for successful treatment with endoscopic surgery. By sharing this case, we aim to raise awareness and improve outcomes for patients with EPAs.

4. Case Introduction

A 64-year-old woman visited the clinic due to dizziness for a week. A head CT scan showed a soft tissue mass in the slope region that destroyed the slope bone (Figure1).

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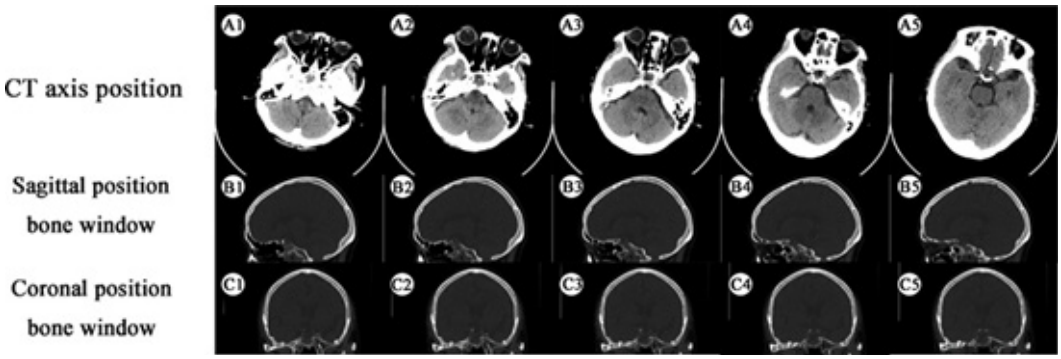

Figure 1: A1-A5: Soft tissue shadow in the slope region, B1-B5: Sagittal bone window, C1-C5: Coronal bone window, indicating significant destruction of the slope bone

A head MRI revealed a nodular lesion in the skull base slope region, showing slightly elongated T1 and T2 signals, heterogeneous internal signals, and uneven contrast enhancement. A portion of the lesion grew towards the sella turcica and cavernous sinus, indicating the possibility of a chordoma (Figure 2).

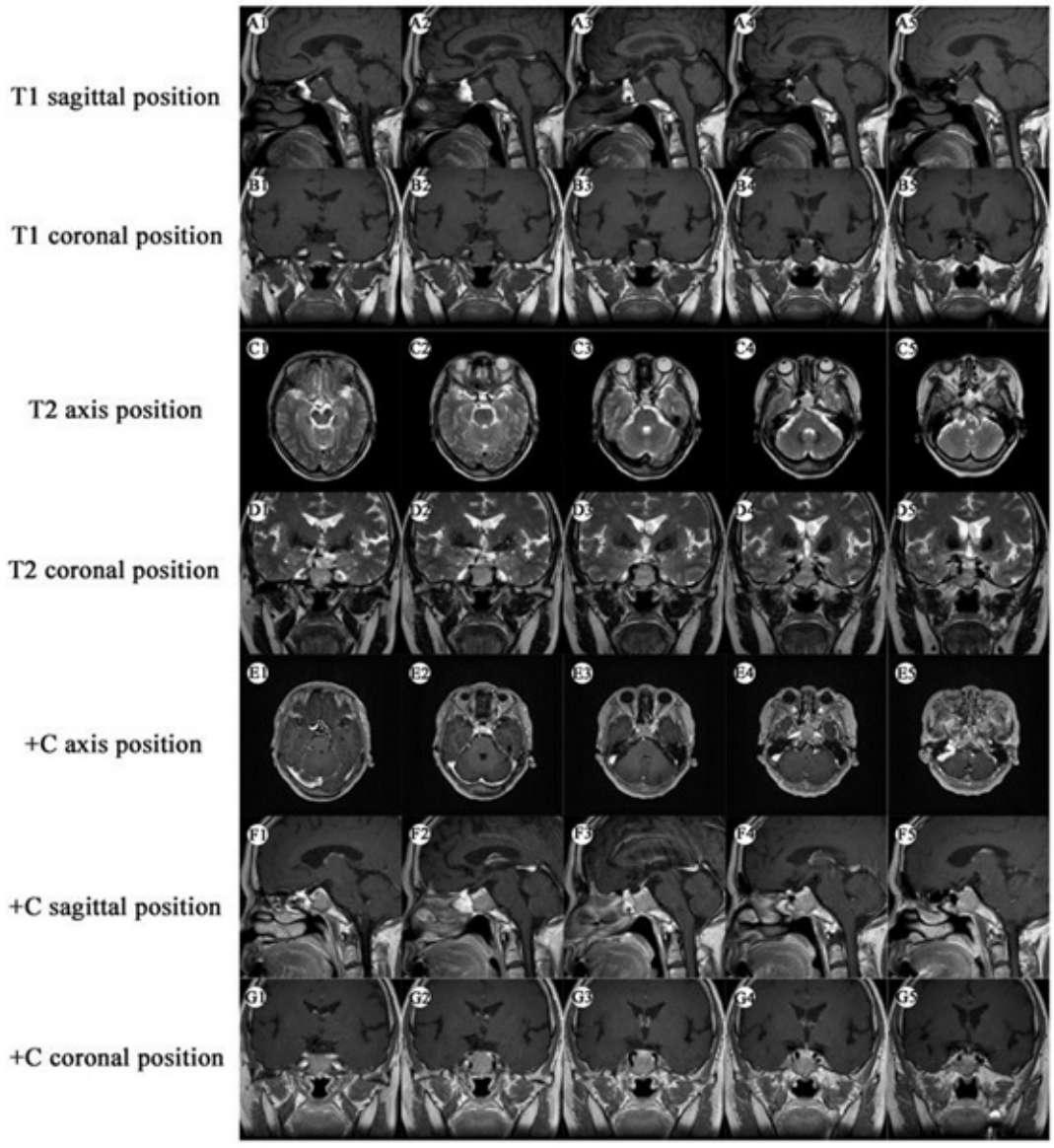

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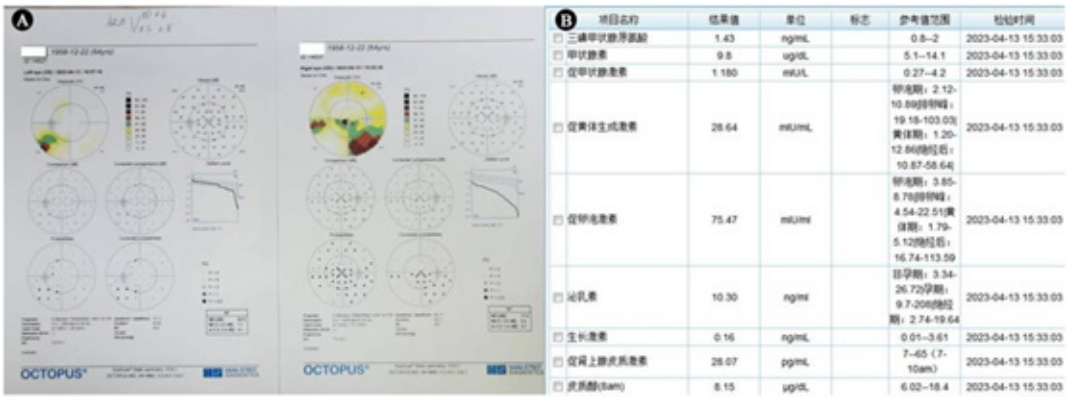
Figure 2: A1-A5 show T1-weighted sagittal images, B1-B5 show T1-weighted coronal images, indicating an iso-intense mass in the slope region, partially extending into the sphenoid sinus and sellar floor; C1-C5 show T2-weighted axial images, D1-D5 show T2-weighted coronal images, suggesting an iso-intense mass with mixed high signal intensity in the slope region, sellar and sphenoid sinus, closely related to the cavernous segment of the internal carotid artery; E1-E5 show contrast-enhanced axial images, F1-F5 show contrast-enhanced sagittal images, G1-G5 show contrast-enhanced coronal images, indicating significant enhancement of the tumor with relatively uniform enhancement.

The patient had a history of hypertension and was taking amlodipine. Upon admission, the patient was alert with normal visual acuity and reflexes. Also, we evaluated the patient's pituitary function and conducted visual acuity and field tests, which showed no significant abnormalities (Figure 3).



项目名称	结果值	单位	标志	参考值范围	检验时间
三碘甲状腺原氨酸	1.43	ng/mL		0.8--2	2023-04-13 15:33:03
甲状腺素	9.8	ug/dL		5.1--14.1	2023-04-13 15:33:03
促甲状腺激素	1.180	mIU/L		0.27--4.2	2023-04-13 15:33:03
促黄体生成激素	28.64	mIU/mL		卵泡期：2.12-10.89[排卵期：19.18-103.03]黄体期：1.20-12.86[绝经后：10.87-58.64]	2023-04-13 15:33:03
促卵泡激素	75.47	mIU/ml		卵泡期：3.85-8.78[排卵期：4.54-22.51]黄体期：1.79-5.12[绝经后：16.74-113.59	2023-04-13 15:33:03
泌乳素	10.30	ng/ml		非孕期：3.34-26.72[孕期：9.7-208[绝经期：2.74-19.64	2023-04-13 15:33:03
生长激素	0.16	ng/mL		0.01--3.61	2023-04-13 15:33:03
促肾上腺皮质激素	28.07	pg/mL		7--65（7-10am）	2023-04-13 15:33:03
皮质醇(8am)	8.15	ug/dL		6.02--18.4	2023-04-13 15:33:03

Figure 3: A shows visual field examination: right eye vision 0.6; left eye vision 0.5; no apparent visual field defect in both eyes. B shows a complete pituitary hormone panel: triiodothyronine (T3), thyroxine (FT4), thyroid-stimulating hormone (TSH), luteinizing hormone (LH), follicle- stimulating hormone (FSH), prolactin (PRL), growth hormone (GH), adrenocorticotropic hormone (ACTH), and cortisol (Cr) levels are all within normal limits.

The treatment plan involved a series of steps. Firstly, multimodal imaging was employed to assess the relationship between the tumor and bilateral internal carotid arteries before surgery. Then we used intraoperative navigation technology to perform endoscopic transsphenoidal surgery to remove the pituitary tumor in the slope area. Multimodal imaging showed that the tumor was closely related to the bilateral internalcarotid arteries, with the tumor compressing the arteries externally (Figure 4). We prepared the mucoperiosteal flap of the right nasal cavity and partially removed the nasal septum to expose the root of the pterygoid bone. Then we utilized intraoperativenavigation technology to determine the approximate location and extent of the tumor.

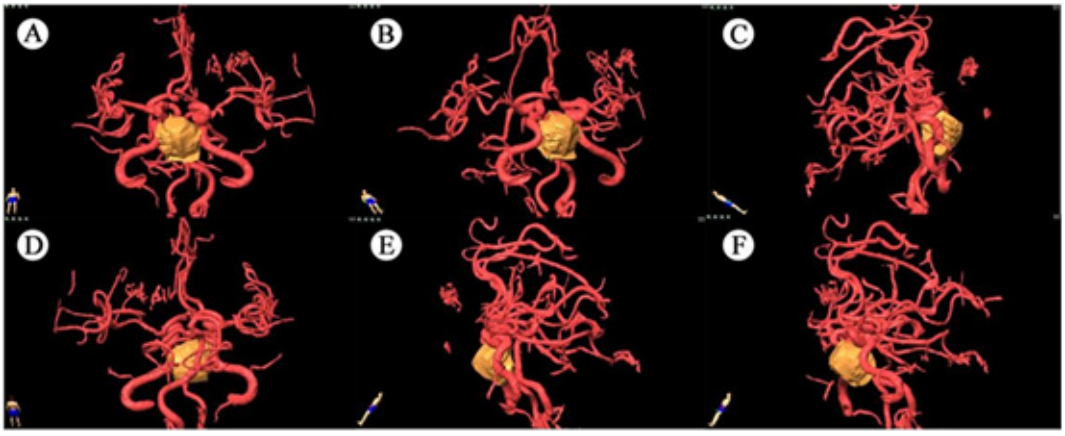


Figure 4: The preoperative multimodal imaging fused the internal carotid artery with the tumor, revealing that the tumor was compressing both sides of the internal carotid artery cavernous segment.

After that, we ground away the pterygoid and slope bone while carefully protecting the internal carotid arteries based on the navigation scope. Upon entering the sphenoid sinus, a portion of the tumor was visible and removed. During this process, we discovered that they had caused damage to the bone at the bottom of the sella turcica, and the dura mater at the bottom of the sella turcica was partially affected. We removednecrotic tumor tissue protruding from the dura mater using a curette after discovering the tumor had invaded a portion of it. After dealing with the tumor in the slope area, we

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addressed the tumor in the sphenoid sinus and sellar region. After grinding away the slope bone, we located the tumor within it and removed necrotic tumor tissue in multiple directions until reaching normal bone tissue. After completing the tumor resection, we achieved hemostasis using hemostatic materials, and they used the mucoperiosteal flap to cover the sellar floor, concluding the surgery. (Figure 5) ("We recorded the entire surgical process in a video titled "Endoscopic Transsphenoidal Resection of Ectopic Pituitary Adenoma in the Slope Area."

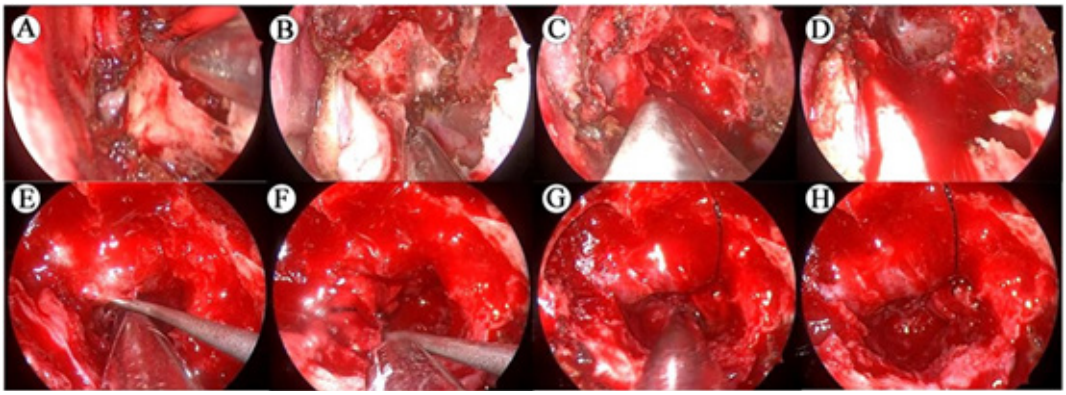

Figure 5: A: Exposed the petrous bone; B: Removed the petrous bone and destroyed the bone of the sloping area; C-D: Entered the cavernous sinus and removed the tumor inside; E: The
tumor invaded the bottom of the pituitary fossa dura mater, and scraped the inside of the pituitary fossa with a scraper; F: Removed most of the tumor in the slope area, probed around, and scraped until normal bone with a hard texture was reached; G-H: The tumor was removed entirely, exposing the bottom of the pituitary fossa, the slope area, and the internal carotid artery on both sides.

The surgery went well, and postoperative imaging showed successful tumor removal. (Figure 6)

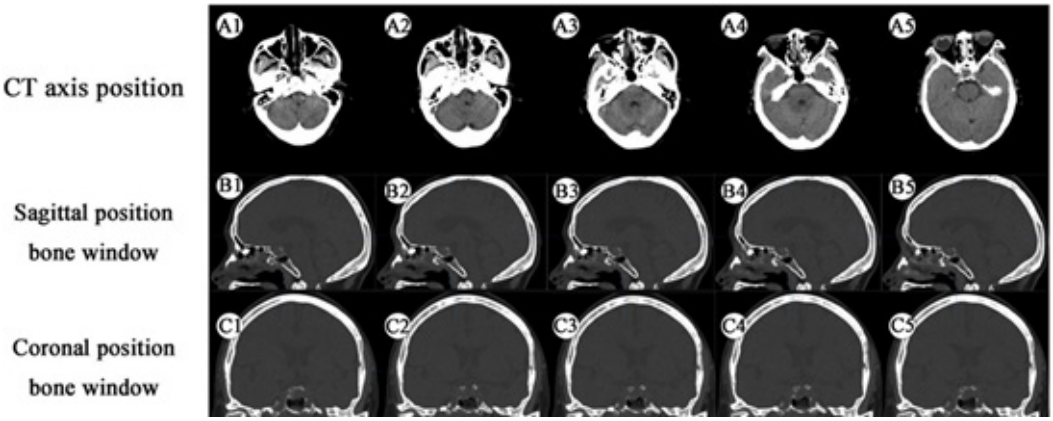

Figure 6: A1-A5 shows postoperative CT images, indicating complete tumor resection in the slope area; B1-B5 are bone window sagittal views, and C1-C5 are coronal views. Compared with preoperative images, the tumor has been partially removed cleanly.

The patient had a smooth recovery with no complications, except for low cortisol levels treated with medication. The patient was discharged after a week. The pathology report showed a pituitary adenoma with a low Ki-67 index, indicating low tumor proliferation. Immunohistochemistry results showed a small amount of ACTH and negative for other hormones, while CD34, EGFR, and MMP-9 were slightlypositive, and P53 was weakly positive in a small amount. (Figure 7)

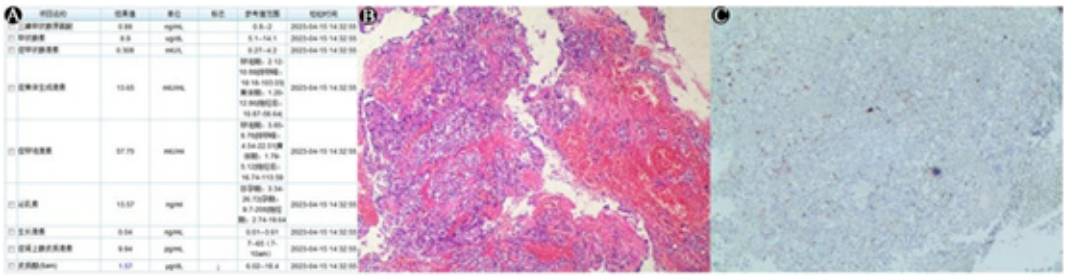

Figure 7: A shows postoperative pituitary hormone levels, with T3, FT4, TSH, LH, FSH, PRL, GH, and ACTH all within the normal range, while Cr is decreased compared to preoperative levels; B-C: postoperative pathology indicates pituitary adenoma, with immunohistochemistry revealing ACTH (small amount), LH (-), GH (-), PRL (-), FSH (-), TSH (-), Ki-67 (+, 3%), CD34 (vascular +), EGFR (+), MMP-9 (small amount +), and P53 (small amount weakly +).

5. Discuss

EPA is a rare condition where a pituitary adenoma grows outside the sella turcica and is not linked to the normal pituitary gland. Slope ectopic pituitary adenoma is a subtype of EPA, mainly occurring in the slope region. The cause and development of EPA are not yet well understood, and there are few documented cases in the medical literature[5-8]. The rarity of slope ectopic pituitary adenomas exposes our limited knowledge and experience in diagnosing and treating this condition, revealing two notable shortcomings. Firstly, our preoperative judgment about the tumor's nature was incorrect highlighting the need for further research and education. Secondly, we observed distinctnecrotic changes in the tumor's texture during the operation but did not perform intraoperative frozen section pathology, missing an opportunity to confirm our suspicions. These errors underscore the necessity for continued learning and improvement in diagnosing and treating slope ectopic pituitary adenomas.

Yang et al. examined 8 pituitary adenomas outside the sella turcica and found that CT imaging showed similar density to adjacent gray matter and moderate enhancementafter contrast administration [9]. Meanwhile, typical MR findings included iso-intensity on T1- and T2-weighted images, with mild enhancement after contrast administration. Nuclear imaging is a crucial diagnostic tool for ectopic pituitary adenomas, allowing accurate localization of pituitary hormone secretion and tumor position [10]. In contrast, chordoma are rare malignant bone tumors typically present as locally destructive midline lesions. Given their relatively late clinical manifestation, the prognosis for chordoma is generally poor [11]. Chordoma usually appear as osteolytic lesions on the upper slope with calcium deposition visible on CT scans, and they show a "honeycomb" appearance on MRI dueto fibrous septa, with a "finger pressure" depression on sagittal and ventral brainstem images [7, 12]. However, in this case, the imaging features did not show typicalchordoma characteristics, such as calcification or honeycomb appearance. Ectopic pituitary adenomas and chordoma may have similar imaging features, making diagnosischallenging, and surgical excision is often necessary for definitive pathological diagnosis.

Surgery is recommended for most pituitary tumors, except prolactinomas, based on tumor size, invasiveness, and optic nerve compression. Endoscopic neurosurgery isthe preferred treatment approach. Diagnosis of ectopic pituitary adenomas often requires surgery and pathology. Some cases of EPAare only discovered after treatment.Surgery can be a diagnostic and therapeutic option for patients with diagnostic difficulties. Timely neural decompression is critical in slope EPAs, as central nervous system disorders are common [12]. To assess the surgical risk and determine the appropriate treatment approach, we performed multimodal imaging before surgery, evaluating the tumor's relationship withthe cavernous sinus segment of the bilateral internal carotid artery. We used intraoperative navigation during surgery to reduce the risk of incomplete resection or injury to the internal carotid artery. The procedure was successful, and the patient had an uneventful postoperative recovery. He was discharged one week after surgery.

6. Conclusion

Diagnosing pituitary adenomas in the clivus is challenging due to bone destruction and differentiation from chordomas. CT and MRI, imaging, and hormone levels, aid indiagnosis. Radionuclide scans are also essential. Endoscopic transsphenoidal surgery isthe preferred treatment. Pre-surgery, evaluating the tumor's relationship with surrounding structures is crucial. During surgery, navigation can assist in determining tumor location and avoiding injury to the internal carotid artery while maximizing resection.

7. Acknowledge

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