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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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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.

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

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 derived from 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 and tube 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 the sella [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 this surgical 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 patient with 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.

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By sharing this case, we aim to raise awareness and improve outcomes for patients with EPAs.

Case introduction

The patient's general condition upon admission

A 64-year-old female patient presented to the clinic with a one-week history of dizziness. A computed tomography (CT) scan of the head revealed a soft tissue mass in the slope region which had caused destruction of the slope bone (Fig. 1). A head magnetic resonance imaging (MRI) revealed a nodular lesion in the skull base slope region, with slightly elongated T1 and T2 signals, heterogeneous internal signals, and uneven contrast enhancement. Additionally, a portion of the lesion was seen to be growing toward the sella turcica and cavernous sinus, indicating the possibility of a chordoma (Fig. 2).

Medical history and physical examination

The patient had a past medical history of hypertension and was taking amlodipine. Upon admission, the patient was alert with normal visual acuity and reflexes. Furthermore, we examined the patient's pituitary function and ran visual acuity and field tests, which showed no significant abnormalities (see Additional file 1: Figure S1).

Preoperative preparation and surgical procedure

Firstly, multimodal imaging was utilized to analyze the connection between the tumor and bilateral internal carotid arteries before the surgery. Subsequently, intraoperative navigation technology was employed to perform endoscopic transsphenoidal surgery to remove the pituitary tumor in the slope area. Multimodal imaging revealed that the tumor was closely related to the bilateral internal carotid arteries, with the tumor compressing the arteries externally (Fig. 3). The mucoperiosteal flap of the right nasal cavity was prepared, and the root of the pterygoid bone was exposed by partially removing the nasal septum. Utilizing intraoperative navigation technology, we were able to determine the approximate location and extent of the tumor. Subsequently, we carefully removed the pterygoid and slope bone while protecting the internal carotid arteries based on the navigation scope. Upon entering the sphenoid sinus, a portion of the tumor was visible and we proceeded to remove it. During this process, we noticed that the tumor had caused damage to the bone at the bottom of the sella turcica and had invaded a portion of the dura mater. We removed necrotic tumor tissue protruding from the dura mater using a curette after discovering the tumor had invaded a portion of it. Following the treatment of the tumor in the slope area, we proceeded to the sphenoid sinus and sellar region. We removed the bone in the slope area to expose the tumor, and then proceeded to remove the necrotic tumor tissue in multiple directions until normal bone tissue was reached. To achieve hemostasis, we employed hemostatic materials, and then used a mucoperiosteal flap to cover the sellar floor, thus concluding the surgery. (Fig. 4) (The video of the operation can be found in the additional files section, Additional file 2: Surgical video)

The prognosis of this patient

The operation was a success, as evidenced by postoperative imaging which showed the tumor had been successfully removed. (Fig. 5) The patient recovered without any issues, apart from the low cortisol levels which were treated with medication. The patient was discharged after a week. The pathology report showed a pituitary adenoma with a low Kiel 67 protein (Ki-67) index, indicating low tumor proliferation. Immunohistochemistry results showed a small amount of adrenocorticotropic hormone (ACTH) and negative for other hormones, while hematopoietic progenitor cell

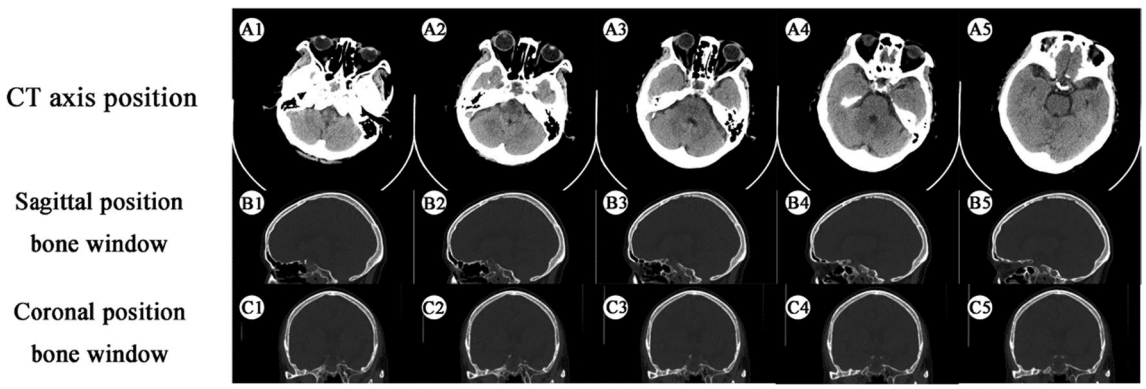

Fig. 1 **A1**–**A5** soft tissue shadow in the slope region, **B1**–**B5** sagittal bone window, **C1**–**C5** coronal bone window, indicating significant destruction of the slope bone

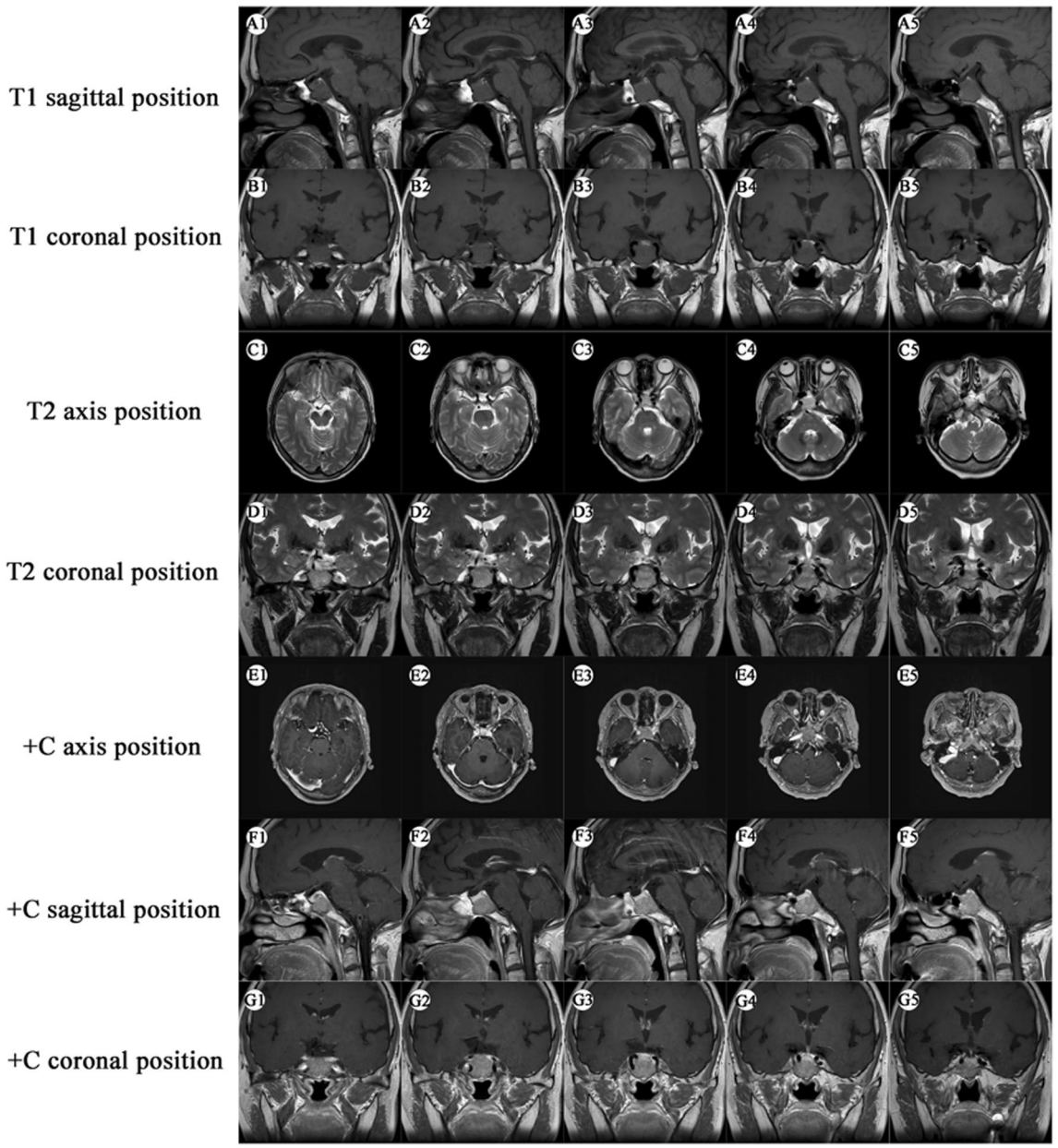

Fig. 2 **A1**–**A5** show T1-weighted sagittal images, **B1**–**B5** show T1-weighted coronal images, indicating an iso-intense mass in the slope region, partially extending into the sphenoid sinus and sellar floor; **C1**–**C5** show T2-weighted axial images, **D1**–**D5** show T2-weighted coronal images, 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

antigen CD34 (CD34), epithelial growth factor receptor (EGFR), and matrix metalloproteinase-9 (MMP-9) were slightly positive, and transformation-related protein 53 (P53) was weakly positive in a small amount. (See Additional file 1: Figure S2).

Discussion

EPA is a rare condition where a pituitary adenoma develops outside the sella turcica and is not connected to the normal pituitary gland. Slope ectopic pituitary adenoma is a subtype of EPA, mainly occurring in the slope region. However, the origin and growth of EPA are yet to be fully

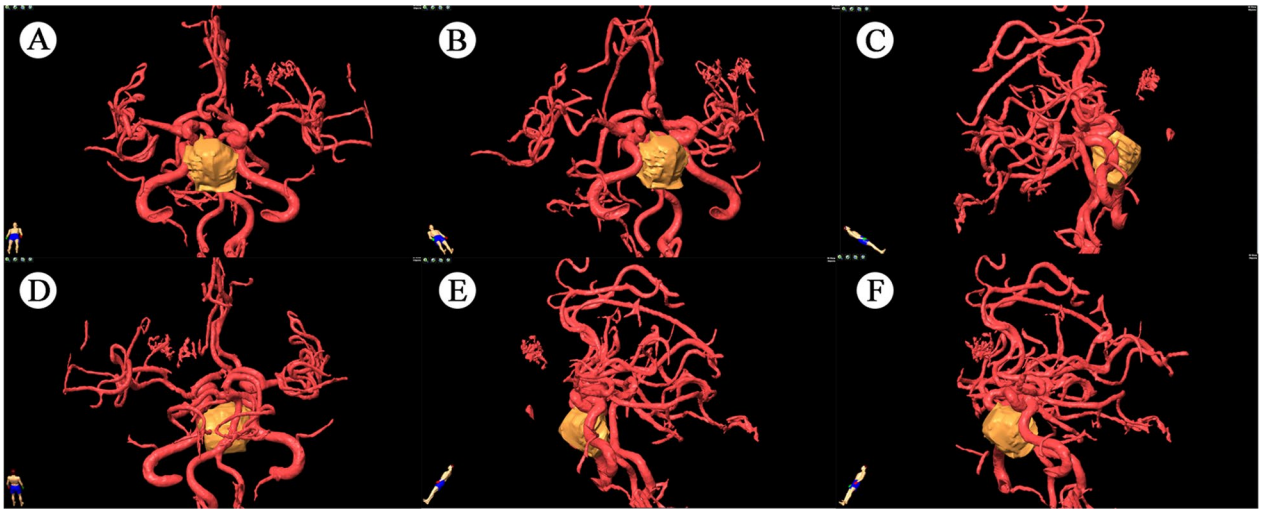

Fig. 3 **A**–**F**: The preoperative multimodal imaging fused the internal carotid artery with the tumor, revealing that the tumor was compressing both sides of the internal carotid artery cavernous segment

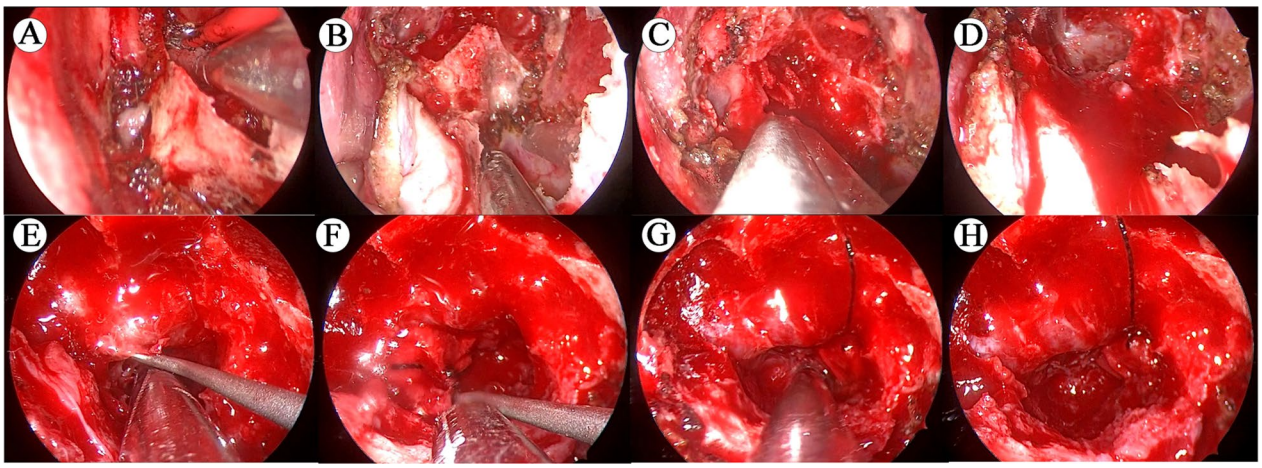

Fig. 4 **A** Exposed the petrous bone; **B** removed the petrous bone and destroyed the bone of the sloping area; **C**, **D** entered the cavernous sinus and removed the tumor inside; **E** the tumor invaded the bottom of the pituitary fossa dura mater, and scraped the inside of the pituitary fossa 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

comprehended and there are only a few reported cases in the medical literature [5–8].

The scarcity of slope ectopic pituitary adenomas highlights the lack of our expertise and understanding in diagnosing and treating this condition, indicating two main deficiencies. Initially, our preoperative assessment of the tumor's characteristics was inaccurate, thus emphasizing the need for further research and education. Moreover, during the procedure we noticed dissimilar necrotic changes in the tumor's texture but did not carry out intraoperative frozen section pathology, thus missing a chance to validate our doubts. These mistakes underline the requirement for ongoing learning and improvement in diagnosing and treating slope ectopic pituitary adenomas.

Yang et al. conducted a study of 8 pituitary adenomas located outside the sella turcica, and through CT imaging, discovered that the density of the adenomas was comparable to that of the adjacent gray matter, with moderate enhancement after the administration of contrast [9]. MRI scans typically showed iso-intensity on T1- and T2-weighted images, with mild enhancement following contrast administration. Nuclear imaging is a key diagnostic tool for ectopic pituitary adenomas, allowing for

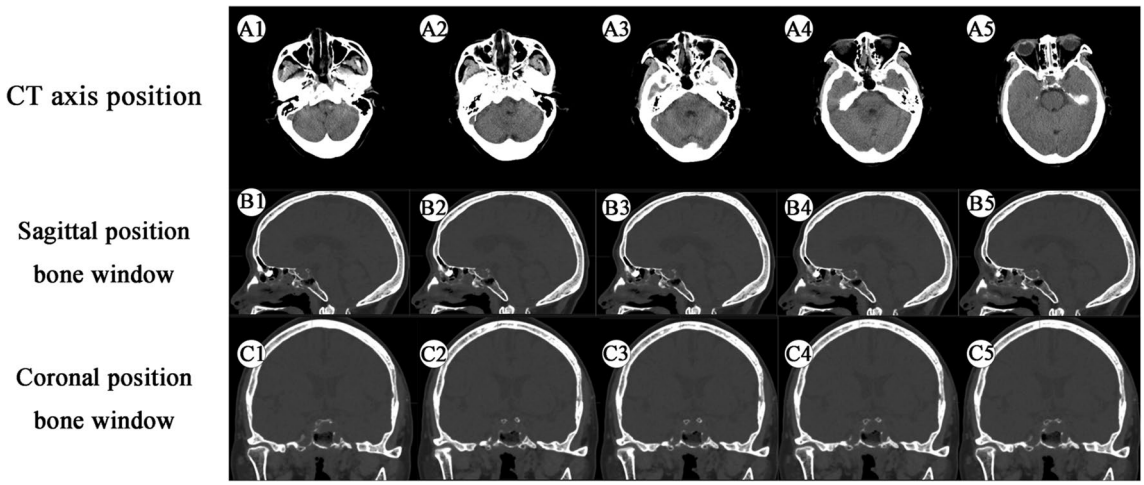

Fig. 5 **A1**–**A5** shows postoperative CT images, indicating complete tumor resection in the slope area; **B1**–**B5** are bone window sagittal views, and **C1**–**C5** are coronal views. Compared with preoperative images, the tumor has been partially removed cleanly

precise localization of pituitary hormone secretion and tumor position [10]. Chordomas are uncommon malignant bone tumors usually appear as locally destructive midline lesions. Owing to their delayed clinical manifestation, the outlook for chordoma is generally poor [11].

Chordomas can be identified on CT scans by the presence of osteolytic lesions on the upper slope, as well as calcium deposits, while MRI scans will display a "honeycomb" pattern due to fibrous septa. Additionally, sagittal and ventral brainstem images may reveal a "finger pressure" depression [7, 12]. However, in this case, the imaging features were not typical for chordoma, such as calcification or honeycomb appearance, making diagnosis difficult. Thus, surgical excision is often needed for a definitive pathological diagnosis, as ectopic pituitary adenomas and chordoma may have similar imaging features.

Surgery is usually recommended for most pituitary tumors, apart from prolactinomas, depending on the size, invasiveness, and optic nerve compression. Endoscopic neurosurgery is the preferred method of treatment. In the case of ectopic pituitary adenomas, surgery and pathology are often necessary for diagnosis. In some cases, EPA is only identified after treatment. Surgery can be a diagnostic and therapeutic option for patients with diagnostic difficulties. It is essential to quickly perform neural decompression in slope EPAs, as central nervous system disorders are common [12].

To evaluate the surgical risk and decide the suitable treatment plan, we conducted multimodal imaging test before surgery to assess the tumor's proximity to the bilateral internal carotid artery's cavernous sinus segment. We utilized intraoperative navigation during the procedure to reduce the chances of incomplete resection or damage to the internal carotid artery. The surgery was successful, and the patient had a smooth postoperative recovery. He was released one week after the surgery.

Conclusion

Diagnosing pituitary adenomas in the clivus is challenging due to the destruction of bone and difficulty in distinguishing it from chordomas. CT and MRI scans, imaging, and hormone levels can help with diagnosis. Radionuclide scans are also essential. Endoscopic transsphenoidal surgery is the preferred treatment. Pre-surgery, it is essential to assess the tumor's relationship with the surrounding structures. During surgery, navigation can be used to identify the tumor's position and to prevent harm to the internal carotid artery while maximizing resection.

Abbreviations

EPA	Ectopic pituitary adenoma
CT	Computed tomography
MRI	Magnetic resonance imaging
KI-67	Kiel 67 protein
ACTH	Adrenocorticotropic hormone
CD34	Hematopoietic progenitor cell antigen CD34, CD34 sialomucin
EGFR	Epithelial growth factor receptor
MMP-9	Matrix metalloproteinase-9
P53	Transformation-related protein 53

Supplementary Information

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Additional file 1. Pituitary function and pathological examination.

Additional file 2. Surgical video.

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Author contributions
First author: J.L.; Corresponding author: C.J.; J.L. was responsible for the writing of this case report, gathering data, and clipping the video; C.J. was entirely responsible for the authenticity of the content, the reliability of the data, and the credibility of the conclusions.

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Availability of data and materials
The raw data for this case report have been uploaded to the additional files, and these data are available from the corresponding authors upon reasonable request.

Declarations

Ethics approval and consent to participate
All procedures complied with the ethical standards of the institutional and/or National Research Council. The study was approved by the Institutional Review Board of the First Affiliated Hospital of Soochow University. Informed consent was obtained from patients.

Consent for publication
Informed Consent to publish has been received from all participants. There is no such information present in the manuscript that can give away the identity of the participant.

Competing interests
There were no competing interests among authors.

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