



Posterior transpetrosal approach to a suprasellar retroinfundibular pituitarytoma: A case report and comprehensive literature review

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ABSTRACT

Introduction: Pituitarytomas are rare benign glial neoplasms (WHO grade I) located in the sellar or suprasellar regions, arising from the neurohypophysis and infundibular area. They typically present with symptoms due to the slow growth of the tumor, including hormonal changes, visual impairment, and headaches.

Research question: This case report evaluates the effectiveness of the posterior transpetrosal approach for the resection of a retroinfundibular suprasellar pituitarytoma, focusing on preserving pituitary function and minimizing surgical risks.

Material and methods: We present a 59-year-old female with a pituitarytoma diagnosed by MRI and digital subtraction angiography (DSA). Preoperative embolization was performed to reduce the tumor's vascularity. The patient underwent a left posterior transpetrosal approach for tumor resection, with key surgical steps focusing on preserving the pituitary stalk, optic chiasm, and perforating vessels.

Results: The posterior transpetrosal approach provided excellent exposure, enabling near-total resection of the tumor. The patient had no new neurological deficits postoperatively, and follow-up MRI at 6 months showed no tumor recurrence.

Discussion and conclusion: This case demonstrates the safety and efficacy of the posterior transpetrosal approach for pituitarytoma resection. The approach allowed for optimal visualization and preservation of critical structures, particularly the pituitary stalk, leading to a favorable clinical outcome. Our findings, supported by a literature review, suggest that this technique is a valuable option for tumors in retroinfundibular and suprasellar locations.

1. Background and importance

Pituitarytomas are exceedingly rare benign glial neoplasms (WHO grade I) located in the sellar or suprasellar region (Lefevre et al., 2018; Chen et al., 2021; Salge-Arrieta et al., 2019; Wei et al., 2021; Louis et al., 2021). They originate from cells in the neurohypophysis and infundibular region (Chen et al., 2021; Wei et al., 2021). The mean age at diagnosis is around 48 years, with no significant gender predisposition

(Lefevre et al., 2018; Salge-Arrieta et al., 2019; Wei et al., 2021). Symptoms typically arise from the progressive mass effect of slow tumor growth, with hormonal changes, visual impairment, and headaches being the most common manifestations, and hypopituitarism being the most prevalent hormonal derangement (Lefevre et al., 2018; Salge-Arrieta et al., 2019).

Treating these lesions is challenging due to their critical location and highly vascularized nature. Since they are usually retroinfundibular,

Abbreviations: ACTH, adrenocorticotrophic hormone; CN, cranial nerve; CSF, cerebrospinal fluid; CT, computed tomography; DI, diabetes insipidus; DSA, digital subtraction angiography; EEA, endoscopic endonasal approach; FSH, follicle-stimulating hormone; GH, growth hormone; GTR, gross total resection; LH, luteinizing hormone; MRI, magnetic resonance imaging; PComA, posterior communicating artery; STR, subtotal resection; TS, transsphenoidal; TSH, thyroid-stimulating hormone; WHO, World Health Organization.

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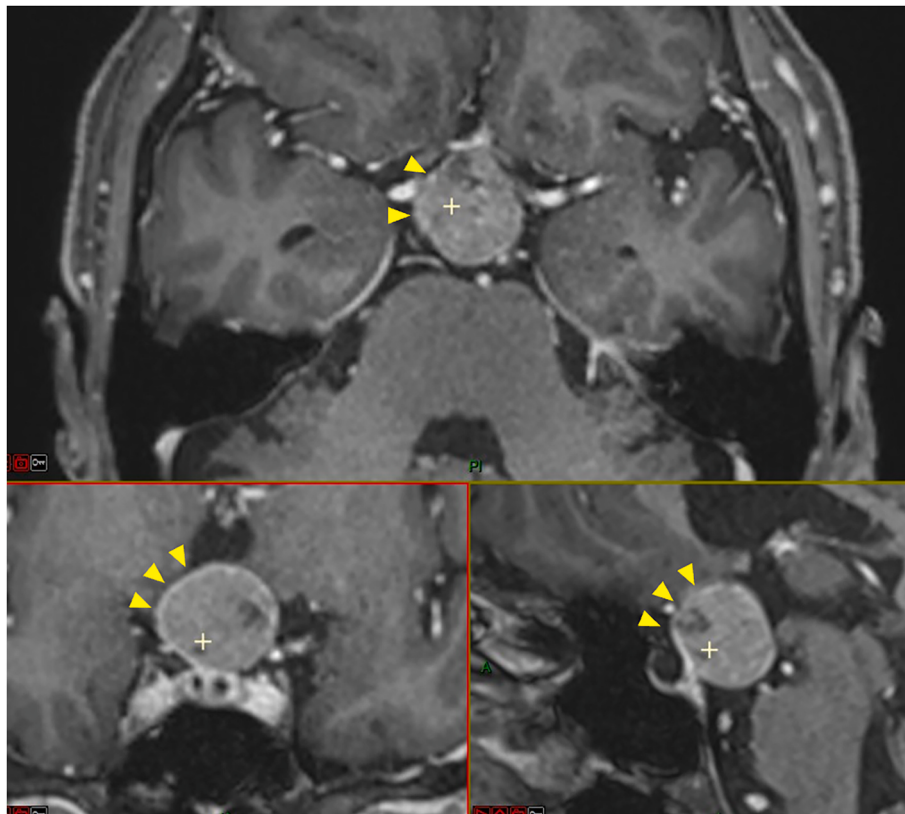


Fig. 1. T1-weighted MRI showing a spherical lesion occupying the retroinfundibular suprasellar space, with homogeneous enhancement by gadolinium. The pituitary stalk and normal pituitary tissue are identifiable through the dynamic contrast-enhanced T1-weighted sequence, bordering the lesion in its upper, anterior, and right lateral portions (yellow arrowheads). MRI, Magnetic Resonance Imaging.

they are interposed anteriorly by the pituitary stalk, superolaterally by the optic chiasm, as well as surrounded by perforating vessels. The rarity of pituicytomas complicates preoperative diagnosis, often resulting in intraoperative discovery of highly vascular lesions, which can lead to significant complications (Wei et al., 2021). Similar to craniopharyngiomas, multiple surgical approaches may be utilized. However, the decision regarding the optimal surgical strategy must consider critical factors, including surrounding neurovascular structures, potential endocrine function, and the risk of substantial intraoperative bleeding.

We report a case involving a 59-year-old patient who underwent a tailored posterior transpetrosal approach for the surgical treatment of a pituicytoma. We discuss the diagnostic and preoperative management of the pathology, as well as the nuances of the surgical technique,

supported by drawings and an operative video. Key surgical steps include tailored drilling of the petrous bone, posterior mobilization of the transverse-sigmoid sinus junction, and preservation of venous anatomy during the tentorial incision. During tumor resection, careful identification and preservation of perforating vessels and the pituitary stalk were emphasized. Additionally, we provide a comprehensive literature review of pituicytoma cases reported to date.

2. Clinical presentation

The patient is a 59-year-old female with a 3-month history of visual impairment. No other neurological deficits or cranial nerve involvement were reported. Ophthalmological evaluation confirmed progressive

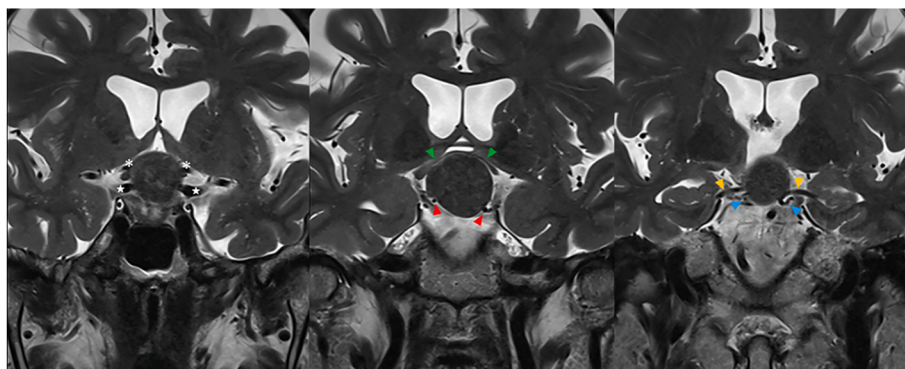


Fig. 2. T2-weighted coronal sections displaying the superiorly displaced optic chiasm (green arrowheads) and the inferiorly displaced oculomotor nerves (blue arrowheads). The tumor is in intimate contact with the carotids (white stars), posterior communicating artery (red arrowheads), anterior cerebral artery (white asterisks), and posterior cerebral artery (yellow arrowheads).

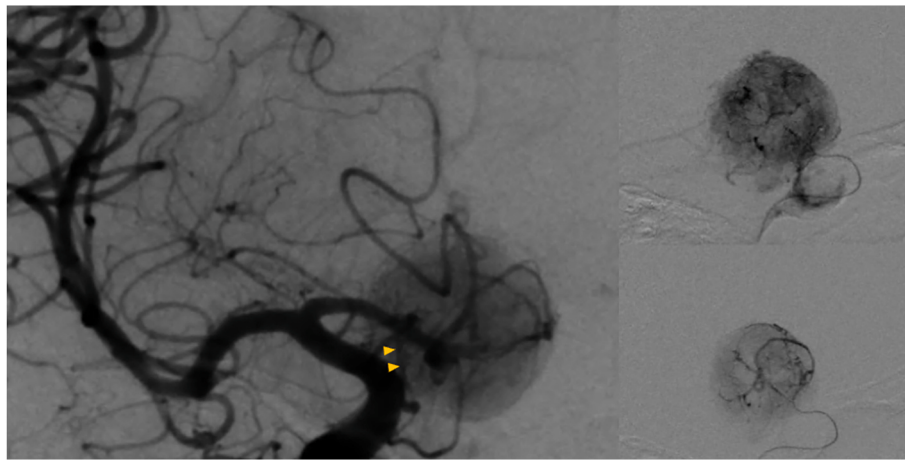


Fig. 3. Pre-embolization angiography (anterior view) illustrating predominant vascularization from the superior hypophyseal artery (yellow arrowheads). Selective catheterization (right images) reveals the tumor's hypervascularization.

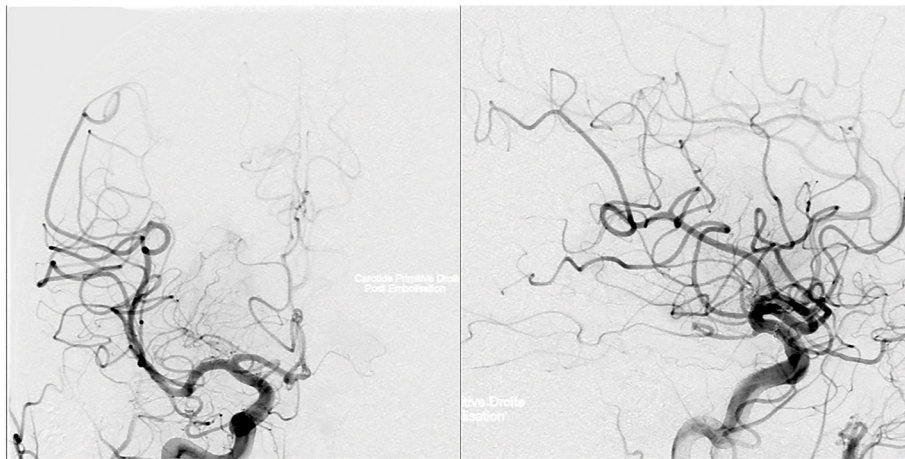


Fig. 4. Post-embolization angiography (anterior and right lateral views) demonstrating approximately 90 % devascularization of the tumor's arterial supply. The coil is visible within the superior hypophyseal artery (yellow arrowheads).

deterioration of bitemporal visual fields. T1-weighted MRI revealed a spherical suprasellar infundibular lesion measuring $22 \times 23 \times 23$ mm, with homogeneous gadolinium enhancement. The normal pituitary stalk and surrounding pituitary tissue were identifiable through dynamic contrast-enhanced T1-weighted sequences along the upper, anterior, and right lateral surfaces of the lesion (Fig. 1). The T2-weighted coronal section indicated thinning and superior/lateral displacement of the chiasm, which was obscuring the lateral aspects on both sides. The oculomotor nerves were displaced inferiorly, closely associated with the carotids, posterior communicating artery, posterior cerebral arteries, and perforators (Fig. 2).

A pituitaryoma was suspected based on the described radiological appearance, characterized by intense and homogeneous contrast enhancement in the infundibular region. To further support the diagnosis and due to the tumor's known hypervascularity, digital subtraction angiography (DSA) was performed prior to surgery. This included high-resolution cone beam CT-angiography with a spatial resolution of 100 μ m for each internal carotid artery territory (Yoshida et al., 2021). This examination revealed a hypervascular tumor primarily supplied by the right side, with secondary contributions from the left side via the superior hypophyseal arteries, as illustrated in Fig. 3.

Preoperative embolization was conducted through the anterior hypophyseal branch, identified as the main vascular supply. This feeder was straight and sufficiently large (>1 mm) at its origin to allow safe

microcatheterization and coiling, with no visible eloquent arteries at risk. Furthermore, proximal occlusion of dural branches at the skull base is known to carry minimal risk of nerve ischemia due to the highly anastomotic nature of cranial nerve vascularization. Approximately 90 % devascularization was achieved, and there was no deterioration in neurological status or emergence of new deficits post-embolization (Figs. 3 and 4).

The endoscopic endonasal approach (EEA) was not considered prior to embolization due to the risk of difficult-to-control tumor bleeding. Following embolization, the endoscopic route remained not our first option, because of the risk of CSF leakage and the tumor's posteriosuperior location relative to the pituitary gland, which could lead to a high risk of postoperative endocrine dysfunction. The left posterior petrosal approach was chosen for its limited risk of CSF leakage and its ability to provide a posterior-to-anterior, inferior-to-superior, and lateral-to-medial line of sight beneath the temporal lobe, aiming to preserve the pituitary stalk located on the right side of the lesion.

The patient underwent a left craniotomy without intraoperative complications. The temporal lobe was gently retracted, allowing for exposure of the tumor after opening the ambient cistern. Cranial nerve III was identified, along with the posterior communicating artery (PCoMA) above it. A corridor was created between the perforators to access the tumor. After tumor debulking, intracapsular dissection of the anterior, posterior, superior, and inferior portions of the tumor was

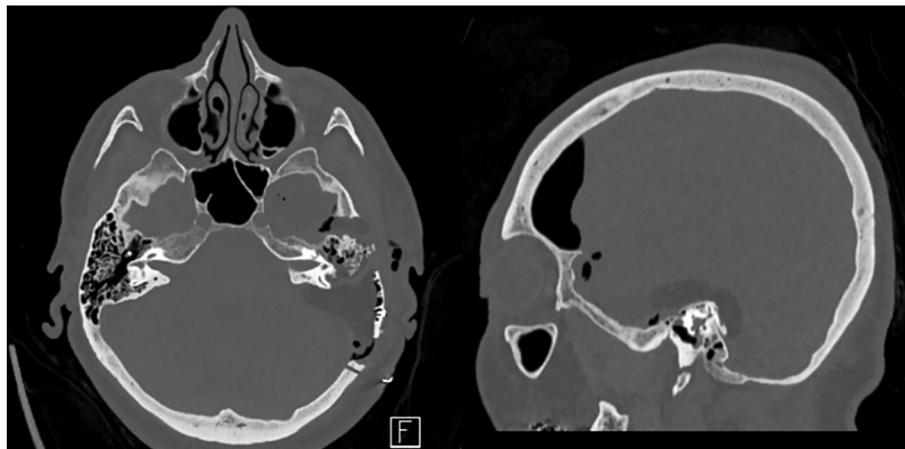


Fig. 5. Postoperative CT scan (axial and sagittal sections) showing adequate bone drilling for the posterior petrosal approach while preserving critical structures. Only superficial exposure of the semicircular canals and retrolabyrinthine space is achieved, without skeletonizing the facial nerve or opening the antrum. CT, Computed Tomography.

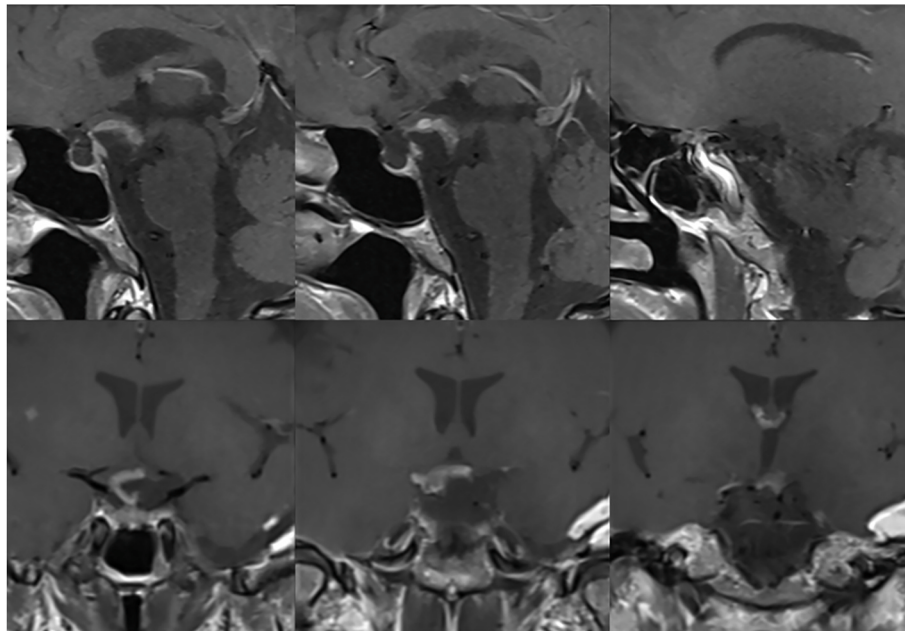


Fig. 6. Postoperative T1-weighted MRI revealing a spontaneously hyperintense area near the optic chiasm and right optic nerve, suggesting a small residual tumor in a region at higher risk for visual and endocrinological sequelae. MRI, Magnetic Resonance Imaging.

performed. The tumor was progressively separated from surrounding structures, including the optic chiasm, basilar artery, and perforators. To preserve endocrine function, a thin remnant was intentionally left along the stalk and chiasm.

After achieving hemostasis, the closure involved covering the opened mastoid cells with fascia and glue, followed by fat grafting and approximation of the opened dura mater. The bone was reconstructed, including the cortical bone of the mastoid portion (Video 1).

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The patient had a favorable outcome and was discharged after one week without new neurological or endocrinological deficits (Fig. 5). Postoperative T1-weighted MRI revealed a small residual lesion along the optic chiasm and stalk (Fig. 6). Histopathological and immunohistochemical studies confirmed the diagnosis of pituitaryoma. The 6-month follow-up MRI showed no evidence of growth of the tumor remnant. Preoperative strategies and surgical steps described are summarized in

Fig. 7. This report was approved by the Ethics Committee of our institution and was conducted in accordance with the Declaration of Helsinki. The patient consented to the publication of her images.

3. Discussion

Pituitaryomas are extremely rare benign neoplasms originating from cells of the neurohypophysis and infundibular region (Chen et al., 2021; Wei et al., 2021). The scarcity of data in the literature complicates the standardization of diagnostic and surgical management procedures.

These tumors can be mistaken for other lesions in the region, such as adenomas, meningiomas, or craniopharyngiomas (Wei et al., 2021). Like craniopharyngiomas, pituitaryomas can arise from various locations along the infundibulum or neurohypophysis (Lefevre et al., 2018; Chen et al., 2021; Wei et al., 2021). Consequently, tumors located posteriorly in the pituitary or pituitary stalk may be misdiagnosed as craniopharyngiomas. Posterior clinoid meningiomas also present a differential

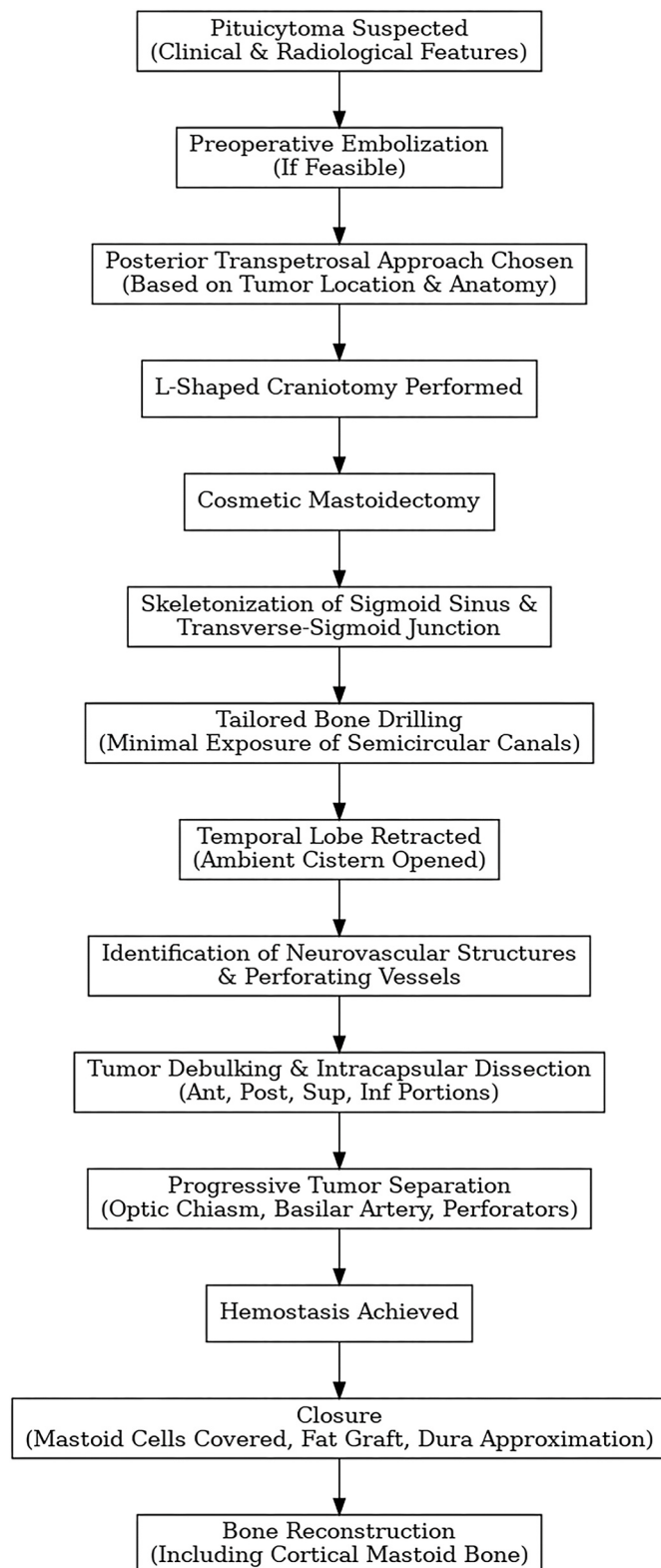


Fig. 7. Flowchart summarizing the preoperative strategies and surgical steps performed in the described case.

diagnosis in this location due to their characteristic intense and homogeneous contrast enhancement (Katsuta et al., 2003).

Pituitaryomas can occupy different portions of the sellar region, with potential suprasellar extension or invasion into the cavernous sinus. Lesions confined to the sella may mimic pituitary adenomas, while

suprasellar lesions can also be confused with craniopharyngiomas or meningiomas of the diaphragma sellae (Lefevre et al., 2018).

The posterior petrosal approach for treating craniopharyngiomas was first proposed by Hakuba et al. (1985) in 1985 and was further elaborated by Al-Mefty (Al-Mefty et al., 2007, 2008). Pituitaryomas, similar to infundibular craniopharyngiomas, occupy the suprasellar retroinfundibular space, with the anteriorly located pituitary gland and stalk pushed to one side of the lesion. Thus, this approach can be effectively utilized for pituitaryomas.

Following an L-shaped temporo-occipital craniotomy, mastoidectomy, dural opening, and tentorial section, transposition of the transverse-sigmoid sinus junction provides an ideal line of sight directed beneath the temporal lobe toward the retroinfundibular region. This approach allows for direct visualization of the tumor and its dissection from surrounding critical structures with minimal retraction.

In this case, utilizing this approach facilitated access to the tumor from behind the pituitary stalk, thereby increasing the likelihood of preserving pituitary function and enhancing visualization of the perforating vessels (Hakuba et al., 1985; Al-Mefty et al., 2007, 2008; Gibbs et al., 2006).

We reviewed the literature for all documented cases to date (Supplementary Table 1). A total of 111 articles were identified, including case reports and series, with 246 pituitaryoma cases reported between 1994 and 2023. (Lefevre et al., 2018; Chen et al., 2021; Salge-Arrieta et al., 2019; Wei et al., 2021), (Katsuta et al., 2003), (Gibbs et al., 2006; Hurley et al., 1994; Nishizawa et al., 1997; Brat et al., 2000; Schultz et al., 2001; Cenacchi et al., 2001; Uesaka et al., 2002; Figarella-Branger et al., 2002; Kowalski et al., 2004; Ulm et al., 2004; Chen, 2005; Takei et al., 2005; Shah et al., 2005; Nakasu et al., 2006; Benveniste et al., 2006; Thirayai et al., 2007; Wolfe et al., 2008; Newnham and Rivera-Woll, 2008; Srivatsa et al., 2008; Keith-Rokosh et al., 2008; Orrego, 2009; Zhi et al., 2009; Lee et al., 2009; Grote et al., 2010; Zhang et al., 2010; Furtado et al., 2010), (Brandão et al., 2010; Hammoud et al., 2010; Phillips et al., 2010; Ogiwara et al., 2011; Kwon and Suh, 2011; Zunarelli et al., 2011; Chu et al., 2011; Mao et al., 2011; Cheng et al., 2012; Pirayesh et al., 2012; Ellis et al., 2012; Kosuge et al., 2012; Secci et al., 2012), (Huang et al., 2012; Karamchandani et al., 2012; Schmalisch et al., 2012; Huynh et al., 2012; Yilmaz et al., 2012; Tian et al., 2013; Ida et al., 2013; Koutourousiou et al., 2013; Shenoy et al., 2013; Chakraborti et al., 2013; Feng et al., 2014; Saeed Kamil et al., 2014; Cambiaso et al., 2015; Kim and Park, 2015; Zygourakis et al., 2015; Teti et al., 2015; Şimşek et al., 2015; Wang et al., 2016; Yang et al., 2016; Neidert et al., 2016; Richer and Keith, 2016; Guo et al., 2016; Xie-Jun et al., 2016; Shim et al., 2017; Peron et al., 2017; Barresi et al., 2017), (Mende et al., 2017; Chang et al., 2018; Nagata et al., 2018; Yoshida et al., 2018; Law-Ye et al., 2018; Cossu et al., 2018, 2019; Maldonado-Morán et al., 2018; Vellutini et al., 2018; Li et al., 2019; Gezer et al., 2019; Guerrero-Pérez et al., 2019; Kuga et al., 2019; Aki et al., 2019), (Aki et al., 2019; Ly and Boulagnon-Rombi, 2019; Marco Del Pont et al., 2020; Chester et al., 2020; Borg et al., 2020; Cao et al., 2020; Feng et al., 2020; McNamara et al., 2020; Chatterjee et al., 2021; Rumei et al., 2020; Ozisik et al., 2021; Das et al., 2021; Cheng et al., 2021; Parkhi et al., 2021; Goodman et al., 2020; Xiao et al., 2022; Shen et al., 2022; Jeon et al., 2021; Wee et al., 2023; Yasuda et al., 2023; Woźniak et al., 2023; Al-Salihi et al., 2023; Trifa et al., 2023; Peng and Wang, 2023; Rubino et al., 2023; Giridharan et al., 2023; Shimizu et al., 2023; Zaki et al., 2023). The mean age at presentation was 48 years, with no gender predisposition. The most common symptoms were headaches, visual impairment, and hormonal changes, which often persisted for months to years before diagnosis.

Imaging findings may lack specificity. On CT scans, pituitaryomas are typically isodense, rarely cystic, and devoid of calcifications. On T1-weighted MRI, they may appear hypo- or isointense with homogeneous contrast enhancement and may appear iso- or hyperintense on T2-weighted MRI (Chen et al., 2021). Tumor sizes in reported cases ranged from 4 to 70 mm. Given the hypervascular nature of these lesions,

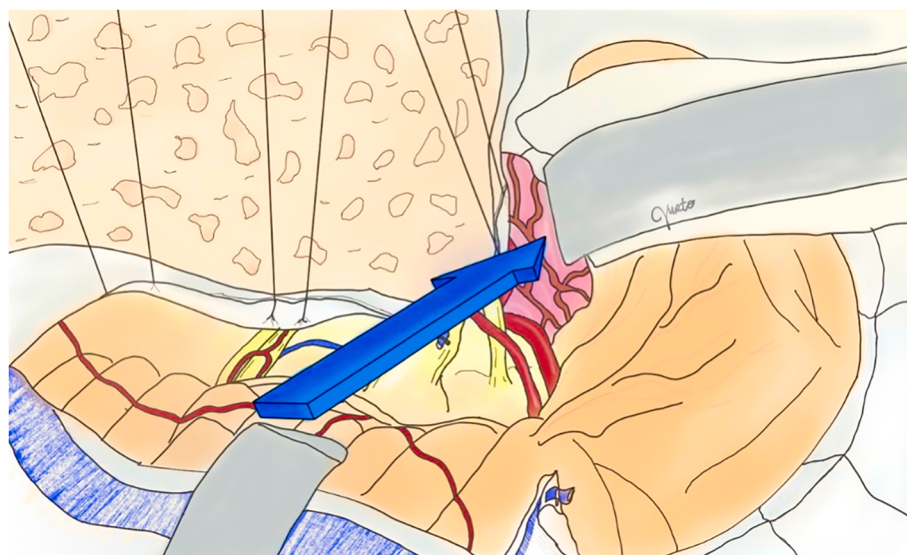


Fig. 8. Concept of posterior petrosectomy. An illustrative drawing from the surgical perspective during posterior petrosectomy to access the retroinfundibular region. The inferior-superior and posterior-anterior angles of view are detailed (blue arrow). The space created through targeted drilling of the petrous bone and transposition of the transverse-sigmoid junction is shown. Key structures such as cranial nerve III (CNIII), posterior communicating artery (PComA), and anterior thalamoperforating arteries are visualized.

preoperative embolization should be considered when suspicion of pituicytoma is high (Salge-Arrieta et al., 2019). In this case, preoperative embolization was performed through the anterior hypophyseal branch, identified as the primary vascular feeder. Among the 246 reviewed cases, only 5 (2 %) had undergone prior embolization, underscoring the diagnostic challenges associated with pituicytomas. The majority of embolized feeding branches originated from the external carotid artery, with a single case involving the left meningohypophyseal trunk. No complications were reported following embolization, while 4 additional cases underwent angiography without embolization due to supply coming from multiple small feeding vessels, carotid siphons, and both anterior and posterior cerebral arteries.

Selection of the surgical approach should consider the surgeon's expertise, tumor morphology, and its relationship to surrounding neurovascular structures and the pituitary gland. Dynamic post-contrast-enhanced MRI sequences are invaluable for localizing the normal pituitary gland. In the reported case, the normal pituitary tissue was identifiable along the upper, anterior, and right lateral surfaces of the lesion, guiding the decision to perform a left posterior transpetrosal approach to obtain a posterior-to-anterior and inferior-to-superior line of sight, thus potentially enhancing the preservation of normal pituitary function (Fig. 8). In our literature review, the endoscopic endonasal approach (EEA) was the most frequently utilized, employed in 56 % of cases, while 20 % of cases did not specify the approach used. Other approaches included frontotemporal, supraorbital, and microscopic transsphenoidal craniotomy. The EEA offers a more natural line of sight for lesions situated anterior to the pituitary; however, this anterior angle of attack presents a significant risk of injury to the perforating vessels that supply blood to the hypothalamus and chiasm. Although techniques for transposing the pituitary gland and stalk to access the retroinfundibular space have been described (Shen et al., 2024; Giammattei et al., 2024), offering a relative reduction in the risk of hormonal disturbances, the challenge of endoscopically controlling hemorrhages in hyper-vascularized tumors (such as pituicytomas) remains a significant limiting factor. Frontotemporal or supraorbital craniotomies may be considered for subfrontal access to anteriorly located tumors. However, for midline suprasellar infundibular lesions, the chiasma often obscures lateral access to the tumor. The transsylvian/transcavernous approach still does not provide a direct view with prior control over the perforating vessels surrounding the tumor and may remain obstructed by a

lateralized optic nerve.

Common complications include significant intraoperative bleeding, transient or permanent diabetes insipidus, and pan- or hypothyroidism. Intraoperative bleeding can necessitate alterations to the surgical approach or even halt the procedure (Lefevre et al., 2018; Kowalski et al., 2004; Ulm et al., 2004; Wolfe et al., 2008; Zhang et al., 2010; Kosuge et al., 2012; Huynh et al., 2012; Kim and Park, 2015; Shim et al., 2017; Mende et al., 2017; Law-Ye et al., 2018; Borg et al., 2020; Das et al., 2021; Shen et al., 2022; Giridharan et al., 2023). Our review identified four reported fatalities (0.02 %), two occurring in the early postoperative period due to excessive intraoperative bleeding, while one fatality happened 14 months post-surgery due to hypopituitarism and electrolyte imbalances (Lee et al., 2009; Ida et al., 2013; Mende et al., 2017; Parkhi et al., 2021).

The objective of maximal safe resection remains paramount, as gross total resection generally correlates with a favorable prognosis (Wei et al., 2021). In cases involving infiltrating lesions that invade surrounding structures, such as the pituitary stalk and hypothalamus, subtotal resection may be an acceptable alternative (Salge-Arrieta et al., 2019; Wei et al., 2021). Radiosurgery has been described with favorable control of residual lesions (Lefevre et al., 2018; Salge-Arrieta et al., 2019). Adjuvant treatments were performed in 10 % of the reviewed cases, typically following reoperations for recurrent tumors (Lefevre et al., 2018; Wei et al., 2021; Hurley et al., 1994; Ulm et al., 2004; Lee et al., 2009; Zhang et al., 2010; Zunarelli et al., 2011; Cheng et al., 2012; Cambiaso et al., 2015; Zygourakis et al., 2015; Wang et al., 2016; Guo et al., 2016; Shim et al., 2017; Mende et al., 2017; Nagata et al., 2018; Marco Del Pont et al., 2020; Ozisik et al., 2021; Goodman et al., 2020; Trifa et al., 2023). Incomplete resection has been identified as the sole independent risk factor for recurrence. Factors influencing tumor resection degree include infiltration of surrounding tissues and substantial intraoperative bleeding (Gibbs et al., 2006; Furtado et al., 2010; Mao et al., 2011; Labidi et al., 2018).

4. Limitations

Despite its advantages, a primary drawback of the posterior petrosal approach for retroinfundibular tumors like pituicytomas is the need to directly manage the PComA perforators. Cranial nerves III and IV are at greater risk compared to the EEA. Moreover, the posterior petrosal

approach may present a steeper learning curve for many neurosurgeons familiar with the anatomy of anterior approaches. Even when angiographic studies are conducted, they may not facilitate subsequent embolization due to the presence of multiple, thin feeders and the potential risk of ischemic complications. Ultimately, maintaining a high index of suspicion preoperatively remains critical for ensuring optimal surgical outcomes.

5. Conclusion

We presented a rare case of a pituitaryoma, detailing the relevant anatomy and accompanied by a comprehensive operative video. Additionally, we provided a thorough literature review of reported pituitaryoma cases. This is the first report of a pituitaryoma successfully managed surgically via a posterior transpetrosal approach in the current literature. A nuanced understanding of this approach enables tailored application to specific cases, minimizing the risk of damage to critical structures along the trajectory.

Disclosure of funding

None.

Declaration of competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.bas.2025.104239>.

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