

Single-stage purely endoscopic surgery for sellar tumors coexisting with intracranial aneurysm: a case series and technical note

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Abstract

Coexisting intracranial aneurysms may be encountered during sellar tumor surgery, but no consensus has been reached on standardized treatment strategies. The simultaneous treatment of sellar tumors resection and coexisting intracranial aneurysms in a single-stage surgery has rarely been reported. Here, we report a case series of sellar tumors coexisting with intracranial aneurysms during a single-stage via purely endoscopic surgery in a single center between January 2015 and July 2022. The patients' clinical information, including age, sex, symptoms, as well as aneurysm location, treatment modality, procedure details, clinical and imaging outcome, was collected and analyzed. Among the selected 8 patients with sellar region tumors combined aneurysms, 3 had craniopharyngiomas, 4 had pituitary tumors, and 1 had meningioma. Among the coexisting intracranial aneurysms, 3 were anterior communicating aneurysms, 4 were internal carotid artery (ICA) aneurysms in the ophthalmic artery segment, and 1 was a middle cerebral artery (MCA) bifurcation aneurysm. Seven aneurysms were diagnosed before surgery, and 1 was diagnosed after intraoperative rupture. Postoperative review using computed tomography angiography (CTA) or digital subtraction angiograph (DSA) revealed complete aneurysms clipping, and enhanced magnetic resonance imaging (MRI) revealed tumor resection. Seven patients had a modified Rankin scale (mRS) score of ≤ 1 and one patient died from perioperative complications. Therefore, preoperative cerebrovascular examination is recommended for patients with sellar tumors to exclude the possibility of intracranial aneurysms, and it is feasible to complete tumor resection and aneurysm clipping in one single-stage purely endoscopic surgery.

Background

Sellar tumors coexisting with intracranial aneurysms are not uncommon but pose a great risk for successful surgery. A variety of sellar tumors coexisted with intracranial aneurysms, including pituitary tumors, craniopharyngiomas, meningiomas, and gliomas[1–4]. The reported prevalence of intracranial aneurysms in pituitary tumors ranges from 2.3–5.4% [5, 6]. When the intracranial aneurysm has close contact with the tumor tissue and tumor-feeding arteries, precise evaluation should be cautiously performed to determine the proper treatment strategy given the devastating consequences of intraoperative aneurysm rupture[7]. Although aneurysms coexist with sellar tumors, the clinical symptoms are mostly caused by tumors. If patients do not routinely receive cerebrovascular examination before intracranial tumor surgery, aneurysms coexisting with sellar tumors are difficult to be diagnosed before surgery, which further increases the potential risk of sellar tumors combined with aneurysms [8]. Even if the aneurysm is diagnosed before surgery, there is no consensus about the detailed treatment strategy for sellar tumors combined with aneurysms. However, whether the dural pathology can be treated simultaneously remained unclear [7, 9, 10].

At present, the fully endoscopic endonasal approach (EEA) and the endoscopic transcranial approach have been used in the surgery of sellar tumors resection or intracranial aneurysm clipping [11–14]. However, few reports existed concerning simultaneous endoscopic sellar tumor removal and aneurysm clipping [8, 15, 16]. Here, we report a series of the purely endoscopic surgery for simultaneous removal of sellar tumors and clipping of aneurysms. We also demonstrated the indications, operation details, safety and efficacy of this single-stage surgery.

Methods

Study design and data collection

This retrospective study was approved by the institutional review board of Zhongshan Hospital, Fudan University. Between January 2015 and July 2022, patients admitted at our institute were enrolled with the following inclusion criteria: (1) sellar tumors coexisting with intracranial aneurysm was diagnosed by computed tomography angiography (CTA) or digital subtraction angiography (DSA) and intraoperative views, and (2) patients underwent simultaneous sellar tumor removal and aneurysm clipping. Written informed consent was acquired from each patient. Basic patient information, tumor

location, size, aneurysm site, aneurysm size, diagnosis history, aneurysm clipping results, tumor resection results and pathology results were collected from medical records. We also reviewed surgical videos and performed clinical follow-ups.

Preoperative Evaluation

Routine preoperative endocrine laboratory tests and enhanced magnetic resonance imaging (MRI) scans were performed. Ruptured aneurysms found during tumor resection are confirmed by exploration, intraoperative clipping and hemostasis. For sellar tumor patients with suspected aneurysms, preoperative CTA or DSA was performed. The diagnostic images and the least invasive access to the lesion of each patient diagnosed as sellar tumor with intracranial aneurysm were comprehensively evaluated before the operation. The surgical protocol was in accordance with the Declaration of Helsinki.

Surgical procedure

The conventional EEA or supraorbital lateral approach with navigation assistance was adopted. If the aneurysm was diagnosed before the operation and if the tumor didn't obstruct the aneurysm exposure, the aneurysm was clipped first. More specifically, the parent artery proximal to the aneurysm, which is paraclival segment of the internal carotid artery, was first exposed and temporarily blocked. Then the aneurysm was separated and clipped permanently. Finally, the tumor was resected under endoscopy. If the tumor blocked the exposure of the aneurysm, the tumor was partially resected first, and the surgeon was be cautious of aneurysm rupture by excessive traction. Partial tumor resection facilitated aneurysm exposure and safe clipping. After aneurysm clipping was confirmed, the residual tumor was completely resected. If the aneurysm was not detected in advance and ruptured during routine tumor resection, sudden arterial hemorrhage would be observed. Quick control of the bleeding point via accurate suction at the rupture point was crucial. After a preliminary judgment of the aneurysm structure, tentative clipping for temporary hemostasis was performed. Finally, following careful exploration, the clip was adjusted, or supplementary clipping if necessary. At this time, we were able to perform complete tumor resection and clear the blood in the surgical field.

Postoperative management and follow-up

Postoperative CTA or DSA examination was performed to confirm the results of aneurysm clipping. Unenhanced computed tomography (CT) and enhanced MRI were performed to evaluate the extent of tumor resection. Clinical follow-up was routinely performed.

Results

During December 2015 and July 2022, a total of 8 patients were identified as coexisting intracranial aneurysms and sellar region tumors. The demographic characteristics and aneurysm features are presented in Table 1. Among these patients, half were male, and the mean age was 59 years. The main clinical manifestations before surgery were visual field defects, headache, acromegaly caused by mass effects and endocrine disorders. Sellar region tumors can be located intrasellar, suprasellar or even in the third ventricle. The maximum diameter of tumor ranged from 11.2 mm to 47.4 mm. Among the coexisting intracranial aneurysms, 4 were anterior communicating aneurysms, 3 were internal carotid artery (ICA) aneurysms in the ophthalmic artery segment, and 1 was a middle cerebral artery (MCA) bifurcation aneurysm. The maximum diameter of the aneurysms ranged from 2.5 mm to 10.5 mm. In this cohort, 4 aneurysms were confirmed by CTA, 3 were confirmed by DSA, and 1 was found during surgery.

The treatment information is summarized in Table 2. Single-stage treatment involving sequential tumor resection and aneurysm clipping was implemented for all patients. Among the 8 patients, 6 patients were performed via EEA approach, 1 patient were performed by lateral supraorbital (LSO) approach and 1 patient was performed by mini-pterional approach. Final pathological examinations revealed 4 pituitary neuroendocrine tumors (PitNETs), 3 craniopharyngiomas and 1

meningioma. Two patients experienced intraoperative rupture before the aneurysms were eventually clipped, and 6 aneurysms didn't rupture intraoperatively. Cerebrospinal fluid (CSF) leakage and central nervous system (CNS) infection were the most detrimental complications; However, most complications recovered after surgery. Finally, one patient diagnosed as craniopharyngioma died because of severe complications and the other seven patients recovered well at discharge (mRS $\leq$ 1).

In this study, we highlighted 3 typical cases to demonstrate the single-stage tumor resection and aneurysm clipping. Patient 2 was a 63-year-old male patient with a giant PitNET coexisting with an anterior communicating artery (ACoA) aneurysm and underwent surgery via the EEA approach in 2017. The patient recovered uneventfully and survived with a significantly improved quality of life (Fig. 1). Patient 5 was a 66-year-old female who presented impaired vision and diuresis. We performed single-stage surgery for craniopharyngioma and right C6 aneurysm through the right LSO approach, and the patient recovered eventfully with improved vision (Fig. 2). Patient 7 was a 54-year-old male with acromegaly for more than one year, and the aneurysm was embedded in the tumor. We performed single-stage treatment of the growth hormone (GH)-secreting PitNET coexisting with right C6 aneurysm via the EEA approach (Fig. 3). After treatment, the GH level (reference range: less than 1.0 ng/ml) decreased from more than 40 ng/ml (before surgery) to 0.5 ng/ml (6 days after surgery) and the patient recovered uneventfully.

Table 1
Baseline characteristics of patients with sellar tumors and intracranial aneurysms.

Patient number	Age, years	Sex	Clinical Symptoms	Tumor location	Tumor size (mm)	Preoperative examination	Aneurysm location	Aneurysm size (mm)
1	63	Male	Visual field defect	Suprasellar	37.1	NA	ACoA	5.1
2	63	Male	Headache	Intrasellar and suprasellar	47.4	CTA	ACoA	2.8
3	35	Female	Visual field defect and menelipsis	Suprasellar and third ventricle	41.8	CTA	Right C6 segment	4.7
5	66	Female	Impaired vision and diuresis	suprasellar	34.6	DSA	Right C6 segment	4.2
4	56	Female	Acromegaly	Intrasellar and cavernous sinus	19.6	CTA	ACoA	7.2
6	65	Female	Dizziness	Tuberculum sellae	11.2	DSA	MCA bifurcation	10.5
7	54	Male	Acromegaly	Intrasellar	17.6	DSA	Right C6 segment	7.1
8	70	Male	Impaired vision	Intrasellar and suprasellar	32.6	CTA	ACoA	2.5

CTA, computed tomography angiography; DSA, digital subtraction angiography; ACoA, anterior communicating artery;

MCA, middle cerebral artery

Table 2
Treatment and clinical outcomes of patients with sellar tumors and intracranial aneurysms

Patient number	Approach	Year of the Operation	Pathological diagnose	Intraoperative aneurysm rupture	Complications	Tumor resection	mRS (6 montahs after operation)
1	EEA	2015	Craniopharyngioma	Yes	None	GTR	1
2	EEA	2017	PitNET	No	None	GTR	0
3	EEA	2019	craniopharyngioma	No	CSF leak and CNS infection	GTR	6
5	LSO	2019	craniopharyngioma	No	CSF leak and CNS infection	GTR	1
4	EEA	2021	PitNET	No	None	GTR	0
6	mini-pterional	2022	Meningioma	No	CSF leak	GTR	0
7	EEA	2022	PitNET	No	None	GTR	1
8	EEA	2022	PitNET	Yes	None	GTR	1

EEA, endoscopic endonasal approach, LSO, Lateral supraorbital approach; PitNET, pituitary neuroendocrine tumor; CSF, cerebrospinal fluid; CNS, central nervous system; GTR, gross total resection; mRS, modified Rankin Scale

Discussion

The incidence of sellar tumors combined with cerebral aneurysms is relatively low, but the operation risk is relatively high due to potential aneurysm rupture during the perioperative period, which can lead to subarachnoid hemorrhage or rupture into the surgical field and sphenoid sinus [3, 9, 17, 18]. Therefore, if sellar tumors coexist with intracranial aneurysms, the potential risk of aneurysm rupture should be fully assessed before surgery, and attention should be given to avoid factors that induce aneurysm rupture throughout the entire surgery [8, 9]. In our study, sellar tumors coexisting with aneurysms were treated via a single-stage operation using purely endoscopic technique, achieving satisfied treatment effect.

Preoperative detection of aneurysms is important for safe surgery for sellar tumors coexisting with aneurysms because a missed diagnose may lead to catastrophic hemorrhage during operation [19]. Additionally, patients with sellar tumors coexisting with aneurysms usually present symptoms caused by tumor mass effects [18]. Although DSA is the gold standard for diagnosing cerebral aneurysms, CTA is a more rapid, less invasive and more cost-effective method. Therefore, CTA is routinely recommended for patients with sellar tumors at our institute at present [10]. Magnetic resonance angiography (MRA) is used as an alternative method for who are contradicted to CTA, such as allergic reactions to contrast agents. If the aneurysm was suspected based on CTA or MRA, DSA should be performed to evaluate the detailed characteristics of the aneurysm, including the size, projection, relative location to the tumor [20]. If the coexisting aneurysms are missed in the diagnosis, surgeons are faced with great potential danger. In our cohort, a cerebral aneurysm in Patient 1 was missed preoperatively, so direct manipulation of the aneurysm sac during tumor isolation caused intraoperative aneurysm rupture. Although the final successful clipping did not cause permanent functional damage, it also resulted in a certain degree of passivity, causing unnecessary blood loss. Intraoperative rupture can be treated with emergent coil embolization, flow diversion, or carotid sacrifice, but adequate preoperative planning can reduce this risk [8]. Therefore, our experience is to recommend routine CTA or MRA prior to surgery to detect possible concomitant intracranial aneurysms in advance, and DSA was also performed if necessary.

The treatment strategy for patients with coexisting intracranial aneurysms and sellar region tumors remains to be fully elucidated [21–25]. One of the conventional treatments is staged surgery. Specially, the aneurysm can be treated with endovascular embolization or surgical clipping first, and the tumor can be resected in the second stage [8, 26]. Some reports have shown that coil embolization before tumor resection is preferred in selected cases, as it facilitates the gross total resection of the sellar tumor [27]. However, embolizing aneurysms with coil could cause the mass effect, and tumor surgical exposure manipulation of a vessel with a coiled aneurysm may be associated with a risk of coil dislodgment and aneurysm rupture. This will affect tumor exposure and totally resection. Occasionally, when the body-to-neck ratio of an aneurysm is not suitable for simple embolization, stent placement is required, and the use of antiplatelet drugs can also cause complications during the surgical resection of the tumor [28]. The rationale for single-stage surgery stems from the capacity to reduce the pain and cost of two times of operation for patients. However, patients should be cautiously evaluated to decide whether the single-stage operation are available [29]. The following aspects should be assessed: size, location and relationship between the tumor and the aneurysm [8]. If the tumor is accompanied by an aneurysm remotely located from the operative site, the possibility of aneurysm rupture does not appear to be substantially different from that of unruptured aneurysms in other locations. However, under this condition, it is also not possible to treat both aneurysms and tumor using one surgical approach. Therefore, it is more suitable for a staged surgery. If unruptured cerebral aneurysms enclosed in or near the tumor affects the tumor exposure and resection, or if the aneurysms related to the tumor's feeding arteries can be exposed using the same neurosurgical approach, single-stage surgery is recommended. In principle, if the risk of aneurysm rupture is high or if the aneurysm impedes access to a sellar tumor or blocks tumor resection surgery, the aneurysm should be treated first.

Although purely endoscopic aneurysm clipping is not yet a routine treatment for aneurysms, several case reports have confirmed the feasibility and effectiveness of endoscopic aneurysm clipping, whether via the nasal or transcranial approach [30–32]. Owing to the advantages-including a panoramic view of the aneurysm direct route to the aneurysm and parent artery, avoidance of brain retraction, improved cosmetic effects, and easier proximal control of the ICA, endoscopic endonasal clipping has been reported as an alternative approach for clipping paraclinoid aneurysms [33]. Since 2007, our institute has accumulated experience in the stages of transnasal endoscopic tumor resection [34], transcranial endoscopic assisted tumor resection [35], and total endoscopic skull base tumor resection [36]. For endoscopic aneurysm clipping surgery, in this group of sellar region tumors with aneurysms, we used a full endoscopic single-stage operation. In our group, there was no neurovascular injury caused by instrument movements in the surgical corridor. Our preliminary results showed that, after overcoming learning curve, for reasonably selected cases, a purely endoscopic technique is feasible and safe for single-stage operations of sellar region tumors coexisting with aneurysms.

Some microneurosurgeons believe that purely endoscopic approach for aneurysm clipping is not a suitable approach because that requires delicate bimanual dissection. However, in our experience, the use of a pneumatic holding arm to fix the endoscope can free both hands to perform with bimanual surgical techniques. The principles of aneurysm clipping under a microscope also follow similar rules like endoscopic clipping: (1) ability to gain proximal and distal parent artery control, (2) exposure of vessels and their respective perforators, and (3) possibility of clip placement [37–39]. However, although it has the advantages of clearer observation, owing to the narrow surgical corridor during endoscopic keyhole surgery, and occupation effect from the endoscope itself, the operation under endoscopy has greater requirements. Therefore, it is very important to design rational surgical approach [40]. The operator needs to evaluate the morphological characteristics, including the aneurysm orientation preoperatively, using imaging studies, and design a comfortable patient position, the direction of the clipping approach and the clipping line. Simultaneously, the approach should optimize access for tumor resection.

In purely endoscopic operations involving both tumor resection and aneurysm clipping, it is crucial to comprehensively consider the interaction effects between the sellar tumor and the aneurysm. If the presence of the tumor does not interfere with the clipping of the aneurysm, we follow the standard principles of aneurysm clipping [41]. Initially, we dissect the feeding artery of the aneurysm for better blood flow control; then, we proceed to isolate and expose the aneurysm

neck and clip the aneurysm. However, if the tumor's mass effect obstructs access for aneurysm anatomical exposure and clipping, we still opt to initially expose the feeding artery of the aneurysm and simulate temporary occlusion. With the aneurysm protected, partial tumor decompression is performed, followed by isolation and clipping of the aneurysm. After complete aneurysm closure, any remaining tumor is removed. For example, in cases of transnasal access for ICA aneurysm clipping, exposure of the paraclival ICA and confirmation of the feasibility of temporary occlusion, tumor removal, and aneurysm clipping should be performed sequentially.

Intraoperative rupture of the aneurysm is a highly perilous condition, particularly when encountered during purely endoscopic surgery [41, 42]. Attention should be given to avoid factors that can induce aneurysm rupture. Blood pressure should be stably maintained to prevent aneurysm rupture induced by stimulation and blood pressure fluctuations. Aggressive hypotensive anesthesia may have prevented intraoperative rupture of the intracranial aneurysm through the systolic blood pressure was maintained at 100–120 mmHg during the operation [43]. Delicate and precise surgical techniques are also important to avoid bleeding caused by injury to the aneurysm during tumor separation and resection. As we demonstrated in Patient 2, traction of the tumor during separation destabilized the aneurysm, which induced its rupture. Some reports indicated that after the tumor is surgically removed, the supporting force provided by the tumor to blood vessels or the aneurysm disappears. Under these circumstances, patients may suffer intraoperative or postoperative aneurysm rupture. The aneurysm may also be located on the blood supply to the tumor, and hemodynamic factors after tumor resection increases local blood flow [44].

Many practitioners believe that hemostasis in such cases can be exceedingly challenging and may lead to catastrophic outcomes. However, our experience suggests that this is not necessarily the case. The key point is that the full endoscopic aneurysm clipping procedure is performed by a neurosurgeon who has completed the learning curve. It typically begins with endoscopic endonasal surgery and endoscopic-assisted procedures to familiarize oneself with the basic skills required for endoscopic surgery. Subsequently, a transition is made to purely endoscopic procedures.

In practical terms, once intraoperative rupture of the aneurysm occurs during surgery, the primary objective is to maintain a clear surgical field [42, 45]. Dual suction devices may be used if necessary. If the feeding artery to the aneurysm has been exposed beforehand, one should promptly apply temporary occlusion to reduce bleeding. Furthermore, suction devices can be employed to identify the rupture site and facilitate visualization. If the neck of the aneurysm is already exposed at this stage, the neurosurgeon should proceed with definitive clipping under clear visualization. In cases where the neck of the aneurysm is not yet well-exposed, the neurosurgeon should resort to palliative clipping to temporarily control bleeding. To expedite the complete exposure and dissection of the aneurysm neck, adjustments or supplementary clipping are subsequently performed, ultimately achieving definitive aneurysm closure.

Despite these findings, some limitations should also be acknowledged. First, our study was a retrospective, single-center study with a small sample size. This could influence its validity and generalizability; thus, prospective, large-scale and multicenter clinical studies should be carried out to validate the results. Second, the intraoperative endoscopic fluorescence was not available, so it was difficult to confirm whether the clipping was complete or whether the parent artery was unobstructed. In the future, we will apply endoscopic fluorescence to perform more precise surgery. Third, the learning curve and surgical experience could affect the treatment clinical outcomes; therefore, surgeons should perform more laboratory practice and training in high-volume neurological endoscope centers. These limitations could guide future clinical and scientific research directions.

Conclusion

Our results suggest that tumor resection and coexisting cerebral aneurysm clipping can be accomplished in single-stage via purely endoscopic operation by neurosurgeon who has completed the learning curve and in the qualified units. Before

seller region tumor surgery, attention should be given to coexisting intracranial aneurysms, and treatment for the coexisting aneurysms should be planned beforehand.

Declarations

Author contributions:

Yang Gao, Chen Li and Zhi Li wrote the manuscript and prepared all the figures; Zhi Li, Puyuan Zhao, Zeyang Li and Tengfei Liu collected data; Liangliang Yang, Hantao Yang analyzed data; Zhigang Yang and Xiaobiao Zhang concept, design the study and completed the review of the manuscript. All authors read and approved the final manuscript.

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Data availability: The dataset and material are available from the corresponding authors on reasonable request.

Ethical approval: This study was conducted in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. All procedures performed in studies involving human participants were approved by the Ethics Committee of Fudan University Zhongshan Hospital.

Consent to participate: Informed consent was obtained from all individual participants included in the study

Consent to publish: The authors affirm that human research participants provided informed consent for publication of the images in all figures included.

Competing interests: The authors declare no competing interests.

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Figures

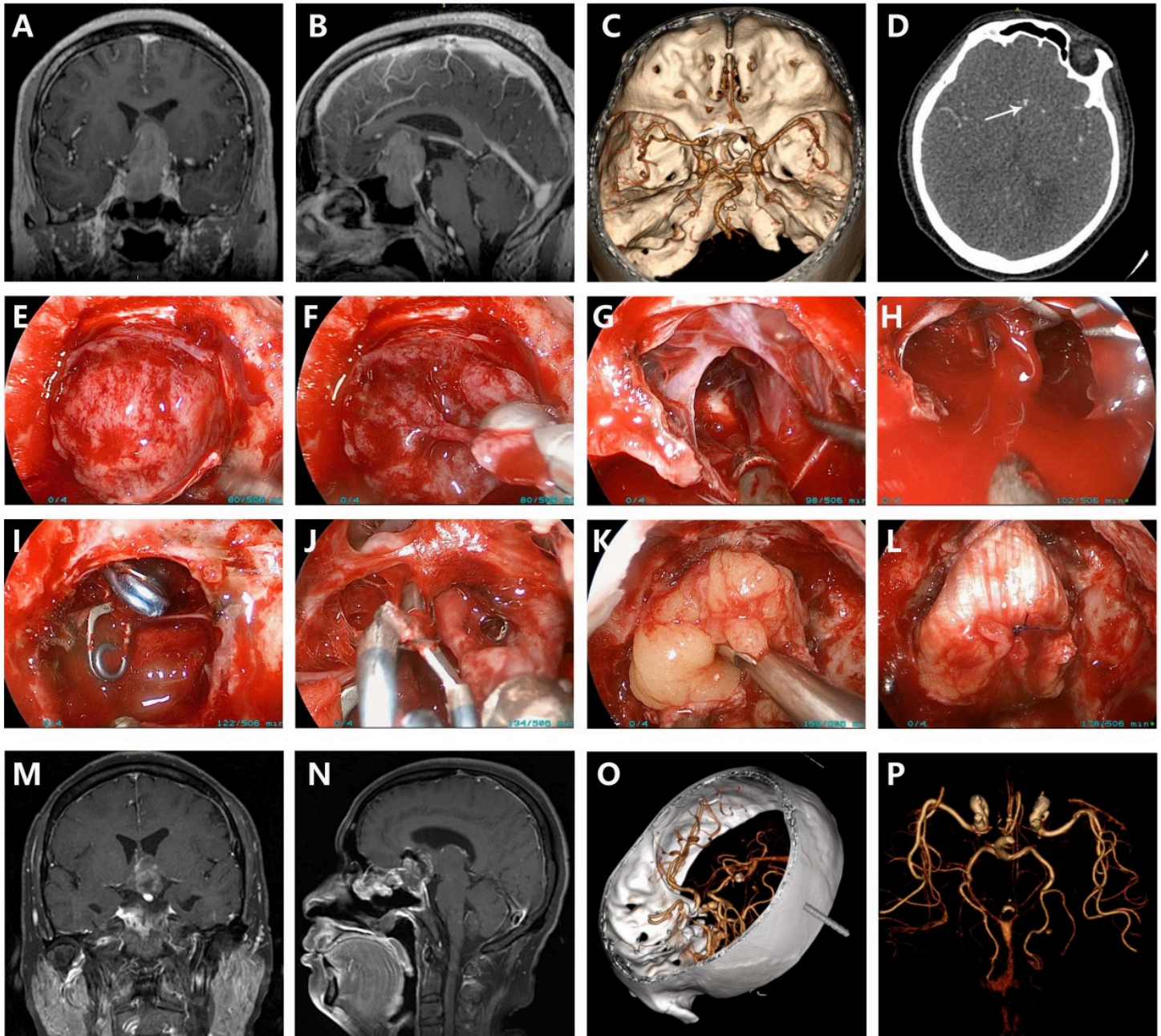


Figure 1

Single-stage surgery for giant PitNET coexisting with AcoA aneurysm through EEA approach (**Patient 2**). This patient complained of headache. Preoperative enhanced MRI images in the coronal and sagittal views showed huge parasellar and suprasellar pituitary tumor invading the third ventricle, the size of the lesion was 47.4*16.2 mm (**A, B**). Three-dimension images of CTA and thin-slice imaging demonstrated one anterior communicating artery aneurysm dominantly supplied by the left A1 (**C, D**); during the operation, the sellar floor dura was routinely incised, exposing tumor tissue (**E**); the tumor was gradually debulked using suction and curettage (**F**); when the main part of the tumor was resected, bleeding was observed in the surgical field (**G**); further exploration identified active arterial bleeding, and intraoperative aneurysm rupture was considered (**H**); the sphenoid platform removal and dural incision were extended to expose the aneurysm, which was then clipped using Aesculap 742/726 aneurysm clips (**I**); after clip, bilateral A1-A2 segments showed good pulsation (**J**); Skull base reconstruction was performed using autologous fat and fascia, secured with interrupted 5-0 Prolene sutures, no postoperative bleeding or cerebrospinal fluid (CSF) leakage was observed (**K**); Follow-up MRI

confirmed no residual pituitary tumor(L,M), and postoperative CTA showed no aneurysm recurrence (**N, O**), the *white arrow* indicates aneurysm.

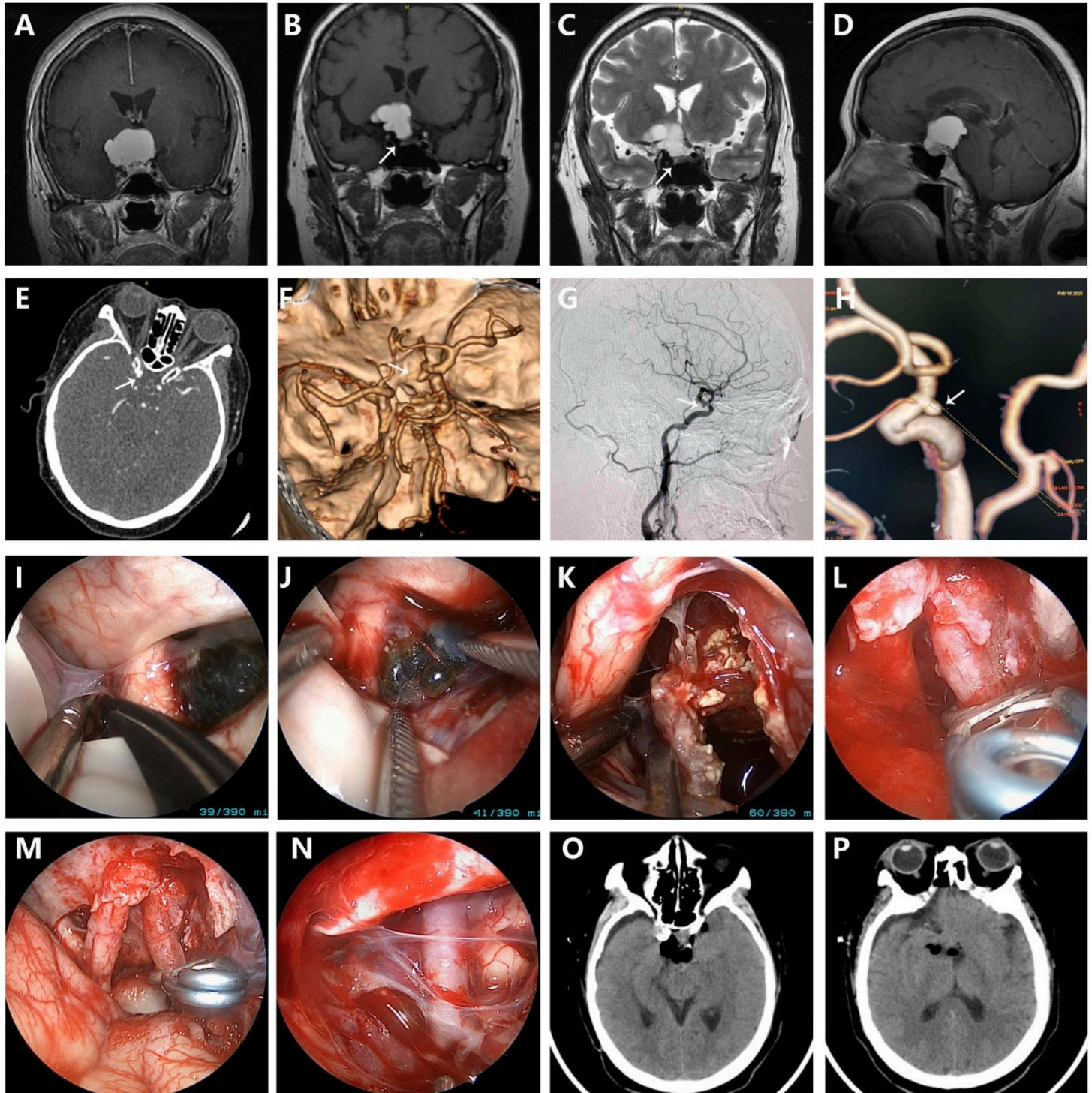


Figure 2

Single-stage surgery for craniopharyngioma and right C6 aneurysm through right LSO approach (**Patient 5**). This patient complained of impaired vision and diuresis. Postcontrast-T1 (**A**), T1-weighted and T2-weighted plain scans (**B-C**), and coronal T1-weighted (**D**) MRI images revealed a cystic-solid mass in the suprasellar region and interpeduncular cistern, and the aneurysm located in the right C6 segment was also observed. CTA cross-sectional imaging (**E**), 3D reconstruction (**F**), DSA angiography (**G**) and 3D reconstruction (**H**) confirmed the right C6 segment aneurysm measuring 2.4mm in the

neck and 2.8mm in the body. Endoscopic views demonstrated the dura mater was incised to expose the optic nerve and tumor(I). The intracapsular decompression was performed, aspirating dark yellow, oily fluid (J). A small portion of the tumor had breached the Liliequist membrane and was resected (K). The anterior clinoid process was drilled away, and the distal and partial proximal dural rings were opened to expose the origin of the ophthalmic artery (L). The aneurysm neck was fully visualized, so after temporary occlusion of the internal carotid artery, the aneurysm was clipped using an FT654 clip (M). No active bleeding was observed in the surgical field (N). Postoperative CT confirmed tumor resection with no signs of hemorrhage (O-P), the *white arrow* indicates aneurysm.

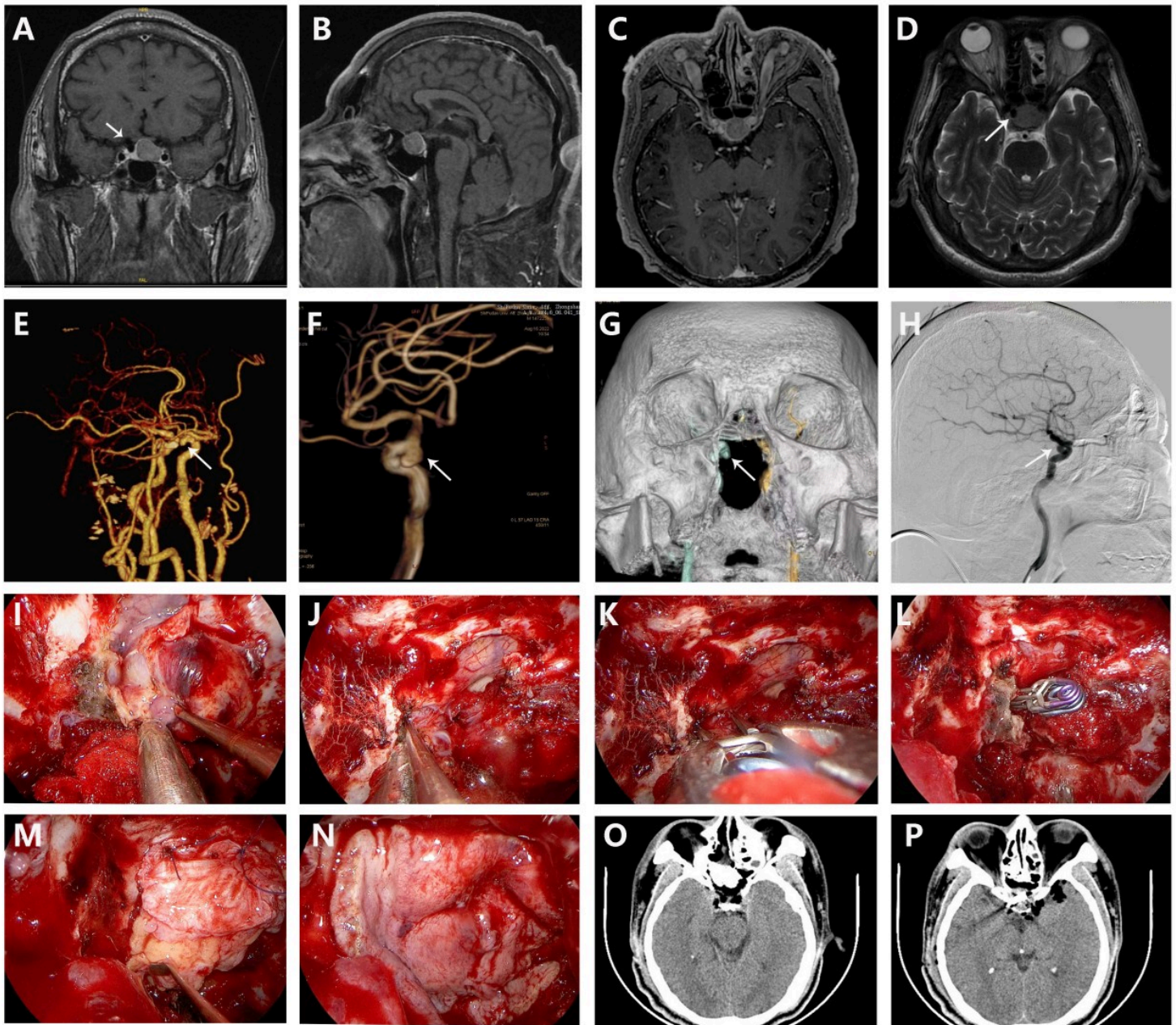


Figure 3

Single-stage treatment of GH-PitNET coexisting with right C6 aneurysm through EEA approach (**Patient 7**). This patient complained of acromegaly. Postcontrast MRI T1-weighted images (A-C) and T2-weighted plain scans (D) showed intrasellar mass and right C6 aneurysm. CTA (E) and DSA (F-H) further confirmed the aneurysm embedded in the tumor, the neck and depth of the aneurysm was 4.5mm and 7.1mm, respectively. Under endoscopic view, the skull base dura was opened, revealing the soft-textured tumor(I); tumor tissue was resected, and gelatin sponge was packed (J). The dura

adjacent to the right sellar floor and tuberculum sellae was further opened and extended to the right side, the aneurysm neck was exposed and dissected, and one Aesculap 750 clip was applied to occlude the neck (**K**). Subsequently, 740 and 720 clips were used to reinforce the closure (**L**). A fascia lata graft harvested from the lateral thigh was sutured and secured to the dura with Prolene sutures (**M-N**). Postoperative CT showed no evidence of hemorrhage (**O-P**), the *white arrow* indicates aneurysm.