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Pure Endoscopic Endonasal Clipping of an Incidental Anterior Communicating Artery Aneurysm: Technical Note

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Abstract:	Anterior communicating artery (AcoA) aneurysm is the most common form of intracranial aneurysm. It occurs rarely together with other intracranial lesion. Today, microsurgical techniques and endovascular methods are used in the treatment of these aneurysms. Endoscopic endonasal approach is a useful technique for midline lesions of the skull base and is underpinned with extensive experience. In this article, we present a 72-years-old female patient who underwent endoscopic endonasal transplanum-transtubercular surgery for tuberculum sellae meningioma followed by clipping of the incidental AcoA aneurysm. After complete removal of a tuberculum sellae meningioma via an endoscopic endonasal approach, an anterior and superior projected saccular AcoA aneurysm in the gyrus rectus area was totally clipped successfully via pure endoscopic endonasal transplanum-transtubercular approach, without any damage to parent arteries. The patient was discharged from the hospital within a short period of time without any postoperative complication. Endoscopic endonasal approach is a new paradigm in the treatment of aneurysm. Although this technique can not be routinely used due to lack of experience, it is an effective and safe method in selected and anatomically appropriate cases. We believe that increased knowledge and experience will create successful results in this approach, and it can offer an alternative method for selected aneurysm cases.

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Pure Endoscopic Endonasal Clipping of an Incidental Anterior Communicating Artery Aneurysm: Technical Note

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Abstract

Anterior communicating artery (AcoA) aneurysm is the most common form of intracranial aneurysm. It occurs rarely together with other intracranial lesion. Today, microsurgical techniques and endovascular methods are used in the treatment of these aneurysms. Endoscopic endonasal approach is a useful technique for midline lesions of the skull base and is underpinned with extensive experience. In this article, we present a 72-years-old female patient who underwent endoscopic endonasal transplanum-transtubercular surgery for tuberculum sellae meningioma followed by clipping of the incidental AcoA aneurysm. After complete removal of a tuberculum sellae meningioma via an endoscopic endonasal approach, an anterior and superior projected saccular AcoA aneurysm in the gyrus rectus area was totally clipped successfully via pure endoscopic endonasal transplanum-transtubercular approach, without any damage to parent arteries. The patient was discharged from the hospital within a short period of time without any postoperative complication. Endoscopic endonasal approach is a new paradigm in the treatment of aneurysm. Although this technique can not be routinely used due to lack of experience, it is an effective and safe method in selected and anatomically appropriate cases. We believe that increased knowledge and experience will create successful results in this approach, and it can offer an alternative method for selected aneurysm cases.

Key words: Aneurysm, Anterior communicating artery, endonasal, endoscopic clipping

Introduction

Cerebral aneurysm and its management remains a frequent and challenging problem in neurosurgery. It is also more important to isolate an aneurysm from the normal circulation without causing any further harm to the patient. Anterior communicating artery (ACoA) aneurysm is the most common form of intracranial aneurysm, accounting for 30-37% of total cerebral aneurysm cases (1). These aneurysms are treated by microsurgical clipping or endovascular technique over the years. Surgical approaches currently represent the gold standard for treatment of intracranial aneurysms, and specifically the pterional transsylvian, pterional subfrontal, and interhemispheric approaches are mostly preferred (1). However, sylvian fissure dissection, frontal lobe retraction, and partial gyrus rectus resection are performed to improve the exposure of the ACoA complex, and these processes can also cause damage to the healthy brain tissue (1). As a result, physiological risk factors and the risk of neuropsychological morbidity is increased. In recent years, less invasive techniques, such as keyhole approaches and supraorbital craniotomy have been used to reduce morbidity, but their usefulness is limited to selected cases (1).

The brain tumors associated with cerebral aneurysms are not rare in neurosurgical practice, with an incidence of 0.7- 5.4 % (2, 3, 4, 5). The most common brain tumors associated with intracranial aneurysms are meningioma, pituitary adenoma, glioma, lipoma and metastatic tumors (4, 6, 7, 8, 9). While the most common brain tumor associated with aneurysm is meningioma, the most common aneurysms associated with brain tumors are internal carotid artery (ICA) and AcoA aneurysms (10, 11). In addition, the aneurysms associated with tumors are mostly unruptured aneurysms (10).

The endoscopic endonasal approach is now widely used for pituitary adenomas. In addition, it is increasingly being performed for lesions around ventral anterior skull base and suprasellar lesions. Moreover, the technological development of endoscopy and instruments has facilitated the manipulation in these areas. In the light of these developments, endoscopic endonasal approach to AcoA complex has achieved considerable interest, because it is a minimally invasive method, and provides a panoramic view and direct access with no need for cerebral retraction (12).

In this article, we present a 72-years-old female patient who underwent endoscopic endonasal resection of a tuberculum sellae meningioma through a transplanum transtubercular approach followed by pure endoscopic endoonasal clipping of the incidental AcoA aneurysm. Our aim is to show that appropriate vascular lesions can be treated with this

minimally invasive technique, but undoubtedly this technique will become more precise as it evolves and as further experience is gained.

Material and Methods

A 72 years old female patient presented at our clinic with a 1-year history of headache and loss of vision in both eyes, right more than left. A cranial and pituitary Magnetic Resonans Imaging (MRI) study, performed without contrast medium because of a chronic renal failure, showed a tumor located at tuberculum sellae in the extra-axial space with a size of 17× 15× 14 cm and consistent with meningioma, and also compression on the right optic nerve, right internal carotid artery (ICA) and optic chiasm (Figure 1). The patient was hospitalized for endoscopic endonasal tumor resection.

Surgical Procedure

The patient was taken to surgery, where she underwent a endoscopic endonasal transplanum-transtubercular approach. Prior to surgery, a lumbar drainage was placed, and the patient was placed in supine position with 20 degree head flexion. A binostril approach was performed with a 0-degree, 4 mm diameter, 18 mm length endoscope (Karl Storz, Tutlingen, Germany). Following the resection of the posterior nasal septum including the vomer, camera imaging was performed in sphenoid sinuses, and intersphenoid sinus septum was excised. Posterior ethmoidectomy was performed using a high speed Midas Rex drill, then the tuberculum sellae and planum sphenoidale were removed. Bleeding from the anterior intercavernous sinus was stopped by bipolar coagulation and haemostatic matrix. Then, the soft mass, which is invading the dura and presenting good cleavage planes with surrounding tissues, was dissected from right ICA and optic chiasm, and was excised gross-totally.

Following mass excision, a glial tissue on the suspected vascular image under the right gyrus rectus was dissected with a microdissector, and a nearly 6 mm length anterior and superior projected AcoA aneurysm was detected. Then, surrounding glial and arachnoid tissues were dissected to expose bilateral A1 and A2 arteries (Figure 2). The aneurysm was planned to be clipped via an endoscopic endonasal approach as the orientation of the aneurysm dome and the aneurysm neck was appropriate, surgical corridor was available for the manipulation of the instruments, and proximal control was obtained. After that AcoA aneurysm was completely clipped using Yasargil's 5mm clip (Aesculap AG, Tuttlingen,

Germany) (Video). The evaluation of flow patterns with micro-Doppler ultrasonography and haemostasis was followed by the closure of surgical incision.

Multilayer reconstruction of this skull base defect was performed with autologous fat and fascia lata graft from right lateral thigh. We also used fibrin glue and fat grafts in the surgical area. Fascia lata graft was placed both under dura and between dura and bone. The closure was accomplished through the use of fibrin glue and Surgicel, and then a Foley catheter was placed.

Results

Post-operatively patient was shifted to ICU for one day without neurological deficit. The following day, the patient was discharged to the ward with stable vital signs. Postoperative MRI imaging showed that the target lesion was completely removed (Figure 3). Also Computer Tomography (CT) angiography demonstrated that the aneurysm was totally closed (Figure 4). The nasal Foley catheter was removed on postoperative day 3, and on postoperative day 4 lumbar drainage was removed and patient was discharged home without any complication.

No complication was observed up to 6 months of follow-up.

Discussion

The use of endovascular techniques in the treatment of intracranial aneurysms has evolved over the last years and become the first-choice technique in the vast majority of cases (13). Although, higher rates of recurrence and retreatment have been reported at long term follow-up after endovascular surgery, direct surgical clipping can still play an important role in management of aneurysms (14). Treatment of aneurysms requires multidisciplinary collaboration among radiologists and neurosurgeons. In this case our aim is to demonstrate the total clipping of an incidental AcoA aneurysm encountered during pure endoscopic endonasal resection of a skull base tumor, and that vascular lesions of the skull base could be treated with the same method in appropriate cases.

Pterional transsylvian approach, described by Yaşargil, is the most popular surgical technique in AcoA aneurysm (15). However, this approach requires sylvian fissure dissection, frontal lobe retraction and partial gyrus resection, all of which contribute to the patient's physiological and neuropsychological morbidity (1, 15). In recent years, less invasive keyhole approaches have been used to reduce morbidity, to improve the exposure of aneurysm without frontal lobe retraction and gyrus resection, and to obtain proximal control (16, 17, 18, 19, 20, 21, 22, 23). This approach may be inadequate in a tight and/or swollen brain.

In recent years, the endoscopic transsphenoidal approach is is increasingly popular for midline skull base lesions (24, 25, 26). Extended endoscopic approaches provide wider access to clivus and upper cervical vertebrae (27, 28). The endoscopic transnasal approach gradually evolved into a way of accessing the whole ventral skull base with the development of endoscopic endonasal approaches (24, 29). Its advantages include direct anatomical access to a large number of intracranial lesions, providing a natural sinus corridor, improved visualization and panoramic view, avoidance of brain retraction and gyrus resection, direct access to the subarachnoid lumbar cistern and the drainage of cerebrospinal fluid (CSF), improved visualization of main vessels and perforating arteries, and more rapid recovery after surgery (1, 14, 30). Based on these advantages, endoscopic endonasal technique has become the treatment of choice not only for many skull base tumors but also for vascular lesions in the same area. For the first time, Kassam et al. reported the clipping of vertebral artery and superior pituitary artery aneurysms via an endoscopic endonasal approach, and conducted clinical and cadaver studies for the treatment of vascular lesions with this technique (14, 24, 30, 31, 32, 33).

The transtuberculum-transplanum approach permitted to show the precommunicating and postcommunicating segments of the anterior cerebral arteries (A1 and A2), the anterior communicating artery (AcoA), the frontopolar arteries (FPA), the superior hypophyseal arteries (sha), the proximal segment of the ophthalmic arteries (OphA), and the supraclinoid portion of the internal carotid arteries (ICA) (30). The exposure of a large portion of the anterior cerebral circulation anatomy, provided by this approach, allows a safe proximal and distal vascular control, and if a temporary clip is required, it should be applied first to the larger A1 segment and placed medial to the perforating arteries. Froelich et al. reported, for the first time, pure endoscopic endonasal clipping of an AcoA aneurysm (1). In this report, a patient with orbital tumor and previously known ACoA aneurysm underwent an operation and complete clipping of the aneurysm was performed in the same setting (1). In our case report, we present a patient, with no previously known aneurysm, who underwent

surgical excision of tuberculum sellae meningioma via endoscopic endonasal transplanum-transtubercular surgery. After complete removal of a tumor, a 6 mm incidental AcoA aneurysm was totally clipped via pure endoscopic endonasal approach. After dissecting the aneurysm from the surrounding structures, both A1 and A2 arteries were visualized, and proximal and distal control was achieved. Since this incidental aneurysm was not bleeding, had a narrow neck and favourable projection, and proximal and distal control was achieved in an adequate surgical site exposure, the aneurysm was completely clipped without any additional intervention.

In the endoscopic endonasal aneurysm surgery, narrow surgical site, poor control of proximal vessels, and narrower surgical site with temporary clip complicate the manipulation (1, 33). Deeply-situated A1 arteries and aneurysms with inferior dome projection severely limit this approach (1, 33). The risk of CSF leakage after the clipping of an aneurysm and the reconstruction of this skull base defect are the difficulties of this approach. Especially the use of long clip makes the repair more difficult (1, 33). With increased experience reconstruction is not a problem anymore and the success rate has risen. We did not experience any problem with our case due to adequate surgical site exposure and proper control of proximal and distal parent arteries. Multilayer reconstruction of skull base using autologous graft has prevented CSF leakage.

Conclusion

In this case report our aim is to demonstrate the successful clipping of AcoA aneurysm via pure endoscopic endonasal approach. In recent years, endoscopic endonasal technique has evolved and become the first-choice of treatment for midline skull base lesions. Thus, it has been used as an alternative method for aneurysms that occured in the same area, and it is not correct to compare this method with gold standard approaches which are well known for long period. However, it is a minimally invasive and effective method in selected cases. There are only a few case reports in the literature and larger studies are needed. It should be noted that extended endoscopic endonasal skull base approach requires specific training and regular surgical experience. In conclusion, endoscopic endonasal aneurysm surgery is a minimally invasive, highly effective, and safe alternative method in selected cases and in the hands of an experienced surgeon.

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Figure Lagends

Figure 1: A: T1 weighted noncontrast coronal pituitary MRI and **B:** T2 weighted noncontrast sagital pituitary MRI showing a extra-axial tumor located at tuberculum sellae and compression on the right optic nerve, right internal carotid artery (ICA) and optic chiasm.

Figure 2: Endoscopic view of an anterior and superior projected AcoA aneurysm and bilateral ACA-A1 and ACA-A2 arteries

Figure 3: A: T2 weighted noncontrast coronal pituitary MRI and **B:** T1 weighted noncontrast sagital pituitary MRI showing a total removal of the tumor with metal artifact caused by aneurysm clip

Figure 4: CT angiography showing the total closing of the aneurysm.

Video: Demostration of pure endoscopic endonasal clipping of an incidental anterior communicating artery aneurysm

Figure 1
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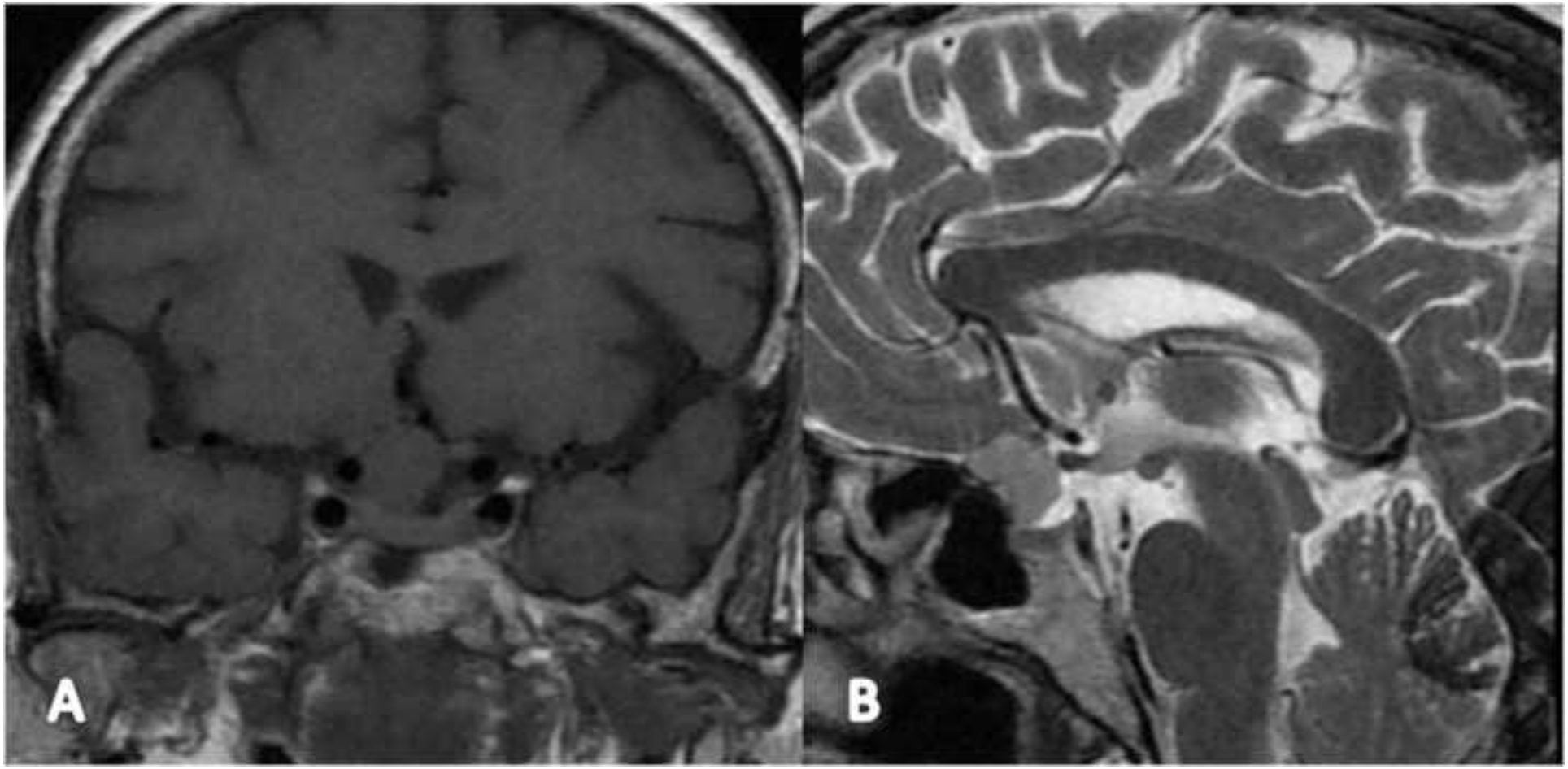

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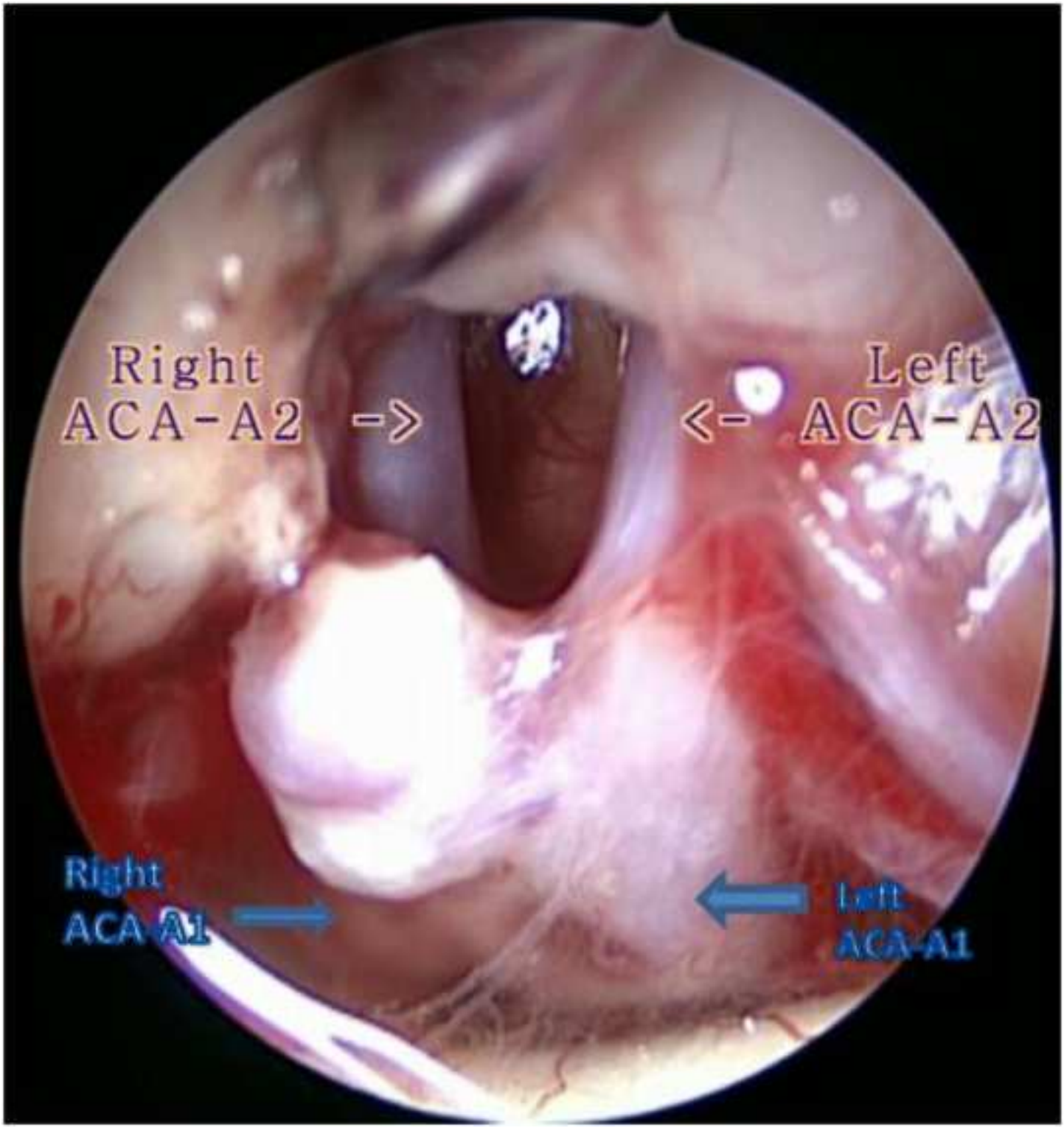

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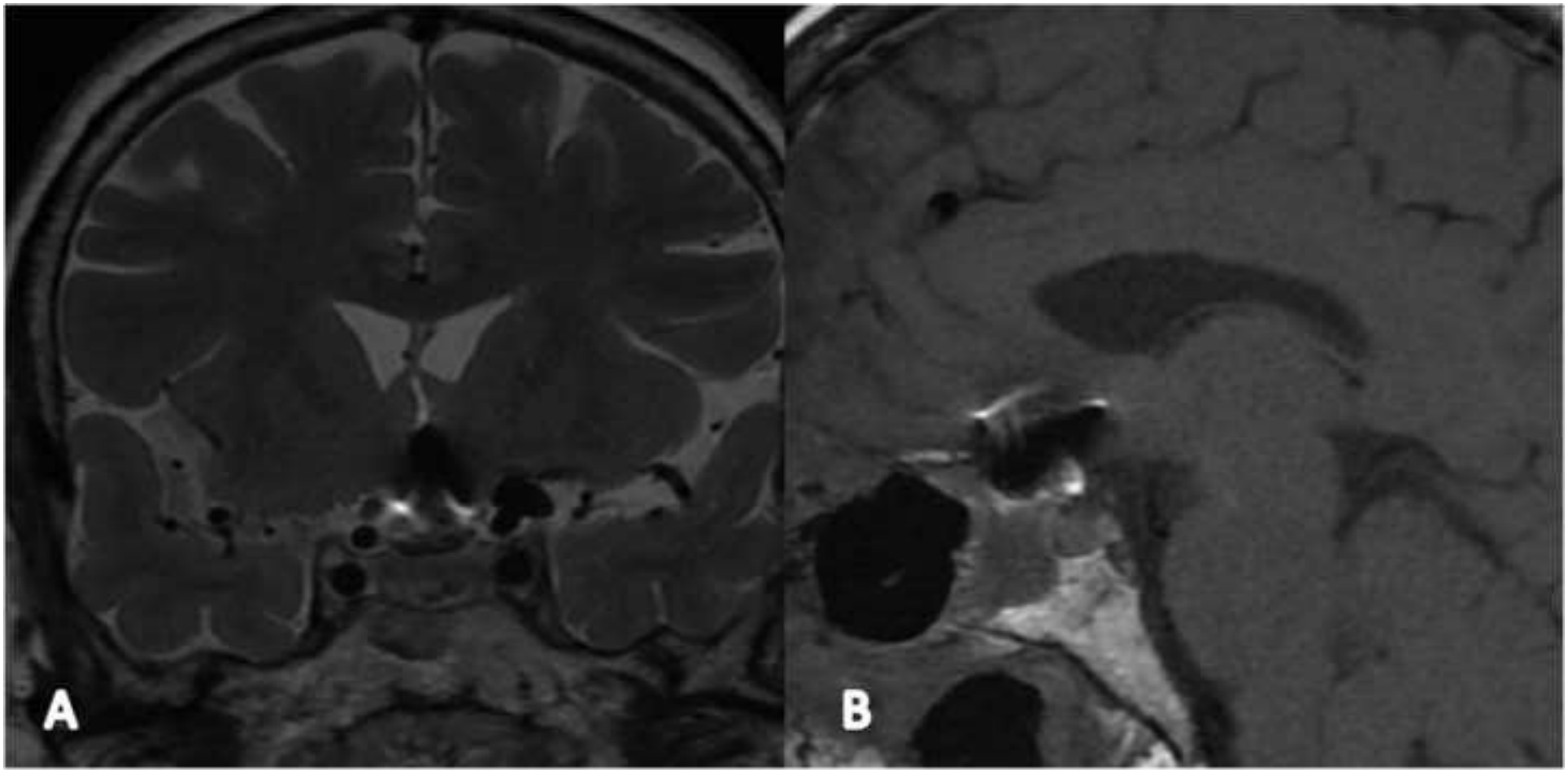

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Supplemental Video File

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