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INTERVENTIONAL NEURORADIOLOGICAL MANAGEMENT OF A UNIQUE CASE OF IATROGENIC VERTEBRAL ARTERY PSEUDOANEURYSM AND VERTEBROSIGMOID FISTULA FOLLOWING RETROSIGMOID CRANIOTOMY OF VESTIBULAR SCHWANNOMA: A RARE CASE REPORT AND LITERATURE REVIEW

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Ethical statement : This case report, titled adheres to the highest ethical standards. In accordance with ethical guidelines, patient consent was obtained for the presentation of this case, and all personal identifiers have been removed to ensure confidentiality.

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Consent

Written informed consent was obtained from the patient's parents to publish this report in accordance with journal's patient consent policy.

Key clinical message

This is a case of a 43-year-old gentleman who underwent craniotomy for resention of a vestibular schwannoma and developed a vertebral artery pseudoaneurysm post-procedure. This was managed successfully by endovascular intervention with a covered stent, leading to recovery. This case highlights the rare occurrence of vascular complications post-craniotomy and their effective management through endovascular techniques.

Abstract:

Background: Vestibular schwannomas are benign, slow-growing tumors originating from Schwann cells. Retro-sigmoid craniotomy is a common surgical approach for their resection but can result in rare complications, including vertebral artery pseudoaneurysms and arteriovenous (AV) fistulas, which can pose diagnostic and therapeutic challenges.

Case Presentation: A 43-year-old male presented with vertigo, headache, and right-sided hearing loss, diagnosed with a vestibular schwannoma. He underwent elective right retro-sigmoid craniotomy for tumor resection. Postoperatively, he developed transient neurological deficits and was discharged in stable condition. However, on the tenth postoperative day, he presented with drowsiness and seizure-like episodes. Imaging revealed a vertebral artery pseudoaneurysm and an AV fistula between the vertebral artery and sigmoid sinus. Endovascular treatment with a covered stent successfully excluded the pseudoaneurysm while maintaining distal vascular flow.

Outcome: The patient was discharged in a stable condition and recovered well post-procedure. This case highlights the importance of advanced imaging and timely image-guided endovascular intervention in managing rare vascular complications of neurosurgery.

Introduction

Vestibular schwannomas, also known as acoustic neuromas, are intracranial, extra-axial nerve sheath tumors that grow slowly and originate from the Schwann cells, investing the vestibular part of the vestibulocochlear nerve (1). When these tumors enlarge, they eventually take up a significant portion of the cerebellopontine angle, which frequently results in symptoms like tinnitus, vertigo, and hearing loss. Schwannomas are solitary

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in 90% of the instances and are categorized as grade 1 benign tumors by the World Health Organization. Acoustic neuromas reportedly occur in 0.6-1.9 individuals per 100,000 population (2). The patient's age, their neurological state, the size, and other features of the tumor influence the treatment plan. Radiation therapy, stereotactic radiosurgery, and microsurgery are available as treatment alternatives. Microsurgical resection is the gold standard for treating large vestibular schwannomas (3). It is frequently carried out utilizing the trans-labyrinthine, middle cranial fossa, or retro-sigmoid approaches (4). Any size of vestibular schwannomas can be removed with the retro-sigmoid approach; however, with this surgical intervention, there is a risk of mortality and postoperative complications in 0.2% and 22% of patients, respectively (5). These complications include facial nerve damage, trigeminal nerve dysfunction, aggravated gait associated with damage to the cerebellum, CSF leaks, and meningitis (6). A very unusual side effect of retro-sigmoid craniotomy is postoperative AV fistulas, which take time to appear clinically (7) (8). Similarly, the vertebral artery may inadvertently be harmed, even though it is beyond the surgical field, because of its abnormal course and loss of anatomical landmarks (9) (10). It is very rare in the literature to find vertebral artery pseudoaneurysm and AV fistula formation between the vertebral artery and sigmoid sinus (11). Such lesions typically follow either penetrating trauma or iatrogenic trauma (12) (13). Surgical correction has historically been the preferred course of treatment for such lesions. Alternative endovascular techniques have also been introduced that allow selective occlusion of the vascular injury (14). Both methods do, however, require sacrificing the vertebral artery. Another alternative endovascular approach is the use of a covered stent or flow diverting stent, which maintains vessel patency (15) (16). Herein, we report a unique case of iatrogenic pseudoaneurysm and arteriovenous fistula in Pakistan that was successfully treated with a covered stent.

Case history and examination

A 43-year-old male presented to the OPD with complaints of vertigo, headache, and right-sided hearing loss for 2 months. Neurological examination revealed intact higher mental functions, including speech and memory.

Investigations and treatment

MRI brain with contrast showed a right cerebellopontine solid-cum-cystic contrast-enhancing lesion (Fig. 1). Findings were consistent with a nerve sheath tumor, and a provisional diagnosis of vestibular schwannoma was made.

The patient was then electively admitted for surgical management. Following pre-operative assessments and anaesthesia clearance, he underwent elective right retro-sigmoid craniotomy and resection of the lesion. Post-procedure, the patient was received in a vitally stable condition in the recovery room, where he was initially drowsy but arousable, and later shifted to a special care unit for further neurological monitoring. He developed odynophagia, hoarseness of voice, and right upper extremity monoparesis, which was managed conservatively. He was shifted to the ward bed and mobilized out of bed. Post-operative MRI brain with contrast showed significant reduction in surrounding oedema and mass effect (Fig. 2). On the third day following surgery, he was discharged in stable condition and on medication.

However, the patient presented again on the tenth day following surgery with complaints of drowsiness and seizure-like episode. His repeat CT brain showed a craniotomy site-resolving hematoma. Acute infarcts in bilateral occipital, left parietal lobes, bilateral cerebellar hemispheres, and left basal ganglia were noted on CT, which are rare to occur. An MRI of the brain with contrast showed extradural collection over the right cerebellar hemisphere. This collection caused a mass effect and partially effaced the fourth ventricle. A large, dilated, tortuous vascular channel was found within the central part of the collection, most likely a vertebral artery pseudoaneurysm showing possible communication with the right sigmoid sinus (Fig. 3).

Pseudoaneurysm of the right vertebral artery and arteriovenous fistula was confirmed with a CT angiogram (Fig. 4).

After that, the patient was scheduled for DSA and endovascular intervention. Briefly, his right femoral artery was punctured, and a 6 Fr sheath was placed by Seldingers technique. Angiographic images were acquired by cannulating both vertebral arteries. The right vertebral angiogram showed a large pseudoaneurysm being filled by a rent in the V3 segment of the right vertebral artery and draining directly into the distal part of the right sigmoid sinus, representing an arteriovenous fistula (Fig. 5). The rent in the vertebral artery was measuring 2.9 mm, with the sac of the pseudoaneurysm measuring 58 x 53 mm. Subsequently, a 6F guiding catheter was advanced into the right vertebral artery across the pseudoaneurysm over a glide wire, and the glide wire was exchanged with a 0.014 BMW microwire. Afterwards, a covered stent measuring 4 mm by 20 mm was placed over a microwire through a Fargo guiding catheter, and the entire system was readjusted to place the covered stent across the pseudoaneurysm (Fig. 6). The post-procedure run showed complete exclusion of pseudoaneurysm with adequate distal flow into the basilar artery and reflux into the left vertebral artery (Fig. 7).

Conclusion and result

Following the procedure, the patient was received in a vitally stable condition in the recovery room, where he was initially drowsy but arousable and later shifted to a special care unit for further neurological monitoring. His drowsiness improved, and he was discharged as planned. Vertebral artery pseudoaneurysm and vertebro-sigmoid fistula formation are exceptionally rare complications of retro-sigmoid craniotomy. The patient's positive early outcome highlights the critical importance of timely diagnosis and intervention to prevent further neurological deficits. Due to their rarity, these complications often lead to a delayed diagnosis. Advanced imaging techniques, like CT angiography or digital subtraction angiography, are crucial for finding and characterizing these lesions because traditional postoperative imaging may not always reveal such complex vascular problems. The successful management of this case through endovascular intervention with a covered stent exemplifies the effectiveness of contemporary neuroradiological techniques in maintaining vascular integrity and managing life-threatening conditions. It also emphasizes how crucial it is to closely monitor and follow up after neurosurgery, since early identification of complications can have a significant impact on the course of treatment. The short-term results of the reported case are satisfactory. However, long-term follow-up data to determine prognosis are still needed.

Discussion

Although very uncommon, vertebral artery injury is well-defined in the literature. The most common causes are blunt or penetrating cervical trauma (from knives, firearms, etc.) and iatrogenic trauma (from surgery, jugular venous catheterization, diagnostic angiography, nerve blocks, etc.) (17). Delayed haemorrhage, thrombosis, stenosis, cerebral ischemia, AV fistula, and pseudoaneurysm formation can all occur in conjunction with vertebral artery injury (18). Rarely do a vertebral artery pseudoaneurysm and an arteriovenous fistula between the internal jugular vein and vertebral artery coexist. A pseudoaneurysm is a locally restricted hematoma outside an artery caused by damage to the vessel wall. The injury penetrates through all three layers of the vessel, causing a leak, which is contained by a new, weak wall formed by the products of the clotting cascade. No vessel wall layer is present in a pseudoaneurysm. A typical complication of vascular access, in addition to haematoma and arteriovenous fistula, is the iatrogenic pseudoaneurysm, which is caused by a perforation in the arterial wall. Despite the fact that pseudoaneurysms can resolve spontaneously(19), ruptures have been observed in 31% to 54% of instances (20). It is imperative that these lesions be diagnosed and treated quickly in order to reduce the chance of morbidity and mortality. The recommended course of treatment in the past was surgery, specifically microvascular repair or vessel ligation. Treatment for aneurysms has evolved due to recent advancements in less-invasive endovascular procedures.

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An arteriovenous fistula is an abnormal communication between an artery and a vein within which blood flows directly from the artery to the vein, avoiding the capillary network. AVFs can be created surgically, arise from a genetic or congenital defect, or be secondary to an iatrogenic injury or trauma. Apart from the surgically produced varieties, these are quite uncommon. Congenital disorders such as fibromuscular dysplasia and neurofibromatosis create a strong predisposition (21). Clinical manifestations differ and are dependent on the fistula's location. The most common signs and symptoms are intracranial hypertension, headaches, seizures, dizziness, drowsiness, and abnormal eye movements (11). The ability of surgeons to be vigilant in the postoperative period and to be aware of the likelihood of fistula formation is crucial for the quick and accurate evaluation of patients who present with these symptoms following surgery. Fistulas that are detected and treated promptly are usually curable; yet, because they progress quickly, they require immediate surgical intervention. Pseudoaneurysm and vertebral AVF can be treated with endovascular and surgical techniques. Surgical procedures such as proximal ligation, trapping, and direct surgical closure are more challenging due to the abnormal anatomical path of the vertebral artery and the difficulty of manipulating it. In addition to requiring significant exposure, surgery also carries the risk of damaging nearby blood vessels and nerve roots. Our primary objective is to repair the pseudo-aneurysm and fistula while safeguarding the principal artery. Endovascular treatments (such as stenting, coiling, detachable balloon, embolization, etc.) are more effective in achieving this goal since they are less intrusive, painless, and require less recovery time (22) (23). AVFs and pseudoaneurysms have been successfully treated with covered stents with few problems. Therefore, covered stents ought to be the first choice of treatment.

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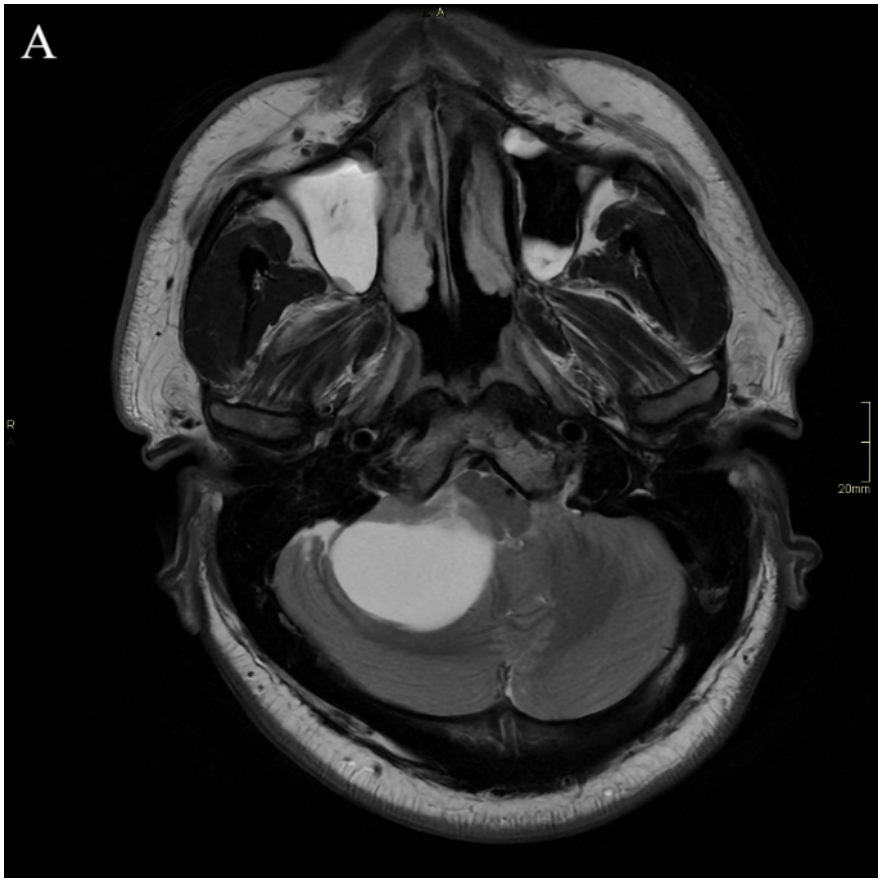
Images



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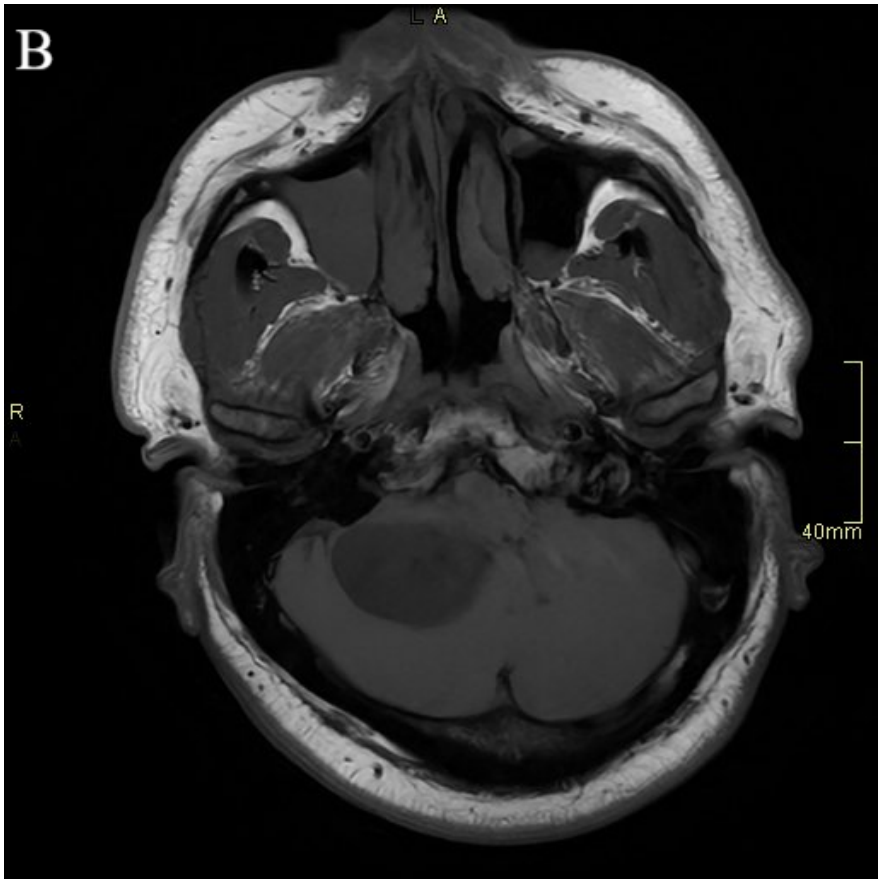

Fig. 1. The T1 & T2-weighted contrast-enhanced MR images taken before the surgery show a right CP angle mass representing nerve sheath tumor.

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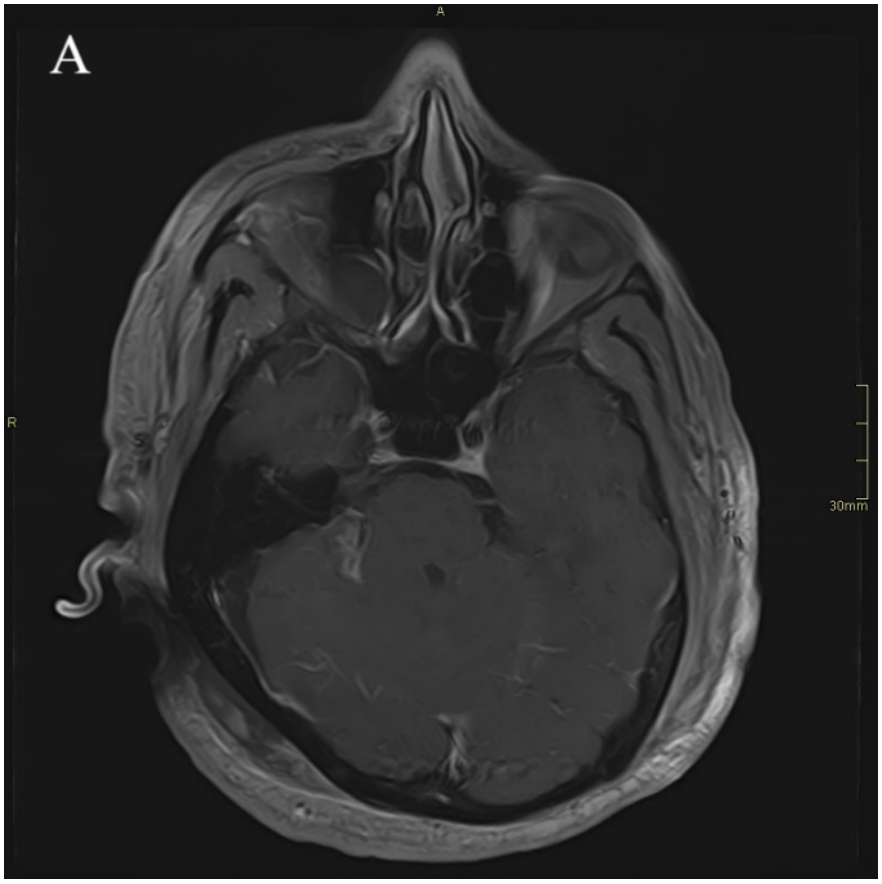

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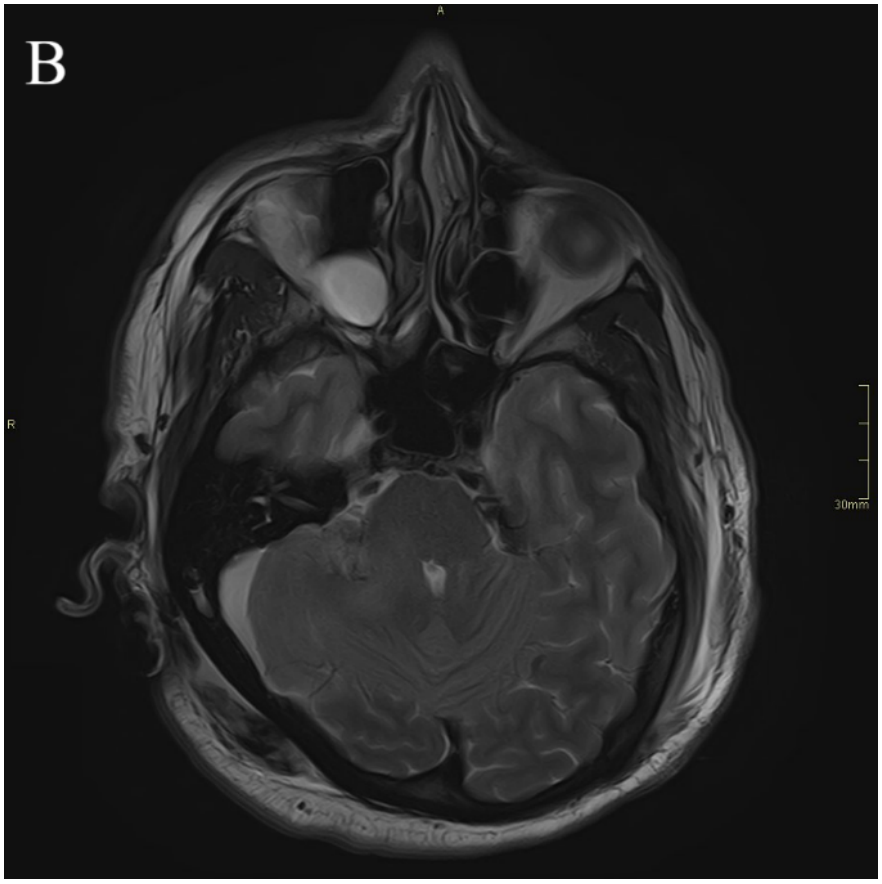

Fig. 2. The T1 & T2-weighted contrast-enhanced MR images taken after the surgery show no tumor remnants or postoperative complications.

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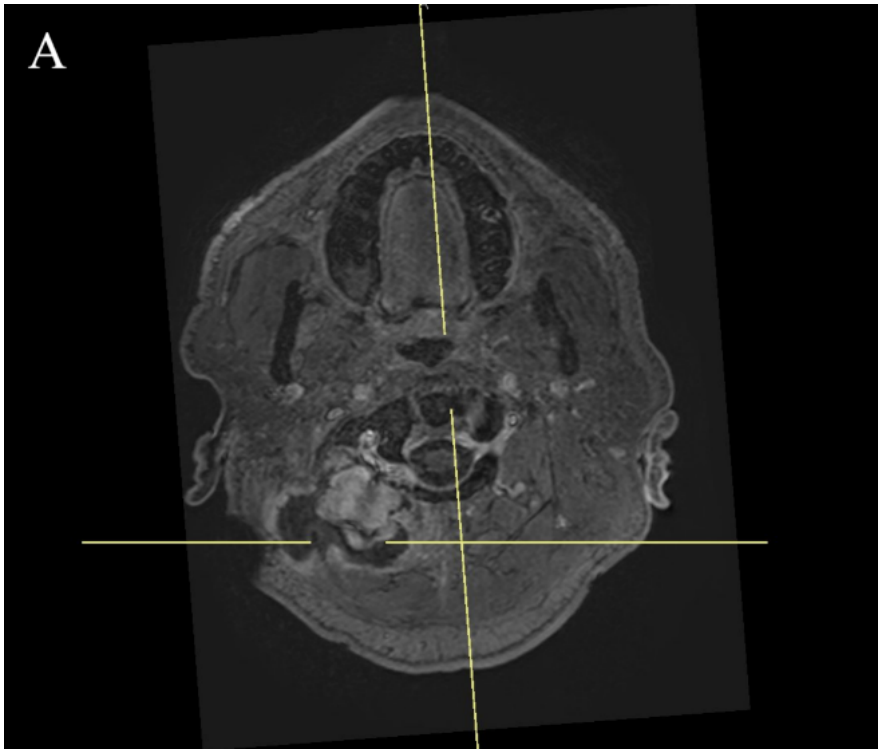

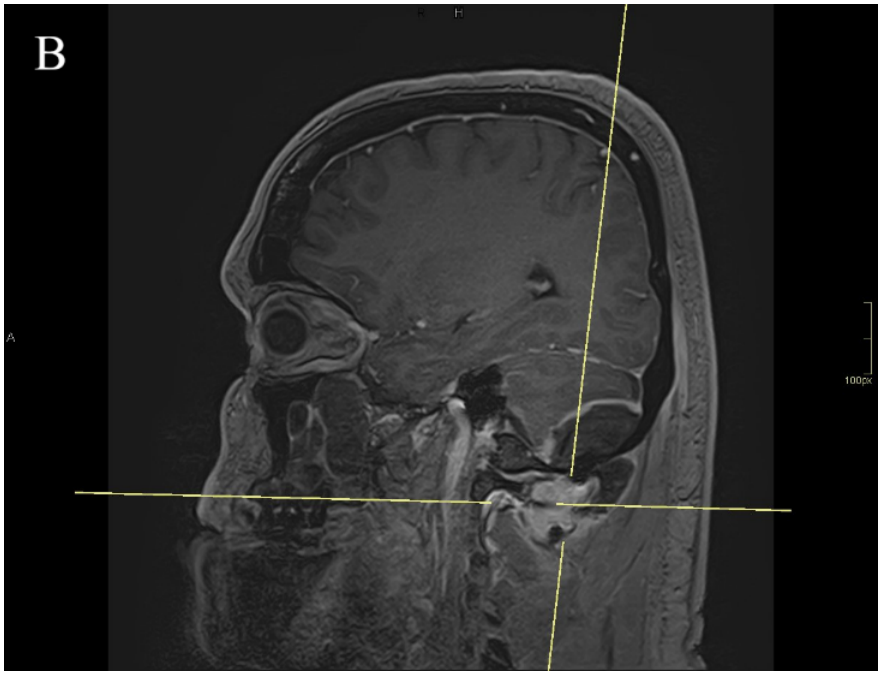

Fig. 3. Contrast-enhanced MR images taken after re-admission show extradural collection over the right cerebellar hemisphere causing mass effect with partial effacement of the fourth ventricle **A)** Axial View **B)** Sagittal View

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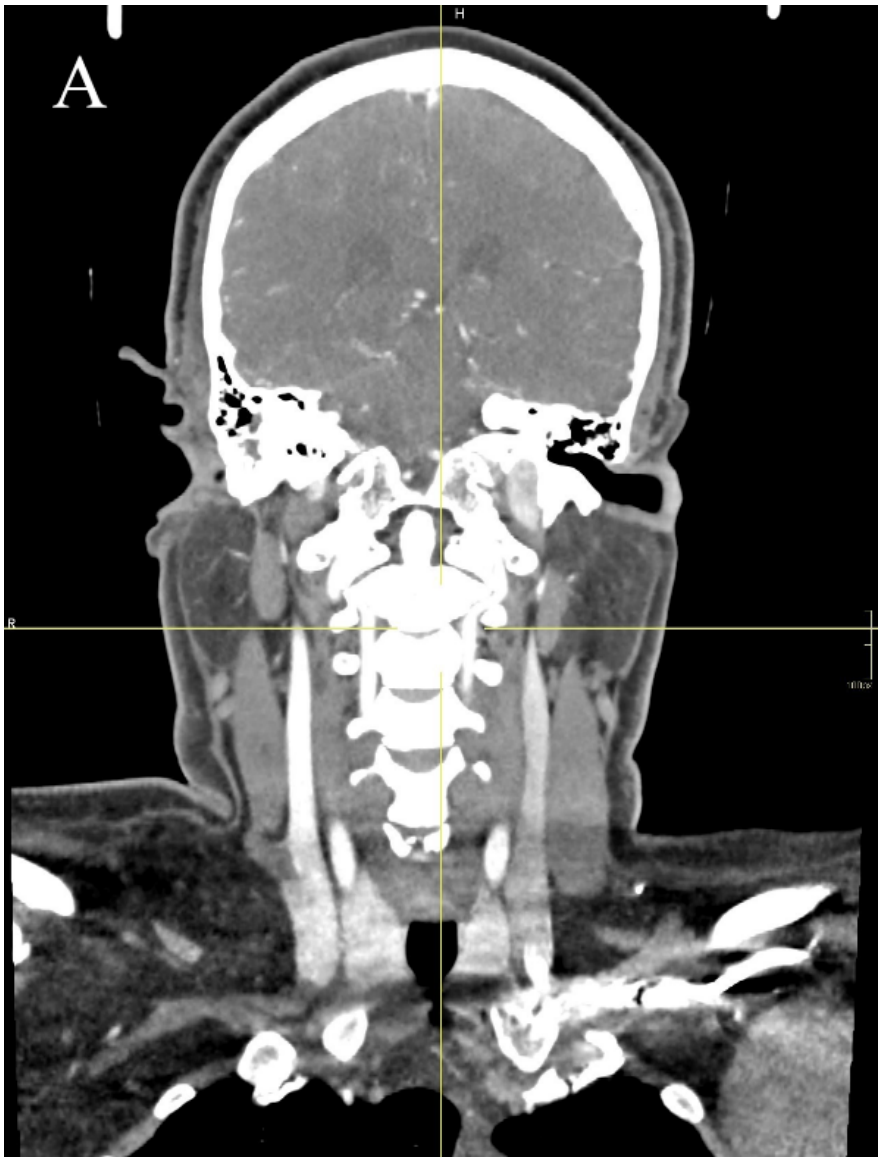

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Fig. 4. CT Angiogram shows **A)** Retrograde filling of right internal jugular vein due to right sided vertebro-sigmoid fistula.**B)** Pooling of contrast within post-surgical collection representing large pseudoaneurysm.

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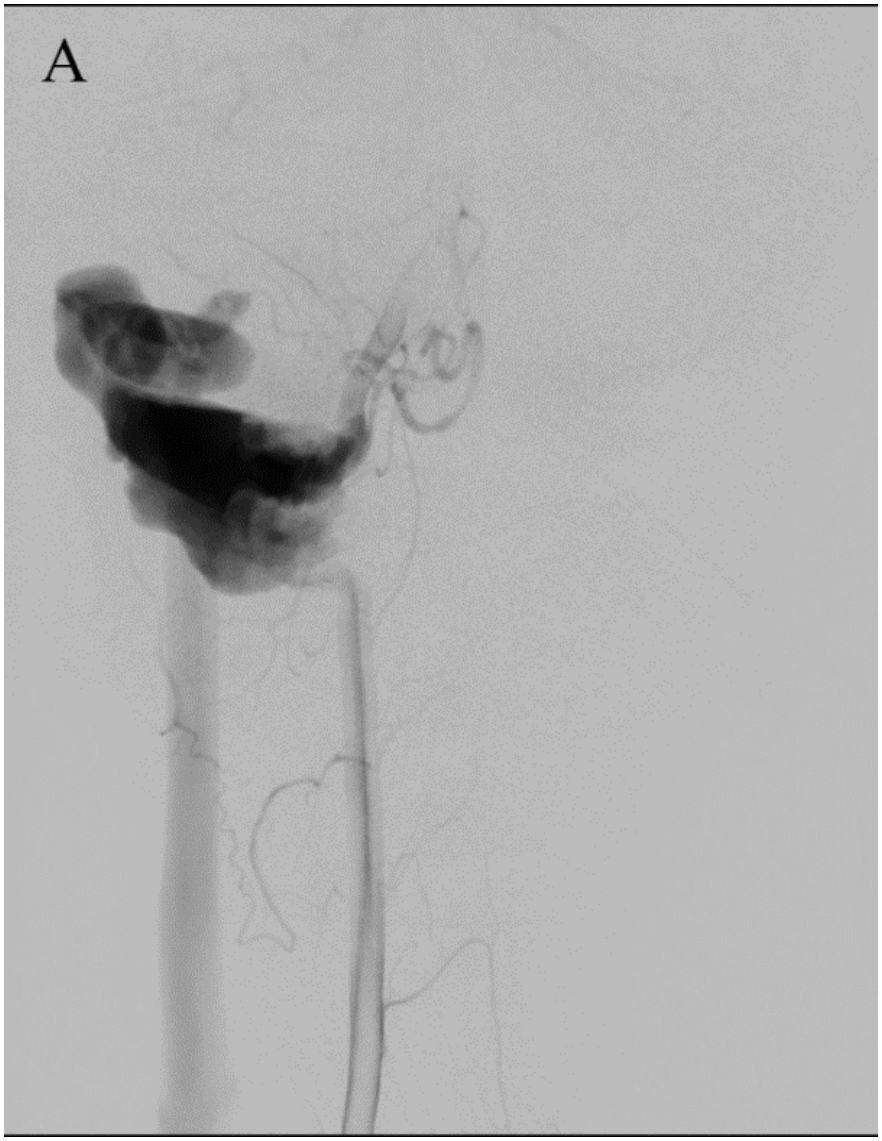

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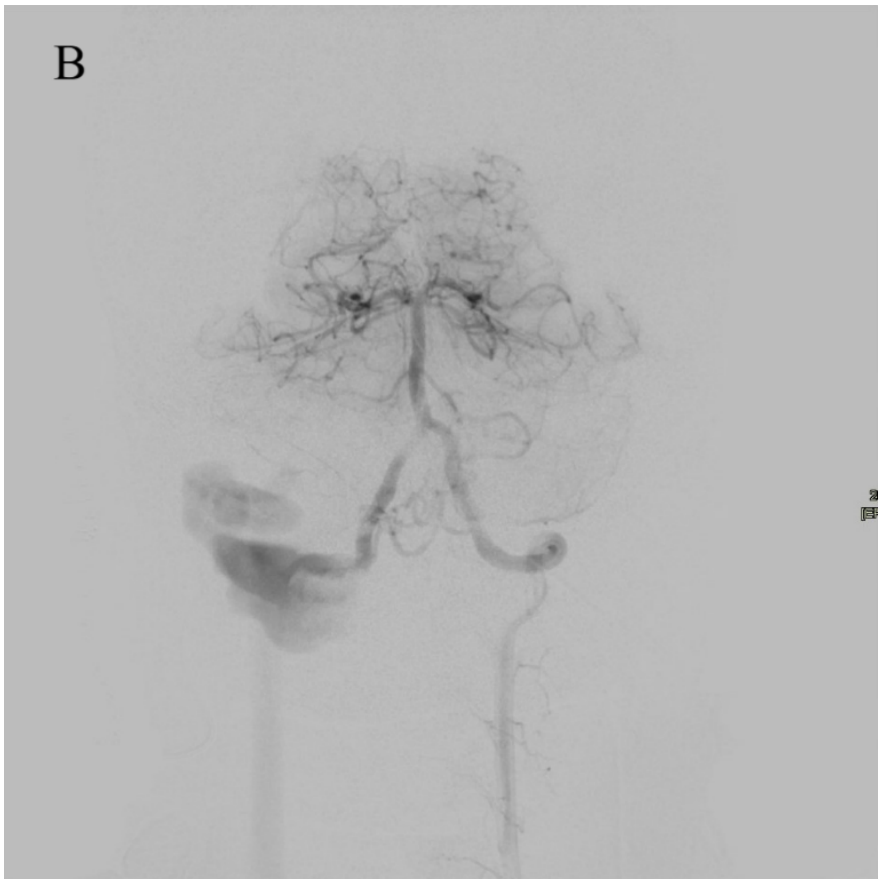

Fig. 5. DSA, right vertebral angiogram shows a large pseudoaneurysm being filled by a rent in the right vertebral artery.

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Fig. 6. Covered stent placed across the pseudoaneurysm

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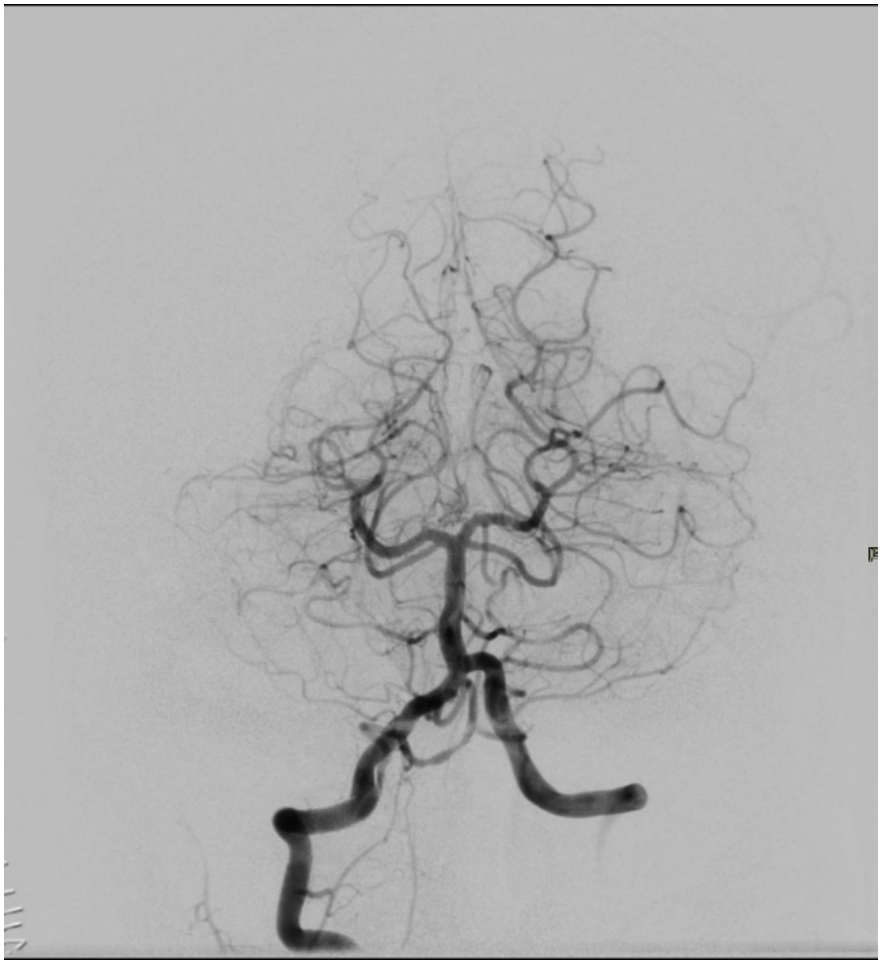

Fig. 7. Post-procedure run showing complete exclusion of the leak and aneurysm with adequate distal flow into the basilar artery.

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