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## Endovascular treatment of complex vertebrobasilar junction aneurysms: A report of two cases

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## ABSTRACT

**INTRODUCTION:** Vertebrobasilar junction (VBJ) aneurysms are uncommon posterior circulation aneurysms. The treatment of VBJ aneurysms is challenging and in most cases, endovascular management is preferred over neurosurgery.

**PRESENTATION OF CASE:** We describe two patients with VBJ aneurysms who underwent successful neuro-interventional procedures. The first patient had concomitant basilar fenestration and was treated with balloon-assisted coiling. The second patient had difficult vascular anatomy and an anterior inferior cerebellar artery-posterior inferior cerebellar artery variant arising from the neck of the aneurysm. Braided stent-assisted coiling was done with transradial access. Both patients had a good neurologic recovery.

**DISCUSSION:** Endovascular management of VBJ aneurysms is often complicated by anatomic difficulties like basilar fenestration, tortuosity of proximal vessels, atheromatous changes, and vascular stenosis. We achieved good post-procedure outcomes in both the patients. Optimal management of complex VBJ aneurysms often requires some modification to the usual interventional technique.

**CONCLUSION:** VBJ aneurysms are generally treated with endovascular techniques. The transradial access, although rarely used by neurointerventionalists, has some distinct advantages over the transfemoral access, especially when dealing with right-sided VBJ aneurysms with marked tortuosity of proximal great vessels.

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## 1. Introduction

Saccular aneurysms of the vertebrobasilar junction (VBJ) account for around 4% of all posterior circulation aneurysms [1]. VBJ aneurysms are often associated with basilar artery (BA) fenestration. The treatment of these aneurysms is challenging because the interruption of vertebrobasilar blood supply can lead to life-threatening consequences. As neurosurgical access to the VBJ is difficult, and arterial fenestration increases surgical complexity, endovascular interventions are increasingly favored as first-line treatment for most types of aneurysms in this location. We describe two patients with complex VBJ aneurysms who were successfully treated with endovascular techniques. The first patient, who had

a saccular right VBJ aneurysm with basilar fenestration, underwent balloon-assisted coiling with transfemoral access. The second patient had a saccular right VBJ aneurysm in association with an anterior inferior cerebellar artery-posterior inferior cerebellar artery (AICA-PICA) variation arising from the neck of the aneurysm. She underwent balloon-angioplasty of the stenotic origin of the right vertebral artery (VA) via transradial access (TRA), followed by braided stent-assisted coiling of the aneurysm. This report has been prepared according to the SCARE guidelines [2].

## 2. Presentation of case

We used two different approaches to occlude the VBJ aneurysms in our patients. A single neuro-interventionalist (SP) performed both the procedures.

## 2.1. Case 1

A 38-year-old male presented to the hospital with a sudden-onset severe headache. Past medical and family history was not remarkable. On examination, there was no obvious neurological

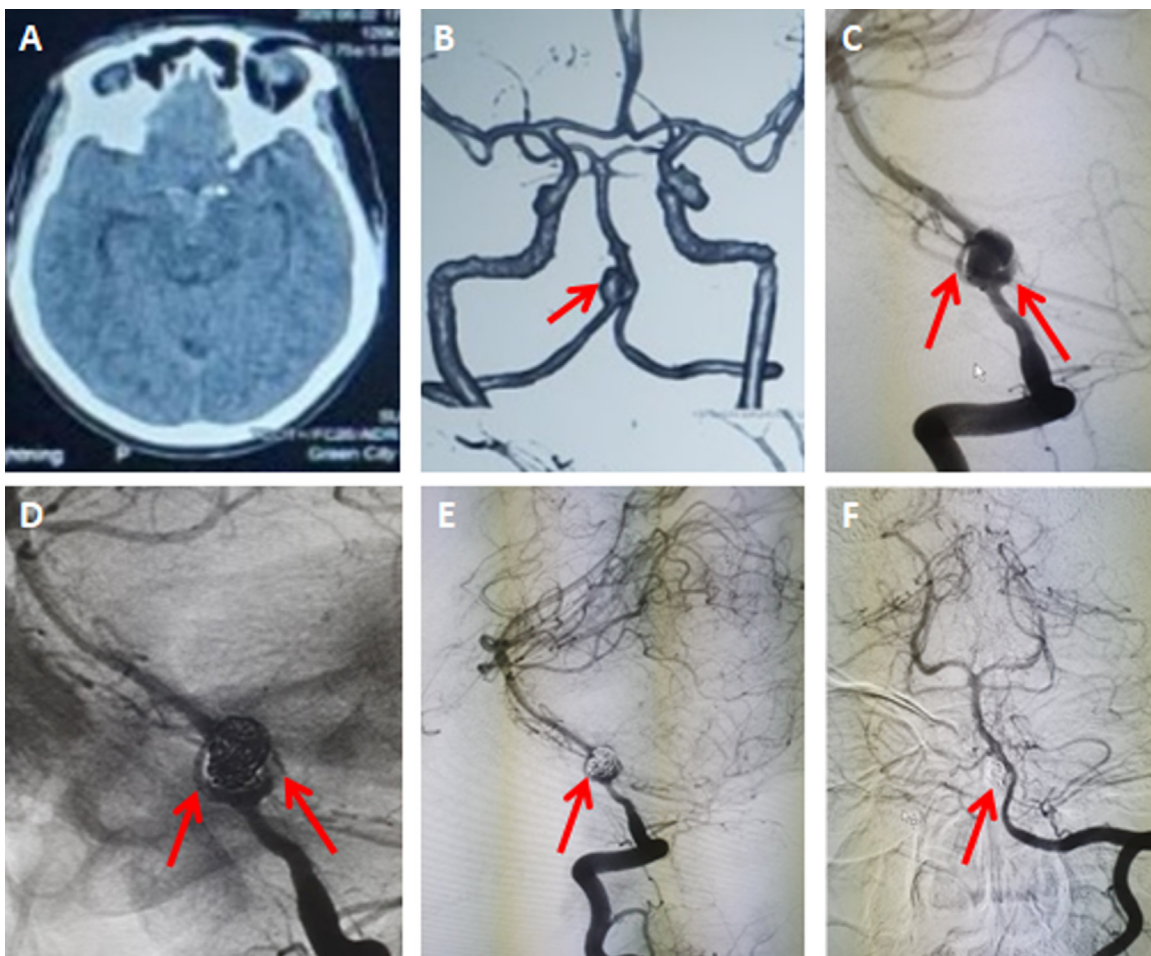
**Abbreviations:** BA, basilar artery; FDD, flow-diversion device; TRA, transradial access; VA, vertebral artery; VBJ, the vertebrobasilar junction.

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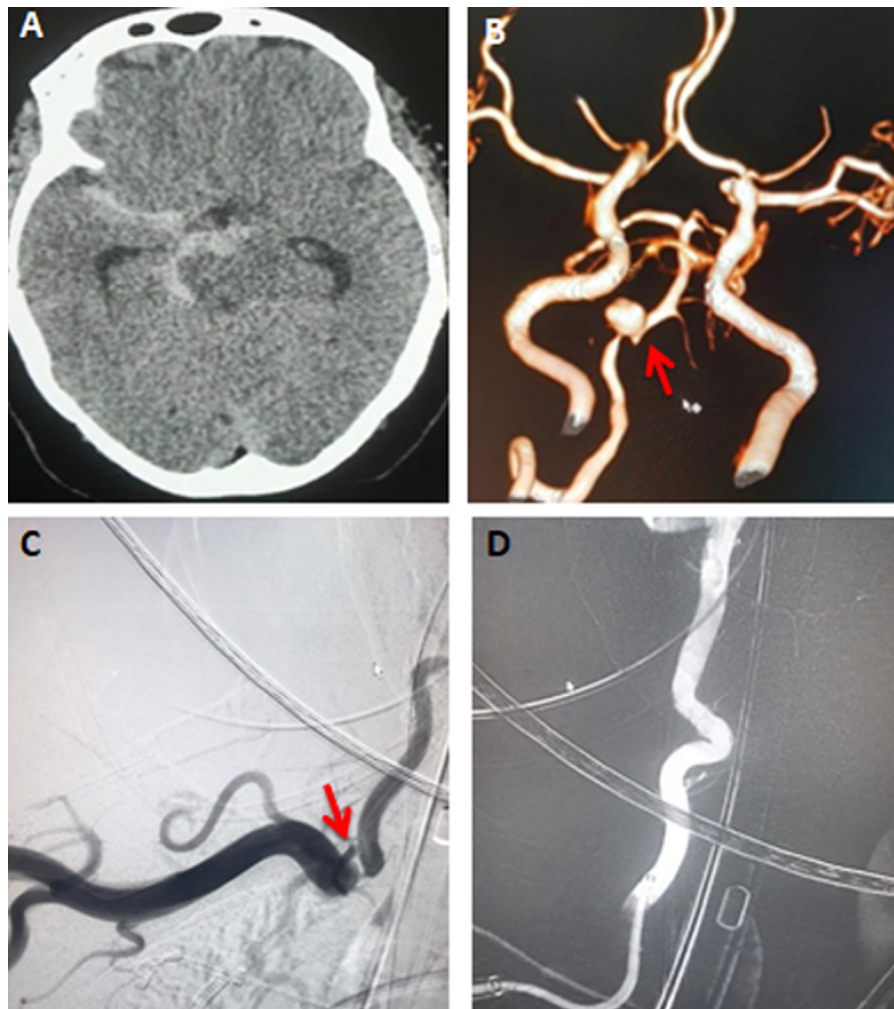
**Fig. 1.** (A) An axial CT-scan shows subarachnoid hemorrhage in the suprasellar cistern (B) A CT-angiograph shows a saccular aneurysm at the vertebrobasilar junction (C) A 2D right vertebral artery angiogram shows a wide-neck saccular aneurysm at the vertebrobasilar junction with basilar fenestration (red-arrows) (D) Coils within the aneurysm sac with patency of both the limbs (red-arrows) (E, F) Check-angiograms show complete aneurysm obliteration with normal distal flow.

deficit. A computed tomography (CT) scan revealed a modified Fisher Grade IV subarachnoid hemorrhage (SAH) (Fig. 1A). A CT-angiography found a ruptured saccular VBJ aneurysm associated with a fenestrated BA (Fig. 1B). Digital subtraction angiography confirmed the presence of fenestrated proximal BA and a saccular aneurysm arising from the origin of the limbs. There was good contrast-filling in the distal BA and its branches (Fig. 1C). We performed balloon-assisted coiling of the aneurysm under general anesthesia. Right femoral access was obtained, and a 6 F neuron-sheath (Neuron 088 Max, Penumbra, USA) was placed into the right proximal VA. Subsequently, an intracranial support catheter (Navien, Medtronic, USA) was passed through the neuron-sheath and advanced up to the distal V2 segment of the VA. A microcatheter (Echelon 10, Medtronic, USA) and a microguidewire (Traxcess 14, Microvention, USA) were then advanced into the aneurysm sac. Subsequently, the aneurysm was coiled (Fig. 1D, E), and the final angiogram showed normal flow in both the fenestrated limbs and in the distal segment of the BA (Fig. 1F).

## 2.2. Case 2

A 55-year-old female patient presented to the emergency department with a severe headache of sudden onset. She did not have any remarkable past medical or family history. There was no neurological deficit on examination. A CT-scan revealed a modified Fisher Grade IV SAH (Fig. 2A). A CT-angiography of the head showed a ruptured saccular right VBJ aneurysm with an AICA-PICA

variant arising from its neck. The right VA was dominant, whereas the left was hypoplastic (Fig. 2B). We planned to perform stent-assisted coiling with a braided stent (3.5 × 25 mm, Leo, Balt, France). Right femoral artery access was taken and a diagnostic angiogram was done, which showed type-II aortic arch with significant atherosclerotic changes, marked tortuosity of the proximal great vessels, severe stenosis at the origin of the right VA (Fig. 2C), and chronic occlusion of the right internal carotid artery. Hence, the procedure was crossed over to the right TRA. A 6 F Neuron Max 088 sheath was placed in the right subclavian artery and the stenotic segment was crossed using a Traxcess 14 microguidewire. Balloon angioplasty was performed using a rapid exchange coronary balloon (3 × 20 mm, NC Trek, Abbott, USA) over the microguidewire. A check-angiogram revealed an approximately 60% reduction in stenosis that was stable over 15 min of observation. Subsequently, the distal access catheter was placed into the distal-most part of the V2 segment of the right VA (Fig. 2D). 2D right VA angiograms revealed a wide-neck saccular aneurysm at the right VBJ with AICA-PICA variant arising from its neck (Fig. 3A). The aneurysm was crossed using a microcatheter (Vasco 21, Balt, France) and Traxcess 14 microguidewire. The Leo stent was then deployed from the BA to the V4 segment of VA (Fig. 3B). After deploying the stent, the aneurysm was accessed through the strut of the stent using a microcatheter (Echelon 10 Micro Catheter, Medtronic, USA) and Traxcess 14 microguidewire. Subsequently, the aneurysm was coiled (Fig. 3C) without obliterating flow in the origin of the AICA-PICA variation (Fig. 3D).



**Fig. 2.** (A) An axial plain CT-scan of the brain shows thick subarachnoid hemorrhage in the right sylvian fissure and perimesencephalic cistern (B) CT-angiography shows a saccular aneurysm in the vertebrobasilar junction with hypoplastic left vertebral artery (C) A 2D right subclavian angiogram shows severe stenosis at the origin of the right vertebral artery (D) Navigation of the distal access catheter into the right vertebral artery after balloon angioplasty.

### 3. Discussion

Posterior circulation aneurysms in the VBJ are rare and often associated with basilar fenestration. The basilar fenestration is most commonly seen in the proximal basilar trunk, and leads to turbulent blood flow, predisposing to the formation of aneurysm, which was seen in the first patient. In the second patient, basilar fenestration was not present; instead, there was an AICA-PICA variant originating from the neck of the aneurysm. There are very few reported cases that describe management of VBJ aneurysms in association with the AICA-PICA variant. Several neurosurgical techniques to treat VBJ aneurysms are described, such as direct clipping, wrapping, clipping with wrapping, and proximal occlusion with or without bypass [3]. However, obtaining optimal neurosurgical access is challenging because of the overlying petrous bone, and the risk of injuring perforating arteries, cranial nerves, and other vital structures close to the brainstem.

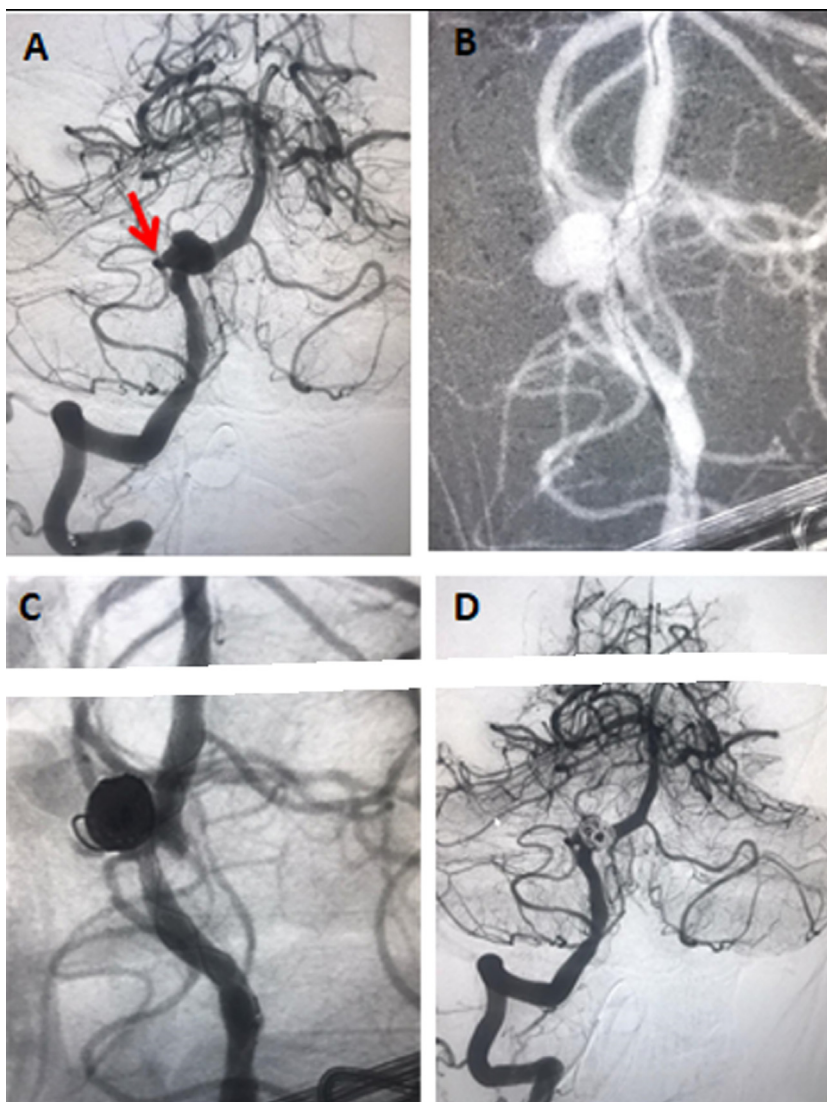
With a steady improvement in neurointervention, there is a growing body of evidence favoring endovascular techniques over neurosurgery to treat most posterior circulating aneurysms, including those in the VBJ [4,5]. Although largely unexplored, some authors also advocate the strategy of combining neurosurgery with endovascular techniques in complex aneurysms [6]. Compared to neurosurgery, the endovascular technique is less invasive, and generally, allows better preservation of blood flow in the

parent and perforating vessels. Common endovascular options in VBJ aneurysms include parent-artery occlusion, stand-alone stents, overlapping stents, and braided stents with adjunctive coil placement [7].

We successfully occluded the aneurysm by balloon-assisted coiling with transfemoral access in our first patient. The patient had a good neurologic recovery. However, in the second case, we encountered technical difficulties. Due to the tortuous vascular anatomy, it was difficult to access the origin of the right VA via the femoral route; hence, we crossed over to the radial route. We initially performed an angioplasty to widen the origin of the VA. We felt that the best therapeutic option would be to place a braided stent from the right VA into the basilar trunk followed by coil embolization of the aneurysm sac. Braided stents have a dense mesh of nitinol with a smaller pore size compared with other conventional self-expandable stents, and also exhibit a moderate flow-diverting effect [8].

TRA is popular in coronary and peripheral interventions and offers some advantages over the transfemoral access, like better post-procedural comfort, quicker ambulation, easy compressibility, and less incidence of puncture-site bleeding. Thus, it may be better in patients on high doses of anticoagulants or antiplatelets, who are at risk of developing access-site bleeding complications. In patients undergoing cardiac interventions, TRA reduces mortality, major adverse cardiac events, and access-site complications





**Fig. 3.** (A) A 2D right vertebral artery angiogram shows a wide-neck sacular aneurysm at the vertebrobasilar junction with AICA- PICA variant arising from its neck (B) Deployment of the braided stent from the basilar artery to the V4 vertebral artery segment covering the aneurysm (C) Coils within aneurysm sac with a stent in the parent artery (D) Final angiogram shows complete obliteration of aneurysm with normal flow in the AICA- PICA variant.

compared with femoral access [9]. Even in neurointerventional procedures, TRA is a safe alternative to the femoral approach. It provides easier access to the origin of the VA, especially on the right side, which may be difficult to access from the femoral artery. There is good stability of guiding catheters and less frequent catheter-herniation. A recent systematic review corroborated these advantages and showed excellent procedural success rate with TRA [10].

In contrast to the general practice of coronary interventions, most neuro-interventionalists rely on femoral access almost exclusively. Reasons for the discrepancy between the two specialties are the general lack of familiarity of TRA among neuro-interventionalists, the undue concern of vessel injury because of the small caliber of the radial artery, and paucity of publications concerning TRA in neurointerventions. However, several recent neurointerventions are being crossed over to TRA, suggesting this trend may be changing [10]. However, TRA may pose challenges for using FDDs, especially when it is necessary to use a guide-catheter larger than 6 F. As with every procedure, careful selection of patients and devices will decrease the failure rate as well as complications in TRA. There are important patient considerations when choosing TRA, like short stature, low body mass, young age, and small wrist circumference.

#### 4. Conclusion

TRA can sometimes mitigate difficulties encountered while performing neuro-interventions for VBJ aneurysms, yet it is rarely described. Hopefully, with the availability of newer devices tailored for transradial access, and more publications supporting its use, TRA becomes more acceptable in complex neuro-interventional procedures. Prospective trials are lacking and clearly warranted.

#### Declaration of Competing Interest

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#### Ethical approval

Submission of case reports are exempt from ethical approval.

## Consent

Written informed consent was obtained from both patients for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

## Author contribution

**Subash Phuyal:** Conceptualization, Writing – Original Draft, Writing – Review and Editing, Project administration. **Raju Poudel:** Conceptualization, Writing – Review and Editing. **Pooja Agrawal:** Conceptualization, Investigation, Writing – Original Draft. **Nirmal Prasad Neupane:** Investigation, Writing – Review and Editing. **Ritesh Lamsal:** Resources, Writing – Original Draft, Writing – Review and Editing.

## Registration of research studies

1. Name of the registry: not applicable.
2. Unique identifying number or registration ID: not applicable.
3. Hyperlink to your specific registration (must be publicly accessible and will be checked): not applicable.

## Guarantor

Dr. Subash Phuyal, accepts full responsibility for the work, and controlled the decision to publish.

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