



Case Report

A case of bilateral vertebral artery dissection treated by bilateral surgical occlusion and low-flow bypass

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Received: 20 February 2024

Accepted: 13 March 2024

Published: 05 April 2024

DOI

10.25259/SNI_125_2024

Quick Response Code:



ABSTRACT

Background: Bilateral vertebral artery dissection aneurysm (VADA) is a rare condition that leads to severe stroke. However, the surgical strategy for its treatment is controversial because the pathology is very complicated and varies in each case. Here, we report a case of bilateral VADA that was successfully treated with staged bilateral VADA occlusion and low-flow bypass.

Case Description: A Japanese man in his 40s presented with bilateral VADA with subarachnoid hemorrhage. He had only mild headaches without any other neurological deficits. Subsequently, the ruptured left VADA was surgically trapped. However, on postoperative day 11, the contralateral VADA enlarged. The right VADA was then proximally clipped via a lateral suboccipital approach. Furthermore, a superficial temporal artery–superior cerebellar artery bypass was performed through a subtemporal approach in advance to preserve cerebral flow in the posterior circulation. The bilateral VADA was obliterated, and the patient had an uneventful postoperative course during the 1-year and 6-month follow-up period.

Conclusion: Bilateral VADA can be successfully treated with staged bilateral VADA obstruction and low-flow bypass. In this case, as the posterior communicating arteries were the fetal type and the precommunicating segments of the posterior cerebral arteries (P1) were hypoplastic, a low-flow bypass was used to supply the basilar and cerebellar arteries, except the posterior cerebral and posterior inferior cerebellar arteries. Furthermore, low-flow bypass is a less invasive option than high-flow bypass.

Keywords: Bilateral vertebral dissection, Direct surgery, Low-flow bypass, Proximal clipping, Subarachnoid hemorrhage, Trapping

INTRODUCTION

The prevalence rate of fusiform aneurysms, including vertebral artery dissection aneurysms (VADA), is reportedly <0.1%.^[2] VADA with subarachnoid hemorrhage (SAH) has been reported to account for approximately 3% of all SAH cases.^[10] Furthermore, 12–30% of these cases have been bilateral VADA.^[10] Thus, bilateral VADA is a rare condition that leads to stroke. However, the surgical strategy for bilateral VADA with SAH is controversial. Trapping the ruptured VADA increases hemodynamic stress at the contralateral VADA, which is a risk factor for expansion and

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rupture of the contralateral VADA. Here, we report a case of bilateral VADA that was successfully treated with staged bilateral VADA occlusion and low-flow bypass.

CASE DESCRIPTION

A man in his early 40s with no past medical history presented with a mild headache that had persisted for two days. He was diagnosed with a SAH that corresponded to the World Federation of Neurosurgical Societies Grade I.^[8] Computed tomography angiography (CTA) revealed a bilateral VADA [Figure 1a]. We confirmed that the left VADA ruptured by hematoma localization on images. Therefore, the left VADA was surgically trapped via a left lateral suboccipital approach on admission. Fresh bleeding was found under adventitia of the left VADA, consistent with a rupture. The posterior inferior cerebellar artery (PICA) was not involved in the VADA. Therefore, we performed proximal clipping distal to the PICA. The trapping was completed without any intraoperative complications. Follow-up CTA revealed left PICA and obliteration of the left VADA on postoperative day 2 [Figure 1b]. However, on postoperative day 11, follow-up CTA revealed asymptomatic enlargement of the contralateral VADA [Figure 1c]. The perforating arteries from the distal part of the right VADA to the medulla oblongata, fetal-type posterior communicating arteries (PCOMs), and hypoplastic precommunicating segment of both the posterior cerebral arteries (P1) were revealed on digital subtraction angiography [Figure 1d]. We planned proximal clipping of the right VADA with a right superficial temporal artery (STA)–superior cerebellar artery (SCA) bypass on postoperative day 17. The right STA–SCA bypass was performed first using a subtemporal approach [Figures 2a and b]. Ultrasonic pulse Doppler velocimeter intraoperatively detected a graft flow rate of 25 mL/min. Proximal clipping distal to the PICA was performed after

completion of the STA–SCA bypass [Figure 2c]. Parts of the proximal VADA vessel walls were thin, indicating a high risk of rupture. Although the VADAs extended up to the vertebral junction, neither of the VADAs was a continuous lesion. We found perforating arteries in the right VADA [Figure 2d]. Ultrasonic pulse Doppler and indocyanine green imaging revealed a PICA, and the perforating arteries from the VADA were preserved. Motor and somatosensory evoked potentials and auditory brainstem response remained stable throughout the surgery. The bilateral VADA was obliterated, and the patent STA–SCA bypass flow was observed using CTA [Figure 3]. No infarction was observed on postoperative magnetic resonance imaging. The patient had an uneventful postoperative course and was discharged about a month after rehabilitation. He received a modified Rankin scale score of 0 at both the 1-year and 6-month follow-up assessments.^[11]

DISCUSSION

We report a case of bilateral VADA that was successfully treated with staged bilateral VADA occlusion and low-flow bypass. The management strategies for bilateral VADA with SAH are controversial. Here, we present an effective surgical option for the treatment of bilateral VADA. The indications for bypass in the treatment of bilateral VADA were selected individually. Some previous studies have reported strategies to preserve perfusion in the basilar and cerebellar arteries. Ota *et al.* and Saito *et al.* reported an efficient treatment of bilateral VADA using high-flow bypass.^[7,9] Murai *et al.* reported successful treatment of bilateral VADA without bypass in a patient with fetal-type PCOM.^[6] High-flow bypass is an invasive surgery; however, it becomes essential in certain cases that could not expect enough perfusion from PCOMs to posterior circulation after bilateral VA occlusion. In the present case, both the PCOMs were of the fetal type, while both the precommunicating

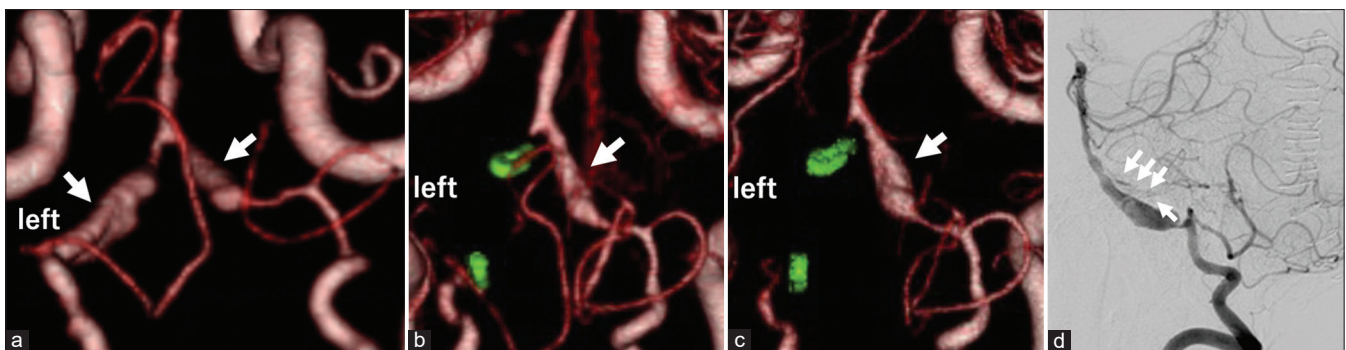


Figure 1: (a) Posterior view of computed tomography angiography on admission demonstrates bilateral vertebral dissection aneurysm (arrows); (b) Posterior view of computed tomography angiography on hospital days 3 (arrows); (c) Posterior view of computed tomography angiography on hospital days 11 reveals that the right vertebral dissection aneurysm is rapidly enlarging (arrows); (d) A lateral view of right vertebral angiography reveals a perforating artery to the medulla oblongata from the distal part of the right vertebral dissection aneurysm (arrows) and hypoplastic precommunicating segment of the posterior cerebral arteries.

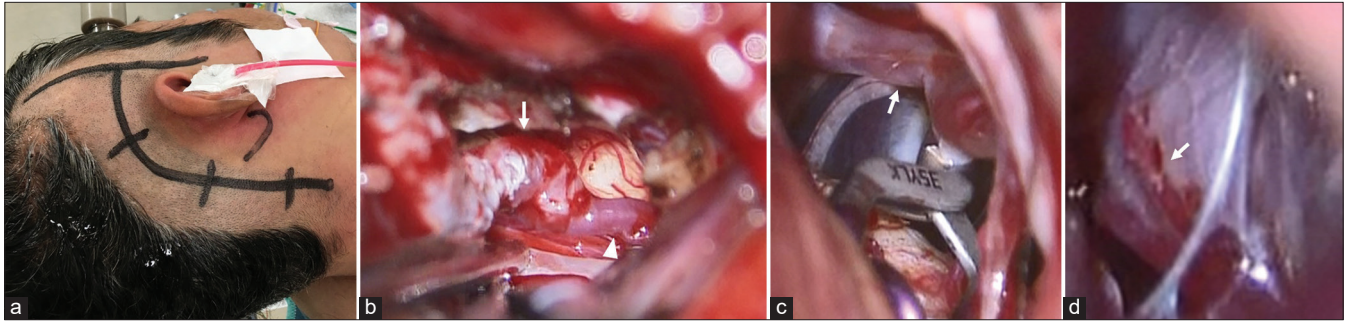


Figure 2: (a) Skin incision line for right superficial temporal artery–superior cerebellar artery (SCA) bypass and proximal clipping of the right vertebral dissection aneurysm; (b) Intraoperative findings of a right superficial temporal artery (arrows)–SCA (arrows head) bypass. The interruption time of a right SCA during the bypass was 28 min; (c) Intraoperative findings of proximal clipping distal to the posterior inferior cerebellar artery (arrows); (d) Intraoperative findings of right vertebral dissection aneurysm and the perforator from the distal part to the brain stem (arrows).

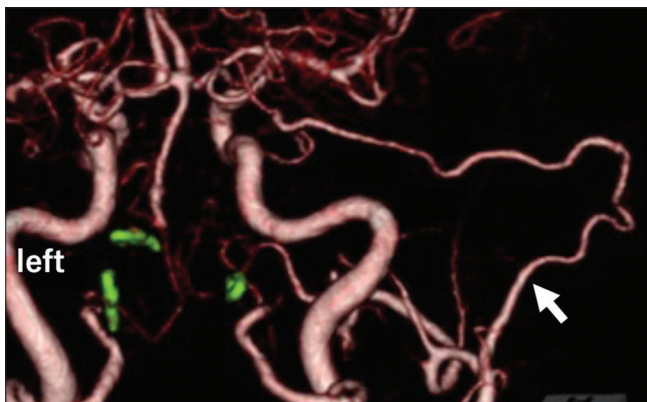


Figure 3: Posterior view of computed tomography angiography demonstrates bilateral vertebral dissection aneurysm obliteration and patent superficial temporal artery–superior cerebellar artery bypass graft (arrows).

segment of posterior cerebral arteries were hypoplastic. Therefore, low-flow bypass was used to supply the basilar and cerebellar arteries, except the posterior cerebral arteries and PICAs. Perfusion from adequate antegrade flow through both the PCOMs and bypass adequately prevented postoperative ischemia [Figure 3]. This can be significantly important in the treatment during the acute stage, with the potential presence of arterial spasm. A low-flow bypass can be a viable treatment option for bilateral VA occlusion, as observed in the present variant of the posterior circulation, because it is less invasive than a high-flow bypass. The right VADA was treated with proximal clipping to preserve perforators in the brainstem. Motoyama *et al.* reported that all 22 cases treated with proximal clipping, including 10 cases distal to the PICA, did not have medulla oblongata infarction.^[5] Furthermore, they reported that no cases ruptured after surgery.^[5] Endovascular internal trapping was recently established as first-line therapy.^[10,12] However, some retrospective studies on internal trapping revealed

a high incidence of postoperative medullary infarction (30%–47%).^[1,3] In our case, we preserved the perforating arteries originating from the VA during surgery. Proximal clipping was an effective treatment option for the non-ruptured VADA. For bilateral VADA, similar to our case, the ruptured site is not confirmed during endovascular treatment, and using a stent would be risky due to the need for antiplatelet drug treatment.^[4] Therefore, we first trapped the suspected ruptured left VADA. Direct surgery also indicated the side of the VADA rupture, which was substantially beneficial for subsequent treatment. Thus, direct surgery may be superior to endovascular treatment in these aspects. We have a limitation. This study is simply a single case. However, as mentioned, this VADA is an extremely rare condition; therefore, we believe that we need to accumulate more cases.

CONCLUSION

We describe a patient with bilateral VADA successfully treated with staged bilateral VADA obstruction and low-flow bypass. In such cases, as perfusion of the PCA is supplied by adequate antegrade flow via PCOMs, low-flow bypass is sufficient to maintain the circulation of the basilar and cerebellar arteries. Based on collateral flow, low-flow bypass may be considered a potential treatment option for bilateral VADA occlusion, as it tends to be less invasive than high-flow bypass.

Ethical approval

Institutional Review Board approval is not required.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

REFERENCES

1. Aihara M, Naito I, Shimizu T, Matsumoto M, Asakura K, Miyamoto N, *et al.* Predictive factors of medullary infarction after endovascular internal trapping using coils for vertebral artery dissecting aneurysms. *J Neurosurg* 2018;129:107-13.
2. Anson JA, Lawton MT, Spetzler RF. Characteristics and surgical treatment of dolichoectatic and fusiform aneurysms. *J Neurosurg* 1996;84:185-93.
3. Endo H, Matsumoto Y, Kondo R, Sato K, Fujimura M, Inoue T, *et al.* Medullary infarction as a poor prognostic factor after internal coil trapping of a ruptured vertebral artery dissection. *J Neurosurg* 2013;118:131-9.
4. Kono K, Shintani A, Fujimoto T, Terada T. Stent-assisted coil embolization and computational fluid dynamics simulations of bilateral vertebral artery dissecting aneurysms presenting with subarachnoid hemorrhage: Case report. *Neurosurgery* 2012;71:E1192-200.
5. Motoyama Y, Takamura Y, Park HS, Miyasaka T, Wada T, Yamada S, *et al.* Appropriate flow reduction for unilateral ruptured vertebral artery dissection by proximal clipping to prevent rebleeding and medullary infarction. *World Neurosurg* 2019;130:e627-33.
6. Murai Y, Matano F, Yokobori S, Onda H, Yokota H, Morita A. Treatment strategies of subarachnoid hemorrhage from bilateral vertebral artery dissection: A case report and literature review focusing on the availability of stent placement. *World Neurosurg* 2017;106:1050.e11.
7. Ota N, Tanikawa R, Eda H, Matsumoto T, Miyazaki T, Matsukawa H, *et al.* Radical treatment for bilateral vertebral artery dissecting aneurysms by reconstruction of the vertebral artery. *J Neurosurg* 2016;125:953-63.
8. Report of world federation of neurological surgeons committee on a universal subarachnoid hemorrhage grading scale. *J Neurosurg* 1988;68:985-6.
9. Saito N, Kamiyama H, Takizawa K, Takebayashi S, Asano T, Kobayashi T, *et al.* Management strategy for bilateral complex vertebral artery aneurysms. *Neurosurg Rev* 2016;39:289-95.
10. Tatsuya I, Koji Y, Hidenori A, Taichi I, Go M, Takakazu K. Stent-assisted coil embolisation for bilateral vertebral artery dissecting aneurysms presenting with subarachnoid haemorrhage. *Neuroradiol J* 2016;29:473-8.
11. van Swieten JC, Koudstaal PJ, Visser MC, Schouten HJ, van Gijn J. Interobserver agreement for the assessment of handicap in stroke patients. *Stroke* 1988;19:604-7.
12. Zhang Y, Tian Z, Zhu W, Liu J, Wang Y, Wang K, *et al.* Endovascular treatment of bilateral intracranial vertebral artery aneurysms: An algorithm based on a 10-year neurointerventional experience. *Stroke Vasc Neurol* 2020;5:291-301.

How to cite this article: Yokoyama T, Nomura S, Ishiguro T, Hodotsuka K, Kuwano A, Tanaka Y, *et al.* A case of bilateral vertebral artery dissection treated by bilateral surgical occlusion and low-flow bypass. *Surg Neurol Int.* 2024;15:121. doi: 10.25259/SNI_125_2024

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