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Case Report

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Extracranial vertebral artery endovascular reconstruction in the setting of subacute total occlusion: case report and review of literature

Abstract

Vertebral artery insufficiency is a significant cause of posterior circulation strokes (PCS). Currently, there are no clear guidelines for the endovascular treatment of extracranial vertebral artery (VA) stenosis. This case report presents a 59-year-old male with a history of left VA stenting who was on antiplatelet therapy and presented to our outpatient clinic with minimal symptoms. Computed tomography angiography (CTA) revealed bilateral vertebral artery occlusion at their origins. The patient subsequently developed acute neurological symptoms, and neuroimaging confirmed a new PCS with hemorrhagic transformation. Vertebral stump syndrome was suspected. The patient underwent successful endovascular reconstruction of the left VA. Following the procedure, he demonstrated clinical improvement, with only mild residual deficits at follow-up. This case highlights the challenges of endovascular intervention, including device selection, anatomical complexity, and procedural risks. Further studies are warranted to optimize treatment strategies and clarify the potential benefits of intervention in patients with occlusive lesions, particularly those with complex vascular anatomy.

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Abbreviations: BMS, bare metal stents; CTA, CT angiogram; DAPT, dual antiplatelet therapy; DES, drug-eluting stents; ICH, intracranial hemorrhage; ISO, in-stent occlusion; ISR, in-stent restenosis; PCS, posterior circulation strokes; QMRA, quantitative magnetic resonance angiography; TFA, trans-femoral approach; TRA, trans-radial approach; USG, ultrasonography; VA, vertebral artery; VAS, vertebral artery stenosis; VBI, vertebrobasilar insufficiency

Introduction

Posterior circulation stroke (PCS) accounts for approximately 20% of all acute ischemic strokes, with vertebrobasilar stenosis responsible for nearly one-quarter of these cases.[1,2] Vertebrobasilar insufficiency (VBI), characterized by reduced blood flow through the posterior cerebral circulation, can result in significant neurological deficits due to the involvement of critical structures such as the brainstem and cerebellum. When vertebral artery stenosis (VAS) becomes symptomatic, it poses an estimated annual stroke recurrence rate of 10–15%.[3]

Vertebral artery stenosis (VAS) is typically managed with antithrombotic therapy, while endovascular intervention is reserved for cases that are refractory to medical management.[4] However, randomized trials have not demonstrated the superiority of endovascular treatment over medical therapy and suggest that intracranial and extracranial VAS should be evaluated as distinct entities in future studies.[5,6] In this context, evidence regarding the endovascular treatment of extracranial VAS remains limited, and current guidelines do not address the management of technically complex cases.

This report presents a case of extracranial VAS complicated by stump syndrome due to a thrombosed stent, successfully treated with endovascular reconstruction, accompanied by a review of the literature.

Case report

Initial presentation

One year prior to presenting to our service, a 59-year-old man with a history of diabetes mellitus and hypertension presented to an external facility with the acute onset of dizziness, unsteady gait, blurry vision, and seeing spiral lights. Physical examination revealed a deviating gait to the right. There was no evidence of weakness, aphasia, or sensory loss.

A CT angiogram (CTA) revealed complete right vertebral artery (VA) occlusion. A cerebral angiogram performed at the external facility confirmed right VA occlusion and left vertebral artery stenosis of the V1 segment. An MRI of the brain showed no acute or subacute ischemic changes. The patient started dual antiplatelet therapy (DAPT). His symptoms resolved, and he was discharged with a plan for elective vertebral artery angioplasty. He subsequently returned for an uneventful left vertebral artery stent placement and was discharged for follow-up. Unfortunately, the patient lost his health insurance at that time.

Reestablishing care

After a 6-month, the patient re-established care at our outpatient service. He was on DAPT and reported mild VBI symptoms, such as occasional and self-resolving lightheadedness when bending over or lifting. The physical examination was non-focal. On the same day, the patient underwent CTA that confirmed right VA occlusion and proximal cervical occlusion of the left VA, with reconstitution of the distal cervical segment from muscular branches. Elective angiography was then scheduled, pending primary care physician clearance.

One week later, the patient awoke with nausea and vomiting. He denied double vision but described a “jumpy” vision. He also denied weakness, headaches, sensory changes, or speech difficulties. On examination, he exhibited nystagmus and ataxia. A primary stroke

assessment was performed, and the patient was transferred to our comprehensive stroke center. Upon arrival at our center, the patient was asymptomatic and had a non-focal examination. An MRI of the brain showed an acute, non-hemorrhagic infarction in the right PICA territory, involving the inferomedial cerebellum (Video 1). MRA of the brain revealed occlusion of the right VA (V4 segment), and cerebral angiography confirmed occlusion of the left vertebral artery at its origin. Bilateral PCAs were perfused through bilateral PCOMs, and the basilar artery was supplied by thyrocervical branches on the left.

Given the patient's asymptomatic status, the initial hypothesis was that the right PICA territory infarction resulted from hypoperfusion, with blood supply via the left VA anastomosis. However, in the neuro ICU, the patient's neurologic status fluctuated. He later experienced clinical deterioration with worsening visual symptoms, dizziness, ataxia, right facial droop, dysarthria, and dysphagia. A repeat MRI revealed bilateral cerebellar infarcts with signs of edema, despite the patient being on DAPT. Considering progressive neurologic worsening and new infarcts in imaging, the endovascular team decided to intervene, as vertebral stump syndrome appeared to be the more likely diagnosis. On the morning of the procedure, the patient complained of posterior headache, and a CT of the head revealed significant posterior edema with mass effect on the 4th ventricle.

Intervention description

The patient was brought to the angio-suite under general anesthesia and neuro monitoring. The right femoral access site was prepped, and a 6-French sheath was placed in the right femoral artery using ultrasound guidance. A 6-French guide catheter was advanced over a VTK catheter into the left vertebral artery. A 27 intermediate catheter was then advanced into the left vertebral cerebral artery over a 14-microwire. The occlusion was at the VA of origin and complicated by a calcified plaque, increasing procedural difficulty. To address the technical challenge, a buddy-wire was anchored in the left brachiocephalic artery to enhance stability while crossing the thrombosed VA (Video 1).

Angioplasty and stenting of the left vertebral artery were performed, with good device apposition and no distal embolization or contrast extravasation. TICI 3 flow was achieved in the left vertebral artery with minimal residual stenosis. After removal of the devices, a Dyna CT (flat-panel imaging) of the head was performed, which showed no evidence of intracranial hemorrhage. The right femoral access site was closed using AngioSeal after performing a femoral angiogram. No changes were noted in the patient's neurologic exam, and he was transferred to the ICU.

Post procedure and follow-up

Post-procedure Day 1, the patient was drowsy but awake and oriented to time and place. On examination, persistent right facial droop, dysarthria, nystagmus, and dysmetria were noted. A CT of the head revealed new or increased intracranial hemorrhage (ICH) compared to the pre-procedural CT.

The patient demonstrated progressive neurological recovery, no new strokes on neuroimaging, and was subsequently discharged. At the 30-day outpatient follow-up, the patient had a deconjugate gaze, right facial paralysis, dysarthric speech, and right upper limb weakness (4/5). No aphasia, additional weakness, or sensory deficits were observed.

Discussion

The posterior circulation is predominantly supplied by the VA, with the left side being dominant in approximately 70% of individuals. The VA is anatomically divided into four segments. Of these, the V1 and V2 segments are more accessible and thus more amenable to endovascular intervention. In contrast, the distal V3 and V4 segments pose greater technical challenges. The V3 segment's tortuosity complicates device navigation, while the V4 segment is critical due to its role in forming the anterior spinal artery, which supplies the anterior two-thirds of the spinal cord. [7]

In the case of VA occlusion, collateral circulation may compensate. However, many patients may lack adequate intracranial anastomoses, as 48–58% of the population has an incomplete circle of Willis.[8]

Clinically, extracranial VAS is typically asymptomatic and often discovered incidentally.[9] Nonetheless, some patients may present with ischemia of the medulla and/or cerebellum, when there is systemic hemodynamic changes or positional alterations.[4,10] In the illustrative case, the patient initially presented in our outpatient setting with only mild lightheadedness and no focal neurological deficits, despite having bilateral extracranial VA occlusion. His posterior circulation was dependent on the anastomosis between the distal left VA and muscular branches, with partial supply from the posterior communicating arteries.

Extracranial VAS is confirmed through imaging. Ultrasonography (USG), the first-line modality, visualizes the artery's origin in up to 60% of cases, with Doppler-USG increasing detection to 80%.[11] MRI and MRA are effective for distal lesions, while CTA reliably detects extracranial VAS and distinguishes between tortuosity and atherosclerosis. However, despite high sensitivity (94%) and specificity (95%), CTA and contrast-enhanced MRA often fail to clearly define the artery's origin.[7,12,13] In this context, Digital subtraction angiography remains the gold standard, although it is reserved for cases where intervention is considered, due to its 1–2% stroke risk.[7]

As randomized trials have been inconclusive regarding the indications for VA intervention, the VERiTAS study utilized neuroimaging biomarkers to predict the stroke risk associated with VAS using quantitative magnetic resonance angiography (QMRA). This study evaluated 82 symptomatic patients with >50% VAS and found that distal low flow was associated with a 28% risk of ischemic events over a 24-month study period. In contrast, patients with normal flow status, as measured by QMRA, had a 9% risk.[14]

Subsequent analysis of this study emphasized the importance of assessing the distal hemodynamic status in VAS when risk-stratifying patients for endovascular stenting, as opposed to relying solely on static measurements such as percentage stenosis, which were used in prior randomized trials.[4,14] However, the majority of patients in this study had intracranial VAS, which may not accurately reflect the stroke risk associated with extracranial disease. Regarding treatment, the first step is to focus on modifiable cardiovascular risk factors (e.g., smoking cessation, a healthy diet, and physical activity) and optimize medical management (e.g., antihypertensive therapy, antiplatelet therapy, statins, and glycemic control). If invasive treatment is decided upon, the femoral artery is typically the access site of choice in 80% of cases. In 20% of cases, an additional access may be made through the ipsilateral brachial or radial artery, particularly in complex cases or when the proximal vertebral artery is acutely angulated.[7]

A single-center, randomized study assessed 102 patients with VA origin stenosis who required stenting. The study compared the safety and effectiveness of three access approaches: ipsilateral trans-radial (TRA), contralateral TRA, and trans-femoral (TFA). The study found no significant differences among the groups in terms of the final

success rate of stent implantation or cerebrovascular events within one month. However, the time from sheath insertion to stent insertion was significantly shorter in the ipsilateral TRA group (median time: 19 minutes [IQR: 12-24.5 minutes]) compared to the TFA group (median time: 29 minutes [IQR: 21-35.5 minutes]) (P<0.01; 95% CI: 10 minutes [6-14 minutes]). Additionally, patient satisfaction and preference favored the radial approach.[15]

Historically, atherosclerotic lesions near the aortic arch often have a poor response to angioplasty alone due to the high elastic recoil in this area. Furthermore, since the most common location for extracranial VAS is near the VA origin, stenting following angioplasty should be considered.[7]

Stent selection is a key consideration in endovascular treatment of extracranial vertebral artery disease. A meta-analysis comparing drug-eluting stents (DES) and bare metal stents (BMS) showed that BMS was associated with significantly higher rates of restenosis (33.6% vs. 15.5%; OR 0.388, p=0.001), recurrent symptoms (11.3% vs. 2.8%; OR 3.319, p=0.011), and target vessel revascularization (19.2% vs. 4.8%; OR 4.099, p=0.001). However, both stent types demonstrated comparable rates of technical and clinical success, as well as periprocedural complications.[16]

A more recent study of 392 symptomatic patients (428 arteries) compared BMS with first- and second-generation DES in VAS angioplasty. No significant differences were observed in in-stent restenosis (ISR) or occlusion (ISO) at 6-month follow-up between DES and BMS (22.8% vs. 19.4%; p = 0.635), or between DES I and DES II (31.6% vs. 27.2%; p = 0.325). However, stainless steel (17.8%) and cobalt-chromium BMS (19%) showed lower ISR/ISO rates compared to platinum-chromium stents (38.9%; p = 0.034). Additionally, ISR/ISO correlated with older age (p = 0.01) and CRP > 5 mg/L (p = 0.043). Stent length was linked to ISR in the DES group (p = 0.024).[17]

The optimal choice between balloon-expandable and self-expanding stents remains insufficiently studied. Limited data suggest balloon-expandable stents may offer lower restenosis rates; however, they are also associated with a higher incidence of stent fractures, particularly with balloon-mounted BMS.[18,19] Overall, current evidence supports balloon-mounted stents as the preferred option for extracranial VAS stenting.[4]

While selected patients with extracranial VAS may benefit from endovascular treatment, the evidence supporting intervention for VA occlusion remains limited.[4] In our case, we opted for intervention due to the new ischemic lesions raising concern for stump syndrome—embolism from stagnant flow at the occluded origin. The occlusion at the VA origin, complicated by a calcified plaque, posed significant technical challenges. To improve stability while crossing the lesion, a buddy-wire was anchored in the left brachiocephalic artery. Though uncommon and potentially risky, this approach was warranted due to the patient's progressive neurological decline.

Author contributions

João Victor Sanders: data collection, video composition, writing, revision and editing. Marion Oliver: surgery, video composition, writing, revision and editing. Krishna Joshi: writing, revision and editing. Demetrius Lopes: surgery, video composition, narration, revision, supervision.

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Ethics Statement

Ethics approval was not required for this case report per institutional guidelines. Informed consent for the procedure and publication (including images and video) was obtained from the patient. Patient anonymity has been maintained.

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Not Applicable

Conflicts of interest

The authors declare that there are no conflicts of interest.

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