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Basilar artery recanalization by proximal balloon occlusion and aspiration in a single vessel vertebrobasilar system: A case report

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Abstract:

The authors present a case of a patient with a hypoplastic right vertebral artery (VA) ending in the posterior inferior cerebellar artery who sustained an acute onset basilar artery occlusion. A balloon-guided catheter was used to proximally occlude the dominant left VA, and aspiration was applied until reversal of flow was achieved in the basilar artery. Thus, basilar artery reperfusion was achieved without the need for stent-retrieval thrombectomy. We believe this represents the first described case of successful thrombectomy in the vertebrobasilar system using only proximal artery occlusion and aspiration. This novel technique may decrease the time to recanalization and improve outcomes for patients with acute basilar artery occlusion in the setting of a hypoplastic contralateral VA.

Keywords:

Balloon angioplasty, basilar artery, interventional neuroradiology

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Introduction

Recent years have yielded compelling data asserting the superiority of mechanical thrombectomy with thrombolytic therapy compared to thrombolytic therapy alone in the anterior cerebral circulation.^[1-6] There is also data to suggest that the decreased time to revascularization of an occluded anterior cerebral circulation vessel correlates positively with patient outcomes.^[7,8] Although no such data are yet published for posterior circulation strokes, emergent recanalization of the basilar artery is significantly associated with decreased mortality and modestly associated with a good patient outcome.^[9] We describe a case, in which a novel therapeutic technique for thrombectomy was employed in the setting of an acute basilar artery occlusion

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in a patient with a hypoplastic vertebral artery (VA) ending in the posterior inferior cerebellar artery (PICA), resulting in rapid reperfusion of the occluded basilar artery.

Case Report

History and examination

RE is a 47-year-old man with a history of opioid abuse and a familial history of a brother sustaining a myocardial infarction at age of 40 years. The patient suffered sudden onset right-sided weakness, vomiting, and a fall downstairs. At the initial presentation, he was awake and alert enough to recount the specific time of symptom onset. Initial examination revealed right upper and lower extremity weakness and a left oculomotor nerve palsy, although he rapidly declined. The National Institute of Health (NIH) Stroke Scale was 18. Computed tomography (CT) angiogram of the head and neck revealed distal basilar artery occlusion, high-grade

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stenosis of the left VA origin with suspected thrombus, and a hypoplastic right VA that terminated in the PICA. The patient received intravenous thrombolytic therapy [Figure 1] (recombinant tissue plasminogen activator) 1.5 h after symptom onset. He was electively intubated and transferred to our institution for emergent thrombectomy.

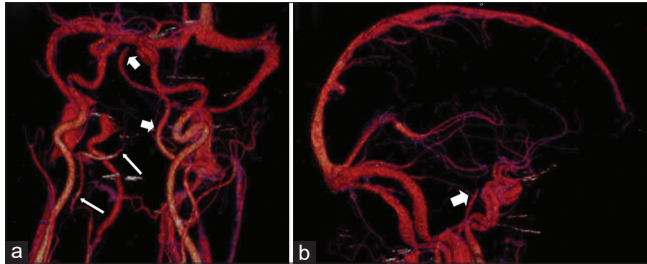


Figure 1: (a) CT angiogram head and neck 3D reconstruction, anterolateral view. Right vertebral artery ends in right PICA (thin arrows). Left vertebral artery is sole supply of basilar artery. Distal basilar artery occlusion is demonstrated. (thick arrows). (b) Lateral view. Distal basilar artery occlusion visualized (thick arrow). CT: Computed tomography, 3D: Three dimensional, PICA: Posterior inferior cerebellar artery

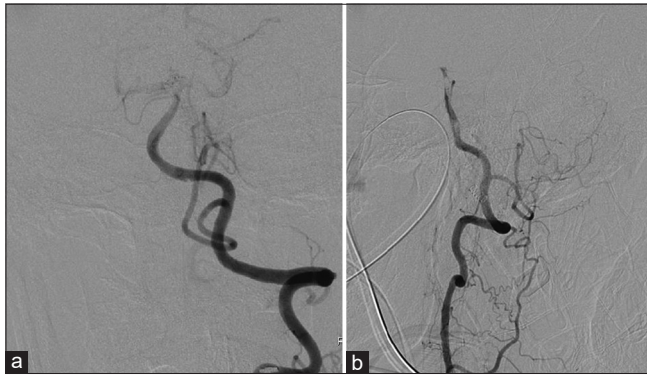


Figure 2: (a) Digital subtraction angiogram, AP view. Distal basilar artery occlusion is visualized. (b) Lateral view. Thrombus is present in the distal basilar artery. Retrograde filling of the left SCA territory via the left PICA. AP: Anterior–posterior, SCA: Superior cerebellar artery, PICA: Posterior inferior cerebellar artery



Figure 3: (a) Digital subtraction angiogram, lateral view. Positioning of inflated balloon-guide catheter in the proximal left vertebral artery before aspiration thrombectomy. (b) AP view after thrombectomy. TIC1 2B reperfusion. Persistent occlusion of left SCA and midsegment of left PCA is appreciated. A small residual thrombus remains at the origin of the left SCA. (c) Lateral view after thrombectomy. AP: Anterior–posterior, SCA: Superior cerebellar artery, PICA: Posterior inferior cerebellar artery

Procedure

On angiography, the left subclavian injection demonstrated subocclusive thrombus in the stenotic origin of the left VA. Thrombus was also visualized in the distal basilar artery with retrograde filling of the left superior cerebellar artery [Figure 2] (SCA) territory via the left PICA. There was incomplete opacification of the right SCA with no parenchymal blush. Injection of the left thyrocervical trunk demonstrated a hypertrophied left ascending pharyngeal artery with multiple sites of anastomoses with the left VA. Due to the emergent circumstances, an injection of the right VA was not performed.

A FlowGate Balloon Guide Catheter (STRYKER, Kalamazoo, MI) was placed in the proximal left VA. The balloon was inflated under subtracted road mapping conditions to achieve vessel occlusion and continuous suction was applied until reversal of flow was achieved. Follow-up angiography demonstrated near-complete revascularization (Thrombolysis in Cerebral Infarction 2B) of the basilar artery with persistent occlusion of the left SCA and of the midsegment of the left posterior cerebral artery. A small residual thrombus remained at the origin of the left SCA [Figure 3]. Revascularization of these vessels was not attempted. Groin to reperfusion time was 18 min.

Despite balloon angioplasty, the control aortic arteriogram revealed progressive thrombus to near occlusion of the left VA origin. Due to the high risk of further intervention, the procedure was terminated. The patient was placed on a low-dose intravenous continuous heparin infusion to prevent further propagation of the left VA thrombus. The total time from symptom onset to basilar artery reperfusion was 3 h and 53 min.

Postoperative course

Postextubation, the patient was found to have a mild left abducens nerve palsy, partial right hemianopsia, and a

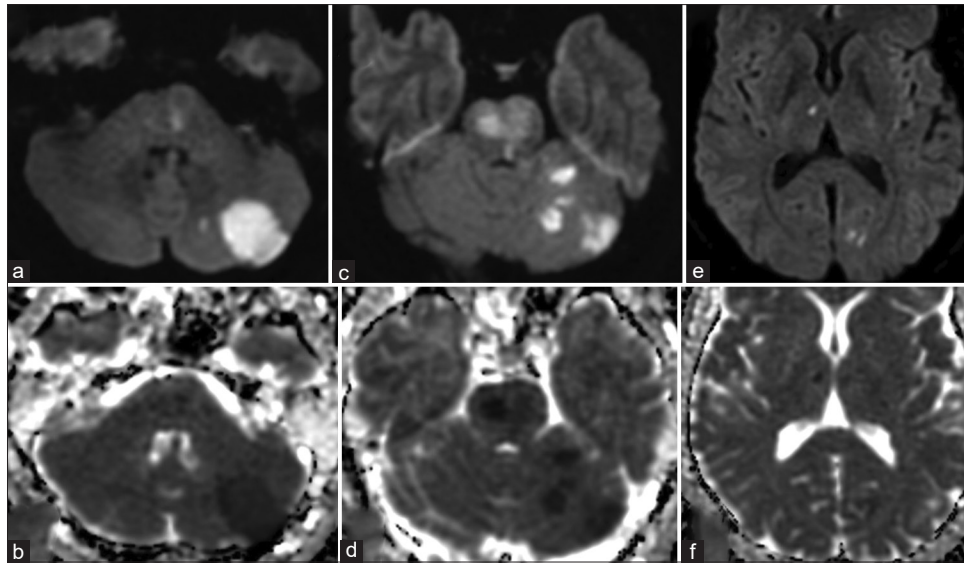


Figure 4: (a and b) DWI/ADC demonstrating left cerebellar infarction at the level of the pons. (c and d) DWI/ADC demonstrating bilateral midbrain and left cerebellar infarcts at the level of the midbrain. (e and f) DWI/ADC demonstrating punctate infarctions of the right thalamus and the left occipital lobe. DWI: Diffusion-weighted imaging, ADC: Apparent diffusion coefficient

mild drift of the right and left lower extremities, NIH stroke scale 4. Diffusion-weighted magnetic resonance imaging obtained 21 h after symptom onset revealed infarcts of the bilateral pons, cerebellum, occipital lobes, and right thalamus [Figure 4]. The suspected etiology of his stroke was thromboembolism due to the severe atherosclerosis of the left VA origin. To prevent the reoccurrence of thrombus, the patient was transitioned to subcutaneous enoxaparin before discharge from the hospital. One-month poststroke, repeat CT angiogram demonstrated interval resolution of the left VA thrombus. The patient was transitioned to aspirin 81 mg daily for secondary stroke prevention. The patient had only mild dysmetria of the left upper extremity, residual right vision loss, and intermittent bradyphasia at follow-up.

Discussion

Prior studies estimate that VA hypoplasia (VAH) occurs in 1.9%–26.5% of the general population.^[10,11] This estimate is complicated, however, as a standardized definition of VAH remains elusive. Several studies have shown the prevalence of VAH is higher in those with acute posterior circulation stroke than in those with anterior circulation stroke or in a normal, healthy population.^[11–14] In addition, some data suggest that a low-flow state in the VA contralateral to that being catheterized may increase the likelihood of full basilar artery recanalization and result in fewer distal emboli after thrombectomy.^[15] In the above-described case, the absence of a functional right VA, as evidenced by the hypoplastic right VA ending in PICA, effectively created a posterior circulation comprised a single vessel distal to the origin of the left VA. Taking advantage of this anatomical circumstance, suction was applied while the

origin of the left VA was occluded by an intravascular balloon resulted in the aspiration of nearly the entire clot burden in the left VA and the basilar artery. Aspiration in this manner, compared to the stepwise use of a stent-retrieval device for clot removal, likely resulted in more rapid reperfusion of the posterior circulation and brainstem.

This may represent the first described case of successful reperfusion of a functionally single-vessel vertebrobasilar arterial system using only proximal balloon-guide catheter occlusion and aspiration at the origin of the VA. In another study of posterior circulation strokes, five cases with contralateral VA occlusion or hypoplasia, tandem vertebrobasilar occlusions were recanalized with great results (TICI 2c-3). The authors utilized the contralateral VA to identify thrombus location in a retrograde manner.^[16] Mixed results have been observed in one small study and two case reports using balloon occlusion and proximal suction for intracranial internal carotid artery thromboses. There is one report of an iatrogenic dissection of the cervical internal carotid artery following the use of this technique.^[17–20] Clot burden reduction in an internal carotid artery T-type occlusion using balloon occlusion and proximal aspiration has also been previously described.^[21]

Age and coexisting comorbidities have been shown to affect outcome in stroke patients.^[22] Our patient was young and had no reported comorbidities. Further studies might explore the effectiveness of this procedure in stroke patients with advanced age and comorbidities such as metabolic syndrome. Modulating the inflammatory response after recanalization has been proposed to improve patient outcomes; however, there

has been minimal success in translating these results to the bedside.^[23] The effectiveness of intra-arterial neuroprotectors after thrombectomy might need to be explored in further studies.

Conclusion

Although balloon occlusion and proximal aspiration alone for thrombectomy would presumably be less effective for patients with bilaterally intact vertebral arteries due to steal from the intact contralateral VA, this technique could decrease the critical time-to-reperfusion in this unique subpopulation of patients with a unilateral hypoplastic VA and a posterior circulation stroke.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

Ashkan Mowla, MD: Speakers Bureau/Consultant to Cerenovus, Stryker, Wallaby Medical, RapidAI, Alexion Pharmaceuticals, Janssen Pharmaceuticals, Medtronic Cardiac Diagnostics and Monitoring, BALT USA, LLC.

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