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SURGICAL NEUROLOGY INTERNATIONAL
SNI: Neurovascular, a supplement to *Surgical Neurology International*
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Editor: **James I. Ausman,** MD, PhD University of California, Los Angeles, CA, USA

Case Report

Ruptured aneurysm at the cortical segment of the distal posterior inferior cerebellar artery associated with hemodynamic stress after basilar artery occlusion

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Received: 29 July 16 Accepted: 24 October 16 Published: 21 December 16

Abstract

Background: A distal posterior inferior cerebellar artery (PICA) *de novo* aneurysm at the cortical segment after atherosclerotic basilar artery occlusion is extremely rare. Here, we report the case of a ruptured distal PICA *de novo* aneurysm 8 years after basilar artery occlusion.

Case Description: A 75-year-old man experienced sudden disturbance of consciousness; computed tomography demonstrated cerebellar and subarachnoid hemorrhage due to a ruptured distal PICA aneurysm. Neck clipping of the aneurysm prevented re-rupture initially, and superficial temporal artery-superior cerebellar artery (STA-SCA) bypass was performed 3 months after admission. Postoperative angiography confirmed patency of the bypass, and the patient was discharged without any new neurological deficits.

Conclusion: This report describes a case of *de novo* development of a saccular distal PICA aneurysm after atherosclerotic basilar artery occlusion. We believe that increased hemodynamic stress at the PICA might have contributed to the occurrence and rupture of the aneurysm. STA-SCA bypass, introduced in the territory of the cerebellar hemisphere, reduces hemodynamic stress, which would prevent the occurrence of *de novo* aneurysm and recurrent bleeding.

Key Words: Distal posterior inferior cerebellar artery aneurysm, hemodynamic stress, neck clipping, superficial temporal artery-superior cerebellar artery bypass

Access this article online
Website:
www.surgicalneurologyint.com
DOI:
10.4103/2152-7806.196377
Quick Response Code:

INTRODUCTION

Posterior inferior cerebellar artery (PICA) aneurysms account for 0.49–3.0% of all intracranial aneurysms.[2,6,10] Majority of these aneurysms are located at the PICA proximal portion because perforating branches of the PICA mainly originate from the proximal segments. It has been reported that multiple factors, such as hemodynamic stress and pathological vessel architecture, might contribute to aneurysm development; however, the

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How to cite this article: Marutani A, Nakagawa I, Park HS, Tamura K, Motoyama Y, Nakase H. Ruptured aneurysm at the cortical segment of the distal posterior inferior cerebellar artery associated with hemodynamic stress after basilar artery occlusion. Surg Neurol Int 2016;7:S1065-8.
http://surgicalneurologyint.com/Ruptured-aneurysm-at-the-cortical-segment-of-the-distal-posterior-inferior-cerebellar-artery-associated-with-hemodynamic-stress-after-basilar-artery-occlusion/

exact mechanisms underlying this pathological condition are not yet fully elucidated.[7] Here, we report the case of a patient with a ruptured distal PICA *de novo* aneurysm at the cortical segment 8 years after occlusion of the basilar artery (BA).

CASE REPORT

A 75-year-old man had a history of left brainstem infarction due to atherosclerotic BA occlusion at the age of 67 years [Figure 1a]. At that time, conservative medical treatment was performed though direct surgery, and endovascular treatment was considered. He was discharged after a month, with moderate right hemiparesis and mild dysarthria. Eight years after BA occlusion, he was admitted to our hospital with sudden onset of right hemiparesis and dysarthria. His Glasgow coma scale score was 6, and computed tomography (CT) showed right cerebellar hematoma and subdural, subarachnoid hemorrhage (SAH), and intraventricular hemorrhage at the posterior cranial fossa [Figure 1b and c]. His Hunt and Hess grade was grade III. Emergent ventricular drainage was performed for acute hydrocephalus.

One week after admission to our hospital, three-dimensional (3D) computed tomography angiography (CTA) and digital subtraction angiography (DSA) revealed a 3.6-mm distal PICA saccular aneurysm at the cortical segment [Figure 2]. He received treatment for meningitis, pneumonia, and a renal function disorder. Neck clipping was performed via a midline suboccipital approach in the prone position to prevent re-rupture 2 months after admission [Figure 3]. Postoperative 3D CTA showed complete clipping of the aneurysm and no ischemic change, and his consciousness was better postoperatively than preoperatively.

A week after the neck clipping, brain scintigraphy showed cerebellar hemodynamic ischemia (right dominant side). Hemodynamic cerebral ischemia can be stratified into Stage I and II ischemia (Misery perfusion). According to vasodilatory and metabolic compensation for reduction of cerebral perfusion pressure, stage II ischemia is defined as a reduction of the resting cerebral blood flow (<34 mL/100 g/min), loss of vascular reserve (<10%), and elevation of the oxygen extraction fraction. Accordingly, in the Japan Extracranial-Intracranial Bypass Trial,[7] the incidence of stroke recurrence was significantly lower in the surgically-treated group than in the medically-treated group.

Three months after the onset of subarachnoid hemorrhage (SAH), right STA-SCA bypass was performed via the right subtemporal approach in the "parkbench" position to prevent the occurrence of a hemodynamic stress-induced *de novo* aneurysm and recurrent bleeding [Figure 4]. Postoperative DSA confirmed bypass patency supplying the bilateral SCA territory [Figure 5a] and showed bilateral posterior cerebral arteries via the posterior communicating artery [Figure 5b]. His postoperative course was uneventful, and he was discharged without neurological deficits. Single photon emission computed tomography (SPECT) performed 3 months after bypass surgery showed improvement in the cerebellar and occipital blood flow (left cerebellar hemisphere: Before, 23.4 and after, 25.4; right cerebellar hemisphere: Before, 25.2 and after, 29.0; left occipital lobe: Before, 33.2 and after, 38.1; right occipital lobe: Before, 35.4 and after, 37.9 mL/100 g/min) [Figure 6]. Magnetic resonance imaging (MRI) 11 months after bypass surgery revealed no *de novo* aneurysm.

Written informed consent was obtained from the patient for the publication of this report.

DISCUSSION

We reported the case of a patient with a ruptured distal PICA aneurysm at the cortical segment 8 years after occlusion of the BA. We performed STA-SCA bypass after neck clipping to reduce hemodynamic stress and avoid recurrence of the PICA aneurysm. To the best of our knowledge, this is the first case report of hemodynamic stress reduction with STA-SCA bypass after neck clipping to avoid recurrence of a PICA aneurysm.

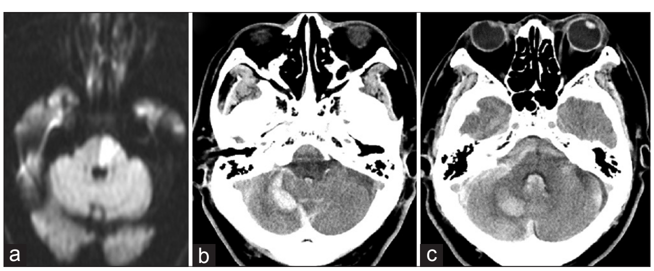

Figure 1: A diffusion-weighted image showing left brainstem infarction (a). Brain computed tomography images showing right cerebellar hemorrhage, subdural hemorrhage, subarachnoid hemorrhage of the posterior cranial fossa, and intraventricular hemorrhage (b, c)

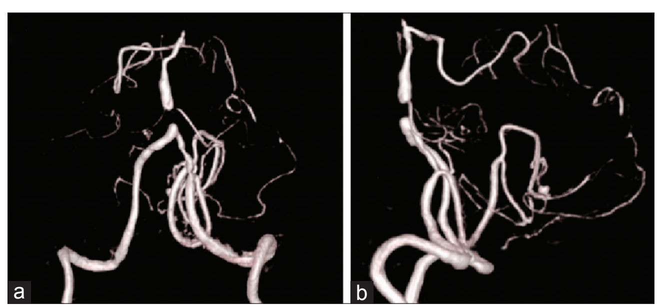

Figure 2: Three-dimensional digital subtraction angiography images showing basilar artery occlusion and a 3.6-mm saccular aneurysm at the cortical segment of the left distal posterior inferior cerebellar artery. (a) anteroposterior view, (b) lateral view

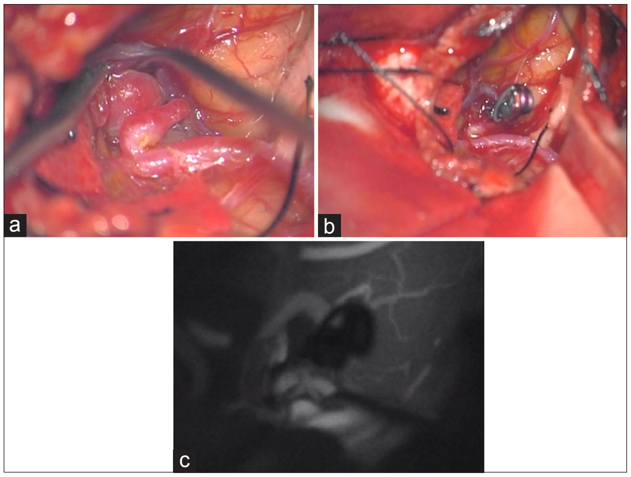

Figure 3: Intraoperative images showing the ruptured distal posterior inferior cerebellar artery aneurysm (a) and neck clipping of the aneurysm (b). Indocyanine green videoangiography showing complete neck clipping (c)

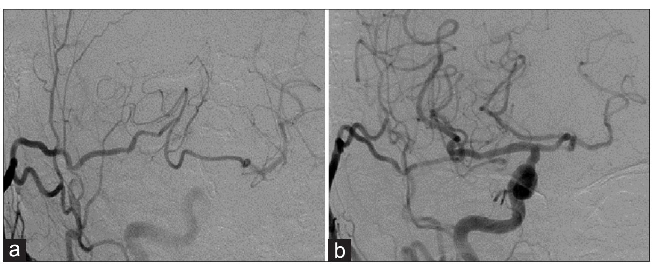

Figure 5: Postoperative digital subtraction angiography performed a month after bypass surgery. Right external cerebral angiography showing the establishment of new blood vessels from the right superior cerebellar artery to the left superior cerebellar artery (a), and right common carotid angiography showing bilateral posterior cerebral arteries via the posterior communicating artery (b)

Since the first case of a ruptured aneurysm in the PICA was reported in 1991,[4] some case reports have described the characteristics of PICA aneurysms. The locations of PICA aneurysms include the anterior-medullary, lateral-medullary, tonsillomedullary, telovelotonsillar, and cortical segments,[9] and the incidences of PICA aneurysms at these locations have been reported to be 13.3%, 30.0%, 23.3%, 20.0%, and 13.3%, respectively.[13] In this previous study, approximately 70% of the aneurysms were located at the lateral-medullary, tonsillomedullary, and telovelotonsillar segments owing to the length of these segments. The possible mechanisms of the formation of a distal PICA aneurysm include hypoplasty of the PICA, presence of an anterior inferior cerebellar artery (AICA)-PICA anastomotic channel, presence of a posterior inferior cerebellar communicating artery, arteriovenous malformation, presence of a primitive trigeminal artery, direct aortic origin of the vertebral artery, and telangiectasia.[5,12] In the present case, the left PICA was connected to the bilateral cerebellum and the right PICA was underdeveloped. These variations might have an influence on the formation of a distal PICA aneurysm.

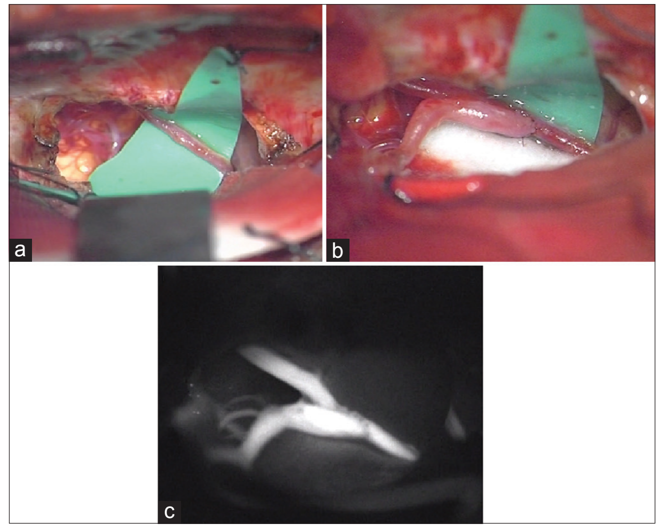

Figure 4: Intraoperative images showing right superficial temporal artery-superior cerebellar artery (STA-SCA) bypass. (a) preparation of the SCA branch, (b) end-to side anastomosis. Indocyanine green videoangiography demonstrating bypass patency (c)

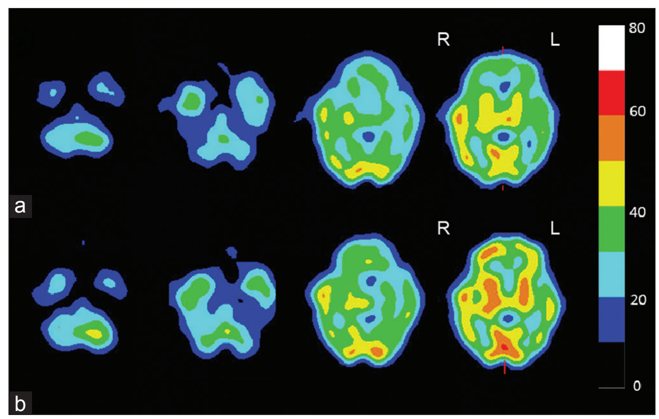

Figure 6: Single photon emission computed tomography images at rest showing improvement of cerebellar and occipital blood flow (mL/100 g/min) before (a) and 3 months after (b) bypass surgery

On the other hand, the increase in hemodynamic stress as a compensation of arterial occlusion in patients with atherosclerotic cerebrovascular diseases or Moyamoya disease has been proposed to be linked to *de novo* aneurysmal formation.[8] Furthermore, the resolution of hemodynamic-induced aneurysms after extracranial-intracranial bypass has been reported.[1] Recently, in the Japan Adult Moyamoya Trial, extracranial-intracranial bypass surgery prevented rebleeding in patients with Moyamoya disease, which is regarded as a decrease in hemodynamic stress in the vessels.[11] Therefore, in the present case, we performed STA-SCA bypass, which would reduce hemodynamic stress in cerebellar circulation and avoid bleeding recurrence or *de novo* aneurysm formation.

The identification of the aneurysm on MRI may be difficult because of its small size. A previous study reported that the PICA aneurysm size was generally small (2–3 mm in diameter) and that angiography facilitated aneurysm detection at this rare location.[12] Furthermore, hemodynamic-induced aneurysms have a small size and can rupture easily.[9] In the present case, the distal PICA aneurysm developed over an 8-year period and ruptured. Recently, 320-detector row computed tomography has been shown to be comparable with DSA for the detection of intracranial aneurysms.[3] Multi-detector CT angiography might be appropriate for the detection of small intracranial aneurysms.

CONCLUSION

We reported a case of a distal PICA *de novo* aneurysm in the cortical segment, which induced hemodynamic stress in the PICA because of basilar artery occlusion. Increased hemodynamic stress may result in a vessel-induced aneurysm, and STA-SCA bypass can reduce hemodynamic stress, which might prevent recurrent cerebellar bleeding and the occurrence of a *de novo* PICA aneurysm.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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