

Development of Unusual Collateral Channel From the Posterior Meningeal Artery After Endovascular Proximal Occlusion of the Posterior Inferior Cerebellar Artery

—Case Report—

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Abstract

A 38-year-old man presented with a dissecting aneurysm of the left proximal posterior inferior cerebellar artery (PICA) manifesting as Wallenberg's syndrome. The patient was treated by endovascular occlusion of the aneurysm and parent artery. Immediately after the treatment, the PICA territory was supplied by collateral circulation via the ipsilateral anterior inferior cerebellar artery. Seven days later, endogenous revascularization of the distal PICA territory had occurred via collateral circulation from the posterior meningeal artery (PMA). This unusual collateral circulation was thought to occur through a pre-existing anastomotic channel between the primitive vessels of the PICA and the PMA during sub-clinical hypoperfusion of the distal PICA territory. This unusual case demonstrates the potential for delayed development of collateral circulation from the PMA to the PICA territory.

Key words: embryology, collateral circulation, posterior inferior cerebellar artery, posterior meningeal artery, proximal occlusion

Introduction

Isolated dissecting aneurysms of the posterior inferior cerebellar artery (PICA) are rare, so no standardized treatment has been established.³⁾ Recently, endovascular treatment has been proposed as an alternative to conventional surgery.^{1-3,9,10)} The outcome after therapeutic endovascular proximal occlusion of the PICA is related to the extent of distal collateral circulation.³⁾ Therefore, preoperative evaluation of the collateral circulation in the PICA territory is important. We treated a patient with dissecting aneurysm of the left proximal PICA, in whom preoperative balloon occlusion test and intraoperative angiography revealed sufficient collateral supply via the ipsilateral anterior inferior cerebellar artery (AICA), but after endovascular treatment the left PICA territory was supplied by an unexpected transdural anastomosis via the left posterior meningeal artery (PMA).

Case Report

A 38-year-old man experienced acute onset of headache and vertigo and was referred to the local hospital. On admission, he presented with Wallenberg's syndrome, and magnetic resonance imaging showed left lateral medullary infarction. Cerebral angiography demonstrated a dissecting aneurysm of the left proximal PICA. Initially, the patient was treated conservatively. However, angiography obtained 6 months later showed progression of the aneurysmal dilatation (Fig. 1). Accordingly, the patient was transferred to our hospital for further management and we decided to perform endovascular occlusion of the aneurysm and parent artery.

Prior to treatment, a non-detachable silicone balloon was placed in the left vertebral artery at the origin of the PICA, and inflated for 15 minutes. No hypotensive challenge or cerebral blood measurement was performed. The patient tolerated the balloon occlusion test without neurological deficit. Right vertebral angiography obtained during the balloon occlusion test showed that the left AICA sup-

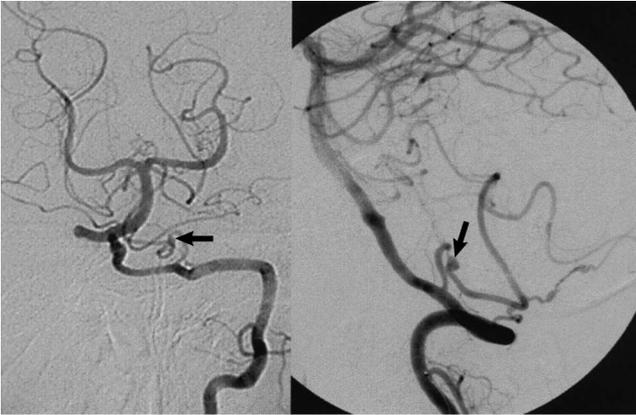


Fig. 1 Left vertebral angiograms showing pearl and string sign in the proximal posterior inferior cerebellar artery (arrows).

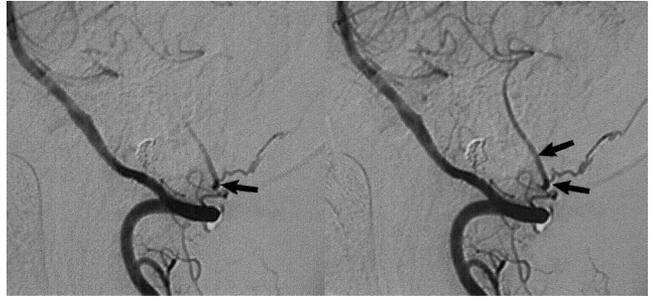


Fig. 3 Left vertebral angiograms performed 7 days after treatment demonstrating the lateral medullary segment of the posterior inferior cerebellar artery (PICA) supplied by the dilated left posterior meningeal artery (PMA) via a newly developed transdural anastomosis (arrows). Note antegrade filling from the lateral medullary segment to the posterior medullary segment of the PICA via the transdural anastomosis supplied by the left PMA.

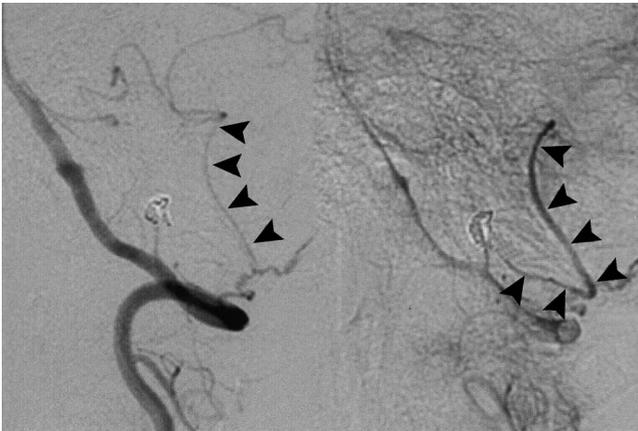


Fig. 2 Left vertebral angiograms obtained immediately after proximal occlusion of the left posterior inferior cerebellar artery (PICA) revealing disappearance of the aneurysm. Arrowheads indicate retrograde filling from the posterior medullary segment to the lateral medullary segment of the PICA via the leptomeningeal anastomosis supplied by the left anterior inferior cerebellar artery.

plied the left PICA territory through a leptomeningeal anastomosis. Endovascular proximal occlusion of the aneurysm was carried out with Guglielmi detachable coils (Boston Scientific Corp., Natick, Mass., U.S.A.). Immediately after proximal occlusion of the left PICA, left vertebral angiography revealed disappearance of the aneurysm and retrograde filling from the posterior medullary segment to the lateral medullary segment of the PICA via the leptomeningeal anastomosis supplied by the left

AICA (Fig. 2). The patient showed no additional neurological deficit after the procedure.

Follow-up angiography performed 7 days after treatment demonstrated the lateral medullary segment of the PICA supplied by a newly developed vessel arising from the left PMA (Fig. 3). The collateral circulation through the leptomeningeal anastomosis from the AICA had disappeared. No infarction had occurred in the territory supplied by the distal left PICA after 36 months.

Discussion

The potential stem of the PICA and the AICA becomes recognizable among the numerous branches of the basilar and vertebral arteries at the 18-mm embryo stage.⁷⁾ However, before the 40-mm embryo stage, these basilar and vertebral branches often anastomose through the longitudinal remnants of a prominent lateral channel (the primitive lateral vertebrobasilar anastomosis). Late retention of the different remnants of the primitive lateral vertebrobasilar anastomosis, AICA and PICA, is variable, and sometimes forms a common trunk.⁷⁾ Furthermore, the terminal branches of the PICA anastomose with the AICA at the border zone areas. Therefore, the PICA territory is usually supplied by the AICA, but could also be supplied by the posterior communicating artery of the contralateral PICA or the superior cerebellar artery.

The PMA usually arises from the third segment of the vertebral artery. After entering the skull, the

PMA courses within the dura mater and supplies the occipital dura mater, the falx cerebelli, and the tentorium cerebelli and falx cerebri. Normally, there is no anastomosis between the PICA and PMA. However, four cases of PMA originating from the PICA have been reported,^{4,6,8)} and one case of PICA originating from the PMA.⁵⁾ In the 12-mm to 20-mm embryo stages, the primitive vessels of the head differentiate into the external, dural, and cerebral vessels. Anastomotic channels exist between these three vascular systems prior to such differentiation.⁸⁾ Such anastomotic channels may be present between the primitive vessels forming the PICA and the PMA, and sometimes persist until adulthood.⁸⁾ However, the delayed development of collateral circulation from the PMA to the PICA territory has not been reported.

The present patient tolerated well the proximal occlusion of the PICA. Angiography suggested the collateral supply from the leptomeningeal anastomosis of the AICA was adequate. However, subclinical hypoperfusion may have occurred in the PICA territory. Under these conditions, pre-existing anastomotic channels between the primitive vessels of the PICA and PMA might develop further, resulting in the unusual collateral circulation to the distal PICA territory from the PMA after endovascular occlusion of the aneurysm and parent artery. In the process of the development of this collateral circulation from the PMA, the leptomeningeal collateral circulation from AICA might regress. Ultimately, the distal PICA territory came to be supplied from the PMA only via transdural anastomosis. The PMA should be considered as one of the potential collateral channels to the PICA territory in therapeutic proximal occlusion of the PICA.

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