Vertebral Artery Dissecting Aneurysm Treated by Proximal Occlusion and Posterior Inferior Cerebellar Artery Reconstruction With Fenestrated Clips

—Case Report—

Yuhui Li, Tetsuyoshi Horiuchi, Fukuo Nakagawa*, and Kazuhiro Hongo

*Department of Neurosurgery, Shinshu University School of Medicine, Matsumoto, Nagano;
Department of Neurosurgery, Azumino Red Cross Hospital, Azumino, Nagano

Abstract

A 57-year-old man presented with subarachnoid hemorrhage caused by a dissecting aneurysm of the vertebral artery close to the origin of the posterior inferior cerebellar artery (PICA). The aneurysm was treated successfully with two fenestrated clips preserving the efferent artery with anterograde blood flow without PICA anastomosis. The postoperative course was uneventful. Postoperative angiography indicated disappearance of the aneurysm and anterograde blood flow of the PICA.

Key words: dissecting aneurysm, fenestrated clip, reconstruction, posterior inferior cerebellar artery, vertebral artery

Introduction

Intracranial vertebral artery (VA) dissecting aneurysm was previously considered rare, but is now being reported more frequently and is increasingly recognized as a source of appreciable morbidity and mortality.[3,8,17–19] In general, progression of VA dissecting aneurysm is a serious condition that markedly affects the clinical course and prognosis.[3,8,17–19] VA dissection is increasingly recognized as a cause of subarachnoid hemorrhage (SAH). The annual incidence rate of spontaneous VA dissection has been reported at about 1 to 1.5 per 100000.[19] Dissecting aneurysms of the intradural VA commonly present with signs and symptoms of neurological deficits as a result of either vertebrobasilar ischemia or SAH. The management of VA dissecting aneurysm is a technical challenge due to the histopathological features and localization.[5,6] The accepted surgical techniques for VA dissecting aneurysm depend on the angiographic findings and localization of the aneurysm in relation to the origin of the posterior inferior cerebellar artery (PICA). Conventional surgical treatment includes trapping of the aneurysm, proximal ligation of the VA, or wrapping of the aneurysm. A bypass may be useful if occlusion of the parent vessel is mandatory and collateral supply is poor,[1,4,9,16] especially because treatment of pre-PICA lesions may induce cerebellar infarction if the VA is occluded in patients with inadequate collateral supply.[23,24] Therefore, VA dissecting aneurysm including the origin of the PICA is usually treated by trapping of the aneurysm, combined with PICA-to-occipital artery (OA) anastomosis,[2,12,22] PICA-to-PICA anastomosis,[10,13,20] or PICA reimplantation to the ipsilateral VA.[7,15] Nevertheless, this PICA revascularization is difficult to implement by endovascular interventions.

Here, we present a case of VA dissecting aneurysm close to the PICA, which was treated with fenestrated clips preserving the efferent artery with anterograde blood flow.

Case Report

A 57-year-old man presented with severe headache and vomiting followed by consciousness disturbance. The patient was transferred to our hospital. On admission, his Glasgow Coma Scale was E1V1M1. Emergency computed tomography (CT) demonstrated diffuse SAH with intraventricular hemorrhage (Fig. 1). After his consciousness improved (E3V4M6), cerebral angiography was performed on Day 1 which indicated a ruptured right VA dissecting aneurysm involving the PICA and an unruptured anterior communicating artery aneurysm (Fig. 2). VA trapping with occipital artery-PICA anastomosis was planned on Day 3.

The patient was placed in the prone lateral position, and a lateral suboccipital craniectomy was performed. The right VA was secured extradurally for proximal control. After incision of the dura, the intradural right VA was identified immediately, and the aneurysm was easily visible close to the origin of the right PICA. Long dissection was observed from proximal to distal of the PICA origin, but the dissection was incomplete as the vessel wall around the PICA origin was normal (Fig. 3). Therefore,
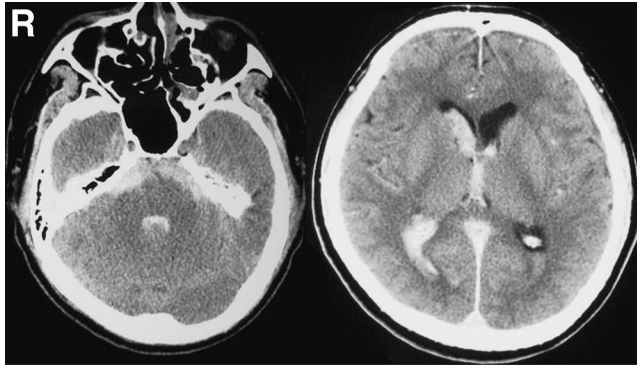
Fig. 1 Computed tomography scans of the brain on admission showing subarachnoid hemorrhage and intraventricular hematoma.

Fig. 4 Schematic representation of the clipping technique. Two fenestration clips are used for proximal occlusion and posterior inferior cerebellar artery (PICA) origin reconstruction (formation clip technique). 1: Straight fenestrated clip, 2: L-shaped fenestrated clip, VA: vertebral artery.
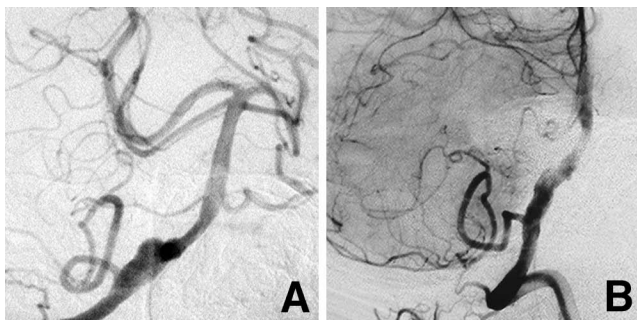

Fig. 2 Right vertebral angiograms (A: oblique view, B: lateral view) showing a ruptured vertebral artery dissecting aneurysm involving the origin of the posterior inferior cerebellar artery.

Fig. 5 Postoperative right vertebral angiogram (lateral view) (A) and three-dimensional computed tomographic angiogram (B) revealing complete obliteration of the right vertebral artery dissecting aneurysm and good flow in the posterior inferior cerebellar artery (*arrow*).
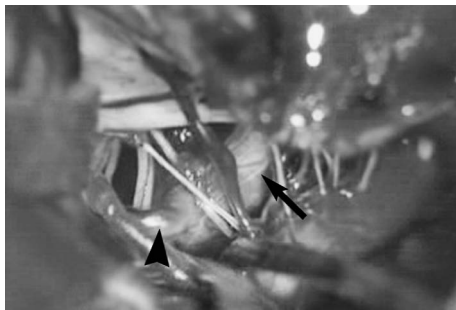

Fig. 3 Intraoperative photograph showing an aneurysmal dilatation starting from the opposite side of the origin of the right posterior inferior cerebellar artery (*arrowhead*), and the right vertebral artery (*arrow*).

The postoperative course was uneventful. The patient recovered well, and experienced no hoarseness, dysphasia, or cerebellar incoordination. Angiography 2 weeks postoperatively and three-dimensional (3D)-CT angiography 2 months postoperatively revealed complete obliteration of the right VA dissecting aneurysm and good PICA flow (Fig. 5). After ventriculoperitoneal shunt placement 1 month later, the patient was transferred to a rehabilitation hospital. 3D-CTangiography has detected no regrowth of the aneurysm for 2 years.

Discussion

PICA-to-PICA or OA-to-PICA anastomosis is useful to avoid ischemic complications in patients with VA dissecting aneurysm close to the origin of the PICA. However, areas perfused by PICA are theoretically at risk of ischemia during vascular anastomosis.[13] Therefore, PICA reconstruction using fenestrated clips, if possible, is a safer procedure than anastomosis. Since clip reconstruc-

proximal occlusion of the aneurysm without PICA anastomosis was performed with the following methods. Under temporary proximal VA occlusion with a temporary clip, proximal occlusion and PICA reconstruction were performed using straight and L-shaped fenestrated clips (Fig. 4). The two fenestrated clips did not affect the blood flow into the right PICA (formation clip technique) (Fig. 4).
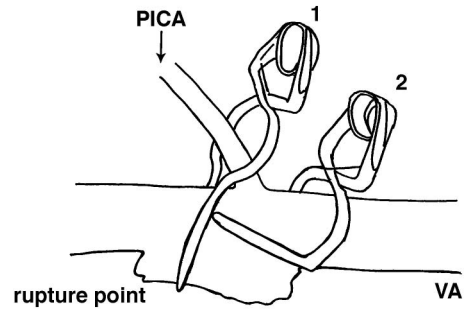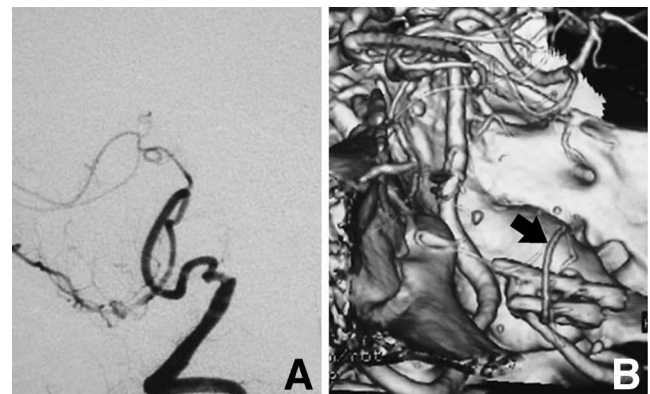
tion of the parent vessel with fenestrated clips was first reported, the fenestrated clip has proven to be an important innovation for treatment of complex aneurysms.[21]

In the present case, preoperative angiography suggested that the aneurysm may involve the PICA origin, so PICA revascularization using OA-PICA bypass was designed preoperatively. However, during the operation, we found that the dissection was incomplete, and the vessel wall around the PICA origin was intact. Therefore, successful obliteration was achieved using fenestrated clips. We used two fenestrated clips for proximal obliteration of the VA and reconstruction of the PICA origin. Using this formation clip technique, anterograde blood flow could pass to the ipsilateral PICA from the fenestration of the clip without PICA anastomosis, which reduced the risk of ischemic complications.[14] This technique is also simpler than vascular anastomosis. However, during surgical exploration, normal and dissected vessels are difficult to precisely distinguish. Therefore, the present clip technique is not applicable for all VA dissecting aneurysms, such as entire dissecting aneurysms or dissection around the PICA origin. Long-term follow up is necessary in this first case of the treatment of VA dissecting aneurysm close to the PICA origin using the formation clip technique. No regrowth of the aneurysm has been observed for the 2 years after surgery. Therefore, our technique appears to be useful in the treatment of this type of VA dissecting aneurysm without bypass.

Conventional treatment of VA dissecting aneurysm including the PICA origin by trapping of the aneurysm, combined with PICA-to-OA, PICA-to-PICA, or PICA-to-VA anastomosis, has some drawbacks, such as the risk of brainstem ischemia while performing the anastomosis,[7,11] and the risk of injury to the lower cranial nerves from surgical manipulation and deficiency of the PICA blood flow after the operation. In this case, the aneurysm was trapped with preservation of the parent and branch arteries around the origin of the PICA, as the fenestrated clips effectively preserved the PICA as intended, and further applications also preserved the perforators, OA, and lower cranial nerves.[21]

References

1) Albuquerque FC, Fiorella DJ, Han PP, Deshmukh VR, Kim LJ, McDougall CG: Endovascular management of intracranial vertebral artery dissecting aneurysms. *Neurosurg Focus* 18(2): E3, 2005

2) Ausman JI, Diaz FG, Mullan S, Gehring R, Sadasivan B, Dujovny M: Posterior inferior to posterior inferior cerebellar artery anastomosis combined with trapping for vertebral artery aneurysm. Case report. *J Neurosurg* 73: 462–465, 1990

3) Caplan LR, Baquis GD, Pessin MS, D'Alton J, Adelman LS, DeWitt LD, Ho K, Izukawa D, Kwan ES: Dissection of the intracranial vertebral artery. *Neurology* 38: 868–877, 1988

4) Chiche L, Praquin B, Koskas F, Kieffer E: Spontaneous dissection of the extracranial vertebral artery: indications and long-term outcome of surgical treatment. *Ann Vasc Surg* 19: 5–10, 2005

5) Fiorella D, Albuquerque FC, Deshmukh VR, Woo HH, Rasmussen PA, Masaryk TJ, McDougall CG: Endovascular reconstruction with the Neuroform stent as monotherapy for the treatment of uncoilable intradural pseudoaneurysms. *Neurosurgery* 59: 291–300, 2006

6) Fiorella D, Albuquerque FC, Woo H, Rasmussen PA, Masaryk TJ, McDougall CG: Neuroform in-stent stenosis: incidence, natural history, and treatment strategies. *Neurosurgery* 59: 34–42, 2006

7) Hamada J, Todaka T, Yano S, Kai Y, Morioka M, Ushio Y: Vertebral artery-posterior inferior cerebellar artery bypass with a superficial temporal artery graft to treat aneurysms involving the posterior inferior cerebellar artery. *J Neurosurg* 96: 867–871, 2002

8) Hosoya T, Adachi M, Yamaguchi K, Haku T, Kayama T, Kato T: Clinical and neuroradiological features of intracranial vertebrobasilar artery dissection. *Stroke* 30: 1083–1090, 1999

9) Iihara K, Sakai N, Murao K, Sakai H, Higashi T, Kogure S, Takahashi JC, Nagata I: Dissecting aneurysms of the vertebral artery: a management strategy. *J Neurosurg* 97: 259–267, 2002

10) Kakino S, Ogasawara K, Kubo Y, Otawara Y, Tomizuka N, Suzuki M, Ogawa A: Treatment of vertebral artery aneurysms with posterior inferior cerebellar artery-posterior inferior cerebellar artery anastomosis combined with parent artery occlusion. *Surg Neurol* 61: 185–189, 2004

11) Khayata MH, Spetzler RF, Mooy JJ, Herman JM, Rekate HL: Combined surgical and endovascular treatment of a giant vertebral artery aneurysm in a child. Case report. *J Neurosurg* 81: 304–307, 1994

12) Lawton MT, Hamilton MG, Morcos JJ, Spetzler RF: Revascularization and aneurysm surgery: current techniques, indications, and outcome. *Neurosurgery* 38: 83–94, 1996

13) Lemole GM Jr, Henn J, Javedan S, Deshmukh V, Spetzler RF: Cerebral revascularization performed using posterior inferior cerebellar artery-posterior inferior cerebellar artery bypass. Report of four cases and literature review. *J Neurosurg* 97: 219–223, 2002

14) Matsushima T, Matsukado K, Natori Y, Inamura T, Hitotsumatsu T, Fukui M: Surgery on a saccular vertebral artery-posterior inferior cerebellar artery aneurysm via the transcondylar fossa (supracondylar transjugular tubercle) approach or the transcondylar approach: surgical results and indications for using two different lateral skull base approaches. *J Neurosurg* 95: 268–274, 2001

15) Ogasawara K, Kubo Y, Tomitsuka N, Sasoh M, Otawara Y, Arai H, Ogawa A: Treatment of vertebral artery aneurysms with transposition of the posterior inferior cerebellar artery to the vertebral artery combined with parent artery occlusion. Technical note. *J Neurosurg* 105: 781–784, 2006

16) Rabinov JD, Hellinger FR, Morris PP, Ogilvy CS, Putman CM: Endovascular management of vertebrobasilar dissecting aneurysms. *AJNR Am J Neuroradiol* 24: 1421–1428, 2003

17) Sasaki O, Ogawa H, Koike T, Koizumi T, Tanaka R: A clinicopathological study of dissecting aneurysms of the intracranial vertebral artery. *J Neurosurg* 75: 874–882, 1991

18) Savitz SI, Caplan LR: Vertebrobasilar disease. *N Engl J Med* 352: 2618–2626, 2005

19) Schievink WI: Spontaneous dissection of the carotid and vertebral arteries. *N Engl J Med* 344: 898–906, 2001

20) Takikawa S, Kamiyama H, Nomura M, Abe H, Saitoh H: [Vertebral dissecting aneurysm treated with trapping and bilateral posterior inferior cerebellar artery side-to side anastomosis; case report]. *No Shinkei Geka* 19: 571–576, 1991 (Japanese)

21) Yang I, Lawton MT: Clipping of complex aneurysms with

fenestration tubes: application and assessment of three types of clip techniques. *Neurosurgery* 62(5 Suppl 2): ONS371–379, 2008

22) Yasui T, Komiyama M, Nishikawa M, Nakajima H: Subarachnoid hemorrhage from vertebral artery dissecting aneurysms involving the origin of the posteroinferior cerebellar artery: report of two cases and review of the literature. *Neurosurgery* 46: 196–201, 2000

23) Zenteno M, Modenesi Freitas JM, Aburto-Murrieta Y, Koppe G, Machado E, Lee A: Balloon-expandable stenting with and without coiling for wide-neck and complex aneurysms. *Surg Neurol* 66: 603–610, 2006

24) Zenteno MA, Santos-Franco JA, Freitas-Modenesi JM, Gomez C, Murillo-Bonilla L, Aburto-Murrieta Y, Diaz-Romero R, Nathal E, Gomez-Llata S, Lee A: Use of the sole stenting technique for the management of aneurysms in the posterior circulation in a prospective series of 20 patients. *J Neurosurg* 108: 1104–1118, 2008

Address reprint requests to: Tetsuyoshi Horiuchi, M.D., Department of Neurosurgery, Shinshu University School of Medicine, 3–1–1 Asahi, Matsumoto 390–8621, Japan.