Using the Snare System to Cross the Acute-Angled Vertebrobasilar Junction in Treating Posterior Inferior Cerebellar Artery Aneurysm with the Stent-Assisted Method via a Retrograde Approach

A Technical Note

HEE SUP SHIN¹, CHANG-WOO RYU², JUN SEOK KOH¹, SEUNG HWAN LEE¹

¹ Department of Neurosurgery and ² Department of Radiology, Kyung Hee University Hospital at Gangdong, Kyung Hee University School of Medicine; Seoul, Korea

Key words: Snare system, acute angle, vertebrobasilar junction, retrograde stenting

Summary

Retrograde stenting via the contralateral vertebral artery (VA) is a safe and effective treatment for posterior inferior cerebellar artery (PICA) aneurysm.

Many methods, including tip shaping and the looping technique, have been attempted as ways to cross the vertebrobasilar (VB) junction. Here, we introduce an alternative method using a Snare system to overcome the acute-angled VB junction after repeated failures using other techniques.

The Snare system was navigated to the proximal basilar artery via the ipsilateral VA. A guidewire was introduced in the contralateral VA and gently advanced to the basilar artery in order to pass through the loop of the Snare system. Following this, the Snare system caught the guidewire and it was very carefully pulled down to the ipsilateral VA crossing the VB junction.

We suggest this technique as a method to cross the acute-angled VB junction after failure of all other attempts to overcome this challenge.

Introduction

Endovascular treatment for intracranial aneurysms of the posterior circulation has advantages over surgical intervention¹. Advancements in devices and techniques for endovascular treatment have made it possible to treat aneurysms that were previously unsuited for treatment by endovascular coiling. Among aneurysms of the posterior circulation, posterior inferior cerebellar artery (PICA) aneurysms require various techniques that allow for neck protection and branch preservation during endovascular coiling due to the anatomic characteristics of the site which include a wide neck, incorporation of the PICA branch into the sac, and the acute-angled PICA branch from the vertebral artery (VA)²⁻⁵.

Retrograde stenting via the contralateral VA is one of the useful options available for treating PICA aneurysms of the wide-necked and acute-angled PICA branch from the VA⁶⁻⁹. In the majority of cases, the guidewire and the microcatheter can cross the vertebrobasilar (VB)

Figure 1 A) Digital subtraction angiography showing a 2×4 mm-sized dome-shaped aneurysm (white arrow) originating from the left posterior inferior cerebellar artery (PICA). B) On CT angiography, the PICA angled acutely from the left vertebral artery.

junction without much effort by shaping the tips of the guidewire and the microcatheter. The looping technique¹⁰ is also a good method to cross the acute-angled VB junction. Occasionally, however, all attempts to cross the VB junction, including tip shaping and the looping technique, fail. Here, we introduce an alternative method to overcome the acute-angled VB junction using a Snare system after repeated failure using other techniques.

Case Report/Technique

Surgical clipping for a ruptured distal anterior cerebral artery (ACA) aneurysm was performed three years ago at our institution on a 56-year-old woman. She recovered from the surgery without any neurologic deficit. At that time, in addition to the distal ACA ruptured aneurysm, the cerebral angiogram revealed a dome-shaped, unruptured, 4 × 2 mm aneurysm located at the origin of the left PICA (Figure 1A). Although small, we decided to treat this PICA aneurysm to prevent rupture because of a slight increase in size after a three-year follow-up period and multiple aneurysms. We selected an endovascular course of treatment for the aneurysm in view of the surgical difficulty, the patient's preference, and recently reported feasible and successful results of endovascular methods in treating

PICA aneurysms¹¹. The dome-shaped aneurysm required neck remodeling using a stent-assisted catheter jailing method. We planned to perform retrograde stenting through the contralateral VA crossing the VB junction, because the left PICA which originated from the left VA formed an acute angle (Figure 1B). Our treatment plan was as follows: (1) arterial puncture of the bilateral femoral arteries and placement of two guiding catheters on the bilateral VAs (double guiding), (2) placement of the microcatheter for stent delivery using the guidewire into the contralateral VA, (3) a retrograde approach of the microcatheter to the PICA via the VB junction, (4) placement of a second microcatheter for coil delivery into the aneurysm lumen via the ipsilateral VA, (5) stent deployment from the proximal PICA to the distal VA (toward the VB junction), and (6) coil embolization.

The endovascular procedure was performed under general anesthesia using the Allura Xper FD20/10 biplane system (Philips Healthcare, Best, the Netherlands). Aspirin (100 mg/day) and clopidogrel (75 mg/day) were administered for five days before treatment. A bolus of 3,000 IU of heparin was administered intravenously after femoral artery sheath placement and additional boluses of 1,000 IU of heparin were administered every hour to maintain an activated clotting time of 250-300 s during the procedure. After two 6F Chaperon® guiding catheters (Mi-

Figure 2 A) The Snare system was navigated to the proximal basilar artery via the left vertebral artery (VA). B) Another microcatheter and guidewire were introduced in the right VA and the guidewire was gently advanced to the basilar artery in order to pass through the loop of the Snare system. C,D) The Snare system then caught the guidewire from the right VA and was pulled down very carefully to the left VA crossing the VB junction. A definitive deviation of the guidewire and the Snare system from the roadmap (arrowheads) during the pull-down procedure is shown.

croVention Inc., Tustin, CA, USA) were positioned into the bilateral VAs, an Excelsior® SL-10® microcatheter (Stryker Neurovascular, Fremont, CA, USA) and a 0.014-inch Traxcess® guidewire (MicroVention Inc., Tustin, CA, USA) were placed in the right VA. Multiple attempts to cross the VB junction were made. First, we tried to cross it directly with the guidewire and microcatheter by shaping them into C and J shapes. After multiple failures using this first method, we tried a wire looping method and a

resistant-branch method to make a looped catheter in the VA using the right PICA and the C1/C2 branch at the cervical VA. Using this looping technique, we were able to position the microcatheter on the VB junction. However, the microcatheter was subsequently pulled up to the basilar artery when the guidewire was pushed into the microcatheter. To overcome the angle of the VB junction, we decided to use the Snare system (Multi-Snare® Micro Sets, pfm medical ag, Köln, Germany). The Snare system was navi-

Figure 3 A,B) The microcatheter in the right vertebral artery (VA) was exchanged for a Prowler® select® plus microcatheter to allow for stent delivery and this microcatheter was able to smoothly select the left posterior inferior cerebellar artery (PICA). C) After selection of the aneurysm via the right VA, an Enterprise™ stent was deployed from the proximal PICA to the distal VA (retrograde approach) through a Prowler® select® plus microcatheter. D) After deployment of the stent, coil embolization was initiated using a stent-assisted catheter jailing maneuver.

gated to the proximal basilar artery via the left VA (Figure 2A) with a Prowler® select® plus microcatheter (Cordis Neurovascular Inc., Miami Lakes, MA, USA). An Excelsior® SL-10® microcatheter and a Traxcess® guidewire were introduced in the right VA and the guidewire was gently advanced to the basilar artery in order to pass through the loop of the Snare system (Figure 2B). Following this, the Snare system caught the Traxcess® guidewire and it was pulled down very carefully to the left VA crossing the VB

junction (Figure 2C,D). After the Snare system was removed, we exchanged the microcatheter in the right VA for a Prowler® select® plus microcatheter to allow for stent delivery. The microcatheter was then able to smoothly select the left PICA. For selection of the aneurysm, an Excelsior® SL-10® microcatheter was placed over a Traxcess® guidewire in the aneurysm lumen. After selection of the aneurysm, an Enterprise™ stent (Cordis Neurovascular Inc., Miami Lakes, MA, USA) was deployed from the proximal

PICA to the distal VA (a retrograde approach). After deployment of the stent, coil embolization was initiated as a general maneuver with three Target® detachable coils (Stryker Neurovascular, Fremont, CA, USA). After endovascular treatment, the patient recovered without complications, and dual antiplatelet therapy (aspirin 100 mg/day + clopidogrel 75 mg/day) was maintained for six months.

Discussion

Although there are several valuable reports on surgical clipping of posterior circulation aneurysms performed by experienced surgeons, the rarity of these aneurysms, limited surgical experience, and technical difficulties make it difficult to treat aneurysms of posterior circulation surgically^{12,13}. As with other aneurysms located in the posterior circulation, surgical clipping of aneurysms originating in the PICA presents technical challenges due to the deep location, adjacent lower cranial nerves and brainstem^{14,15}. Because of these characteristics, endovascular management of aneurysms originating in the PICA has become increasingly utilized in recent years^{5,16}, and proved a safe and effective therapy in a recently published large series¹¹. Among endovascular treatments, however, PICA origin aneurysms have some complex anatomical findings including being wide-necked, the acute-angled PICA branching from the VA, and incorporated the branch into the sac²⁻⁵. In these cases, neck protection and branch preserving techniques - such as stent-assisted balloon remodeling, use of multiple catheters, and catheter protection - are frequently needed. The stent-assisted technique is generally the most acceptable technique for achieving both neck protection and PICA preservation^{6,17}.

In the majority of cases, the PICA branches acutely from the VA. Retrograde stenting via the contralateral VA is suitable for this acute-angled branching PICA. Cho et al. suggested that retrograde stenting has two advantages: 1) full coverage of the aneurysmal neck and 2) horizontal positioning of the stent prevents it from kinking or ovalization at an acute angle⁶. Ecker et al. first described retrograde stenting via the contralateral VA for coil embolization of PICA aneurysms⁷. They report staged stenting (via the contralateral VA) and coiling (via the ipsilateral VA) with a six-week time interval. Others reported that a double guiding system

and dual femoral puncture were applied to allow for simultaneous one-step stenting and coiling⁹. In a recent report, a single guiding system utilizing a single femoral puncture was sufficient to allow for coil embolization in 60% of patients⁶. We performed a catheter jailing technique in order to achieve catheter stabilization during coiling using double-guiding systems and dual femoral punctures.

During a retrograde stenting procedure via the contralateral VA, shaping the tips of the guidewires and the microcatheters helps in crossing the VB junction from one VA to another. However, in “acute-angled” VB junctions, shaping the tips of wires and catheters is insufficient and a “looping technique” is required. Various methods of making such catheter loops have been introduced¹⁰. Among them, there are two widely used and easily applied methods of creating a looped catheter; 1) making a loop of the wire followed by catheter looping, and 2) a resistant-branch method using a small branch such as the C2 or C3 branch at the VA¹⁸. In the current case, we were unable to overcome the challenges presented by the acute-angled VB junction, despite numerous attempts including excessive wire shaping, steam shaping of the microcatheter and use of the looping technique described above. Finally, we took advantage of the Snare system that was designed to retrieve and manipulate intraluminal foreign bodies and were able to perform a successful procedure without any technical difficulties. We used the Snare system via the contralateral VA to snatch and pull down the guidewire positioned at the basilar artery. However, this technique was technically demanding in that a dual guiding system was required and very careful and gentle maneuvers were needed while pulling down the Snare system subsequent to catching the guidewire. Figures 2C and D show a definite deviation of the guidewire and the Snare system from the roadmap during the pull-down procedure. We believe this deviation occurred as a result of pulling down the VB system to the trajectory of the Snare system, and this could result in injury to the large arterial wall and small arteries arising from the basilar artery. Because we were concerned about this unexpected deviation that could result in uncontrolled bleed under conditions of full loading with antiplatelets and heparin, we considered surgical clipping or follow-up monitoring after abandoning an endovascular treatment if this attempt had failed.

Actually, this snare technique is a well-established technique practiced in peripheral vascular interventions such as endovascular aneurysm repair. In cerebrovascular procedures, however, most reports utilizing the Snare system have been cases involving retrieval of intravascular foreign bodies and treatment devices like coils and stents. Hanaoka et al. reported their experiences of using the Snare system to intravenously catch the microcatheter in treating a dural arteriovenous fistula ¹⁹. To our knowledge, this is the first report in English describing the use of the Snare system

to cross the VB junction and to treat an intracranial aneurysm.

Conclusion

We suggest that our Snare system technique can be used to cross the acute-angled VB junction if other attempts have failed and if a dual guiding system is available. In order to prevent arterial injury, careful and gentle manipulation is needed when pulling down the Snare system after catching the guidewire.

References

- 1 Wiebers DO, Whisnant JP, Huston J 3rd, et al. Unruptured intracranial aneurysms: natural history, clinical outcome, and risks of surgical and endovascular treatment. *Lancet*. 2003; 362 (9378): 103-110. doi: 10.1016/S0140-6736(03)13860-3.
- 2 Al-khayat H, Al-Khayat H, Beshay J, et al. Vertebral artery-posterior inferior cerebellar artery aneurysms: clinical and lower cranial nerve outcomes in 52 patients. *Neurosurgery*. 2005; 56 (1): 2-10. Discussion 11.
- 3 Crowley RW, Albuquerque FC, Ducruet AF, et al. Technical considerations in the endovascular management of aneurysms of the posterior inferior cerebellar artery. *Neurosurgery*. 2012; 71 (2 Suppl Operative): ons204-17. Discussion ons217-8. doi: 10.1227/NEU.0b013e31826920b4.
- 4 Moret J, Ross IB, Weill A, et al. The retrograde approach: a consideration for the endovascular treatment of aneurysms. *Am J Neuroradiol*. 2000; 21 (2): 262-268.
- 5 Peluso JP, van Rooij WJ, Sluzewski M, et al. Posterior inferior cerebellar artery aneurysms: incidence, clinical presentation, and outcome of endovascular treatment. *Am J Neuroradiol*. 2008; 29 (1): 86-90. doi: 10.3174/ajnr.A0758.
- 6 Cho YD, Kang HS, Lee WJ, et al. Stent-assisted coil embolization of wide-necked posterior inferior cerebellar artery aneurysms. *Neuroradiology*. 2013; 55 (7): 877-882. doi: 10.1007/s00234-013-1178-1.
- 7 Ecker RD, Hanel RA, Levy EI, et al. Contralateral vertebral approach for stenting and coil embolization of a large, thrombosed vertebral-posterior inferior cerebellar artery aneurysm. Case report. *J Neurosurg*. 2007; 107 (6): 1214-1216. doi: 10.3171/JNS-07/12/1214.
- 8 Jeon SI, Kwon BJ, Seo DH, et al. Bilateral approach for stent-assisted coiling of posterior inferior cerebellar artery aneurysms - two cases. *J Cerebrovasc Endovasc Neurosurg*. 2012; 14 (3): 223-227. doi: 10.7461/jcen.2012.14.3.223.
- 9 Roh HG, Chun YI, Choi JW, et al. Retrograde stent placement for coil embolization of a wide-necked posterior inferior cerebellar artery aneurysm. *Kor J Radiol*. 2012; 13 (4): 510-514. doi: 10.3348/kjr.2012.13.4.510.
- 10 Kwon BJ, Im SH, Park JC, et al. Shaping and navigating methods of microcatheters for endovascular treatment of paraclinoid aneurysms. *Neurosurgery*. 2010; 67 (1): 34-40. Discussion 40. doi: 10.1227/01.NEU.0000370891.67129.2F.
- 11 Chalouchi N, Jabbour P, Starke RM, et al. Endovascular treatment of proximal and distal posterior inferior cerebellar artery aneurysms. *J Neurosurg*. 2013; 118 (5): 991-999. doi: 10.3171/2012.12.JNS121240.
- 12 Peerless SJ, Hernesniemi JA, Gutman FB, et al. Early surgery for ruptured vertebrobasilar aneurysms. *J Neurosurg*. 1994; 80 (4): 643-649. doi: 10.3171/jns.1994.80.4.0643.
- 13 Drake CG. The treatment of aneurysms of the posterior circulation. *Clin Neurosurg*. 1979; 26: 96-144.
- 14 D'Ambrosio AL, Kreiter KT, Bush CA, et al. Far lateral suboccipital approach for the treatment of proximal posterior inferior cerebellar artery aneurysms: surgical results and long-term outcome. *Neurosurgery*. 2004; 55 (1): 39-50. Discussion 50-4.
- 15 Bragg TM, Duckworth EA. Contralateral far-lateral approach for clipping of a ruptured vertebral artery-posterior inferior cerebellar artery aneurysm. *Neurosurg focus*. 2008; 25 (6): E9. doi: 10.3171/FOC.2008.25.12.E9.
- 16 Mukonoweshuro W, Laitt RD, Hughes DG. Endovascular treatment of PICA aneurysms. *Neuroradiology*. 2003; 45 (3): 188-192.
- 17 Kim MJ, Chung J, Kim SL, et al. Stenting from the vertebral artery to the posterior inferior cerebellar artery. *Am J Neuroradiol*. 2012; 33 (2): 348-352. doi: 10.3174/ajnr.A2741.
- 18 Kwon BJ, Seo DH, Ha Y et al. Endovascular treatment of wide-necked cerebral aneurysms with an acute angle branch incorporated into the sac: novel methods of branch access in 8 aneurysms. *Neurointervention*. 2012; 7 (2): 93-101. doi: 10.5469/neuroint.2012.7.2.93.
- 19 Hanaoka M, Satoh K, Satomi J, et al. Microcatheter pull-up technique in the transvenous embolization of an isolated sinus dural arteriovenous fistula. Technical note. *J Neurosurg*. 2006; 104 (6): 974-977. doi: 10.3171/jns.2006.104.6.974.

Chang-Woo Ryu, MD, PhD
Department of Radiology,
Kyung Hee University Hospital at Gangdong
892 Dongnam-ro, Gangdong-gu, Seoul, Korea
Tel.: +82-2-440-6186 - Fax: +82-2-440-6932
E-mail: md.cwryu@gmail.com