Use of the Coupler Microanastomotic Device for the Treatment of a Distal Posterior Inferior Cerebellar Artery Aneurysm Via Excision and End-to-End Anastomosis—A Case Report

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BACKGROUND AND IMPORTANCE: The Coupler microanastomotic device (Medical Companies Alliance, Birmingham, Alabama) aims at facilitating safe and efficient end-to-end reconstruction of the native vessel ends following resection of intracranial aneurysms.

CLINICAL PRESENTATION: We report the first case of the Coupler device used to treat a ruptured posterior inferior cerebellar artery (PICA) aneurysm. Following aneurysmal trapping and excision, the native parent vessel ends were connected in an end-to-end fashion.

CONCLUSION: The microanastomotic Coupler device is an acceptable option for end-to-end anastomosis and was successfully applied in the management of a ruptured fusiform PICA aneurysm.

KEY WORDS: Case report, Fusiform aneurysm, Intracranial anastomosis, Microanastomotic system, Posterior inferior cerebellar artery aneurysm

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The Coupler microanastomotic device (Medical Companies Alliance, Birmingham, Alabama) has been described previously to perform intracranial-to-intracranial (IC-IC) bypass for the treatment of complex cerebral aneurysms.1,2 The main advantages of utilizing the Coupler device are the time reduction needed to perform the anastomosis while achieving complete obliteration of the lesion while maintaining parent vessel patency.

We report the first case of utilizing the Coupler device in the posterior fossa for the treatment of a ruptured, distal posterior inferior cerebellar artery (PICA) fusiform circumferential aneurysm. The aneurysm was treated surgically by primary aneurysmal excision accompanied by surgical anastomosis of both ends of the vessel with the Coupler device.

ABBREVIATIONS: CT, computed tomography; EC-IC, extracranial-to-intracranial; IC-IC, intracranial-to-intracranial; PICA, posterior inferior cerebellar artery

CLINICAL PRESENTATION

A 44-yr-old man presented to the emergency department with an acute onset of severe headache, nausea, and vomiting. Hunt & Hess grade on admission was 2 with a modified Fisher grade of 2. He had no significant family history of subarachnoid hemorrhage. Past medical and surgical history was significant for obesity and sleep apnea. Noncontrast head computed tomography (CT) demonstrated diffuse subarachnoid hemorrhage throughout the basal cisterns with significant intraventricular hemorrhage and hydrocephalus. Diagnostic cerebral angiogram revealed a 3.0 × 4.0 mm right fusiform and PICA aneurysm along the lateral medullary segment (Figure 1). Right frontal external ventricular drain was placed. Due to the fusiform shape of the aneurysm and the dysplastic segment as well as the acute rupture of the aneurysm, we chose to pursue an open surgical intervention rather than an endovascular approach. Consent was obtained from the family. A midline suboccipital craniectomy with C1-2 laminectomy was performed in a traditional fashion. An irregular fusiform PICA aneurysm was visualized. Upon inspection, the entire lateral medullary segment of the PICA was dysplastic along
its entire circumference (Figure 2A). At this point, as primary clip application was not deemed feasible, a decision was made not to clip-wrap the aneurysm, but rather resect the aneurysm and reconstruct the diseased vessel. After the application of temporary clips proximally and distally, the dysplastic segment and the entire aneurysm was excised. The ends were loaded consecutively into a 2-mm ring of the microanastomotic device by utilizing the Pierce ring-end forceps (Figure 2B and 2C). The temporary clips were removed following the for a total of 10 min after their initial application (Figure 2D and 2E). Utilizing Doppler ultrasonography, a good flow was found to be present along the proximal and distal segments of the artery. This finding was confirmed by indocyanine green video-angiography (Figure 2F). Postoperative angiography demonstrated complete aneurysm obliteration with good opacification of contrast at the anastomotic site along with patency of proximal and distal parent vasculature (Figure 2G). The patient made good recovery and his modified Rankin scale was 3 at last follow-up at 10 mo after surgery.

**DISCUSSION**

Choosing the correct treatment pathway for PICA aneurysms can be challenging. The small caliber of the PICA, the characteristically broad neck of those aneurysms, along with perforators to the brain stem and adjacent cranial nerves all create a challenging treatment approach, whether a microsurgical or endovascular route is pursued.

The surgical option of utilizing IC-IC anastomosis for the treatment of complex aneurysms has been shown to offer the advantage of lesion obliteration with concomitant restoration of blood flow to the parent vessel.\(^1\) Previously, the utility of this Coupler device for extracranial-to-intracranial (EC-IC) bypass procedures with excellent short- and long-term patency rates has been reported.\(^1,3\)

The decision to resect the aneurysm and anastomose rather than clip reconstruct is based on certain aneurysm and parent vessel characteristics such as distal location without any perforators arising from that segment, lack of arterial branches arising from the parent vessels at the location of the aneurysms, involvement of the entire vessel circumference with the disease process, and availability of critical length of normal vessel for both temporary clip and manipulation required for anastomosis.

The use of a microanastomotic device for anastomosis of small-caliber vessels without the need for sutures was first described by Berggren et al.\(^2\) Experimental studies where this device was used have confirmed excellent short- and long-term patency rates. Timing is reduced significantly when using the Coupler device when compared to the classic suture method, thus reducing temporary clip time and the implicit neuronal ischemic injury. The rings of the device are also compatible with magnetic resonance imaging.

The Coupler device has been widely accepted in other microsurgical specialties, including plastic surgery, vascular surgery, and thoracic surgery.\(^4\) Many studies validated the effectiveness of these devices for both venous and arterial vascular anastomoses.\(^5\) Thrombosis incidence of these devices is very low, ranging from 0.6% to 3%,\(^6\) as the endothelia of the donor and recipient vessels are in direct contact to each other without any stitch.

There are technical nuances that should be kept in mind when using this device. It is important to select the ring size that most closely matches the size of the vessel. The ring sizes available are 1 mm, 1.5 mm, 2 mm, 2.5 mm, 3 mm, 3.5 mm, and 4 mm in diameter. They consist of 2 parallel rings with 6 pins each
that insert into each other. A ring that is too large may result in tearing of or damage to vessel ends. A ring that is too small can obstruct flow. Detailed information on size selection was previously described by the senior author.1,2

The case presented herein was ideal for this treatment because of several vascular features. The aneurysm was located distal to the main perforating brainstem arteries arising from the early arterial segments of the PICA and there were no branching points along the planned anastomotic segment. Another feature that made this case amenable for the use of the Coupler device is the increased caliber of the PICA as well as the redundant nature of the PICA, which provided the critical length needed for manipulating the vessel for anastomosis.

One more scenario to mention here is that in the event of failure to successfully anastomose the vessel ends with this device, one should be prepared to quickly identify this and then go on to perform an end-to-end suture anastomosis. For this, again, a sufficient length of the parent vessel should be kept prepared prior to trapping of the aneurysm. Also, astute judgement from an experienced surgeon making the decision to use this device is imperative for a successful surgical and clinical outcome as sacrificing the vessel can be unfortunate if the bypass does not succeed.

In the current era, an endovascular option has to be factored in the treatment paradigm. In the case described herein, the options such as stent-assisted coiling or flow diversion are not ideal as dual antiplatelet treatments will be required, with the
potential of further IC bleeding and jeopardizing ventriculoperitoneal shunt placement if needed. However, in a different scenario of an unruptured PICA aneurysm with similar angioarchitectural characteristics, endovascular options such as flow diversion, stent, or assisted coiling may indeed be exercised.

**CONCLUSION**

The microanastomotic Coupler device is suitable for end-to-end anastomosis and was successfully applied in the management of a ruptured fusiform PICA aneurysm. As the time under temporary clipping is reduced in comparison to suture anastomosis, this method carries an inherent merit and add to the armamentarium of the comprehensive treatment of patients with complex cerebrovascular disorders.

**Disclosures**

The authors have no personal, financial, or institutional interest in any of the drugs, materials, or devices described in this article.

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