Endovascular embolization of an external carotid-retromandibular arteriovenous fistula using the Amplatzer vascular plug

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Abstract

Objective: The Amplatzer vascular plug (AVP) is a new embolic device with advantages in embolization of high-flow vessels. We report a case involving implantation of an AVP into the retromandibular vein and coil-embolization of an arteriovenous fistula (AVF).

Case presentation: We present the case of a 31-year-old woman with an external carotid artery (ECA)-retromandibular vein AVF. She complained of pulsatile tinnitus after a sagittal split-ramus osteotomy. The high-flow left ECA-retromandibular vein AVF was depicted in the arterial phase using selective external carotid angiography (ECAG). Endovascular embolization treatment of the fistula using an AVP and coils was planned. We initially intended to introduce the AVP into the fistula via a transvenous route through the left external jugular vein, but could not pass the 5-Fr guiding catheter round the hairpin curve between the fistula and ECA. We therefore changed treatment strategy, placing an 8 mm AVP into the retromandibular vein. Fistula closure was almost obtained after implantation, but shunt flow from a narrow channel remained. We then embolized the fistula using coils, from the AVP to the fistula inlet. The fistula was occluded using five coils.

Conclusion: We treated the patient with implantation of an AVP in the retromandibular vein and coil-embolization of the AVF. Advantages of the AVP are its stability for high-flow vessel occlusion and its cost-effectiveness when compared with coils. However, this device has disadvantages in the ease of its delivery to distal vessels. Therefore, using this device in craniofacial lesions needs technical refinement.

Key words

Amplatzer vascular plug, endovascular, arteriovenous fistula, external carotid artery

Introduction

The Amplatzer vascular plug (AVP) (AGA Medical Corporation, Minneapolis, Minnesota) is a new embolic device that ensures permanent occlusion of vessels (Fig. 1). The AVP is a self-expanding cylindrical nitinol mesh case. It has been approved in Japan since 2012 for embolization of vessels other than coronary and intracranial vessels. This device has various advantages over other materials such as coils or glue. The AVP can be retracted and repositioned, has a lower migration risk than coils, and has a lower total cost of embolization than coils. Therefore, it has advantages in a case that needs embolization of wide high-flow vessels.

Very few cases of AVP use in craniofacial contexts have been reported to date. Herein, we describe the case of a post-traumatic arteriovenous fistula that arose from the left external carotid artery and drained into the retromandibular
vein. The patient was treated with implantation of an AVP into the retromandibular vein and coil-embolization of the arteriovenous fistula (AVF).

Case presentation

A 31-year-old woman underwent a sagittal split-ramus osteotomy in the dentistry department of another hospital. She complained of pulsatile tinnitus following the operation, and was diagnosed with a facial AVF by 3DCTA (Fig. 2). Physical examination revealed a left-sided cervical bruit.

On admission, DSA and cone-beam 3DCTA were performed to assess the lesion and aid development of an interventional treatment strategy. The high-flow left external carotid artery (ECA)-retromandibular vein AVF was depicted in the arterial phase using selective external carotid angiography (Fig. 3). The fistula had an inlet from the ECA, and two outlet veins (a wide route and a narrow route) that drained into the retromandibular vein. The left ECA was 8 mm in diameter, and the wide fistula outlet route was 4 mm in diameter. The retromandibular vein was notably dilated to 7 mm, and most of the blood drained into the left external jugular vein (EJV). The patient had no symptoms other than tinnitus, and this AVF did not seem to influence intracranial perfusion. However, the patient preference was to undergo treatment. Due to the high risk of facial palsy in surgical treatment, we planned endovascular embolization of the fistula using an AVP and

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Fig. 1
Figure of the Amplatzer vascular plug, its pusher wire, and the loader. The lower list is labeling of compliance with catheter and sheath.

Fig. 2

Fig. 2
3DCTA showed a facial arteriovenous fistula (black arrow).

Fig. 3
The high-flow left external carotid artery (ECA)-retromandibular vein arteriovenous fistula (AVF) and dilation of the retromandibular vein were depicted in the arterial phase by selective external carotid angiography (ECAG). ECAG and cone-beam CT showed the ECA, the wide outlet route of the AVF (black arrow), the retromandibular vein, and the external jugular vein.
ECV: external cephalic version

The endovascular treatment was performed under general anesthesia. Vascular access was obtained via the left common femoral artery and the right common femoral vein using a 5-Fr and a 6-Fr sheath respectively. Heparin (3000 IU) was administered. We initially intended to introduce the AVP into the fistula via a transvenous route. We tried to approach the fistula via the left EJV using a 5-Fr guiding catheter (Envoy MPD 90 cm, Codman & Shurtleff, Johnson & Johnson, Raynham, MA, USA), 3.6-Fr inner catheter (OK2M 125 cm, Katecs, Osaka), and guide wire (Surf 0.035 inch 150 cm, PIOLAX, Kanagawa). Although we passed the 3.6-Fr inner catheter over the guide wire from the retromandibular vein into the left ECA via the wide outlet route of the fistula, the 5-Fr guiding catheter could not pass round the hairpin curve between the fistula and ECA (Fig. 4). There was also a risk of fistula wall rupture involved when removing the inner catheter after placement of the tip of the guiding catheter into the fistula. Thus, we had to change treatment strategy. We decided to use the AVP for occlusion of the retromandibular vein at the outlet of the fistula. We placed a 6-Fr guiding catheter (Optimo, Tokai Medical Products, Aichi) into the left ECA, and passed a microcatheter (Headway 45, MicroVention TERUMO, Tustin, CA, USA) over a micro guide wire (Chikai 14, ASAHI INTECC, Tokyo) into the retromandibular vein via the wide outlet route of the fistula, in preparation for coil embolization of the fistula. We inserted the 5-Fr guiding catheter to just distal of the fistula in the retromandibular vein, placed
an 8 mm AVP into the retromandibular vein at the wide outlet of the fistula, and inflated the Optimo balloon during AVP implantation to prevent migration of the AVP by controlling flow in the left ECA (Fig. 5). Closure of the wide outlet route of the fistula was obtained 20 minutes after implantation of the AVP, but shunt flow from the narrow channel still remained. We then coil-embolized the fistula using the microcatheter. Embolization was from the AVP to the inlet of the fistula, under balloon occlusion of the ECA (Fig. 6, 7). The fistula was occluded completely using five coils. The patient suffered no complications and her pulsatile tinnitus resolved following the treatment.

The patient was discharged five days after the procedure. Recanalization was not evident on the ultrasound performed six months after treatment.

Discussion

The Amplatzer vascular plug has been widely used to embolize various high-flow shunts in centers worldwide. Commonly reported uses of this device are in internal iliac arteries, pulmonary AVFs, and a variety of other aneurysms and AVFs. Treatment of head and neck lesions has also been reported.1–5)

Post-traumatic facial AVFs other than carotid-jugular
Coil-embolization of the fistula using the microcatheter was performed. Embolization was from the Amplatzer vascular plug to the inlet of the fistula. The fistula was occluded completely using five coils.

AVFs have rarely been reported. However, many authors have reported iatrogenic and post-traumatic carotid-jugular AVFs. Iatrogenic cases are most commonly caused by cannulation of the internal jugular vein. These high-flow shunt cases were previously treated with open surgery, but now endovascular treatment has become mainstream. In 2000, Deshmukh, et al. reported a case where a carotid-jugular AVF was treated with balloon embolization. Recently, many authors have reported cases of carotid-jugular AVFs successfully treated using a covered stent. Rohit, et al. and Güneyli, et al. reported cases treated using AVPs.

To our knowledge, an ECA-retromandibular vein AVF has not been previously reported. Although Güneyli, et al. reported an internal maxillary artery pseudoaneurysm case, use of the AVP in facial lesions has not been widely reported to date. Advantages of the AVP are its stability for high-flow vessel occlusion and its cost-effectiveness when compared with coils. In addition, the plug can be resheathed and redeployed when repositioning is required. This device has advantages over both coils and balloons for embolization. However, this device has a disadvantage related to its delivery to a target site. The AVP needs a 5–7-Fr guiding catheter, and its rigidity and external diameter limits its use in distal vessels. We could not pass a 5-Fr guiding catheter through the fistula and had to abandon this technique in order to deliver the AVP into the fistula. The delivery wire of the AVP is stiff, and it compromises delivery of the plug. A more delicate delivery system needs to be developed for the therapeutic occlusion of more distal vessels in the craniofacial region.

Ong, et al. reported the therapeutic sacrifice of major craniocerebral arteries using the AVP. The authors successfully used the AVP to therapeutically occlude the internal carotid artery (ICA) and the vertebral artery. However, the AVP was designed for arterial and venous occlusion in the peripheral vessels, and their use of the AVP for intracranial vessels was “off-label.” Ong, et al. also noted that “rigidity of the delivery system limits its current use to vessels below the skull base” and that “a lower-profile plug with a more delicate delivery system would improve the navigability of the device and enable its placement in the smaller-caliber intracranial vessels.” Development of a softer and easier-to-deliver device could offer a safer and more cost-effective avenue for the treatment of intracranial high-flow fistulae such as direct
carotid cavernous fistulae in the future.

Conclusion

We treated this patient with implantation of the AVP into the retromandibular vein and coil-embolization of the AVF. Advantages of the AVP are its stability for high-flow vessel occlusion and its cost-effectiveness when compared with coils. However, this device has disadvantages in the ease of its delivery to distal vessels. Therefore, using this device in craniofacial lesions needs technical refinement.

The authors declare that they have no conflict of interest.

References


5) Rohit MK, Sinha AK, Kamana NK. Early experience on peripheral vascular application of the vascular plugs. Indian Heart J 2013; 65: 536–545.


