Vascular plugs on peripheral vascular treatment: How, when and why.

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Learning objectives

• To demonstrate the value of vascular plugs in the endovascular treatment of many pathologies.
• To know how and when we can use vascular plugs and why they are the treatment of choice in most of cases.
• To share our experience in this kind of procedure with cases from our center.
Background

The Amplatzer Vascular Plug (AVP) is an established embolic device that can be an excellent alternative to coils or detachable balloons to embolize medium to large vessels with high flow.

The device is easy to use and it can be deployed accurately in the vessel we want to treat with high resistance to migration and a low recanalization rate, with no absolute contraindications.
Findings and procedure details

There are four models of AVP (AVP, AVP II, AVP III, and AVP 4), with different design and features that fit different vascular anatomies, hemodynamic situations, and clinical problems.

All models of the AVP contains two components: a vascular plug and a delivery wire. All plugs are made with nitinol braids, which have a self-expanding feature, and they have radiopaque platinum marker bands for high visibility under fluoroscopy.

There is a stainless-steel screw on one of the platinum marker bands attaches to a delivery cable. Once the position of a deployed device is accurate, the device can be released by rotating the cable counterclockwise to complete implantation.

AVP different types differ in that the AVP has a single lobe, the AVP II has 3 lobes, and the AVP III and AVP 4 have 2 lobes. Furthermore, the AVP and AVP 4 have single-layered braids, whereas the AVP II and AVP III have a multiple-layered design.

The AVP is a single-layered cylindrical device and is available in diameters ranging from 4 to 16 mm. The AVP is particularly well suited for landing zones that are limited in length.

The AVP II has 3 segments, including the central lobe and 2 discs on each side of the lobe. It has 6 layers of mesh, so it contains more densely woven nitinol mesh providing better occlusive properties and making the device longer than the AVP.

The AVP III has an oblong cross-sectional shape with multiple nitinol mesh layers and extended rims and it has been used in treatment of paravalvular leakage.

The AVP 4 is available in 5 sizes ranging from 4 to 8 mm.

The main difference is that the AVP 4 can be delivered through a standard 0.038-inch diagnostic catheter without the need to exchange for a sheath or a guiding catheter once the diagnostic catheter is in place.

Deployment of an AVP is achieved by unscrewing the plug from the delivery wire by counterclockwise rotation, and it can be very accurately placed within the target vessel.

The device is well visualized through radiopaque platinum markers and contrast medium can be injected through the delivery system to confirm the device position in the vessel.
before treatment. Furthermore, the plug can be withdrawn into the delivery device and redepolyed if it’s necessary.

AVP is very useful in large-diameter, high-flow arteries or fistulas, whereas coils can migrate distally; and even if a plug has been completely released, it can sometimes still be retrieved with a snare.

Migration is a rare complication of AVP, because the device is self-expanding and has sufficient radial force on the vessel wall to minimize movement.

The 3 segments of the AVP II and the 2 segments of the AVP III and AVP 4 increase the surface area of the contact point, theoretically making these devices more stable than the AVP.

Concerning migration, is a rare complication of AVP because the device is self-expanding and has sufficient radial force on the vessel wall to minimize movement. In addition, the 3 segments of the AVP II and the 2 segments of the AVP III and AVP 4 increase the surface area of the contact point, theoretically making these devices more stable than the AVP.

An AVP procedure should be considered a technical failure unless complete occlusion of the target vessel has been demonstrated. If necessary, additional embolic material, such as coils or additional AVPs should be used to guarantee complete occlusion. This is particularly manifest in active bleeding, large diameter vessel, high-flow status or coagulopathy. In the other hand, spontaneous recanalization of the plug after successful occlusion of a target vessel is very rare.

The AVP is not able to seal the target vessel instantly to stop the flow, because there are small interstices in the mesh of the device and, in addition, it does not have any intrinsic thrombogenic property other than being a foreign body.

Instead, the small holes in the plug reduce the flow and form a clot to seal the device, so it will take time to achieve complete occlusion after successful deployment of the AVP. This time is called occlusion time, which is highly variable and it may be prolonged in high-flow status, large vessel diameter or coagulopathy.

One disadvantage of this device is that a 4-Fr sheath or 5-Fr guiding catheter is required for delivering AVP and AVP II to the target vessel, a 4-Fr sheath or 6-Fr guiding catheter is required in AVP III and AVP 4 can be delivered through a 4-Fr diagnostic catheter.
The rigidity of the release wire also could be problematic in tortuous vessels and, because of the configuration of the AVP, a relatively straight segment of target vessel with a fairly constant diameter is needed for deployment.

Another advantage of AVP is that it contains nitinol wire, so the device is compatible with magnetic resonance imaging.

Clinical applications of AVP are highly variable, and it can be used in both arteries and veins.

Arteries typically have high flow, and AVP has an advantage over coils in embolizing large, high-flow vessels in which coil migration is possible or a large number of coils may be needed.

The most common treatments in arteries are:

Internal iliac artery to prevent endoleak in patients before EVAR or to treat internal iliac artery aneurysms by placing the device distal and proximal to the aneurysmal sac.

Carotid Artery to treat fusiform giant cerebral aneurysms, caroticocavernous fistulae and to control torrential head and neck haemorrhage from many causes.

Splenic Artery Embolization in portal hypertension, splenic artery aneurysm, splenic trauma to avoid splenectomy; being an alternative to surgery in a lot of cases.

Renal Artery, in renal arteriovenous fistula or bleeding angiomyolipoma.

Gastroduodenal Artery, being a common procedure for the treatment of duodenal bleeding.

Veins generally have a larger caliber than arteries. In these cases, the AVP has a significant advantage over coils in its ability to embolize large vessels in which a high number of coils would otherwise be needed.

The main procedures in vein treatment with AVP are:

Portal vein embolization in preoperative hepatic resection or in preoperative embolization of the tumor side portal vein to stimulate contralateral liver lobular hypertrophi.
Pulmonary arteriovenous malformation (PAVM) and Patent ductus arteriosus (PDA) are the most frequently treated entities.

Hemodialysis arteriovenous fistula, where endovascular embolization with AVP has been shown to be superior to surgery.

Transjugular intrahepatic portosystemic shunt (TIPS) occlusion.

Spermatic vein in varicocele, where AVP shows excellent results and which is the most frequent entity treated in our center by AVP.

Ovarian vein in pelvic varicose veins.
Fig. 1: Patient with dilation of the left spermatic vein.

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**Fig. 2:** Varicocele closed by Amplatzer® Vascular Plug 4.

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**Fig. 3:** Subsequent control. No filling of the vein is observed.

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Fig. 4: Another patient with dilated espermatic vein. Pretreatment venography.

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Fig. 5: Control after embolization with Amplatzer® Vascular Plug 4.

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Conclusion

- AVP is a very good choice in the treatment of many vascular disease.
- Its use is simple, safe and quite effective
- Different models allows this treatment be used in different kind of vessels and variety of pathology with satisfactory results.