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Original Article

Early experience on peripheral vascular application of the vascular plugs



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ABSTRACT

Background: Transcatheter closure of various congenital and acquired vascular malformations with Amplatzer Vascular plugs I and II has been established. Here we present our experience with device closure.

Materials and methods: Between October 2006 and August 2012, nine (three males and six females) patients aged between 11 months and 62 years (mean age 19 years) underwent percutaneous device closure with AVP I and II vascular plugs for congenital and acquired arteriovenous malformation and cardiac diverticulum are presented here.

Results: One case of coronary cameral fistula, four cases of pulmonary arteriovenous fistula, one case of large major aortopulmonary collaterals (in tetralogy of Fallot closed before intracardiac repair), one case of congenital cardiac diverticulum, one case of fistula between external carotid artery and internal jugular vein and one case of iatrogenic carotid jugular fistula were successfully closed with AVP I and II plugs. Overall in nine cases, 16 AVP I and II plugs were deployed to occlude feeding vessels and one cardiac diverticulum. The technical success rate was 100%. No major complications were observed.

Conclusion: Amplatzer vascular plugs can be used successfully for closure of various congenital and acquired vascular malformations with good result.

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1. Introduction

Portsmann was the first to report transcatheter blood vessel closure in 1967. He had closed patent ductus arteriosus by using Ivalon plug.¹ Advancements in technology have resulted in development of new devices to the interventionist's armamentarium. Amplatzer vascular plugs (AVP; AGA Medical, Golden Valley, MN, USA) have emerged as the new tools for transcatheter embolizations in the peripheral vasculature, occlusion of abnormal vessel communications and congenital

cardiac defects. The AVP is a self-expanding cylindrical device, similar to the Amplatzer septal and ductal occluding devices.

2. The Amplatzer vascular plug

The AVP is a self-expandable cylindrical device made of nitinol mesh wires. Its structure allows the device to be compressed inside the catheter, which returns to its intended

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shape when it comes out of the catheter and occlude the vessel. Platinum markers are present on both ends of the device. A stainless steel micro screw is welded to one of the platinum marker bands, which allows attachment to the 135 cm long delivery cable. The available device size ranges from 4 mm to 16 mm in AVP I and 4 to 22 mm in AVP II, with increments of 2 mm. It is preloaded in a loader and delivered through guiding catheters ranging in size from 5 F to 10 F.^{2,3} Once positioned by holding the delivery shaft steady and pulling the outer guiding catheter back, it is released by rotating the delivery cable counter clockwise. Device is selected 30%–50% larger than the vessel diameter. Its flexibility allows it to adjust to the vessel shape and over sizing prevents the migration of the device after deployment. Amplatzer vascular plug II (AVP II) and more recently AVP III and AVP IV were designed for better occlusive properties. It contains a finer, more densely woven nitinol, braided in two layers in the smaller devices and three layers in devices bigger than 10 mm.⁴ AVP I and IV are single layered, and AVP II and III are multilayered. The use of vascular plug I in patients with congenital and acquired cardiovascular disease had been reported,² more recently there was increasing use of vascular plug II in patients with congenital and acquired defects.^{4–6} AVP I used for short landing zones, AVP II used for variable landing zones with shorter occlusion time, AVP III for high-flow embolization and AVP IV used for tortuous vessel and rapid embolization.

We describe here our experience with AVP for occluding various peripheral and central arteries and veins, including occlusion of pulmonary arteriovenous malformations (PAVMs) and cardiac diverticulum.

2.1. Materials and methods

Between October 2006 and August 2012, nine patients (3 males, 6 females) aged between 11 months and 62 years (mean age, 19 years) underwent percutaneous vessel closure with the AVP. Transfemoral approach was the preferred vascular

access and intravenous conscious sedation given for all the procedures.

2.2. Results

Patient characteristics and treatment details are described in Table 1. AVP was used for occluding various peripheral and central arteries and veins, including occlusion of coronary arteriovenous fistulas, PAVMs and cardiac diverticulum.

3. Coronary arteriovenous fistula

An eleven-month-old male child with history of failure to thrive and poor weight gain had continuous murmur in right precordial region. Echocardiography showed right coronary artery (RCA) fistula opening into right ventricle. Angiography revealed a large fistula opening from RCA into right ventricle (Fig. 1a). Judkin's right (JR) catheter 5 F was used to hook RCA through the 6 F carotid shuttle sheath (Cook, USA). Terumo wire was passed from fistula to right ventricle and pulmonary artery. Over this JR, 6 F Carotid shuttle sheath was passed up to the point of delivery. Amplatzer vascular plug (AVP I) was deployed. There was partial occlusion of the fistula and clearly visible right coronary artery at end of the procedure (Fig. 1b). There were no signs of RCA territory ischemia post-intervention. Echocardiogram done 24 h later showed no residual flow across the fistula. On follow-up, the child had a grade II systolic murmur and a weight gain of four and half kilograms.

4. Large pulmonary arteriovenous fistulas (cases 2–5 Table 1)

4.1. Case 2

A 62-year-old male with history of headache and breathlessness had central cyanosis and clubbing on examination. Echocardiography showed structurally normal heart.

Table 1 – Patient characteristics and procedures done.

Case no	Sex	Age (years)	Indication	Location	Delivery system	Device for total occlusion
1	Male	11 month	Coronary cameral fistula	Right coronary artery	Carotid shuttle sheath 6 F	AVP I plug
2	Male	62	Large PAVM	Both lungs	Cook sheath 6 F	2 AVP II plugs
3	Female	34	Large PAVM	Right lower lobe segment	Cook sheath 10 F	AVP I plug
4	Female	35	Large PAVM	Right lower lobe segment	Cook sheath 11 F	AVP II
5	Male	12	Large PAVM and paradoxical embolism	Left upper lobe segment	Cook sheath 7 F	5 AVP I plugs
6	Female	12	Large MAPCA in tetralogy Fallot	Right upper lobe segment	Judkins right 4 6 F	AVP II plug
7	Female	12	Cardiac diverticulum	Left ventricle	Cook sheath 9 F	2 ADO devices and AVP I plug
8	Male	15	Large neck swelling	Common carotid to internal jugular vein	Carotid shuttle sheath 6 F	AVP II plug
9	Female	13	Large arteriovenous fistula	External carotid to external jugular vein	Carotid shuttle sheath 6 F	AVP II plug

AVP – Amplatzer vascular plug, PAVM – Pulmonary arteriovenous malformation, MAPCA – Major aortopulmonary collateral arteries.

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