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CASE REPORT

Percutaneous Closure of a Large Unligated Vertical Vein Using the Amplatzer Vascular Plug II After Supracardiac Total Anomalous Pulmonary Venous Connection (TAPVC) Repair

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Abstract It is well known that the vertical vein (VV) may have to be left open after repair of a total anomalous pulmonary venous connection (TAPVC) in children with preoperative obstruction, whose left heart chambers are small (Cope et al. in Ann Thorac Surg 64:23–29, 3). An unligated VV has been found to reduce pulmonary arterial pressure, decrease perioperative pulmonary hypertensive crisis, and provide better hemodynamics postoperatively (Chowdhry et al. in J Thorac Cardiovasc Surg 133:1286–1294, 2). Although these VVs are expected to close later, they may remain patent in about half of these children (Cheung et al. J Paediatr Child Health 41:361–364, 1).The patent VVs may be a cause for significant left-to-right shunting, and the children may be symptomatic. The case report describes a child who had a large patent VV after repair of supracardiac TAPVC and its closure using the Amplatzer Vascular Plug II device.

Keywords Amplatzer Vascular Plug II · TAPVC · Total anomalous pulmonary venous connection · Vertical vein

Case Report

A 4-month-old baby boy underwent surgical repair of obstructed supracardiac a total anomalous pulmonary venous connection (TAPVC) by the Tucker technique [7]. The pulmonary venous confluence was anastomosed to the superior wall of the left atrium. The vertical vein (VV) was left open because of high pulmonary artery pressure.

The boy was transferred to the intensive care unit with an open chest. On postoperative day 1, temporary occlusion of the VV was attempted surgically but was not tolerated, as manifested by junctional rhythm and desaturation. Hence, VV was left unligated. The boy was extubated on postoperative day10 and required noninvasive ventilation for another 15 days due to bronchopneumonia.

At serial follow-up assessment, the boy had recurrent respiratory tract infections. Examination showed a widely split second heart sound and an ejection systolic murmur at the left upper sternal border. Electrocardiography (ECG) exhibited right ventricular hypertrophy. Chest x-ray showed cardiomegaly and increased pulmonary vascularity. Echocardiography exhibited unrestricted flow from the pulmonary veins to left atrium. A large patent VV measuring 9 mm in diameter was seen, with significant left-to-right shunting. The right atrium and ventricle were dilated. Hence, at the age of 1 year, the boy, weighing of 9 kg, was taken for transcatheter closure of the VV.

Technique of Percutaneous Closure

The procedure was performed with the boy under general anesthesia accompanied by an antibiotic cover. Vascular access was obtained via the right femoral vein using a 6-Fr sheath. The VV was crossed using a 4-Fr multipurpose angiographic (MPA) diagnostic catheter and a 0.035-in. × 260-cm J-tipped Radifocus® Guide wire M Standard type (Terumo Corp, Tokyo, Japan).

An angiogram of the VV was obtained to delineate the pulmonary venous drainage. The VV was found to be uniformly broad, measuring 13 mm in diameter (Fig. 1,

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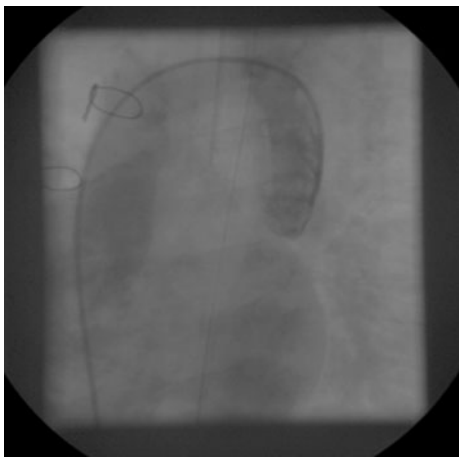

Fig. 1 Hand injection of the vertical vein (VV) using the end-hole catheter

Movie clip 1). The sheath was exchanged for an 8-Fr short sheath. A 7-Fr patent ductus arteriosus occluder delivery system was passed through the short sheath over the wire into the VV.

The 18-mm Amplatzer Vascular Plug II (AGA Medical Corporation, Plymouth, MN, USA), which was 1.5 times the diameter of the VV as measured angiographically, was chosen and positioned with the distal disc at the origin of the VV. It then was deployed just distal to the confluence. There was complete occlusion of the VV, but the proximal disc protruded into the left innominate vein (LIV), occluding its flow as seen angiographically (Fig. 2, Movie clip 2). Hence, the device was retrieved and replaced with the 14-mm Amplatzer Vascular Plug II, which was 1.5 times the diameter of the VV as measured by echocardiography (Fig. 3, Movie clip 3). The device filled the entire VV, with no dead space in which blood could stagnate and form clots. Angiography showed smooth flow across the LIV (Fig. 4, Movie clip 4). The sheath was removed immediately as the child was not heparinized because an arterial sheath was not used.

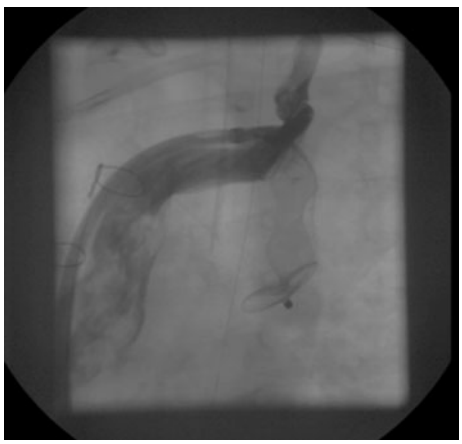

Fig. 2 Angiogram of the left innominate vein (LIV) showing occlusion of the LIV by the protruding distal disc of the 18-mm Amplatzer Vascular Plug II

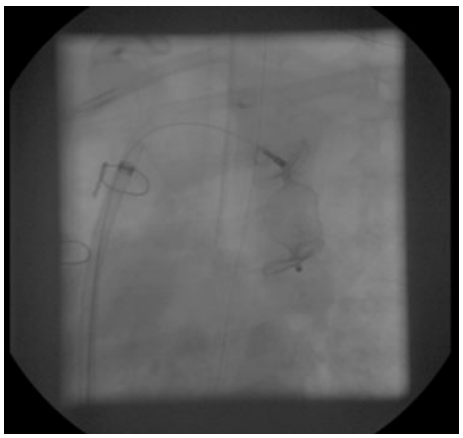

Fig. 3 A 14-mm Amplatzer Vascular Plug II being compacted into the vertical vein (VV)

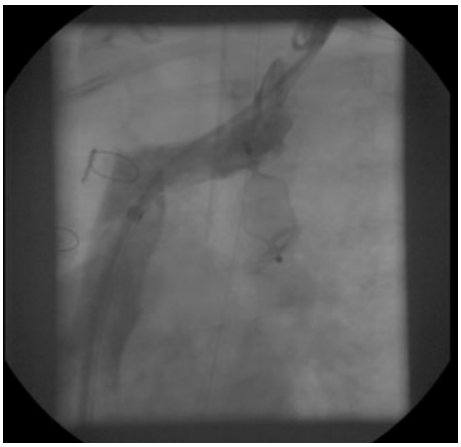

Fig. 4 Angiogram showing the smooth flow of contrast in the left innominate vein (LIV) after deployment of the 14-mm Amplatzer Vascular Plug II

The child had an excellent recovery and was discharged 2 days after the procedure receiving antiplatelet therapy. A postprocedure echocardiography confirmed the good position of the device, with complete occlusion of the VV and laminar flow across the LIV and right superior vena cava. At the follow-up assessment after 6 weeks, the child had remained asymptomatic.

Discussion

During TAPVC repair, VV ligation usually is performed to eliminate left-to-right shunting of blood. The VV is left open when the left atrium is small and noncompliant [3]. Low cardiac output and pulmonary hypertension with pulmonary hypertensive crisis in the postoperative period are serious sequelae if the ligation of VV is not tolerated.

An unligated VV has been found to reduce pulmonary arterial pressure, decrease peri-operative pulmonary hypertensive crisis, and provide better hemodynamics postoperatively [2]. Cope et al. [3] suggested that leaving the VV unligated was a safe option and that it may be expected to close spontaneously in most cases. Later reports, however, suggested that an unligated VV may be persistent and could require subsequent surgical or interventional closure [1]. From our institution, we had reported two children who needed surgical ligation of the VV later [6].

In the recent past, we have reported percutaneous closure of the VV after repair of supracardiac TAPVC using an Amplatzer duct occluder in a partially banded VV [5]. Use of Amplatzer Vascular Plug 1 for closure of persistent unligated VV after infracardiac TAPVC repair has been reported [4]. Although isolated reports describe interventional closure, use of Amplatzer Vascular Plug II to close a large VV after supracardiac TAPVC repair has not been reported to our knowledge.

Amplatzer Vascular Plug II, which successfully occluded the VV, had a diameter approximately 50 % larger than the vessel diameter as measured by echocardiography. In this case, the echocardiograophic measurement seemed to correlate better with the actual size of the VV. The clinician using Amplatzer Vascular Plug II must ensure that the occlusion site has sufficient length to accommodate the deployed device so that the device does not obstruct flow in the proximal or distal vascular structures.

We conclude that a patent VV left unligated and unbanded after supracardiac TAPVC repair may be successfully treated via percutaneous means by choosing an appropriate device.

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