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Brief Report

Use of an Amplatzer vascular occluding device to close a synthetic Blalock–Taussig shunt in an infant

Ben Anderson, Gary Sholler

The Adolph Basser Cardiology Institute, Department of Paediatric Cardiology, The Children's Hospital at Westmead, Sydney, Australia

Abstract We describe our experience with the closure of a synthetic Blalock–Taussig shunt using an Amplatzer vascular occluding device placed with the aid an exteriorised guidewire loop in an infant with congenital cardiac disease. The technique used in a neonate and the physiological benefits of this approach are discussed. We highlight the extended use of the Amplatzer vascular plug in this clinical setting and the advantages of using and the exteriorised guidewire loop for its placement.

Keywords: Interventional catheterisation; neonate; congenital; heart disease; heart failure

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The Amplatzer vascular plug has been used in previous instances to successfully occlude arteriovenous malformations.[1] Here, we describe the use of an Amplatzer vascular plug to occlude a modified Blalock–Taussig shunt, which was causing pulmonary over-circulation in an infant with severe congenital cardiac disease.

Case report

A male infant was born at term with pulmonary atresia with an intact ventricular septum. The infant was initially commenced on prostaglandin therapy to maintain ductal patency. At 4 days of age, the infant underwent pulmonary valvotomy under inflow occlusion to augment the pulmonary blood flow. The duct was not ligated. Postoperatively the prostaglandin infusion was weaned; however, the saturations dropped and the clinical condition of the child deteriorated. Right ventricular compliance remained poor and the forward flow through the pulmonary valve was inadequate for maintaining the circulation in the absence of the arterial duct. Prostaglandin therapy was recommenced with immediate effect.

At 10 days of age the infant underwent the insertion of a modified Blalock–Taussig shunt with a 3.5-millimetre Goretex synthetic shunt from the left subclavian artery to the left pulmonary artery. Prostaglandin therapy was discontinued, resulting in the closure of the arterial duct over the ensuing days. The postoperative course was complicated by increasing pulmonary blood flow and congestive cardiac failure as right ventricular compliance improved, with ongoing tachypnoea, feeding difficulties and poor growth. The saturations were consistently in the low 90s.

After 3 weeks, there was an inadequate weight gain and ongoing evidence of pulmonary overcirculation with high saturations and clinical congestive cardiac failure. The decision was made to attempt to device occlude the shunt, and allow the right ventricular forward flow to maintain pulmonary circulation, rather than submit the infant to further surgery. Potential benefits of the catheter-based approach are that it avoids further thoracotomy; allows test occlusion of the shunt with both lungs inflated, which provides a more accurate assessment of the saturations and shunts; and facilitates a potentially faster recovery in an ill neonate.

Correspondence to: Dr Ben Anderson, Adolph Basser Cardiology Institute, The Children's Hospital at Westmead, Corner of Hawkesbury Road and Hainsworth Street, Westmead, Sydney, New South Wales, Australia. Tel: +61 2 9845 2345; Fax: +61 2 9845 2163; E-mail: benanderson@uq.edu.au

Cardiac catheterisation

At 4 weeks of age, the infant underwent cardiac catheterisation. The left femoral artery was cannulated for continuous blood pressure monitoring and intermittent blood gas monitoring. Using the Seldinger technique, a 5F sheath was placed percutaneously in the right femoral vein and a 4F sheath in the right femoral artery. Access to the left Blalock–Taussig shunt was initially attempted transvenously with a 4F right coronary catheter, from the right atrium, across the atrial septum, through the left ventricle and around the aortic arch. It was not possible to engage the origin of the Blalock–Taussig shunt with this approach.

The distal end of the shunt could also not be engaged in an approach from the transvenous right ventricular pulmonary artery approach. Because of these difficulties the shunt was accessed via the aorta using a 4F JR2 right coronary catheter. A wire was passed through this catheter to the main pulmonary artery and was then snared using an Amplatzer snare inserted from the right femoral vein via right heart to the main pulmonary artery. The wire was then withdrawn through the venous sheath to complete the loop.

This wire loop provided a significantly more stable route for the introduction of subsequent catheters, rather than the alternative option of simply placing the distal end of the wire in a branch pulmonary artery. A 4F arrow wedge pressure balloon catheter was then placed via the arterial sheath and positioned in the left Blalock–Taussig shunt. The balloon was inflated and trial of the complete occlusion of the shunt was confirmed with contrast injection. The child was monitored with continuous saturation, heart rate, and blood pressure monitoring, and intermittent acid-base analysis was performed for the ensuing 30 minutes. With the occlusion of the shunt the saturation dropped from 90 to 70%, and the diastolic blood pressure rose by 15 millimetres of mercury. Serial blood gas analysis remained stable.

A soft-tipped Amplatzer delivery catheter was introduced over the wire retrogradely from the descending aorta to the left subclavian artery, across the shunt and into the main pulmonary artery. The wire was then removed with the sheath remaining in place. A 6-millimetre Amplatzer vascular occluding device was introduced via the sheath, and was positioned in the shunt after some manipulation. Difficulties included kinking of the catheter at the junction of the wire and the Amplatzer vascular plug at the point of acute angulation as the catheter entered the shunt. Angiography showed minimal residual shunt flow after deployment.

The child remained intubated and ventilated and returned to the neonatal intensive care unit. Echocardiography confirmed occlusion of the shunt, and chest X-ray confirmed the device position in the chest. The saturations remained in the range of 70–75% at rest, and the child was clinically stable. After discharge the saturations trended upwards, and at follow-up were 80% in air. A cranial magnetic resonance imaging scan performed after the procedure was normal.

Discussion

We believe that this case illustrates some useful technical points. The shunt was accessed via a catheter passed retrogradely through the aorta, which facilitated catheter manipulation into the origin of the Blalock–Taussig shunt. This was not possible with either approach via the pulmonary artery, or with attempted anterograde access via the foramen ovale and left ventricular route, which may have been related to both patient size and the angulation of the Blalock–Taussig shunt and right ventricular outflow tract. We found the strategy of securing the loop of the exchange wire by snaring to be useful, as it allowed completion of the loop exterior to the body and offered a stable route with correspondingly increased safety margins for the placement of the subsequent catheters.

One of the difficulties faced during this procedure was the kinking of the delivery catheter, particularly at the junction between the wire and the device where this was angled to enter the shunt, as the device was manipulated to the tip of the introducing catheter. Potentially, the use of a catheter with a firm yet flexible tip may help alleviate this problem in the future. A nitinol-tipped catheter may be one option to achieve this.

This case represents a novel "extended" use for the Amplatzer vascular plug for the closure of a surgically placed left-sided synthetic Blalock–Taussig shunt. The catheter-based occlusion of the Blalock–Taussig shunt in this situation offered a number of benefits, including avoidance of a further thoracotomy in an unwell infant, with more rapid recovery time; and more physiological assessment of the effect of shunt occlusion on oxygenation and circulatory status given that the inflation of both lungs is maintained during the procedure.

Reference

1. Hill SL, Hijazi ZM, Hellenbrand WE, Cheatham JP. Evaluation of the Amplatzer vascular plug for embolization of peripheral vascular malformations associated with cogenital cardiac disease. Catheter Cardiovasc Interv 2006; 67: 113–119.