Transcatheter Closure of Modified Blalock- Taussig Shunt Using Amplatzer® Vascular Plug During Surgical Correction of Tetralogy of Fallot: Cardiologists to the Rescue.

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Introduction

Transcatheter closure of prosthetic shunts in hybrid fashion is described in literature with promising results. Adopted materials include coils, devices and vascular plugs. Each method has their advantages and disadvantages. We describe a successful occlusion of modified Blalock- Taussig (BT) shunt using Amplatzer® vascular plug (AVP) highlighting the technique and its advantages.

Key words - Blalock- Taussig (BT) shunt, Transcatheter closure, Amplatzer® vascular plug (AVP), Tetralogy of Fallot, Hybrid procedure

Case History

14-year-old girl underwent Tetralogy of Fallot repair. She had left modified Blalock- Taussig (BT) shunt at the age of 3 yrs. During the surgery surgical team had difficulty in ligating the BT shunt as there were adhesions with significantly high risk of bleeding during the surgery. Therefore, it was decided to go ahead with catheter intervention to occlude the BT shunt on the same day of the surgery.

Child was taken into the catheterisation laboratory under same anaesthesia and device closure of left BT shunt was done using Amplatzer® vascular plug.

Access obtained through the left femoral artery due to thrombosed right femoral artery. 5 F short sheath was inserted and aortic angiogram performed through 4F pigtail catheter to delineate BT shunt and left subclavian artery anatomy (Figure1). 4F RCA catheter was advanced under the fluoroscopic guidance and BT shunt was crossed using 0.038" Therumo® exchange length guidewire. Guidewire was stabilised at distal right pulmonary artery (Figure 2). Then RCA catheter was advanced over the guidewire to cross the BT shunt (Figure 3).

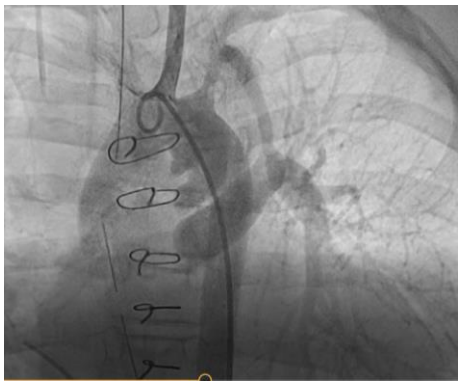


Figure 1

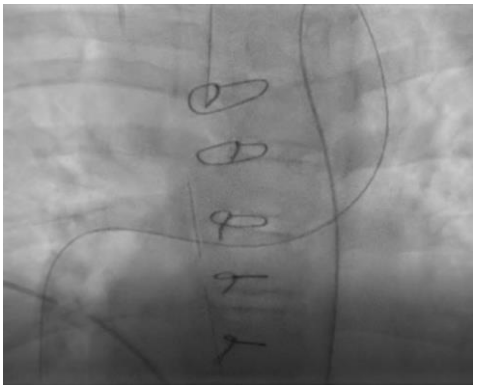


Figure 2

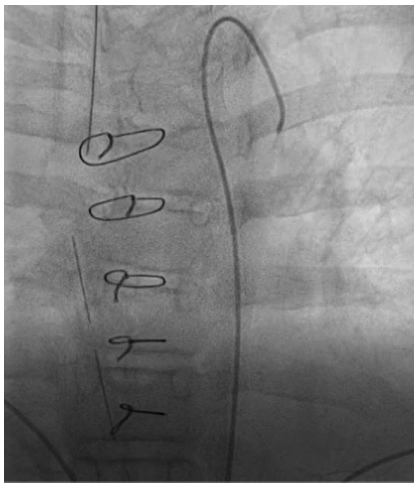


Figure 3

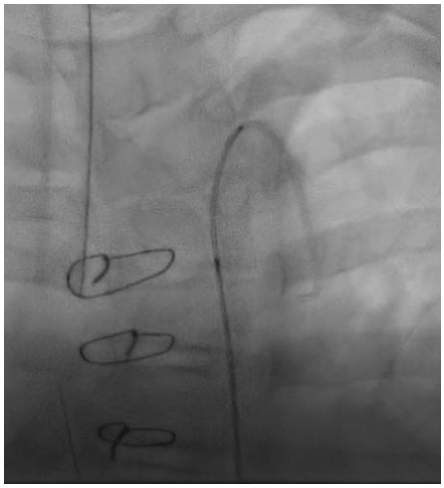


Figure 4

At first 8/13.5 mm vascular plug was deployed through the RCA. But the attempt failed as it was difficult to take the acute angle at the BT shunt origin (Figure 4). Then it was decided to deploy the vascular plug using 4 F Amplatzer® delivery system (ADO 11 delivery system). Before the procedure in vitro testing of vascular plug deployment through the delivery system was checked and it was successful.

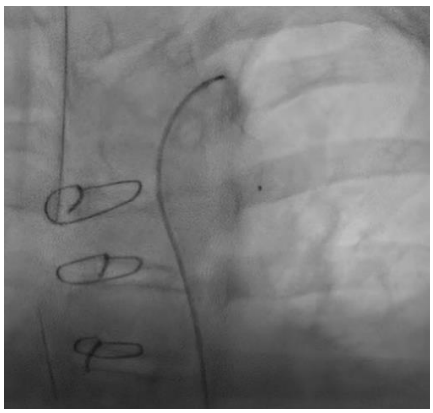


Figure 5

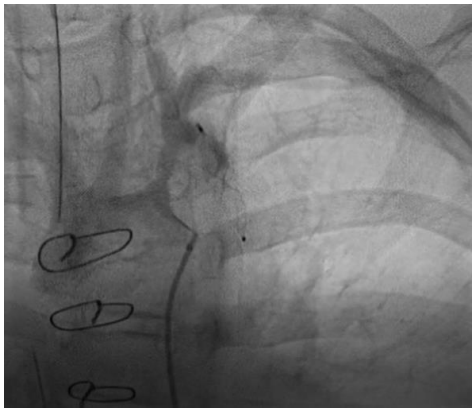


Figure 6

4 F Amplatzer® delivery system was advanced over the guidewire and positioned in left BT shunt (Figure 5). 8/13.5 mm vascular plug was delivered and BT shunt was occluded. Post procedure angiogram revealed unobstructed left subclavian artery and good device configuration with occluded BT shunt (Figure 6).

Discussion

Dissection of functioning BT shunt during the corrective surgery of complex cardiac lesion is challenging due to associated complications. Documented surgical complications are injury to local structures (phrenic nerve, recurrent laryngeal nerve and thorasic duct) and primary haemorrhage. Previous seroma and infection causing adhesions leads to long dissection time, further complicating the procedure[1]. Therefore, transcatheter approach to occlude BT shunt will minimise mentioned surgical complications and reduce the surgical duration.

Diaphragmatic palsy following BT shunt takedown is an important complication[2], mainly due to dissection and electrocautery around the shunt[3] leading to prolong mechanical ventilation. Predominantly young infants with weak intercostal muscles, paradoxical diaphragmatic motions, compliant chest wall and horizontally oriented rib cage are affected by the mentioned complication[4]. Since the patient described is a teenager, effect of phrenic nerve damage was not a major concern. Another important complication of BT shunt ligation is chylothorax leading to prolonged hospital stay[5]. Recurrent laryngeal nerve injury leading to ineffective cough and aspiration was documented specially in young children after the surgical ligation of BT shunt[6].

Therefore, it is quite evident that surgical ligation of BT shunt is not without complications. But in the described teenager the major complication anticipated was primary haemorrhage.

BT shunt closure after the corrective surgery is mainly indicated to prevent pulmonary flooding. In our patient we decided to proceed with the transcatheter closure to prevent mentioned complications and did it in hybrid fashion to minimise the complications of pulmonary overflow.

The technique of transcatheter closure of BT shunt developed gradually, initially limited to the occlusion of residual shunts after the surgery[7]. Different techniques and devices were used during the transcatheter closure with variable results.

Initial attempted closure with coils led to high 21- 29% embolization rates[8]. Subsequent introduction of snare techniques, detachable balloons and devices improved the outcome of transcatheter closure and reproducibility[9]. Major challenges in transcatheter occlusion of a BT shunt are due to its length, relative rigidity and lack of constricture of BT shunt leading to high rates of coil/device migration[9].

Although there is a significant risk of embolization, coils are still preferred as they are more economical. However newer generation of vascular plugs are flexible and easily deployed through small catheters. We witnessed the advantages of mentioned features during our procedure.

Amplatzer® duct occluder commonly available in our catheter laboratory was not selected for the procedure as it is mainly designed and configured for the closure of type A ductus arteriosus[10]. Considering the morphology of the BT shunt, Amplatzer® vascular plug (AVP) permitted a greater and homogenous support surface within the shunt. We used an AVP of 50-75% greater diameter than the BT shunt diameter (8mm device in 5mm shunt) according to the manufacture guidelines[9].

Important disadvantage of transcatheter closure of BT shunts is leaving behind an undivided shunt, which leads to tenting of pulmonary artery with the growth of the child[11]. But in view of our scenario we hope that the particular complication will not be seen as the child was 14 years during the procedure.

Therefore, we consider the transcatheter closure of BT shunt in hybrid fashion in cardiac surgeries using AVP is a safe, reproducible and effective procedure, which reduces the surgical morbidity and mortality. However long-term follow-up and further randomised studies are indicated to consolidate the procedure as a routine practice.

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