

Endovascular stent implantation as a primary method of treatment for blocked modified Blalock–Taussig shunt

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ABSTRACT

Modified Blalock–Taussig shunt is a commonly performed palliative cardiac surgery. Complications like early or late occlusion have been reported in approximately 10% of patients. Thrombosis, stenosis, or kinking are possible mechanisms that lead to shunt obstruction which may be life-threatening and need urgent intervention in form of medical, surgical, or interventional catheterization. Traditionally, these patients are managed in the operating room with shunt revision but with advancing techniques, percutaneous interventions are being increasingly deployed to salvage these patients effectively. We describe our experience of two cases of blocked modified Blalock–Taussig shunt, which was successfully managed by stenting the shunt.

Keywords: Blocked Blalock–Taussig shunt, percutaneous intervention, stenting

INTRODUCTION

Modified Blalock–Taussig (BT) shunt is a commonly performed palliative cardiac surgery. Early or late occlusion has been reported in approximately 10% of BT shunts.^[1] Various causes like thrombosis, stenosis, or kinking may lead to acute or chronic shunt obstruction which may be life-threatening due to associated hypoxia and need urgent intervention in form of medical, surgical, or interventional catheterization. We describe our experience of two cases of blocked BT shunt, which were successfully managed by stenting the shunt.

CASE REPORTS

Case 1

This is a 12-week-old male infant diagnosed with pulmonary atresia with ventricular septal defect. He underwent right modified BT shunt (3 mm) on day 3 of life. The child was discharged in stable condition on

aspirin prophylaxis on day 11 of life with saturation of 80%. After 4 weeks of discharge, the child developed gastroenteritis with severe dehydration. After initial stabilization, he was referred to pediatric cardiac unit for further management. On admission, he was in respiratory distress with saturation of 45% and had features of septic shock with thrombocytopenia. Echo showed blocked shunt and the patient was taken to catheterization laboratory after fluid resuscitation. In the catheterization laboratory, the patient underwent balloon dilatation followed by stent placement (cobalt-chromium, everolimus-eluting 3.5 mm × 38 mm stent).

Case 2

This is an 8-week-old male infant, who was operated at 2 days of life for tracheoesophageal fistula and right modified BT shunt (3.5 mm) was done on day 3 of life for Tetralogy of Fallot. The child was discharged in stable

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condition on aspirin prophylaxis on day 9 of life with saturation of 85%. He was asymptomatic till 8 weeks age when he was brought to the emergency with respiratory distress with saturation was 55%, echo revealed blocked shunt. The patient was given heparin bolus followed by infusion. As there was no response to medical management, the patient was planned for catheter intervention. In the catheter laboratory, the patient underwent balloon dilatation followed by stent placement (cobalt-chromium, everolimus-eluting 4 mm × 38 mm stent).

Catheter procedure details

Both these patients were taken for catheter laboratory intervention because of failure of medical management. Indication of intervention was severe hypoxemia with oxygen saturation <60%, severe acidosis, hypotension, shock, and resistance to medical management. In the catheter laboratory, subclavian artery angiogram and selective shunt angiogram were performed to profile the shunt [Figure 1]. Shunt was crossed with coronary 0.014" guide wire and exchanged with right Judkin's catheter. Mechanical suction was performed followed by balloon dilatation of shunt using high-pressure coronary balloon catheters. This was followed by repeat subclavian injection after 5 min to see the response of balloon dilatation [Figure 2a]. As in both cases, we had partial response in contrast flow through BT shunt, premounted stent was implanted across the shunt [Figure 2b]. Poststenting, oxygen saturation, arterial blood gas and angiogram were recorded. Successful result was achieved in both cases (improvement in saturation immediately following procedure >75%, and improvement in acidosis along with hemodynamics).

DISCUSSION

Complete acute shunt occlusion is a life-threatening emergency and may lead to death if not relieved

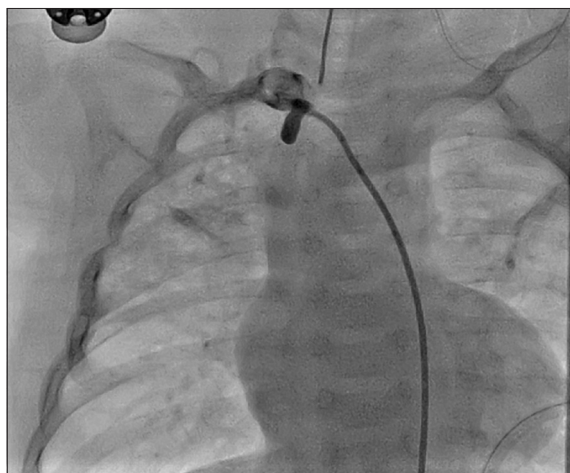


Figure 1: Proximal occlusion of right modified Blalock-Taussig shunt

urgently. Gradual occlusion of shunt is also a possibility in which patients have increased hypoxia, cyanosis, and exercise intolerance. There are multiple causes which can lead to shunt occlusions such as thrombosis, shunt kinking, and stenosis. In India, severe dehydration due to acute gastroenteritis remains an important cause for shunt occlusion. Patients admitted to intensive care unit for other medical conditions with frequent episodes of hypotension are also prone to shunt occlusion. Stricture at the surgical suture site, neointimal proliferation are other contributing factors. Previous studies have reported that smaller shunt size is a principal cause for shunt occlusion.^[2] Younger age with low weight has a significant association with shunt narrowing.^[3] Bacterial infections and prothrombotic phenomena are well-established fact for shunt occlusion. Interstage mortality (10%–15%) before the next surgical intervention because of shunt occlusion remains the important cause of concern.

Patients with acute shunt occlusion become tachypneic with acidotic breathing, hypoxemic with saturation levels falling to even <50%. Clinically, the disappearance of previously documented shunt murmur may be the early sign of shunt blockage. Echo Doppler with pulse and continuous wave Doppler will pick up shunt blockage and either computed tomography angiogram, conventional innominate, or subclavian angiography will be confirmatory. In the past, surgical shunt revision was the only option for blocked BT shunt. Currently, various therapeutic modalities for blocked BT shunt are being tried like pharmacological thrombolysis, mechanical thrombolysis, balloon dilatation, stent placement, etc.

Usually, in immediate postoperative period, shunt is blocked by acute thrombosis completely obliterating the shunt lumen. Sometimes, it is associated with distal obstruction at the junction of shunt and branch pulmonary arteries. In such cases, early recanalization is possible by systemic or local fibrinolytic^[4] accompanied by balloon dilatation.^[5] Thrombolytic therapy carries a significant risk of bleeding which prohibits its use by many centers. However, in patients of gradual

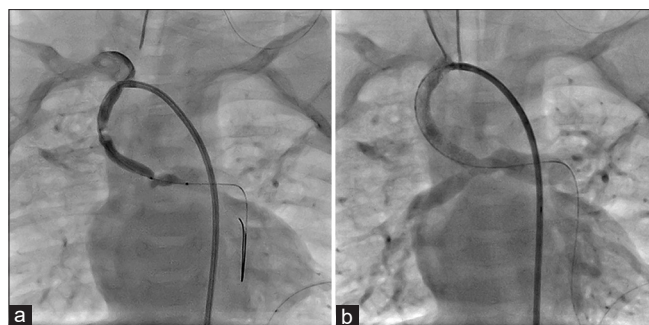


Figure 2: (a) Angiographic view showing partially opened right modified Blalock-Taussig shunt after balloon dilatation. (b) Angiographic view of contrast flow after successful stent implantation

occlusion, the mechanism of obstruction is quite different like neointimal hypertrophy, calcification, kinking, etc., Such cases generally will not benefit much from thrombolytic therapy with balloon dilatation alone. Successful recanalization in such patients can be achieved by stenting the shunt.^[6] Both of our patients were critically sick, saturation was <60% and they were severely acidotic. Hence, considering the risk of bleeding due to coagulation disturbances, we did not consider thrombolytic therapy. Moreover, if we fail in the catheter laboratory procedure, we can't take the patient for surgery after thrombolysis. In both of our patients, there was no improvement in saturation after balloon dilatation and repeat shunt angiogram revealed narrowing of the shunt lumen again. Hence, shunt was finally planned for stenting.

The first report of successful stent implantation was described by Zahn *et al.*^[7] who implanted stent in an 8-day-old child with hypoplastic left heart syndrome who developed acute shunt occlusion. Moszura *et al.* reviewed their experience with recanalization of shunt blockage in 23 patients. Balloon angioplasty was undertaken in 22 of 23 patients with improvement.^[8] However, three of their patients required stent implantation.

Deployment of stent is a promising option for patients who develop shunt occlusion either in immediate postoperative period or in follow-up. Shunt revision in these patients carries surgical risk and added risk of infection. Stent implantation is a comparatively less invasive procedure in these patients with successful results.

CONCLUSION

Percutaneous intervention of blocked BT shunt is a safe and effective method of recanalization as an alternative to surgical revision of shunt. Endovascular stent implantation should be considered in patients who do not improve after balloon dilatation.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for

his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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