Cardiol Young 2002; 12: 496–498

ISSN 1047-9511

Brief Report

"Bail-out" stenting for acute obstruction of a modified Blalock-Taussig shunt following selective angiography

Hideshi Tomita, George Hayashi, Shigeyuki Echigo

Department of Pediatrics, National Cardiovascular Center, Osaka, Japan

Abstract A 3-year-old boy developed acute obstruction of a left modified Blalock-Taussig shunt following selective power injection of contrast in the shunt. Balloon dilation was ineffective due to rapid recoil of the narrowed segment, but implantation of a stent effectively abolished the obstruction. The obstruction itself may have been produced by an intimal flap caused by the power injection.

Keywords: Bail-out stenting; Blalock-Taussig shunt; obstruction

There are several reports of restoration of Blalock-Taussig shunts using stents after partial or complete occlusion due to intraluminal thrombosis, intimal hyperplasia, or fibrosis at the site of suture lines.[1–5] We here report recanalisation using a stent of acute obstruction in a modified Blalock-Taussig shunt with extremely unusual pathogenesis.

Case report

We implanted a stent to relieve stenosis of the left lower pulmonary vein in a 3-year-old boy weighing 9.6 kg. He had presented with pulmonary atresia, intact ventricular septum, and an unguarded tricuspid valvar orifice. Previously, at the age of 1 month, a right modified Blalock-Taussig shunt had been constructed using a 4 mm polytetrafluoroethylene graft. Because of excessive flow of blood to the right lung associated with complete occlusion of the left upper pulmonary vein, and stenosis of the left lower pulmonary vein, both first documented at the age of 13 months, we subsequently reconstructed surgically the left lower pulmonary vein at the age of 15 months. The right modified Blalock-Taussig shunt was ligated, and a left-sided modified Blalock-Taussig shunt was constructed using a 5 mm polyfluoroethylene graft to promote growth of the hypoplastic left pulmonary artery. Despite these efforts, there was residual stenosis of the right pulmonary artery, and the left lower pulmonary vein, with persisting hypoxia, the saturation of oxygen measured percutaneously being between 70 and 80%. At this point, attempts to construct a Glenn shunt, combined with surgical reconstruction of the right pulmonary artery, were abandoned because of pulmonary hypertension, measured at 34 mm of mercury systolic pressure, and 25 mm diastolic pressure, with a mean of 30 mm. The left pulmonary vein remained obstructed. An additional systemic-pulmonary shunt was precluded because of volume overload on the left ventricle, the end-diastolic volume exceeding 200% of the normal predicted value. Instead, we performed balloon angioplasty of the stenosed right pulmonary artery and left lower pulmonary vein at the age of 21 months. This produced a transient increase of the saturation of oxygen, measured percutaneously, from 70 to 80% to about 85%. The level of pulmonary hypertension remained unchanged. Because the obstructed left pulmonary vein was regarded as the main cause of pulmonary hypertension and hypoxia, saturations of oxygen remaining between 60 and 80%, despite continuous treatment with oxygen delivered at home, we implanted a stent as a palliative procedure. The left modified Blalock-Taussig shunt had been shown to be fully patent at cardiac catheterization carried out 3 months before the implantation of the stent (Fig. 1). Written informed consent for implantation of the

Correspondence to: Hideshi Tomita, MD, Department of Pediatrics, Sapporo Medical University of School of Medicine, South-1 West-16, Chuo-ku, Sapporo, 060-8543, Japan. Tel: +81 11 6111 2111; Fax: +81 11 611 0352; E-mail: tomitah@sapmed.ac.jp

Accepted for publication 24 June 2002

https://doi.org/10.1017/S1047951102000884 Published online by Cambridge University Press

stent was obtained from his parent. The pulmonary venogram, performed prior to implantation of the stent (Fig. 2, left) showed the narrowest portion, with a diameter of 1.3 mm, at the junction of the left lower pulmonary vein and the left atrium. The diameter of the proximal portion was measured at 3.3 mm. Although two side branches were shown very close to stenosis, we considered it better to dilate the main branch than to leave all branches stenotic. Because of the enlarged atrium, and acute angle at the venoatrial junction, approach to this lesion had been exceedingly difficult at every catheterization. Consequently, we decided to implant a flexible Palmaz Corinthian stent (PQ 185 BLS) with a diameter of 5 mm and a length of 18 mm, rather than using a stiff original Palmaz stent that would have needed a long sheath to implant. After successful implantation of the stent (Fig. 2, middle), we planned a pulmonary angiogram from the shunt to confirm the return of blood from the left pulmonary artery. We placed a 4 French pigtail catheter at the orifice of the shunt over a 0.035 inch angled Radifocus guide wire. Prior to placement, we cut the tip of the catheter to make the loop smaller. A power injection of contrast (Iopamiron 360, Schering Japan Co.) through this catheter, to a total of 10 ml given at 7 ml/s, revealed no stasis of contrast at the left lower pulmonary vein. Severe hypoxia, with saturation of oxygen from 10 to 30%, developed immediately after the injection. An aortogram through a 4 French pigtail catheter, inserted in the contralateral groin, showed critical stenosis at the orifice of the left subclavian artery (Fig. 2, right, arrow). As the saturation of oxygen increased when the catheter was pushed forwards into the left subclavian artery, and fell when it was pulled back, we deduced that an intimal flap had been raised at the orifice of the left subclavian artery, causing the stenosis. As dilation using an Opta LP balloon, with a diameter of 5 mm, did not improve the situation, we decided to stent the stenosis. A Palmaz Corinthian

Figure 1.
An aortogram 3 months taken before implantation of a stent. Note that the left modified Blalock-Taussig shunt was fully patent.

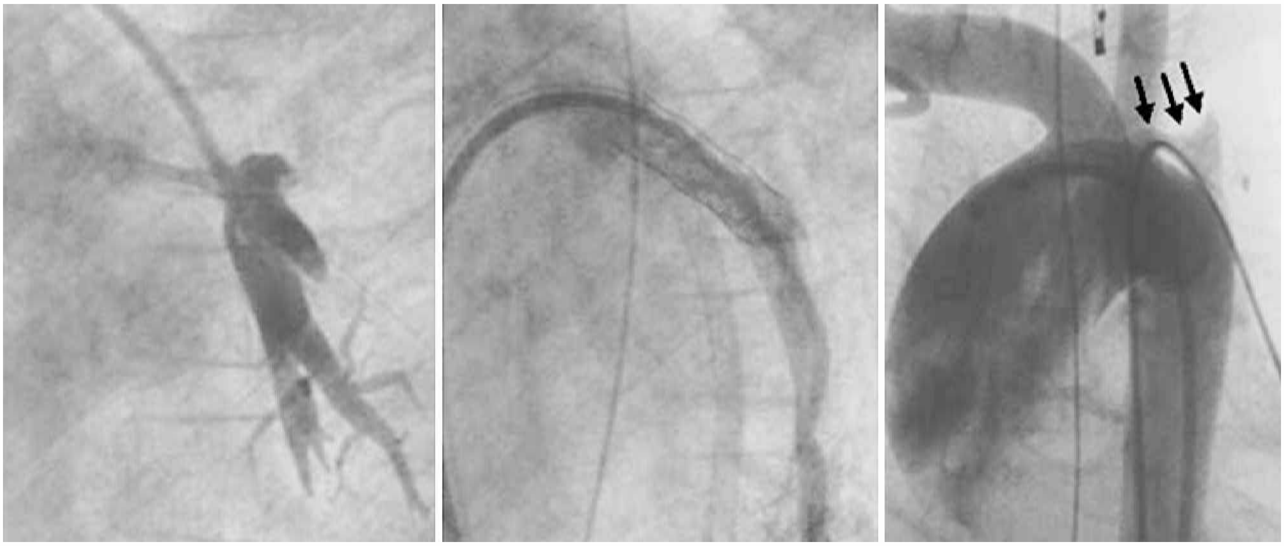

Figure 2.
The left panel shows a venogram in the left lower pulmonary vein prior to implantation of the stent. Note the tight stenosis at the venoatrial junction. The middle panel shows the situation after implantation, with successful relief of the stenosis. The right panel shows the aortogram taken subsequent to the abrupt fall in saturations of oxygen. Note the critical stenosis at the orifice of the shunt (arrow).

https://doi.org/10.1017/S1047951102000884 Published online by Cambridge University Press

stent (PQ155 BLS) was delivered over a 0.035 inch Radifocus angled guide wire placed in the peripheral left lower pulmonary artery without using a long sheath. Several test injections to confirm the position of the stent were done through the pigtail catheter. Because saturations of oxygen remained between 50 and 60% after placing the first stent, a second similar stent was implanted distally to the first, with the stents half overlapping each other. After implantation of the second stent, flow of blood through the shunt was adequately restored, and the saturation of oxygen recovered to between 80 and 85%. Although flow of blood to the left subclavian artery was blocked even after implantation of the stent, retrograde flow through the left vertebral artery was confirmed. Systemic anticoagulation was used throughout the procedure, and an infusion of heparin was maintained for 48 h, keeping the activated clotting time at 150–200 s. Warfarin and dipyridamole were given from the day after the implantation. No neurological sequel was detected after recovery from anesthesia. Although follow-up angiography 3 months later revealed some narrowing of the stent in the left lower pulmonary vein, there was no restenosis of the stent in the shunt.

Discussion

Acute obstruction of the orifice of a shunt, as occurred in our case, is extremely uncommon. Manipulation of catheters, including pressure studies, angiography, and balloon dilation, through such shunts is a well-established procedure in patients where the approach route to the pulmonary arteries is exclusively via the shunt. In our patient, we had to introduce a catheter several times through the shunt to measure pulmonary pressure and to perform a pulmonary angiogram. Formation of intimal flaps develops occasionally due to manipulation of catheters or guide wires, or during balloon angioplasty. Cutting the tip of the pigtail catheter may have added some risk. We felt no resistance to passage of the guide wire or catheter, however, and saturations of oxygen remained stable during these procedures. Furthermore, saturations of oxygen dropped abruptly after the power injection. As the intimal flap developed in the left subclavian artery, at the site of the tip of the pigtail catheter, we speculate that a small intimal injury caused by the guide wire or manipulation of the catheter was extended by the power injection. Although cutting a diagnostic catheter has been a common procedure in over 800 catheterizations per year in children at our center, we should strictly restrict such a modification. Emergency placement of a stent for acute obstruction of a Blalock-Tasussig shunt has recently been reported, most commonly because of intraluminal formation of thrombus.[1,2,4,5] We chose to use a Palmaz Corinthian stent, considering it would be easier to navigate this stent around the acute angle at the takeoff of the shunt than would an original Palmaz stent. As the shunt was initially 5 mm in diameter, we did not use a coronary stent. The stents of this kind at our disposal had a limited maximal dilatable diameter of around 4.5 mm. An Easy Wallstent of shorter length might be better for such an acute angled lesion,[3] but that pattern was also unavailable in our center. One concern about implanting a stent in such a situation was potential obstruction of the left subclavian artery, and subsequently the vertebral arteries. Prograde flow to these arteries, however, was already blocked in our patient, though we confirmed retrograde flow. Consequently, there was no neurological complication. We believe, therefore, that implantation of stents can be an effective life-saving procedure in such a critical situation.

References

1. Zahn EM, Chang AC, Aldousany A, Burke RP. Emergent stent placement for acute Blalock-Taussig shunt obstruction after stage 1 Norwood surgery. Cathet Cardiovasc Diagn 1997; 42: 191–194.
2. Peuster M, Fink C, Bertram, Paul T, Hausdorf G. Transcatheter recanalization and subsequent stent implantation for the treatment of early postoperative thrombosis of modified Blalock-Taussig shunts in two children. Cathet Cardiovasc Diagn 1998; 45: 405–408.
3. Bader R, Somerville J, Redington A. Use of self expanding stents in stenotic aortopulmonary shunts in adult with complex heart disease. Heart 1999; 82: 27–29.
4. El-said HG, Clapp S, Fagan TE, Conwell J, Nihill MR. Stenting of stenosed aortopulmonary collaterals and shunts for palliation of pulmonary atresia/ventricular septal defect. Cathet Cardiovasc Intervent 2000; 49: 430–436.
5. Lee KJ, Humpl T, Hashmi A, Nykanen DG, Williams WG, Benson LN. Restoration of aortopulmonary shunt patency. Am J Cardiol 2001; 88: 325–328.