Balloon angioplasty for supravalvular aortic stenosis as an early complication following arterial switch operation

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ABSTRACT

Supravalvular aortic stenosis as an early complication of transposition of the great artery repair is rare with few cases reported. Furthermore, transcatheter intervention is uncommon as surgical re-intervention has been traditionally done. We describe two cases of supravalvular aortic stenosis at the anastomotic site as an early complication of the arterial switch operation. Both patients underwent balloon angioplasty of the supravalvular aorta with improvement in postangioplasty gradients and angiographic appearance. Both patients at short-term follow-up had persistent improved gradient without need for further intervention.

Keywords: Angioplasty, arterial switch operation, supravalvular aortic stenosis

INTRODUCTION

The arterial switch operation (ASO) has become the preferred surgical therapy for transposition of the great arteries (TGAs) since its first successful application in 1975.[1] This operation entails major reconstruction of both great arteries including the transfer of the coronary arteries and anterior translocation of the pulmonary artery, known as the Lecompte maneuver. Pulmonary artery stenosis is a well-known complication after the Lecompte maneuver. However, supravalvular aortic stenosis (SVAS) after ASO is uncommon.[2,3] We describe two cases of supravalvular aortic stenosis after ASO, who underwent balloon angioplasty with good short-term result.

CASE REPORTS

Case 1

Our first patient was a male and diagnosed with dextro-TGA (D-TGA) prenatally. He underwent a balloon atrial septostomy on the day of life (DOL) 1 and an ASO at 3 days old. His postoperative course was uneventful and he was discharged on postoperative day 13. He was followed routinely in clinic, and at his 3-month follow-up, he remained asymptomatic. However, his echocardiogram revealed stenosis at the aortic anastomotic site with a peak gradient of 90 mmHg and a mean of 48 mmHg with preserved ventricular function. He underwent cardiac catheterization at 4 months old, and hemodynamics revealed an elevated left ventricular end-diastolic pressure of 18 mmHg and a 90 mmHg peak-to-peak gradient across the supravalvular aortic anastomotic site. Left ventricular angiography showed a dilated aortic root and SVAS with the narrowest portion measuring 4 mm [Figure 1]. Supravalvular balloon angioplasty was initially performed with a 5 mm × 2 cm Armada balloon with no waist noted. Multiple balloon sizes were used with a final 9 mm × 2 cm Sterling balloon inflated to 10 atm with elimination of the waist noted. Repeat angiography revealed no vascular injury and the supravalvular aortic measurement increased to 7 mm [Figure 2]. The peak-to-peak gradient improved to 25 mmHg. Due to the 9 mm balloon size being two times the initial measurement of 4 mm, the decision was made to not dilate further. He is currently 14 months

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old and his most recent echocardiogram, 8-month status post balloon angioplasty, revealed no evidence of SVAS with a peak gradient of 15 mmHg. He has undergone no further interventions at this time.

Case 2

Our second patient was also male and was diagnosed with D-TGA prenatally. He subsequently underwent a balloon atrial septostomy on DOL 0 and an ASO at 8 days old. His postoperative course was uneventful and he was discharged on postoperative day 13. He was followed routinely in clinic, and there was initial concern for SVAS at his 3-month-old appointment with an echo revealing SVAS with a peak gradient of 66 mmHg. He subsequently underwent cardiac catheterization at 6 months old, and hemodynamics revealed a 40 mmHg peak-to-peak gradient across the supravalvular aortic anastomotic site. Left ventricular angiography showed a dilated aortic root and SVAS with the narrowest portion measuring 5 mm [Figure 2]. Supravalvular balloon angioplasty was initially performed with a 6 mm × 2 cm Tyshak II balloon to 4 atm with elimination of waist noted during inflation. There was however no angiographic improvement noted and no vascular injury. Multiple balloon were serially used with a final 10 mm × 2 cm Sterling balloon inflated to 10 atm with elimination of the waist noted. Repeat angiography revealed no vascular injury and the supravalvular aortic measurement increased to 7 mm [Figure 2]. The peak-to-peak gradient improved to 16 mmHg. The patient also underwent balloon angioplasty of a hypoplastic right pulmonary artery at the same time. At last follow-up, he was 7 months old and remained asymptomatic. His echocardiogram showed no significant gradient across the ascending aorta.

DISCUSSION

SVAS as an early complication of ASO is rare. Review of the literature revealed a reported incidence ranging from 3% to 4%[4,5] which is comparable to the incidence at our institution of 3% ($n = 2$) of all ASO performed since 2000. The mechanism of stenosis is unclear. Various correlations have been made between the use of nonabsorbable sutures during ASO, sutures placed too tightly causing scar tissue formation, a discrepancy in pulmonary-to-aortic annular size, and a pulmonary-to-aortic ratio of >1.5:1 with an increased risk of supravalvular aortic stenosis.[5,6] Presurgical echocardiogram for both of our patients revealed no discrepancy in pulmonary and aortic valve annulus size (1.1 and 1.2 cm; 1.1 and 1.1 cm, respectively) and pulmonary-to-aortic ratios of 0.9:1 and 1:1. It is plausible that the aortic sinotubular anastomoses were created with tension on the anastomotic site with nonabsorbable sutures which resulted in formation of fibrous tissue and stenosis.

Surgical correction has been the standard with the reoperation rate for SVAS after ASO reported between 0.7% and 1.3%.[2,7] We demonstrated that transcatheter balloon angioplasty is a reasonable alternative and avoids the inherent risks of reoperation including repeat sternotomy and cardiac bypass. We were able to demonstrate significant improvement in vessel diameter without need for short-term re-intervention in both cases. Of note, balloon angioplasty revealed compliant lesions and was ultimately performed with a balloon size two times the initial diameter of the anastomotic site. This resulted in effective elimination of the waist without significant vessel recoil. We would recommend progressive balloon angioplasty up to two times the vessel diameter with consideration of distal aortic measurements as a reference for future cases. In both cases, the balloon size used was less than the aortic annulus size.

There are risks associated with aortic angioplasty including rupture and aneurysm formation. We did serial dilation with 1 mm increments in the balloon size. Angiography was repeated after angioplasty to make sure that there was no vessel injury before proceeding to next balloon size. The long-term risk of aneurysm formation should be assessed by a computed tomography scan or magnetic resonance imaging.

CONCLUSION

Supravalvar aortic stenosis is a rare early complication following ASO. This can be treated with balloon

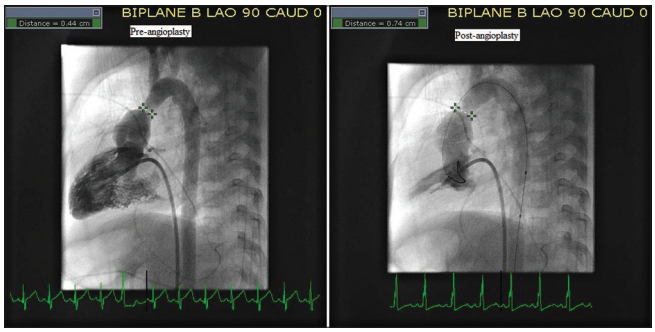

Figure 1: Case 1 – Preangioplasty supravalvular aorta measuring 4.4 mm and postangioplasty measuring 7.4 mm

Figure 2: Case 2 – Preangioplasty supravalvular aorta measuring 5.1 mm and postangioplasty measuring 7.3 mm

angioplasty with balloon size up to 2 times the size of stenosis with good short-term results.

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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