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Brief Report

Coronary arterial compression treated by stenting after replacement of the mitral valve in a child

Mervat A. Assaqqat, Walid Hassan, Ghassan Siblini

Department of Cardiovascular Diseases, King Faisal Specialist Hospital and Research Center, Riyadh, Saudi Arabia

Abstract We describe the clinical history of a nine years old girl with Shone's syndrome. She underwent balloon angioplasty of the aortic coarctation in infancy, and later developed severe sub-aortic stenosis and moderate mitral valvar stenosis. The mitral valve was therefore replaced with a mechanical prosthesis, and the sub-aortic shelf was resected. Immediately after the operation, she developed signs of myocardial ischemia. Coronary angiography showed compression of the middle part of the circumflex artery by the mechanical prosthesis, the obstructed segment being successfully dilated using a coronary arterial stent.

Keywords: Myocardial infarction; mitral valvar prosthesis; mitral valvar disease

Due to the proximity of the circumflex artery to the posterior annulus of the mitral valve, arterial compression is well documented in adults undergoing replacement of the valve with a mechanical prosthesis.[1–6] This can result in irreversible myocardial infarction post operatively, with complete occlusion of the circumflex artery. The problem has been reported mostly in the setting of adults with a right dominant coronary arterial system.[7] To our knowledge, this complication of mitral valvar replacement has not previously been reported in a child with a left dominant coronary arterial system. Options for treatment include transcatheter revascularization with stenting of the obstructed coronary.[8,9] Stenting has been reported to be feasible in children for other causes of coronary arterial obstruction, so this was the option we chose when encountered by compression of the coronary artery in our patient.

Case report

Our patient was a 9-year-old girl who was first seen at 2 months of age with congestive heart failure. Echocardiography showed a variant of Shone's syndrome, consisting of a parachute mitral valve, at that time with no significant stenosis, a mildly stenotic bifoliate aortic valve, with a peak gradient across it of 25 mmHg, and severe aortic coarctation. She was also found to have severe left ventricular hypertrophy with poor left ventricular function.

Because of the impaired left ventricular function, the coarctation was dilated successfully with a balloon, the peak gradient across the aortic arch dropping from 55 to 10 mmHg.

On follow-up, we discovered recoarctation of the aorta along with the appearance of a gradient across the mitral valve. At a second cardiac catheterization, the coarctation was again dilated with a balloon. Haemodynamic assessment at this time showed mild aortic stenosis, but severe mitral stenosis, with pulmonary hypertension and elevated pulmonary vascular resistance, the indexed resistance being 11 Wood units per square meter. The patient was referred for either surgical repair or replacement of the stenotic mitral valve. Intra-operative inspection of the valve revealed a double orifice and a solitary papillary muscle, with redundant leaflets deemed unsuitable for surgical repair. The valve was therefore replaced using a CarboMedics bi-leaflet mechanical prostheses of 16 mm. The patient was adequately anticoagulated using oral warfarin.

Further follow-up at the age of nine years revealed no recoarctation of the aorta, with a moderate peak

Correspondence to: Dr Ghassan Siblini, Pediatric Cardiologist, Pediatric Cardiology Section, Department of Cardiovascular Diseases, MBC 16, King Faisal Specialist Hospital and Research Center, P.O. Box 3354, Riyadh, 11211, Saudi Arabia. Tel: +966 6467272 ext 32065; Fax: +966 1 4427482; E-mail: gsiblini@kfshrc.edu.sa

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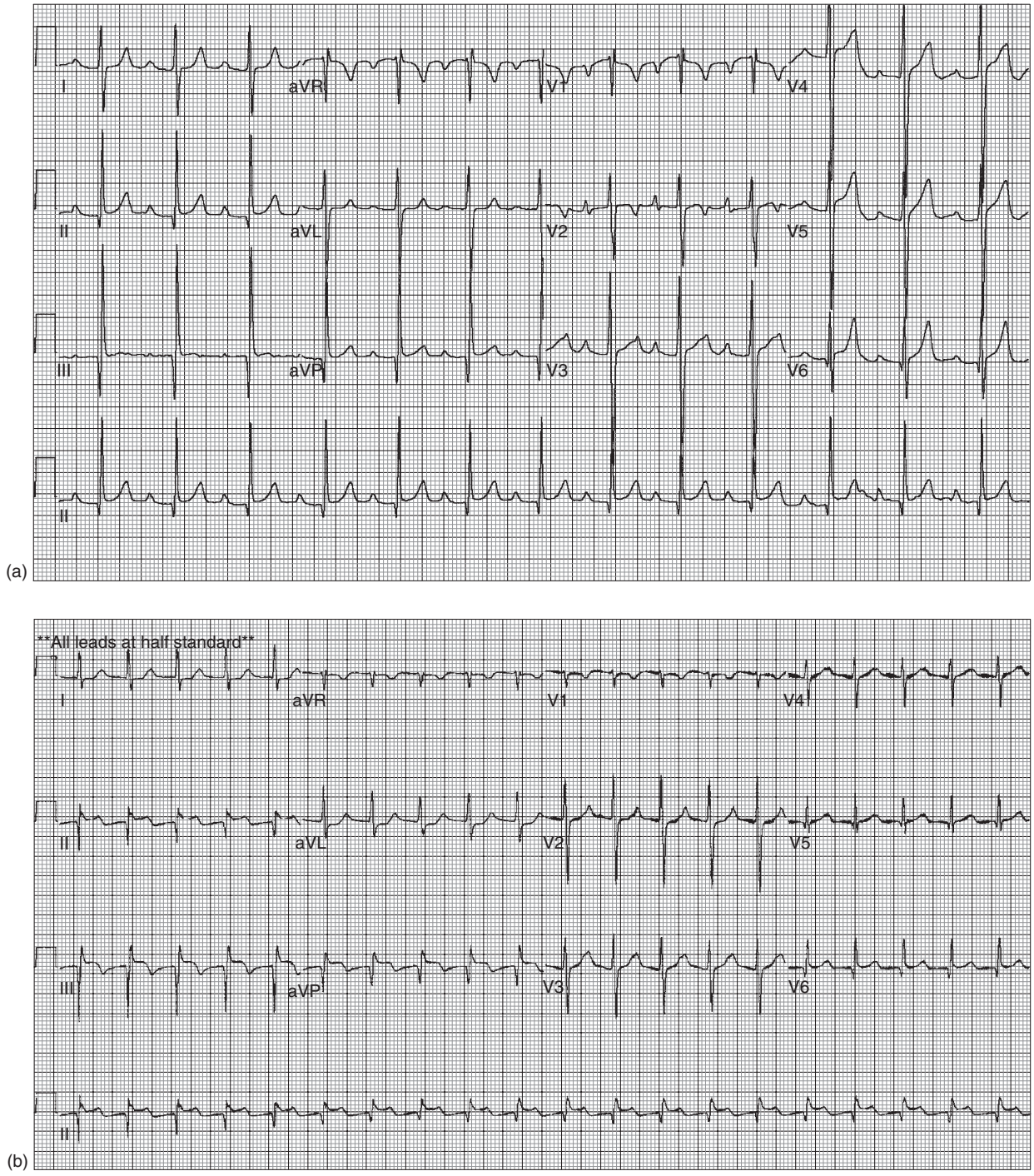

Figure 1.

The pre-operative electrocardiogram (a) showed sinus rhythm, first degree atrioventricular block, and severe left ventricular hypertrophy, with Q waves in the inferior leads. The post-operative electrocardiogram (b) showed elevation of the S-T segments in the inferior leads, lead II, III and AVF, suggestive of ischemia in the area supplied by the left coronary artery. Subsequent to implantation of the stent (c), the electrocardiogram showed normalization of the S-T segment but evidence of inferior infarction.

gradient of 31 mmHg across the valvar prosthesis, and a mean gradient of 11 mmHg. A sub-aortic fibromuscular ridge was now noted, causing moderate sub-aortic obstruction, with a peak gradient of 90 mmHg, and a mean gradient of 46 mmHg, along with mild aortic regurgitation. At that time her electrocardiogram showed sinus rhythm, first degree atrioventricular block, severe left ventricular hypertrophy with Q-waves in the inferior leads. No ischemic changes were seen in the ST segments (Fig. 1a).

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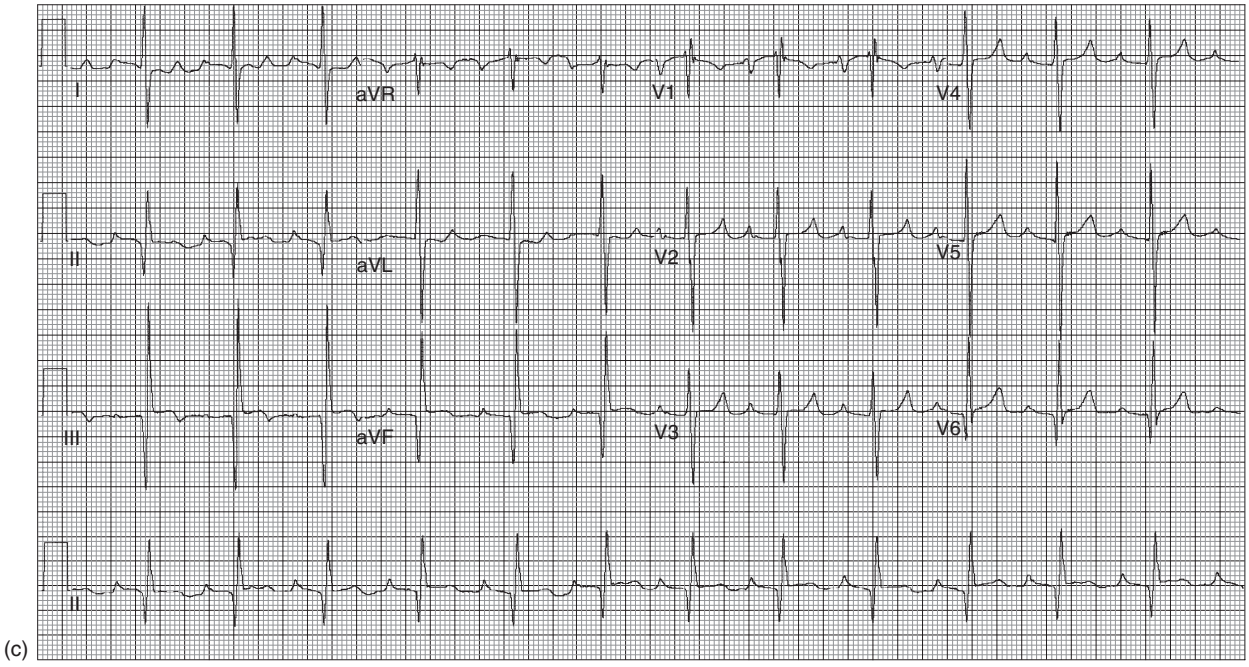

(c)

Figure 1. ***(Continued)***

Table 1. Values of cardiac enzymes before and after implantation of the stent.

Time	Creatine kinase (normal: 24–195 U/L)	MB fraction (normal: up to 4 µg/L)
Pre-intervention		
Immediately post-operatively	411	29
Six hours post-operatively	3366	139
Post-intervention		
Six hours after intervention	906	12
Twenty-four hours after intervention	300	3

The patient underwent re-sternotomy for resection of the subaortic shelf, septal myomectomy, and replacement of the prosthesis using an inverted aortic CarboMedics valve of 23 mm.

Immediately postoperatively, persistent elevation of the ST segments was seen in the inferior leads of her 12 lead electrocardiograms. Cardiac enzymes increased over the next few hours which, along with electrocardiographic changes, were deemed to indicate myocardial ischemia and infarction (Table 1). This was confirmed by the echocardiogram, which showed hypokinesia of the inferior wall and mildly depressed left ventricular systolic function. The patient was therefore taken to the cardiac catheterization laboratory, where coronary angiography was performed. This revealed normal coronary arterial origins, with a left dominant coronary circulation, but with two sites of systolic compression and residual diastolic narrowing of 95% in the middle and distal segments of the circumflex artery, compromising flow to the inferior septum (Fig. 2a).

We decided to implant a stent in the compressed segment of the left circumflex artery. Using a 7-French Left Judkins guiding Catheter, and a 0.014″ ACS-Hi-Torque floppy II Guide Wire with MICROLIDE® Coating, a Cypher™ 2.5 mm by 18 mm Rapamycin coated stent was deployed in the circumflex artery, using one inflation at 12 atmospheres. Angiography taken after deployment revealed a good result, with only mild narrowing, of less than 50%, in the distal segment, and no residual systolic compression (Fig. 2b). The patient was extubated on the following day, with improvement of the changes in the ST segments, and a decrease in the cardiac enzymes (Fig. 1c). The patient is now maintained on full anticoagulation and anti-platelet therapy, as well as beta-blockade. She was discharged home in stable condition on these medications. Repeat of the 12 lead electrocardiogram prior to discharge showed no evidence of new ischemia, although persistent Q-waves in the inferior leads suggested the presence of myocardial infarction.

The patient will now require careful follow-up. As far as we are aware, no data is available in the literature on the long-term effect of drug eluting stents placed in children. We plan to see her within six weeks, using a myocardial viability test to assess indirectly the

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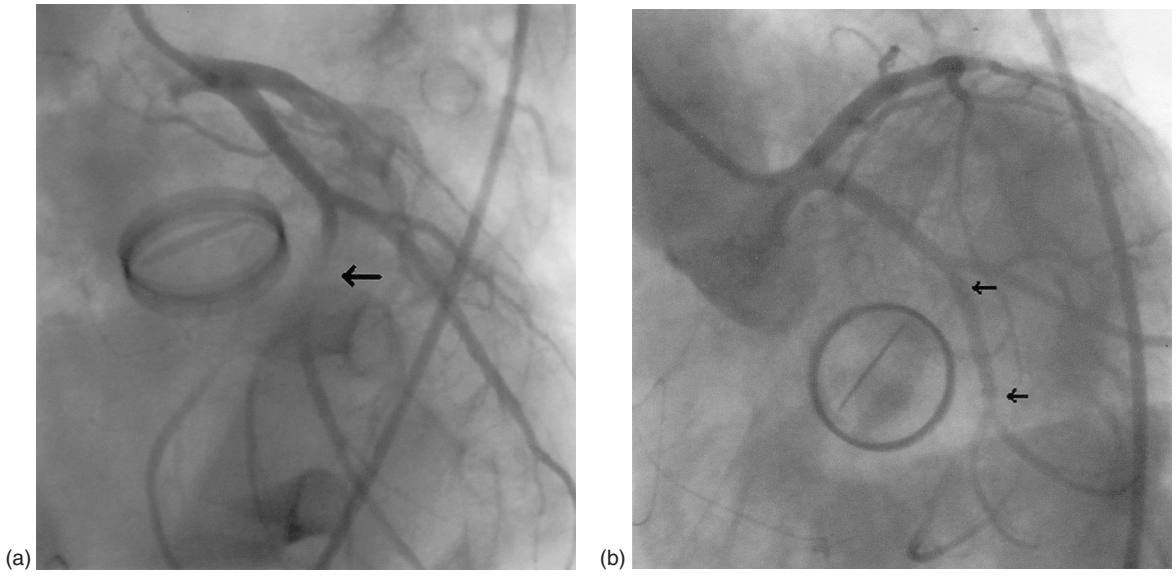

Figure 2.
Left coronary arterial angiography prior to stenting (A) showed compression (arrow) where the circumflex artery was narrowed laterally by the CarboMedics prosthesis. After stenting (B), patency of the circumflex artery was restored (arrows), albeit with residual mild distal stenosis.

re-perfusion to the ischemic inferior septum. Yearly stress test echocardiography, with further myocardial viability perfusion studies will then be needed.

Discussion

Coronary arterial injury is known to occur during operations on the mitral valve due to occlusion of the lumen by the prosthetic ring, or by dissection, laceration, or suture of the artery.[1] Irreversible myocardial infarction is usually the consequence, leaving the patient with decreased myocardial contractility and impaired left ventricular function. Early recognition is crucial to maintain myocardial viability and preserve function. Our experience shows that such compression of the circumflex artery, causing myocardial ischemia, can also occur in children undergoing mechanical replacement of the mitral valve, but the complication can be managed by appropriate insertion of a stent. The prognosis over the long term, however, remains uncertain.

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