Paradoxical Hypertension after Successful Cheatham Platinum Stent Implantation in an Adolescent with Coarctation of the Aorta

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Stent implantation using a Cheatham Platinum (CP) stent for coarctation of the aorta (CoA) is a promising treatment alternative to traditional surgical repair. However, there are no earlier reports in the literature focusing on use of this stent in a Taiwanese patient. Herein we report a 16-year-old boy with CoA presenting with heart murmur and exercise intolerance who underwent successful CP stent placement. However, severe hypertension with arterial blood pressure increasing to 207/104 mmHg occurred four hours after stent implantation. There was no abdominal pain, nausea or vomiting. The patient’s hypertension was controlled by intravenous nitroglycerin infusion, followed by an oral antihypertensive agent for the following 7 days. Experience from this case highlighted the usefulness of CP stent implantation for native CoA, and the importance of early recognition and management of paradoxical hypertension after CoA stenting.

Key Words: Coarctation of the aorta • Hypertension • Postcoarctectomy syndrome

INTRODUCTION

Coarctation of the aorta (CoA) of varying degrees may occur at any point from the transverse arch to the iliac bifurcation, but 98% occur just below the origin of the left subclavian artery at the origin of the ductus arteriosus (juxtaductal coarctation). The anomaly occurs twice as often in males, and is associated with a bicuspid aortic valve in more than 70% of the patients. Most CoA could be diagnosed in infancy and childhood. However, approximately 25% of these cases are initially recognized in patients > 10 years of age.1,2 If the CoA is presented in infancy and early childhood, it is usually surgically repaired.2 For older children and adults with newly diagnosed (native) CoA, nonsurgical management, particularly stent implantation, has evolved as a safe and effective treatment option.3 Herein we present our experience with implanting the Cheatham Platinum (CP) stent to treat native CoA in an adolescent, which is the first reported case of CoA stenting using this newly designed, large-diameter stent in Taiwan. Treatment outcome as well as complications were described in detail.

CASE REPORT

A 16-year-old boy was incidentally found to have a heart murmur before presenting to our clinic. He was generally well until one year ago when he started to experience shortness of breath and chest tightness occasionally, especially after exercise. Upon physical examination, a grade II/VI systolic murmur was noticed at the left midsternal border. Hypertension (144/86 mmHg) was found, with a systolic pressure difference of 45 mmHg between the upper and lower limbs. Pulsation of
bilateral lower limbs decreased significantly. With a preliminary diagnosis of CoA, image studies were arranged. The patient’s chest X-ray showed a normal heart size without notching on the ribs. Echocardiographic imaging confirmed the diagnosis of CoA, with a discrete narrowing at the aortic isthmus and a peak Doppler pressure gradient of 55 mmHg. In addition, bicuspid aortic valve with mild aortic regurgitation was also noted. Cardiac MRI clearly revealed the location and morphology of the stenotic site with the development of prominent collateral arteries (Figure 1).

Under general anesthesia, cardiac catheterization was performed for the purpose of CoA stenting. Descending aortogram showed a discrete stenosis at the aortic isthmus with the narrowest diameter of 5.52 mm. There was a 25 mmHg blood pressure difference between the ascending aorta and the right femoral artery when recorded simultaneously. Considering the diameter and length of the stenotic area, as well as the diameter of the surrounding structures (transverse arch 14.22 mm, and descending aorta 19.68 mm), a 34 mm CP stent (CP8Z34, NuMED, Hopkinton, NY, USA) mounted on a 18 × 40 mm NuMED balloon-in-balloon catheter was implanted through a 12 Fr delivery system (Figure 2). After stent implantation, the pressure gradient between the ascending aorta and right femoral artery decreased to 3 mmHg. The puncture site at the right femoral artery was closed surgically after removing the sheath and achieving protamine reversal.

Four hours after stent implantation, however, the patient developed severe hypertension with arterial blood pressure rising to 207/104 mmHg, which was measured through the arterial line. There was no abdominal pain, anorexia, nausea, vomiting, headache or seizure. Intravenous nitroglycerin infusion was administered immediately, and the systolic blood pressure gradually lowered to 130-140 mmHg. In the subsequent 7 days, we titrated the nitroglycerin dose and shifted to oral an antihypertensive agent, amlodipine. The patient was discharged home 7 days after CoA stenting without the use of any antihypertensive medications. Follow-up echocardiography 3 months after CoA stenting showed a pressure gradient of 15 mmHg across the CoA stenting site. At the 6th month after stent implantation, the patient remained normotensive (right arm pressure: 121 / 67 mmHg), and the difference in blood pressure between the upper and lower limb was minimal.

Figure 1. Severe coarctation of the aorta and prominent left subclavian artery and left intercostal collaterals were demonstrated on cardiac magnetic resonance imaging.

Figure 2. (A) Descending aortogram showed a discrete narrowing at aortic isthmus, just distal to the origin of left subclavian artery. (B) A 3.4 cm chatham platinum stent mounted on an 18 × 40 mm BIB (balloon-in-balloon) catheter was placed. (C) Follow-up descending aortogram showed that the stenosis was significantly relieved by the stent.
DISCUSSION

There are various treatment options for CoA in different age groups. Surgery remains the treatment of choice for those patients still in infancy and early childhood, but there is a trend toward non-surgical approaches (e.g. balloon angioplasty or stent implantation) for older children, adolescents, and adults. Surgical repair with resection of the coarctation site with end-to-end anastomosis was first introduced in 1945. This innovation was followed by modified approaches such as extended end-to-end anastomosis, left subclavian flap aortoplasty repair, and prosthetic patch aortoplasty repair on the basis of the anatomy of the coarctation. In 1982, balloon angioplasty was first used to treat aortic recoarctation. However, high incidence of restenosis and aneurysm formation after balloon angioplasty is the major drawback, especially for native CoA. In the early 1990s, endovascular stent placement was initiated. Compared to balloon angioplasty, the likelihood of encountering aortic wall injury of any type (e.g. aneurysm formation) at follow-up was significantly lower if a stent was used. CP stent was designed to be used in the aorta; it has rounded ends to reduce the risk of aortic wall injury. The safety and efficacy of CP stent for native and recurrent CoA have been reported recently in the Coarctation of the Aorta Stent Trial (COAST). Although stent fracture and reintervention are common, CP stent for CoA has been proven to be a promising treatment option in selected patients.

Our patient developed paradoxical hypertension after stent implantation. He did not have abdominal pain, nausea, vomiting or other presentations suggesting of bowel necrosis. This episode may ultimately prove to be an aborted postcoarctectomy syndrome. Early recognition of pathological hypertension by arterial line tracing and timely administration of intravenous antihypertensive medication may be the key to preventing the onset of this full-blown disease. The pathogenesis of paradoxical hypertension may be induced by sympathetic nervous system activation for the initial phase, followed by renin angiotensin system activation in the second phase. Stretching the aortic wall might cause an increase in arterial pressure and heart rate through a sympatho-sympathetic reflex. Unfortunately, we could not obtain detailed neurohormonal profiles of this patient when he developed pathological hypertension. Paradoxical hypertension may not be a rare complication after CoA stenting. In the COAST study, postprocedural paradoxical hypertension occurred in 7% of the patients. Nonetheless, the incidence of this complication may be much lower in the stent group compared to surgical patients, in which the incidence has been reported to be as high as 75%.

In summary, CP stent implantation is a promising treatment option for native CoA in selected patients. However, postprocedural paradoxical hypertension could occur following successful CoA stenting, so early recognition and effective management are warranted.

REFERENCES