Challenging Pediatric coarctation treated with hybrid approach: Five-years follow-up

Sonia El-Saeidi[1], Hossam Hassanein[1], Ashraf Abdel Raheem[1], Mohamed Maher[1], Ahmed Abdel Fattah[1], and Wael Attia[1]

[1]Cairo University Kasr Alainy Faculty of Medicine

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Abstract

Two patients suffering from recurrent coarctation after native coarctation surgery, were scheduled for cardiac catheterization in a hybrid setting by the age of two & three years. Through right anterior mini-thoracotomy unmounted stents were successfully placed in the coarctant segment. One-year follow-up did not show echocardiographic improvement, yet, they were controlled on medical therapy. Five-years follow-up showed stent breakage in the first case, while the second showed stent stenosis that needed balloon dilatation.

Introduction:

Isolated coarctation of the aorta (CoA) is a common congenital heart disease easily correctable in the neonatal period or in childhood using different surgical approaches (1). Recurrent coarctation (re-CoA) is a common observation following surgical repair (2). The first line in treatment of re-CoA is percutaneous transluminal angioplasty (PTA) (3). Yet, in cases with long narrow segments of re-CoA, PTA is not effective, with a high incidence of restenosis during the first year (3). A more definitive method to relief obstruction is stenting the narrow segment via implantating a stent that is expandable as the body grows (4). Such procedures are not easy to perform in infants and young children whose vessels are small compared to large delivery catheters required for the procedure. Hybrid technique for stent implantation via access through ascending aorta has been introduced to solve such problem (5).

Case 1: Long segment retrocardiac coarctation.

A female patient presented with chest infection by the age of one year. Chest X-ray showed cardiomegaly and echocardiography revealed dilated left ventricle (LV) with marked impairment of LV systolic function.

She was referred to our cardiomyopathy clinic, examination showed non-palpable femoral pulse. Echocardiography confirmed the diagnosis of DCM, but there was no evidence of coarctation, yet, there was small descending aorta at level of diaphragm. Multi-slice CT angiography (MSCT) was done, revealed a tight long segment of coarctation in mid-thoracic aorta [Fig 1]. Surgical correction was done at the age of 15 months [fig 2].

However, she continued to need frequent admissions for heart failure and chest infections. Follow-up MSCT after 2 months from surgery revealed recurrence of short coarctation segment with poor LV systolic function.

By the age of 2 years she was scheduled for cardiac catheterization. The femoral artery was so small to be cannulated by a 4F sheath. So, we approached the left axillary artery. There was long segment of narrowing and ballooning of this segment was performed. Unfortunately, there was no significant improvement in patient's clinical condition, or myocardial contractility.

The hybrid approach:

By the age of 3 years she was rescheduled for cardiac catheterization in a hybrid setting for direct access to aorta, to allow placement of suitable sized stent (that can be dilated later to adult size) through a large sheath.

In cath lab, our surgeon did a right anterior mini-thoracotomy through the 3rd intercostal space [Fig 3], then opened the pericardium exposing ascending aorta. He placed 2 purse-string sutures through which he fixed 9F sheath in ascending aorta. We had chosen genesis Palmaz unmounted stent and mounted it on Opta balloon. We placed the stent in place, the balloon was inflated and carefully withdrawn [Fig 4].

Then the surgeons removed the sheath, tied the purse-string and closed the chest wall. The patient stayed in the ICU for a couple of days and was discharged home on medical treatment.

The patient's contractility did not return to normal; however, she did not need further hospitalizations.

Case 2: William's syndrome with severe aortic coarctation

At the age of 5 months a female patient presented to our clinic with asymptomatic systemic hypertension. Echocardiographic examination revealed LV hypertrophy with short segment CoA distal to the origin of the left subclavian artery. Coarctectomy was done and passed smoothly without complications.

There was re-CoA after coarctectomy. At the age of 9 months, we decided to balloon dilate the re-CoA resulting in reduction of the pressure gradient across descending aorta [Fig 5].

By the age of 2 years, she was rescheduled for cardiac catheterization in a hybrid setting for direct access to the aorta, to allow placement of a suitable sized stent (that can be inflated to adult size) through a large sheath.

Through the same surgical approach as the first case, the surgeon fixed 9F sheath in ascending aorta through which we placed a genesis Palmaz stent [Fig 6]. She stayed for a couple of days in the ICU and was discharged home on medical treatment.

Five-years follow-up of both cases:

The first case had fracture of the stent and we decided not to intervene unless her condition worsens [Fig 7].

The second case showed re-stenosis of the stent, which was ballooned with a larger balloon in the cath Lab [Fig 8].

Discussion:

Currently stent implantation is the standard management in adolescents and adults with CoA. It is not a routinely considered therapeutic strategy for infants and young children, due to technical difficulties and limited potential of growth of the implanted stent (7).

Our cases had re-CoA following surgical repair. Accordingly, the decision to stent this segment seemed to be most appropriate. Previously, using stents for treatment of post-surgical long segment coarctation was extremely difficult, as most cases are small infants with small arterial access not feasible for using large delivery systems to implant appropriate stents that can reach adult size in the future (8). Our concerns were that our patients would soon need another surgery to remove the small stent and do another repair. Surgical re-intervention in such cases may carry the risk of many complications (8), which may be difficult to be tolerated in our myopathic or hypertensive patients.

Recently hybrid stenting of the aortic coarctation is becoming safer due to advances in stent and balloon catheter design even in low birth weight neonates (9). Hybrid procedure allowed us to access the aorta and insert a stent that could reach adult size, needing just balloon dilatations. This would buy the patient few more years, giving the myocardium chance to recover. We have chosen right anterior mini-thoracotomy approach for direct access of ascending aorta. This approach is also used in some centers for managing very

low birth weight infants with coarctation who represent a high surgical risk, using coronary stents (9, 10, 11).

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Fig 1: MSCT showing coarctation in mid-thoracic aorta

Fig 2: The surgical procedure end to end anastomosis with anterior PTFE patch

Fig 3: RT lateral mini-thoracotomy incision

Fig 4: Hybrid procedure in case 1; sheath placed through ascending aorta and stent placement

Fig 5: Balloon dilatation for re-CoA

Fig 6: Hybrid procedure in case 2; sheath placed through ascending aorta and stent placement

Fig 7: Broken stent

Fig 8: Balloon dilatation for stent stenosis.