

Coarctation of aorta intervention: When covered stents should have been first choice?

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ABSTRACT

Coarctation of aorta (CoA) is one of the common congenital heart diseases. The two approaches for intervention in CoA include surgical and transcatheter (TC). Out of the two TC interventions available, stenting has been proved better than balloon angioplasty. We have two types of stents; the conventional ones – balloon expandable and the covered stent grafts. The elective covered stent implantation in all CoA has not offered any advantage. However, there are peculiar situations, apart from acute aortic complications, when they should be considered the first choice. We describe our experience of three cases of coarctation stenting, in which covered stenting should have been the preferred choice. A 32-year-old female with Turner's syndrome and severe CoA developed dissection after balloon angioplasty which was successfully managed with a covered stent. A 27-year-old female with near atresia of aorta was managed with balloon expandable stent which remained underexpanded despite post dilatation. A 17-year-old girl with severe CoA and patent ductus arteriosus (PDA) was managed with balloon angioplasty for the CoA and Amplatzer Duct Occluder I for the PDA. However, she developed re-coarctation in 6 months which was managed with a covered stent. Not all CoA requires the covered stents, but there are certain "high risk" CoA which require covered stent as first choice.

Keywords: Aortic dissection, atresia of aorta, coarctation of aorta, covered stent, Turner's syndrome

INTRODUCTION

Coarctation of aorta (CoA) accounts for 5%–8% of all congenital heart diseases (CHDs)^[1] and is more common in males. Being a relatively common CHD associated with increased mortality and decreased life expectancy, CoA must be intervened. There are broadly two approaches to repair the CoA, surgical correction, and transcatheter (TC) intervention. Due to noninvasive nature and equivalent short- and long-term results, TC approach is preferred in older children and adults.^[2] We here present three cases of severe CoA in young adults, where covered graft stent either bailed us out or could have been preferred option. There has been enough

evidence that stenting is better than balloon angioplasty, but with scarce literature, whether we should use only covered stents upfront in all CoA is unclear.

CASE REPORTS

Case 1

A 32-year-old female with Turner syndrome and uncontrolled hypertension (HTN) on three drugs was evaluated and found to have severe CoA [Figure 1a]. The lesion was dilated with 8 mm × 20 mm followed by 10 mm × 20 mm Tyshak^R balloon (NuMed, USA).

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Postdilatation she developed severe back pain and angiography revealed dissection of aorta [Figure 1b]. A 16 mm × 61 mm Advanta V12 covered stent (Atrium Medical, Netherlands) was deployed and postdilated with 20 mm, followed by 22 mm Maxi LD balloon (Cordis, USA) which resulted in complete sealing of proximal dissection [Figures 1c,1d and supplementary Figure 1].

Case 2

A 27-year-old female with HTN and bad obstetric history was diagnosed with severe CoA on evaluation. Aortogram revealed near atresia of the aorta [Figure 2a]. The lesion was crossed with Asahi Gaia first wire (Asahi Intec, Japan) using radial access and was predilated with 3 mm coronary balloon [Figure 2b and c]. A mounted 18 mm × 45 mm Cheatham platinum (CP) bare stent (NuMed, USA) was deployed and post dilated. Despite using balloon for post dilatation, the stent remained under expanded in the middle with a waist [Figure 2d]. Use of covered graft stent would have allowed us to use post dilatation at higher pressure in view of the backup and thus allowing adequate stent expansion. On follow-up, her HTN is under control on two drugs and she underwent uncomplicated pregnancy with normal child birth. Follow-up computed tomography aortogram showed under expanded coarctation stent. A redo procedure was planned, but the patient preferred to continue on medical management.

Case 3

Balloon angioplasty with 14 mm Tyshak[®] balloon was done for severe CoA in a 17-year-old girl who also had concomitant small patent ductus arteriosus (PDA) [Figure 3a]. PDA was closed with 6 mm × 4 mm Amplatzer Duct Occluder I (ADO I) device (AGA Medical Corporation, USA). Post dilatation, the gradient across CoA was 16 mmHg [Figure 3b].

She was kept under close follow-up and was found to have new onset HTN at 6 months. Evaluation revealed a gradient of 50 mmHg across the CoA segment, for which she was successfully treated with 16 mm × 45 mm covered CP stent [Figures 3c and 3d].

DISCUSSION

CoA is not rare, it decreases the life expectancy and there is increased morbidity even years after the successful repair.^[3,4] Being less invasive nature and with equivalent results to surgery, TC intervention is now the preferred modality of treatment in older children and adults unless there is a complex anatomy or associated cardiac lesions. Stenting compares favorably with surgery in acute reduction of gradients in native as well as recurrent CoA; and in short term and intermediate follow-up. Out of two TC interventions, studies have shown that stenting has more acute reduction in pressure gradients, reduced recoil of vessel, and reduced complication rates as compared to balloon angioplasty.^[5-7]

There are two types of stent available: conventional and covered stents (luminal area covered with polytetrafluoroethylene). Theoretically, the covered stents appear to be superior. They cover the injured endoluminal surface of aorta, thereby reducing the possibility of thrombosis, aneurysms, and due to shear radial strength, the stent infolding, fractures, and restenosis rates may decrease. In younger children, they may be preferred as they can be re-dilated to keep pace with their somatic growth.

Given the presumed advantages of covered stents, it is tempting to jump to conclusion that all CoA should be stented with a covered one, but data are scarce. Sohrabi *et al.*^[8] did a randomized trial in patients with severe CoA and showed that rates of recoarctation and

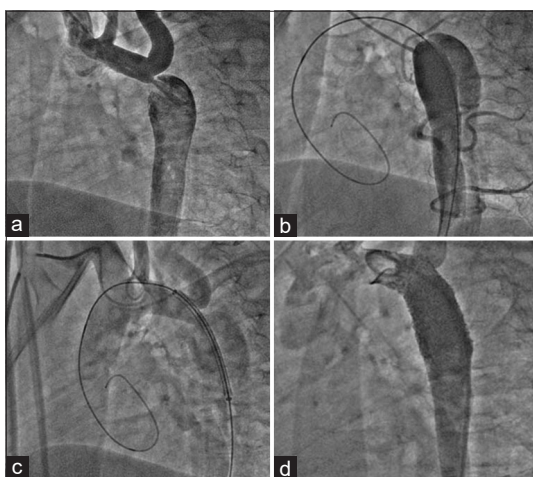


Figure 1: Procedural details of Case 1: (a) Aortogram through right radial route revealing severe coarctation of aorta; (b) dissection of aorta post dilatation; (c) covered stent placement; (d) Final result following postdilatation

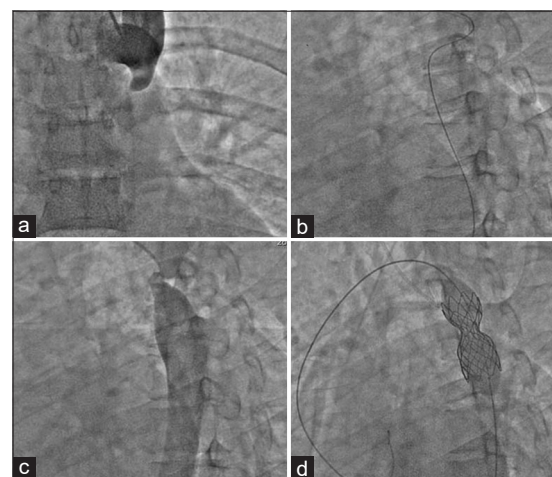


Figure 2: Procedural details of Case 2: (a) aortogram through right radial route revealing near total atresia of aorta; (b) Lesion crossed with Asahi Gaia first coronary wire; (c) Angiography post balloon dilatation; (d) Under expanded bare stent

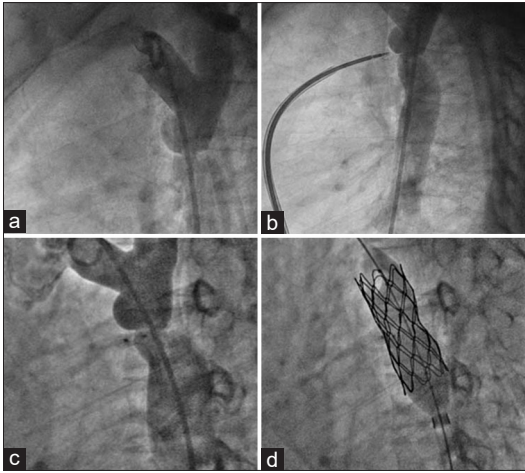


Figure 3: Procedural details of Case 3: (a) Aortogram through right femoral route revealing severe coarctation of aorta with small patent ductus arteriosus; (b) Post 14 mm Tyshak Balloon Dilatation for coarctation of aorta and Amplatzer Duct Occluder I device closure of patent ductus arteriosus; (c) Re-coarctation of aorta at 6 month follow-up; (d) Post-Cheatham Platinum covered stent deployment

pseudoaneurysm formation in two types of stents were not statistically different at 31 months of follow-up. Furthermore, there are few concerns with covered stents: the heavier profile requiring larger sheaths which may cause more access site vascular injury, stent migration compromising a major branch, cost, and availability. Hijazi and Kenny^[9] opined that the covered stents should be reserved for patients with high-risk CoA, with previous aneurysms and for acute complications during procedure such as dissection and perforation. Based on previous data, high risk is defined as CoA in patients >40 years, with Turner syndrome, and those with near atresia of the aorta.^[7,10,11] The adult CoA is at high risk because of chronic nature and more fibrotic disease.

As for our patients were concerned, the patient with Turner's syndrome has been categorized as high risk, so the first choice should have been a covered stent which was used that also rescued the acute complication also, i.e., aortic dissection. Furthermore, direct stenting upfront without preceding balloon angioplasty could have avoided the aortic wall injury, the aortic dissection in this patient. The second patient had near atresia of aorta, where again the covered stent is preferred, as higher pressures are required to dilate the fibrotic segment. However, we used bare stent; hence could not achieve optimal result angiographically though the pressure gradient across the segment was <20 mmHg. In the COAST II trial, which showed covered stent can treat and prevent aortic wall injury during CoA intervention, both near aortic atresia and Turner's syndrome were included in the study.^[12] The third patient also had a very tight CoA and a PDA; we could have used the covered stent in the first go which could have also taken care of PDA without an additional ADO I device. In view of

good-sized aortic isthmus, we tried balloon angioplasty for CoA and device occlusion for PDA as have been described before.^[13] However, we subsequently required a covered stent for re-coarctation at 6 months of follow-up. Hence, we ended up doing two procedures using ADO I device and a covered stent subsequently, which could have been accomplished in a single procedure.

CONCLUSION

Not all CoA requires covered stents but "high-risk CoA" should be offered the same as first choice to achieve optimal results and avoid subsequent re-interventions. The covered stent should be available to deal with acute complications in institute where aortic interventions are done.

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.

REFERENCES

- Hoffman JI, Kaplan S. The incidence of congenital heart disease. *J Am Coll Cardiol* 2002;39:1890-900.
- Salcher M, Naci H, Law TJ, Kuehne T, Schubert S, Kelm M, et al. Balloon dilatation and stenting for aortic coarctation: A systematic review and meta-analysis. *Circ Cardiovasc Interv* 2016;9: e003153.
- Celermajer DS, Greaves K. Survivors of coarctation repair: Fixed but not cured. *Heart* 2002;88:113-4.
- Toro-Salazar OH, Steinberger J, Thomas W, Rocchini AP, Carpenter B, Moller JH. Long-term follow-up of patients after coarctation of the aorta repair. *Am J Cardiol* 2002;89:541-7.
- Hamdan MA, Maheshwari S, Fahey JT, Hellenbrand WE. Endovascular stents for coarctation of the aorta: Initial results and intermediate-term follow-up. *J Am Coll Cardiol* 2001;38:1518-23.
- Chessa M, Carrozza M, Butera G, Piazza L, Negura DG, Bussadori C, et al. Results and mid-long-term follow-up of stent implantation for native and recurrent coarctation of the aorta. *Eur Heart J* 2005;26:2728-32.
- Forbes TJ, Moore P, Pedra CA, Zahn EM, Nykanen D, Amin Z, et al. Intermediate follow-up following

- intravascular stenting for treatment of coarctation of the aorta. *Catheter Cardiovasc Interv* 2007;70:569-77.
8. Sohrabi B, Jamshidi P, Yaghoubi A, Habibzadeh A, Hashemi-Aghdam Y, Moin A, *et al.* Comparison between covered and bare Cheatham-Platinum stents for endovascular treatment of patients with native post-ductal aortic coarctation: Immediate and intermediate-term results. *JACC Cardiovasc Interv* 2014;7:416-23.
 9. Hijazi ZM, Kenny DP. Covered stents for coarctation of the aorta: Treating the interventionalist or the patient? *JACC Cardiovasc Interv* 2014;7:424-5.
 10. Kenny D, Margey R, Turner MS, Tometzki AJ, Walsh KP, Martin RP. Self-expanding and balloon expandable covered stents in the treatment of aortic coarctation with or without aneurysm formation. *Catheter Cardiovasc Interv* 2008;72:65-71.
 11. Forbes TJ, Garekar S, Amin Z, Zahn EM, Nykanen D, Moore P, *et al.* Procedural results and acute complications in stenting native and recurrent coarctation of the aorta in patients over 4 years of age: A multi-institutional study. *Catheter Cardiovasc Interv* 2007;70:276-85.
 12. Taggart NW, Minahan M, Cabalka AK, Cetta F, Usmani K, Ringel RE, *et al.* Immediate outcomes of covered stent placement for treatment or prevention of aortic wall injury associated with coarctation of the aorta (COAST II). *JACC Cardiovasc Interv* 2016;9:484-93.
 13. Singhi AK, Sivakumar K. Different transcatheter strategies for aortic coarctation associated with patent ductus arteriosus. *Indian Heart J* 2012;64:423-6.



Supplementary Figure 1: Postprocedure computed tomography aortogram in Patient 1 showing complete sealing of the dissection by the well-apposed stent