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Case Report

Dual Wire Technique for Aortic Coarctation Stent Placement

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A young adult presented for percutaneous treatment of a narrow aortic coarctation. A very large left subclavian artery originated immediately proximal to the coarctation. In order not to exclude or jail the left subclavian artery with a stent, a double wire technique was used. From a femoral approach, two guide wires were positioned, one in the aortic arch and another in the subclavian artery. A stent crimped over a 16-mm balloon and a 4-Fr catheter was advanced over the two wires within a 14-Fr long introducer sheath. The stent was successfully deployed and molded within the bifurcation by a kissing balloon technique, relieving the obstruction and leaving a guaranteed passage to the subclavian artery. The double wire technique is an elegant way to deliver a stent safely across a narrowing with guaranteed access to important side branches. © 2011 Wiley-Liss, Inc.

Key words: double wire technique; stent; jailing side vessel

INTRODUCTION

Balloon angioplasty and expandable endovascular stents have been used successfully in the treatment of stenotic large vessels in various locations of coarctation [1]. In grown-ups with coarctation, the current treatment of choice is stent delivery to get a safe and a lasting result with minimal gradient [2]. In most centers with a large experience in percutaneous treatment of narrow coarctations, a covered stent (if available) is the technique of choice to avoid an open vessel wall tear, which might result in a fatal bleed.

Stent treatment has however some disadvantages: the need for a bigger sized sheath with potentially more vascular trauma, stent embolization, or covering the orifice of a side vessel, thereby jailing or excluding this vessel from anterograde flow or further interventional approach. When deploying a stent across a narrowing with important side vessels in the vicinity, it may be very difficult to find an ideal compromise between stenting the stenosis and keeping the orifice of the side vessel "open." This case report describes a double wire technique that offers the best possible compromise in a predictable way.

CASE REPORT

A 19-year-old man was admitted for percutaneous stenting of an aortic coarctation. Magnetic resonance imaging had shown a severe coarctation with a minimal diameter of 8 mm and a very large subclavian artery originating immediately proximal of the coarctation.

A covered stent was chosen, as the required dilation of the narrow coarctation to 20 mm could induce a vascular transmural tear. A double wire technique was chosen to guarantee the flow to the left subclavian artery.

Bench testing was performed to determine the best acceptable compromise regarding initial balloon deployment and sheath size:

- The use of two balloons that would open the stent at more than 14 mm at initial deployment would require a large sheath >16 Fr; we therefore chose the combination of a balloon and a simple catheter;

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Conflict of interest: MG is proctor for Numed.

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- The size of the initial balloon had to be sufficient to anchor the stent within the coarctation; we chose a 16-mm Z-Med II balloon (Numed, Hopkinton, NY) as this was the largest stent delivery balloon that fits a 9 Fr sheath;
- The combination of a negative pressurized 16-mm Z-Med II balloon (recommended delivery sheath 9 Fr) with a 4 Fr catheter, both surrounded by a covered 8 Zig Cheatham-Platinum stent (Covered CP stent, NUMED, Hopkinton, NY) does fit in a 14-Fr Mullins delivery sheath (Fig. 1A and B);
- A 0.035″ guide wire was placed in the left subclavian artery;
- A long 14-Fr Mullins sheath was advanced beyond the coarctation;

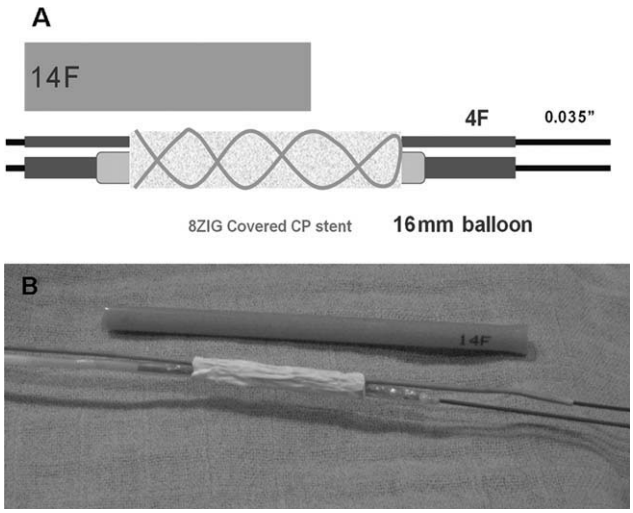

Fig. 1. (A) Schematic drawing of double-wire stent complex (see text) and (B) covered CP stent on 16-mm Z-Med II balloon 9 Fr plus 4 Fr catheter; this complex fits within a 14 Fr sheath.

- Another 0.035″ wire was placed in the ascending aorta, and the 14-F Mullins sheath was advanced as far as possible; contrast hand injection confirmed this position;
- The balloon-4-Fr catheter-CP stent, protected by a short (5 cm) 14 Fr tube, was advanced over the two wires across the valve of the Mullins sheath; the short tube was removed from the valve, and the stent complex was advanced as distal as possible at the bifurcation (Fig. 2A);
- The 14-Fr long sheath was pulled back, thereby uncovering the stent halfway; this allows sequential opening of the stent, which is our routine in single balloon stent opening (Fig. 2B); this maneuver also allows maximal advancement of the stent at the bifurcation; the sheath was then withdrawn until well behind the balloon, allowing to fully expand the stent with the 16-mm balloon;
- The 4 Fr catheter was removed, thereby being able to advance a 10-mm balloon (OptaPro, Cordis, Roden, Netherlands) over the wire through the 14 Fr sheath into the left subclavian artery; the stent was then flared into the isthmus and subclavian artery with a kissing balloon technique: both balloons (the 16 mm and 10 mm) being halfway out of the stent flared nicely the CP stent (Fig. 2C);
- A Tyshak 22-mm balloon (Numed, Hopkinton, NY) was used to nearly fully deploy the stent; a mild narrowing at the coarctation site, which was pressure resistant at four atmospheres was left. The hemodynamic evaluation after the dilatation of the covered stent showed no measurable residual gradient (Fig. 2D).
- The sheath was removed, and bleeding was controlled with prolonged compression after neutralization of heparin.

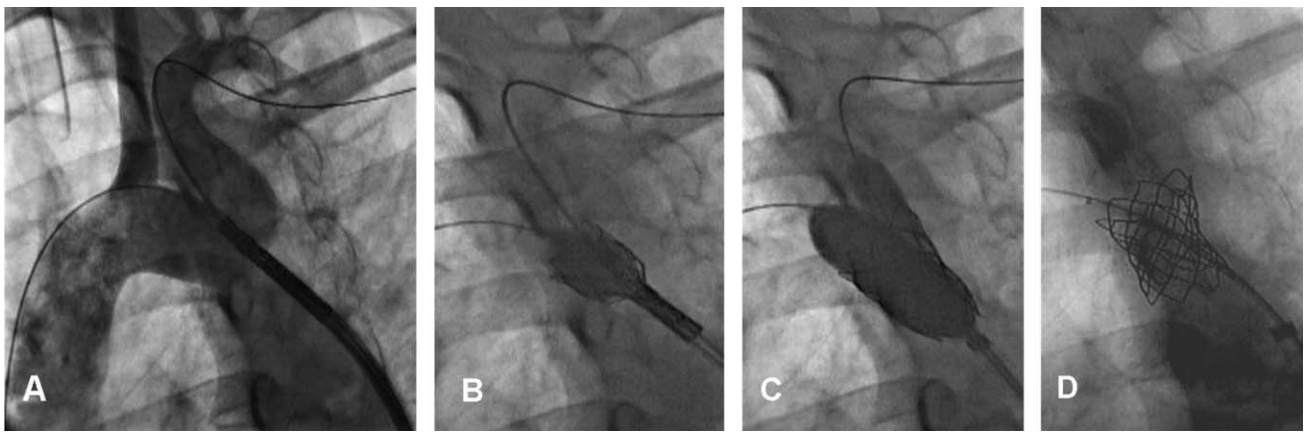

Fig. 2. (A) Angiogram through sheath, double wire: one in the subclavian artery and one in the ascending aorta, stent in sheath; (B) sequential opening of stent, sheath maximally advanced in bifurcation; (C) kissing balloon technique: 16 mm and 10 mm balloons through a 14 Fr sheath; (D) final results after stent expansion with mild flaring: no residual gradient across the aortic coarctation.

The procedure was uncomplicated, and the patient was discharged the following day without any medication.

DISCUSSION

Stenting is the treatment of choice for coarctation in grown-ups [3]. Typically, the coarctation is distant of the origin of the subclavian artery allowing uncomplicated stent delivery, but exceptions do occur. If the stenosis is very close to (one or more) side branches, it may be problematic to keep access to all vessels. Options then are:

1. Stent the dominant vessel (in casu the aorta) and cross the neck vessel with the stent, accepting either to occlude or jail this vessel. This is usually well tolerated with adequate anterograde flow but has the disadvantage of uncertain absence of thombus formation for the future in a young person. If later dilation or recrossing of the stent struts is required, dislodgment of endovascular peal with embolization in a vertebral artery is possible [4].
2. Deploy the stent by single wire technique, whereby the stenosis is sufficiently covered to have adequate relief of the stenosis and retention of the stent, but allowing to re-enter the subclavian artery and to flare the stent by kissing balloon technique. A drawback is that if the stent is positioned too proximal to the origin of the left subclavian artery, no re-entry of the neck vessel is possible; if the stent is positioned too distally, it may be insufficiently anchored, resulting in embolization of the stent especially during the attempts to re-enter the subclavian artery. If this delivery technique fails, all complications (like jailing the vessel or embolization of the stent) will be aggravated by using a covered stent.
3. Use of a double wire technique [5] to deliver the stent: the stent can be deployed in a predictable and safe manner:
   - Use of a double wire guarantees access to the side vessel, in casu the subclavian artery;
   - The stent is deployed in its ideal position: as close to the origin of the neck vessel as possible;
   - The "price" in vascular agression is acceptable: a single wire technique to deliver a covered stent would currently require an 11 Fr sheath for the 16-mm Adventa stent, or a 12 Fr sheath for a 16-mm Z-Med II or BIB balloon mounted covered CP stent (then followed by postdilation), or a 13 Fr sheath if the stent were mounted on a 20-mm balloon; in this patient, a 14 Fr sheath was used. In our experience, the use of a 14 Fr sheath in the adult femoral artery is well tolerated, with no need for a vascular closure device especially in "young" patients.

We preferred to use a covered stent as the coarctation site was expected to be stretched and dilated in a very significant manner (from 8 to 20 mm), thereby risking to create a transmural tear. The use of a covered stent does decrease the low but undeniable risk of bleeding into the thorax. In this patient with the stenosis at the bifurcation, a bleeding from a tear into the subclavian artery would be difficult to control; a covered stent in this specific situation will not guarantee 100% safe stretching without a bleeding tear, but all reasonable adjuncts that improve safety must be considered. This technique can probably be used in complex lesions with more side vessels.

We conclude that the double wire technique is an elegant, safe, and reproducible technique to optimally deliver a stent across a stenosis concomitantly keeping important side vessels open.

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