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Treatment of Coexistent Coarctation and Aneurysm of the Aorta with Covered Stent in a Pediatric Patient

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Abstract. Intravascular stents have emerged as an effective alternative to surgery and balloon angioplasty in the treatment of native and recoarctation of aorta. Balloon angioplasty, although effective in the treatment of native coarctation of the aorta, is associated with several complications such as recoarctation, aneurysm formation, aortic dissection, and vascular injury. In this report, we present the use of a covered stent to treat a patient who developed recoarctation of the aorta with an associated aneurysm following balloon angioplasty of her native coarctation.

Key words: Aortic aneurysm — Covered stent — Balloon angioplasty — Recoarctation

Case Report

FB is a 14-year old girl who presented at 2 years of age with a history of frequent upper respiratory tract infections and easy fatigability. She was diagnosed as having a sinus venosus atrial septal defect associated with partial anomalous pulmonary venous return (PAPVR), with the right upper pulmonary veins draining directly into her superior vena cava (SVC) – right atrial (RA) junction. She underwent closure of her sinus venosus atrial septal defect, baffling of her right pulmonary vein to her left atrium, and patch augmentation of the SVC–RA junction. At 10 years of age, the patient was found to have reobstruction at the SVC–RA junction, for which she underwent surgical revision of her SVC–RA anastomosis. One year later, for the first time the patient was noted to have coarctation of the aorta. She underwent balloon angioplasty of the native coarctation segment. Immediately following balloon angioplasty of the coarctation segment, no intimal flap or aneurysm formation were observed and the systolic gradient decreased from 55 to 15–20 mmHg. She did well until 14 years of age, when she presented with severe headaches associated with activity. Further evaluation revealed reobstruction at the SVC–RA junction and recoarctation of the aorta. She was referred for intravascular stent placement across the recoarctation site and SVC–RA obstruction.

FB underwent cardiac catheterization under general anesthesia in January 2001. Two 5-Fr sheaths were placed in the right and left femoral arteries, and a 7-Fr sheath was placed in the left femoral vein. A 5-Fr pigtail catheter was placed in the midthoracic aorta, and a 4-Fr JB glide catheter was advanced to the ascending aorta. Simultaneous pressure measurements were obtained across the aortic arch. The pigtail catheter was advanced to the proximal transverse aortic arch where a cineangiogram was taken, providing detailed anatomy and measurements of the transverse aortic arch region. In addition to recoarctation, an 8.1×6.8 mm aneurysm was observed at the site of coarctation (Fig. 1). The recoarctation segment, located in the distal isthmic portion of the arch, was tubular, with no intimal flaps or dissections observed. The narrowed coarctation segment measured 5.8×6.0 mm in diameter, with the isthmus proximal to the coarctation site measuring 12 mm and the descending aorta at the level of the diaphragm measuring 17 mm in diameter. Hemodynamic evaluation under general anesthesia re-

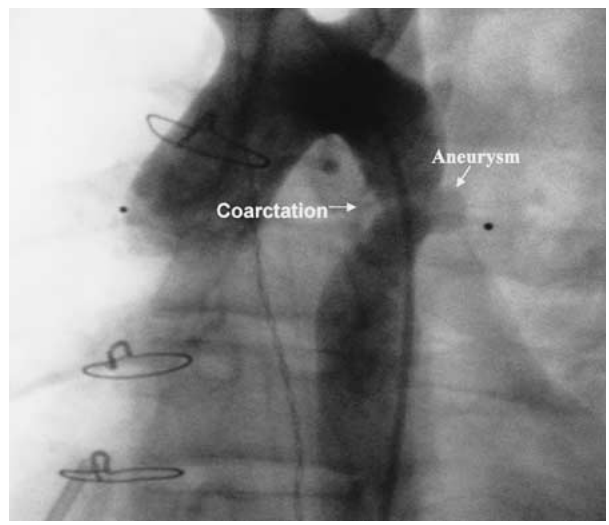

Fig. 1. Cineangiogram of transverse and proximal descending aortic arch. The area of coarctation with associated aneurysm formation is depicted. The aneurysm measured 6.8×8.1 mm in diameter. The coarctation segment measured 6.1 mm in diameter.

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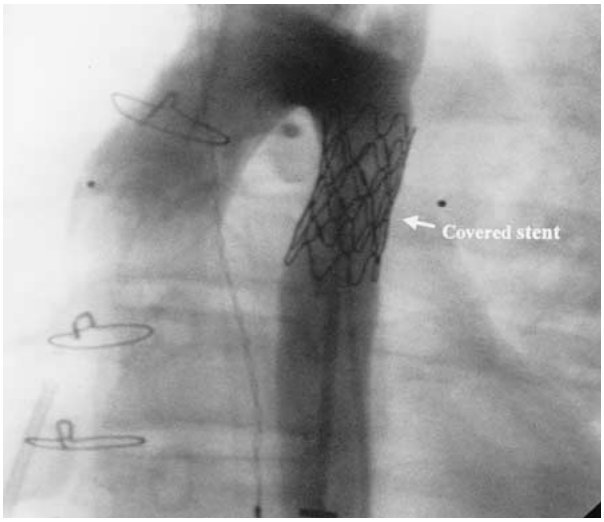

Fig. 2. Cineangiogram of transverse and proximal descending aortic arch after the use of a covered stent. The covered stent was deployed with elimination of the coarctation segment along with the aneurysm.

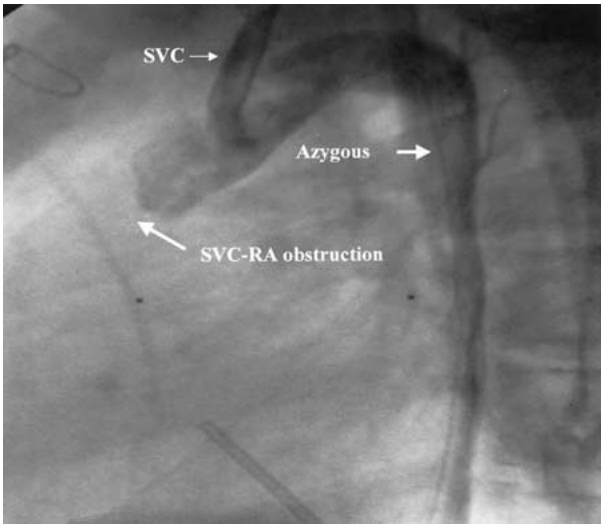

Fig. 3. Cineangiogram of the superior vena cava (*SVC*). Complete obstruction was observed at the entrance of the SVC into the right atrium (*RA*). Azygous runoff toward the inferior vena cava is noted.

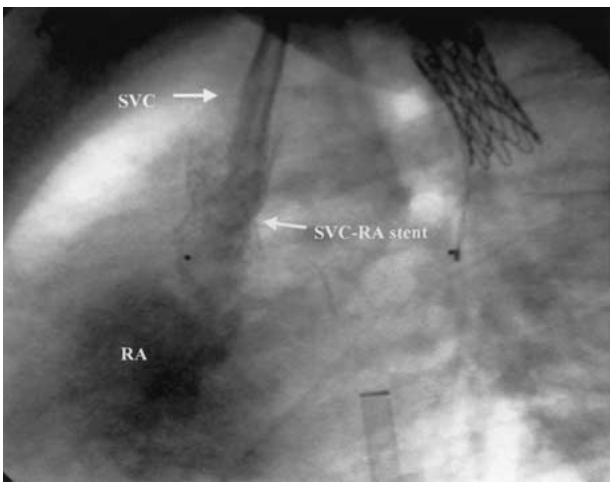

Fig. 4. Cineangiogram of the superior vena cava (*SVC*) status postintravascular stent placement at the SVC–right atrium (*RA*) junction. Unobstructed flow is observed entering into the RA. No azygous runoff is observed.

vealed a systolic gradient of 18 mmHg across the coarctation site. Due to the aneurysm, it was believed that a covered stent would be more appropriate for treatment of the recoarctation of the aorta. A 0.035 inch Rosen wire was advanced through the pigtail catheter into the right subclavian artery. A 13-Fr, 60-cm Mullins sheath (Cook, Bloomington, IN, USA) was exchanged for the 5-Fr sheath and advanced over the wire across the coarctation site. A Cheatham-Platinum stent, 30 mm in length (Numed, Hopkington, NJ, USA), covered with polytetrafluoroethylene (PTFE) material, was preloaded on a BIB balloon (12 mm × 4 cm outer diameter and 4 mm × 2 cm inner diameter) (Numed). Following inflation of the internal diameter balloon, a 4-Fr JB glide catheter was advanced through the contralateral arterial vessel, where hand injections were performed to document the precise origin of the left subclavian artery and coarctation/aneurysm site. The stent was fully dilated on the BIB balloon to a maximum of 12 mm in diameter, with the BIB balloon being exchanged for a 12 × 4 Power Flex balloon (Cordis, Sommerville, NJ, USA) and inflated to 9 atm. The balloon was removed, and a 7-Fr multipurpose catheter was advanced across the transverse arch. Simultaneous pressure measurements indicated no residual gradient across the coarctation segment. A final cineangiogram was performed across the coarctation site and showed no residual angiographic evidence of coarctation or aneurysm (Fig. 2).

To address the SVC–RA obstruction, a transeptal needle was used to traverse the obstructed segment and a P308 stent was deployed as described by Ward et al. [11] (Figs. 3 and 4). Simultaneous right pulmonary artery wedge injections were performed to ensure there would be no obstruction to right pulmonary venous flow into the left atrium following stent placement.

FB was discharged home the following morning on aspirin and atenolol. At 9 month follow-up, she had no resting hypertension or blood pressure gradient, with good pulses present in both lower extremities. Her headaches have completely resolved.

Discussion

Extensive literature exists on performing balloon angioplasty for treatment of native coarctation of the aorta in older children and adults [3, 9, 10]. The results have been shown to be reasonable at both acute and intermediate follow-up [9, 10]. Recently, intravascular stents have been used as an alternative to surgery and balloon'angioplasty for treatment of native and recurrent coarctation of the aorta in older children and adults [2, 7, 8].

The development of aneurysms following balloon angioplasty for the treatment of native coarctation of the aorta is a well-described risk. Older children and adults appear to be more prone to the development of aneurysms, with most centers encountering this complication in 5–9% of their patients [3, 5, 10]. Aneurysms that occur at the coarctation site following balloon angioplasty have traditionally been treated conservatively. Mendelson et al. [6] found no significant change in the size of aneurysms following balloon angioplasty in two patients during a 6-year follow-up. However, our patient required repeat intervention secondary to recoarctation. Although repeat balloon angioplasty and/or intravascular stent placement were considered, we were concerned about the possibility of causing a dissection or enlargement of the aneurysm. Surgical resection was considered, although it would have been associated with increased risk. Therefore, it was believed that the best option would be to place a covered stent over the recoarctation segment. The covered stent would provide extra support of the aneurysmic vessel wall in addition to eliminating the recoarctation segment.

There are few reports of treatment of coarctation of the aorta with an associated aneurysm with a covered stent. In one case report, a covered stent was used successfully to treat an aneurysm associated with coarctation of the aorta in a 23-year-old man [1]. Placement of the covered stent was performed through a 16-Fr sheath via a femoral cutdown. Another case report described placement of a covered stent percutaneously, through a 14-Fr sheath, to treat an aortic pseudoaneurysm in a 15-year-old girl with neurofibromatosis [4].

To our knowledge, this is the first pediatric patient to have a covered stent placed to successfully treat recoarctation of the aorta with an associated aneurysm. In this case, we were able to deliver the premounted covered stent on a BIB balloon through a 13-Fr sheath, achieving acute success. Although we are optimistic about this patient's long-term outcome, caution is warranted because the adequacy in redilating the stent, and the integrity of the PTFE material following redilation, remains to be evaluated. Animal studies are under way to determine whether a covered stent can be safely reexpanded at a later time.

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