Discussion

Early surgical intervention is critical for the treatment of acute aortic dissection and acute aortic valve endocarditis, because the mortality increases from the onset of symptoms.² Diagnostic imaging, however, including CT, echocardiography, and coronary angiography, along with preparation for operative correction, usually takes longer than 4 hours, increasing the patient's risk.¹ Although surgical repair should only be performed after coronary diagnostic imaging to avoid ischemic complications, coronary angiography is often a high-risk procedure for these patients.⁴

To circumvent this problem, we propose a simplified approach involving intraoperative angiography. This diagnostic tool was initially used to evaluate the grafts after coronary artery bypass grafting.⁵ This method showed a high accuracy in the identification of coronary lesions without adverse effects on either the cardiac function or histologic appearance of the coronary arteries.^{3,4} Multislice CT could be an alternative diagnostic tool for the preoperative screening of coronary disease. CT presents some limitations relative to intraoperative angiography, however, such as 2-fold higher radiation doses (approximately 34 mGy versus approximately 80 mGy) and 10-fold higher contrast medium consumption (about 10 mL iopromide vs about 100 mL). This difference may be of relevance, especially for patients with aortic valve endocarditis and impaired renal function.

In our patients, intraoperative angiography allowed us to detect coronary anomalies that could be surgically corrected in 2 of 7 cases. In our opinion, aortic root angiography may reliably demonstrate coronary artery lesions in patients who undergo heart surgery without preoperative catheterization.

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Novel use of an aortic endograft in the closure of a Fontan circuit leak

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Unintended residual interatrial communications or baffle leaks after the lateral tunnel Fontan operation have been well described.¹ Such unintended communications have the potential to result in hypoxemia, cyanosis, exercise intolerance, and paradoxical embolization.² Surgical eradication of these leaks has the attendant risks of reoperative sternotomy and cardiopulmonary bypass. Therefore, transcatheter approaches are now commonly used. No ideal device exists for this task. Gian-

turco coils (Cook Medical, Bloomington, Ind), Amplatzer septal occluders (AGA Medical, Plymouth, Minn), and CardioSEAL VSD occluders (NMT Medical, Boston, Mass) have been used with varying degrees of success. These devices often prove ineffective because of their inability to conform to the complex atrial anatomy. Balloon-expandable covered stents have been used to exclude leaks and intentional fenestrations with good success.³ However, balloon-expandable covered stents of sufficient size are not available in the United States. We describe the novel use of a commercially available adult-size, self-expanding aortic stent graft to seal a large, symptomatic Fontan baffle leak.

Clinical Summary

A 15-year-old male with dextrocardia, bilateral superior vena cavae, common atrium, and unbalanced atrioventricular canal defect had undergone multiple cardiothoracic surgeries culminating in a fenestrated lateral tunnel Fontan. He presented with exercise intolerance. Exercise testing demonstrated resting saturations of 91% to 96%. Saturations decreased to 63% at peak exercise. Cardiac catheterization demonstrated right-to-left shunting (Qp:Qs 0.7) via both the fenestration and a large baffle leak. The baffle leak could not be

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Figure 1. A, Superior anterior baffle leak (*white arrow*) in patient with dextrocardia. B, Sizing balloon is used to occlude the left PA. C, Stent can be seen deployed across the baffle leak (*white arrow*). D, Final angiography demonstrates successful closure of the baffle leak.

Figure 2. Aortic extender stent graft cuff (WL Gore and Associates, Flagstaff, Ariz).

crossed and was left untreated. The fenestration was closed with a 4-mm Amplatzer septal occluder.

Despite fenestration occlusion, the patient continued to have significant exercise-induced desaturation. Reintervention using an aortic stent graft was planned. Bilateral common femoral veins and the left internal jugular vein were accessed. Angiography demonstrated

a large leak at the superior anterior suture line of the Fontan baffle (Figure 1, A). The baffle at this level measured 19 mm with a 2-cm proximal landing zone. An aortic extender cuff 23 mm in diameter by 33 mm in length (WL Gore and Associates; Flagstaff, Ariz) was selected (Figure 2). The device, normally delivered via an 18F sheath, was delivered through a 16F sheath (Figure 1, C). An 18-mm sizing balloon (Numed Inc, Hopkinton, NY) was positioned in the left pulmonary artery (PA) via the left internal jugular vein and inflated during stent deployment to prevent forward migration of the stent and inadvertent PA occlusion (Figure 1, B). After deployment, a compliant CODA balloon (Cook Medical, Bloomington, Ind) was used to angioplasty the stent, ensuring good wall apposition. Final angiography demonstrated good stent placement with no leak (Figure 1, D). Sheaths were removed and hemostasis was obtained using direct manual pressure. The patient was discharged within 48 hours on warfarin with a goal international normalized ratio of 2.

Cardiac magnetic resonance imaging 2 months after stent placement demonstrated good stent apposition, no baffle distortion, and no residual shunt. During exercise stress testing 4 months after stent placement, the baseline saturation was 99% and the saturation at peak exercise was 98%.

Discussion

We demonstrate the successful use of a commercially available aortic stent graft in the repair of a lateral tunnel Fontan baffle leak. The GORE (WL Gore and Associates) aortic extender cuff we used is constructed of expanded polytetrafluoroethylene

(ePTFE) with an outer self-expanding Nitinol support structure. The aortic extender cuff is an adjunctive stent graft used for treatment of infrarenal abdominal aortic aneurysms demonstrating a type I (proximal sealing zone) endoleak. The exterior scaffolding confers flexibility and durability to the device, and the ePTFE provides the lumen with a smooth, nonthrombogenic surface. Although no published data exist, we believe that having the scaffolding isolated behind the ePTFE may help reduce the risk of thrombus formation. Endografts offer several advantages over other transcatheter devices: The target lesion does not need to be crossed; multiple leaks can be occluded with a single device; minimal proximal and distal landing zones are needed; and the devices conform well to the complex anatomy. These devices are available in a wide array of sizes and configurations that allow endovascular treatment to be individually tailored to a particular patient's anatomy. Self-expanding endografts may "jump" slightly during expansion. We inflated a sizing balloon in the left PA during stent deployment to prevent migration of the stent across the PA origins. We selected the more caudal left PA to ensure protection of both the left and right PA ostia. Post-stent placement balloon angioplasty was used to ensure apposition to

the baffle wall. The major limitation to using endografts in the pediatric population is the need for an large introducer sheaths. We were able to deploy this particular endograft using a 16F sheath, which may help to expand applicability.

Conclusions

Follow-up imaging demonstrated stable stent position and configuration with no demonstrable leak after 2 months. Saturations remained 98% during exercise testing 4 months after intervention.

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