Hilum-to-Hilum Gore-Tex Tube Replacement of Central Pulmonary Arteries

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Patients born with hypoplastic pulmonary arteries require recurrent procedures of shunting, patch reconstructions, balloon dilations, and occasionally stenting to achieve adult-size vessels. We have applied a hilum-to-hilum Gore-Tex conduit replacement for the stenosed central pulmonary arteries to 12 consecutive patients with a Gore-Tex tube of 14 mm (9 patients) or 12 mm (3 patients) at a median age of 6.7 years (range, 1.6 to 16.9). There were 8 patients with biventricular repair (2 patients with heart transplantation) and 4 patients with Fontan completions. After a follow-up time of 25 ± 22 months, there was no mortality, reintervention, or restenosis.


Technique

The Institutional Review Board at The Royal Children’s Hospital approved this study, and the need for consent was waived because of the retrospective nature of the study. From January 2008 to November 2013, 12 consecutive patients (9 male and 3 female individuals) underwent reconstruction of their pulmonary arteries from hilum to hilum by the interposition of a Gore-Tex conduit. The median age at the time of operation was 7.1 years (range, 1.6 to 16.9 years). Six patients with biventricular circulation had the following diagnoses: pulmonary atresia and ventricular septal defect (1 patient), pulmonary atresia, ventricular septal defect, and major aortopulmonary collateral arteries (MAPCAs) (3 patients), tetralogy of Fallot with hypoplastic pulmonary arteries (1 patient), and truncus arteriosus (1 patient). The cardiac morphology of the 4 patients undergoing Fontan completion was pulmonary atresia with intact ventricular septum in 2 patients and hypoplastic left heart syndrome in 2 patients. The other 2 patients undergoing orthotopic heart transplantation had failure of cavopulmonary circulation (one Kawashima, one extracardiac conduit Fontan).

Before undergoing the hilum-to-hilum Gore-Tex conduit interposition to the pulmonary artery, the patients had undergone the following operations: 20 modified Blalock-Taussig shunts or central shunts in 10 patients, 10 pulmonary artery patch repairs in 7 patients, and 13 catheter interventions (ballooning or stenting) in 5 patients. The 4 patients undergoing Fontan completion had been previously been identified to have left pulmonary artery hypoplasia and had undergone intermediate procedures to achieve growth of this hypoplastic left pulmonary artery. This additional procedure had been performed through a thoracotomy in 3 patients and a sternotomy in 1 patient. The left pulmonary artery was ligated on the left side of the cavopulmonary anastomosis, effectively transforming the bidirectional cavopulmonary shunt in a classic Glenn procedure, and a separate left modified Blalock-Taussig shunt (3 patients) or a central shunt (1 patient) were performed [3]. Three patients underwent implantation with a 6-mm shunt and 1 patient with an 8-mm shunt.

At the time of pulmonary artery reconstruction (Fig 1), extensive dissection of all pulmonary branches was performed to enable the placement of snuggers on the lobar branches. The incision was extended on the lower lobar branch on both sides, and the extremity of the Gore-Tex was cut transversely or obliquely depending on the orientation of the vessels. In biventricular repair and heart transplantation, an appropriately sized hole was created in the inferior surface of the conduit, and the donor pulmonary artery or the right ventricle–pulmonary artery...
conduit was anastomosed to this opening. During Fontan completion, an 18-mm Gore-Tex conduit was anastomosed in a T fashion in a similar opening performed on the right side of the conduit.

Postoperatively, all patients undergoing biventricular repair or heart transplantation received maintenance daily aspirin (5 mg/kg), and patients undergoing Fontan completion were given warfarin with a target international normalized ratio of 2.

**Results**

There were no immediate postoperative complications or mortality. After a mean follow-up time of 25 ± 22 months, all patients were in New York Heart Association class I. The pulmonary arteries were investigated postoperatively by catheterization in 7 patients and echocardiography in all patients. No gradient could be detected in any patient. No thrombus material was identified in any of these investigations.

**Comment**

The conventional reported techniques to relieve extensive pulmonary artery stenosis is extensive patching of these vessels with pericardial or Gore-Tex patches or, at the extreme, their replacement with a pericardial roll. These techniques have been fraught with a high risk of reintervention [1, 2, 4, 5]. We have found replacement of the pulmonary arteries from hilum to hilum with an adult-size Gore-Tex conduit to be an efficient technique for relieving extensive stenosis of the pulmonary arteries. The realization of two separate anastomoses does not take more time than patching from hilum to hilum, and we are confident that the synthetic conduit will not be subjected to any remodeling. In our still limited experience, we have not observed any intraluminal thrombus or reduction in the caliber of the conduits, and we therefore believe that these initial results may be long lasting.

We believe that a conduit 14 mm in diameter would be suitable for most adults. In 3 patients we were unable to use a 14-mm conduit and used a 12-mm conduit because either there was not enough space under the aorta for the conduit or the distal pulmonary arteries were too small to accommodate its anastomosis. Four of these patients had a Fontan procedure, and we believe that a 12-mm conduit on only a very short segment of artery is still an acceptable size in this setting.

**Conclusion**

Excision of the central pulmonary arteries and their replacement by a hilum-to-hilum Gore-Tex tube interposition graft is a technique providing reliable and
effective relief of central pulmonary artery obstruction for patients in biventricular circulation and in Fontan circulation. It is a simple alternative to extensive reconstruction of the central pulmonary arteries.

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References


