Allograft carotid artery as a systemic-to-pulmonary conduit

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Synthetic polytetrafluoroethylene grafts are established conduits for palliative systemic-to-pulmonary artery shunting in infants with cyanotic congenital heart disease. Although readily available, these conduits are stiff, may kink, and are prone to thrombosis. There are technical difficulties in anastomosing synthetic material to small, thin-walled infant pulmonary arteries, sometimes resulting in bleeding or stenosis. As an alternative, we present our experience with allograft carotid artery conduits as systemic–pulmonary shunts.

Clinical Summary

Between 2000 and 2006, 30 carotid allografts were employed in 27 infants with cyanotic congenital heart disease. Twenty-five modified Blalock shunts and 4 central shunts were implanted. One infant received a carotid allograft to create an absent right pulmonary artery (see below).

All carotid allografts were supplied from the Oxford Valve Bank. They were collected from valve donors at autopsy and antibiotic treated, cryopreserved, stored, and thawed according to the Guidelines of the UK National Tissue Bank. The vessels ranged from 4 to 7 mm in diameter. Standard operative techniques (including intraoperative heparinization) were used to create the shunts, and all patients received postoperative antiplatelet therapy with aspirin. Patients were followed with echocardiography and angiography before corrective surgery up to 48 months (mean follow-up: 12.4 ± 3.4 months; Figure 1, A).

This biologic graft was very easy to suture, with no intraoperative bleeding in any case. The heparin was not reversed at the conclusion of the procedure. No patient had acute or chronic graft thrombosis, perigraft leak, or infection. One infant with total anomalous pulmonary venous drainage (TAPVD) and pulmonary atresia died suddenly 12 hours after complete correction with a central shunt. At autopsy the 5 × 5-mm shunt was patent and the TAPVD repair satisfactory. One shunt showed narrowing at 24 months in an infant with pulmonary atresia (Figure 1, B). Histologic assessment of the allograft revealed chronic inflammatory changes compatible with tissue rejection. A contralateral shunt was inserted.

In one 4.2-kg infant with an absent right pulmonary artery and severe pulmonary hypertension in the left lung, a 4-mm modified Blalock shunt was first implanted in the hilar arterial remnant. Six weeks later, a second 7-mm carotid allograft was used to create a neo-right pulmonary artery. This greatly reduced the pulmonary artery pressure. We do not believe that this reconstruction would be possible with synthetic shunt material.

When the major corrective procedures were performed, the shunt was easy to locate and divide. A histologic section of a 2-year-old shunt is shown in Figure 2. Elastic van Gieson solution was used to stain the elastic fibers in the allograft. Focal intimal hyperplasia is present, but there is no inflammatory response or calcification.

Figure 1. A, Allograft shunt at 2 years. B, Shunt in which suspected tissue rejection caused decreased flow at 6 months. A second contralateral shunt was implanted. This was the only case in which an inflammatory response or rejection was suspected.
Discussion
Carotid artery allografts offer distinct advantages over synthetic grafts, particularly in small infants. Human tissue demonstrates no oozing of blood or serous leakage from the suture holes and is more resistant to infection than are synthetic materials. The lack of thrombogenicity is also a major advantage when using biologic tissue. In this series, all shunts remained patent, even in the graft that narrowed through a suspected immunologic response. In the absence of a local tissue bank, the availability of human carotid arteries is problematic. So far, the potential uses of donated blood vessels are underestimated. For example, we use descending aortic tubes to improve the safety of left ventricular assist device cannulation and ascending aorta or pulmonary artery wall as patch material where eventual stiffening and calcification is unimportant. Accordingly, we obtain as much healthy vascular tissue as possible when harvesting aortic and pulmonary valves from cadaveric donors. The risk of immunoreactivity has not proven to be of importance in the short term between shunting and the corrective procedure. Bogats and colleagues2 and Tam and associates3 have reported the use of saphenous vein allografts as an alternative for modified Blalock shunts. In their series there was no fibrosis or calcification seen in 4 patients up to 55 months.2

In conclusion, the use of carotid allograft facilitates the microvascular anastomoses in infants with cyanotic congenital heart disease. These conduits have a very low propensity for thrombosis, and the potential for immunogenecity does not preclude their use.

References

Unusual systemic venous return with absence of superior caval veins
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The absence of the right superior vena cava in situs solitus is a rare anomaly. It is usually associated with persistence of the left superior vena cava or other cardiac abnormalities.1 We report here an extremely uncommon case of bilateral absence of the superior vena cava, with no associated cardiac anomaly, evaluated through a high-resolution computed tomography (CT) scan.

Clinical Summary
A 14-month-old boy was admitted to our department because of a cardiac murmur discovered during a routine pediatric evaluation. On physical examination, a systolic heart murmur of grade 1/6 to 2/6 was found. No chronic heart failure or syndromic dysmorphism had been found. The electrocardiogram showed sinus rhythm and no evidence of atrioventricular arrhythmia. A transthoracic echocardiogram found a situs solitus, levocardia with atrioventricular and ventriculoarterial concordance, normal-sized ventricles, normal intracardiac anatomy, and the inferior vena cava draining normally into the right atrium. No superior caval vein could be seen.

We performed cardiac CT scanning to confirm the presumptive diagnosis: 64-slice CT scan (LightSpeed VCT; General Electric, Milwaukee, Wis), slice thickness 0.625 mm, speed of rotation 0.4 second, pitch 0.9, 80 kV, milliampere modulation during the acquisition, and peripheral injection of contrast agent (iohexol 300...