Figure 3. Angiography of the pulmonary artery after a bilateral bidirectional cavopulmonary shunt revealed almost complete unifocalization of the pulmonary artery.

In conclusion, the midline 1-staged unifocalization followed by a staged Fontan procedure is an effective strategy for patients having a univentricular heart and pulmonary atresia with MAP-CAs.

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Closed correction of systemic semilunar valve insufficiency in the neonate

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Systemic semilunar valve regurgitation can be a life-threatening hemodynamic lesion in the neonate with congenital heart disease. Although congenital aortic stenosis remains a vexing problem, a number of interventions have been designed to provide relief. Unfortunately, procedures designed to provide a more competent systemic semilunar valve in the neonate are limited. The reproducibility of reparative techniques might be unpredictable, and prosthetics are limited to small-caliber homografts; both approaches require cardiopulmo-

nary bypass. We describe our experience with a surgical technique that treats systemic semilunar valve regurgitation in the neonate without the need for cardiopulmonary bypass.

Clinical Summary

Patient 1 was 5-day-old boy given a diagnosis of truncus arteriosus (type IA) with interrupted aortic arch type A. The truncal valve was moderately stenotic (predicted gradient, 40 mm Hg) with moderate-to-severe insufficiency. At the time of the operation, a nodular, 4-leaflet truncal valve was found that was composed of 3 major and 1 minor leaflets. The minor leaflet was sutured to the adjacent leaflets in an attempt reduce the regurgitation.

Attempts at weaning from cardiopulmonary bypass met with low systemic blood pressures and increased left atrial pressures. Transesophageal echocardiography (TEE) showed moderate-to-severe truncal valve regurgitation. With the heart beating and off bypass, pledgeted 4-0 Prolene sutures were passed along the ventriculoarterial junction at the predicted level of the leaflet insertion into the truncal valve annulus. With continuous TEE imaging, the annuloplasty stitch was tightened until regurgitation was reduced from moderate-severe to trivial-mild, without stenosis (Figure 1, A and B, and Figure 2). Hemodynamics responded appropriately, and the patient was weaned from bypass without incident. At 6

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Figure 1. A, After repair of patient 1, moderate-to-severe truncal valve regurgitation resulted in marginal hemodynamics. **B,** By using continuous TEE monitoring, the annuloplasty stitch was cinched down until truncal regurgitation was reduced to trivial to mild severity. Hemodynamics responded appropriately.

months' follow-up, the patient is doing well, with mild-to-moderate truncal insufficiency.

Patient 2 was a newborn girl referred to our institution with the diagnosis of hypoplastic left heart syndrome (aortic atresia/mitral stenosis). The child was taken to the operating room at 5 days of age for a Norwood procedure. Primary arterial cannulation was performed through a polytetrafluoroethylene* graft anastomosed to the innominate artery, as previously described.¹ A modified Brawn technique using only autologous tissue in the aortic reconstruction was performed. With control of the aorta and the brachiocephalic vessels, the arch was reconstructed during continuous cerebral and cardiac perfusion. The patient was weaned easily from bypass on $5 \mu\text{g} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ dopamine. Postoperatively, the patient remained stable for approximately 8 hours, when arterial blood gasses demonstrated progressive pulmonary overcirculation. Management attempts were unsuccessful, and she was emergently cannulated for extracorporeal membrane oxygenation support. On extracorporeal membrane oxygenation, there was gradual recovery of cardiac function, and she was weaned 5 days later. Echocardiography with the cannulas clamped and in place demonstrated mild-to-moderate tricuspid valve regurgitation and trivial pulmonary valve regurgitation. One hour after decannulation, the patient experienced progressive hypotension and acidosis. Repeat echocardiography demonstrated new-onset moderate-to-

Figure 2. Postannuloplasty Doppler gradient across the truncal valve measured 1.8 m/sec.

*Gore-Tex graft, registered trademark of W. L. Gore & Associates, Inc, Newark, Del.

Figure 3. By using pledgeted nonabsorbable sutures, the external annuloplasty stitch is placed at the predicted level of leaflet insertion into the annulus. While assessing valve function with echocardiography (TEE or epicardial), the annuloplasty stitch is tightened. Real-time echocardiographic data allow reduction of the annular circumference to the desired degree.

severe pulmonary insufficiency, presumably the result of a cannulation injury. At the bedside in the intensive care unit, pledgeted 5-0 Prolene mattress sutures were placed along the ventriculoarterial junction of the pulmonary valve (Figure 3). While tying the sutures down, continuous epicardial echocardiographic imaging of the pulmonary valve showed improvement in pulmonary insufficiency from moderate-severe to trivial-mild, without stenosis.

With reduction in pulmonary valve insufficiency, systemic blood pressures improved, blood gasses normalized, and the chest was closed 2 days later.

Discussion

Systemic semilunar valve regurgitation can be a life-threatening lesion in the neonate, particularly among patients supported by a single ventricle. In both patients an external annuloplasty of the systemic semilunar valve resulted in significant improvement of valvular insufficiency. Although subvalvular annuloplasty of the aortic valve has been reported in adults, these are open techniques that require cardiopulmonary bypass with cardiac ischemia.^{2,3}

It should be noted that in both patients there was a single dominant great artery with a large semilunar valve and annulus. In addition, in both patients the systemic artery was mounted on a discrete infundibulum, rendering these valves particularly amenable for external annuloplasty, with little risk of iatrogenic valvular stenosis or coronary artery injury. Although this approach limits the annular plication to a segment of the annulus and constitutes a partial annuloplasty, partial annular reduction has proved effective for other forms of congenital aortic valve disease.⁴ Real-time echocardiographic (TEE or epicardial) assessment of valve function during the annuloplasty allows adjustments such that valve function can be optimized.

In summary, we present an external annuloplasty technique that has proved effective in reducing systemic semilunar valve regurgitation in the neonate. Using this technique, we have salvaged 2 neonates, avoiding open procedures with their attendant morbidity and mortality. Although we cannot comment on the long-term outcome of these repairs, this technique has demonstrated value in the acute situation offering few attractive alternatives.

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