The development of the extracardiac conduit for reconstruction of “blue” ventricle to pulmonary artery continuity has revolutionized the surgery of many complex congenital defects. In infants with anomalies such as tetralogy of Fallot, non-valved reconstruction of the right ventricular outflow has been well tolerated with a low early reoperation rate (e.g., 100% reoperation-free at 4 years in the Boston Children’s Hospital series). However, patients developing progressive right ventricular dilatation have required later replacement with a valved prosthesis. Other anatomic situations, particularly that of pulmonary atresia or pulmonary atresia accompanying other defects (e.g., corrected transposition) that have usually been repaired during childhood rather than infancy, have done best with right ventricular outflow tract reconstructions utilizing valved conduits (Rastelli concept). There are neonatal and infant reconstructions that are optimally accomplished with valved conduits (e.g., truncus arteriosus, absent pulmonary valve syndrome). The allograft has become the conduit of choice for all right ventricular outflow tract reconstructions.

Symptoms of progressive right ventricular failure due to pulmonary insufficiency include fluid retention, fatigue, and exercise intolerance. Once right ventricular dilatation progresses to the point that tricuspid regurgitation occurs, symptomatology advances rapidly. Right ventricular function has been demonstrated to improve following placement of a pulmonary valve. Tricuspid insufficiency is important as a marker for deteriorating right ventricular function and as a potent hemodynamic burden in the presence of outflow tract abnormalities. As the San Francisco experience has demonstrated, once tricuspid incompetence develops rapid and persistent right ventricular failure follows that is difficult to mitigate medically. There is marked improvement with restoration of pulmonary sufficiency even if a murmur or mild tricuspid regurgitation persists. If pulmonary valve replacement is postponed and tricuspid regurgitation progresses, the reconstructive surgery must include restoration of tricuspid competence.

Performance of most models of mechanical valves in the right side of the heart has been relatively poor, and in general either bioprostheses or allografts have been recommended. In the series from Chicago, more than one-third of the patients developed prosthetic pulmonary valvular dysfunction less than 1 year following insertion of a mechanical prosthesis. Thus despite the issue of accelerated failure, if an allograft is not available a porcine prosthesis is probably the optimal choice for the right ventricular outflow tract position.

Ideally, anticoagulation in children is avoided. Unfortunately, porcine prostheses have not fared well in the right-sided circulation, although they have done somewhat better in older children and young adults. Mechanical prostheses are associated with a significant rate of dysfunction in the right-sided position. Synthetic right heart conduits have been noted to require replacement 100% of the time.
by 10 years following insertion, although initial early results are good.6

Fontan and colleagues have reported on more that 100 allograft aortic valve conduits with only one replacement for allograft valve dysfunction and no thromboembolism or hemolysis; in the same series, a pressure gradient (13–85 mm Hg, mean 39 mm Hg) was present in only 14 ventricle-dependent conduits.14 In this series from France, gradients across the allograft conduits occurred at three sites in the pre-valvular region, five sites in the valvular or undetermined region, and five sites in the postvalvular (presumably distal anastomosis) region.15 In the United States Kirklin and associates have demonstrated a 94% actuarial freedom from reoperation for obstruction in cryopreserved allograft conduits at 3.5 years.16

A functioning right ventricular outflow valve is recommended for either primary or secondary reconstructions where there is (1) symptomatic right ventricular dysfunction, (2) fixed pulmonary hypertension, (3) hypoplastic pulmonary arteries, (4) pulmonary insufficiency with right ventricular dilatation, (5) tricuspid regurgitation, (6) echocardiographic evidence of small right ventricular volume or poor performance, (7) absent pulmonary valve syndrome, (8) peripheral pulmonary stenoses, (9) highly reactive pulmonary circulation (e.g., neonatal truncus).16

If there were a perfect valve substitute that could grow or be of adult size when placed in the pulmonary position, it could be argued that a valved reconstruction of the right ventricular outflow tract could be applicable in all cases to (1) protect against the long-term effects of pulmonary insufficiency including right ventricular dysfunction and dilatation, (2) accomplish right ventricular outflow tract reconstruction without relative obstruction, and (3) prevent or mitigate tricuspid dysfunction. At present, we do not recommend universal application, e.g., for routine primary tetralogy of Fallot repairs.17 However, a proportion of patients with nonvalved conduits or transannular patches return with progressive right ventricular dysfunction, especially when additional preload or afterload lesions are present, and require reconstruction with an allograft.18

References