Commentary: Preserving right ventricular function: New valves, but still a challenging problem

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Matsushima and colleagues1 from Kobe Children’s Hospital present results of a curved, hand-sewn polytetrafluoroethylene (PTFE) conduit with a bileaflet valve implanted in 50 patients of varying ages and diagnoses. The 16-mm diameter conduit, placed in 39 of 50 patients, had 100% freedom from replacement at 5 and 8 years. Only 2 of a total of 50 valves had moderate or greater regurgitation at around 4 years’ follow-up.

PTFE remains a promising material for the construction of heart valves. It is biocompatible, widely available, inexpensive, and can be tailored to patient-specific anatomy. The clinical use of handmade PTFE valves has been reported for at least 3 decades.2 Recently, Hongu and colleagues3 reported overall 91% 5-year freedom from replacement among 1776 handmade trileaflet PTFE valved conduits. Diaz-Castrillon and colleagues4 found similar results with their bileaflet valve in 99 patients. Results in the current study are certainly comparable to these. By comparison, published 5- and 8-year freedom from replacement for other conduit types in the 16- to 18-mm range is on average 80% to 85% and 65% to 70%, respectively.5

The structure and mechanism of these valves vary considerably. For example, whereas competence is achieved by leaflet free-edge coaptation in most constructs, in the present model, it is achieved by free-edge contact with the graft wall. The latter construct was published by Nunn and colleagues6 in 2008 (Figure 1). Many videos exist to illustrate the various techniques.7 See, for example, the video describing construction of a trileaflet PTFE valve/conduit at https://www.youtube.com/watch?v=TIGREzczjU24.

In numerous studies, the most frequent modes of failure (other than being outgrown) include leaflet malfunction and distal sclerotic stenosis. Stiffening and calcification has been occasionally noted in the leaflets. This is because, although PTFE is impervious to cellular ingrowth, it is not impervious to molecular infiltration and calcification. Distal suture line stenosis is often described as pulmonary stenosis; that is, a separate problem. One should think of it, instead, as a distal conduit problem. Can we do something about that? When feasible, should we dunk the graft distally into an augmented pulmonary bifurcation (as in the Sano)? Should we routinely bevel the distal graft and augment it anteriorly with a more compliant patch-like homograft, so that it may respond to serial catheter/interventional dilation/stenting?

The final, and critical question is whether these valves/valved conduits will change our time-related management of right ventricle (RV) to pulmonary artery continuity. When a transannular patch (with or without a handmade valve placed) is required in tetralogy of Fallot/pulmonary stenosis, the next procedure, whether surgical or interventional, should occur before there is any discernible...
evidence of a dilating, dysfunctional RV, or subtle progression toward an acquired restrictive physiology from long-standing strain. Waiting until an adult pulmonary valve can be placed may be waiting too long. One would hope that an interim operation or intervention to place a 16- to 20-mm valve is a justifiable tradeoff for potentially permanent RV damage. For anomalies requiring an initial conduit, the same guidelines should hold. The 16- to 18-mm PTFE valved conduits described above, placed when a child is aged 1 to 3 years, can provide the bridge to an adult-sized conduit. Preserving RV function should be the driving surgical imperative.

References

FIGURE 1. Final steps in constructing the valve, originally described by Nunn and colleagues. The bileaflet valve, with a shape similar to a miniature paper airplane, is anchored into an opening in the conduit, trimmed, then the opening roofed over with a measured oversize patch. From Nunn and colleagues’ Figure 5. Used with permission of the publisher.