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

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Central Message:

Hand-sewn PTFE valves/valved conduits remain a viable alternative to manage RV to PA continuity. The underlying imperative continues to be preservation of RV function over time.

Central Picture Legend:

Model airplanes or heart valves?: Hard to tell! (Credit: Jennifer Powers, Science Friday\(^9\))

Figure 1 Caption:

Final steps in constructing the valve in the present paper, 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, Bennetts and Onikul, Fig 5.\(^6\) Used with permission of publisher.

In this issue of the *Journal* Matsushima and colleagues from the Kobe Children’s Hospital present results of a curved, hand-sewn polytetrafluoroethylene (PTFE) conduit with a bi-leaflet valve implanted in 50 patients of varying ages and diagnoses.\(^1\) The 16 mm diameter conduit, placed in 39 of 50 patients, had 100% freedom from replacement at 5 and 8 years. Only two of a total of fifty 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 three decades.\(^2\) Recently, Hongu and
colleagues reported overall 91% 5-year freedom from replacement among 1,776 handmade tri-leaflet PTFE valved conduits.³ Diaz-Castrillon and the Pittsburgh group found similar results with their bi-leaflet valve in 99 patients.⁴ 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 16-18 mm range is on average 80-85% and 65-70%, respectively.⁵

The structure and mechanism of these valves vary considerably. For example, while 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 Graham Nunn and colleagues in 2008: Figure 1.⁶) Many videos exist to illustrate the various techniques.⁷,⁸

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,” i.e., 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 (PA) 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 16-20mm valve is a justifiable tradeoff for potentially permanent RV damage. For anomalies requiring an initial conduit, the same guidelines should hold. The 16-18 mm PTFE valved conduits described above, placed at 1-3 years old, can provide the “bridge” to an adult sized conduit. Preserving RV function should be the driving surgical imperative.

References:


8. See, for example, this video by Thomas Mathew describing construction of a trileaflet PTFE valve/conduit. https://www.youtube.com/watch?v=TIGREzcjU24).
