



Intraoperative Balloon Pulmonary Annulus Dilation: A New Alchemy or Polishing a Meatball?

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There is a clear advantage in freedom from reoperation and event-free survival if the pulmonary valve is functional after tetralogy of Fallot (TOF) repair.^{1,2} Even when the valve cannot be spared completely, there may be advantage to preserving the annulus alone. Of repaired TOF patients who enjoy normal exercise testing and are reintervention-free 35 years later, many have mild residual pulmonary stenosis (pulmonary valve annulus z-score -1.5), suggesting that infundibular or annular integrity may play a physiologic role as important as valve competence.³ Minimal crossing of the annulus by a judicious transannular patch has the same freedom from reoperation as does a competent, spared valve, so even if neither the annulus nor valve can be spared, there may still be advantage in sparing as much of the infundibulum as possible.^{4,5} Though there may be advantage in leaving mild stenosis, there is obvious cost incurred by leaving too much stenosis, just as there is cost in leaving too little (an oversized transannular patch). Going too far with heroic valve-sparing efforts applied to the wrong valve can increase the composite risks posed by pulmonary stenosis and pulmonary insufficiency, and the effort can turn counterproductive by mid- or long term.⁶ Competing risks of volume load from insufficiency and pressure load from residual stenosis complicate intraoperative decisions, growth predictions, and have spawned numerous techniques aiming to optimize the annulus and adjacent territories north and south of the annulus.

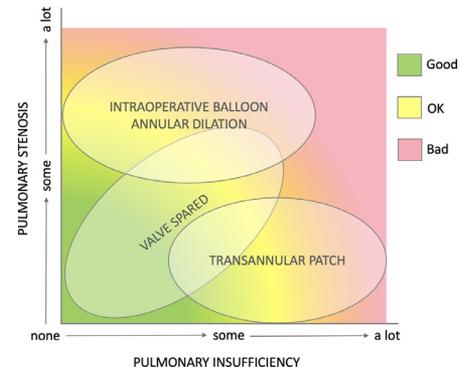
Hypothesizing that circumferential microdisruption of the annular fibrous skeleton may permit flow-responsive valve and annulus to grow and maintain competence, some recent enthusiasm for intraoperative balloon dilation now has maturing mid-term results to think about. Hofferberth et al, in a series of 162 patients, followed to 2.5 years, show intraoperative balloon annular dilation does not do much to preserve pulmonary valve function, results in RV dimensions equivalent to those with transannular patch, and possibly elevates risk for reintervention.⁷ The right ventricular end diastolic dimension in the study population

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Composite risk complicates the choice to spare the valve, annulus, or infundibulum.

Central Message

Comparison with a transannular patch cohort will be required to know if intraoperative balloon dilation of the annulus is more effective than a judicious transannular patch at tetralogy repair.

did not differ over time from a matched group who underwent a standard transannular patch approach, and progressive pulmonary insufficiency was also observed. An institution that formerly championed the method now questions its value.

María Lozano-Balseiro et al,⁸ in this issue of the *Seminars*, breathe new enthusiasm into the alchemistic idea that intraoperative balloon dilation turns a dysplastic annulus into a growing valve apparatus. Mid-term results are encouraging, with evidence for PV annular growth, and zero reinterventions at 3.75-year follow-up. These more encouraging results may come from more conservative patient selection as much as it comes from technique. The study excluded patients <3 months of age. The decision to proceed or not to a valve-sparing repair was made with a “combination of preoperative echocardiogram and intraoperative surgical inspection,” rendering patient selection more artform than protocol. Additionally, more aggressive annular stretching was performed than the Boston group, targeting a z-score of zero. Descriptive evidence suggests that a refinement of patient selection and an aggressive intraoperative annular dilation may yield greater success.

It is a lesson repeated in history many times that optimal results depend on developing criteria for appropriate patient selection. This point is reiterated by Lozano-Balseiro et al, whose work revisits intraoperative balloon dilation with results that deserve attention, though more work is needed before conclusions are firm.

Despite encouraging mid-term reintervention results, 21% of patients developed significant pulmonary insufficiency. Considering an approach that includes an infundibulotomy sufficiently large to close the Ventricular septal defect (leaving a nonintact infundibulum), and a significant incidence of pulmonary valve incompetence, the real question becomes whether the extra equipment and work involved with stretching and preserving a small fibrous ribbon of annular tissue, barely separating 2 patches, at the expense of some infundibular muscle, is any more effective than a modest transannular patch or infundibulum-sparing approach. The role of the infundibulum in preserving right ventricular physiology is recognized, and the value of preserving it intact or near intact may outweigh the value of preserving a fibrous annulus, especially if pulmonary insufficiency ensues by both approaches.⁵

The real answer to the question will require comparison of outcomes between a balloon-dilated annulus-sparing cohort and an infundibulum-sparing cohort or transannular patch cohort over time.

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