Commentary

Surgical repair of tetralogy of Fallot: the quest for the 'ideal' repair

Thierry Bové

Department of Cardiac Surgery, University Hospital of Gent, Gent, Belgium

Correspondence to: Thierry Bove, MD, PhD. Department of Cardiac Surgery, University Hospital of Gent, De Pintelaan 185, 5K12, 9000 Gent, Belgium. Email: Thierry.bove@ugent.be.

Provenance: This is a Guest Commentary commissioned by the Section Editor Xicheng Deng (Department of Cardiothoracic Surgery, Hunan Children's Hospital, Changsha, China).

Comment on: Simon BV, Swartz MF, Egan M, *et al*. Use of a Dacron Annular Sparing Versus Limited Transannular Patch With Nominal Pulmonary Annular Expansion in Infants With Tetralogy of Fallot. Ann Thorac Surg 2017;103:186-92.

Submitted Sep 25, 2016. Accepted for publication Oct 10, 2016.

doi: 10.21037/tp.2016.11.02

View this article at: http://dx.doi.org/10.21037/tp.2016.11.02

After more than 40 years' experience with surgical repair of tetralogy of Fallot (TOF), the focus centralized on the growing evidence that longstanding pulmonary insufficiency is deleterious for right ventricular function and clinical outcome. This subsequently enhanced the search for surgical techniques aiming to relief the right ventricular outflow tract (RVOT) obstruction, while minimizing the degree of pulmonary regurgitation (PR).

In this paper, Simon and colleagues reported on their results of primary complete repair in 94 TOF infants, using either a limited transannular RVOT reconstruction with a Dacron patch tailored to a nominal pulmonary annulus expansion, or an annulus-sparing approach (1). As expected, the pulmonary annulus size was preoperatively larger in infants treated with the latter technique. After a mean follow-up of approximately 8 years, a more than moderate PR was noticed more frequently in the first group, 50.4% versus 30.9%, however without reaching a significant difference in freedom from severe PR at 10 years (73.5% versus 93.2%). In addition, there was no significant difference in dilation of the right ventricle between both techniques, by measuring the normalized z-value of the basal RV diameter. They finally concluded that RVOT reconstruction in TOF, using only a limited transannular incision and a stiff Dacron patch, that restricts the pulmonary annulus expansion during the natural growth process, affords the same long-term perspective as in instances where the entire pulmonary annulus integrity can be preserved.

This paper is in line with recent publications, advocating surgical repair of TOF by avoiding as much as possible a right ventricular incision and preserving pulmonary valve function (2-5). Presently, TOF repair should consist of a transatrial transtricuspid approach to close the ventricular septal defect and to resect the obstructive infundibular muscle bundles, and a transpulmonary access to tackle the pulmonary valve component and eventually the hypoplasia of the pulmonary artery. Of course, the type and extent of RVOT reconstruction is mainly dictated by the morphology of the RVOT, bearing in mind that the primary goal of TOF repair is still the maximal relief of the obstructive RV physiology. This inherently implicates that, in presence of a hypoplastic pulmonary annulus, a transannular extension of the incision is required, followed by annulus enlargement through adding a patch. The way that all these features are conceived, both at the time of decision-making for correction as well as at the moment of the operative repair itself, can make the ultimate difference for the long-term outcome of each individual child with TOF. Referring this statement to the work of Simon *et al*. (1), a few issues hereon need to be addressed.

(I) How to define a pulmonary annulus to be too small? Hypoplasia of a cardiac structure like a valve in pediatric cardiology, is usually expressed in z-value, being the deviation of the observed measurement from the mean value, taking account of the size and age of the overall population (6). In general, a pulmonary annulus yielding a z-value <–2, is considered to be hypoplastic. Here, repair will require a transannular incision to relief otherwise the inevitable residual stenosis when left intact, in presence

of a sustained, full cardiac output. The debate becomes interesting for the pulmonary annulus with a z-score of –1 or –2. Transannular patching is still the most reliable option, although intra-operative balloon dilation of the pulmonary annulus has been forwarded as a promising additional tool (7,8). When the pulmonary annulus is nearly of the appropriate size, carrying a z-value of –1 to 0, preservation of the pulmonary valve should be pursued.

(II) The second question concerns the extent of transannular incision towards the right ventricle, when the native pulmonary annulus is deemed to be too small. According to Simon *et al*. (1), a maximal effort to spare the infundibulum is recommended. However, it is surprising that still an infundibular incision is made, even when the pulmonary valve annulus is maintained. Previous investigation in an animal model mimicking the physiology of TOF, has pointed to the important contribution of the preserved integrity of the infundibulum, on the global systolic RV function as well as for its accommodating effect on the chronic PR-related volume-overload (9). Moreover, an infundibulum-sparing approach yields a superior clinical perspective than the classical transannular patch repair, by minimizing the severity of chronic and ongoing pulmonary insufficiency (3). Therefore, any surgical damage of the RV, even when it only is limited to the infundibulum, should be avoided to anticipate immediate and progressive RV dysfunction, certainly when it is already subjected to PR (9,10).

(III) The choice of patch tissue and patch amplitude becomes primordial when a transannular patch is needed. Simon *et al*. are preferring the use of a non-distensible tissue graft (1), whereas in many cases reconstruction is performed with autologous pericardial tissue. Although they claim the static and inert character of this patch material as main advantage in relation to later growth of the native pulmonary annulus, another advantage of the lack of distensibility might be related to the decreased capacitance effect at the level of the pulmonary artery, in co-existence of significant PR. Kilner *et al*. demonstrated the relationship between pulmonary arterial compliance and proximal/distal resistance, and its effect on PR (11). Consequently, it is assumable that a patch with increased distensibility enhances the volume-loading effect on the RV in the long-term. In addition, as the magnitude of PR is directly proportional to the size of the regurgitant orifice, the basal width of the transannular patch should be tailored to enlarge the native pulmonary annular orifice just to the predicted pulmonary annulus adjusted for age and size of the infant (12).

The study of Simon *et al*. (1) is valuable as it endorses the efforts during surgical RVOT reconstruction, to anticipate on the chronic inconvenience of PR on RV dynamics, as principal determinant of late adverse outcome in TOF patients. However, the study also entails two side-notes. First, the follow-up time in this study is undeniably too preliminary to support the enthusiasm on their surgical approach, bearing in mind that patients operated on in former eras, usually with large transannular patches, were often clinically doing well for more than one decade. Secondly, to objectivate the superiority of a surgical policy on ventricular function, more advanced imaging techniques like nuclear magnetic resonance, are mandatory in the follow-up of TOF, since the quantification of PR and RV dilation or dysfunction by solely echocardiography is strongly subjected to erroneous interpretation.

Acknowledgements

None.

Footnote

Conflicts of Interest: The author has no conflicts of interest to declare.

References

1. Simon BV, Swartz MF, Egan M, et al. Use of a Dacron Annular Sparing Versus Limited Transannular Patch With Nominal Pulmonary Annular Expansion in Infants With Tetralogy of Fallot. Ann Thorac Surg 2017;103:186-92.
2. Karl TR, Sano S, Pornviliwan S, et al. Tetralogy of Fallot: favorable outcome of nonneonatal transatrial, transpulmonary repair. Ann Thorac Surg 1992;54:903-7.
3. Bové T, François K, Van De Kerckhove K, et al. Assessment of a right-ventricular infundibulum-sparing approach in transatrial-transpulmonary repair of tetralogy of Fallot. Eur J Cardiothorac Surg 2012;41:126-33.
4. Stewart RD, Backer CL, Young L, et al. Tetralogy of Fallot: results of a pulmonary valve-sparing strategy. Ann Thorac Surg 2005;80:1431-8; discussion 1438-9.
5. van den Berg J, Hop WC, Strengers JL, et al. Clinical condition at mid-to-late follow-up after transatrial-transpulmonary repair of tetralogy of Fallot. J Thorac Cardiovasc Surg 2007;133:470-7.
6. Sluysmans T, Colan SD. Theoretical and empirical derivation of cardiovascular allometric relationships in

children. J Appl Physiol (1985) 2005;99:445-57.
7. Robinson JD, Rathod RH, Brown DW, et al. The evolving role of intraoperative balloon pulmonary valvuloplasty in valve-sparing repair of tetralogy of Fallot. J Thorac Cardiovasc Surg 2011;142:1367-73.
8. Vida VL, Padalino MA, Maschietto N, et al. The balloon dilation of the pulmonary valve during early repair of tetralogy of Fallot. Catheter Cardiovasc Interv 2012;80:915-21.
9. Bove T, Bouchez S, De Hert S, et al. Acute and chronic effects of dysfunction of right ventricular outflow tract components on right ventricular performance in a porcine model: implications for primary repair of tetralogy of fallot. J Am Coll Cardiol 2012;60:64-71.
10. d'Udekem Y, Ovaert C, Grandjean F, et al. Tetralogy of Fallot: transannular and right ventricular patching equally affect late functional status. Circulation 2000;102:III116-22.
11. Kilner PJ, Balossino R, Dubini G, et al. Pulmonary regurgitation: the effects of varying pulmonary artery compliance, and of increased resistance proximal or distal to the compliance. Int J Cardiol 2009;133:157-66.
12. Uebing A, Fischer G, Bethge M, et al. Influence of the pulmonary annulus diameter on pulmonary regurgitation and right ventricular pressure load after repair of tetralogy of Fallot. Heart 2002;88:510-4.

Cite this article as: Bové T. Surgical repair of tetralogy of Fallot: the quest for the 'ideal' repair. Transl Pediatr 2017;6(1):64-66. doi: 10.21037/tp.2016.11.02