

Editorial Comment

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Not just palliation: integrating patent ductus arteriosus and right ventricular outflow tract stenting into modern surgical pathways for tetralogy of Fallot

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Tetralogy of Fallot remains one of the most prevalent cyanotic CHDs. In its most severe phenotypes—characterised by marked anterior deviation of the conal septum and significant pulmonary valve abnormalities ranging from critical stenosis to functional atresia—patients often present with profound cyanosis and hypoplastic pulmonary arteries.

In such extreme anatomical settings, primary complete repair is frequently not feasible. A palliative strategy aimed at improving systemic oxygen saturation, promoting pulmonary artery growth, and allowing somatic development therefore represents the preferred initial approach. In contemporary practice, however, the clinical dilemma is no longer whether palliation is required, but rather which palliative strategy best aligns with the anticipated surgical pathway and long-term right ventricular outcome. Although the systemic-to-pulmonary arterial shunt has historically played a central role in relieving cyanosis, its limitations are well recognised. Distortion of the pulmonary arteries, non-uniform branch growth, and shunt-related morbidity may negatively influence the feasibility and quality of subsequent definitive repair.^{1,2}

Over the past two decades, the emergence of transcatheter palliative techniques—most notably patent ductus arteriosus stenting and right ventricular outflow tract stenting—has substantially reshaped the palliative landscape. In parallel, surgical strategies for tetralogy of Fallot have evolved, with increasing attention to timing, valve preservation, and long-term right ventricular function. Consequently, palliation should no longer be considered an isolated step, but rather an integral component of a comprehensive, patient-specific surgical plan.³

Rai and colleagues⁴ presented a large single-centre experience with right ventricular outflow tract stenting in patients with Fallot-type physiology. Their report confirms the versatility of this technique, which can be applied across a wide age spectrum and in heterogeneous anatomical substrates, provided that anatomical and functional continuity between the right ventricle and pulmonary arteries is preserved. Importantly, right ventricular outflow tract stenting was not limited to the neonatal period but extended to older infants and children presenting with hypoxic spells, late referral, severe pulmonary artery hypoplasia, or unfavourable conditions for early definitive repair. In these scenarios, right ventricular outflow tract stenting effectively served as either a bridge to decision-making or a bridge to optimal surgery.

Symmetric and harmonious growth of the pulmonary arteries is a cornerstone for successful definitive repair. Therefore, the selection of the initial palliative strategy must prioritise its impact on pulmonary artery development. Patent ductus arteriosus stenting, when used as first-line palliation in duct-dependent pulmonary circulation, has demonstrated efficacy comparable to the modified Blalock–Taussig shunt in improving oxygen saturation, while showing superiority in promoting homogeneous pulmonary artery growth.⁵ By preserving the native right ventricular outflow tract and pulmonary valve apparatus, patent ductus arteriosus stenting maintains greater surgical flexibility, particularly for valve-sparing strategies.

This approach is most effective during the first two to three weeks of life, when the ductus arteriosus remains sufficiently compliant to allow uniform stent expansion. Beyond the neonatal period, late ductal recanalisation may be associated with stent fracture, early in-stent restenosis, and neointimal proliferation. These limitations become clinically relevant when the patent ductus arteriosus represents the sole source of pulmonary blood flow and when palliation is required for more than four to six months. In addition, ductal tortuosity and associated branch pulmonary artery stenoses may result in uneven pulmonary blood flow and asymmetric arterial growth.

Similarly, right ventricular outflow tract stenting should not be viewed merely as an alternative to the surgical shunt, but rather as a physiologically oriented strategy. By relieving infundibular and valvar obstruction, right ventricular outflow tract stenting restores pulsatile antegrade flow from the right ventricle to the pulmonary arteries. This more physiological haemodynamic profile has been consistently associated with more balanced pulmonary artery growth compared with surgical shunts. In the comparative study by Quandt *et al.*,⁶ patients undergoing right ventricular outflow tract stenting exhibited significantly greater pulmonary

artery growth, assessed by Z-scores, and required pulmonary artery plasty less frequently at the time of definitive repair than those palliated with a modified Blalock–Taussig shunt.⁶ These observations have been corroborated by other series.

Despite its advantages, right ventricular outflow tract stenting is not universally applicable. A major limitation is the potential compromise of the pulmonary valve, which may preclude future valve-sparing surgical approaches. Accordingly, ideal candidates include neonates and infants with a patent but critically stenotic right ventricular outflow tract, low body weight or clinical instability, severe pulmonary valve hypoplasia unsuitable for conservative repair, coronary artery anomalies necessitating conduit placement, or clinical scenarios requiring a prolonged bridge to surgery exceeding nine months. Beyond anatomy, the anticipated timing to definitive repair represents a pivotal determinant in selecting between patent ductus arteriosus and right ventricular outflow tract stenting.

Unlike patent ductus arteriosus stenting, right ventricular outflow tract stenting can be safely considered beyond the neonatal period, as demonstrated by Rai *et al.*⁴ Furthermore, the use of peripheral balloon-expandable stents allows for subsequent redilatation in line with somatic growth, an important advantage over coronary stents. Covered stents have been proposed to reduce neointimal proliferation and facilitate surgical removal, although current evidence does not suggest a meaningful impact on the timing of definitive repair.⁷ Bioresorbable stents may represent a future option, but adequate radial strength remains essential to counteract dynamic muscular obstruction of the right ventricular outflow tract.

A 2021 meta-analysis by Ghaderian *et al.*,⁸ including 354 patients from ten studies, reported an overall procedural success rate of 93.6% for right ventricular outflow tract stenting. The analysis confirmed its clinical effectiveness and non-inferiority compared with surgical shunts in terms of pulmonary artery growth and oxygen saturation improvement, while also demonstrating lower post-procedural morbidity and mortality.⁸

In summary, patent ductus arteriosus stenting and right ventricular outflow tract stenting should be regarded as complementary transcatheter palliative strategies rather than competing alternatives. In patients in whom both options are technically feasible, a shared decision-making process involving interventional cardiologists and congenital cardiac surgeons is essential. From a

surgical perspective, the choice of palliation should not impose constraints on the definitive repair, but rather facilitate the most physiological and durable corrective strategy. Consideration of patient age, anticipated timing of repair, and the planned surgical approach allows palliation to be tailored to the individual patient, thereby optimising both short- and long-term outcomes. Ongoing refinements in device technology, imaging guidance, and patient selection are likely to further consolidate the role of transcatheter palliation as an integral component of individualised surgical pathways.

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References

1. Petrucci O, O'Brien SM, Jacobs ML, *et al.* Risk factors for mortality and morbidity after the neonatal Blalock–Taussig shunt procedure. *Ann Thorac Surg* 2011; 92: 642–652.
2. Savla JJ, Faerber JA, Huang Y-SV, *et al.* 2-year outcomes after complete or staged procedure for tetralogy of Fallot in neonates. *J Am Coll Cardiol* 2019; 74: 1570–1579.
3. Expert Consensus Panel, Miller JR, Stephens EH, *et al.* The American Association for Thoracic Surgery (AATS) 2022 expert consensus document: management of infants and neonates with tetralogy of Fallot. *J Thorac Cardiovasc Surg* 2023; 165: 221–250. DOI: [10.1016/j.jtcvs.2022.07.025](https://doi.org/10.1016/j.jtcvs.2022.07.025).
4. Rai P, S.V. K, Khan MUD, *et al.* Results of right ventricular outflow tract stenting as a primary palliation in symptomatic children having Fallot type of lesion. *Cardiol Young* 2026; 35: 1–7. DOI: [10.1017/S104795112511055X](https://doi.org/10.1017/S104795112511055X).
5. Santoro G, Capozzi G, Caianiello G, *et al.* Pulmonary artery growth after palliation of congenital heart disease with duct-dependent pulmonary circulation: arterial duct stenting versus surgical shunt. *J Am Coll Cardiol* 2009; 54: 2180–2186. DOI: [10.1016/j.jacc.2009.07.043](https://doi.org/10.1016/j.jacc.2009.07.043).
6. Quandt D, Ramchandani B, Stickley J, *et al.* Stenting of the right ventricular outflow tract promotes better pulmonary arterial growth compared with modified blalock-taussig shunt palliation in tetralogy of Fallot-type lesions. *JACC Cardiovasc Interv* 2017; 10: 1774–1784. DOI: [10.1016/j.jcin.2017.06.023](https://doi.org/10.1016/j.jcin.2017.06.023).
7. Luxford JC, Adams PE, Roberts PA, *et al.* Right ventricular outflow tract stenting is a safe and effective bridge to definitive repair in symptomatic infants with tetralogy of fallot. *Heart Lung Circ* 2023; 32: 638–644. DOI: [10.1016/j.hlc.2023.02.010](https://doi.org/10.1016/j.hlc.2023.02.010).
8. Ghaderian M, Ahmadi A, Sabri MR, *et al.* Clinical outcome of right ventricular outflow tract stenting versus Blalock–Taussig shunt in tetralogy of Fallot: a systematic review and meta-analysis. *Curr Probl Cardiol* 2021; 46: 100643. DOI: [10.1016/j.cpcardiol.2020.100643](https://doi.org/10.1016/j.cpcardiol.2020.100643).