resulting in an aneurysm-like ventricular chamber no longer contributes to antegrade flow.⁶ The enlarged infundibulum in combination with distal stenosis may lead to RVOT turbulence and loss of kinetic energy further negatively contributing to RV remodeling. In contrast, an inverse trapezoid shape may reflect preservation of a relatively small (but contractile) infundibulum and supra-annular patching of the PA. Proximal stenosis leaving segments that are not actively contributing to forward flow distal also reduces regurgitation in part due to a more restrictive ventricular physiology.

Unfortunately, Shen and colleagues³ lack an analysis of the results with regard to the surgical strategy. More details on the surgical approach are needed to better understand the relationship between the chosen strategy and the subsequent morphology of the RVOT and to guide intraoperative decision making. It is also unfortunate that instead of using 3-dimensional data, only lateral-view measurements were analyzed for their main results. Although they report correlation between frontal and lateral measurements, they also stress that diameters of the RVOT and mid main PA were larger in lateral projections, but diameters of the pulmonary valve annulus and distal main PA were smaller compared with frontal

projections. The hemodynamic relevance of the RVOT geometry and how it should influence surgical strategy can only be fully understood if the RVOT is captured in its entirety.

Long-term outcome of ToF is determined by the RVOT as many previous studies have already proven. Shen and colleagues³ stress once again that it is time to pay tribute to that misunderstood chamber called the right ventricular infundibulum.

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Commentary: More is not always better

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Advanced cardiac imaging provides ever-increasing amounts of anatomic and physiologic data on congenital heart disease. As with many things in life, more is not always better. To surgeons, more data are better when they inform our decision making and thus improve surgical outcomes.

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CENTRAL MESSAGE

Advanced cardiac imaging provides ever-increasing amounts of data on congenital heart disease. Practical application of these data by surgeons is not always straightforward.

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Shen and colleagues¹ use cardiac magnetic resonance imaging in patients with repaired tetralogy of Fallot (TOF) to associate 4 unique right ventricular outflow tract (RVOT) morphologies with varying levels of ventricular remodeling. Although prior studies have described the characteristics of RVOT morphologies following reconstruction, this study adds the correlations of distinct geometric categories with right ventricular volume and QRS duration. Additionally, they show that size discrepancy between the branch pulmonary arteries is associated with worse long-term exercise capacity.¹

Although well addressed by the authors, this study has limitations. There is no consistency in the time from cardiac magnetic resonance imaging to exercise capacity evaluation. The authors assert that because the time intervals were similar in patients with branch pulmonary artery (PA) discrepancy to those without, the influence of PA size discrepancy on exercise capacity is valid. This does not seem to adequately address the difference in the exercise capacity over time. Other factors not specific to RVOT and PA geometry that could influence performance on exercise testing include residual lesions, left ventricular dysfunction, atrioventricular valve regurgitation, noncardiac lung pathologies,^{2,3} and neurocognitive function.⁴ It is also notable that patients unable to achieve a maximal exercise effort were excluded from the analysis, which seems to impose a type of selection bias. The correlation of exercise capacity as a marker of functional status with RVOT morphology and branch PA anatomy would be more useful if the authors had controlled for confounding factors and included all exercise data, even the poor performers.

When considering applicability of this study, it is important to note that the authors describe a homogeneous population that does not represent the entire spectrum of patients with repaired TOF. All patients in this cohort underwent transventricular repair with a patch and had significant residual pulmonary insufficiency. However, there are a variety

of techniques that can be employed to repair TOF and many surgeons utilize a right atrial approach to avoid potential deleterious effects of a ventriculotomy.^{5,6} Additionally, the mean age at complete repair in this study is 2.5 years and does not include any infant or neonatal repairs, which are not uncommon in the current era.^{7,8}

In their conclusion, the authors endorse a proactive approach to branch PA stenosis and less-extensive incision/patching of the RVOT as beneficial for preservation of mechanics, without making a practical association to the geometric categories they defined. This does not seem novel or additive to the surgical literature. The article is well composed, and the findings could prove helpful for device development and percutaneous intervention in the RVOT. That said, it remains to be seen how we can use the data in this study to improve surgical outcomes.

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