postponing complete repair negatively impacts brain growth and language development[7]; and patient factors may be more important than operative factors in predicting neurodevelopmental outcomes.[8]

I congratulate the authors on a timely, thought-provoking article.

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Commentary: Is there still a role for the systemic-to-pulmonary artery shunt in tetralogy?

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CENTRAL MESSAGE

Although most tetralogy infants are amenable to primary repair, there exists at-risk neonates who benefit from staged palliation followed by complete repair.

The surgical treatment of tetralogy of Fallot (TOF) remains a great success story with the introduction of a palliative systemic-to-pulmonary artery shunt by Drs Blalock, Thomas, and Taussig[1] followed with complete surgical repair by Lillehei and colleagues.[2] Now, more than 70 years after initial surgical repair, there continues to be considerable debate over the optimal timing of repair of this lesion.

Although most centers agree with elective complete repair at the age of 3 to 6 months, the real controversy is what to do with the symptomatic neonate. Proponents of a 2-stage approach with neonatal palliation followed by complete repair cite benefits including increased somatic growth leading to a higher preservation of the pulmonary valve, avoidance of cardiopulmonary bypass and/or deep hypothermic circulatory arrest in the neonatal period, less risk of reoperation, lower rates of morbidity, and shorter length of hospital stay.[3,4]

In this issue of *The Journal of Thoracic and Cardiovascular Surgery*, Zurakowski and Jonas[5] present their expert opinion supporting early primary repair of TOF as well as

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suggest reasons they believe the Blalock-Taussig shunt is making a resurgence. The authors cite 3 generally accepted advantages for early primary repair. The first is the establishment of a biventricular circulation. With the elimination of the ventricular septal defect, the right ventricle will ostensibly have less hypertrophy, with implications for improved diastolic compliance in the long term. Another advantage of a biventricular repair is normal oxygen and substrate delivery to the still developing brain and other organs. The second advantage of early repair is the reduction of psychological burden experienced by the parents of children who are palliated but not yet definitively repaired. Finally, early primary repair might have a lower mortality rate and reduced cost compared with a 2-stage approach. The authors should be commended for presenting a strong argument advocating for early primary TOF repair.

Zurakowski and Jonas then speculate about several causes for a migration away from early primary repair. These causes include a focus on early hospital mortality, a focus on the numbers of cases surgeons and hospitals are performing (termed "data analytics"), and the limitations of administrative databases. A final possible cause for the reduction in the number of early repairs is that the way congenital surgeons are being trained is evolving. All of the scrutiny given to short-term outcomes complicates the maturation of technical skills required to perform neonatal heart surgery. It is important to remember this is an opinion piece, and, although interesting, these speculations might not have anything to do with the decision to palliate a neonatal TOF. As the authors have published in the past,[6] other factors such as prematurity, low birth weight, extracardiac anomalies, and nonelective surgery increase morbidity and hospital resource utilization when patients undergo early primary TOF repair and these factors should play a role in the surgical decision-making.

The argument for a 2-stage approach is supported in the literature. Recently, Mahajan and colleagues[7] reported their near 20-year experience with a strategy of using a systemic-to-pulmonary shunt in all neonates and young infants requiring early surgical TOF intervention. In their 59 patients they notably reported a pulmonary valve-sparing repair in 42%, a 5% incidence of arrhythmia, and a freedom from reoperation of 87% and 82% at 5 and 10 years, respectively. Bailey and colleagues[3] presented their experience with managing neonatal TOF with either primary repair or a staged approach. Although mortality was similar between the 2 strategies, the neonatal primary repair group had longer cardiopulmonary bypass and deep hypothermic circulatory arrest, as well as higher rates of early morbidity. Of note, there was no difference in total intensive care unit time, hospital length of stay, or reintervention rate in a comparison of the 2 treatment pathways. Other institutions have reported similar successes in using a staged strategy.[4,8,9]

In conclusion, the correct pathway for surgical management of a neonate with symptomatic TOF continues to be surgeon/institution driven with literature supporting both strategies. Our preference has been early primary repair in patients with no other anomalies and good-sized branch pulmonary arteries. In the presence of prematurity, low birth weight, coronary anomalies, small branch pulmonary arteries, or extracardiac anomalies, we believe these neonates are better served with a staged approach including either ductal stenting or systemic-to-pulmonary artery shunt followed by complete repair.

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