Commentary: Unlocking the enigma of neurobehavioral abnormalities after surgery for congenital heart disease

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Central Message

An animal model of fetal hypoxia might provide important understanding of potential neurological sequelae in patients with congenital heart disease.

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With mortality rates decreasing due to advances in surgical and perioperative care of patients with congenital heart disease (CHD), the focus has shifted from survival to functional outcomes, in particular neurobehavioral function. Although it has been well established that young children undergoing interventions to treat CHD are at risk for neurodevelopmental issues, important gaps in knowledge limit our understanding of the etiologic mechanisms and therefore our ability to mitigate or prevent such issues. The Boston Circulatory Arrest Study represents the first effort to determine best practices aimed to understand the potential effect of operative strategies and improve neurodevelopmental outcomes.¹ On the basis of the findings, significant attention was paid to perfusion strategies during a very narrow window in the episode of care. However, despite some modifications in perfusion practice, no effect on neurobehavioral outcomes was shown. Moreover, a follow-up study of this cohort showed that regardless of the strategy chosen, the outcomes were not too dissimilar. More importantly it seemed that each perfusion strategy was associated with specific neurobehavioral issues, which set these patients apart from other children.²

The notion that certain types of CHD can be associated with preexisting neurological lesions has been well documented in the recent era, supporting the notion that there is a lot more to neurodevelopmental outcomes than the mode of circulatory support during surgery. The presence of periventricular leukomalacia or stroke before any intervention speak to the fact that perhaps abnormal circulatory patterns, with or without hypoxia, could play a significant role in the genesis of neurobehavioral issues.^{3,4} In addition, the association of microcephaly with aortic atresia and delayed brain maturation in patients with CHD compared with control neonates provide additional support to the notion that prenatal injury might be a significant contributor to the neurodevelopmental sequelae that affect some children with CHD.⁵

In light of this compelling evidence, the logical approach would seem to be to study a variety of factors that might

influence brain development in utero. The work presented by Lawrence and colleagues⁶ in this issue of *The Journal of Thoracic and Cardiovascular Surgery* represents an important initial step in that direction. The availability of a fetal model provides a unique opportunity to study the effect that abnormal circulatory patterns and ultimately decreased oxygen delivery might have in the developing brain, on different cell lines and perhaps create an opportunity to study strategies to ameliorate or eliminate some of the debilitating neurobehavioral sequelae that continue to affect some of these patients. It is entirely possible that this work might be the key to amplify our understanding and define best practices to achieve the best functional outcome for our patients.

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