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The Need to Understand Brain Health and Improve Brain Outcomes for Children and Adolescents Warrants Adoption of a More Proactive Approach to Brain Monitoring

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Cerebral ischemia and stroke occur with the use of pediatric extracorporeal membrane oxygenation (ECMO) but strategies to mitigate these complications are lacking (1). A number of factors are contributory. First, while an important therapeutic and life saving treatment, the number of children who seek medical attention and require ECMO is small. Second, is the challenge that regardless of disease burden, brain monitoring has not yet realized its technological and clinical utility in the care of children with critical illness or who are at risk of neurological deterioration. This includes children and adolescents who are critically ill, under general anesthesia or receiving procedural sedation. Third, scientifically rigorous research examining the role and value of neuromonitoring in pediatrics is lacking. Fourth, there are challenges with contextualizing findings from the published studies because of the paucity of understanding of normal cerebrovascular physiology. Fifth, the effect of age and sex are understood in a limited manner, making it difficult to compare data from disease states to that of healthy normal children. Sixth, in the absence of robust data from children and adolescents, comparisons are sometimes made between disease states in children with normative data in adults, rendering data interpretation problematic. Seventh, the culture in pediatric medicine tends to be more conservative and careful than in adult medicine where there is a greater culture of monitoring in general. Eighth, there may be a feeling that even if we do no not deliver optimal and titrated care, plasticity and development processes will rectify any potential problems. Ninth, many pediatric hospitals do not have infrastructure or expertise for advanced brain monitoring, making it difficult for researchers to conduct this type of research. Finally, the practice of pediatric medicine has structurally become very siloed with separate hospitals and few opportunities for joint educational sessions, leaving few opportunities for synergy in innovation. Collectively, these factors may limit the progress we are able to make in understanding how to optimize brain health in the most vulnerable children.

Despite these challenges, O'Brien and colleagues present results of a prospective observational multicenter study describing changes in cerebrovascular physiology during pediatric ECMO in this edition of the journal (2). They should be congratulated for

assembling a group of interested sites from across the nation to address what would otherwise be an orphaned question, which is to understand if the use of transcranial Doppler (TCD) ultrasonography can be used to identify those patients at risk of acute neurological injury. The authors did not conclusively achieve this goal and there were no patients with cerebral hemorrhage. However, their findings that middle cerebral artery flow velocities are significantly lower than published normative values for critically ill, mechanically ventilated, sedated children does advance our understanding of the effect of ECMO on estimates of cerebral perfusion. The fact that higher pulsatility index occurred among those with acute neurological injury not only suggests that pulsatility index may be a marker but also may shed some light on the role of ECMO on cerebrovascular resistance. A number of design factors may have strengthened this study such as standardization of the clinical scenario and medications used but this was beyond the scope of this preliminary study. The authors correctly acknowledge the need for a larger study with strong interrater reliability, larger sample size, and a greater understanding of venous-venous ECMO on cerebral vasculature.

The use of TCD ultrasonography has been used in pediatric medicine in a few conditions, and there are opportunities to advance the use of this technology for other conditions. Transcranial Doppler ultrasonography is recognized to prevent stroke in sickle cell anemia (3) which means that most children's hospitals have vascular technologists who can be engaged in other clinical settings. Transcranial Doppler studies in brain death, cardiac arrest, sepsis, diabetic ketoacidosis and traumatic brain injury have shown abnormalities in estimated cerebral perfusion (4–8). Yet, even in these conditions, TCD use is not common. Despite limitations, the non-invasive nature and the ability to perform repeated examinations suggests that expanding the use of TCD represents a unique opportunity to improve brain outcomes in children at risk of neurological injury.

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