

NEUROCRITICAL CARE**Cerebral Oxygen Saturation in Pediatric Patients On ECMO**Elizabeth Mayne MD PhD¹ and Andrea C. Pardo MD^{1*}¹Department of Neurology, Lurie Children's Hospital of Chicago, Chicago, IL*Correspondence: Andrea C. Pardo, E-mail: apardo@luriechildrens.org**Related Article:** Tsou PY, Garcia AV, Yiu A, Vaidya DM, Bembea MM. Association of Cerebral Oximetry with Outcomes after Extracorporeal Membrane Oxygenation. *Neurocrit Care*. 2020 Oct;33(2):429–37.**Keywords:** ECMO; NIR Spectroscopy; Neurocritical care

Investigators from Johns Hopkins University School of Medicine report that decreased cerebral regional oxygenation saturation (rSO₂) was associated with higher mortality and poor short-term neurologic outcomes in children supported on extracorporeal membrane oxygenation (ECMO). This single-center, retrospective cohort study included a total of 153 PICU patients with a median age of 12.5 days (range 2 days to 15 months), most of whom were on veno-arterial ECMO for a median of 5.2 days. Only 36.5% of the patients survived to hospital discharge, and the authors evaluated the survivors' neurologic outcome using the pediatric cerebral performance score at discharge. Neonates had more favorable outcomes than other age groups. In a multivariate analysis, the authors found that individual rSO₂ readings below established thresholds ($\leq 40\%$ and $\leq 50\%$); decrease of 20% or more from baseline rSO₂; and cumulative percentage of the ECMO run with rSO₂ below the above thresholds were associated with worse neurologic outcomes (defined as PCPC ≥ 3 , where 1 is normal and 5 is brain death). Secondary outcomes included mortality and abnormal neuroimaging within 6 weeks of the ECMO run. Children who died prior to discharge were more likely to have had rSO₂ values below 40 or 50%, or an rSO₂ drop of at least 20% during their ECMO course. Most patients underwent neuroimaging (CT, MRI, and/or cranial ultrasound) within 6 weeks of their ECMO run; 43.7% of those who underwent neuroimaging had abnormalities, mostly ischemic stroke, intracranial hemorrhage, and/or hypoxic ischemic injury. After adjusting for confounding factors, the authors found that any rSO₂ reading $\leq 50\%$ or a decline of $> 20\%$ were associated with abnormal imaging. [1]

COMMENTARY. Children on ECMO are at a high risk of neurologic injury [2], but they often require significant sedation and neuromuscular blockade, limiting the sensitivity of the neurologic exam to detect neurologic dysfunction. Neuroimaging other than head ultrasound or portable CT is frequently not possible. Consequently, there is a clear need to identify modifiable risk factors for poor neurologic outcomes and bedside neuromonitoring technologies that could provide clinically actionable data. rSO₂ has been shown to improve neurologic outcomes after cardiac surgery, and this study suggests that it may also be useful in children on ECMO. Many confounding factors contribute to neurologic outcomes

in ECMO (age, ECMO indication, underlying comorbidity, etc.), and one of the study's strengths is the large sample size that enabled the authors to control for some of these factors. [3]. This suggests that children whose ECMO shows marked low rSO₂ should have an established plan for monitoring of neurologic status after ECMO, whether as an inpatient consultation or outpatient referral. In the appropriate clinical context, consistently low rSO₂ or significant rSO₂ drop in heavily sedated or paralyzed patients might indicate portable neuroimaging where available. If bedside cranial ultrasound or CT while on ECMO is not feasible, a post-decannulation neurologic exam may help triage the timing and necessity of imaging.

Because of the study's retrospective nature, the authors could not demonstrate whether the low rSO₂ values mediate poor neurologic outcome and mortality or if systemic illness causes neurologic injury and rSO₂ is simply a marker of global illness severity. For example, in situations of supply-demand mismatch such as hypotension or hypoxemia, a low rSO₂ likely reflects a condition that would cause neurologic injury if left unchecked, and interventions to alleviate or reverse the pathology would be expected to improve neurologic outcomes. Conversely, rSO₂ may also change following hemorrhage or stroke, in which the injury has already occurred, and the low rSO₂ is symptomatic, rather than causative, of the injury. The authors have established that rSO₂ monitoring in children on ECMO has a role in detecting neurologic injury; prospective studies will be required to determine whether rSO₂-directed interventions can also prevent neurologic injury in this population.

Disclosures

The authors have declared that no competing interests exist.

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