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Pediatric Neurocritical Care: From Field to Follow-Up

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Over the last few decades pediatric care has become increasingly subspecialized as the breadth and depth of knowledge of how to care for children expands. Pediatric critical care emerged as a subspecialty in the 1980s. More recently, pediatric neurocritical care has gained momentum as its own subspecialty focused on managing acute neurologic diseases and injuries.^{1,2} Providers have established important clinical pathways for improving patient care and neurologic outcomes in the pediatric intensive care unit (PICU),^{3–6} and there is increasing pediatric presence at a number of intradisciplinary national and international meetings and consortiums focusing on traumatic brain injury, status epilepticus, and stroke. The subspecialty is expanding with an appreciation for the role of neurocritical care in preserving the integrity of the brain and nervous system during all critical illnesses. This has shaped pediatric neurocritical care into a multidisciplinary prism channeling input from providers in pediatric neurology, critical care, neurosurgery, and others, in a common direction to improve patient outcomes. A patient's recovery cannot occur in silos and instead requires awareness and integration of all aspects of patient care. Toward this goal, we brought together a multidisciplinary group of providers, including the first responders, nurses, neurosurgeons, critical care pediatricians, and neurologists to the first Pediatric Neurocritical Care Symposium: From Field to Follow-up to discuss the full spectrum of care for children with neurocritical illnesses.

In this focus issue, we want to share the perspectives and lessons learned from the Pediatric Neurocritical Symposium, hosted by St. Louis Children's Hospital and Washington University School of Medicine on April 5, 2019. The speakers and authors cover considerations in trauma, the leading cause of childhood mortality. Cerebrovascular injury resulting from head trauma is discussed in the article by Galardi et al.⁷ The authors note how neurologists can aide in neurologic screening, as strokes may occur in the days to weeks after the initial injury, and discuss considerations for optimizing neuroprotection when competing priorities from multiorgan injury exist.

The symposium and this focus issue also examine medically complex patients from a neurocritical care perspective. Resuscitative science, following cardiac arrest and using extracorporeal membrane oxygenation (ECMO), has improved survival but has done so with

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neurologic risks. Smith and Friess⁸ review the present state of cardiac arrest care and its impact on long-term outcomes. Said et al.⁹ explore the present state and future directions of neuromonitoring in ECMO. EEG has demonstrated utility as a neuromonitoring tool for diagnosing seizures¹⁰ and informing prognosis^{11,12} in ECMO, cardiac arrest, and other complex systemic diseases. These and other indications for EEG monitoring that move beyond seizure detection are discussed in the article by Griffith et al.¹³

The field of neurocritical care is moving at a rapid pace, and these reviews discuss many exciting new areas of research and quality improvement. With improved survival, there are more opportunities to consider the longitudinal dimension of neurocritical care. There is an increasing appreciation that although the neurocognitive and psychosocial impacts may start within the PICU, they often continue beyond its walls and continue during recovery. Dr. Cynthia Ortinu¹⁴ describes the importance of brain-focused care for patients with congenital heart disease. The last review in this focus issue, by Hartman et al.,¹⁵ describes post-intensive care unit syndrome and highlights the dramatic impact that critical illness and a PICU stay can have on the quality of life of a child, their parents, siblings, and others. They remind us that for many patients and families, our work is not done when they walk out of the hospital doors. Traditionally, we have focused on the enormous task of improving PICU survival, but we should not lose sight of what has always been the ultimate goal: reintegrating patients into school, home, and the community.

This is an exciting time to be taking care of patients in neurocritical care at any point along their trajectory from initial management in the field, through the duration of the PICU stay, and into recovery and follow-up. We hope this focus issue illustrates why pediatric neurocritical care needs to be one of the broadest, most inclusive and collaborative specialties within pediatrics.

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References

1. Glass HC, Bonifacio SL, Shimotake T, Ferriero DM. Neurocritical care for neonates. *Neurocrit Care*. 2010;12:421–429. [PubMed: 20066514]
2. LaRovere KL, Riviello JJ. Emerging subspecialties in neurology: building a career and a field: pediatric neurocritical care. *Neurology*. 2008;70:e89–e91. [PubMed: 18505973]
3. Adelson PD, Bratton SL, Carney NA, et al. Guidelines for the acute medical management of severe traumatic brain injury in infants, children, and adolescents. Chapter 1: Introduction. *Pediatr Crit Care Med*. 2003;4:S2–S4. [PubMed: 12847337]
4. Pineda JA, Leonard JR, Mazotas IG, et al. Effect of implementation of a paediatric neurocritical care programme on outcomes after severe traumatic brain injury: a retrospective cohort study. *Lancet Neurol*. 2013;12:45–52. [PubMed: 23200264]
5. Riviello JJ, Ashwal S, Hirtz D, et al. Practice parameter: diagnostic assessment of the child with status epilepticus (an evidence-based review): report of the Quality Standards Subcommittee of the American Academy of Neurology and the Practice Committee of the Child Neurology Society. *Neurology*. 2006;67:1542–1550. [PubMed: 17101884]

6. Roach ES, Golomb MR, Adams R, et al. Management of stroke in infants and children: a scientific statement from a Special Writing Group of the American Heart Association Stroke Council and the Council on Cardiovascular Disease in the Young. *Stroke*. 2008;39:2644–2691. [PubMed: 18635845]
7. Galardi MM, Strahle JM, Skidmore A, Kansagra AP, Williams KP. Cerebral vascular complications of pediatric blunt trauma. *Pediatr Neurol*, in press.
8. Smith A, Friess SH. Neurological outcome in children after cardiac arrest. *Pediatr Neurol*, in press.
9. Said A, Williams KP, Bembea MM. Neurological complications of pediatric extracorporeal membrane oxygenation support. *Pediatr Neurol*, in press.
10. Abend NS, Wusthoff CJ, Goldberg EM, Dlugos DJ. Electrographic seizures and status epilepticus in critically ill children and neonates with encephalopathy. *Lancet Neurol*. 2013;12:1170–1179. [PubMed: 24229615]
11. Ducharme-Crevier L, Press CA, Kurz JE, et al. Early presence of sleep spindles on electroencephalography is associated with good outcome after pediatric cardiac arrest. *Pediatr Crit Care Med*. 2017;18:452–460. [PubMed: 28328788]
12. Ostendorf AP, Hartman ME, Friess SH. Early electroencephalographic findings correlate with neurologic outcome in children following cardiac arrest. *Pediatr Crit Care Med*. 2016;17:667–676. [PubMed: 27164188]
13. Griffith JL, Tomko SR, Guerriero RM. Continuous EEG monitoring in critically ill infants and children. *Pediatr Neurol*, in press.
14. Ortinau C. The congenital heart disease brain: prenatal considerations for perioperative neurocritical care. *Pediatr Neurol*, in press.
15. Hartman ME, Williams CN, Piantino JA. Post-intensive care syndrome for the pediatric neurologist. *Pediatr Neurol*, in press.