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Functional status after pediatric critical care: Is it the disease, the cure, or both?

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The medical and surgical care of critically ill children has improved such that mortality is fairly rare, but the risk of significant morbidity is high.(1, 2) A number of investigators have described cognitive(3-6), physical(7, 8), mental health(9), quality of life(10), and family(11) sequelae acquired by pediatric survivors of critical care. Opioid(12) or sedative(13) exposure, severity of illness or injury(3, 5, 14) and extracorporeal life support(5) may be risk factors for these sequelae in children. However, our overall understanding of the relative effects of disease and treatment on these sequelae is incomplete.

Adult survivors of critical care have similar problems. The Society of Critical Care Medicine has now held two multidisciplinary stakeholders' conferences, and a recent manuscript describes current knowledge gaps and an action plan.(15) "Post-intensive care syndrome" (PICS) is the recommended term for this constellation of effects in an adult patient (PICS-F in a family member).(16)

These post-illness sequelae may persist several years or more in both children(13) and adults.(17) Given the imperative to minimize the lifetime disease burden of our patients, detailed longitudinal data in children are badly needed.

In this issue of *Pediatric Critical Care Medicine*, Choong et al report the results of a single-center prospective pilot study of functional outcomes after critical illness in children.(18) The study was conducted over one winter season (October 2012 to April 2013) at a Canadian children's hospital. Eligible patients were at least 12 months of age, had a minimum of a 48 hour Pediatric Intensive Care Unit (PICU) stay, and were below their baseline functional status when screened for the study.

The study's stated primary outcome was feasibility, defined as the ability to screen, enroll, and follow patients eligible for a larger study with a similar design.(19) The authors also report patient-level secondary outcomes that they used to design the larger study and to generate hypotheses. These patient-level outcomes included a caregiver interview assessment of the child's functional status at baseline (prior to their critical illness) and

direct assessment of the child at 3 and 6 months after PICU discharge. One strength of this report is that the authors categorized functional status using the World Health Organization (WHO) framework for measuring child health and disability, the International Classification of Functioning, Disability and Health (ICF-CY).(20) This classification is designed to relate directly to the International Classification of Diseases (ICD-10). The authors also used functional status instruments with a wide range of granularity. Instruments ranged from the Pediatric Cerebral Performance Category (PCPC) and Pediatric Overall Performance Category (POPC)(21), which are coarse but easily administered measures, to the Pediatric Evaluation of Disability Inventory (PEDI), which is much more detailed.

The consent rate was good (85%), and follow-up was 93% at 3 months and 71% at 6 months. The sample size was small (N = 33), but the authors were appropriately transparent about their intentions and conservative in their conclusions. The population was similar to that in many PICU's with approximately one-third of the patients severely disabled at baseline. PICU (median 10 days) and hospital (median 19 days) stays were fairly long. Hospital (37%) and ICU (27%) readmission were common, as was found in other recent studies.(1)

By some measures, the study subjects had overall lower functional status at 3 months after critical illness compared to baseline. Although this pilot study was not powered to test for a trend, 6 month functional status appeared to be higher than that at 3 months but not back to baseline. Children with normal baseline function were more likely than those with a pre-existing chronic condition to recover to baseline by 6 months. Several hypotheses emerged, including that severity of illness may influence both the degree of functional decline and the rate of recovery. These hypotheses fit with other work. Among children with traumatic brain injury, for example, those with severe (versus moderate) injury at younger ages have less ability to both recover from their injury and continue to age-appropriately gain new skills. (22)

Interpretation of research in this area can be challenging because many different outcome measures are used. Gold-standard neuropsychological, functional, and quality of life instruments (Vineland, ABAS II, WeeFIM, PedsQL, the PEDI used in this study, and many others) provide detailed information but are time-consuming, expensive, and require trained personnel. Easily administered scales such as the PCPC and POPC lack the sensitivity and precision to reliably serve as outcome measures for interventions. The Functional Status Scale(23) (FSS, not to be confused with the Functional Skills Scale used in this study) developed by the Collaborative Pediatric Critical Care Research Network is more granular than the PCPC and POPC but still easy to administer. The Glasgow Outcome Scale-Extended, Pediatric version (GOS-E Peds)(24) is also easily administered and has been used in studies of children with traumatic brain injury.(25) Overall, greater standardization of outcome measures and cross-validation would be beneficial for both future research and evidence-based practice change.

The most important limitation of this study's design is that, even if adequately powered, it would not include sufficient data to allow us to separate the impact of the illness or injury from the impact of the care we provide. Controlled longitudinal studies with data from

baseline status, peak illness or shortly post-injury, at ICU discharge, at hospital discharge, and several months later would help us to identify any potentially modifiable features of our care.

Strengths of this study include the use of the WHO ICF, an international framework for functional status, and a wide range of functional status measures. This report is also an excellent example of the type of collaboration between PICU and pediatric rehabilitation investigators that will be necessary to broaden our understanding of PICS in children.

Overall, this report adds to the body of literature that functional outcomes in children are lower after critical illness.(3-5, 26) This study is important because Choong and colleagues have established a thoughtful research trajectory that is likely to meaningfully contribute to our understanding of PICS in children. I look forward to the results of their multi-center study.(19)

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