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Outcomes for Children with Traumatic Brain Injury (TBI) – How Can the Functional Status Scale Contribute?

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The topic of outcomes of children after traumatic brain injury (TBI) is extremely important and anything but straightforward. The mere mention of the term “TBI” connotes different reactions from various members of the health care team – with some immediately picturing a conscious child with a concussion after a sports injury, others imagining a child regaining consciousness in the Emergency Department after a motor vehicle accident and still others visualizing a profoundly comatose child with catastrophic findings on neuroimaging who will require maximal therapies simply to survive. Secondly, the choice of what outcome is important and to what constituency has never been fully reconciled. Most of us have encountered parents who feel that a surviving child with severe disabilities is a favorable outcome, despite the fact that clinicians may disagree with this assessment. Even with objective testing, choices of tests can be quite difficult. In children with mild injuries, global tests that assess levels of consciousness are unhelpful. On the severe end of the spectrum, some children may not be able to complete detailed neuropsychological tests due to fatigue or difficulty in interacting with the examiner. Importantly, clinical researchers (and funding agencies) studying children with these severe injuries have always worried that an interventional trial that improves mortality but converts survivors into subjects with a vegetative outcome would be wholly undesirable. Lastly, outcomes – defined in any manner – clearly change over time after an injury to a developing brain. So, the timing of when to assess any outcome continues to be debated to this day.

Within this milieu, there is no shortage of potential tests. Recently, the National Institute of Neurological Disorders and Stroke sponsored an effort to establish common outcome measures for children with TBI (1). Seventeen leaders in the field identified outcome domains (academics, adaptive/daily living skills, family/environment, global outcome, quality of life, infant/toddler measures, language/communication, neuropsychological impairment, physical functioning, psychiatric functioning, consciousness, social

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participation, social cognition and TBI-related symptoms) and then sought to identify a single measure within each domain that could be considered a “Core” data element for research studies going forward. While the group considered some practical aspects in making their choices – specifically brevity, ease of administration and cost – there was no real consensus from the group on which tests are absolutely essential for general populations of children with TBI of varying severity. Moreover, many other tests could be considered as “Supplemental” or “Emerging” tests within this common outcome framework – leaving choices of tests largely up to individual clinicians and researchers.

Concurrently, the Collaborative Pediatric Critical Care Research Network developed the Functional Status Score (FSS) (2). With the expressed desire to “...*measure the changing functional status (such as motor or major cognitive deficits) of children during hospitalization*” to “*enable a large PICU outcome study*”, the group completed a preliminary manuscript describing the tool in 836 children, followed by manuscripts that compared the tool to Pediatric Cerebral Performance Category (3) and to predict new morbidities (4). In this issue of the *Journal*, Drs. Bennett and colleagues use this new tool for the first time in a TBI-based population of children (5). Using an observational study design at two level 1 trauma centers in the US, this study found an inverse relationship between admission Glasgow Coma Scale (GCS) score and FSS at hospital discharge in the overall cohort. In a more comprehensive study at one of the centers, the authors found that (i) the vast majority of survivors of TBI had normal baseline FSS, (ii) a substantial minority (37%) of survivors had a new disability diagnosed (based on the FSS criteria that has previously been published (4)) and (iii) more than half of the survivors with severe TBI (GCS = 8) met the criteria for a new disability at hospital discharge.

Bennett and colleagues should be congratulated for publishing this first paper that uses this user-friendly outcome tool in children with TBI and for their unique findings. However, there are significant limitations to the study that require exploration. First, the study uses the FSS at two different trauma centers with different data collection strategies. As outlined above, only one of the centers used a pre- and post-injury assessment of FSS - limiting the study's ability to demonstrate how disabilities may evolve after the injury has occurred. Second, the sample size is small – for both cohorts. One of the proposed strengths of FSS is the ease of which the test can be administered, particularly the rapidity with which data can be generated. Because of this sample size limitation, many of the analyses within the manuscript exploring associations between FSS and other TBI characteristics (age, injury mechanism, admission pupillary reactivity, CT scans and others) appear preliminary with the dataset employed by this study. It may be possible that such ambitious hypotheses could be addressed within a larger dataset, perhaps the 10,000+ subject dataset generated by Pollack and colleagues (4). Alternatively, use of FSS in larger observational study in the future may prove fruitful in testing these associations. Lastly, as with other outcomes tests, the timing of the FSS testing in this study should give us pause in data interpretation and extrapolation. For children with TBI, healing and improvement are generally observed for months and months after the injury. Moreover, it is common for children with this disorder to leave the hospital while receiving medications that can alter their sensorium. So, while it is interesting that so many children meet the criteria for new disability using this score, the overall burden of disability from TBI in this cohort is impossible to truly estimate because the FSS was

only administered at the time of hospital discharge. It would be quite interesting to determine how long these disabilities persist during the child's recovery.

In summary, this manuscript adds to our knowledge about challenges facing children with TBI as they leave the hospital and continue on with the rest of their lives. The paper demonstrates that the FSS can be implemented as part of routine practice in two different health care systems and the relationships observed between the FSS and patient characteristics can serve as a baseline for work going forward in the coming years. As a field, establishing which outcomes tests can be readily administered while also measuring relevant outcomes for various populations of children with TBI is an essential next step in developing therapies for this disorder that is highly prevalent and morbid.

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References

1. McCauley SR, Wilde EA, Anderson VA, et al. Recommendations for the use of common outcome measures in pediatric traumatic brain injury research. *J Neurotrauma*. 2012; 29(4):678–705. [PubMed: 21644810]
2. Pollack MM, Holubkov R, Glass P, et al. Functional Status Scale: new pediatric outcome measure. *Pediatrics*. 2009; 124(1):e18–28. [PubMed: 19564265]
3. Pollack MM, Holubkov R, Funai T, et al. Relationship between the functional status scale and the pediatric overall performance category and pediatric cerebral performance category scales. *JAMA Pediatr*. 2014; 168(7):671–676. [PubMed: 24862461]
4. Pollack MM, Holubkov R, Funai T, et al. Simultaneous Prediction of New Morbidity, Mortality, and Survival Without New Morbidity From Pediatric Intensive Care: A New Paradigm for Outcomes Assessment. *Crit Care Med*. 2015; 43(8):1699–1709. [PubMed: 25985385]
5. Bennett TD, Dixon RR, Kartchner C, et al. Functional status scale in children with traumatic brain injury; A prospective cohort study. *Pediatr Crit Care Med*. 2016 in press.