EDITORIAL

Pediatric Neurotrauma: Closing the Gaps

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Trauma is one of the leading causes of morbidity and mortality in our country, among which neurotrauma contributes to a significant portion. Road traffic accidents (RTA) roughly cause almost 5,00,000 injuries every year, out of which more than 1,50,000 lives are lost annually. This figure has been in steady rise over the past few years, barring a transient decline during the pandemic of SARS-CoV-2.[1,2] Pediatric trauma differs from trauma in adults due to the inherent anatomical and physiological differences across different age-groups in children and also the differing mechanisms that result in these injuries. Also, the developing immature brain is particularly vulnerable to both direct injury and secondary injury caused by physiological derangements resulting from injuries. It is also being realized that low and middle income countries (LMIC) such as ours that are experiencing rapid socio-economic transformation suffer from the silent epidemic of traumatic brain injury (TBI), contributed by an exponential increase in motorized transport and disparities in prehospital care, transport and healthcare facilities.[3,4]

Whereas RTA are the commonest causes of neurotrauma among the adult population, accidental falls are the leading cause of TBI in young children. Even among the pediatric population, bimodal distribution of age is noted, with peak incidence in the toddler age-group and adolescents. Younger children sustain TBI due to accidental falls from stairs or the terrace while being unsupervised and also during motor vehicle accidents.[5] Non-accidental trauma is another consideration in young infants. Adolescents sustain TBI more commonly while on roads due to vehicle collisions and during sports activities, assaults, etc.

Children are prone to head injury since head size is larger relative to the body and is also poorly supported by neck muscles and ligaments. Also, systemic anatomic and physiological differences in the airways, breathing and circulation make them vulnerable to significant physiological derangement during serious injuries.[6] The resultant hypoxia, hypercapnia, hypotension result in secondary brain injury and add to the primary brain insult sustained at the time of physical impact. These differences impact our approach to management as well as outcomes of pediatric TBI compared to the adult population. Physiological factors in children also make them susceptible to quicker decompensation – their smaller blood volumes result in hemodynamic disturbances with a lesser degree of blood loss, hypothermia occurs commonly due to exposure, and the blood pressure ranges and cerebral perfusion pressure (CPP) thresholds are quite different. While considering the outcomes following neurotrauma, neuronal plasticity in children does offer an advantage in terms of better recovery with appropriate rehabilitation, however, on the flip side, the long-term effects of trauma to an immature developing brain are still not very well understood.[7] There are reports of long term inflammatory processes getting triggered by even mild head trauma, potentially causing early-onset neurodegenerative diseases at a much younger age.[8] Having known such variations exist between neurotrauma in adults and children, the available literature on Pediatric TBI, especially from LMICs is scarce.

In this issue, the authors, Pujari et al., have explored the clinico epidemiological profile and outcomes of children with TBI admitted to a tertiary Pediatric Intensive Care Unit (PICU) over a 10-year period.[9] The majority of the study cohort consisted of children less than 5 years age, and injury resulting from falls was the commonest mechanism encountered in this age-group. Also, mortality was higher in this subgroup. Understanding the age differences and injury mechanisms will also be essential for planning prevention strategies in children such as creating a child-safe environment in houses, schools and other such places. Lower pediatric trauma score and polytrauma had independent associations with mortality in the study cohort. Younger children often suffer from polytrauma rather than isolated organ injuries, and resuscitation following the principles of "Advanced Trauma Life Support (ATLS)" and "Pediatric Advanced Life Support (PALS)" is crucial to identify life-threatening problems systematically and intervene at the right times.

The prevalence of hypotension at admission and trauma induced coagulopathy was higher in the severe TBI group, and this subset also had higher mortality. Both hypotension and raised intracranial pressure affect CPP and the time duration for which the thresholds are not met has a huge impact on the outcomes. Different CPP thresholds are defined for children across the different age-groups. It has been proven that cerebral autoregulation is impaired in neurotrauma, and the derangement is greatest following moderate to severe TBI, and this is associated with poorer outcomes.[10,11] Recently, cerebral autoregulation guided management was found feasible and safe in adult trauma patients, and more data is needed in this regard to decipher the optimal thresholds and management strategies in children.[12]

Safe transport of children with multiple and serious injuries is another area that needs to be improved. In this study cohort,

only 14.9% of patients presented within 6 hours of trauma, and much of the initial hours were already lost. Pediatric neurotrauma care requires multidisciplinary collaboration among neurosurgeons, pediatric emergency and critical care specialists, neuro-rehabilitation professionals and dedicated centers that provide such services. Improved prehospital care, provision of timely resuscitation at the trauma site, and safe and reliable hospital transfers will also help in better preservation of physiological status when these children present to higher centers.[3]

Follow-up of children with neurotrauma is equally important to understand the effect of injury to developing brains over time and also identify the specific needs for these kids following hospital discharge. The current study, being retrospective in nature, has followed up patients till hospital discharge and good recovery (Glasgow outcome scale–5) was noted in 61.7% of survivors in the short period. More longitudinal multi-center studies will be needed with structured follow-up, specifically addressing issues such as developmental outcomes, the incidence of post-traumatic epilepsy, cognitive changes and changes in quality of life following trauma. There are still a lot of knowledge gaps on neurotrauma, especially in the pediatric population. Prospective, multi-center studies and a nationwide Trauma registry will be able to fill much of the gaps and help in enhancing pediatric trauma care services in our setting.

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