EDITORIAL

Unveiling the Complexity of Traumatic Brain Injury: Insights from Clinical Scoring Systems

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Introduction

In India, a staggering 1.5–2 million individuals are estimated to sustain traumatic brain injuries (TBIs) annually, with nearly 1 million tragically succumbing to their injuries. Road accidents are the primary cause, accounting for 60% of TBIs, followed by falls and violence.[1]

The need for rehabilitation following brain injuries is not only significant but also continuously rising. India, along with other developing nations, faces immense challenges in preventing TBIs, providing effective pre-hospital care, and ensuring proper rehabilitation amidst their rapidly evolving environments. Addressing these challenges is crucial to lessen the devastating burden of TBIs on individuals, families, and healthcare systems.[2] The starting point to this process is assessing and outcome prediction. The severity of TBI can range from minor injuries to severe trauma, necessitating accurate initial clinical assessment and documentation.[1,2]

Clinical Scoring System in Traumatic Brain Injury

Clinical scores provide a quick, objective assessment of neurological function, allowing consistent evaluation across different healthcare settings and providers. The clinical scoring system facilitates communication and collaboration between medical professionals involved in the patient's care. They help categorize the severity of a TBI, guide initial treatment, and allocate resources effectively. In addition, they track changes in a patient's neurological state over time, enabling assessment of treatment effectiveness and identification of potential complications. This allows adjustments in care plans and early intervention when needed. Overall they also aid in prognosis prediction. While limitations exist in this aspect, scores can offer some insight into a patient's potential recovery trajectory, aiding in setting realistic expectations for families and guiding rehabilitation planning. Scoring systems empowers research efforts by providing comparable data across the studies, leading to a better understanding of TBIs and the development of improved treatment strategies.

In the ever-evolving landscape of TBI Glasgow coma scale (GCS) was the initial method of assessment. The GCS, a scale developed in 1974, has long been the gold standard tool for assessing consciousness in neurologically injured patients.[3] The GCS though lauded for its simplicity for utilizing only three parameters of eye, verbal, and motor response, faces growing scrutiny in many aspects, despite its widespread use, critics point to weaknesses like limited outcome prediction, inconsistent application by different caregivers, and potential for scoring discrepancies.[4] These limitations suggest the GCS might not be enough on its own as a potent tool thus prompting the development of newer scores like the full outline of unResponsiveness (FOUR) score in 2005 and the GCS-P score in 2018.[5–7]

The FOUR score incorporates additional parameters such as brainstem reflexes and respiration, providing a more holistic assessment.[6] On the other hand, the GCS-P score (GCS with pupil reactivity information) was designed to augment prognostic accuracy (Fig. 1).[7]

Outcome Prediction in Traumatic Brain Injury

Chawnchhim et al. conducted a prospective cohort study comparing the predictive abilities of GCS, FOUR, and GCS-P scores in terms of functional outcomes at 3 months post-TBI. The study, which included 204 TBI patients, utilized the extended Glasgow outcome score (GOSE) for outcome assessment. Notably, the study found that all three scores were comparable in predicting functional outcomes, but coma scores assessed at 48 hours were superior in predicting poor outcomes compared to initial admission scores. The literature comparing these scores is scarce, making this study particularly relevant. The initial coma scores were assessed in the Emergency Department, followed by a reassessment after 48 hours.[8]

The predictive abilities of the coma scores for in-hospital mortality were assessed through receiver operating curve (ROC) analysis. Both initial and 48-hour coma scores demonstrated comparable and excellent predictive abilities for mortality, with AUC values ranging from 0.65 to 0.88. The study did not find GCS-P to be superior to GCS in predicting mortality. When evaluating functional outcomes at 3 months, all three coma scores proved to

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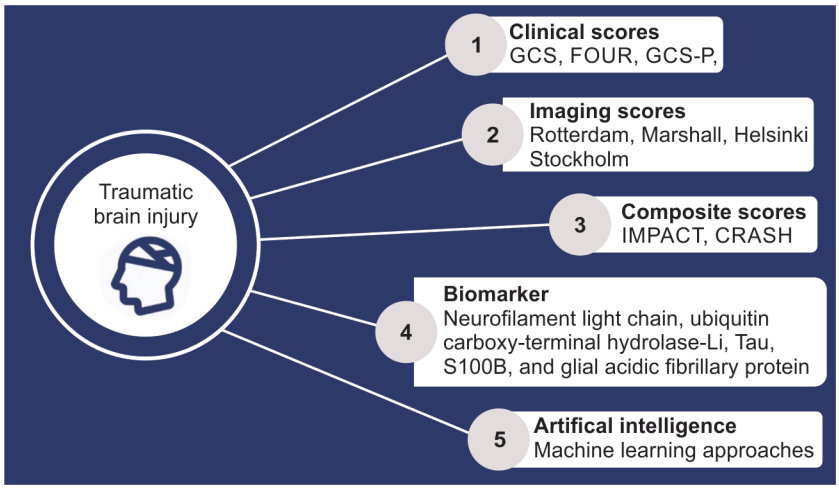

Fig. 1: Various modalities for outcome prediction in traumatic brain injury

be good predictors of poor outcomes. Notably, the coma scores assessed at 48 hours demonstrated better predictive power for poor outcomes compared to the initial admission scores. The study further determined cut-off values for predicting poor outcomes, with a GCS score of 8, a GCS-P score of 8, and a FOUR score of 9 identified as optimal.[8]

In the prediction of outcome, various parameters like hospital mortality, functional outcomes at different time points, and duration of hospital stay should be considered. Various scoring systems have been explored in the realm of traumatic brain injury for outcome prediction. Assessment includes clinical, biochemical, and radiological findings. Clinical scores include GCS, FOUR, GCS-P, imaging scores like Marshall and Rotterdam CT and prediction scores like CRASH and IMPACT have been studied in various settings. Prognostic models that incorporate not only traditional predictors but also CT scans and laboratory results, effectively distinguish between patients with good and poor outcomes at 6 months after a TBI.[9,10] Recent research focused on biomarkers like glial fibrillary acidic protein (GFAP) and ubiquitin C-terminal hydrolase L1 (UCH-L1) as day-of-injury predictors of functional outcome after traumatic brain injury exhibiting good to excellent prognostic value for death and unfavorable outcomes, outperforming their diagnostic utility. However, they lack efficacy in predicting a 6-month recovery. This prognostic information is most valuable for patients with GCS scores ranging from 3 to 12.[11] Machine learning algorithms are transforming TBI treatment prediction. By analyzing diverse data like demographics, lab results, and scans, algorithms can predict outcomes like survival and recovery risk. This empowers clinicians to personalize treatment plans and allocate resources effectively. While not a replacement for expertise, ML holds immense potential to improve patient care and outcomes (Fig. 1).[12]

Irrespective of the type of scoring system used the timing of application, temporal association the type of injury, and limitations should be considered while applying these scores.

Comparative analyses with existing literature underscored the significance of this study. While some studies favored the FOUR score as a superior predictor of mortality, this study found all three scores to be comparable.[13] The correlation of coma scores with the length of ICU and hospital stay was also explored, revealing an inverse relationship between increasing coma scores and the duration of stay. The ability to accurately predict patient outcomes is crucial in managing TBI. A recent study provided moderate evidence that the GCS and FOUR scores perform similarly in predicting in-hospital mortality and unfavorable outcomes. This finding offers medical staff the flexibility to choose the most appropriate tool based on the specific context and resources available.[14]

Despite its contributions, the study acknowledges certain limitations. Conducted during the COVID-19 pandemic, the study might have been affected by changes in TBI incidence and restricted patient recruitment. Additionally, increased mortality and morbidity due to COVID-19 could have influenced study outcomes, and limitations in follow-up care might have impacted the assessment of 3-month outcomes.

Conclusion

This study provides valuable insights into the predictive abilities of GCS, FOUR, and GCS-P scores in TBI patients. While all three scores demonstrated comparable efficacy in predicting functional outcomes, coma scores assessed at 48 hours emerged as superior predictors of poor outcomes at 3 months. This nuanced understanding of the predictive capacities of these scores contributes to the ongoing dialogue surrounding TBI prognostication and highlights the need for further research in this critical area. Irrespective of the type of scoring system instituted, reassessment at regular intervals using objective parameters is imperative. The advantages and disadvantages of each scoring parameter should be explored and a holistic approach should be employed to prognosticate patients with traumatic brain injury.

Author Contributions

MK: Writing and reviewing.

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