Pediatric traumatic brain injury outcome

see also Traumatic brain injury outcome.

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Neuropsychological and behavioral outcomes for injured children vary with the severity of the injury, child age at injury, premorbid child characteristics, family factors, and the family's socioeconomic status. Each of these factors needs to be taken into account when designing rehabilitation strategies and assessing factors related to outcomes [1)]

The Functional Status Score (FSS) can be implemented as part of routine practice in two different healthcare 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 [2)].

The multi-center, prospectively collected CENTER-TBI core and registry databases were screened and patients were included when younger than 18 years at enrollment and admitted to the regular ward (admission stratum) or intensive care unit (ICU stratum) following TBI. Patient demographics, injury causes, clinical findings, brain CT imaging details, and outcome (GOSE at 6 months follow-up) were retrieved and analyzed. Injury characteristics were compared between patients admitted to the regular ward and ICU and a multivariate analysis of factors predicting an unfavorable outcome (GOSE 1-4) was performed. Results from the core study were compared to the registry dataset which includes larger patient numbers but no follow-up data. Results: Two hundred and twenty-seven patients in the core dataset and 687 patients in the registry dataset were included in this study. In the core dataset, road-traffic incidents were the most common cause of injury overall and in the ICU stratum, while incidental falls were most common in the admission stratum. Brain injury was considered serious to severe in the majority of patients and concurrent injuries in other body parts were very common. Intracranial abnormalities were detected in 60% of initial brain CTs. Intra- and extracranial surgical interventions were performed in one-fifth of patients. The overall mortality rate was 3% and the rate of unfavorable outcomes was 10%, with those numbers being considerably higher among ICU patients. GCS and the occurrence of secondary insults could be identified as independent predictors of an unfavorable outcome [3].

There are few specific prognostic models specifically developed for the pediatric traumatic brain injury (TBI) population.

Fang et al. aimed to combine multiple machine learning approaches to building hybrid models for predicting the prognosis and length of hospital stay for adults and children with TBI.

They collected relevant clinical information from patients treated at the Neurosurgery Center of the Second Affiliated Hospital of Anhui Medical University between May 2017 and May 2022, of which 80% was used for training the model and 20% for testing via screening and data splitting. They trained and tested the machine learning models using 5 cross-validations to avoid overfitting. In the machine learning models, 11 types of independent variables were used as input variables and the Glasgow Outcome Scale score, was used to evaluate patients' prognosis, and patient length of stay was used as the output variable. Once the models were trained, we obtained and compared the errors of each machine-learning model from 5 rounds of cross-validation to select the best predictive model. The model was then externally tested using clinical data of patients treated at the First Affiliated Hospital of Anhui Medical University from June 2021 to February 2022.

Results: The final convolutional neural network-support vector machine (CNN-SVM) model predicted the Glasgow Outcome Scale score with an accuracy of 93% and 93.69% in the test and external validation sets, respectively, and an area under the curve of 94.68% and 94.32% in the test and external validation sets, respectively. The mean absolute percentage error of the final built convolutional neural network-support vector regression (CNN-SVR) model predicting inpatient time in the test set and external validation set was 10.72% and 10.44%, respectively. The coefficient of determination (R2) was 0.93 and 0.92 in the test set and external validation set, respectively. Compared with a back-propagation neural network, CNN, and SVM models built separately, our hybrid model was identified to be optimal and had high confidence.

This study demonstrates the clinical utility of 2 hybrid models built by combining multiple machine learning approaches to accurately predict the prognosis and length of stay in hospital for adults and children with TBI. Application of these models may reduce the burden on physicians when assessing TBI and assist clinicians in the medical decision-making process [4].

Mikkonen et al., tested the predictive performance of existing prognostic tools, originally developed for the adult TBI population, in pediatric TBI patients requiring stays in the ICU.

They used the Finnish Intensive Care Consortium database to identify pediatric patients (< 18 years of age) treated in 4 academic ICUs in Finland between 2003 and 2013. They tested the predictive performance of 4 classification systems-the International Mission for Prognosis and Analysis of Clinical Trials (IMPACT) TBI model, the Helsinki CT score, the Rotterdam CT score, and the Marshall computed tomography classification-by assessing the area under the receiver operating characteristic curve (AUC) and the explanatory variation (pseudo-R2 statistic). The primary outcome was 6-month functional outcome (favorable outcome defined as a Glasgow Outcome Scale score of 3-5).

Overall, 341 patients (median age 14 years) were included; of these, 291 patients had primary head CT scans available. The IMPACT core-based model showed an AUC of 0.85 (95% CI 0.78-0.91) and a pseudo-R2 value of 0.40. Of the CT scoring systems, the Helsinki CT score displayed the highest performance (AUC 0.84, 95% CI 0.78-0.90; pseudo-R2 0.39) followed by the Rotterdam CT score (AUC 0.80, 95% CI 0.73-0.86; pseudo-R2 0.34).

Prognostic tools originally developed for the adult TBI population seemed to perform well in pediatric TBI. Of the tested CT scoring systems, the Helsinki CT score yielded the highest predictive value [5].

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