DEVELOPMENT AND VALIDATION OF A PREDICTIVE MODEL FOR CHILDHOOD MORTALITY AFTER A TRAUMATIC BRAIN INJURY: ANALYSIS OF THE NATIONAL TRAUMA DATA BANK

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Abstract

Introduction: Traumatic brain injury (TBI) is a significant cause of morbidity and mortality in children. While most TBI-related admissions are mild, identifying early predictors of poor outcome may assist clinicians with timely medical decisions and effective triage utilization.

Objective: We sought to develop and validate a clinical tool for predicting in-hospital death in children after a traumatic brain injury.

Methods: Data was collected for children (≤18 years) from the National Trauma Data Bank between the years of 2007 to 2015. We included children who sustained any TBI, defined as: (i) open and closed skull fractures, (ii) cerebellar, cortical, or brain stem contusions, and (iii) subarachnoid, subdural, or epidural hemorrhages. We excluded studies that did not report patient age or individuals who were dead on arrival or died in the emergency room (ER). Our interest was in clinical variables that can be readily measured upon admission to the ER. As such, the predictors included patient demographics, mechanism and intent of injury, vital signs in the ER, mode of transportation, respiratory status, time from injury to ER arrival, Glasgow Coma Score (GCS), and Injury Severity Score (ISS). Multivariable logistic regression, with forward selection, was used to investigate associations between predictive variable and mortality. We randomly split the samples into a training set (70%) and a test set (30%). Model performance was measured via the C-statistic and accuracy [(true positive + true negative) / patient population].

Results: A total of 124,078 children were included in the study (69% male; median [IQR] age, 13.0 [6.0, 16.0.] years; 69% White). The rate of death was 5.5% (n=6,862). Children more likely to die were older (16 vs. 12 years, $p<5\%$), arrived faster to the ER (69 vs. 52 minutes, $p<5\%$), had a lower GCS (15 vs. 3, $p<5\%$), and higher ISS (30 vs. 14, $p<5\%$). The final model had 13 variables that performed well with a C-statistic of 95.7% (95% CI, 95.4% - 96.0%) and accuracy of 95.2%.

Conclusion: Herein, we provide an accurate early prediction model for mortality in children after a TBI. Translation of our findings has led to the development of a web application that can be used by emergency healthcare providers in trauma centers.

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