Early Identification of Posttraumatic Stress Disorder in Trauma Patients: Development of a Multivariable Risk Prediction Model (Traumatic Injury PTSD Prediction Score (TIPPS))

Victoria Grace Kravets, Joel Derosa, Alexandra Catherine Ernst, William Michael Reisman, Ruth Parker, Dorian A Lamis, Abigail Powers Lott, Mara Lynne Schenker

Emory University

INTRODUCTION: Acute traumatic injury has known psychological sequelae, including posttraumatic stress disorder (PTSD). PTSD rates one-year following trauma range from 1.9% in Australian motor vehicle accident survivors to 91% in US school shooting victims. Most studies range from 20-40%, and vary based on country and patient population. Injury severity does not reliably predict PTSD, but violent mechanisms do, and nearly 6 years after gun violence, 48.6% of victims report chronic PTSD. Trauma patients with PTSD have higher complication rates, increased healthcare utilization, delayed return to work, and impaired overall function. Despite the high prevalence and sequela of PTSD, trauma recovery is generally focused on the physical self, at the expense of diagnosing and treating psychological effects. The purpose of this study was to build a risk prediction model (TIPPS) to identify trauma patients at the time of injury who are at high risk for PTSD one year later, to allow real-time diagnosis and referral to behavioral health at the time of injury.

METHODS: Data for this study was collected at an urban, Level 1 Trauma Center from 2018-19. Patients 18 and older presenting with an operative orthopaedic trauma injury were eligible for enrollment in an IRB-approved comprehensive social determinants of health study. Data were collected through an initial survey and medical records at the time of injury. One year later, patients underwent phone screening, including a 5-item validated score for PTSD. Respondents screened positive for probable PTSD if they answered “yes” to any 3 of the 5 PTSD questions. Univariate analysis examined associations between injury-related, personal, and community factors and PTSD at 1 year. Differences were evaluated using $\chi^2$, Fischer exact tests, $t$-tests, or Wilcoxon rank-sum tests, with a $p$-value < 0.05 significant. Several multivariable logistic regression models were assessed based on Akaike Information Criterion and Area Under the Receiver Operator Characteristic (AUROC). After determination of the best fitted model, a novel PTSD risk prediction model was designed by assigning weights to each parameter based on the methods outlined in Charlson et al.

RESULTS:
A total of 329 patients were enrolled and 87 (26%) completed the 1-year follow-up survey. One year following trauma, 58% screened positive for probable chronic PTSD. PTSD was associated with younger age ($p=0.004$), not gender, race, insurance status, education, distressed community living, or injury severity on injury assessment. Patients who screened positive for depression (PHQ-2, $p=0.007$), substance misuse (SOAPP score, $p=0.03$), or acute stress disorder (PTSD-5, $p=0.02$) at the time of injury had higher rates of PTSD at 1 year. Other factors identified on the 1-year survey that were also associated included: not having a primary care physician ($p=0.001$), and instability of finances ($p=0.04$), housing ($p=0.05$) or relationships ($p=0.02$). The best fit multivariable regression model to predict PTSD at one-year incorporated age, insurance, violent mechanism, and two initial acute stress screening questions (AUROC 0.89, 95% CI: 0.80-0.98). Weights were assigned as previously described, and the TIPPS index added to a total of 19, with a mean of 12.9 ± 4.0 for those who had probable PTSD at 1 year, compared to 5.9 ± 4.2 for those who did not ($p<0.001$) (Table).

DISCUSSION AND CONCLUSION:
PTSD is common following traumatic injury, and can be predicted using a novel risk score that incorporates age, insurance status, violent injury mechanism, and acute stress reaction symptoms. Stability in life (financial, relationship, housing), as well as having an ongoing relationship with the healthcare system (via primary care physician) may be protective of chronic PTSD. Future studies are needed to validate this risk tool in other patient populations, and test the influence of behavioral health intervention at the time of initial hospitalization on chronic PTSD.
<table>
<thead>
<tr>
<th>Parameters</th>
<th>Weighted Index</th>
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<tbody>
<tr>
<td>Age &lt;60</td>
<td>3</td>
</tr>
<tr>
<td>Uninsured</td>
<td>2</td>
</tr>
<tr>
<td>Violent Injury Mechanism (Rob, Gunshot, Assault)</td>
<td>2</td>
</tr>
</tbody>
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- When thinking about the trauma you most recently suffered, have you tried hard not to think about the event(s) or went out of your way to avoid situations that reminded you of the event(s)?
- When thinking about the trauma you most recently suffered, have you been constantly on guard, watchful, or easily startled?

Max possible score: 39