Classification of Traumatic Brain Injury Severity Complexities in Retrospective Data

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LEARNER OBJECTIVES:
1. Describe two tools currently used in the pre-hospital or acute care setting to document brain injury severity in the traumatic brain injured patient (GCS and AIS).
2. Examine the methodology complexities researchers encounter in combining and categorizing brain injury severity data in retrospective databases, such as in the National Trauma Data Bank (NTDB).
3. Critique other methods of categorizing brain injury severity in the future, such as neuroimaging and biomarkers.
Acknowledgement

Committee on Trauma, American College of Surgeons, National Trauma Data Bank (NTDB) National Sample Project (NSP) 2010, Chicago, Illinois, USA.

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Introduction

• Methodological challenges may influence the robustness of studies using retrospective data.

• Issues of missing data and multiple tools used to stratify injury.

• Two tools commonly used to classify brain injury, the Glasgow Coma Scale and Abbreviated Injury Score.
<table>
<thead>
<tr>
<th>Feature</th>
<th>Scale Responses</th>
<th>Score Notation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye opening</td>
<td>Spontaneous</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>To speech</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>To pain</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>1</td>
</tr>
<tr>
<td>Verbal response</td>
<td>Orientated</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Confused conversation</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Words (inappropriate)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Sounds</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>(incomprehensible)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Best motor response</td>
<td>Obey commands</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Localize pain</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Flexion – Normal</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>- Abnormal</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Extend</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>1</td>
</tr>
<tr>
<td>Total Coma Score</td>
<td></td>
<td>3-15</td>
</tr>
</tbody>
</table>
## Abbreviated Injury Scale (AIS)

<table>
<thead>
<tr>
<th>AIS Code</th>
<th>Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIS 1</td>
<td>Minor</td>
</tr>
<tr>
<td>AIS 2</td>
<td>Moderate</td>
</tr>
<tr>
<td>AIS 3</td>
<td>Serious but not life threatening</td>
</tr>
<tr>
<td>AIS 4</td>
<td>Severe, life threatening, survival probable</td>
</tr>
<tr>
<td>AIS 5</td>
<td>Critical, survival uncertain</td>
</tr>
<tr>
<td>AIS 6</td>
<td>Virtually unsurvivable</td>
</tr>
</tbody>
</table>
Background

• The Glasgow Coma Scale (GCS) is commonly used to categorize injury severity as mild, moderate, or severe.

• When the GCS score is unavailable in retrospective data, the Abbreviated Injury Score (AIS) is often used.

• Discrepancies have been noted in prior research when the two tools have been used in conjunction.
Purpose

- To describe and compare the differences in two tools used in the classification of TBI severity, the Glasgow Coma Scale (GCS) and the head Abbreviated Injury Score (AIS) using retrospective data.
Methodology

• Correlational and descriptive statistics were used to analyze and describe two TBI severity classification methods.

• A large sample of TBI patients (N=56,131); treated at level I and level II trauma centers in the United States; and who were included in the National Sample Program (NSP) of the National Trauma Data Bank (NTDB); were examined.
## Literature Search

<table>
<thead>
<tr>
<th>Author</th>
<th>TBI Severity</th>
<th>Classification Criteria</th>
<th>Data Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hoffman et al., 2012</td>
<td>Mild, Moderate, and Severe</td>
<td>AIS of head $\geq 2$</td>
<td>Retrospective</td>
</tr>
<tr>
<td>Mosenthal et al., 2002</td>
<td>Mild, Moderate, and Severe</td>
<td>AIS of head $\geq 3$</td>
<td>Retrospective</td>
</tr>
</tbody>
</table>
| Cuthbert et al., 2011 | Moderate and Severe | GCS 3 to 12  
AIS of head $\geq 3$ | Retrospective |
| Bowman et al., 2007  | Moderate and Severe | AIS of head $\geq 3$                     | Retrospective |
| Chan et al., 2001    | Moderate and Severe | AIS of head $\geq 2$                     | Retrospective |
| Mellick et al., 2003 | Severe             | AIS of head $\geq 4$                     | Retrospective |
Statistical Analyses

A bar chart showing the distribution of AIS Severity among different GCS levels:
- AIS Severity = 2% (GCS-2)
- AIS Severity = 9% (GCS-1)
- AIS Severity = 46% (GCS Severity)
- AIS Severity = 39% (GCS+1)
- AIS Severity = 3% (GCS+2)
Results: Demographic

The study population was:

- 67% male,
- 67% non-Hispanic white,
- Most often treated in trauma centers in the southern United States region (38%),
- Most injuries resulted from blunt trauma (93%),
- With 56% from non-motor vehicle collisions (MVC’s).
Observation of the AIS classification system showed that it tends to over-score TBI severity compared to the GCS classification.

The methods (GCS & AIS) had a weak, inverse relationship with a correlation coefficient (Pearson’s r) of -0.3980, which was significant at <0.001.
Discussion

• GCS scores are commonly used to stratify TBI patient samples.

• Missing data is common in retrospective data and often the AIS score is utilized when the GCS score is missing.

• Prior research had not looked at the correlation between the two tools (GCS and AIS).
Conclusions

- Retrospective data is abundant and useful in answering questions pertaining to the trauma patient.

- Researchers must be mindful when combining data.

- Inconsistencies in combining AIS and GCS scores.

- Reinforced the need for additional classification methods in retrospective research, such as neuro-imaging and biomarkers.


