
Professor Harold (Hank) B. Weiss - PhD MPH
Thursday, 4:30 PM
Session H8- Injury Intelligence

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Traumatic brain injury (TBI) is an important public health problem and a significant source of child injury morbidity and mortality in the US.

At least 0.5 million TBI occur in the USA each year.
Incidence rates of paediatric (0-19) TBI-related hospitalizations in the US by injury severity category
Objective

To determine if the trends in in-hospital survival from severe child TBI (SATBI) and functional outcomes at hospital discharge of survivors have changed significantly in Pennsylvania, from 1998-2007
Methods

Study population

Pennsylvania Trauma Outcome Study (PTOS) 1998-2007

31 level I and level II Trauma Centers

PTOS began in 1986 – Contains over 400,000 trauma cases.

‘02 Population = 12.3 Million
Methods

- Case selection

  - TBI patients were identified from the PTOS using the Barell matrix to categorize injury diagnoses
    - Uses CDC case definition for TBI

  - Exclusion criteria:
    - > 48 hours between injury and admission
    - > 18 years of age
    - Adverse effects or medical care
Methods

- Classification of severity
  - Severe traumatic brain injury (SATBI):
    - Head-neck abbreviated injury scale (AIS) ≥ 4
  - AIS derived from ICD-9-CM codes using the international classification of disease programming for injury categorization (ICDPIIC) algorithm
Methods

- Study data
  - Demographics (age, sex, race, co-morbidities)
  - Injury characteristics (date of event, mechanism)
  - ICD-9-CM codes (severity [AIS-NISS], presence of severe extra-cranial injuries)
  - Hospital information (date of admission, length of stay in days, type of trauma center level [I/II])
Methods

- **Outcome variables**
  - Discharge status (*death* or *alive*)
  - Functional status at hospital discharge for patients discharged alive (≥ 2 years):

- **Domains**
  - Feeding
  - Transfer mobility
  - Locomotion
  - Expression
  - Social interaction

- **Values**
  - 1 – Complete dependence
  - 2 – Modified dependence
  - 3 – Independent with device
  - 4 – Complete independence
Methods

- **Complete Independence means:**
  - **Feeding:** Eats from dish and drinks from a cup presented in customary manner on table or tray, open cartons, pours liquids, etc.
  - **Locomotion:** Walks a minimum of 150 feet without assistive devices.
  - **Expression:** Expresses complex ideas intelligibly & fluently, verbal or nonverbal, including signing & writing.
  - **Transfer mobility:** Approaches, sits, and gets up to a standing position from a chair or bed. Transfers safely.
  - **Social Interaction:** Interacts appropriately with staff, other patients, and family members.
Methods

- Statistical analysis
  - Trends of survival after severe adult TBI
    \[ \% = \frac{\text{Severe TBI patients discharged alive}}{\text{Severe TBI patients}} \]
  - Trends of functional status score at hospital discharge (≥ 2 years)
    \[ \% = \frac{\text{Patients with functional status score = 1, 2, 3, or 4}}{\text{Severe TBI patients discharged alive}} \]
Methods

- Statistical analysis
  - Generalized linear mixed effect models
    - Random effect: trauma centers
  - Discharge status fitted into logistic regression
    - Odds of survival ($p_{\text{Alive}}/p_{\text{Death}}$)
  - Functional status score for each domain fitted into logistic regressions
    - Odds of “Complete independence” ($p_{\text{Score}=4}/p_{\text{Score} \leq 3}$)
Methods

- Statistical analysis
  - Sensitivity analysis
    - Missing data = 1 in each domain of functional status scores
  - Findings are presented as OR, 95%CI, and P values

- 254,152 patients with admission <48h after the injury
- 45,271 patients aged <18 (Children) (18%)
- 19,615 children with diagnoses of TBI (43%)
- 4,813 children with severe TBI (AIS≥4) (25%)
Age of children with severe TBI, PTOS, 1998-2007
Rates of Pennsylvania Trauma Centre’s severe TBI in children (0-17 years) - PTOS, 1998-2007
Median age of children with severe TBI by year, PTOS, 1998-2007
Gender distribution of children with severe TBI by year, PTOS, 1998-2007
Distribution of mechanisms of injury of children with severe TBI by year - PTOS, 1998-2007

Mechanism of injury:
- Motor Vehicle Traffic: 41.22%
- Fall: 23.48%
- Transport/other: 17.54%
- Struck by/against: 10.22%
- Other: 7.54%

Graph showing the distribution of mechanisms of injury over the years from 1998 to 2007.
Mortality of injury of children with severe TBI by year PTOS, 1998-2007

Adjusted for:
- age, sex, race, co-morbidities, injury mechanisms, presence of extra-cranial injuries, NISS, length of hospital stay, and hospital trauma level

Trend analysis: OR 0.91, 95%CI 0.87 – 0.94, p<0.001
Proportion of children with complete independence status at hospital discharge after severe TBI by year - PTOS, 1998-2007

Adjusted for:
- age, sex, race, co-morbidities, injury mechanisms, presence of extra-cranial injuries, NISS, length of hospital stay, and hospital trauma level
Trend analyses of complete independence scores of each domain, Children with severe TBI PTOS, 1998-2007

<table>
<thead>
<tr>
<th>Complete independence score**</th>
<th>OR</th>
<th>95% CI</th>
<th>P value</th>
<th>Sensitivity analysis*</th>
<th>OR</th>
<th>95% CI</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feeding</td>
<td>1.16</td>
<td>1.12-1.20</td>
<td>&lt;0.001</td>
<td>1.06</td>
<td>1.03-1.09</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Locomotion</td>
<td>1.11</td>
<td>1.07-1.15</td>
<td>&lt;0.001</td>
<td>1.04</td>
<td>1.01-1.07</td>
<td>0.005</td>
<td></td>
</tr>
<tr>
<td>Expression</td>
<td>1.12</td>
<td>1.08-1.17</td>
<td>&lt;0.001</td>
<td>1.03</td>
<td>1.01-1.06</td>
<td>0.008</td>
<td></td>
</tr>
<tr>
<td>Transfer Mobility</td>
<td>1.12</td>
<td>1.08-1.16</td>
<td>&lt;0.001</td>
<td>1.04</td>
<td>1.01-1.07</td>
<td>0.003</td>
<td></td>
</tr>
<tr>
<td>Social Interaction</td>
<td>1.12</td>
<td>1.08-1.17</td>
<td>&lt;0.001</td>
<td>1.04</td>
<td>1.01-1.07</td>
<td>0.005</td>
<td></td>
</tr>
</tbody>
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OR, odds ratio; CI, confidence intervals. Regression analysis was performed separately for complete independence scores of each domain (feeding, locomotion, expression, transfer mobility, and social interaction). Multivariate logistic regressions were adjusted for age, sex, race, preexisting conditions, injury mechanisms, presence of extra-cranial injuries, NISS, length of hospital stay, trauma center, and hospital trauma level. *Sensitivity analysis were performed assigning the missing data in functional status scores to the worst outcome (complete dependence or FIM=1). **A “complete independence score” is the best functional outcome or a FIM=4 in each domain.
Discussion

- Most recent trends of survival and functional status at hospital discharge associated with severe child TBI

- Many are recovering from their TBI: survival and good scores of cognitive functional status at hospital discharge are improving over time:
  - Maturation of the trauma system in Pennsylvania
Severe child TBI in PA trauma centers is increasing.

But outcomes are improving.

Still, the prevalence of SATBI-related functional limitation is increasing over time.
Discussion

- **Limitations**
  - Difference in treatments by institution
  - Data entry personnel – accurate classification of cases and outcome assessment
  - Severe TBI may occur in non-accredited trauma centers

- **Strengths**
  - State wide trauma registry over 10 years
  - Strong triage protocols reviewed by state agency
Thanks

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