May 8th, 10:30 AM - 12:00 PM

Improving the Outcome Prognostication of Critically Ill Patients with Moderate-Severe TBI

Susanne Muehlschlegel
University of Massachusetts Medical School

Follow this and additional works at: https://escholarship.umassmed.edu/cts_retreat

Part of the Health Services Administration Commons, Nervous System Diseases Commons, Neurology Commons, Translational Medical Research Commons, and the Trauma Commons
Creative Commons Attribution-Noncommercial-Share Alike 3.0 License
This work is licensed under a Creative Commons Attribution-Noncommercial-Share Alike 3.0 License.
Improving the Outcome Prognostication of Critically Ill Patients with moderate-severe TBI

Susanne Muehlschlegel, MD, MPH
Assistant Professor of Neurocritical Care
UMASS Depts. Of Neurology, Anesthesia/Critical Care and Surgery
Disclosures

• No conflict of interest

• Research support:
  – American Heart Association  AHA 09SDG2030022
  – Worcester Research Foundation 2010
  – Faculty Scholar Award 2011
  – Departmental
Traumatic Brain Injury remains a real public health problem in the U.S. (and worldwide).

Appr. 1.7 million Americans sustain a TBI annually

- 25% of these are moderate-severe TBI.

From: http://www.cdc.gov/traumaticbraininjury/statistics.html

From: www.nutridesk.com.au

From: www.break.com

Moderate-severe TBI
GCS 3-12

From: http://www.cdc.gov/traumaticbraininjury/statistics.html
Outcome prognostication is extremely important for families and clinicians.

**Families**
- Informed decisions about Aggressiveness of care and Future planning

**Clinicians**
- Need to provide information to Families and other providers which will Guide aggressiveness of care (prevent self-fulfilling prophecies)

**Improved Outcome Prognostication**
Withdrawal of Care may lead to self-fulfilling prophecies.

Death

Clinician assessment

Assumption of likely outcome

Family decides to withdraw care based on clinician prediction

Clinician predicts poor outcome to family

Withdrawal of support in intracerebral hemorrhage may lead to self-fulfilling prophecies

K.J. Becker, MD; A.B. Baxter, MD; W.A. Cohen, MD; H.M. Bybee, BSN; D.L. Tirschwell, MD, MSc; D.W. Newell, MD; H.R. Winn, MD; and W.T. Longstreth, Jr., MD

Becker et al. Neurology 2001
TBI is a heterogeneous disease, making outcome prognostication difficult.
The outcome prediction in TBI is complex.

**Figure 1: Overview of the components of prognosis in traumatic brain injury**

GCS = Glasgow coma scale. AIS/ISS = abbreviated injury score/injury severity score. ICP = intracranial pressure. PO₂ = partial pressure of oxygen.
The IMPACT data set has lead to the validated IMPACT predictors.

http://www.tbi-impact.org/

IMPACT = International Mission for Prognosis and Clinical Trial design in TBI
3 centers:
   Erasmus University in Rotterdam, Netherlands
   University of Edinburgh, Scotland,
   Virginia Commonwealth University Medical College, Richmond, VA

IMPACT: 11 studies total (8 RCT; 3 observational cohort studies) n=9099
The IMPACT study risk calculator is a free online tool to estimate the 6-month outcome after TBI.

From: http://www.tbi-impact.org
Admission characteristics are strong prognosticators as shown by the IMPACT data.

The cumulative $R^2$ of the full model is 0.35.

The IMPACT predictors only explain about 1/3 of the outcome variability.

*Figure 2*: Prognostic value of different components of traumatic brain injury prognosis ($R^2$) in the IMPACT dataset (n=8686)

The cumulative $R'$ of the full model is 0.35. IMPACT=International Mission for Prognosis and Clinical Trial design in TBI. $R^2$=proportion of variability in outcome explained by the predictor(s). Data from Murray and colleagues. 

From: Lingsma et al. Lancet Neurol 2010
The IMPACT score ignores the hospital course.

• Our hypothesis:

- Admission "IMPACT variables" → Long ICU stay → Outcome
- Long ICU stay → Medical Complications
- Long ICU stay → Neurological Complications
Prior literature shows that non-neurologic organ failure may contribute to 2/3 of all TBI deaths.

• The number of organs failing correlates with mortality.
• All studies retrospective and largest n=209

Kemp et al. American Surgeon 2008; Zguyn et al. CCM 2005
UMASS OPTIMISM Study (Outcome Prognostication in Traumatic Brain Injury)

 Started Nov 2009, ongoing
 Total n=238

 limited to moderate-severe TBI
 456 datafields

 Demographics
 Pre-hospital data
 Trauma ED data
 Head CT data – consensus by all three neurointensivists
 ICU admission “enrollment” post-resuscitation GCS first 24h unless intoxicated
 NSG interventions
 Specific ICU complications, predefined,
 reviewed weekly, – consensus by all three neurointensivists
 Outcome: GOS at hospital discharge
 3-month, 12-month by phone, recently added 6-month:
 GOS, GOSE, mRS, Lawton ADL, SF-12, TICS
ICU medical complications are common in our cohort:

<table>
<thead>
<tr>
<th>Medical Complication</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute Myocardial Infarction</td>
<td>2%</td>
</tr>
<tr>
<td>Rhabdomyolysis</td>
<td>2%</td>
</tr>
<tr>
<td>Acute liver failure</td>
<td>4%</td>
</tr>
<tr>
<td>Venous Thromboembolism</td>
<td>5%</td>
</tr>
<tr>
<td>Cardiac arrest</td>
<td>6%</td>
</tr>
<tr>
<td>Acute renal failure</td>
<td>7%</td>
</tr>
<tr>
<td>Disseminated intravascular coagulation</td>
<td>8%</td>
</tr>
<tr>
<td>ARDS</td>
<td>9%</td>
</tr>
<tr>
<td>Pulmonary edema</td>
<td>12%</td>
</tr>
<tr>
<td>Urinary Tract Infection</td>
<td>13%</td>
</tr>
<tr>
<td>Ventilator associated pneumonia (VAP)</td>
<td>18%</td>
</tr>
<tr>
<td>New arrhythm</td>
<td>23%</td>
</tr>
<tr>
<td>Hyponatremia</td>
<td>29%</td>
</tr>
<tr>
<td>Anemia requiring transfusion</td>
<td>33%</td>
</tr>
<tr>
<td>Sepsis including septic shock</td>
<td>36%</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>41%</td>
</tr>
<tr>
<td>Hypotension requiring pressors</td>
<td>42%</td>
</tr>
<tr>
<td>Systemic Inflammatory Response Syndrome (SIRS)</td>
<td>60%</td>
</tr>
<tr>
<td>Fever</td>
<td>62%</td>
</tr>
<tr>
<td>Hyperglycemia</td>
<td>79%</td>
</tr>
</tbody>
</table>

Muehlschlegel et al. Neurocritical Care 2013
These are the neurological ICU complications in our cohort:

- CNS infection: 0.5%
- Ischemic Stroke: 7%
- Seizure: 11%
- Brain edema Rx osmotherapy: 37%
- Rebleed: 39%
- Herniation: 39%
- ICP crisis*: 62%

*ICP crisis in n=62 patients with ICP monitor in place

N=213

Muehlschlegel et al. Neurocritical Care 2013
ICU complications contribute significantly and to a high degree to the outcome variability.
In summary, outcomes research may identify modifiable predictors of outcome.

- Outcome prognostication is extremely important
- Be aware of self-fulfilling prophecies
- Focus on ICU course to identify factors that may explain the other 2/3 of the variability of outcome after TBI
Thank you...

....Any questions?

"How do you want it—the crystal mumbo-jumbo or statistical probability?"

From: www.CartoonStock.com