Improving the Outcome Prognostication of Critically Ill Patients with moderate-severe TBI

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• No conflict of interest

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  – Departmental
Traumatic Brain Injury remains a real public health problem in the U.S. (and worldwide).

Approximately 1.7 million Americans sustain a TBI annually:

- **52,000** Deaths
- **275,000** Hospitalizations
- **1,365,000** Emergency Department Visits
- **??** Receiving Other Medical Care or No Care*

Moderate-severe TBI
GCS 3-12

• 25% of these are moderate-severe TBI.
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.

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.
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.

From: Lingsma et al. Lancet Neurol 2010

Figure 2: Prognostic value of different components of traumatic brain injury prognosis ($R^2$) in the IMPACT dataset (n=8686)
The cumulative $R^2$ 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.20
The IMPACT score ignores the hospital course.

• Our hypothesis:
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>Condition</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>Hypertension requiring pressors</td>
<td>13%</td>
</tr>
<tr>
<td>Ventilator associated pneumonia (VAP)</td>
<td>18%</td>
</tr>
<tr>
<td>New arrhythmia</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>Disseminated Intravascular Coagulation</td>
<td>60%</td>
</tr>
<tr>
<td>Systemic Inflammatory Response Syndrome (SIRS)</td>
<td>62%</td>
</tr>
<tr>
<td>Fever</td>
<td>79%</td>
</tr>
<tr>
<td>Hyperglycemia</td>
<td>80%</td>
</tr>
</tbody>
</table>

N=213

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

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

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

Muehlschlegel et al. Neurocritical Care 2013
ICU complications contribute significantly and to a high degree to the outcome variability.

Muehlschlegel et al. Neurocritical Care 2013
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