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

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• No conflict of interest

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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

Moderate-severe TBI
GCS 3-12

From: www.nutridesk.com.au

From: www.break.com

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

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

From: Lingsma et al. Lancet Neurol 2010
The IMPACT data set has lead to the validated IMPACT predictors.

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

http://www.tbi-impact.org/
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 $R^2$ 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. 

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

- Our hypothesis:

  - Admission "IMPACT variables"
  - Long ICU stay
  - Medical Complications
  - Neurological Complications

  Outcome
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:

- Hyperglycemia: 79%
- Fever: 62%
- Systemic Inflammatory Response Syndrome (SIRS): 60%
- Hypotension requiring pressors: 42%
- Pneumonia: 41%
- Sepsis including septic shock: 42%
- Anemia requiring transfusion: 60%
- Hyponatremia: 62%
- Ventilator associated pneumonia (VAP): 79%
- Urinary Tract Infection: 62%
- Pulmonary edema: 62%
- ARDS: 62%
- Disseminated intravascular coagulation: 62%
- Acute renal failure: 62%
- Cardiac arrest: 62%
- Venous Thromboembolism: 62%
- Acute liver failure: 62%
- Rhabdomyolysis: 62%
- New arrythmia: 62%

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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%

*N=213

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

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ICU complications contribute significantly and to a high degree to the outcome variability.

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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?"