Natasha Li , MD PGY2
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CRC Block 3

Severe Traumatic Brain Injury Outcomes After Initiation of Guidelines for Management

a. Study Purpose and Rationale

According to the CDC Injury Prevention Program, traumatic Brain Injury is the most common acquired cause of death and disability in childhood in developed countries.[1] Head trauma in children <18 yo results in ~7400 deaths, 60,000 hospitalizations and 60,000 ED visits.[2] Additionally the overall health care cost of traumatic brain injury is approximately 56.3 billion dollars per year. [3]

The poor outcome, and significance traumatic brain injury has on the health care system, has sparked a surge in research in this field. Although the exact pathophysiology is becoming better understood, there remain questions to be answered. What is known in the pathophysiology of traumatic brain injury is it can be broken down into a two hit model. Here, the primary insult is direct parenchymal damage caused by the trauma. This leads to hypoperfusion of the brain while at the same time requiring increase metabolic demands.[4] This leads to a cascade of secondary insults from biochemical, cellular, and metabolic responses, and exogenous responses. All the while, at 24-72 hours after injury there is significant cerebral swelling, increasing intracranial hypertension, and thereby decreasing cerebral perfusion.[5] This places the brain in a downward spiral where secondary insult is further perpetuating itself.

The key to management of those with severe traumatic brain injury is to minimize the secondary insults in an effort to break the cycle of continued injury. This theory, marked the basis behind the study of and initiation of guidelines for the treatment of severe traumatic brain injury, initially published in 2003.[6]

It is important to ask ourselves if guidelines and improved clinical knowledge, translate to improved outcomes for patients. To the best of our knowledge, no study exists addressing the question of the severe traumatic brain injury guidelines improving outcomes. As such, this study poses the question; did the institution of the guidelines for the management of severe traumatic brain injury published in 2003 improve the outcome of patients? The null hypothesis being, there will be no statistical difference in GOS scores before and after the institution of the guidelines for the acute medical management of severe traumatic brain injury in pediatric patients.

b. Study Design and Statistical Analysis

This study is a retrospective analysis of data complied by a database at Children's Medical Center Dallas, called the Brain Nerve Injury and Repository Database. Data on

patients was collected from 2001 to 2013, on children who were admitted to their institution for head injury cause by blunt force.

Patients were included in this study if enrolled in this database, between the age of 0-21, and suffered severe traumatic brain injury, defined by the GCS score at presentation to the ED of less than or equal to 8.

GCS Score (Appendix 1) has been an externally validated measure of severity of traumatic brain injury. GCS Scores <9 were defines as severe traumatic brain injury, 9-12 were moderate traumatic brain injury, and 13-15 were mild traumatic brain injury.

Primary outcome measured was GOS score. GOS scores have also been externally validated means of measuring outcomes of those with traumatic brain injury. GOS score of 1 defined as death. GOS score of 2 indicated a vegetative state defined as being unaware of self and environment. GOS score of 3 indicated severe disability, defined as unable to live independently. GOS score of 4 indicated moderate disability, defined as able to live independently, and GOS score of 5 indicated mild disability, defined as able to return to work/school. Secondary Outcome measured is length of PICU stay, and length of hospital stay.

Patients were excluded if there was no documented GOS score upon discharge, and those with mechanisms of injury secondary to non-accidental trauma..

An unpaired T-Test will be used to compare pre 2003 GOS scores to post 2003 GOS scores. A statistical significance is defined as <0.05. A graphical representation of the data will be created to look at the slope of GOS scores over time, and Regression analysis will be applied to determine if there is a significant difference in the slope of the GOS scores over time prior to and after the initiation of management guidelines.

A power analysis was conducted using a $p < 0.05$, and a power of 80%, to determine the necessary N to see a statistical significance, with an effect of a change in the mean GOS score of 0.3. Based on this analysis we should have 124 subjects in order to detect a difference in mean GOS of 0.3 with 80% certainty. In the database, we have 173 subjects from 2001-2003, compared to 500 subjects from 2003 to current. Which makes this study more than adequately powered.

c. Study Procedure

No procedures were performed for this study.

d. Study Drugs

No drugs were given for this study.

e. Medical Devices

No medical devices were used for this study.

f. Study Questionnaire

No questionnaires were used during this study.

g. Study Subjects

Subjects who were enrolled in the BNIRD database were included in this study if their presenting GCS score was less than or equal to 8. Patients were excluded from this study if GOS scores were not documented upon discharge, if mechanism of injury was secondary to non-accidental trauma, or if mechanism of injury was not recorded.

h. Recruitment of subjects

No requirement was done for this study.

i. Confidentiality of Study Data

Investigators involved in the BNIRD database only receive de-identified samples and data. Therefore, No information will be published that could be directly linked to a donor-participant.

j. Potential Conflict of Interest

No investigator or university has proprietary interest in or might stand to benefit in any other way from the results of the investigation.

k. Location of Study

Brain and Nerve Injury Center Repository and Database database is located at Children's Medical Center Dallas. Analysis of the data for this study was completed at Children's Hospital of New York, Pediatric ICU.

l. Potential Risks

No potential risks are present for this study.

m. Potential Benefits

Although individual subjects will not benefit from this study, there is a system wide benefit to determining if clinical knowledge and standards, translates to improved patient outcome.

n. Alternative Therapies

No alternative therapies exist.

o. Compensation to Subjects – N/A

No compensation to subjects made by this study.

p. Costs to Subjects

This study was of no cost to subjects.

q. Minors as Research Subjects

Database coordinators for BNRID obtained IRB approval and clearance by their pediatric committee.

r. Radiation and Radioactive Substances

No radiation or radioactive substances used during this study.

Appendix

Appendix 1. Glasgow Coma Scale Score

	Adult	Pediatric
Eye Opening	4 Spontaneous 3 To verbal Stimuli 2 To painful stimuli 1 No eye opening	4 Spontaneous 3 To verbal stimuli 2 To painful stimuli 1 No eye opening
Verbal Response	5 Oriented 4 Confused 3 Inappropriate words 2 Incomprehensible 1 No verbal response	5 Appropriate coo & cry 4 Irritable cry 3 Inconsolable cry 2 Grunts 1 No verbal response
Motor Response	6 Obeys commands 5 Localizes pain 4 Withdraws to pain 3 Flexion to pain 2 Extension to pain 1 No motor response	6 Normal spontaneous 5 Withdraws to touch 4 Withdraws to pain 3 Flexion to pain 2 Extension to pain 1 No motor response

References

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[3] Schneier AJ, et al. Incidence of pediatric traumatic brain injury and associated hospital resource utilization in the United States. *Pediatrics*. 2006; 118(2):482-492.

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