Adoption of the Brain Injury Guidelines for management of traumatic brain injury at a community level II trauma center

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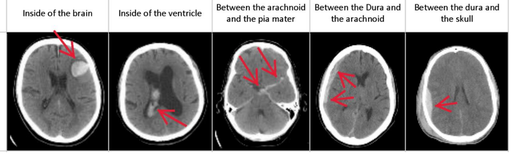
ABSTRACT

Traumatic brain injury (TBI), particularly when associated with intracranial hemorrhage (ICH), is a condition with increasing incidence and burden on health systems. Only in recent years have guidelines, such as the Brain Injury Guidelines (BIG), emerged that address goals of reducing unneeded specialist consultation, hospitalization, and ICU admissions, all of which have been associated with standard practice regardless of intracranial bleed type or severity. Despite BIG having been validated in multiple studies over the past decade, there is still delay among lower-volume institutions to adopt BIG. This project attempts to evaluate historical management of TBI at Northeast Georgia Medical Center (NGMC), a community level II trauma center, before recent implementation of BIG. Using preliminary 2019 NGMC trauma registry data and chart review, we determined relative frequencies of retroactively-assigned BIG categories for patients presenting to the trauma bay with TBI. Additionally, we were able to determine for each category the average: hospital length of stay, ICU length of stay, and number of head radiographs obtained. It is hoped this data analysis can be further extrapolated to include additional data before and after BIG implementation to validate BIG in a smaller community trauma center and to identify potential cost savings.

BACKGROUND

The incidence of TBI has risen significantly over the past decade with Centers for Disease Control data showing rates of TBI-related emergency department (ED) visits increasing for all age groups from 2001 to 2010. (Fig. 1) In 2014, TBI in the United States accounted for 2.2. million ED visits and 280,000 hospitalizations, and TBI costs the U.S. health system nearly $30 billion annually.[1,2] This alarming data highlights the need to reduce TBI-related costs. This can be done through improved TBI characterization and utilization of qualified health care providers, such as acute care surgeons, to better triage patients with low-risk TBI categories known to be safely managed without reflexive specialist consultation, hospitalization, additional imaging, or transfer to facilities where specialist services are available. The development of BIG in 2014 and subsequent studies validating its utility have helped in shifting the paradigm surrounding TBI management.[3,4] (Table 2) These guidelines divide brain injuries into three categories based on elements from the patient's history, clinical features, and radiographic features on initial CT that incorporate intracranial bleeding type and severity. Once the TBI is categorized, management can be tailored to the associated therapeutic plan for that category with specific recommendations concerning hospitalization, repeat head CT, and specialist consultation.

Table 1. Descriptions and representative CT images of common types of intracranial hemorrhage seen in trauma patients.

	Intraparenchymal	Intraventricular	Subarachnoid	Subdural	Epidural
Location	Inside of the brain	Inside of the ventricle	Between the arachnoid and the pia mater	Between the Dura and the arachnoid	Between the dura and the skull
Imaging					

Unfortunately, BIG implementation and validation has been largely limited to large trauma centers that manage a high-volume of TBIs, while smaller community institutions like NGMC have been hesitant in such endeavors. This could be due to reasons such as variability of instuitional protocol or lack of local academic advocacy in using recent evidence to encourage positive practice changes. It was noticed that there was a lack of academic advocacy at NGMC concerning the evidence surrounding BIG for supporting local changes in established protocol. This prompted an institutional conversation that resulted in the adoption of BIG at NGHS as well as, subsequently, this retrospective study that attempted to characterize the management of TBI at NGHS prior to the adoption of BIG. (Fig. 2)

U.S. Rates of TBI-Related Emergency Department Visits from 2001-2010

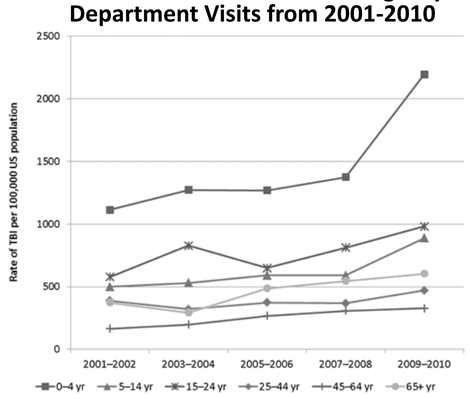


Figure 1. CDC rates of TBI-related emergency department visits by age group in the U.S. increased from 2001-2010.[1]

Table 2. Brain injury guidelines (BIG) developed in 2014 by Joseph et. al.[3]

Brain Injury Guidelines			
Variables	**BIG 1**	**BIG 2**	**BIG 3**
LOC	Yes/No	Yes/No	Yes/No
Neurologic examination	Normal	Normal	Abnormal
Intoxication	No	No/Yes	No/Yes
CAMP	No	No	Yes
Skull Fracture	No	Non-displaced	Displaced
SDH	≤ 4mm	5 - 7 mm	≥ 8 mm
EDH	≤ 4mm	5 - 7 mm	≥ 8 mm
IPH	≤ 4mm, 1 location	5 - 7 mm, 2 locations	≥ 8 mm, multiple locations
SAH	Trace	Localized	Scattered
IVH	No	No	Yes
THERAPEUTIC PLAN			
Hospitalization	Observation (6hrs)	Yes	Yes
RHCT	No	No	Yes
NSC	No	No	Yes

METHODS

Timeline and Account of BIG Implementation at NGHS

February 2020
Dr. Cormican and Dr. Richart from TACS discuss with NGHS Multidisciplinary Trauma Peer Review Committee (MTPRC) supporting evidence for BIG criteria and desire to implement at NGMC.

March 2020
Dr. Schultz from neurosurgery provides formal feedback to MTPRC and a collective decision is made to involve and educate PM&R and ED physicians before operationalizing and adopting BIG at NGMC.

April 2020
Dr. Cormican develops a draft of *Minor Traumatic Brin Injury Management Recommendations* and shares with Dr. Schultz and other MTPRC members prior to a third meeting during which all agreed to adopt BIG at NGMC.

May-July 2020
Dr. Cormican presents Multidisciplinary Trauma Systems/Operations Committee (MTSOC) with summarized review of MTPRC approved BIG guidelines. Further relational work is completed to secure protocols for a newly established Emergency Observation Unit for TBI and chest injury.

August 2020
Retrospective chart review begins for trauma registry data over 2019 TBI patient data.

BIG protocol goes live at NGMC and BIG category becomes a data element captured in the NGMC trauma registry.

Figure 2. Timeline and account of collaborative planning of BIG implementation at NGHS among involved stakeholders over the past year.

The NGHS trauma data registry was used to access data for trauma patients who were diagnosed with TBI during 2019. To date, a total of 74 patients from this dataset of 315 patients have undergone retrospective chart review and have been retroactively assigned a BIG category based on Table 2. Additionally, clinical outcome data points were recorded for each patient. These were averaged for each BIG category and specifically include: total hospital length of stay, ICU length of stay, and average number of head radiographs obtained. When acquiring this data, radiographs from non-NGHS facilities of patients transferred to NGMC were not incorporated, and patients with polytrauma potentially confounding their hospital length of stay were excluded. Additionally, data was not incorporated for patients less than 18 years of age and for patients transferred to another hospital from NGMC. If a patient did not require ICU stay, said patient was assigned an ICU length of stay value of zero, which was used in overall averages. After making these adjustments, there were a total of 46 patients included in this preliminary data analysis. Collected data points for each BIG category are listed in Table 3.

RESULTS

Table 3. Preliminary average clinical outcome data points of retroactively assigned BIG categories for trauma patients with TBI during 2019.

	BIG 1	BIG 2	BIG 3
Percent of total trauma patients with TBIs	15.2%	32.6%	52.2%
Average hospital length of stay (days)	2.82	4.42	4.31
Average ICU length of stay	0.71	1.00	2.88
Average number of head radiographs obtained during admission	2.43	1.73	3.04

DISCUSSION

There are a few notable points of discussion from this preliminary data analysis, which so far, has only included 46 of potentially 315 trauma patients from 2019 at NGMC with TBI managed before BIG implementation.

- The finding that retrospectively-assigned BIG 1 patients had an average hospital length of stay of 2.82 days suggests there were unneeded hospital admissions for BIG 1 TBIs in 2019.
- The finding that retrospectively-assigned BIG 1 and 2 patients had average ICU lengths of stay of 0.71 and 1.00 days, respectively, suggests there were unneeded elevations of care for these BIG 1 and 2 TBIs in 2019.
- The finding that retroactively-assigned BIG 1 and 2 patients had average numbers of head radiographs of 2.43 and 1.73, respectively, suggests a significant number of unneeded head radiographs were obtained for BIG 2 and particularly BIG 1 TBIs in 2019 as both categories do not require repeat imaging per BIG.
- The above findings all suggest potentially significant cost savings from BIG implementation at NGMC by reducing unneeded hospitalizations, elevations of care, and head imaging pending further registry and cost data analysis
- Study limitations from this preliminary data analysis:
  - Only included 46/74 patients that have, to date, undergone chart review out of a total of 315 trauma patients pulled from the 2019 TBI data report
  - Did not include average number of specialist (neurosurgery or neurology) consultations per BIG category
  - Did not attempt to characterize effects of inpatient anticoagulation prophylaxis on hospital length of stay or number of head radiographs per BIG category
  - Did not include pediatric patients

FUTURE WORK

Much work is to be done analyzing the remainder of 2019 TBI data. Findings will be incorporated with data reported here, and future post-BIG-implementation TBI data will be continue to be collected via the trauma registry along with associated BIG category for each TBI admission. It is anticipated that this project will continue until a sufficient *n* is obtained to validate adoption of BIG at NGHS by looking for significant difference in the clinical outcomes reported here and by evaluating potential cost savings from potential differences in these clinical outcomes.

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