Severe Traumatic Brain Injury at a Tertiary Referral Center in Tanzania: Epidemiology and Adherence to Brain Trauma Foundation Guidelines

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■ BACKGROUND: **Severe traumatic brain injury (TBI) is a major cause of death and disability worldwide. Prospective TBI data from sub-Saharan Africa are sparse. This study examines epidemiology and explores management of patients with severe TBI and adherence to Brain Trauma Foundation Guidelines at a tertiary care referral hospital in Tanzania.**

■ METHODS: **Patients with severe TBI hospitalized at Bugando Medical Centre were recorded in a prospective registry including epidemiologic, clinical, treatment, and outcome data.**

■ RESULTS: **Between September 2013 and October 2015, 371 patients with TBI were admitted; 33% (115/371) had severe TBI. Mean age was 32.0 years ± 20.1, and most patients were male (80.0%). Vehicular injuries were the most common cause of injury (65.2%). Approximately half of the patients (47.8%) were hospitalized on the day of injury. Computed tomography of the brain was performed in 49.6% of patients, and 58.3% were admitted to the intensive care unit. Continuous arterial blood pressure monitoring and intracranial pressure monitoring were not performed in any patient. Of patients with severe TBI, 38.3% received hyperosmolar therapy, and 35.7% underwent craniotomy. The 2-week mortality was 34.8%.**

■ CONCLUSIONS: **Mortality of patients with severe TBI at Bugando Medical Centre, Tanzania, is approximately twice that in high-income countries. Intensive care unit care, computed tomography imaging, and continuous arterial blood pressure and intracranial pressure monitoring are underused or unavailable in the tertiary referral hospital setting. Improving outcomes after severe TBI will require concerted investment in prehospital care and improvement in availability of intensive care unit resources, computed tomography, and expertise in multidisciplinary care.**

INTRODUCTION

Injuries are a leading cause of death and disability around the world, totaling 4.8 million per year and responsible for approximately 10% of all deaths globally.[1,2] Head injuries are among the most likely injuries to result in death or disability.[3] Traumatic brain injury (TBI) is a rural as well as urban problem,[4-6] and patients in low- and middle-income countries have more than twice the odds of dying after severe TBI compared with patients in high-income countries, with mortality >50% in some low- and middle-income countries.[7,8] The incidence of TBI in sub-Saharan Africa (SSA) may be 3.5 times higher than the global incidence and is predicted to reach 14 million per year by 2050.[9,10]

Key words
- Adherence
- Guidelines
- Mortality
- Sub-Saharan Africa
- Tanzania
- Traumatic brain injury

Abbreviations and Acronyms
BMC: Bugando Medical Centre
BTF: Brain Trauma Foundation
CPP: Cerebral perfusion pressure
CT: Computed tomography
GCS: Glasgow Coma Scale
ICP: Intracranial pressure
ICU: Intensive care unit
SSA: Sub-Saharan Africa
TBI: Traumatic brain injury

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Early predictors of prognosis after severe TBI include age, Glasgow Coma Scale (GCS) score, pupillary reactivity, systemic hypotension, abnormality on brain computed tomography (CT), and presence of an intracranial surgical lesion.[11-14] Guidelines for management of severe TBI that have been formulated based on the best clinical evidence by the Brain Trauma Foundation (BTF) focus on avoidance and treatment of hypotension and hypoxia and monitoring and treatment of increased intracranial pressure (ICP) and decreased cerebral perfusion pressure (CPP). Recommendations for the optimal medical management of severe TBI include surgical intervention, sedation/analgesia, hyperosmolar agents, hyperventilation, therapeutic coma, early implementation of nutrition, and avoidance of steroids.[15,16] Adherence to these guidelines has been shown to improve outcomes after severe TBI with reduction in mortality and long-term disability.[11,17] The feasibility of implementing BTF guidelines and the current adherence in the care of patients with TBI in SSA have not been assessed. In this study, we analyzed the epidemiology, treatment, and outcome of severe TBI in northwestern Tanzania.

MATERIALS AND METHODS

Study Design and Procedure

We established a prospective TBI registry at Bugando Medical Centre (BMC), Mwanza, Tanzania, in 2013 for the purpose of quality improvement. Data on management of TBI were collected prospectively between September 1, 2013, and October 31, 2015. Ethical approval was obtained from the Ethics Committee of BMC and the Institutional Review Board of Weill Cornell Medical College, and all data were deidentified to maintain patient confidentiality. Patients hospitalized with TBI at BMC were entered into the registry within 24 hours of arrival. Registry data were recorded daily up to the day 14 of hospitalization and again on the day of discharge. The 2-week mortality was also recorded. Two medical students visited the surgical wards and intensive care unit (ICU) daily and recorded prespecified data elements for patients with TBI on paper forms. These data were transferred onto a secure computer at the supervising investigator's office (Luke Smart) and the paper forms were destroyed.

Study Site

This study was conducted at a tertiary care referral center located in Mwanza, the second largest city in Tanzania with a population of >700,000 people. BMC is the largest hospital in the northwestern part of the country and serves as the primary referral and teaching hospital for the Lake Zone with a catchment of approximately 13 million people. BMC has 900 beds with a capacity of 150 surgical beds with approximately 1300 surgical admissions per year. The surgical department has 6 subspecialties: general, cardiothoracic, orthopedic, otolaryngology, urology, and neurologic surgery. Two surgeons primarily provide neurosurgical services; 1 has completed postgraduate education, and 1 has completed 1 year of internship and accumulated several years of experience. The surgeons are assisted as needed by orthopedic and general surgery staff. There is also a 24-hour emergency department staffed by general practice physicians. The ICU has 13 beds and serves as a multispecialty ICU, including pediatrics. A senior house officer with critical care experience of at least 6 months staffs the ICU during the daytime. An anesthetist-intensivist who is in the operating room supervises the medical officer. The nursing ratio is 4:1; the nurses are not critical care certified. **Table 1** illustrates availability of basic resources as would be required to implement guidelines-based standards.

Study Population

During the first year of the registry, all patients with TBI who were admitted to the ICU were registered. During the second year, the registry was expanded to include patients admitted to surgical wards, as many patients with TBI were not being admitted to the ICU. Patients with TBI who died in the emergency department or who were dead on arrival were not included in the registry, as records of these were frequently unavailable.

Study Variables

Severe TBI was defined as GCS score $\leq$8.[18] Data elements used in the registry were based on known predictors of TBI outcome (age, initial GCS and pupillary reactivity, arterial hypotension, abnormal brain CT, and presence of a surgical lesion on brain CT), basic demographics (sex, mechanism of injury, days between injury and hospitalization), and elements related to guideline-based treatment (antiseizure therapy, hyperosmolar therapy, mechanical ventilation, intracranial monitoring).[16] Arterial hypotension was defined as systolic blood pressure <90 mm Hg; hypoxia, oxygen saturation as measured by pulse oximetry <90%; abnormal pupillary reactivity, <1 mm response to light; asymmetric pupils, >1 mm difference; and abnormal CT scan was defined as having any 1 of the following features: cerebral edema, intracranial hematoma, compressed basal cisterns, midline shift, traumatic subarachnoid hemorrhage, or infarction. In addition to the above-mentioned data, in the second year we included additional details on day of ICU admission, day of CT imaging, deep vein thrombosis prophylaxis, and enteral nutrition.

Statistical Analyses

SAS Version 9.3 (SAS Institute Inc., Cary, North Carolina, USA) was used for data analyses. We calculated summary statistics using frequencies and proportions for categorical variables and means, standard deviations, medians, and interquartile ranges for continuous variables depending on the distribution of the data. Univariate logistic regression models were used to assess the association of 2-week mortality with individual risk factors that were identified a priori, including age, sex, admission GCS score, pupillary response, hypotension, days between injury and hospitalization, CT scan abnormality, and surgical lesion. Variables associated with 2-week mortality in the univariate analyses were included in the multivariable logistic regression model. Patients with missing covariate data were excluded from regression analyses. Crude and adjusted odds ratios with 95% confidence intervals were reported. All statistical tests were 2-sided, with a significance level of $P < 0.05$.

RESULTS

Patient Characteristics

Between September 2013 and October 2015, 371 patients with TBI were admitted to BMC. Of these, 115 patients had severe TBI and were included in the registry. Patients with severe TBI were also