Distribution and Characteristics of Severe Traumatic Brain Injury at Mulago National Referral Hospital in Uganda

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■ OBJECTIVE: **Road traffic accidents are a leading cause of injury in low- and middle-income countries, where mortality rates are disproportionately higher. Patients with severe traumatic brain injury (TBI) tend to have very poor outcomes. To reduce the burden from severe TBI, we describe its distribution at Mulago National Referral Hospital (Kampala, Uganda) and identify the associations between outcomes and patient characteristics, offering insights into prevention and future research efforts to improve clinical care.**

■ METHODS: **This is a single-institution, retrospective chart review including patients of all ages with a Glasgow Coma Scale (GCS) score of 8 or less (measured upon admission). A database was compiled to maximize all available clinical variables. Descriptive statistics and univariable and multivariable regression models were fitted to identify significant associations with outcome (died or discharged).**

■ RESULTS: **One hundred twenty patients were identified between July 1, 2008, and June 30, 2009. The cumulative incidence of admissions is 89 per 100,000. Thirty-one patients died in the hospital, yielding a 25.8% mortality rate. Motorcycle road traffic accident was the leading mechanism of injury, and males ages 15–29 years comprised the predominant demographic (42.5% of patients). Initial GCS, change in GCS score during hospital stay, and the presence of hematoma were strongest predictors of outcome.**

■ CONCLUSIONS: **Severe TBI was a common condition for injury-related hospital admissions at Mulago Hospital. The capacity for neurosurgery may have explained the relatively lower mortality rate than previously reported from Sub-Saharan Africa. Further investigations are needed. Targeted prevention programs focused on motorcycle users and helmet law enforcement should decrease the incidence of severe TBI.**

INTRODUCTION

From 2015 to 2030, road traffic injuries will become the fifth-leading cause of death (47). Current approximations suggest 90% of deaths from injuries occur in low- and middle-income countries (LMICs) (46). Traumatic brain injury (TBI) outcomes are among the worst in LMICs and the incidence is greater; the Sub-Saharan Africa (SSA) region has an incidence of 150–170 per 100,000 compared with a global average of 106 per 100,000 (18). The incidence is likely an underestimate because of the typically nascent or nonexistent trauma care infrastructure, which leaves many patients presenting late at referral hospitals. Moreover, TBI deaths are underreported because victims are likely routed first to mortuaries, as 50% of TBI mortality occurs within the first 2 hours from the moment of primary injury (14). Rapid infrastructure growth and motorization in the SSA region is likely to exacerbate this trend. In the United States, TBI has long been recognized as a "silent"

Key words
- Africa
- Closed head injury
- Epidemiology
- Head injury
- Incidence
- Traumatic brain injuries

Abbreviations and Acronyms
CI: Confidence interval
CT: Computed tomography
GCS: Glasgow Coma Scale
LMICs: Low- and middle-income countries
OR: Odds ratio
RTA: Road traffic accident
SSA: Sub-Saharan Africa
TBI: Traumatic brain injury

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epidemic, with immense public health impact with annual costs estimated at USD 76.5 billion (9). Countries in the SSA region carries a disproportionate burden with greater mortality, worsened outcomes, and greater impact from ensuing disability. In terms of capacity, human resources are lacking. There is 1 neurosurgeon per 10,000,000 average for the African continent compared with 102 per 10,000,000 in Europe and 56 per 10,000,000 globally (45).

The evidence base for TBI in SSA countries has been enriched within the previous 10 years as the result of increased descriptive studies, establishment of prospective databases, and expansion of sites for the international cohort study, Clinical Randomisation of an Antifibrinolytic in Significant Haemorrhage (CRASH) trials (1, 8, 28, 35, 36, 48). CRASH trial results of 8927 patients predict that a TBI victim in a LMIC has twice the odds of dying after severe TBI (odds ratio [OR] 2.23, 95% confidence interval [CI] 1.51–3.30). In Uganda, head injury is one of the top 4 common admission diagnoses, contributing to a total 45.3% mortality rate in one study of intensive care unit patients and 75% head injury–specific mortality rate in another study of all casualty department admissions (17, 24). Head/neck injury is associated with 65% of all injury-related fatalities in urban Uganda (19). The literature from SSA countries specifically related to severe TBI is scarce. We undertook this retrospective analysis to describe distribution of severe TBI at Mulago Hospital, the national referral hospital of Uganda. Secondary objectives were to identify associations between outcomes and patient characteristics in order to potentiate platforms for more effective prevention and inform future research efforts at Mualgo Hospital.

METHODS

This was a single-institution study at Mulago Hospital, which has an immediate catchment area of the Kampala Capital City (estimated population 1,516,210 in 2014), but patients are referred from throughout the country (44). Injuries are triaged and treated in the Casualty Department; more severe injuries are admitted and many are referred to the Surgery Department. Mulago Hospital has 1500 beds and admits 130,000–140,000 patients per year. The Neurosurgery Unit employs 4 of Uganda's 5 formally trained neurosurgeons, uses a shared elective operating room and casualty operating rooms as necessary, and provides intensive care in a 4- to 8-bed high-dependency surgery unit (16, 24).

We performed a retrospective review of medical records for severe TBI patients admitted within a 1-year period (July 1,2008 to June 30, 2009). The inclusion criterion was a confirmed diagnosis of TBI with an initial Glasgow Coma Scale (GCS) score between 3 and 8. Patients with general head injury were excluded from analysis. A database was assembled that included patient demographics, discharge status, initial and greatest GCS score, date of trauma, date of admission, date of treatments, mechanism of injury, pupillary reactivity, medications, neurosurgical procedure (if applicable), and pathologies detected by a diagnostic computed tomography (CT) scan. During the study period, Mulago's one available CT scanner was functional without interruption, 4 neurosurgeons provided 24-hour coverage, and at least 1 of 5 operating rooms were available for neurosurgical cases; thus, the management of TBI was consistently at maximum potential for capacity.

Pearson χ^2 tests were used to compare categorical demographic and patient clinical variables effect on outcomes (dichotomized as dead or discharged). Fisher exact tests were used for smaller proportions. Logistic regression was used to determine relationship of 4 exposure variables (GCS admit, presence of hematoma, pupillary reactivity, and age) on the odds of being dead or discharged. The multivariate model was constructed based on the CRASH trials prognostic model for TBI outcomes and selection of the 4 available variables (7). The significance level was set to 0.05 for all analyses. The 1-year cumulative incidence of severe TBI admissions was calculated with the use of total severe TBI admissions and total admissions for the 1-year period (16). All statistical analyses were performed using StataCorp STATA 13 SE (College Station, Texas, USA). All graphics were produced using Microsoft Excel 2010 (Redmond, Washington, USA). Institutional review board approval was granted by the Mulago Hospital Research and Ethics Committee and Duke University Health System Institutional Review Board.

RESULTS

One hundred twenty patients met the inclusion criteria within the 1-year period (July 1, 2008 to June 30, 2009). Thirty-one of 120 patients died, yielding an in-hospital mortality rate of 25.8%. Demographics are depicted in **Table 1** and **Figure 1A**.

Mechanisms of Injury

The most common mechanism of injury was road traffic accident (RTA), which contributed to 79% of all severe TBI cases. Thirty-four percent were motorbike accidents, 25% were pedestrians struck by a vehicle, and 20% were vehicular accidents in which the patient was a passenger or driver in a motor vehicle. Assaults, bicycle accidents, falls, and one animal-related trauma were grouped into an "other" category because they were of low-velocity impact (**Table 1**, **Figure 1B**). **Figure 1C** depicts the mechanism of injury by age and sex. The incidence was greatest in male patients age 15–29 years, in whom motorcycle RTA was the leading mechanism of injury ($P < 0.001$). For the 0- to 14-year age group, the leading mechanism of injury was being struck as a pedestrian.

Incidence of Severe TBI

The cumulative incidence of admissions was 89 per 100,000. Sixty-six patients (55.0%) sustained closed-head injuries, and 54 patients (45%) sustained open (mainly depressed skull fractures). The average age was 25.0 (16.7 standard deviation, range 1–87). Of 4 age groups (0–14, 15–29, 30–44, and ≥45 years), the 15- to 29-year age group contributed the greatest number of cases with 51 patients (42.5%). Mortality was greatest in the ≥45 years group at 40.0% (**Table 1** and **Figure 1A**). The male/female ratio was 4.5:1. Median hospitalization length was 7 days (interquartile range, 5–14.5 days). Sixty-three patients (52.5%) presented directly to Mulago after injury, and 57 patients (47.5%) were referred; 71 patients (59.2%) were transferred to Mulago within the same day of primary injury (**Table 1**).