



Epidemiology, Management, and Functional Outcomes of Traumatic Brain Injury in Sub-Saharan Africa

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■ BACKGROUND: Trauma accounts for 4.7 million deaths each year, with an estimated 90% of these occurring in low- and middle-income countries (LMICs). Approximately half of trauma-related deaths are caused by central nervous system injury. Because a thorough understanding of traumatic brain injury (TBI) in LMICs is essential to mitigate TBI-related mortality, we established a clinical and radiographic database to characterize TBI in our low-income setting.

■ METHODS: This is a review of prospectively collected data from Kamuzu Central Hospital, a tertiary care center in the capital of Malawi. All patients admitted from October 2016 through May 2017 with a history of head trauma, altered consciousness, and/or radiographic evidence TBI were included. We performed descriptive statistics, a Cox regression analysis, and a survival analysis.

■ RESULTS: There were 280 patients who met inclusion criteria; of these, 80.5% were men. The mean age was 28.8 ± 16.3 years. Median Glasgow Coma Scale (GCS) score was 12 (interquartile range, 8–15). Road traffic crashes constituted the most common injury mechanism (60.7%). There were 148 (52.3%) patients who received a computed tomography scan, with the most common findings being contusions (26.1%). Of the patients, 88 (33.0%) had severe TBI, defined as a GCS score ≤8, of whom 27.6% were intubated and 10.3% received tracheostomies. Overall mortality was 30.9%. Of patients who survived, 80.1% made a good recovery. Female sex was protective, and the only significant predictor of poor functional outcome was

presence of severe TBI (hazard ratio, 2.98; 95% confidence interval, 1.79–4.95).

■ CONCLUSIONS: TBI represents a significant part of the global neurosurgical burden of disease. Implementation of proven in-hospital interventions for these patients is critical to attenuate TBI-related morbidity and mortality.

INTRODUCTION

Globally, trauma is a significant cause of morbidity and mortality, with more than 4.7 million deaths and approximately 40–50 million disabled after injury annually.¹ Traumatic brain injury (TBI) is the most important single injury contributing to traumatic mortality and morbidity. Injury as a whole, and TBI in particular, is expected to become a leading cause of global morbidity and mortality by the year 2020.

In low- and middle-income countries (LMICs), where an estimated 90% of all trauma-related deaths occur,² data suggest that up to half of all trauma-related mortality can be attributed to injury to the central nervous system.³ The odds of mortality in patients with TBI in LMICs, including sub-Saharan Africa, are more than twice as high as patients in high-income countries.⁴ TBI incidence ranges between 150 and 316 cases per 100,000 inhabitants per year in LMICs.⁵ The increasing incidence of TBI deaths is caused by a combination of urbanization, a growing middle class, the availability of cheaper cars and motorcycles, and a growing and aging population in the absence of a mature health care system. The effects of TBI are not limited to an individual's health but are also a cause of increased socioeconomic burden.⁶

Key words

- Functional outcomes
- Low-income settings
- Trauma
- Traumatic brain injury

Abbreviations and Acronyms

CT: Computed tomography
GCS: Glasgow Coma Scale
GOS: Glasgow Outcome Scale
ICP: Intracranial pressure
ICU: Intensive care unit
KCH: Kamuzu Central Hospital

LMIC: Low- and middle-income country

TBI: Traumatic brain injury

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There is little information on TBI in Africa to inform necessary public health policy, and resource-appropriate clinical management to help reduce TBI-related mortality and morbidity burden. We therefore established a TBI database at our tertiary care center in Malawi to better characterize the presentation, management, and functional outcomes after TBI in our low-resource setting.

METHODS

This is a retrospective review of prospectively collected data from Kamuzu Central Hospital (KCH). All admitted patients who presented from October 2016 through May 2017 with a history of head trauma and associated altered level of consciousness or radiographic evidence of TBI were included. Patients who were brought in dead, or treated and discharged from the emergency department, were excluded, as were patients who had head trauma but no loss of consciousness, a decrease in their Glasgow Come Scale (GCS) score, or had no radiographic evidence of TBI. Because of the retrospective nature of the study, patient consent was not obtained.

Variables collected included demographics, mechanism of injury, and vital signs. Clinical variables such as GCS score, pupillary examination, and focal neurologic findings were captured at admission and again at 24 hours after presentation. Radiographic findings and surgical interventions were recorded as they occurred throughout the hospital stay. The patient's Glasgow Outcome Scale (GOS) score, as determined by the staff neurosurgeon, was recorded at the time of patient disposition (death/discharge/transfer/absconded).

Analyses performed include descriptive statistics of the population and a bivariate analysis in which patients were stratified according to favorable versus poor outcome, with favorable outcome being defined as good recovery or moderate disability per the GOS score, and poor outcome being defined as severe disability, vegetative state, or death. Statistical significance of differences between groups was assessed using Pearson χ^2 test for categorical variables, analysis of variance for continuous variables, and Mann-Whitney rank-sum test for ordinal variables. Cox proportional hazards modeling and a survival time analysis, defining failure as either death or poor functional outcome (severe disability or vegetative state), were performed. Survival analysis was based on time of injury to time of discharge disposition. All analyses were performed using Stata/IC 14.1 (StataCorp, College Station, Texas, USA). The University of North Carolina Institutional Review Board and the National Health Science Review Committee of Malawi approved this study.

Setting

Malawi is a land-locked country in southeastern Africa with a population of 18.6 million people, with a life expectancy of 61.2 years and a gross domestic product of \$493 per capita.⁷ KCH is a 1000-bed tertiary care center, located in Lilongwe, the capital city, and serving a catchment of 6 million people in central Malawi. KCH has a general surgery residency and a staff of surgical consultants, including general and orthopedic surgeons, and urologists, a pediatric surgeon, and 1 neurosurgeon. Operating theaters are available, but operational capacity is limited by the availability of nursing and anesthetic staff. Basic laboratory investigations are

available, as are x-rays, ultrasounds, and a computed tomography (CT) scanner.

RESULTS

During the 8-month study period, 280 patients were admitted to KCH with a primary diagnosis of TBI (Table 1). Based on data

Table 1. Traumatic Brain Injury Patient Characteristics (N = 280)

Patient Characteristics	Value
Age, mean \pm SD (years)	28.8 \pm 16.3
Male sex	215 (80.5)
Injury etiology	
RTI	162 (60.7)
Assault	66 (24.7)
Fall	27 (10.1)
Other	12 (4.5)
Median time from injury to presentation at KCH (median, IQR) (days)	0 (0–1)
Transferred in	160 (60.4)
Admission GCS eye score (median, IQR)	3 (1–4)
Admission GCS verbal score (median, IQR)	4 (2–5)
Admission GCS motor score (median, IQR)	5 (4–6)
Admission GCS total score (median, IQR)	12 (8–15)
Neurologic signs and symptoms	
Retrograde amnesia	11 (3.9)
Weakness or paralysis	28 (10.0)
Numbness	5 (1.8)
Ataxia	9 (3.2)
Aphasia	18 (6.4)
Seizures	27 (9.6)
Right pupil abnormal	167 (62.5)
Left pupil abnormal	160 (60.4)
Pupils asymmetrical	64 (24.6)
Associated spinal injury	9 (3.2)
Associated injury to chest, abdomen, and extremities	108 (40.4)
Disposition from casualty	
Admitted to ward	179 (67.6)
Admitted to HDU	25 (9.4)
Admitted to ICU	21 (7.9)
Straight to theater	6 (2.3)
Died in casualty	34 (12.8)

Values are number of patients (%) or as otherwise indicated.
KCH, Kamuzu Central Hospital; IQR, interquartile range; GCS, Glasgow Coma Scale; HDU, high-dependency unit; ICU, intensive care unit; RTI, road traffic injury.

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