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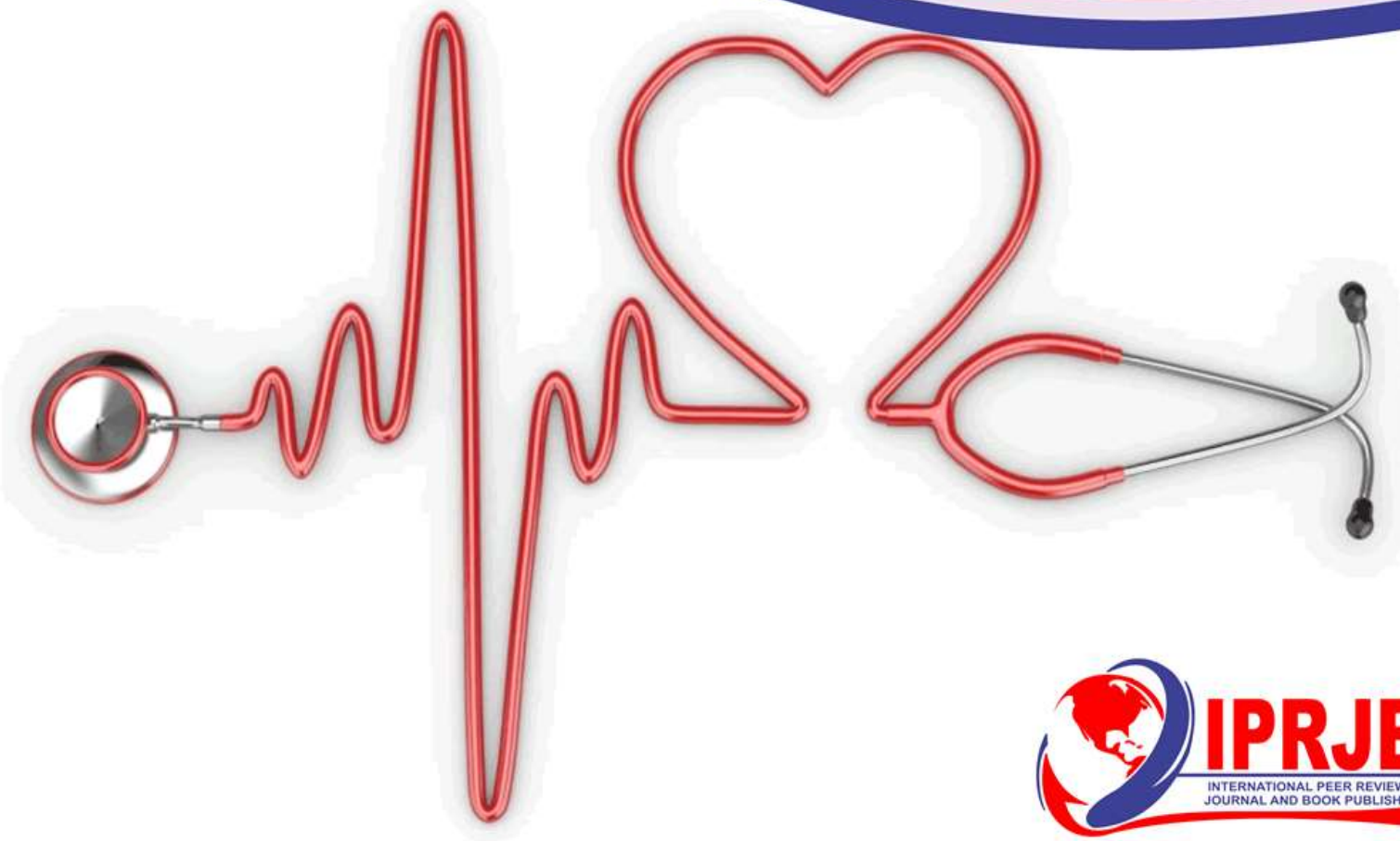

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Outcomes and Their Predictors in Post-Intensive Care Patients Admitted With Traumatic Brain Injury at Mbarara Regional Referral Hospital, Southwestern Uganda: A Retrospective Study

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Abstract

Purpose: Traumatic brain injury (TBI) is a leading cause of morbidity and mortality worldwide. TBIs are increasing in Uganda, but little is known about outcomes and their predictors in post-ICU patients. This study assessed outcomes and their predictors in post-ICU patients admitted with TBI at Mbarara Regional Referral Hospital (MRRH) in south-western Uganda.

Methodology: Retrospective study was used to review hospital records of patients admitted to the Intensive Care Unit (ICU) for MRRH with TBI. Data were entered into Excel, cleaned and exported to Stata version for analysis and presented as mean (standard deviation), median (interquartile range) and number (percent), while using the chi-square test and multinomial logistic regression as predictors for Post-ICU outcomes were used

Findings: In the study, males dominated at 73%, while 81% were of working age (15-64 years). Road traffic accidents (83%) were the most common injury mechanism, followed by physical injury at 11%. Length of stay in the Intensive Care Unit was 9 (IQR = 4–8) days, mean GCS at ICU admission and discharge was 7.7 (±2.65) and 10 (±3.27), respectively. Fifty-seven patients (63%) were discharged home; with 73% good recovery Glasgow coma Outcome Scale of hospital discharges. Post-ICU outcomes were associated with GCS at ICU discharge ($X^2 = 26.338, p < 0.001$). Having moderate Glasgow Coma Scale on ICU discharge was 3.59 times higher of being discharged home than dying compared to severe GCS on ICU discharge (OR=3.59; 95%CI, 1.11 to 11.63). This study established GCS as a statistical predictor of patient outcomes at ICU discharge.

Unique Contribution to Theory, Practice and Policy: Based on the findings of this study, prevention of TBI is critical in order to reduce incidence of TBI related mortality. Policy makers to put rules that continuously teach and enforce road safety and traffic rules to all road users.

Keywords: *Traumatic Brain Injury, Post Intensive Care Patients, Outcomes and Predictors*

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INTRODUCTION

Traumatic Brain Injury (TBI) is a public health problem that reduces the quality of life and productivity of survivors [1]. Globally, TBI is associated with high mortality and morbidity rate, with 365,000 individuals seeking medical attention [2]. In Sub- Saharan Africa (SSA), the incidence rate of TBI ranges from 150-170 per 100,000 people which is high compared to the global rate of 106 per 100,000 [3]. According to the Ugandan Ministry of Health (MOH) report, approximately 130,000-140,000 patients are admitted annually to all hospitals in Uganda as a result of TBI, of which 61,568 are emergencies [4].

Most patients suffering from TBI require demanding and expensive care, including critical care and rehabilitation management, for a long period of time [5]. TBI Patients admitted to an intensive care unit (ICU) are discharged when their physiological condition has stabilized and the need for ICU monitoring and care is no longer required [6]. However, the transition of care for patients discharged with TBI from the ICU to the hospital wards is quite challenging. These patients have high acuity and are moved from ICUs which are resource rich setting to the general hospital wards that are low resource setting on the general hospital wards [7]. There is less number of specialized expert health care providers on the wards and standardized discharge protocols to assist in the integration of the ICU patient onto the ward [8].

These transfers could be especially important as patients with TBI are generally transferred to new wards with less intensive observation and care [9]. Ehikhametalor, Fisher [10] suggest guidelines to facilitate the best transfer should be put in place to guide proper care during and after patient transfer. This study evaluated outcomes and their predictors in post-ICU patients admitted with TBI to the Mbarara Regional Referral Hospital (MRRH) in south-western Uganda.

Conceptual framework

The figure below illustrates the outcomes of TBI and their predictors. The conceptual framework explains the interaction between various predictors for TBI and how they influence patients' wellbeing by causing either favorable or unfavorable outcome in a patient with TBI. In this study, predictors considered were age, sex, mechanism of injury, Glasgow coma scale score at ICU discharge, timely and kind of interventions; surgical care and nursing management offered to patients with TBI post ICU discharge. The outcomes referred to death, ICU re-admission and discharge home.

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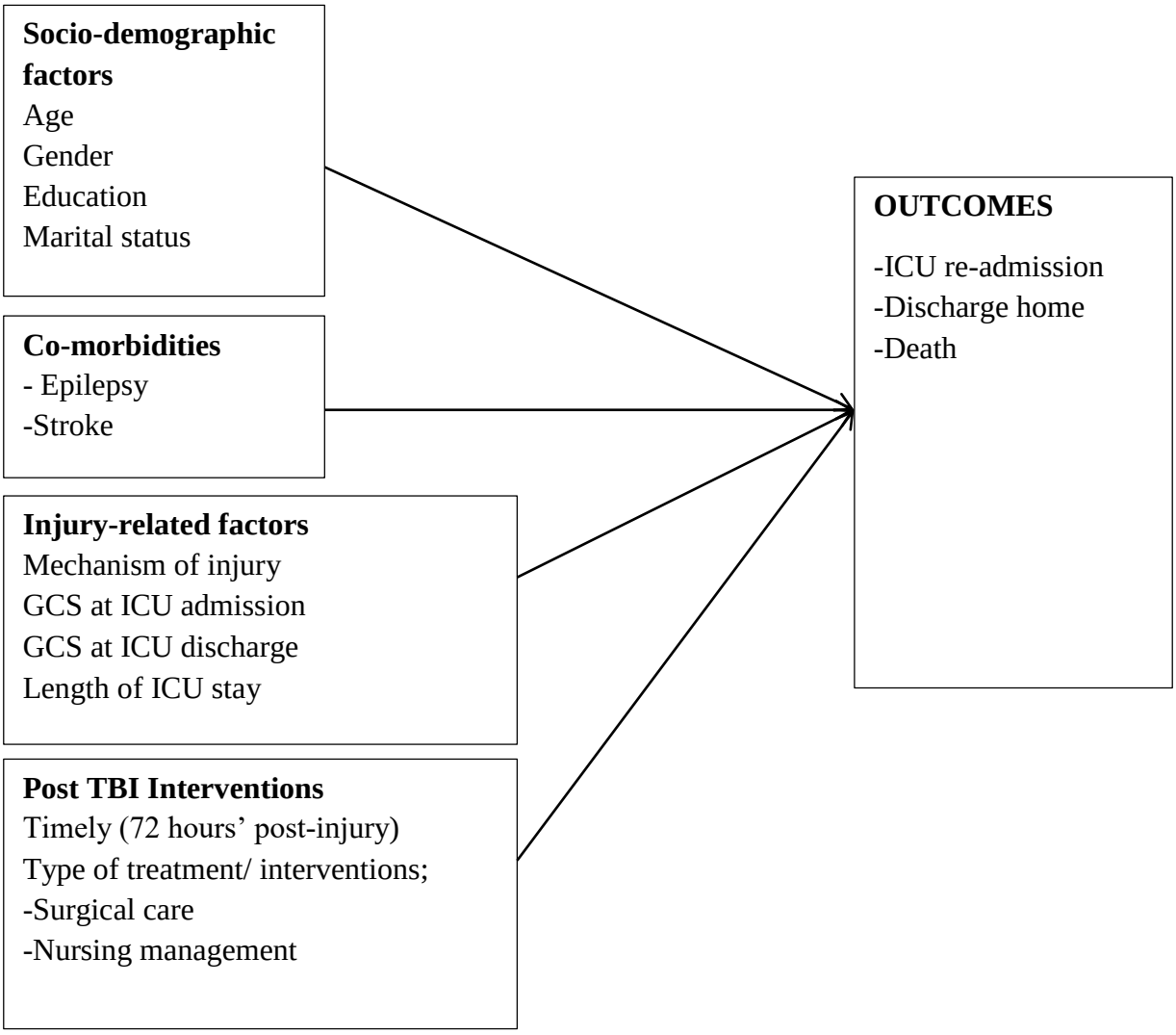

Figure 1: Conceptual Framework

METHODOLOGY

Study design: A retrospective design was considered to allow more participants as few of the TBI cases were encountered and their stay in the hospital was unpredictable.

Study setting: The study was conducted at MRRH in Mbarara Municipality, south-western Uganda. It has a bed capacity of over 350 beds however, it handles more cases, as it serves as a regional referral of western region particularly patients from the districts of Mbarara, Rwampara, Sheema, Bushenyi, Ntungamo, Kiruhuura, Ibanda, Kabale, Masaka, Buhweju, Rubiriizi, Mitooma, and Isingiro. It also serves patients from Rwanda, Burundi and Tanzania. It is a major referral and teaching hospital, with several specialized health facilities and research facilities. The ICU is housed in new complex and has bed capacity of 8 adult patients.

Study Population

A review of medical records of patients admitted to the ICU at Mbarara Regional Referral Hospital (MRRH) with TBI from October, 2012 to October, 2020. We included medical

records from patients with a history of injury; Glasgow Coma Scale (GCS) score less than 15 and no known terminal illness. Patients' medical records with missing key baseline information (clinical intervention, GCS at admission and discharge from ICU, Glasgow outcome scale (GOS) at hospital discharge) and those who were referred to other health facilities (as it was difficult to know their GOS at hospital discharge where they we referred) were excluded from the study. Patients with comorbidities and other major traumatic injuries were excluded as they would contribute to poor outcome.

Study Variables

Independent variables included age, gender, mechanism of injury, Glasgow Coma Scale score at ICU admission and discharge, length of hospital stay, kind of interventions; surgical care and nursing management offered to patients with TBI post-ICU discharge.

Dependent variables included death, readmission to ICU and discharge home after ICU discharge and GOS at hospital discharge; Death, vegetative state, severe disability, moderate disability and speedy recovery.

Data Collection Tool

Abstraction tool was used to collect data for this research. The tool was developed, modified and adapted from existing literature like outcome measures for TBI in India [11] and a comparison of predictive value of GCS in Uganda [12]. The data collection tool covered the areas of socio-demographics, injury mechanism, clinical interventions, Glasgow coma scale score at ICU admission and discharge, patient's outcomes after ICU discharge (discharge home, ICU re-admission, and death) and Glasgow outcome scale score at hospital discharge.

Quality Control

The abstraction tool was reviewed by experts including a senior nurse, a physician, and an ICU neurologist. The abstraction tool pre-test was performed on 10 charts for 2020 traumatic brain injury discharge files obtained from the Archives Office of the MRRH and checked for adequacy of content and ability to collect data relevant to the study. Adjustments were made in the tool after the pretest to match the purpose of the study.

Appropriate measures were taken to ascertain completeness; including training of the research assistants that were engaged in the data collection. Data were entered, cleaned and cross-checked before analysis.

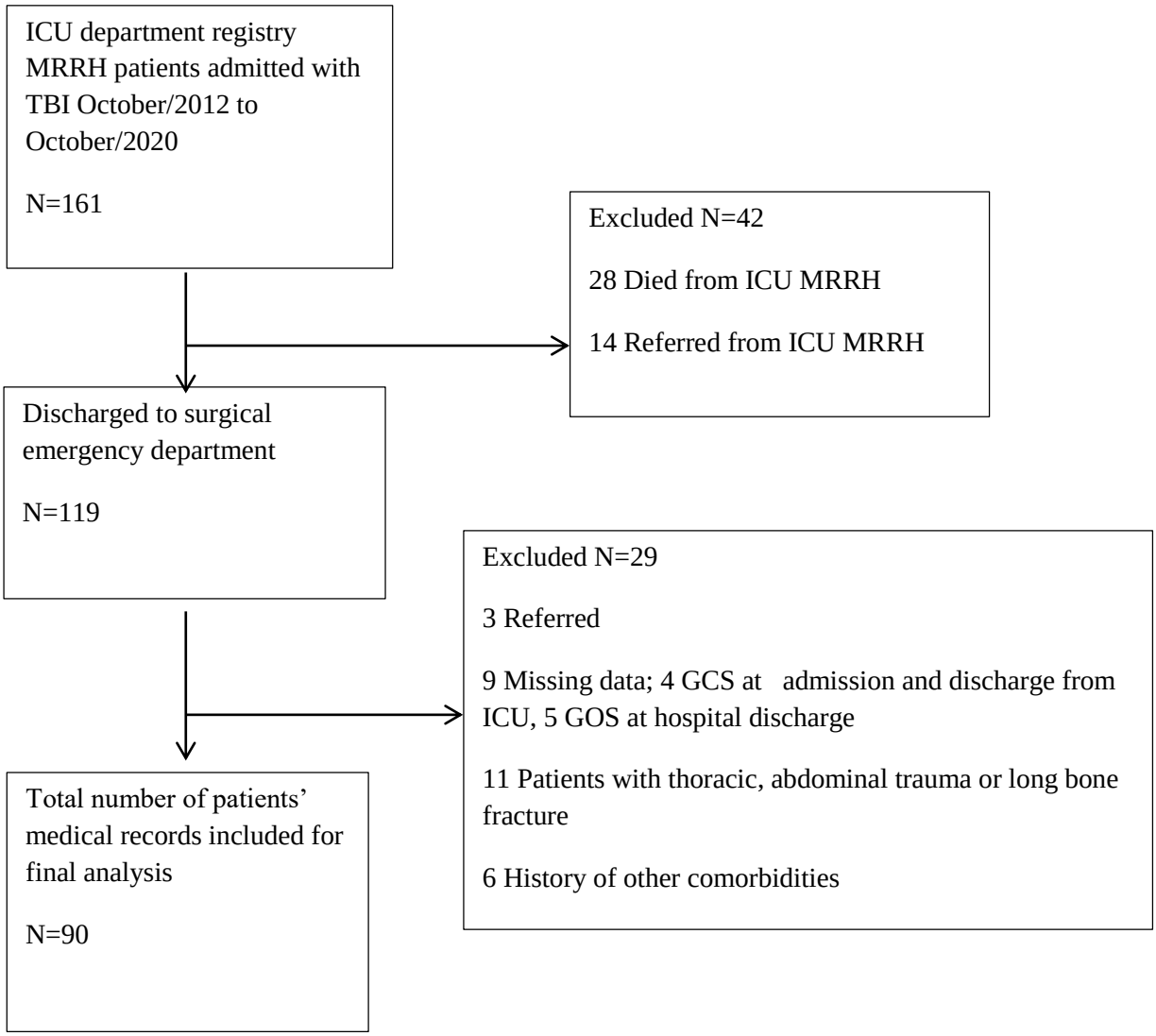

Figure 2: Sample Size Determination Flow Diagram

Ethics Considered

The study honored ethical approval from Mbarara University of Science and Technology Research Ethics Committee (Ref: MUREC 1/7) who granted Waiver of consent form since the study was to review patients' medical records. Permission was obtained from Director, Mbarara Regional Referral Hospital to conduct a study and review patients' medical records from Mbarara Regional Referral Hospital. Patient names were not captured on the abstraction tool to make certain confidentiality.

Statistical Analysis

Data were entered into a Microsoft Excel spreadsheet, cleaned, analyzed using Stata version 15. Patient characteristics and outcome data after ICU were presented as mean (standard deviation) or median (interquartile range) for continuous variables and count (percent) for categorical variables. The predictors of post-ICU outcomes among patients with traumatic brain injury at discharge at MRRH were determined by using bivariate analysis, Chi-square

tests for categorical variables across the outcomes categories with p-value set at <0.05 as level of significance. A multinomial logistic regression model was performed to identify predictors of post-ICU TBI outcomes.

RESULTS

Table 1: Descriptive Statistics of Characteristics of Patients' Medical Records Admitted With Traumatic Brain Injury Post ICU Discharge at MRRH

Characteristic of Patients	N (%)
Sex	
Male	66(73)
Female	24(27)
Injury mechanism	
Road traffic accident	75(83)
Fall from height	5(6)
Assault	10(11)
Type of injury	
Focal	53(59)
Diffuse	37(41)
Age ($\bar{x} \pm SD$)	34 ± 16.27
Age categories	
0-14	10 (11)
15-64	73 (81)
65+	7 (8)
Length of ICU stay in days (median(IQR))	9(4-18)
GCS at admission ($\bar{x} \pm SD$)	7.7 ± 2.65
GCS at ICU discharge ($\bar{x} \pm SD$)	10 ± 3.27
Post ICU outcomes	
Death	23(26)
Discharged home	57(63)
ICU re admission	10(11)

The medical records of ninety (90) patients were analyzed and mean patient age was 34 years with a standard deviation of 16.27 and with a male predominance (73%). Eighty-one percent (81%) were aged between 15 to 64 years. The injury mechanisms most common were traffic accidents (83%), physical injury (11%), falling from a height (6%). with 59% having focal injuries and only 41% having diffuse injuries. Intensive Care Unit length of stay was 9 days with an interquartile range of 4 to 18. GCS on admission and discharge was 7.7 and 10, respectively, with a standard deviation of 2.65 and 3.27, respectively. Seventy-six percent (76%) patients' medical records had neurosurgical intervention done, with 43(63%) craniotomy, (17)25% burr hole and 6(9%) surgical toilet. According to the medical records, 57(63%) of the patients with TBI were discharged home.

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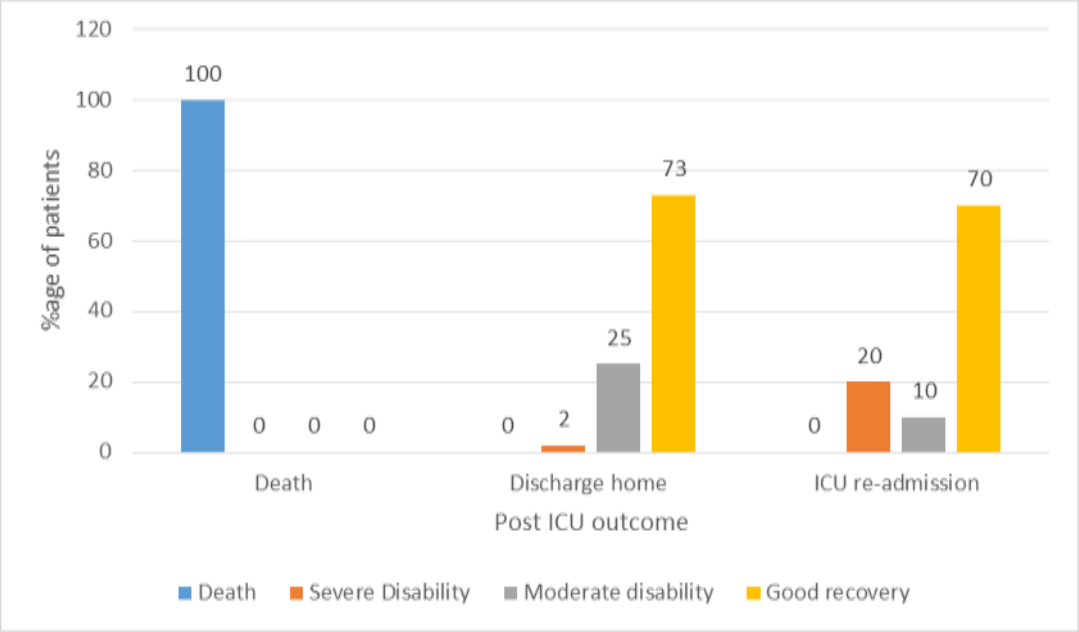

Figure 3: A Graph of Distribution of Post-ICU Outcomes of Patients' Medical Records Admitted With Traumatic Brain Injury at Discharge from Mbarara Regional Referral Hospital across GOS

Out of 90 patients discharged from Intensive Care Unit with TBI, 57(63%) discharged home (table 1) that was translated to 42 (73%) good recovery GOS, 14 (25%) moderate disability GOS and 1(1.8%) severe disability GOS at hospital discharge. Twenty-three patients (26%) died before hospital discharge. Only 10 (11%) were re-admitted to Intensive Care Unit with 7(70%) good recovery GOS, 2(20%) severe disability and 1 (10%) moderate disability at hospital discharge.

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Table 2: A Bivariate Analysis of Post ICU Outcome and Study Variables

Variable	Post ICU outcome				
	Death (n=23)	Discharged home (n=57)	ICU readmission (n=10)		
	N (%)	N (%)	N (%)	X^2	p-value
Sex					
Male	19(29)	41(62)	6(9)	1.978	0.372
Female	4(17)	16(67)	4(17)		
Age					
0-14	0(0)	9(90)	1(10)	5.001	0.287
15-64	22(30)	43(59)	8(11)		
65+	1(14)	5(71)	1(14)		
Injury Mechanism					
Road traffic accident	20(27)	46(61)	9(12)		
Fall from height	1(20)	3(60)	1(20)	2.232	0.693
Assault	2(20)	8(80)	0(0)		
Types of injury					
Focal	12(23)	36(68)	5(9)	1.184	0.553
Diffuse	11(30)	21(57)	5(14)		
Clinical interventions					
Neurosurgical					
No	4(18)	16(72)	2(9)	1.132	0.568
Yes	19(28)	41(60)	8(12)		
Radiology					
Skull x-ray	1(100)	0(0)	0(0)	2.946	0.229
CT scan	22(23)	57(64)	10(11)		
Surgical					
Craniotomy	12(28)	26(61)	5(12)		
Surgical toilet	1(17)	4(67)	1(17)	4.351	0.629
Elevation of skull	0(0)	1(50)	1(50)		
Burr hole	6(35)	10(59)	1(6)		
Nursing					
Oxygen therapy and vital signs	0(0)	3(100)	0(0)		
Oxygen therapy, urinary catheter and vital signs	15(39)	20(53)	3(8)	12.836	0.118
Urinary catheter	4(36)	5(46)	2(18)		
Urinary catheter and vital signs	4(14)	20(71)	4(14)		
Vital signs	090)	9(90)	1(10)		
Medications					
Analgesics	2(67)	1(33)	0(0)		
Analgesics and others	7(19)	22(61)	7(19)	8.827	0.184
All	11(24)	31(69)	3(7)		
Others	3(50)	3(50)	0(0)		
Categories of GCS ICU admission					
Severe TBI	16(28)	33(57)	9(16)		
Moderate TBI	6(21)	22(76)	1(3)	4.416	0.353
Mild TBI	1(33)	2(67)	0(0)		
Categories of GCS ICU discharge					
Severe TBI	12(57)	7(33)	2(10)	26.338	<0.001
Moderate TBI	11(27)	23(56)	7(17)		
Mild TBI	0(0)	27(96)	1(4)		

At a bivariate analysis, GCS at discharge from Intensive Care Unit was associated with post ICU outcomes; $X^2 = 26.338, p < 0.001$

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Table 3: Multinomial Logistic Regression of Post ICU Outcomes and GCS at ICU Discharge

Post ICU outcomes	Odd ratios	95% CI	p-value
Death	(base outcome)		
Discharge home			
GCS at ICU discharge			
Severe	Ref		
Moderate	3.59	1.11 to 11.63	0.033
Mild	$1.25x10^{+8}$	$4.53x10^{+7}$ to $3.46x10^{+8}$	0.991
Constant	0.58	0.23 to 0.23	0.257
ICU re admission			
GCS at ICU discharge			
Severe	Ref		
Moderate	3.82	0.65 to 22.47	0.170
Mild	$1.62x10^{+7}$	$1.35x10^{+6}$ to $1.94x10^{+8}$	0.992
Constant	0.17	0.04 to 0.74	0.019

Patients with moderate GCS at Intensive Care Unit discharge were 3.59 times to be discharged home than dying compared to the patients having a severe GCS at discharge from Intensive Care Unit (OR=3.59; 95%CI, 1.11 to 11.63). Patients who were discharged from Intensive Care Unit having severe GCS, re- admitted were 0.17 times to be discharged home alive (OR= 0.17; 95% CI, 0.04 to 0.74).

Discussion

Of the 90 patients' medical records reviewed, 66(73%) were males, 73(81%) were in working age (15 to 64 years) and 75(83%) were involved in Road Traffic Accidents (RTA). This is due to the fact that for male persons at this age, productivity is high a factor that explains their RTA involvement as drivers, riders or passengers in search for a living. This finding was consistent with a study in Austria where 134 females and 305 males had TBI [13]. The pattern is also similar to reports from Latin America, where it was found that TBI due to RTA was more frequent in males between the ages of 15 and 35 years, and RTA was a common cause of TBI (Dunne et al., 2020). This is also supported by the high incidence (59%) of the focal injuries and 41% of the diffuse injuries, a finding that rhymes with earlier reports [14, 15]. As these patients' medical records had sustained severe to life-threatening injuries, numerous clinical interventions were done. Majority (63%) underwent craniotomy, burr hole (25%), surgical toilet (9%) and elevation of skull (3%). These interventions have been described and are compensatory mechanisms operating to relieve and maintain a constant intracranial pressure since the skull is a rigid expandable structure. From this study also, half of the patients' medical records received mannitol, analgesic and other medications. The utilization of these medications limit elevation of intracranial pressure related to agitation, discomfort, cough or pain and facilitates the neurologic response. This is consistent with previous reports, the pharmacological use of analgesia, hyperosmolar agents and sedation has been described [16-18].

Out of 90 patients' medical records, 63% (N=57) were discharged home having 42 (73%) good recovery GOS, 14 (25%) moderate disability GOS and 1(1.8%) severe disability GOS at hospital discharge with 9 days of stay in Intensive Care Unit. Study indicated a good prognosis

after a long ICU hospitalization. ICU support among TBI patients forms an essential component of health care system; observing or offering care for the critically ill patients and improves on their outcome. Although it is costly, the positive attribute of ICU survival has been overwhelmingly documented and this demands that; policy systems ensure maximum operational and care within ICU [19, 20]. This factor should control discharge plan in acute care. This is in line with studies by [15, 18, 21, 22] revealed that longer ICU length of stay as evidenced from our study, patients admitted with TBI are associated with a home discharge. Besides, there were patients' medical records with unfavorable outcomes, namely re-admission (11%) to ICU and deaths (26%). The mortality reported from this study is lower than the 27.8% that was earlier documented from a study that audited the life outcome of TBI patients in a rural Ugandan hospital. However, it is higher than the 9.6% post-ICU mortality found from a neurosurgical registry that describes care process and determines risk factors that predict poor outcomes for TBI patients presenting to Mulago National Referral Hospital [23]. Although results should be compared with some caution, as Mulago study included only those patients who were referred to neurosurgical department, while this study included all patients admitted in ICU with TBI; it was also true that mortality in this study was clearly high, which may be explained by lack of diagnostic equipment. As earlier reported, choice of the outcome is multifactorial and may result from a complex interplay as a result of pre-admission, admission, ICU care and post-ICU discharge [21, 22]. In-hospital deaths following successful ICU discharge of TBI patients have been an early-time onset of other life-threatening complications [24].

The association of post-ICU outcomes of patients admitted with TBI suggested that GCS at discharge from ICU was associated with post-ICU outcomes ($X^2 = 26.338, p < 0.001$) at bivariate level of analysis. Patients' medical records with moderate GCS at ICU discharge were 3.59 times higher to be discharged home than dying compared to the patients with a severe GCS at discharge from ICU (OR=3.59; 95%CI, 1.11-11.63). Based on the Odds Ratio (OR) test, GCS at ICU discharge significantly predicts outcome at hospital discharge with $p < 0.001$. As expected, findings were consistent with meta-analysis that highlighted GCS score as a predictor of mortality in patients with TBI [12]. This affirms that deteriorating health as indicated by GCS as a predictor of health outcome. As seen in a previous study, high GCS motor score at admission was associated with low in-hospital mortality [25]. Subarachnoid hemorrhage, assault, ventilator support, older aged male and diffuse axonal injury have been found to be associated with high in-hospital mortality [26-28]. The lack of a statistical association of factors with mortality, in contrast to previous studies, and discrepancy was due to the limited number of patients in the present study, thereby reducing its impact on all-cause of mortality.

Limitations

Given the specific nature of this study, the challenges of missing data and recruiting only patients' medical records admitted and discharged from ICU with a diagnosis of TBI, thus our small sample size, our findings are preliminary, and further research is needed with larger sample size in order to generalize these results to those admitted with TBI on the Emergency ward.

Conclusion

The study has elucidated that eighty-one percent (81%) of patients' medical records admitted with TBI were in 15 to 64 years' age category. The prevalent injuries were road traffic accident,

assault and fall from height. In addition, 9 days of stay in ICU, GCS score on admission and discharge from the ICU were 7.7 and 10 respectively. Moderate GCS score on discharge from ICU was a positive indicator to be discharged home. Based on the outcomes of this study, prevention of TBI is critical in order to reduce incidence of TBI related mortality. Policy makers put rules that continuously teach and enforce road safety and traffic rules to all road users.

What Is Already Known

Traumatic brain injury (TBI) is leading cause of morbidity and mortality worldwide

Road traffic accidents are leading cause of TBI worldwide

What This Study Adds

GCS at discharge from Intensive Care Unit predicts outcomes of post-Intensive Care Unit patient admitted with TBI.

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Competing Interests: There were no competing interests.

Disclosure: The work reported in this manuscript is based on a thesis by the first author leading to award of a master's degree of Mbarara University of Science and Technology.

Author Contributions

All author rendered a significant contribution to conception and design, data collection, analysis and interpretation of data, participated in drafting the article, agreed on this current journal for submission, approved the final version to be published and accepted to be accountable for all aspects of the work.

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