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JOURNAL OF SPINE AND NEUROSCIENCE
ISSN NO: 2694-1201

Research

DOI: 10.14302/issn.2694-1201.jsn-20-3554

Factors Affecting Traumatic Brain Injury Outcome Among Patients Treated for Head Injury at Surgical Side, in Nekemte Referral Hospital, Oromia, Ethiopia.

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Abstract

Background: Traumatic brain injury is an expanding major public health problem and the leading cause of death of the young and productive part of the world's population. Research is mainly done in high-income countries where only a small proportion of the worldwide fatalities occur. Only few studies have examined prognostic factors of traumatic brain injury outcome in developing countries including Ethiopia. This study was aimed at defining the peculiar demographic and other associated factors of traumatic brain injury (TBI) outcome among patients treated for head injury at Nekemte Referral Hospital.

Objective: The main purpose of this study was to describe the magnitude of TBI outcome and assess factors associated with unfavourable outcome of TBI among patients treated for head injury at the surgical side in Nekemte Referral Hospital from July 8, 2016 to July 7, 2018.

Methods: A retrospective cross-sectional document review was conducted among TBI patients treated for head injury from July 8, 2016 to July 7, 2018 at Nekemte Referral Hospital. Data were collected using a pre-tested data collection format. Data analysis was done using SPSS version 20. Descriptive statistics were computed and association between the dependent and independent variables were assessed by using logistic regression. Odds ratios with 95% confidence interval were computed. Significant association was declared when the p value was <0.05.

Results: In this study, out of 378 cases 95 (25.1%) were discharged with unfavourable outcome of which 37 (9.8%) were neurologic deficits and 58 were deaths giving overall mortality rate of 15.3%. Patient age>60years (AOR: 15.13; 95%CI: 3.575-64.028), time interval from injury to treatment (AOR: 16.054; 95%CI: 5.832-44.194), low GCS (AOR: 18.224; 95%CI: 4.167, 79.695), conservative management (AOR: 20.774; 95%CI: 6.106-70.681), pupils abnormality (AOR: 9.078; 95%CI: AOR: 2.996-27.509) were associated with unfavourable outcome.

Conclusions: A quarter of patients treated for TBI at Nekemte Referral Hospital are discharged with unfavourable outcomes. Old age, delayed presentation to the hospital, low GCS, conservative management, and pupillary abnormality increase the odds of unfavourable outcome. Timely management of TBI before patients develop secondary brain injury and use of surgical intervention based on CT scan diagnosis will reduce the occurrence of unfavourable outcome.

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Keywords: Traumatic Brain Injury, Head Injury.

Received: Aug 24, 2020 **Accepted:** Sep 04, 2020 **Published:** Sep 10, 2020

Editor: Quenum kouassi jean marie kisito, Université Mohamed V Souissi, Rabat, Morocco

Back Ground Information

Most international definition of traumatic brain injury(TBI) require some neurological symptoms or signs such as loss of consciousness, confusion or disorientation, drowsiness, obtundation, stuperousness, a period of amnesia and/or focal neurological deficit [1]. The head injury may involve different mechanisms such as pedestrian struck by motor vehicle, occupant ejected from motor vehicle, a fall from a height of greater than one metre or more than five stairs, or less for infants and children aged under five years [2, 3].

The most commonly used criterion for classifying the severity of TBI has been the Glasgow Coma Scale (GCS) score. The GCS grades a person's level of consciousness on a scale of 3–15 based on Verbal: 1=no response; 2=incomprehensible sounds; 3=inappropriate words; 4=disoriented, confused; 5=oriented, converses normally. Motor: 1=no response; 2=extension to painful stimuli; 3=abnormal flexion to painful stimuli; 4=flexion/withdrawal to painful stimuli; 5=localises painful stimuli; 6=obeys commands. And eye -opening reactions: 1=no response; 2=open in response to pain; 3=open in response to speech; 4=open spontaneously[2, 3].

The scores are categorized as follows: mild TBI= 13 to 15 (of a maximum 15); moderate TBI= 9 to 12; and severe TBI= 3 to 8 (with 3 being the minimum score). Based on radiology (skull x-ray, brain computed tomography (CT), and magnetic resonance imaging (MRI) diagnosis will be subdural hematoma (SDH) ,skull fracture, epidural hematoma (EDH). The possible treatment will be conservative or surgery which will have favourable or unfavourable outcome[3, 4]. Head trauma is the most common cause of TBI with the majority of cases related to motor vehicle accidents, car accidents, falls, and assaults[5].

In the early hospital admission phase of patients with severe TBI, treatment and diagnostic assessment is done according to the advanced trauma life support protocol like:- Adequate oxygenation and blood pressure support with systolic blood pressure (SBP) of greater than 90 millimetre of mercury ,Vital signs including heart rate, blood pressure, respiratory status ,pulse oximetry, and temperature require ongoing monitoring, a neurologic examination should be completed as soon as possible to determine the clinical severity of the TBI [6, 7].

The efforts to evaluate and manage increased intracranial pressure (ICP) should begin in the emergency department. Patients with severe TBI (GCS ≤8) and clinical symptoms suggesting possible impending hernia ion from elevated ICP such as:- Unilaterally or bilaterally fixed and dilated pupil(s), decorticate or decerebrate posturing, bradycardia, hypertension, and/or respiratory depression should be treated urgently, with head elevation, hyperventilation, and osmotic therapy (mannitol 1 g/kg iv) concurrently with neuroimaging and other assessments [6, 8].

Indications for emergency surgery after severe head injury are based upon neurologic status, usually defined by the GCS score, and findings on brain CT criteria such as large hematoma volume or thickness and evidence of mass effect including midline shift ,type of surgery are can be burr-hole & evacuation, elevation of depressed skull fracture, and craniotomy & evacuation. Since 1970's GSC score and CT scanning has been used in evaluating TBI patients [6, 9, 10].

Trauma presents with variety of injuries and problems that demand rapid evaluation, and intervention to save life and prevent permanent disability. TBI is

recognized as a major public health problem that is the frequent cause of death and disability in young people and makes considerable demand on health services[3]. People presenting with suspected TBI should not be discharged to the community until they have achieved a GCS score of 15[6].

Methods and Materials

Study Design and Period

A retrospective cross-sectional facility based document review was conducted to describe the magnitude of TBI outcome and to identify factors associated with TBI outcomes among TBI patients treated for head injury at surgical side in Nekemte Referral Hospital. The study period was from July 8, 2016 to July 7, 2018.

Study Population

All TBI patients treated at the surgical side in Nekemte Referral Hospital from July 8, 2016 to July 7, 2018.

Sample Size Calculation

Sample size was computed for magnitude of TBI outcome based on the proportion of overall mortality among TBI patients as estimated based on a study done in Kenya which was 56.2% [14], an absolute precision of 5% and 95% level of confidence.

$$n = \frac{(z\,\alpha/2)^2 p\,(1-p)}{d^2}$$

$$n = \frac{(1.96)^2 0.562\,(1-0.562)}{(0.05)^2}$$

n = 378

Where n= was sample size

P= was overall mortality proportion of head injury patients following treatment

d= margin of error

Accordingly, the total sample size determined was 378

Sampling Techniques

The registration numbers of traumatic brain injury patients who treated at Nekemte Referral Hospital surgical department from July 8, 2016 to July 7, 2018 were traced from logbooks. The sampling interval or ²k² was calculated by dividing the total number of traumatic brain injury patients treated during the mentioned period based on the log books reviewed (811) to the final sample size(378) and the calculated k-value was approximated and taken as 2. Then the list of all TBI patients was prepared by the principal investigator. This list served as a sampling frame. The first chart was randomly selected using lottery method and the subsequent charts were identified by systemic random sampling method using a sampling interval of 2.

Data Management and Analysis

Data was coded, entered, recoded, cleaned and analysed using SPSS version 20 software. Descriptive analysis was carried out to explore the socio-demographic characteristics and other characteristics of the study participants and magnitude of TBI outcome following treatment. Bivariate analysis was carried out to examine the relationship between the outcome variable and the selected associated factors and those factors which have P-value less than or equal to 0.25 were selected for inclusion in to the multivariate logistic regression model. A multivariate logistic regression analysis was run to identify independent predictors of outcome among TBI patients treated for head injuries at surgical side in Nekemte Referral Hospital and significant association were declared at p-values of less than or equal to 0.05.

Results

Socio-Demographic Characteristics of Traumatic Brain Injury Patients

A total of 811 traumatic brain injury patients (TBI) were treated in Nekemte Referral Hospital at the surgical side from July 8, 2016 through July 7, 2018. Of these, 378 (46.6%) met the inclusion criteria for the study. Among the 378 TBI patients 257(68%) were males and 121(32%) were females. The mean age in years was 37.6 and standard deviation was 16.85. The highest age proportion 40.5% was in the age group 20 to 40 years and the lowest 14% was old age (above 60 years). Most of the traumatic brain injury patients were from Rural area which account 221 (58.5%) while 157 (41.5%) from the Urban area. (Table 1)

Table 1. Socio-demographic characteristics of traumatic brain injury patients treated at the surgical side, in Nekemte Referral Hospital, Oromia, and Ethiopia from July 8, 2016 to July 7, 2018.

Variable	Number	percent
Age in years(n=378)		
Less than 20	70	18.5
20-40	153	40.5
41-60	102	27
above 60	53	14
Sex(n=378)		
Male	257	68
Female	121	32
Residence(n=378)		
Rural	221	58.5
Urban	157	41.5

Cause/Mechanism of Head Injury

Regarding mechanism of injury most of the patients sustained traumatic brain injury (TBI) from road traffic accident (RTA) which accounted 286(75.7%) followed by fall down comprised 50(13.2%), and interpersonal violence (assault) comprised 42(11.1%). (Figure 1)

Clinical Profile of Traumatic Brain Injury Patients

Out of 378 traumatic brain injury patients, about 7(1.9%) of them had history of chronic illness at the time of admission. Majority 233(61.6%) had loss of consciousness and few of them 45(11.9%) had convulsion. Up to 52(13.3%) of them had increased intracranial pressure (ICP). About 67(17.7%) of moderate to severe TBI patients had bilateral pupillary abnormality while 54(14.3%) had unilateral pupillary abnormality. Up to 27(7.1%) of them had systolic hypotension at the time of admission among 124 (32.8%) TBI patients having radiological imaging 17 (4.5%), 19(5%), 88(23.3%) were abnormal findings as depressed skull fracture (DSF), epidural hematoma (EDH), and subdural hematoma (SDH) respectively. (Figure 2)

Severity of Traumatic Brain Injury

Out of 378 TBI patients based on GCS severity score, about 71(18.8%) were with severe TBI, 97 (25.6%) were with moderate TBI and 210(55.6%) were with mild TBI. (Figure 3) About 242(64%) of TBI patients came for treatment within 24 hours while 136 (36%) came after 24hours. (Figure 4)

Associated Injuries

Of the 378 TBI patients, 61(16.1%) had associated injuries of which 29(7.7%) had chest injury, 1(0.3%) had pelvic injury, 9(2.4%) had abdominal injury, 2(0.5%) had neck injury, 1(0.3%) had facial injury and 19(5%) had spinal injury. (Figure 5)

Management Outcome of Traumatic Brain Injury Patients

Out of the 378 TBI patients, 283(74.9%) had favourable outcome while the remaining 95(25.1%) had unfavourable outcome up on discharge. Among the 124 (32.8%) surgically treated TBI patients, 104(83.9%) had favourable outcome while 15(12.1%) died and 5(4%) were discharged with neurologic deficits. However, from 254(67.2%) patients who were managed conservatively 179(70.5%) had favourable outcome while 43(16.9%) died and 32(12.6%) were discharged with neurologic

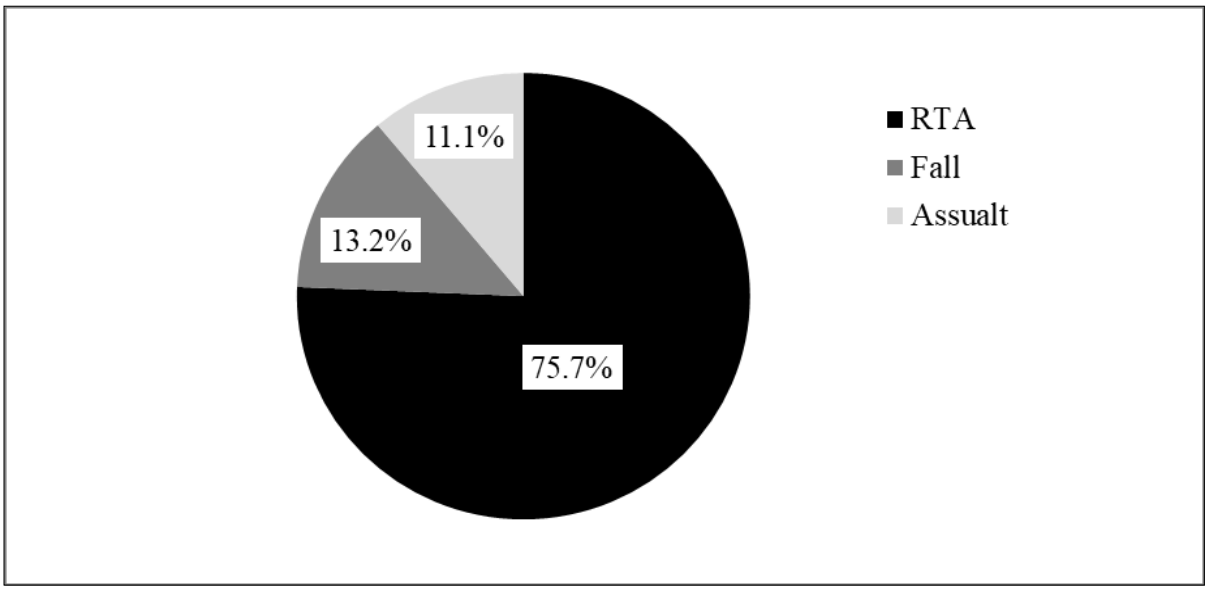

Figure 1. Distribution of cause/mechanism of injury of traumatic brain injury patients treated at the surgical side, in Nekemte Referral Hospital, Oromia, and Ethiopia from July 8, 2016 to July 7, 2018.

deficits. Overall mortality rate of TBI in the study was 58 (15.3%). (Table 2)

Factors Associated with Unfavourable Outcome

Based on bivariate logistic regression analysis age, time interval from injury to treatment, Glasgow coma score, systolic hypotension, steroid treatment, mechanism of injury, conservative management, associated injury, bilateral pupillary abnormality, increased intracranial pressure(ICP), and convulsion were found to have association with traumatic brain injury(TBI) outcome at p-value less than or equal to 0.25.

However, in multivariate logistic regression analysis TBI patients age above 60 years with mortality rate of 26(6.9%) had 15.13 times higher odds of unfavourable outcome [AOR (95%CI) = 15.13(3.575-64.028)]. Besides those who were admitted and managed after 24 hours with mortality rate of 47 (12.4%) had 16.054 times higher odds of unfavourable outcome relative to those patients who came and managed within 24 hours [AOR (95%CI)=16.054(5.832 -44.194)]. Low GCS level (GCS=3-8) at the time of admission with mortality rate of 52(13.8%) was associated with a18.224times higher odds of unfavourable outcome than those with GCS of 9 and above [AOR (95%CI) = 18.224(4.167-79.695)].

Those with conservative management with a mortality rate of 43(11.4%) had 20.774 times more odds of unfavourable outcome relative to those patients managed by surgery [AOR (95%CI) = 20.774(6.106-70.681)]. What is more, presence of associated injury with mortality rate of 35(9.3%) was associated with a 5.894 times higher odds of unfavourable outcome than those without associated injuries [AOR (95%CI)= 5.894(2.025-17.156)] and patients with bilateral pupillary abnormality with mortality rate of 21(5.6%) had 9.078 times more odds of unfavourable outcome than those patients with unilateral abnormal pupils [AOR (95%CI)= 9.078(2.996-27.509)] . (Table 3, 4)

Discussion

In this study,95 (25.1%) of traumatic brain injury patients had unfavourable outcome up on discharge out of which 15.3% were death and the rest 9.8% were neurologic deficits like limb weakness. This result is lower than the study done in New Zealand in which the overall mortality rate of moderate to severe TBI patients was 34% [6]. Moreover, a study done in Kenya on moderate to severe TBI patients had shown the overall mortality rate was 56.2 %[22]. In this study, the lower proportion of mortality rate might be due to a

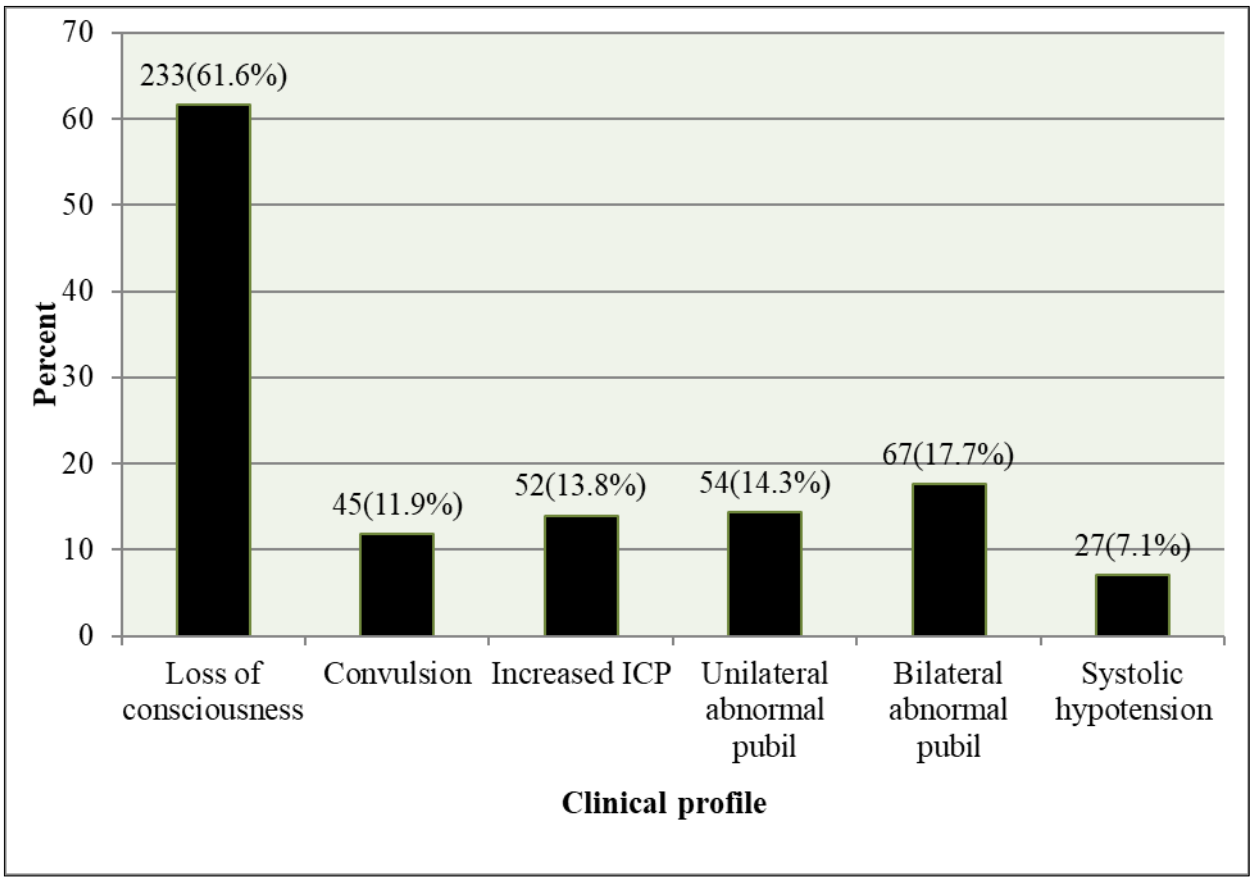

Figure 2. The clinical profile of traumatic brain injury patients treated at the surgical side, in Nekemte Referral Hospital, Oromia, Ethiopia from July 8, 2016 to July7, 2018.

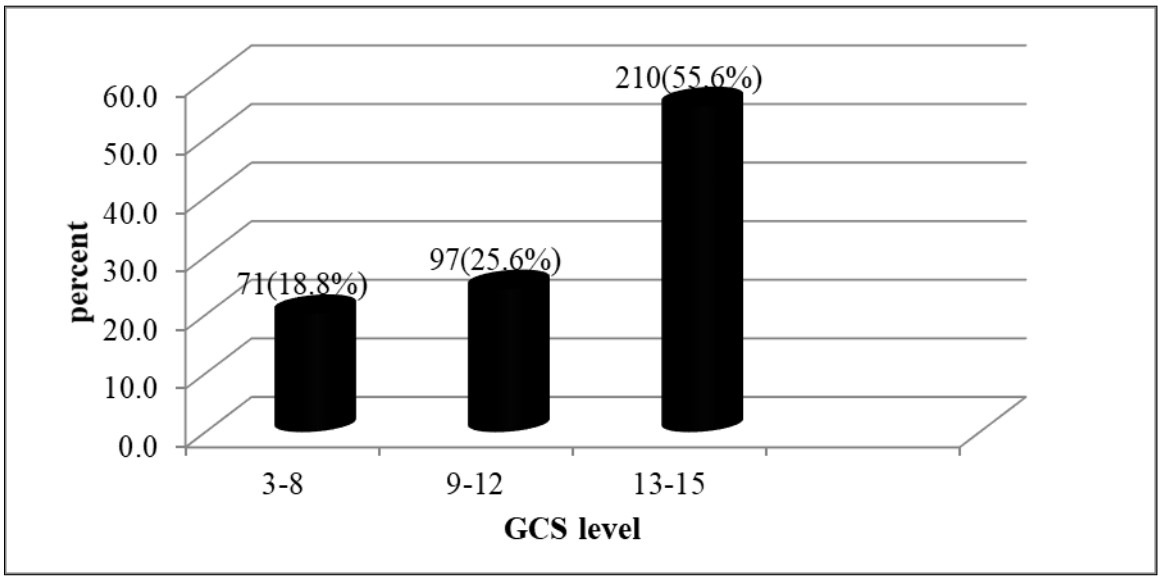

Figure 3. Distribution of severity of traumatic brain injury treated at the surgical side, in Nekemte Referral Hospital, Oromia, and Ethiopia from July 8, 2016 to July 7, 2018.

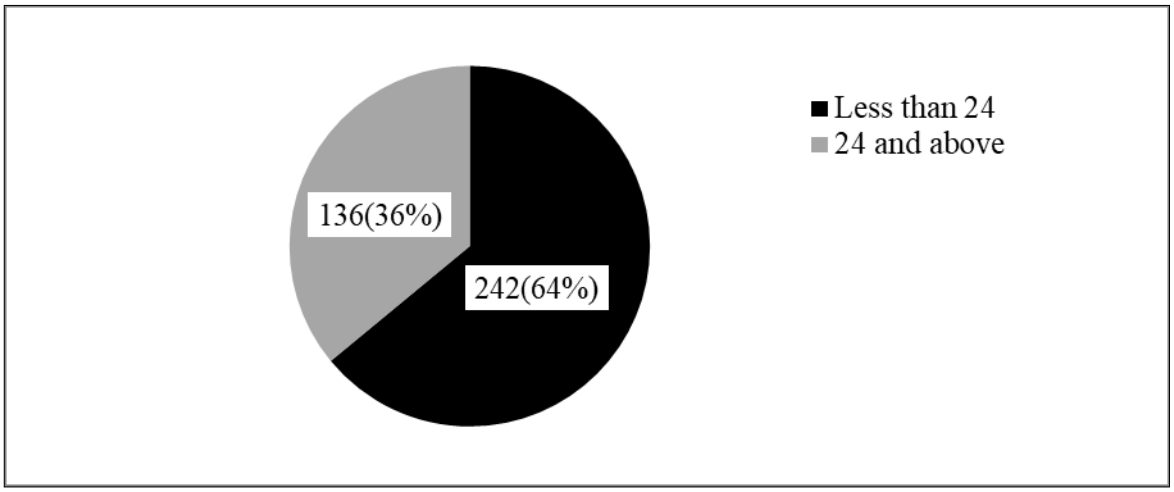

Figure 4. Distribution of time interval from injury to the treatment of traumatic brain injury treated at the surgical side, in Nekemte Referral Hospital, Oromia, and Ethiopia from July 8, 2016 to July 7, 2018.

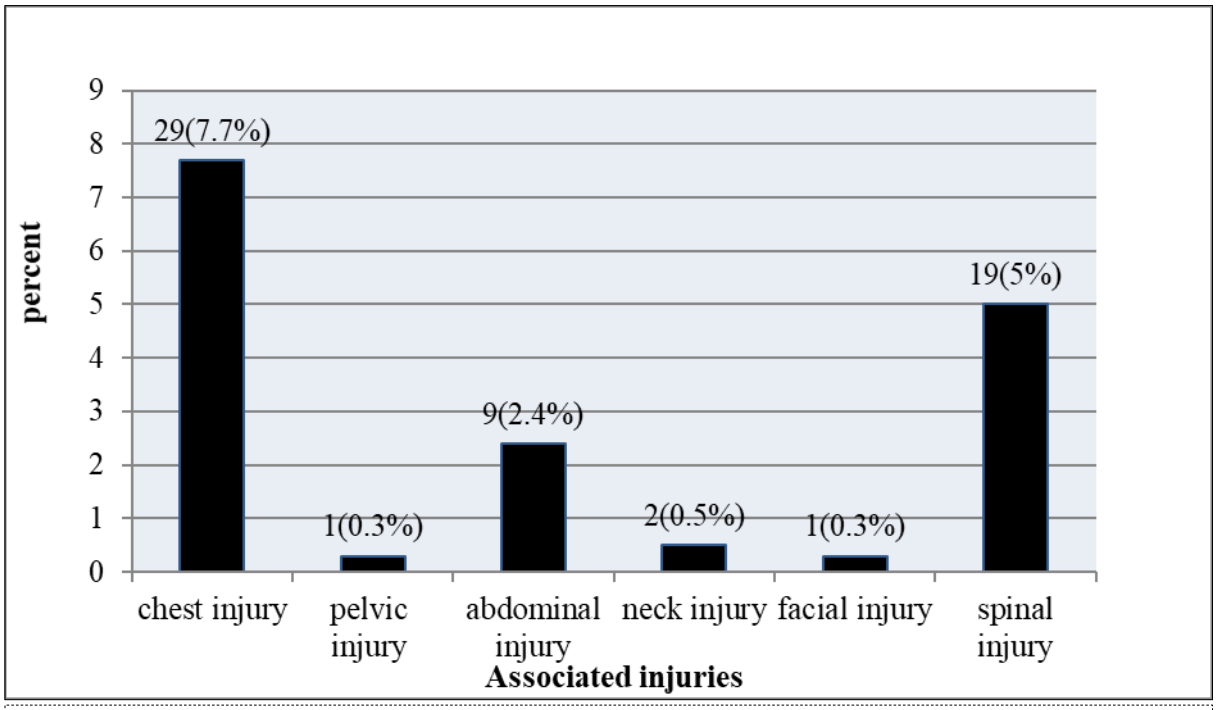

Figure 5. Distribution of associated injury treated at surgical side, in Nekemte Referral Hospital, Oromia, Ethiopia from July 8, 2016 to July7, 2018.

Table 2. Distribution of treatment factors and outcome of traumatic brain injury patients treated at surgical side, in Nekemte Referral Hospital, Oromia, Ethiopia from July 8, 2016 to July7, 2018.

Variable	Number	Percent
Treatment used (n=378)		
Conservative	254	67.2
Surgery	124	32.8
Steroid treatment (n=378)		
No	287	75.9
Yes	91	24.1
Condition on discharge (n=378)		
Favourable	283	74.9
Unfavourable	95	25.1
Unfavourable(n=95)		
neurologic deficit	37	9.8
Dead	58	15.3

Table 3. Distribution of factors associated with unfavourable outcome of traumatic brain injury patients treated at surgical side, in Nekemte Referral Hospital, Oromia, Ethiopia from July8, 2016 to July7, 2018.

Variable	TBI outcome		COR (95%CI)	AOR (95%CI)
	Favourable	Unfavourable		
Age in years				
<20	61(87.1%)	9(12.9%)	1	1
20-40	130(85%)	23(15%)	1.199(0.524-2.746)	0.939(0.265-3.332)
41-60	78(76.5%)	24(23.5%)	2.085(0.904-4.812)	3.452(0.962-12.392)
>60	14(26.4%)	39(73.6%)	18.881(7.458-47.797)	15.13(3.575-64.028)**
Time at presentation				
<24hours	226(93.4)	16(6.6%)	1	1
≥24hours	57(41.9%)	79(58.1%)	19.577(10.628-36.059)	16.054(5.832-44.194)**
GCS level at admission				
3-8	19(26.8%)	52(73.2%)	29.193(14.298-59.603)	18.224(4.167-79.695)**
9-12	72(74.2%)	25(25.8%)	3.704(1.907-7.192)	2.965(0.978-8.994)
13-15	192(91.4%)	18(8.6%)	1	1

Table 4. continued (distribution of factors associated with unfavourable outcome of traumatic brain injury patients treated at surgical side, in Nekemte Referral Hospital, Oromia, Ethiopia from July8, 2016 to July7, 2018).

Variable	TBI outcome		COR (95%CI)	AOR (95%CI)
	Favourable	Unfavourable		
Hypotension				
No	271(77.2%)	80(22.8%)	1	1
Yes	12(44.4%)	15(55.6%)	4.234(1.905-9.414)	2.369(0.671-8.358)
Steroid treatment				
No	225(78.4%)	62(21.6%)	1	1
Yes	58(63.7%)	33(36.3%)	2.065(1.238-3.444)	2.044(0.805-5.188)
Conservative treatment				
No	104(83.9%)	20(16.1%)	1	1
Yes	179(70.5%)	75(29.5%)	2.179(1.258-3.774)	20.774(6.106-70.681)**
Associated injuries				
No	266(83.9%)	51(16.1%)	1	1
Yes	17(27.9%)	44(72.1%)	13.499(7.155-25.470)	5.894(2.025-17.156)**
Bilateral abnormal pupil				
No	251(80.7%)	60(19.3%)	1	1
Yes	32(47.8%)	35(52.2%)	4.576(2.624-7.978)	9.078(2.996-27.509)**
ICP*				
No	263(80.9)	63(19.3%)	1	1
Yes	20(38.5%)	32(61.5%)	6.679(3.584-12.449)	3.223(0.853-12.183)
Convulsion				
No	258(77.5%)	75(22.5%)	1	1
Yes	25(55.6%)	20(44.4%)	2.752(1.449-5.228)	0.301(0.077-1.172)

**Statistically significant association with a p-value of less than or equal to 0.05

*Increased intracranial pressure

majority of the patients were with a diagnosis of mild TBI which had less likelihood of unfavourable outcome. In this study, the risk factors analysed were advanced age above 60 years, associated injuries, delayed presentation for treatment (later than 24 hours), low GCS level (8 and less), bilateral pupil abnormality, and conservative management had statistically significant association.

According to this study, the leading causes of TBI were road traffic accident (RTA) which accounts 286 (75.7%) followed by falling down accident which accounts 50(13.2%) and assault which accounts 22 (10.5%). This study is nearly similar to the study done in Japan on 210 head injury patients in which RTAs accounts 65% ,falls accounts 28%, and assault accounts 7%(2). In contrast to this study, a study done in Norway on 585 TBI patients the leading causes of TBI were falling down accidents which accounts 299(51%), RTA accounts 126(21%), assault accounts 81(14%) [18]. The highest proportion of RTA in this study could be due to lack of awareness of an individual and the community while using the vehicles and crossing the road.

In this study, those patients who were treated with steroid had a mortality rate of 22(5.6%). Similar study done in New Zealand has shown that patients who were treated with steroid with a diagnosis of any severity has higher mortality rate 18%(n=152) than those who don't treated with steroid and conclude that steroids are associated with increased mortality and are contraindicated [6]. Similarly study done in Nigeria also revealed that among 221 patients who were treated with steroids had mortality rate of 23%[16]. In this study, even though lower mortality rate, still steroid was clinically important due to its compromization of systemic body respond to injuries like cerebral auto regulation and increase cerebral blood flow thereby increase intracranial pressure which further deteriorate the clinical condition of the patient secondary to mass effect on cranial nerves and cerebral cortex.

According to this study, age above 60 years had 15.13 times higher odds of unfavourable outcome relative to age group less than 60 years. In addition, a study done in New Zealand has shown that patients age above 60 years were found to have about four times higher odds of poor outcome relative to patients in lower age group [6]. Moreover, a study done in Egypt has shown that as the age of patient increases the odds of unfavourable outcome also increases by more than five times [17]. In this study, higher unfavourable outcome among old people could be due to atrophy of brain parenchyma and also due to age related immune-suppression, which makes them susceptible to have unfavourable outcome.

In this study, patients who came for treatment later than 24 hours had 16.054 times higher odds of unfavourable outcome than those who came within 24 hours. This study is nearly similar to the study done in New Zealand in which patients who come later than 24hours had 12 times higher odds of unfavorable outcome compared to those who come within 24 hours [6]. Furthermore, this study is in line with the study done in Kenya , in which those patients who came later than 24hours had seven times higher odds of unfavourable outcome compared to those patients who came within 24hours [22]. The more unfavourable outcome might be due to patients' arrival for treatment after the development of secondary brain injuries like hypotension, increased intracranial pressure, and hematoma which by themselves had the poor predictor of outcome.

According to this study, TBI patients with GCS 8 and less had 18.224 times higher odds of unfavourable outcome relative to those patients with GCS 9 and above. This is nearly similar to the study done in Egypt in which TBI patients with GCS 8 and less had 9.4 times more odds of unfavorable outcome compared to those patient with the GCS of 9 and above [17]. In contrast to the above study, a study done in Kenya revealed that the GCS score of 8 and less on admission had about 0.02 times higher odds of death compared to those admitted with the GCS score of greater than 8[22]. In the this study increased unfavourable outcome could be due to development of secondary brain injuries and coexisting injuries in which both of them had the poor predictor of treatment outcome.

In this study, bilateral pupil's abnormality had 9.078 times higher odds of unfavourable outcome than those unilaterally abnormal pupils. This is nearly similar to the study done in United States in which bilateral abnormal pupils had eleven times higher odds of

unfavourable outcome relative to those patients with unilateral pupils [7]

In contrary, a study done in Kenya has shown that TBI patients with bilateral abnormal pupils had 29 times more odds of unfavourable outcome compared to those patients with unilateral abnormal pupils[22]. In this study, the lower unfavourable outcome could be due to the majority of the patients had mild TBI diagnosis at admission which could have less likelihood of developing abnormal pupils.

In this study, associated injuries had 5.894 times higher odds of unfavourable outcome relative to those patients without associated injuries. This study is nearly similar to the study conducted in India in which associated injuries had 4.6 times higher odds of unfavourable outcome relative to those patients without associated injuries [1]. Additionally, a study done in Ethiopia, Jimma Specialized Hospital which reported that, besides the quality of intervention available associated injuries had statistically significant association compared to those patients without associated injuries [3]. This could be due to additional surgical procedures undergone for associated injuries like laparotomy, thoracostomy and its possible complications.

According to this study, TBI patients treated conservatively had 20.774 times higher odds of unfavourable outcome relative to those patients treated by surgery. This study is nearly similar to the study done in Enugu, Nigeria in which those patients treated conservatively had unfavourable outcome relative to those patients treated by surgery[5]. This study is agreed with the study done in Kenya in which those patients managed conservatively had 26 times higher odds of unfavourable outcome compared to those patients managed by surgery [22]. In this study, relatively higher unfavourable outcome could be due to the absence of diagnostic imaging modality and Neurosurgery for moderate to severe TBI at study area during the study period.

Limitation of the Study

As the data was taken from secondary source some of the factors such as smoking and alcohol consumption, which could possibly affect the management outcome of TBI, were not included. So the association of these factors with the management outcome could not be known.

In this study the condition of patients after the discharge was not known. Therefore, the magnitude of unfavourable outcome could have been underestimated.

Conclusions and Recommendations

Conclusions

In this study, a quarter of patients treated for TBI had unfavourable outcomes up on discharge. From the overall mechanism of injury, a significant number was accounted for by road traffic accident indicating the public health importance. In this result, even though the majority of TBI patients were managed conservatively those who were managed by surgery had favourable outcome upon discharge. In this study, old age (above 60 years), delay in getting treatment (coming later than 24hours), conservative care, low GCS (GCS=3-8), bilateral abnormal pupils, and the presence of associated injuries were found to be significantly association with unfavourable outcome among TBI patients treated for head injuries.

Recommendations

According to this study, since road traffic accidents was the major mechanism of traumatic brain injury occurrence, I would like to recommend Nekemte Referral Hospital to give awareness for the community and to individuals about the consequence of this road traffic accidents on an individuals and community in collaboration with traffic police, Zonal health department, and mass media like FM-Radio.

In this result, since the majority of the patients were managed conservatively which was associated with unfavourable outcome, I would like to recommend Nekemte Referral Hospital to use CT scan imaging service and neurosurgery for moderate to severe traumatic brain injury patients to improve conservative care.

In this study, since associated injuries were associated with unfavourable outcome, I would like to recommend Nekemte Referral Hospital to establish rehabilitation centre and a multidisciplinary team approach for the better management of traumatic brain injury patients and to prevent structural and functional neurologic impairments besides reducing mortality rate.

According to this study, since increased age and delay in getting treatment had an association with unfavourable outcome up on discharge, I would like to recommend Nekemte Referral Hospital to give awareness to an individual and the community to seek medical help without delay and before patient develops secondary brain injuries in collaboration with its stake holders like regional health department, mass media.

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