Analysis of Traumatic Head Injury in Kathmandu, Nepal

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Degree Project, Programme in Medicine

Analysis of Traumatic Head Injury in Kathmandu, Nepal

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Abstract

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Background

Nepal is one of the worlds poorest countries. Traumatic brain injury (TBI) is a major strain on Nepal's healthcare. The fatalities are about 15-20 times higher than in more developed countries such as Sweden. More studies about TBI are crucial in order to decrease mortality and morbidity.

Objectives

The objective of the study us to characterise patients who are admitted to a neurosurgical tertiary care centre at Tribhuvan University Teaching Hospital (TUTH) and to assess the value of Glasgow Coma Scale (GCS) at admission and if surgery affects the outcome. An auxiliary aim is to study if the results differs between men and women.

Methods

In a prospective observation study, information about patients admitted to the neurosurgical tertiary care centre at TUTH was collected during October and November 2015. Inclusion criteria were: admitted with a brain injury caused by trauma and age of 16 or more.
The severity of the injuries was classified with GCS. The outcome was classified with Glasgow Outcome Score (GOS).

Results

A total of 46 patients were included, 33 males and 13 females. The most common modes of injury were fall from ground/heights and road traffic accidents. Patients admitted with GCS 3-8 had worse outcome (-1.5 GOS, p=0.002) than patients admitted with GCS 13-15. In patients who had undergone surgery the outcome tended to be worse (-0.5 GOS, p=0.097). The most common mode of injury was fall from ground/heights and road traffic accidents.

Conclusions

GCS at admission can be used to predict the outcome of patients with TBI. Surgery worsened the outcome but this was not statistically confirmed. A study with larger sample needs to be done to analyse differences between males and females.

Key words: Neurosurgery, Traumatic brain injury, Glasgow Coma Scale, Glasgow Outcome Scale, Nepal

Introduction

Traumatic brain injuries (TBI) are often defined as "an alteration in brain functions, or other evidence of pathology of the brain that is caused by an external force" (1). TBI is one of the leading causes of mortality and morbidity, not only in the industrialized world but the developing world as well. In developing countries TBI is a major contributor to socio-economic costs (2). The World Health organisation (WHO) predicts that it will be one of the most dominant causes of death and disability by the year of 2020 (1). Traumatic injuries are often overlooked and are sometimes called "the neglected disease of modern society" (2).

Much of the cellular and molecular mechanisms in traumatic brain injuries have been learned the past twenty years. But there have not been successful translations into clinical trials, and improvements concerning the treatment are largely missing. A potential cause for this might be that traumatic brain injuries are a heterogeneous group of conditions (3). Moreover, it is hard to classify TBI properly so that patients who might benefit from different treatment may be easily identified. So if the treatments are not improved, then a major ambition must be to decrease number of accidents leading to TBI in order to lower the mortality rate and to make sure that the incidence of traumatic brain injuries declines.

Classification of traumatic brain injuries

Today, there are three main types of classification of TBI: clinical indices of severity, pathoanatomic type and physical mechanism. The later ones are often used when studying acute management and the bio-mechanic aspect of traumatic brain injuries. Classification of injuries by clinical indices of severity is most commonly used in clinical treatment plans. The classification is based on neurologic injury severity criteria. The so called "Glasgow Coma

Scale" (GCS) is most regularly used due to high inter-observer reliability and, in addition, because the scale has good prognostic capabilities (3). The GCS is a 15-point scale and is a way to record the conscious state of patients. The details about GCS will be displayed in table 1 in the method section. The odds of death within 14 days have also been shown to increase as the GCS score decreases (4).

Outcome of traumatic brain injuries

The most widely used way to assess the outcome of TBI is with the Glasgow Outcome Scale (GOS). The 5-point scale is easy to use but has had some important shortcomings due to that it is usually based on an unstructured short interview without any written protocol. The results can vary between different evaluators. It is also often interpreted that the score mainly takes in consideration physical rather than emotional and cognitive symptoms. Both emotional and cognitive problems are often considered to be at least as important as physical deficit after TBI. The GOS focuses on how the injury has affected major areas of life rather than specific symptoms or particular neurological deficits. The purpose of the score is not to give detailed information about patients' individual difficulties but rather the overall outcome. Even though GOS has several shortcomings it is the most recognised way to evaluate outcome after TBI (5). The GOS will be displayed in table 2 in the method section.

Even though the GCS has very good prognostic capabilities and the correlation between low GCS and poor outcome is well-studied (4, 3), it is important to have in mind that the scale was not intended to be used as a measure of the probable outcome of the TBI. In order to assess the prognosis different features in multivariate models should be used (4).

Differences between genders

Males comprise a greater proportion of TBI in general (6, 7, 8). In one study in USA on TBI caused by work related trauma, by Vicky C. Chang et al, the relative proportions between males and females varied, from 93% males to <70%. An important aspect of the difference is that males are overrepresented in physically demanding and unsafe jobs (6). Other studies on the subject have revealed that the mortality rate among patients admitted to hospital with severe TBI is 1.17 times greater among males than females (7).

Traumatic brain injuries in Nepal

Nepal is a federal democratic republic, land-locked between China in the north and India in the south. It is one of the poorest and least developed countries in the world, GDP (gross domestic product) is 2400 US dollars/capita, 2014. Approximately 25% of its population is living below the poverty line (1.25 US dollars/day). 22-25% of its GDP depends on remittances. The life expectancy at birth is 67.5 years. The median age of the population is at the moment 23.4 years. Health expenditures are about 6% of Nepal's GDP, which place it as 125 of 191 in the world regarding health expenditures (9).

Regarding the situation about general trauma in Nepal, it is the third most common cause of death and stands for 8% of all mortality cases in the country. Therefore, Nepal is an ideal country to study medical conditions caused by trauma. However, the data about accidents and trauma is not completely satisfying (10). Because of that, it is imperative that more research about traumatic injuries is conducted. In one of few studies regarding the spectrum of head injuries, made by Bajracharya A et al, the three top causes of traumatic brain injuries were: fall from heights, road traffic accidents and physical assaults. The male to female ratio was 2.7:1 and the majority of the patients belonged to the age group of 21-40 years (8). One study

made at Tribuhuvan University Teaching Hospital (TUTH) by Sarah McClennan and Carolyn Snider showed that 5% of all emergency room visits were due to TBI. Also, 30% of all deaths of the emergency room visits were due to TBI (11).

The increase in number of registered vehicles has made the number of fatalities in road accidents to go up in Nepal (12). A decision to implement a ban on drunk driving has been a way to prevent the numbers to increase even further (13). Still, the burden of traumatic injuries on the Nepalese health resources is substantial. The fatalities are 15-20 times higher than in developed countries (12). When formulating different preventative plans in order to decrease the burden of traumatic injuries, there must be data about the causes of accidents and which part of the population that are mostly afflicted by trauma. The knowledge about traumatic brain injuries is limited. This is an important reason why traumatic brain injuries should be studied in Nepal (14).

Specific objectives

The main objective of this study is to investigate how the outcome is affected by admission GCS and treatment in patients admitted to a neurosurgical tertiary care centre at TUTH. The second objective is to characterise what kind of patients that is admitted and to investigate if the results differs between men and women. This could contribute to the knowledge about TBI, give examples in which areas different strategic plans need to be conducted in order to decrease the number of accidents that leads to TBI.

Material and Methods

This is a prospective observation study of head injuries at TUTH in Nepal. Information about patients admitted to the neurosurgical tertiary care center at TUTH was collected during 10 weeks during the autumn of 2015. Inclusion criteria were: admitted with a brain injury caused by trauma and age of 16 or over. Patients presented at the emergency with a TBI but that were not admitted, were not included. Patients that did not survive the transportation to the hospital or died at the emergency were not included. The variables collected were: age, gender, mode of injury, admission GCS, admitted to ward or the ICU, operated/conservative, days in the ICU, diagnosis (based on neuroimaging), days in hospital and the outcome at discharge assessed with GOS (Glasgow outcome scale). The information was collected with the approval from the IRB (international review board) at TUTH, see appendix 1, and from the director of the department of surgery, Prof. Sushil K Shilpakar.

The severity of the injury was classified with GCS at admission (4), see table 1. The GCS was set by the general surgical resident on call.

Table 1 – Glasgow Coma Scale. The result in each category is added to a score between 3-15

Eye opening		Verbal response		Best motor response	
1	None	1	None	1	None
2	To pressure	2	Sounds	2	Extension
3	To speech	3	Words	3	Abnormal flexion
4	Spontaneous	4	Confused	4	Normal Flexion (withdrawal)
		5	Oriented	5	Localising
				6	Obeying commands

GCS 13-15 was defined as minor TBI, 9-12 as moderate and 3-8 as severe. The patients were divided into age groups 16-26, 27-37, 38-48, 49-59 and ≥60. The injuries were also classified by pathoanathomic type, the diagnoses used were: epidural hematoma (EDH), subdural hematoma (SDH), subarchnoid hemorrhage (SAH), contusions, fractures of the skull and the occurrence of pneumocefalus. One patient could qualify for more than one group if more than one diagnose was identified.

The Outcome of the patients was assessed with the GOS at end of admission (15), see table 2.

Table 2 – The levels of Glasgow Outcome Scale	
1	DEATH
2	PERSISTENT VEGETATIVE STATE - Patient exhibits no obvious cortical function
3	SEVERE DISABILITY - Patient depends upon others for daily support due to mental or physical disability or both
4	MODERATE DISABILITY - Patient is independent as far as daily life is concerned. The disabilities found include varying degrees of dysphasia, hemiparesis, or ataxia, as well as intellectual and memory deficits and personality changes.
5	GOOD RECOVERY - Resumption of normal activities even though there may be minor neurological or psychological deficits.

The score was determined together with the neurosurgical residents. If the patient showed no neurological deficits, a 5 was set. If the patient showed neurological deficits that would not affect his/her everyday life, a 4 was set. If the deficit was at the level that it interfered with the patient everyday life, a 3 was set. If the patient was discharged but still unconscious, a 2 was set. If the patient died during the admission, a 1 was set.

Ethics

The study was performed according to the Helsinki Declaration which means that all data were de-identified. Furthermore, the data collection did not alter the management, the treatment or the outcome of the patients and no harm was done to the patients. Ethical approval was also conducted by the Institutional Review Board (IRB), Institute of Medicine at TUTH, see appendix 1.

Data collection procedures

10 weeks, 22th of September until 1th of December 2015, was spent together with the two neurosurgical residents at the department of surgery at TUTH. At rounds information about patients admitted with traumatic brain injuries was collected with a pro forma, see appendix 2. The data was retrieved from the handwritten medical charts, if it was any risk for misinterpretation the residents were consulted. The patients were then followed until the day of discharge when the outcome, using GOS, was assessed together with the resident and the number of days in the ICU and in the hospital was recorded.

Variable analyses and Statistical methods

All descriptive statistics and figures were made in IBM® SPSS Statistics 23. To test the differences/similarities seen in results between males and females statistically, independent sample T-test was performed in SPSS. Due to a small female group and not normal distributed data, the T-test was complemented with a Mann-whitney U-test. If the U-test could not be performed due to that the data did not have a similar distribution in both the female and the male group, a median-test was performed instead. The test used for every variable is as followed: Age: median test. Days admitted: median test. Days in the ICU if all patients were included: T-test. Days in the ICU if patients that not attended the ICU were excluded: median-test. Outcome: U-test.

When testing if the results differed between the genders regarding: admitted to ward or the ICU, difference in severity and if the patient were treated conservatively or surgically a Chi2-test was performed. Due to small sample groups Fischer's exact test was used for significance testing when possible.

A linear regression, ANOVA univariate analysis of variance, was performed in SPSS to determine how outcome was influenced by admission GCS and kind of treatment. Statistical significance was set at $p < 0.05$.

To see if there were any connections between treatment and outcome in each diagnose group a Chi2-test was performed. Fisher's exact test was used exclusively due to small sample groups.

Results

A total of 46 patients were included, 33 males (72%) and 13 females (28%). No patient admitted and discharged during the study period was excluded. The median age was 38, see table 3 for the age distribution.

Table 3 – Patients in every age group and mean/median age

	Frequency	Percent	Mean	Median	Minimum	Maximum	Std. Deviation
AGE							
16-26	10	22					
27-37	12	26					
38-48	12	26					
49-59	7	15					
≥60	5	10					
Total	46	100	38.65	38.00	18	83	15.351

Table 4 – Female and male distribution

	Frequency	Percent
SEX		
F	13	28
M	33	72
Total	46	100

The median days admitted was 7.5 days. The mean days admitted in the ICU was 2.39 days (the median was 0 days) and 5.5 days if the patients not admitted to the ICU at all were excluded (the median was 8.3 days), see table 5 for detailed information about days admitted and days in the ICU.

Table 5 – Days admitted in total and days admitted to the ICU							
	Frequency	Percent	Mean	Median	Minimum	Maximum	Std. Deviation
DAYS Admitted							
1-3	9	20					
4-6	9	20					
7-9	11	24					
10-12	8	17					
13-15	5	11					
16-18	3	6					
19-21	1	2					
Total	46	100	8.28	7.50	1	19	4.90
DAYS ADMITTED IN the ICU							
0	26	56					
1-2	3	7					
3-4	2	4					
5-6	9	20					
7-8	3	7					
9-10	2	4					
11-12	1	2					
Total	46	100	2.39	0.00	0	11	3.21
Total, when excluding patients with 0 days in the ICU	20		5.50	8.28	2	11	2.52

The majority of patients, (n=33, 72%) were assessed as 5 on the GOS. For exact number of patients in every GOS category, see table 6.

Table 6 – The outcome of the discharge assessed with GOS							
	Frequency	Percent	Mean	Median	Minimum	Maximum	Std. Deviation
OUTCOME AT DISCHARGE (GOS)							
1	2	4					
2	1	2					
3	1	2					
4	9	20					
5	33	72					
Total	46	100	4.52	5.00	1	5	0.98

The most common mode of injury was fall from height, followed by: road traffic accidents and fall from ground. 27 patients were admitted to an ordinary ward and 19 to the ICU. See table 7 for details.

Table 7 – Mode of injuries and were patients became admitted		
	Frequency	Percent
MODE OF INJURY		
Fall from ground	10	22
Fall from height	17	37
Physical assault	3	7
Road traffic accident	15	32
Stone blew to head	1	2
Total	46	100
ADMITTED TO WARD OR ICU		
Ward	27	59
ICU	19	41
Total	46	100

Nineteen patients were operated on and 27 patients were managed conservatively. 37 patients were classified as having a minor traumatic brain injury, 5 as moderate and 4 as severe, see

table 8. A total of 3 patients were operated on in the severe group, 1 in the moderate group and 15 in the minor group, see table 9.

Table 8 – Patients in each severity group and which treatment the patients underwent during their admission		
	Frequency	Percent
SEVERITY		
Minor	37	80
Moderate	5	11
Severe	4	9
Total	46	100
TREATMENT		
Operated	19	41
Conservative	27	59
Total	46	100

Table 9 – patients operated/conservative in the severity groups			
	Operated	**Conservative**	*Total*
Severity			
Severe	3	1	4
Moderate	1	4	5
Minor	15	22	37
Total	19	27	46

The most common pathoanatomic diagnoses were contusion followed by subdural haemorrhage and epidural haemorrhage, see table 10 for detailed information about the diagnoses. One patient could be diagnosed with more than one diagnosis. This makes the total number of diagnoses to exceed the total number of patients. For distribution of diagnoses in different age groups see Figure 1.

Table 10 – Diagnoses set		
	Frequency	Percent
DIAGNOSIS		
Epidural haemorrhage	8	11
Subdural haemorrhage	14	19
Contusion	25	34
Pneumocefalus	3	4
Skull fracture	8	11
Subarachnoid haemorrhage	8	11
Parenchymal bleed	1	1
Damage to spine	6	8
Diffuse Axonal Injury	1	1
Total	74*	100

*One patient can be diagnosed with more than one pathoanatomic diagnose. Because of that the total number of diagnoses exceed the total number of patients.

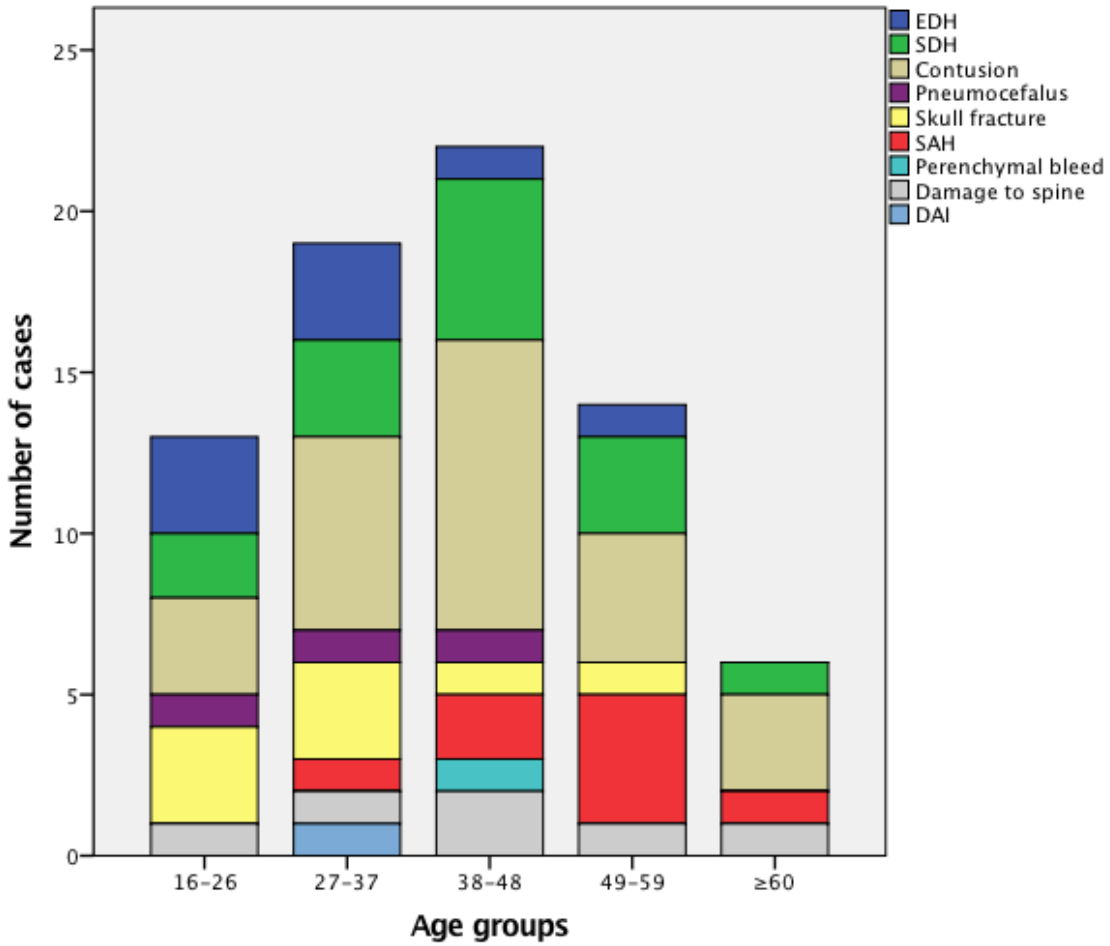

Figure 1. The distribution of diagnoses in different age groups. EDH (epidural haemorrhage). SDH (subdural haemorrhage). SAH (subarchnoidal haemorrhage). DAI (diffuse axional injury).

Difference between sexes

No statistically significant difference could be seen between Females (F) and Males (M) regarding age (p=0.425), days admitted in total (p=0.102), days admitted in the ICU when all patients were included (p=0.317), days admitted in the ICU if patients with 0 days were excluded (p=0.642) and outcome at discharge (p=0.746). for further details regarding exact values see table 11.

Table 11 – Results divided by male and female regarding age, days admitted, days admitted in the ICU and outcome at discharge.

		AGE	DAYS ADMITTED	DAYS ADMITTED IN the ICU	DAYS ADMITTED IN the ICU (IF ADMITTED)*	OUTCOME AT DISCHARGE (GOS)
Female	Mean	40.62	10.23	3.15	6.83	4.54
	Median	35.00	10.00	0.00	5.50	5.00
	Number of cases	13	13	13	6	13
	Std. Deviation	15.43	5.25	3.9	2.56	0.97
Male	Mean	37.88	7.52	2.09	4.93	4.52
	Median	40.00	7.00	0.00	5.00	5.00
	Number of cases	33	33	33	14	33
	Std. Deviation	15.49	4.62	3.91	2.52	1.00
Total	Mean	38.65	8.28	2.39	5.00	4.52
	Median	38.00	7.50	0.00	5.00	5.00
	Number of cases	46	46	46	20	46
	Std. Deviation	15.35	4.90	3.21	2.52	0.98

* Patients that had 0 days in the ICU were excluded.

53.8% of the females were admitted directly to ward compared to 60.6% in the male group, see table 12. A Chi2-test did not find any correlation between sex and if the patient was admitted directly to ward or to the ICU (p=0.675).

In the Female group 92.3% had minor TBI, 7.7% moderate and 0% severe compared to the male group in where 75.8% had minor TBI, 12.1% moderate and 12.1% severe, see table 12. A Chi2-test did not show any correlation between sex and severity (p=0.357)

30.8% females were operated on compared to 45.5% of the males, see table 12. No statistical correlation could be showed with chi2-test (p=0.510).

Table 12 – Results divided by male and female regarding mode of injury, admitted to ward or the ICU, severity and treatment.

	Female	Percent		Male	Percent
MODE OF INJURY					
Fall from ground	4	31		6	18
Fall from height	5	38		12	36
Physical assault	1	8		2	6
Road traffic accident	3	23		12	36
Stone blew to head	0	0		1	3
Total	13	100		33	100
ADMITTED TO WARD OR ICU					
Ward	7	54		20	61
ICU	6	46		13	39
Total	13	100		33	100
SEVERITY					
Minor	12	92		25	76
Moderate	1	8		4	12
Severe	0	0		4	12
Total	13	100		33	100
TREATMENT					
Operated	4	31		15	46
Conservative	9	69		18	54
Total	13	100		33	100

See table 12 for mode of injury in the different groups. The three most common types of injuries, fall from heights/ground and road traffic accidents, were the most common in both groups.

Linear regression

In order to tell if the variables, if the patient had undergone surgery as a treatment and severity, were significant to use in a linear regression model, a F-test was performed for. A F-test shows how suitable and significant the data fits the type of regression used. A p-value below 0.05 is seen as significant. The severity variable was significant with a p-value of 0.008. The treatment variable on the other hand was not statistical significant with a p-value of 0.097, see table 13. This indicates that the sample in each group (operated/conservative) is too small to analyse properly, but the variable could still be used in the regression.

The R squared value for our model was 0.283, which means that the model can explain about 28% the reasons for alterations in GOS.

Table 13 – F-test (goal variable=GOS)

Source	F	Sig. (p-value)
Operated or conservative	2.886	0.097
Severity	5.408	0.008

Linear regression was performed with univariate analysis of variance. The result demonstrated that the severity of the injury at admission affected the outcome. Patients in the severe group had -1.520 lower value on the GOS compared to patients in the minor group

(p=0.02, 95% confidence interval -2.453, -0.586). The decrease in Glasgow Outcome Score in the moderate group, -0.169, was not statistically confirmed (p=0.686), see table 14.

The regression also displayed that the treatment did alter the outcome. Patient that had undergone surgery had a -0.452 lower Glasgow outcome Score. This was not statistically confirmed (p=0.097, 95% confidence interval -0.990, 0.085), see table 14.

Table 14 – Results of linear regression how treatment and severity at admission influenced the outcome.

					95% Confidence interval	
Parameter	Difference in GOS	Std. Error	t	sig. (p-value)	Lower bound	Upper bound
Conservative	0					
Operated	-0.452	0.266	-1.699	0.097	-0.990	0.085
Minor	0					
Moderate	-0.169	0.414	-0.407	0.686	-1.004	0.667
Severe	-1.520	0.463	-3.285	0.02	-2.453	-0.586

Analysis of each diagnose group

Table 15 – The outcome at discharge in the groups operated or conservative divided by diagnosis. The diagnoses Pneumocefalus, DAI and Parenchymal bleed are excluded due to few patients.							
Diagnosis							
		Outcome at discharge					
		1	2	3	4	5	Total
SDH							
	Operated	1	0	0	2	4	7
	Conservative	0	0	0	1	6	7
	Total	1	0	0	3	10	14
EDH							
	Operated	1	0	0	0	5	6
	Conservative	0	0	0	0	2	2
	Total	1	0	0	0	7	8
Contusion							
	Operated	1	0	0	4	3	8
	Conservative	0	0	1	3	13	17
	Total	1	0	1	7	16	25
Skull fracture							
	Operated	1	0	0	1	2	4
	Conservative	0	0	0	1	3	4
	Total	1	0	0	2	5	8
SAH							
	Operated	1	0	0	1	1	3
	Conservative	0	0	0	1	4	5
	Total	1	0	0	2	5	8
Damage to spine							
	Operated	0	0	0	2	0	2
	Conservative	0	0	1	1	2	4
	Total	0	0	1	3	2	6

In table 15 is the outcome at discharge in the groups operated or conservative divided by diagnosis displayed. The diagnoses Pneumocefalus, DAI and Parenchymal bleed were excluded due to too few patients. In the different diagnose groups no statistical connection between surgical or conservative treatment could be showed. The p-value for each diagnose were as followed: SDH: p=0.56. EDH: p=0.75. Contusion: p=0.12. Skull fracture: p=1.00. SAH: p=0.64. Damage to spine: p=0.60.

Discussion with Conclusions and Implications

Key findings

The ratio of men to women admitted to the neurosurgical centre was 2.5:1. It was more common to be admitted straight to an ordinary ward, than to the ICU.

The mean outcome was 4.5 on the GOS, 33 patients were completely restored and 11 suffered from various neurological deficits. 2 patients died during their admission.
Road traffic accidents together with fall accidents stand for a vast majority of the accidents that leads to traumatic brain injuries. The most common diagnosis after investigations was contusion that stands for 34% of all the diagnoses set.

A vast majority, 80% of the patients admitted had a minor traumatic brain injury. A majority of the patients were treated conservatively.

The results between the gender groups did alter in almost every variable except the outcome. The differences could however not be confirmed statistically.

Statistical analysis suggested that the severity of the injury affected the outcome, so did if the patient was treated conservatively or operated on. The outcome was worse if the patient had a severe injury with a GCS 3-8 at admission than if the damage was set as minor with a GCS of 13-15. The outcome was worse if the patient had surgery, this was not statistically confirmed compared to the severity of the injury.

Discussion of the results

The results implicated that the group of patients in the severe group, GCS 3-8, had worse outcome than if the patient was in the minor group, GCS 13-15). Several studies have shown that outcome can be associated with the level of consciousness, assessed with GCS at admission (3, 4). This is a cheap and easy way to tell something about prognosis in countries where expensive equipment, for example MR-imaging, and laboratory tests can not be performed.

This study could not statistically show any differences between minor and moderate TBI. It would be very interesting to investigate the connection between every step of the GCS at admission and the outcome. In order to do so a larger sample of patients would be needed in every GCS step. One could for example do the analysis by dividing the GCS into three groups (minor, moderate and severe). This is often used in other studies (3) and the question is if the difference between one step in the 15 scale GCS is interesting or if it is easier to implement the results in the clinic if the injuries are divided into the three groups instead.

The other variable used in the regression was how the patient was treated, surgical or conservative. More patients were treated conservatively than surgically. The initial F-test that was made before the regression indicated that the variable was not significant ($p=0.097$). With a p-value in this range it is possible that the number of patients included in the analysis was too low. 19 patients were operated and 27 were managed conservative.

The regression showed that the treatment tended to have an impact on the outcome. If the patient had undergone surgery the outcome tended to be worse. But this could not be confirmed statistically ($p=0.097$). A possible reason why patient that got operated had a worse

outcome could be that more patients in the moderate and severe groups got operated due to more extensive bleeding etc. In the severe group 3 patients got operated compared to 1 that was managed conservatively. In the moderate group only 1 out of total 5 patients got operated. In the minor group 15 out of total 37 got operated. This means that the two variables treatment and admission GCS were not completely separated from each other. In order to properly examine the effect of surgical treatment, a study with a larger sample should be conducted. In a larger study the different types of surgical treatment could be assessed and one could analyse if the way the conservative treatment was managed would alter the outcome. Here could also the influence of the admission severity to the treatment be calculated for.

Studies in the epidemiology of TBI in Nepal and United States of America shows that males are over represented (6, 7, 8) In this study the male to female ratio is approximately 2.5:1. This is in line with other results on the subject (8). In this study several variables differed between the sexes, please see table 11 and 7 in the result section.

A study conducted by Vicky C. Chang et al show difference in mortality between males and females. A reason for the difference could be that males are often undertaking work that can lead to hazardous accidents (6). Other reasons could be that males do more drunk driving than females and are in general over represented in the traffic.

Due to the small size of the female group it was impossible to see any statistically confirmed the differences in this study. The gender groups did not differ when it came to outcome. High p-values in both T-tests and U-tests indicates that it is likely that there is no difference in outcome between the sexes. In the other variables the limited number of females makes it

hard to draw any conclusions. A study that focused on this issue should be conducted, a significant larger sample.

In this study three types of accidents leading to TBI represented the vast majority. Road traffic accidents, fall from ground level and fall from heights, see table 12. Studies made in Nepal have presented similar results (8, 11, 14). This makes it clear that the traffic is an important area were improvements in order to decline TBI should be made. Nepal has recently applied a ban on drunk driving (13). This is one important factor but more needs to be done. More distinct traffic rules and more education about traffic safety are examples of measurements that could possibly be implemented. Further research about the driving skills of patients that are victims of traumatic accidents is an example how it could be possible to investigate different possibilities in order to increase the safety.

More research on the fall accidents might also be needed, especially the ones that occurs from heights. One possibility is to increase safety arrangements near public places, large workplaces and other places were the risk of falling is high.

A study conducted by Bajracharya A et al, made in the purpose to map traumatic brain injuries in Nepal showed that the majority of the patients belonged to the age group of 21-40 years (8). This study did not include patients below 16 years in this study, due to harder ethic regulations in Nepal when conducting studies with minors included. Because of that, the age groups in this study looked a bit different. A majority of the patients were either 27-37 years or 38-48. Close behind was also the age group with patients in the age of 16-26. So slightly different than that study. Young people are still in majority. A reason for this could be that

young people are more exposed to situations when accidents occur, like traffic and unsafe working situations.

Very few patients belonged to the age group ≥60 years. A reason for this can be that the average life expectancy in Nepal is rather low (67.5 years) and the median age is 23.4 years (9). So few people in the population belongs to the older age groups.

It would be interesting to analyse how the outcome was influences by the days that the patients spent in the hospital in general and in the ICU. No such analyse is made in this study because of how the health system is organised in Nepal. The healthcare is completely financed by the patient itself (16). Both the fee for the bed in the ward/ICU and all material used in the care. This makes a substantial bias to the number of days that patients spend in the hospital and the ICU.

Regarding how surgery influenced the outcome in every diagnose group no statistical connection between treatment and outcome could be seen in any diagnosis. When divided by diagnosis very few patients were included in the analysis. Another shortcoming about this analysis is that one patient could qualify for more than one diagnose. Furthermore, it was not specified which surgical procedure that was done, this made it impossible to know if one or more of the diagnoses set caused the need for surgery. In a larger study one head diagnose should be used and the surgical procedures should also be specified in order to investigate this further.

Methodological considerations and Limitations

A major and unavoidable matter that has to be taken in consideration when drawing conclusions from the results in this study is the blockade between Nepal and India that took place during the study period. The reason for this was that on the 20th of September a new constitution was admitted in Nepal (17). Some minorities were not satisfied with parts of the new constitution which led to violent and deadly demonstrations along the border to India. Nepal is currently relying on India for import of petroleum products. So during the time that the study took place the import of petrol was struggling due to closed border points because of the demonstrations (18, 19). Road traffic accidents are a major cause leading to traumatic brain injuries, this has been presented in an other study (11) including this. At many periods during the study it was impossible for private households to purchase petrol. The queues to the gasoline stations reached several kilometers at times. The lack of gasoline for the ordinary citizen did not only lead to a dramatic decline in road traffic, it led to great difficulties for victims of accidents to make their way to the hospital. This situation made the number of patients admitted with traumatic brain injuries exceptional low compared to other time periods.

Another aspect that needs to be discussed is how well the sample of this study reflects the population in Kathmandu/Nepal. The blockade made it hard for people outside the Katmandu valley to access health care, the large hospitals are located in the cities (16) and the neurosurgical tertiary-level services are only available in the Kathmandu valley (20). Regarding the distribution of males and females it was similar to the distribution seen in other studies (6, 7, 8). Maybe, the time from accident to the first contact with the healthcare was longer for the patients from outside of Kathmandu? Maybe patients with minor TBI that happened outside of Kathmandu did not seek healthcare at all? Such effects were not analysed

in this study but are also something that has to be taken in consideration when analyzing the results.

A possible limitation could be that comorbidity was not studied. For example, patients with other severe illnesses could have worse outcome due to this and not due to the TBI, this is a possible confounder. The economical aspects discussed above can also not be ignored. It would have been interesting to investigate whether the financial status of the patients influenced the outcome. For example, patients that did not have the economical strength to pay for additional days at the hospital, days were more physiotherapy and recovery could have been done, which maybe could alter the GOS.

Regarding the distribution of males and females it was similar to the distribution seen in other studies (6, 7, 8).

A possible limitation of this study is how the outcome of the patient was assessed, with GOS at end of admission. At discharge, bedside, the potential neurological deficits were recorded and the GOS set. As was mentioned in the introduction GOS often focuses on neurological deficit of the somatic kind. This is also the case in the present study. The focus was not set on the psychological deficits that often occur after TBI (5). The GOS was determined at the end of the admission, which made it impossible to take any improvements or worsening of the deficits after the admission in consideration. A way to set the GOS in a truer way would be to check up on every patient at a fixed time period so that the initial GOS of the admission could be reevaluated. This was not possible due to this study's limited time period.

Another limitation is that the GCS at admission was set by different general surgical residents. Therefore, it is not certain that the GCS was set in a stringent manor. The GCS was evaluated the first time the neurosurgical residents met the patient, but due to admissions at night and on weekends, the time between admission and the new evaluation could be long. So the GCS set by the general surgical resident at call was used in the study.

Regarding the linear regression, the statistical conditions were not optimal because of the small sample and that the data of the variables used in the regression (GOS and severity) were not completely normal distributed. The R-square value was rather low (0.283) which means that the model can explain 28% of what factors that influence the GOS. The model could still be used in this study, but if a larger study should be conducted, it would then have been more suitable if a sharper statistical method was used. These circumstances need to be considered when interpreting the conclusions of this study.

Conclusions

The main conclusion of this study is that GCS at admission is connected to the outcome of the patients at a neurosurgical centre in Kathmandu Nepal. The examination at admission is an easy and cheap way to be able to predict the outcome in countries were the assets in the health care are limited. An important question was if the good prognostic capabilities of GCS could be implemented at the neurosurgical tertiary care centre at TUTH. The conclusion is that it is possible to do so.

The sample was too small to draw any certain conclusions about how the treatment altered the outcome, a greater study needs to be conducted.

The sample was also too small to draw conclusions about differences between males and females.

The majority of the accidents that lead to TBI were falls and road traffic accidents. This is in line with earlier studies on the subject. It is in these two areas preventative measures should be taken.

Populärvetenskaplig sammanfattning på svenska

Traumatiska skador orsakade av olyckor är en av de vanligaste orsakerna till lidande och död i den mindre utvecklade delen av världen. WHO förutspår att skador orsakade av olyckor kommer att öka framöver, vilket gör att mer forskning på området behövs. Det här är en studie som undersöker traumatiska hjärnskador i Nepal. Under 10 veckor registrerades alla patienter som lades in på den neurokirurgiska kliniken på Tribhuvan University Teaching Hospital i Kathmandu.

I studien samlades information om patienternas ålder, antal dagar på sjukhus, dagar på intensivvårdsavdelning och om man lades in på vanlig avdelning eller intensivvårdsavdelning in. Vi registrerade om patienterna blev opererade eller inte, vilken vakenhetsgrad de hade vid inläggningen, vilken diagnos de hade samt vilken typ av olycka de råkat ut för. Eventuella konsekvenser av skadan på patientens vardagliga liv i form av funktionsnedsättningar registrerades i slutet av inläggningen. I studien ingick endast patienter över 16 år. Totalt innefattade studien 46 patienter, 13 kvinnor och 33 män.

Resultaten visar att vakenhetsgraden vid inläggning kan användas för att ge information om hur allvarlig funktionsnedsättning patienten riskerar efter vårdtiden på sjukhuset. Patienter som befann sig lägre på skalan, dvs som var vid mindre medvetande vid inskrivning hade högre grad av funktionsnedsättning än de med högre värden på skalan. Även patienter som opererades tenderade att ha högre grad av funktionsnedsättning. Detta kunde inte säkerställas statistiskt utan en större studie med fler patienter hade behövt göras för att säkerställa detta. Mätning av vakenhetsgraden vid inläggning är ett enkelt och billigt sätt att bedöma risken för funktionsnedsättning och kan ge information om förväntad prognos till anhöriga i ett tidigt skede.

Vi ville också se om det fanns några skillnader i resultat mellan kvinnor och män, men då endast 13 kvinnor inkluderades i studien kunde inga säkra slutsatser dras, utan även här hade en större studie behövts utföras.

De vanligaste typerna av olyckor i studien var fallolyckor från marknivå samt från höjder och trafikolyckor, vilket även tidigare studier har kommit fram till. Detta är viktig information när man skall komma fram till preventiva åtgärder för att minska de traumatiska skadorna.

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Appendices

Appendix 1 – Approval from IRB

त्रिभुवन विश्वविद्यालय
चिकित्सा शास्त्र अध्ययन संस्थान
डीनको कार्यालय, महाराजगंज
पो.ब.नं.: १५२४, काठमाडौं, नेपाल ।
फोन नं.: ४४१०९११, ४४१२०४०, ४४१३७२९, ४४१८१८७

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पत्र संख्या / Ref. No.:- 59(6-11-E)/A2/A3

मिति / Date.:-
5 October, 2015

Research Department

Mr. Erik Stenholm
Medical Student
Sahlgrenska Academy
University of Gothenburg
Sweden.

Ref: Approval of Research Proposal: Analysis of head injury in Kathmandu, Nepal-a prospective analysis of head injuries admitted in a tertiary care center in Kathmandu.

Dear Mr. Stenholm,
Thank you for the submission of research proposal entitled **"Analysis of head injury in Kathmandu, Nepal-a prospective analysis of head injuries admitted in a tertiary care center in Kathmandu."** to the Institutional Review Board (IRB), Institute of Medicine (IOM) Tribhuvan University on 29 September, 2015.

I am pleased to inform you that the above mentioned proposal has been approved by Institutional Review Board (IRB), Institute of Medicine on 5 October, 2015.

As per IRB rules and regulations the investigator has to strictly follow the protocol stipulated in the proposal. Any change in objective, problem statement, research questions or hypothesis, methodology, implementation procedure, data management and budget may be made so and implemented after prior approval from this Research Department and IRB. Thus, it is compulsory to submit the detail of such changes intended or desired with justifications prior to actual change in the protocol.

You are also requested to follow the ethical guideline of IRB, Institute of Medicine.

After completion of your study you must submit a copy of final report to the Research Department.

If you have any further queries, please do not hesitate to contact us.

Prof. Dr. Jeevan Bahadur Sherchand
Member Secretary
Institutional Review Board

Research Department
Institute of Medicine
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Cc
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Appendix 2 – Pro forma

ate dmitt d	Hosp No.	Name	Ag e	Se x	Mode of injury	Admis sion GCS	Ad mitt ed to war d or ICU	Operated or conservative	Da ys in IC U	Diagnosis	Da ys in Ho spit al	Outcom at Dischar e GOS