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ORIGINAL ARTICLE

Frequency and Outcome of Traumatic Subarachnoid Hemorrhage in patients presenting with Traumatic Brain Injury at Tertiary Care Hospital, Karachi

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ABSTRACT

Aim: To determine the frequency and outcome of traumatic subarachnoid hemorrhage (tSAH) in patients presenting with traumatic brain injury.

Method: A cross-sectional study was conducted at the Department of Neurosurgery, JPMC, Karachi from August 2021 to July 2022. Patients presenting with traumatic brain injury at the Department of Neurosurgery, JPMC, Karachi were enrolled in this study. A brief history of demographic information, duration, and mode of head injury was taken at the time of admission. CT scan brain was performed and interpreted.The findings of quantitative and qualitative variables (gender, smoking status, diabetes mellitus (DM) type II, hypertension, associated brain injuries, mode of head injury, tSAH, and good outcome) were recorded in the performance.

Results: A total of 267 patients were enrolled in the study. The majority of the patients were aged between 21-48 years. Around 197(73.8%) patients were male and 75(28.1%) were female. The cause of traumatic brain injury was found to be road traffic accidents in 157(58.8%) individuals. The Glasgow coma scale (GCS) at presentation was 3-8 in (33.70%) of patients, 9 -13 in (43.07%) of patients, and 14-15 in (23.22%) of patients. At the time of discharge, GCS was 14-15 in (40.07%), 9-13 in (25.09%) patients, 3-8 in 23.59%, and 11.23% of patients died. It was found that both age (p=0.003), gender (p=0.002), and other brain injuries (p=0.0001) were significantly associated with the outcome.

Conclusion: The present study revealed the outcome of traumatic subarachnoid hemorrhage (tSAH) in the majority of the patients was unfavorable. Age, diabetes mellitus, smoking, and other associated brain injuries were significantly related to unfavorable outcomes in the study.

Keywords: Traumatic subarachnoid hemorrhage, traumatic brain injury, GCS, neurosurgery

INTRODUCTION

For neurosurgeons all over the world, Traumatic Brain Injury (TBI) persists to be a great challenge to date. Out of all the injuries coming under the term traumatic brain injury, traumatic Subarachnoid Hemorrhage (tSAH) has been documented to be one of the most common causes of long-term neurological dysfunction and morbidity. TBI patients being diagnosed with tSAH have a total incidence ranging from 26% to 53%[1-2]. A total of 67 to 317 people per 100,000 individuals suffer from the head injury, among which the death rate varies from almost 4% to 8% in patients with moderate trauma to almost 50% among patients who suffer severe head trauma[3-4]. The SAH occurs most commonly due to trauma, making it an important component of the umbrella term TBI. Traumatic Brain Injury (TBI) commonly leads to long-term morbidity and mortality among the young population of Pakistan. TBI of a milder state or in its primary stages is preventable from progressing and secondary outcomes of its trauma are treatable. In patients with TBI, the rate of mortality is found to be double in cases of diagnosed tSAH. The prognostic outcomes in the group of patients with SAH are predicted utilizing GCS and the extent of subarachnoid bleed that can be seen on Computed Tomography Sca (CT scan) as indicated by the fisher grade[5].

tSAH is linked with cerebral contusions and skull fractures[6]. The pattern of SAH is to be usually found along with contusion and subdural hematoma, where it spreads outside the boundaries of lacerations and is found encircling penetrating trauma[7]. Basilar SAH is termed when the affected brain portion is the ventral surface of the brainstem. Following a SAH, CSF studies highlight polymorphonuclear responses in the next 24 hours, gradually more highlighted by the following 48 hours[8]. Polymorphonuclear (PMN) leukocytes are then replaced by lymphocytes and macrophages after these 48 hours. While the exact cause of tSAH remains unknown, proposed theories include: 1) short-term oscillatory motion of the brain caused by rotational acceleration; 2) hyperextension resulting in stretching of the vertebrobasilar artery; 3) blow to cervical carotid artery resulting in raised intra-arterial pressure; 4) traumatic tears of bridging veins or pial vessels; 5) blood of a contusion origin being collected in subarachnoid space. No cause is found in some cases is also not rare[9,10].

A study reported by Eisenberg et al that included 753 patients witha severe head injury, a raised intracranial pressure (ICP), and the rate of mortality is correlated with CT scan findings of midline shift, blood in subarachnoid space and obliteration or compression of cisterns[9]. Additionally, blood within the basal cistern predicts 70% of bad outcomes[11,12]. Sagher et al found the prevalence of tSAH and good outcomes in patients presenting with traumatic brain injury to be 88.7% and 53.3% respectively[13].

According to the severity of the trauma, the available resources try to comprehend the diagnosis and care of the patients suffering from SAH. The intention is to analyze the cost-effectiveness of the current management, shorten the stay, and redistribute the use of the already scarce resources using this data. Recent literature reports that patients suffering from SAH secondary to mild TBI (mTBI) possess a reduced risk of clinical deterioration and that, in the majority of cases, surgical intervention is not required[26].

However, there is a paucity of local data. There is a need to fill this knowledge gap as the traumatic injury is common in Karachi. Moreover, demographic, lifestyles, and risk factors vary from other countries. The present study aimedto find out the

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frequency of tSAH in patients presenting with TBI at Tertiary Care Hospital, Karachi. Secondly, the study also assessed the outcome of patients with tSAH.

The findings of this study will be significant for the patients as it reveals the outcomes of the patients with SAH therefore will help the doctors to treat such patients at their earliest.

METHOD

Study design and duration: We conducted a cross-sectional study at the Department of Neurosurgery, JPMC, Karachi between 2021 to 2022. A non-probability convenience sampling technique was used to get the participants enrolled in the study. Ethical permission was granted by Hospital Review Board.

Sample size and calculation: Help was taken from a selected statistics software to calculate the sample size, by considering the prevalence of tSAH to be 88.7%[13], with a 5% margin of error and confidence level of 95%. The sample size came out to be 154 patients.

Inclusion and Exclusion criteria: Patients who presented with TBI were enrolled in the study irrespective of gender, and age >12 years. Patients who presented later than 24 hours after acquiring the injury, those with a history of venous thromboembolism or stroke, or those who needed surgery due to SAH or associated brain injuries, were excluded from the study. Patients with penetrating injuries were also not included.

Data collection: Patients presenting with traumatic brain injury at the Department of Neurosurgery, JPMC, Karachi were enrolled in this study. A brief history of demographic information and duration and mode of head injury was taken at the time of admission. CT scan heads were performed. A patient was diagnosed with tSAH when bleeding in the subarachnoid space around the brain was observable in the Sylvian fissure, basal cistern, and tentorium) with Modified fisher grade ≥1 on computed tomography.

The patients were labeled as having either a good outcome(Glasgow outcome score 5) or poor outcome (Glasgow outcome score<5) byusing the Glasgow Outcome Score within 14 days of hospital stay. The results of the quantitative such as the age and duration of head injury, and qualitative variables that include gender, hypertension status, diabetes mellitus type II, smoking status, Modified fisher grade, mode of head injury, traumatic subarachnoid hemorrhage, and good outcome) were recorded in the proforma.

Data analysis: Scientific analysis of the collected data was carried out on SPSS Version 20. Presentation of demographic data was given in simple descriptive statistics including mean and standard deviation for age and duration of head trauma. Mean SD ± was documented for the quantitative variables. A p-value of ≤ 0.05 was considered to be significant statistically, and the post-stratification chi-square/fisher test was applied.

RESULTS

A total of 267 patients were enrolled in the study. The majority of the patients were aged between 21-48 years. Almost 3/4th of the population was male. The cause of traumatic brain injury was found to be road traffic accidents in 157(58.8%) individuals (Table 1).

The Glasgow coma scale (GCS) at presentation was 3-8 in (33.70%) of patients, 9 -13 in (43.07%) of patients, and 14-15 in (23.22%) of patients. At the time of discharge, GCS was 14-15 in (40.07%), 9-13 in (25.09%) patients, 3-8 in (23.59%), and (11.23%) of patients died.

Table 3 illustrated the relationship between patient outcomes with age groups and gender. It was found that both age (p=0.003) and gender (p=0.002) were significantly associated with the outcome.

Table 1.Sociodemographic and Clinical Profile of Study Participants

Age (years)	**n (%)**
<20 years	51 (19.1%)
21-40 years	129 (48.3%)
41-60 years	62 (23.2%)
< 60 years	26 (9.7%)
Gender	
Male	197 (73.8%)
Female	75 (28.1%)
Etiology	
Road traffic accidents	157 (58.8%)
Fall from height	75 (28.09%)
Blunt trauma	34 (12.73%)
Diabetes Mellitus Type II	
Yes	62 (23.2%)
No	205 (76.7%)
Smoking	
Yes	108 (40.4%)
No	159 (59.5%)
Associated brain injuries	
Yes	165(61.79%)
No	102(38.20%)

Table 2: GCS Score and Outcome of Traumatic Subarachnoid Hemorrhage in Study Participants

Parameter	**n**
Initial GCS	
3-8	90 (33.70%)
9-13	115 (43.07%)
14-15	62(23.22%)
GCS score at the time of discharge	
14-15	107 (40.07%)
9-13	67 (25.09%)
3-8	63(23.59%)
Dead	30(11.23%)
Outcome	
Unfavorable	160 (59.93%)
Favorable	107 (40.07%)

Table 3. Distribution of Age Groups and Gender in Study Participants

Parameter	**Outcome**		**P-value**
	Unfavorable (160)	**Favorable (107)**	
Age (years)			
<20 years	30 (58.8%)	21 (41.2%)	0.003
21-40 years	77 (59.7%)	52 (40.3%)	
41-60 years	37 (59.7%)	25 (40.3%)	
< 60 years	16 (61.5%)	10 (38.5%)	
Gender			
Male (197)	115 (59.9%)	77 (40.1%)	0.002
Female (75)	45 (60%)	30 (40%)	
Diabetes Mellitus Type II			
Yes (62)	30 (48.4%)	32 (51.6%)	0.034
No 205)	130 (63.4%)	75 (36.6%)	
Smoking Status			
Yes (108)	57 (52.8%)	51 (47.2%)	0.049
No (159)	103 (64.8%)	56 (35.2%)	
Associated brain injuries			< .001
Yes (165)	100	34	
No (102)	60	73	

DISCUSSION

The patients who presented with tSAH hadthe worst outcome in countries like Pakistan when compared with the developed countries. The major reasons are the severity of the trauma, delayed presentation of the patients to the hospitals, lack of ATLS protocols in the pre-hospital stage,and lack of well-equippedneurointensive care units for the patients. The rates of mortality and morbidity due to the tSAH can significantly drop if

these barriers can be overcome by creating awareness and properly following the traffic rules. Traumatic head injury is a major cause of disability and death around the world.There were approximately 223,135 TBI-related hospitalizations in the United States in 2019[14]. Nearly 40% of all deaths from acute injury are traumatic head injuries in the US[15].

According to our study, traumatic SAH was more common among males than females. There were 197(73.8%) males and 75(28.1%) females included. This is similar to a study done in Canada,which reported that males are more likely to be suffering from traumatic brain injuries[16]. In addition, a study in Brazil supports this finding with 85.9% of traumatic brain trauma patients being men[17]. Skansaar et al. report similar results[18]. On the other hand, our study result was different from a study done by Cooper et al. that reported more females suffering from these injuries than males[19].

In this study majority of patients were aged between 21-48 years. There were 51(19.1%) patients <20 years, among which 30(58.8%) had unfavorable outcomes and 21(41.2%) had a favorable outcome, 129(48.3%) patients between 21-40 years, 62(23.2%) patients between 41-60 years and 26(9.7%) <60 years. It was found age is associated with outcomes and elderly patients havea worse outcome than young patients. Older adults with TBI have more complications, longer morbidity, and higher mortality than their younger counterparts due to differences in brain anatomy, heavier comorbidity burdens, and more frequent use of anticoagulants and anti-platelets[20,21].

Our findings suggest that road traffic accidents are the leading cause of traumatic SAH with 157 (58.8%) of such injuries occurring due to road traffic accidents. While 75(28.09%) patients came with a history of falls from height and 34(12.7%) came with blunt trauma.

In our study, men and women have a relatively equal chance of unfavorable outcomes in traumatic brain injuries. This result is different from a study by Levin et al. that reports women as being more susceptible to cognitive and somatic symptoms of Traumatic brain injuries[22].

The GCS scale was less than 9 for a majority of patients(70.9 %) in this study. This is similar to a study done in the UK which reported a GCS range of 6 to 7[23]. However, this finding is different from a study done in Europe which reports an average GCS of 10[18].

There were unfavorable outcomes in approximately 60% of patients with subarachnoid hemorrhage in our study. In contrast, unfavorable outcomes were less than 43% in three months in a study by Roquer et al[24]. Our study was different from a study by Steyerberg et al, which reported unfavorable outcomes in less than 50% of patients[25].

A reason for unfavorable outcomes being more prevalent in our hospital setting can be the failure to follow ATLS protocol during the transfer of patients from trauma site to hospital. Subsequently, patients often seek help very late, only when symptoms have aggravated. At times, hospitals are not fully equipped to provide neurosurgical facilities for cases of accidental trauma. Poor outcomes of Traumatic head trauma can be reduced by better-equipped hospital staff and training. Besides this, awareness campaigns about traffic safety and better traffic control will also help in this purpose.

Limitations of this study include a small sample size. This study was done in a single hospital. Patient outcomes may vary from other institutions due to different management styles. This may limit the generalizability of the findings. However, confounding was reduced in this study by stratification into different groups such as age, gender, and smoking status.

In hindsight, the most common cause of traumatic subarachnoid hemorrhage/ traumatic brain injury is road traffic accidents. Accessibility to fine neurosurgical facilities in both rural and urban areas is a challenge and poses a serious threat to patient outcomes. Consequently, strategies should be developed keeping in mind all the above-mentioned findings to reduce negative outcomes of traumatic subarachnoid hemorrhage/ traumatic brain injury.

CONCLUSION

The present study revealed the outcome of traumatic subarachnoid hemorrhage (tSAH) in the majority of the patients was unfavorable. Age, gender, diabetes mellitus, and smoking were significantly related to unfavorable outcomes in the study.

Authorship and contribution declaration: Each author of this article fulfilled following Criteria of Authorship:

1. Conception and design of or acquisition of data or analysis and interpretation of data.
2. Drafting the manuscript or revising it critically for important intellectual content.
3. Final approval of the version for publication.

All authors agree to be responsible for all aspects of their research work.

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