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ANALYSIS OF FACTORS CAUSING DELAY IN ARRIVAL OF HEAD INJURY PATIENTS AT TERTIARY CARE CENTRE: A PROSPECTIVE OBSERVATIONAL STUDY

Neurosurgery

Dr. Tusharkant Arora Senior resident, Vardhman Mahavir Medical College (V.M.M.C) & Safdarjung Hospital, New Delhi.

Dr Shankar KB* Professor and Head, Vardhman Mahavir Medical College (V.M.M.C) & Safdarjung Hospital, New Delhi. *Corresponding Author

Sharma KC Professor, Vardhman Mahavir Medical College (V.M.M.C) & Safdarjung Hospital, New Delhi.

Mankotiya S Deepankar Assistant Professor in the Department of Neurosurgery Vardhman Mahavir Medical College (V.M.M.C) & Safdarjung Hospital, New Delhi.

ABSTRACT

Background: India accounts for six percent of world's Road traffic accidents (RTA).[1] Nearly half of all traumatic brain injuries(TBI) patients are transported to a hospital without neurosurgical expertise which increases morbidity and mortality[2,3]. **Methods:** A total of 412 head injuries cases were included. A complete history, clinical examination, routine and special investigation, method of transportation, alcohol or substance abuse and outcome were noted.

Results: Most common cause of head injuries was RTA (76%) followed by fall (15.78%) and assault (7.52%). After performing univariate logistic regression, first hospital, time for CT, mode of injury, gender, education level, injury place, referral, alcohol/drug, handicap and high energy injury were the significant factors responsible for late admission.

Conclusions: The common reason due to the delay in arriving the hospital being lack of neurosurgeons, computerized tomography(CT) scan head followed by lack of beds or ICU facilities and high cost in private hospitals.

KEYWORDS

Road Traffic Accidents, Traumatic Brain Injuries

INTRODUCTION

At least 10 million individuals worldwide are hospitalized or succumb to death as a result of traumatic brain injury (TBI) annually. [4] Around 85% of all global road deaths, 90% of the disability-adjusted life years lost due to crashes occur in low-income and middle-income countries. [5]

The RTA rate of 35 per 1000 vehicles in India is one of the highest in the world and so is the associated RTA fatality rate of 25.3 per 10,000 vehicles.[1] RTAs account for 16.8 deaths per 100,000 population and around 2 million people in India are disabled due to RTAs.[6] Estimated cost of RTAs in India is three percent of the GDP, which is much higher than that in high-income countries. [7]

The prognosis of an injured patient depends on how early he/she receives specialty care. The American College of Surgeons Committee on Trauma and Centre for Disease and Prevention recommend field triage, direct transport of patients with TBI to hospitals with availability of neurosurgical care including CT scanning, intracranial monitoring and treatment. [8,9,10] Despite this nearly half of all TBI patients are transported to a hospital without neurosurgical expertise which leads to increase mortality [2,3].

Thus knowing the astounding magnitude of the problem as well as paucity of studies in the Indian scenario and keeping in mind the developing economy, this study was done in an attempt to garner information for ensuring steps and policies to prevent delay in arrival of traumatic brain injury patients at tertiary care centre.

MATERIALS AND METHODS

This study was conducted in Neurosurgery department at VMMC & Safdarjung Hospital, New Delhi. It was prospective observational cohort Study and a total of 412 consecutive head injuries cases were selected which met the inclusion and exclusion criteria between September 2016 to June 2018.

Inclusion criteria: 1. Patients with head injury fulfilling the criteria to be classified as traumatic brain injury i.e. loss of consciousness and / or PTA/ seizures/ vomiting/ ENT bleed/ on CT scan proven. 2.Patients of acute head injury within one week of injury. 3.Patients giving consent to be included in study.

Exclusion criteria: Patients who are unable to furnish the required history either by relatives or bystanders or police. 2. Patients with lacerations, avulsions, concussions of face, scalp, eye, ear, forehead etc. without the aforementioned criteria. 3.Patients with neoplasms, birth trauma, cerebral anoxia, inflammatory infarction or toxic encephalopathy. 4.Patients with intracranial hemorrhage or stroke without associated trauma.5. Children under 10 years of age who are not accompanied by guardians giving the history.

After taking consent, a complete history, clinical examination, routine and special investigation, method of transportation, objective evidence of alcohol or substance abuse and outcome at end were noted. The study was approved by the Institutional ethical committee. All information was kept confidential.

STATISTICAL ANALYSIS

The data was analysis using Statistical Package for Social Sciences (SPSS) version 21.0.

Quantitative variables were compared using Independent T test/Mann-Whitney Test (when the data sets were not normally distributed) between the two groups. Qualitative variables were correlated using Chi-Square test/Fisher's exact test. Univariate and multivariate logistic regression was used to assess the significant factors that leads to late admission. A p value of <0.05 was considered statistically significant.

RESULTS AND OBSERVATIONS

A total 412 cases were grouped into as early arrival to time $\leq$1.5 hours vs. >1.5hours from injury i.e late arrival to Safdarjung hospital. Males outnumber females compromising 78% of victims. The maximum number of victims(34.71%) were in the age group between 21-29 years followed by 31-40 year age group (18.45%) with least 61-70 years (6.07%).

The mean age of patients with TBI versus the mode of injury was statistically significant ($p=0.0001$). Hence the victims of RTA were significantly younger with mean age 35.87 years compared to victims of fall which was more in elderly with mean age 47.92years. There is no significant correlation between age and severity of head injury by Glasgow coma scale (GCS) ($p=0.1465$).

In modes of injury, the most common culprit was RTA about 76% followed by fall and assault 15.78%, 7.52 % respectively. The mode of

injury had a significant correlation with severity of head injury as shown by GCS. RTA victims had the most severe TBI followed by assault with a 'p' value < 0.0001. RTA has the maximum percentage of patients suffering from severe TBI 45.45% and mild TBI in only 30%.

The percentage of deaths amongst victims of RTA was pretty high (88.89%).The contribution of fall was low (11.11%). There is a significant correlation between gender and mode of injury (p < 0.000). 80% of males had TBI due to RTA and 17% due to falls. Amongst females only 62.5% TBI was due to RTA, 25% due to fall and 12.5% as a result of assault.

Most patients (59.2%) came to this hospital residing in Delhi rest were from oustskirts (40.7%) (NCR). The distribution according to GCS grading of head injury i.e. 41.86% mild, 23.26% moderate and 34.88% were severe.

The employed (59.47%) compromised the biggest number of victims on the road hence unfortunately the regular pliers, followed by unemployed (34.71%), industrial worker (3.64%) and retired(2.18%). There is a definitive correlation between severity of TBI or GCS and patient occupation. The retirees and employed had a poorer GCS with a 'p' value < 0.0001.

Education wise the just literate (48.84%) were the maximum cases followed by 12th pass (27.91%) whereas the graduates and above and illiterate both were equal (11.63%). There is a statistically significant correlation of GCS to education (p=0.0001) the severity being worst with the best educated.

There is a statistically significant correlation between education and mode of injury (p <0.0001). Though RTA predominates in all age groups but educated group being more affected by RTA and less by falls or assault which is more a bane of educationally and socially backward.

Previous offenders were only 6.06%. Amongst the TBI patients secondary to falls about 25% had history of previous falls. The mean age of patients with TBI versus the previous fall was statistically significant (p=0.0001) and elderly with mean age > 64years being the likely victims. The majority of TBI patients (93%) were not impaired by pre-existing comorbidities. The GCS is lesser in patients with no comorbidities though not statistically significant (p =0.494).

About 23.26% TBI patients were inebriated or under the influence of alcohol/drugs. The mean age of patients with TBI under influence of alcohol was ≤36 years though not statistically significant (p=0.858). The mean GCS in patients under the influence of alcohol/drugs was significantly lower i.e. mean 7.6 compared to 10.6 in others (p < 0.0001). More than 28% male being the only culprits in this study. There was a statistically significant correlation between gender and alcohol influence (p < 0.0001). Only 4.65% had previous handicap which might have contributed to the TBI.

Fatality percentage in RTA showed motor bike riders and pedestrians each constitute 37.5% of deaths. Rest 12.50% each were car occupants and cyclits. Vulnerable road users suffer in total 87.5% of fatalities. Loss of consciousness (LOC) was asymptom in above 93% of TBI victims followed by seizures (14%). Vomiting was symptom amongst 37.21% whereas 39.53% presented with ear and nose bleed as one or only symptom.

NCCT finding showed contusion in 60.47%, Extradural hemorrhage (EDH) in 27.91%, subdural hematoma (SDH) in 25.58%, fracture of skull bones in 44.19%, sub arachnoid hemorrhage(SAH) in 34.88% and diffuse axonal injury (DAI) in 13.95% of patients either alone or in combination with other injuries. The majority of patients had one type of injury or two on CT scan i.e. 32.56% each. The severity of head injury significantly correlates with number of injuries evident on NCCT head, worst GCS for maximum injuries (p=0.001).

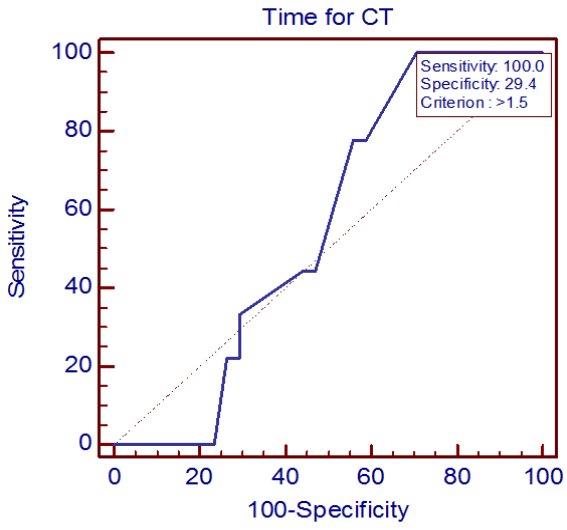
A substantial number i.e. 39.53% underwent surgery for TBI. The majority (79 %) were discharged from our hospital alive with varying degrees of morbidity. The primary reason for patient referral to our tertiary care centre was the lack of neurosurgeons (76.74%) at the nearest or first hospital taken after the accident, 11.63% came due to lack of beds, 4.65% had to come to this government hospital due to financial constraints and 7% came for better treatment or second opinion or for ICU/ Ventilator facilities.

There is a definitive correlation between severity of TBI or GCS and patients who obeyed the traffic laws. The ones violating traffic regulations had a poorer GCS (p < 0.0001). Also those who obeyed laws in previous RTA is significantly less then those that did not obey laws in previous RTA (p=0.0025). There was a statistically significant correlation between occupation and obeying laws (p<0.0001). Interestingly, the unemployed and economically backward tried harder to obey the law (66.67%) whereas the employed individuals (60.87%), industrial workers (100%) broke the law. There was a statistically significant correlation between education and obeying laws (p<0.0001). Interestingly, the illiterate and just literate more obeyed the law (66.67% and 56.25%) whereas the well educated i.e 12th passed and graduate (60% and 60%) more often broke the law. A significant cases (mean value 15) fell victim of stray animals on the road.

The mean time to reach final tertiary care centre is significantly related to referral (p < 0.0001). Hence the delay in presentation to final tertiary care hospital was maximum (average 16.4 hours) was due to non availability of beds followed by the lack of neurosurgeons (mean 7.34 hours).

The time for CT or reaching the final tertiary centre was evaluated against fatality using a ROC curve and a cutoff of 1.5 hours was established (graph 1). Thus in this study there was significant relation to fatality if the delay in reaching final tertiary centre was greater than 1.5 hours (p <0.0001).

GRAPH 1



There was correlation between severity of head injury and death versus discharge. Most mild TBI were discharged whereas majority death occurred in severe TBI group (77.78%). Among late arrival to our hospital group, high energy trauma was significantly more associated 67.72%.

The reason for referral is significantly correlated to the final management of patient i.e. surgery or conservative. The highest number requiring surgery (168) 63.06% did come due to lack of neurosurgeons in peripheral hospitals and also a significant number could not afford surgery elsewhere.

TABLE 1

Sample size n=412	Mean ± SD	Median	Min-Max	Inter quartile Range
AGE (years)	38.6 ± 17.06	34	14-83	25 – 47
First Hospital(hours)	1.56 ± 3.36	1	0.15-24	0.500 - 1.500
GCS	10.37 ± 4.49	11	3-15	6 – 15

Time for CT(hours)	7.3 ± 15.64	3	1-96	2 - 5.500
Time to reach SJH(hours)	5.91 ± 13.48	2.5	1-96	1.500 – 5

TABLE 2:Univariate logistic regression for delay admission

	Base line value	Std. of Error(S.E)	p value	Odds ratio	95% C.I.for Odds ratio	
					Lower	Upper
AGE	0.002	0.006	0.705	1.002	0.991	1.014
First Hospital	1.422	0.230	**<0.0001**	4.144	2.640	6.506
Time for CT	1.138	0.119	**<0.0001**	3.120	2.472	3.938
MODE						
RTA				1		
Fall	0.878	0.309	**0.005**	2.405	1.311	4.411
Assault	1.992	0.618	**0.001**	7.330	2.183	24.609
SEX						
Male						
Female	-0.562	0.239	**0.019**	0.570	0.357	0.911
OCCUPATION						
Unemployed				1		
Employed	0.132	0.216	0.540	1.141	0.747	1.744
Industrial/construction worker	1.461	0.779	0.061	4.308	0.937	19.814
Retired	-	-	-	-	-	-
EDUCATION						
Illiterate				1		
Literate	0.065	0.360	0.857	1.067	0.527	2.159
12th pass	0.002	0.378	0.996	1.002	0.477	2.102
Graduate and above	-2.856	0.574	**<.0001**	0.057	0.019	0.177
Injury place						
Delhi				1.000		
Outstation(NCR)	0.574	0.206	**0.005**	1.776	1.185	2.660
GCS						
Mild				1		
Moderate	-0.200	0.229	0.383	0.819	0.522	1.283
Severe	0.230	0.271	0.396	1.259	0.740	2.141
Referred	2.188	0.503	**<0.0001**	8.919	3.327	23.911
Comorbidities	0.186	0.387	0.631	1.204	0.564	2.571
Alcohol /drug	0.604	0.261	**0.021**	1.830	1.097	3.052
Handicap	1.638	0.623	**0.009**	5.144	1.518	17.428
Severity TBI						
Mild				1		
Moderate	0.230	0.271	0.396	1.259	0.740	2.141
Severe	-0.200	0.229	0.383	0.819	0.522	1.283
High energy injury	-0.423	0.212	**0.046**	0.655	0.432	0.993
Pre hospital physician consultation	-0.247	0.235	0.294	0.781	0.493	1.239

After performing univariate logistic regression (Table 2), first hospital, time for CT, mode of injury, gender, education level, injury place, referral, alcohol/drug, handicap and high energy injury were the significant factors responsible for late admission. Odds ratio interpretation showed that the increase in time in first hospital stay by 1 hour, risk of late admission in tertiary centre increased by 31.44%. similarly if mode of injury was fall and assault, then risk of late admission significantly increased with odds ratio of 2.405 and 7.330 respectively as compared to RTA.

TABLE 3 :Multivariate logistic regression for delay admission

	Basal line value	Std of Error	P value	Odds ratio	95% C.I.for Odds ratio	
					Lower	Upper
First Hospital	3.548	0.583	**<0.0001**	34.741	11.087	108.862
Time for CT	0.838	0.148	**<0.0001**	2.311	1.730	3.087
MODE						
RTA				1		
Fall	0.517	0.758	0.495	1.676	0.380	7.400
Assault	-6.874	1.630	**<0.0001**	0.001	0.000	0.025
SEX						
Male				1.000		
Female	-0.809	0.646	0.210	0.445	0.126	1.578
EDUCATION						
Illiterate				1		
Literate	1.164	0.699	0.096	3.204	0.813	12.619
12th pass	-0.908	0.618	0.142	0.403	0.120	1.354
Graduate and above	-9.249	30.405	0.761	0.0001	0.000	7.31+**21**
Injury place						
Delhi				1.000		
Outstation	-1.267	0.608	**0.037**	0.282	0.086	0.927
Refrerred	4.445	0.964	**<0.0001**	85.236	12.885	563.830
Alcohol/drug	-0.286	0.612	0.641	0.751	0.226	2.494
Handicap	3.255	1.251	**0.009**	25.914	2.233	300.696
High energy injury	-0.172	0.586	0.769	0.842	0.267	2.655

After adjusting for confounding factors, on performing multivariate logistic regression(Table 3), first hospital, time for CT, mode of injury, injury place, referral, handicap were the significant factors responsible for late admission.

DISCUSSION

This study was carried in the Neurosurgery Department of Safdarjung Hospital in Delhi, between September 2016 to June 2018. A total of 412 patients who fulfilled the criteria were consecutively enrolled in the study after informed consent.

TBI is a significant public health problem worldwide and is predicted to surpass many diseases as a major cause of death and disability by the year 2020.[11] The WHO predicts that RTI would become the sixth commonest cause of death by the year 2020 and the fifth by 2030. [11,5]

In this study the commonest mode of injury causing TBI was RTA compromising the lion share i.e.76.74% followed by falls 18.6% and lastly assault a meagre 4.65% which corresponds to other studies and alsoto the global scenario [11,12].

Among cities, Delhi has the highest fatality with the alarming growth rate of human (39%) and vehicular population (15%) is far higher than the national average i.e. 23% and 2.5/1000 respectively. [13]

We found that the maximum number i.e. 286(55.43%) were in the 20-49 year age group followed by 40-59 year group and least in the >79 year age group. Hence, the most affected were the young and productive age group. This correlates to other studies in the global and Indian literature. [14-16]

In our study, men were the predominant victims of RTI comprising more than 76% i.e. almost 4:1 ratio to females. The Sathyasekaran, [17] Arvind et al[18] and Marvin Hsaio et al [19]also had predominance of male victims in their studies. This has been explained as a result of limited exposure of women to out-door activities and limited access to vehicles. [20,21]

According to severity of TBI (based on GCS) the maximum fell in the mild TBI (41.9%) but a sizeable number suffered from severe TBI (34.9%) hence high morbidity and mortality which correlates to other studies. [22] Bharati et al reported that based on the GCS grading, 32% had severe, 25% moderate and 42% minor brain injuries at the time of admission. [22]

The vast majority were employed along with industrial workers. Hence, the victims were the population who are gainfully employed and are daily commuters. Thus, explaining the social and economic burden of TBI consistent with other studies. [23-25] As a result, nearly 200,000 families annually are newly bereaved or have family members disabled for life. [5] In our study, the head injury was most severe in retired individuals (elderly) and not much difference amongst the employed and unemployed.

Most TBI victims (48.84%) were in the group compromising up to 10th pass or just literate and the smallest group being of the graduates and above (11.6%) which correlates with other Indian studies.[21,23] A substantial cases (26%) were under the influence of alcohol were victims of TBI which included car drivers, motor cyclists and even pedestrians. This is probably an underestimation as alcohol smell may not be evident, deliberate hiding of the facts and that the other party causing the accident but unavailable may have consumed alcohol. This is higher than other Indian studies which showed 15-25% of RTIs were under influence of alcohol. [26-29]

The inebriated TBI victims of RTA were all male (28%). Also, they showed an average poorer GCS (7.6) than the non alcohol/drug intoxicated victims. The mean age was younger of TBI victims under influence of alcohol i.e. 36 years consistent with other studies. [26]

Only 4.65% had previous handicap which might have contributed to the TBI. In a study by Tiwari and Ganveer [30] observed that a large proportion of drivers with non-fatal RTI had visual (44%) and/or hearing impairment (10%). The GCS is lesser in patients with no comorbidities though not statistically significant. However, patients with comorbid conditions were usually late to reach hospital.

A quarter of the patients of fall had a previous history of fall and in children its due to negligence and lack of safe playing spaces. In the elderly it's due to the declining health in form of visual deterioration, poor balance etc. [31,32] Nearly two thirds of the falls occur at home.[7,22] This injury mode is significantly associated with late arrival of patients at SJH

Violence related TBI were 4.65% of the total in this study. The greater proportion were females. All of them were discharged and there were no fatalities. The highest number of deaths (82%) occurred in the age group of 15–44 years, with a male to female ratio of 4:1. Studies on TBI have reported that nearly 10–15% of hospital admissions and 5% of mortality are related to violence. [26,33]

A significant number of patients (44%) had TBI were due to breaking the traffic rules. Nearly 9% were victims of TBI due to animal infestation on the road which is a menace of developing countries and the solution lies with the government more than the individual. These rules being breaking the red light, over speeding, non-usage of helmet, lack of seatbelt, walking as well as drinking and driving were comparable to other studies. [22,26,33]

In a review of the economic impact of RTIs highlighted that the estimated economic loss due to RTI was to the tune of nearly Rs 550,000 million every year or nearly 3% of India's GDP for the year 2000[34] . Pedestrians compromised 39.39% of all RTA victims in our study like literature statistics in Northern India. [27]The fatality percentage was 37.5% which is close to 29% by Singh H et al [35] to 92% in a study by Singh and Misra. [36]

Most common presenting symptom of head injury patients was LOC (93.07%) then ENT bleeding (39.5%) followed by vomiting (37.2%) then by headache, dizziness, irritability, anxiety, blurred vision, insomnia, easy fatigability, seizures (11.95%).

Intracranial haemrrohage being the most common CT finding out of which haemorrhagic contusion or haematoma (60%) was seen more often which is unlike other studies where SDH forms the majority.[9,15,37] The next most common being skull fracture (44%) with linear undisplaced type being encountered more and DAI seen in 13%. Least common finding or lack thereof was intraventricular haemorrhage but never in isolation. The CT findings were in isolation or with one other in 32.56% and 4 or more together in only 4.65%. These findings correlate with other studies. [9,15,37]

This study was conducted in Delhi at a tertiary care hospital hence, majority of patients were referred from some other center within the city or from outstation. The primary reason for patient referral to our tertiary care center was the lack of neurosurgeons at the nearest or first hospital taken to after the accident like the study by Fitzgerald et al. [39] 11.63% came due to lack of beds and 4.65% had to come to this government due to financial constraints as in other studies.[39] Other reasons were to get better treatment or second opinion or for ICU/ Ventilator facilities (7%). About 42.4%(168) patients referred due to lack of neurosurgeons required surgery eventually whereas 50% due to non-affordability and 40% of those lacking beds in other hospital needed surgery.

The patients reached the final hospital or could get CT head done with neurosurgery referral anywhere between 1-96 hours from time of injury as seen in other studies in literature. [23] In this study, there was significant correlation to fatality (100%) if the delay in reaching final tertiary center was greater than 1.5 hours. Such unfavorable results were documented in other studies.[23]

CONCLUSION

Traumatic brain injury is a significant cause of mortality and morbidity in globally and in India, the primary reason being road traffic accidents. The victims were predominantly male and in the productive age group hence the stupendous social and economic burden. The most common reason being lack of neurosurgeons and CT scan (>1.5 hours) followed by lack of beds or ICU facilities and high cost in private hospitals have contributed to the morbidity and mortality. Male gender, old age, low energy trauma like fall at home, place of injury outside Delhi, alcohol/drugs intoxication, poor GCS, absence of pre hospital physician involvement, no major extra cranial injuries and illiteracy were most common factors contributing to late arrival of patients at tertiary care centre.

Theses data suggest that educational efforts at primary level, field triaging, early access to CT scan, direct transport of severe TBI patients to tertiary care centre may improve morbidity and mortality.

LIMITATIONS OF THE STUDY:

We could not collect information about important indicators such as velocity of impact, type of road where accident occurred, and post-discharge outcome of patients. it is plausible that only a certain proportion of all traumatic brain injuries will reach the hospital and many of those with severe injuries may have died in the pre-hospital setting, and many with mild injuries may not have sought clinical care. Referral bias is also possible.

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