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Original Article

Prehospital Care in Traumatic Brain Injury: Factors Affecting Patient's Outcome

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Abstract

Background: Traumatic brain injury (TBI) is the leading cause of deaths worldwide. The morbidity and mortality due to TBI are related to both primary as well as secondary insults. The patients who survive from the primary insults, some may still have long-term disabilities. Most of these outcomes are related to the high incidence of prehospital secondary brain insults. Knowledge of these variables and timely management of the disease at the prehospital level can significantly improve the outcome and decrease the mortality. **Aims:** The present study is aimed to evaluate the current status of prehospital care, prehospital factors, epidemiological characteristics, and outcome of TBI patients at a Level 1 trauma center. **Material and Methods:** It is a prospective observational study of 830 cases of TBI, done from November 15, 2015, to March 15, 2016, in the Department of Neurosurgery, Institute of Traumatology, SMS Medical College, Jaipur, Rajasthan, India. **Results:** Analysis of data revealed that the incidence of TBI in males is four times higher than females. Most patients are in the age group of 21–30 years (30.24%) followed by 31–40 years (18.55%). Road traffic injury (69.52%) is the most common mode of injury in the age group of 21–30 years followed by injury due to fall (22.77%) which mostly affects the age group of 0–10 years (72.64%) and 61–70 years (38.6%). Analysis of different factors revealed that age is significantly correlated with the outcome having $P = 0.016$. Glasgow Coma Scale, saturation of peripheral oxygen, systolic blood pressure at admission are also significantly correlated with the outcome having $P < 0.001$, $P < 0.001$, and $P < 0.001$, respectively. **Conclusion:** It is evident from the study that the factors which affect the outcome of a TBI are influenced by prehospital care, and thus prehospital management of the TBIs can definitely improve the outcomes.

Keywords: *Glasgow Outcome Score, prehospital care, traumatic brain injury*

Introduction

Traumatic brain injury (TBI) is a major burden on the health care system affecting approximately 10 million people yearly across the world and is also the leading cause of death and disability despite the concentrated efforts made toward its prevention and care over the last few decades.[1-4] Incidences of TBI is rising throughout the world due to increased use of vehicles in the developing countries[5,6] and increased life expectancy in developed countries.[7]

In India, TBI is mostly caused by road traffic injuries (60%) followed by falls (20–25%) and violence.[8] In 2005, road traffic injuries resulted in estimated 110,000 deaths, 2.5 million hospitalizations, 8–9 million minor injuries, and economic losses to the tune of 3% of the gross domestic product in India.[9]

The morbidity and mortality of TBIs are related to both primary as well as secondary insults. Moreover, some of the patients who survive from the primary insult may still have long-term disabilities. Most of these outcomes are related to the presence of high incidence of prehospital secondary brain insults. Therefore, knowledge of these variables and timely management of the disease at the prehospital level can significantly improve the outcome and decrease the mortality. These factors have led to the questions on the prehospital determinants of the outcome in TBIs.

It has also been seen that there have been differences in the outcome between developed and developing countries. One of the studies comparing the outcomes from head injuries came up with an interesting observation. It reported that when TBIs in the USA were compared with those in India, there was not much difference

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between severe TBIs and most mild TBIs. However, it was noted that in moderate TBIs the difference in outcome was significant.[10] This was attributed to the near absence of prehospital care and neurosurgical facilities available at the medical centers in India.

Evidence-based guidelines for the prehospital management of TBI were developed by the Brain Trauma Foundation in 1995, and revised in 2008.[11] These guidelines could provide the standardized protocols for the management of patients with TBIs. However, these guidelines are not followed in most of the developing countries like India for many reasons. The present study is aimed to evaluate the current status of the prehospital care, prehospital factors, epidemiological characteristics, and the outcome of TBI patients at a Level 1 trauma center.

Materials and Methods

The study was conducted in the Department of Neurosurgery, Institute of Traumatology, SMS Medical College, Jaipur, Rajasthan, India between November 15, 2015, and March 15, 2016. A total of 830 patients were enrolled in the study after ethical clearance from the Ethical Committee of SMS Medical College, Jaipur, Rajasthan, India. All patients were managed as per head injury protocol of the institute. Data of individual patients were collected from admission to discharge/death as per performa which includes age, sex, mode of injury, mode of transportation, duration in reaching hospital, distance from hospital, Glasgow Coma Scale (GCS), systolic blood pressure (SBP), saturation of peripheral oxygen (SpO_2) at admission and GCS, Glasgow Outcome Score at discharge.

This is a prospective observational study. Statistical analysis was done using Chi-square test (MEDCALC version 12.2.1.0).

Results

A total of 830 patients were enrolled in this study. Most patients affected were in the age group of 21–30 years (30.24%) followed by 31–40 years (18.55%). About 80% were male, and 20% were female. Road traffic injury (69.52%) was seen as the most common mode of injury in the age group 21–30 years followed by injury due to fall (22.77%) which mostly affected the age group of 0–10 years (72.64%) and 61–70 years (38.6%) [Table 1]. Among the road traffic injuries, two wheelers were involved in 79.54% cases [Table 2]. In road traffic injuries, 86.48% of patients were occupants of the vehicle while only 13.61% were pedestrians. Safety devices such as helmets, seat belts, and child restraint were used in 14.43% patients only. Most of the patients were attended by the members of public as first responder (83.13%) [Table 3] and transported to definitive treatment centers in ambulances (65.4%) [Table 4], but none of them received any care in the form of vitals monitoring, intravenous (IV) fluid administration and airway protection at the site of trauma and during transportation. Time duration to reach definitive treatment centers was <1 h in 34.58% of patients and between 1 and 4 h in 56.02% of patients. Mild (GCS 13–15), moderate (GCS 9–12) and severe (GCS 3) head injuries comprised of 46.14%, 28.19%, and 25.66%, respectively.

Analysis of the different factors revealed that age was significantly correlated with outcome having $P = 0.016$ [Table 5]. GCS, SpO_2, SBP at admission were also significantly correlated with outcome having $P < 0.001$, $P < 0.001$, and $P < 0.001$, respectively [Tables 6-8].

Discussion

Incidences, as well as the severity of TBI, are on the rise throughout the globe due to rapid industrialization in the developing countries[5,6] and increased life expectancy in developed countries.[7] Different studies have shown that early resuscitation and prehospital care provide better outcomes in TBIs. Transportation of severely injured patients from the site of injury to Level 1 trauma centers is directly associated with the reduction in mortality and morbidity. Resuscitation of TBI patients at the accident sites is crucial in minimizing morbidity and mortality. This can be achieved through prehospital care which is poorly developed in India.[12] To best of our knowledge, this study is the first of its kind from India.

Table 1: Incidence of mode of injury in different age groups

Age	Mode of injury, *n* (%)					Total, *n* (%)
	Traffic accident	Fall	Violence	Sport	Other	
0-10	28 (26.42)	77 (72.64)	0 (0.00)	0 (0.00)	1 (0.94)	106 (12.77)
11-20	93 (68.38)	28 (20.59)	5 (3.68)	2 (1.47)	8 (5.88)	136 (16.39)
21-30	210 (83.67)	22 (8.76)	13 (5.18)	1 (0.40)	5 (1.99)	251 (30.24)
31-40	125 (81.17)	18 (11.69)	7 (4.55)	0 (0.00)	4 (2.60)	154 (18.55)
41-50	65 (73.03)	16 (17.98)	5 (5.62)	0 (0.00)	3 (3.37)	89 (10.72)
51-60	40 (71.43)	10 (17.86)	6 (10.71)	0 (0.00)	0 (0.00)	56 (6.75)
61-70	12 (46.15)	10 (38.46)	1 (3.85)	0 (0.00)	3 (11.54)	26 (3.13)
71-80	2 (20.00)	8 (80.00)	0 (0.00)	0 (0.00)	0 (0.00)	10 (1.20)
>80	2 (100.0)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	2 (0.24)
Total	577 (69.52)	189 (22.77)	37 (4.46)	3 (0.36)	24 (2.89)	830 (100.0)

In this study, most patients were in the age group 21–30 years and 80% of those were male. Road traffic injuries were the most common mode of injury followed by fall. In road traffic injuries, two wheeler accidents were most common. Most of the victims were occupants and safety devices were used only by 14.43% of patients. Members of the public were the first responders at the trauma site in 83.13% cases. Although 65.42% of patients were transported to the hospital in ambulances, none of them received any care in the form of vitals monitoring, IV fluid administration and airway protection at the site of trauma and during transportation. Time duration to reach hospital was 1–4 h in 56.02% cases and <1 h in 34.58% cases. Clinical factors which influence the outcome of TBI are GCS, SpO_2, and SBP at admission and they are mostly influenced by the prehospital care.

Patients with TBI are likely to worsen rapidly from two adverse factors in the prehospital phase, namely, hypotension and hypoxia. The first responders have to recognize and assess TBI and make an important decision about the choice of hospital destination.[13]

The majority of patients in India are brought to the emergency department by relatives or bystanders in private vehicles, and prehospital emergency medical services remain under-organized. Field triage often relies on bystanders who transport injured victims to the nearest clinics, which are often unable to provide appropriate treatment.[14] Major urban areas also have a loosely networked trauma system, untrained emergency medical services personnel and unequipped ambulances.[14] Our observation of members of public as the first responder supports the notion that prehospital care in India requires much improvement.

Table 2: Vehicle involved in road traffic injuries

Vehicle	Total, *n* (%)
Motorcycle/moped	459 (79.54)
Motorcar	64 (11.09)
Truck/bus	44 (7.62)
Bicycle	10 (1.73)
Total	577 (100.00)

Table 3: First responder at the site of injury

First responder	Total, *n* (%)
Member of public	690 (83.13)
Ambulance officer or paramedic	77 (9.28)
Local medical officer	2 (0.24)
Medical retrieval team	0 (0)
Not known	61 (7.23)
Total	830 (100.00)

Table 4: Mode of transportation

Mode of transportation	Total, *n* (%)
Ambulance	543 (65.42)
Private vehicle	275 (33.13)
Others	12 (1.45)
Total	830 (100.00)

Table 5: Correlation of age with outcome (Glasgow Outcome Score) in traumatic brain injury

Age	GOS, *n* (%)					Total
	1	2	3	4	5	
0-10	4 (3.77)	3 (2.83)	12 (11.32)	2 (1.89)	85 (80.19)	106 (12.77)
11-20	10 (7.35)	9 (6.62)	9 (6.62)	4 (2.94)	104 (76.47)	136 (16.39)
21-30	30 (11.95)	14 (5.58)	34 (13.55)	16 (6.37)	157 (62.55)	251 (30.24)
31-40	13 (8.44)	9 (5.84)	19 (12.34)	11 (7.14)	102 (66.23)	154 (18.55)
41-50	11 (12.36)	7 (7.87)	9 (10.11)	2 (2.25)	60 (67.42)	89 (10.72)
51-60	9 (16.07)	6 (10.71)	7 (12.50)	2 (3.57)	32 (57.14)	56 (6.75)
61-70	3 (11.54)	3 (11.54)	1 (3.85)	3 (11.54)	16 (61.54)	26 (3.13)
71-80	4 (40.00)	1 (10.00)	2 (20.00)	0 (0.00)	3 (30.00)	10 (1.20)
>80	1 (50.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (50.00)	2 (0.24)
Total	85 (10.24)	52 (6.27)	93 (11.20)	40 (4.82)	560 (67.47)	830 (100.0)

χ^2=51.459 with 32 df; *P*=0.016. GOS – Glasgow Outcome Score; df – Degrees of freedom

Table 6: Correlation of Glasgow Coma Scale at admission with outcome (Glasgow Outcome Score) in traumatic brain injury

GCS at admission	GOS, *n* (%)					Total
	1	2	3	4	5	
Mild	3 (0.78)	0 (0.00)	1 (0.26)	2 (0.52)	377 (98.43)	383 (46.14)
Moderate	11 (4.70)	15 (6.41)	40 (17.09)	27 (11.54)	141 (60.26)	234 (28.19)
Severe	71 (33.33)	37 (17.37)	52 (24.41)	11 (5.16)	42 (19.72)	213 (25.66)
Total	85 (10.24)	52 (6.27)	93 (11.20)	40 (4.82)	560 (67.47)	830 (100.00)

χ^2=463.521 with 8 df; *P*<0.001. GCS – Glasgow Coma Scale; GOS – Glasgow Outcome Score; df – Degrees of freedom

Table 7: Correlation of saturation of peripheral oxygen at admission with outcome (Glasgow Outcome Score) in traumatic brain injury

SpO_2 >90	GOS, *n* (%)					Total
	1	2	3	4	5	
Yes	20 (2.95)	31 (4.57)	62 (9.14)	35 (5.16)	530 (78.17)	678 (81.69)
No	65 (42.76)	21 (13.82)	31 (20.39)	5 (3.29)	30 (19.74)	152 (18.31)
Total	85 (10.24)	52 (6.27)	93 (11.20)	40 (4.82)	560 (67.47)	830 (100.0)

χ^2=286.881 with 4 df; *P*<0.001. GOS – Glasgow Outcome Score; df – Degrees of freedom; SpO_2 – Saturation of peripheral oxygen

Table 8: Correlation of systolic blood pressure at admission with outcome (Glasgow Outcome Score) in traumatic brain injury

SBP <90 mmHg	GOS, *n* (%)					Total
	1	2	3	4	5	
No	60 (7.69)	45 (5.77)	85 (10.90)	39 (5.00)	551 (70.64)	780 (93.98)
Yes	25 (50.00)	7 (14.00)	8 (16.00)	1 (2.00)	9 (18.00)	50 (6.02)
Total	85 (10.24)	52 (6.27)	93 (11.20)	40 (4.82)	560 (67.47)	830 (100.0)

χ^2=108.476 with 4 df; *P*<0.001, SBP – Systolic blood pressure; df – Degrees of freedom; GOS – Glasgow Outcome Score

The outcomes of TBIs can be improved by attending the priorities of reaching the victims in the shortest possible time, evacuating them to the hospital, taking care of airway, oxygenation, and maintaining total perfusion pressure through judicious IV infusions. Depending on the skills of emergency medical technician/paramedic, use of laryngeal mask airway/endotracheal tube can be considered.[12]

Conclusion

Prehospital care is a vital part of the management of TBIs and determinants which have bearing on the outcomes are GCS, SBP, and SpO_2. Apart from prehospital care, road safety laws should be implemented strictly, and public awareness programs should be conducted regarding the road safety methods and laws. Infrastructure in the form of dedicated trauma centers, well-equipped ambulances with trained trauma staff, should be developed. All these things require strong government policies to strengthen the system.

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Conflicts of interest

There are no conflicts of interest.

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