ISSN 1220-8841 (Print)
ISSN 2344-4959 (Online)

ROMANIAN
NEUROSURGERY

Vol. XXXIV | No. 4 December 2020

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DOI: 10.33962/roneuro-2020-088

Romanian Neurosurgery (2020) XXXIV (4): pp. 518-523
DOI: 10.33962/roneuro-2020-088
www.journals.lapub.co.uk/index.php/roneurosurgery

Pre-hospital care: demography, current profile and future trends. Improving the health of traumatic brain injury patients

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Keywords
pre-hospital care, hypoxia, hypotension, ambulance, intubation, traumatic brain injury

ABSTRACT

Introduction. Traumatic brain injury (TBI) is a major public health problem throughout the world. It is one of the leading causes of mortality and disability as a consequence results in a great financial burden on societies. Damage to the brain following trauma does not occur only at the moment of injury but also develops over a period of hours to days with the further secondary insult of the brain.

Methods. This was a prospective study done between April 2017 to March 2019. A total of 2134 patients were enrolled for this study with a collection of data in a formatted proforma. All the patients of trauma with clinical or radiological evidence of head injury coming to the trauma centre were included.

Results. In our study patient, mortality was 6.79% in patients receiving pre-hospital care compared to 12.03% in patients not receiving adequate pre-hospital care. 29.42% were in the age group of 21–30 years. RTA (overall 64.45%) was the most common mode of injury in the age group 21–30 years with 81.36% cases. Mortality in first emergency care provider by ambulance paramedics was 5.69% and member of the public was 10.10%.

Conclusion. It was observed that mortality was higher in patients not receiving adequate pre-hospital care. Early resuscitation facilities at the site of the accident have to be introduced and improved with the execution of rapid transportation to trauma care centres.

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ISSN online 2344-4959
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First published
December 2020 by
London Academic Publishing
www.lapub.co.uk

INTRODUCTION

Traumatic brain injury (TBI) is a major burden on the health care system in developing countries like India. It is one of the leading causes of mortality and disability worldwide as a consequence results in a great financial burden on societies. Research in the area of neurological trauma has shown that the totality of damage to the brain following trauma does not occur at the moment of injury but develops over a period ranging from hours to days. Brain injury occurs with further insult from secondary causes like hypotension, hypoxia, cerebral

edema, raised intracranial pressure, and expansion of the mass lesion. The incidence of TBI has increased significantly in the last 30 years but the mortality has decreased as a result of better management and availability of health care services.[1,2] In developing countries there is a large number of lives lost due to lack of pre-hospital care whereas in developed countries life expectancy has increased [3] due to advancements in pre-hospital and better understanding of pathophysiological processes in TBI.

To achieve better outcomes an early critical intervention in delaying or preventing secondary brain insults and maintaining cerebral perfusion is of paramount importance. This can be done with simple measures done just after trauma following ATLS guidelines with the prevention of hypotension and hypoxia. Evidence-based guidelines have been developed for the management of traumatic brain injury and implemented over the past decade, particularly within the intensive care unit (ICU) environment. However, the uncertainty of the efficacy of pre-hospital advanced life support interventions remains as such. In pre-hospital care, the standard management procedure for severe traumatic brain injury varies from case to case due to divergent scene conditions and characteristics. Multiple factors such as mechanism of injury, severity, and pattern, location of the accident, mode of transport, the time interval between trauma and first care and experience and skill level of paramedic contribute to this varied response.[4]

As a consequence of this uncertainty in the efficacy, further investigations and researches are the need of the hour. While pre-hospital management of severe TBI has become progressively more advanced, many challenges are remaining especially in the early recognition and treatment of severe brain trauma by ambulance paramedics. The expeditious transport of patients with brain injuries to an appropriate facility and the prevention of secondary insult is of increasing importance in the reduction of mortality and morbidity in brain trauma patients.[5] It is crucial that the first health care provider must be familiar with the complex presentation of severe traumatic brain injury patients in the initial stages of injury. Early recognition and response to traumatic brain injury can significantly impact on neurological outcome. Paramedics must have a sound knowledge of the interventions which may minimize secondary insult with the pre-hospital treatment of hypoxemia and hypotension being crucial components of traumatic brain injury management.

This study can be used to formulate new guidelines and plans to tackle the delay in first care to patients with TBI.

Methodology

The study was conducted at a level 1 trauma center of SMS medical college, Jaipur, India between April 2017 to march 2019. Overall, 2134 patients were enrolled for this study with a collection of data in a formatted proforma from admission to discharge. The data was collected from patients and their relatives. The ethical committee clearance was obtained prior to the commencement of the study. All the patients of trauma with clinical or radiological evidence of head injury or associated other injury coming to the trauma center were included.

It was a prospective observational study. Data of individual patients were collected in the form of age, sex, mode of injury, mode of transportation, distance from the hospital, Care providers, Safety equipment used by the vehicle, duration in reaching the hospital, pre-hospital care, Glasgow Coma Scale (GCS), saturation of peripheral oxygen (SpO2), systolic blood pressure (SBP) at admission and Glasgow Outcome score (GOS) at time of discharge. Based on GCS, TBI cases were graded as mild (13-15), moderate (9-12), and severe (<8). This neurosurgical center is one of the leading institutes of India and Asia catering to both urban and rural populations.

After researching various literature published, we could conclude that this study is one of the largest in the world and is unique with maximum variations in population.

RESULTS

During the period from April 2017 to March 2019 data from 2134 TBI patients was collected. The mean age was 31.65+ 15.1 years. In our study 69.89% were males and 31.11% were females **(Table 1)**. Males were 2.21 times more common than females. Most patients affected were in the age group of 21–30 years (29.42%) followed by 31–40 years (22.68%). Road traffic injury (64.45%) was seen as the most common mode of injury in the age group 21–30 years (81.36%) followed by injury due to fall (21.41%) which mostly affected the age group of 0–10 years

(71.44%) and above 60 years (33.80.%) **(Table 2).** Most of the patients were attended by the members of public as a first responder (77.41%) **(Table 3)** and transported to definitive treatment centers in ambulances (66.82%) **(Table 4)** but most of them not received care in the form of vitals monitoring, intravenous (IV) fluid administration and airway protection at the site of trauma and during transportation**.** Safety devices such as helmets, seat belts, and child restraint were used in 27.03% patients only **(Table 5).** Alcohol consumption while driving is 14.53% **(Table 6)**. Time duration to reach definitive treatment centers was <1 hour in 3.13% of patients, between 1 and 4 hours in 16.16% of patients, between 4 and 12 hours in 56.04% and >12 h in 24.65% of patients **(Table 7)**. 32.29%, patients were primary referrals, and 67.71%, patients were secondarily referred to our study center **(Table 8).** The overall mild injury was seen in 49.11% cases, moderate in 31.02%, and severe in 19.87% **(Table 9)**.

Table 1. Different age groups and outcome

Age in years	The total no. of cases n (%)	Out come Alive Death n=1901(%) n=233 (%)	
Age yrs.(mean)	31.65+ 15.1	33.24 ± 14.5	41.36 ± 17.8
0-10	191(8.95)	183 (8.58)	8(4.18)
11-20	233(10.91)	221 (10.36)	12(5.15)
21-30	628(29.42)	554 (25.96)	74(11.78)
31-40	484(22.68)	428 (20.06)	56(11.57)
41-50	232(10.87)	192 (8.99)	40(17.24)
51-60	153(7.17)	139 (6.51)	14(9.15)
>60	213(9.98)	184 (8.62)	29(13.61)
Total Male Female	1470(68.89) 664(31.11)	1311(89.19) 590(88.85)	159(10.81) 74(11.14)

Table 2. Incidence of mode of injury in different age groups

Age (years)	Total cases n(%) n=2134	mode of injury RTA Fall Assault Sports Others n(%) n(%) n(%) n(%) n(%)				
0-10	191 (8.95)	41 (21.47)	130 (68.06)	Nil	12 (6.28)	8 (4.19)
11-20	233 (10.92)	128 (54.93)	54 (23.17)	15 (6.43)	24 (10.3)	12 (5.15)
21-30	628 (29.43)	511 (81.36)	43 (6.85)	29 (4.61)	5 (0.79)	40 (6.36)
31-40	484 (22.68)	357 (73.76)	69 (14.26)	34 (7.02)	Nil	24 (4.96)
41-50	232 (10.87)	144 (62.06)	54 (23.27)	26 (11.20)	Nil	8(3.44)
51-60	153	71	35	45	Nil	2(1.31)
	(7.17)	(46.41)	(22.87)	(29.41)		
>60	213 (9.98)	124 (58.21)	72 (33.80)	13 (6.10)	Nil	4 (1.88)
Total	2134 (100)	1376 (64.48)	457 (21.41)	162 (7.59)	41 (1.92	98 (4.60)

Table 3. First emergency care provider

Care providers	No of patient n (%)	Outcome Alive Death n (%) n (%)	
Member of public	1652 (77.41)	1485 (89.89)	90 (80.35)
Ambulance officer or paramedic	123 (5.76)	116 (94.30)	7(5.69)
Relatives	247 (11.57)	210 (85.02)	37 (14.98)
Medical retrieval team	Nil	Nil	Nil
Unknown	112 (5.24)	90 (80.35)	22 (19.64)

Table 4. Mode of transportation

Mode	First Hospital Total no of cases N=1445(%)	Study center Total no of cases n(%)	Outcome Alive Death n(%) n(%)	
Ambulance	432 (29.90)	1426 (66.82)	398 (92.13)	34 (7.8)
Private vehicle	1013 (70.10)	708 (33.18)	1503 (88.30)	199 (11.69)

Table 5. Safety equipment used

Equipment	No of patient n(%)	Outcome Alive Death n(%) n(%)	
Helmet- Urban Rural	204(20.90) 139(68.13) 65(31.87)	189(92.64) 131(94.24%) 58(89.23%)	15(7.35) 8(5.76%) 7(10.77%)
Seatbelt	168(78.50)	157(93.45)	11(6.54)
Child restraint	Nil	nil	Nil
Unknown	495(23.20)	447(9.03)	48(96.97)

Table 6. Substance abuse

	No of patient n(%)	Outcome Alive Death n(%) n(%)	
Alcohol involvement	310(14.53)	243(78.39)	67(21.61)
Alcohol breath on admission	213(10.00)	184(86.38)	29(13.62)

Drug involvement	10(0.47)	8(80.00)	2(20.00)
Using mobile phone at time of accident	43(2.00)	35(81.40)	8(18.60)
Prior head injury	43(2.00)	33 (76.74)	10(23.25)
Multiple addiction	46(2.16)	33(71.74)	13(28.26)
None	1469(68.84))	1365(92.92)	104(7.08)

Table 7. Time to arrival at hospital

Time to arrival at hospital –	First hospital n (%)	Study center n (%)	Outcome Alive, n(%) Death, n(%)	
<1 hrs	1364(63.92)	67 (3.13)	59 (88.05)	8 (11.94)
1-4 hrs	585 (27.41)	345 (16.16)	328 (95.07)	17 (4.92)
4-12 hrs	123 (5.76)	1196(56.04)	1040 (86.96)	156 (15.00)
>12 hrs	62 (2.91)	526 (24.65)	474 (90.11)	52 (09.89)

Table 8. Correlation of SBP and SpO2 and outcome

Systolic blood pressure	No of patient (%)	Outcome Alive, n(%) Death, n(%)	
>90 mmHg	1885(88.33))	1745(92.57)	140(7.43)
<90 mmHg	249(11.69)	156(8.20)	93(37.35)
SpO2 -			
<90%	339(15.89)	216(63.72)	123(36.28)
>90%	1785(84.11)	1675(93.84)	110(6.16)
First CT			
Primary hospital	456(21.36)	425(93.20)	31(6.79)
Study center	1678(78.63)	1476(87.96)	202(12.03)
Referral -			
Primary	689(32.29)	632(91.73)	57(8.27)
Secondary	1445(67.71)	1269(87.82)	76(12.18)

Table 9. Severity of injury

GCS on admission	Total no of cases, n (%)	Outcome Alive, n (%) Deaths, n (%)	
Mild (13-15)	1048 (49.11)	1036(98.85)	12 (1.1)
Moderate (9-12)	662(31.02)	608(91.84)	54 (8.15)
Severe (<8)	424 (19.87)	257(60.61)	167(39.38)

Discussion

With rapid industrialization, the cases of TBI are rising, and so does its severity. But the advancement in pre-hospital care is lacking in developing countries. Different studies have shown that early resuscitation and pre-hospital care are cardinal to better outcomes in TBI. Mortality and morbidity of the severely injured patient can be reduced significantly by directly transporting them from the scene to Level I trauma centers. Early identification and prompt management lead to a better survival rate in cases of TBI. This can be achieved through pre-hospital care which was non-existent in India.[6-8]

In our study, the incidence of head injury was highest in the age group 21-30 years i.e. 29.42% and commonest mode of injury were as RTA in 64.45% cases followed by fall from height in 21.41%. Similar studies conducted by Meena et al.[9] and Phonprasert et al.[10] showed 69.52% and 58% of cases were due to RTA respectively. Gururaj et al.[11] in his study claimed 60% of cases were due to RTA and 20-25% cases were of falls. Thus, RTA was found to be the most common mode in almost all studies. [9-11] It was most probably due to excessive congestion of traffic on roads, less traffic sense, poor conditions of the road, not using helmet by bike riders, and not following the road traffic rules.

Alcohol consumption while driving is also a contributing factor for increasing RTAs in young adults. In studies by Esser et al.[12] and Gururaj[13] the percentage of alcohol consumption was 17.9% and 14.50% respectively which is comparable to our study which is 14.53%. The patient using a helmet more often sustain milder head injuries, whereas, a patient without a helmet was having more severe injuries. Alcohol consumption was associated with more severe head injuries and high mortality of 21.61% compared to 7.08% in patients not using any drug and alcohol.

In our study private vehicle was the most common mode of transport at the first hospital while the ambulance was the most common mode at the study center. There was clearly a decrease in mortality of patients transported by ambulance (7.80%) than by private vehicle (11.69%), the difference was due to early identification and less time taken to reach the hospital and early treatment resulting in decreased secondary insults.

Prevention of hypoxia and hypotension is of utmost importance with the maintenance of cerebral perfusion. The presence of leads to multiple cascades of events leading to increased cerebral edema decreased cerebral perfusion, decreased

tissue, and vital organ perfusion. These all contribute to poor outcomes. In our study patients with SBP, less than 90 mmHg on admission had a mortality of 37.35% than patients with SBP, more than 90 mmHg 7.43 % mortality. The mortality in patients with SPO2 less than 90% was 36.28% compared to 6.16% in patients with SpO2 above 90%. Our study suggested that most of the primary or first hospitals overlooked the importance of monitoring oxygen saturation and blood pressure with increased chances of missing hypoxia, hypotension, thereby undervaluation of important secondary changes in the brain ultimately increasing the risk of worse outcomes. In the primary hospital CT scan had done in 21.36% and mortality 6.79% and study center 78.63% and mortality 12.03 %. Patients with their CT brain done at the first hospital within 4 hours after injury performed better. Early CT brain is a critical step in managing TBI cases with early information about operative intervention required, thus preventing further insult to the brain. Thus it is very critical for the emergency staff to be well versed with an indication of CT brain in trauma patients. For providing good pre-hospital care there are needs for intensive training of medical personnel and adequate resources at primary and secondary level health care facilities.

Time lapsed in reaching the hospital is also a significant factor determining the outcome. There is a major part of critical time lost in transportation. The prognosis of TBI is excellent if the patients get appropriate treatment in the golden hour. Our study noted that around 3.13%, 16.16%, 56.04%, and 24.65% of patients reached the hospital in less than 1 hour, 1-4 hour, 4-12 hour, and more than 12 hours respectively. In a comparative study by Gururaj,[13] only 25% reached hospital within 3 hours and 20% reached after 24 hours. The time interval between the time to arrive at the injury site and the hospital is one of the deciding factors between life and death. The overall mortality was found to be 10.92% as compared to 16% by both Phonprasert et al.10 and Narwade et al.[14]

The maximum severity of the injury was shifted to the hospital by private vehicle, without any vital monitoring. It was observed that mild, moderate, and severe TBI cases were 49.11%, 31.02%, and 19.87% respectively. A study by Natarajan et al.[15] showed the total number of mild, moderate, and severe injuries were 42%, 30%, and 28%, respectively. In our study, it was observed that mortality was highest in severe TBI (39.38%) and 1.1% in mild TBI.

In our study patient, mortality was 6.79% in patients receiving pre-hospital care compared to patients 12.03% in patients not receiving adequate pre-hospital care. This clearly signifies that pre-hospital care is a crucial step in managing TBI patients.

Chennai had 8.16% mortality, Bangalore had 8.6% and 5.5% mortality rate in 2002 and 2005 respectively whereas the mortality rate in Delhi was 10.49%. In recent years the mortality has decreased due to the availability of better health care facilities. With intensive studies and data registry in the USA and other western countries, they have formed better pre-hospital guidelines for trauma patients thus are able to avoid preventable deaths and disability.

Our study showed that patient with TBI need aggressive management in the form of, victims reaching the hospital in the shortest possible time, taking care of airway by use of laryngeal mask/endotracheal tube intubation, oxygenation and iv infusion for maintaining perfusion pressure for prevention of secondary brain injuries like hypoxia, hypotension, and cerebral edema. We can apply this data to develop new action plans and public awareness programs and developing adequate neurotrauma care protocols for aggressive management of patients with poor admission GCS score.

CONCLUSION

It is recommended that essentially, the outcome in TBIs can be improved by attending to priorities of reaching the victims in the shortest possible time, and evacuating them to hospital, taking care of airway, oxygenation and maintaining total perfusion pressure through judicious IV infusions. Depending upon the skills of Emergency Medical Technician / Paramedic, the use of Laryngeal Mask Airway / Endotracheal Tube can be considered. Infrastructure in the form of dedicated trauma centers, well-equipped ambulances with trained trauma staff, should be developed.

Abbreviation

TBI- Traumatic brain injury, ICU- intensive care unit, GOS-Glasgow Outcome Score, GCS- Glasgow Coma Scale, SBP-systolic blood pressure, SpO2 - saturation of peripheral oxygen.

Financial support and sponsorship
Nil

Conflicts of interest
There are no conflicts of interest.

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