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Pre-hospital determinants of outcome in traumatic brain injury: Experiences from first comprehensive integrated pre-hospital care providers in India: GVK — EMRI Experience

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Abstract: Indian studies have reported that nearly 1.5 to 2 million persons are injured and 1 million succumb to death every year in India due to traumatic brain injury. Road traffic injuries are the leading cause (60%) of TBIs followed by falls (20%-25%) and violence (10%).It is also a known fact that the best facilities, equipment and skill sets in terms of emergency room, ICU facilities, neurosurgical skills and equipment cannot reverse damage sustained at scene of injury or enroute to hospital. Airway obstruction and aspiration are major cause of death in treatable head injuries. The aims of prevention of secondary brain injury can be met with only in pre-hospital settings. All these facts underscore the need for an efficient pre-hospital care management of head injuries. However, in India, till 2005, no comprehensive data has been available on this aspect of management, because there was no integrated comprehensive pre-hospital care providing service available. In 2005, Emergency Management and Research Institute (EMRI) was established, to take a lead role in providing pre-hospital care. We wish to share our experience and the findings in pre hospital management of Traumatic Brain Injuries(TBI).

This is retrospective study of 1607 cases of traumatic brain injury handled by EMRI, in the state of Andhra Pradesh, from 01 Jan 08 to 31 Dec 08. Data captured on patient case report forms (PCR) for this segment of emergencies was reviewed. We studied various components of the data having a bearing on outcome, namely the social, demographic, clinical determinants, response times and outcome.

The demographic determinants reveal that incidence of head injury in men is more than twice that in women. It is the people in prime of their age (21-45) who are affected most. The share of victims handled by EMRI shows a preponderance of economically deprived population amongst victims. Analysis of different risk factors revealed that systolic BP at scene and at hospital is significantly correlated with outcome. Paired sample T-test showing a 2-tailed significance of $P<0.01$at 95 % CI: 3.717-8.777, with T value of 4.843. GCS analysis revealed significant correlation with outcome at level of $p<0.01$, with Pearson's 'R' value of .071. Age of victim showed significant correlation at $p<0.05$ level with Pearson's R value of.087. SPO_2 showed significant correlation with outcome with a significance at level of $p < 0.01$, and Pearson's 'R' value of 0.217. The mean response time was found to be statistically significant at $p<0.05$ level and a 'Pearson's R' value of .094. One way Anova studies showed distance to be significant at $P< 0.05$ level at 95 % CI : 16.56-43.35, with a f value of 4.376.

It is evident from the study that the analysis of risk factors leading to establishing guidelines and protocols for pre hospital management of head injuries can definitely contribute to improving outcomes in TBI.

Keywords: EMRI; Pre-hospital management; traumatic brain injury; vehicular accidents

INTRODUCTION

Traumatic brain injuries are recognized to be the leading cause of mortality and morbidity due to injuries. It is reported to afflict millions of people throughout the world each year. Mortality following head injury has been reported to be in the range of 39-51%[1,2]. Indian statistics

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reveal road traffic injuries as the leading cause (60%) of TBIs, followed by falls (20%-25%), and violence[3]. In 2005, road traffic injuries resulted in the death of an estimated 110,000 persons, 2.5 million hospitalizations, 8-9 million minor injuries and economic losses to the tune of 3% of the gross domestic product (GDP) in India[4].

It is also understood that the mortality and morbidity in traumatic brain injury is due to primary injury as well as secondary brain injury. The critical phase has been somewhat arbitrarily defined as the first 10 min[5]. Secondary Injury is a cascading process that induces apnea and triggers on stress-related massive sympathetic discharge[6]. New insights into the mechanisms of cerebral edema and ischemic brain injury led to an understanding of secondary injury which may manifest within minutes or hours after the primary insult. Various reports in literature have emphasized on role of ischemia in first 24 h following head injury, which is commonly known as secondary injury[7]. These factors have led to questions on the pre hospital determinants of outcome in traumatic brain injury. It has also been seen that there have been differences in outcome in developed countries and developing countries. One of the studies comparing outcome from head injuries came up with an interesting observation. It reported that when Traumatic Brain injuries in USA were compared with those in India, there was not much difference in severe TBIs and most mild TBIs. However, it was noted that in moderate TBIs the difference in outcome was significant. This was attributed to near absence of pre-hospital care and neurosurgical facilities available at Medical centers[8]. Prior to 2005, it was widely reported that there is no system in place to take care of victims of road traffic accidents and the victim often died in absence of expeditious transfer to suitable hospital[9,10,11].

GVK-Emergency management and Research Institute, the only comprehensive EMS providing services in India, has been established in 2005, and has covered ten states by now. GVK EMRI effectively covers a population of 434,608,503, and an area of 472754 square miles. Nearly 42.27% of India's territory is covered by these operations. With a fleet of nearly 1100 mobile emergency units, and an emergency database since mid-2006, the research team at the institute compiled all data for the period Jan1st 2008-Dec 31st 2008 for all cases presenting with the chief complaint of head injury to Andhra Pradesh services of GVK-EMRI.

This is the first Indian study on TBIs to capture data from the scene to hospital and provides insights which were previously not available, especially with regards to TBI victims from rural areas.

Andhra Pradesh is fifth largest state of India, with an area of 2,76,754 sq. km, accounting for 8.4 % of India's territory.

METHODOLOGY

A retrospective analysis of the victims of "Traumatic Brain injuries" to study pre hospital determinants of outcome, was carried out in state of Andhra Pradesh. The patients included those serviced by the Emergency Management and Research Institute (EMRI) between the period of 1st January 2008 to December 31st 2008. Andhra Pradesh has 23 districts, each having differing proportions of urban, rural and tribal areas. Data captured on patient case report forms (PCR) for this segment of emergencies was reviewed. We studied various components of the data, namely the social, demographic, clinical determinants, and response times, collected on the PCR forms of victims of vehicular accidents and the interventions with respect to the 48-hour follow-up status. This population was selected as it contributed to 15 % of all emergencies catered to by EMRI and was the second most common reason for beneficiaries utilizing this service. The patient case records (PCRs) completed by the EMT (Emergency management technician) in the field are returned to the Institute, where each PCR is then reviewed for accuracy and quality. All the collated information is then entered into a central database. A follow up call is made after 48 hours to determine the outcome measured as either fatal or stable. A repeat call is made 120 hours later if the patient is described as critical at 48 hours. Such follow up calls also record individual clinical status at 48 hour and 120 hour respectively. The analysis was carried out using SPSS version 16.0 .Descriptive as well as inferential statistics were used.

RESULTS

A total of 1607 cases were studied. The study aimed to see if there are any correlations between different socio demographic factors, and patterns of clinical status on scene with the outcome. It was observed that there was significant difference in incidence as regards male/female head trauma victims (70:30). It was noted that within group mortality in females (2.45%) was less as compared

to males (4.12%) (Table 1 refers). It is seen that bulk of TBIs were contributed by vehicular/non vehicular trauma (63.20%), and assault cases contributed to 22.63% of cases (Fig 1 refers). When distribution of TBI amongst different occupations was considered, it was notable that though transport workers constituted just 1.06 % of all TBI victims, within group mortality in this class was highest (21.42%), followed by employees (8.95 %). The incidence of TBI in victims pursuing other occupations included daily wage workers (49 %), employees (5.80 %), housewife (15 5 %) and self employed (7.50%) (Fig 2 refers). As regards social status, maximum victims belonged to backward caste (48.10%) as compared to Scheduled caste (23.20 %). The reach of services was maximally utilized by marginalized class of social strata i.e Scheduled caste, backward caste and scheduled tribes constituting 82 % while other caste was represented by 18% of cases. However, when within group mortality was considered there was no significant difference (Table 2 refers).

Table 1: Gender based distribution and outcome in TBIs

Count →	Victim Status		
Gender ↓	Expired	All else	Total
F	12	478	490
M	46	1069	1115
Total	58	1549	1607

Table 2: Social status and outcome in TBIs

Social Status	Victim Status		
	Expired	All else	Total
BC	32	741	773
OC	13	271	284
SC	7	366	373
ST	6	169	175
Total	58	1549	1607

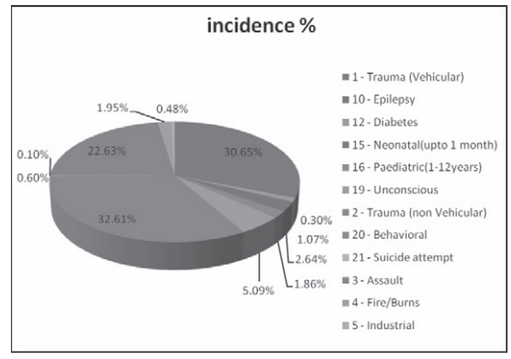

Fig 1: Incidence of TBIs by cause

Analysis of different risk factors revealed that systolic BP at scene and at hospital is significantly correlated with outcome. Paired sample T-test shows a 2-tailed significance of P<0.01at 95 % CI: 3.717-8.777, with T value of 4.843. Similar results are available for SPO_2at scene and SPO_2 at hospital revealing a 2-tailed significance at level of <0.01 at 95 % CI: 5.0259-8.635 (Table 3 refers).

GCS analysis revealed significant correlation with outcome at level of p < 0.01, with Pearson's 'R' value of .071. Age of victim showed significant correlation at p<0.05 level with Pearson's R value of.087. SPO_2 showed significant correlation with outcome with a significance

Table 3: Paired Sample T-test:
Impact of clinical factors on outcome

Paired Samples Test					
		Paired Differences	Confidence Interval		Sig.(2-tailed)
			Lower	Upper	
Pair 1	BP-At scene-BP-At Hosp	6.2467	3.7166	8.7767	0.00
Pair 2	SPO2-At scene-SPO2-At Hosp	6.8291	5.0259	8.6325	0.00

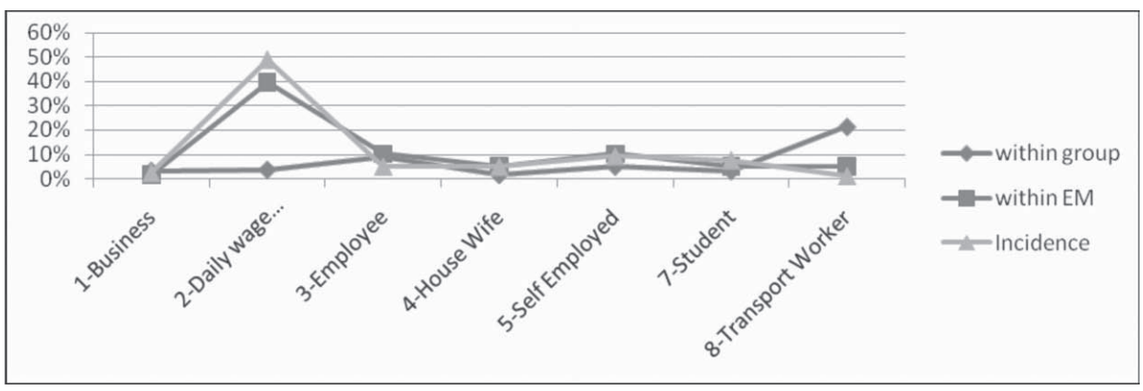

Fig 2: Incidence of TBI : occupation wise distribution and mortality Within group and within Emergency

at level of p < 0.01, and Pearson's 'R' value of 0.217. The mean response time was found to be statistically significant at p < 0.05 level and a 'Pearson's R' value of .094 (Table 4 Refers). Anova one way studies showed distance to be significant at P< 0.01 level, with f value of 11.543. The pulse at scene was noted to be significant at level of p < 0.01. The age and total time taken to reach the scene and take the patient to hospital was also found significant at p < 0.01 level (Table 5 refers).

DISCUSSION

Different studies have emphasized early resuscitation and pre hospital care as pivotal to better outcomes in TBIs. Transportation of severely injured patients from the scene directly to Level I trauma centers is associated with a reduction in mortality and morbidity. Resuscitation of head injured patients at the accident site is paramount in minimizing morbidity and mortality. This can be achieved through pre-hospital care which was non-existent in our country[12,13]. This is the first study to have inferences drawn from a pre-hospital care providers experience.

Table 4: Correlations between variables and outcome

S. No	Variable	Significance	Pearson's Value R
1.	Age	<0.01	0.087
2.	GCS	<0.01	0.071
3	SPO2	<0.01	0.217
4.	Mean Response time	<0.05	0.094

Table 5: Factors affecting outcome (Anova–One way)

		df	F	Sig.
Distance	Between Groups	3	11.543	0.000
	Within Groups	1592		
	Total	1595		
Pulse	Between Groups	3		
	Within Groups	1592		
	Total	1595		
SPO2	Between Groups	3	1.078	0.357
	Within Groups	1592		
	Total	1595		
Age	Between Groups	3	12.283	0.000
	Within Groups	1592		
	Total	1595		
Time	Between Groups	3	15.220	0.000
	Within Groups	1592		
	Total	1595		

The study revealed a prominent gender bias with males outnumbering females in as far as incidence of head injury as well as fatal outcome was considered. This is understandable, since most of the cases are due to vehicular accidents, and there is male dominance as far as driving is concerned. The socio economic distribution of cases and their outcome is influenced more by the utilization pattern of GVK-EMRI services than to actual trends of incidence of TBI in general population. If at all, it can be positively said that the services have been an effective mechanism to overcome inverse care law. What is relevant to note, is the fact that transport workers reflect an inordinate increased incidence, which may be considered an occupational hazard for them making them more vulnerable to TBIs. Regarding socio economic status, it is important to note that outcome often depends upon the medical facilities that the TBI Victims have access to. Thus, it would emerge that some of the outcomes in this study are different from what they otherwise would have been, as noted in some of the hospital based studies.

The clinical determinants of outcome have a bearing on the pre-hospital care. Statistically the pulse, SPO2 , GCS , and systolic blood pressure affect outcome in TBIs. Paired sample T-test unequivocally establish the effect of change in parameters (during transport to hospital) like BP and SPO2 on the outcome, and has a bearing on pre-hospital care.

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, use of Laryngeal Mask Airway/ Endotracheal Tube can be considered.

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