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Evaluation of Pre-Hospital Time and Care on Patient Mortality in the Setting of Trauma Care: A Pilot Study in Gujarat, India

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Abstract

Context: In the setting of acute trauma, it has been hypothesized that pre-hospital transport times in excess of 60 minutes will result in increased morbidity and mortality. The idea of a "golden hour" has been investigated deeply in developed countries; however, limited data exist on the relationship between time to treatment and mortality in trauma patients in developing countries such as India.

Objective: To determine if a correlation exists between pre-hospital time and mortality for trauma patients in Gujarat, India as well as identifying if other factors such as mechanism of injury and the use of ambulatory IV fluids affects patient mortality.

Methods: A retrospective chart review was performed for all patients presenting to Shreeji Trauma Care Centre (Vadodara, Gujarat, India) for trauma related injuries over a 60-day period. Data was compiled and entered into contingency tables for all nominal and ordinal data. GraphPad Prism 6.01™ was used for statistical analysis of the 2x2 contingency tables and two-tailed Fisher's exact test was applied to attain direct p-values. Two-tailed Student's t-test was used for comparisons of means.

Results: 109 patients presented with physical trauma (89 males); mean age 40 years (range 5–84 years). Most common causes were vehicular accidents (47%), fall from heights (17%) and assault (15%). Of the 75 patients who received care within 60 minutes, two died. 18 reached the hospital after 90 minutes, 3 of whom died. Increased time to treatment was statistically associated with decreased patient survival ($p = 0.0001$).

Conclusion: Increased time to treatment correlated with increased mortality, supporting the importance of the "golden hour" exists in developing countries. Further work is needed to elucidate additional factors that influence patient mortality in trauma patients.

Introduction

Trauma is a universal health problem, resulting in significant morbidity and mortality worldwide. It has been hypothesized that for trauma patients, pre-hospital transport times in excess of 60 minutes will result in increased morbidity and mortality. This potentially crucial period of time after the initial injury has been deemed the "golden hour."[1] While the majority of the population in more economical developed countries have access to definitive trauma care, most of the world's population does not. [2]

The effect of shortened pre-hospital time on the survival rate of trauma patients in developing countries is not well described; however, various studies have been performed in developed countries. In a case control study of over 12,000 patients, Sampalis and colleagues demonstrated that an out of hospital time greater than 60 minutes in the Montreal area correlated with a threefold increase in death for multiple trauma patients. [3] Additionally, these authors also showed that reduced pre-hospital time is most beneficial in patients with severe head trauma, intra-abdominal bleeds, severe thoracic injuries, and for rural trauma patients. They opined that every additional minute of out of hospital time increased the risk of dying for patients with major traumas by 5%, and for every 10 minutes it increased by 57%. Similarly, Dinh et al. also concluded that survival benefits extended past the traditional golden hour with decreased mortality still being seen with care provided within 90-120 minutes of initial injury.[4]

Management of trauma that has become standard of care in developed countries is not yet generalizable to the rest of the world. In developing countries such as India, little information exists regarding the care of trauma patients. Road traffic injuries cause a substantial number of trauma related deaths within developing nations. Within the United States alone, motor vehicle crashes resulted in 32,719 deaths in 2013.[5] However, in the same year, India reported 137,572 deaths were caused by road accidents. When comparing the statistic of persons killed in road accidents for the year 2010, both countries have similar rates of death per 100,000 population with 10.63 in the United States and 11.43 in India.[6] Part of the high mortality rate for patients with poly-traumas is due to the underdeveloped trauma care system in India and well as lack of pre-hospital care.[7] The trauma care system in India is uncoordinated due to inefficient trauma services, financial constraints, and the lack of government involvement in developing a single trauma care system across the country.[7] However, it has been hypothesized that interventions to improve pre-hospital transport can significantly impact mortality.[7]

Currently, little data exist that provide information on transport time for trauma patients in India and the effect on patient outcomes. Various studies done in the United

States have compared the significance of the "golden hour" of care for trauma patients.[1,4,8] However, definitive conclusions about the effect of the "golden hour" remain elusive, as other studies do not reveal improved survival with shorter out of hospital times among injured adults.[9,10] With uncertainty surrounding the "golden hour" and limited data available for India, the objective of this study is to investigate if a correlation between pre-hospital time and mortality for trauma patients exists in Gujarat, India.

Materials and Methods

A retrospective chart review was performed for all patients presenting to Shreeji Trauma Care Centre (Vadodara, Gujarat, India) for all trauma related injuries during the months of May and June 2015. Shreeji Trauma Care Centre is a 70-bed, multi-specialty surgical hospital with an average of 4-5 major and minor traumas a day. Trauma causes were classified into four categories: 1) motor vehicle crashes, 2) fall from a height, 3) assault, and 4) motor vehicle pedestrian trauma. Data was abstracted from patient's medical charts by hospital staff and recorded on de-identified data collection forms. In addition to demographic data that included age and gender, additional information was recorded including: admission status, Glasgow coma scale score (GCS), systolic blood pressure (SBP), respiratory rate (RR), approximate time of injury, total travel time to trauma centre, reported reason for delay to the hospital, ambulatory and intravenous (IV) fluid administration en route, if patient was able to afford care, approximate time patient was treated or evaluated, and patient outcome.

Exclusion criteria included patients less than 1 years of age, patients presenting after traumas that occurred 48 hours or more prior to receiving medical attention, and incomplete patient data forms. Data was compiled and entered into contingency tables for all nominal and ordinal data. GraphPad Prism 6.01™ was used for statistical analysis of the 2x2 contingency tables and two-tailed Fisher's exact test was applied to attain direct p-values. Two-tailed Student's t-test was used for comparisons of means. The threshold for statistical significance in this study was set as $p \leq 0.05$. This study was approved by the university's institutional review board.

Results

Medical records obtained from Shreeji Trauma Care Centre during the months of May 2015 to June 2015, inclusive of all trauma charts, report 109 patients that presented with a chief complaint of physical trauma. Following the predetermined exclusion protocol, 7 charts were excluded due to incompleteness. Patient population consisted of 89 males and 20 females, with a mean age of 39.7 years. Age distribution ranged from 5–84 years of age, with the majority of patients in 20–60 years age group. The cause of the injury were attributed to vehicular accidents (47%), fall from heights (17%), assault (15%), falls from slips (7%), burns (7%), and other cases of trauma that did not fit into the aforementioned categories (7%).

Of the 109 patients, eight were treated and subsequently discharged from the emergency department, one patient was not treated and subsequently discharged, and eight patients were referred outside the hospital for financial reasons (upon the patient's request). Patients who reached the trauma care center within 1 hour after sustaining injury included 75 (68.8%), of which two died. Of the 16 (14.7%) patients who reached the hospital within 90 minutes after sustaining injury, three died. Eighteen (16.5%) reached the hospital after 90 minutes following an injury, of which three patients died. The average GCS score for all 109 patients was 12.87 and the percentage of patients that received ambulatory services in the form of IV fluids was 42.2%. Of the 109 patients 101 patients were discharged alive, while eight patients died within 48 hours of injury.

Using descriptive statistics, patient outcome was compared: The age of the patients, causes of injury, revised trauma scores (RTS), pre-treatment times (travel and transportation time summed with time spent at the hospital before treatment), if patient waited more than an hour to seek medical care, IV fluid usage en route to the trauma care centre, and the mean travel and transportation times (Table 1). It was determined that when compared to patient outcome, the age of the patient ($p = 0.99$), cause of injury ($p = 0.38$), RTS ($p = 0.48$), pre-treatment times ($p = 0.33$), IV fluid usage en route to the trauma care centre ($p = 0.45$) did not show a statistically significant difference. However, comparative data revealed mean travel and transportation time had a statistically significant difference on patient survival ($p = 0.0001$).

Discussion

In regards to trauma care in India, as of 2013, there exists no national or regional guidelines for triage, patient delivery decisions, pre-hospital treatment plans, and transfer protocols.[11] There is also no national agency to take charge of organizing an efficient trauma system[12] and there is no formal definition of what constitutes as an emergency under Indian law.[11] The effects of the lack of uniformity on the national level can be observed during assessment of transportation and care of victims of trauma.

To help identify potential variables affecting patient outcome in a trauma setting, this study analyzed the charts and outcomes of 109 trauma patients at Shreeji Trauma Care Centre. In the course of the retrospective review of patient charts, of the variables investigated, it was identified that increased travel and transportation time directly correlated with negative patient outcomes.

In all but one case of patient mortality, the transport time and pre-treatment time was within 10 minutes of each other, signifying immediate treatment on arrival. However, there was one case where the patient eventually died where patient care was delayed by nearly 4.5 hours due to the family deciding to wait, which caused the high difference (~40 minutes) between the mean

transport time and mean pre-treatment time in the patients who died. If this case were to be excluded, the average transportation time and pre-treatment time for this group would be 102 minutes and 103 minutes respectively and the statistical significance would be unchanged when compared to the patients who survived.

For the trauma where patients survived, the average delay in treatment as interpreted by the difference between the mean pre-treatment time and the mean transportation time is 43 minutes.

Reasons for delays in transportation time and its correlation to patient outcome that have been observed in this study included

		Patient outcome		
		Survived	Deceased	p-value
Gender	Male	82	7	0.35
	Female	20	0	
Mean Age (years)		39.6	39.7	0.99
Mechanism of Injury	Motor Vehicle Crash	46	4	0.70
	Non-Motor Vehicle Crash	56	3	
Revised Trauma Score (RTS)		7.16	7.49	0.48
Patient Delayed Medical Care (>1 hour)	Yes	17	2	0.60
	No	85	5	
Mean Transport Time (mins)		38.5	90.7	0.0001
Mean Pre-Treatment Time (mins)		81.5	131	0.33
Use of Ambulatory IV Fluids	Yes	58	5	0.70
	No	44	2	

Table 1. Descriptive variables and comparison of patient outcomes.

lack of access to proper ambulatory services, patient referral between government and private hospitals adding to delay in patients obtaining definitive care, and patients unwillingness to seek medical attention until symptoms became dire. Other factors such as age, cause of injury, revised trauma score, pre-treatment times, and IV fluid usage during transportation were not statistically significant when compared to patient mortality. These data suggests that improvements in ambulance time would lead to improved patient outcomes as the "golden hour" suggests.

From injury to treatment, multiple improvements can be made to reduce the travel time to treatment and the quality of pre-hospital care to better serve victims of trauma. Though India has 102, the phone number for ambulatory service, there is a lack of confidence in the responsiveness of the system.[13] There also is 108, the phone number for emergencies, though there are concerns with trauma patients who are not transported for care despite being assigned a high priority status when the call was first received.[14]

Ramanujam and Aschkenasy reported in 2007 that half of the trauma victims arriving at an urban hospital in Chennai, India had no formal pre-hospital intervention.[16] In 2004, only 4% of ambulance personnel had certified formal training and a third of ambulances serve merely for transportation, with no paramedics on board.[17] Since then, at least 14 of the Indian states introduced pre-hospital emergency medical systems;[15] however, there still exists a perception that pre-hospital care is inconsistent and unreliable[15] due to the lack of trained professionals in ambulatory services creating an environment of variable patient care.[13] Our data show that pre-treatment time and IV usage did not affect patient mortality (Table 1). This is in agreement with Anand and colleagues who assert that pre-hospital fluid resuscitation is controversial for major trauma.[18]

With regards to transportation time, factors such as traffic congestion and poor organization of trauma care has led to problems in accessibility to proper care.[12] In a study investigating the pre-hospital profile of patients who died due to trauma at a trauma centre in Puducherry, India, it was found that the more than half of the patients were referred to another hospital, 70% required at least two vehicles to transport them to definitive care.[11] Similarly, in our study, five patients sought care at Shreeji Trauma Care Centre due to the long wait times they experienced at the government hospitals nearby. Increased transport time and insufficient care may also be attributed to the choice of the first medical encounter being a decision made by the patient themselves or bystanders at the scene. This regularly leads to care being provided by the closest medical facility regardless of if they are equipped with the appropriate resources to treat major trauma.[11,15] In addition to transportation time, adequate patient care also relies on

dissemination of proper pre-hospital treatment.

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Patients may also misjudge the severity of their injuries, leading to longer pre-hospital treatment times and delayed medical care. We observed that 19 patients waited more than one hour to seek medical attention following a trauma. Many of these patients reported they believed that they would either heal on their own or that their symptoms were not significant enough to need medical intervention. It is hypothesized that the delayed pre-hospital time for patients waiting to seek medical attention could be correlated with a lack of knowledge of symptoms that are associated with trauma.

Conclusion

Trauma is a field where time plays a crucial factor in patient outcome. In agreement with the "golden hour", the data presented demonstrate that transportation time after trauma influences patient mortality. Further studies of this nature expanding on the investigation of the effects of transportation time and patient outcomes need to be performed.

Reflections by the Primary Author

This research experience provided me with the opportunity to observe the delivery of healthcare in another country and to consider the importance of analysis of epidemiological data. My mentor, Dr. Elisabeth Guenther, has been a great inspiration to me in the pursuit of understanding how to critically analyze data and its application towards practicing evidence based medicine. As a student pursuing a residency in Pediatrics, I believe that this is an undervalued yet important skill especially in times where topics such as vaccinations and possible co-morbidities have become a controversial topic. This experience provided me with a taste of the investigative aspect of medicine, which I hope to continue throughout my practice. I would like to thank Dr. Rupesh Shah for allowing us to conduct our research at Shreeji Trauma Care Centre. I would also like to thank Praful Patel for his help in organizing and making this project possible.

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