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Analysis of Risk Factors with Hospital Mortality in Pedestrian Injured Patients; A Dataset Analysis of a Level-I Trauma Center in Southern Iran

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ABSTRACT

Objective: To determine the indicators predicting the hospital mortality in pedestrian injured patients admitted to a level I trauma center in Southern Iran.
Methods: This case control study was conducted in a Level-I trauma hospital in Shiraz. We selected all survived pedestrians who were admitted in the hospital with duration of admission more than 24 hours in one year from March 2016 to February 2017 as control group and compared with all non-survived pedestrian patients who expired in the hospital according to clinical from March 2012 to February 2017. Multiple logistic regression was performed to identify factors of hospital effect on pedestrian mortality and results expressed by Odds Ratios and their confidence intervals (CI) of 95%.
Results: A total of 424 survived pedestrian injured patients were compare to 117 non-survived one. Their mean of survived and non-survived patients were 43.79±19.37 and 56.76±18.55 years respectively of which 361 (66.7%) and 180 (33.3%) were men and women, respectively. We found that the gender does not have any relation with hospital mortality (p=0.275). Followed by, age is in relevance with mortality. Glasgow Coma Scale (GCS), Injury Severity Score (ISS), blood urea nitrogen (BUN), platelet (PLT), potassium (K) and hemoglobin (Hb) are significant factor which are associated with mortality. According to logistic analysis GCS ≤8 (p<0.001), low hemoglobin level <9 (p=0.030), BUN >24 (p<0.001), thrombocytopenia <150,000 (p<0.001), and hypokalemia <3.5 (p=0.01) were independently associated with hospital mortality. Among them, GCS≤8 was 72.237 times more likely to be associated with hospital mortality (OR=72.24, CI95%=23.19- 225.05).
Conclusion: The results suggest that GCS score, ISS, hemoglobin level, platelet count, BUN and potassium level might be independent factors associated with hospital mortality in pedestrian injured patients.

Keywords: Hospital mortality; Injury; Pedestrian; Accidents; Traffic.

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Introduction

Road traffic injuries (RTI) remain a global public health problem, and are responsible for 1.2 million global deaths each year [1]. According to statistics of the World Health Organization (WHO), in the year 2011 road-related trauma is ranked as the ninth leading cause of death and it is anticipated to be the seventh in 2030 [2]. Furthermore, about 50% of total road-related fatalities occur among vulnerable road users. Pedestrians are one of the most vulnerable road users, and more than 20 % of the world's road-related deaths occur among pedestrians. Pedestrian injuries are unique and important subsets of road-related trauma because of those remain a considerable source of morbidity and mortality worldwide [3]. Most pedestrian mortality accounts in low- and middle-income countries with figures reaching up to 75 % [4]. Iran is among the countries with high incidence of traffic accident deaths. After cardiovascular diseases, RTIs are the third cause of mortality in the country [5]. Similarly, in Iran, pedestrian injuries comprise the major portion of all of the accidents. The studies demonstrate that, pedestrian deaths account for 6,258 of the people (22.7%) of all deaths due to traffic accidents in 2007, and this had grown to 28% by 2011 [3].

Recognizing and defining risk factors of pedestrian injury and fatality can help to improve policies and programs for making pedestrian safety. Although the most of the studies has been devoted to pedestrian risk fatality according to behavioral and environmental factors, rather less attention has been paid to individual and clinical factors.

To the of our knowledge, there has been no data in literature to survey indicators predicting hospital mortality in pedestrian injured patients in Iran. So, the objective of this study was to determine the indicators predicting hospital mortality in pedestrian injured patients of Shahid Rajaee (Emtiaz) Trauma Hospital, the main referral center for trauma in the south of Iran Shiraz.

Materials and Methods

Study Population

We conducted the study in Shahid Rajaee (Emtiaz) Trauma Hospital (a level I referral center for trauma patients over 16 years of age at Fars Province, affiliated to Shiraz University of Medical Sciences, Shiraz, Iran). This hospital is a 200-bed governmental academic adult trauma center of Shiraz. Shiraz is the capital and main city of Fars Province, located in the southern part of Iran with population of 1.4 million according to the recent national census [6].

The pedestrians in the subject of this study are those who were injured by motor vehicles including cars, buses, and motorcycles, and those with incomplete document were excluded from the study. We also excluded trauma patients with other mechanisms of injury and who admitted for less than 24 hours admission. The study was performed under a protocol approved by the Institutional Review Board (IRB) of Shiraz University of Medical Sciences and the approval of the Ethics Committee was accomplished before the study was commenced. The signing of an Informed Consent Form was dismissed, due to the observational and retrospective nature of the study. An analytic, case control study was performed comparing the both groups that were survived and died. Survived group selected from the pedestrian who admitted from March 2016 to February 2017 as control group and compare them to all non-survived pedestrian patients who expired in the hospital from March 2012 to February 2017. As the frequency of dead patients were not enough in one year, so we consider all the dead patients who had complete document in the hospital in six years.

Study Protocol

Parameters for comparison were the epidemiologic aspects (age, gender), trauma characteristics, clinical, and laboratory findings. The examined variables were including age, gender, transportation type, duration and care provided, injury profiles, site of injury, Injury Severity Score (ISS), Glasgow Coma Scale (GCS) at the time of entering the emergency department, laboratory data within 24h of admission [CBC, BUN, creatinine, and electrolytes], and the patients' outcomes. The ISS was computed by using the method described previously [7]. It is calculated as the sum of squares of the highest Abbreviated Injury Scale (AIS) scores in the three most severely injured body regions. Information such as socio demographic were obtained through interview with the patients and clinical, laboratory and other information obtained from the patient's medical records. Age was categorized into three groups: 15-40, 40-60, and over 60 years old. Also, laboratory data and other clinical findings were categorized into normal and abnormal values. The site of injury includes head, neck, thoracic, abdomen, vertebra and extremities.

Statistical Analysis

The data were analyzed using statistical package for social sciences (SPSS Inc., Chicago, IL, USA) version 17.0. Normality of data was tested by Kolmogorov–Smirnov test and the frequency distributions (histograms). All data were expressed as mean and Standard Deviations (±SD) or number and percentage as needed. Pearson's chi-square or Fisher's exact test were used to compare the difference of proportions. Multiple logistic regression was performed to identify factors of hospital effect on pedestrian 'mortality by the method "forward method" with results expressed by Odds Ratios and their confidence intervals (CI) of 95%.

$$\ln(y) = \alpha + \beta_1 * GCS + \beta_2 * ISS + \beta_3 * HB\ level +$$

$$\beta_4 * \text{Platelet count} + \beta_5 * \text{BUN} + \beta_6 * \text{Serum K}$$

Probability variables identified by univariate analysis with p-value up to 0.10 were included in the multivariate models. A *p*-value of less than 0.05 was considered significant.

Results

The total number of 424 patients (78.3%) were survived and 117 (21.7%) patients were died during two hospital courses. Their average age (SD) of survived and non –survived patients were 43.79 (19.37) and 56.76 (18.55) years respectively ($p<0.001$). Of which 361 (66.7%) and 180 (33.3%) were male and female, respectively. Pearson's chi-square or Fisher's exact showed that age is associated with hospital mortality (*p*-value=0.000) The univariate analysis demonstrated for the patients age 60 and over ($p<0.001$), GCS≤8 ($p<0.001$), ISS ≥16 ($p<0.001$), low hemoglobin level ($p<0.001$), platelet count <150000 ($p<0.001$), BUN >24 ($p<0.001$), creatinine >1.5 ($p<0.001$), hypernatremia (Na >145) ($p<0.001$), and hypokalemia (K<3.5) ($p<0.001$), as the potential predictive factors of in-hospital mortality (Table 1).ISS along with mentioned variables are potential predictive factors of in-hospital mortality (Table 1). Moreover, the mortality rate of patients with extremities and vertebral injuries was significantly lower than them without these injuries.

The six factors which turned out to be significantly associated with mortality in the univariate analysis were included in steps of multivariate logistic regression analysis. Deviance coefficient for goodness of fit of model is 497.23 which is absolutely significant (*p*-value=0.00). Independent factors influencing hospital mortality were GCS ≤8 ($p<0.001$), low hemoglobin level ($p=0.030$), BUN >24 ($p<0.001$), thrombocytopenia ($p<0.001$), and hypokalemia ($p=0.010$). Among them, hospital mortality 72.237 times more likely to be associated with GCS≤8 (OR=72.24, CI95%=23.19- 225.05) and was about 3.356 times more common in patients with BUN>24 and ISS≥16 (OR=3.36, CI95%=0.91-12.32; OR=9.80, CI95%=1.95-49.20; respectively) (Table 2).

Discussion

In general, there was a strong association between death and cause of trauma. The most of the analysis

Table 1. Predictors of hospital mortality in pedestrian trauma patients.

Variable	Surviving group (%)	Non-surviving group (%)	*p* value
Age			
16-40	205 (89.9)	23 (10.1)	<0.001
40-60	112 (77.2)	33 (22.8)	
>60	103 (66.5)	52 (33.5)	
Gender			
Male	278 (77.00)	83 (23.00)	0.275
Female	146 (81.1)	34 (18.9)	
Marital status			
Married	88 (75.56)	29 (24.44)	<0.001
Single	349 (82.33)	75 (17.67)	
Type of transfer to hospital			
EMS	325 (77.2)	96 (22.8)	0.483
Personal	53 (80.3)	13 (19.7)	
SBP			
60-120	181 (72.7)	68 (27.3)	<0.001
Lowest than 60	0 (0)	2 (100)	
Highest 120	237 (85.3)	41 (14.7)	
Respiratory rate			
12-20	395 (82)	87 (18)	<0.001
Lowest 12	5 (50)	5 (50)	
Highest 20	19 (59.4)	13 (40.6)	
GCS[a]			
≤8	19 (20.0)	76 (80.00)	<0.001
9-12	8 (61.5)	5 (38.5)	
13-15	364 (94.8)	20 (5.2)	
ISS mean7.79 (5.4)	6.73 (4.8)	11.59 (5.9)	<0.001
ISS[b]			
0-8	271 (93.8)	18 (6.2)	<0.001
9-15	134 (63.8)	76 (36.2)	
≥16	18 (43.9)	23 (56.1)	
Head and neck injury			
Yes	129 (82.7)	27 (17.3)	0.117
No	294 (76.6)	90 (23.4)	

Thoracic injury			
Yes	79 (81.4)	18 (18.6)	0.418
No	345 (77.7)	99 (22.3)	
Abdominal injury			
Yes	61 (72.6)	23 (27.4)	0.163
No	363 (79.4)	94 (20.6)	
Vertebral injury			
Yes	79 (90.8)	8 (9.2)	0.002
No	345 (76.00)	109 (24.00)	
Extremities injury			
Yes	299 (83.5)	59 (16.5)	<0.001
No	125 (68.3)	58 (31.7)	
Hb level			
>12	222 (89.9)	25 (10.1)	<0.001
9-12	139 (69.5)	61 (30.5)	
<9	23 (47.9)	25 (52.1)	
Platelet count			
<150,000	279 (85.1)	49 (14.9)	<0.001
150,000-450,000	63 (51.2)	60 (48.8)	
BUN			
≤24	327 (86.1)	53 (13.9)	<0.001
>24	33 (47.1)	37 (52.9)	
Creatinine			
Normal (≤1.5)	346 (83.6)	68 (16.4)	<0.001
Abnormal (>1.5)	19 (45.2)	23 (54.8)	
Serum Na			
Normal (136-145)	301 (83.4)	60 (16.6)	<0.001
Hyponatremia (Na<136)	37 (74/00)	13 (26.00)	
Hypernatremia (Na>145)	26 (49.1)	27 (50.9)	
Serum K			
Normal (3.5-5)	330 (81.9)	73 (18.1)	<0.001
Hypokalemia (K<3.5)	24 (52.2)	22 (47.8)	
Heperkalemia (K>5)	11 (64.7)	6 (35.3)	

[a]GCS: Glasgow Coma Scale; [b]ISS: Injury Severity Score

Table 2. Multivariate analysis to determine risk factors for the mortality of pedestrian trauma victims.

Variable	B	OR (95% CI)	*p* value
GCS			
13-15			Ref
9-12	2.98	19.67 (3.11-124.35)	0.002
≤8	4.28	72.24 (23.19-225.05)	<0.001
ISS			
0-8			Ref
9-15	0.83	2.29 (0.83-6.32)	0.111
≥16	2.28	9.803 (1.95-49.20)	0.006
Hb level			
>12			Ref
9-12	1.40	4.07 (1.44-11.49)	0.008
<9	0.67	1.95 (0.22-17.05)	0.030
Platelet count			
150,000-450,000			Ref
<150,000	1.95	7.04 (2.50-19.83)	<0.001
BUN			
≤24			Ref
>24	1.21	3.36 (0.91-12.32)	<0.001
Serum K			
Normal (3.5-5)			Ref
Hypokalemia (K<3.5)	2.19	8.90 (2.46-32.21)	0.01
Heperkalemia (K>5)	-0.08	0.92 (0.09-9.47)	.945

demonstrated that the mortality of the pedestrians, cyclists and motorcyclists was higher than other trauma patients [8,9]. This finding is related to the inadequate protection from trauma among this group, which makes them more exposed to severe injuries. There remains a need, from country to country, to identify risk factors related to mortality of trauma patients. To the interesting of our knowledge, this is the first research which especially investigating clinical and laboratory factors associated with hospital mortality for pedestrian injured patients.

The analysis show that risk factors influencing in-hospital mortality includes age over 60 years old, GCS≤8, ISS≥16, low hemoglobin level, thrombocytopenia, abnormal BUN or creatinine, hypernatremia, and hypokalemia in univariate analysis. While, the logistic regression model revealed that GCS score≤8, ISS≥16, low hemoglobin level, abnormal BUN level, thrombocytopenia, and hypokalemia were the most relevant to in-hospital mortality.

Other studies [10-12] also corroborated with the results of this study which studied mortality risks of injured patients. They reported that the majority of patients were male (66.7%) and that gender did not influence mortality. Moreover, our findings showed that about 50% of the non-survivors were older than 60 years. However, advanced age is associated with mortality in pedestrian injuries, but it was not remained independent in the presence of all other factors. Among independent risk factors, GCS≤8, abnormal BUN and ISS≥16 were more likely associated with hospital mortality. In terms of GCS and ISS, our finding is similar to what was reported by others in multiple trauma patients [13-15]. Age, presence of isolated neurological damage, base excess, and hemoglobin were considered as the risk factors of hospital mortality by Lichtveld *et al*., [16]. In another study by Kuhls *et al*., [14] age and GCS were identified as the greatest risk of death in trauma patients.

Our study demonstrated that abnormal renal function (BUN>24) is a great risk of in-hospital mortality. Whereas, the most trauma studies focused on coagulation laboratory tests [17] and were not considered other laboratory tests such as renal function or electrolyte imbalance as death risk factors in trauma patients.

Extremity injuries occur more frequently than the head injury among adults. However, our results did not show any relationship between the head injuries and in-hospital mortality. This result is contrast with the result from Ghaem et al., which has showed that odds of mortality was more in pedestrian patients with head and neck injuries [OR: 7.92, 95% CI (4.18-14.99) than other injuries [18].

There were a number limiting factors diminishing the impact of our findings, of which patient population in a single referral institution is the most important factor. Thus, our results may not be representative of pedestrian fatalities risks in all regions of Iran. Second, we performed a retrospective study. Third clinical features and laboratory data of pedestrian injured patients admitted to hospital were analysis. In particular, pre-hospital factors were lost, because some of the patients' data related to pre-hospital were not recorded with sufficient details to allow this.

This study was conducted to determine the indicators predicting hospital mortality in pedestrian injured patients in Shiraz, Iran. Five hundred forty pedestrian injured patients were admitted to the local hospital during the period of study. Multivariate logistic regression analysis was conducted. GCS score, ISS, low hemoglobin level, BUN>24, thrombocytopenia and hypokalemia were independently associated with hospital mortality in pedestrian injured patients. The patients which referred to our center can be considered as a sample of the total population of Fars province. Therefore, our findings can be helpful for improving health policy and management in trauma centers to prevent hospital deaths in pedestrian injured patients. However, a national trauma registry is needed for performing multicenter studies to be well-known risk factors of mortality in pedestrian injured patients in the future.

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