Effect of private versus emergency medical systems transportation in motor vehicle accident victims: Trauma Center Experience in Saudi Arabia

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Abstract:
OBJECTIVE: To assess the effect of the mode of transportation of trauma patients (emergency medical service [EMS] vs. non-EMS) on their final clinical outcome in terms of mortality and length of hospital stay.

MATERIALS AND METHODS: A retrospective study included all patients who were involved in motor vehicle crashes, and who were transferred immediately to an emergency department of a trauma care center from December 2008 to December 2012. Patients were classified into two groups: those brought through EMS and those brought by non-EMS (private transport). Information on demographic characteristics including age and gender was recorded and medical data such as blood pressure, pulse, oxygen saturation, temperature, initial Glasgow Coma Score (GCS), saturation, temperature, initial Glasgow Coma Score (GCS), injury severity score (ISS), and final outcome (discharged or expired) were obtained. Descriptive statistics, mean and standard deviation (SD) were computed for continuous variables and statistical significance was tested by t-test or Mann-Whitney U-test. Categorical variables were described by frequency distribution and percentages; Chi-square or Fisher’s exact test as appropriate were employed to test for statistical significance. Logistics regression was performed with mortality as dependent variable and mode of transport and all demographic and prehospital variables as independent variables. A general linear model analysis was performed to test whether the mode of transport was significant to length of hospital stay in EMS and non-EMS clients.

RESULTS: Out of 308 patients identified during the study period, 232 were transported through EMS and 76 through non-EMS. The two groups were similar with regard to mortality and length of stay. The crude mortality rate was 30.6% (95% confidence interval [CI]: 24.64–36.53) in the EMS group and 28.9% (95% CI: 18.44–38.76) in the non-EMS group (p = 0.785). The average length of hospital stay was 9 days (interquartile range [IQR] = 8, 95% CI: 7.3–10.1) for the EMS group and 8 days (IQR = 9.5, 95% CI: 6.7–10.9) for the non-EMS group (p = 0.803). Multivariate analysis showed that of the study variables, only the injury severity score (ISS) and Glasgow coma score (GCS) were significant to mortality (p < 0.01), and GCS was more significant to the length of hospital stay (p < 0.01).

CONCLUSIONS: There was no significant difference between the EMS and non-EMS groups as they relate to mortality and length of stay in hospital. However, the mortality and length of hospital stay was statistically significant to ISS and GCS.

Key words: Car crashes, outcome, transportation

Introduction

Road traffic accidents have become an alarming major cause of death. A report by the World Health Organization in 2013 projects that motor vehicle crashes (MVCs) will reach 1.9 million by the year 2020. The report also shows that the death in road traffic accidents in almost all high-income countries is decreasing, while it is increasing in the majority of low-income countries.

There has been rapid economic growth in Saudi Arabia, a developing country, resulting in an enormous increase in the rate of motorization (vehicle per 1000 population) associated with a rapidly expanding road network. As a result, traffic accidents have become a serious problem for the country. The magnitude of this problem of traffic accidents in the Kingdom of Saudi Arabia over the last 15 years and traffic safety of other countries were studied. During the...
period 1971–1994, the number of traffic accidents, injuries, and fatalities increased by thirty, six, and seven, respectively. Ansari et al., 2000 showed that with the rise in both the fatality rate and the severity of the accidents, there is need for urgent action.[2]

It is expected that by 2030, there would be over 4 million road traffic accidents in Saudi Arabia. Between 1971 and 1997, 564,762 people died or were injured in road traffic accidents, a figure equivalent to 3.5% of the total population in Saudi Arabia. During this period, 66,914 people died on the roads in Saudi Arabia as a result of road accidents, which means that one person is killed and four are injured every hour. Over 65% of accidents occur because of the excessive speeds at which vehicles travel and/or drivers who disobey traffic signals. Twenty percent of beds in the Ministry of Health Hospitals are occupied by traffic accidents victims, and 81% of deaths in those hospitals are due to road traffic accidents. In addition, 79.2% of patients admitted to Riyadh Armed Forces Hospital with spinal injuries as a result of motor vehicle accidents. In terms of trauma outcome, the national study on the costs and outcomes of trauma identified a 25% reduction in mortality for severely injured patients who received care at a Level I trauma center rather than at a nontrauma center.[3]

When an injury does occur, emergency medical service (EMS) providers must ensure that patients receive prompt and appropriate emergency care at the scene of the accident and are transported immediately to a health-care facility for further evaluation and treatment. Determining the appropriate facility to which an injured patient should be transported can have a profound impact on subsequent morbidity or mortality. Although basic emergency services are generally consistent across emergency departments (EDs), certain hospitals, called “trauma centers,” have additional expertise and equipment for treating severely injured patients. Rapid transport of trauma patients to the hospital is likely to improve the outcome.

The aim of this study was to compare the effect of mode of transportation (EMS vs. non-EMS or private transport) on mortality and length of hospital stay.

Materials and Methods

A retrospective study was carried out at a tertiary care hospital in Saudi Arabia. Medical records of all the trauma patients who were brought to the hospital from December 2008 to December 2012 were reviewed.

Patients were classified into two groups: those brought through EMS and those brought by non-EMS (private transport). Demographic data including age and gender were recorded and medical data such as blood pressure, pulse, oxygen saturation, temperature, initial Glasgow Coma Score (GCS), fluid given, injury severity score (ISS), duration of stay in hospital, and final outcome (discharged or expired) were obtained.

Continuous variables following normal distribution were described using mean and standard deviation [SD], and analyzed using independent t-test; median and interquartile range were used to describe abnormal data, and was analyzed by Mann–Whitney U-test. Categorical variables were described using frequency with percentage and were analyzed by Chi-square or Fisher's exact test as appropriate. A multivariate analysis was performed using logistics regression where the outcome (mortality) was introduced as the dependent variable. Independent variables included mode of transport and all demographic and prehospital variables. Similarly, nonlinear regression (length of stay not in a linear function) was used for the length of stay (outcome variable) was modeled against all above mentioned independent variables.

Results

During the study period, we identified a total of 308 accident victims transported to the hospital; 232 were brought through EMS transportation and 76 by private transportation. The mean age of the patients brought through EMS was 27.14 ± 11.1 and non-EMS was 23.52 ± 13.9 (p = 0.022). With regard to gender, there were 91.8% and 86.8% males in EMS and non-EMS group, respectively, (p = 0.198). The mean systolic blood pressure (SBP) of patients brought through EMS was 125.19 ± 29.1 and 125.09 ± 23.2 in the non-EMS group, (p = 0.979). The mean GCS (mean ± SD) was 13.55 ± 3.5 in the EMS group and 12.86 ± 3.6 in the non-EMS group, with P = 0.699. The ISS (median, interquartile range [IQR]) was 16 [8] and 14 [8] in the EMS versus non-EMS group, respectively, (p = 0.364). The length of stay (median, IQR) was 8 [9.5] for EMS group compared to 8 [9.5] for non-EMS group (p = 0.803) [Table 1].

In terms of mortality, there was no difference as (30.6%) in the EMS group expired while 28.9% non-EMS patients died, (p = 0.785) [Figure 1]. Table 2 presents the results of logistic regression analysis for the association between transport modality and outcome (discharged/expired). Coefficient of determination (r²) was 0.840 (84%) and indicated a high-level variance explained between dependent and independent variables. GCS and ISS were significantly associated with mortality.

Table 1: Characteristics of the patients by mode of transport to the hospital

| Patient characteristics | EMS transport | Private transport (non-EMS) | p-Value |
|-------------------------|---------------|-----------------------------|---------|
| Age (mean±SD)           | 27.14±11.1    | 23.52±13.9                  | 0.022   |
| Gender (%)              |               |                             |         |
| Male                    | 213 (91.8)    | 66 (86.8)                   | 0.198   |
| Female                  | 19 (8.2)      | 10 (13.2)                   |         |
| SBP (mean±SD)           | 125.19±29.1   | 125.09±23.2                 | 0.979   |
| DBP (mean±SD)           | 71.55±19.2    | 71.89±16.2                  | 0.888   |
| Pulse (mean±SD)         | 89.91±27.6    | 92.05±31.9                  | 0.576   |
| Temperature (mean±SD)   | 35.48±6.4     | 36.12±4.0                   | 0.435   |
| GCS (mean±SD)           | 13.55±3.5     | 12.86±3.6                   | 0.699   |
| ISS (median, IQR)       | 16 (8)        | 14 (8)                      | 0.346   |
| LOS (median, IQR)       | 9.0 (8)       | 8 (9.5)                     | 0.803   |
| Outcome                 |               |                             |         |
| Discharged              | 161 (69.4)    | 54 (71.1)                   | 0.785   |
| Expired                 | 71 (30.6)     | 22 (28.9)                   |         |

SBP = Systolic blood pressure, DBP = Diastolic blood pressure, GCS = Glasgow Coma Score, ISS = Injury severity score, SD = Standard deviation, IQR = Interquartile range, LOS = Length of stay, EMS = Emergency medical service.
mortality of the patients and the mode of transport. No significant association was found between gender, age, and mode of transport, blood pressure, pulse, temperature, and the mode of transport.

Table 3 shows the association between transport modality and length of hospital stay in multivariate analysis. In this model, coefficient of determination ($r^2$) was 0.897 (90%) and indicated a high level of variance between dependent and independent variables. There was a significant association between GCS and the length of stay in hospital. None of the other variables, were found to be statistically significantly associated with the length of hospital stay.

### Discussion

The results of the present study showed that there is no significant difference in terms of mortality and length of hospital stay of trauma victims with respect to the mode of transportation from the scene of the accident to the nearest trauma center. These findings could be attributed to the fact that any delay in transporting trauma patients to the most appropriate facility because of time-wasting by EMS personnel could affect the definitive treatment options available in trauma centers. Studies on the transfer of patients to trauma centers have shown that the outcome is better than those sent to nontrauma centers regardless of the distance. A study to evaluate the effect of trauma center care on mortality of moderately to severely injured patients compared to a large nontrauma center hospitals showed that 1104 (7.4%) patients died in the ED or hospital as opposed to 4087 (27.2%) selected patients who were discharged home. After adjusting for differences in a mix of cases, including age, comorbidities, and injury severity, researchers determined that mortality of severely injured patients treated at Level I trauma centers in the course of 1 year was lower than of those treated at large nontrauma center hospitals (10.4% and 13.8%), respectively.[5]

Whether EMS transport will improve the outcome of trauma victims is still debatable. Some studies support the findings of our cohort study, in which non-EMS transport or private transport has not been shown to be inferior and might even be better in terms of the outcome of trauma patients. Demetriades et al. showed that the EMS group had a mortality rate twice that of those of the non-EMS group (28.8% vs. 14.1%).

![Figure 1: Mode of transport versus outcome (discharged and expired)](image)

![Table 2: Odds ratio for the association between transport modality and outcome (discharged, expired) after adjusting for other variables: Logistic regression analysis](table)

| Independent variable | Coefficient | OR* | 95% CI** for OR |
|----------------------|-------------|-----|----------------|
| Age (years)          |             |     |                |
| <30                  | -0.004      | 0.996 | 0.641-1.819 |
| ≥30                  | Reference   |     |                |
| Gender               |             |     |                |
| Male                 | 0.035       | 1.035 | 0.588-1.402 |
| Female               | Reference   |     |                |
| Mode of transport    |             |     |                |
| EMS                  | -0.381      | 0.683 | 0.261-1.859 |
| Public               | Reference   |     |                |
| SBP                  | -0.021      | 0.980 | 0.411-2.310 |
| DBP                  | 0.016       | 1.017 | 0.643-1.899 |
| Pulse                | 0.016       | 1.017 | 0.512-2.314 |
| Temperature          | -0.026      | 0.974 | 0.268-1.506 |
| GCS                  | -0.270      | 0.763 | 0.306-1.621 |
| ICS                  | 0.061       | 1.063 | 0.419-2.691 |

After controlling for confounding factors, the adjusted mortality of patients with ISS >15 was 28.2% for the EMS group and 17.9% for the non-EMS group ($P<0.001$).[8]

Other studies have shown a better outcome of patients transported through EMS personnel[7] and have also indicated that the EMS system would improve the country’s health-care systems since it creates a substantially faster access to care and augments a country’s capacity to deal with a wide range of emergency conditions.[8,9]

The findings of an association between ISS and mortality were also reported in a study in Iran. The results indicated that patients who died in the 1st h after admission had the highest...
ISS (average of 70.2) whereas those who died after 72 h had the lowest ISS.[10,11]

In terms of GCS and predictability of clinical outcome, our study showed a significant correlation between GCS and the length of hospital stay. Similar findings were reported by a previous study, in which it was found that using GCS, age and SBP (GAP score) could predict in-hospital mortality more accurately than using other trauma scoring systems.[12]

Limitations
For this study, we adopted retrospective design, which carries the risk of case selection bias. In addition, we measured only GSS and ISS of the two groups in terms of morbidity conditions. Therefore, we recommend that future studies should include a look at other modes of transport associated complications or morbidities that may affect GCS or ISS.

Conclusion
In terms of mortality and length of hospital stay of patients who are injured in MVC, there is no statistically significant difference between those transported through EMS and those who are not. However, the mortality and the length of hospital stay are statistically significant with higher ISS and lower GCS, which are considered major disability measures after trauma. Further prospective studies are required to confirm this conclusion and study other morbidity conditions in both groups.

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Conflicts of interest
There are no conflicts of interest.

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