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Trauma profile at a tertiary intensive care unit in Saudi Arabia

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BACKGROUND AND OBJECTIVES: Trauma is a leading cause of death worldwide and in Saudi Arabia. This study describes the injury profiles and ICU outcomes of patients in a tertiary trauma care referral center in Riyadh, Saudi Arabia.

DESIGN AND SETTING: A retrospective analysis of ICU data collected prospectively over 5 years in a 21-bed medical and surgical intensive care unit (ICU) in a tertiary care teaching hospital.

PATIENTS AND METHODS: We collected ICU data on all patients admitted secondary to motor vehicle accidents (MVAs), excluding patients younger than 18 years, brain dead patients and readmissions. We collected data on age, gender, and Glasgow coma scale score at admission, injury severity scores, Acute Physiology and Chronic Health Evaluation II (APACHE II) score, and other data. Multivariate logistic regression was used to identify predictors of mortality.

RESULTS: During the study period, of 1659 patients, MVA was the most common cause of injury (78.4%), followed by pedestrian accident (12.7%). ICU mortality included 221 patients (13.3%) during the study period. Severe head injury, age > 60 years, Glascow coma scale score, injury severity scores, APACHE II and international normalized ratio were independent predictors of mortality.

CONCLUSION: MVA is very common in our country and leads to significant mortality and morbidity. Public education and strict law enforcement are needed to reduce these adverse events.

Trauma is a leading cause of death worldwide and in Saudi Arabia.[1] Motor vehicle accidents (MVA) are a major health hazard worldwide and traumatic injury secondary to MVA is a leading cause of mortality, morbidity and disability worldwide in young adults.[2] In the United States, approximately 95 per 100 000 people sustain injuries that require hospitalization per year,[3] which leads to approximately 15 deaths per 100 000 people per year.[4] Due to the rapid expansion of road construction and the number of vehicles in Saudi Arabia, MVAs are a major public health issue.[5] MVA victims occupy 20% of the ministry of health beds and account for 80% of deaths in ministry of health hospitals.[6] The social, emotional and financial costs of supporting MVA survivors are substantial because MVA-related disabilities persist for many years.[7] Approximately 75% of handicapped people in Saudi Arabia were injured in an MVA, and more than half of these accidents were classified as severe.[8] On average,

one person is killed and four are injured every hour in the Saudi Arabia.[6] The annual expenditure of managing MVAs in the country is estimated to be approximately 2% to 9% of the total national income.[9] Over the course of the last 25 years, approximately 3.5% of the total population was either injured or killed in MVAs.[6] Very few studies have reported injury profiles and outcomes from Saudi Arabia;[10-12] however, many studies have reported injury profiles and outcomes in the United States and Europe.[13-15] We describe MVA-related injury profiles and outcomes in a tertiary trauma care referral center in Riyadh, Saudi Arabia.

PATIENTS AND METHODS

The study was conducted in a 21-bed medical and surgical intensive care unit (ICU) in a 900-bed tertiary care teaching hospital in Riyadh, Saudi Arabia. This ICU is a closed unit that is administrated by in-

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house, full-time, and board-certified intensivists and has more than 1100 admissions per year. This study was approved by the local institutional review board (IRB) of King Abdulaziz Medical City, Riyadh.

We prospectively collected ICU data on all patients who were admitted to the ICU secondary to MVAs between September 1999 and December 2009. We excluded patients who were younger than 18 years, brain dead patients and readmissions. We collected the following data: baseline demographics, including age, gender, and Glasgow coma scale (GCS) score on admission, in addition to body mass index (BMI), lactic acid level, international normalized ratio, platelet count, serum creatinine, the use of vasopressors, mechanical ventilation duration (MVD) (calculated as the number of calendar days on mechanical ventilation), the type of injury, injury severity scores (ISS), and the Acute Physiology and Chronic Health Evaluation II (APACHE II) scores. Patients were followed until discharge from the hospital or death, whichever occurred first.

Continuous data are expressed as the mean (standard deviation) and were compared using the t test. Categorical data are expressed as percentages and were compared using the chi-square test. To identify predictors of ICU mortality, stepwise multivariate logistic regression analyses were carried out, which included clinically and statistically significant variables. Statistical significance was defined as an alpha of less than .05. Statistical analyses were performed using Minitab for Windows (release 13.1).

RESULTS

The study included 1659 patients. **Table 1** describes the baseline characteristics of patients who were divided into two groups: those who survived (1438 patients) and those who died in the ICU (221 patients). The two groups were similar in terms of gender and BMI. Patients who died were older (aged more than 60 years), had higher ISS, higher APACHE II scores, higher lactic acid levels, higher serum creatinine levels, higher INR levels, and had higher platelet counts. In addition, these patients had more head, abdominal, thoracic, and fewer maxillo-facial injuries and were more reliant on inotropes and mechanical ventilation in comparison to those who survived. As indicated in **Table 2**, MVA was the most common cause of injury.

Patients who died during their ICU stay had shorter ICU length of stay, shorter mechanical ventilation durations, higher APACHE II scores, higher mortality predicted models on admission to the ICU (MPM0s) and higher mortality predicted models

Table 1. Characteristics of the patients who were included in this study.

Variable	Survived (n=1438)	Died (n=221)	P
Age (years)	**29.8 (13.84)**	**34.1 (17.7)**	
<60	1363 (94.8)	195 (88.2)	<.0001
≥60	75 (5.2)	26 (11.8)	.0002
Sex			
M	1335 (92.8)	209 (94.6)	.34
F	103 (7.2)	12 (5.4)	.39
Injury severity score	24.0 (11.3)	31.4 (14.8)	<.0001
Glascow coma scale score	8.4 (4.3)	4.7 (3.1)	<.0001
APACHE II	17.2 (6.5)	25.5 (6.4)	<.0001
Body mass index (kg/m²)	26.0 (6.1)	26.0 (6.0)	0.93
Lactic Acid (mg/dL)	2.84 (2.1)	4.9 (3.5)	<.0001
Creatinine (mg/dL)	82.2 (46.6)	114.7 (96.5)	<.0001
International normalized ratio	1.3 (0.5)	1.8 (1.6)	<.0001
Platelet count (×103/μL)	193.2 (109.7)	139.6 (80.7)	<.0001
Use of inotropes	616 (42.8)	133 (60.2)	<.0001
Use of mechanical ventilation	129 (90.2)	215 (97.2)	.0006
Types of injuries			
Head	866 (60.2)	176 (79.6)	<.0001
Abdomen	261(18.1)	54 (24.4)	.03
Thoracic	503 (34.9)	55 (24.9)	.003
Maxillofacial-head neck	348 (24.2)	36 (16.3)	.01
Vascular	79 (5.5)	12 (5.4)	0.97
Lower extremity fractures	348 (24.2)	42 (19)	.09
Upper extremity fractures	247(17.2)	34 (15.4)	0.5
Other ortho/soft tissues	66 (4.6)	6 (2.7)	0.2
Pelvic fractures	229 (15.9)	37 (16.7)	0.76
Spinal injury no paralysis	229 (15.9)	24 (10.9)	.051
Spinal injury + paralysis	56 (3.9)	4 (1.8)	0.12

Values are expressed as the mean (standard deviation) or as number (percent). APACHE II: Acute Physiology and Chronic Health Evaluation II

after 24 hrs of ICU admission (MPM24s) (**Table 3**). Severe head injury, age >60 yrs, ISS, APACHE II score, INR and GCS score were found to be independent predictors of mortality in these patients (**Table 4**).

Table 2. The mechanism of trauma.

Type of Trauma	All 1659	Survived 1438 (86.7)	Died 221 (13.3)
Motor vehicle accident	1301 (78.4)	1160 (80.6)	141 (63.8)
Pedestrians	212 (12.7)	177 (12.3)	35 (15.8)
Cycle	17 (1.0)	14 (1)	3 (1.4)
Gunshot injury	28 (1.7)	28 (1.9)	0
Penetrating injury	53 (3.2)	47 (3.2)	6 (2.7)
Other	48 (2.9)	12 (0.8)	36 (16.2)

Values are expressed as number (percent).

Table 3. Patient outcomes.

Variable	All	Survived	Died	P
ICU length of stay	11.4 (15)	12 (15)	8 (8)	<.0001
MV duration	9 (9)	9 (9)	7 (8)	.006
Pred Mortality APACHEII	20 (17.7)	17.89 (15.76)	40.96 (22.1)	<.0001
Pred Mortality MPM0	25.1 (20.1)	21.68 (17.22)	47.4 (23.22)	<.0001
Pred Mortality MPM24	27.2 (22.6)	25.2 (21.2)	42.85 (26.89)	<.0001

Values are expressed as the mean (standard deviation) or as number (percent). APACHE II: Acute Physiology and Chronic Health Evaluation II. MPM0: mortality predicted models on admission to ICU. MPM24: mortality predicted models after 24 hrs of ICU admission

Table 4. Predicators of hospital mortality.

Variable	Adjusted odds ratio (95% C)	P
Head injury	1.85 (1.2-2.84)	<.05
Age	1.02 (1.0-1.02)	<.05
Injury severity score	1.04 (1.02-1.06)	<.05
APACHE II	1.11 (1.07-1.14)	<.05
International normalized ratio	1.39 (1.1-1.7)	<.05
Glasgow coma scale	1.32 (1.25-1.41)	<.05

All continuous variables are expressed as per unit increases: age, injury severity score, APACHE II (Acute Physiology and Chronic Health Evaluation II), international normalized ratio, and Glasgow coma scale.

DISCUSSION

Our study demonstrates that MVA was the dominant cause of trauma. Advanced age, a higher ISS, head injury and GCS score are predictors of worse outcomes for critically ill trauma patients who were admitted to our ICU. The economic costs of trauma are high because most of the injuries occur in young individuals.[16]

Trauma deaths among young people tend to deplete the pool of human resources.[9,16] MVAs are the leading cause of injury-related deaths worldwide, especially in Saudi Arabia. The recent sharp rise in living standards in the country has resulted in dramatic changes to the road network and an increase in the number of cars, which have resulted in an increase in the number of MVAs. Further, MVAs are associated with the most severe cases of injury and are the leading cause of death. Driver error was the primary contributing factor for MVAs in Saudi Arabia; alcohol and drug abuse are not common factors for MVAs because these substances are banned in the country.[17] Unfortunately, many programs have failed to educate drivers on improved safety. This trend is consistent across several developed countries. The low percentage of female patients in the current study can be explained by the fact that females are not allowed to drive vehicles in Saudi Arabia.[12]

MVAs are associated with the most severe cases of head injury and are the most common cause of death. Traumatic head injury is the leading cause of death and morbidity.[18] Bahloul et al have conducted a retrospective study regarding the prognosis of trauma in Tunisia and found that MVA is the most common cause of trauma, which is similar to our finding, but contrary to studies in the United States.[16] There are conflicting results on the influence of age on the outcome of trauma due to disparate sample sizes and the lack of other confounding factors that affect trauma outcome.[19]

In accordance with other studies, mortality is higher in the elderly; this might be explained by the fact that the young victims tolerate periods of coma or decerebration better than the elderly and by the presence of preexisting disease and an exaggerated physiological response of elderly patients to a given level of injury.[16,19] Although this group represents a small group of trauma patients, these patients require a disproportionate amount of health resources.[20] The GCS is a useful tool and should be meticulously and carefully performed.[16] The correlation of outcome with the GCS score on admission, as demonstrated in our cohort, has been well established by earlier studies.[16,21]

In our study, the ISS was found to be an independent predictor of mortality, as in other studies.[16,22] As in our study, other studies from the Middle East have also found that the ISS is a predictor of mortality.[23] Wong and his colleagues have conducted a prospective study of consecutive trauma patients who were admitted to a medical-surgical ICU in Toronto, Canada and found that both APACHE II scores and ISS accurately predict mortality in ICU trauma patients, which is a finding that is similar to our results.[24] Patients who present

with severe head injury are at the highest risk for the development of complications and poor outcomes.[25] Our findings highlight the high resource-requirements that are associated with patients with trauma, wherein a high proportion of patients require mechanical ventilation and tracheotomy.[7] Our study did not reveal any impact of obesity on the outcome of trauma patients, which is in contradiction to a previous study in which obesity was found to be an independent predictor of mortality.[26]

This study has several strengths. The data was analyzed from a prospectively collected database from a tertiary care referral center. As a limitation, the data used were obtained from an ICU database, and information regarding host factors, such as a patient's physiological reserves and pre-injury medical status, which could influence mortality after major trauma, were not recorded. In conclusion, MVAs are very common in our country, leading to significant mortality and morbidity. Nationwide prevention programs in terms of public education and strict law enforcement are needed to reduce these adverse events.

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