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ORIGINAL RESEARCH

Associated Factors of the Need for Mechanical Ventilation Following Traumatic Injuries; a Registry-Based Study on 2,708 Cases in Iran

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Abstract: **Introduction:** Traumatic injuries can affect respiration both directly and indirectly. This study aimed to evaluate the predictive factors of need for mechanical ventilation (MV) following traumatic injuries. **Methods:** This Retrospective registry-based cross-sectional study comprised trauma patients admitted to a major referral trauma center in Iran, from March 28, 2019, to January 31, 2023, identified within the National Trauma Registry of Iran (NTRI). Logistic regression analysis was used to assess the association between demographic and clinical variables with the need for MV.
Results: A total of 2708 trauma patients with a mean age of 41.79 ± 21.84 (range:1-98) years were included (73.4% male). A total of 251 (9.3%) patients were admitted to the Intensive Care Unit (ICU); 113 (4.2%) experienced MV. The significant associated factors of need for MV based on the univariable analysis were age ≥ 65 years (p <0.001); penetrating trauma (p < 0.001) and falling (p = 0.01); private mode of transportation to ED (p < 0.001); site of injury (p < 0.001); heart rate ≥ 100/ minutes (p = 0.04); O2 saturation < 90 % on room air (p < 0.01); Glasgow Coma Scale (GCS) < 13 (p< 0.001); and injury Severity Score (ISS) ≥ 9 (p< 0.001). Based on the multivariate logistic regression analysis, the independent predictors of the need for MV in trauma patients were the site of injury (p < 0.001), GCS < 13 (p < 0.001), and ISS ≥ 9 (p < 0.001).
Conclusion: Based on the findings, ISS ≥ 9, GCS < 13, and site of injury were among the independent predictors of the need for MV following trauma.

Keywords: Wounds and injuries; Registries; Respiration; Accidental falls; Medical records

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1. Introduction

Trauma stands as the prevalent cause of mortality in individuals within the first three decades of life and ranks as the third leading cause of death across all age groups (1). Trauma is among Iran's leading causes of mortality and morbidity, as well (2, 3). The diverse spectrum of traumatic injuries contributes to the severity of lung injury, underscoring the essential need for a strong system to promptly escalate ventilatory support when required (1). Traumatic injuries can affect respiration directly and indirectly. In trauma cases, mechanical ventilation (MV) focuses on preserving brain tissue, with respiratory function being of secondary importance (4, 5). With a rising number of severe trauma cases, it is crucial for physicians to be well-informed about various aspects of respiratory support in traumatic situations (5).

Numerous previous studies have delved into the predictive factors associated with the need for MV in trauma patients. These investigations have highlighted various critical variables that can significantly impact the need for MV and subsequent patient outcomes. In recent studies conducted in major trauma centers, it was found that the Glasgow Coma Scale (GCS) scores on admission were strongly correlated with the need for MV in trauma patients. Patients with lower GCS scores were more likely to require MV due to the severity of their injuries and impaired neurological status (6, 7).

Additionally, the role of injury severity in predicting the need for MV in trauma cases has been investigated in a wide range of studies (8, 9). Patients with higher Injury Severity Scores (ISS) were found to have a significantly increased chance of requiring MV during their treatment (8, 9).

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Based on the above-mentioned points, this study aimed to investigate the epidemiological and clinical characteristics of patients admitted to a major trauma center, focusing on the predictive factors associated with the need for MV.

2. Methods

2.1. Study design and setting

This retrospective registry-based cross-sectional study comprised trauma patients admitted to Taleghani Hospital, Kermanshah, a major referral trauma center in Iran, from March 28, 2019, to January 31, 2023, identified within the National Trauma Registry of Iran (NTRI) (10, 11). The logistic regression analysis was used to assess the association between demographic and clinical variables and the need for MV.

As a result of the high burden of trauma mortality and morbidity in the Iranian population, the NTRI was founded in 2014 by the Ministry of Health and Medical Education (MOHME). NTRI was appointed to the Sina Trauma and Surgery Research Center (STSRC) to improve trauma care delivery. Many major centers have joined the program since then. One of the joined centers was a major referral trauma center in Kermanshah, in the western part of Iran. With an area of 23,361 square kilometers, it accounts for almost 1.6% of the country's total land area, and with a population of 1,938,060, it accounts for about 2.5% of its total population.

The study protocol was based on the tenets of the Declaration of Helsinki. This study was approved by the ethics committee of Sina Hospital, Tehran University of Medical Sciences (Approval ID: IR.TUMS.SINAHOSPITAL.REC.1399.090).

2.2. Participants

The inclusion criteria for the admitted patients in all collaborating hospitals were the following: hospitalization for more than 24 hours, transferring from other centers' intensive care unit (ICU), or post-trauma death. Each patient meeting the above criteria and admitted at Taleghani Hospital, Kermanshah, Iran, between March 28, 2019, and January 31, 2023, was included in this study. Patients who were admitted due to non-traumatic causes and those who were discharged under 24 hours were excluded from the study.

2.3. Data gathering (Registry Process)

An expert panel was developed with 16 experts in five specialties: traumatologists, trauma epidemiologists, health information system experts, surgeons, and emergency medicine specialists from various active trauma registries nationwide. The expert panel determined the inclusion criteria and the minimum dataset (MDS) required for the registry questionnaire (10). Based on the main NTRI protocol, the adopted MDS for this study consisted of 99 variables: demographic data (n=18), injury characteristics (n=20), prehospital data (n=22), emergency department information (n=23), injury severity indicators (n=3), diagnosis (n=2), procedures (n = 2), outcomes (n = 6), and financial points (n = 3). Three registrars with a medical background were trained for the program and filled out the questionnaires. Patients' data were retrieved through documented profiles, interviews with the patients, and the center's administrative database, known as the Health Information System (HIS). If the patient was not well-oriented, an interview with their informed acquaintances was performed. The retrieved data were uploaded to the NTRI web-based portal utilizing "C#.net 4" as language and "SQL-server 2012 r2" as server software. Data were also double-checked by an experienced reviewer for completeness and validity. Furthermore, the accuracy of input injury severity data was appraised by a surgeon using the Abbreviated Injury Scale (AIS), AIS pre-dot code, and (ISS), based on instructions defined by the Association for Advancement of Automotive Medicine (AAAM) (12).

The causes of injury were divided into four main groups: Road Traffic Injuries (RTIs), penetrating injuries due to stab and/or cut, falling, and others. Falling was defined by the WHO as an unintentional drop to the ground or lower level (13). Drowning, animal attacks, burns, heat injuries, and unknown reasons are all laid in "others" categories.

The AIS was employed for grading injury severity. Afterwards, ISS was calculated based on AIS scores, which ranged from 1 to 75 (14, 15). Multiple trauma refers to individuals who have sustained injuries in more than one body area, regardless of the severity of those injuries (16, 17). GCS was categorized as mild injury (13-15), moderate (9-12), and severe (3-8), based on the literature (18).

Systolic blood pressure (SBP) ≤ 90 mmHg was defined as low SBP. Tachycardia was defined as heart rate (HR) ≥ 100 beats per minute. Tachypnea was determined by respiratory rate (RR) ≥ 20 breaths per minute; O2 saturation < 90% on room air represented hypoxemia, and temperature < 36 °C was considered a representative of hypothermia.

2.4. Outcome

The main studied outcome in this study was need for MV as respiratory support.

2.5. Statistical analysis

Frequency and percentage were used to describe nominal and categorical variables. The association between clinical and demographic variables with MV was assessed using univariable and multivariable logistic regression models. P<0.05 was considered statistically significant. Statistical analyses were conducted using the STATA software version 15.0 (Stata Corp, College Station, TX, USA).

3. Results

3.1. Baseline characteristics of studied cases

A total of 2708 trauma patients with a mean age of 41.79 ± 21.84 (range:1-98) years were included (73.4% male). The baseline characteristics of the studied patients are outlined in Table 1. The first two most common quarterly dividend admission times were 12-18 and 18-24, reported in 927 (34.2%) and 877 (19.5%) cases, respectively. Falling and RTIs were the main two causes of injuries, reported in 1267 (46.8%) and 1054 (38.9%) trauma patients, respectively. The mode of transport in 1444 (53.3%) patients was through a private car, whereas in 1208 (44.6%) was an ambulance. Intentional trauma was documented in 228 (8.4%) cases. The most common injury site was extremities, registered in 1722 (63.6%), followed by multiple trauma in 473 (17.5%) cases.

At the time of admission, 84 (3.1%) experienced hypotension, 82 (3%) presented with tachycardia, 657 (24.2%) presented with tachypnea, and 13 (0.5%) presented with hypothermia. The ISS was ≤ 8 in 1992 (73.6%) cases, 9-15 in 626 (23.1%), and ≥ 16 in 67 (2.5%) patients.

3.2. Associated factors of need for MV based on univariate analysis

A total of 251 (9.3%) patients were admitted to the ICU; 113 (4.2%) experienced MV. Table 1 compares the baseline and clinical characteristics of studied patients between cases with and without the need for MV.

The significant associated factors of need for MV based on the univariable analysis were age ≥ 65 years (p <0.001); penetrating trauma (p < 0.001) and falling (p = 0.01); private mode of transportation to ED (p < 0.001); site of injury (p < 0.001); HR ≥ 100/ minutes (p = 0.04); O2 saturation < 90 % on room air (p < 0.01); GCS < 13 (p< 0.001); and ISS ≥ 9 (p< 0.001).

The odds of need for MV in traumatic patients with head and neck injuries were 12 times higher than those with extremity injuries (odds ratio (OR): 12, 95% confidence interval (CI): 6.89 to 20.89). Unadjusted OR of need for MV was 20.79 (13.38 to 32.30) and 66.63 (32.43 to 136.89) times higher in patients with GCS: 9-12 and GCS: 3-8, compared to those with GCS: 13-15. The odds of MV in patients with severe (i.e., ISS≥16) and moderate (i.e., ISS:9-15) trauma severity was 24.50 (95%CI: 13.13 to 45.71) and 5.76 (95%CI: 3.73 to 8.91) times more, compared to patients with mild ISS (i.e., ISS: 1-8).

While adjusted for body region and ISS, the odds of need for MV in GCS:9-12 and 3-8 decreased to 12.35 (95%CI: 7.63 to 20.01) and 24.94 (95%CI: 11.03 to 56.38), respectively (p < 0.001). Besides, when adjusted for GCS and ISS, the odds of experiencing MV in head and neck injuries decreased to 6.50 (95%CI: 3.40, 12.43) compared to extremities.

3.3. Associated factors of need for MV based on multivariate analysis

Based on the multivariate logistic regression analysis (table 2), the independent predictors of the need for MV in trauma patients were the site of injury (p < 0.001), GCS < 13 (p < 0.001), and ISS ≥ 9 (p < 0.001).

The adjusted odds of need for MV in severe (i.e., ISS ≥ 16) and moderate (i.e., ISS:9-15) cases were 4.59 (95%CI: 2.15 to 9.82) and 4.78 (95%CI: 2.87 to 7.95) times more, compared to mild ISS (i.e., ISS: 1-8).

4. Discussion

This study explored the epidemiological and clinical characteristics of trauma patients admitted to a major trauma center in Kermanshah, Iran, focusing on the factors associated with the need for MV. Our findings revealed significant associations between injury severity, GCS score, and site of injury with the need for MV in trauma patients. These results provide critical insights into the predictors of MV in trauma patients, which can help guide clinical management and resource allocation in trauma care. The results demonstrated that 4.2% of the trauma patients required MV, with the need for MV being significantly associated with lower GCS scores, higher ISS scores, and specific sites of injury such as the head/neck and spine/back. Among all, the most significant predictor of need for MV was GCS scores (3-8), followed by GCS scores (9–12). This highlights the critical role of impaired consciousness in predicting the need for respiratory support. There are potential advantages in undergoing MV for these patients, including airway protection against aspiration, enhanced oxygenation, and continuous ventilation control (19, 20). Moreover, the current study, in line with the findings of Feyh et al. and Pasquali et al., emphasizes the utility of ISS as a tool for assessing the severity of trauma and predicting the need for advanced respiratory support (8, 9). Patients with severe trauma (ISS ≥16) were significantly more likely to require MV. Patients with high ISS were more likely to have multisystem trauma, which can lead to hypoxia, acidosis, and systemic inflammatory responses (21), all of which contribute to respiratory failure and the need for MV. These findings are consistent with the understanding that severe injuries and compromised neurological status necessitate respiratory support to maintain adequate oxygenation and ventilation (22).

In a single-center study by Fazel et al., the extremities were the most common site of injury (58.8%), followed by the head, neck, and spine (31.2%) (23). In another study by Yadollahi et al., extremity injuries were reported in 43.6%, followed by head and neck injuries in 33.9% (24). However, in this study, extremities were the leading zone of injury (63.6%); subsequently, multiple trauma (17.5%) and head/neck injury (10.3%) took second and third place, respectively. The main rationale behind these differences is the unique category of body regions in each study, as none of the above studies developed a "multiple trauma" item to their region as we did. In terms of site of injury, patients with head/neck and spine/back injuries had a significantly higher chance of requiring MV compared to those with extremity injuries. These results suggest that traumatic injuries to critical anatomical regions, particularly those affecting the central nervous system (CNS) or respiratory pathways, play a pivotal role in determining the need for MV (25). This aligns with prior research indicating that respiratory compromise due to neurological dysfunction or airway compromise often necessitates MV in trauma patients (25).

Although the mechanism of injury was not directly associated with the need for MV, it highlights the high burden of trauma in the studied region and the importance of preventive measures. Surprisingly, in the current study, road traffic injury was the second leading cause of trauma after falling, affecting 1,054 (38.9%) cases. In a previous study of NTRI in a major trauma Center in Tehran, encompassing 3,430 cases, RTC was the first cause of trauma (26). However, in this study, falling-related injuries surpassed RTC. The altered distribution of injury mechanisms in this study might probably be due to lifestyle habits, occupational practices, age demographics within this region, the center's nature, and its county's cultural background. Furthermore, since in Kermanshah province many people live in rural areas (37.7%), agricultural-related injuries like falling while picking up fruits/crops could happen more in this population (27). Another cause of the rising number of falling-related injuries in this province is linked to the hazardous work of kolberi, a prevalent but perilous form of labor in some Iranian border regions and villages over the past decade (28). Kolbers must go several kilometers through long mountainous routes with heavy loads. Thus, they are prone to the risk of falling from heights (28, 29). Kolberi, exposes workers to fatal risks, particularly falling off cliffs while running for their lives or during their nightly journeys (30).

O2 saturation had the most missing data, with 772 cases. We performed the multiple logistic regression model once again, only on patients whose O2 saturation we had (1936 patients). In line with our current finding, new results also showed that GCS, ISS, and body regions had a significant association with MV (without any significant relationship with the O2 saturation) in these patients. Consequently, we found that this missing data couldn't cause any bias in our results and conclusion.

The findings of this study have important clinical implications. Early identification of trauma patients at high risk for MV based on GCS, ISS, and site of injury can allow healthcare providers to prioritize interventions, allocate resources efficiently, and potentially improve outcomes. For example, patients presenting with head, neck, or spine injuries should be closely monitored for signs of respiratory compromise, and early intubation should be considered in those with severe injuries or low GCS scores. These findings also highlight the need for effective prehospital care and rapid transport to trauma centers equipped to provide advanced respiratory support.

In this study, 55.1% of cases were admitted to hospital in less than 100 minutes. It is reported that a one-minute increase in prehospital response time may elevate the risk of mortality by 17% (31). In this regard, there is a generally growing belief in "the golden hour" immediately following injury, which might remarkably affect patients' outcomes (32, 33). In summary, in a comprehensive systematic review assessing the influence of prehospital time, it is postulated that rapid transport is beneficial for patients with neurotrauma and hemodynamically unstable penetrating injuries (32).

Altogether, these findings may assist us in developing our healthcare system by providing patient care proportionate to their baseline clinical and demographic findings. These insights can also inform and refine trauma care policies in other regions, especially developing countries with similar healthcare challenges. By leveraging this data, healthcare systems can prioritize resource allocation, improve trauma management strategies, and enhance public education to reduce trauma incidence and improve patient outcomes. Such data-driven approaches are crucial for advancing the quality of trauma care and saving lives in low- and middle-income countries.

5. Limitations

Although a comprehensive process of data retrieval was accomplished in this study, considerable missing data might affect the results. Further studies should be performed with less missing data. One potential issue may arise from the inclusion and exclusion criteria we established. Selection bias could be introduced by potentially omitting less severe trauma cases that may differ significantly from those included in our study. Also, discrepancies in data reporting could still arise due to subjective interpretations during patient interviews or information retrieval, especially in patients who were not well-oriented. To reduce this risk, we trained registrars and employed a dual-data-checking process. Nevertheless, a conspicuous number of included patients in this study may help us generalize our findings to other Iranian and other nations' populations. Long-term follow-up of included patients may extend our understanding of outcomes and the effects of each variable on them. Besides, due to the small number of deceased cases in this study (39 (1.4%)), calculating adjusted OR was not applicable.

6. Conclusions

This study highlights the significant association between GCS < 13, ISS ≥ 9, and injury sites with the need for MV in trauma patients. The findings underscore the importance of early identification and management of patients with severe trauma or compromised neurological status. These results provide valuable insights for clinicians and policymakers to enhance trauma care systems, particularly in resource-limited settings. Further research is warranted to explore long-term outcomes and evaluate the impact of targeted interventions on reducing the need for MV and improving trauma care.

7. Declarations

7.1. Acknowledgments

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7.2. Author Contribution

P.S., Kh.N., and V.B. contributed to the study design and methodology. V.R. and M.Z. supervised and modified the whole process. Z.R. contributed to the manuscript provision, data analysis, and submission process. M.H. and R.F. contributed to writing the original draft. S.P. helped in study coordination. All authors have read and approved the manuscript.

7.3. Funding/Support

This study was funded by the Sina Trauma and Surgery Research Center.

7.4. Competing interests

The authors declare that they have no conflict of interest.

7.5. Ethical consideration

The study protocol was based on the tenets of the Declaration of Helsinki. This study was approved by the ethics committee of Sina Hospital, Tehran University of Medical Sciences (Approval ID: IR.TUMS.SINAHOSPITAL.REC.1399.090).

7.6. Patient consent for publication

Not required.

7.7. Availability of data and materials

We have presented all the necessary data in this manuscript. Further data can be accessed via the corresponding author upon reasonable request.

7.8. Using artificial intelligence chatbots

No artificial intelligence chatbots were used in this study.

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Table 1: Association between baseline and clinical characteristics of patients and need for mechanical ventilation (MV) based on univariable analysis (N = 2708)

Variables	N (%)	Need for MV		OR (95%CI)	P-value
		Yes	No		
Gender					
Male	1989 (73.4)	91 (80.5)	1898 (73.1)	1	—
Female	719 (26.6)	22 (19.5)	697 (26.9)	0.65 (0.40 to 1.05)	0.08
Age (years)					
< 18	345 (12.7)	10 (8.8)	335 (12.9)	1	—
18 - 64	1876 (69.3)	73 (64.6)	1803 (69.5)	1.35 (0.69 to 2.65)	0.37
≥ 65	487 (18)	30 (26.5)	457 (17.6)	2.19 (0.01 to 0.05)	<0.001
Trauma to ED time (minutes)					
≤ 100	1493 (58.3)	66 (62.3)	1427 (58.1)	1	—
> 100	1069 (41.7)	40 (37.7)	1029 (41.9)	0.84 (0.56 to 1.25)	0.39
Missing	146	7	139		
Mechanism of trauma (based on CDC definitions)					
Unintentional	2478 (91.6)	107 (96.4)	2371 (91.4)	1	—
Intentional	228 (8.4)	4 (3.6)	224 (8.6)	0.39 (0.14 to 1.08)	0.07
Missing	2	2	0		
Cause of Injury					
Penetrating trauma	293 (10.8)	4 (3.5)	289 (11.1)	0.22 (0.08 to 0.63)	<0.001
RTI	1054 (38.9)	60 (53.1)	994 (38.3)	1	—
Falling	1267 (46.8)	46 (40.7)	1221 (47.1)	0.62 (0.42 to 92)	0.01
Other	94 (3.5)	3 (2.7)	91 (3.5)	0.54 (0.16 to 1.77)	0.31
Occurrence time					
00-06	374 (13.8)	21 (18.6)	353 (13.6)	1	—
06-12	529 (19.5)	20 (17.7)	509 (19.6)	0.66 (0.35 to 1.23)	0.19
12-18	927 (34.2)	36 (31.9)	891 (34.3)	0.67 (0.39 to 1.17)	0.17
18-24	877 (32.4)	36 (31.9)	841 (32.4)	0.71 (0.41 to 1.25)	0.24
Mode of transportation					
Ambulance	1208 (44.6)	72 (63.7)	1136 (43.8)	1	—
Private car	1444 (53.3)	39 (34.5)	1405 (54.2)	0.43 (0.29 to 0.65)	<0.001
Other	55 (2.0)	2 (1.8)	53 (2.0)	0.59 (0.14 to 2.49)	0.47
Missing	1	0	1		
Site of injury					
Extremities	279 (10.3)	36 (31.9)	243 (9.4)	1	—
Head and neck	87 (3.2)	8 (7.1)	79 (3.0)	12 (6.89 to 20.89)	<0.001
Thorax	32 (1.2)	1 (0.9)	31 (1.2)	8.20 (3.52 to 19.09)	<0.001
Abdomen	115 (4.2)	6 (5.3)	109 (4.2)	2.61 (0.34 to 20.04)	0.35
Spine and back	473 (17.5)	41 (36.3)	432 (16.6)	4.45 (1.76 to 11.27)	<0.01
Multiple Trauma	1989 (73.4)	91 (80.5)	1898 (73.1)	7.68 (4.49 to 13.14)	<0.001
SBP (mmHg)					
> 91	2616 (96.9)	105 (94.6)	2511 (97.0)	1	—
≤ 91	84 (3.1)	6 (5.4)	78 (3.0)	1.84 (0.78 to 4.31)	0.16
Missing	8	2	6		
Heart rate (/minutes)					
<100	2621 (97.0)	104 (93.7)	2517 (97.1)	1	—
≥ 100	82 (3.0)	7 (6.3)	75 (2.9)	2.25 (1.01 to 5.02)	0.04
Missing	8	2	6		
Respiratory rate (/ minutes)					
<20	2035 (75.6)	85 (76.6)	1950 (75.6)	1	—
≥ 20	657 (24.4)	26 (23.4)	631 (24.4)	0.94 (0.60 to 1.48)	0.80
Missing	16	2	14		
O2 saturation (%)					
≥ 90	1811 (93.5)	72 (71.3)	1739 (94.8)	1	—
<90	125 (6.5)	29 (28.7)	96 (5.2)	7.29 (4.52 to 11.76)	<0.01
Missing	772	12	760		

Table 1: Association between baseline and clinical characteristics of patients and need for mechanical ventilation (MV) based on univariable analysis (N = 2708)

Variables	N (%)	Need for MV		OR (95%CI)	P-value
		Yes	No		
Temperature (°C)					
≥ 36	2597 (99.5)	104 (100)	2493 (99.5)	1	—
<36	13 (0.5)	0 (0.0)	13 (0.5)	NA	0.99
Missing	98	9	89		
GCS					
13-15	2437 (90.3)	38 (33.6)	2399 (92.7)	1	—
9-12	226 (8.4)	56 (49.6)	170 (6.6)	20.79(13.38-32.30)	<0.001
3-8	37 (1.4)	19 (16.8)	18 (0.7)	66.63(32.43-136.89)	<0.001
Missing	8	0	8		
ISS					
Mild (1-8)	1992 (74.2)	34 (30.6)	1992 (74.2)	1	—
Moderate (9-15)	626 (23.3)	57 (51.4)	626 (23.3)	5.76 (3.73 to 8.91)	<0.001
Severe (≥16)	67 (2.5)	20 (18.0)	47 (1.8)	24.50 (13.13-45.71)	<0.001
Missing	23	2	21		

Data are presented as number (%) and crude odds ratio (OR) with 95% confidence interval (CI). RTI: Road Traffic Injuries; CDC: Disease Control and Prevention; SBP: Systolic Blood Pressure; ED: Emergency Department; ISS: Injury Severity Score; GCS: Glasgow Coma Scale; NA: not applicable. A P-value less than 0.05 was considered statistically significant. All measures are recorded at the time of admission to the emergency department.

Table 2: Multivariate logistic regression analysis of the association between the need for mechanical ventilation (MV) and characteristics of trauma patients

Variables	Adjusted OR (95% CI)	P-value
Site of injury		
Extremities	1	Ref.
Head and neck	6.50 (3.40 to 12.43)	<0.001
Thorax	5.44 (2.03 to 14.58)	<0.01
Abdomen	1.90 (0.22 to 15.83)	0.55
Spine and back	7.55 (2.66 to 21.41)	<0.001
Multiple trauma	4.59 (2.45 to 8.58)	<0.001
Glasgow Coma Scale (GCS)		
13 to 15	1	Ref.
9 to 12	12.35 (7.63 to 20.01)	<0.001
3 to 8	24.94 (11.03 to 56.38)	<0.001
Injury Severity Score (ISS)		
<9	1	Ref.
9 to 15	4.78 (2.87 to 7.95)	<0.001
≥16	4.59 (2.15 to 9.82)	<0.001

OR: odds ratio; CI: confidence interval. A P-value less than 0.05 was considered statistically significant.