

ORIGINAL ARTICLE

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Evaluation of the relationship between the level of spinal vertebra injuries due to traffic accidents and additional injuries**Celil Alkan¹, Hatice Seyma Akca¹, Mehmet Necdet Yildiz², Kamil Kokulu¹, Serdar Ozdemir¹, Serkan Emre Eroglu¹**¹*University of Health Sciences, Umraniye Training and Research Hospital, Istanbul, Turkey*²*Sultanbeyli State Hospital, Clinic of Emergency, Istanbul, Turkey*

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Abstract

Vertebral injuries are mostly seen in patients with multiple trauma. Because of high energy trauma, especially in young patients, it is associated with additional injuries. It was observed that there are not enough studies on this subject in our country. In this study, we aimed to explain the incidence of vertebral injuries and the characteristics of both concomitant and vertebral injuries and contribute to the literature by investigating the presence of additional injuries in patients with vertebral injuries resulting from traffic accidents. Data were recorded on the age, sex, type of trauma, spinal injury level, additional organ injury, GCS, neurological deficits, intensive care admittance, and mortality status of all patients. The data used in the study were obtained from the hospital's automation system and patients' files. The mean age of the 166 spinal trauma patients included in the study was 36.7 ± 15.4 (Median:35; 95% CI:34.1-38.7) years and 65.7% of the patients were male. Mortality rate in emergency department was 0.6%, mortality frequency was not associated with additional organ injury, trauma cause and spinal level but the results were not statistically significant ($p > 0.05$). The presence of additional injury increased the frequency of intensive care admission, the results were statistically significant ($p < 0.05$). Because of spinal injuries are sult of high-energy traumas, additional organ injuries are common pathologies. For this reason, patients with spinal trauma should be evaluated for additional injuries. Although vertebral injuries are mostly evaluated together with patients with multiple trauma, it should not be forgotten its relationship with additional injuries.

Keywords: Spinal trauma, motor vehicle accidents, organ injuries**Introduction**

In most countries, the rate of acute injuries of the spinal cord is 20–40 cases per 1 million. In Turkey, the spinal cord injury frequency is 12.7 cases per 1 million, with a reported incidence rate of between 500–600 cases annually [1]. According to clinical tables, complete spinal cord injuries makes up 45% of injuries, whereas incomplete spinal cord injuries account for 55% of injuries [2]. In terms of the site of injury, spinal cord injuries most commonly affect the cervical spinal cord (55%), followed by the thoracic spinal cord (30%) and lumbar spinal cord (15%) [2]. Direct radiography is the most common visualization method for thoracic and lumbar vertebrae [3]. The high number of patients admitted, the age-related osteoporotic changes and, of course, the occurrence of vertebral injuries mostly in multiple trauma patients require computed tomography using. Breathing difficulties are the most common symptom of spinal trauma.

Other common spinal cord injury symptoms include atelectasis, pneumonia, and respiratory failure [4]. In cases of spinal trauma, muscle weakness, venous stasis, and increased clotting increases the risk of. Due to excessive and uncontrolled sympathetic nervous system discharge, autonomic dysreflexia may also develop in cases of spinal injury.

In patients without respiratory and neurological symptoms, we may encounter vertebral injuries. After the diagnosis of vertebral injury, the possibility of additional pathologies should not be forgotten.

Vertebral injuries are mostly seen in patients with multiple trauma. Because of high energy trauma, especially in young patients, it is associated with additional injuries. It was observed that there are not enough studies on this subject in our country. A retrospective study was designed considering that missed injuries or surgical complications may be added.

In addition to the approach to multiple trauma patients, it should be kept in mind that the severity of vertebral injuries and vertebral injuries may be overlooked even with detailed examination and physical examination.

***Corresponding Author:** Hatice Seyma Akca, University of Health Sciences, Umraniye Training and Research Hospital, Istanbul, Turkey
E-mail: drhaticeseyma@hotmail.com

The frequency of cervical, thoracic and lumbar spine injuries varied in studies in different countries. The accompanying injuries also differed by country. We wanted to emphasize that additional injuries should not be overlooked in severe injuries such as vertebral injuries.

In this study, we aimed to explain the incidence of vertebral injuries and the characteristics of both concomitant and vertebral injuries and contribute to the literature by investigating the presence of additional injuries in patients with vertebral injuries resulting from traffic accidents.

Different types of vertebral injuries may coexist with different types of additional injuries. We wanted to provide systematic diagnosis and treatment of patients presenting with vertebra injury with our statistically significant results.

Materials and Methods

The study population comprised patients with suspected spinal trauma who were brought to the Ümraniye Emergency Medical Clinic between 1 January 2015 and 31 December 2015 following traffic accidents.

Data were recorded on the age, sex, type of trauma, spinal injury level, additional organ injury, GCS, neurological deficits, intensive care admittance, and mortality status of all patients. The data used in the study were obtained from the hospital's automation system and patients' files. Inaccessible patients' data from hospital records due to the patient consent was required or waived by the local ethics committee will likely be required were excluded from the study.

The data were evaluated using the Statistical Package for Social Sciences. The Kolmogorov-Smirnov test was conducted to determine the distribution range of the descriptive statistics. For the expression of quantitative data, the mean, standard deviation (SD), and median values are presented. For qualitative data, the number of cases (n) and percentage (%) are presented. For the analysis of quantitative data, the Kruskal-Wallis test was used. For analyzing quantitative data, Pearson's chi-squared and Fisher's exact chi-squared tests were conducted. The results are presented with their 95% confidence intervals (CIs). Significance was accepted at $p < 0.05$.

Patients with and without additional injuries were evaluated using the registry system.

The relationship between vertebral level and age, gender, GCS, ICU hospitalization, neurological deficit and mortality were evaluated.

The relationship between additional injuries and vertebral level was evaluated.

We tried to find out which vertebral level additional injuries are more common, and whether these additional injuries affect mortality and hospitalization. Severe soft tissue injuries, open or closed extremity fractures, intraabdominal free fluid, solid organ injuries, rib fractures, pneumothorax, hemothorax, severe vascular injuries, cardiac injuries, myocardial contusion, pericardial effusion were included in the additional injuries.

Patients with vertebral trauma admitted within 1 year were screened retrospectively. Vertebra traumas diagnosed in the emergency department were included in the study. Severe vertebral traumas that were not admitted to our hospital despite the suggestion of follow-up were excluded from the study. Patients with examination findings and soft tissue trauma that could not be obtained from the records were excluded from the study.

The permission is taken from the patients who are cooperative and oriented; It was obtained from relatives of patients with low GCS.

Results

The mean age of the 166 spinal trauma patients was 36.4 ± 15.0 (95% CI: 34.1–38.7), and the age range of the patients varied between 9 and 91 years. One hundred-nine (65.7%) patients were males.

In the study, 99 (59.6%) patients had been injured due to in-car traffic accidents (ICTAs), 50 (30.1%) patients had been injured in non-car traffic accidents (non-CTAs), and 17 (10.3%) patients had been injured in motorcycle accidents. The most common sites of injuries were as lumbar vertebrae (56%). Among the study population, 86.7% of the patients have a GCS score of 15 or lower.

Table 1. Comparing with Trauma and Additional Injuries

	ICTA (n:99) n (%)	Non-CTA (n:50) n (%)	Motorcycle (n:17) n (%)	p*
Head	10 (10.1)	4 (8.0)	0	0.365
	14 (14.1)	5 (10.0)	1 (5.9)	0.697
Abdomen	10 (10.1)	3 (6.0)	2 (11.8)	0.654
Pelvis	14 (14.1)	8 (16.0)	1 (5.9)	0.472
Upper Extremities	10 (10.1)	8 (16.0)	3 (17.6)	0.455
Lower Extremities	14 (14.1)	7 (14.0)	3 (17.6)	0.716

*Fisher's Exact test

(n: case, ICTA:in car trauma accident, non-CTA: non car trauma accident.)

Table 2. Comparing with Thoracic Vertebral Injuries and Additional Injuries

	Thoracic Vertebral Injuries		p
	Yes (n:47) n(%)	No (n:119) n(%)	
Head	5 (10.6)	9 (7.6)	0.542**
Thorax	11 (23.4)	9 (7.6)	0.005*
Abdomen	5 (10.6)	10 (8.4)	0.764**
Pelvis	4 (8.5)	19 (16.0)	0.210*
Upper Extremities	7 (14.9)	14 (11.8)	0.585*
Lower Extremities	10 (21.3)	14 (11.8)	0.116*

*Pearson ki-kare, ** Fisher'sExact test (n: case)

Additional injuries were detected in 60 (36.1%) patients. The most common sites of injury were the pelvis (n=x, 13.9%) and lower extremities (n=x, 14.5%). There was no statistically significant relationship between the spinal injury level and age ($p > 0.05$). (Table 1).

Among males and females, the most common cause of injury was an ICTA. There was no significant relationship between the trauma type and sex ($p > 0.05$), the results were not statistically significant. Among vertebral injuries, lumbar vertebrae injuries were the most common in males and females. There was no statistically significant relationship between the spinal injury level and sex.

When the relationship between the trauma type and the Glasgow Coma Scale was examined, non-CTAs, and motorcycle accidents. There was no association between GCS and trauma ($p > 0.05$) but the results were not statistically significant.

The most frequently injured areas in cases of ICTAs were the thorax, pelvis, and lower extremities. In cases of non-CTAs, the most commonly injured sites were the pelvis and upper extremities. In motorcycle accidents, the most frequently injured areas were upper and lower extremities.

There was no statistically significant association between cervical and coccyx injuries and additional injuries. Head, abdomen, pelvic, upper and lower extremity injuries showed no statistically significant association with thoracic vertebrae injuries ($p > 0.05$). However, the frequency of thoracic trauma was significantly higher in patients with thoracic vertebral injuries ($p < 0.05$) (Table 2).

The pelvis was the most frequently (12.9%) injured area in patients with lumbar vertebrae injuries. Head, abdomen, upper pelvic, and lower extremity injuries showed no statistically significant relationship with lumbar vertebrae injuries ($p > 0.05$). However, the frequency of thoracic trauma was significantly lower in patients with lumbar vertebrae injuries ($p < 0.05$) (Table 3).

Table 3. Comparing with lumbar vertebral injuries and additional injuries

	Lumbar Vertebral Injuries		p*
	Yes (n:73)	No (n:93)	
Head	11 (11.8)	3 (4.1)	0.076
Thorax	7 (7.5)	13 (17.8)	0.043
Abdomen	8 (8.6)	7 (9.6)	0.826
Pelvis	12 (12.9)	11 (15.1)	0.689
Upper Extremities	9 (9.7)	12 (16.4)	0.193
Lower Extremities	11 (11.8)	13 (17.8)	0.277

*Pearson ki-kare (n:case)

In patients with sacral vertebrae injuries, the pelvis (48.1%) was the most frequently injured site. There was no statistically significant correlation of head, thorax, upper extremity, and lower extremity injuries with sacral vertebrae injuries ($p > 0.05$). However, the frequency of abdominal and pelvic trauma was significantly higher in patients with these types of injuries ($p < 0.05$) (Table 4).

Neurological deficits were detected in 5 (3%) patients. In these patients, 4 (80%) cases were the result of were ICTAs, and 1 (20%) was the result of non-CTA. No statistically significant correlation was found between the trauma type and neurological deficits ($p > 0.05$) (Table 5).

Table 4. Comparing with sacral vertebral injuries and additional injuries

	Sacral Vertebral Injuries		p*
	Yes(n:27)	No(n:139)	
Head	4 (14.8)	10 (7.2)	0.248
Thorax	5 (18.5)	15 (10.8)	0.328
Abdomen	8 (29.6)	7 (5.0)	0.001
Pelvis	13 (48.1)	10 (7.2)	0.001
Upper Extremities	5 (18.5)	16 (11.5)	0.343
Lower Extremities	7 (25.9)	17 (12.2)	0.076

* Fisher's Exact test (n:case)

Table 5. Comparing with trauma type and neurological deficits

	Neurological Deficits		p*
	Yes (n:5)	No (n:161)	
ICTA	4 (80.0)	95 (59)	0.649
Non-CTA	1 (20.0)	49 (30.4)	
Motorcycle	0	17 (10.6)	

* Fisher's Exact Test (n: case, ICTA: in car trauma accident, non-CTA: non car trauma accident.)

In patients admitted to the intensive care unit, head injuries (64.3%) most commonly accompanied spinal trauma. There was no statistically significant relationship between thoracic and upper and lower extremity injuries and admittance to the intensive care unit ($p > 0.05$). Head, abdomen, and pelvic trauma were significantly higher among patients admitted to the intensive care unit ($p < 0.05$) (Table 6).

Table 6. Comparing with intensive care unit admissions and additional injuries

	Intensive Care Unit Admissions		p
	Yes (n:14) n(%)	No (n:152) n(%)	
Head	9 (64.3)	5 (3.3)	<0.001
Thorax	4 (28.6)	16 (10.5)	0.069
Abdomen	6 (42.9)	9 (5.9)	<0.001
Pelvis	6 (42.9)	17 (11.2)	0.005
Upper Extremities	3 (21.4)	18 (11.8)	0.391
Lower Extremities	6 (42.9)	18 (11.8)	0.007

One patient died. This patient had thoracic and sacral vertebrae injuries. There was no statistically significant association between the mortality rate and spinal trauma level ($p > 0.05$) (Table 7). This patient had thoracic, cavernous, pelvic, and upper extremity injuries, in addition to spinal trauma. There was no significant association between the mortality rate and additional pathologies associated with spinal trauma ($p > 0.05$) (Table 8)

Table 7. Comparing with mortality and spinal trauma level

	Mortality Rate		p *
	Yes (n:1)	No (n:165)	
	n(%)	n(%)	
Cervical	0	147 (89.1)	>0.999
Thoracal	1 (100)	46 (27.9)	0.283
Lumbal	0	93 (56.4)	0.440
Sacral	1 (100)	26 (15.8)	0.163
Coxics	0	3 (1.8)	>0.999

* Fisher's Exact test (n: case)

Table 8. Comparing with mortality and additional injuries

	Mortality Rate		p *
	Yes (n:1)	No (n:165)	
	n(%)	n(%)	
Head	0	14 (8.5)	>0.999
Thorax	1 (100)	19 (11.5)	0.120
Abdomen	1 (100)	14 (8.5)	0.090
Pelvis	1 (100)	22 (13.3)	0.139
Upper extremities	1 (100)	20 (12.1)	0.127
Lower extremities	0	24 (14.5)	>0.999

* Fisher's Exact test (n: case)

Discussion

In our study, the mean age of the patients was 36.7 years, and 66% of the patients were males. The majority of injuries were the result of non-CTAs, with motorcycle accidents accounting for the lowest number of injuries and hospital admissions.

In Turkey, vehicles carrying more than one passenger in the traffic and the high frequency of ICTAs cause more than one person injured in these accidents. The absence of a seating area for every passenger on public transport and a lack of compliance with traffic laws are also potential causes of accidents leading to spinal injuries. Previous studies on motor vehicle accidents reported that, spinal trauma, thoracic, cervical, cervicothoracic, and thoracolumbar vertebrae injuries are the most common one in the injury ranking [5-10].

Cervical injuries (so-called whiplash injuries) are common in CTAs due to rear-impact collisions [11]. In the present study, the most frequent vertebra injuries were lumbar puncture injuries. Thoracic vertebra injuries was second frequency. Cervical trauma may have been missed because of the retrospective nature of our study. Only traffic accidents are included in the system records of the registered patients, and only the registration is made with this record. In particular, the lack of protective equipment for motorcycle drivers may result in fewer cervical injuries but more of widespread traumas and the presence of cervical injured patients at the scene.

Previous studies reported various additional injuries (e.g., thoracic, head, or extremity) in motor vehicle accidents that caused spinal trauma [7,10-12]. According to some studies, the

most frequent causes of spinal trauma were ICTAs, followed by motorcycle accidents [13-17]. In our study, 36% of spinal trauma patients had additional injuries, and there was no statistically significant relationship between the type of spinal trauma and type of additional injury.

A number of studies reported that spinal injuries were accompanied by a high possibility of brain injuries [18-20]. Studies indicated that GCS was lower in motorcyclists, and that this was associated with direct exposure of the head area to trauma [6,21,22]. In some studies, the most common additional injuries in motorcycle accidents were spinal trauma, in addition to bone fractures and dermabrasions [17,23,24].

Studies have reported differences in the rate of neurological deficits due to spinal trauma [6,7,11]. In the present study, the neurological deficit frequency was 3%, and neurological deficits were not correlated with the trauma type or trauma level.

In a previous study 61% of spinal trauma patients who died also had cranial trauma [18]. Studies reported lower fatality levels among spinal trauma patients with lung, liver, and splenic injuries, as well as among spinal trauma patients with lower extremity and pelvic fractures [19,20]. In our study, the rate of intensive care admittance was 8.4%. The frequency of admittance to the intensive care unit was higher among spinal trauma patients with additional injuries (head, warts, and pelvic), although there was no correlation between the trauma type and spinal trauma level. Considering the frequency of admittance to the intensive care unit in our study, it is likely that many spinal trauma patients with additional injuries were followed up in the clinic.

Our study is important in terms of showing that spinal traumas associated with additional injuries increase the ICU stay.

Detailed physical examination should be performed at the first admission of patients with multiple trauma with vertebral injury.

Vital signs and symptoms should be reviewed during follow-up.

Discharged decision should not be made early and patients discharged should be informed.

Limitations

Since our study was retrospective, deficiencies in the records caused us to exclude some cases. Cardiac arrest was excluded because the causes of death were not only vertebral trauma.

This caused a change in mortality rates.

Conclusion

The mortality rate in our study was % 0.6. The mortality rate was not related to the trauma type, spinal trauma level, or presence of additional organ injuries. It is likely that the trauma type, trauma level, and additional organ injury on the mortality are effective.

In conclusion, additional organ injuries are common in cases of spinal injuries caused by high-impact trauma. The spinal trauma level in traffic accidents was related to the occurrence of additional organ injuries. Therefore, patients with spinal trauma should undergo assessments for additional organ injuries, particularly at

the level of the spinal injury.

Although additional organ injuries were not found to be effective in mortality; increased the rate of hospitalization. Detailed research and meta-analyzes may show that additional injuries also cause statistically significant increases in mortality.

For this, there is a need for researches where patient follow-up can be performed for months.

Competing interests

The authors declare that they have no competing interest.

Financial Disclosure

There are no financial supports

Ethical approval

This study was approved by the Institutional Ethics Committee and conducted in compliance with the ethical principles according to the Declaration of Helsinki.

Celil Alkan ORCID: 0000-0001-6728-0404

Hatice Seyma Akca ORCID: 0000-0003-2823-9577

Mehmet Necdet Yildiz ORCID: 0000-0001-6728-0404

Kamil Kokulu ORCID: 0000-0002-6132-0898

Serdar Ozdemir ORCID: 0000-0002-6186-6110

Serkan Emre Eroglu ORCID: 0000-0002-3183-3713

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