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Original Article

Is clavicular fracture associated with concomitant injuries in multi-trauma patients?

Shiva Salmasi[1], Sadaf Dilmaqani[2], Haniyeh Ebrahimi Bakhtavar[3], Alireza Ala[2], Farzad Rahmani[4]

[1]Internal Medicine Department, Eisenhower Medical Center, Rancho Mirage, CA, United States
[2]Emergency Medicine Department, Emergency and Trauma Care Research Center, Faculty of Medicine, Tabriz University of Medical Sciences, Tabriz, Iran
[3]Emergency Medicine Department, Faculty of Medicine, Tabriz Islamic Azad University of Medical Sciences, Tabriz, Iran
[4]Emergency Medicine Department, Road Traffic Injury Research Center, Faculty of Medicine, Tabriz University of Medical Sciences, Tabriz, Iran

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***Corresponding author:**
Farzad Rahmani,
Email: Rahmanif@tbzmed.ac.ir

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Abstract

Objective: This study aimed to evaluate the relationship between clavicular fracture and associated injuries in multi-traumatic patients.

Methods: In this prospective cohort study, 185 multi-traumatic patients referred to the Emergency Department of Imam Reza (AS) Hospital of Tabriz University of Medical Sciences were selected between August 2019 and September 2021. The census sampling method was used until the required sample size was achieved. The following patient information was recorded and studied: mechanism of trauma, age, gender, Glasgow Coma Scale (GCS) score, systolic blood pressure (SBP), the presence of clavicular fracture, concomitant injuries, hospital outcome, duration of hospitalization, and severity of trauma. The participants were divided into two groups based on the presence of a clavicular fracture. Data were analyzed using SPSS software.

Results: Of all 185 patients, 51 had clavicular fractures. The mean age of the patients was 34.72 ± 12.99. Of all patients, 27.6% had clavicular fractures. There was no statistically significant difference in GCS scores between the two groups ($P=0.927$). The highest percentage of injuries associated with clavicular traumas was traumatic brain injuries, with rates of 22.4% and 19.6% in the study and control groups, respectively. There were statistically significant differences in concomitant injuries between the two groups ($P<0.001$). There was no statistically significant relationship between clavicular fracture and the patient's outcome ($P=0.10$), nor between clavicular fracture and GAP (GCS, age, SBP) ($P=0.143$) or New Trauma Score (NTS) ($P=0.257$).

Conclusion: The results showed a difference in the associated injuries between the groups; however, there was no statistically significant difference in patient outcomes. Healthcare providers are suggested to consider concomitant injuries in patients with clavicular fractures.

Keywords: Multiple-trauma, Clavicular fracture, Emergency department, Mortality

Introduction

Trauma injuries are a major health concern and a significant global burden, particularly in middle and low-income countries, as they are one of the main contributors to hospital-related costs. Approximately 45 million people worldwide experience moderate to severe disability every year as a result of trauma. Moreover, it has been estimated that almost 5 million people die as a result of traumatic injuries every year (1,2). The common cause of mortality among people aged 15–24 is trauma, which accounts for about 30% of ICU admissions per year. Additionally, based on previous reports, and regardless of age, trauma is the third cause of death in societies (3,4). Traffic accidents are the leading cause of severe injuries among young people. Violence and burns are the next in the rankings (1,5).

Usually, mid-shaft clavicular fractures occur in young adults, and medial and lateral fractures occur in older adults (6). Clavicle fractures due to multi-trauma incidents are usually accompanied by injuries to the adjacent areas (7). Sports activities and traffic road crashes are the usual causes of clavicle injuries; direct fall on the shoulder is the most prevalent mechanism of clavicular fracture. Most (~75.5%) fractures happen in the middle third of the clavicle, followed by about 19% and 4% in the lateral and medial parts, respectively (8,9).

Recent studies have highlighted the importance of diagnosing clavicular fractures and their association with injuries in the chest, upper limbs, and cervical spine (7,10-13). Using simple and convenient scoring systems to determine the severity of trauma could help physicians and nurses identify the severity of injuries and plan an appropriate approach to treatment. There are several scoring systems that adequately estimate mortality rates. Therefore, these scores could be employed in on-scene triage and predicting mortality (14,15).

Considering the possibility of rapid diagnosis of clavicle fracture, even with a simple examination or plain radiography, and according to the results of previous studies, finding this type of fracture along with other findings in vital organs can help increase the clinicians' accuracy in the diagnosis. This study aims to assess the relationship between clavicular fractures and concomitant injuries, hospital outcomes, and trauma severity in multi-traumatic patients.

Methods

In this prospective cohort study, 185 multi-traumatic patients referred to the Emergency Department of Imam Reza (AS) hospital affiliated with Tabriz University of Medical Sciences were selected between August 2019 and September 2021 with the approval of the ethics committee with the code IR.TBZMED.REC.1396.933. The census sampling method was used until the required sample size was achieved.

The inclusion criteria included age between 18 and 60, clavicular fracture, multiple trauma (trauma to more than two organs), and admission to the hospital. The inclusion criteria for the control group were the same as those for the study group, except the former did not have clavicular fractures. The exclusion criteria were the absence of inclusion criteria and not providing consent.

To calculate the sample size, preliminary information regarding the Injury Severity Score (ISS) of patients in the two groups was obtained based on the study by van Laarhoven et al (13). The ISS score was 29.2 ± 10.1 in the study group (with clavicle fracture) and 24.9 ± 9.1 in the control group (without clavicle fracture). Considering the reliability of 0.95, the power of 80% of the two-tail test, and the double sample size for the control group, a sample size of 170 was calculated using the G*Power software. The sample sizes were 40 and 120 patients for the study and control groups, respectively. In addition, considering a 10% drop-out in the sample, the size of each group was increased by 10%. The final total sample size was 185 subjects: 51 patients with clavicular fracture (test group) and 134 patients without clavicular fracture (control group).

Written informed consent was obtained from all the patients. Then, a checklist was completed by the assigned physician. It included 18 variables, including patients' characteristics, physical examination results, paraclinical data, and outcomes. The study data were recorded on patient admission and included mechanism of trauma, age, gender, Glasgow Coma Scale (GCS) score, systolic blood pressure (SBP), the presence of clavicular fracture, concomitant injuries, hospital outcome, trauma severity, and duration of hospitalization. The GCS score was calculated based on the patient's eye, verbal, and motor responses to stimuli and ranged between 3 and 15 (16). The SBP was measured using a sphygmomanometer.

In this study, patients were divided into two groups: a study group with clavicular fractures (51 patients) and a control group without clavicular fractures (134 patients). Then, the presence of trauma to the chest or upper extremities and cervical spine damage was recorded in both groups. Finally, the mortality rate, duration of hospitalization, and severity of trauma were recorded. The trauma severity was evaluated using GAP (GCS, age, SBP) and New Trauma Score (NTS) (17,18).

All data were analyzed in SPSS 17.0 using descriptive statistical methods (mean ± standard deviation), frequency (percentage), and median. The normal distribution of data was examined using the Kolmogorov-Smirnov test. In quantitative data with abnormal distribution, the median (IQR 25%–75%) was used to describe the data, and the Mann-Whitney U test was used to compare the two groups. The chi-square test was used to compare qualitative data in both groups. Independent samples t-test was used to compare quantitative data. The odds ratio was calculated for the variables. A *P*values < 0.05 were considered significant.

Results

In this study, 185 patients with multiple traumas were studied. The patients in the case group ($n = 51$) had clavicular fractures, but the patients in the control group ($n = 134$) did not. The mean age of patients was 34.79 ± 12.99 years old (18–82). Of all patients, 138 (74.6%) were male, and the rest were female. The common causes of trauma were car accidents (113 patients, 61.1%), motorcycle accidents (49 patients, 26.5%), and pedestrian accidents (23 patients, 12.4%). The median of GCS in all patients was 15. Concerning fracture location, the most common fracture type in patients with clavicular fractures was mid-clavicular fracture (48 patients, 94.1%).

Table 1 compares the demographic variables and vital signs of patients between the two groups. Only mean arterial pressure (MAP) has a significant statistical difference between the two groups ($P = 0.007$), but the absolute differences reported are small (< 10 mm Hg).

Table 2 compares variables related to concurrent injuries, hospital outcomes, and trauma severity between two study population groups. Based on the results shown in Table 2, only concomitant injuries showed a significant statistical difference between the two groups ($P < 0.001$). These results show that patients with clavicle fractures are more likely to have concurrent thoracic injuries than others.

Discussion

In multiple trauma patients, the clavicular injury rate was 3%. Clavicular injury can happen with simultaneous damage to nearby vital organs such as the heart, lungs, and large vessels (7). In scientific texts, the clavicle is also referred to as the thoracic gateway (19). In this

Table 1. Comparison of the demographic variables and vital signs of patients between two groups

Variable	Case group (n = 51)	Control group (n = 134)	*P* value
Age	35 (24-49)	30 (25-41)	0.304[a]
Gender			0.460[b]
Male	40 (78.4%)	98 (73.1%)	
Female	11 (21.6%)	36 (26.9%)	
Vital sign (median 25-75)			
MAP (mm Hg)	93.33 (83.33-96.67)	86.67 (82.42-93.33)	0.007[a]
O2 saturation (%)	97 (91-99)	97 (95-98)	0.993[a]
Respiratory rate (/minute)	17.50 (15-19.25)	17.50 (16-19)	0.845[a]
Heart rate (/minute)	83.50 (76.50-92)	87 (80-98.50)	0.090[a]
GCS	15 (15-15)	15 (15-15)	0.927[a]
Mechanism of injury			
Pedestrian to car	6 (11.8%)	17 (12.7%)	0.959[b]
Car to car	2 (62.7%)	81 (60.4%)	
Motorcycle to car	13 (25.5%)	36 (26.9%)	
Admission			
Yes	16 (31.4%)	32 (23.9%)	0.299[b]
No	35 (68.6%)	102 (76.1%)	
Admission duration (h) (median 25-75)	29 (2-168)	44 (21-144)	0.356[a]

MAP, mean arterial pressure
[a] Mann-Whitney U; [b] Chi square test.

Table 2. Comparison of variables related to subsequent injury, hospital outcome, and trauma severity between two groups

Variable	Case group (n = 51)	Control group (n = 134)	*P* value
Associated Injuries			<0.001[a]
Traumatic brain injury	10 (19.6%)	30 (22.4%)	
Extremities injury	9 (17.6%)	0 (0%)	
Chest injury	7 (13.7%)	0 (0%)	
Multiple injuries	3 (5.9%)	12 (9.0%)	
Abdominal injury	1 (2.0%)	29 (21.6%)	
Without injury	21 (41.2%)	63 (47.0%)	
Hospital Outcome			0.160[a]
Death	4 (7.8%)	22 (16.4%)	
Alive	47 (92.2%)	112 (83.6%)	
Trauma severity (GAP)	21.92 ± 3.32	20.94 ± 4.30	0.143[b]
GAP severity			0.402[a]
Mild	47 (92.2%)	112 (83.6%)	
Moderate	2 (3.9%)	12 (9.0%)	
Severe	2 (3.9%)	10 (7.5%)	
Trauma severity (NTS)	21.23 ± 3.14	20.42 ± 4.67	0.257[b]
NTS severity			0.377[a]
Mild	47 (92.2%)	112 (83.6%)	
Moderate	1 (2.0%)	4 (3.0%)	
Severe	3 (5.9%)	18 (13.4%)	
High severe	0 (0.0%)	0 (0.0%)	

[a] Fischer exact test; [b] Independent samples *t* test.

study, we evaluated clavicular fractures and their relation with concurrent injuries in multiple trauma patients. Our results showed that in patients with a clavicular fracture, the incidence of chest injury was higher than in other patients.

Fractures of the clavicle, which primarily occur in young males (approximately 70%), account for 2.6%–4% of all fractures in adults and almost 10–15% of all fractures in pediatrics. Clavicular fractures are common among both children and adults. The highest incidence of mid-shaft fractures is seen in people under the age of 30, and medial and lateral fractures are seen in patients above 70 years old (6,8,20).

The mean age of patients in this study was 34.72 ± 12.99. In the study of Amer et al, the incidence of clavicular open fracture was higher in young patients. In our study, we did not have patients with open clavicle fractures (7). In our study, male patients accounted for a large proportion of the patients; the likelihood of men working outside is higher in comparison to women, which means they are at higher risk of accidents at work and injuries from physical trauma; this could be the probable reason for the higher number of men in this study. The common mechanism of trauma (~61.5% of patients) was vehicle accidents. Motorcycle crashes and pedestrian accidents were in the following ranks. In the study by Herteleer et al, bicycle crashes (30.5%), motor-bike accidents (10.2%), vehicle accidents (18.8%), and sport-related injuries (18%) were the most critical mechanisms of injuries, the greater part of which occurred in the 41–50-year-old age group (6).

The most common site of clavicular fracture in this study was mid-shaft, which was observed in 94.1% of patients. According to recent studies, mid-shaft fractures are the most common fractures, accounting for 69% to 82% of all clavicular fractures, whereas distal fractures represent 21 to 28 percent. Injuries in the medial end are the least common (approximately 2 to 3 percent of all clavicular fractures) (21). In the study by Stegeman et al, the fracture type is mainly affected by age; however, the mechanism of trauma is not (22).

In patients with blunt chest trauma, the rate of simultaneous fracture of the clavicle and ribs or flail chest was 18.8%. The rates of clavicular fracture in patients with one, two, three, and flail chest were 14.1%, 16.3%, 19.1%, and 20.4%, respectively (23). Considering the anatomic location of the clavicle, previous studies have hypothesized that the impact forces leading to clavicle fractures also place higher strain on the chest/ribs, increasing the risk of thoracic trauma; passengers thrown forward are more likely to suffer direct impact injuries to the shoulder/chest regions (7,13,23).

In this study, traumatic brain, abdominal, and extremity injuries and chest trauma accounted for the highest percentage of injuries associated with clavicular trauma. In most cases, the thoracic and abdominal areas were injured severely in crashes. Considering the high prevalence of thoracic injuries in multi-traumas, obtaining plain thoracic X-rays during the emergency plan of action is well-accepted. Clavicular fractures can be spotted easily alongside classic thoracic injuries, such as rip series fractures, pneumothorax, and suspicious mediastinal signs. Easily diagnosed clavicular fractures can be used as an indicator for thoracic and upper extremity injuries that could have been missed using other methods in multi-traumatic patients (24).

Limitations

One of the main limitations of this study was the lack of follow-up due to the discharge of patients from the hospital with personal consent. The other limitation was referring patients to non-university-affiliated medical centers, which made the follow-ups impractical.

Conclusion

Clavicular fractures are primarily the result of motor vehicle accidents and are common in multi-traumatic patients. According to the results, there was a difference in concomitant injuries between the groups. However, there was no statistically significant difference in patient outcomes. The results of this study can be used in the initial evaluation of patients with multiple traumas with clavicle fractures to diagnose the concomitant injuries and their treatment. It is suggested that healthcare providers' consideration of concomitant injuries can be beneficial to patients with clavicular fractures.

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Authors' Contribution

Conceptualization: Farzad Rahmani.
Data curation: Sadaf Dilmaqani.
Formal analysis: Haniyeh Ebrahimi Bakhtavar.
Investigation: Sadaf Dilmaqani.
Methodology: Farzad Rahmani.
Project administration: Farzad Rahmani.
Resources: Farzad Rahmani.
Supervision: Farzad Rahmani.
Validation: Alireza Ala.
Visualization: Alireza Ala.
Writing-original draft: Haniyeh Ebrahimi Bakhtavar.
Writing-review and editing: Farzad Rahmani.

Competing Interests

None.

Ethical Approval

The Ethics Committee of Tabriz University of Medical Sciences approved this study with the code IR.TBZMED.REC.1396.933.

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