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# Retrospective analysis of patients with sternal fracture

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## Abstract:

**OBJECTIVES:** Sternal fractures (SFs) are rare pathologies that mainly occur as a result of traffic accidents, which can cause mortality due to concomitant complications. In this study, we aimed to evaluate clinical processes and termination status of patients diagnosed with a SF in the emergency department.

**METHODOLOGY:** Patients diagnosed with a SF in the emergency department during 8 years were retrospectively reviewed. The demographic and clinical characteristics of the patients were recorded, and standard data forms were created.

**RESULTS:** In total, 128 patients were included in the study; 81 (63.3%) patients were male, and the mean age was 49.4 years. When the fracture mechanism was examined, car traffic accidents were the most common type and the cause of fracture in 85 (66.4%) patients. The most common thoracic pathology accompanying SFs was rib fractures (35.9%), and the most common extrathoracic pathology was cranial pathology (27.3%). Pericardial effusion was detected in 12 (9.4%) patients. Of the participating patients, one died and the others were hospitalized.

**CONCLUSION:** Since SFs and associated complications can be life-threatening, emergency room physicians should consider it in the diagnosis. In particular, the necessary examinations and follow-up should be done to assess cardiac damage.

## Keywords:

Fracture, sternum, thorax

## Introduction

Although sternal fracture (SF) is rare, it occurs as a result of a fall, direct blunt trauma to the sternum, or most often due to traffic accidents.<sup>[1]</sup> SF has been reported in 3%–6.8% of cases sustaining motor vehicle collision.<sup>[2]</sup> The incidence of SFs has increased after fastening seat belts have become mandatory, as the seat belt presses on the sternum during injury.<sup>[3,4]</sup>

The diagnosis is usually made by a lateral lung X-ray or computed tomography (CT)

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scans of the thorax.<sup>[2]</sup> It is necessary to obtain electrocardiography (ECG), echocardiography, and follow-up cardiac enzymes to detect myocardial damage.<sup>[2]</sup>

SFs may have a wide range of consequences such as pleural effusion, hemothorax, pneumothorax, pericardial effusion, pneumomediastinum, and retrosternal hematoma.<sup>[5]</sup> SFs are considered serious, even life-threatening injuries with a mortality of 24%–45%.<sup>[3]</sup>

More than 95% of cases with SFs are treated conservatively.<sup>[1]</sup> Conservative trauma management suggests monitoring of cases with SFs which may be accompanied by severe thoracic injuries or blunt cardiac injuries.<sup>[6]</sup>

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**Box-ED****What is already known on the study topic?**

Sternal fractures occur as a result of a fall, direct blunt trauma to the sternum, or most often due to traffic accidents.

**What is the importance odd this study for readers?**

Many pathologies such as pleural effusion, hemothorax, pneumothorax, pericardial effusion, pneumomediastinum, and retrosternal hematoma may accompany sternal fractures.

**How is this study structured?**

This is a retrospective, clinical trial with 128 participants.

**What does this study tell us?**

Sternal fractures can cause fatal complications, so emergency physicians should be careful in these patients.

We aimed to evaluate the demographic and clinical data of patients and discuss the diagnosis and treatment characteristics in the emergency department. Furthermore, with this study, it was emphasized that patients diagnosed with sternum fracture should be evaluated carefully in the emergency department because of the fatal complications.

## Methodology

The study was granted approval by the Ethics Board of Erciyes University Faculty of Medicine (Ethics Committee Decision No: 2017/59). Patients aged <18 years were also included in the study.

A total of 128 patients who were admitted to the Emergency Department of Erciyes University between January 2006 and December 2013 after sustaining trauma and who were diagnosed with a SF were retrospectively reviewed. The demographic data of patients, Glasgow Coma Scores (GCS), trauma mechanism, tests, treatments and endpoints in the emergency department, concomitant pathologies, and length of hospital stay (LOS) were recorded to establish a database. Furthermore, the type and localization of the SF was determined, and the relationship with other parameters was compared.

Statistical analysis of our research was conducted using the IBM SPSS Statistics for Windows, Version 21 and MedCalc® Statistical Software version 15.8. Kruskal-Wallis and Mann-Whitney U tests were used to compare the data, and  $P < 0.05$  was considered statistically significant.

## Results

A total of 128 patients were included in the study; 81 (63.3%) patients were male and 47 (36.7%) were female. The mean age of the patients was 49.4 years (minimum:

13 years, maximum: 84 years). The GCS scores of the patients on admission to the emergency department and yearly distribution of the number of admissions were evaluated. The baseline demographic characteristics of the patients are listed in Table 1. On admission to the emergency department, the patients' mean systolic blood pressure was  $129 \pm 22$  mmHg and mean diastolic blood pressure was  $75 \pm 12$  mmHg.

When the fracture mechanisms were examined, car traffic accident was found to be the most common cause occurring in 85 (66.4%) patients. The age and sex of the patients were compared with the fracture mechanism, showing no statistically significant difference ( $P = 0.413$  and  $P = 0.407$ ). When fracture localizations were evaluated, SF was detected in 59 (46.1%) patients, the most common being the corpus localization. In addition, five (3.9%) patients had fractures in multiple localizations. Sixteen (12.5%) patients had displaced SF. The SF characteristics of patients are listed in Table 1. A comparison between the age and sex of the patients and fracture localizations revealed no statistically significant difference ( $P = 0.211$  and  $P = 0.759$ ).

When the tests performed in the emergency room were evaluated, it was determined that all patients involved in the study underwent ECG recording, and 17 (13.3%) patients had pathological findings as sinus tachycardia, arrhythmias, and ST-segment changes in ECG recordings. A comparison between the fracture localization and ECG findings revealed no statistically significant difference ( $P = 0.240$ ). The echocardiography

**Table 1: Baseline characteristics of the patients**

	<i>n</i> (%)
Gender	
Male	81 (63.3)
Female	47 (36.7)
GCS	
<10	1 (0.8)
10-15	19 (14.8)
15	108 (84.4)
Cause of trauma	
Fall	10 (7.8)
Falling from high	16 (12.5)
Assault	6 (4.7)
In car traffic accident	85 (66.4)
Nonvehicle traffic accident	11 (8.6)
Sternal fracture zone	
Manubrium	51 (39.8)
Corpus	59 (46.1)
Xyphoid	13 (10.2)
Multiple	5 (3.9)
Type of fracture	
Displaced	16 (12.5)
Nondisplaced	112 (87.5)

GCS=Glasgow Coma Score

records of 65 (50.8%) patients were available, and pericardial effusion was detected in 12 (9.4%). In emergency department records, troponin results were available for 12 (9.4%) patients, showing higher than the normal range only in two patients. Creatine kinase and creatine kinase-myocardial band results were available for 116 (90.6%) patients, showing higher than normal range in 92 (71.9%) patients. Cardiac effects in the patients are listed in Table 2.

There are intrathoracic and extrathoracic pathologies accompanying fractures of the sternum. Rib fracture was the most common condition accompanying thoracic pathology (35.9%). Cranial pathologies were the most common nonthoracic pathology (27.3%). Other pathologies accompanying the sternal are listed in Table 3.

Only one patient included in the study died in the emergency department. Other patients were hospitalized; there were no patients referred to another institution. Thirty-nine (30.5%) patients were admitted to the ward, and 88 (68.8%) patients were

**Table 2: Cardiac effects of patients**

	n (%)
Electrocardiography	
Normal sinus rhythm	111 (86.7)
Pathological findings	17 (13.3)
Echocardiography	
Normal	53 (41.4)
Pericardial effusion	12 (9.4)
Troponin results	
In the normal range	10 (7.8)
Higher than the normal range	2 (1.6)
Creatine kinase and creatine kinase-myocardial band results	
In the normal range	24 (18.7)
Higher than the normal range	92 (71.9)

**Table 3: Additional pathological findings of patients**

	n (%)
Thorax pathology	
Pneumomediastinum	2 (1.6)
Pneumothorax	21 (16.4)
Hemothorax	25 (19.5)
Rib fractures	46 (35.9)
Vertebral fracture	23 (18)
Scapula fracture	3 (2.3)
Pulmonary contusion	36 (28.1)
Clavicle fracture	7 (5.5)
Nonthorax pathology	
Head	35 (27.3)
Cervical	3 (2.3)
Abdomen	15 (11.7)
Extremity	31 (24.2)

admitted to the intensive care unit. One hundred and four patients (81.2%) are hospitalized due to sternum fracture-related complications. Fourteen (10.9%) patients were surgically treated, and 113 (88.3%) patients received conservative treatments such as analgesia, rest, breathing exercises, and corset fixation. A comparison between the trauma mechanism and the fracture localization revealed no statistically significant difference ( $P = 0.598$ ).

When LOS was evaluated, the mean LOS was calculated as  $6 \pm 3$  days. A comparison between LOS and fracture type as the therapies administered revealed a statistically significant difference ( $P = 0.0002$ ). A comparison between age and LOS revealed no statistically significant difference ( $P = 0.841$ ).

## Discussion

SFs, particularly those associated with road traffic accidents, have an increasing frequency in the emergency department.<sup>[6]</sup> Vital signs must be carefully monitored while evaluating a patient with sternal trauma and accompanying injuries to the other organ systems must be ruled out.<sup>[7]</sup> In the literature, it was reported that 60%–90% of SFs occurred as a result of motor vehicle accidents.<sup>[2]</sup> In this study, similar to the literature, 96% of SFs were found to be the result of traffic accidents.

The mean age and sex ratio of patients included in the study were similar to those reported in the literature.<sup>[3,8]</sup> The mean diastolic and systolic blood pressure values of patients at the time of admission were similar to those reported in a study by Celik *et al.*, who evaluated the effects of SFs and associated injuries.<sup>[9]</sup>

SFs are usually accompanied by tenderness, swelling, crepitation, or deformity, so the diagnosis is easy, while the final diagnosis is made using a lateral lung X-ray or thoracic CT.<sup>[9]</sup> It is believed that thoracic CT is preferred for the final diagnosis, since the patients included in our study presented after sustaining high-energy traumas that may be accompanied by additional pathologies. Similar to the study by Uluşan and Karakurt, mostly displaced fractures were found that were often located on the sternal corpus.<sup>[5]</sup>

Similar to the literature, thoracic pathologies most often accompanying SFs were rib fractures, and the most common extrathoracic pathologies were cranial pathologies.<sup>[7]</sup>

Myocardial damage is observed in 90% of patients with blunt chest trauma, and the diagnosis is made by ECG, cardiac enzyme monitoring, and echocardiography.<sup>[10]</sup> All patients in this study had undergone ECG, and

ECG changes had been observed in 13.3% of patients undergoing ECG examination, and pericardial effusion had been detected in 12 (9.4%) patients undergoing echocardiography. In a study examining traumatic SFs, Turhan *et al.* detected ECG changes in 22.7% and pericardial effusion in 18.2%.<sup>[11]</sup> In our study, the rates were considered to be lower due to the high number of patients.

More than 95% of SFs are treated with conservative methods such as analgesia, rest, breathing exercises, and corset fixation.<sup>[12]</sup> Similarly, most patients underwent conservative treatment. There have been patients who underwent surgical treatment due to accompanying pathologies.

In a retrospective study by Potaris *et al.* evaluating the management of SFs, 14 patients were discharged from the emergency department, and the mean LOS was 6.7 days.<sup>[8]</sup> In our study, the mean LOS was 6.4 days, but differently from the other study, no patient was discharged from the emergency department. A comparison between LOS and the therapies administered revealed a statistically significant difference ( $P = 0.0001$ ). Similar to the study by Turhan *et al.*, the present study observed no statistically significant difference between LOS and age and fracture type (displaced-nondisplaced) of the patients.<sup>[11]</sup>

### Limitations

A retrospective and single-center study design is the most important limitation of the study. The treatment course and clinical course after hospitalization could not be evaluated in detail due to missing data in the patient records.

### Conclusion

SFs are rare but may be mortal due to accompanying pathologies and cardiac damage. Emergency doctors should be careful in patients diagnosed with a SF, and ECG, cardiac enzymes, and echocardiography must be kept in mind to monitor myocardial damage. Additional pathologies must be investigated as such pathologies affect the decision to hospitalize and LOS.

### Presentation(s) or awards at a meeting

International Critical Care and Emergency Medicine Congress as a poster, in May 2017, in Antalya.

### Author contribution statement

Conceived and designed the experiments; ÖÖ and PD. Performed the experiments; NB. Analyzed and interpreted the data; ŞY and NB. Contributed reagents, materials, analysis tools, or data; ŞY and NB. Wrote the paper; ŞY.

### Conflicts of interest

None declared.

### Ethical approval

Erciyes University noninvasive clinical research ethics committee approval number is 2017/59. Date: 03.02.2017.

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