ORIGINAL ARTICLE

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Characteristics of the Sternal Fractures and Associated Injuries: A Three-year Clinical Experience
Sternal Fractures and Associated Injuries

ABSTRACT

Objective: Although they constitute a small portion of thoracic trauma, sternal fractures require attention as they may be indicators of major cardiac injuries. The aim of this study is to review the diagnosis, treatment, and outcome of such patients administered to our emergency department.

Methods: The archive files of the patients administered to the emergency department due to thoracic trauma and diagnosed to have sternal fractures between January 2015 and December 2017 were reviewed for age, gender, type of trauma, type of injury, associated injuries, and clinical outcome.

Results: There were 27 male, and 6 female patients. The mean age was 48.9 ± 16.50 years (20-79). The most frequent cause was vehicle accident. The sternal fracture was isolated in 13, and associated with other injuries in 20 patients. Eight of the isolated fracture patients and all of the complicated group were hospitalized. Six of the patients underwent tube thoracostomy, one bilateral. When the length of hospital stay is compared between the two groups, sternal fracture with associated injury patients stayed in the hospital for significantly longer periods.

Conclusions: Although isolated sternal fracture is benign in nature and may be treated with basic measures, when associated with other injuries, it becomes more complicated to treat, and the length of hospital stay increases significantly.

Keywords: Sternum Fracture, Associated Injuries

Sternum Fraktürü ve Eşlik Eden Yaralanmaların Özellikleri; Üç Yıllık Klinik Deneyim Sternum Fraktürü ve Eşlik Eden Yaralanmalar

ÖZET

Amaç: Sternum fraktürleri, göğüs travması sonrası acil serviste görülen patolojilerin küçük bir yüzdesini oluşturmasına rağmen, kardiyak yaralanmaların habercisi olabilmeleri nedeni ile tanı ve izlemleri önem taşımaktadır. Amaç bu hastaların tanı, izlem ve tedavisindeki yaklaşımları tartışmaktır

Gereç ve Yöntem: Çalışma Ocak 2015 – Aralık 2017 tarihleri arasında göğüs travması sebebi ile acil servise başvuru yapan ve sternum fraktürü tanısı alan 33 hastanın demografik ve klinik özellikleri retrospektif olarak değerlendirildi.

Bulgular: Hastaların 27'si erkek, 6'sı kadındı. Yaş ortalaması 48.9 ± 16.50 (20-79) olarak tespit edildi. En sık görülen etiyolojik neden trafik kazası olarak bulundu. Hastaların 13'ünde izole sternum fraktürü tespit edilirken 20'sinde komplike fraktür görüldü. Eşlik eden en sık travmatik patoloji kot fraktürü olarak tespit edildi. İzole fraktürlerin 8'i hastaneye yatırılırken komplike fraktürlerin tamamının tedavisi hastaneye yatırılarak yapıldı. Olguların 6 sına tüp torakostomi uygulandı, bunlardan birisi iki taraflıydı. Hastanede yatış süreleri açısından değerlendirildiğinde komplike sternum fraktürü mevcut olan hastaların izole fraktürlere göre istatistiksel olarak anlamlı bir şekilde uzun olduğu tespit edildi.

Sonuç: İzole sternum fraktürleri medikal yöntemlerle güvenle yönetilerek hastanede kalış süresi kısa, iyi prognozlu travmalar olarak değerlendirebilir. Eşlik eden yaralanma tespit edilen hastalarda meydana gelen patolojiler nedeniyle hem hastanede kalış süresi hem de morbiditenin arttığı kanısındayız.

Anahtar Kelimeler: Sternum Fraktürü, Eşlik Eden Yaralanmalar

INTRODUCTION

Twenty-five percent of all deaths following trauma are due to thoracic trauma (1,2). Sternal fractures occur in 3-8% of blunt thoracic trauma (3-5). The major function of the sternum is to cover and to protect the vital organs such as the heart, and the lungs. Thus, a fracture of sternum is more serious when these structures are injured (4, 5). One of the most important factors indicating morbidity is the accompanying organ traumas (1, 2, 6).

The aim of this study is to review the clinical data of patients applied to the emergency room (ER) in a tertiary hospital due to thoracic trauma and diagnosed to have sternum fracture, either isolated or associated with other injuries. We assessed the possible effects of accompanying injuries on clinical outcome, morbidity, mortality, and length of hospital stay in these patients.

MATERIAL AND METHODS

Patient Selection: Following the institutional review board permission (2018/47) the archive files of patients applied to the ER at a tertiary hospital due to trauma between the 1st of January, 2015 and the 31st of December, 2017 were reviewed for cases of sternal fracture. The age, gender, type of trauma, the extent of trauma, accompanying injuries, treatment, morbidity, mortality, and length of hospital stay were noted from these files.

All patients had chest computed tomography (CT) examinations following admission to the ER. Routine examinations included electrocardiography (ECG), creatine kinase (CK), creatine kinase myocardial band (CK-MB), and troponine levels in the serum. They were monitored for at least 12 hours. In case of suspected cardiac trauma the patients underwent echocardiography (ECHO). The patients were divided into two groups: 1) patients without any signs or symptoms of associated injuries were diagnosed as isolated sternal fracture, 2) patients with associated injuries were diagnosed as complicated sternal fracture. All patients were consulted with the thoracic surgeons, orthopedists, neurosurgeons and were either discharged with analgesics and outpatient follow-up, or were hospitalized.

Statistical Analysis: For statistical analysis SPSS version 20 (Statistical Package for the Social Sciences, 20 Inc. Chicago, IL, USA) was used. For numerical variables definitive statistics, i.e. mean ± standard deviation (SD), and median (minimum-maximum) were used. For categorical variables number of cases and percentage is calculated. To assess the possible relationships between the length of hospital stay and other factors, a linear regression model was used with a p value less than 0.05 taken as significant.

RESULTS

There were 33 cases of sternal fracture within the selected period. The mean age was 48.9 ± 16.5 years (range 20-79 years). Of the patients 27 were male (81.8%), and 6 were female (18.2%). All patients were conscious and had tenderness at palpation of their sterna. Etiologically the most frequent cause was vehicle accident (n=23, 69.7%).

Thirteen of the patients had isolated sternal fracture (39.4%), and the remaining 20 patients had associated injuries (60.6%) and were diagnosed as complicated sternal fracture. The most frequent associated injury in these patients was rib fracture (n=15, 75%). In patients complicated with rib fractures 3 had traumatic pneumothorax, and 3 had traumatic hemopneumothorax. These 6 patients were all treated with tube thoracostomy, one with bilateral tubes (Figure 1). Associated injuries included spinal trauma in 6 (30%), extremity fractures in 2 (10%), multiple trauma in 2 (10%), and mandible fracture in 1 (5%) patients (Table 1).

Table 1. Basic characteristics of the study population

	Number/Mean value	%/SD*
Age	48.93	16.50
Gender		
Female	6	18.2
Male	27	81.8
Trauma cause		
Vehicle accident	23	69.7
Fall	10	30.3
Site of sternal fracture	26	78.8
Corpus	7	21.2
Manubrium		
Fracture type		
Displaced	5	15.2
Non-displaced	28	84.8
Clinical outcome		
Discharg eafter ED** follow up	4	12.1
Hospitalized	19	87.9
Associated injury		
Rib fracture	15	45.5
Spinal trauma	6	18.1
Pneumothorax	3	9
Hemopneumothorax	3	9
Multiple trauma	2	6
Extremity fracture	2	6
Mandible fracture	1	3

SD: standard deviation; **ED: emergency department.

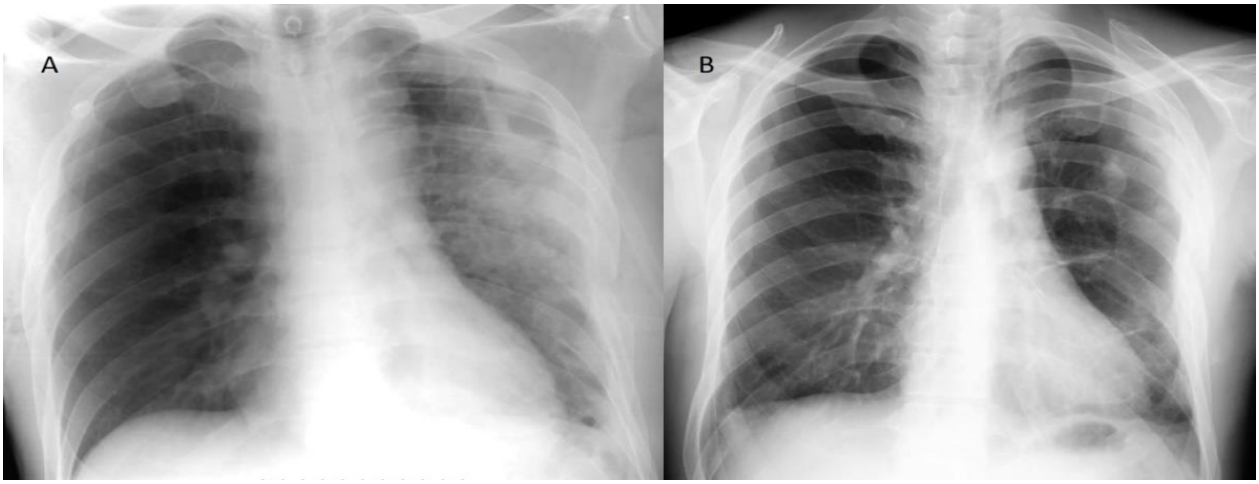

Figure 1. A. Chest x-ray of a patient with hemothorax on the right, and hemopneumothorax on the left side, treated with bilateral tube thoracostomy, B. Chest x-ray of the same patient at time of discharge.

Isolated sternal fracture did not cause ECG changes whereas complicated sternal fracture patients had minimal elevation in serum cardiac enzyme levels and minimal pericardial effusion revealed by ECHO in 5 (25%). The most frequent site of sternal fracture was the corpus (n=26, 78.8%). In 5 of the patients (15.2%) the edges of the fracture were displaced (Figure 2). These patients were the same patients with cardiac findings mentioned above. In 4 patients the fracture was placed in the manubrium, and the other one was in the corpus, all associated with rib fractures.

None of the patients underwent surgical sternal fixation. The treatment consisted of analgesics, antibiotics for prophylaxis, mucokinetics, and bed rest. A pillow was placed under the back of the patients to provide an extension in the sternum to help re-positioning of the fractured sternum. The patients were advised to continue the same postural treatment at home after discharge.

The mean length of hospital stay was 2.00±2.00 days in the isolated sternal fracture patients, whereas it was 11.55±9.95 days in the complicated group. Of this group of patients, thoracic trauma patients had a significantly shorter length of stay when compared to patients with spinal and extremity fractures. Patients with sternal fracture due to fall from various heights stayed significantly longer in the hospital in comparison to vehicle accidents, as well (Table 2).

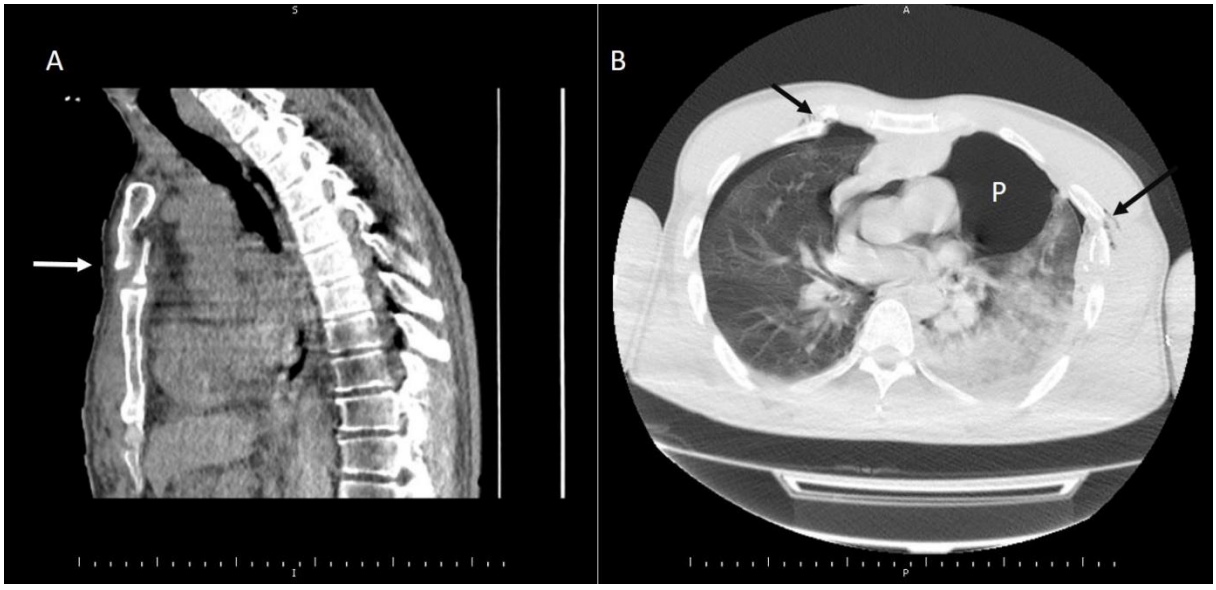

Figure 2. A. Chest computed tomography presenting a displaced sternal fracture (white arrow) in the sagittal plane, B. Chest computed tomography of the same patient presenting multiple rib fractures (black arrows) on both sides in the coronal plane.

Table 2. Statistical analysis of the factors affecting length of hospital stay.

Factor	Number	p value
Age		
60 >	24	0.165
60 ≤	9	
Fracture type		
Isolated	13	0.000*
Complicated	20	
Trauma type		
Vehicle accident	23	0.087
Fall	10	

**Statistically significant*

No morbidity or mortality was seen in isolated sternal fracture patients. These patients were discharged without any surgical treatment. Six patients in the complicated group, however, were treated with tube thoracostomy as a result of traumatic pneumothorax and hemopneumothorax. Two patients with extremity fractures were surgically fixated, one patient with spleen rupture underwent splenectomy, and one patient with open extremity fractures was surgically repaired. There was no mortality in the complicated sternal fracture group either. The patients with cardiac consequences were monitored for 2 days and clinical regression was revealed at the 12th, the 24th, and the 48th hour controls.

DISCUSSION

Thoracic trauma due to various causes is responsible for a quarter of deaths due to trauma, and is the most frequent cause of sternal fractures (7-9). Sternal fractures usually occur as a result of blunt thoracic trauma due to vehicle accidents in 3-8% of all cases. In our series, the majority of sternal fractures were due to vehicle accidents, as well (n=23, 69.7%).

The prominent symptom in the conscious patient is pain and tenderness over the sternum. During physical examination ecchymosis, hematoma, and contusion may be inspected. Palpation may induce pain, and irregularity and step sign may be present (10). Postero-anterior, lateral and oblique chest x-rays are reported to be crucial (11-13). After the multi detector CT unit was established, however, we prefer CT scan of the brain, thorax, and abdomen of all trauma patients. We believe this saves precious time in diagnosis and treatment of life-threatening injuries. X-rays are reserved for extremities and follow up purposes. All patients in our series had chest CTs performed.

Sternal fractures occur in the corpus sterni in 77-89% of cases (14-16). In our series the fractures in corpus was seen in 78.8% of the patients. Displacement is reported to be present in 11-16.6% of sternal fractures (17, 18). In our series displacement was found in 15.8% of complicated sternal fractures. During hospitalization the insertion of a pillow in the back of patients as advocated by Celik et al is preferred and found helpful in displaced sternal fractures (19). Cardiac injury may be present as much as 90% in blunt thoracic trauma cases (20, 21). In suspicion of myocardial injury, serum cardiac enzyme levels and ECG are proven useful (8). Further examination with ECHO is advocated in patients with elevated serum cardiac enzyme levels and abnormal ECG findings (22). Our patients were monitored according to this guideline and ECHO was performed in patients with elevated enzyme levels and abnormal ECG strips. Minimal pericardial effusion was revealed in 3 of 15 patients (20%) using ECHO, and these effusions resolved in a week with clinical follow-up without any further intervention. No patients in our series had myocardial injury.

Length of hospital stay in sternal fracture is reported between 2 to 10 days (17). This period strongly depends on the associated injuries (14). Isolated sternal fractures usually have good to excellent prognosis and do not require surgical procedures (14, 17). Treatment in such cases consists of analgesics and respiratory physiotherapy (14, 17, 19). The prognosis of sternal fractures is actually determined by the associated injuries. Accordingly, the length of hospital stay was significantly shorter in isolated sternal fracture patients in our series.

In conclusion, our series as well as other in the literature suggest that sternal fractures are rare and usually occur due to vehicle accidents. Diagnosis is based on physical examination and chest x-ray findings. In cardiac injury suspected cases, ECG, serum cardiac enzyme levels, and in selected cases ECHO is proved useful. If isolated, basic analgesic treatment and respiratory physiotherapy will suffice and recovery is expected in a short period. In cases with associated injuries, however, further treatment including surgical interventions and a longer hospital stay is required.

REFERENCES

1. Sirmali M, Türüt H, Topçu S, et al. A comprehensive analysis of traumatic rib fractures: morbidity, mortality and management Eur J Cardio Surg 2003;24:133-138.
2. Galan G, Peiialver JC, Paris E et al. Blunt chest injuries in 1696 patients Eur J Cardio Surg 1992;6:284-287.
3. Brookes JG, Dunn RJ, Rogers IR. Sternal fractures: a retrospective analysis of 272 cases. J Trauma 1993;35:46–54
4. Roy-Shapira A, Levi I, Khoda J. Sternal fractures: a red flag or a red herring? J Trauma 1994;37:59–61
5. Porter RS, Zhao N. Patterns of injury in belted and unbelted individuals presenting to a trauma center after motor vehicle crash: seat belt syndrome revisited. Ann Emerg Med 1998;32:418–424
6. Ziegler DW, Agarwal NN. The morbidity and mortality of rib fractures. J Trauma 1994;37:975-979.
7. Horikawa A, Miyakoshi N, Kodama H et al. Insufficiency Fracture of the Sternum Simulating Myocardial Infarction: Case Report and Review of the Literature. Tohoku J Exp Med 2007:211;89-93.

8. Hills MW, Delprado AM, Deane SA. Sternal fractures: associated injuries and management. J Trauma 1993;35:55–60.
9. Demirhan Ö, Kaynak MK. Thoracic traumas. Solunum 2003;6:320-337
10. Bilgin M, Akcalı Y, Hasdıraz L, et al. Isolated sternal fractures: a hallmark of violent injury. Turk Goğus Kalp Damar Cer Derg 2009;17:33-35
11. Richardson JD, Grover FL, Trinkle JK. Early operative management of isolated sternal fractures. J Trauma 1975; 15:156-158
12. Crestanello JA, Samuels LE, Kaufman MS, et al. Sternal fracture with mediastinal hematoma: delayed cardiopulmonary sequelae. J Trauma 1999;47:161–164
13. Saab M, Kurdy NM, Birkinshaw R. Widening of the mediastinum following a sternal fracture. Int J Clin Pract 1997;51:256–257
14. Athanassiadi K, Gerazounis M, Moustardas M, et al. Sternal fractures: retrospective analysis of 100 cases. World J Surg 2002;26:1243-1246.
15. Von Garrel T, Ince A, Junge A, Schnabel M, Bahrs C. The sternal fracture: radiographic analysis of 200 fractures with special reference to concomitant injuries. J Trauma 2004;57:837-844.
16. Potaris K, Gakidis J, Mihos P, Voutsinas V, Deligeorgis A, Petsinis V. Management of sternal fractures: 239 cases. Asian Cardiovasc Thorac Ann 2002;10:145–149.
17. Velissaris T, Tang AT, Patel A, et al. Traumatic sternal fracture: outcome following admission to a Thoracic Surgical Unit. Injury 2003;34:924-927
18. Uluşan A, Karakurt Ö. Cardiac findings of sternal fractures due to thoracic trauma: A five-year retrospective study. Ulus Travma Acil Cerrahi Derg 2018;24:249-254.
19. Celik B, Sahin E, Nadir A, et al. Sternum fractures and effects of associated injuries. Thorac Cardiovasc Surg. 2009;57:468-471.
20. Harley DP, Mena I. Cardiac and vascular sequelae of sternal fractures. J Trauma 1986;26:553-555.
21. Gouldman J, Miller RS. Sternal fracture: A benign entity? Am Surg 1997;63:17-19.
22. Wiener Y, Achildiev B, Karni T, et al. Echocardiogram in sternal fracture. Am J Emerg Med 2001;19:403-405.