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Research Article

Chest Blunt Trauma of Less Than Three Rib Fractures: A Cohort of 250 Case Series

Abbas Jaafar Khaleel Al-Anbari*, Noor Abbas Hummadi Fayadh
Department of Surgery, College of Medicine, Al-Nahrain University, Baghdad, Iraq
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Abstract

Background: The most frequent bone fracture, rib fractures, affects 10–20% of individuals with violent trauma and, in extreme circumstances, can also injure the internal organs. ***Objective***: To share our experience in treating individuals who have isolated rib fractures due to trauma without concurrent trauma and evaluate the importance of patients' follow-up. ***Methods***: This was a retrospective study of 250 patients (aged approximately 10 or more). All patients were initially treated without surgery. After management, the following information was collected: sex, fracture characteristics, mechanism of injury, age, selective CT scan examinations, and median follow-up time. ***Results***: 250 consecutive patients aged 10 or older were enrolled; 184 (73.6%) of these patients were men, and their ages ranged from 10 to 67 (mean: 61.4; median: 65). False ribs (VIII-XII) were more affected, and the most frequent mechanism of rib fracture was a household accident. Associated injuries occurred in only 13 (5.2%) patients, and pneumothorax was the most frequent complication, which was recorded in 10 (4%) patients. ***Conclusions***: While dealing with patients who have sustained thoracic trauma, a trauma team needs to be more informed to offer them effective treatment options. Accurate diagnosis, sufficient analgesia, and efficient physical treatment are necessary to prevent complications. Estimating the number of broken ribs can help management decisions and is crucial for categorizing patients who are at a high risk of complications.

Keywords: Blunt chest trauma; Hemothorax; Hemopneumothorax; Pneumothorax; Rib fractures.

إصابة صدمة الصدر مع أقل من ثلاثة كسور في الأضلاع: مجموعة من 250 حالة متسلسلة

الخلاصة

الخلفية: أكثر كسور العظم شيوعا هي كسور الأضلاع، تصيب 10–20٪ من الأفراد الذين يعانون من إصابات عنيفة، وفي الحالات القصوى، قد تؤذي الأعضاء الداخلية أيضا. **الهدف**: مشاركة خبرتنا في علاج الأفراد الذين تعرضوا لكسور أضلاع معزولة بسبب صدمة دون إصابة متزامنة وتقييم أهمية متابعة المرضى. **الطرائق**: كانت هذه دراسة بأثر رجعي شملت 250 مريضا (أعمارهم حوالي 10 سنوات أو أكثر). تم علاج جميع المرضى في البداية دون جراحة. بعد العلاج، تم استرجاع البيانات التالية: الجنس، ملامح الكسر، آلية الصدمة، العمر، فحوصات الأشعة المقطعية الانتقائية الإشعاعية، ومتوسط وقت المتابعة. **النتائج**: تم تسجيل 250 مريضا متتاليا تبلغ أعمارهم 10 سنوات أو أكثر؛ وكان 184 (73.6٪) من هؤلاء المرضى رجالا، وتراوحت أعمارهم بين 10 و67 عاما (المتوسط: 61.4؛ المتوسط: 65). كانت الأضلاع الزائفة (VIII-XII) أكثر تأثرا، وكانت الآلية الأكثر شيوعا لكسر الأضلاع حادثا منزليا. حدثت الإصابات المرتبطة فقط في 13 مريضا (5.2٪) فقط، وكان استرواح الصدر هو المضاعفات الأكثر شيوعا، وقد تم تسجيله في 10 (4٪) مرضى. **الاستنتاجات**: أثناء التعامل مع مرضى تعرضوا لإصابة صدرية، يحتاج فريق الإصابات إلى أن يكون أكثر اطلاعا ليقدم لهم خيارات علاجية فعالة. التشخيص الدقيق، وتخفيف الألم الكافي، والعلاج الطبيعي الفعال ضرورية لمنع المضاعفات. تقدير عدد الأضلاع المكسورة يمكن أن يساعد في اتخاذ قرارات الإدارة، وهو أمر بالغ الأهمية لتصنيف المرضى المعرضين لخطر كبير للمضاعفات.

* ***Corresponding author***: Abbas J. K. Al-Anbari, Department of Surgery, College of Medicine, Al-Nahrain University, Baghdad, Iraq; Email: abbasjaafer@nahrainuniv.edu.iq
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INTRODUCTION

Rib fractures occur when one or more of the bones in the rib cage are broken. This can be caused by trauma to the thorax, such as a fall or a car accident. Rib fractures could be due to medical conditions like osteoporosis or trauma, in which 15% of all trauma patients and 60% of thoracic trauma patients suffer from fractured ribs [1,2]. Although rib fractures alone do not pose a life-threatening threat, clinically, patients' symptoms can range from mild to severe and can cause significant pain and discomfort, necessitate the use of splints, and impair respiratory function [3]. Isolated rib fractures, which involve one to three ribs, are generally less dangerous than rib serial fractures, although they can still result in consequences, including hemopneumothorax, pneumothorax, or pulmonary edema, even a few weeks later [4]. Rib fractures often coincide with other serious injuries, such as pneumothorax (25.3%), hemothorax (20.9%), and others [5,6]. The risk of complications, including pneumonia, escalates with the number of rib fractures; for instance, 51% of patients with more than six rib fractures develop pneumonia [7]. With each subsequent rib fracture, the risk of complications from multiple rib fractures increases by 29% and includes increased pneumonia rates [8], ventilator dependence, duration of stay in the ICU and hospital, and death risk [9]. Rib fractures heal far more slowly than possible immobile fractures because of the constant motion of the chest wall during respiration; six months after an injury, the prevalence of impairment approaches 40% [10]. This study aimed to share our expertise in treating individuals who have isolated rib fractures

due to trauma without concurrent trauma and to evaluate the importance of patients' follow-up.

METHODS

Study design

This was a retrospective study of the radiological and clinical outcomes in a series of 250 subjects (aged approximately 10 or more) who had no first features of respiratory distress and had fewer than three acute fractured ribs. All patients were initially treated without surgery. Individuals who had sternal fractures and those who had chest tubes as their main form of treatment were eliminated. Following management, the following data were retrieved: sex, fracture features, trauma mechanism, age, and median follow-up time. Since the study was retrospective, signed consent from the included participants was not required. Statistical analysis was finalized after the data were transferred to an Excel spreadsheet, and the collected data are expressed as a number and percentage.

Study population and setting

Between January 2021 and December 2022, each of the 250 patients who were a part of this study presented at our tertiary unit at Al-Imamain Al-Kadhymain Teaching Hospital. To make the overview simpler, each patient was classified into three categories depending on their age (group I: 10-29 years; group II: 30-49 years; group III: > 50 years); number of fractured ribs (one or two); as well as the site of the fractured ribs (true ribs: I–VII; false ribs: VIII–XII ribs; and together).

Radiological fracture

Assessment of the rib X-ray images of the involved sites was taken after the initial clinically based physical examination, along with radiographs. Two independent radiologists and trauma surgeons reviewed the radiographs. Point-of-care sonography and an "E-FAST (extended focused assessment with sonography in trauma) scan" were performed on a trauma patient to look for pericardial fluid or peritoneum, hemothorax, and subcutaneous emphysema after confirming there were fewer than three fractured ribs and ruling out a pneumothorax. In this study population, a computed tomographic (CT) chest examination was not performed because it is more useful in symptomatic and polytrauma patients during the initial evaluation. An example of rib fractures detected on chest X-ray and CT are shown in Figures 1 and 2. We exclude patients who experienced immediate respiratory distress.

Treatment protocol

Individuals with fewer than three fractured ribs, no clinical features of breathlessness, and no pneumothorax with no free peritoneal effusion underwent conservative management with analgesics. After their initial presentation, every patient was given an appointment for a follow-up chest radiograph between 5 and 14 days later. All patients underwent regular observations. Initially, no chest CT scan was performed. However, a subsequent chest CT scan was performed (n= 7) in case the conventional chest radiograph was inconclusive or the patient reported having trouble breathing.

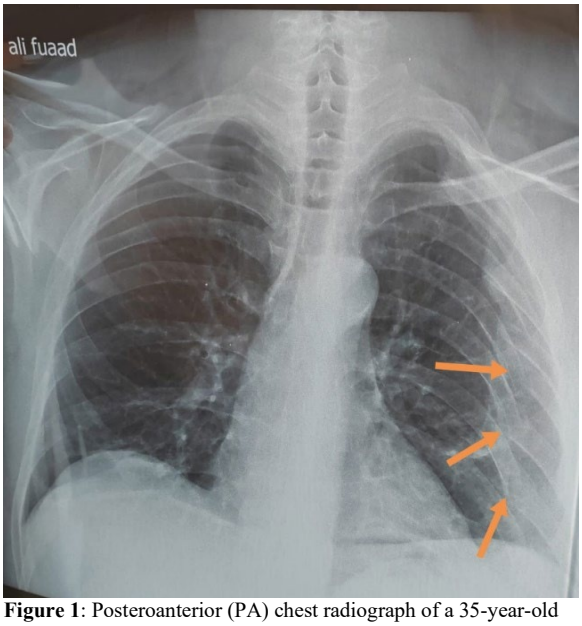

Figure 1: Posteroanterior (PA) chest radiograph of a 35-year-old male following a road traffic accident, demonstrating multiple left-sided rib fractures (arrows).

Figure 2: CT scan of the chest showing rib fractures in a 21-year-old male following a road traffic accident. The image demonstrates displaced fractures of the left lateral ribs (arrows), with preserved alignment of the surrounding thoracic structures.

Ethical considerations

The study was approved by the Institutional Review Board of the College of Medicine, Al-Nahrain University (2020-04-147 at 19-4-2020) and the local hospital authority.

Data analysis

The analysis of the data was performed with the IBM SPSS Statistics for Windows version 26.0 (IBM Corp., Armonk, NY, USA). The frequencies and percentages were used to describe categorical variables. The Shapiro-Wilk test was used to test the normality of continuous variables (age, follow-up duration); non-normally distributed data were denoted by median and range, and the normally distributed data were denoted by means and standard deviation. No comparative statistical tests were done because it was a descriptive case series with no control group.

RESULTS

In this study, 250 consecutive patients aged 10 or older were enrolled; 184 (73.6%) of these patients were men, and their ages ranged from 10 to 67 (mean: 61.4; median: 65). Road traffic accidents (24% of injuries) were the most frequent cause of injury. Table 1 provides a summary of all information, including the characteristics of fractured ribs.

Table 1: Summary of all the clinical and demographic characteristics of rib fractures included in the study

Characteristics	Descriptive data	n(%)
Age classes (year)	10 – 29	80(32)
	30 – 49	100(40)
	> 50	70(28)
Sex	Males	184(73.6)
	Females	66(26.4)
Mechanism of injuries	Road traffic accidents	40(16)
	Accident at work	20(8.0)
	Sport accident	50(20)
	Fall at home	140(56)
Site of rib fracture	I – VII	75(30)
	VIII-XII	155(62)
	Both	20(8)
No of rib fracture	One	150(60)
	Two	100(40)
Laterality	Left side	110(44)
	Right side	125(50)
	Bilateral	15(6)
Follow-up duration	12±2.8 days	

Values are presented as frequency, percentage, and mean±SD.

Table 2 showed the complications of rib fractures of the study's enrolled subjects that occurred in only 13 (5.2%) patients. Pneumothorax was the most frequent complication, which was recorded in 10 (4%) patients.

Table 2: Complications of rib fractures of the study's enrolled subjects

Complications	n(%)
Pneumothorax	10(4)
hemothorax	2(0.8)
Hemopneumothorax	1(0.4)
Total	13(5.2)

A representative CT image of post-traumatic pneumothorax is presented in Figure 3.

DISCUSSION

In this study, 250 patients who had no more than three symptomatic acute rib fractures were treated non-surgically. The short-term clinical and radiological results of this treatment were assessed. The most frequent risk factors in the current two-year study were the age group of 30–49 years (40%), male sex (73.6%), and accidents caused by household falls.

Figure 3: Axial CT scan (lung window) of the chest demonstrating a Left-sided pneumothorax in the same 21-year-old male patient. It reveals a hyperlucent left pleural space with lung edge retraction, consistent with moderate pneumothorax.

While the underlying agony is typically difficult to manage, early effective analgesics avoid hypoventilation, permit deep breathing, effective coughing to get rid of chest secretions, and compliance with supportive care [11,12]. Ultimately, this minimizes the requirement for respiratory assistance and subsequent pulmonary problems such as pneumonia, atelectasis, and respiratory failure [13,14]. According to the available published research, the primary risk factors for poor outcomes in cases with thoracic wall damage were diverse. Of these, individuals aged over 60 years [15] receive an additional point, plus one point for each subsequent 10-year increase starting at the age of 10 or older [16]. The second associated risk factor was the male sex [15-18]. Several series of fractured ribs similarly demonstrated the larger percentage of male subjects in the current study (73.4% of total patients) [17-19]. This high percentage may have resulted from males living more active lifestyles and driving more frequently [2,12]. In several well-documented clinical studies, the etiology of the trauma included highway accidents [20], but in the current study, household accidents were the most common reason for rib fractures. The virtual group sizes for the accidents, however, were comparable in earlier research, with motor vehicle accidents and falls often making up the largest groups [17,19]. Our case series followed the recommendation made in several studies that all hospitalized patients with suspected fractured ribs should undergo chest radiographs. Plain films alone, however, may significantly undervalue actual injuries in thoracic traumas. Murphy noted that more than 60% of fractured ribs remain undetected on thoracic X-rays [21]. Chest X-rays taken at the time of admission frequently underestimate the severity of pulmonary contusions. “The National Institute for Health and Care Excellence” (2016) suggests an initial and extensive indication of CT chest imaging in cases with supposed chest trauma, especially in the presence of anticoagulation or numerous comorbidities [22].

This recommendation is based on the aforementioned factors. Surgeons should consider scanning multiple anatomical areas concurrently if they suspect other injuries. The following pieces of advice should be explained and given to patients who are assessed as suitable and safe for discharge homes. Firstly, the significance of deep breathing exercises, mobilization, and coughing. Secondly, routine analgesia to enable a deep breath [3,12]. Thirdly, it is important to know when and where to seek medical support, especially if one experiences dyspnea, a productive cough, develops a fever, or has insufficiently controlled discomfort [4,14]. And finally, the anticipated period of recovery may be extended up to 4-6 weeks to ameliorate [15]. False rib (VIII-XII) fractures occurred more frequently in the current study than actual rib (I-VII) fractures. However, a study of 380 cases that attempted to assess the patterns of serial rib fractures following blunt chest trauma was unable to support these conclusions [19]. The affected rib level did not seem to be influenced by the various causes of the accidents. Since rib levels five to seven are the longest, and the single rib lengths exhibit a comparable distribution to the distribution of the fracture in the previous studies, the distribution of rib fractures is likely a function of rib length [2]. This is supported by the fact that more than half of all fractured ribs were found in levels of ribs 4 to 7 [23]. These long ribs are undoubtedly more vulnerable to mechanical loading, which increases their likelihood of eventual breakage. According to various clinical investigations, upper abdominal injuries may be related to lower rib fractures (7–12) [15]. We are unable to replicate these findings in our study. Like the findings of prior studies [20]. Pneumothorax, hemothorax, or hemopneumothorax complications were reported in 13 (5.2%) of the patients enrolled in the current study. In research involving 214 patients, pneumothorax (26.2%) was the most frequently related chest damage [17], which was also supported by a recent review [24]. In a retrospective, thorough analysis of the “National Trauma Data Bank," Flagel hypothesized that for every additional fractured rib, the risk of related intrathoracic injuries, such as pneumothorax, increased dramatically [25].

Study Limitations

There are a number of limitations in this study. To start with, its single-centered, retrospective design restricts its generalizability and causes a possible selection bias. Second, lack of routine CT of the chest in all of the patients might have underdiagnosed occult traumas like subtle pneumothoraxes or non-displaced fractures. Third, there was a relatively short follow-up (median 12 days), and this might not be sensitive to delayed complications (e.g., late pneumonia or chronic pain). Fourth, the pain scores, analgesic needs, and pulmonary function tests were not recorded in a systematic way, which did not allow assessing functional recovery. Fifth, the research did not have a comparison group (e.g., patients who were operated or had over three rib fractures). Lastly, it had an inadequate sample size to conduct multivariate analysis that could determine independent risk factors for complications.

Conclusion

Hospital admissions due to rib fractures are frequent and are linked with severe morbidity. Hence, while dealing with patients who have sustained thoracic trauma, a trauma team needs to be more informed to offer them effective treatment options. Accurate diagnosis, sufficient analgesia, and efficient physical treatment are necessary to prevent complications. Estimating the number of rib fractures can help management decisions and is crucial for categorizing cases that are at a high risk of complications.

Conflict of interests

The authors declared no conflict of interest.

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The authors did not receive any source of funds.

Data sharing statement

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

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