








## ANALYSIS OF PATIENTS WITH BLUNT THORAX TRAUMA AND RIB FRACTURE; EVALUATION OF 201 CASES

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### ABSTRACT

**Introduction:** Aim of this study is to evaluate the association of rib fracture with pneumothorax, hemothorax, hemopneumothorax, lung contusion, subcutaneous emphysema, pneumomediastinum, sternum fracture and clavícula fracture in patients who admitted to our clinics with thorax trauma

**Patients and Methods:** Between January 2017 and October 2018, 201 patients with thorax trauma and rib fracture who admitted to Afyon Health Sciences University, Faculty of Medicine, Department of Thoracic Surgery and underwent treatment and follow up were included in the study. Age, sex, computerized tomography (CT) findings and duration of hospitalization of the patients were retrospectively evaluated.

**Results:** Of the 201 patients with rib fracture, 152 were male, 49 were female, mean age was 51.46 and mean duration of hospitalization was 4 days. Total number of rib fracture was 716 and 430 of the fractures were displaced and 286 were non-displaced. Also 346 of the fractures were in the mid segment ribs (5-8th ribs), 224 of them were in the high segment (1-4th ribs) and 146 of the fractures were in the lower ribs (9-12th ribs). Of the patients with rib fracture, 57.7% had pneumothorax, 44.1% had lung contusion, 27.9% had subcutaneous emphysema, 27.4% had hemothorax, 18.4% had hemopneumothorax, 10.9% had sternum fracture, 9.5% had clavícula fracture and 4.5% had pneumomediastinum.

**Discussion and conclusions:** According to our study, traumatic rib fractures are most commonly in the displaced form and in the middle segment ribs (5-8th). Pathologies accompanying displaced rib fractures are more common than non-displaced fractures. Each complication should be evaluated individually and should be treated by the required method.

## 1. Introduction

Thorax traumas constitute one third of all trauma emergencies and responsible from nearly 20-25% of all traumatic life losses [1]. Blunt thorax traumas (BTT) are most commonly produced by traffic accidents, followed by assault, falling down, crushing and squeezing [2]. In the <40 years old adults, most common cause of accidental deaths are traffic accidents [3]. Thorax traumas are the third common type of all trauma cases [4]. The most common finding in the thorax traumas are rib fractures. Rib fractures are generally caused by BTT and are most commonly observed in the 4-9th ribs [5,6].

## 2. Patients and Methods

Ethics committee approval was received from Afyonkarahisar University of Health Sciences 2019/4 dated and numbered.

A total of 201 patients with thorax trauma and rib fracture who admitted to Afyon Health Sciences University, Faculty of Medicine, Department of Thoracic Surgery between January 2017 and October 2018 were included in the study. The hospital files and computerized thorax tomographies (CT) of the patients were retrospectively evaluated. Age, sex, numbers, levels and sides of the fractured ribs, accompanying intrathoracic pathologies; pneumothorax, hemothorax, hemopneumothorax, thorax contusion,

sternum fracture, pneumomediastinum, subcutaneous amphysema, clavicle fractures and duration of hospitalization were recorded. All study patients were called for outpatient follow up at least one time. Afterwards, the follow up was either ended or continued according to present findings. The relationship between rib fractures and intrathoracic injuries were evaluated.

### 3. Results

Demographic properties of the patients are shown in Table 1. The duration of hospitalization of the patients ranged between 0 to 31 days with a mean duration of  $4 \pm 3.86$  days.

**Table 1: Demographic Features**

|       | Number of patients | Age range | The average age | Standard deviation |
|-------|--------------------|-----------|-----------------|--------------------|
| Men   | 152                | 19-91     | 50,45           |                    |
| Women | 49                 | 19-82     | 54,63           |                    |
| Total | 201                | 19-91     | 51.47           | $\pm 17.93$        |

Total number and distribution of rib fractures are given in Table 2. Number of right sided rib fractures were 389 and most commonly displaced and in middle segments with 16.3%, while number of left sided rib fractures were 327 and most commonly displaced and in middle segments with 12.3%. Rib fractures were most commonly in the middle segments with 48.3% and least commonly in the lower segments with 20.4%.

**Table 2: Rib Fracture Distribution**

| Displaced rib fracture |                               | n          | Non-displaced rib fracture |                                   | n          | Total      | %             |
|------------------------|-------------------------------|------------|----------------------------|-----------------------------------|------------|------------|---------------|
| <b>Right</b>           | upper (1-4) kot fr displaced  | 74         | <b>Right</b>               | upper (1-4) kot fr non-displaced  | 43         | 117        | 16.34         |
|                        | middle (5-8) kot fr displaced | 117        |                            | middle (5-8) kot fr non-displaced | 65         | 182        | 25.42         |
|                        | lower (9-12) kot fr displaced | 54         |                            | lower (9-12) kot fr non-displaced | 36         | 90         | 12.57         |
| <b>Left</b>            | upper (1-4) kot fr displaced  | 66         | <b>Left</b>                | upper (1-4) kot fr non-displaced  | 41         | 107        | 14.94         |
|                        | middle (5-8) kot fr displaced | 88         |                            | middle (4-8) kot fr non-displaced | 76         | 164        | 22.91         |
|                        | lower (9-12) kot fr displaced | 31         |                            | lower (9-12) kot fr non-displaced | 25         | 56         | 7.82          |
| <b>Total</b>           |                               | <b>430</b> |                            |                                   | <b>286</b> | <b>716</b> | <b>100.00</b> |

The pathologic finding associated with rib fractures are given in Table 3. The bilateral rib fracture cases were associated with 6 lung contusions, 5 pneumothorax, 2 clavicle fractures and one subcutaneous amphysema. Of the other pathologies, there was 9 pneumomediastinum and 22 sternum fractures. Subcutaneous amphysema was present in 56 cases with 62.5% in the right side and in 3 of the patients the pathology was bilateral. Clavicle fracture was present in 19 patients, most commonly right sided with 52.6% and bilateral in 2 patients.

### 4. Discussion

Thorax injuries are a significant situation which affects significant vital organs and alters the cardiorespiratory balance, hence affecting other systems and requiring urgent management [7]. Thorax traumas constitute 1/3 of all trauma emergencies [2]. In the literature 30% of the chest traumas were penetrating and 70% are blunt traumas [8]. All of our patients had blunt thorax trauma. The most common cause of blunt thorax traumas are traffic accidents, followed by assault, falling down and crushing [2]. Previous studies stated that 1/4 of all trauma casualties are caused by thorax traumas [1, 5]. Only 2 of our patients were dead following trauma. This low frequency is probably resulted from the admittance of only blunt thorax trauma cases. The most common pathology in thorax traumas are rib fractures [6]. The reason

Table 3: Pathologies Associated with Rib Fractures

|                               |              | n          | %            | % distribution |
|-------------------------------|--------------|------------|--------------|----------------|
| <b>Pneumothorax</b>           | Right        | 75         | 37.31        | 64.65          |
|                               | Left         | 41         | 20.39        | 53.35          |
|                               | <b>Total</b> | <b>116</b> | <b>57.7</b>  | <b>100</b>     |
| <b>Hemothorax</b>             | Right        | 34         | 16.92        | 61.82          |
|                               | Left         | 21         | 10.45        | 38.18          |
|                               | <b>Total</b> | <b>55</b>  | <b>27.36</b> | <b>100</b>     |
| <b>Hemopneumothorax</b>       | Right        | 24         | 11.94        | 64.86          |
|                               | Left         | 13         | 6.47         | 35.14          |
|                               | <b>Total</b> | <b>37</b>  | <b>18.41</b> | <b>100</b>     |
| <b>Lung Contusion</b>         | Right        | 49         | 24.38        | 54.44          |
|                               | Left         | 41         | 20.40        | 45.56          |
|                               | <b>Total</b> | <b>90</b>  | <b>44.78</b> | <b>100</b>     |
| <b>Subcutaneous Emphysema</b> | Right        | 35         | 17.41        | 62.50          |
|                               | Left         | 21         | 10.45        | 37.50          |
|                               | <b>Total</b> | <b>56</b>  | <b>27.86</b> | <b>100</b>     |
| <b>Clavicle Fracture</b>      | Right        | 10         | 4.98         | 52.63          |
|                               | Left         | 9          | 4.48         | 47.37          |
|                               | <b>Total</b> | <b>19</b>  | <b>9.45</b>  | <b>100</b>     |
| <b>Pneumomediastinum</b>      | n            | %          |              |                |
|                               | 9            | 4.48       |              |                |
| <b>Sternum Fracture</b>       | n            | %          |              |                |
|                               | 22           | 10.95      |              |                |

of hemothorax and pneumothorax in blunt thorax traumas is the pulmonary parenchymal injury caused by broken rib pieces [9]. Rib fracture was radiologically present in all of our study patients. The diagnosis of hemothorax or pneumothorax was confirmed by routine thorasynthesis of all suspected cases. Only contraindication for thorasynthesis was coagulopathy [10]. Males take over a more active role in the society; hence they are more commonly exposed to traumas [6]. In parallel, chest traumas are more commonly observed in males and between 2nd and 5th decades [11]. The mean age of our study patients was  $51.5 \pm 17$  in accordance with the literature. Thorax injuries are not generally isolated and they are commonly together with head traumas, other bone fractures and intraabdominal injuries [12]. In

our study, we excluded cases with extrathoracic injuries.

Lung contusion has a frequency of 17-70% in all parenchymal injuries and has an important role with its potentially high morbidity and mortality rate [12]. The mechanism of lung contusion is explained by two mechanisms; first is direct compression of the traumatic agent to lung parenchyma. Second mechanism is the serious shift of lungs, tracheobronchial tree and mediastinal structures as a result of generally traffic accidents [13, 14]. It is usually caused by blunt traumas and is close to the solid structures such as vertebrae, ribs, liver and heart [12]. Chest wall shows resistance to injury and reflects the absorbed kinetic energy to the lung and alveoli are stretched and torn with different mechanisms

following positive pressure. Afterwards, the blood enters the interstitium and the alveolar space [13]. As a result, lung contusion is the occurrence of interstitial and alveolar damage following thorax traumas and without lung laceration [15]. In the following days, the lung contusion may increase, decrease or remain the same [16]. Physical examination findings may be absent in lung contusion [12]. In the posteroanterior chest x-ray, radiologic findings are not present in the posttraumatic 1-2 hours, however significant contusions may be detected in the 3rd-4th hour x-rays [13]. In 24 hours all the contusion findings are settled [12]. Contusion was present in 12.7% of patients in the study of Imamoglu et al. [4], and 12.5% of the patients in the study of Apiliogullari et al. [6]. Lung contusion was significantly more common in our study with 44.8%.

Rib fractures are the most common pathology in the thorax traumas [6]. They are most commonly caused by motor vehicle accidents [17]. In different studies, the incidences of traumatic rib fractures are reported to be between 7-40%, while isolated rib fractures are reported to be between 6-12% [17]. The frequency of rib fracture was 36.4% in the study of Imamoglu et al. [4], and 28.6% in the study of Cangir et al. [3]. At least one rib fracture was present in all of our study patients. The site of fracture is generally in the weakest site of the rib, which is the angulation area, close to the lateral portion [18]. Fractures are most commonly at the 4-9th ribs [11]. In our study, the fractures were present in the 4-9th ribs on 48.3% of the cases. First and second ribs are the most stable ones, surrounded by clavicle, scapula and shoulder region and are harder to break [19]. Fracture of 1st and 2nd ribs were 3.6 and 6.8% consecutively in our study with the least frequency of all rib fractures. Moreover 1st and 2nd ribs have significant vessel and nerve neighbourhoods and injuries of these structures in the fractures of these ribs are reported to be 14% in a study [20]. Males are more active in the society and in parallel they are

exposed to traumas more commonly than females [6]. Chest traumas are also more common in males and between 2nd and 5th decades [11]. In accordance with the literature, the frequency of males was 72.1% (n: 183) and mean age was around 5th decade in our study.

Pneumothorax is another common complication of thorax trauma [21]. Traumatic pneumothorax generally results from the alteration of visceral pleura integrity by the broken ribs [2,6]. The frequency of pneumothorax was reported to be 30.9% by Imamoglu et al. [4], 20.8% by Cangir et al. [3] and 33.9% by Serin et al. [2]. Pneumothorax was present in 116 (57.7%) of our study patients. It was right sided in 64.6%, left sided in 35.4% and bilateral in 8 cases.

Hemothorax and hemopneumothorax are other common problems of thorax traumas [21]. These problems are also cause after rib fractures. In a study by Apilioglu et al., hemothorax was observed in 20.8% and hemopneumothorax was present in 8.3% of the patients [6]. Cangir et al., reported 7.1% hemothorax and 20.9% hemopneumothorax in their study [2]. In our study hemothorax was present in 27.4% of the patients and was right sided in 61.8% of the cases. Hemopneumothorax was 18.4% and was right sided in 66.9% of the cases.

Sternum fracture is less common than rib fractures and is caused by severe traumas over the anterior wall of thorax, usually by steering wheel crushes [3]. The frequency of sternum fracture was reported to be 2% by Apiliogullari [6], 3.6% by Imamoglu et al. [4], and 10.7% by Cangir et al. [3]. Sternum fracture was present in 19.9% of our study patients.

Of other posttraumatic pathologies, subcutaneous emphysema was reported to be 10.9% by Imamoglu et al. [4] and 17.8% by Yazkan et al. [12]. It was present in 27.9% of our study patients. Fracture of clavicle was reported to be 5.5% by Imamoglu et al. [4], 12% by Apiliogullari [6] and 9.5% in our study. Our posttraumatic pneumomediastinum rate was 4.5%.

The mortality rate was reported to be 3.6% by Imamoglu et al., 4.1% by Yazkan et al. [12], and 1% in our study.

The rate differences between our study and other studies are probably due to the inclusion of patients with isolated thoracic trauma and rib fractures.

## 5. Conclusion

The most common pathology that is encountered after blunt thorax traumas are rib fractures. It is most commonly observed in the mid segment ribs. Rib fractures may be accompanied by pneumothorax, hemothorax, lung contusion, pneumomediastinum, subcutaneous emphysema, sternum fracture and clavicle fracture. The most common concomitant pathology is pneumothorax. The presence of these complications and mortality are determined by the age of the patient and the number of fractured ribs. The complications should be treated appropriately.

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