Rib fractures, a public health issue-a multi regional retrospective study

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Abstract

We performed a retrospective study focusing on examining all rib fracture cases discharged from 4 thoracic surgery clinics in Romania. Over a period of 3 years, we analyzed data regarding the patients, diagnosis and number of days spent in the hospital. 2.417 patients were included in this study and all patient evolutions were taken into account. The most patients suffered from multiple rib fractures, involving four or more ribs. In total average hospital stay was 5.46 days. The pneumothorax was the most common encountered complication followed by hemo-pneumothorax, hemothorax and lung contusion. Men seem to be at a higher risk to develop a rib fracture than women. Fracture incidence increased with age in both sexes. The main goal when treating thoracic traumatic pathology is attaining less impairment of pulmonary functions and fast social reintegration. Management of rib fractures must be tailored to each individual case.

Keywords: rib fracture, chest trauma, flail chest

Introduction:

Hospital admissions in a trauma center generally include rib fractures which can be either single, segmental or multiple. This type of injury can be caused by sport activity, falls, blunt force trauma, maneuvers in cardiopulmonary resuscitation and seldomly by bone tumors. Flail chest is described as a medical condition in which at least 3 ribs are fractured in minimum in 2 locations[1]. An unstable chest wall can often be associated with traumatic lung injuries (contusions, lacerations), pneumothorax or hemothorax, prolonged mechanical ventilation, pneumonia and chronic pain after discharge.

Although numerous surgical and medical treatments of rib fractures have been described and practiced, a worldwide accepted guideline is still deficient and treatment remains controversial to this day. It is safe to say that when treating rib fractures, one aims to prevent and minimize associated complications [2].

The essential approach when treating thoracic trauma is complete patient evaluation and prioritization of the significance and severity of all the sustained lesions. A dynamic systematic attitude and meticulous assessment are adamant in order to treat life-threatening injuries and identify patients at risk of developing complications [3].

In Romania 7249 trauma related deaths were registered in 2016 and in 2017 the length of hospital stays for patients diagnosed with different types of accidents and injuries was 6.5 days. Thoracic trauma is frequently encountered in a multi-trauma patient and responsible for 25% of all trauma deaths[4, 5, 6]. Having these facts in mind we performed a retrospective study focusing on examining all rib fracture cases discharged from 4 thoracic surgery clinics in Romania

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Materials and methods:

Over a period of 3 years, we analyzed data regarding the patients, diagnosis and number of days spent in the hospital from 4 thoracic surgery clinics in the following hospitals: Spitalul Clinic Județean de Urgență „Dr. Constantin Oprea” Baia Mare, Spitalul Clinic Județean de Urgență “Sf. Aposol Andrei” Constanța, Spitalul Clinic Județean de Urgență Craiova and Spitalul Clinic Municipal de Urgență Timișoara. The medical software Hipocrate and Info World were used to obtain all charts of discharged patients from these 4 clinics between 1.01.2016 to 31.12.2019.

All patients discharged with the following diagnosis were included in this study:

- fracture of the first rib (S22.31)
- fracture of one rib, other than the first rib (S22.32)
- multiple rib fractures, not specified (S22.40)
- multiple rib fractures, involving the first rib (S22.41)
- multiple rib fractures, involving two ribs (S22.42)
- multiple rib fractures, involving three ribs (S22.43)
- multiple rib fractures, involving four or more ribs (S22.44)
- flail chest (S22.5)

Patients that were underage or discharged from other clinics than thoracic surgery were not included. All patient evolutions were taken into account. A total of 10.802 patient charts were pooled for analysis.

Study limitations are present due to the fact that not all the hospitals use the same medical software and provide different data.

Results:

In Baia Mare a total of 1.448 patient charts were scanned and 149 were included in the study. In Constanța a total of 1.128 patient charts were scanned and 190 were included in the study. In Craiova a total of 5.171 patient charts were scanned and 1.659 were included in the study. In Timișoara a total of 3.055 of patient charts were scanned and 413 were included in the study. 2.417 patients were included in this study.

Standard treatment consisted in rapid active pain control, muscle relaxant, anti-inflammatory medication and prophylactic antibiotherapy when complications were present. Associated pneumothorax, hemo-pneumothorax or

hemothorax received pleural drainage which was encountered in 21% of discharged patients. After chest tube insertion for hemothorax and hemo-pneumothorax, if the pleural drainage was over 2 liters fresh blood or the recorded drainage was more than 300 ml/h of fresh blood for 2 consecutive hours, then an exploratory thoracotomy was performed. Emergency surgery was also performed in cases that associated significant pulmonary lacerations or major blood vessel injury.

Surgical fixation of the rib fractures with plate systems was performed in 1.72% cases.

In Timișoara pain was measured in dynamics using visual analog pain scores with the value of 5.7 at three months.

In 2019 a total of 593 patients were diagnosed with rib fractures:

- 29 patients in Baia Mare
- 62 in Constanța
- 403 in Craiova
- 99 in Timișoara

In 2018 a total of 654 patients were diagnosed with rib fractures:

- 48 patients in Baia Mare
- 80 in Constanța
- 419 in Craiova
- 107 in Timișoara

In 2017 a total of 601 patients were diagnosed with rib fractures:

- 41 patients in Baia Mare
- 48 in Constanța
- 406 in Craiova
- 100 in Timișoara

In 2016 a total of 569 patients were diagnosed with rib fractures:

- 31 patients in Baia Mare
- 0 in Constanța (due to hardware errors)
- 431 in Craiova
- 107 in Timișoara

In figure 1 is presented average age of patients: 26%. 647 of the patients were female (50 in Baia Mare, 45 in Constanța, 475 in Craiova and 77 in Timișoara) while 74% were male (99 in Baia Mare, 145 in Constanța, 1185 in Craiova and 336 in Timișoara).

Figure 1: Average age of patients included in the study

Fracture incidence increased with age in both sexes. Elderly people especially in the 60-69 age group are the most numerous. After 39 years of age the number of persons diagnosed with rib fractures continues to grow steadily until reaching the 60-69 age groups. People older than 70 years of age and younger than 90 years are still more numerous than younger people located in the 18-39 age groups.

In total average hospital stay was 5.46 days; in Baia Mare 4.81 days, in Constanta 6.4 days, Craiova 4.75 days and in Timisoara 5.91 days.

In **Baia Mare** discharged patients presented the following main discharge diagnostics (Table I)

Table I: Diagnostics of discharged patients in Baia Mare 2016-2019

Diagnostic	Female patients	Male Patients	Total
Fracture of the first rib	2	5	7
Fracture of one rib, other than the first rib	6	16	22
Multiple rib fractures, not specified	4	16	20
Multiple rib fractures, involving two ribs	10	15	25
Multiple rib fractures, involving three ribs	2	8	10
Multiple rib fractures, involving four or more ribs	11	30	41
Flail chest	15	9	24
Total number of patients	50	99	149

In **Constanța** discharged patients presented the following main discharge diagnostics (Table II):

Table II: Diagnostics of discharged patients in Constanța 2016-2019

Diagnostic	Female patients	Male Patients	Total
Fracture of the first rib	2	5	7
Fracture of one rib, other than the first rib	4	13	17
Multiple rib fractures, not specified	3	12	15
Multiple rib fractures, involving two ribs	3	11	14
Multiple rib fractures, involving three ribs	4	17	21
Multiple rib fractures, involving four or more ribs	28	84	112
Flail chest	1	3	4
Total number of patients	45	145	190

In **Craiova** discharged patients presented the following main discharge diagnostics (Table III)

Table III: Diagnostics of discharged patients in Craiova 2016-2019

Diagnostic	Female patients	Male Patients	Total
Fracture of the first rib	3	6	9
Fracture of one rib, other than the first rib	36	120	156
Multiple rib fractures, not specified	65	164	229
Multiple rib fractures, involving two ribs	90	217	307
Multiple rib fractures, involving three ribs	86	186	272
Multiple rib fractures, involving four or more ribs	195	490	685
Flail chest		1	1
Total number of patients	475	1184	1659

In **Timișoara** discharged patients presented the following main discharge diagnostics (Table IV):

Table IV: Diagnostics of discharged patients in Timisoara 2016-2019

Diagnostic	Female patients	Male Patients	Total
Fracture of the first rib	1	13	14
Fracture of one rib, other than the first rib	9	26	35
Multiple rib fractures, not specified	33	149	182
Multiple rib fractures, involving two ribs	4	20	24
Multiple rib fractures, involving three ribs	3	19	22
Multiple rib fractures, involving four or more ribs	19	76	95
Flail chest	8	33	41
Total number of patients	77	336	413

The most patients suffered from multiple rib fractures, involving four or more ribs.

The pneumothorax was the most common complication present in 12% of the discharged patients, followed by hemo-pneumothorax present in 5%, hemothorax in 4% and lung contusion in 3%.

Discussions:

Chest trauma with rib fractures remains a problematic issue in our country. Our study covered a three-year period in only four thoracic surgery and trauma centers. We consider the number of cases recorded to be high; if we consider the fact that a simple chest x-ray can overlook the rib fractures, then many of the patients are underdiagnosed, because not all hospitals have access to computed tomography, especially in territorial, non-academic centers. The year distribution/center is uniform, suggesting that thoracic trauma is a constant over the years.

As we have shown, the majority of patients have four or more ribs fractured at the time of admission. If we consider that thoracic trauma associates with other traumatic components (head injuries, spleen, liver or kidney ruptures) then this pathology suddenly gains complexity, making the management of these patients very difficult and often requiring multidisciplinary approach.

Males seem to be at a higher risk to develop a rib fracture than women. In a country such as Romania men are still predominantly involved in physical labor and engage more in risky household activities. Criminal rates are still high, especially in rural areas and men are more likely to try to interfere and try to settle conflicts. Moreover, fewer women possess a driver's license and tend to be more prudent in traffic.

Elder persons may be prone to thoracic trauma and rib fractures due to the fact that with age starts the process of cartilage ossification and their chest wall starts to stiffen. They may also develop osteoporotic bones which are fragile and more likely to break. As we have shown, the fracture frequencies are higher in the sixth decade of life. At this age, many of the patients have other comorbidities, such as BPCO, pneumoconiosis, silicosis that limit lung volumes. Any traumatic events increase the respiratory restrictions with direct impact to the outcome of the patient. Many patients have underlying cardiac disease, an important percentage requiring also anticoagulant treatments. The association of hemo-pneumothorax is not uncommon, thus bleeding for this patient category can be fatal.

Intrathoracic pressure is directly responsible for the ability of the air to move in and out of the lungs. A large number of muscles (the diaphragm, the intercostals, parasternal, accessory and abdominals) play a vital role in respiration [8]. When the integrity of the thoracic wall is disrupted and ribs are no longer able to perform their physiologic action the following negative effects will occur: ineffective ventilation, pulmonary contusion, and hypoventilation with atelectasis. The first two effects can

evolve with edema, hemorrhage and necrosis, while the latter develop from the pain caused by the rib fractures. Pain leads to a decreased tidal volume and atelectasis[7]. In order to avoid such complication pain management is applied as soon as the patient enters the hospital and is continuously repeated. Adequate pulmonary hygiene is crucial and early mobilization is recommended[9]. Fluid administration should be cautiously exercised if a lung contusion is present because large amounts of fluids can worsen pulmonary edema[10].

Moreover, many patients complain about chest pain long after the event causing the fractures occurs, especially in patients that are managed conservatively, without surgical approach for fixation and approximation of the ribs. This is caused either by vicious ossification, which leads to calcification of the intercostal space that compresses the intercostal nerve, or by vicious consolidation of the fracture, when the fragments are not properly aligned, leading to nerve compression also. These vicious bone consolidations are more frequent in our country due to the fact that osteosynthesis materials are expensive and therefore the thoracic surgeon's access to the latter is limited. Nevertheless, the literature reports conclude that chronic pain after rib fractures is more common than expected [11,12,13].

At 2- and 3-month follow-ups many patients still complain about pain or stiffness of the affected side. Using the visual analogic pain scales, we recorded mean values of 5.7 out of 10, and a significant number of patients complained about pain even during rest time. A small percentage of the patients required various types of recovery treatments in specialized centers, and some of them even required surgery for intercostal neurectomy, because the pain affected their quality of life, enabling them to perform basic day-to-day activities.

Conclusion:

Management of rib fractures must be tailored to each individual case. The main goal when treating thoracic traumatic pathology is attaining less impairment of pulmonary functions and fast social reintegration.

Patient's age, associated complications and extent of trauma to other organs and systems have to be considered in order to apply the best treatment possible. A worldwide guide for rib fracture treatment would provide numerous advantages.

Conflict of Interest:

Authors have no conflict of interest to disclose

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