Risk factors for late pneumothorax in patients with minor rib fractures after blunt chest trauma

Hıdır Esme[1]

1 Health Sciences University, Konya City Hospital, Department of Thoracic Surgery, Konya, Türkiye

Abstract

Aim: Traumatic pneumothorax is a preventable cause of death in trauma patients. Treatment of small traumatic pneumothorax without respiratory distress is controversial. In this study, we tried to determine the risk factors for the development of late traumatic pneumothorax and the safety of treatment with observation in appropriate patients.

Methods: Between August 2020 and December 2023, 167 patients admitted to the emergency department for blunt chest trauma with less than four rib fractures were retrospectively analyzed. Age, gender, mechanism of trauma, number of rib fractures, rib fracture location, concomitant traumas and pulmonary complications were recorded.

Results: The study included 167 patients. There were 107 males (%) and 60 females (%). The age of the patients ranged from 17 to 89 years (mean, 52.6 years). Early pneumothorax was seen in 10 patients (0.59%) and late pneumothorax in nine patients (0.53%). In statistical analysis, there was a significant correlation between late pneumothorax and the number of rib fractures (p=0.001) and subcutaneous emphysema (p=0.023). There was no significant association between late pneumothorax and other parameters.

Conclusion: Increased number of rib fractures and pulmonary complications are harbingers of traumatic pneumothorax. Observation is an adequate treatment modality in late pneumothoraxes without respiratory distress and radiologic progression.

***Keywords**: Blunt trauma, late pneumothorax, risk factors*

1. Introduction

Chest trauma accounts for 10% to 15% of all trauma and is the cause of death in 25% of all trauma-related deaths.[1] After major trauma, the incidence of traumatic pneumothorax has been reported to be higher than 20% .[2] Traumatic pneumothorax is a preventable cause of death in trauma patients. The treatment of small traumatic pneumothorax not accompanied by respiratory distress is controversial. Although simple interventions such as percutaneous tube thoracostomy can be life-saving, such procedures can be associated with significant morbidity when managed by personnel without appropriate training in trauma.[3] Although small primary spontaneous pneumothorax can be managed conservatively, the safety of close observation for late traumatic pneumothorax is questionable. In this study, we tried to determine the risk factors in the development of traumatic late pneumothorax and the reliability of observation in appropriate patients.

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2. Materials and Methods

Between August 2020 and December 2023, 167 patients admitted to the emergency department for blunt chest trauma with less than 4 rib fractures were retrospectively analyzed. Age, gender, mechanism of trauma (motor vehicle accident, falling from high, assault or pedestrian injury (automobile-pedestrian or automobile-bicycle injury), number of rib fractures, rib fracture location, concomitant traumas and pulmonary complications (pneumothorax, hemothorax, hemopneumothorax, pulmonary contusion and subcutaneous emphysema) were recorded.

Direct chest radiography is ordered for all patients admitted to the trauma department of the hospital emergency outpatient clinic, and thoracic computed tomography is performed in patients with suspected lung parenchymal pathology or mediastinal pathology. Thorax computed tomography was performed in 124 of the 167 patients included in the study (Figure 1 and 2). No significant difference was observed in terms of pneumothorax in any of the 124 patients who underwent thorax CT. However, different clinical features were detected in 32 patients in terms of rib fracture and lung contusion. Radiologic examinations related to other systems are ordered and evaluated by the emergency physician or the relevant clinical specialist according to the history and physical examination. Pneumothorax detected in the emergency department is considered

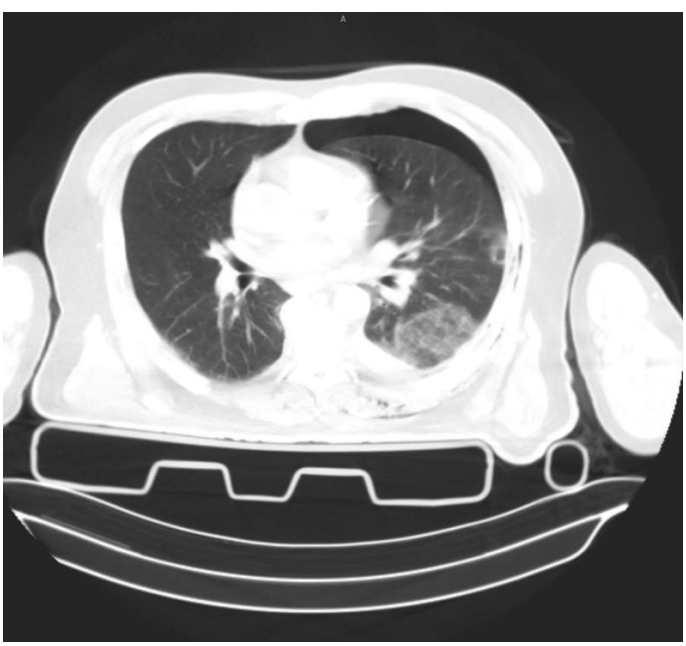
early pneumothorax, while pneumothorax occurring after hospitalization is defined as delayed pneumothorax. Tube thoracostomy was performed by thoracic surgeons in the emergency department. Tube thoracostomy was performed on symptomatic patients with moderate and high degree pneumothorax. Patients with mild pneumothorax were followed up.

Figure 1

Image of right traumatic pneumothorax in thorax computed tomography coronal section.

Figure 2

Image of left traumatic pneumothorax in thorax computed tomography sagital section.



SSPS 20.0 statistical software (IBM-SPSS Inc., Chicago, IL, USA) was used to analyze the data obtained in the study. Chi-square test was used to compare categorical variables in statistical analyses. Student's T test was used to compare continuous variables between two groups. In the study, $p<0.05$ was taken as the limit of statistical significance.

3. Results

The study included 167 patients. 107 patients were male (%) and 60 were female (%). The age of the patients ranged from 17 to 89 years (mean, 52.6 years). Early pneumothorax was seen in 10 patients (0.59%) and late pneumothorax in 9 patients (0.53%). The clinical characteristics of patients with blunt chest trauma are shown in Table 1.

Table 1

Clinical characteristics of patients with blunt chest trauma

Features		n (%)
Age (average, years)		52.4 (19-86)
Gender	· Female · Male	60 (35.9) 107(64)
Trauma mechanism	· Motor vehicle accident · Falling from high · Assault · Pedestrian accident	97(58) 44(26.3) 16(9.5) 9(5.3)
Number of rib fracture	· 1 · 2 · 3	47(28.1) 69(41.3) 51(30.5)
Rib fracture side	· Right · Left · Bilateral	89(53.2) 67(40.1) 11(6.5)
Rib fracture localization	· 1st – 3rd rib · 4th – 9th rib · 10th – 12th rib	33(19.7) 114(68.2) 20(11.9)
Pulmonary complication	· Early pneumothorax · Hemothorax · Hemopnemothorax · Contusion · Subcutaneous emphysema	10(5.9) 21(12.5) 7(4.1) 36(21.5) 18(10.7)
Late stage pneumothorax		9(5.3)
Isolated chest trauma		56(33.5)
Concomitant trauma	· Head trauma · Extremity trauma · Abdominal trauma · Facial trauma · Scapula/clavicula fracture	40(23.9) 32(19.1) 18(10.7) 12(7.1) 9(5.3)
Length of hospital stay (Mean, days)		6,36 (3-17)

Of the 10 patients who initially presented with early pneumothorax, 7 (70%) underwent tube thoracostomy and 3 (30%) were placed on observation. None of the patients in the observation group required further intervention. Late pneumothorax was detected in 9 (5.3%) patients. Late pneumothorax was most common in the first 2 days (mean 2.3 (1-7) days).

Tube thoracostomy for drainage was performed in 6 (66.6%) of these 9 patients, while observation was sufficient in 3 (33.3%). The

indication for tube thoracostomy was respiratory distress in 4 patients and progressive increase in pneumothorax during follow-up in 2 patients. The mean duration of chest tube follow-up was 4.7 (2-7) days. Clinical findings of patients with late pneumothorax are shown in Table 2. The mean hospitalization period of all patients was 6.36 (3-17) days. Due to traumas accompanying blunt thoracic trauma, spleen laceration repair in 2 patients and colon and diaphragm rupture repair in 1 patient were performed by the general surgery clinic, and lower extremity surgery in 5 patients, upper extremity surgery in 3 patients, and clavicle surgery in 2 patients were performed by the orthopedics clinic. The mean duration of hospitalization in patients with late pneumothorax was 8.93 (5-15) days. Mortality was 1.79% (n = 3/167). Statistically, there was a significant association between late pneumothorax and the number of rib fractures (p=0.001) and subcutaneous emphysema (p=0.023). There was no significant association between late pneumothorax and other parameters.

Table 2

Risk factors affecting late pneumothorax

	Late pneumothorax n (%)	p
Trauma mechanism		
· Motor vehicle accident	5 (55.5)	0.530
· Falling	2 (22.2)	
· Assault	1 (11.1)	
· Pedestrian accident	1 (11.1)	
Number of rib fracture		
· 1	1 (11.1)	0.001
· 2	2 (22.2)	
· 3	6 (66.6)	
Rib fracture localization		
· 1st – 3rd rib	2 (22.2)	0.875
· 4th – 9th rib	5 (55.5)	
· 10th – 12th rib	2 (22.2)	
Rib fracture side		
· Right	5 (55.5)	0.650
· Left	3 (33.3)	
· Bilateral	1 (11.1)	
Pulmonary complication		
· Early pneumothorax	2 (22.2)	0.023
· Hemothorax	0	
· Hemopnemothorax	7 (77.7)	
· Contusion	0	
· Subcutaneous emphysema	0	
Concomitant trauma		
· Head trauma	3 (33.3)	0.985
· Extremity trauma	1 (11.1)	
· Abdominal trauma	0	
· Facial trauma	3 (33.3)	
· Scapula/clavicula fracture	0	

4. Discussion

Traumatic pneumothorax is a preventable cause of death. The incidence of traumatic pneumothorax after major trauma is reported to be more than 20%.[2] In our study, traumatic pneumothorax was seen in 19 of our patients (11.36%). The incidence of early pneumothorax was 5.98% (10/167) and the incidence of late pneumothorax was 5.38% (9/167). According to the recommendation of The American College of Surgeons Committee, the treatment of traumatic pneumothorax is observation and/or tube thoracostomy in patients at risk of conversion to life-threatening tension pneumothorax.[4] Because of the risk of tension pneumothorax in traumatic pneumothoraxes, the idea of performing tube thoracostomy even if the amount of pneumothorax is small is common, especially in patients who are intubated or who will receive general anesthesia. However, the need for tube thoracostomy in small pneumothoraxes is controversial. Although tube thoracostomy is considered a relatively simple procedure, it may have a complication rate of up to 30%.[5] Deneuville reported that the risk of complications increased 10-fold in tube thoracostomies performed by physicians other than thoracic surgeons and physicians undergoing specialized training.[3] Therefore, routine tube thoracostomy in traumatic pneumothorax without respiratory distress or pneumothorax progression is controversial. In our study, 3 (30%) of 10 patients with early pneumothorax and 3 (33.3%) of 9 patients with late pneumothorax were treated with tube thoracostomy without progression in clinical findings and radiologic follow-up.

Tube thoracostomy was performed in 6 of 9 patients with late pneumothorax. Indications for tube thoracostomy were respiratory distress in 4 patients and radiologic progression of pneumothorax in 2 patients. The mean follow-up period of chest tube was 4.7 (2-7) days. Late pneumothorax was most common in the first 2 days (mean 2.3 (1-7) days). In 3 of 9 patients with late pneumothorax, observation and oxygen support were sufficient without further intervention. Misthos et al.[6] reported 14 cases of late pneumothorax and 57.1% (8 cases) of them were treated with observation. Our results and the results of other studies in the literature [7,8] suggest that routine chest tube placement is not necessary in all traumatic pneumothorax.

The mean hospital stay of all patients was 6.36 (3-17) days. The mean length of hospital stay in patients with late pneumothorax was 8.93 (5-15) days. Although no adverse outcome was recorded in late pneumothoraxes followed up with observation, hospital stay was longer in these patients. We attributed the longer hospital stay in patients with late pneumothorax to more rib fractures and tube thoracostomy follow-up.

Lung parenchymal lesions in pneumothorax are usually caused by rib fractures. As in our study, the risk of pneumothorax increases with the number of rib fractures. Since air leakage is usually low in small lacerations of the lung, it is highly probable that pneumothorax is not seen on direct chest radiographs taken at inspiration. PA chest radiographs ordered by clinicians are taken by radiology technicians at the end of a deep inspiration regardless of the etiology. In fact, a PA chest radiograph taken at expiration is more sensitive in visualizing small pneumothoraxes. We believe that PA chest radiographs of all patients with blunt thoracic trauma should be taken at expiration, which has an important role in diagnosis and treatment. Therefore, it would be appropriate to inform radiology technicians about this issue. Although Thoracic Computed Tomography has been proven to be an important diagnostic tool in revealing pneumothorax, its effect on treatment has been found to be only 0.9%.[9] Therefore, in patients with minor blunt thoracic trauma, PA chest radiography performed at expirium is both cost-effective and diagnostically adequate radiologic examination.

In conclusion, increased number of rib fractures and pulmonary complications are harbingers of traumatic pneumothorax. Observation is an adequate treatment method in late pneumothoraxes without respiratory distress and radiologic progression.

Statement of ethics

This study was approved by Institutional Review Board (Konya City Hospital IRB Number:04-46, Date:2024) and written informed consent was obtained from all patients before enrolment in the trial.

Source of Finance

The authors declare that they have received no financial support for this study

Conflict of interest statement

The authors declare that they have no conflict of interest.

Availability of data and materials

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

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