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THE TREATMENT RESULTS OF PNEUMOTHORAX IN BLUNT CHEST TRAUMA

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ABSTRACT

Background: *Blunt chest trauma is one of the leading causes of post-traumatic death in both developed and developing countries. Pneumothorax is a common injury after blunt chest trauma. It occurs when there are signs of air remaining in the pleural cavity after injury, even though the pleural cavity does not communicate with the outside environment. Diagnosis is based on signs and symptoms, including chest pain, shortness of breath, hyperresonant to percussion, decreased breath sounds, decreased tactile fremitus. Chest X-rays are essential for diagnosis, and chest computed tomography can provide more accurate results. Treatment methods vary but often involve pleural drainage as a primary and important step, in addition to options such as conservative treatment or surgery.* ***Objectives:*** *To study the clinical, imaging features, and treatment results of pneumothorax in blunt chest trauma.* ***Materials and methods:*** *All patients with pneumothorax in blunt chest trauma were treated at Can Tho Central General Hospital from April 2022 to April 2023.* ***Results:*** *The average age was 45.95 ± 18.16 years. Men constituted 89% of the patient population, and traffic accidents were the cause in 86% of cases. Chest pain and dyspnea were two common symptoms of pneumothorax after blunt chest trauma, accounting for 91.9% and 40.5%, respectively. The incidence of rib fractures is quite high, accounting for 83.8% of cases. Out of 37 cases, one case was managed conservatively, while pleural drainage was performed in 36 cases (97.3%). Among the cases requiring pleural drainage, three cases (8.3%) required thoracotomy. The overall treatment success rate was 100%, with an average hospital stay of 8.3 ± 3.5 days. The presence of more or fewer rib fractures can impact the treatment duration for the patient, as 78.6% of patients with more than 4 broken ribs had a hospital stay of at least 8 days.* ***Conclusion:*** *Pneumothorax is a common injury following blunt chest trauma, and it occurs more frequently in men than women. The prevalent clinical features include chest pain, dyspnea, decreased breath sounds, and subcutaneous emphysema. The age of the patient and the number of fractures also impact the time required for treatment of this condition.*

Keywords: *Blunt chest trauma, pneumothorax, thoracostomy.*

I. INTRODUCTION

Blunt chest trauma is a common surgical emergency frequently encountered in clinical settings, often resulting from traffic accidents. The associated injuries may include rib fractures, pulmonary contusion, pneumothorax, and hemothorax. Pneumothorax, characterized by the accumulation of air between the two layers of the pleura or in the pleural cavity, is a common complication of blunt chest trauma, with severity ranging from asymptomatic to life-threatening. Patients may present with symptoms such as chest pain, dyspnea, decreased tactile fremitus, and decreased breath sounds, with chest pain and dyspnea being the most prominent. Chest X-ray plays a crucial role in diagnosis,

supplemented by computed tomography (CT) for more accurate results. The most commonly employed treatment method is pleural drainage, which yields effective outcomes, alongside conservative management or surgical intervention. Currently, there is limited research on this topic, and data on the incidence of pneumothorax following blunt chest trauma in Can Tho and the surrounding region have not been updated for a long time. Additionally, accurate and up-to-date information is crucial for improving early diagnosis, optimizing treatment strategies, and guiding clinical decision-making. Therefore, this study aims to investigate the clinical and imaging characteristics, as well as the treatment approaches, with the objective of enriching the current database.

II. MATERIALS AND METHODS

2.1. Materials

All patients diagnosed with pneumothorax resulting from blunt chest trauma were treated at the Department of Thoracic and Vascular Surgery, Can Tho Central General Hospital, from April 2022 to April 2023.

Inclusion criteria: presentation with chest pain, dyspnea, unequal breath sounds, decreased tactile fremitus, and hyperresonance on percussion during physical examination; and confirmation by chest X-ray revealing absent lung markings and a white pleural line.

2.2. Methods

- Study design: A prospective descriptive study was conducted at the Department of Thoracic and Vascular Surgery, Can Tho Central General Hospital, from April 2022 to April 2023.

- Study contents:

+ We selected patients that matched the criteria and collected data from clinical characteristics, imaging, follow-up care, and treatment methods.

+ We described patients'characteristics based on the following variables: general characteristics (age, gender, causes of injury), clinical characteristics (chest pain, shortness of breath, hyperresonant to percussion, decreased breath sounds, decreased tactile fremitus, chest wall distortion, subcutaneous emphysema), injuries (rib fractures, clavicle fractures, scapula fractures, pulmonary contusion, hemopneumothorax), treatment methods (conservative treatment, thoracostomy and thoracotomy, insertion site of chest tube, sizes of chest tube, drainage time), treatment outcome (the length of hospital stay, treatment results of each method, overall results).

- Statistical analysis: Analyzing data with SPSS Version 18.0 for Windows. Qualitative variables are presented as frequencies (percentages). A two-sample T-test is used to compare two independent samples ($p < 0.05$ is considered to be statistically significant).

- Ethics approval: Data were collected on patients' clinical characteristics, imaging findings, treatment methods, and follow-up care; no attempts were made to modify the course of treatment. Collected data were encrypted, confidential, and used solely for research purposes. The study protocol and ethics were approved by the medical ethics committee of Can Tho University of Medicine and Pharmacy.

III. RESULTS

3.1. General characteristics of patients

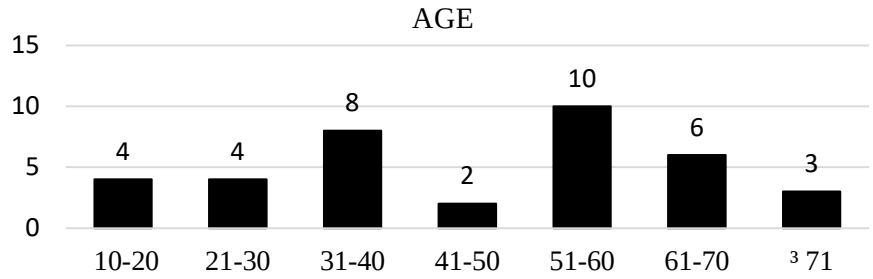

Figure 1. Age distribution

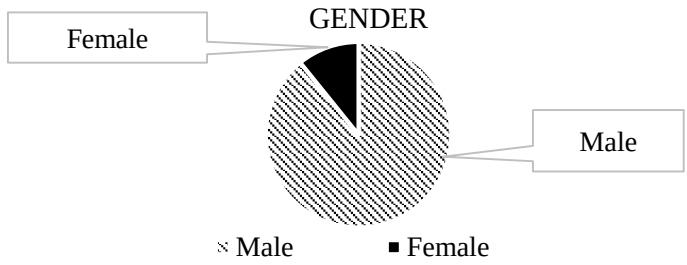

Figure 2. Gender distribution

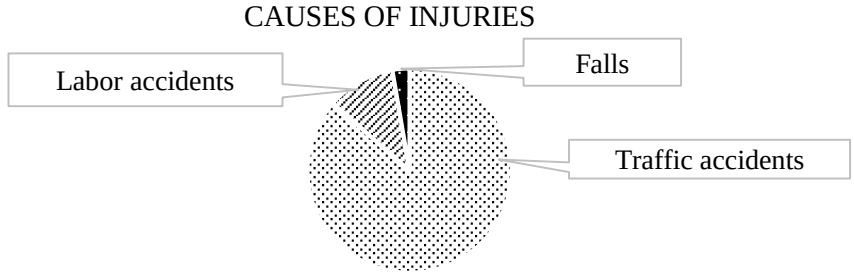

Figure 3. The causes of injuries

In this study, pneumothorax in blunt chest trauma, were most common in the age group from 31 to 70 years, accounting for 68.4%, with an average age of 45.95 ± 18.16 years. Most patients were male, accounting for 89% of the total cases. Traffic accidents were the most common cause, accounting for 86%.

3.2. Clinical characteristics of patients with pneumothorax in blunt chest trauma

Table 1. Clinical characteristics of patients

Clinical characteristics of patients		N	Percentage (%)
Symptoms	Chest pain	34	91.9
	Dyspnea	15	40.5
Signs	Decreased breath sounds	31	83.8
	Decreased tactile fremitus	3	8.1
	Hyper-resonant to percussion	1	2.7
	Chest wall distortion	1	2.7
	Subcutaneous emphysema	7	18.9
	Hypotension	1	2.7

Chest pain and dyspnea were the most common symtomps with 91,9% and 40,5%. The highest percentages of clinical characteritiscs is decreased breath sounds with 83.3%.

Table 2. Characteristics of injuries

Injuries		N	Percentage (%)
Side of injuries	Right side	22	59.5
	Left side	12	32.4
	Both sides	3	8.1
Rib fractures		31	83.8
Clavicle fractures		5	13.5
Scapula fractures		5	13.5
Lung and pleural injuries	Hemopneumothorax	9	24.3
	Pulmonary contusion	17	45.9

Injuries occurred more often on the left side, with a rate of 32.4%. In a sample of 37 cases, 31 cases were rib fractures, accounting for 83.8%. In addition, there were 5 cases of clavicle fractures (13.5%) and 5 cases of scapula fractures (13.5%). In terms of lung and pleural injuries, pneumohemothorax accounted for 24.3%, and accompanied by pulmonary contusion accounted for 45.9%.

3.3. Treatment methods and results

Table 3. Treatment methods

Treatment methods	N	Percentage (%)
Conservative treatment	1	2.7
Thoracostomy	36	97.3
Thoracotomy	3	8.1

Table 4.Treatment results

Treatment methods	Results			
	N	Good	Poor	Treatment success rate
Conservative treatment	1	1	0	100%
Thoracostomy	36	33	3*	91.67%
Thoracotomy	3*	3	0	100%
Overall	37	37	0	100%
The length of hospital stay	8,3 ± 3,5 days			

(*) 3 patients received Thoracostomy firstly and then required thoracotomy.

36 patients (97.3%) received pleural drainage treatment. In which three patients (8.33%) worsing then received thoracotomy. One patient was treated conservatively. The success rate of treatment was 100%. The length of hospital stay was 8.3 ± 3.5 days.

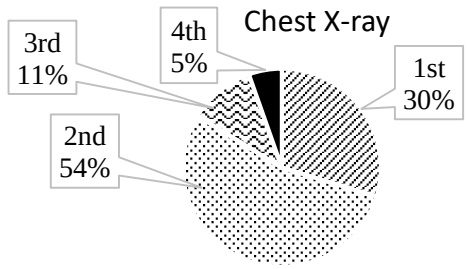

Figure 4. X-ray

Most patients undergo 1-2 chest X-rays to detect and follow-up pneumothorax.

Table 5. The difference of the length of hospital stay and age

Characteristics	The length of hospital stays		p
	Under 8 days (n=19) Frequency %	Over 8 days (n=18) Frequency %	
≤ 40 years old	12 (75)	4 (25)	0,012
> 40 years old	7 (33,3)	14 (66,7)	

In our study have differs between two groups of patiens with under 40 years old and over 40 years old about the length of treated in hospital (p=0.012).

Table 6. The difference of the length of hospital stay and rib fractures

Characteristics		The length of hospital stays		p
		Under 8 days (n=16) Frequency %	Over 8 days (n=16) Frequency %	
Rib fractures	< 4	13 (76.5)	4 (23.5)	0,002
	≥ 4	3 (21.4)	11 (78.6)	

The group of patients with less than 4 ribs fractures had more the length of hospital stay under 8 days than the group of patients with 4 or more ribs fractures, and this difference was statistically significant (p=0.002).

IV. DISCUSSION

In cases of pneumothorax in patients with blunt chest trauma, it is commonly seen to be more prevalent in men. Our study found that 89.2% of the cases were in men, while 10.8% were in women, resulting in a male-to-female ratio of 8:1. Similar results were reported in previous research by domestic authors Doan Duy Hung and Doan Quoc Hung in 2012-2014, with 85% of cases in men and 15% in women. Another study conducted in 2021 by authors Dang Cong Hieu and Vu Anh Hai found that 78.1% of cases were in men. Foreign research conducted by Ararso Baru and colleagues showed that 73.6% of cases were in men and 26.6% were in women. Additionally, a study in Saudi Arabia by author Suliman Alghnam reported that 77.6% of cases were in men. Furthermore, age also plays a role in treatment duration, with 66% of patients over the age of 40 requiring longer hospital treatment. The study included patients with a wide age range due to the same condition. However, the results revealed that the average age of the patients was 45.95, with the majority falling within this age group. Among the middle-aged and older individuals aged 31 to 70, 70.2% were represented, aligning with findings from previous studies. Doan Duy Hung and Doan Quoc Hung's research indicated an average patient age of 46.67 ± 16.97, with a high percentage of patients being of working age at 73.48% [1]. Similarly, research by Ararso Baru and colleagues showed that ages 31-50 accounted for 68.8% of cases [3]. In our study, there was a high proportion of patients from other occupational groups (75.5%), followed by farmers (13.5%), and no significant difference was observed between occupations.

The clinical presentations of pneumothorax can vary widely, from being asymptomatic to showing typical signs. The most common symptoms are chest pain and shortness of breath, accounting for 64% and 85% of cases, respectively [6]. In our study, 91.9% of patients experienced chest pain, while 40.5% had dyspnea. Doan Duy Hung and Doan Quoc Hung reported slightly different figures of 87.6% for chest pain and 50.4% for dyspnea [1]. The physical examination revealed that 83.8% of cases had decreased breath sounds, and 18% presented with subcutaneous emphysema. Doan Duy Hung and Doan

Quoc Hung reported slightly different numbers of 70.8% for decreased or absent breath sounds and 21.2% for subcutaneous emphysema. It's worth noting that 69.9% of patients experienced sharp pain, although this examination was not performed in our study [1].

When dealing with patients who have suffered blunt chest trauma and are suspected to have pneumothorax, the initial clinical examination and quick results are crucial, especially in emergency cases. X-rays are used to promptly evaluate chest damage. In a survey, it was found that the majority of patients underwent two X-rays (54.1%), while the lowest number of X-rays taken was four (5.4%). However, the study was limited because it did not collect and analyze the characteristics of common lesions seen on X-rays. Although computed tomography (CT) has high accuracy in diagnosis, it is used sparingly due to its cost and long implementation time. In the survey, 51% of cases did not use CT. Ultrasound is a suitable choice for assessing pleural conditions, particularly for patients suspected of having effusion from blunt chest trauma. However, it is rarely used to investigate pneumothorax, with 97.3% of cases not utilizing ultrasound. Data from the study by Doan Duy Hung and Doan Quoc Hung indicate a high utilization of plain chest X-rays as the primary imaging modality for diagnosis, with 95.7% performed upon hospital admission. Of these, 23.8% were conducted in the emergency department for severe conditions requiring immediate intensive care. Depending on the patient's condition, ultrasound is performed in the ultrasound room in 86.7% of cases. It's worth noting that the author in this study did not record any CT scans [1].

The drainage method is commonly used in the majority of pneumothorax cases and has demonstrated high effectiveness. This method, along with others such as observation, aspiration, laparoscopic surgery, or open chest surgery, has been found to be effective. In our study, 36 out of 37 cases (97.3%) underwent drainage initially, and the results indicated that 33 out of the 36 (91.7%) cases had positive outcomes. Another study by Shiva Thakur reported a high success rate of 88.2% [5]. In our study, there were 3 cases where pleural drainage had to be converted to thoracotomy. The overall success rate of treatment is 100%, and the average hospital stay is 8.3 ± 3.5 days.

Upon examining the data, we discovered that rib fractures play a significant role in determining the severity of thoracic injuries and are prevalent in CVT cases. According to Doan Duy Hung, 96 out of 113 patients studied had rib fractures, accounting for 94.6% [1]. Meanwhile, according to Ararso Baru and colleagues, the rate of rib fractures is 62.33% [3]. Our own results showed that rib fractures accounted for 83.3% of cases. Notably, the presence of more or fewer rib fractures can impact the treatment duration for the patient, as 78.6% of patients with more than 4 broken ribs had a hospital stay of at least 8 days. This finding is consistent with Dr. Tuan's conclusion, which indicates that patients with a greater number of rib fractures tend to have longer hospital stays [10].

V. CONCLUSION

Pneumothorax is a common injury following blunt chest trauma, and it occurs more frequently in men than women. It is primarily caused by traffic accidents. The prevalent clinical features include chest pain, dyspnea, decreased breath sounds, and subcutaneous emphysema. X-rays are the primary diagnostic tool due to their speed and convenience in evaluating trauma patients. Pleural drainage is a highly effective treatment. The age of the patient and the number of fractures also impact the time required for treatment of this condition.

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