

## THE TREATMENT RESULTS OF HEMOTHORAX IN BLUNT CHEST TRAUMA

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### ABSTRACT

**Background:** Blunt chest trauma is a life-threatening emergency that has a variety of injuries, from chest wall contusions and rib fractures to lung and pleural injuries, from trachea and esophagus to heart and large vessels trauma, of which hemothorax is a common complication of blunt chest trauma. Diagnosis is based on signs and symptoms, including blood loss, pleural effusion syndrome, and imaging findings. Conservative treatment and thoracostomy are the most common treatments and succeed in almost all cases, while the rest require thoracotomy. Follow-up care is necessary to perform strategy changes immediately for the best overall results. **Objectives:** To study

*the clinical, imaging features, and treatment results of hemothorax in blunt chest trauma. **Materials and methods:** A prospective descriptive study of 41 patients with hemothorax was conducted at the Department of Thoracic Surgery, Can Tho General Hospital, from April 2022 to December 2022. **Results:** The mean age was  $53.24 \pm 8.97$ ; 70.73% were male; traffic accident was the most common cause (73.17%); chest pain and dyspnea were the two most frequent symptoms, accounting for 97.56% and 48.78%, respectively; the syndrome of decreased breath sounds, dullness to percussion and decreased tactile fremitus was found in 78.05%. The mean number of rib fractures was  $4.24 + 2.29$ ; the most common ribs fractured were the 4th through 10th ribs (53.66%); hemothorax and hemopneumothorax accounted for 75.61% and 24.39%, respectively; 28 patients (68.29%) received conservative treatment, in which three patients (10.71%) worsening then received pleural drainage, as a whole, 16 patients in total received pleural drainage treatment; the overall treatment success rate was 97.56%, and 1 case (2.44%) had a complication of empyema; the length of hospital stay was  $7.29 \pm 2.69$  days and differed between the two groups of patients with minimal hemothorax and other hemothorax ( $p=0.049$ ). **Conclusions:** Chest pain and dyspnea were the most common clinical symptoms; conservative treatment is common and follow-up is important; the overall treatment success rate was 97.56% and the length of hospital stay was  $7.29 \pm 2.69$  days.*

**Keywords:** blunt chest trauma, hemothorax, hemopneumothorax, thoracostomy, empyema

## I. INTRODUCTION

Blunt chest trauma is a common and life-threatening emergency, accounting for 5-6% of emergency trauma and the leading cause of death in young people under 40 [1]. Blunt chest trauma has a variety of injuries, from chest wall contusions and rib fractures to lung and pleural injuries, from trachea and esophagus to heart and large vessels trauma, of which hemothorax is a common complication of blunt chest trauma [2]. Bleeding into the hemothorax is triggered either by damage to the chest wall, the lung parenchyma, the heart, and large blood vessels, or the diaphragm or by leakage of blood from the abdominal cavity accompanying the rupture of the diaphragm. Besides, the indirect mechanism of injury causes pulmonary laceration through a tear of lung parenchyma adhesion. Hemothorax has many degrees, from minimal (several tens or hundreds of milliliters) to massive (1,5 liters or more). Diagnosis of hemothorax is based on (1) the severity of hemorrhagic shock and associated symptoms depending on the volume of blood loss; (2) signs and symptoms of pleural fluid such as chest pain, dyspnea, decreased breath sounds, dullness to percussion, decreased tactile fremitus; (3) chest x-ray confirmation. The management of hemothorax through conservative treatment, intravenous fluid, and thoracostomy succeeds in almost all cases (85%), while the rest requires thoracotomy [3]. The adverse outcome of hemothorax related to the severity of the injury is commonly empyema leading to a prolonged hospital stay [4], [5]. In the present era, chest injury is relatively prevalent, with highly significant consequences. Even though hemothorax is a common complication of blunt chest trauma, few articles on this topic have been published in the Mekong Delta. Hence, our group conducted a study to evaluate the treatment results in patients with hemothorax in blunt chest trauma to supply more information and a database on this field.

## II. MATERIALS AND METHODS

**2.1. Study population and setting:** All patients with hemothorax in blunt chest trauma at the Department of Thoracic Surgery, Can Tho General Hospital, from April 2022 to December 2022, were invited to participate. We excluded the following cases: patients under

16 years old, those who died in the emergency department or outside the hospital, and those who died due to a combined injury or other adverse events unrelated to injury during treatment.

## 2.2. Study methods

### 2.2.1. Study design

A prospective descriptive study was conducted at the Department of Thoracic Surgery, Can Tho General Hospital, from April 2022 to December 2022

### 2.2.2. 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, dyspnea, hemoptysis, decreased breath sounds, dullness to percussion, decreased tactile fremitus, chest wall distortion, subcutaneous emphysema), injuries (rib fractures, clavicle fractures, scapula fractures, hemothorax, pulmonary contusion, hemopneumothorax), treatment methods (conservative treatment with or without thoracentesis, 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).

### 2.2.4. Statistical analysis

Analyzing data with Stata 16.0. Qualitative variables were presented as frequencies (percentages). Quantitative variables with no standard normal distribution were presented as the median (interquartile range). A two-sample t-test was used to compare two independent samples ( $p < 0.05$  is considered statistically significant).

### 2.2.5. Ethics approval

Data were collected from clinical characteristics, imaging, treatment methods, and follow-up care of patients; no attempts were made to modify the course of treatment. Collected data was encrypted, confidential, and only 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

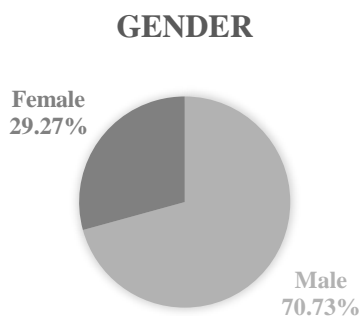


Figure 1. Gender distribution

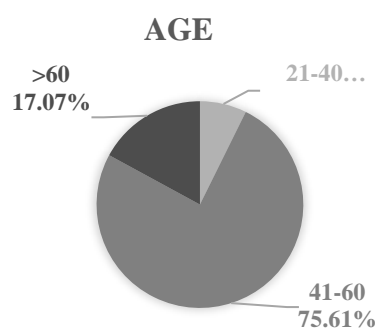


Figure 2. Age distribution

CAUSES OF INJURIES



Figure 3. The causes of injuries

In our study, hemothorax in blunt chest trauma in males was common, contributing to 70.73% of all cases. The mean age was  $53.24 \pm 8.97$  years old, of which the age group 41-60 accounted for the highest percentage (75.61%). Traffic accidents accounted for 73.17%, making them the most frequent cause.

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

Table 1. Clinical characteristics of patients

Clinical characteristics of patients		N	Percentage (%)
Symptoms	Chest pain	40	97.56
	Dyspnea	20	48.78
	Hemoptysis	1	2.44
Clinical characteristics of patients		N	Percentage (%)
Signs	Decreased breath sounds Dullness to percussion Decreased tactile fremitus	32	78.05
	Chest wall distortion	7	17.07
	Subcutaneous emphysema	10	24.39

The two most frequent symptoms, accounting for 97.56% and 48.78%, respectively, were chest pain and dyspnea. Hemoptysis was present in roughly 2.44% of patients. Pleural effusion-related symptoms, such as decreased breath sounds, dullness to percussion, and decreased tactile fremitus, were seen often (78.05%). Chest wall distortion and subcutaneous emphysema occurred at 17.07% and 24.39%, respectively.

Table 2. Characteristics of injuries

Injuries		N	Percentage (%)	
Side of injuries	Right side	11	26.83	
	Left side	24	58.54	
	Both sides	6	14.63	
Rib fractures	No rib fractures	1	2.44	
	1st - 3rd rib	13	31.71	
	11th - 12th rib	3	7.32	
	4th – 10th	22	53.66	
	Mean	4.24 ± 2.29 ribs		
Clavicle fractures		8	19.51	
Scapula fractures		1	2.44	
Lung and pleural injuries	Hemothorax	Minimal	23	56.10
		Moderate	8	19.51
		Overall	31	75.61
	Hemopneumothorax		10	24.39
	Pulmonary contusion		13	31.71

Injuries occurred more often on the left side, with a rate of 58.54%. The most common rib fracture location is from the 4th to the 10th rib, accounting for 53.66%. The average number of broken ribs is about  $4.24 \pm 2.29$  ribs. Moreover, there were eight clavicle fractures (19.51%) and 2.44% occurrences of scapula fractures. In terms of lung and pleural injuries, hemothorax accounted for 75.61%, the rest hemopneumothorax accounted for 24.39%, and pulmonary contusion accounted for 31.71%.

### 3.3. Treatment methods and results

Table 3. Treatment methods

Treatment methods	N	Percentage (%)
Conservative treatment without thoracentesis	27	65.85
Conservative treatment with thoracentesis	1	2.44
Thoracostomy	13	31.71
Thoracotomy	0	0

Table 4. Treatment results

Treatment methods	Results			
	N	Good	Poor	Treatment success rate
Conservative treatment	28	25	3*	89.29%
Thoracostomy	16(*)	15	1	93.75%
Thoracotomy	0	0	0	0
Overall	41	40	1	97.56%
The length of hospital stay	7.29 ± 2.69 days			

(\*) 3 patients received conservative treatment first and then required thoracostomy.

28 patients (68.29%) received conservative treatment, with one thoracentesis case accounting for 2.44%. Among them, three patients (10.71%) were worsening and then received pleural drainage. The treatment success rate was 97.56% overall, whereas one case of ineffective treatment was complications of empyema. The length of hospital stay was  $7.29 + 2.69$  days.

Table 5. Thoracostomy

Characteristics		N	Percentage (%)
Insertion site of chest tube	Triangle of safety	15	93.75
	8th intercostal space	1	6.25
Sizes of chest tube	32 Fr	16	100%
Drainage time		Median: 4 days (1st: 3 days; 3rd: 5 days)	

93.75% of the chest tube placement was in the safety triangle, and only 1 case (6.25%) had the 8th intercostal pleural tube inserted. A 32 Fr tube was used in all pleural drainage procedures. The first and third quartiles were 3 and 5 days, respectively, whereas the median drainage time was 4 days.

Table 6. The difference of the length of hospital stay in 2 groups

Lung and pleural injuries		The length of hospital stay	p
Hemothorax	Minimal	7.29 ± 2.69 days	p = 0.049(*)
	Moderate to massive or hemopneumothorax		
Pulmonary contusion	Present		p = 0.848(*)
	Absent		

(\*) Two-Sample t-Test is used to compare two independent samples

The mean length of hospital stay differed between the two groups of patients with minimal hemothorax and moderate to massive hemothorax or hemopneumothorax ( $p=0.049$ ). There was no difference in the mean length of hospital stay in the two groups of patients with and without pulmonary contusion ( $p=0.848$ ).

#### IV. DISCUSSION

Hemothorax in blunt chest trauma is a common and severe injury. Hemothorax in blunt chest trauma is a common and severe injury. The number of traffic accidents nationwide is rising, mainly due to the development of our country, more people traveling and more traffic. It is also the leading cause of injuries in blunt chest trauma, including hemothorax [3],[6]. Our study's percentage of traffic accidents (73.17%) is relatively comparable to Khang's published research (68.8%) [7]. Young or middle-aged males often account for a higher percentage of the population who have experienced trauma and hemothorax in blunt chest trauma [3], [6]. Our study comprised 41 patients with blunt chest trauma with hemothorax, including 70.73% male patients; the mean age was 53.24 years old, and the predominant age group was middle-aged (41-60 years old), with 75.61%. Compared to our research, Dr.Khang's study also showed that men were the majority (87.5%) [7].

Diagnosis of injuries in blunt chest trauma is based on clinical and imaging features. Most patients with hemothorax in blunt chest trauma have dyspnea and chest pain as their main symptoms [8]. Our research participants had chest pain and shortness of breath, respectively, accounting for 97.56% and 48.78%, slightly less than the other study's patients with 100% and 78.1% [7]. The syndrome of decreased breath sounds, dullness to percussion, and decreased tactile fremitus were found in 78.05% of cases. In the study of Bokhari et al., the sensitivity and specificity of clinical examination by auscultation in patients with hemothorax after chest trauma were 100% and 99.8%, respectively [8]. Hence, clinical examination is crucial to diagnose hemothorax in blunt chest trauma. The most common injured side is the left side, with 58.06%, equivalent to the studies on blunt chest trauma of author Binh and Hieu [9], [10]. A rib fracture is a common injury in blunt chest trauma; the most common fracture site is the fourth to tenth ribs, which is similar to our results (53.66%), followed by the first to third ribs (31.71%). In 41 cases, 2.44% had no rib fracture, most were minimal (56.10%), and moderate and massive amounts accounted for 14.63% and 4.88%, respectively. The rate of hemothorax was 6.7% in trauma patients without rib fractures, 24.9% in those with one or two broken ribs, and 81.4% in those with more than two broken ribs, respectively, according to the study by Liman et al. [11].

There were many methods for managing hemothorax, including conservative management, thoracentesis, thoracostomy, thoracotomy, and endoscopic thoracic surgery; however, in most cases, conservative management and thoracostomy were successful [3]. We recorded 83.87% of patients with conservative treatment, of which (25/28) 89.29% had good progress, and 3/28 (11.54%) required thoracostomy followed. The study by Chrysou et al. recorded conservative treatment for 90% of cases, of which 54.5% required a thoracostomy, while Dr.Khang's study was 37.50% and 58.30%, respectively[7], [12]. Our conservative treatment success rate is greater than that of previous studies, which might be due to the small size of our study population. Usually, the amount of blood draining through the drain must be reduced gradually in the first 12 hours. If the chest x-ray shows complete lung expansion and the amount of blood draining through the drain is less than 75 ml/hour in 8 hours, the drain should be removed sooner rather than later [6]. In our study, the median

drainage time was 4 days, longer than  $2.85 \pm 0.9$  days, by Dr. Khang et al. The size of the drainage tube used was 32Fr, according to recommendations for hemothorax treatment. Most frequently, the drainage site was inside the safe triangle, but one case of first surgery at the fracture site occurred in the sixth intercostal space. Due to the patient's severe pain and increased risk of infection, the drain was repositioned at the 8th intercostal position. This is the only case where the treatment result is not good, and the patient suffers from complications of empyema. The overall success percentage of the treatment was 97.56%. The hospital stay varies from 3 to 5 days in cases of blunt chest trauma with uncomplicated rib fractures; in terms of hemothorax, the hospital stay may be prolonged due to the requirement to monitor illness development, follow up the drainage, and manage complications, if any [6]. The length of hospital stay was  $7.29 \pm 2.69$  days in our study, equivalent to that of Dr. Phuong,  $8.4 \pm 4.8$  days in all blunt chest trauma patients [13]. To compare the length of hospital stay, we divided 2 groups: the group with the minimal amount of hemothorax and the other group (moderate to massive or hemopneumothorax); the results showed a difference in length of hospital stay ( $p=0.049$ ). The other test with 2 groups, patients with and without pulmonary contusion, showed no difference ( $p=0.848$ ).

## V. CONCLUSION

Blunt chest trauma is a life-threatening emergency, and hemothorax is a common injury. The most prevalent cause was a traffic accident, with males and the older preeminent. Chest pain and dyspnea were the most common clinical symptoms. Conservative treatment and pleural drainage were essential methods. The treatment success rate was 97.56% overall. The mean length of hospital stay differs between the patients with minimal hemothorax and other hemothorax.

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