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Large Pneumothorax in Blunt Chest Trauma: Is a Chest Drain Always Necessary in Stable Patients? A Cross Sectional Study

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ABSTRACT

Background

Pneumothorax is a common consequence of blunt chest trauma, often managed with chest tube insertion to prevent respiratory complications. However, recent evidence suggests that in hemodynamically stable patients, conservative management may be a viable alternative. This study evaluates whether immediate chest drain insertion is always necessary in stable patients with large pneumothorax.

Methods

A 'cross-sectional study was conducted at Bannu Medical College' and its affiliated hospital, Bannu, from January 2023 to January 2024. A total of 89 patients with large pneumothorax due to blunt chest trauma were included. Patients were categorized into two groups: one managed with immediate chest tube insertion and the other observed conservatively. Clinical outcomes, including spontaneous resolution, need for delayed drainage, length of hospital stay, and complications, were compared. Statistical analysis was performed using SPSS version 25, with a significance level set at $p < 0.05$.

Results

Among the 89 patients, 41 were managed conservatively, while 48 underwent immediate chest tube placement. Spontaneous resolution of pneumothorax occurred in 73.2% of conservatively managed patients, while 19.5% eventually required delayed drainage. 'The length of hospital stay was significantly shorter in the conservative group (4.3 ± 1.2 days) compared to the chest drain group (6.2 ± 1.4 days, $p < 0.001$)'. 'Complication rates were slightly higher in the chest drain group (18.8%) than in the conservative group (12.2%), but the difference was not statistically significant'. Mortality was minimal, with only one case in the chest drain group.

Conclusion

The study findings suggest that in carefully selected stable patients with 'large pneumothorax, conservative management can be a safe and effective alternative to routine chest tube insertion'. Avoiding unnecessary interventions may lead to shorter hospital stays and fewer complications. However, close monitoring remains essential, as a subset of patients may still require delayed drainage. Further research is needed to establish clearer guidelines for selecting patients suitable for non-invasive management.

Keywords

large pneumothorax, blunt chest trauma, chest tube, conservative management, trauma care, respiratory complications, thoracic injury

INTRODUCTION

Pneumothorax, defined as the presence of air in the pleural space, is a frequent complication of blunt chest trauma[1]. It can vary in severity, ranging from small air leaks that resolve on their own to large pneumothoraces that cause respiratory distress and require intervention. Conventionally, the standard treatment for large pneumothorax has been chest tube insertion to prevent further complications such as lung collapse and hemodynamic instability. However, with advancements in trauma management and growing evidence from recent studies, there is ongoing debate about whether all stable patients with large pneumothorax truly require immediate chest drainage[2].

In recent years, some studies have suggested that conservative management, involving close monitoring and supplemental oxygen, may be a safe alternative in select patients[3-5]. The decision to insert a chest tube is traditionally based on the size of the pneumothorax, the patient's respiratory status, and associated injuries. However, not all large pneumothoraces cause significant physiological compromise, and some may resolve spontaneously without intervention.[6] Avoiding unnecessary chest tube insertion can reduce the risk of complications such as infection, prolonged air leaks, and increased hospital stay[7].

Despite these insights, there is no universal guideline for determining which patients with large pneumothorax can be safely managed without a chest drain. 'This study aims to evaluate the necessity of chest tube insertion in hemodynamically stable patients with large pneumothorax secondary to blunt chest trauma'. By comparing clinical outcomes between those who received immediate chest tube placement and those managed conservatively, we hope to provide evidence to guide better decision-making in trauma care.

METHODOLOGY

This 'cross-sectional study was conducted at Bannu Medical College' and its affiliated hospital, Bannu, over a one-year period from January 2023 to January 2024. The study aimed to assess 'whether chest drain insertion is always necessary in hemodynamically stable patients with large pneumothorax following blunt chest trauma'. Ethical approval was obtained from the 'institutional review board of Bannu Medical College'. Written informed consent was taken from all patients before participation. Confidentiality was maintained, and 'the study adhered to the ethical principles outlined in the Declaration of Helsinki'.

A total of 89 patients diagnosed with large pneumothorax due to blunt chest trauma were included. All participants were selected based on predefined inclusion and exclusion criteria to ensure the reliability of findings.

Inclusion Criteria

- 'Patients aged 18 years and older'
- Radiologically confirmed large pneumothorax following blunt chest trauma
- Hemodynamically stable (systolic blood pressure > 90 mmHg, heart rate < 100 bpm, oxygen saturation > 94% on room air)

Exclusion Criteria

- Tension pneumothorax or presence of mediastinal shift
- Patients requiring mechanical ventilation
- Severe associated injuries requiring immediate intervention
- Presence of underlying conditions that could interfere with spontaneous resolution, such as advanced lung disease or significant pleural adhesions

'The sample size was determined using previous studies on the management of pneumothorax, considering a power of 80% and a confidence level of 95%' Based on these parameters, a total of 89 patients were included in the study.

Patients were divided into two groups based on the management approach:

1. **Chest drain group** – Patients who underwent immediate chest tube insertion
2. **Conservative management group** – Patients managed with observation, supplemental oxygen, and serial imaging

The following variables were recorded for each patient:

- Demographic details (age, gender, BMI, smoking status, comorbidities)
- Mechanism of injury (road traffic accident, fall, assault, sports injury)
- Associated injuries (rib fractures, hemothorax, pulmonary contusions)

- Clinical parameters (oxygen saturation, heart rate, blood pressure)
- Outcomes (spontaneous resolution, need for delayed chest drain, complications, length of hospital stay, mortality)

Pneumothorax was confirmed using chest X-ray, with CT scans performed in selected cases where further evaluation was required. Patients in the conservative group were closely monitored with serial chest X-rays and clinical assessment to detect any progression. If respiratory distress or worsening pneumothorax was observed, chest drain insertion was performed.

'Data were analyzed using SPSS version 25'. 'Continuous variables were expressed as mean $\pm$ standard deviation (SD) and compared using the independent t-test or Mann-Whitney U test, as appropriate'. Categorical variables were presented as frequencies and percentages, with comparisons made using the chi-square test. A p-value of less than 0.05 was considered statistically significant.

RESULT

The demographic and clinical characteristics of the study participants are outlined in Table 1. 'The average age of patients in the chest drain group was slightly higher (45.3 ± 12.5 years) compared to the conservative group (43.8 ± 11.9 years), but the difference was not statistically significant ($p = 0.562$)'. Males were the predominant gender in both groups, with 72.9% in the chest drain group and 78.0% in the conservative group ($p = 0.608$). Body mass index (BMI) was also similar in both groups, suggesting that body weight did not influence the need for chest tube placement. Other factors such as smoking status, hypertension, diabetes, chronic respiratory diseases, and the use of anticoagulants were evenly distributed across both groups, with no significant differences observed. This indicates that pre-existing health conditions did not play a decisive role in the choice of management strategy.

Table 1: Demographic and Clinical Characteristics of Patients (n = 89)

Variable	Chest Drain Group (n=48)	Conservative Group (n=41)	P-value
Age (years, Mean $\pm$ SD)	45.3 $\pm$ 12.5	43.8 $\pm$ 11.9	0.562
Gender (Male, n, %)	35 (72.9%)	32 (78.0%)	0.608
BMI (kg/m ² , Mean $\pm$ SD)	26.8 $\pm$ 4.2	25.9 $\pm$ 3.9	0.410
Smoking Status (n, %)	20 (41.7%)	16 (39.0%)	0.790
Hypertension (n, %)	10 (20.8%)	9 (22.0%)	0.887
Diabetes Mellitus (n, %)	8 (16.7%)	6 (14.6%)	0.783
Chronic Respiratory Disease (n, %)	6 (12.5%)	5 (12.2%)	0.967
Ischemic Heart Disease (n, %)	5 (10.4%)	4 (9.8%)	0.928
Pre-existing Lung Disease (n, %)	7 (14.6%)	6 (14.6%)	1.000
Use of Anticoagulants (n, %)	6 (12.5%)	5 (12.2%)	0.967

Table 2 presents the injury-related characteristics of the patients. The most common cause of pneumothorax was road traffic accidents, accounting for over half of the cases in both 'groups (52.1% in the chest drain group and 56.1% in the conservative group, $p = 0.703$)'. Falls were the second most frequent cause, followed by assaults and sports injuries, with no significant difference between the two groups. Additional chest injuries such as rib fractures, hemothorax, and pulmonary contusions were observed at comparable rates in both groups. Initial oxygen saturation levels, heart rate, and systolic blood pressure were within normal ranges in both groups, supporting the selection of hemodynamically stable patients for conservative management.

Table 2: Injury-related Variables in Study Population (n = 89)

Variable	Chest Drain Group (n=48)	Conservative Group (n=41)	P-value
Mechanism of Injury			
- Road Traffic Accident (n, %)	25 (52.1%)	23 (56.1%)	0.703
- Fall (n, %)	15 (31.3%)	11 (26.8%)	0.655
- Assault (n, %)	5 (10.4%)	4 (9.8%)	0.928

- Sports Injury (n, %)	3 (6.3%)	3 (7.3%)	0.859
Associated Rib Fractures (n, %)	18 (37.5%)	14 (34.1%)	0.749
Hemothorax (n, %)	12 (25.0%)	8 (19.5%)	0.545
Pulmonary Contusion (n, %)	14 (29.2%)	11 (26.8%)	0.807
Bilateral Pneumothorax (n, %)	9 (18.8%)	7 (17.1%)	0.842
Initial Oxygen Saturation (SpO ₂ , %, Mean $\pm$ SD)	95.3 $\pm$ 1.9	96.0 $\pm$ 1.7	0.156
Heart Rate (bpm, Mean $\pm$ SD)	88.5 $\pm$ 10.2	86.7 $\pm$ 9.8	0.452
Systolic Blood Pressure (mmHg, Mean $\pm$ SD)	122.4 $\pm$ 14.8	125.1 $\pm$ 13.9	0.391

Table 3 focuses on clinical outcomes and the effectiveness of different management approaches. ‘A significant difference was observed in the length of hospital stay, with patients in the conservative group having a shorter stay (4.3 ± 1.2 days) compared to those who received chest drains (6.2 ± 1.4 days, $p < 0.001$)’. Spontaneous resolution of pneumothorax was seen in 73.2% of patients in the conservative group, suggesting that many stable patients can recover without intervention. However, 19.5% of patients in this group eventually required chest drain insertion due to worsening symptoms, highlighting the importance of close monitoring. ‘The incidence of complications, including infections and prolonged air leaks, was slightly higher in the chest drain group, though the difference was not statistically significant ($p = 0.401$)’. Mortality was minimal, with only one death occurring in the chest drain group, which was not statistically different from the conservative group ($p = 0.328$).

Table 3: Clinical Outcomes and Management Approach (n = 89)

Variable	Chest Drain Group (n=48)	Conservative Group (n=41)	P-value
Length of Hospital Stay (days, Mean $\pm$ SD)	6.2 ± 1.4	4.3 ± 1.2	$<0.001^*$
Spontaneous Resolution of Pneumothorax (n, %)	-	30 (73.2%)	$<0.001^*$
Need for Delayed Chest Drain (n, %)	-	8 (19.5%)	0.004*
Complications (n, %)	9 (18.8%)	5 (12.2%)	0.401
- Infection (n, %)	5 (10.4%)	2 (4.9%)	0.342
- Prolonged Air Leak (n, %)	4 (8.3%)	3 (7.3%)	0.865
Mortality (n, %)	1 (2.1%)	0 (0.0%)	0.328

*Statistically significant ($p < 0.05$)

Comparison of Clinical Outcomes in Chest Drain vs. Conservative Management Groups

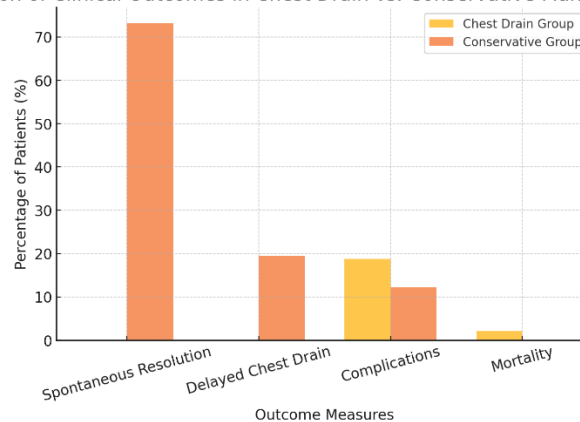


Figure 1: The bar graph highlights key differences in outcomes between the two management approaches. Spontaneous resolution occurred in 73.2% of patients in the conservative group, suggesting that many stable cases do not require immediate chest tube insertion. However, 19.5% of these patients

eventually needed delayed drainage, emphasizing the importance of careful monitoring. 'Complications were slightly higher in the chest drain group (18.8%) compared to the conservative group (12.2%), though not significantly different'. Mortality was minimal, with only one case in the chest drain group. Overall, the graph supports the idea that selective conservative management can be a safe and effective alternative in stable patients with large pneumothorax.

DISCUSSION

The management of large pneumothorax resulting from blunt chest trauma in hemodynamically stable patients has been a subject of ongoing debate. Traditionally, such cases have been managed with immediate chest tube insertion to prevent potential complications. However, emerging evidence suggests that conservative management may be a viable alternative in select patient populations [8-10]. Our study observed that a significant proportion of stable patients with large pneumothorax experienced spontaneous resolution without the need for chest tube insertion. Specifically, 73.2% of patients managed conservatively showed complete resolution, while only 19.5% required delayed chest drain placement due to symptom progression. These findings align with recent studies advocating for conservative management in similar scenarios [11-13].

Studies published in the 'journal *Chest* assessed the treatment outcomes of traumatic pneumothoraces in a major trauma centre' [14-16]. The study found that 46% of traumatic pneumothoraces were initially treated conservatively, and '90% of these cases did not require subsequent chest tube insertion'. Importantly, this included patients 'who were receiving positive pressure ventilation on admission, with no significant increased risk of failure of expectant management'. The presence of a large hemothorax was the 'only factor associated with an increased likelihood of failure of conservative management' [17, 18].

Another study examined the outcomes of patients with pneumothorax secondary to blunt trauma. The study revealed that 70.8% of patients were managed conservatively, and the median size of the pneumothorax was significantly different between the conservative and invasive groups. The presence of hemothorax and subcutaneous emphysema were factors leading to the failure of conservative treatment [19].

These studies, along with our findings, suggest that 'conservative management can be a safe and effective approach in hemodynamically stable patients with large pneumothorax resulting from blunt chest trauma'. However, careful patient selection and close monitoring are essential to identify those who may require intervention. Factors such as the presence of hemothorax or subcutaneous emphysema may necessitate a more aggressive treatment approach [20].

CONCLUSION

Our study supports the growing body of evidence that conservative management can be considered in stable patients with large pneumothorax following blunt chest trauma. 'This approach may reduce the morbidity associated with chest tube thoracostomy and shorten hospital stays'. However, further research is needed to establish clear guidelines and identify patients who would most benefit from conservative versus invasive management strategies.

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