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Non-Iatrogenic Traumatic Chylothorax: A Single Centre Case Series Study

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ABSTRACT

Background: Chylothorax is a condition in which chyle (lymphatic fluid containing protein, triglycerides, and lymphocytes) is seen in the pleural space. The underlying etiologies of chylothorax are classified as traumatic or non-traumatic, which guides treatment approaches. Non-traumatic chylothorax was once more prevalent, and was associated with cancer, infection, or inflammatory processes. Traumatic chylothorax is often caused by damage to the thoracic duct, either by direct trauma or as a postoperative/iatrogenic complication.

Objective: This study aimed to evaluate the clinical characteristics, management strategies, and outcomes of patients with non-iatrogenic traumatic chylothorax.

Patients and methods: This case series study retrospectively analyzes traumatic chylothorax cases treated between April 2018 and March 2024.

Results: Mean age was 32.6 ± 12.7 years. Males were more frequent than females (88.9% and 11.1% respectively). Bomb blast was the main mode of trauma (66.7%). Two thirds (66.7%) had right affection. Initial chest drainage (ICD) (mL), ICD total drainage (mL) and ICD duration (hours) were higher in cases with right laterality. Good response was in majority of cases (88.9%), the only poor case (11.1%) had right laterality. Infection and dehydration were infrequent (22.2% and 11.1% respectively). All cases with such complications had right laterality. Mean hospital length of stay was 11.8 ± 4.6 days, it was higher in cases with right than left laterality (13.3 ± 4.8 versus 8.7 ± 2.1 days).

Conclusion: This study provided valuable insights into the management of non-iatrogenic traumatic chylothorax, emphasizing the efficacy of conservative treatment approaches. With a sample of nine cases over a six-year period, our findings demonstrated that conservative management (including dietary modification, fluid replacement, monitoring of protein levels, and adjunctive use of octreotide) successfully resolved chylothorax in 88.9% of cases. This high success rate underscored the potential of non-invasive management for chylothorax resulting from trauma, particularly in cases without extensive thoracic structural damage.

Keywords: Chylothorax, Traumatic chylothorax, Penetrating trauma, Blunt trauma.

INTRODUCTION

Chylothorax is a condition characterized by the presence of chyle, a lymphatic fluid rich in protein, triglycerides, and lymphocytes, in the pleural space. This rare pleural effusion can result from traumatic or nontraumatic causes, each of which necessitates distinct therapeutic approaches. Historically, nontraumatic chylothorax was more prevalent, commonly associated with malignancies, infections, and inflammatory processes. In contrast, traumatic chylothorax generally arises from injury to the thoracic duct, either due to direct trauma or as a postoperative or iatrogenic complication, with a particularly high risk following certain surgical procedures [(1)].

Traumatic chylothorax itself is an exceptionally rare consequence of thoracic trauma or surgery, with iatrogenic causes accounting for approximately 80% of cases. Among surgical procedures, esophageal surgery has a reported incidence of chylothorax ranging from 0.5% to 3%, and the condition can have a mortality rate as high as 50% when it arises post-esophagectomy. Non-iatrogenic traumatic chylothoraces, however, are exceedingly uncommon, with an incidence rate of 0.2% to 3% in cases of blunt thoracic trauma and 0.9% to 1.3% in penetrating injuries. When recognized late or inadequately managed, chylothorax can lead to severe complications, including nutritional depletion, dehydration, physiological imbalance, and immune suppression, underscoring the importance of early and effective intervention [(2)].

The diagnosis of chylothorax cannot rely on gross appearance alone, as it lacks sensitivity and specificity. Thus, biochemical analysis is essential. A pleural fluid triglyceride level >1.24 mmol/L (110 mg/dL) with a cholesterol level < 5.18 mmol/L (200 mg/dL) confirms chylothorax, and in ambiguous cases, lipoprotein electrophoresis to detect chylomicrons can provide diagnostic certainty [(2-4)].

Effective management of chylothorax typically requires a multidisciplinary approach, engaging respiratory physicians, thoracic surgeons, oncologists (in malignant cases), interventional radiologists, dietitians, and pharmacists to optimize patient outcomes [(5, 6)].

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Our series study was carried out at New Najran General Hospital, East Najran, Saudi Arabia, which is a secondary-level trauma facility situated along a major highway. The hospital frequently treats trauma patients from various contexts, including traffic accidents and conflict-related injuries, in addition to being in a war zone, receiving a variety of war related traumas. With a full range of surgical subspecialties and extensive trauma training, the hospital is well-equipped to handle complex cases of traumatic chylothorax and contribute valuable insights into the management of this rare condition.

The objective of the study was to evaluate the clinical characteristics, management strategies, and outcomes of patients with non-iatrogenic traumatic chylothorax. By analyzing a case series of patients treated with conservative and surgical interventions, the study sought to contribute to the limited literature on this rare condition and provide insights into effective management protocols, with a particular focus on the success of conservative treatment approaches and associated outcomes.

PATIENTS AND METHODS

This case series study retrospectively analyzed traumatic chylothorax cases treated between April 2018 and March 2024.

A total of 11 traumatic chylothorax cases were initially identified. Of these, two were excluded as they involved postoperative cases from external hospitals. Thus, the study included nine non-iatrogenic traumatic chylothorax cases, all related to traumatic accidents.

Data collection:

Data were collected on the following variables:

- **Demographic and clinical data:** Age, gender, and clinical presentation.
- **Trauma characteristics:** Mode of trauma and laterality.
- **Diagnostic findings:** Radiographic imaging, CT findings, pleural fluid analysis, and criteria for chylothorax diagnosis.
- **Treatment details:** Type of intervention (Conservative or surgical), initial intercostal drainage (ICD) duration, total ICD drainage, and response to conservative management.
- **Complications:** Infection, thromboembolism, electrolyte disturbances.
- **Hospital course:** Length of stay and clinical outcomes.

Diagnostic criteria:

Chylothorax was diagnosed based on:

- **Pleural fluid analysis:** Milky appearance, triglyceride level >110 mg/dL, or presence of chylomicrons.
- **Supportive imaging findings:** Chest CT and other radiographic imaging, interpreted within the clinical context, with or without a fatty food challenge.

Management protocol:

All patients underwent initial management with intercostal tube drainage. Conservative treatment measures included:

- **Dietary management:** Low-fat diet or medium-chain triglycerides (MCT), total parenteral nutrition (TPN) as needed.
- **Fluid and electrolyte management:** Fluid replacement and protein level monitoring with replacement as needed.
- **Pharmacologic support:** Broad-spectrum antibiotics and octreotide administration (50 µg q 8 hours subcutaneously).
- **Advanced interventions:** Pleurodesis was considered in cases unresponsive to conservative measures.
- **Multidisciplinary approach:** Thoracic surgeons, pulmonologists, nutritionists, radiologists, and pharmacists were involved in patient care.

Follow-up and outcome assessment

Patients were monitored clinically and radiologically throughout their hospital stay to assess:

- Effectiveness of conservative management.
- Complications and need for further intervention.
- Length of hospital stay.

The study's approach provided comprehensive insights into the management and outcomes of traumatic chylothorax in a non-iatrogenic context.

Ethical approval: The Ethics Committee of the New Najran General Hospital, approved this project. Each participant completed a permission form when all information was received. Throughout its implementation, the study complied with the Helsinki Declaration.

Statistical analysis

Version 28.0 of the IBM SPSS statistical program was used to code, tabulate, and statistically analyze the gathered data. The independent t-test was used to compare the quantitative data after it was represented as mean ± SD and checked for normality using the Shapiro-Wilk Kolmogorov-Smirnov test. Qualitative data is expressed as percentages and numbers, and Fisher's exact test is used to compare them. A significance level of p-value ≤ 0.050 was used.

RESULTS

The mean age was 32.6 ± 12.7 years. Males were more frequent than females (88.9% and 11.1% respectively). Bomb blast was the main mode of trauma (66.7%). Two thirds (66.7%) had right

affection, the other 33.3% had left trauma. ICD initial drainage (mL), ICD total drainage (mL) and ICD duration (hours) were higher in cases with right laterality. Good response was in majority of cases (88.9%), the only poor case (11.1%) had right laterality. Infection and dehydration were infrequent (22.2% and 11.1% respectively), all cases with such complications had right laterality. Mean of hospital length stay (days) was 11.8 ± 4.6, it was higher in cases with right than in left laterality (13.3 ± 4.8 versus 8.7 ± 2.1)**.**

In terms of initial chest drainage (ICD) findings, right-laterality cases exhibited a higher average initial drainage volume (665 mL) than left-laterality cases (453.3 mL), though this difference was not statistically significant (p = 0.063). Additionally, total drainage was greater for right-laterality cases (2300 mL) compared to left-laterality cases (1666.7 mL) that did not reach significance (p = 0.080). Duration of ICD was also longer for right-laterality cases (10.8 days versus 6.0 days for left-laterality), but with a non-significant p-value of 0.227.

Pleural fluid analysis revealed comparable triglyceride (TG) levels between groups, with mean TG levels of 192.8 mg/dL for right-laterality and 179 mg/dL for left-laterality cases with no significant difference (p = 0.671).

Treatment outcomes were positive in the majority of cases, with 88.9% of patients responding well to conservative management. All left-laterality cases had a favorable response, while one right-laterality case showed a poor response, though this difference was also statistically insignificant (p = 0.999).

Complications were infrequent, with infection occurring in 22.2% and dehydration in 11.1% of cases, exclusively in right-laterality cases. However, these differences did not reach statistical significance (p = 0.500 for infection and 0.999 for dehydration). **Hospital stay** duration averaged 11.8 days, with right-laterality cases staying longer on average (13.3 days) than in left-laterality cases (8.7 days), but this was not statistically significant (p = 0.164) (Table 1).

Table (1): Description of the studied cases and comparison according to laterality

Variables		All cases (Total=9)	Laterality		p-value
			Right (Total=6)	Left (Total=3)	
Age (years)		32.6±12.7	35.7±14.4	26.3±5.9	^0.330
Sex	**Male**	8 (88.9%)	5 (83.3%)	3 (100.0%)	§0.999
	Female	1 (11.1%)	1 (16.7%)	0 (0.0%)	
Mode of trauma	**Bomb blast**	6 (66.7%)	4 (66.7%)	2 (66.7%)	§0.999
	Road traffic accident	3 (33.3%)	2 (33.3%)	1 (33.3%)	
ICD initial drainage (mL)		594.4±165.3	665.0±155.4	453.3±64.3	^0.063
ICD total drainage (mL)		2088.9±517.7	2300.0±484.8	1666.7±288.7	^0.080
ICD duration (days)		9.2±5.4	10.8±5.9	6.0±2.6	^0.227
Pleural fluid analysis (TGs)		188.2±41.9	192.8±39.8	179.0±53.6	^0.671
Response	**Good**	8 (88.9%)	5 (83.3%)	3 (100.0%)	§0.999
	Poor	1 (11.1%)	1 (16.7%)	0 (0.0%)	
Complications	**Infection**	2 (22.2%)	2 (33.3%)	0 (0.0%)	§0.500
	Dehydration	1 (11.1%)	1 (16.7%)	0 (0.0%)	§0.999
Hospital length of stay (days)		11.8±4.6	13.3±4.8	8.7±2.1	^0.164

^Independent t-test. #Fisher's exact test.

The following figures (1 to 3) show CT chest images taken for 3 of our patients, all of them sustained bomb blast, which led to chylothorax by both blunt and penetrating mechanisms.

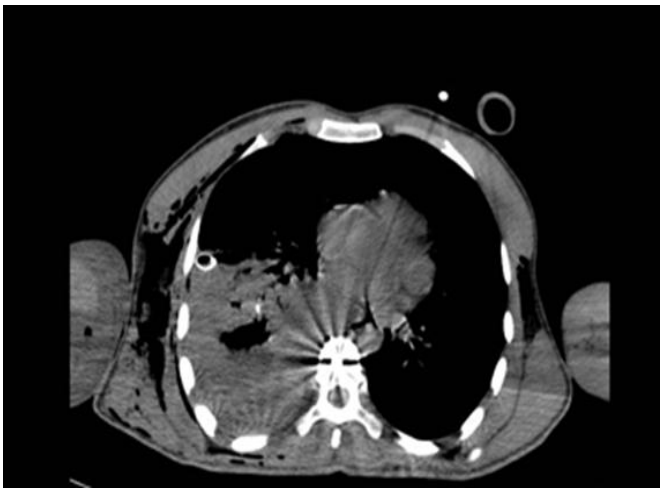

Figure (1): Patient with right chest shrapnel entry, which resided in thoracic vertebra close to thoracic duct.

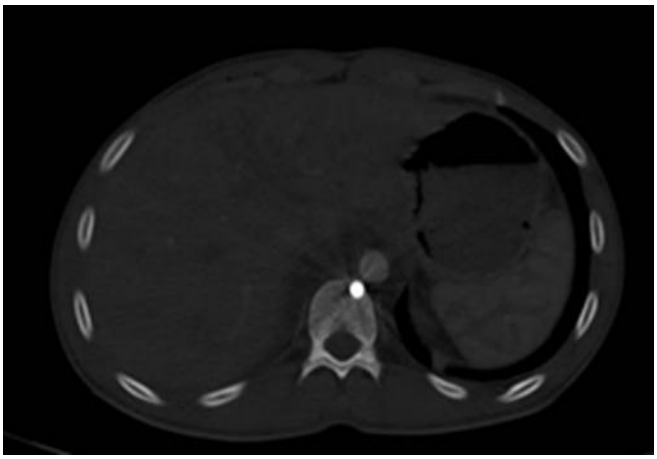

Figure (2): Patient with shrapnel injury from bomb blast located at aortic opening of diaphragm.

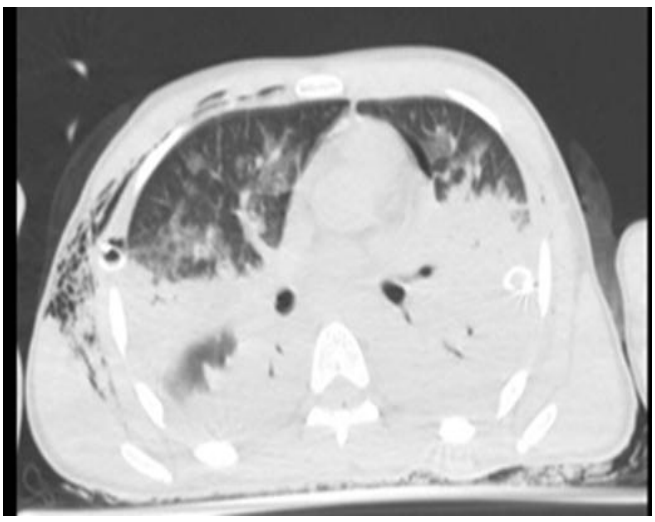

Figure (3): Patient with significant injury related to bomb blast, leading to bilateral lung contusions, right side chylothorax and left side hemopneumothorax.

DISCUSSION

An uncommon clinical condition known as chylothorax is the buildup of chyle in the pleural cavity. It is caused by disruption of the thoracic duct and has mostly non-traumatic etiologies. In particular, traumatic chylothorax is extremely rare, occurring 0.9%–1.3% after penetrating trauma and 0.2–3.0% after blunt thoracic trauma [(2)].

The case series study focused on non-iatrogenic traumatic chylothorax (a rare condition), analyzing nine cases of non-iatrogenic chylothorax from April 2018 to March 2024. Patients' demographics and trauma modes were examined in relation to laterality (right or left-sided chylothorax). The mean age of patients was 32.6 years, with slightly older patients in the right-laterality group (mean age 35.7 years) compared to the left-laterality group (26.3 years). However, this age difference was not statistically significant ($p = 0.330$). The study also observed a male predominance, with 88.9% of cases being male (mainly war injuries). Gender distribution and trauma mode (66.7% caused by bomb trauma and 33.3% by road traffic accidents) were similarly balanced across both laterality groups, with no significant differences ($p = 0.999$).

These findings align with **Spasic *et al.*** [(7)] and **Mohamed *et al.*** [(8)], who also reported chylothorax following blunt trauma from motor vehicle accidents or falls. However, **Nyatsambo *et al.*** [(9)] presented a unique case of chylothorax following penetrating chest trauma, emphasizing that while chylothorax can arise from various trauma modes, non-iatrogenic blunt trauma is the common. Unlike our study, case of **Nyatsambo** [(9)] had a delayed presentation with severe respiratory distress, likely contributing to a more complex management pathway.

In terms of initial chest drainage (ICD) findings, right-laterality cases exhibited a higher average initial drainage volume (665 mL) than left-laterality cases (453.3 mL), though this difference was not statistically significant ($p = 0.063$). Additionally, total drainage was greater for right-laterality cases (2300 mL) compared to left-laterality cases (1666.7 mL), which did not reach significance ($p = 0.080$). Duration of ICD was also longer for right-laterality cases (10.8 days versus 6.0 days for left-laterality), but with a non-significant p-value of 0.227.

In comparison, **Nyatsambo *et al.*** [(9)] reported a single-case ICD output of 2 L initially, which rapidly decreased over several days, while **Spasic *et al.*** [(7)] noted high initial drainage volumes that required surgical intervention when conservative management failed.

In **Mohamed *et al.*** [(8)], bilateral effusions demanded multiple thoracentesis sessions, especially during symptom exacerbations. Overall, our findings on ICD volumes suggest that although conservative management was generally sufficient, higher initial drainage volumes may correlate with cases that

necessitate surgical approaches, as seen in **Spasic *et al.*** [7].

Pleural fluid analysis revealed comparable triglyceride (TG) levels between groups, with mean TG levels of 192.8 mg/dL for right-laterality and 179 mg/dL for left-laterality cases, with no significant difference (p = 0.671). Treatment outcomes were positive in the majority of cases, with 88.9% of patients responding well to conservative management. All left-laterality cases had a favorable response, while one right-laterality case showed a poor response, though this difference was also statistically insignificant (p = 0.999).

Nyatsambo *et al.* [9] reported that triglyceride levels confirmed chylothorax at 23.5 mmol/L, while **Mohamed *et al.*** [8] documented extremely elevated levels of 4,750 mg/dL, both led to conservative treatment success without surgical procedures. However, **Spasic *et al.*** [7] encountered persistent high output despite conservative management, necessitating a thoracotomy to repair the thoracic duct. This variation suggests that while conservative approaches yield high success rates, elevated or persistent pleural fluid volumes, as seen in **Spasic *et al.*** [7] may indicate the need for surgical intervention when conservative methods fail to decrease drainage over time.

Complications were infrequent, with infection occurring in 22.2% and dehydration in 11.1% of cases, exclusively in right-laterality cases. However, these differences did not reach statistical significance (p = 0.500 for infection and 0.999 for dehydration). Hospital stay duration averaged 11.8 days, with right-laterality cases staying longer on average (13.3 days) than left-laterality cases (8.7 days), though this did not achieve statistical significance (p = 0.164). In concordance with our results, **Nyatsambo *et al.*** [9] reported minimal complications and a slightly shorter stay of 10 days, while **Mohamed *et al.*** [8] documented a similar duration but noted recurrent symptoms necessitating re-admission.

Spasic *et al.* [7] experienced the most extended hospital course due to surgical intervention, aligning with higher initial drainage and complications, resulting in a prolonged hospital stay of over two weeks. This comparison indicates that while conservative management often reduces hospital stay and complications, cases requiring surgery, as in **Spasic *et al.*** [7] tend to experience longer hospitalization due to recovery from invasive procedures.

Conversely, **Spasic *et al.*** [7] diverged from our study due to the need for surgical intervention in managing a case of traumatic chylothorax following a motor vehicle accident.

Despite initially attempting conservative management, **Spasic *et al.*** [7] observed persistently high chylous fluid output, prompting a thoracotomy to ligate the thoracic duct. This difference may be attributed to the specific nature of the trauma where blunt thoracic trauma leading to rib fractures and pneumomediastinum, potentially causing a more extensive and severe disruption to the thoracic duct. These anatomical injuries may limit the success of conservative measures, as structural repair of the duct becomes necessary.

Additionally, the patient in **Spasic *et al.*** [7] had a prolonged hospital stay, which is indicative of the complexities associated with surgical recovery and the more invasive management required for severe blunt trauma. Overall, our study highlighted the potential for conservative management to improve outcomes in traumatic chylothorax, supporting its continued use as a primary treatment strategy for this rare but challenging condition.

Strengths of the study

The study contributed valuable insights into the rare condition of non-iatrogenic traumatic chylothorax, particularly in a single-center setting, which allowed for consistent data collection and management approaches. By focusing on a specific subset of chylothorax cases (traumatic, non-iatrogenic), the study minimized variability associated with postoperative complications and better isolation of the trauma-related etiology. The comprehensive nature of the data covering demographics, trauma modes, clinical management, complications, and outcomes provided a well-rounded understanding of patient responses to conservative treatments. Additionally, the study's multidisciplinary approach, involving thoracic surgeons, pulmonologists, nutritionists, radiologists, and pharmacists, underscored the importance of collaborative management for complex cases.

Limitations of the study:

Despite its contributions, the study had several limitations that impact the generalizability and statistical power of its findings. The small sample size of nine cases restricts the ability to detect statistically significant differences, particularly when comparing outcomes based on trauma laterality. Additionally, as a retrospective case series, the study lacked randomization and control groups, which limit causal inferences and could introduce selection bias. Another limitation was the study's single-center design, which may not capture variations in practice patterns across different institutions and settings, potentially impacting the applicability of findings to broader populations.

CONCLUSION

This study provided valuable insights into the management of non-iatrogenic traumatic chylothorax, emphasizing the efficacy of conservative treatment approaches. With a sample of nine cases over a six-year period, our findings demonstrated that conservative management including dietary

modification, fluid replacement, monitoring of protein levels, and adjunctive use of octreotide successfully resolved chylothorax in 88.9% of cases. This high success rate underscored the potential of non-invasive management for chylothorax resulting from trauma, particularly in cases without extensive thoracic structural damage. The minimal complication rates and relatively short hospital stays observed further supported conservative management as a reliable and effective approach for this patient population. Nonetheless, right-laterality trauma might warrant closer monitoring given the observed trends toward increased resource utilization.

Conflict of interest: None.
Financial disclosures: None.

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