Chylothorax caused by blunt chest trauma: a review of literature

Fahmi Hussein Kakamad^{1,2} · Rawezh Qadir M. Salih^{2,3} · Shvan Hussein Mohammed² ·
Ahmed Ghafour HamaSaeed⁴ · Dlawar Ali Mohammed⁵ · Vanya Ibrahim Jwamer⁶ · Pshtiwan Gharib Ali⁵ ·
Tomas M.Sharif M.Mikael^{2,7} · Marwan Nasih Hassan⁶ · Rebwar Ahmed Ali² · Abdulwahid Mohammed Salih⁸

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Abstract

Chylothorax is the accumulation of chyle in the pleural cavity that typically contains a high concentration of triglycerides. Blunt chest trauma is a rare cause. The aim of this study is to review all of the reported cases of chylothorax caused by blunt chest trauma. Available databases were explored systematically for the condition and the eligible papers were included. The literature search revealed 30 studies with 39 cases, 72.3% of the cases were male, and 21.7% of the patients were female. The age range varied between 4 and 75 years with a mean age of 35.8 years. All of the patients were diagnosed after fluid sampling from the pleural fluid by thoracentesis and/or chest tube insertion. About 71.4% of the patients were treated successfully by conservative management; others (28.6%) were managed surgically. Although it is a rare condition, persistent milky drainage after blunt chest trauma should raise the suspicion of chylothorax. Pleural fluid sampling is the cornerstone of the diagnosis. In the majority of the cases, conservative treatment is quite enough. Surgery is indicated whenever non-operative measures failed.

Keywords Conservative management · Thoracic duct · Injury · Trauma · Operation

Introduction

Chylothorax is the accumulation of chyle in the pleural cavity that typically contains a high concentration of triglycerides (> 110 mg/dL [> 1.24 mmol/L]). Generally, it occurs because of a leak from the main trunk or the tributaries of the thoracic duct [1]. Longelot was accredited with the first description of chylothorax in German literature while in the setting of the trauma, the first case was outlined by Quincke [2]. If left untreated, it is a fatal disease, causing death in 30–50% of the cases from malnutrition, immunodeficiency, or heart

failure [1]. The condition can be categorized as congenital and acquired; the latter could be spontaneous, traumatic iatrogenic, or traumatic non-iatrogenic [3]. Iatrogenic cases are accounted for the majority of conditions, predominantly, during operation for the esophageal diseases (0.4% to 2%) [4]. Penetrating chest trauma in the form of gunshot or stab wounds is the second most prevalent cause of chylothorax [5]. The precise etiology of the disease is not well recognized in nearly 15% of the cases [6]. Chylothorax caused by blunt chest trauma is a rare entity. The etiology is thought to be due to an abrupt hyperextension of the vertebral column leading to

✉ Fahmi Hussein Kakamad
fahmi.hussein@univsul.edu.iq

¹ Faculty of Medical Sciences, School of Medicine, Department of Cardiothoracic and Vascular Surgery, University of Sulaimani, François Mitterrand street, Sulaimani, Kurdistan, Iraq

² Kscien Organization for Scientific Research, Hamdi street, Sulaimani, Kurdistan, Iraq

³ Shar Medical Center Laboratory Department, Shar Medical Center, Ibrahim pasha street, Sulaimani, Kurdistan, Iraq

⁴ Shar Hospital Pharmacy Department, Shar Hospital, Sulaimani, Kurdistan, Iraq

⁵ Faculty of Medical Sciences, School of Pharmacy, University of Sulaimani, François Mitterrand street, Sulaimani, Kurdistan, Iraq

⁶ Undergraduate Student, Faculty of Medical Sciences, School of Medicine, University of Sulaimani, François Mitterrand street, Sulaimani, Kurdistan, Iraq

⁷ Medi Laboratory, Goran street, Sulaimani, Kurdistan, Iraq

⁸ Faculty of Medical Sciences, School of Medicine, Department of Surgery, University of Sulaimani, François Mitterrand street, Sulaimani, Kurdistan, Iraq

forceful stretching and subsequent rupture of the thoracic duct [1]. Others believe that blunt thoracic duct injury is due to the shearing exertion of the acute angle of the right diaphragmatic crus especially when the duct distended after a meal. This can be caused by acceleration-deceleration trauma [7]. Penetrating duct injuries by fractured vertebral pieces or osteophytes are other possible explanation for thoracic duct injuries in the context of blunt chest trauma [4].

To this date, there is no consensus about the management of chylothorax after blunt chest trauma and the clinical course remains obscure as well. The aim of this study is to review the reported cases of blunt chest trauma causing chylothorax.

Methods

Search and information sources

PubMed, Science Direct, Medline on OVID, Scopus, Wiley online, Web of Science, and Google Scholar were chased and scrutinized for English-language papers issued before January 1, 2019. The keywords were chylothorax, and blunt trauma, blunt trauma and chylothorax, blunt thoracic duct injury, thoracic duct trauma. The data collection was augmented by the references of the included articles.

Eligibility criteria

For a paper to be incorporated into this study, it had to present at least one new case of chylothorax caused by blunt thoracic trauma.

Data assemblage and review process

The information from the included articles were extracted by five authors (first, second, third, eighth, and ninth authors). The researchers of the included studies were not contacted to obtain and/or confirm the data. Although several data were extracted, only some of them were pooled again and re-analyzed (metadata) including sample size, socio-demographic characteristics of the cases, clinical presentations, duration, the method of diagnosis, management strategy, complications, and outcome.

Summary measures and synthesis of results

According to the significance of the articles, some of them were illustrated and summarized shortly. The variables were demonstrated as mean values, and ranges of variation and percentages. A table has been created and the reports were separately presented.

Results

The literature search revealed about 100 articles. From which 68 articles were excluded by the eligibility criteria. Two other studies were excluded because they were published in the predatory journals. The remaining 30 studies were undergone review and analysis, which contained 39 patients, (Fig. 1). Majority of the patients (72.3%) were male. The age varied between 4 and 75 years with a mean age of 35.8 years. The latency period ranged between an immediate occurrence of the chylothorax and a 20-year interval (a fraction of them (9 cases, 23.7%) was between 2 and 7 days; others were very variable measuring in hours, days, weeks, months, years, or decades). The left and right sides were equally involved (each 35%); bilateral occurrence was reported in 30%. All of the cases were reported to have severe blunt trauma to various body parts. About 47.7% of the cases were associated with vertebral fracture. One patient reported chyloperitonium. Another patient reported cerebral edema, acetabular fracture, and tibial fracture. All the patients were diagnosed after sampling the pleural fluid by thoracentesis and/or chest tube insertion. Ten percent of the cases underwent lymphangiogram in spite of thoracentesis. Conservative management was successful in 71.4% of the patients; others (28.6%) were managed surgically; from this fraction, and two patients (5.7%) underwent thoracoscopic ligation of the thoracic duct. One patient underwent both thoracotomy and laparotomy. Those patients underwent operation (both thoracotomy and thoracoscopy) had drainage more than 800 cc/days for several days [3, 8, 9]. Table 1 shows relevant data regarding chylothorax caused by blunt chest trauma.

Fig 1 Flow chart of the search process

Table 1 Reported cases of chylothorax caused by blunt chest trauma

Author et al (year) ref number	Total number of patients	Age (years)	Total number of male patients	Number of patients with right side drain	Number of patients with bilateral drain	Conservative treatment in N (%)	Surgery N (%)	Day of appearance of milky fluid	Volume of drainage	Method of diagnosis	Any other information summary
Ahmed et al. [29]	1	42	1	1	0	1	0	2	800–1000 cc	Pleural fluid analysis	D10 and multiple bilateral rib fracture
BomLee et al. [6]	1	11	1	1	0	1	0	3	N/K	Pleural fluid analysis	Multiple fracture
Brown et al. [8]	1	53	1	0	0	0	1	1	2000 cc	Pleural fluid analysis	Flail chest
Chamberlain et al. [10]	1	29	1	1	0	0	1	21	10,000 cc	Pleural fluid analysis	Fracture of D4 and D10, aortic pseudoaneurysm
Dulchavsky et al. [19]	1	N/K	N/K	N/K	N/K	1	0	N/K	N/K	Pleural fluid analysis	N/K
Espadas et al. [20]	6	N/K	N/K	N/K	N/K	6	0	N/K	N/K	Pleural fluid analysis	N/K
Ferri et al. [11]	1	N/K	N/K	N/K	N/K	N/K	N/K	N/K	N/K	Pleural fluid analysis	N/K
Golden [14]	1	53	0	0	N/K	0	1	5	3000–4000 cc	Pleural fluid analysis	N/K
Huber et al. [13]	1	47	1	0	N/K	0	1	3	N/K	Pleural fluid analysis	Fracture of D11
Ikonomidis et al. [1]	2	17	1	N/K	N/K	2	0	N/K	N/K	Pleural fluid analysis + lymphangiogram	One case had Fracture of mandible and patella. Other fracture of C2,D3, L1–L5
Janzing et al. [28]	1	N/K	N/K	N/K	N/K	0	1	N/K	N/K	Pleural fluid analysis	N/K
Kamiyoshihara et al. [3]	1	51	1	0	1	0	1	20	800–1500 cc	Pleural fluid analysis	D7
Kavarana et al. [4]	2	-75 -22	2	1	1	2	0	-2 -6	800–1000 cc	Pleural fluid analysis	One case had fracture of 2 ribs and sternoclavicular joint
Kozul et al. [9]	1	18	1	0	1	1	0	11	N/K	Pleural fluid analysis	Fracture of T8,9, L1,2
Lee et al. [5]	1	70	1	1	0	0	1	5	3000 to 4000cc	Pleural fluid analysis	N/K
Lindhorst et al. [21]	1	24	1	N/K	N/K	1	0	N/K	N/K	Pleural fluid analysis	Fracture of D6 and D7
Litzau et al. [15]	1	66	0	1	0	1	0	3	N/L	Pleural fluid analysis	N/K
McCormick et al. [18]	1	N/K	1	N/K	N/K	1	0	N/K	N/K	Pleural fluid analysis + lymphangiogram	N/K
Milano et al. [7]	1	26	0	0	0	1	0	330	N/K	Pleural fluid analysis	N/K
Mohamed et al. [16]	1	51	1	0	1	1	0	5	N/K	Pleural fluid analysis	N/K
Ozcelik et al. [31]	1	15	1	1	0	0	1	75	N/K	Pleural fluid analysis	Right main bronchus disruption
Platz et al. [22]	3	N/K	N/K	N/K	N/K	3	0	N/K	N/K	Pleural fluid analysis	N/K
Rathod et al. [12]	1	N/K	N/K	N/K	N/K	N/K	N/K	N/K	N/K	Pleural fluid analysis	N/K
Schurz et al. [23]	1	39	1	0	0	1	0	14	N/K	Pleural fluid analysis	Fracture of D9
Seitelman et al. [32]	1	50	0	0	0	1	0	10	N/K	Pleural fluid analysis	Acetabular fracture
Serin-Ezer et al. [24]	1	4	1	0	1	1	0	2	N/K	Pleural fluid analysis	Cerebral edema, tibial fracture
Silen et al. [27]	1	N/K	N/K	N/K	N/K	0	1	N/K	N/K	Pleural fluid analysis	N/K
Sokouti et al. [2]	1	1	1	0	1	0	1	11	2000–3000 cc	Pleural fluid analysis	Chyloperitonium
Sriprasad et al. [17]	1	27	0	0	0	1	0	7	N/K	Pleural fluid analysis + lymphangiogram	Dislocation of D1,D2, with subarachnoid hemorrhage

Discussion

Each day, about 1.5 to 2.5 l of chyle fluid returns to the circulating system through the thoracic duct, which is well protected anteriorly by the mediastinum and posteriorly by the thoracic vertebrae. Chylothorax results whenever the duct is injured and chyle leaks into the pleural space [1, 10–12].

There is a latency period between initial blunt trauma and clinical manifestation of chylothorax. This latency period has been described to be ranging anywhere between a few minutes (immediate onset) and 20-year interval [1, 3]. However, in the majority of the cases, milky drain appeared in two to seven days [4, 6, 13–17]. Ikonomidis et al. reported a case of blunt trauma resulting from a road traffic accident in a 17-year-old patient. The patient's primary injuries consisted of pneumomediastinum, bilateral pulmonary contusion, and immediate bilateral milky drainage; the discharge was later confirmed to be chylothorax. This is an example of immediate chylothorax. On the other end, Kamiyoshihara and colleagues received a 51-year-old male with a bilateral pleural collection; this was confirmed to be chylothorax too despite the initial injury being blunt chest trauma with D7 vertebral fracture before 20 years. The sampling of the pleural fluid confirmed the diagnosis of bilateral chylothorax. During thoracoscopy, there was a chyle leak just below and adjacent to the site of the previous vertebral fracture [1, 3]. Milano and his colleagues attempted to explain this delay in presentation and long latency period between the clinical manifestation of the chylothorax and initial trauma by chyloma formation. According to their theory, early in the course of the trauma, the chyle leak from the thoracic duct or its tributaries would be contained by the pleura forming a thin-walled cyst with chyle content called chyloma with subsequent progressive enlargement, chyloma would rupture into the both or one of the pleural cavity forming bilateral or unilateral chylothorax respectively [7].

Chest x-ray and computed tomography scan (CT scan) show pleural collection and any associated vertebral fracture while chemical analysis of the pleural fluid affirms the diagnosis of the chylothorax. Triglyceride level greater than 110 mg/dL is the diagnostic clear-cut value while it rules out the condition when it is less than 50 mg/dL [6]. In these metadata, almost all cases were diagnosed with fluid analysis. Lymphography was performed for four cases (10%) to confirm the diagnosis and determine the site of the leak [1, 7, 17, 18]. Usage of lymphograms may not be well justified, as the diagnosis can be confirmed by pleural fluid analysis alone. Many times, the site of the leak can be anywhere in the thoracic duct and treatment is difficult; for some cases, where it remains unfound, ligation at the entrance to the chest is recommended [1, 4, 10].

Various management options for chylothorax have been advocated among different centers. In general, the

management can be categorized into conservative and surgical treatment (Fig. 2).

Conservative management composes of two main elements: first, to decrease lymphatic production by starvation and total parenteral nutrition and second, enhancing complete lung re-expansion. The latter is regarded as the cornerstone of the management as the expanded lung promotes sealing of the injured site. Re-expansion can be achieved through proper pleural drainage with aggressive chest physiotherapy. Early mobilization, bronchodilators, effective analgesics, and humidified oxygen are other secondary components of conservative management [4]. Octreotide is recommended by some authors as adjunctive therapy [8]. Conservative management could be practiced for two weeks or any length of time as far as a consistent diminution of the drainage is observed [1]. In the current metadata, conservative treatment succeeded in 71.4% of the cases. [1, 4, 6, 7, 9, 16, 17, 19–24]. Routine conservative management is not recommended as it yields 50% mortality rate; this decreased to 10% with classical surgical intervention. It even decreased more with early minimal invasive therapies including embolization and needle interruption of the thoracic duct [25].

Surgical techniques include the classical thoracotomy or thoroscopic surgery. In either approach, mass ligation at the diaphragmatic level or selective ligation at the site of the leak is performed [1]. Van Pernis once reported that in 40% of the human being, thoracic duct duplicates at the level of T8 to T12; from this perspective, mass ligation at the level of the diaphragm might be more justified [26]. One hour before the intervention, instillation of heavy cream or olive oil through a nasogastric tube or per oral is recommended to aid easier identification of the duct as this increases the flow rate and makes the drain heavier [3, 11, 14]. According to these metadata, 28.6% of the patients underwent surgical intervention. [2, 3, 5, 8, 10, 13, 14, 26–29].

In 22.8% of the cases, classical posterolateral thoracotomy was performed and in two cases, surgical ligation was done by thoracoscopy [5, 9]. Sokouti and Aghdam reported a 15-year-old male with a history of blunt chest trauma before 11 years; thoracotomy and ligation of thoracic duct failed to control the condition. The patient underwent laparotomy, which revealed chyloperitoneum as well. The thoracic duct was ligated below the diaphragm and the condition cured [2].

Management of post-traumatic (iatrogenic) chylothorax has recently seen a change towards early intervention using minimally invasive methods (needle interruption of the thoracic duct or embolization). Itkin et al. reviewed institutional experience with minimal invasive management of iatrogenic chylothorax and reported overall 71% success rate with minimal morbidity [25]. Whether this can be applied to the chylothorax caused by blunt trauma or not is not well known.

Pleurodesis as a sole management has been used in case of chylothorax associated with malignancy and in combination

Fig. 2 Proposed algorithm for the management of chylothorax caused by blunt chest trauma

with other therapeutic modalities (especially when mass ligation performed without clear identification of the duct) [30]. In the context of chylothorax caused by blunt trauma, its role is unknown as none of the authors addressed this issue.

It is worthy to note that in almost all cases, immediate cessation of drainage has never been reported after a successful surgical intervention. Rather, surgeons have observed a gradual decrease for a variable length of time [2, 3, 8, 10, 31]. Sokouti et al. performed thoracotomy and laparotomy for a case with combined blunt chylothorax and chyloperitoneum; although the drainage decreased to nearly half of the amount drained preoperatively, the chyle drain stopped from the thoracic tube after 46 days and from the peritoneum after 60 days [2].

There are important limitations in this study. The study comprises primarily of case reports; some of which are from a much earlier era. Thus, the management strategy summarized may be a reflection of a treatment approach from earlier decades when minimally invasive procedures were not

common. Also, not all diagnostic parameters have been adequately described in certain cases. The data missing in some literature cannot be replaced, for example, when triglyceride level in pleural fluid is between 50 and 110 mg/dl, the diagnosis is not addressed in the reviewed papers.

Conclusion

Although it is very rare, persistent milky drainage after blunt chest trauma should raise the suspicion of chylothorax. There may be a latency period of about one week. Pleural fluid sampling is the cornerstone of the diagnosis. In the majority of the cases, conservative treatment have been shown to be satisfactory with surgery indicated whenever conservative treatment failed. However, there is a growing evidence confirming that with the introduction of minimally invasive techniques, early intervention may be possible depending on the availability of expertise in the treating center.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethics statements Ethical approval has been granted from Kscien Organization for Scientific Research.

Human and animal rights and informed consent Not applicable being a review article.

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