Yıl 2024, Cilt: 38 Sayı: 1, 74- 94, 23.07.2024

Travmatik olmayan şilotoraksın cerrahi tedavisi ve sonuçları: bir vaka serisi

Surgical management and outcomes of nontraumatic chylothorax: a case series

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Amaç: Nontravmatik şilotoraks nadir görülen ancak zorlayıcı bir klinik problem olmaya devam etmektedir. Standart bir tedavi algoritması yoktur ve bu nedenle klinik deneyimlerin aktarılması yol göstericidir. Bu olgu serisinde, dokuz nontravmatik şilotoraks olgusunun; tanı, takip ve tedavi sürecindeki cerrahi deneyimlerimizi paylaşmayı amaçladık.

Gereç ve Yöntemler: Nontravmatik şilotoraks kliniği ile başvuran ve daha önce herhangi bir tanısı olmayan dokuz olgunun tanı ve cerrahi tedavi sürecini retrospektif olarak analiz ettik.

Bulgular: Ortalama yaşı 52,8 (27-83) olan dokuz hasta çalışmaya dahil edildi. Şilotoraksın etiyolojisinde en sık sebep malignite saptandı (%44,4). Tüm hastalara torasentezle tanı konuldu ve tüp torakostomi uygulandı. Ardından konservatif tedavi uygulanan bu hastalardan ikisinde (%22,2) tek başına konservatif tedavi yaklaşımı yeterli oldu. Geri kalan yedi (%77,8) hastada ise günlük drenaj 500 cc'nin üzerinde devam etti. Bu hastalarda talk plöredez, somatostatin ve video yardımlı torakoskopik girişim gibi ek prosedürlere ihtiyaç duyuldu.

Sonuç: Tüm nontravmatik şilotoraks hastalarına başlangıçta tüp torakostomi ve konservatif tedavi yaklaşımı önerilir. Başarılı olunmaması durumunda talk plörodez ve/veya somatostatin tedavisi uygulanabilir. Buna rağmen başarı sağlanamazsa, video yardımlı torakoskopik cerrahi ile duktus torasikus ligasyonu düşünülmelidir.

Anahtar Kelimeler: şilotoraks, somatostatin analoğu, lenfatik sızıntı, torasentez, VATS

Türkçe Kısa Başlık: Travmatik olmayan şilotoraksın tedavi ve sonuçları

ABSTRACT

Purpose: Nontraumatic chylothorax remains a rare but challenging clinical problem. There is no standard treatment algorithm and therefore the transfer of clinical experience is instructive. In this case series, nine non-traumatic chylothorax cases; We aimed to share our surgical experiences during the diagnosis, follow-up and treatment process.

Material and Methods: We retrospectively analyzed the diagnosis and surgical treatment process of nine cases who presented with non-traumatic chylothorax clinic and had no previous diagnosis.

Results: Nine patients with a mean age of 52.8 (27-83) were included in the study. The most common cause of chylothorax was malignancy (44.4%). All patients were diagnosed by thoracentesis and tube thoracostomy was performed. Conservative treatment approach alone was sufficient in two (22.2%) of these patients who subsequently received conservative treatment. In the remaining seven (77.8%) patients, daily drainage continued to exceed 500 cc. These patients required additional procedures such as talc pleurodesis, somatostatin, and video-assisted thoracoscopic intervention.

Conclusion: Initially, tube thoracostomy and conservative treatment approach are recommended for all non-traumatic chylothorax patients. If unsuccessful, talc pleurodesis and/or somatostatin therapy can be applied. If success is not achieved, ductus thoracicus ligation with video-assisted thoracoscopic surgery should be considered.

Keywords: chylothorax, somatostatin analogue, lymphatic leak, thoracentesis, VATS

Running Title: Treatment and results of non-traumatıc chylothorax

INTRODUCTION

Lymphy fluid accumulation in the pleural cavity is referred to as chylothorax. Chylothorax is a rare condition, accounting for only 3% of all pleural effusions (1). The etiology of the disease varies with age, and it is classified into two groups: those with and without a history of trauma. Post-traumatic chylothorax occurs due to the sudden hyperextension of the vertebral column, leading to injury to the thoracic duct just above the diaphragm (2). In 10% of patients, the etiology remains unidentified, and this is referred to as idiopathic chylothorax (3). Intrathoracic organ surgeries, particularly esophageal surgery, can lead to iatrogenic chylothorax due to damage to the thoracic duct.

Non-traumatic chylothorax is most commonly caused by malignancies, with lymphomas accounting for approximately 70-75% of cases (4). The mechanism behind chylothorax related to malignancies is the obstruction of the thoracic duct. Obstruction in the duct compresses the lymphatic vessels, preventing lymphatic fluid drainage from the lung periphery and leading to the accumulation of lymphatic fluid in the pleural space (5).

In addition to malignancies, some non-traumatic causes of chylothorax include certain congenital diseases, venous thrombosis, granulomatous diseases, and infectious diseases, particularly tuberculosis.

The most common complaints associated with the accumulation of lymphatic fluid in the intrapleural space are shortness of breath and cough. Chest pain and fever are rare because the fluid is sterile and non- irritating (6). Due to the loss of various essential elements, these patients are prone to hypoproteinemia, electrolyte disturbances such as hyponatremia, hypocalcemia, and metabolic acidosis. Among the long-term complications of chylothorax are lymphopenia and hypogammaglobulinemia. This leads to a decrease in humoral and cellular immunity, ultimately resulting in immunosuppression. Chylothorax is potentially a dangerous clinical entity, and older studies have reported mortality rates ranging from 10% after reoperation to as high as 50% with conservative treatment (5).

There is no universally accepted consensus on the treatment of chylothorax. This study aims to report our clinical and surgical experience in the management of chylothorax and to share our institutional insights for managing this complex condition.

PATIENTS AND METHODS

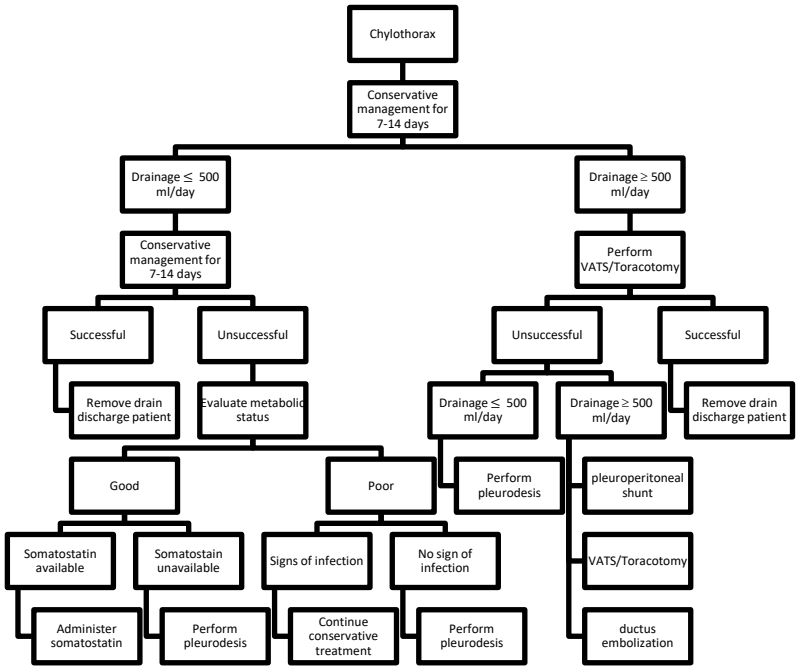
This study is a analysis of nontraumatic chylothorax cases treated in the chest surgery clinic between January 2010 and January 2023. Patients with chylothorax who have undergone trauma or surgery within the last month were excluded from the study. A total of nine patients were diagnosed with nontraumatic chylothorax, and the treatment methods applied were analyzed. The diagnosis of chylothorax was made by demonstrating a triglyceride concentration >110 mg/dl in the pleural fluid sample obtained by thoracentesis. This study was approved by the institutional ethics committee.

After a detailed history and physical examination, all patients had their accompanying illnesses comprehensively assessed, and the etiology of chylothorax was investigated. In all patients, serum and pleural fluid biochemistry, pleural fluid cytology, direct fluorescent staining for acid-fast bacilli in pleural fluid, and bacterial culture were performed. To investigate the etiology, all patients underwent a chest X-ray, contrast-enhanced thoracic computed tomography (CT), abdominal ultrasonography, and echocardiography. Patients with suspected malignancy underwent positron emission tomography (PET), and if necessary, tissue biopsies were performed. Patients with suspected thrombosis underwent advanced examinations with color doppler ultrasonography.

Patients diagnosed with chylothorax were initially given conservative treatment. This treatment protocol consisted of a low-fat, medium-chain triglyceride-rich oral diet, total parenteral nutrition through a central venous catheter, and the placement of a chest tube for complete lung expansion and decompression of the pleural space. The daily drainage of chyle

fluid was carefully measured and recorded. Usually, this conservative management continued for 10 days. In cases where conservative treatment failed and the daily chyle drainage exceeded 500 cc, additional treatments such as pleurodesis with talc (4 g of sterile talc with an average particle size of 25 µm in 50 mL 0.9% NaCl solution, administered through the chest tube and clamped for 4 hours) and/or somatostatin infusion at a dose of 50 µg three times daily were applied. In cases where these approaches were unsuccessful, general anesthesia was administered, and ductus thoracicus ligation (DTL) was performed using video-assisted thoracoscopic surgery (VATS). A right-sided approach was preferred for surgical repair to facilitate access to the ductus thoracicus. Selective lung ventilation was achieved using a double-lumen tube. The patient was placed in the left lateral position, and a triportal technique was used. The leak was detected by administering 100 cc of vegetable oil through the oral gastric tube and was repaired primarily with non-absorbable sutures. Patients were extubated and monitored at the end of the surgery. Oral feeding was initiated from the first postoperative day. The nature and amount of chest tube drainage were carefully monitored. When there was no drainage observed, the treatment was considered successful, and the chest tube was removed. The treatment steps applied to the patients are summarized as the treatment algorithm (Figure 1).

TREATMENT ALGORITHM



RESULTS

Of the nine patients included in the study, two were man (22.2%), and seven were women (77.7%). The mean age was 52.8 years, ranging from 27 to 83. The presentation of chylothorax was more common in the right hemithorax (88.9%).

Eight (88.9%) patients had additional diseases. Hypertension in five patients (Case 1, 2, 4, 6, 7), diabetes in five patients (Case 2, 5, 6, 8, 9), coronary artery disease in two patients (Case 5, 6), and hypothyroidism in three patients (Case 1, 3, 5) were detected. Two patients (Cases 2, 4) were active smokers, while the other seven patients had either never smoked or had quit at least ten years ago. No patients were taking anticoagulant medications. All patients had shortness of breath and cough, and one patient (Case 7) also had back pain (Table 1).

In Cases 2, 3, 4, and 5, breathlessness was more severe compared to other patients, and these patients had lower oxygen saturation in room air. Tube thoracostomy was performed on these patients who had milky, odorless fluid detected by thoracentesis, and whose biochemistry was compatible with chylothorax. There was no growth in the pleural fluid culture

of any of the cases. In this way, empyema was excluded from the differential diagnosis. Laboratory examination of pleural fluids showed triglycerides >110 mg/dL, cholesterol <200 mg/dL, fluid/serum cholesterol ratio below one, and triglyceride ratio above one (Table 2). Two patients (Case 2, 3) had abdominal, two patients (Case 4, 5) had supraclavicular and infraclavicular lymphadenopathy, three patients (Case 2, 6, 8) had pericardial effusion, one patient had abdominal fluid (Case 2), one patient (Case 9) had multiple enlarged lymph nodes in the mediastinum, while no additional pathology was found in only two patients (Case 1, 7) despite the tests performed. In cases 2, 3, 4, 5, and 9, a PET/CT scan was requested due to suspicion of malignancy. In case 2, the fluid in the abdomen was sampled by a general surgeon, and the patient was diagnosed with omental mesothelioma. Case 3, with a mediastinal mass, and cases 4 and 5, with pathologically enlarged supraclavicular lymph nodes and confirmed F-18 fludeoxyglucose (FDG) uptake on Positron Emission Tomography/Computerized Tomography (PET/CT), were diagnosed with lymphoma through a "trucut" biopsy performed by an interventional radiologist. In cases 6 and 8, who had pericardial effusion, carotid doppler ultrasound and echocardiography were repeated. Case 6 was found to have a thrombus in the aorta, while case 8 had a thrombus in the jugular vein. Both patients were consulted with cardiology and cardiovascular surgery, and low molecular weight heparin was initiated. Case 9, who had numerous pathologically enlarged lymph nodes in the mediastinum, underwent endobronchial ultrasound (EBUS) for sampling of lymph nodes 4R and 7. As the pathology result indicated a granulomatous infection, the patient was referred to the chest diseases clinic and started on anti-tuberculosis treatment. Patients 1 and 7, for whom no pathology was detected in imaging methods, were followed up with conservative treatment. At the time of admission, only four patients (44.4%) had drainage below 500 ml/24 hours, while the remaining five patients (55.6%) had drainage exceeding 500 ml/24 hours.

The oral feeding of all patients was discontinued for at least ten days, and total parentheral nutrition (TPN) was initiated. In cases 3 and 5, the drainage decreased to less than 500 cc per day with diet and TPN treatment, and it was observed that the chylous drainage did

not continue after oral intake was resumed. Therefore, there was no need for additional treatments such as somatostatin or talc pleurodesis in these two cases. The drainage for these two patients was discontinued two days after resuming a normal diet.

Among the seven patients whose daily chylous drainage continued to exceed 500 cc despite diet treatment, somotostatin was started at a dose of 50 µg every eight hours on the second day of diet treatment in Case 2 and Case 9, who did not have diarrhea, dizziness or hepatotoxicity. On the third day of somatostatin treatment, chylous drainage ceased in patient 2, while in patient 9, even on the fifth day of somatostatin treatment, drainage exceeded 500 cc per day. Patient 2, in whom drainage ceased with somatostatin treatment, and patient 9, who had elevated CRP and fever, did not undergo talc pleurodesis.

Patients 1, 4, 6, 7, and 8, in whom somatostatin treatment could not be administered due to supply issues or metabolic disturbances and who had no expansion defect on chest X-rays, were treated with 4 mg talc through the drain via the slurry method. While patients 1, 4, 6, and 8 had their chylothorax drainage stopped after talc pleurodesis, patient 7 continued to have chylothorax drainage despite pleurodesis. Cases 7 and 9, in whom drainage continued and the daily drainage volume was over 500 cc, underwent VATS for ductus ligation. In the postoperative period, the drains of these two patients, in whom chyle leakage was not present, were removed within five days. The average drainage duration was 16.4 days (ranging from 12 to 22 days), and the mean length of hospital stay was 18.7 days (ranging from 14 to 26 days). During their hospital stay, there were no complications or mortality related to the treatments applied to the patients. Patients diagnosed with the etiology of chylothorax were referred to the relevant departments for treatment of their underlying conditions (Table 3).

In Case 2 and Case 3, during the first month after discharge, in Case 5 during the second month, and in Case 9 during the third month, chylothorax recurrence was detected due to shortness of breath, and they underwent repeat tube thoracostomy. Oral intake was suspended, and TPN infusion was initiated for four patients. It was observed that the fever and

elevated C- Reactive Protein (CRP) in Patient 9 improved. For four patients in whom chylous drainage persisted despite dietary treatment, 4 mg of talc was administered through the drain using the slurry method. Somatostatin and the somatostatin analog octreotide couldn't be administered to these patients due to its unavailability. It was learned that Case 9 had interrupted anti-tuberculosis treatment, so anti-tuberculosis treatment was resumed. Starting from the second day after talc pleurodesis, there was no chyle drainage in four patients, and these patients were discharged after their drains were removed.

DISCUSSION

Chylothorax is defined as the accumulation of lymphatic fluid in the pleural cavity, either unilaterally or bilaterally. Trauma is the most common cause, with malignancies ranking first among non-traumatic causes (8). In our study, lymphoma was detected in three patients, while omental mesothelioma was detected in one patient, with no malignancies identified in six cases.

Some studies have linked the frequency of chylothorax to the characteristics of the population served by the hospital (9). In a retrospective study conducted 203 chylothorax patients, most of whom had traumatic etiology and none of whom were associated with tuberculosis, were identified in a tertiary care hospital in the United States (10). Similarly, in a retrospective study it was reported that 60% of chylothorax cases were attributed to non-traumatic causes, and none were associated with tuberculosis (9). Many studies have reported that lymphoma is the most common cause of chylothorax among malignancies, and tuberculosis-associated chylothorax is rare (11). In tuberculosis-associated chylothorax, the mortality rate is 6% due to the development of treatment resistance, fluid recurrence, and the resulting severe malnutrition and cachexia (12).

The diagnosis encompasses clinical findings, radiology, and pleural fluid analysis. In a study analyzing 22 chylothorax cases it was demonstrated that chylothorax can occur with various pleural fluid combinations, but a lymphocyte-predominant protein-discordant exudate

confirmed the diagnosis of chylothorax (13). In our study, one patient was diagnosed with tuberculosis-associated chylothorax, which proved to be resistant to treatment. Despite duct ligation, a recurrence of chylothorax was observed three months later. During this period, it was discovered that the patient had interrupted the antituberculous treatment. In addition to conservative treatment, talc pleurodesis was performed, and antituberculous therapy was restarted. As a result of these combined treatment approaches, drainage ceased. In general, surgical ligation can be successful in approximately 90% of chylothorax cases, but one out of every nine patients may require multiple procedures. However, data regarding DTL are predominantly associated with traumatic causes, and there is limited data for non-traumatic chylothorax cases. In the literature, complications rates of up to 38.3% and mortality have been reported in one-fourth of patients undergoing surgery for chylothorax. However, it has been noted that over time, outcomes have improved with early intervention, better patient selection, and advances in supportive measures (14). Although the majority of chylothorax patients are asymptomatic, an increase in the accumulation of fluid in the pleural cavity can lead to the development of shortness of breath and cough. Since the rate of fluid accumulation in chylothorax patients is typically slow, initial respiratory symptoms are mild (15). However, total ductus thoracic compression or rapid fluid accumulation due to extensive tissue damage can lead to acute and severe respiratory distress. In our study, it was observed that patients with a malignancy diagnosis had more severe respiratory distress. This raised the possibility that the compression of the ductus thoracicus by the existing mass or lymphadenopathies could be the underlying cause. The initial radiological examination that should be requested for diagnosing patients is the postero-anterior chest X-ray. Subsequently, lateral and lateral decubitus X-rays, thoracic ultrasound, and chest CT can be performed. These diagnostic methods are necessary to confirm the presence and localization of pleural effusion. Injury above the level of the fourth thoracic vertebra along the course of the thoracic duct results in chylothorax in the left hemithorax. In our study, pleural effusion was detected in the right hemithorax in eight cases, while one case had it in the left hemithorax. It has been reported that in tuberculosis-associated chylothorax, 45% had right-sided, 32% had bilateral, and 46%

had mediastinal lymphadenopathy, indicating variability in the affected side of chylothorax (16). In our study, one patient was diagnosed with tuberculosis-associated chylothorax in the right hemithorax, and while no parenchymal lesions were found on chest CT, widespread mediastinal lymphadenopathies were observed. The examination of pleural fluid obtained through thoracentesis from patients with detected pleural effusion using diagnostic methods is sufficient for diagnosis. A triglyceride level in pleural fluid exceeding 110 milligrams per deciliter confirms the diagnosis of chylothorax. If triglyceride values are inconclusive, the detection of chylomicrons in lipoprotein analysis further solidifies the diagnosis (17,18). In a single-center study involving 103 adult chylothorax patients, the examined triglyceride value was found to be 728 ± 797 mg/dL, and the cholesterol value was 66 ± 30 mg/dL (19). In our study, all cases had a pleural fluid triglyceride level above 100 mg/dL and a cholesterol level below 200 mg/dL (Table 2).

In patients diagnosed with chylothorax, the first step is to evacuate the chyle. For this purpose, thoracentesis can be performed, and tube thoracostomy may be necessary (20). The evacuation of pleural fluid with a chest tube allows the lung to re-expand, and as a result, the expanded lung can compress the leakage area, potentially stopping the leak. The treatment plan following lymphatic fluid drainage involves taking measures to reduce lymphatic flow from the duct. For this purpose, a dietary program is implemented that includes medium-chain fatty acids (8-12 carbons) that are directly absorbed from the portal system and does not contain long-chain fatty acids. If pleural effusion drainage does not decrease despite dietary measures, oral intake should be completely discontinued, and TPN should be initiated (21, 22). After starting TPN, if chylous drainage falls below 500 ml in 24 hours, it indicates the success of conservative treatment (23).

In cases where dietary and TPN treatments do not yield a response, adding somatostatin or octreotide therapy can lead to favorable outcomes. Somatostatin reduces intestinal blood flow and decreases chylomicron synthesis (24). As a side effect of treatment, liver damage, nausea, constipation, malabsorption, and hypoglycemia can occur (25).

Somatostatin's high cost and difficulty in procurement are among its disadvantages. Considering that chylothorax itself can lead to malnutrition, dehydration, and immune deficiency, it is more appropriate to administer somatostatin and analogs with serious side effects during the initial period of treatment if they can be obtained without deteriorating the patient's metabolic condition.

In our study, among all the patients in whom oral intake was stopped and TPN was initiated, seven had drainage fall below 500 ml per day. For the two patients whose drainage did not decrease below 500 cc, somatostatin was added to their treatment. In one patient, the leak stopped on the second day of somatostatin treatment, while in the other patient, the leak continued. When conservative treatment is inadequate, somatostatin cannot be used due to metabolic side effects, or it cannot be procured, pleurodesis becomes one of the treatment options. There are studies demonstrating that pleurodesis has a success rate of 80-100% both in postoperative lymphatic leaks and non-surgery-related chylothoraces (26). In our study, pleurodesis was performed in five patients, and four of them responded to treatment. None of these patients experienced a recurrence in the first year.

In patients diagnosed with malignancy, it has been observed that chylothorax treatment can be prolonged, and chylothorax may recur as long as the primary disease is not treated (27). In our study, three out of four patients with recurrent chylothorax, one with malignancy and one with tuberculosis diagnosis, had their chylothorax resolved with conservative treatment (Case 3 and 5), one had chylothorax resolved after somatostatin treatment (Case 2), and in one case (Case 9), it was determined that talc pleurodesis was not performed during the initial chylothorax episodes due to elevated CRP levels and fever. All four of these patients underwent talc pleurodesis during the recurrence period, and somatostatin treatment could not be administered due to its unavailability. The observation that all recurrent patients who underwent pleurodesis responded to treatment is remarkable. In a study involving 67 cases, they reported that success was achieved in 24 out of 46 patients with TPN, in 20 patients, the treatment was augmented with talc pleurodesis, and only two patients required surgical

treatment (28). In a study conducted they presented a series of 26 cases in which they achieved a success rate of 73% with conservative treatment (29). Surgical DTL is considered as a treatment option for cases resistant to medical treatment. Although surgical indications have not been clearly defined, reported that early surgical intervention significantly reduces mortality (30). Therefore, in patients with chylous leakage exceeding 1000 mL per day before the seventh day, (31) in cases where drainage exceeds 500 mL within the first 24 hours, and (26) when there is more than 900 mL of drainage on the second postoperative day, surgery was argued to be performed (33). DTL, pleurodesis, or a combination of all treatments should be performed with a multidisciplinary approach depending on the underlying pathology and patient prognosis. DTL can be performed via thoracotomy or VATS. Studies have shown that surgical success is higher in traumatic chylothorax compared to non-traumatic cases (34). In our study, we performed VATS ductus ligation in two patients with ongoing chylous drainage of 500 cc or more per day despite the conservative treatment. In both postoperative patients, chyle leakage was not observed.

Our study has some limitations. Firstly, it is an analysis of nine patients treated in a single surgical unit, which may introduce selection bias. Secondly, it is a retrospective study. A prospective study would be more ideal to answer some questions. Thirdly, alternative options such as ductus thoracic embolization, which has been used in recent years, were not utilized in this study, and treatment success could not be compared.

CONCLUSION:

Ultimately, non-traumatic chylothorax is a pathology with a high risk of morbidity and mortality if treatment is delayed. Treatment should begin immediately after confirmation of the diagnosis through biochemical methods. First and foremost, the etiology should be determined, and the treatment approach should be tailored accordingly. Chylous effusion should be drained, and conservative treatment should be initiated. In cases resistant to conservative treatment, if it can be provided without deteriorating the patient's metabolic

condition, somatostatin therapy should be added early in the treatment process. Talc pleurodesis has been shown to be effective in the treatment of both initial and recurrent chylothorax episodes. While larger patient groups are needed to shape chylothorax treatment algorithms, somatostatin and/or talc pleurodesis should definitely be administered in appropriate patients with chylothorax. However, if the daily drainage volume remains above 500 ml despite somatostatin or pleurodesis, DTL should be preferred. DTL with VATS is safe, feasible, and effective in the management of these cases.

References:

1- Cholet C, Delalandre C, Monnier-Cholley L, et al.. Nontraumatic chylothorax: nonenhanced MR lymphography. RadioGraphics 2020; 40: 1554–1573. doi: 10.1148/rg.2020200044

2- Majdalany BS, Murrey DA, Kapoor BS, et al.. ACR Appropriateness Criteria® Chylothorax Treatment Planning. J Am Coll Radiol 2017; 14: S118–S126. doi: 10.1016/j.jacr.2017.02.025

3- Rudrappa M, Paul M. Chylothorax. 2023 Feb 21. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan–. PMID: 29083798.

4- McGrath EE, Blades Z, Anderson PB. Chylothorax: aetiology, diagnosis and therapeutic options. Respir Med 2010; 104: 1–8. doi: 10.1016/j.rmed.2009.08.010

5- Pulle MV, Puri HV, Asaf BB, Bishnoi S, Yadav A, Kumar A. Chylothorax - Modalities of management and outcomes: A case series. Lung India. 2021 Mar-Apr;38(2):154-160. doi: 10.4103/lungindia.lungindia_526_20. PMID: 33687010; PMCID: PMC8098887.

6- Huggins JT. Chylothorax and cholesterol pleural effusion. Semin Respir Crit Care Med 2010; 31: 743–750. doi: 10.1055/s-0030-1269834

7- Aşık K, Tuğ T, Konuk S, Ali H, Aydın S. Tümör, Tüberküloz ve Şilotoraks Olgusu. Arch Clin Med Case Rep. 2018;2(3):68-74

8- Cortés-Télles A, Rojas-Serrano J, Torre-Bouscoulet L. Quilotórax: frecuencia, causas y desenlaces. Neumol Cir Torax. 2010; 69(3): 157-162.

9- Doerr CH, Allen MS, Nichols FC 3rd, Ryu JH. Etiology of chylothorax in 203 patients. Mayo Clin Proc. 2005 Jul;80(7):867-70.

10- Schild HH, Strassburg CP, Welz A, Kalff J.Treatment options in patients with chylothorax. Dtsch Arztebl Int. 2013 Nov 29;110(48):819-26.

11- Ajagopala S, Kancherla R, Ramanathan RP. Tuberculosis-Associated Chylothorax: Case Report and Systematic Review of the Literature. Respiration. 2018;95(4):260-268.

12- Agrawal A, Chaddha U, Kaul V, Desai A, Gillaspie E, Maldonado F. Multidisciplinary Management of Chylothorax. Chest. 2022 Dec;162(6):1402-1412. doi: 10.1016/j.chest.2022.06.012. Epub 2022 Jun 20. PMID: 35738344.

13- Ur Rehman K, Sivakumar P. Non-traumatic chylothorax: diagnostic and therapeutic strategies. Breathe (Sheff). 2022 Jun;18(2):210163. doi: 10.1183/20734735.0163-2021. Epub 2022 Aug 9. PMID: 36337134; PMCID: PMC9584559.

14- Ruiz de Villa A, Spencer S, Sircar S, Bassi R, Charles K, Okonoboh P. An Unusual Case of Non-traumatic Chylothorax. Cureus. 2022 Dec 14;14(12):e32506. doi: 10.7759/cureus.32506. PMID: 36654639; PMCID: PMC9838086.

15- Rajagopala S, Kancherla R, Ramanathan RP. Tuberculosis-Associated Chylothorax: Case Report and Systematic Review of the Literature. Respiration. 2018;95(4):260-268.

16- Gotuzo E. Tuberculosis: ¿quilotórax o seudoquilotórax? Cartas al Director. Anales de Medicina Interna. 2005;22(9): 449-450. | Link

17- Piñeros J, Caicedo V, Camacho L. Quilotórax Traumático: Presentación de un caso. Acta Médica Colombiana. 1977;2(4): 257-262. | Link

18- Maldonado F, Cartin-Ceba R, Hawkins FJ, et al.. Medical and surgical management of chylothorax and associated outcomes. Am J Med Sci 2010; 339: 314–318. doi: 10.1097/MAJ.0b013e3181cdcd6c

19- Gada PB, Sachdev RR, Ansari WA, Jadhav AA. Scourge of tuberculosis: A rare case of simultaneous chylothorax and chylous ascites. Lung India. 2023 May-Jun;40(3):271-274. doi: 10.4103/lungindia.lungindia_494_22. PMID: 37148027; PMCID: PMC10298829.

20- Sun JD, Shum T, Behzadi F, Hammer MM. Imaging Findings of Thoracic Lymphatic Abnormalities. Radiographics. 2022 Sep-Oct;42(5):1265-1282. doi: 10.1148/rg.220040. Epub 2022 Aug 12. PMID: 35960666.

21- Janardhan HP, Jung R, Trivedi CM. Lymphatic System in Organ Development, Function, and Regeneration. Circ Res. 2023 Apr 28;132(9):1181-1184. doi: 10.1161/CIRCRESAHA.123.322867. Epub 2023 Apr 27. PMID: 37104565; PMCID: PMC10155258.

22- Selle J.G, Snyder 3rd, W.H, Schreiber J.T. Chylothorax: indications for surgery. Ann. Surg. 1973; 177: 245-249

23- Lim KA, Kim SH, Huh J, Kang IS, Lee HJ, Jun TG, et al. Somatostatin for postoperative chylothorax after surgery for children with congenital heart disease. J Korean Med Sci 2005; 20(6): 947-951. 19.

24- Doğan R, Demircin M, Doğan OF, Öç M, Kuzgun E. Effectiveness of somatostatin in the conservative management of chylothorax. Turk J Pediatr 2004; 46(3): 262-264.

25- Nadolski G. Nontraumatic Chylothorax: Diagnostic Algorithm and Treatment Options. Tech Vasc Interv Radiol. 2016 Dec;19(4):286-290.

26- Zabeck H, Muley T, Dienemann H, Hoffmann H. Management of chylothorax in adults: when is surgery indicated? Thorac Cardiovasc Surg 2011; 59(4): 243-246.

27- Cho HJ, Kim DK, Lee GD, Sim HJ, Choi SH, Kim HR, et al. Chylothorax complicating pulmonary resection for lung cancer: effective management and pleurodesis. Ann Thorac Surg 2014; 97(2): 408-413.

28- Akın H, Olcmen A, Isgorucu O, Denizkiran I, Dincer I. Approach to patients with chylothorax complicating pulmonary resection. Thoracic Cardiovasc Surg 2012; 60(2): 135-139.

29- Kutlu CA, Sayar A, Olgac G, et al. Chylothorax: a complication following lung resection in patients with NSCLC—chylothorax following lung resection. Thorac Cardiovasc Surg 2003; 51: 342- 5.

30- Takuwa T, Yoshida J, Ono S, et al. Low-fat diet management strategy for chylothorax after pulmonary resection and lymph node dissection for primary lung cancer. J Thorac Cardiovasc Surg 2013; 14: 571- 4.

31- Dugue L, Sauvanet A, Farges O, Goharin A, Le Mee J, Belghiti J. Output of chyle as an indicator of treatment for chylothorax complicating oesophagectomy. BJS. 1998; 85: 1147-1149

32- Nadolski GJ, Itkin M. Feasibility of ultrasound-guided intranodal lymphangiogram for thoracic duct embolization. J Vasc Interv Radiol 2012; 23: 613–616. doi: 10.1016/j.jvir.2012.01.078

Declarations:

Ethics approval and consent to participate: The study has been approved by the ethics committee at 2020 – KAEK - 139with protocol number 2022/50-58. **Informed consent:** All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. Ethics committee approval has been granted from our institution and informed consent has been obtained from all participants.

Competing interests: The authors declare that they have no competing interests.

Consent for publication: Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal

Code availability: Not applicable

Availability of data and material: All data generated or analysed during this study are included in this published article [and its supplementary information files]

Competing interests: The authors declare that they have no competing interests.

Funding: There is no specific funding related to this research. On behalf of all authors, the corresponding author states that there is no conflict of interest.

Conflict of Interest: BAS made substantial contributions to the design of the work;

BG participated in the design of the study and SS performed the statistical analysis,

SY drafted the manuscript, FT conceived of the study, and participated in its design, EYS coordination and helped to draft the manuscript. AU revised it. All authors read and approved the final manuscript.

Acknowledgements: Not applicable

Table 1. Clinical Characteristics of the Cases

Case	Age	Additional Illness	Complaint	Smoking
1	59	Hypertension, Hypothyroidism	Shortness of breath, cough	None
2	33	Hypertension, Diabetes, emboli in neck veins	Shortness of breath, cough	Yes
3	35	Hypothyroidism	Shortness of breath, cough	None
4	58	Hypertension, Coronary Artery Disease	Shortness of breath, cough	Yes
5	79	Hypertension, Hypothyroidism, Diabetes	Shortness of breath, cough	None
6	83	Hypertension, Diabetes, Coronary Artery Disease	Shortness of breath, cough	None
7	27	None	Shortness of breath, cough, back pain	None
8	42	Chronic Kidney Disease, Diabetes	Shortness of breath, cough	None
9	59	Diabetes	Shortness of breath, cough	None

Table 2. Pleural Fluid and Serum Analysis

CASE	PLEURAL FLUİD					SERUM			
	Triglyceride Mg/dL	Cholesterol Mg/dL	Triglyceride/ Cholesterol	Protein g/L	LDH U/L	Protein g/L	LDH U/L	CRP Mg/L	Leukocyte X10.3/uL
1	1333	165	8,07	75	70	59	162	3,2	10,7
2	709	106	6,68	72	283	72	364	6,6	9,4
3	1440	135	10,66	5	16	58	112	2,5	8,4
4	979	72	13,59	3,85	239	63	313	0,9	4,9
5	136	50	2,72	2,63	407	65	191	8,38	9,4
6	1226	60	20,43	6,97	89	63	235	12,7	11
7	1210	84	14,40	6,9	140	63	189	1,7	6,4
8	209	56	3,73	3,41	140	62	172	4,8	7
9	1107	108	10,25	5,04	159	74	173	3,5	3,7

Table 3. Treatments Applied to the Cases and Diagnoses of the Cases

Case	Side	Nutrition	Applied Treatment	Tests Performed	Findings	Diagnosis	Hospitalization Duration (day)	Recurrence
1	Right	TPN	TT, TALC	US	None	None	13	None
2	Right	TPN	TT, SOMATOSTATIN	PET,Carotid Doppler	Mediastinal Lap, Abdominal Lap, Abdominal Fluid, pericardial effusion	Omental Mesothelioma	25	Yes
3	Right	TPN	TT	US,PET, Trucut biyopsy	Mediastinal Mass, Abdominal Lap	Lymphoma	12	Yes
4	Left	TPN	TT, TALC	US,PET, Trucut biyopsy	Right Supraclavicular Lap	Lymphoma	20	None
5	Right	TPN	TT	US,PET,Trucut biyopsy	Right Supraclavicular Lap	Lymphoma	16	Yes
6	Right	TPN	TT, TALC, LMWH	US, Carotid Doppler	Pericardial Effusion	Aortic Thrombus	13	None
7	Right	TPN	TT, TALC, DTL	US	None	None	25	None
8	Right	TPN	TT, TALC, LMWH	US, Carotid Doppler	Pericardial Effusion	Jugular Thrombus	15	None
9	Right	TPN	TT, SOMATOSTATİN, DTL	PET, EBUS	Mediastinal Lap	Tuberculosis	29	Recurred after 3 months

TPN: Total Parenteral Nutrition **TT:** Tube Thoracostomy **LMWH:** Low Molecular Weight Heparin **DTL:** Ductus Thorasicus Ligation **US:** Ultrasonography **PET:** Positron emission tomography **EBUS:** Endobronchial Ultrasonography