Original Article

Chylothorax - Modalities of management and outcomes: A case series

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ABSTRACT

Background: At present, there are no universally accepted protocols for the management of chylothorax. This study aims at reporting the clinical experience and presenting our institutional protocol for managing chylothorax. **Materials and Methods:** This is a retrospective analysis of chylothorax patients managed at a dedicated thoracic surgical unit over 8 years. A detailed analysis of demography and perioperative variables including complications was carried out. Factors influencing failure of conservative and surgical therapy were analyzed. **Results:** A total of 26 patients were included with a mean age of 42.4 years (range, 2–72 years). Postsurgical chylothorax was the most common variant (53.8%). Majority (46.1%) of the patients had >1000 ml/24 h intercostal tube drainage at presentation. All patients were initially subjected to conservative management, of which 11 (42.4%) patients were managed successfully with conservative therapy alone. Rest 15 (57.6%) patients required video-assisted thoracoscopic thoracic duct ligation, which was successful in 10/15 (66.7%) patients, whereas additional intervention was required in 5/15 (33.3%) patients. Drain output of >1000 ml/day was an independent predictor of failure of conservative therapy. Nontraumatic bilateral chylothorax was associated with high probability of failure of surgical therapy in the first attempt and may require additional treatment modality. **Conclusions:** Initial conservative management is recommended for all chylothorax patients, which is unlikely to succeed if daily drainage is >1000 ml/24 h. VATS thoracic duct ligation is recommended in such cases. Nontraumatic bilateral chylothorax has higher surgical failure rates. In such cases, additional procedures in the form of pleurodesis and/or thoracic duct embolization/disruption should be considered.

KEY WORDS: Chylothorax, conservative, failure, surgery, outcomes

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INTRODUCTION

Chylothorax occurs due to either disruption or dysfunction to the flow of chyle through the thoracic duct or its tributaries.[1] Thoracic duct arises from cisterna chyli at the second lumbar vertebra and ascends into the chest through the aortic hiatus of the diaphragm and lies in between azygos vein and aorta. As it ascends through the mediastinum, it receives multiple lymphatic tributaries which drain parietal pleura and lung parenchyma.[2] Thoracic duct transports lymphatic flow of 1.5–2.4 l/24 h.[3] Nevertheless, various anatomical variations are reported in the course of thoracic duct.[4]

The etiology of chylothorax can be divided into traumatic and nontraumatic as illustrated in Figure 1. A proportion

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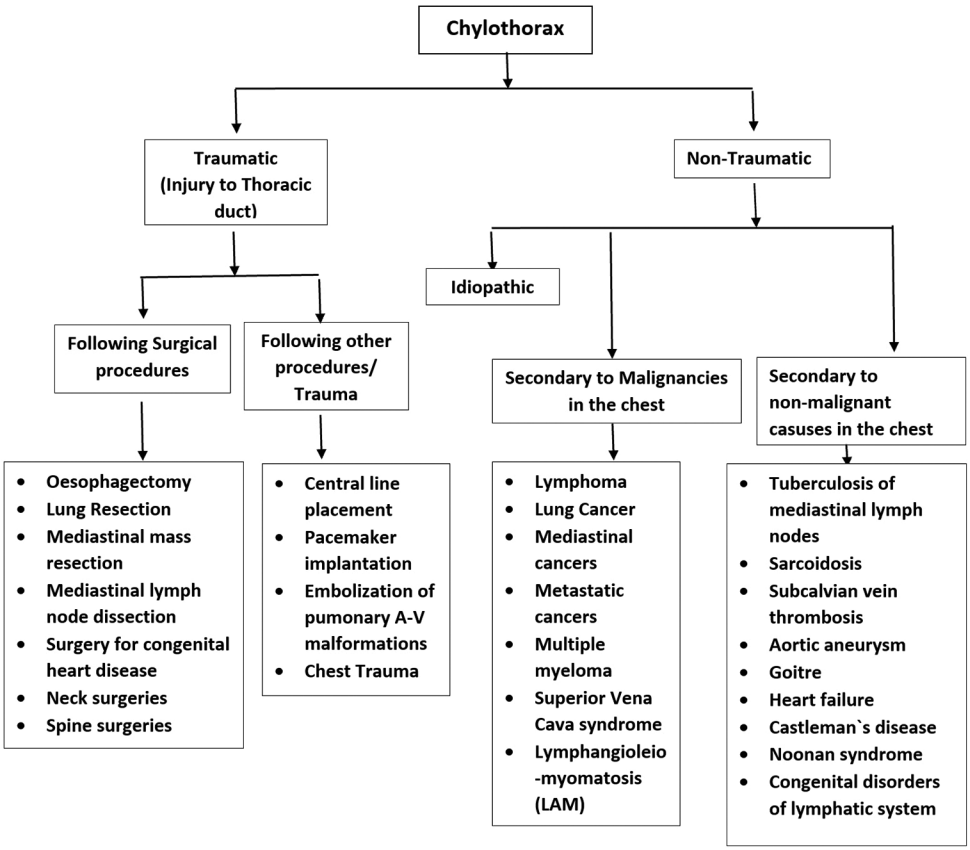

Figure 1: Etiological classification of chylothorax

of patients pertaining to particular etiology differ according to the type of cases being managed at the institution. Thoracic surgical procedures are the leading cause of traumatic chylothorax, whereas malignancy-related chylothorax is the predominant cause in the nontraumatic variety.[5,6] The available literature reports the incidence of chylothorax to be from 0.5% to 2.3% after esophagectomy and anatomical lung resection.[7,8] Dyspnea, cough, chest discomfort, weight loss, and fatigue are the common presenting symptoms. Due to the bacteriostatic property of the chyle, inflammatory response is rare; thus, fever and chest pain are uncommon presenting symptoms.[9] Due to loss of various essential elements, these patients are prone to malnourishment, hypoproteinemia, and electrolyte disturbances such as hyponatremia, hypocalcaemia, and metabolic acidosis. Long-term complications of chylothorax include lymphopenia and hypogammaglobulinemia, leading to decreased humoral as well as cellular immunity, ultimately causing immunosuppression.

The management of chylothorax is not standardized. Currently, there is no universally accepted consensus/ algorithm regarding the management of chylothorax. The available therapeutic modalities are listed in Figure 2. This study aims at reporting our clinical as well as surgical experience of chylothorax management and providing our institutional guidelines for managing this complex clinical entity.

MATERIALS AND METHODS

Study population and detailed evaluation

This is a retrospective analysis of the prospectively maintained data from March 2012 to December 2019 at a tertiary care center in New Delhi. A total of 26 patients were diagnosed to have chylothorax and managed with various modalities. This study was approved by the institutional ethics committee.

Diagnosis of chylothorax was made if there was chylous drainage from the intercostal drain (ICD) which was confirmed by the demonstration of pleural fluid triglyceride concentration of >110 mg/dl. After detailed history and physical examination, all patients underwent thorough assessment of their general condition and comorbidities. Etiology of chylothorax was also recorded. Pleural fluid was sent for protein, sugar, adenine deaminase, cytology, direct fluorescent staining for acid–fast bacilli, bacterial culture, and rapid mycobacterial culture in all patients. In patients with suspicion of loculated chylothorax, contrast-enhanced computed tomography scan of the chest was performed.

Management approach

Patients diagnosed as chylothorax were initially given short-course conservative management. The protocol included nil per oral (NPO) or enteral diet which

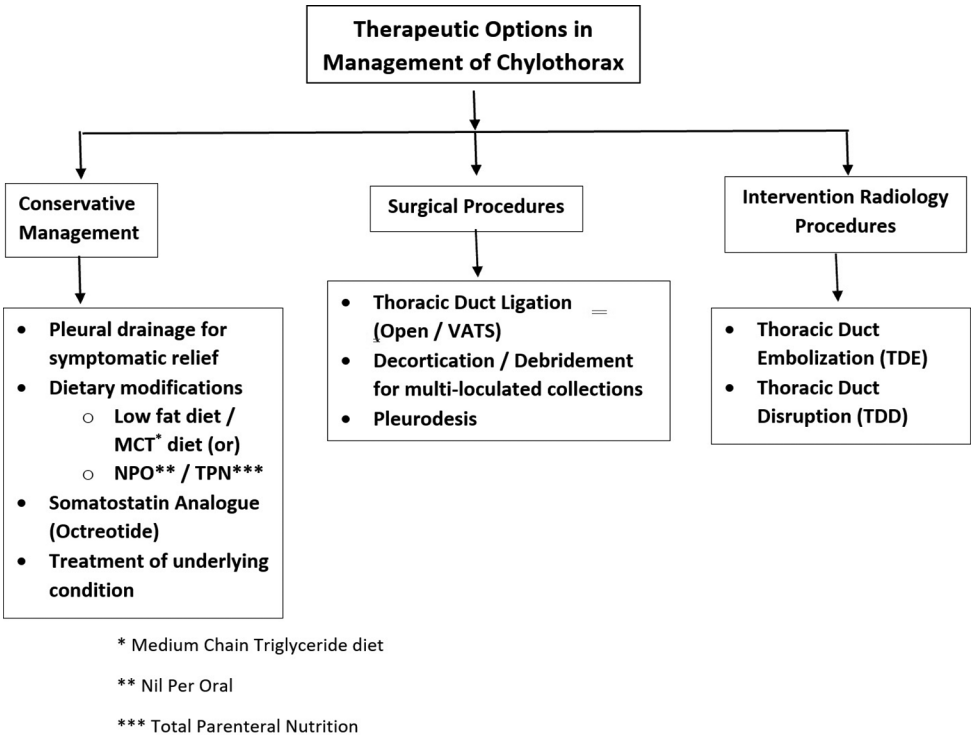

Figure 2: Various therapeutic options in management of chylothorax

was fat-free and supplemented with medium-chain triglycerides (MCTs), total parenteral nutrition through a central venous line, decompression of pleural space with ICD insertion for complete lung expansion, and injection octreotide (Sandostatin; Novartis, Basel, Switzerland) at a dose of 100 mg three times a day subcutaneously. Daily drainage of chylous fluid was carefully measured. Usually, this conservative management was continued for 1–2 weeks. In cases where conservative management failed, surgical intervention in the form of video-assisted thoracoscopic (VATS) thoracic duct ligation was advised. We followed a more aggressive approach for high-output postsurgical chylothorax, where the surgery was advised after 5 days of failed conservative therapy. Detailed institutional protocol is illustrated in Figure 3.

Surgical technique of video-assisted thoracoscopic thoracic duct ligation

The procedure was performed under general anesthesia. We always chose right-sided approach for ligation of thoracic duct. Selective lung ventilation was achieved through double-lumen tube. The patient was placed in the left lateral position and triportal technique was used. The procedure was started by dissection in the supradiaphragmatic area. Mediastinal pleura over the azygos vein was divided and dissection continued medially in between azygos vein and thoracic aorta. The thoracic duct was identified as a thin, glistening structure present between the azygos vein and the aorta. Tissue between aorta and azygos vein just above the level of diaphragmatic hiatus was ligated *en masse* with silk suture at three sites. We did not routinely perform a pleurodesis procedure (chemical/mechanical) with thoracic duct ligation, except in patients with multiloculated pleural collection with thickened parietal pleura where complete parietal pleurectomy was also done along with the drainage of pleural collection. All patients were extubated at the end of surgery and transferred to the ward for monitoring. Oral feeding was started from the postoperative day 1. Early ambulation and aggressive chest physiotherapy were continued. The nature and quantity of chest tube drainage were carefully watched.

Treatment was considered successful when there were resolution of cloudy ICD drainage and volume of chest drain <2 ml/kg/day. Failure of intervention was defined as nonresolution in the quantity and quality of chylous drainage with the need for additional procedure or long-term catheter drainage.

If the surgical intervention failed, we used a pleurodesis method (mechanical/chemical) to achieve pleural symphysis. From 2016, we started utilizing the techniques of thoracic duct embolization (TDE)/thoracic duct disruption (TDD) as an adjunctive therapy if surgical intervention fails.

Technique of thoracic duct embolization/thoracic duct disruption

Lymphangiography with pedal or ultrasound-guided intranodal lymphatic cannulation allows visualization of large lymphatics in the retroperitoneum, which leads to cisterna chyli. Cisterna chyli are then accessed by transabdominal percutaneous needle cannulation. In TDE

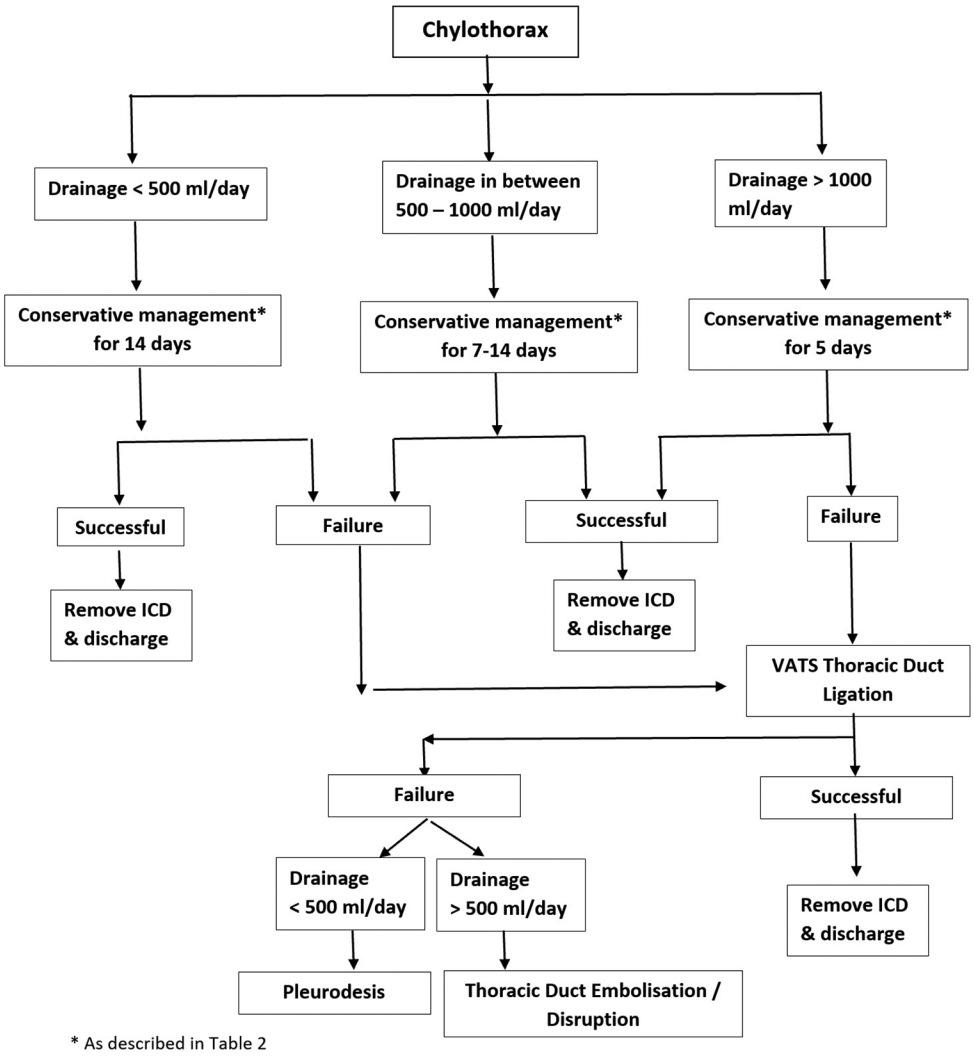

Figure 3: "Centre for Chest Surgery" algorithm for stepwise management of chylothorax

following cannulation of the cisterna chyli, a catheter is advanced into the thoracic duct with instillation of contrast to localize the leak. The affected thoracic segment is then embolized with either coils or surgical "glue." In cases where thoracic duct cannot be cannulated, it can be disrupted by multiple needle passes through the duct under fluoroscopic guidance. This method is called TDD.

Statistical analysis

Statistical testing was conducted with the Statistical Package for the Social Sciences system version SPSS 17.0 (IBM inc, USA). Continuous variables were presented as mean ± standard deviation or median (interquartile range). Categorical variables were expressed as frequencies and percentages. The comparison of normally distributed continuous variables between the groups was performed using Student's *t*-test. Nominal categorical data between the groups were compared using Chi-square test or Fisher's exact test as appropriate. Nonnormal distribution continuous variables were compared using Mann–Whitney U-test. Association of various factors predicting the failure of conservative and surgical therapy was compared using binary logistic regression analysis. For all statistical tests, $P < 0.05$ was taken to indicate as significant.

RESULTS

Demographic characteristics

There were 19 males (73%) and 7 females (27%), with a mean age of 42.4 years (range, 2–72 years). Comorbidities were present in 7 (26.9%) patients. Chylothorax presentation was more common on the right side (46.1%). Bilateral chylothorax was present in 4 (15.3%) cases. Traumatic chylothorax was a common variant (57.6%), in which postsurgical (iatrogenic) chylothorax was the predominant variety. At presentation, only 9 (34.6%) patients had drainage <500 ml/24 h, whereas majority (46.1%) had >1000 ml/24 h drainage [Table 1].

Treatment modalities and outcomes

All of 26 (100%) patients were initially subjected to conservative management. Of these, 11 (42.4%) patients were managed successfully with conservative therapy

alone, whereas 15 (57.6%) patients required surgical intervention in the form of VATS thoracic duct ligation. This procedure was successful in 10/15 (66.7%) patients, whereas another intervention was required in 5/15 (33.3%) patients. Surgical failures were managed with TALC slurry (hydrated magnesium silicate)instillation through chest drain in 2 patients and surgical mechanical pleurodesis in one patient, TDE in one patient, and TDD in one patient. TDE and TDD were available in our institute only from 2016. There was one death in the surgical group, a patient who developed chylothorax after right pneumonectomy for posttubercular destroyed lung with extensive adhesions. This patient's chylothorax was managed successfully, but he later developed bronchopleural fistula and died due to sepsis. Mean hospital stay was higher in the surgical group than conservative group (14.8 vs. 8.8 in days). This is because the surgical group also had undergone a trial of conservative therapy before the decision of surgical intervention [Figure 4].

Factors influencing "failure" of conservative management and surgical therapy

On linear regression analysis, "daily drain output of >1000 ml/day" was an independent predictor of failure of conservative therapy. Nontraumatic bilateral chylothorax was associated with high probability of failure of surgical therapy in the first attempt and may require additional treatment modality [Tables 2 and 3].

DISCUSSION

Chylothorax has varied etiology and the management is not standardized. Chylothorax is a potentially dangerous clinical entity, with older studies reporting a mortality rate of 10% after reoperation and up to 50% after conservative management.[10,11] No treatment protocol has been accepted universally for the management of chylothorax. This is because of various clinical factors that are unique to each patient including the etiology, symptomatology, amount of chyle drainage per day, and available local expertise. Large randomized studies comparing various therapies are lacking in the literature; hence, our proposed approach is based on the institutional clinical experience after critically analyzing the results.

Usually, patients with low output (<500 ml/day) do not merit an urgent surgery. All of these patients should undergo a trial of conservative management which includes insertion of ICD for symptom relief and NPO or MCT diet with injectable somatostatin analogs, while underlying disorder is being addressed.[12-14] This approach helps reduce the rate of chyle production/accumulation and may heal the chyle leak without the need for surgical intervention in many cases. Many previous studies have reported successful outcomes with conservative approach.[15,16] The present study also highlights the fact that 42.3% of patients can be managed successfully with conservative therapy alone with no mortality. However, Cerfolio[17] reported that chylothorax after pulmonary resection with a daily drain output of >450 ml, which persists beyond 48 h, may require surgical intervention. Merrigan *et al*.[18] also emphasized the role of surgical intervention if daily drain output is ≥1 l for 5 days. Our study also reports the similar finding that if the daily chyle output is >1000 ml/day for 5 days or more, it is unlikely to be successful by conservative method and will require definitive surgical intervention.

Table 1: Demographic details and disease characteristics

Characteristics	Frequency (%)
Male	19 (73)
Female	7 (27)
Age (years), median	42.4 (−43)
Comorbidities	
Hypertension	3 (11.5)
Diabetes mellitus	3 (11.5)
Hypothyroidism	1 (3.8)
Side of the disease	
Right side	12 (46.1)
Left side	10 (38.4)
Bilateral	4 (15.3)
Etiology	
Postsurgical	
Esophagectomy	2 (7.2)
Mediastinal mass resection	8 (30.7)
Pulmonary resection	3 (11.5)
Neck cystic mass excision	1 (3.8)
Malignancy related	1 (3.8)
Posttraumatic	1 (3.8)
LAM	1 (3.8)
Idiopathic	9 (34.6)
Daily output (ml/day)	
<500	9 (34.6)
500–1000	5 (19.2)
>1000	12 (46.1)
Type of intervention	
Conservative alone	11 (42.3)
Surgical therapy	10 (38.4)
Thoracic duct embolization/disruption	5 (19.2)

LAM: Lymphangioleiomyomatosis

Table 2: Factors predicting failure of conservative therapy - assessed by logistic regression model

	OR	SE	95% CI	*P*
Age	0.98	0.34	0.92–1.06	0.76
Sex	0.79	0.95	0.07–8.32	0.84
Type of chylothorax	0.20	0.24	0.02–2.16	0.19
Duration of symptoms	1.10	1.43	0.08–14.03	0.93
Drainage/day (ml)				
<500	Reference	Reference	Reference	-
500–1000	2.71	5.22	0.83–18.62	0.06
>1000	2.21	3.58	1.36–36	0.02

OR: Odds ratio, CI: Confidence interval, SE: Standard error

Table 3: Factors predicting failure of surgical therapy - Assessed by logistic regression model

	OR	SE	95% CI	*P*
Age	0.96	0.33	0.89–1.03	0.27
Sex	1.71	2.25	0.13–22.51	0.68
Nontraumatic chylothorax	16.0	18.90	1.09–23.42	0.04
Duration of symptoms (>1 month)	3.49	4.00	0.37–14.9	0.27
Bilateral disease	10.23	12.15	0.99–10.4	0.04

OR: Odds ratio, CI: Confidence interval, SE: Standard error

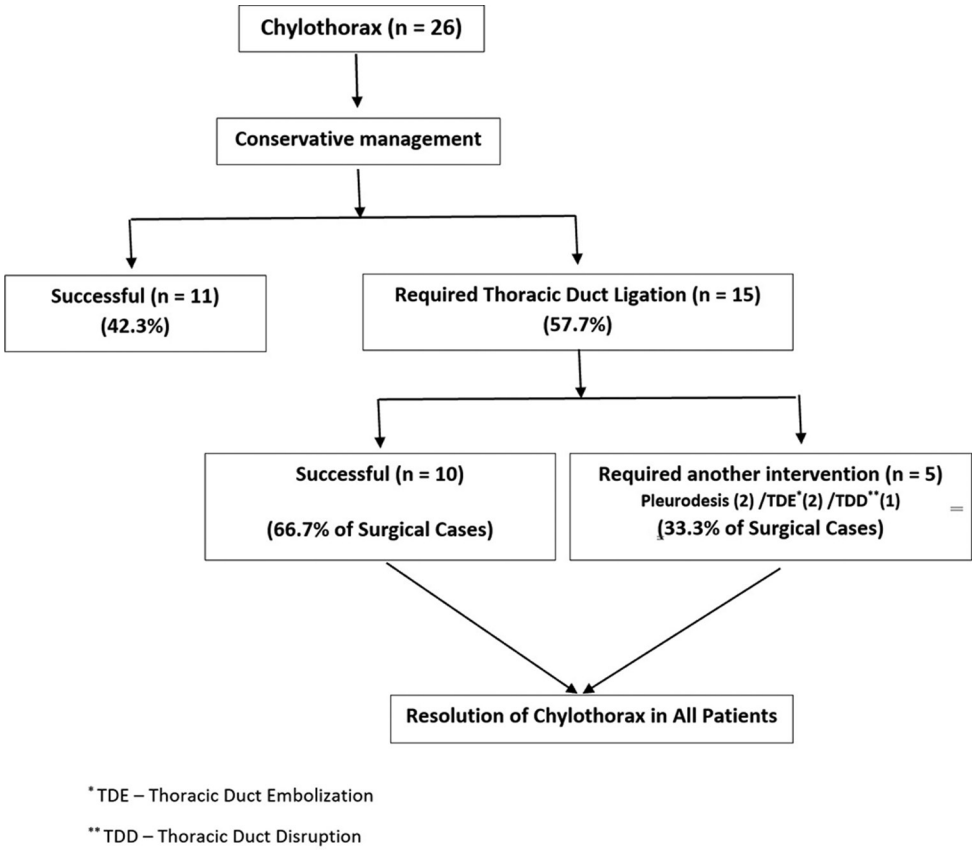

Figure 4: Flowchart of management of chylothorax in the study population

VATS is the preferred modality for thoracic duct ligation.[19,20] In cases of late referral or prolonged symptoms, due to the local inflammation, identifying the thoracic duct is challenging at times. Preoperative or intraoperative instillation of fatty liquids through the nasogastric tube can help in the identification of the leak intraoperatively.[21] Clipping or ligating the thoracic duct is done just cephalad to the aortic hiatus.[22] If a leak cannot be identified, mass ligation of the tissue between aorta, azygos vein, and pericardium is recommended. Sometimes, a pleurodesis method (chemical or mechanical) is added to the ligation intraoperatively to decrease the possibility of recurrence. Surgical ligation of the thoracic duct provides best results in traumatic/postoperative chylothorax with high-volume (>1 l/day) chyle leak.[23-25] However, the outcome of this modality is less certain in nontraumatic/idiopathic chylothorax patients. In the previous studies, overall success rates after thoracic duct ligation have ranged between 67% and 91%.[26,27] In this series, the success rate of this procedure in the first attempt was 66.7%. This can be explained by the high percentage of "nontraumatic" type of chylothorax in the operative group. On correlation of various factors, traumatic chylothorax with high-volume (>1 l/day) chyle leak had the best chance of success following surgery while "nontraumatic" variant of chylothorax with bilateral presentation was associated with higher probability of failure following surgery. This should be considered while deciding on surgical intervention.

The recently evolved techniques such as TDE or needle disruption have been attempted in traumatic as well as nontraumatic chylothorax.[28] These procedures have the advantage of less invasion, possibility of identification of leak, as well as definitive treatment in the same sitting. These methods are commonly indicated when ligation of thoracic duct fails or as an alternative in poor surgical candidates and in patients who had failed pleurodesis method (surgery is difficult in these patients in view of dense adhesions).[29,30] However, the expertise required for this procedure is limited to a few centers only. As the number of patients subjected to these procedures after surgery is very small, it is not possible for us to comment whether TDE or TDD should be tried before considering surgical intervention.

The present study is relatively a large study which describes the results of various modalities of the treatment. It is difficult to draw an algorithm given the fact that chylothorax has various etiologies. Our center has all the facilities of surgery as well as interventional radiology procedures such as TDE/TDD. In this study, 42.3% of the patients responded to conservative therapy alone, whereas 57.7% of the patients had to be taken up for surgery. Using individual or combination of available facilities, we could achieve chylothorax resolution in 100% of patients with a mortality rate of 3.8%.

A management algorithm for chylothorax, based on our institutional experience, is proposed herewith [Figure 3].

Limitations

This is a retrospective study of 26 cases managed in a surgical unit, and hence, possibility of selection bias is there. The TDE was available only since 2016, so there is no true comparison between the modalities of treatment. A prospective trial would be ideal to answer these questions.

CONCLUSIONS

Chylothorax continues to be a therapeutic challenge for the clinicians and requires a multidisciplinary management. An initial trial of conservative management is recommended for all patients. However, conservative therapy alone is unlikely to succeed if daily drainage is >1000 ml/24 h, in which case thoracic duct ligation is preferred. VATS thoracic duct ligation is safe, feasible, and effective in the management of these cases. Nontraumatic and bilateral chylothorax has higher failure rates following surgery; therefore, in such cases, additional procedures in the form of pleurodesis and/or TDE/TDD should be considered.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Huggins JT. Chylothorax and cholesterol pleural effusion. Semin Respir Crit Care Med 2010;31:743-50.
2. Weidner WA, Steiner RM. Roentgenographic demonstration of intrapulmonary and pleural lymphatics during lymphangiography. Radiology 1971;100:533-9.
3. Macfarlane JR, Holman CW. Chylothorax. Am Rev Respir Dis 1972;105:287-91.
4. Johnson OW, Chick JF, Chauhan NR, Fairchild AH, Fan CM, Stecker MS, *et al*. The thoracic duct: Clinical importance, anatomic variation, imaging, and embolization. Eur Radiol 2016;26:2482-93.
5. Valentine VG, Raffin TA. The management of chylothorax. Chest 1992;102:586-91.
6. Doerr CH, Allen MS, Nichols FC 3rd, Ryu JH. Etiology of chylothorax in 203 patients. Mayo Clin Proc 2005;80:867-70.
7. Sarkaria IS, Finley DJ, Bains MS, Adusumilli PS, Rizk NP, Huang J, *et al*. Chylothorax and recurrent laryngeal nerve injury associated with robotic video-assisted mediastinal lymph node dissection. Innovations (Phila) 2015;10:170-3.
8. Bryant AS, Minnich DJ, Wei B, Cerfolio RJ. The incidence and management of postoperative chylothorax after pulmonary resection and thoracic mediastinal lymph node dissection. Ann Thorac Surg 2014;98:232-5.
9. Prakash UB. Chylothorax and pseudochylothorax. Eur Respir Mon 2002;7:249.
10. Milsom JW, Kron IL, Rheuban KS, Rodgers BM. Chylothorax: An assessment of current surgical management. J Thorac Cardiovasc Surg 1985;89:221-7.
11. Lam KH, Lim ST, Wong J, Ong GB. Chylothorax following resection of the oesophagus. Br J Surg 1979;66:105-9.
12. Takuwa T, Yoshida J, Ono S, Hishida T, Nishimura M, Aokage K, *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;146:571-4.
13. Marts BC, Naunheim KS, Fiore AC, Pennington DG. Conservative versus surgical management of chylothorax. Am J Surg 1992;164:532-4.
14. 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;97:408-13.
15. Stager V, Le L, Wood RE. Postoperative chylothorax successfully treated using conservative strategies. Proc (Bayl Univ Med Cent) 2010;23:134-8.
16. Fujita T, Daiko H. Efficacy and predictor of octreotide treatment for postoperative chylothorax after thoracic esophagectomy. World J Surg 2014;38:2039-45.
17. Cerfolio RJ. Chylothorax after esophagogastrectomy. Thorac Surg Clin 2006;16:49-52.
18. Merrigan BA, Winter DC, O'Sullivan GC. Chylothorax. Br J Surg 1997;84:15-20.
19. Scott KJ, Simko E. Thoracoscopic management of cervical thoracic duct injuries: An alternative approach. Otolaryngol Head Neck Surg 2003;128:755-7.
20. Christodoulou M, Ris HB, Pezzetta E. Video-assisted right supradiaphragmatic thoracic duct ligation for non-traumatic recurrent chylothorax. Eur J Cardiothorac Surg 2006;29:810-4.
21. Zabeck H, Muley T, Dienemann H, Hoffmann H. Management of chylothorax in adults: When is surgery indicated? Thorac Cardiovasc Surg 2011;59:243-6.
22. Nair SK, Petko M, Hayward MP. Aetiology and management of chylothorax in adults. Eur J Cardiothorac Surg 2007;32:362-9.
23. McGrath EE, Blades Z, Anderson PB. Chylothorax: Aetiology, diagnosis and therapeutic options. Respir Med 2010;104:1-8.
24. Akin H, Olcmen A, Isgorucu O, Denizkiran I, Dincer I. Approach to patients with chylothorax complicating pulmonary resection. Thorac Cardiovasc Surg 2012;60:135-9.
25. Miao L, Zhang Y, Hu H, Ma L, Shun Y, Xiang J, *et al*. Incidence and management of chylothorax after esophagectomy. Thorac Cancer 2015;6:354-8.
26. Bolger C, Walsh TN, Tanner WA, Keeling P, Hennessy TP. Chylothorax after oesophagectomy. Br J Surg 1991;78:587-8.
27. Cerfolio RJ, Allen MS, Deschamps C, Trastek VF, Pairolero PC. Postoperative chylothorax. J Thorac Cardiovasc Surg 1996;112:1361-5.
28. Pamarthi V, Stecker MS, Schenker MP, Baum RA, Killoran TP, Suzuki Han A, *et al*. Thoracic duct embolization and disruption for treatment of chylous effusions: Experience with 105 patients. J Vasc Interv Radiol 2014;25:1398-404.
29. Toliyat M, Singh K, Sibley RC, Chamarthy M, Kalva SP, Pillai AK. Interventional radiology in the management of thoracic duct injuries: Anatomy, techniques and results. Clin Imaging 2017;42:183-92.
30. Lyon S, Mott N, Koukounaras J, Shoobridge J, Hudson PV. Role of interventional radiology in the management of chylothorax: A review of the current management of high output chylothorax. Cardiovasc Intervent Radiol 2013;36:599-607.