



---

## CHYLOTHORAX: APPROACHES TO DIAGNOSIS AND TREATMENT

**Prima Hari Nastiti<sup>1</sup>, Dewi Sekarsari<sup>2</sup>, Retno Asih Setyaningrum<sup>3</sup>, Nur Aisyah Wijaya<sup>4</sup>, Taufiq Hidayat<sup>5</sup>, Arda Pratama Putra Chafid<sup>6</sup>, Rika Hapsari<sup>7</sup>, Dhihintia Jiwangga Suta Winarno<sup>8</sup>, Mahrus A Rahman<sup>9</sup>**

Universitas Airlangga, East Java, Indonesia

prima.hari.nastiti-2019@fk.unair.ac.id<sup>1</sup>, tataadewi@gmail.com<sup>2</sup>, retno-as@fk.unair.ac.id<sup>3</sup>,

nur.aisyah.widjaja-2017@fk.unair.ac.id<sup>4</sup>, taufiqh@fk.unair.ac.id<sup>5</sup>, ardappc@gmail.com<sup>6</sup>,

rika.hapsari@fk.unair.ac.id<sup>7</sup>, dhihintiajiwangga@yahoo.com<sup>8</sup>, mahrus.a@fk.unair.ac.id<sup>9</sup>

---

### KEYWORDS

chylothorax, chylous effusion, pleural effusion, children

---

### ABSTRACT

Chylothorax is a rare disease and epidemiologically is most commonly found in children. It can also result in severe respiratory morbidity such as pleural effusion and has a high mortality rate in children. Conservative treatment and consideration of surgical intervention may be warranted as the primary goal of chylothorax management is to remove fluid accumulation in the pleural cavity, avoid recurrence, treat associated problems, and find the underlying cause while maintaining optimal nutrition. We report two cases of chylothorax in children. Data were collected retrospectively from children diagnosed with chylothorax in the pediatric ward of RSUD Dr. Soetomo in 2022. This is a series of cases that includes two children diagnosed with chylothorax. Case series involving two patients who underwent cardiac and congenital thoracic surgery and developed chylothorax. Patients receiving partial parenteral nutrition with MCT have improved drainage outcomes. After birth, thoracentesis closes the thoracic drainage, and life support is usually necessary for babies with chylothorax because they often have poor cardiopulmonary function.

---

DOI: 10.58860/ijsh.v3i1.154

**Corresponding Author:** Prima Hari Nastiti  
**Email:** prima.hari.nastiti.2019@fk.unair.ac.id

## INTRODUCTION

According to Dori et al. (2017), the chyle accumulation in the pleural area is known as chylothorax. In children, chylothorax is a relatively uncommon cause of pleural effusion, but it can result in severe respiratory morbidity, malnourishment, and immunodeficiency, which can cost more and cause more extended hospital stays (Dori et al., 2017; Krishnamurthy & Malhotra, 2017). The cause of chylothorax is either a disturbance or malfunction of the chyle flow via the thoracic duct or any of its branches. The thoracic duct rises from the cisterna chyli near the second lumbar vertebra, passes through the diaphragm's aortic hiatus, and is between the aorta and the zygos vein. It receives several lymphatic tributaries that drain the lung parenchyma and parietal pleura as it ascends into the mediastinum. The lymphatic flow through the thoracic duct is 1.5–2.4 l/24 h. Nevertheless, various anatomical variations are reported during the thoracic duct (Pulle et al., 2021).

According to research, chylothorax has been linked to births and surgical procedures (Krishnamurthy & Malhotra, 2017). Although the exact cause is unknown, it might be linked to lymphatic system maldevelopment. A different kind of chylothorax called traumatic chylothorax differs from the congenital idiopathic or spontaneous form in that it can occur as a symptom of venous congestion caused by tumors, thrombosis, cancers, etc., or as a complication of surgery involving iatrogenic rupture of the ductus thoracic (surgery for congenital heart disease or atresia of the esophagus) (Krishnamurthy & Malhotra, 2017). Following congenital heart disease (CHD) cardiac

surgery in children, postoperative chylothorax is a recognized risk. This conclusion may reflect the growing complexity of surgical procedures since the incidence has steadily climbed over the past few decades. Theoretically, rather than a genuine rise in frequency, a more excellent diagnosis of this complication has resulted from increasing awareness of it (Pulle et al., 2021).

The diagnosis of chylothorax is based on the demonstration of chylomicrons through elevated triglyceride levels in the pleural fluid above the established cut-off limit of 1.24mmol/L (110mg/dL) and elevated lymphocytes (>1000cells/ $\mu$ L) on the fluid microscopy (Rocha et al., 2021). However, the absence of age-specific cut-off limits for triglyceride levels in the chyle and dependence of chyle triglyceride on oral fat intake poses a challenge in diagnosing chylothorax in infants, as observed in the preterm infant with a milky pleural effusion previously reported (Tutor, 2014).

Guidelines consensus on managing chylothorax are still being determined, and institution- or surgeon-specific approaches are the current norm (Bender et al., 2016). With conservative treatment, complete resolution of pleural fluid can be observed within 30 days for 80% of congenital chylothorax patients (Mery et al., 2014). Nutrition therapy plays a significant role in the conservative treatment of chronic leaks. Standard treatment requires discontinuing breast milk feeding due to the abundance of long-chain triglycerides and transitioning to a medium-chain triglyceride (MCT) based formula. Ideally, a 90% MCT resolves the condition faster than a lesser concentration (60% MCT). Due to a lack of resources in several developing countries or the cost constraint of importing 90% MCT feed, 60 -70% MCT can be used as it significantly impacts the course of the illness (DiLauro et al., 2020).

Overall mortality rates for chylothorax range from 18 to 44%, depending on associated conditions, gestational age, duration, and severity (Buckley et al., 2017). In severe cases with large amounts of pleural effusions, lung hypoplasia might result and, consequently, heart failure due to compromised vascular flow and hydrops fetalis (Dehghan, 2019). This paper examines current evidence-based management and critical approaches to diagnosing and treating chylothorax. This report investigation attempts to provide clear clinical guidelines of methods preferred in various clinical situations.

## CASE

This report describes two cases of chylothorax that were spontaneous and following congenital heart surgery. The first case presented, a one-month-old infant with a weight of 2200 gr, came to our emergency room (ER) with shortness of breath, which had worsened in the last two weeks. The patient also presented with fever, tachycardia, grunting, chest retraction, and low oxygen saturation. Breath sounds were markedly decreased on the right hemithorax. Points of maximal impulse were heard at the fourth intercostal space, the right parasternal area. There was no murmur. Laboratory examination showed a high white blood count and high C-reactive protein. The analysis of the pleural fluid sample showed an exudate (color: yellow; WBC: 7650; lymphocyte: 97%; glucose: 265 mg/dl; protein: 3.6 g/dl) and a sterile culture. The radiology examination by chest x-ray and chest CT scan with contrast showed right pleural effusion and pneumonia.

**Table 1. Case analysis**

Characteristic	Case 1	Case 2
Gender	Girl	Boy
Age	Infancy	Childhood
Nutritional States	Moderate Malnutrition	Stunted
Causes	Idiopathic	Traumatic
Daily Output	4-5ml/BW/hour	6-8ml/BW/hour

Characteristic	Case 1	Case 2
Comorbidity	Prematurity	Congenital Heart Disease Acute Malignant Arrhythmia
Management	MCT milk formula with parenteral nutrition	MCT milk formula with parenteral nutrition
Composition of Parenteral Nutrition	Calorie 162 kkal (50% RDA HA) Protein 7 gr Lipid 4 gr BN 165 GIR 6.81	Calorie 502 kkal (50% RDA HA) Protein 13.5 gr Lipid 23 gr BN 174 GIR 4.91
Response to nutritional therapy	Discharge in day-11	Did well in 3 days after nutritional management
Prognosis	Ad vitam : dubia ad bonam Ad functionam : dubia ad bonam Ad sanationam : dubia ad bonam	Ad vitam : dubia ad malam Ad functionam : dubia ad malam Ad sanationam : dubia ad malam

The second case presented a 16-month-old male child with complaints of breathlessness for a week. There was no history of fever, cough, hemoptysis, throat pain, earache, and loss of weight. Palliative surgery Bidirectional Glenn shunt was performed two weeks back for an underlying cyanotic congenital heart disease: tricuspid atresia, pulmonary atresia, ASD restrictive, and moderate mitral regurgitation. The postoperative period was uneventful. He had suffused conjunctivae, central cyanosis, frontal and parietal bones were prominent, Grade 3 clubbing in all four limbs, and a linear scar mark near the sternal area. On admission, his oxygen saturation was 74%, pulse rate was 102/min and regular, respiratory rate was 48/min, and blood pressure was normal in all four limbs. A grade 3/6 ejection systolic murmur at the left parasternal area was present on cardiac examination. Upon respiratory examination, there were decreased chest movements on the left side and the tracheal shift to the right side. No air entry was heard on the left side of the chest, and a stony, dull note was obtained on percussion. The radiology examination by chest x-ray showed left pleural effusion and pneumonia. Laboratory examination showed hyponatremia, and analysis of the pleural fluid sample showed an exudate (color: yellow; WBC: 4150; lymphocyte: 40%; glucose: 132 mg/dl; protein: 2.5 g/dl) and a sterile culture.

Conservative management (total parenteral nutrition, bowel rest, pleural drainage, and octreotide, followed by a low-fat diet) was successful in all 2 cases within a reasonable period. Unfortunately, the patients were after a BCPS procedure. One patient with congenital chylothorax managed to recover with conservative therapy for 11 days. Meanwhile, one post-BCPS procedure patient died due to acute malignant arrhythmia.

## RESULT AND DISCUSSION

We reported two cases of infant and toddler chylothorax. Chylothorax is a rare illness that can occur at any age. However, it is most common in children, according to epidemiology. Since Asellius's initial report in 1627–1628, it has been acknowledged as a clinical entity (Dori et al., 2017). Chyle buildup in the thorax happens in three stages of life: infancy, childhood, and adulthood. The first instance was a one-month-old baby whose primary complaint was spontaneous chylothorax associated with dyspnea. An outstanding review by Randolph and Gross (1957) likely correctly refers

to what has been referred to as "spontaneous chylothorax" in the neonatal era (Krishnamurthy & Malhotra, 2017). In a minimal number of cases, an etiological cause such as birth trauma, convulsions, or respiratory obstruction may be identified. Since fewer than 20 cases have been reported, it is still possible that an underlying lymphatic system problem predisposes chylothorax development.

Furthermore, chylothorax has been linked to several genetic abnormalities, including Turner syndrome, Noonan syndrome, and trisomy 21. First, the patients did not experience syndromic symptoms and lived without long-term consequences. According to Krishnamurthy and Malhotra (2017), chylothorax can generally be brought on by intrinsic lymphatic system anomalies, thoracic duct injury, or disruption from trauma, surgery, cancer, or cardiovascular disease. It may be linked to congenital duct defects, either isolated or associated with generalized lymphatic vessel dysplasia or, more rarely, the result of direct trauma at birth (Pulle et al., 2021).

Following the Bidirectional Cava Pulmonary Shunt (BCPS) operation, day fifteen saw the presentation of our second case. A simple chest radiograph is used to evaluate this at first. Trauma resulting from penetrating injuries or after heart and excellent vascular procedures is the most common aetiological cause in children. Chylothorax typically presents with an acute or subacute onset, while pseudo-chylothorax and empyema present with a subtle onset (Rocha et al., 2021). Traumatic chylothorax commonly presents with a latent period of two to ten days, but up to 25 days have been described, with the average being seven days (Tutor, 2014). According to Rocha et al., the approach for post-traumatic chylothorax, with cardiovascular thoracic-surgery-related chylothorax being classified as such, asymptomatic patients with small effusion can be managed with either bowel rest and parenteral nutrition or nutritional measures (Tutor, 2014; Rocha et al., 2021).

We described a case series in which dyspnea was the primary complaint. A physical examination revealed a reduction in breath sounds. In most patients, the clinical picture is clear-cut. According to Mery et al. (2014), there is respiratory distress, unilateral pleural effusion evidence, and a potential history of trauma, either surgical or nonoperative. A pleural effusion is linked to the newborn's respiratory distress symptoms and indicators. It is always essential to consider the possibility of chylous extravasation in patients with other signs of lymphatic abnormalities. Once more, the diagnosis should be made based on respiratory symptoms unrelated to pyrexia and may be accompanied by inadequate nutrition (DiLauro et al., 2020). The chyle leakage rate and the chylothorax length determine the clinical symptoms. According to Buckley et al. (2017), rapid, substantial chyle accumulation can induce a positive pressure within the pleural cavity, which can result in severe cardiorespiratory morbidity. As seen in the index patient, pleural effusion resulting from a traumatic chylothorax may be latent for two to ten days, depending on the clinical appearance. Conversely, 50% of cases of congenital chylothorax appear with pleural effusion on the first day of life, typically manifesting as a space-occupying lesion restricting lung development (Bender et al., 2016; Dehghan, 2019).

Aspiration of the chylous effusion, which was identified by its milky appearance, sterility on culture, absence of odor, lymphocytic predominance in the leucocyte count, and triglyceride concentration >100 mg/dL, validated the diagnosis in this instance. A buildup of triglyceride-rich fluid in the pleural cavity is known as chylothorax (Samanidis et al., 2022). Comprising immunoglobulins, lymphocytes, and dietary lipids, chyle is an alkaline bacteriostatic fluid that is non-inflammatory (AICNU, 2015; Neumann et al., 2020). Every day, the thoracic duct moves a sizable amount of chyle, which, if the flow is disrupted, causes a quick and substantial buildup of fluid in the pleural cavity (Justice et al., 2018). The thoracic duct, which runs on the right side of the vertebral

column and locates its central portion within the right hemithorax, is formed when the lymphatics from the lower half of the body merge behind the aorta. This helps to explain why right-sided chylothorax is so common. A chyloma, or collection of chyle beneath the pleura, forms throughout the ordinary course of chylothorax and finally bursts through the pleura to amass within the pleural space. Pleural fluid protein concentration  $>20$  g/L, triglyceride concentration  $>100$  mg/dl, number of cells per milliliter  $>100$  with lymphocyte predominance, and sterile culture are the criteria for the diagnosis of chylothorax (Attar & Donn, 2017).

Diagnosing chylothorax in children and newborns can be challenging since the level of chyle triglycerides is not well-defined. This is especially true if the newborn is not receiving full enteral feedings, as is the situation with infants. Van Straaten et al. and Büttiker et al. suggested using a lower triglyceride limit (1.1 mmol/L) for chyle in pediatric patients (Senarathne et al., 2021). Büttiker et al. revised their study's diagnostic criteria for pediatric chylothorax, defining it as pleural fluid triglyceride  $>1.1$  mmol/L and an absolute cell count  $> 1000$  cells/ $\mu$ L with a lymphocyte fraction  $>80\%$ . Other researchers subsequently used these criteria (Neumann et al., 2020). They also underlined the necessity of requiring a minimal oral fat intake in order to identify chylothorax, particularly in newborn babies, since it becomes more challenging to distinguish between chylous and non-chylous effusions in the absence of oral fat intake (Justice et al., 2018). However, since food intake and malnutrition are highly variable confounding variables, reducing the cut-off point could not always clear up the diagnostic muddle. Regardless of the patient's age, Maldonado et al. observed that 14% of chylomicron-positive pleural effusions had triglyceride levels  $<1.24$  mmol/L, which they attributed to fasting or malnutrition (Senarathne et al., 2021). This observation emphasizes the importance of considering the clinical setting when interpreting biochemical results. A critically unwell newborn, as seen in the index patient, would have a lower-than-average fat intake, which would result in less chylomicron synthesis and, thus, lower-than-expected triglyceride levels in chyle, which might still fall short of the revised cut-off point. In order to account for any confounding variables, another method of interpreting fluid biochemistry is to use "ratios" for the diagnosis. Fluid-to-serum triglyceride ratio  $>1$ , fluid-to-serum cholesterol ratio  $<1$ , and fluid triglyceride-to-cholesterol ratio  $>1$  are recommended for diagnosing chylothorax. These ratios were shown during the diagnostic workup in the index patient. When the chyle is standing, it divides into three layers: a dependent layer that contains mainly lymphocytes and cellular components, a creamy topmost layer that contains chylomicrons, and a milky intermediate layer. Pseudocylothorax, empyema, and extravasated parenteral lipid delivered via a central line are the other primary differential diagnoses in patients presenting with "milky" pleural effusions, given the similarity in the macroscopic appearance (Hermon et al., 2019).

Chylothorax early warning signs include a daily chest tube output of more than 400 milliliters. In order to confirm suspicions, a pleural fluid analysis should be ordered by the doctor in response to high outputs from the chest tube (Senarathne et al., 2021). According to Staats et al., there is a less than 1% possibility that pleural fluid with a triglyceride content of  $>110$  mg/dl (1.24 mmol/l) is not chylous, which supports the diagnosis and increases the test's specificity. Physicians can definitely and with high sensitivity rule out a chylothorax when the triglyceride level is less than 50 mg/dl, which is linked to a likelihood of less than 5% being chylous. When pleural triglyceride levels are between 50 and 110 mg/dl, ambiguity only arises, according to the study's cut-off values. The diagnosis in this situation should be confirmed using lipoprotein electrophoresis, the gold standard for diagnosing a chylothorax. Considering the patient's nutritional state is essential, even if these cut-off numbers are commonly accepted (White et al., 2019).

Other techniques for analyzing pleural fluid include total protein, amylase, lactic dehydrogenase (LDH), pH, cholesterol, glucose, and cell count. Agrawal and colleagues have emphasized the significance of employing the variables above in order to distinguish between a chylothorax that is only produced by chyle extravasating from the thoracic duct or its tributaries and a chylothorax that is caused by the presence of coexisting disorders (Bryant et al., 2014). Despite having a protein content of 2-3 g/dl, which would indicate that chyle is a transudate, the majority of chylothoraxes (86%) are exudative (Lee et al., 2016; Healy et al., 2017). According to these authors, a typical chyle has an increased triglyceride or chylomicron level, is lymphocyte-predominant (>50% lymphocytes), and is protein-discordant (fluid/serum total protein ratio of >0.50 and LDH concentration of <160 IU/l). Additionally, congestive heart failure, lymphoma, pancreatic cancer, radiation therapy, amyloidosis and obstruction of the superior vena cava, nephrotic syndrome, and cirrhosis can all be secondary causes of transudative effusions. In addition, elevated LDH levels have been observed in the diagnosis of cirrhosis, pneumonia, and infected biliopleural fistulas. According to Downie et al. (2014), patients with chylous pleural effusions who do not meet the requirements of lymphocyte-predominant, protein-discordant exudate should have their secondary causes of chylothorax further assessed. Ahmed et al. (2018) state that pseudo-chylothorax typically arises from cholesterol crystal development in long-standing pleural effusions without interfering with the thoracic duct. In pseudo-chylothorax, but not in chylothorax, adding 1-2 mL of ethyl ether can remove the "milky" look; in empyema, however, the turbidity is caused by suspended pus cells, resulting in a clear supernatant after centrifugation.

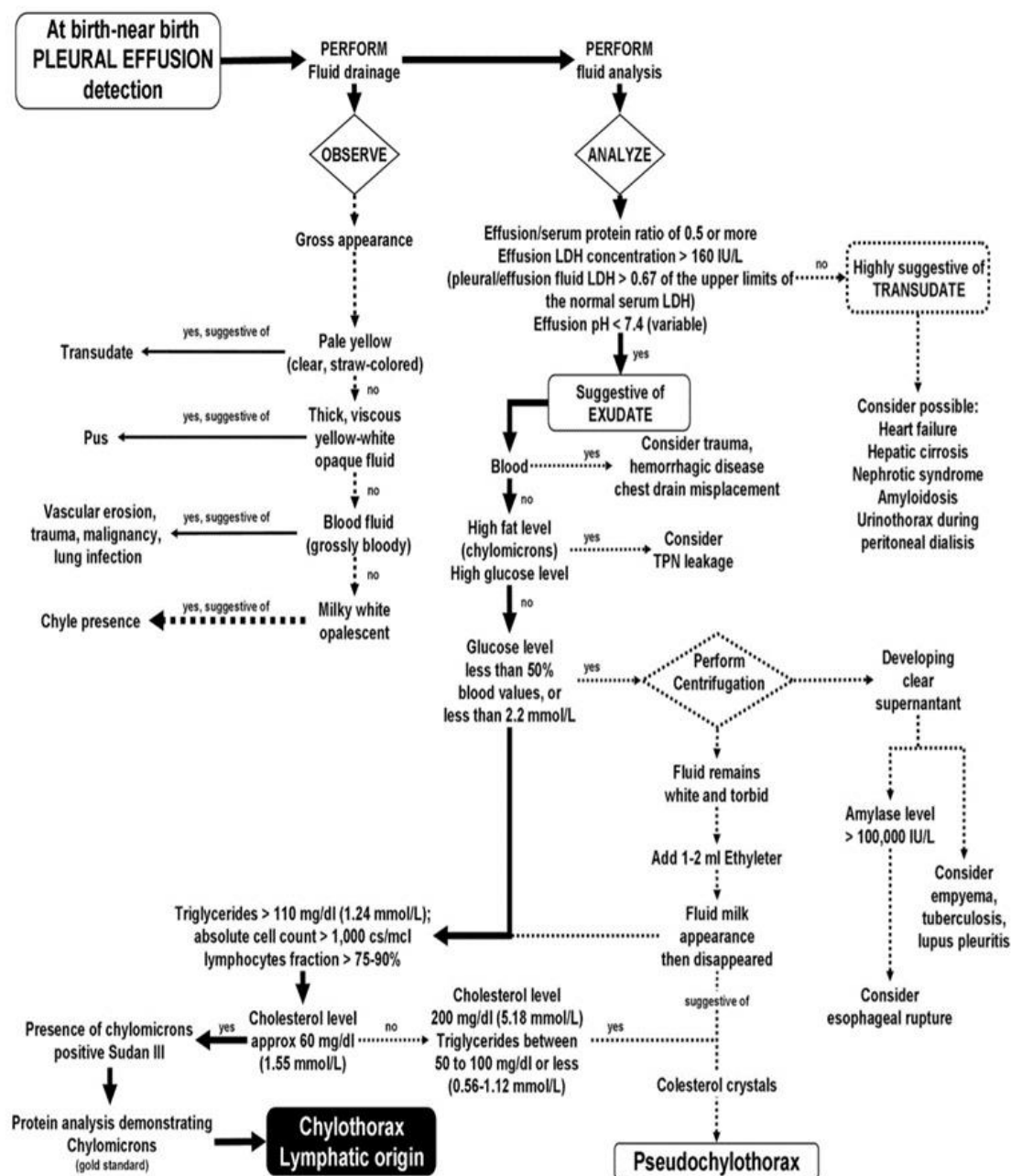


Figure 1. Algorithm of Chylothorax Diagnostic

If an infant's pleural fluid is "milky," there may be several possible causes, including chylothorax, empyema, lipid leakage from a central line, or extravasated milk from a perforated esophagus. The biochemical and morphological analyses of the thoracentesis fluid ruled out the possibility of milk extravasation into the pleural cavity and empyema. Because of the patient's acute presentation, pseudo-chylothorax was deemed implausible despite being a primary differential diagnosis under "milky" effusions. The pleural fluid's low cholesterol levels further ruled it out (Kankanarachchi et al., 2021). The presence of chylomicrons can be confirmed by the elevated fluid triglyceride levels above the established cut-off limit of 1.24 mmol/L (110mg/dL) or by the gold standard lipoprotein electrophoresis (Rocha et al., 2021; Neumann et al., 2020; Justice et al., 2018).

Fluid triglyceride levels  $<0.56\text{mmol/L}$  typically exclude chylothorax. Therefore, lipoprotein electrophoresis is essential, especially when the triglyceride levels are inconclusive ( $0.56\text{--}1.24\text{mmol/L}$  or  $50\text{--}110\text{mg/dL}$ ), as observed in this patient (Justice et al., 2018; Attar & Donn, 2017).

In our case series, chylothorax was identified, and a chest tube was inserted to provide continuous drainage of the pleural area. Since MCT contains triglycerides with short enough fatty acids to be absorbed straight into the venous system without passing through the lymphatic channel, it was included as a caloric source. The treatment of fluid imbalances is guided in part by the quantification of drainage. After the infant was getting full enteral feedings the second time. As long as the chylous flow has sufficiently diminished, the gut is once more challenged six weeks after discharge with a fat-free diet—in our case, a fat-free formula. The main goals of chylothorax care are to stabilize the patient and allow for replenishment, ventilator support, and lung expansion through chylothorax drainage. Medium-chain triglyceride (MCT) feeding and octreotide in continuous pleural fluid are two specific treatments. The final surgical treatment in case the above methods do not work is to locate the site of the thoracic duct rupture using lymphangiography and directly ligate the duct (Rocha et al., 2021; Neumann et al., 2020).

Furthermore, the decrease of lymphocytes and immunoglobulins in the chyle may have contributed to the index patient's worsening sepsis, among other factors, and ultimately resulted in her death. The modified definition may not be able to resolve the challenge of diagnosing chylothorax in neonates and chylothorax in patients who are malnourished or not fed orally, regardless of age, as the index case shows that its applicability for pediatric chylothorax depends on the minimum amount of oral fat intake. There are published care guidelines for children and infants with chylothorax, however there are no guidelines for treating neonates with the same condition.

An essential part of treatment for people with chylothorax is diet fat composition. The length of the fatty acid chain affects the mechanism of fat absorption. Saturated fatty acids with chain lengths of  $6 \pm 12$  carbons are present in MCT. Compared to LCTs, MCTs are more readily absorbed since they are water soluble. Since digested MCTs avoid the lymphatic system and enter the portal vein circulation directly, they decrease lymphatic flow. Currently, pleural chyle drainage and nutritional assistance are the conservative methods of treating chylothorax. In order to reduce chyle flow via the thoracic duct and give the injured thoracic duct time to recover, nutritional assistance attempts to modify the diet. However, when digested LCTs enter the bloodstream through the thoracic duct after being absorbed by the lymphatic system, they enhance thoracic flow. The latter consists of  $3\text{ g/kg/week}$  of lipids (once weekly or in three divided doses), fat-soluble vitamins, and an MCT diet or modified breast milk. Octreotide infusion is still an option for each patient. A low-fat diet (MCT or modified breast milk) can be gradually replaced with breast milk or a customized formula once the chylothorax is dry. On the other hand, in symptomatic patients with respiratory compromise, it is recommended to treat medium- to large-volume effusions with TPN and bowel rest. The chest drains can be taken out once scanty drainage ( $< 2\text{ mL/kg/day}$  with enteral-only MCT or modified breast milk diet and no medicines) is seen. It is recommended to stick to an MCT or modified breast milk diet for six weeks. Breast milk or modified formula should be gradually substituted after this point. If there is a partial response, which is defined as drainage of less than  $10\text{ mL/kg/day}$ , conservative treatment may be continued for three to five weeks before considering invasive surgeries. After one week of conservative treatment, invasive methods are suggested if the patient produces  $> 10\text{ mL/kg/day}$ , or if they produce  $> 100\text{ mL/day}$  for five days in a row, or if they have difficult-to-control metabolic and nutritional problems.



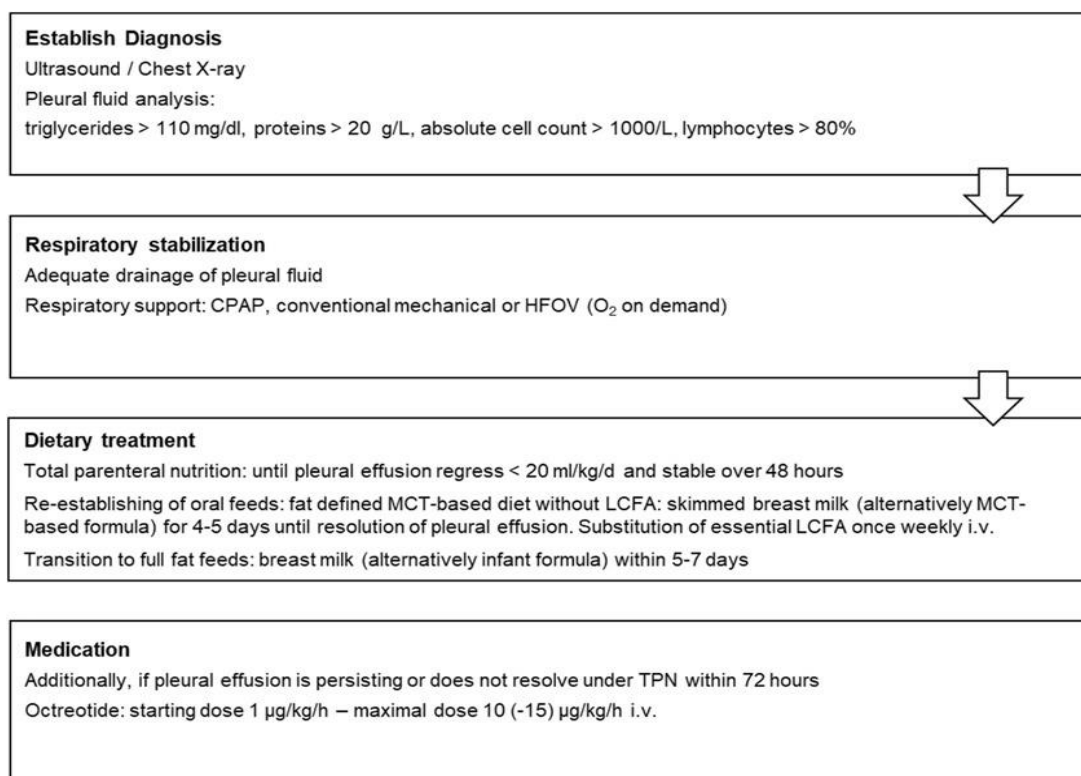


Figure 2 Algorithm of Chylothorax Treatment

Staying nourished is one of the most important parts of chylothorax. Parenteral nutrition, MCFA-rich formula, and intravenous fluids are the available therapeutic approaches. 2. Formulations rich in MCFA and having 8–12 carbon chains can bypass the lymphatic system and go straight into the portal venous system. In fewer than seven days, every patient in this case series transitioned from taking Pregestimil to breastfeeding. In settings with limited resources, enhanced skimmed breast milk may be used as a substitute without a specialized formula.

The exact mechanism of action of octreotide in the treatment of chylothorax is unknown, however it is believed to cause vasoconstriction in the splanchnic arteries by reducing intestinal blood flow and chyle generation. The use of subcutaneous octreotide for chylothorax was first reported by Young et al. at doses ranging from 40µg/kg/day to 70µg/kg/day. Since then, octreotide has been given intravenously and subcutaneously to treat chylothorax, with positive outcomes. Nevertheless, no randomized controlled clinical trials assess the drug's safety profile, duration, dosage, or effectiveness. Intravenous octreotide is often administered as a continuous infusion, ranging from 0.3 to 10 µg/kg/hour. Since nutrition treatment has been documented to resolve drainage production, octreotide was not used in our situation. Additionally, octreotide adverse effects include arrhythmias, hyperglycemia, pulmonary hypertension, and necrotizing enterocolitis.

Patients who are not improving under conservative care may benefit from surgical procedures or chemical pleurodesis. The available surgical alternatives include thoracoscopic pleurodesis and thoracic duct ligation. On the other hand, opinions differ about the precise time of the procedure (Chai et al., 2019). Chemical pleurodesis makes use of talc, picibanil, oxytetracycline, and povidone-iodine. Patients who demonstrate poor response to conservative treatment may be urged to proceed with definitive treatments, such as thoracic duct ligation or embolization, as the success rate of conservative care varies according to etiologies and output volume. A lymphangiogram regarding thoracic duct ligation should be used to pinpoint the location of a thoracic leak. Next, depending on

the available skill level, the ligation can be performed by either an open thoracotomy or a video-assisted thoracoscopy. In recent years, radiological intervention has grown in popularity due to its less incision requirements compared to surgery. There aren't many studies that directly compare surgery and radiological intervention. Nonetheless, the success rate of thoracic duct ligation (up to 90%) is higher than that of embolization (peaking at 75%), provided that both procedures are carried out correctly. The morbidity and death rates between surgery (40%) and radiological treatments (0% - 2%) were shown to differ significantly, even with the higher efficacy (Chai et al., 2019; Kankanarachchi et al., 2021). However, considering that most studies also included many patients with postoperative chylothorax, the statistics should only serve as guidance (Yee et al., 2018).

An unusual presentation in children, chylothorax results in mortality ranging from 20% to 60%. In 2017, Helen H et al. published a case study of five newborns who suffered from chylothorax; all of the babies had hydrops fetalis that was discovered prenatally. When hydrops fetalis is present, the death rate is 98%. The primary causes of the elevated mortality are congestive heart failure and pulmonary hypoplasia (Healy et al., 2017). Neonatal chylothorax has a high mortality rate of 20% to 60% despite the availability of medicinal and surgical therapy options, particularly when combined with concomitant comorbidities (Kankanarachchi et al., 2021).

## **CONCLUSION**

a case series involving two patients who underwent cardiac and congenital thoracic surgical operations and developed chylothorax. Patients who received partial parenteral nourishment by MCT have resolved drainage output. After birth, thoracentesis closed thoracic drainage, and life support is typically necessary for infants with chylothorax since they frequently have poor cardiopulmonary function. Malnutrition, dehydration, and electrolyte imbalance are the outcomes of chylothorax drainage, which also causes the loss of lymphocytes, coagulation factors, proteins, lipids, and fat-soluble vitamins during treatment. The risk of nosocomial infection and septicemia may also rise sharply. Thus, a fundamental component of conservative chylothorax treatment is life support. The primary goals of chylothorax management are to eliminate any fluid that has already accumulated, avoid recurrence, treat any related issues, and search for the underlying cause while preserving optimal nutrition. The techniques to eliminate the fluid already there are placing a chest tube and continuously suction draining. Avoiding future fluid accumulation using a low-fat diet, MCFA-rich formula, and octreotide medication is standard practice. Infants' lymphatics in their chest wall are tiny and have many collateral veins. In newborns, treatment with lymphangiography, embolization, or thoracic duct ligation is complex and has a significant risk of anesthesia. Conservative treatment is currently the primary option because it has been shown in prior studies to have a success rate of about 75% for treating chylothorax, particularly in children with mild chylous exudation. In order to encourage pleural effusion absorption and thoracic lymphatic regeneration, it is crucial to investigate a safe and efficient treatment.

## REFERENCES

- Ahmed, M., Alshafei, A. H., Khan, A., & Gouda, A. (2018). Neonatal bilateral chylothorax treated by octreotide. *Hamdan Med Journal*, 11, 34–36.
- AICNU. (2015). Lekha V.S. Nutritional Management of Chylothorax. <https://aicnu.org/wp-content/uploads/2015/01/Chylothorax.pdf>.
- Attar, M. A., & Donn, S. M. (2017). Congenital chylothorax. *Seminars in Fetal and Neonatal Medicine*, 22(4), 234–239.
- Bender, B., Murthy, V., & Chamberlain, R. S. (2016). The changing management of chylothorax in the modern era. *European Journal of Cardio-Thoracic Surgery*, 49(1), 18–24. <https://doi.org/10.1093/ejcts/ezv041>
- Bryant, A. S., Minnich, D. J., Wei, B., & Cerfolio, R. J. (2014). The incidence and management of postoperative chylothorax after pulmonary resection and thoracic mediastinal lymph node dissection. *The Annals of Thoracic Surgery*, 98(1), 232–237. <https://doi.org/10.1016/j.athoracsur.2014.03.003>
- Buckley, J. R., Graham, E. M., Gaies, M., Alten, J. A., Cooper, D. S., Costello, J. M., Domnina, Y., Klugman, D., Pasquali, S. K., & Donohue, J. E. (2017). Clinical epidemiology and center variation in chylothorax rates after cardiac surgery in children: a Pediatric Cardiac Critical Care Consortium report. *Cardiology in the Young*, 27(9), 1678–1685.
- Chai, T., Lin, Y., Kang, M., & Lin, J. (2019). Thoracotomy versus video-assisted thoracoscopic lung cancer resection: A protocol for a systematic review and meta-analysis. *Medicine*, 98(10).
- Dehghan, K. (2019). Idiopathic chylothorax in a term neonate and successful treatment with octreotide and medium chain triglyceride-enriched formula: a case report. *International Journal of Pediatrics*, 7(6), 9535–9540. <https://doi.org/10.22038/ijp.2019.38710.3310>
- DiLauro, S., Russell, J., McCrindle, B. W., Tomlinson, C., Unger, S., & O'Connor, D. L. (2020). Growth of cardiac infants with post-surgical chylothorax can be supported using modified fat breast milk with proactive nutrient enrichment and advancement feeding protocols in an open-label trial. *Clinical Nutrition ESPEN*, pp. 38, 19–27. <https://doi.org/10.22038/ijp.2019.38710.3310>
- Dori, L., Smaropoulos, E., Tagarakis, G., Foroulis, C. N., Zarogoulidis, P., Huang, H., Chong, B., Hohenforst-Schmidt, W., & Tsikopoulos, G. (2017). Successful treatment of familial congenital chylothorax by ligating the thoracic duct: A case report. *Respiratory Medicine Case Reports*, pp. 21, 66–68. <https://doi.org/10.1016/j.rmcr.2017.03.017>
- Downie, L., Sasi, A., & Malhotra, A. (2014). Congenital chylothorax: associations and neonatal outcomes. *Journal of Paediatrics and Child Health*, 50(3), 234–238.
- Healy, H., Gipson, K., Hay, S., Bates, S., & Kinane, T. B. (2017). A case series is a management and outcome of congenital chylothorax in the neonatal intensive care unit. *Pediatric Investigation*, 1(1), 21–25. <https://doi.org/10.1155/2021/6634326>
- Hermon, M., Tenner, E., Burda, G., Strohmaier, W., Schlager, G., & Golej, J. (2019). Chylothorax and chylous-like diseases in children: clinical management. *Frontiers in Pediatrics*, 7, 258. <https://doi.org/10.3389/fped.2019.00258>
- Justice, L., Buckley, J. R., Floh, A., Horsley, M., Alten, J., Anand, V., & Schwartz, S. M. (2018). Nutrition considerations in the pediatric cardiac intensive care unit patient. *World Journal for Pediatric and Congenital Heart Surgery*, 9(3), 333–343.
- Kankanarachchi, I., Priyankara, K. K. S., Lakman, K. K. K., Withanaarachchi, K., & Gunathilaka, P. K. G. (2021). Two Cases of Congenital Chylethorax: A Successful Story of Medical Management. *Case Reports in Pediatrics*, 2021, 1–4. <https://doi.org/10.1155/2021/6634326>
- Krishnamurthy, M. B., & Malhotra, A. (2017). Congenital chylothorax: current perspectives and trends. *Research and Reports in Neonatology*, pp. 53–63. <https://doi.org/https://doi.org/10.2147/RRN.S128703>
- Lee, C.-J., Tsao, P.-N., Chen, C.-Y., Hsieh, W.-S., Liou, J., & Chou, H.-C. (2016). Prenatal therapy improves the survival of premature infants with congenital chylothorax. *Pediatrics & Neonatology*, 57(2), 127–132.

- Mery, C. M., Moffett, B. S., Khan, M. S., Zhang, W., Guzmán-Pruneda, F. A., Fraser Jr, C. D., & Cabrera, A. G. (2014). Incidence and treatment of chylothorax after cardiac surgery in children: analysis of a large multi-institution database. *The Journal of Thoracic and Cardiovascular Surgery*, 147(2), 678–686. <https://doi.org/10.1016/j.jtcvs.2013.09.068>
- Neumann, L., Springer, T., Nieschke, K., Kostelka, M., & Dähnert, I. (2020). ChyloBEST: Chylothorax in infants and nutrition with low-fat breast milk. *Pediatric Cardiology*, 41, 108–113.
- Pulle, M. V., Puri, H. V., Asaf, B. Bin, Bishnoi, S., Yadav, A., & Kumar, A. (2021). Chylothorax-Modalities of management and outcomes: A case series. *Lung India: Official Organ of Indian Chest Society*, 38(2), 154. [https://doi.org/10.4103/lungindia.lungindia\\_526\\_20](https://doi.org/10.4103/lungindia.lungindia_526_20)
- Rocha, G., Arnet, V., Soares, P., Gomes, A. C., Costa, S., Guerra, P., Casanova, J., & Azevedo, I. (2021). Chylothorax in the neonate—a stepwise approach algorithm. *Pediatric Pulmonology*, 56(10), 3093–3105.
- Samanidis, G., Kourelis, G., Bounta, S., & Kanakis, M. (2022). Postoperative Chylothorax in Neonates and Infants after Congenital Heart Disease Surgery—Current Aspects in Diagnosis and Treatment. *Nutrients*, 14(9), 1803. <https://doi.org/10.3390/nu14091803>
- Senarathne, U. D., Rodrigo, R., & Dayanath, B. K. T. P. (2021). Milky pleural effusion in a neonate and approach to investigating chylothorax. *BMJ Case Reports*, 14(9).
- Tutor, J. D. (2014). Chylothorax in infants and children. *Pediatrics*, 133(4), 722–733. <https://doi.org/10.1542/peds.2013-2072>
- White, M. K., Bhat, R., & Greenough, A. (2019). Neonatal chylothoraces: a 10-year experience in a tertiary neonatal referral center. *Case Reports in Pediatrics*, 2019.
- Yee, K. C. K., Hern, O. T., Ching, N. Z., Pillai, N., Henry, A., & Chan, L. T. (2018). An Extraordinary Case of Idiopathic Chylothorax in a Rural Setting. *Open Access Library Journal*, 5(10), 1–7. <https://doi.org/https://doi.org/10.4236/oalib.1104924>



© 2023 by the authors. It was submitted for possible open-access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).