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CHARACTERISTICS OF CHYLOTHORAX FOLLOWING PEDIATRIC CONGENITAL HEART SURGERY AT CHO RAY HOSPITAL

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ABSTRACT

Objective: To evaluate the characteristics of postoperative chylothorax in pediatric patients undergoing cardiac surgery at the Pediatric Cardiac Surgical Department, Cho Ray Hospital, from March 2017 to May 2026.

Methods: This retrospective descriptive cross-sectional study included all pediatric patients diagnosed with postoperative chylothorax at the Pediatric Cardiac Surgical Department, Cho Ray Hospital, between March 2017 and May 2026. Clinical data and treatment outcomes were collected and analyzed using statistical methods.

Results: Over the nearly nine-year study period, 21 cases of chylothorax following congenital heart surgery in children were identified. Most patients had complex congenital heart disease, particularly single-ventricle physiology. The most common surgical procedures were the Fontan operation (47.6%) and bidirectional Glenn shunt (23.8%). Chylothorax predominantly developed after postoperative day 7 and was more frequently observed in the right pleural cavity (61.9%). Most patients had a pleural drainage volume of less than 40 mL/kg/day. Management primarily consisted of pleural drainage combined with conservative medical therapy, with a mean drainage duration of 6.6 ± 2.3 days.

Conclusions: Postoperative chylothorax in pediatric congenital heart surgery patients occurred predominantly in those with complex congenital heart disease, particularly single-ventricle physiology, following Glenn and Fontan procedures. This complication typically presented late in the postoperative period, was mainly right-sided, and was generally associated with mild to moderate drainage volumes. Conservative management combined with pleural drainage yielded favorable outcomes in most cases.

Keywords: *Chylothorax; congenital heart disease.*

1. INTRODUCTION

Congenital heart disease (CHD) is one of the most common congenital anomalies in children, with a reported incidence of approximately 8–10 per 1,000 live births according to recent epidemiological studies. In complex CHD, postoperative complications remain a major challenge, substantially affecting treatment duration, healthcare costs, and long-term prognosis. Among these complications, postoperative chylothorax is a relatively uncommon but potentially serious condition that may adversely affect patient recovery and clinical outcomes if not promptly recognized and managed.

The diagnosis of chylothorax requires two essential components: the presence of pleural effusion and confirmation that the pleural fluid is chylous in nature Chyle is a milky lymphatic fluid produced during the digestion and absorption of dietary fats. It contains chylomicrons, fat-soluble vitamins, lymphocytes, and immunoglobulins. Chylothorax results from leakage of lymphatic fluid into the pleural cavity and is commonly associated with injury to the thoracic duct or lymphatic vessels during surgery, elevated central venous pressure following single-ventricle palliation procedures, or central venous thrombosis impairing lymphatic drainage. Previous studies have reported an incidence of postoperative chylothorax ranging from 0.5% to 6.5% following congenital heart surgery. The incidence appears to be increasing due to the growing number of surgical procedures and the increasing complexity of contemporary cardiac interventions. Certain patient populations are at particularly high risk, including neonates, patients with single-ventricle physiology, those undergoing bidirectional Glenn shunt or Fontan procedures, children with chromosomal abnormalities, and patients requiring prolonged cardiopulmonary bypass.

Numerous studies worldwide have investigated the incidence, risk factors, and treatment strategies for postoperative chylothorax in pediatric patients undergoing congenital heart surgery. However, data from Vietnam remain limited, particularly regarding studies evaluating clinical characteristics, laboratory findings, and treatment outcomes in real-world settings at major cardiac surgery centers.

2. METHODS

2.1. Study Population and Sampling

All pediatric patients younger than 17 years of age with congenital heart disease who developed postoperative chylothorax following cardiac surgery at Cho Ray Hospital between March 2017 and May 2026 were included in the study.

2.2. Study Design

2.2.1. A retrospective descriptive cross-sectional study was conducted.

Study Procedures

Medical records of pediatric patients diagnosed with postoperative chylothorax following congenital heart surgery were reviewed. Collected data included demographic characteristics, clinical diagnoses, laboratory findings, treatment modalities, and treatment outcomes.

Data Collection and Statistical Analysis

Data were extracted from medical records, entered into Microsoft Excel, and subsequently analyzed using Stata statistical software version 16.0.

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3. RESULTS

3.1. Characteristics of the Study Population

Over the nearly nine-year study period, a total of 21 patients meeting the inclusion criteria were enrolled in the study.

Table 1. Demographic Characteristics of the Study Population

Characteristic	Median (IQR)
Age (years)	4 (3–5.75)
Weight (kg)	17 (12–24)
Male/Female	12/9

The study population consisted predominantly of young children, with a median age of 4 years and a median body weight of 17 kg. The sex distribution was relatively balanced, with no significant difference between male and female patients.

Table 2. Types of Congenital Heart Disease

Congenital Heart Disease	n (%)
Ventricular septal defect	1 (4.8)
Tetralogy of Fallot	4 (19.0)
Complete atrioventricular septal defect	1 (4.8)
Single-ventricle physiology	12 (57.1)
Double-outlet right ventricle	3 (14.2)

Single-ventricle physiology was the most common diagnosis among patients who developed postoperative chylothorax. Overall, complex congenital heart diseases accounted for the majority of cases in the study population.

Table 3. Surgical Procedures

Surgical Procedure	n (%)
Ventricular septal defect closure	1 (4.8)
Total repair of Tetralogy of Fallot	3 (14.2)
Redo right ventricle-to-pulmonary artery conduit replacement	1 (4.8)
Complete repair of atrioventricular septal defect	1 (4.8)
Bidirectional Glenn shunt	5 (23.8)
Fontan procedure	10 (47.6)

The Fontan procedure and bidirectional Glenn shunt were the two most frequently performed surgical procedures among patients who developed postoperative chylothorax.

3.2. Characteristics of Chylothorax

Table 4. Time of Onset of Chylothorax

Time of Onset	n (%)
≤ 3 days	1 (4.8)
4–7 days	5 (23.8)
≥ 7 days	15 (71.4)

Most cases of chylothorax occurred after postoperative day 7. Early-onset chylothorax during the first few postoperative days was less common.

Table 5. Distribution of Pleural Effusion

Location	n (%)
Left pleural cavity	3 (14.2)
Right pleural cavity	13 (61.9)
Bilateral pleural cavities	5 (23.8)

Right-sided pleural effusion was the most common presentation. Although less frequent, bilateral pleural effusions often suggested a more severe clinical condition.

Table 6. Chylous Drainage Volume

Chylous Drainage Volume	n (%)
< 20 mL/kg/day	10 (47.6)
20–40 mL/kg/day	7 (33.3)
> 40 mL/kg/day	4 (19.1)

Most patients had a chylous drainage volume of less than 40 mL/kg/day. However, a small proportion of patients experienced high-output chylous drainage.

3.3. Treatment Outcomes

Table 7. Treatment modality

Treatment Modality	n (%)
Medical management alone	3 (14.2)
Pleural drainage	18 (85.7)

The most of case was pleural drainage (85.7%)

Table 8. Treatment duration

Treatment Duration	Mean, SD, %
Duration of pleural drainage	6.6 ± 2.3 days
Hospital length of stay	31.5 ± 12.6 days
The mortality rate	0%

Hospital length of stay is so long and no mortality.

4. DISCUSSION

In the present study, most patients who developed chylothorax following congenital heart surgery were young children, with a median age of 4 years and a median body weight of 17 kg. This finding reflects the characteristics of patients with complex congenital heart disease, many of whom require surgical intervention early in life to prevent the progression of heart failure, pulmonary hypertension, or chronic hypoxemia. In young children, the lymphatic system is not yet fully developed, and the lymphatic vessels are thinner and more vulnerable to injury during surgery, thereby increasing the risk of postoperative chylothorax. Furthermore, younger children generally have limited nutritional reserves, making the consequences of chyle loss more pronounced than in older children or adults. The nearly equal sex distribution observed in our study suggests that sex is unlikely to be a major determinant of chylothorax risk.

Single-ventricle physiology represented the largest subgroup among patients who developed postoperative chylothorax. This observation is consistent with findings from previous international studies investigating chylothorax in children with congenital heart disease. Patients with single-ventricle physiology typically undergo staged palliative procedures such as the bidirectional Glenn and Fontan operations, in which postoperative hemodynamics depend heavily on elevated central venous pressure. Persistent elevation of systemic venous pressure impairs lymphatic return to the central circulation, leading to lymphatic congestion and subsequent leakage of chyle into the pleural space. In addition, extensive surgical dissection and repeated interventions may further increase the risk of lymphatic injury in these patients.

The Fontan procedure and bidirectional Glenn shunt were the most common surgical procedures associated with postoperative chylothorax in our study. This finding is consistent with the underlying pathophysiological mechanisms of chylothorax following single-ventricle palliation. After the Fontan procedure, systemic venous pressure is intentionally maintained at a higher level to facilitate pulmonary blood flow in the absence of a subpulmonary ventricle. This hemodynamic condition increases the burden on the lymphatic system and predisposes patients to persistent chyle leakage. Several studies have reported a substantially higher incidence of chylothorax following Fontan procedures compared with conventional biventricular repairs, besause: elevated and sustained central venous pressure (CVP), typically ranging from 12 - 16 mmHg; increased lymph production in the liver and intestin, the elevated

inferior vena cava (IVC) pressure in Fontan circulation propagates backward into the hepatic veins and splanchnic circulation and higher risk of mechanical injury during reoperation. These findings underscore the importance of close postoperative surveillance in patients with single-ventricle circulation.

Most cases in our study were diagnosed after postoperative day 7. This timing coincides with the reintroduction of enteral feeding, particularly diets containing long-chain triglycerides. As lymphatic flow increases following fat absorption, previously occult lymphatic leaks may become clinically apparent, resulting in increased pleural drainage and the characteristic milky appearance of chylous effusion. Similar findings have been reported in previous studies, indicating that chylothorax often becomes evident only after gastrointestinal function and enteral nutrition have been reestablished. Therefore, careful monitoring of pleural drainage volume and appearance following the initiation of feeding is crucial for early diagnosis.

Regarding the distribution of pleural effusions, right-sided involvement was the most common finding. This may be related to the anatomical course of the thoracic duct and the surgical approaches frequently employed during congenital heart surgery. The thoracic duct traverses the posterior mediastinum and exhibits considerable anatomical variability, rendering it susceptible to injury during complex surgical procedures. Although less common, bilateral pleural effusions were generally associated with more extensive lymphatic leakage or widespread lymphatic dysfunction, often resulting in a more challenging clinical course.

Most patients in our study had chylous drainage volumes below 40 mL/kg/day, corresponding to mild-to-moderate disease severity. This finding suggests that the majority of cases can be successfully managed with conservative treatment when diagnosed early. Nevertheless, several patients experienced high-output drainage exceeding 40 mL/kg/day. These patients are at increased risk of protein depletion, hypoalbuminemia, electrolyte imbalance, and immunosuppression secondary to prolonged lymphocyte loss. Continuous nutritional losses may also impair postoperative recovery and prolong hospitalization. Previous studies have identified high-output chylous drainage as a predictor of failure of conservative treatment and a potential indication for surgical intervention.

With regard to management, most patients were treated with pleural drainage combined with conservative medical therapy, including dietary modification, pharmacologic treatment, and replacement of nutritional losses. This approach remains the first-line treatment strategy for postoperative chylothorax following congenital heart surgery. This finding is in agreement with the study by Ahmed et al., in which the authors recommended conservative management, including pleural drainage and nutritional modification, as the first-line therapeutic approach for the majority of patients with postoperative chylothorax after congenital heart surgery. Conservative measures reduce lymphatic flow, promote spontaneous closure of lymphatic leaks, and minimize the need for surgical intervention. The mean drainage duration in our study was 6.6 ± 2.3 days, which is relatively short compared with some published reports. This may indicate that most patients were diagnosed before the condition became severe and responded well to initial treatment. Furthermore, close postoperative monitoring likely facilitated early detection and timely intervention, thereby preventing disease progression and shortening recovery time. No mortality was observed in our study cohort. Compared with the study by Mery et al., in which the mean treatment duration generally exceeded 10 days and some patients required surgical intervention, our findings suggest favorable outcomes with a conservative management strategy. The absence of mortality in our cohort is

also consistent with the declining mortality rates associated with postoperative chylothorax reported in recent studies, likely reflecting improvements in surgical techniques, perioperative intensive care, and postoperative nutritional support.

5. CONCLUSIONS

Postoperative chylothorax following congenital heart surgery occurred predominantly in patients with complex congenital heart disease, particularly those with single-ventricle physiology and those undergoing bidirectional Glenn or Fontan procedures.

The complication typically developed after postoperative day 7 and was predominantly right-sided.

Most cases were characterized by mild-to-moderate chest tube drainage output and responded well to conservative management combined with pleural drainage.

Prolonged hospital stay was observed among affected patients.

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