



A transudative chylothorax associated with superior vena cava syndrome

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ABSTRACT

The chylothorax is a lymphocyte predominant protein-discordant exudative pleural effusions with low lactate dehydrogenase and elevated triglyceride levels. Transudative chylothoraces associated with Superior Cava syndrome (SVC) are an extremely rare clinical entity. In this manuscript, we describe a case of transudative chylothorax due to SVC obstruction secondary to thrombosis of a peripherally inserted central venous catheter, which ultimately resolved after endovascular intervention. In our review of the literature, only five cases of transudative chylothorax associated with SVC syndrome were identified with 60% of cases associated with thrombosis and complications due to catheters in the central venous circulation. Treatment of the underlying cause is key to resolution of the chylothorax. Thoracentesis is an initial intervention for diagnostic and therapeutic purposes. Endovascular intervention is the primary mode of treatment for SVC thrombosis and stenting is preferred for malignant causes, however anticoagulation alone has been reported in the resolution of chylothorax. In patients with recurrent chylothorax despite of relief of SVC obstruction, a medium-chain triglyceride diet and octreotide can be prescribed in order to decrease the chyle flow in the thoracic duct. Surgical ligation of the thoracic duct can be considered if medical management and endovascular treatment fails.

1. Introduction

Chylothorax is the accumulation of lymphatic fluid in the pleural space. Disruption of the thoracic duct and lymphatic drainage, either by iatrogenic damage, or malignant obstruction, are the most common etiologies for the development of chylothorax. Chylothoraces are predominantly exudative, lymphocyte-rich fluid with elevated triglyceride and chylomicron levels, however transudative chylothorax has been reported in certain conditions, such as cirrhosis and congestive heart failure.

In this manuscript, we describe an extremely rare case of a transudative chylothorax secondary to superior vena cava syndrome (SVC) as well as a description of five previously reported cases of transudative chylothoraces associated with SVC syndrome published in the English literature between 1960 and 2018 via a Medline search using the search terms: *chylothorax*, *chyle* and *pleural effusion*, *SVC syndrome* and *transudative pleural effusion*, and *SVC syndrome and chylothorax*. In addition, we have described the clinical characteristics and pleural fluid analyses (PFA) of all five cases in the extant literature (Table 1). In this review, we will discuss the pathophysiology and the approach to the diagnosis

and management of transudative chylothoraces associated with SVC syndrome.

2. Case

A 54-year-old woman with history of chronic lymphocytic leukemia presented with a two-month history of dyspnea and swelling of her upper extremities and face. Computerized topography of the chest with intravenous contrast demonstrated superior vena cava extrinsic compression by surrounding lymph nodes and a thrombus within the left subclavian, left brachiocephalic and right distal brachiocephalic veins with extension to the proximal superior vena cava (Fig. 1). A left sided pleural effusion was also identified. The patient had a recently placed peripherally inserted central venous catheter line in the right cephalic vein.

Diagnostic thoracentesis of the left thorax revealed a milky colored fluid. Pleural fluid analysis was consistent with a transudative effusion with an elevated triglyceride level (117mg/dl). The pH was 7.42, and pleural protein to serum ratio was 0.38, pleural LDH to serum ratio was 0.35 (Table 1). The pleural fluid was lymphocyte predominant with

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Table 1
Case of Transudative Chylothorax associated with SVC Obstruction from the Albany Medical Center Hospital.

Pt.	pH	Protein	P/S [#]	LDH	LDH/ULNS [*]	Glucose	WBC	N % L %	Triglyceride	Etiology	Outcome
1	7.42	1.4	0.38	79	0.35	126	0.092	14% 86%	117	PICC line implanted in right subclavian vein with thrombus	Endovascular intervention with resolution

ULNS: Upper limit of Normal Serum (IU/L).

P/S[#]: Pleural fluid/Serum ratio.

NR: Not Reported.

N: Neutrophils (%).

L: Lymphocytes (%).

Protein (mg/dL).

WBC cells/mm³.

Glucose(mg/dl).

Trig:Triglyceride(mg/dl).

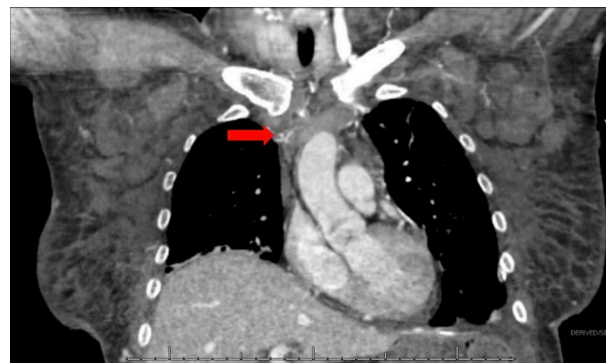


Fig. 1. Computed tomography of the chest with intravenous contrast (coronal view) demonstrating thrombus within the left subclavian, left brachiocephalic and right distal brachiocephalic veins with extension to the proximal superior vena cava (Red Arrow). A left-sided pleural effusion is present as well. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

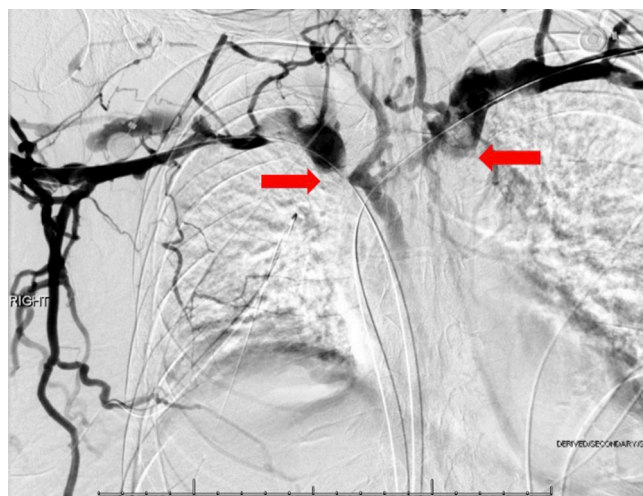


Fig. 2. Venogram of the chest under fluoroscopy demonstrating decreased blood flow in bilateral brachiocephalic and SVC due to thrombus (Red Arrows). (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

86% lymphocytes with a total of ninety-two white blood cells.

A small-bore 12-french pigtail catheter was placed in the pleural space for pleural drainage. The patient continued to have significant high output drainage from chest tube. Venogram performed by the vascular interventional radiologist team again demonstrated occlusion of the bilateral brachiocephalic veins with extension of clot into the SVC (Fig. 2). Mechanical thrombectomies were subsequently performed with stent placement. Post-procedural venogram demonstrated patient superior vena cava with brisk flow and minimal residual thrombotic burden in the bilateral brachiocephalic veins (Fig. 3). The patient had dramatic improvement in her symptoms post-procedure. The chest tube had reduced subsequent output and the patient was discharged. Follow-up chest radiograph at a six-month interval demonstrated resolution of the bilateral pleural effusions.

3. Discussion

Chylothorax has been described in the medical literature since the 1600s [1]. However, one of the earliest reported cases was described by SH Watts at the University of Virginia in 1921, whereby a psychotic

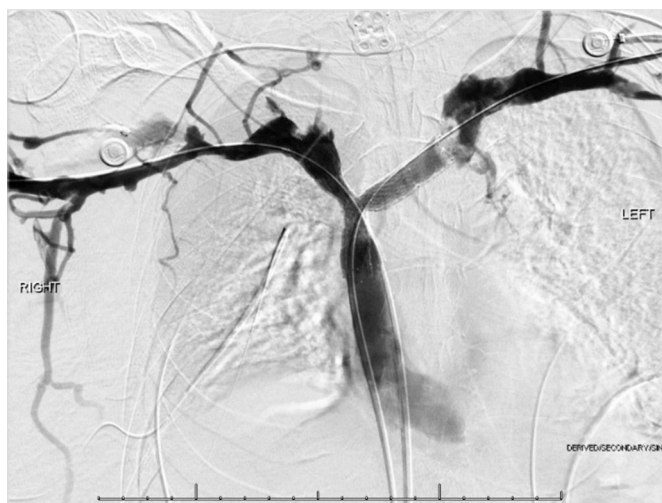


Fig. 3. Post-procedural venogram of the chest demonstrating minimal residual thrombotic burden in bilateral brachiocephalic veins after mechanical thrombectomy and stent placement with brisk outflow in the SVC.

individual developed a traumatic chylothorax after puncturing himself with a blade the area of the suprasternal notch [2]. The association of SVC obstruction and the production of chylothorax was first identified by Blalock, Cunningham and Robison in 1936, whereby surgical ligation of the SVC in dogs and cats produced chyle accumulation in the pleural space in approximately 50% subjected animals [3].

Chylothoraces affect approximately 1500 persons annually in the United States [4,5]. Typically chylothoraces are exudative in nature. Transudative chylothorax is rare, and the most common etiologies include congestive heart failure, nephrotic syndrome and cirrhosis [6,7]. SVC syndrome is an extremely rare cause of transudative chylothorax.

In our review of the literature, we only identified five cases of transudative chylothoraces in the setting of SVC syndrome [8–11]. This number is limited by the fact that a majority of the ten cases of chylothorax associated with SVC syndrome do not have PFA detailed in the reports. In our literature review, 2/5 (40%) of the cases were identified in pediatric patients; 3/5 cases (60%) of transudative effusions associated with SVC syndrome were attributed to thrombosis of central venous catheters (Table 2). Two cases (40%) were associated with hypercoagulable states (nephrotic syndrome, and concomitant AIDS and active pulmonary tuberculosis infection) causing central venous thrombosis.

The pleural fluid analysis of the typically chylothorax demonstrates lymphocytic-predominant protein-discordant exudative pleural effusions with low lactate dehydrogenase levels and triglyceride levels greater than 110 mg/dL [12]. Pleural fluid to serum ratio of triglycerides can be less than 1.0 if patient is fasting [13], in which case chylomicron level can help differentiate a chylothorax versus a pseudochylothorax. LDH typically does not fulfill the exudative criteria, and when elevated, malignancy should be considered as a potential underlying etiology.

In review of the extant medical literature, there were limited complete pleural fluid analyses reported (Table 2). Mean pleural fluid pH reported was 7.59 (range 7.50–7.70), mean glucose of 109 mg/dL (range 100.8–110 mg/dL), mean pleural fluid protein was 2.43 g/dL (range 0.0–3.6 g/dL), mean LDH of 85 IU/L (range 18–114 IU/L), and mean triglyceride level of 376.4 mg/dL (range 128–1035 mg/dL). The range of triglyceride level may be secondary to fasting level at the time of thoracentesis [14]. In 2/5 (40%), the cell count was detailed; mean WBC 428 cells/mm³ (range 375–480 cells/mm³) with a lymphocyte predominance. Our analysis was limited by lack of full pleural fluid analysis in the cases collected.

Table 2
Cases of Transudative Chylothorax associated with SVC Obstruction in Literature Review.

Case	Pt. #	pH	Protein	P/S#	LDH	LDH/ULNS*	Glucose	WBC	N %	L %	Trig	Etiology	Outcome
Kho 20178	1	NR	NR	0.33	NR	0.33	NR	NR	NR	NR	128	Left-axillary to brachiocephalic central venous thrombus;	Resolution with chest tube placement, anticoagulation and fat free diet.
Luks 20139	1	7.5	3.6	NR	105	NR	100.8	NR	NR	NR	202	Hypercoagulable state with AIDS and Tuberculosis	Angioplasty failed and Port was removed
Luks 20139	2	7.6	2.9	NR	114	NR	108	NR	NR	NR	234	Port placement/left-sided central venous catheter	Bilateral chest tubes were placed; angioplasty of the SVCO, eventually had a superior vena cava stent.
Alkayed 201310	3	7.7	3.2	NR	103	NR	NR	375	N: 5%, L: 77%	NR	1035	Left-sided hickman catheter; bilateral chylothorax	Catheter removed, anticoagulation and angioplasty
Hanna 199711	4	7.54	0.0	NR	18	0.11	118	480	N: 2%, L: 98%	NR	283	Central venous catheter associated thrombosis	Treatment of nephrotic syndrome; Resolution

ULNS: Upper limit of Normal Serum (IU/L).

P/S*: Pleural fluid/Serum ratio.

NR: Not Reported.

N: Neutrophils (%).

L: Lymphocytes (%).

Protein (mg/dL).

WBC cells/mm³.

Glucose (mg/dL).

SVC syndrome is predominately caused by venous thrombosis leading to impaired venous drainage of the head, neck and upper extremities [6,15–17]. The anatomical location of the thoracic duct is critical to the pathophysiology and development of the chylothorax. The thoracic duct originates at the cisterna chyli and enters the right hemithorax through the aortic hiatus. It ascends in the chest cavity and crosses to the left at 5th or 6th thoracic vertebra, and terminates at the angle of the left subclavian and internal jugular veins [18]. Thus, trauma below the 5th and 6th thoracic vertebra will cause right-sided chylothorax, whereas above will cause left-sided effusions.

The pathophysiology of chylothorax in SVC syndrome is hypothesized to be a result of chyle leakage in the pleural space due to increased pressure in the thoracic duct from the increased venous pressure distal to the SVC obstruction, which leads to higher lymph formation and decreased thoracic inflow [7], which may be confounded by increased lymphatic-venous collateral circulation [3]. This theory is supported by the resolution of chylothorax after endovascular intervention, such as angioplasty or stenting [5,9]. A similar mechanism is thought to be involved in chylopericardium, which has been reported in association with chylothorax secondary to SVC syndrome [10,19].

Treatment of the underlying cause is key to resolution of the chylothorax. Thoracentesis is an initial intervention for diagnostic and therapeutic purposes. Endovascular intervention is the primary mode of treatment for SVC thrombosis and stenting is preferred for malignant causes [20]. However, anticoagulation alone in cases of central thrombosis has been reported with successful resolution of the chylothorax [7]. In patients with recurrent chylothorax despite of relief of SVC obstruction, a medium-chain triglyceride diet and octreotide can be prescribed in order to decrease the chyle flow in the thoracic duct [21,22]. Rarely, surgical ligation of the thoracic duct can be considered if medical management and endovascular treatment fails.

Our patient had SVC syndrome due to thrombus in the right brachiocephalic system from a recent peripherally inserted central venous line and external compression due to enlarged lymph nodes. We believe that the chylothorax was due to SVC obstruction as opposed to leukemia due to the fact: a) pleural fluid was transudative; b) cytopathology and flow cytometry were negative for leukemic cells; c) pleural effusion resolved after SVC syndrome correction.

Conflicts of interest

This manuscript has not been previously published nor has it been submitted for publication elsewhere. The four authors (Adam Austin MD, Faris Al-Faris MD, Aakash Modi MD, Amit Chopra MD) were responsible in part for the concept, content review, editing and analysis for this manuscript and approve its submission. We have no conflict of

interest or potential for financial gain associated with the publication of this manuscript.

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