



GI/GU/Thoracic/Non-Vascular Interventions Case Report

Transpulmonary CT-guided thoracic duct disruption in the visceral compartment of the mediastinum: A case report

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ABSTRACT

There are multiple methods of accessing the thoracic duct for embolization or disruption, including fluoroscopic guided transabdominal puncture of the cisterna chyli, direct ultrasound access, and retrograde catheterization. We present a chylothorax patient in whom the cisterna chyli was not visualized, and retrograde catheterization or ultrasound access of the thoracic duct was not possible. We were able to disrupt the thoracic duct through a CT-guided transpulmonary approach in the high visceral mediastinum. This approach could be considered for chylothorax management, particularly in patients with a chest tube in place.

Keywords: Chylothorax, Cisterna chyli, Thoracic duct embolization, Transpulmonary, Visceral mediastinum

INTRODUCTION

Chylothorax is caused by leakage from the lymphatic vessels, especially from the thoracic duct. The management of chylothorax depends on the etiology and amount of chylothorax. Conservative treatment is the first-line treatment with a success rate ranging from 16% to 75%, generally consisting of a medium-chain triglyceride diet to reduce the lymphatic flow, total parenteral nutrition, pleural drainage, and octreotide administration if output continues.^[1] Radiological treatments, including lymphangiography and thoracic duct embolization, are considered in patients who failed conservative therapy for both non-traumatic and traumatic chylothorax. The overall success rate ranges from 27% to 68% in non-traumatic chylothorax and up to 90% for traumatic chylothorax.^[1,2] Surgical techniques like thoracic duct ligation are typically the last option in patients with a persistent leak despite conservative treatment or radiological interventions. Surgical interventions have a success rate of approximately 90%. However, it is associated with complications in up to 38% of cases and mortality in up to 25% of cases.^[1]

Thoracic duct embolization, a percutaneous alternative to thoracic duct ligation, was first described by Dr. Constantine Cope in 1995. The procedure involved pedal lymphangiography followed by transabdominal access into the thoracic duct for embolization. Since then, numerous improvements in the technique have generated more widespread adaption. Intranodal lymphangiography, typically requiring ultrasound-guided needle placement, has replaced pedal lymphangiography in most places. There are several new ways of accessing the thoracic duct, including transvenous and transcervical retrograde access.^[2] Even with the newer techniques,

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the procedure can be challenging. We describe one such case in which the cisterna chyli could not be visualized after intranodal lymphangiography, and transvenous retrograde access was not possible. The thoracic duct was identified in the high visceral mediastinum following lymphangiography, and we attempted access to the duct through transpulmonary approach under CT guidance.

CASE REPORT

A 75-year-old man presented to the hospital following a motorcycle injury that resulted in the left-sided rib fractures, hemothorax, and a mediastinal hematoma. He underwent a left thoracotomy, rib plating, and hemothorax evacuation the following day. There was persistent output from the chest tube with pleural fluid analysis consistent with chylothorax. Initially, the patient was managed conservatively with minimal improvement. Approximately 500 mL of output presented from the chest tube daily. Interventional radiology was consulted on post-operative day 15 for thoracic duct embolization.

Bilateral intranodal lymphangiography was performed using the standard technique described by Nadolski and Itkin.^[3] Under ultrasound guidance, a 25-gauge needle (Boston Scientific, Natick Massachusetts) was placed into a right inguinal node with the needle tip close to the transitional zone between the cortex and hilum using a shallow angle. About 1 mL of Lipiodol (Guerbet LLC, Princeton New Jersey) was administered, which demonstrated efferent lymphatics confirming intranodal placement. One of the left inguinal nodes was then accessed and position confirmed. Under fluoroscopic guidance, Lipiodol was hand injected bilaterally at a rate of 1 mL/5 min. A sequential compression device was used to speed the lymphatic flow. A total of 10 mL of Lipiodol was administered. The cisterna chyli could not be confidently identified. However, the upper chest fluoroscopy images suggested possible disruption of the thoracic duct with spillage of Lipiodol at the high mediastinum or plexiform pattern branching of the thoracic duct [Figure 1]. At this point, we stopped administering additional Lipiodol and attempted to access the thoracic duct through a transvenous retrograde approach was performed while the patient was in the angiographic suite and was unsuccessful. The presence of a cardiac pacemaker and the thoracic duct leakage within the neck increased the technical difficulty of the procedure. The patient also had bandages and edema of the neck. Hence, we did not attempt ultrasound-guided direct thoracic duct access.

The patient was transferred to CT immediately following the venogram. A chest CT confirmed spillage of contrast in the mediastinum [Figure 2]. The thoracic duct could be identified in the visceral compartment of the high mediastinum. Under CT guidance, a 21-gauge needle (Boston Scientific, Natick Massachusetts) was advanced through a transpulmonary approach toward the thoracic duct in the posterior

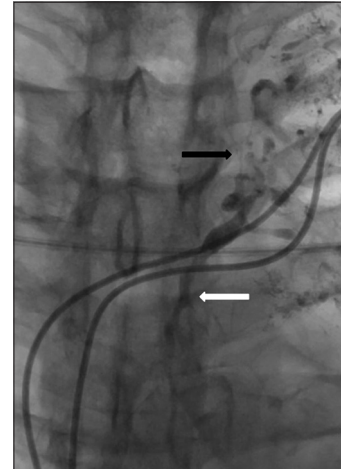


Figure 1: A 75-year-old man presented with chylothorax following a motorcycle injury. Lymphangiogram showing spillage of Lipiodol suggesting thoracic duct disruption in high mediastinum/low neck (black arrow). The thoracic duct can be visualized in the mediastinum (white arrow). The patient has a pacemaker in place.



Figure 2: A 75-year-old man presented with chylothorax following a motorcycle injury. CT chest confirming spillage of contrast in high mediastinum (black arrow). Thoracic duct is visualized in the mediastinum at the posteromedial aspect of aortic arch (white arrow).

mediastinum [Figure 3]. Once the needle appeared to be within the duct, a V-18 guidewire (Boston Scientific, Natick Massachusetts) was advanced through the needle. However, the wire did not advance within the duct. Repeat attempts were also unsuccessful. There was a small pocket of air within the duct and some of the Lipiodol was observed leaking outside the duct, suggesting duct disruption [Figure 4]. The patient was followed for a few days to assess the response of lymphangiography and thoracic duct disruption. If necessary, a repeat procedure was planned under general anesthesia to decrease respiratory motion.

There were no complications following the procedure. The patient's chest tube output decreased to <100 mL within 2 days,



Figure 3: A 75-year-old man presented with chylothorax following a motorcycle injury. CT fluoroscopy image in soft-tissue window demonstrating needle approaching the thoracic duct in visceral mediastinum between the thoracic aorta and esophagus (white arrow).

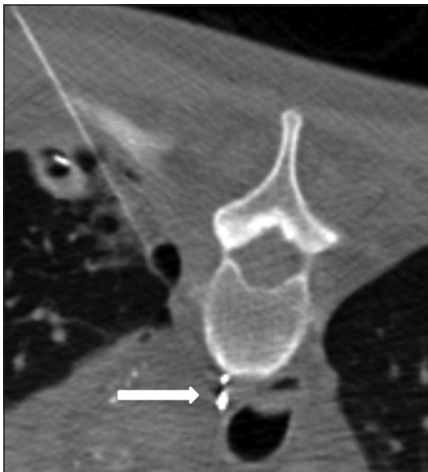


Figure 4: A 75-year-old man presented with chylothorax following a motorcycle injury. CT fluoroscopy image in bone window demonstrating a pocket of air within the thoracic duct and injected Lipiodol visualized outside the duct suggesting duct disruption (white arrow).

and the chest tube was removed 3-day post-lymphangiogram. The patient responded well and did not need any additional interventions. The procedure was performed in 2018 and the most recent CT in 2021 demonstrated residual mediastinal hematoma and pleural thickening.

DISCUSSION

The thoracic duct is accessible through multiple approaches. Fluoroscopic-guided access of the cisterna chyli after intranodal lymphangiography is now the most commonly described technique due to shorter procedure time and increased technical success.^[2] However, this technique can be technically challenging in obese patients and in patients in

whom the cisterna chyli is not confidently identified. CT and transabdominal MR imaging/ultrasound fusion guidance approaches to access the thoracic duct in the retroperitoneum have also been described.^[4,5]

Ultrasound-guided access of the cervical thoracic duct is an alternate technique.^[6] Yet, it is difficult in a patient similar to ours where the neck is inaccessible due to trauma and disruption of the duct in this region. Retrograde catheterization of the thoracic duct from the subclavian vein is a less invasive alternative with a success rate of up to 60%. It is beneficial if the thoracic duct drains into the venous angle; the cervical section of the thoracic duct has a simple, not plexiform configuration.^[7]

Needle disruption of the cisterna chyli when catheterization and embolization fail has demonstrated a therapeutic effect.^[8] It is not clear whether our patient responded specifically to the needle disruption, as lymphangiography alone can also be effective for diagnosing and treating chyle leakages.^[2] The success rate of lymphangiography can be more than 50% and thoracic duct disruption can be more than 70%.^[2] We stopped administering Lipiodol after observing it flowing up to the low neck. The total volume administered for our procedure was 10 mL, with the manufacturer's dose limit being 8 mL per limb. A much higher dose of Lipiodol can be administered safely for refractory chylothorax. In one of the recent articles, the authors used 40–140 mL with a mean of 75 mL Lipiodol for high-output post-surgical chylothorax patients with an 83% success rate.^[9] Instead of waiting for the response to lymphangiography, we decided to attempt a transpulmonary embolization or disruption of the thoracic duct for more definitive treatment as the duct could be visualized on CT and since the patient already had a chest tube.

Understanding the anatomy of the thoracic duct in the mediastinum will further improve management if newer minimally invasive techniques for ligating the duct develop. Accessing the thoracic duct in the mediastinum can also be used with a CT-guided injection of N-butyl cyanoacrylate glue near the site of leakage.^[10] Transabdominal access to the thoracic duct is generally a safe procedure even after transgressing structures such as the liver, pancreas, portal vein, duodenum, colon, pericardium, and inferior vena cava. However, it may occasionally cause complications such as pancreatitis and biliary peritonitis. Accessing the mediastinal thoracic duct through a transpulmonary approach can also have complications like pneumothorax. Most patients, including our patient who presented with traumatic chylothorax, typically have a chest tube in place, which eliminates the risk of pneumothorax. Furthermore, the transfer of the patient from the angiographic suite to CT is not always feasible, whereas a combined CT and angiographic suite would improve procedural time and difficulty. In the future, a transpulmonary approach in the high visceral

compartment of the mediastinum could be considered and utilized when alternative methods of accessing the thoracic duct for embolization fail.

CONCLUSION

Transpulmonary access of the thoracic duct in the high visceral compartment of the mediastinum is feasible. It can be utilized when other techniques to access the thoracic duct are not possible.

Declaration of patient consent

Patient's consent not required as patients identity is not disclosed or compromised.

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Conflicts of interest

There are no conflicts of interest.

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