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Case Report

Combined antegrade and retrograde thoracic duct embolization for complete transection of the thoracic duct☆,☆☆,★

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ABSTRACT

Chylothorax is an uncommon complication after thoracoabdominal surgery and is typically due to injury of the thoracic duct (TD) or one of its tributaries. Patients who fail conservative management benefit from thoracic duct embolization (TDE). TDE is a percutaneous technique that includes pedal or intranodal lymphangiography, transabdominal catheterization of the TD, and glue embolization of the TD. Alternative access to the TD can be achieved via retrograde transvenous approach or direct US-guided puncture in the left neck followed by TDE.

This case involves chylothorax in a 58-year-old male due to disruption of the main TD during esophagectomy, resulting in disjointed leaks from 2 separate areas related to a single complex injury. Lymphangiography and embolization via both transcervical and transabdominal approaches were performed to stop the leak.

Introduction

The thoracic duct (TD) is the main pathway of lymphatic drainage in the body [1]. Although 40%-60% of patients demonstrate anatomic variations, the TD typically begins with the cisterna chyli in the abdomen and extends upward through the aortic diaphragmatic hiatus [1]. Injury of the TD or one of its branches can result in chylothorax [1]. If left untreated, this may be life-threatening; postoperative chylothorax is associated with a 5-fold increase in 30-day mortality [2]. Patients with chylothorax are usually treated by with conservative management (Total Parenteral Nutrition or low fat diet, octreotide, and pleural drainage). In recent years lymphangiography and TDE have replaced surgical ligation as the interventions of choice for patients with chylothorax [1,3]. For intranodal lymphangiography a 25-G needle is advanced into a lymph node under ultrasound guidance, and oil-based (eg,

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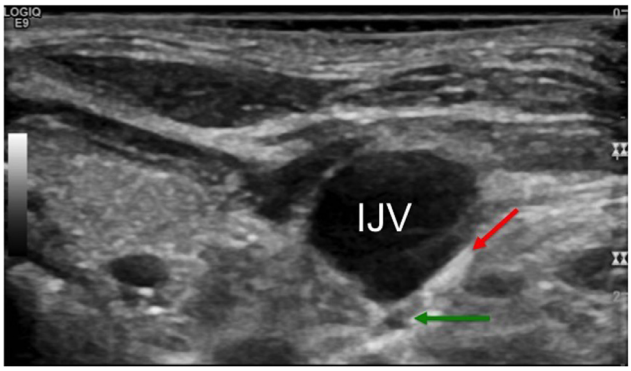

Fig. 1 – Ultrasound-guided transcervical needle-access to the thoracic duct near the junction of left internal jugular vein (IJV) and subclavian vein. red arrow = needle tip; green arrow = thoracic duct.

Lipiodol) contrast is then injected under fluoroscopy [3]. Due to the embolic properties of oil-based contrast, lymphangiography can itself be therapeutic if the leak is less than 500 mL per day [4].

Once the lymphatic system has been opacified by lymphangiography TDE may be performed transabdominally using a 22-G needle under fluoroscopy. The preferred target is a lumbar channel that drains into the cisterna chyli, as this minimizes the potential for chylous ascites from the access; however, the cisterna chili itself may also be accessed directly. Retrograde catheterization of the TD has also been described [5]. Transcervical puncture of the TD can be performed under US guidance at its venous insertion point (at the junction of the subclavian vein and internal jugular vein) [5]. Retrograde catheterization can also be performed via a transvenous approach [6]. For all approaches, a 0.018″ wire is used to cannulate the TD and the needle is exchanged for a microcatheter. Iodinated contrast is then injected to evaluate the anatomy and identify the leak and its origin [1,7]. Embolization is typically performed with coils and cyanoacrylate glue [1,7]. The retrograde approach can potentially decrease procedure time and eliminate the injection of oil-based contrast material.

Herein is described a case in which complete transection of the TD resulted in a disjointed leak. This presented a challenge in treatment. Ultimately a combined bidirectional approach was used for TDE.

Case report

A 58-year-old man with esophageal cancer status post recent esophagectomy presented with chylothorax and continuous high-output (>1 l/24 h) from a right chest tube despite conservative management. On POD #8 IR was consulted for evaluation. Ultrasound-guided transcervical TD access was performed using a 22-G Chiba needle for access (Fig. 1). A 2.4-French Progreat microcatheter (Terumo, Shibuya, Tokyo, Japan) was advanced to the leak over a V-18 ControlWire (Boston Scientific, Marlborough, MA). Contrast injection through the microcatheter demonstrated a large lymphatic leak in the chest without opacification of the caudal portion of the TD (Fig. 2), but the leak was unable to be crossed. The cranial portion of the TD was then embolized with glue using continuous fluoroscopic guidance. The glue used for embolization was an *N*-butyl cyanoacrylate (n-BCA)-etiodized oil emulsion in a 1:1 ratio (TRUFILL n-BCA Liquid Embolic System; DePuy Synthes, Raynham, MA) (Lipiodol; Guerbet LLC, Princeton NJ.). Given that the TD was transected and that the leakage was presumed to originate from the caudal portion of the TD, the decision was made to also perform intranodal lymphangiography and transabdominal TDE. The lymphangiogram demonstrated a large lymphatic leak fed by the caudal aspect of the TD. Transabdominal TDE was then performed of the caudal TD utilizing the same glue mixture as in the previous embolization (Fig. 3).

Following this bidirectional TD embolization of disjointed leaks from 2 separate areas, the daily chest tube output immediately dropped (<300 mL/24 h). The patient's fluid-loss related dehydration improved, and he was discharged with a chest tube on POD #20. The tube was removed 1 month later as an outpatient without issue. In this case, the chest tube was kept in place for an extended period for dyspnea at the discretion of thoracic surgeon.

Discussion

In a recent meta-analysis of 9 studies involving a total of 407 patients, Kim et al. reported that lymphangiography had technical and clinical success rates of 94.2% and 56.6% respectively [8]. The same study found technical and clinical success rates of 63.1% and 79.4% respectively for transabdominal TDE [8]. Transcervical TD puncture is a newer approach, with limited exploration in the literature. A small study by Guevara et al. recently reported a technical success rate of 100% for accessing the TD under US guidance, with 60% clinical success for transcervical TDE, this is somewhat lower than clinical success rates reported for transabdominal TDE [5]. It should be noted that these studies included all causes of chylothorax. It is known that iatrogenic chylothoraces, such as postesophagectomy, have a higher clinical success rate with TDE than do spontaneous causes [9].

This case demonstrates the feasibility of combining 2 TDE approaches. Approach from the neck allowed for evaluation and embolization of the TD from the venous insertion point down to the cranial point of TD transection, and approach from the abdomen allowed for evaluation from the groin lymph nodes to the cisterna chyli and to the caudal point of TD transection.

Typically only embolization of the inflow side of the leak is needed. In this case, transcervical approach was attempted first because this is the approach that the operator prefers due to experience and shorter procedure time. Preprocedurally, the operator expected to be able to cross the leak and embolize both the inflow and the outflow (prior to the procedure, it was unknown that the TD was completely transected). However, the operator was unable to cross caudally from the transcervical access, and so decided to embolize the cranial TD at this point. The benefit of embolization of the cranial portion of the

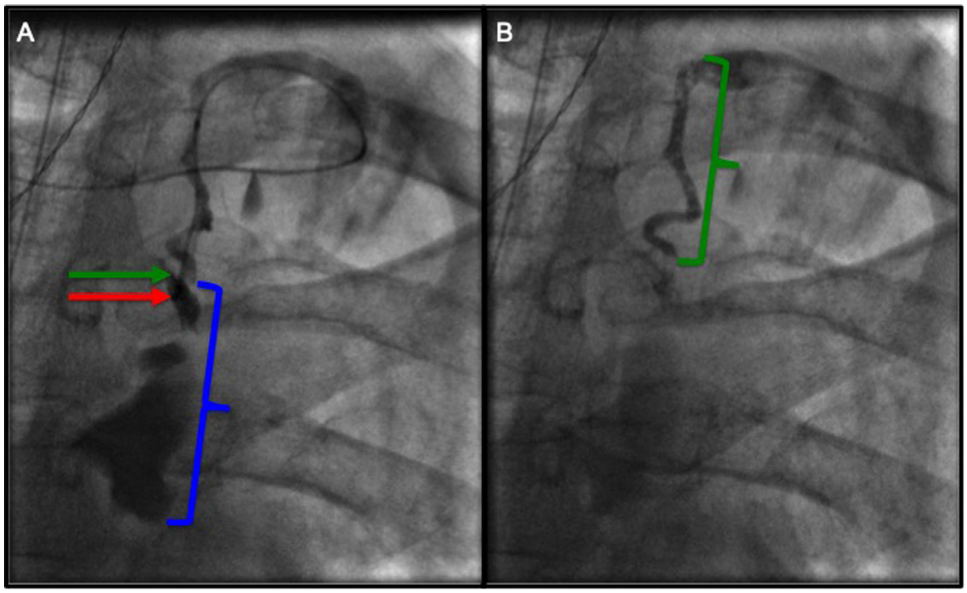

Fig. 2 – (A) Transcervical access with catheter near the leak; green arrow = transected end of cranial portion of the thoracic duct; red arrow = microcatheter tip within the leak; blue bracket = extravasated contrast. (B) Following transcervical TDE; green bracket = glue within the cranial portion of the thoracic duct.

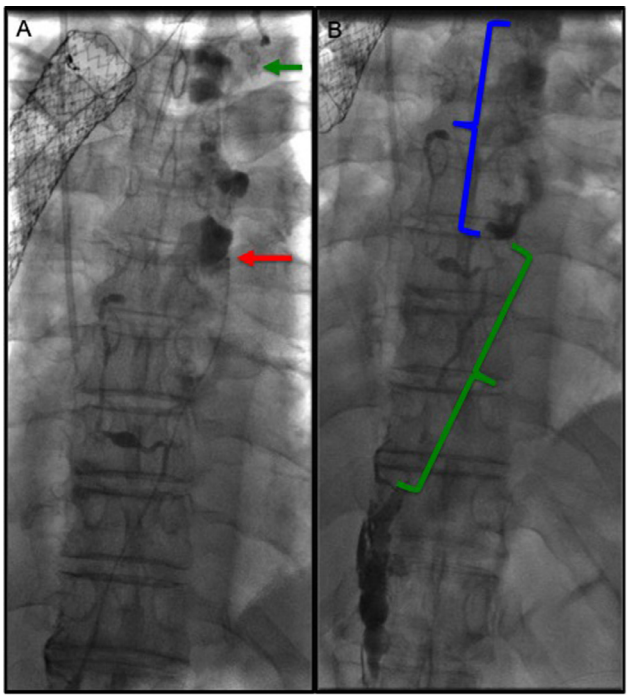

Fig. 3 – (A) Transabdominal access with catheter near the leak; green arrow = transected end of cranial portion of the thoracic duct; red arrow = microcatheter tip within the leak. Note that the distance between the 2 transected ends of the TD is greater than 3 vertebral body units. (B) Following transabdominal TDE; blue bracket = extravasated contrast; green bracket = glue within the caudal portion of the thoracic duct.

TD in this setting is unknown. In our experience, embolization of the caudal TD is not always successful in the setting of a transected TD; therefore, it was felt there was potential benefit to embolizing the cranial component. This therapeutic effect of cranial TD embolization is likely related to collateral pathways which drain into the cranial portion beyond the area of caudal embolization (with backflow into the leak). It was then decided to proceed with lymphangiography and transabdominal access which allowed embolization of the inflow side of the leak.

A key point of distinction is that the injury was to the main TD itself. When a leak occurs due to disruption of a branch of the TD, any of the approaches described above can be utilized; however, in this patient disruption and separation of 2 leaking ends of the TD rendered the retrograde approach alone ineffective, thereby necessitating a combined approach.

MR lymphangiography could potentially be helpful in outlining the TD anatomy and to plan the access prior to TDE. In cases where there is continuity of the main TD, a single approach, either transabdominal or transcervical should theoretically be equally effective; and in fact, one could argue that in such cases the transcervical approach is preferable due to the fact that lymphangiography can be skipped and the procedure time is shorter. However, in cases of main TD transection, we would suggest to first perform antegrade embolization from a transabdominal approach. If this is not successful, then an embolization from a retrograde approach would be advised.

The combined bidirectional approach proved effective in this case and may be considered for cases involving transection of the main TD. This is the first such case to be published; however, the true value of the bidirectional approach remains unknown. Future studies may elucidate the benefit of this approach.

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