Article published online: 2021-07-30

Technical Note: Thoracic duct embolization for treatment of chylothorax: A novel guidance technique for puncture using combined MRI and fluoroscopy

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Abstract

Thoracic duct embolization (TDE) is an established radiological interventional procedure for thoracic duct injuries. Traditionally, it is done under fluoroscopic guidance after opacifying the thoracic duct with bipedal lymphangiography. We describe our experience in usinga heavily T2W sequence for guiding thoracic duct puncture and direct injection of glue through the puncture needle without cannulating the duct.

Key words: Chylothorax; thoracic duct embolization; MRCP; direct glue injection without cannulation

Introduction

Thoracic duct embolization (TDE) is an interventional procedure for treating chylothorax resulting from thoracic duct injuries. The main challenge for the interventional radiologist is in localizing and entering the cisterna chyli or thoracic duct. Usually, fluoroscopic guidance is used after opacifying the thoracic duct with bipedal lymphangiography. Direct lymphangiography is rarely performed today. Recent studies have proved the efficiency of MRI in imaging lymphatic channels.[1] We present a case where we successfully planned and performed TDE using a novel guidance technique, combining MRI and fluoroscopy, to puncture the lymphatic sac. For embolization of the thoracic duct we directly injected dilute Histoacryl® glue through the puncture needle itself. To the best of our knowledge, such a technique has not been reported previously.

Access this article online	
Quick Response Code:	Website: www.ijri.org
	DOI: 10.4103/0971-3026.101077

Case Report

A 51-year-old man underwent laparoscopy-assisted esophagogastrectomy with pyloroplasty and feeding jejunostomy for carcinoma of the mid-esophagus. After an uneventful immediate postoperative period he was discharged from the hospital. Three weeks later he presented with increasing breathlessness. A large right-sided pleural effusion was detected and USG-guided pleural tap and pigtail catheter insertion were done. Pleural fluid cytology showed a lymphocyte-rich effusion with triglycerides content of 239.2 mg/dl, suggestive of chylothorax. Lymphoscintigraphy showed no significant colloid tracer collection in the pleural cavities. He had suffered significant weight loss. Percutaneous diagnostic lymphangiography was planned under MRCP guidance. The total serum protein measured 2.2 g/dl and albumin 0.8 g/dl on the day prior to the procedure.

We imaged the thoracic duct using a heavily T2W sequence as used in magnetic resonance cholangiopancreatography (MRCP) (three-dimensional, free-breathing, heavily T2W, single shot fast spin echo sequence (SSFE)). Two prominent saccular lymphatic structures were seen at the D12-L1 level [Figure 1]. The larger one, measuring 17×9×7 mm, was situated in the prevertebral region overlying the left

Figure 1: Coronal T2W SSFSE MRI shows lymphatic sacs (arrow) and channels (arrowhead) in the prevertebral region

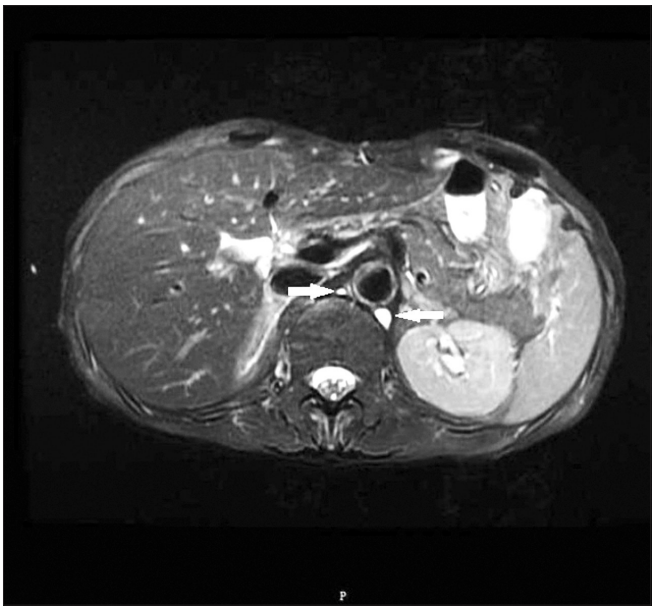

Figure 2: Axial T2W MRI shows a large lymphatic sac (left arrow) in the left prevertebral region, posterior to the aorta. A smaller lymphatic sac (right arrow) is seen anterior to the vertebral body, to the right of the aorta

L1 pedicle.A second, smaller, saccular lymphatic structure was seen overlying the spinous process [Figure 2]. We selected the second one for puncture as the larger one was located posterior to the aorta.The patient was shifted to the fluoroscopy suite and, under local anesthesia, a Chiba needle was introduced through the anterior abdominal wall. Using 'down the barrel' fluoroscopy, the needle was passed up to the vertebral body, targeting the spinous process of D12. Gentle injection of nonionic contrast showed filling of the retroperitoneal lymphatic sacs and the thoracic duct. The duct was interrupted at the D4 level, with extravasation of contrast into a small prevertebral collection. This was suggestive of leak [Figure 3], and thoracic duct embolization was planned.

Before starting the puncture, an approximately 12% solution of Histoacryl® glue (3.5 ml Lipiodol and 0.5 ml n-butyl-2 cyanoacrylate) was prepared and kept ready. The lymphatic sac was punctured with the same technique described earlier, and the position was confirmed by injecting contrast. The glue preparation was now injected slowly through the puncture needle and the movement of the glue was watched closely. Glue was seen to fill the entire duct. When it entered the collection [Figure 4], the injection was stopped and the needle was withdrawn. No extravasation of glue occurred at the puncture site. The patient tolerated the procedure well. There were no procedure-related complications. The chest drainage decreased, and the serum albumin level rose to 1.5 mg/dl on the 8th day after the procedure. The chest catheter was removed on the 9th day after the procedure. At review in the outpatient department (OPD) two weeks later, he was doing well and had started gaining weight. Serum albumin values had risen to 2.2 g/dl and when reviewed at three months, he had gained weight without any evidence of ascites, pleural effusion or lower limb edema.

Discussion

The thoracic duct arises from the cisterna chyli, which is located anterior to the L1-L2 vertebral bodies. The duct courses in the midline, anterior to the thoracic vertebrae, crosses the midline at the D5 level and continues upwards to the C7 level, where it arches laterally and drains into the left subclavian vein at the jugulo-subclavian junction.[2] The very small caliber of the duct, the depth at which it lies, and frequent anatomical variations are responsible for the problems faced when attempting percutaneous access. In some patients, these structures are represented by multiple channels. Conventionally, opacification of the cisterna chyli and thoracic duct is achieved by performing bipedal lymphangiography, following which an appropriate segment of the duct is punctured under fluoroscopic guidance. Lymphangiograms are now being performed in very few centers. Both the equipment and skill to perform the procedure is scarce, which is a major impediment for the interventional radiologist attempting thoracic duct embolization.[3]

High-output chylothorax caused by thoracic duct leak occurs in 1%-4% of esophageal surgeries.[4-6] It initially presents as

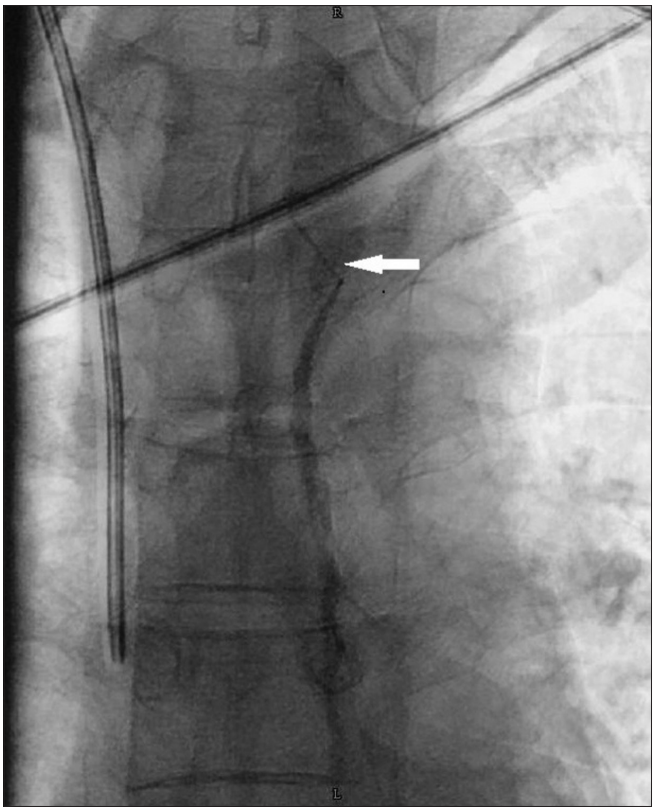

Figure 3: Frontal fluoroscopy image shows interruption of the thoracic duct at the D4 level, with contrast tracking out (arrow)

pleural effusion or persistent drainage through a chest tube. Pleural fluid triglyceride level>110 mg/dl is confirmatory.[7] Traditionally, low-output chylothorax (<1000 ml/day) is treated conservatively with total parental nutrition or a medium-chain fatty acid diet.[8] High-output chylothorax usually mandates early surgical ligation via an open or video-assisted technique.[9,10] In 1999, Cope *et al.* described a low-risk percutaneous approach forembolization of the thoracic duct via the cisterna chyli or retroperitoneal lymphatic vessels.[11] Later, several authors presented their experience in case reports and small series.[12-17] All these studies describe a two-step procedure for performing TDE. Bipedal lymphangiography is first performed, followed by percutaneous puncture of the duct. An 0.018" wire followed by a 3F microcatheter is introduced into the duct, and then embolization is done with a combination of coils and Histoacryl® glue. If the thoracic duct or lymphatic sacs are not satisfactorily visualized, or if the anatomy is not favorable, the percutaneous technique is abandoned.

MRI with a heavily T2W sequence as used in MRCP has shown greater sensitivity in identifying the cisterna chyli than is reported for lymphangiography and CT scan.[18] Erden *et al*,identified the abdominal confluence of lymphatic trunks and cisterna chyli in 96% of the cases.[18] Using lymphangiography, the classic appearance of the cisterna chyli was seen in 53%[19] whereas, with CT scan, it was seen

Figure 4: Frontal fluoroscopy images shows glue cast filling the thoracic duct and sealing the leak site (arrow)

in only 1.7% cases.[20] The heavily T2W sequences depict all stationary fluids in the body, irrespective of the location, as bright structures against a dark background. Because of its retrocrural location, the visualization of the duct will not be affected by overlap of other fluid-containing organs, diaphragmatic movements, or intestinal peristalsis. The major advantages of using MRCP sequences for visualizing and guiding percutaneous puncture include the avoidance of an invasive lymphangiography and its complications, the better rate of visualization of the thoracic duct and lymphatic channels than with bipedal lymphangiography, the three-dimensional visualization of thoracic duct anatomy, and the possibility of obtaining the anatomic information within minutes. The only significant disadvantage is the lack of a live roadmap (like a lymphangiographicallyopacified duct) at the time of puncture.

In this case, we successfully performed direct injection of glue through the puncture needle itself instead of attempting cannulation of the thoracic duct for glue injection. The thoracic duct is a delicate structure and

cannulation with a microcatheter can fail. We felt that cannulation can be safely avoided if good needle position and opacification of the thoracic duct are seen on contrast injection. In patients in whom cannulation was not possible, Cope *et al.* have reported successful management of chylothorax by disruption of the thoracic duct with multiple punctures. Boffa *et al.* could cannulate only 12 out of 22 lymphangiographically imaged thoracic ducts and proceeded with duct disruption in 10 cases.[21] They also reported that embolization is preferable to disruption.

To summarize, chylothorax is a challenging postoperative complication but can be effectively managed with percutaneous embolization. MRCP sequences allow quick and accurate localization of the cisterna chili and thoracic duct, and thus enable safe guidance for performing thoracic duct embolization.

Acknowledgement

Dr. O.V. Sudheer and other doctors of Gastro intestinal surgery department, AIMS.

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Cite this article as: Praveen A, Sreekumar KP, Nazar PK, Moorthy S. Technical Note: Thoracic duct embolization for treatment of chylothorax: A novel guidance technique for puncture using combined MRI and fluoroscopy. Indian J Radiol Imaging 2012;22:89-92.

Source of Support: Nil, **Conflict of Interest:** None declared.