

Feasibility of Ultrasound-guided Intranodal Lymphangiogram for Thoracic Duct Embolization

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ABSTRACT

Purpose: To show the feasibility of opacifying the thoracic duct using ultrasound-guided intranodal lymphangiogram (IL) for thoracic duct embolization (TDE).

Materials and Methods: Six patients (two women and four men, mean age, 59.2 y [range, 43–74 y]) underwent IL and TDE for chylothorax. Under ultrasound guidance, a needle was positioned in a groin lymph node, and lipiodol was injected. The thoracic duct was catheterized, and embolization was performed as indicated. Cumulative times from start of the procedure until initiation of the lymphangiogram, until identification of target lymphatic, until catheterization of the thoracic duct, and until completion of the procedure were collected. Times were compared with times of a control group of six patients (two women and four men, mean age, 66.7 y [range, 49–82 y]) who had undergone TDE using pedal lymphangiography (PL).

Results: The procedure of opacification, catheterization, and embolization of the thoracic duct was successful in all cases. Cumulative times (mean \pm standard deviation) in the IL and PL groups from start of the procedure until (i) initial lymphangiogram were 20.5 minutes \pm 8.6 and 46.5 minutes \pm 22.6, (ii) identification of a target lymphatic for catheterization were 60.5 minutes \pm 18.2 and 110.5 minutes \pm 31.6, (iii) catheterization of the thoracic duct were 79.0 minutes \pm 28.9 and 128.2 minutes \pm 37.0, and (iv) completion of procedure were 125.8 minutes \pm 49.0 and 152.8 minutes \pm 36.4.

Conclusions: IL is a feasible technique to visualize the thoracic duct for embolization. Using IL, the thoracic duct may be more quickly visualized and catheterized for TDE than with PL.

ABBREVIATIONS

IL = intranodal lymphangiography, PL = pedal lymphangiography, TDE = thoracic duct embolization

Thoracic duct embolization (TDE) is a percutaneous minimally invasive alternative to open surgical ligation of the thoracic duct for treating chylothorax of any etiology. The procedure has been successful on initial attempt in 73.8% of patients with nontraumatic etiologies and 71% of patients with post-traumatic chylothorax without appreciable morbidity or mortality (1,2). The traditional procedure involves bilateral pedal lymphangiography (PL) followed by trans-abdominal catheterization of the cisterna chyli or thoracic

duct. After catheterization, the thoracic duct is interrupted with embolization coils or *N*-butyl cyanoacrylate glue, or both, to stop the chyle leak (3).

PL is both time-consuming and technically challenging and remains a significant barrier to performing a TDE. Blind injection of the groin lymph nodes with lipiodol has been described previously as alternative to conventional lymphangiography (4). Rajebi et al (5) described intranodal lymphangiography (IL) in pediatric patients to image and treat lymphatic malformations. In one patient in their study, catheterization of the thoracic duct was attempted suggesting IL may be a feasible alternative to PL for TDE. We present our initial experience using ultrasound-guided IL to visualize the thoracic duct for embolization to treat chylothorax and compare ultrasound-guided IL with PL.

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MATERIALS AND METHODS

Health Insurance Portability and Accountability Act waiver and institutional review board approval were granted before beginning this study. A retrospective review was performed of six consecutive patients undergoing IL for TDE between

April and June 2011. All patients had symptomatic chylothorax including the following etiologies: postesophagectomy (one patient), postlobectomy (two patients), postcoronary artery bypass graft surgery (one patient), postthyroidectomy (one patient), and idiopathic (one patient). There were four men and two women with a mean age of 59.2 years (range, 43–74 y). The endpoint for technical success was catheterization and embolization of thoracic duct as indicated. The endpoint for clinical success was resolution of chylothorax. Patient follow-up examinations were performed 2 weeks after the procedure.

Ultrasound-guided Intranodal Lymphangiogram Technique

Ultrasound of the groin was performed to identify suitable lymph nodes. The size of the lymph node was not recorded. An inguinal node was directly accessed under ultrasound guidance with a 25-gauge or 26-gauge spinal needle (BD Medical, Franklin Lakes, New Jersey). To minimize needle movement, the needle was assembled before nodal access as follows: The stylet was removed, and the needle was attached to a 3-mL polycarbonate syringe (Merit Medical, South Jordan, Utah) and flushed with oil-based contrast agent (Ethiodol; Savage Laboratories, Melville, New York). The needle tip was positioned in the transitional zone between the cortex and hilum of the lymph node (**Fig 1**). A shallow angle for puncture was used to create a long subcutaneous tract to assist in stabilizing the needle. Under fluoroscopic guidance, contrast agent was injected by hand at a rate of about 1 mL per 5 minutes. Initial injection was observed under fluoroscopic guidance to identify the efferent lymphatic or lymph node to confirm proper positioning of the needle (**Fig 2a–d**). If the lymph node or its efferent lymphatics were not clearly identified or extravasation was observed, the position of the needle was adjusted or an adjacent lymph node was accessed. A lymph node in the opposite groin was accessed using the above-described steps of the technique. A total volume of approximately 3–6 mL of lipiodol was injected into each lymph node. Infusion of contrast agent was terminated when the lymphatics at approximately the L3 level were opacified. If at the end of the contrast injection the cisterna chyli was not visualized, the initial bolus was followed by injection of normal saline at 1 mL per 5 minutes to facilitate propagation of the contrast agent. The thoracic duct was then accessed, and embolization was performed as previously described (3).

Comparison between Pedal Lymphangiography and Intranodal Lymphangiography

One theoretical advantage of intranodal injection is decreasing TDE procedure time. We compared the IL group with the previous six consecutive patients who had undergone TDE using PL. This group consisted of two women and four men with a mean age of 66.7 years (range 49–82 y). All patients had symptomatic iatrogenic chylothorax including the following etiologies: post-thoracic aortic

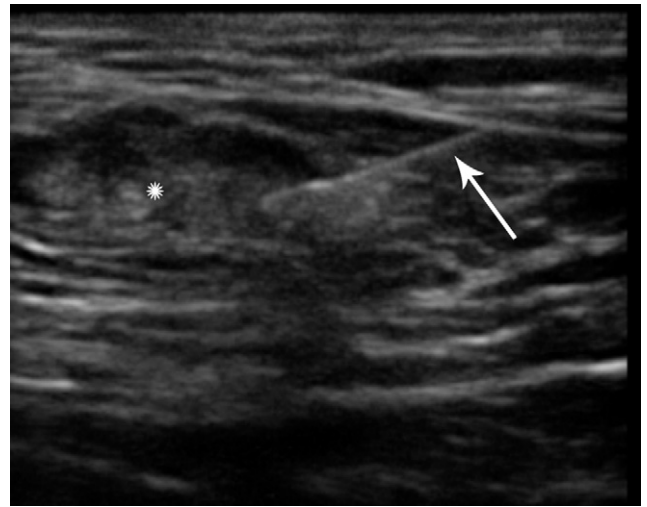


Figure 1. Ultrasound image shows access of the groin lymph node (star) with a needle (arrow).

repair (one patient), postlobectomy (two patients), postcoronary artery bypass graft surgery (two patients), and post-pericardial window surgery (one patient).

The cumulative times from the start of the procedure until (i) initiation of lymphangiogram, (ii) identification of a target lymphatic for catheterization, (iii) catheterization of the thoracic duct, and (iv) completion of the procedure (ie, total procedure time) were collected from the images and the procedure notes (**Table 1**). Additionally, the time spent on embolization of the thoracic duct was calculated by subtracting the cumulative time from the start of the procedure until catheterization of the thoracic duct from the total procedure time.

RESULTS

Ultrasound-guided IL was successful in all patients. All injections were performed uneventfully, with observation of small but inconsequential extravasation of the contrast agent from lymph node puncture sites. The lumbar lymphatics, cisterna chyli, and thoracic duct were visualized adequately and were catheterized successfully in all patients. Subsequently, the embolization was performed successfully in all patients for a technical success rate of 100%. Chylothorax resolved in five of the six patients for a clinical success rate of 83.3%. In the one patient in whom embolization failed to resolve the chylothorax, chylous ascites was later found to be the source of the chyle leak. No minor or major complications occurred. No patients reported pain or swelling in the inguinal region after the procedure or at initial follow-up examination 2 weeks later.

Comparison of procedure times suggested a reduction in portions of the TDE procedure in the IL group mainly because of a reduction of the time to access the lymphatic system and time to visualize the thoracic duct. The time

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