CLINICAL STUDY

US–Guided, Direct Puncture Retrograde Thoracic Duct Access, Lymphangiography, and Embolization: Feasibility and Efficacy

Carlos J. Guevara, MD, Kristy L. Rialon, MD, Raja S. Ramaswamy, MD, Seung K. Kim, MD, and Michael D. Darcy, MD

ABSTRACT

Purpose: To describe technical details, success rate, and advantages of direct puncture of the thoracic duct (TD) under direct ultrasound (US) guidance at venous insertion in the left neck.

Materials and Methods: All patients who underwent attempted thoracic duct embolization (TDE) via US-guided retrograde TD access in the left neck were retrospectively reviewed. Indications for lymphangiography were iatrogenic chyle leak, pulmonary lymphangiectasia, and plastic bronchitis. Ten patients with mean age 41.4 years (range, 21 d to 72 y) underwent US–guided TD access via the left neck. Technical details, procedural times, and clinical outcomes were evaluated. TD access time was defined as time from start of procedure to successful access of TD, and total procedural time was defined from start of procedure until TDE.

Results: All attempts at TD access via the neck were successful. Technical and clinical success of TDE was 60%. There were no complications. Mean TD access time was 17 minutes (range, 2–47 min), and mean total procedure time was 49 minutes (range, 25-69 min). Mean follow-up time was 5.4 months (range, 3–10 months).

Conclusions: TDE via US–guided access in the left neck is technically feasible and safe with a potential decrease in procedure time and elimination of oil-based contrast material.

ABBREVIATIONS

IJV = internal jugular vein, TD = thoracic duct, TDE = thoracic duct embolization

Percutaneous transabdominal thoracic duct embolization (TDE) is a minimally invasive technique to treat chylous leaks in the abdomen, chest, and neck that was first described by Cope in 1998 (1). Intranodal lymphangiography has recently replaced pedal lymphangiography because of its decrease in procedural times. Both techniques require the use of oil-based contrast material, which carries a small risk if injected at high volumes ($>$ 20 mL per procedure or 0.25 mL/kg) or if there is a right-to-left shunt (2–6). Alternative approaches to TDE have been described, including transvenous retrograde access of the thoracic duct (TD) and other lymphatic branches (7,8) and injection of the lymphatic leak with contrast material with retrograde opacification and cannulation of the TD under fluoroscopic guidance (9). These techniques have been used as a backup after pedal or intranodal lymphangiography has failed, and in the case of transvenous access, high technical success has been difficult to reproduce.

It is common to visualize the terminal portion of the TD as it inserts into the venous system at the base of the left neck during lymphangiography or ultrasound (US) of the left neck (10). The superficial location of the TD and the high accuracy in identifying the TD in the left neck under US guidance provides a route to access the central lymphatics without the need for oil-based contrast lymphangiography. The purpose of this study is to describe the technical details, clinical outcomes, and procedural times associated with US-guided direct puncture of the TD at its venous insertion in the left neck followed by TDE.

From the Mallinckrodt Institute of Radiology (C.J.G., R.S.R., S.K.K., M.D.D.), Washington University School of Medicine, 510 S. Kingshighway Boulevard, Box 8131, St. Louis, MO 63110; and Department of Surgery (K.L.R.), Duke University Medical Center, Durham, North Carolina. Received April 12, 2016; final revision received June 2, 2016; accepted June 25, 2016. **Address correspondence to** C.J.G.; E-mail: guevarac@mir.wustl.edu

M.D.D. receives personal fees from W.L. Gore & Associates (Flagstaff, Arizona). None of the other authors have identified a conflict of interest.

J Vasc Interv Radiol 2016; XX:▮▮▮–▮▮▮

http://dx.doi.org/10.1016/j.jvir.2016.06.030

MATERIALS AND METHODS

This institutional review board–approved, retrospective electronic medical review included all consecutive patients who underwent US-guided TD cannulation in the left neck and subsequent TDE between August 2015 and January 2016. Patients were excluded if they underwent TDE by transabdominal access after intranodal lymphangiography.

Patient Characteristics

Demographic data, etiology of lymphatic leak, technical details, procedural times, complications, and clinical outcomes were evaluated in 10 patients (3 female and 7 male) with a mean age of 41.4 years (range, 21 d to 72 y) (Table). Two patients were excluded because they underwent transabdominal TDE after oil-based intranodal lymphangiography without an attempt at left neck access.

In 9 of 10 patients, conservative measures to treat the lymphatic leak, which included octreotide, total parenteral nutrition, and drainage of the collection, failed. Patient 3 had a prior Fontan procedure with chronic plastic bronchitis and difficulty breathing. Despite serial bronchoscopy with lavage, inhalation of tissue plasminogen activator, and bronchodilators, the patient remained symptomatic.

Technique

General anesthesia was used in 4 procedures because of the patient's age or patient discomfort. The remaining 6 procedures were performed with moderate sedation.

The first 2 patients in the cohort underwent intranodal lymphangiography as described by Rajebi et al (3) and Nadolski and Itkin (4). Transabdominal cannulation of the TD was unsuccessful; however, the terminal portion of the TD in the left neck was opacified by contrast material and accessed under US guidance (Figs 1, 2). Following this initial experience, the remaining 8 patients underwent US-guided access of the terminal portion of the TD in the left neck without the need for intranodal lymphangiography. Before the procedure, cross-sectional imaging of the chest was reviewed to identify the TD insertion at the left venous angle (junction of the internal jugular vein [IJV] and the subclavian vein). The TD is located between the IJV and the left vertebral vein (Fig 3a–c). The linear probe was oriented in a position in which the needle trajectory would avoid arterial structures and would direct the needle away from the insertion site and toward the TD. In 2 patients, the TD was accessed through the IJV and into the TD, while orienting the US probe parallel to the IJV and the TD (Fig 3a–c).

After administration of local anesthesia, the TD was accessed with a 21-gauge micropuncture set (Cook, Inc, Bloomington, Indiana), and an 0.018-inch guide wire was advanced into the TD. The 3-F transitional dilator from the micropuncture set was advanced over the wire, and ioversol contrast agent (Optiray 300; Guerbet LLC, Bloomington, Indiana) was injected to confirm that the TD had been accessed (Fig 2). An 0.018-inch GLIDE WIRE GT Guidewire (Terumo Medical Corporation, Somerset, New Jersey) was advanced centrally into the TD within the mediastinum, and a 2.4-F PROGREAT (Terumo Medical Corporation) 130-cm microcatheter was advanced over the wire. If the wire did not advance freely down into the abdomen, contrast agent was injected to delineate the course of the TD. Once the microcatheter was located at the level of the cisterna chyli, images were obtained to study the TD and the area of chylous leak (Figs 4, 5a). Embolization of the duct was performed distal to the leak and central to the cisterna chyli with 3- to 6-mm Micronester coils (Cook, Inc). The microcatheter was then manipulated across the coil pack, and further embolization was performed with *N*-butyl cyanoacrylate (Depuy Synthes, West Chester, Pennsylvania) mixed with ethiodized oil (Lipiodol; Guerbet LLC) in a 1:1 ratio. Glue was injected across and proximal to the coil pack, followed by removal of the microcatheter (Fig 5b).

The technique for patients with TD injury in the left neck was modified only to obtain access into the TD central to the injury and not into the cisterna chyli. Embolization was performed proximal to the area of injury in the left neck by injecting *N*-butyl cyanoacrylate only or microcoils with Gelfoam (Pfizer, New York, New York).

Technical success for TD access was defined as the ability to successfully access the TD in the left neck under US guidance. TDE technical success was defined as the ability to access the TD in the left neck with US and subsequent embolization of the TD. Clinical success was defined as resolution of symptoms for which the procedure was performed. TD access time was defined as the time between the start of the procedure and successful cannulation of the duct, which was confirmed by contrast agent injection. Total procedural time was defined as the time between the start of the procedure to the moment where the microcatheter was removed after embolization.

RESULTS

Patient demographic information, etiology of lymphatic leak, and technical and clinical outcomes are summarized in the Table. The etiologies of the lymphatic leak were chylothorax secondary to radical left neck dissection, chyle leak in the left neck after parathyroid surgery, chylothorax secondary to esophageal surgery with gastric pull-through and TD ligation, chylothorax secondary to left lower lobe resection, plastic bronchitis in a patient with congenital heart disease and remote