Lymphatic IR: Chest

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【Introduction】

Traumatic lymphorrhea is a rare but potentially life-threatening complication. Post-operative lymphorrehea is the leading cause of traumatic lymphorrhea and can arise anywhere within the lymphatic system and manifest in various forms, from clear lymphatic fluid to chylous fluid (1). Lymphangiography itself has a therapeutic effect; however, the reported therapeutic efficacy of lymphangiography for post-operative lymphatic leakage is not so high. Therefore, adjunctive embolization techniques with glue in addition to lipiodol lymphangiography are essential.

Chylothorax associated with injury of the thoracic duct (TD) is a particularly difficult complication to manage. Treatment has traditionally consisted of conservative treatment and/or surgery (TD ligation, pleurodesis). Recently, thoracic duct embolization (TDE) has become a viable treatment alternative to open surgery due to its high success rate and minimal complications (2). More recently, modified TDE has been reported, including a retrograde approach from the subclavian vein (2). These kinds of treatment strategies must be selected based on the lymphatic anatomy and injury site. In this presentation, I would like to introduce the procedures of various kinds of lymphatic IR for chylothorax.

【Anatomy】

There are three distinct lymphatic systems that are different in function and fluid composition: liver, intestinal, and soft tissue lymphatic systems. The cisterna chyli receives lymph from the right and left lumbar trunks, hepatic lymphatics, and intestinal trunk. The TD carries 1–2 L of lymphatic fluid a day; 80% of this fluid comes from intestinal and hepatic lymphatic ducts. The TD is the largest lymphatic duct in the body, measuring up to 45 cm in length and 2 to 5 mm in diameter. The TD begins from the CC and enters the thoracic cavity at the aortic hiatus, with the aorta on its left and the azygos vein on its right.

【Chyrothorax】

Chylothorax results from the leakage of intestinal lymphatic fluid from the TD and its tributaries. The most common cause of the chylous leak is iatrogenic, particularly thoracic or abdominal surgery. It has been reported to occur at a rate of 0.42% for all general thoracic surgery procedures (3).
Traditionally, low-output chylothorax (<1000 mL/d) is treated conservatively with total parental nutrition (4). High-output chylothorax usually mandates early surgical ligation via an open or video technique (5-6).

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【History of TDE】
TDE is developed by the fathers of Interventional Radiology, Dr. Constantine Cope. Initially, Cope tested the feasibility of TD cannulation in a porcine model (7). In his next animal experiment, the TD and cisterna chyli (CC) were lacerated and embolized with metal and platinum coils (8). In 1998, Cope published TDE results on his first five human patients (9).

【Anatomical variation of TD and CC】
Several classifications have been developed to describe commonly seen anatomic variations. Among them, Johnson et al. described the useful anatomical variations of the TD/cisterna chyli based on clinical relevance: normal, complete left-sided course, complete right-sided course, proximal and distal duplications, plexiform variation and total absence of the cisterna chyli (10).

【Technique of TDE】
TDE consists of three parts: lymphangiography, access to the TD, and embolization of the TD.

1) Lymphangiography
The traditional procedure was bilateral pedal lymphangiography (PL), which is both time-consuming and technically challenging and remains a significant barrier to performing a TDE. Ultrasound-guided intranodal lymphangiography (IL) is alternative

method to PL (11, 12). Ultrasound of the groin is performed to identify suitable lymph nodes. Then, an inguinal node is directly punctured under ultrasound guidance with a 23-gauge needle. The needle tip should be positioned in the transitional zone between the cortex and hilum of the lymph node. Under fluoroscopic guidance, lipiodol is injected by hand at a rate of about 1 mL per 5 minutes.

2) Access to the TD
Transabdominal direct puncture of the TD or CC is the first choice when intranodal lymphangiography confirms a normal anatomy. When an anatomical variation of the TD is revealed by IL, a safe and feasible access route should immediately be confirmed by subsequent plain CT/cone-beam CT after lymphangiography. A left-sided TD/CC or a duplicated TD located close to, or behind the aorta confers the potential risk of penetrating the aorta during direct puncture under fluoroscopy. Direct puncture of the TD would be technically demanding if IL reveals a thin TD with no cisterna chyli. Transabdominal access might be feasible in this circumstance, but the CT-guided translumbar approach should be considered. After the puncture of the TD, the guidewire is inserted into the TD. Then, a microcatheter can be advanced over-the-wire proximal to the source of a chyle leak.
The transabdominal approach is difficult when patients have anatomical anomalies such as a complete left-sided TD or a plexiform variation. Therefore, the percutaneous transvenous retrograde approach via the basilica or cephalic vein through the ostial valve of the TD is an option (13). With reference to lymphangiography, a 4-F or 5-F pre-shaped catheter such as a RIM should be attached to the ostial valve at the junction and then a microcatheter and a 0.016-inch guidewire can be coaxially introduced and advanced into the lower thoracic duct.

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【Modified TDE】

1) Retrograde transvenous approach
At first, lymphangiography from the groin lymph node is performed. Based on the finding of lymphangiography, the TD is cannulated through the subclavian vein. At the termination of the TD, there exists a valve. Therefore, cannulation of the TD is a technically challenging procedure. After successful cannulation of the TD, a microcatheter is advanced into the TD. Then, lymphangiography through the microcatheter is performed to visualize the leakage point. Finally, embolization of a leakage point is performed using glue and/or coils.

2) CT guided puncture of the TD
When transabdominal puncture of the TD is impossible, CT-guided puncture of the TD/tributaries is performed. Glue injection through the puncture needle is performed.

【Complications of TDE】
With the growing experience of TD embolization for chylothorax, complications of the procedure, although rare, are now being recognized. Itkin et al (13) reported 3 minor complications out of 106 procedures, which includes asymptomatic embolization of the pulmonary artery with glue and 2 cases of leg edema and pedal suture dehiscence that resulted in would infections. The leg edema eventually subsided, and the infections were cured with local care and antibiotics. Laslett et al (16) retrospectively evaluated the delayed complications after technically successful TDE. Mean length of follow-up was 34 months. Among 49 patients, four of 49 patients (8%) had chronic leg swelling that was probably related to the procedure, three (6%) had abdominal swelling, and six (12%) had chronic diarrhea. As for abdominal swelling, they concluded that swelling was considered to be unrelated to the procedure. In two patients with diarrhea, diarrhea was considered to result from another reason. Two of the four cases of probably-related diarrhea were severe and required medication. Given the well-known significant mortality and morbidity of untreated chylothorax, TDE can be a feasible treatment option for chylothorax.

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Ref

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