Thoracic Duct Embolization
Technique & Results

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• No relevant financial relationship reported
– Case
– How to do TDE
  • Pre-TDE Evaluation
  • Techniques
  • Post-TDE Follow-up
– Clinical Results
– Conclusion
Case
• 51 F
  – Pulmonary lymphangioleiomyomatosis
  – Asymptomatic for 48 yrs
  – Symptomatic chylous effusion started in 2013
  – 1-2 thoracentesis/week
  – On Sirolimus for LAM
  – No change on her chylous effusion
  – IR intervention requested

What can we do for her??
How To Do TDE...
• **Pre-TDE Evaluation:**
  
  – Fluid evaluation
    • Confirm diagnosis of chylous fluid (> 110 mg/dL Triglyceride)
  
  – Conservative Treatment
    • Thoracentesis; Fluid resuscitation; low fat/MCT diet/TPN
  
  – Evaluation of recent images (pelvic CT or US)
    • Groin lymph node mapping
Recent abdominal/pelvis CT
1. Pedal or Intranodal lymphangiogram
2. Trans-abdominal Cysterna Chyli Cannulation
3. Thoracic Duct Catheterization
4. Coil or Glue Embolization
Materials & Methods:

- Moderate sedation
- Abx = cefazolin 1 gm IV x 1
- 1% Isosulfan Blue + 1% Lidocaine or 1% Methylene Blue + 1% Lidocaine
  (ONLY FOR PEDAL LYMPHANGIOGRAM)
- 30G needle (Cook Inc.)
  (ONLY FOR PEDAL LYMPHANGIOGRAM)
- ~ 20 mL of Ethiodol or Lipidol
- If cisterna chyli is not opacified, 20 mL of saline can be injected.
- 21 or 22G, 15 or 20 cm Chiba needle
- Trans-abdominal approach
- Stiff 0.018 wire – V18, NITREX
- Microcatheter
- Iodinated water-soluble contrast – to identify the leak
- Embolization above (if possible) and below the leak
- Coils, Trufill (1:2.5 with Ethiodol); probably not Onyx.
Techniques

Injection of 50:50 solution of 1% Lymphazurin (methylene blue) & 1% Lidocaine into the web of feet (Red Arrows)

10-30 min to see the streaks of lymphatics (Black arrows)

Carefully dissect the pedal lymphatic.
Cannulation of lymphatics with 30G lymphangiogram Needle (Cook Medical)

- Use a magnifying Loop to cannulate
- Stick the lymphatics out of the skin and cannulate

Lee EW et al. Korean J Radiol 2014
Inject Lipiodol through the cannulated lymphatics

Usually < 20 cc of Lipiodol

If needed, can bolus 20 cc saline to push the Lipiodol

Identify the Cisterna Chyli
Pedal Lymphangiogram....

TDE Techniques
Ultrasound surveillance of bilateral groins

US guided cannulation of groin lymph node using 25G x 2 or 3 inch spinal needle
Intranodal Lymphangiogram

25G spinal needle access

Lipiodol injection at 12 cc/Hr rate using Hobbs Lymphangiogram Pump or anesthesia infusion pump.
Spot lymphangiogram images every 5-10 mins
Identifying Cisterna Chyli or the largest lymphatics
Identifying lymphatic leaks
Trans-abdominal Cisterna Chyli Cannulation

1. 22G Chiba

2. Stiff 014 or 018 microwire (Nitrex, V14, V18)
Embolization of lymphatic leak

1. 018 microcoils
2. Pushable vs. Detachable
Embolization of thoracic duct and lymphatic leak

1. n-BCA Glue
2. Onyx???
Post-TDE Follow Up:

- 2-4 days of inpatient monitoring
- Routine lab
- Imaging (CXR/KUB) follow up in 1-2 days
- CT follow up in high risk patients or concerning for complications
- Routine thoracic surgery or pulmonology follow ups
Clinical Results

• 1995: Swine study by Dr. Constantine Cope (JVIR 1995)

• 1996: Swine/Canine study by Dr. Constantine Cope (JVIR 1996)
• 1998: First 5 Pts U Penn (JVIR)
• 1999: 11 Pts U Penn (JVIR)
• 2002: 42 Pts U Penn (JVIR)
• 2009: 109 Pts in U Penn (J Thorac Cardiovasc Surg) Dr. Itkin
• 2014: 105 Pts in BWH (JVIR)
• 2016: 40 Patients in UCLA
Nonoperative thoracic duct embolization for traumatic thoracic duct leak: Experience in 109 patients

Maxim Itkin, MD, John C. Kucharczuk, MD, Andrew Kwak, MD, Scott O. Trerotola, MD, and Larry R. Kaiser, MD

**Results:** A total of 106 patients presented with chylothorax, 1 patient presented with chylopericardium, and 2 patients presented with cervical lymphocele. Twenty patients (18%) had previous failed thoracic duct ligation. In 108 of 109 patients, a lymphangiogram was successful. Catheterization of the thoracic duct was achieved in 73 patients (67%). In 71 of these 73 patients, embolization of the thoracic duct was performed. Endovascular coils or liquid embolic agent was used to occlude the thoracic duct. In 18 of 33 cases of unsuccessful catheterization, thoracic duct needle interruption was attempted below the diaphragm. Resolution of the chyle leak was observed in 64 of 71 patients (90%) post-embolization. Needle interruption of the thoracic duct was successful in 13 of 18 patients (72%). In 17 of the 20 patients who had previous attempts at thoracic duct ligation, embolization or interruption was attempted and successful in 15 (88%). The overall success rate for the entire series was 71% (77/109). There were 3 (3%) minor complications.

**Conclusion:** Catheter embolization or needle interruption of the thoracic duct is safe, feasible, and successful in eliminating a high-output chyle leak in the majority (71%) of patients. This minimally invasive, although technically challenging, procedure should be the initial approach for the treatment of a traumatic chylothorax. (J Thorac Cardiovasc Surg 2010;139:584-90)

- 106 pts in 13 yrs
- Technical Success rate = 67% (73/106)
- Clinical Success rate = 90% (64/71)
- Complications = 3% (PE, leg edema)
Nonoperative thoracic duct embolization for traumatic thoracic duct leak: Experience in 109 patients

Maxim Itkin, MD, a John C. Kucharczuk, M.D., a Andrew Kwak, MD, a Scott O. Trerotola, MD, a and Larry R. Kaiser, MD

Patient Characteristics

<table>
<thead>
<tr>
<th>Procedures</th>
<th>Count</th>
<th>Details</th>
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<tbody>
<tr>
<td>Mediastinal surgery</td>
<td>36</td>
<td>(31 esophectomy)</td>
</tr>
<tr>
<td>Pulmonary surgery</td>
<td>33</td>
<td>(29 lung for Cancer)</td>
</tr>
<tr>
<td>Cardiac surgery</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Aortic surgery</td>
<td>11</td>
<td></td>
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<tr>
<td>Head and Neck</td>
<td>5</td>
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<tr>
<td>Trauma</td>
<td>4</td>
<td></td>
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<tr>
<td>Spinal surgery</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>109</strong></td>
<td></td>
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</tbody>
</table>
TDE
Clinical Results

Thoracic Duct Embolization for Nontraumatic Chylous Effusion
Experience in 34 Patients

Gregory J. Nadolski, MD; and Maxim Itkin, MD

- 34 pts in 13 yrs
- Technical Success rate = 71% (24/34)
- Clinical Success rate = 16 – 75 % depends on underlying lymphangiographic findings
• 105 pts in 9 yrs (53 TDEs; 42 TDDs)
• Technical Success rate = 79% (95/120)
• Clinical Success rate = 72% (38/53)
• Minor Complications = 6.7% (2 PE, 1 PVT, 2 retained wires)
Feasibility of Ultrasound-guided Intranodal Lymphangiogram for Thoracic Duct Embolization

Gregory J. Nadolski, MD, and Maxim Itkin, MD

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 ± standard deviation) in the IL and PL groups from start of the procedure until (i) initial lymphangiogram were 20.5 minutes ± 8.6 and 46.5 minutes ± 22.6, (ii) identification of a target lymphatic for catheterization were 60.5 minutes ± 18.2 and 110.5 minutes ± 31.6, (iii) catheterization of the thoracic duct were 79.0 minutes ± 28.9 and 128.2 minutes ± 37.0, and (iv) completion of procedure were 125.8 minutes ± 49.0 and 152.8 minutes ± 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.
Percutaneous Transvenous Embolization of the Thoracic Duct in the Treatment of Chylothorax in Two Patients

From: Yuya Koike, MD
Chihiro Hirai, MD
Jun-ichi Nishimura, MD, PhD
Nobukazu Moriya, MD
Yasushi Katsumata, MD, PhD

Koike et al. JVIR 2012
N = 40 (from 2012-2016)

Technical Success

- Lymphangiogram = 38/40 (95%)
- TD Cannulation = 32/40 (80%)
- TD Embolization = 30/32 (94%)

Clinical Outcome

- Improvement of chylothorax (Trig<100) = 29/32 (91%)
- Complete resolution of chylothorax = 28/32 (88%)

Complications = 5/40 (12.5%)

- Infection, non-symptomatic Lipiodol PE, Leg edema
TDE:

1. Not easy but Safe, effective, and reproducible.

2. Significant impact on patient care; potentially a life-saving procedure.
THANK YOU

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