Management of Chyle Leak

Rajeev H. Mehta, MD, FACS

IBAB 2014

Tucson, AZ
Thoracic Duct (TD) Anatomy

- Runs in the posterior mediastinum along the anterior aspect of vertebral bodies
- Run on the right side of the esophagus crosses to the left at T5/T6 vertebra.
- Enters the neck posterior to the left common carotid artery
- Arches superior, anterior, and lateral to form a loop (anterior to vertebral artery and thyrocervical trunk)
- Courses between IJ vein and anterior scalene muscle superficial to the phrenic nerve.

Termination of Thoracic Duct

- Usually 3-5 cm above the clavicle (can be up to 8 cm)
- Average diameter 2-4 mm
- Duct opening is always within 2 cm of the IJ-subclavian vein junction
- There is always a valve in the distal 1 cm to prevent retrograde flow of venous blood.

Termination of Thoracic Duct

- Greenfield & Gottlieb study: Terminal portion is quite variable: — 60% entered IJV, — 34% entered subclavian

- Kinnaert study: — 13% single duct, — 66% multiple channels ending as a short common duct, — 21% multiple channels ending separately

- Rarely, TD rarely does not cross midline and ends in right IJ vein

Anatomy of Thoracic Duct

Upper

Middle

Lower
Right Lymphatic Duct

- A single duct on the right side is rare (< 5%).
- Consists of multiple trunks terminating separately in the region of the right IJ vein-subclavian vein junction. (More protected as it usually lies under the subclavian vein.)
- Does not arch into the neck so leaks are less common & smaller
Composition of Chyle

- Protein (3% or > 30 g/L) - mostly albumin (plasma is 6%)
- Electrolytes - similar to plasma but lower calcium
- Emulsified fats (1-3%), mostly TG (4-40 g/L)
- Glucose level similar to plasma
- Cells — mainly T lymphocytes
Composition of Chyle

- Also contains pancreatic enzymes — amylase, lipase, acid phosphatase, alkaline phosphotase, and transaminases.

- Daily drainage 2-4 liters (but can increase up to 8 liters); increases with movement, peristalsis, breathing, coughing, straining, & fatty meal.

- Pressure can reach up to 28 cm H₂O.
Physiology of Chyle

- Long chain Triglycerides (LCTG) (70% of dietary fat) enters the blood via chyle
- Medium and short chain TG are absorbed directly into the portal circulation
- MCT = 12 carbon atoms or less
Factors Affecting Chyle Flow and Composition

- TD has muscular wall contracting every 10-15 seconds, controlled by autonomic nervous system. Vagal stimulation and acetylcholine vasoconstricts TD; epinephrine dilates TD.

- Water by mouth can increase the flow of chyle by 20%.

Diagnosis of Chyle Leak

• Incidence of chyle leak 1-2.5% after neck dissection mostly on the left side (75-92%)

• Fluid with triglyceride level > 100 mg/dl or greater than serum level

• Chylomicrons > 4% (up to 4% can be from fat breakdown during normal healing)

• Micro exam: presence of fat globules (which clear with alkali and ether or stain with Sudan III) and chylomicrons is diagnostic.

• Increased drainage with initiation of enteral diet. Cream challenge (cream with methylene blue) — rate of passage of ingested fat is about 1.5 hours & peaks at 6 hours
Complications of Chyle Leak

- Weakness, dehydration, edema, immune deficiency
- Low sodium, chloride, protein, and WBCs (T cells)
- Skin flap induration/necrosis and delayed wound healing
- Carotid blowout
- Chylothorax (chyle in pleural space)
- Prolonged hospitalization
Medical Mgmt of Chyle Leak
(Cure rate of 30-80%)

- Drain and/or serial aspirations (pressure dressings not recommended due to risk of flap necrosis)
- Bedrest
- Monitor fluids, electrolytes, albumin, hemoglobin
- Diet modification - enteral vs. PPN vs. TPN

Medical Mgmt of Chyle Leak

- MCT enteral feedings:
  - Portagen (87% MCT & 13% LCT)
  - Monogen (93% MCT & only 7% LCT) tastes better & better G.I. tolerance
- Fat soluble vitamins A, D, E, K need to supplemented as well
<table>
<thead>
<tr>
<th>ENTERAL FORMULA</th>
<th>KCAL/L</th>
<th>MCT/LCT%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monogen (powder)</td>
<td>735</td>
<td>93/7</td>
</tr>
<tr>
<td>Optimental</td>
<td>1000</td>
<td>28/72</td>
</tr>
<tr>
<td>Peptamen</td>
<td>1000</td>
<td>70/30</td>
</tr>
<tr>
<td>Peptamen AF</td>
<td>1200</td>
<td>50/50</td>
</tr>
<tr>
<td>Peptamen 1.5</td>
<td>1500</td>
<td>70/30</td>
</tr>
<tr>
<td>Perative</td>
<td>1300</td>
<td>40/60</td>
</tr>
<tr>
<td>Portagen (powder)</td>
<td>1000</td>
<td>87/13</td>
</tr>
<tr>
<td>Vital HN (powder)</td>
<td>1000</td>
<td>48/52</td>
</tr>
<tr>
<td>Vital HN 1.5</td>
<td>1500</td>
<td>47/53</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FAT FREE SUPPLEMENTS</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource Fruit Beverage</td>
<td>1060</td>
<td>0</td>
</tr>
<tr>
<td>Enlive!</td>
<td>1250</td>
<td>0</td>
</tr>
<tr>
<td>Boost Breeze</td>
<td>680</td>
<td>0</td>
</tr>
</tbody>
</table>

Essential Fatty Acids (EFA)

- Primary EFA is linoleic acid from which the body can make arachadonic acid and linolenic acid.

- Fat free diet will cause EFA deficiency in 2-4 weeks
  - skin lesions/eczema, impaired wound healing, thrombocytopenia, growth problems in children

- MCT oil does not provide adequate EFA

- Fun fact: IV propofol (Diprivan) 150ml is adequate source of daily EFA
# Oils with EFA

<table>
<thead>
<tr>
<th>OIL</th>
<th>GRAMS PER TEASPOON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flaxseed</td>
<td>3.3</td>
</tr>
<tr>
<td>Sunflower</td>
<td>3.3</td>
</tr>
<tr>
<td>Walnut</td>
<td>3.3</td>
</tr>
<tr>
<td>Wheat germ</td>
<td>3.1</td>
</tr>
<tr>
<td>Soybean</td>
<td>2.9</td>
</tr>
<tr>
<td>Corn</td>
<td>2.7</td>
</tr>
<tr>
<td>Canola</td>
<td>1.5</td>
</tr>
<tr>
<td>Almond</td>
<td>0.9</td>
</tr>
<tr>
<td>Olive</td>
<td>0.5</td>
</tr>
</tbody>
</table>
Minimally Invasive Mgmt of Chyle Leak

• Somatostatin/octreotide, midodrine, orlistat

• Negative-pressure wound therapy

• Sclerotherapy

• Percutaneous lymphangiography-guided cannulation with TD embolization and needle disruption

• Thorascopic TD ligation
Medical Mgmt of Chyle Leak
Somatostatin/Octreotide

- Octreotide = long-acting synthetic analog of somatostatin, resolved within 24 hours after two weeks of leak
- decreases pancreatic and GI secretions
- reduces hepatic venous pressure & splanchnic blood flow
- reduces TD lymph flow rate and TG ratio (lymph to serum)
  - IV somatostatin 3.5 to 7 ug/kg/hr or SQ octreotide 0.1- 0.5 mg q 8 h x 6-8d
- complications - increases gallstones, abdominal pain, steatorrhea

Medical Mgmt of Chyle Leak
Midodrine

• alpha-1 agonist (also Etilefrine but not commercially available in the U.S.)

• readily available, oral drug used in treating orthostatic and hemodialysis induced hypotension

• causes contraction of lymphatic vessels —> reduced flow

• case report of persistent leak of 52 days, reduced flow within 24 hours and complete resolution after 4 days

Medical Mgmt of Chyle Leak
Orlistat

- 120mg TID (a half hour before meals)
- pancreatic lipase inhibitor, (used as an outpatient)
- lipase breaks down fat in duodenum, so orlistat blocks intestinal absorption of fat
- side effects = steatorrhea, fecal urgency, abdominal discomfort

Medical Mgmt of Chyle Leak
Negative-pressure wound therapy

- High pressure -600 mmHg better than low pressure -125 mmHg; (4 vs 7 days)

- 14 Fr NGT gauze-covered tip to reduce risk of blowout

Wu G et al. Prospective randomized trial of high vs low negative pressure suction in mgmt of chyle fistula after neck dissection for metastatic thyroid carcinoma. Head & Neck, Dec 2012, 1711-5.
Minimally Invasive Mgmt
Sclerotherapy

• tetracycline, doxycycline — neurotoxic to vagus or phrenic

• povidone/iodine
  
  • 30 ml 10% povidone/iodine via catheter clamped for 30 min BID

• OK-432 (lyophilized Strep progenies)—works well for lymphoceles
  
  • Intralesional injection of 0.1-0.2 mg OK-432 in 10 ml saline after aspiration of fluid (4/4 lymphoceles resolved)

• low grade fever & local pain after injection of OK-432


Minimally Invasive Mgmt
Percutaneous TDE & needle interruption

- Percutaneous lymphangiography-guided cannulation with embolization of TD

- 109 patients, success rate = 71% (30% not catheterizable due to previous abdominal surgery, anomalies, diseased lymphatics, etc.)

- First pedal lymphography (tedious) to opacify large retroperitoneal lymph vessels (right arm if right lymphatic duct), then a duct > 2mm is cannulated transabdominally with fluoro, then TD embolized.

Minimally Invasive Mgmt
Thorascopic Ligation of TD

- **Thorascopic** TD ligation (VATS = video-assisted thorascopic surgery)

  - Right sided thorascopic approach just above the diaphragm between the azygos vein & aorta

  - Mass ligation vs. selective TD ligation with frozen section confirmation

- **Laparascopic** TD Ligation just below the diaphragm (if thorascopic approach fails)


Indications for Surgery
(Controversial)

• Spiro et al. — 14 leaks, >600 mls in 24 hrs

• Southwestern — 15 leaks—24 hr > 1000 mls

• Crumley & Smith — 12 leaks—24 hr > 500 mls x 4 days

• Dugue — 14 leaks — 10 ml/kg/24 hr x @ POD#5

• Zabeck — immediate repair for >900 ml / 24 h

Adjunctive Measures to Surgery

- Trendelenburg position with Valsalva, & cream per NG
- Loupe or microscope magnification
- Gelfoam pledgets, vicryl mesh, or acid cellulose (Surgicel)
- Fibrin glue (Tisseel or Tissucol Kit) or cyanoacrylate glue (Histoacryl/Dermabond) — apply abx eye ointment to carotid, IJV and vagus to protect these structures (exothermic reaction)
- Local muscle flap (SCM, scalene, omohyoid, pec flap)

Take Home Points

• TD anatomy is unpredictable in 50% of patients predisposing them to surgical trauma

• Enteral feeding of choice is Monogen; add EFA if more than 2-4 weeks

• Place drain to high wall suction

• Use somatostatin/octreotide, midodrine, & orlistat
Take Home Points

• Consider NPO with PPN or TPN

• >1000 ml chyle in 24 hrs or complications => early surgical intervention

• With neck exploration, use clips/sutures, Surgicel, Tisseel/Dermabond, and local muscle flap

• Rare problem with many possible treatment options makes standardization of optimal mgmt difficult.