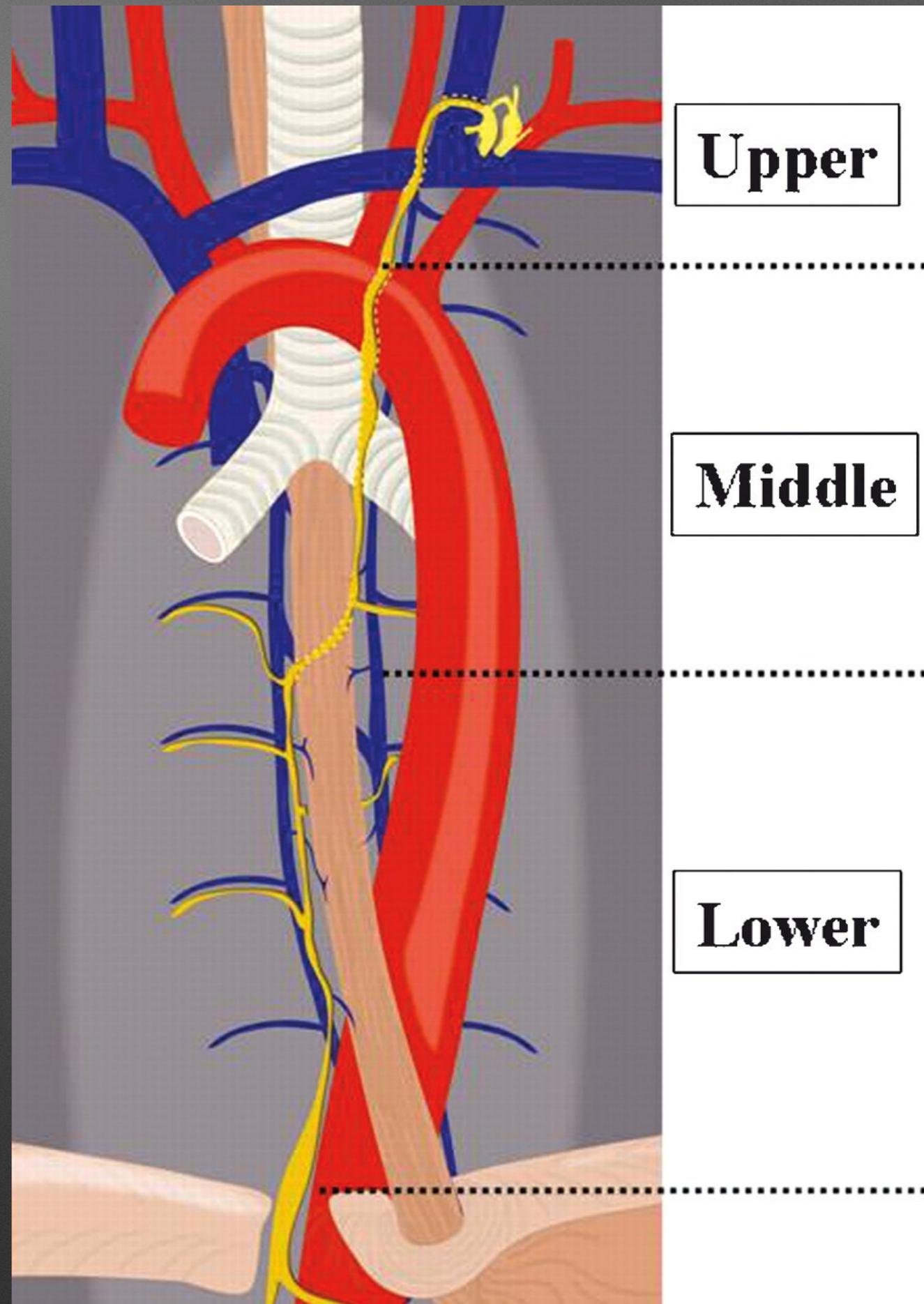


Management of Chyle Leak

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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.

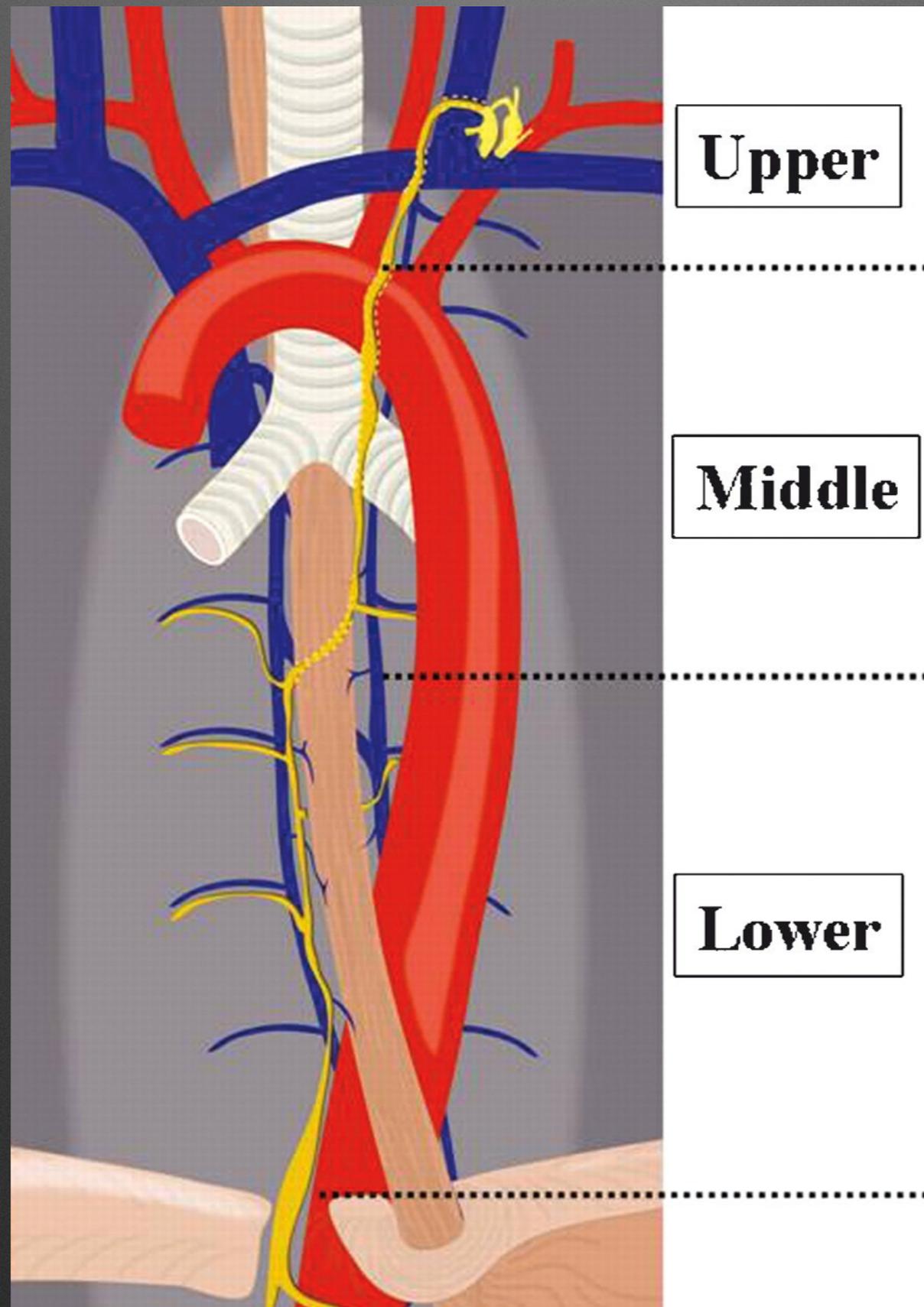
Termination of Thoracic Duct

- 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 1cm 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



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 phosphatase, 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 be supplemented as well

ENTERAL FORMULA	KCAL/L	MCT/LCT%
Monogen (powder)	735	93/7
Optimental	1000	28/72
Peptamen	1000	70/30
Peptamen AF	1200	50/50
Peptamen 1.5	1500	70/30
Perative	1300	40/60
Portagen (powder)	1000	87/13
Vital HN (powder)	1000	48/52
Vital HN 1.5	1500	47/53
FAT FREE SUPPLEMENTS		
Resource Fruit Beverage	1060	0
Enlive!	1250	0
Boost Breeze	680	0

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

OIL	GRAMS PER TEASPOON
Flaxseed	3.3
Sunflower	3.3
Walnut	3.3
Wheat germ	3.1
Soybean	2.9
Corn	2.7
Canola	1.5
Almond	0.9
Olive	0.5

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

Nyquist GG et al. Octreotide in the medical mgmt of chyle fistula. *Otolaryngology-Head & Neck Surgery* 128(6), 2003, 910-911.

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.

Coskun A et al. Somatostatin in medical mgmt of chyle fistula after neck dissection for papillary thyroid carcinoma. *Am J of Oto-Head & Neck Medicine & Surgery*, 31 (2010) 395-6.

Kadota H, et al. Mgmt of chylous fistula after neck dissection using negative-pressure wound therapy: A preliminary report. *Laryngoscope* 122: May 2012, 997-9.

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

Seelig MH et al. Treatment of a postoperative cervical chylous lymphocele by percutaneous sclerosing with povidone-iodine. *Journal of Vascular Surgery* 27(6), June 1998, 1148-51.

Roh JL, Park CI. OK-432 sclerotherapy of cervical chylous lymphocele after neck dissection. *Laryngoscope* 2008; 118: 999-1002.

Huang PM, Lee YC. A new technique of continuous pleural irrigation with minocycline administration for refractory chylothorax. *Thorac Cardiovasc Surg* 2011; 59: 436-438.

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.

Cope C. Mgmt of chylothorax via percutaneous embolization. *Current Opinion in Pulmonary Medicine* 2004, 10:311-314.

Itkin M et al. Nonoperative thoracic duct embolization for traumatic thoracic duct leak: Experience in 109 patients. *The Journal of Thoracic and Cardiovascular Surgery*, March 2010, 584-590.

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)

Ilczyszyn A et al. Mgmt of chyle leak post neck dissection: A case report and literature review. *Journal of Plastic, Reconstructive & Aesthetic Surgery* 2011, 64:e223-30.

Icaza OJ Jr. et al. Laparoscopic ligation of the thoracic duct in management of chylothorax. *Journal of Laparoendoscopic & Advanced Surgical Techniques. Part A.* 12(2): 2002 Apr.129-133.

Van Natta TL et al. Thorascopic thoracic duct ligation for persistent cervical chyle leak: Utility of immediate pathologic confirmation. *Journal of the Society of Laparoendoscopic Surgeons* (2009) 13:430-432.

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

Spiro JD et al. The mgmt of Chyle Fistula. Laryngoscope 100: July 1990, p. 771-4.

Nussenbaum B et al. Systematic mgmt of chyle fistula: The Southwestern experience and review of the literature. Head & Neck Surgery: January 2000, p. 31-8.

Crumley RL, Smith JD. Postoperative chylous fistula prevention and management. Laryngoscope 1976; 86: 804-13.

Dugue L et al. British Journal of Surgery 1998, 85, 1147-49

Zabeck H et al. Mgmt of chylothorax in adults: When is surgery indicated? Thorac Cardiovasc Surg 2011; 59: 243-246.

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)

Blythe JN et al. Use of N-butyl-2-cyanoacrylate tissue glue in thoracic duct injury during neck dissection surgery. *British Journal of Oral & Maxillofacial Surgery* 49(2011) 486-487.

Zhengjiang L. et al. Omohyoid muscle flap in prevention of chyle fistula. *J Oral Maxillofac Surg* 65: 2007, 1430-1432.

Qureshi SS et al. A novel technique of mgmt of high output chyle leak after neck dissection. (SCM) *Journal of Surgical Oncology* 2007; 96: 176-177.

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.