Management of Chylothorax

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Case Presentation

CC

- xx yo AA F presented to KCHC on xxxx with three weeks of worsening productive cough, and three days of fever and chills.
- She denied chest pain or SOB.

Case Presentation

PMH

- Recent diagnosis of RUL adenocarcinoma of the lung.
- Osteopenia

Case Presentation

- Meds: ASA, Fosamax
- PSH: None
- NKDA
- Social: 20 pack year Hx (quit smoking 4 years prior). No EtOH. No IVDA.

Case Presentation

PE

- Vitals: T 100.8, BP 103/67, HR 98, RR 18
- Gen: Well appearing. No respiratory distress.
- HEENT: No LAD.
- Heart: RRR, S1S2
- Chest: RUL decreased air entry, dull to percussion, + egophany, + rales BL
- Abd: Soft, non-tender, no mass.
- Ext: No C/C/E

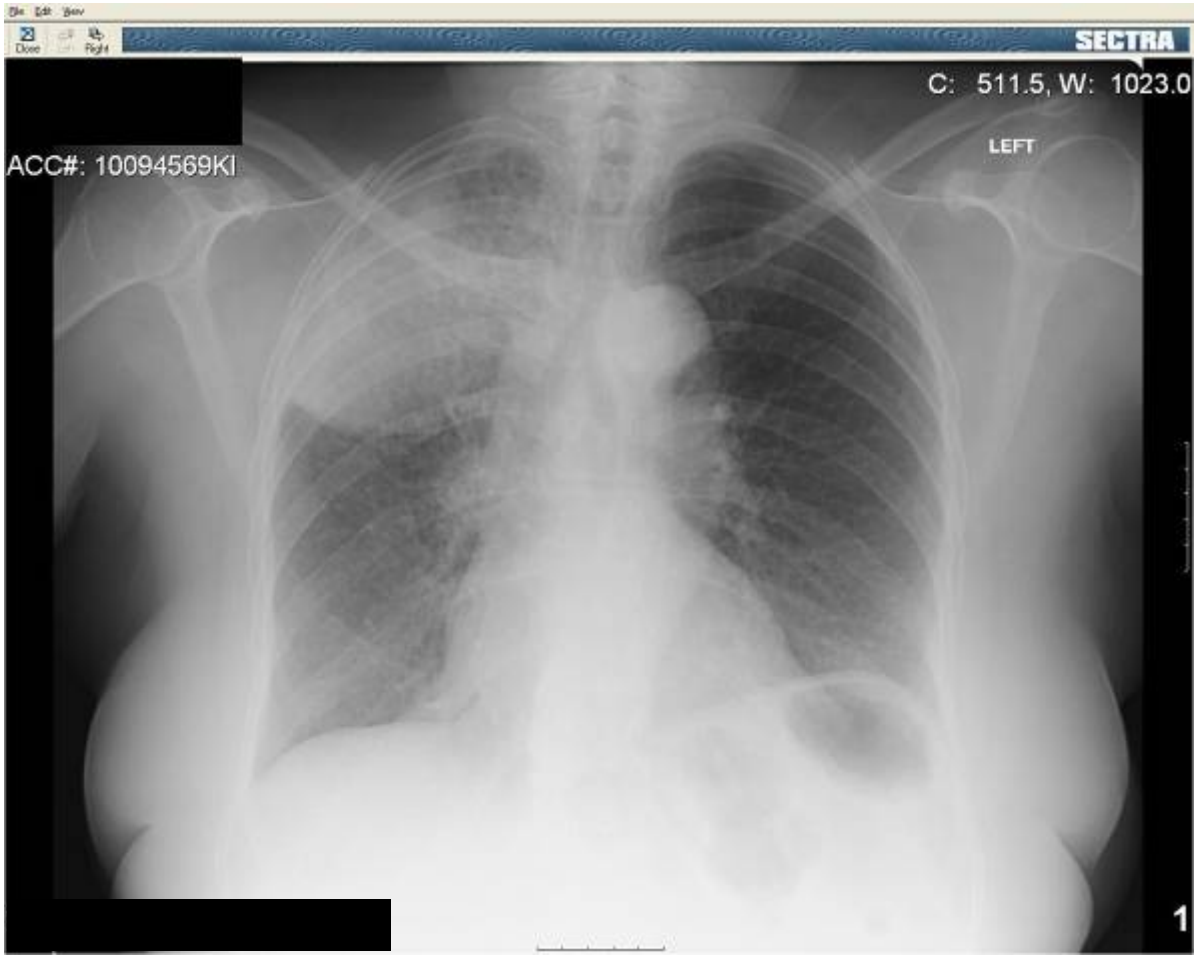
Case Presentation

Labs

- CBC: 18.65/8.6/27.2/675 79%

- Chem:139/3.9/101/19/13/0.7/115/9.0

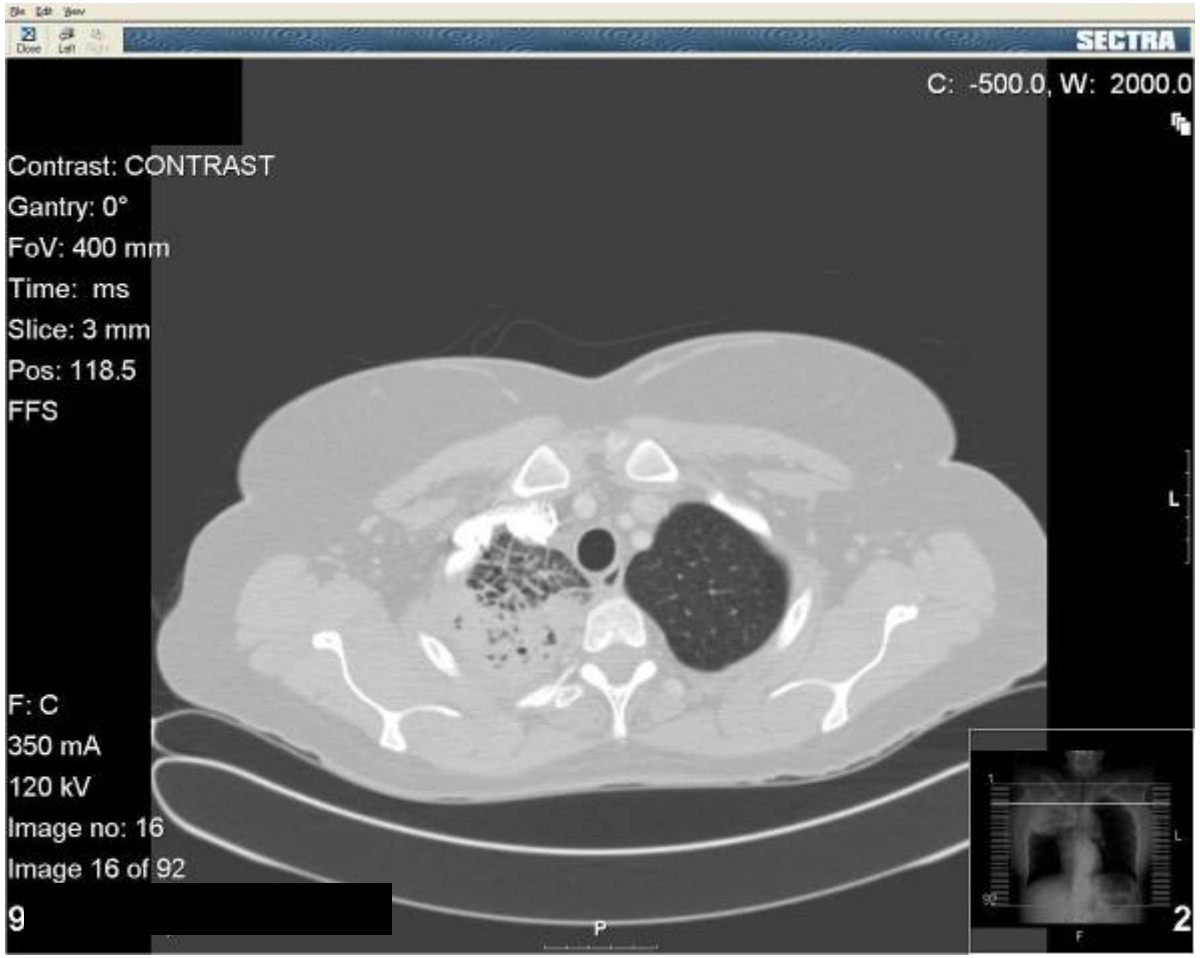
Case Presentation



Case Presentation

- Admitted to Medicine for treatment of post-obstructive pneumonia.
- CT Surgery consulted to evaluate the potential surgical resection of the mass.

Case Presentation



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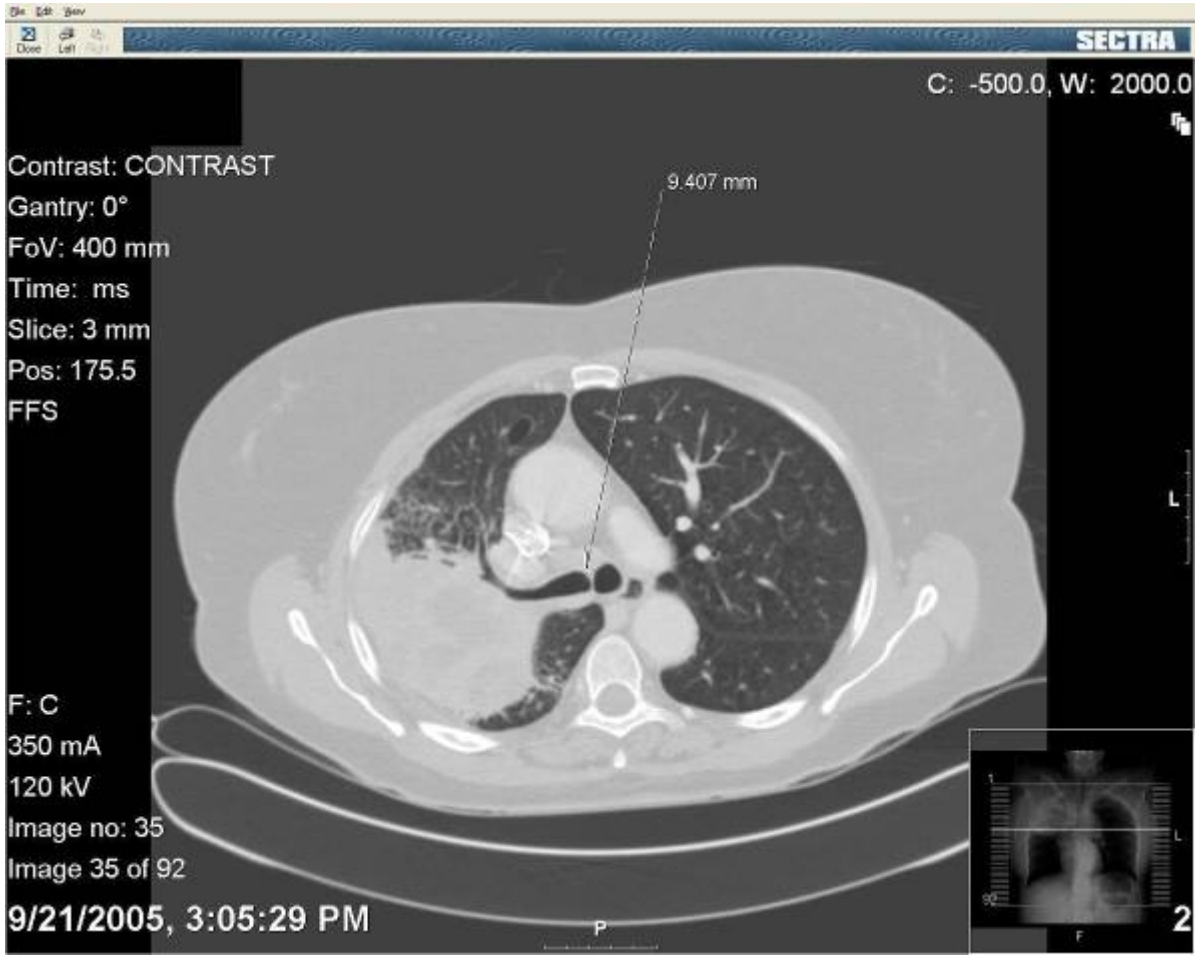

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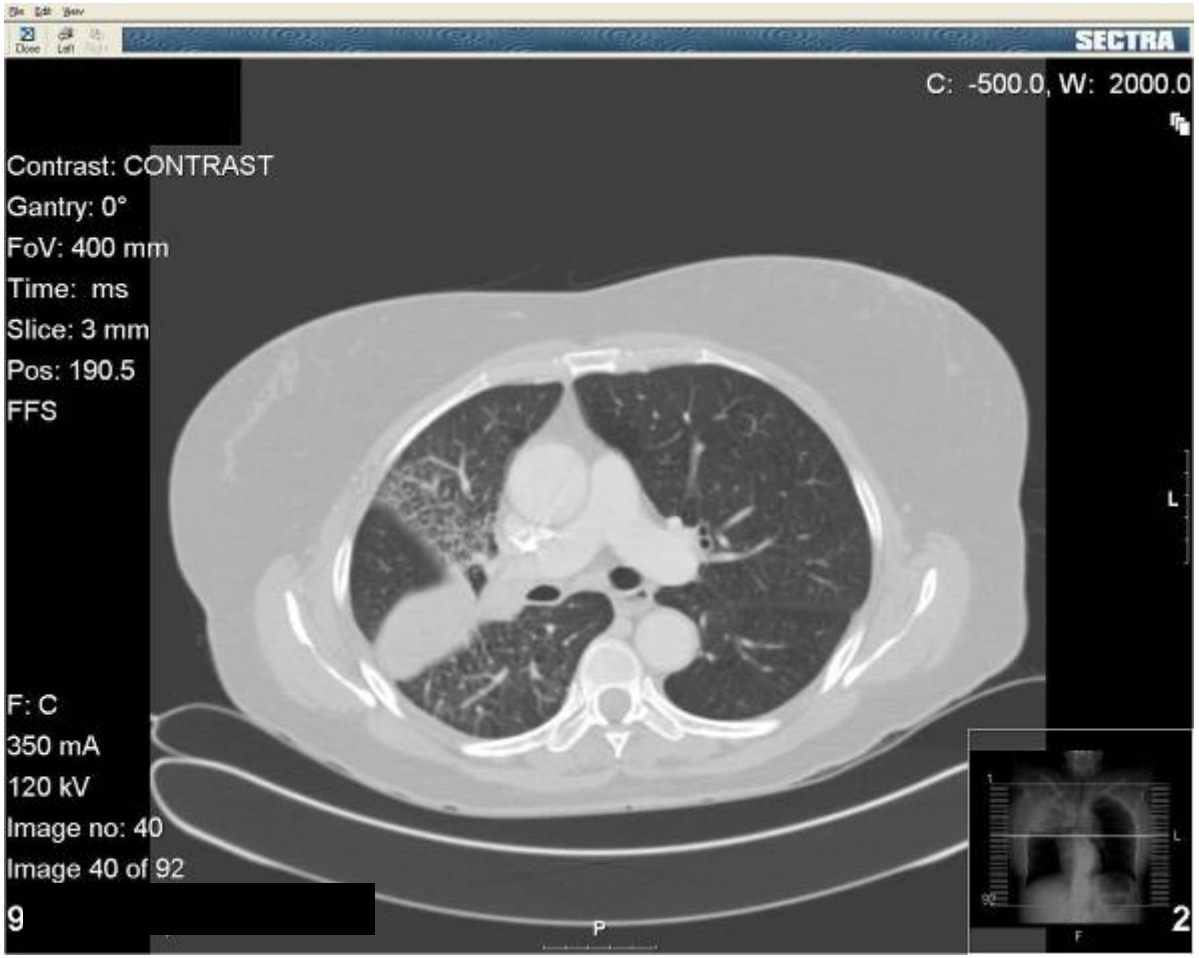

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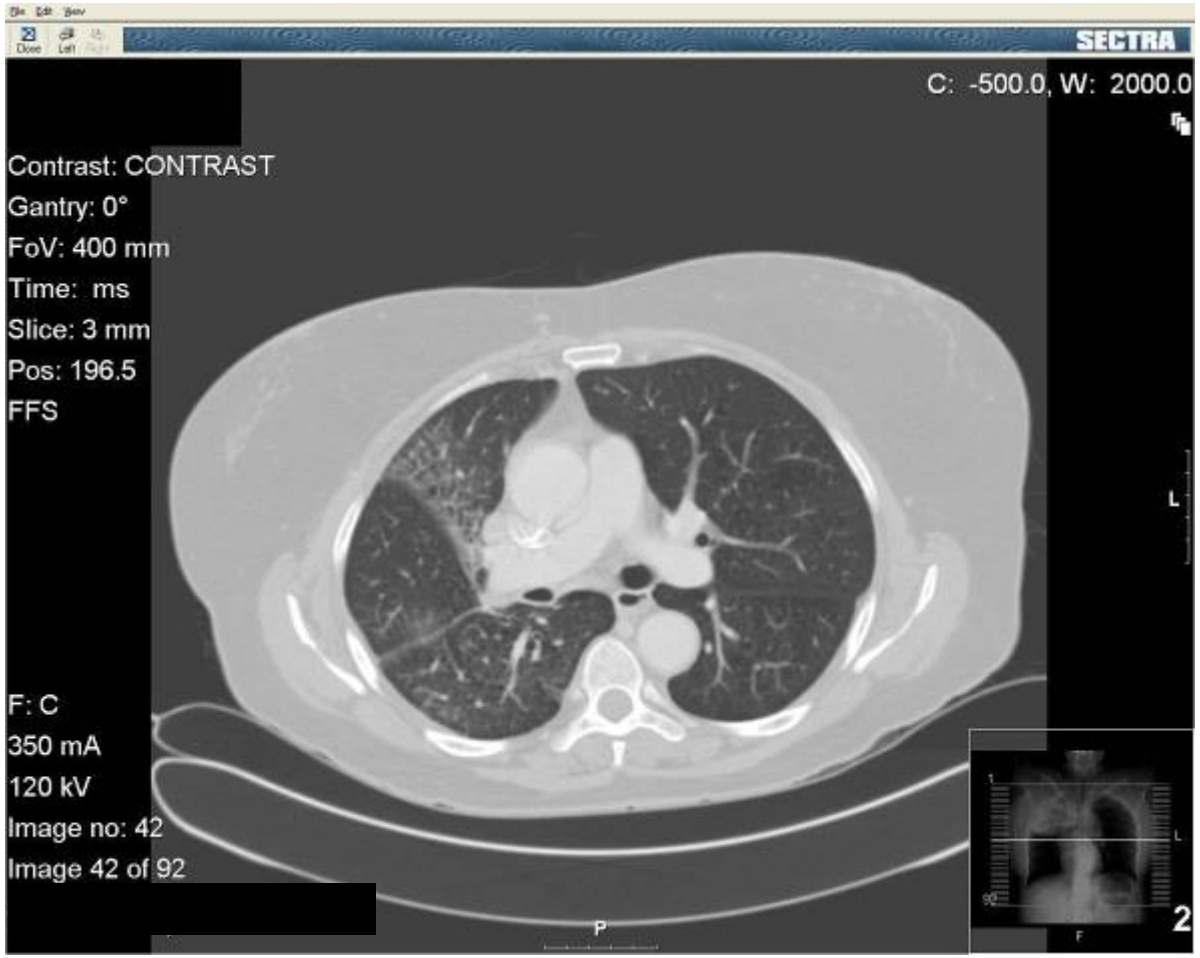

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PFTs:

- FEV1 1.9 L
- DLCO 0.58% of predicted

Perfusion Scan:

- RUL 10% of perfusion, Rt lung 42% of total perfusion.

- Good candidate for lobectomy - post surgical FEV1 of 1.7L
- Marginal candidate for pneumonectomy – post surgical FEV1 of 1.1L

- HD#5 - mediastinoscopy performed. Tissue biopsy– 2 LNs negative for malignancy.

Case Presentation

OR Course

- HD 12 - OR for right thoracotomy, lobectomy and possible right lung resection.
- Mass encompassed the right upper and middle lobes and part of the lower lobe.
- Invasive to anterior rib cage and posterior thoracic wall near the spine.
- No resection performed.
- Chest tubes placed. Chest closed.
- Pt admitted to SICU.

Case Presentation

Hospital Course

- POD#1 - Pt started on diet.

  Chest tube out put – 160cc and 100cc.
- POD#2 – Chest tubes placed on H2O seal and the pt was transferred to floor.
- One CT pulled.

Case Presentation

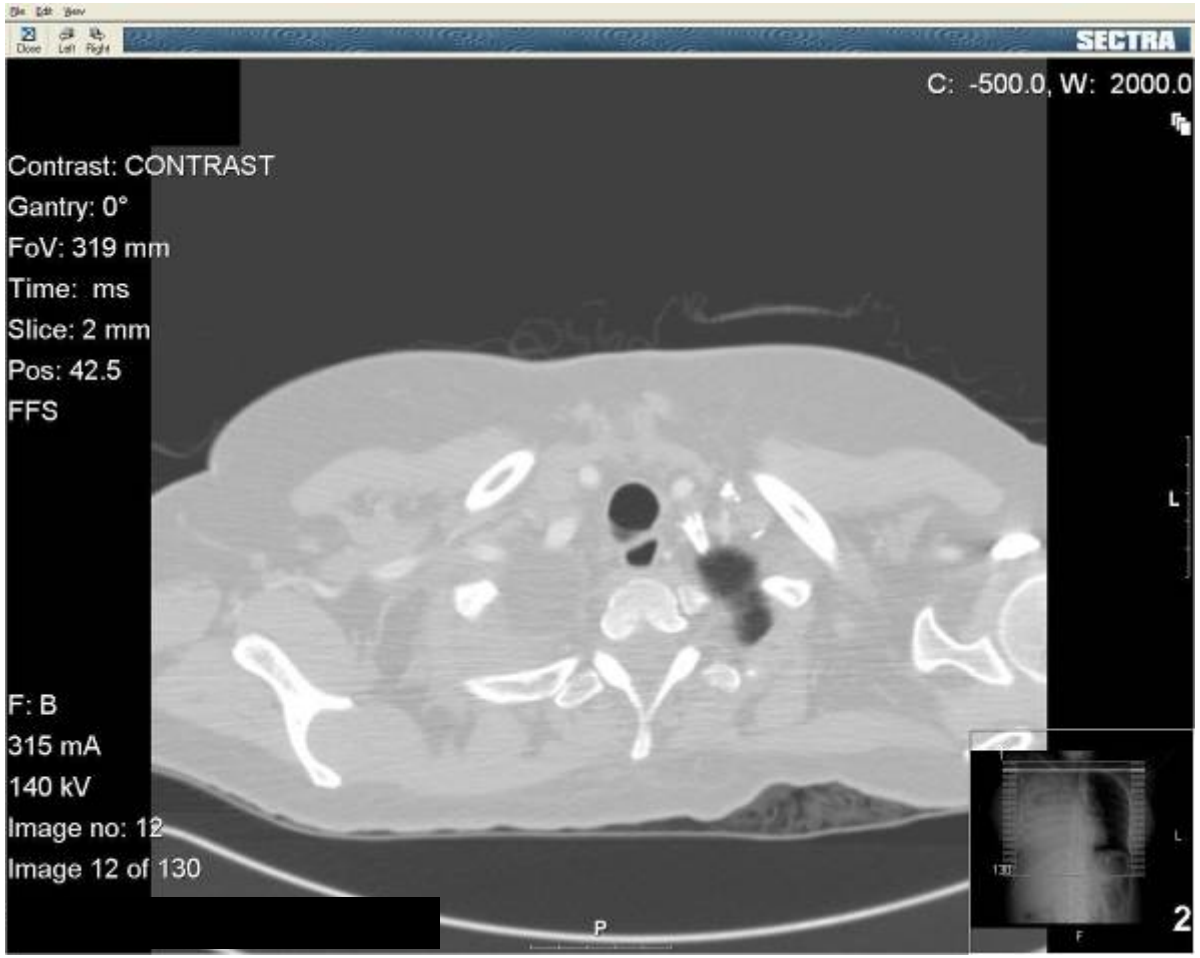
Hospital Course

- POD#3 - remaining CT noted to have milky output 30cc.
- Pleural cell count and lipid profile sent:
  Trig 513 mg/dl, Chol 77 mg/dl, HDL 10 mg/dl.
- Patient placed on low fat diet and the chest tube continued to suction drainage.
- POD#11 - Chest tube had minimal serous drainage on regular diet.
  Chest tube removed and patient discharged home.
- Cancer stage – IIIa/?IIIb.

Case Presentation

- 1 month post-op she was readmitted to Medicine with SOB.
- CT revealed large right pleural effusion.
- CT Surgery consulted. Chest tube placed with 2L of chylous output.

Case Presentation



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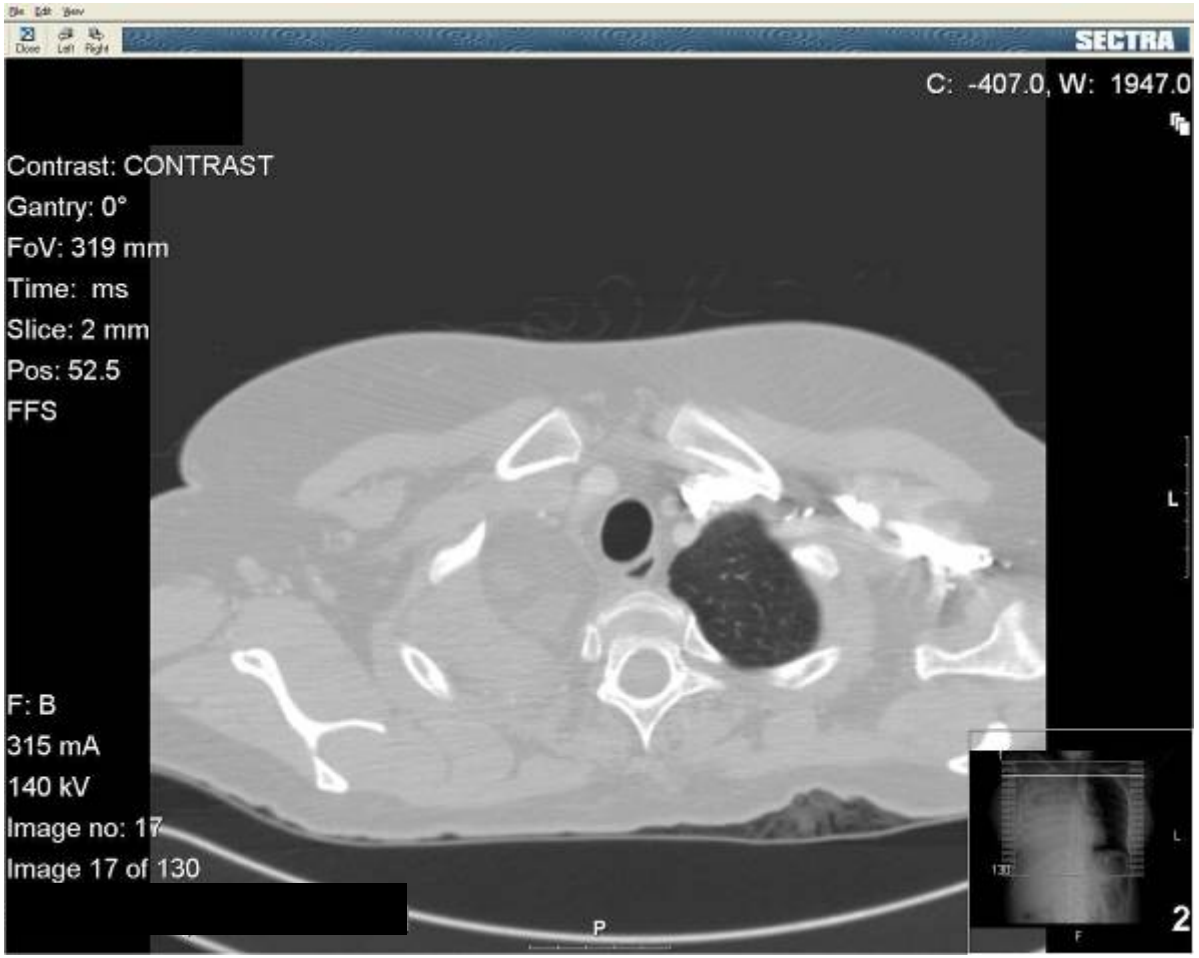

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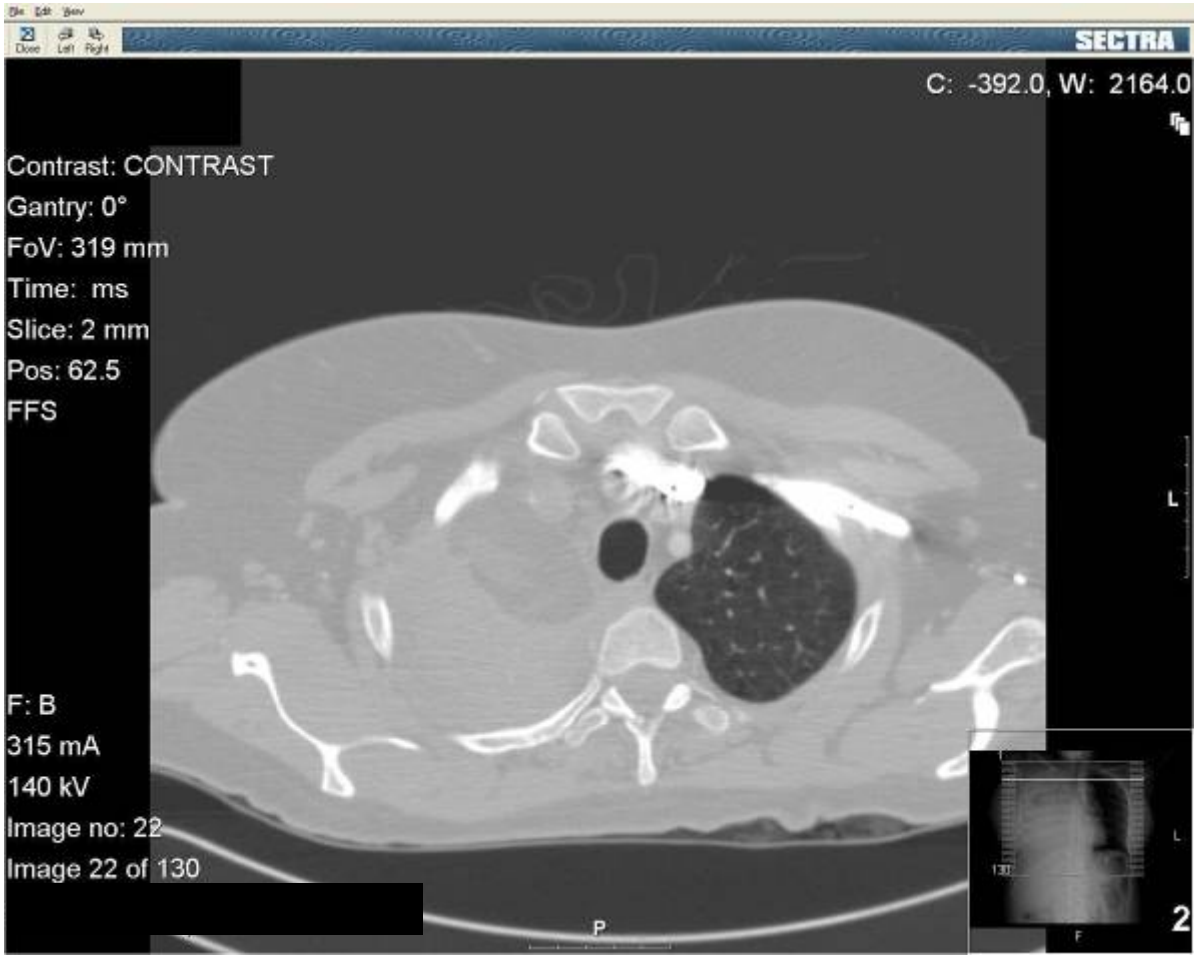

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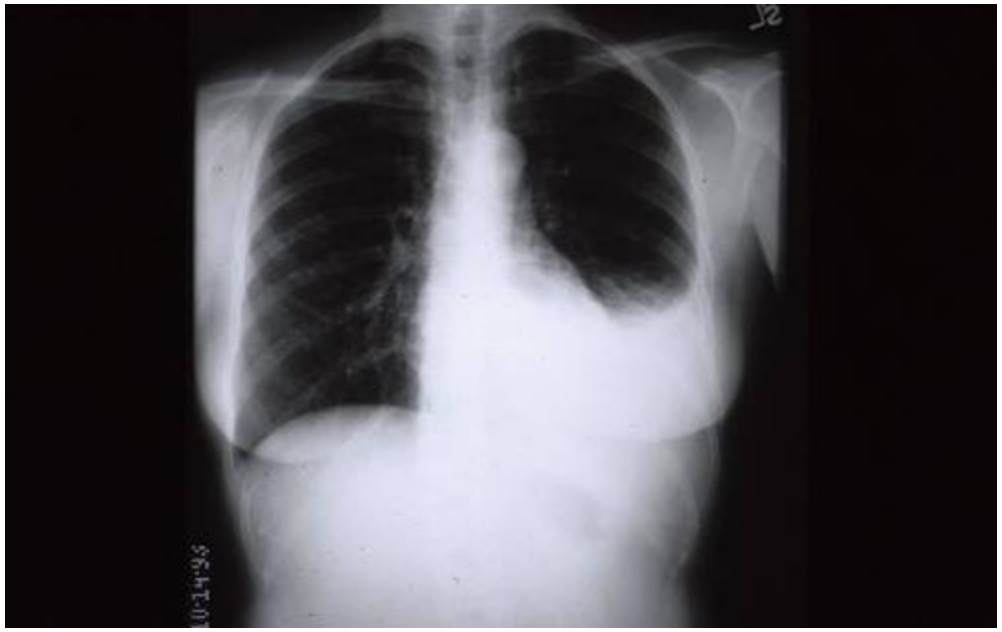
Case Presentation

- Pt placed on diet of medium chain fatty acids.
- Output decreased, became serous in nature and her chest tube removed on hospital day 10.
- She was discharged home on hospital day 12 to begin course of Chemo Tx and RT at SUNY Downstate with plan to reevaluate for surgical resection vs definitive RT.

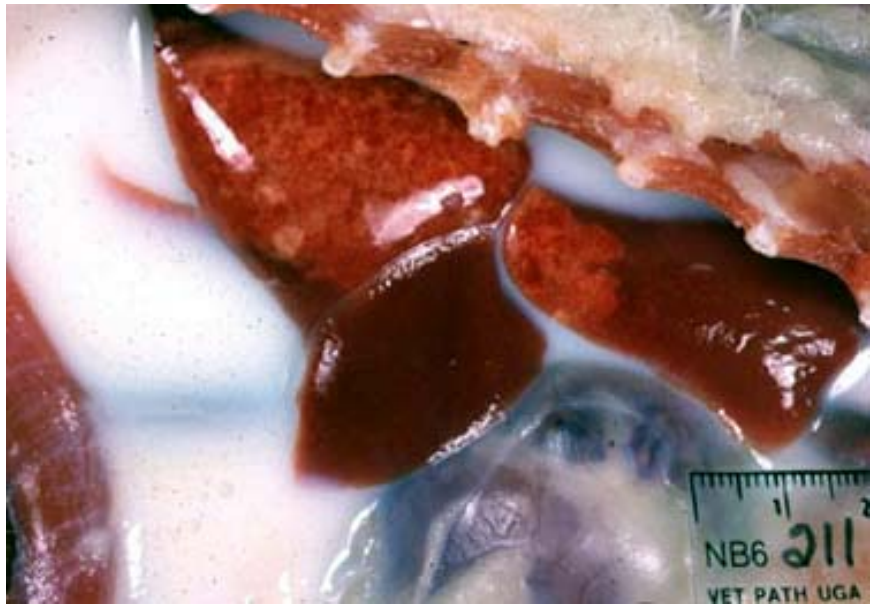
Management of Chylothorax



Management of Chylothorax

Chylothorax

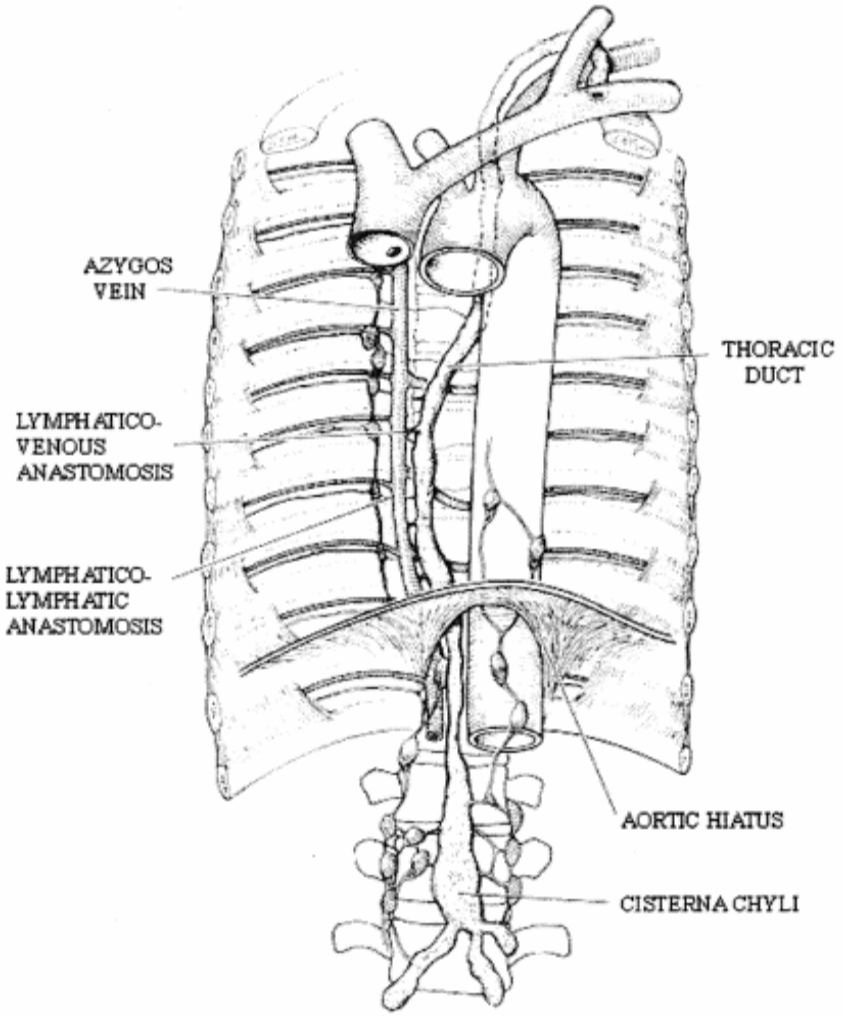
- The accumulation of excess lymphatic fluid in the pleural space.
- Usually caused by leak from thoracic duct or one of its major branches.
- Results from obstruction or laceration of the duct.
- Common causes include neoplasms, trauma, infection, and venous thrombosis.



Management of Chylothorax

Thoracic Duct Anatomy

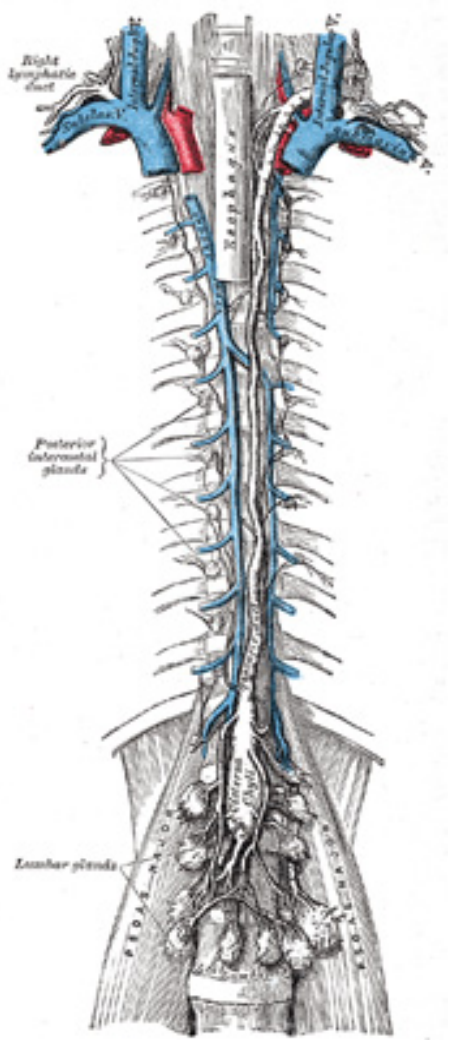
- Davis (1915) “Constant only in its variability”
- Originates from the cisterna chyli.
- Enters thorax through aortic hiatus.
- Ascends along anterior surface of the vertebral bodies.
- Posterior to esophagus, between the aorta and the azygos vein.
- At T5-T7 crosses to the left behind the aorta and ascends on left side of the esophagus.



Management of Chylothorax

Thoracic Duct Anatomy

- Above clavicle, duct turns laterally.
- It turns inferiorly to enter the venous system at the subclavian-internal jugular vein junction.
- A bicuspid valve prevents entry of blood into the lymphatic system.
- The right duct is small (2cm in length). Drains lymph from right head, and chest.
- Injury below T5 to T6 results in right chylothorax. Injury above this level results in left chylothorax.



Management of Chylothorax

Physiology of Thoracic Duct

- Principal function of the thoracic duct is the transport of digestive fat to the venous system.
- Unidirectional flow is ensured by: multiple valves throughout the duct, intrinsic wall contraction, abdominal-thoracic pressure gradient.
- Flow rate through the duct affected by rate of lymph formation in GI tract.

Management of Chylothorax

Etiology of Chylothorax

Congenital

Traumatic

Surgical

Diagnostic procedures

Neoplasms

Infections

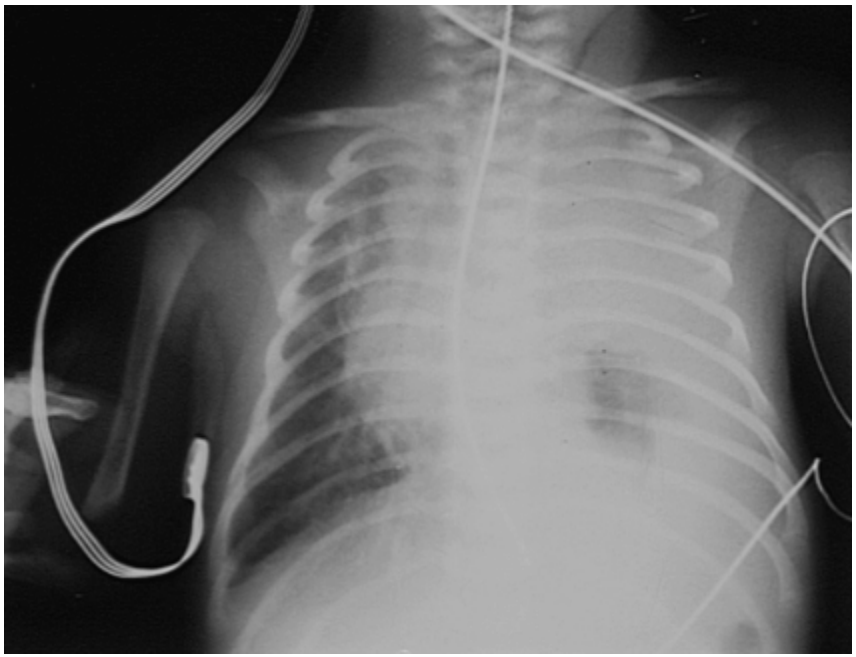
Miscellaneous

- Venous thrombosis
- Chylous ascites
- Pancreatitis

Management of Chylothorax

Congenital Chylothorax

- Congenital chylothorax is the leading cause of pleural effusion in the neonate.
- Fluid initially clear but turns turbid with milk feeding.
- Causes include birth trauma and congenital duct defect.
- Associated with a variety of congenital syndromes.



Management of Chylothorax

Traumatic Chylothorax

- Thoracic duct injury may occur with blunt or penetrating trauma or during surgery.
- Non-penetrating injury is more common.
- Injury by gunshot or stab wound is rare.

Management of Chylothorax

Neoplastic Cause of Chylothorax

- Benign and malignant tumors may involve thoracic duct through lymphatic permeation, direct invasion or tumor embolus.
- Most frequently found malignant tumors include lymphomas, lymphosarcomas, and primary lung carcinomas.
- Benign lesions of the thoracic duct include: lymphangiomas, mediastinal hygromas, and pulmonary lymphangioleiomyomatosis.
- 50% of chylothoraces in adults caused by tumors.

  Of these 75% are lymphomas.

Management of Chylothorax

Infectious Causes of Chylothorax

- Tuberculosis, fungal diseases, lymphangitis, filariasis, and non-specific mediastinitis.
- Results in lymph node enlargement and lymphatic obstruction.

Other Causes of Chylothorax

- Vomiting or violent coughing after a fatty meal. Malignancy must be considered in this setting.
- Thrombosis of great veins into which duct drains.

Management of Chylothorax

Thoracic Duct Fluid Composition

- Thoracic duct fluid contains fatty chyle and lymph.
- Chyle is milky, white, odorless, and alkaline.
- Ductal lymph is clear during fasting and becomes milky after a fatty meal.
- It is strongly bacteriostatic.
- Contains lipids, proteins, electrolytes, lymphocytes.

Management of Chylothorax

Composition of Chyle

Lipids

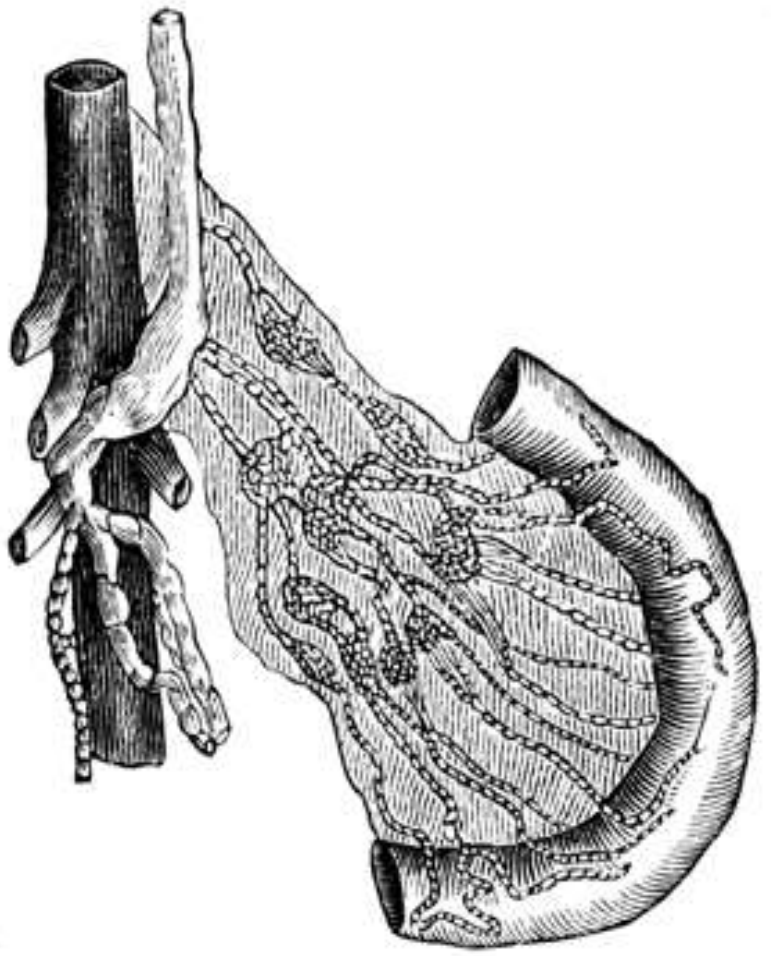
- Main component of chyle is fat .
- 60% to 70% of ingested fat absorbed by intestinal lymphatics. Conveyed to blood by thoracic duct.
- Lymphatic fat is transported as chylomicrons.
- Fatty acids with less than 10 carbon atoms absorbed directly into venous portal system.

Proteins

- Lymphatics are main pathway for return of extravascular proteins to the vascular space.
- Protein content is half the concentration of plasma.

Electrolytes

- Electrolyte composition similar to plasma.



Management of Chylothorax

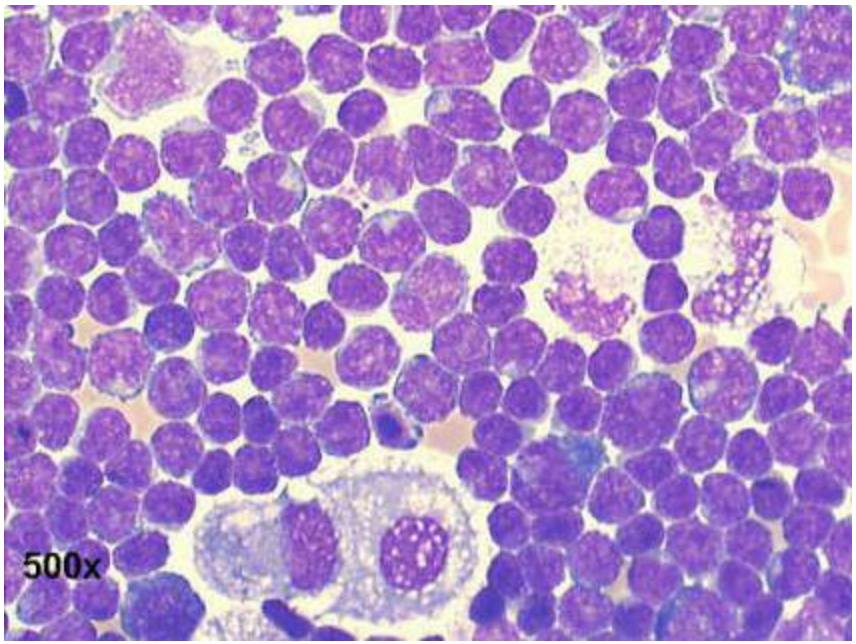
Composition of Chyle

Cellular Elements

- Lymphocytes are main cellular elements.
- 90% T lymphocytes.
- Prolonged drainage of thoracic duct depletes lymphocytes impairing immune system.

Miscellaneous Elements

- Fat soluble vitamins, antibodies, urea nitrogen, and enzymes.



Management of Chylothorax

Pathophysiology of Chylothorax

- Leads to cardiopulmonary abnormalities and metabolic and immunologic deficiencies.
- Chylothorax can compress the lung resulting in shortness of breath and respiratory distress.
- Empyema is a rare complication due to the bacteriostatic nature of lecithin and fatty acids. Sterile chyle does not cause pleuritic pain or a fibrotic inflammatory reaction.
- Loss of proteins and vitamins, more than fat, leads to metabolic and nutritional defects, immunodeficiency, coagulopathy, malnutrition and death.

Management of Chylothorax

Clinical Features

- Post-surgical patients may have a latent period of 2-10 days due to restricted diet.
- Compression of lung and mediastinum causes dyspnea and fatigue.
- Repeated drainage leads to loss of proteins, fat-soluble vitamins, and antibodies.
- Loss of high volume of chyle can lead to cardiovascular instability if fluid is not replaced.
- Death is inevitable if supportive or surgical treatment does not resolve the leak.

Management of Chylothorax

Diagnosis of Chylothorax

History

- Pleural effusion with a diagnosis associated with chylothorax.
- History of trauma after heavy meal.
- Recent surgical procedure in distribution of thoracic duct.

Laboratory Studies

- Blood chemistry and hematologic studies are often normal immediately after injury to the duct.
- Fluid analysis of drainage confirms diagnosis.

Management of Chylothorax

Fluid Analysis

- Diagnosis confirmed by finding of free microscopic fat, high fat content and low protein content.
- Chyle may be mistaken for pus but there is no odor and cultures are negative. Gram stain reveals lymphocytes (rather than PMLs) with no bacteria.
- Clear or bloody fluid does not rule out chylous leak.

Management of Chylothorax

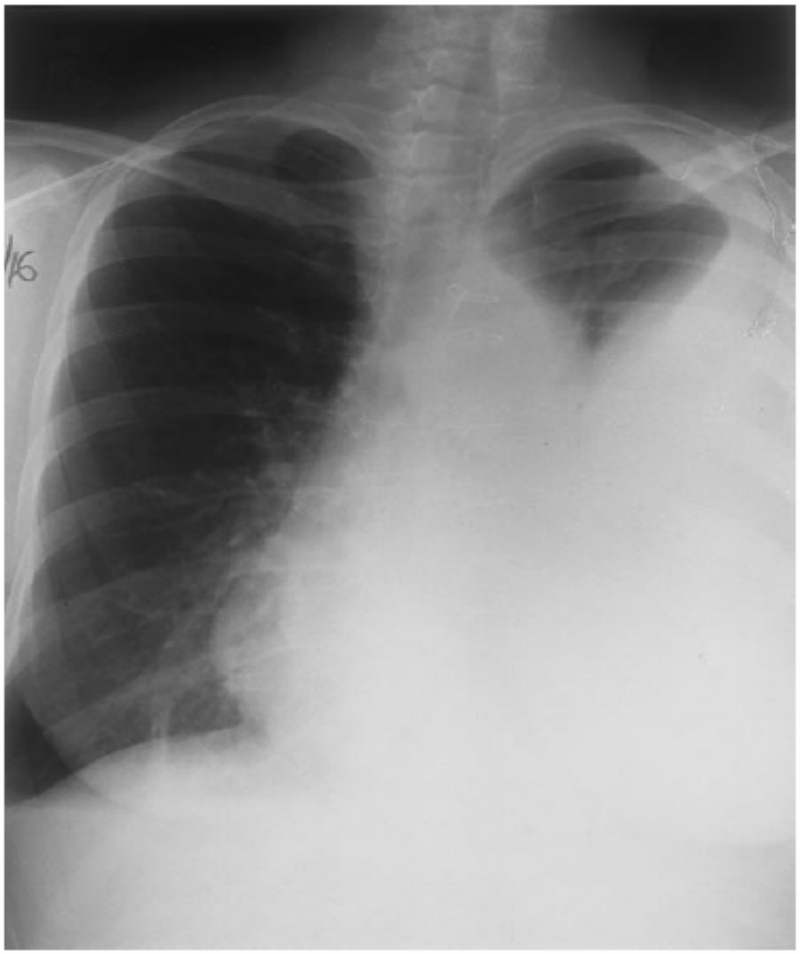
Diagnostic Tests

- Triglyceride level > 110 mg/dl (99% sensitive)
- Triglyceride level < 0.50 mg/dl (5% chance that fluid is chyle)
- Cholesterol/triglyceride ratio <1
- Gram's stain
- Sudan III stain
- Chylomicrons on electrophoresis
- pH: 7.4-7.8

Management of Chylothorax

Radiologic Studies

- No valid radiographic findings to differentiate chylothorax from pleural effusions



Management of Chylothorax

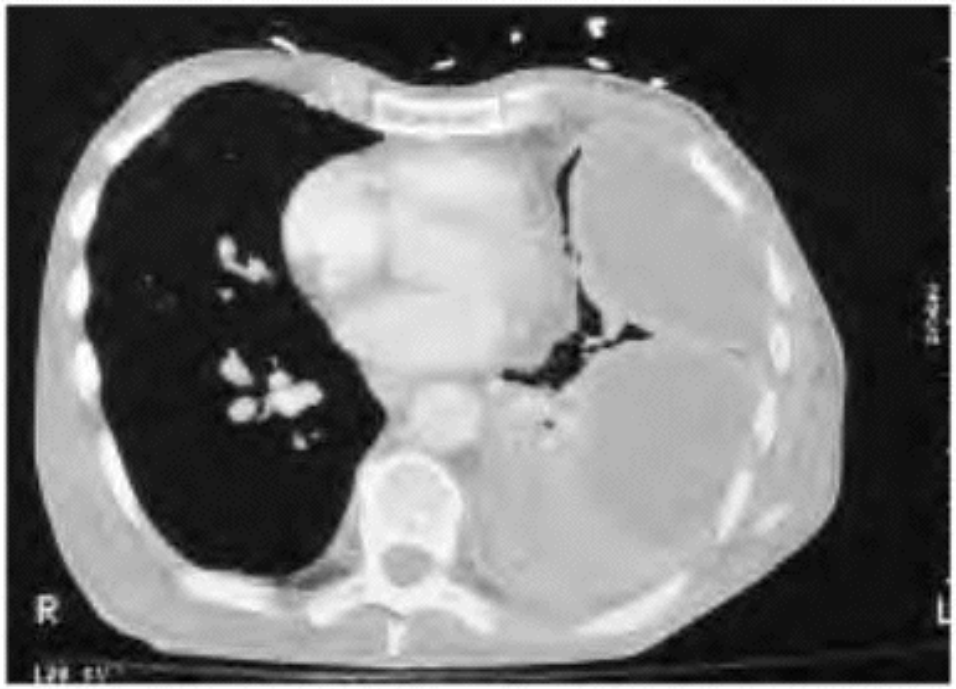
Radiologic Studies

- Bipedal lymphangiogram may be used to diagnose thoracic duct laceration

Management of Chylothorax

Radiologic Studies

- CT is limited in localizing site of leak but may be used to diagnose etiology.



Management of Chylothorax

Conservative Management of Chylothorax

- Initial management is conservative
- Re-expand the lung by drainage of chylothorax, prevent dehydration, maintain nutrition, reduce chyle formation.
- Tube thoracostomy preferred method of drainage.
- Maintain adequate nutrition and correct fluid and electrolyte imbalances.

Management of Chylothorax

Conservative Management of Chylothorax

- Enteral formulas with low fat content and medium chain-triglycerides is the first strategy.
  - Medium chain triglycerides pass directly into portal vein.
  - The body produces endogenous non-medium-chain triglycerides and this strategy may fail.
- NPO and total parenteral nutrition (TPN) is the most effective method of decreasing chyle production.

Management of Chylothorax

Conservative Management of Chylothorax

- No consensus on optimal duration of non-surgical management.
- 25-75% resolve non-surgically in 10-14 days.
- Neonates or debilitated patients may demand more prompt surgical solution.
- If closure of the chyle leak is thought to have occurred, then a high fat challenge meal is given before removal of the chest tube.

Management of Chylothorax

Somatostatin in the Treatment of Chylothorax

Case Report:

- 79-year-old F with non-Hodgkin's lymphoma admitted with massive chylothorax.
- Despite tube thoracostomy, TPN and attempted pleurodesis, drainage remained high.
- Octreotide added as an adjunt on HD 18 and chest tube drainage stopped 3 days later.
- Possible mechanism: Reduction of lymphatic flow by increasing resistance to splanchnic blood flow and by decreasing GI secretions.

Nicholas J. Demos, MS, MD et al Somatostatin in the Treatment of Chylothorax, Chest. 2001;119:964-966

Management of Chylothorax

Operative Mangement

- If conservative treatment fails, surgery should be performed.
- Timing of surgery is controversial.
  - Drainage lasts 1 to 3 weeks.
  - Daily output > 200mL to 500mL per day.

Management of Chylothorax

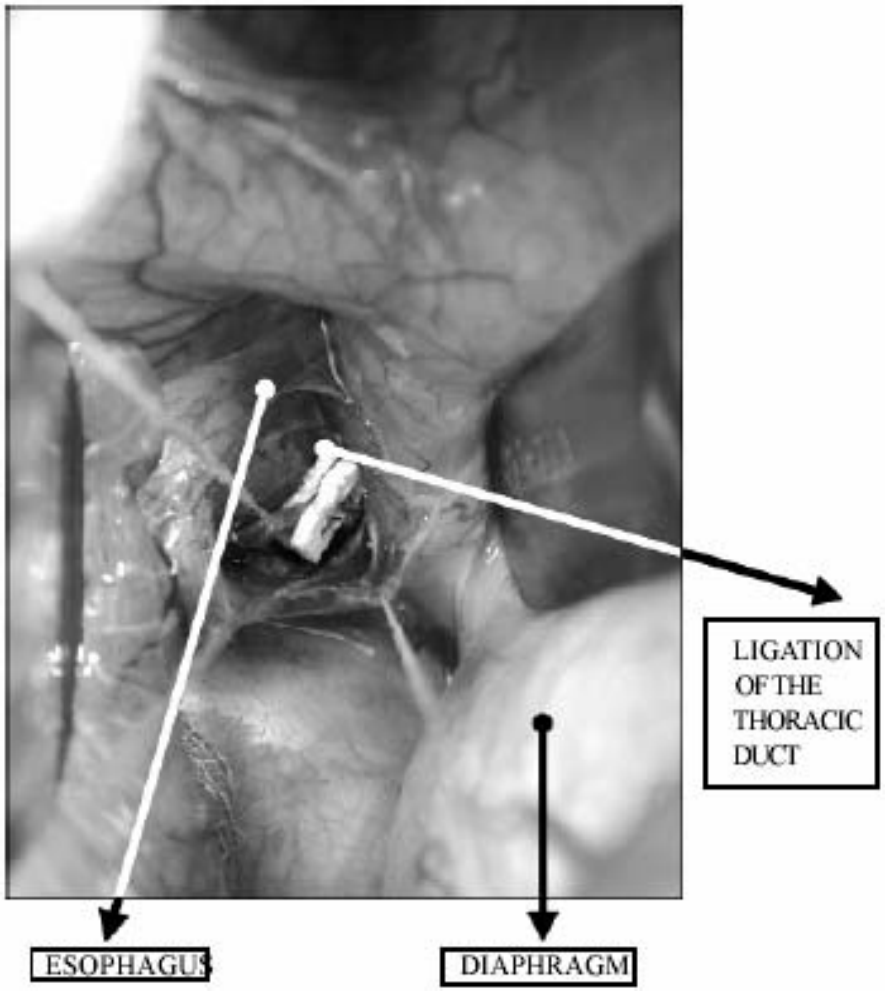
Operative Techniques

- Direct ligation of thoracic duct
- Supradiaphragmatic mass ligation of the thoracic duct
- Video Assisted Thoracic Surgery (VATS)
- Pleurodesis
- Fibrin glue

Management of Chylothorax

Thoracic Duct Ligation

- 19 post-operative chylothoraces.
- *Results:*
- Group A: 11 patients treated non-operatively.
  - 4 resolved.
  - 7 required re-operation for persistent high output.
- Group B: 8 patients underwent early re-operation.
  - All recovered.
  - No major complications hospital deaths.
  - Shorter length of stay.
- *Conclusions:*
- Re-operation should be performed immediately after diagnosis to avoid the complications of chylothorax.

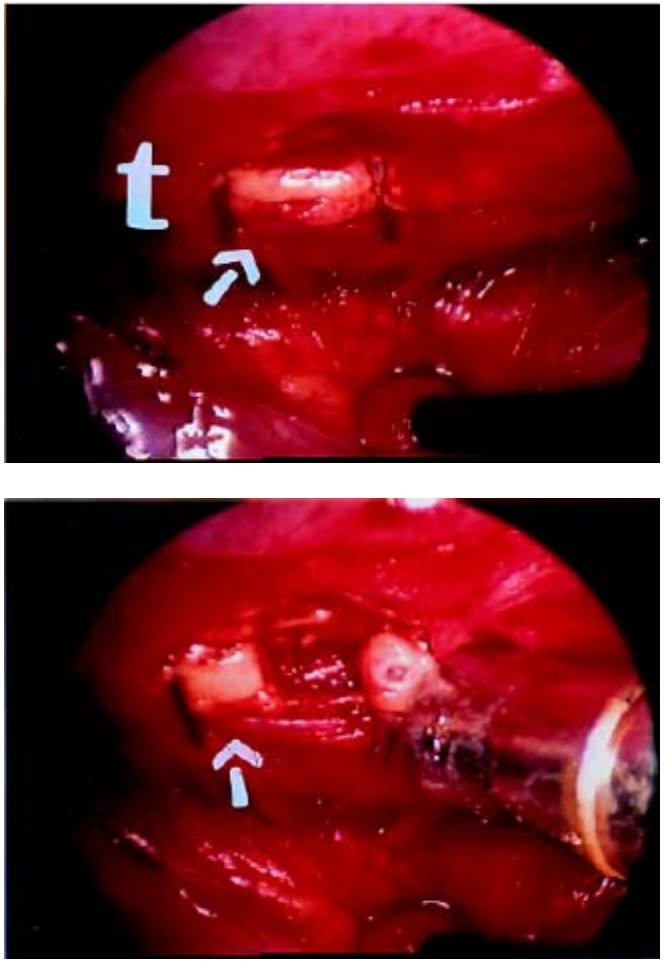


Merigliano, Stefano MD et al, Chylothorax Complicating Esophagectomy for Cancer: A Plea for Early Thoracic Duct Ligation, J Thorac Cardiovasc Surg 2000;119:453-7

Management of Chylothorax

VATS for Ligation of Thoracic Duct

- 4 patients treated by video-assisted thoracic surgery without thoracotomy.
- Precise ligation and division of the thoracic duct just above the diaphragm performed.
- No recurrence of chylothorax or chylopericardium during follow-up.
- *Conclusions:* Video-assisted thoracic surgery without a thoracotomy is effective in treating chylothorax and carries minimal morbidity.



Peter N. Wurnig, MD, et al, Thoracoscopic Direct Clipping of the Thoracic Duct for Chylopericardium and Chylothorax, Ann Thorac Surg 2000;70:1662–5

Management of Chylothorax

Percutaneous Embolization of Thoracic Duct

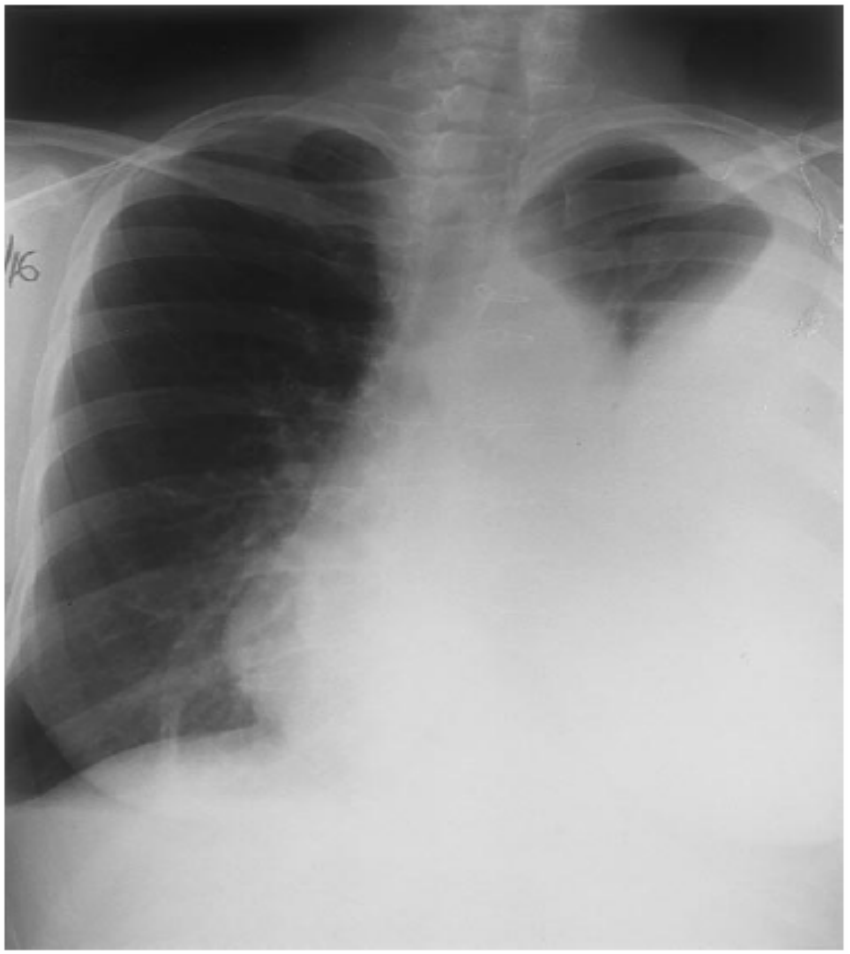
- Indicated for patients who are poor surgical candidates.
- 42 patients with chylothorax sent for thoracic duct embolization.
- *Results:*
  - Thoracic duct catheterized in 29 and embolized in 26.
  - 16 patients completely resolved within 7 days.
  - 6 patients resolved within 3 weeks.
  - 7 patients had surgical ligation of thoracic duct.
  - No morbidity or mortality as a result of percutaneous procedures.

Constantin Cope, MD and Larry R. Kaiser, Management of Unremitting Chylothorax by Percutaneous Embolization and Blockage of Retroperitoneal Lymphatic Vessels in 42 Patients, MD Journal of Vascular and Interventional Radiology 13:1139-1148 (2002)

Management of Chylothorax

Case Report: Thoracic Duct Embolization

- 53 yo F with dyspnea after aortic valve replacement and CABG.
- Chest X-Ray 8 days after surgery shows left pleural effusion that proved to be a chylothorax.
- Refractory to conservative management.



***Bonn, Joseph, et al, Percutaneous Embolization of Thoracic Duct Injury, Circulation*. 2000;102:268-269.**

Management of Chylothorax

Case Report: Thoracic Duct Embolization

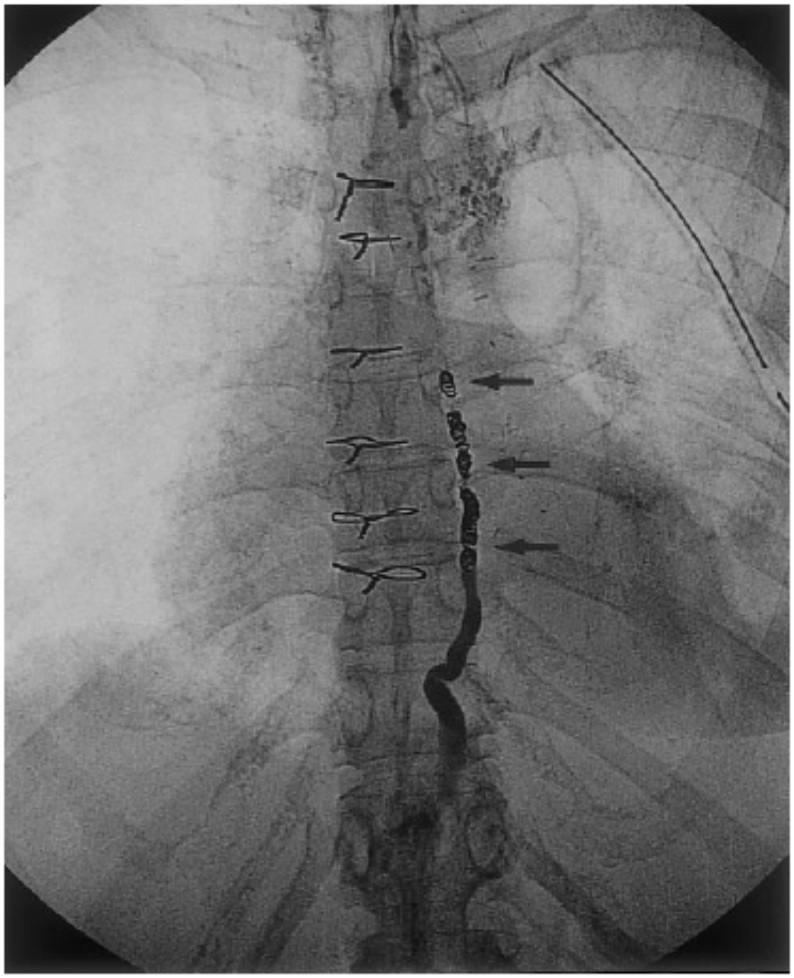
- Cisterna chyli opacified by pedal lymphangiography.
- Cisterna chyli accessed percutaneously in the upper abdomen under fluoroscopic guidance, to the mid-thoracic duct.
- Opacified thoracic duct showed leak into the left pleural space.

Bonn, Joseph, et al, Percutaneous Embolization of Thoracic Duct Injury, Circulation. 2000;102:268-269.

Management of Chylothorax

Case Report: Thoracic Duct Embolization

- Embolization performed by coils and gelatin sponge passed into the midthoracic duct to occlude it proximal to the leak.



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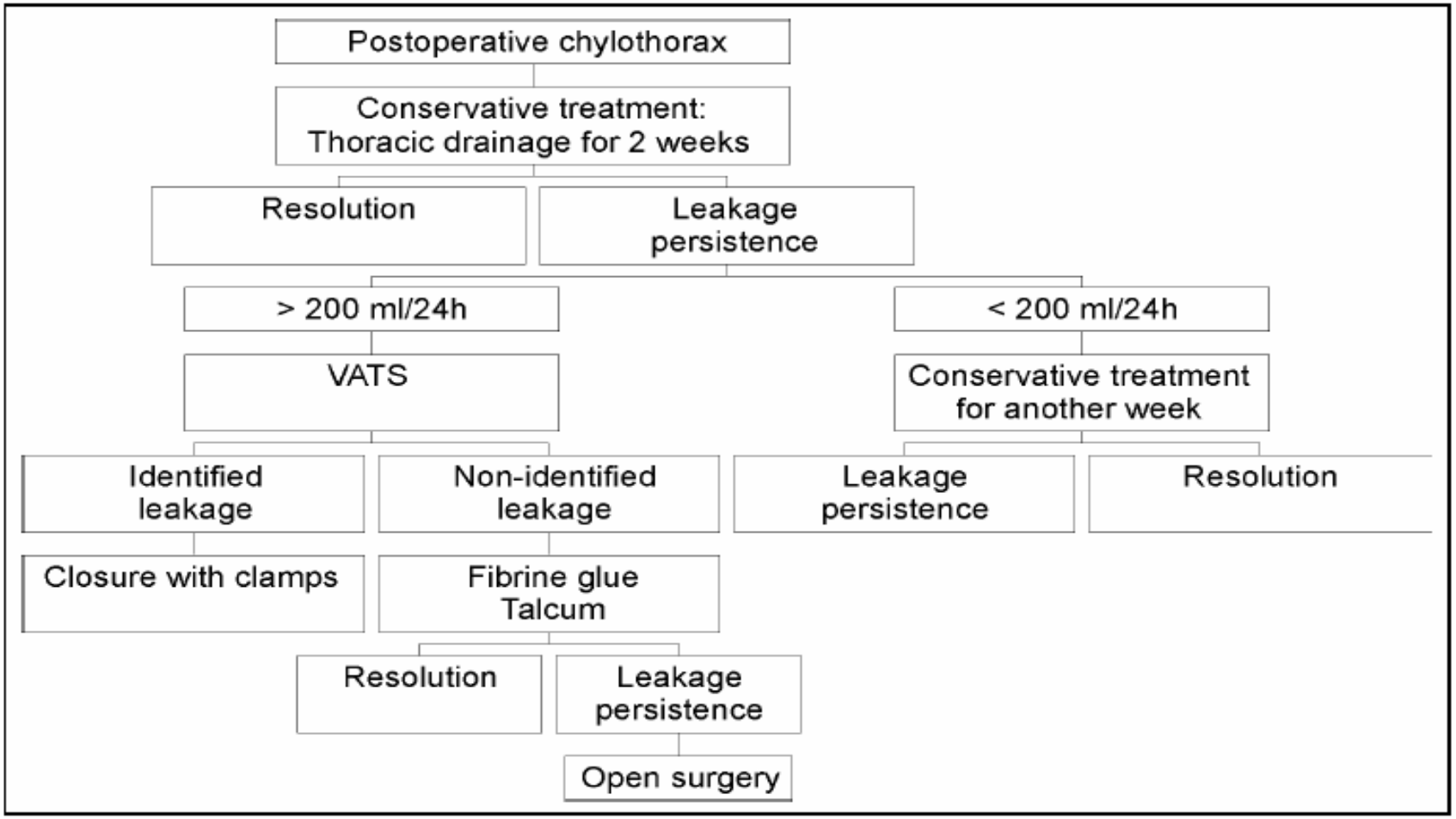
Management of Chylothorax

Case Report: Thoracic Duct Embolization

- Thoracostomy drainage declined over the next 3 days. Chest tube removed.
- She remained asymptomatic 9 months later.

***Bonn, Joseph, et al, Percutaneous Embolization of Thoracic Duct Injury, Circulation*. 2000;102:268-269.**

Management of Chylothorax



Pêgo-Fernandes et al, Ligation of the thoracic duct for the treatment of chylothorax, Arq Bras Cardiol, 2003;81:314-7

Management of Chylothorax

Summary and Key Points

- Anatomy of thoracic duct is highly variable.
- Enters thorax through the aortic hiatus to the right of the aorta at T10-T11.
- Loss of proteins and vitamins, more than fat loss, leads to metabolic and nutritional defects, immunodeficiency, coagulopathy, malnutrition and death.
- Diagnosis: Triglyceride level > 110 mg/dl

Management of Chylothorax

Summary and Key Points

- Treatment is initially conservative:
  - Tube drainage.
  - Medium-chain fatty acid diet.
  - Fluid and electrolyte support.
  - NPO and TPN

- Failure of conservative treatment requires surgical solution.