Thoracostomy: An Update on Imaging Features and Current Surgical Practice

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Disclosure of Commercial Interest

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Objectives

• Review clinical indications for a thoracostomy

• Present radiologic features that imaging physicians can provide to aid in clinical decision making prior to thoracostomy

• Illustrate imaging features of the thorax post thoracostomy

• Demonstrate long-term changes in patients who have had a thoracostomy
Introduction

• Pleural space infections, or empyemas, are a serious complication that can occur after partial or complete lung resection or in the setting of chronic pleural disease due to conditions such as chronic lung infection or connective tissue disease.

• Successful treatment of empyemas requires drainage of the infected pleural space, closure of any existing bronchopleural fistula, and expansion of the remaining lung parenchyma or pleural cavity obliteration in the case of post-pneumonectomy empyema.
Introduction

• In 1935, Leo Eloesser introduced a surgical thoracostomy technique, originally intended for tuberculous empyemas, that could serve as a treatment alternative when tube thoracostomy is inadequate or when patients are too ill for surgical decortication.

• This technique involved creation of a skin flap, resection of underlying ribs, and folding of the flap into the thorax to create an opening into the chest for infected pleural space drainage.

• The Eloesser flap and its subsequent modified approaches (such as Clagett procedure) have proven to be a potentially life saving procedure for certain patients.
Pre-Thoracostomy Imaging

• Empyemas can be diagnosed on thoracic imaging by identifying suspicious pleural/pneumonectomy space features including air locules, air-fluid levels, and loculation of fluid collections

• Bronchopleural fistulas can be visualized directly or suggested indirectly by a sentinel air foci adjacent to a bronchial stump

• Imaging is carefully reviewed during pre-surgical planning to ensure that the selected thoracostomy window is at the most dependent portion of the empyema and that its position will allow for easy access for wound packing
Post-Thoracostomy Imaging

- Sequential thoracic radiographic and CT imaging, performed in both the immediate and long-term post-thoracostomy periods, can identify features indicative of thoracostomy success or failure.

- These features include:
  - Resolving or enlarging of the air-fluid levels
  - Patency or occlusion of the thoracostomy
  - Resolution or persistence of bronchopleural fistulas/air leaks
  - Persistence or obliteration of the pleural space
  - Empyema recurrence in patients status post thoracostomy closure
Case 1

- 70-year-old male status post left pneumonectomy for squamous cell carcinoma. Frontal (left) and lateral (center) chest radiographs obtained 2 months post-pneumonectomy demonstrate air-fluid level (arrows) within left-sided pneumonectomy cavity concerning for empyema. CT image (right) demonstrates multiple air locules extending to bronchial stump (arrow) consistent with bronchial stump dehiscence and bronchopleural fistula, as well as overlying soft tissue infection of the left chest wall (asterisk).
Case 1 – Post-Operative Appearance

- After unsuccessful attempted surgical repair and re-closure of the bronchial stump, patient underwent left-sided Eloesser flap thoracostomy. Axial (left) and coronal (right) CT images demonstrate expected post-operative appearance with left-sided chest wall defect and high density packing material.
Case 2

- 94 year-old male hospitalized with recurrent parapneumonic effusions requiring repeat chest tube drainage. Chest radiograph (left) and axial (center) and coronal (right) CT images demonstrate right pleural effusion containing air locules (yellow arrows) and air-fluid level (purple arrows), consistent with empyema.
Case 2 – Post-Operative Appearance

- Patient developed respiratory distress, requiring ICU admission. Right-sided Eloesser flap thoracostomy was performed with chest radiographs obtained immediately post-op (left) and 10 days post-op (right) demonstrating expected right chest wall defect (arrows) and empyema drainage. Initial chest radiograph (left) demonstrates packing material (asterisk) with 10 day post-operative radiograph demonstrating persistence of cavity without packing material.
Case 3

• 57 year-old male status post left pneumonectomy for central left upper lobe lung cancer. Chest radiograph (left) and axial CT image (right) obtained 1 month post-pneumonectomy demonstrate multiple air-fluid levels within the left pneumonectomy cavity (arrows), consistent with empyema and concerning for bronchopleural fistula.
Case 3 – Good Expected Outcome

- Patient underwent left-sided Eloesser flap thoracostomy with coronal CT image (left) demonstrating expected chest wall defect. After successful empyema drainage, flap closure was performed 6 months post-thoracostomy, with coronal (center) and axial (right) CT images obtained 3 months post-closure demonstrating near-complete obliteration of the pneumonectomy cavity with only small amount of residual simple fluid (arrow).
• 68 year-old female with metastatic breast cancer status post left upper lobe mass resection with post-op course complicated by Aspergillus infection. Coronal (left) and axial (right) CT images demonstrate persistent left upper lung cavity with irregular wall thickening and with air-fluid level seen on axial image (arrow), consistent with empyema and suspicious for bronchopleural fistula.
Patient underwent left-sided Eloesser flap thoracostomy with chest radiograph (left) and axial CT image obtained 1 month post-op demonstrating expected chest wall defect and high density packing material (asterisk). FDG-PET coronal maximum intensity projection image (right) from same time period showing diffuse uptake associated with thoracostomy site (arrow).
Case 4 – Persistent Bronchopleural Fistula

• Axial (left) and coronal (right) CT images obtained 8 months post-Eloesser flap thoracostomy demonstrate thoracostomy patency and high density packing material. Large persistent bronchopleural fistula is also seen (arrows).
Case 5

- 34 year-old male status post right pneumonectomy for a self inflicted gunshot wound. Chest radiograph (left) and axial CT image (right) demonstrate multiple air-fluid levels (asterisk) within the right-sided pneumonectomy cavity, consistent with empyema, with evidence of bronchopleural fistula on CT imaging (arrow).
Case 5

- Chest radiograph obtained in the immediate post-operative period status post right-sided Eloesser flap thoracostomy (left) demonstrates expected post-operative changes, including chest wall defect and hyperdense packing material (asterisk). Chest radiograph obtained 3 months post-Eloesser flap thoracostomy (right) demonstrates re-accumulation of pleural fluid with air-fluid level and suggestion of bronchopleural fistula (arrow).
Case 5

- Patient subsequently underwent thoracomyoplasty with attempted latissimus dorsi muscle flap closure of bronchopleural fistula. Axial (left) and coronal (right) CT images obtained 3 years post-operatively demonstrate expected post-operative appearance of latissimus dorsi muscle flap (arrows).
Case 5 – Bronchial Stump Dehiscence

• Axial (left) and coronal (right) CT images obtained 3 years post-operatively also demonstrate late dehiscence of the bronchial stump (arrows), raising concern for future complications including recurrent empyema.
32 year-old male with history of metastatic hemangioendothelioma status post right pneumonectomy. Chest radiograph (left) and axial (center) and coronal (right) CT imaging demonstrate air locules and air-fluid levels (arrows) within the right pneumonectomy cavity, consistent with empyema, which has persisted despite chest tube placement. Coronal CT image also demonstrates sequela of right hemidiaphragm reconstruction.
Case 6

- Radiographic (left) and axial (center) and coronal (right) CT imaging obtained 1 month status post Eloesser flap thoracostomy demonstrate expected post-operative changes including right chest wall defect and high density packing material (arrows).
Case 6 – Intrathoracic Hemorrhage

- Radiograph obtained 2 months post-Eloesser flap (right) demonstrates increased density of packing material (arrow) when compared with prior radiograph obtained 1 month post-Eloesser flap (left), as well as growing right-sided pneumothorax (asterisk). Patient had developed interval massive right-sided intrathoracic hemorrhage within the pneumonectomy cavity.
71 year-old male with past medical history significant for end-stage liver disease. Frontal (left) and lateral (center) radiographs demonstrate loculated right-sided pleural effusion (arrows). CT image (right) demonstrates right-sided pleural fluid collection with thickened wall that contains several air locules, consistent with empyema.
Due to persistence of empyema despite repeated attempts at tube drainage and patient’s inability to undergo surgical decortication due to medical comorbidities, right-sided Eloesser flap thoracostomy was performed. Chest radiograph (left) and coronal (center) and axial (right) CT images obtained in the immediate post-operative period demonstrate expected post-operative appearance with right chest wall defect and high density packing material (arrow).
Case 7

- 8 months status post-Eloesser flap thoracostomy, after evidence of successful right-sided empyema drainage, patient underwent flap closure with a Clagett window closure procedure. Axial (left) and coronal (right) CT images obtained 11 days after flap closure demonstrate recurrent right-sided pleural collection with thickened wall and containing air locules with extension into overlying chest wall (empyema necessitans).
Axial (left) and sagittal (right) CT images demonstrate sequelae of repeat right-sided Eloesser flap thoracostomy with resulting drainage of empyema and improved aeration of the right lung. Patient’s thoracostomy remains patent to the present date with no current plans for repeated attempt at closure.
Case 8

- 53 year-old male status post left pneumonectomy for squamous cell carcinoma. Frontal (left) and lateral (right) chest radiographs obtained 2 weeks post-pneumonectomy demonstrate leftward mediastinal shift and development of air-fluid level (yellow arrows) within the left-sided pneumonectomy cavity, concerning for empyema formation. Subtle foci of gas also seen within posterior left chest wall soft tissues (purple arrows).
Case 8

Follow-up frontal (left) and lateral (right) chest radiographs obtained 2 days later demonstrate marked interval increase in chest wall and intrathoracic air-fluid levels (arrows), consistent with empyema necessitans.
Case 8

- Axial (left) and coronal (right) CT images obtained 2 months post-Eloesser flap thoracostomy demonstrate expected post-operative changes and interval improvement of left-sided empyema with some persistence of the left-sided pneumonectomy cavity (asterisk).
Case 8

- CT images obtained 4 months post-Eloesser flap thoracostomy demonstrate sequelae of interval latissimus dorsi muscle flap closure (arrows) performed for suspected bronchial stump leak with resulting obliteration of the left pneumonectomy space.
Case 8 – Good Long-Term Outcome

• CT images obtained 4 years post-Eloesser flap thoracostomy demonstrate successful surgical outcome with persistent obliteration of the left-sided pneumonectomy cavity and no evidence of recurrent bronchopleural fistula or empyema.
Summary

• The preceding slides demonstrate a variety of patient presentations leading to Eloesser flap thoracostomy, some of which were closed (Clagett procedure) with good long-term results.

• Thoracic radiographic and CT imaging allow identification of the variety of immediate and long-term post-operative appearances, including bronchopleural fistulas, recurrent empyemas, and an unexpected intrathoracic hemorrhage.
References


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