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Case Study

A Case Study on Empyema Necessitans

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Abstract

Empyema Necessitans (EN) is a rare complication of a pleural effusion. Empyema is characterized by the presence of pus in the pleural space, typically resulting from a complicated chest infection (TB) or pneumonia. Pneumonia can lead to severe complications, including para-pneumonic effusions, empyema, and potentially life-threatening sepsis, especially in individuals with underlying conditions that weaken the immune system. A 45-year-old male patient presented to the General Medicine department with persistent, progressive right lateral thoracic swelling for the last 2 months which was associated with mild pain on palpation. He complained chest pain on breathing, fever with chills, and a weight loss of around 6kg over the last 2 months. He denied symptoms of haemoptysis, shortness of breath, orthopnoea or recent travel. However, he did report a weight loss of approximately 6 kg in the last 2 months, with a BMI of 17.7. He had a past medical history of pneumonia a few months ago, and a cough with expectoration for 1 month. He also had a history of hypertension. He was a labourer at a construction site and had a history of smoking for 7 years. Values of ESR and CRP and WBC were found elevated. The patient was hospitalized for 7 days with Antibiotic course, Analgesic & PPIs. A chest X-ray was carried out, revealing pleural effusion in the right lung. Consequently, a Chest CT scan was also ordered, which showed a fluid-density collection in the right hemithorax along the lateral chest wall, measuring about 5.0 cm in its maximum thickness, with passively collapsed underlying parenchyma. Based on the findings from the CT scan, the patient was admitted for surgical intervention. Subsequently, under sedation, thoracentesis was performed, and a sample was sent for testing which revealed yellowish purulent discharge coming from the thoracic cavity through the intercoastal space revealing a connection between fluid collection outside the thoracic wall and the pleural cavity and showed positive for streptococcus pneumoniae. The entire content was then drained by ICD tube insertion thus diagnosing Empyema Necessitans (EN).

Keywords: Empyema Necessitans; Para Pneumonic Effusion; Pleural Cavity; Thoracentesis; Thoracostomy

Introduction

Pleural effusion [1]

Pleural effusion, often referred to as "water on the lungs," occurs when excess fluid accumulates between pleura layers surrounding your lungs. The pleura are thin membranes that cover your lungs and the interior of your chest cavity.

Under normal circumstances, a small amount of fluid is present in the pleura to lubricate and facilitate smooth lung movement during breathing. However, with pleural effusion, there is an excessive buildup of this fluid around your lungs. This occurs because the body is either generating too much fluid or failing to absorb enough of the fluid it produces.

Healthcare providers categorize pleural effusion into two main types based on the nature of the fluid around the lungs.

The excess fluid may be:

- **Transudative**: This type is protein-poor and watery. It often results from conditions such as cirrhosis or heart failure. Transudative pleural effusion occurs due to increased pressure from the fluid itself.
- **Exudative**: This type is protein-rich. It commonly arises from cancer or infections. Exudative pleural effusion happens because too much fluid is passing through the smallest blood vessels or because the lymphatic system is not draining properly.

Empyema necessitans

It is a rare complication of pleural effusion. Empyema is characterized by the presence of pus in the pleural space, typically resulting from a complicated chest infection or pneumonia. Pneumonia can lead to severe complications, including para-pneumonic effusions, empyema, and potentially life-threatening sepsis, especially in individuals with underlying conditions that weaken the immune system, such as diabetes, lung cancer, alcoholism, or pulmonary aspiration [2].

Empyema necessitans (EN) is an uncommon condition where a pus-filled infection in the soft tissues develops because of a sinus tract connecting an empyema to the thoracic wall [3]. Under normal circumstances, the pleural space contains a small amount of fluid. However, an infection can lead to accumulation of fluid that exceeds the rate at which it can be absorbed. This fluid becomes contaminated with the bacteria responsible for the pneumonia or infection, eventually thickening. This thickened fluid can cause the linings of the lungs and chest cavity to adhere to each other, forming pockets known as empyema. This condition can prevent the lungs from fully expanding, leading to breathing difficulties [4].

This condition poses considerable challenges for both diagnosis and treatment because of its rarity and the risk of serious complications [5]. Empyema necessitans is a rare and prolonged complication of poorly managed or uncontrolled pleural effusion, marked by the spread of pus through the soft tissues and skin of the chest wall. The pus eventually bursts and creates a fistula between the pleural cavity and the skin. This condition is often associated with infections caused by Mycobacterium tuberculosis and Actinomyces Israeli. Among non-tubercular causes, Staphylococcus is the most frequent pathogen. Other possible microorganisms include *Pneumococci, Escherichia coli, Pseudomonas, Klebsiella,* and various anaerobes [6].

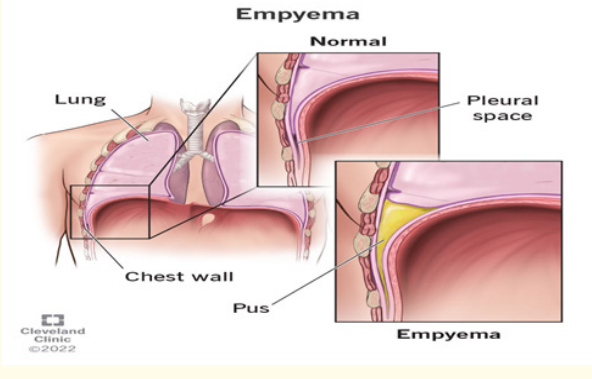

Figure 1: Empyema.

Epidemiology [7]

Empyema necessitans is uncommon, and its incidence is low when compared to other types of empyema. It is often reported in case studies or small series rather than large scale epidemiological studies. It can occur in individuals of any age but is more frequent in children and young adults due to higher incidence of bacterial pneumonia in these age groups. No strong evidence suggests significant gender predisposition. The prevalence and incidence vary depending upon the geographic region. In region with high rates of bacterial infections or limited access to antibiotics, Empyema necessitans may be more prevalent. It is found that approximately 32,000 cases per year of empyema necessitans are reported.

Etiology of empyema necessitans [8]

Empyema never has a primary cause, Secondary causes are; Empyema most commonly arises as a complication of bacterial pneumonia when the infection does not respond adequately to treatment.

Other potential causes include:

- **Bronchiectasis:** A chronic condition where the airways become abnormally dilated, leading to mucus accumulation and increased susceptibility to infections.
- **Blood clots or blockages:** These can obstruct blood flow to the lungs, resulting in lung tissue death, or pulmonary infarction.
- **Chest surgery:** Though rare, this can occasionally lead to empyema.
- **Endoscopy:** This procedure may sometimes lead to empyema.Severe chest injuries.
- **Systemic infections:** Infections from other parts of the body that spread through the bloodstream.
- **Inhaled food:** Rarely, if you have swallowing difficulties, this can lead to an infection that causes empyema.
- **Tuberculosis:** It can sometimes lead to empyema.

Risk factors for developing empyema include:

- COPD (Chronic obstructive pulmonary disease).
- Weakened immune system
- Acid reflux
- Excessive alcohol consumption or frequent use of recreational drugs
- Empyema can affect both adults and children.

Tuberculosis and pneumonia are most common causes for developing an empyema in various countries. Pneumonia can be caused by various types of bacteria, with Streptococcus pneumoniae and Staphylococcus aureus being the most common. Empyema can sometimes develop after chest surgery, as medical instruments might introduce bacteria into the pleural cavity.

Clinical manifestation [9]

Empyema can be classified as either simple or complex, depending on the stage and severity of the condition; Simple empyema occurs in early stages of illness when the pus is still free- flowing.

Symptoms of simple empyema include

Shortness of breath, Dry cough, Fever, Sweating, Sharp chest pain, Headache, Loss of appetite, Confusion Complex empyema develops later in the illness and involves more severe inflammation. In this stage, scar tissue may form, dividing the chest cavity into smaller compartment, a process known as loculation, which makes treatment more challenging. If the infection worsens, it can lead to formation of a thick layer over the pleura, called pleura peel, which impairs lung expansion and requires surgical intervention.

Additional symptoms of complex empyema include:

Difficulty breathing, reduced breath sounds, weight loss, chest pain, & tactile fremitus.

Risk factors [10]

Pleural space infections often arise as a complication of pneumonia acquired either in the community or in a hospital setting. Other potential causes include:

- Penetrating injuries to the chest,
- Thoracic surgery
- Oesophageal rupture
- Pulmonary tuberculosis
- Lung abscesses Bronchiectasis, s
- Subphrenic abscesses
- Rib osteomyelitis
- Risk factors for developing empyema include being older than 60 years of age, male.

Pathogenesis [11]

Exudative stage

In the initial phase of bacterial infection, an acute inflammatory response occurs between the lung tissue and the visceral pleura. This response is driven by proinflammatory cytokines, which increase capillary permeability and lead to the accumulation of neutrophil-rich fluid in the pleural space. This type of exudative fluid typically flows freely, and with proper antibiotic treatment, it usually resolves without needing invasive drainage.

Fibrinopurulent and loculated stage

If treatment is not administered, the effusion can progress to a more complicated stage where fibrin clots and membranes form, creating isolated pockets of fluid within the pleural space. During this stage, bacterial cultures often become positive, and management requires both antimicrobial therapy and drainage of the fluid.

Chronic organizational stage

If the fluid is not drained, fibroblasts can form a thick pleural peel between the visceral and parietal pleura over time. This peel can envelop the lung tissue, leading to complications such as impaired gas exchange, a trapped lung, or chronic empyema.

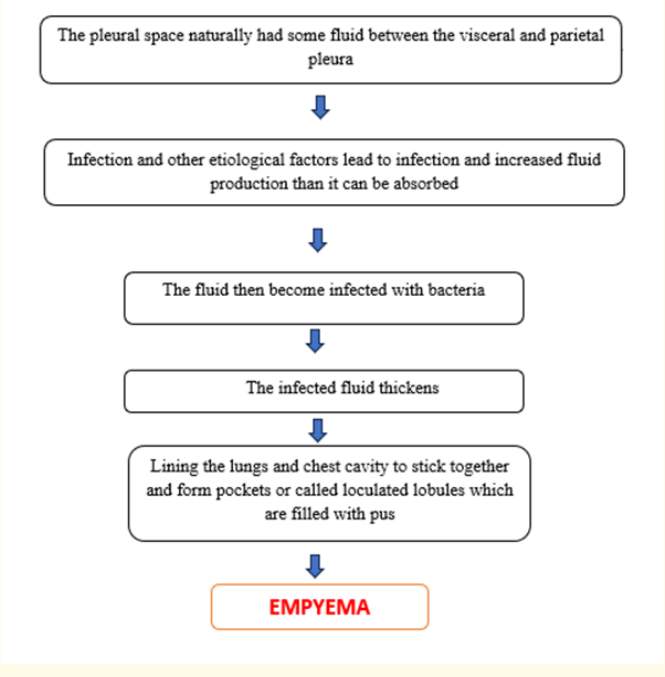

Figure 2

Diagnosis [12]

Empyema is diagnosed through a comprehensive review of the patient's medical history and a physical examination. During the exam, a healthcare provider may use a stethoscope to listen for signs of pneumonia and fluid accumulation in the chest. Because many conditions can mimic these symptoms, additional diagnostic tests are often required.

Initially, chest X-rays are typically ordered to check for pleural effusion, which appears as blunting of the costodiaphragmatic angles on the X-ray. This blunting indicates that the angle between the diaphragm and the rib is obscured or has unclear borders due to fluid accumulation.

If the X-ray results are inconclusive, an ultrasound may be used. Empyema can be suspected if the ultrasound shows thickening of the parietal and visceral pleura with fluid between them, presenting as a uniform anechoic area.

A chest CT scan is also essential for diagnosing empyema, especially when performed with intravenous (IV) contrast. Both ultrasound and CT scans are highly sensitive for detecting empyema. On CT, the pleura may appear thickened, separated, and enhanced by the contrast, and the CT scan provides detailed imaging of the lung tissue to identify other potential issues.

Following these imaging procedures, a thoracentesis is generally performed to drain the fluid from the pleural space and send it for analysis and culture. Although all pleural fluids should be cultured, negative results do not rule out empyema, as some bacteria are difficult to grow in cultures.

Stages of empyema [13]

- **Early, serous, acute stage, one or more of:**
  - Ph <7.2
  - Glucose<40 mg/dl
  - LDH> 1000 IU/dl
  - Protein > 2.5 g/dl
  - WBC> 500/L
  - Specific gravity >1.018
  - Thin serous or cloudy fluid generally sterile
- **Fibrinopurulent/intermediate stage**
  - Thicker fluid
  - Opaque fluid
  - Fluid with positive culture reports
- **Late/organizing stage**
  - An organizing peel with entrapment of the lungs

Management/treatment [13]

Treating empyema generally involves a combination of medical and surgical procedure; The priority is to start antibiotics promptly to control the infection. The choice of antibiotics is initially based on whether the infection is community-acquired or hospital-acquired and may be adjusted based on culture-sensitivity report.

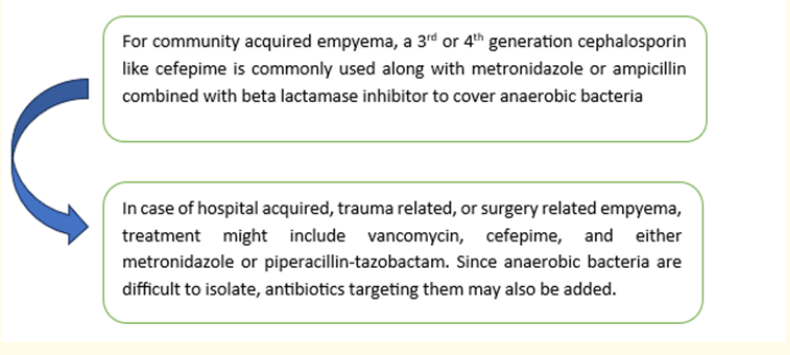

Figure 3

Antibiotic treatment usually lasts between "2 and 6 weeks" depending on the infection and response to treatment. There is no proven benefit in administering antibiotics directly into the pleura.

Drainage

Draining the pus is crucial for resolving empyema. The common method is thoracostomy, where a chest tube is placed in the pleural cavity. The tube's placement is confirmed via X-ray or a CT scan. To prevent blockage, the tube is frequently flushed with saline. If fluid accumulation continues, more invasive measures may be needed, such as, inserting larger tubes or performing surgery. chest tubes are removed when the daily drainage drops below 50-100 ml for more than two consecutive days, imaging shows reduced pleural effusion and there are no signs of ongoing infection.

Surgical treatment aims to remove the pus from the pleural cavity and facilitate proper lung expansion. For acute empyema requiring surgery, video-assisted thoracoscopic surgery (VATS)s often preferred. This minimally invasive procedure results in less blood loss, reduced pain, improved respiratory outcomes, shorter hospital stays, and better survival rates. If a complication arises that cannot be managed with VATS, the procedure may be converted to an open thoracotomy, which involves a larger incision in the pleural space.

After the infection has resolved, some individuals may experience fibrosis and lung restriction, leading to difficulty in breathing. In such cases, decortication-a surgical procedure to remove abnormal fibrous tissue from the lung's surface, chest wall, or diaphragm, may be considered. This procedure is typically evaluated if symptoms persist for 6 months or more after the infection and is significantly impact the individual's quality of life (QOL).

Case Report

A 45-year-old male patient presented to the General medicine department with persistent, progressive right lateral thoracic swelling for over the last 2 months which was associated with mild pain on palpation. He complained chest pain while breathing, fever with chills, and weight loss of around 6kg since last 2 months. He denied symptoms of haemoptysis, shortness of breath, orthopnoea, recent travel, However, he did report a weight loss of approximately 6 kg in the last 2 months, and had a BMI of 17.7. He had a past medical history of pneumonia few months ago, and cough with expectoration for 1 month. He was a labourer at a construction site and had a history of smoking for 7 years. Notably, there existed a family history of Pneumonia. Specifically, the patient's father, who resided with the patient, had successfully recovered from pneumonia one year earlier. Additionally, it should be noted that he had been taking antibiotics prior to the current presentation, which had been prescribed by a private physician from his local area. He also had a history of Hypertension and was on regular medication.

On objective examination, the patient was found to have a

- Lower respiratory rate
- Oxygen saturation of 94% on room air
- Patient was found to have a BP rate of 170/100 mmHg
- Pulse rate was 130bpm.

On systemic examination respiratory system showed

- Decreased breath sounds on ride side and dull note on right side
- CNS examination showed that the patient was conscious and oriented
- Per abdominal examination showed soft and non-tender abdomen.

Other investigations

Physical examination	A heterogeneous, soft, fixed, and fluctuant swelling measuring 5 × 5 cm solitary swelling at the level of the 7th intercostal space on the right lateral chest wall. The swelling exhibited mild tenderness, along with local signs of erythema and purulent discharge.
Laboratory test	All parameters, including total leukocytes count, hemoglobin, platelets, and serum creatinine, and other parameters fell within normal limits, except for CRP and ESR. Furthermore, a few days after admission, white blood cell levels were found to be elevated.
ESR (Erythrocyte sedimentation rate)	78 mm/hr
CRP (C-reactive protein)	36.5 mg/dl
Chest X ray	Pleural effusion in the right lung.
Chest CT scan	A Fluid density collection was present in the right hemithorax along the lateral chest wall, measuring approximately 5.0 cm in its maximum thickness, with passively collapsed underlying parenchyma.
Fluid analysis	Fluid was sent for culture and sensitivity testing, which showed positive for Streptococcus pneumoniae.

Table 1

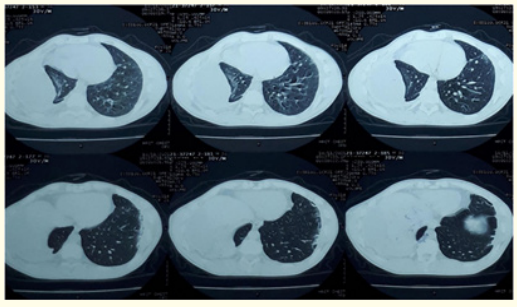

Figure 4: Chest CT scan indicating fluid density collection that was present in right hemi thorax region.

Based on the findings from the CT scan, the patient was admitted for surgical intervention. Subsequently, under sedation thoracentesis was performed which revealed yellowish purulent material coming from the thoracic cavity through the intercoastal space revealing a connection between fluid collection outside the thoracic wall and the pleural cavity, thus diagnosing empyema necessitans (EN). The whole content was then drained and a thoracostomy tube (ICD tube) was then placed to drain the intrapleural empyema, and the wound was closed. A post-operative chest X-ray confirmed the correct placement of the chest tube. Additionally, a sample of the drained fluid was sent for culture and sensitivity testing, which showed positive for Streptococcus pneumonia.

Post-operatively, the patient stayed hospitalized for 7 days and the following treatment was given.

Treatment given

After 7 days, the patient was discharged with improved health symptoms, and a hemodynamically stable condition. He was asked to continue the antibiotic course for 7 more days and was advised to follow up after 10 days.

Discharge medications

Sl. no	Medication	Dose	Route	Freq	Days
1	Inj. Ceftriaxone	1g	IV	1-0-1	For 7 days
2	Inj. Levofloxacin	500 mg	IV	1-0-1	For 7 days
3	Inj. Pantoprazole	40 mg	IV	1-0-0	For 7 days
4	Inj. Tramadol	50 mg	IV	1-0-1	For 7 days
5	Inj. Amikacin	750 mg	IV	1-0-0	For 7 days
6	Inj. Ondansetron	4 mg	IV	1-0-1	For 7 days
7	Tab. Amlodipine	5 mg	PO	1-0-0	For 7 days
8	Inj. Paracetamol	1g	IV	1-0-1	For 7 days

Table 2

Sl. no	Medication	Dose	Route	Freq	Days
1	Tab Pantoprazole	40 mg	PO	1-0-1	For 7 days
2	Tab Levofloxacin	500 mg	PO	1-0-1	For 7 days
3	Tab Ultracet	50 mg	PO	SOS	SOS
4	Tab Amikacin	750 mg	PO	1-0-0	For 7 days

Table 3

Discussion

Empyema Necessitans is a rare complication of pleural effusion. Empyema is characterized by the presence of pus in the pleural space, typically resulting from a complicated chest infection (TB) or pneumonia. Pneumonia can lead to severe complications, including parapneumonic effusions, empyema, and potentially life-threatening sepsis, especially in individuals with underlying conditions that weaken the immune system. A 45-year-old male patient presented in General medicine department with persistent, progressive right lateral thoracic swelling for the last 2 months which was associated with mild pain on palpation. He complained chest pain while breathing, fever with chills, and weight loss of around 6kg since last 2 months. He denied symptoms of haemoptysis, shortness of breath, orthopnoea, recent travel, However, he did report a weight loss of approximately 6 kg over the last 2 months, reporting a BMI of 17.7. He had a past medical history of pneumonia few months ago, and cough with expectoration for 1 month. He also had a history of hypertension. He was a labourer at a construction site and had a history of smoking for 7 years. Laboratory values of ESR and CRP and WBC were found elevated. The patient was hospitalized for 7 days with antibiotics such as Ceftriaxone, Levofloxacin and Amikacin to treat the infection; Proton pump inhibitors such as Pantoprazole to prevent GI irritation; 5HT3 antagonists such as Ondansetron to prevent nausea and vomiting; antihypertensives such as Amlodipine to maintain blood pressure; analgesics and antipyretics such as Paracetamol and pain killers such as Tramadol to reduce pain. A chest X-ray was carried out, revealing pleural effusion in the right lung. Consequently, a Chest CT scan was also ordered which showed a fluid density collection that was present in the right hemi thorax along the lateral chest wall, measuring about 5.0 cm in its maximum thickness, with passively collapsed underlying parenchyma. Based on the findings from the CT scan, the patient was admitted for surgical intervention. Subsequently, under sedation thoracentesis was performed, which revealed yellowish purulent material coming from the thoracic cavity through the intercoastal space, revealing a connection between fluid collection outside the thoracic wall and the pleural cavity. The whole content was then drained and a thoracostomy tube (ICD tube) was then placed to drain the intrapleural empyema, and the wound was closed. A post-operative chest X-ray confirmed the correct placement of the chest tube. Additionally, a sample of the drained fluid was sent for culture and sensitivity testing, which showed positive for Streptococcus pneumoniae, thus diagnosing Empyema Necessitans (EN). Post-operatively, the patient stayed hospitalized for 7 days. After 7 days, the patient was discharged with improved health symptoms, and a hemodynamically stable condition. He was asked to continue the antibiotic course for 7 more days and was advised to follow up after 10 days.

Conclusion

Medical practitioners have followed rational treatment guidelines (STGs) to treat an empyema necessitans, which requires a thorough pleural fluid sample and investigations, including a microbiological and biochemical work-up, to establish an etiological diagnosis. Pneumonia and TB is still the most common and typical cause of Empyema necessitans. ICD tube insertion and antibacterial chemotherapy are still part of the treatment. But for extended periods of time, ICD is required. This condition can be prevented by lung related vaccinations (PCV 13), maintaining hygiene, avoiding environment irritants. There is a lack of information in the literature about Empyema necessitans, which makes further research necessary to aid in the effective management of the condition.

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