Subcutaneous Emphysema Following Chest Tube Insertion in a Patient with Secondary Spontaneous Pneumothorax Due to Chronic Obstructive Pulmonary Disease: A Case Report.

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Abstract

Pneumothorax, characterized by the accumulation of air in the pleural cavity and subsequent lung collapse, is a critical clinical entity with significant morbidity, particularly in patients with underlying chronic lung disease such as chronic obstructive pulmonary disease (COPD). Subcutaneous emphysema, although a recognized complication of chest tube insertion, can present diagnostic and management challenges, especially in patients with severe underlying lung disease. We report the case of a 71-year-old male with a history of moderate smoking and untreated COPD who presented with acute worsening dyspnea, pleuritic chest pain, and productive cough. The patient was initially diagnosed with an acute exacerbation of COPD and subsequently developed a left-sided secondary spontaneous pneumothorax, confirmed by chest radiography. Following chest tube insertion, the patient developed extensive subcutaneous emphysema, manifesting as palpable crepitus and swelling extending from the left chest to the neck and abdomen. This case highlights the importance of early recognition and management of pneumothorax and its potential complications in patients with pneumothorax. Subcutaneous emphysema following chest tube insertion can rapidly progress and compromise respiratory function. Awareness of risk factors and vigilant monitoring are essential to optimize outcomes in this vulnerable patient population.

Keywords: Subcutaneous emphysema, pneumothorax, chest tube complications.

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Introduction

Pneumothorax, defined as the presence of air in the pleural cavity leading to lung collapse, is a significant global health issue with notable differences in incidence based on age, sex, and underlying risk factors. The annual incidence of primary spontaneous pneumothorax (PSP) is reported as 18–28 cases per 100,000 men and 1.2–6 cases per 100,000 women. In the United States, the incidence is estimated at 7 per 100,000 men and 1 per 100,000 women per year. Secondary spontaneous pneumothorax (SSP) occurs more frequently in older adults, with an incidence of 6.3 per 100,000 men and 2.0 per 100,000 women per year.[1]

PSP most commonly affects young adults, particularly tall, thin men aged 20–40 years, with a peak incidence in the early 20s. Data suggested a much higher prevalence among males compare to female. SSP is more frequent in individuals aged 60–65 years, often associated with underlying lung diseases such as COPD.[2] Smoking is the most significant modifiable risk factor, increasing the risk of PSP by more than 20-fold in male and nearly 10-fold in male compared to non-smokers. The risk escalates coherently with the number of cigarettes smoking. Other risk factors include low body mass index, genetic predisposition, and the presence of apical pleural blebs or bullae.[3,4]

The incidence of pneumothorax in patients with chronic lung disease is significantly higher than in the general population. Epidemiological data indicate the annual incidence of secondary spontaneous pneumothorax (SSP) in COPD patients is reported to be 26 per 100.000 cases. A recent large cohort study found that 9.3% of COPD patients developed pneumothorax. Another study reported an annual incidence of first-ever SSP in COPD or emphysema patients as 50 cases per 100.000 per year, with higher rates among male patients.[5,6]

Pneumothorax, particularly in its tension form, constitutes a medical emergency requiring immediate diagnosis and

intervention. The clinical presentation is characterized by sudden acute signs and symptoms that, when recognized promptly, can be life-saving. The most common presenting features are the development of sharp, pleuritic chest pain, typically localized to one side, accompanied by acute shortness of breath. On physical examination, auscultation reveals markedly absent breath sounds on the affected side. This finding is a critical diagnostic clue, particularly in the context of trauma or underlying lung pathology. Percussion of the chest wall over the affected area typically yields a hyper resonant sound, reflecting the presence of free air within the pleural space. The accumulation of intrapleural air under pressure may cause a visible shift of the trachea away from the affected side. Concurrently, jugular venous distension may be observed, indicative of impaired venous return and rising intrathoracic pressure. Patients may exhibit pronounced respiratory distress, including tachypnea, use of accessory muscles, and asymmetrical chest expansion.[7] Clinical signs and symptoms of pneumothorax are frequently identical to acute condition of lung disease, selecting the appropriate treatment is critical since improper management will result in serious complications such as subcutaneous emphysema.[8]

Case presentation

A 71-year-old male patient arrived at the emergency ward with a Chief Complaint a worsening dyspnea for 1 day before admission. The patient reports progressive shortness of breath over the last week. There is a history of intermittent dyspnea over the past 8 months, occasionally accompanied by wheezing. The dyspnea is exacerbated by minimal exertion (walking less than 100 meters) and is relieved by assuming a semi-recumbent or sitting position. There is no history of peripheral edema. The patient denies nocturnal awakenings due to dyspnea or cough. The patient also describes a chronic productive cough with white sputum for the past 8 months. Over the past week, the sputum has become yellowish. Left-sided chest pain worsened 1 days prior to admission. The pain does not radiate to the back or other areas and improved following chest tube insertion. The patient reports sharp, stabbing chest pain for the past month, which intensifies with coughing. The patient has experienced intermittent fever over the last 5 days. There are no reports of night sweats unrelated to physical activity, loss of appetite, or weight loss. There were no known metabolic comorbidities such as diabetes mellitus, hypertension, and other systemic diseases related to his condition. The patient is classified as a moderate smoker according to the Brinkman Index and continues to smoke at present. The patient has not previously received any specific pharmacological therapy for the previous symptoms.

Patient was admitted to the nearby hospital three days ago and diagnosed with acute exacerbation of COPD and on day after, patient symptom is worsened and left side pneumothorax was found following chest X-ray examination. After chest tube insertion, the patient developed subcutaneous emphysema, initially over the anterior chest and subsequently spreading to the posterior chest, neck, and abdomen, accompanied by a nasal quality to the voice, patient then referred to central hospital for better management.

The patient's clinical condition was conscious, with vital signs showing blood pressure of 150/98 mmHg, heart rate of 125 beats per minute, a respiratory rate of 26 times per minute without accessory respiratory muscle involvement, and peripheral oxygen saturation of 95% supported with 3 litre per minute oxygen in nasal cannula. No irregular heart sounds, murmurs or gallops were not detected. Thoracic examination showed asymmetrical in left lung movement. Tactile fremitus decreased on the left hemithorax. Ronchi presents in lower bilateral lung fields. Chest tube with 22 French diameter was inserted in left anterior axillary line between 5-6 intercostal rib. Crepitus palpation as a sign of subcutaneous emphysema was appeared in the left neck region, left anterior and posterior hemithorax until epigastric and left hypochondriac regions (figure 1).

Figure 1. A notable swelling was observed on the left side of the patient's neck extending towards the upper region of the left side chest.

The prior chest x ray examination (figure 2a) showed the left hemithorax appears hyperlucent with a visible absence of vascular markings and mediastinum is slightly to the right suggesting the presence of a left-sided pneumothorax. The chest X-ray after chest tube insertion (figure 2b) showed and evidence of increased radiolucency and flattening of the right hemidiaphragm, which is consistent with underlying COPD and possible emphysematous changes. The left lung shows increased interstitial markings, which may indicate underlying lung infection. Sub cutaneous emphysema is suggested by the presence of radiolucent streaks in the soft tissues of the left and right chest wall and possibly extending into the neck and abdominal region (blue arrow). Peripheral blood examination found increase number of leucocyte (16.740 gr/dl) and segmented neutrophil (93%). The findings from patient's history, physical examination, and peripheral blood tests are consistent with subcutaneous emphysema grade 5 as a complication of secondary spontaneous pneumothorax and an acute bacterial infection in COPD exacerbation.

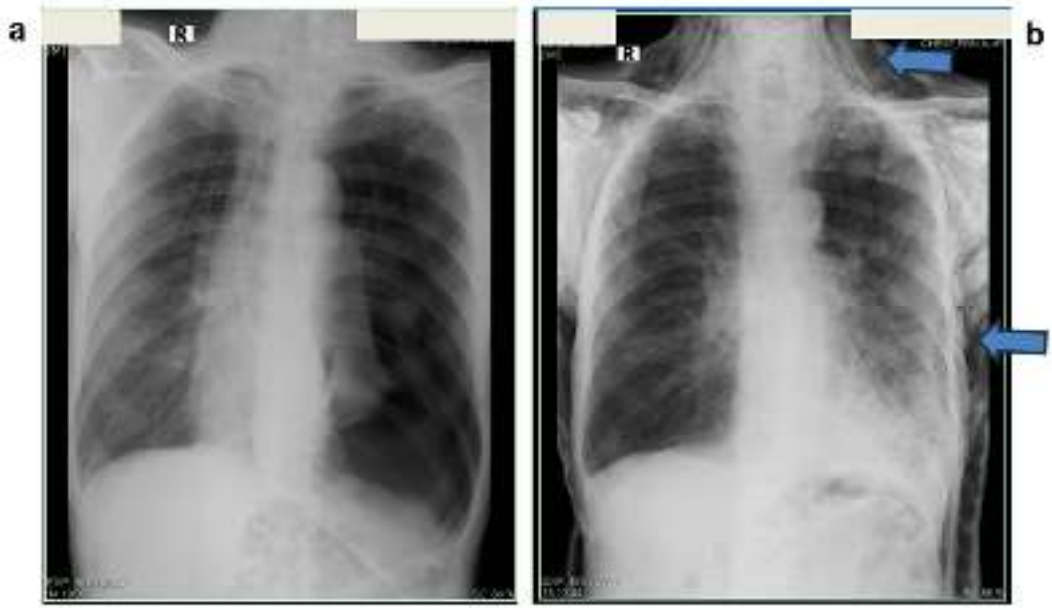

Figure 2. (a) left side pneumothorax causing slightly mediastinal shift to the right. (b) subcutaneous emphysema appeared a day after chest tube insertions (blue arrow).

Discussion

Subcutaneous emphysema is characterized by the presence of air within the subcutaneous tissues. The etiology of this condition is diverse, encompassing a range of traumatic, iatrogenic, infectious, and spontaneous causes.[9] Trauma remains one of the most common etiologies of subcutaneous emphysema. Both blunt and penetrating injuries to the chest, neck, or face can disrupt the integrity of the respiratory tract, pleura, or esophagus, causing air to escape into the subcutaneous tissues. Rib fractures, stab wounds, and gunshot injuries are frequently implicated in such cases. Conditions that result in alveolar rupture, such as pneumothorax or barotrauma, can allow air to dissect along tissue planes and accumulate subcutaneously. This is particularly observed in patients with underlying lung pathology or those subjected to positive pressure ventilation. Medical interventions are known contributors to subcutaneous emphysema.[10] Procedures such as endotracheal intubation, bronchoscopy, central venous catheter placement, thoracic surgery, and laparoscopic operations may induce air leaking into the subcutaneous space. Certain infections, caused by gas-forming organisms such as *Clostridium* species, can produce subcutaneous emphysema. Gas gangrene and necrotizing fasciitis are severe infectious processes that may present with this clinical finding. The last is perforation of the oesophagus, whether spontaneous (e.g., Boerhaave syndrome) or secondary to trauma or instrumentation, can lead to the escape of air into the mediastinum and subsequently into the subcutaneous tissues.[11,12]

Subcutaneous emphysema is a recognized complication after chest tube placement, though the reported frequency varies depending on the patient population and underlying condition. In thoracic surgical patients, the incidence of clinically apparent subcutaneous emphysema was reported after chest tube or thoracic surgery.[13] Subcutaneous emphysema is most commonly associated with pneumothorax, especially in patients with underlying COPD or other underlying lung diseases. The majority of cases are mild and resolve with conservative management, but severe cases can occur, particularly if there is persistent air leak or improper chest tube function.[14]

There are several factors that can increase the risk of subcutaneous emphysema following chest tube placement. The first is due

to malposition or improper placement of the chest tube. It mostly happens when the tip of the tube is not correctly positioned within the pleural cavity, air leak can escape into the subcutaneous tissues of the chest wall, neck, or face. The second possible cause is an obstruction of the chest tube. If the tube becomes blocked, air that should be evacuated from the pleural space to the drainage bottle may be forced into the subcutaneous tissues. Inappropriate tube size also can be a potential cause of air leak into the subcutaneous part of the chest wall. The use of an inappropriately sized chest tube, particularly one that is too small relative to the incision or the chest wall tract, may result in inadequate sealing between the tube and surrounding tissues. This mismatch can create a potential way for air from the pleural cavity to escape into the subcutaneous tissue, rather than being effectively evacuated through the tube. Furthermore, a chest tube of insufficient diameter may be unable to accommodate the volume of an ongoing air leak, thereby predisposing to the accumulation of air within the subcutaneous space.[14,15]

Subcutaneous emphysema often presented with a sign of prominent swelling and smooth bulging of the skin, most notably involving the neck and upper chest regions. The patient reported a sore throat and neck pain, accompanied by discomfort and pain in the chest. Additional symptoms included difficulty breathing (dyspnea), swallowing (dysphagia), and speaking, as well as episodes of wheezing. The patient described a sensation of pressure in the affected areas, and also noted a gas or bloating sensation beneath the skin.[9] On physical examination, there was evident localized swelling (edema) in the neck and chest. Palpation of the affected regions revealed palpable crepitus—a distinctive crackling or popping sensation under the skin, mimicking of tissue paper or "warm Rice Krispies"—as air was displaced through the subcutaneous tissues. When compressing the neck and supraclavicular region, crackles were audible. In this case, the swelling extended visibly, raising concern for potential airway compromise due to the extensive accumulation of subcutaneous air. Palpation occasionally caused the trapped air bubbles to move or burst.[16]

Table 1. Grading of Subcutaneous Emphysema by Anatomical Extent.[17]

Grade	Anatomical extent
1	The base of the neck
2	The entire neck area
3	The subpectoralis major region (upper anterior chest wall)
4	The chest wall and entire neck area
5	The chest wall, neck, orbit, scalp, abdominal wall, upper limbs, and scrotum

Subcutaneous emphysema associated with pneumothorax requires a systematic approach in order to both resolving the underlying pneumothorax and treating the accumulation of subcutaneous air. The treatment strategy is determined by the severity of the emphysema, the extent of the pneumothorax, and the presence of any associated complications.[15]

Treatment of the underlying pneumothorax is an early evacuation of air from the pleural space. This is typically achieved through the insertion of a tube thoracostomy. The chest tube insertion aims to facilitates the re-expansion of the lung and prevents further leakage of air into the subcutaneous tissues. In a condition of a chest tube is already inserted prior to the subcutaneous emphysema appear, and it continues to progress, consideration should be given to replacing the tube with a larger bore drain or increasing the suction pressure applied to the drainage system. High-flow supplemental oxygen is recommended as it accelerates the reabsorption of subcutaneous air. This occurs via an increased gradient for nitrogen washout, promoting the diffusion of nitrogen from the subcutaneous tissues into the alveoli for exhalation.[18]

In cases of extensive or rapidly progressive subcutaneous emphysema, direct decompression of subcutaneous air should be

performed using several methods. The simplest method is by performing manual decompression by doing massage to the affected area towards the drainage site. Placement of fenestrated subcutaneous drains or catheters under gentle suction can provide continuous evacuation of trapped air. A blow hole, a small infra clavicular skin incisions, may be created to facilitate the passive escape of subcutaneous air. The last is by performing surgical decompression or emergency tracheostomy in a condition of airway obstruction is imminent.[19,20]

Most cases of subcutaneous emphysema resolve within 10 to 14 days once the underlying cause is effectively treated. Mild cases may resolve in about 10 days, while even severe cases typically resolve within two weeks after appropriate intervention. The duration required for subcutaneous emphysema to resolve varies considerably and is influenced by multiple clinical condition and patient-related factors. Understanding these determinants is essential for optimizing patient management. The magnitude and persistence of the underlying air leak are primary determinants of recovery time. Larger or ongoing air leaks, such as those resulting from incomplete lung re-expansion or the presence of a bronchopleural fistula, can significantly prolong the presence of subcutaneous emphysema. Appropriate treatment of the etiology of subcutaneous emphysema—whether trauma, pneumothorax, malignancy, infection, or postoperative complications—affects both the severity and duration of the condition. Cases associated with chronic lung disease or recurrent cases tend to resolve in a longer duration. Individual characteristics of the patient such as elderly age, lower body mass index, and poor baseline pulmonary function have been identified as risk factors for more extensive or prolonged subcutaneous emphysema.[14,21]

Conclusion

Subcutaneous emphysema (SE) is a recognized complication following chest tube placement, most commonly associated with pneumothorax or other underlying lung diseases. The main causes of SE after chest tube insertion include improper tube placement, tube obstruction, and the use of an inappropriately sized tube. These issues can allow air to escape from the pleural space into the subcutaneous tissues, rather than being effectively evacuated through the tube.

Most cases of SE are mild and resolve with conservative management once the underlying cause is addressed. However, severe or rapidly progressing SE may require additional interventions, such as replacing the chest tube with a larger one, increasing suction, or directly decompressing the subcutaneous air. The prognosis is generally good, with most cases resolving within 10 to 14 days, but recovery can be prolonged in patients with persistent air leaks, chronic lung disease, or other complicating factors.

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