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TRACHEAL PERFORATION AND SUBCUTANEOUS EMPHYSEMA SECONDARY TO PSEUDOMEMBRANOUS INVASIVE ASPERGILLUS TRACHEOBRONCHITIS SUCCESSFULLY MANAGED WITH ENDOTRACHEAL TUBE MANIPULATION

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ABSTRACT

Introduction: Aspergillus is a ubiquitous fungus causing various pulmonary diseases depending on the host's immune status. Aspergillus tracheobronchitis, a rare form of invasive aspergillosis, primarily affects severely immunocompromised or critically ill patients. We present the first known case of Aspergillus tracheobronchitis complicated by tracheal perforation and subcutaneous emphysema successfully treated with conservative endotracheal tube manipulation.

Case description: A 64-year-old male with type 2 diabetes mellitus presented with generalized weakness and abdominal discomfort, later diagnosed with a perforated cecum requiring right colectomy. His postoperative course in the intensive care unit was complicated by septic shock, acute kidney injury, and failed extubation due to airway compromise. Seven days after the failed extubation, he developed subcutaneous emphysema in the neck. Chest computed tomography scan showed neck, left chest wall, and mediastinal emphysema. Bronchoscopy identified a focal black necrotic lesion on the left proximal tracheal wall and multiple small mucosal ulcerations throughout the proximal to distal trachea. The endotracheal tube was advanced beyond proximal tracheal necrotic lesion. Subcutaneous emphysema reduced overnight, suggesting that the lesion was the source of the air leak. Bronchial washings confirmed Aspergillus fumigatus, establishing a diagnosis of invasive Aspergillus tracheobronchitis. Treatment with voriconazole prevented further expansion of emphysema, which gradually resolved.

Conclusion: Subcutaneous emphysema in ventilated patients with tracheobronchitis is a rare and challenging complication. This case demonstrates successful management through endotracheal tube manipulation to tamponade the lesion, highlighting subcutaneous emphysema as a potential manifestation of Aspergillus tracheobronchitis and offering a minimally invasive treatment approach.

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KEYWORDS

Aspergillus, invasive Aspergillosis, Aspergillus tracheobronchitis, subcutaneous emphysema, mediastinal emphysema

LEARNING POINTS

- Subcutaneous emphysema may present as a manifestation of Aspergillus/fungal tracheobronchitis.
- Aspergillus tracheobronchitis should be considered in patients with predisposing factors such as lung transplantation, acquired immunodeficiency syndrome (AIDS), diabetes mellitus, chronic obstructive pulmonary disease, and malignancies.
- Tracheal perforation caused by Aspergillus tracheobronchitis can be managed through endotracheal tube manipulation.

INTRODUCTION

Aspergillus is a ubiquitous fungus that can lead to a variety of pulmonary conditions depending on the host's immune status. Common forms of aspergillosis include allergic bronchopulmonary aspergillosis, invasive aspergillosis, chronic necrotizing aspergillosis, and aspergilloma. Aspergillus tracheobronchitis, a rare form of invasive aspergillosis, typically occurs in critically ill or severely immunocompromised patients and only rarely causes tracheal perforation and subcutaneous emphysema[1,2]. Here, we present the first known case of Aspergillus tracheobronchitis complicated by subcutaneous emphysema of the neck and chest wall, along with mediastinal emphysema that was successfully managed using conservative manipulation of the endotracheal tube, without the need for surgical intervention.

CASE DESCRIPTION

A64-year-oldmalenon-smokerwithahistoryofhypertension, type 2 diabetes mellitus, chronic kidney disease, deep venous thrombosis, and leg osteomyelitis presented with generalized weakness, dizziness, and abdominal discomfort for one week. An initial computed tomography (CT) scan of the abdomen and pelvis did not reveal any abnormalities to explain his abdominal symptoms. Ten days later, due to persistent abdominal discomfort, an abdominal and chest X-ray was performed, which identified pneumoperitoneum. The patient was urgently taken to the operating room and underwent a right colectomy for a perforated cecum. The patient's postoperative course in the intensive care unit was

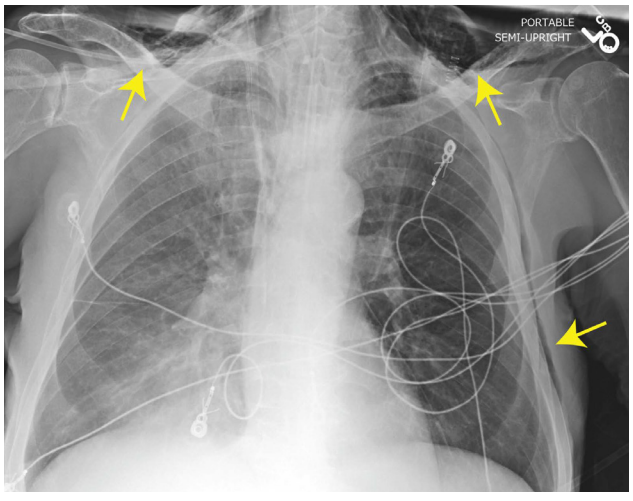


Figure 1. Chest X-ray showed subcutaneous gas in the neck and left chest wall, along with the previously identified airspace disease in the right lung. Yellow arrows indicate subcutaneous gas.

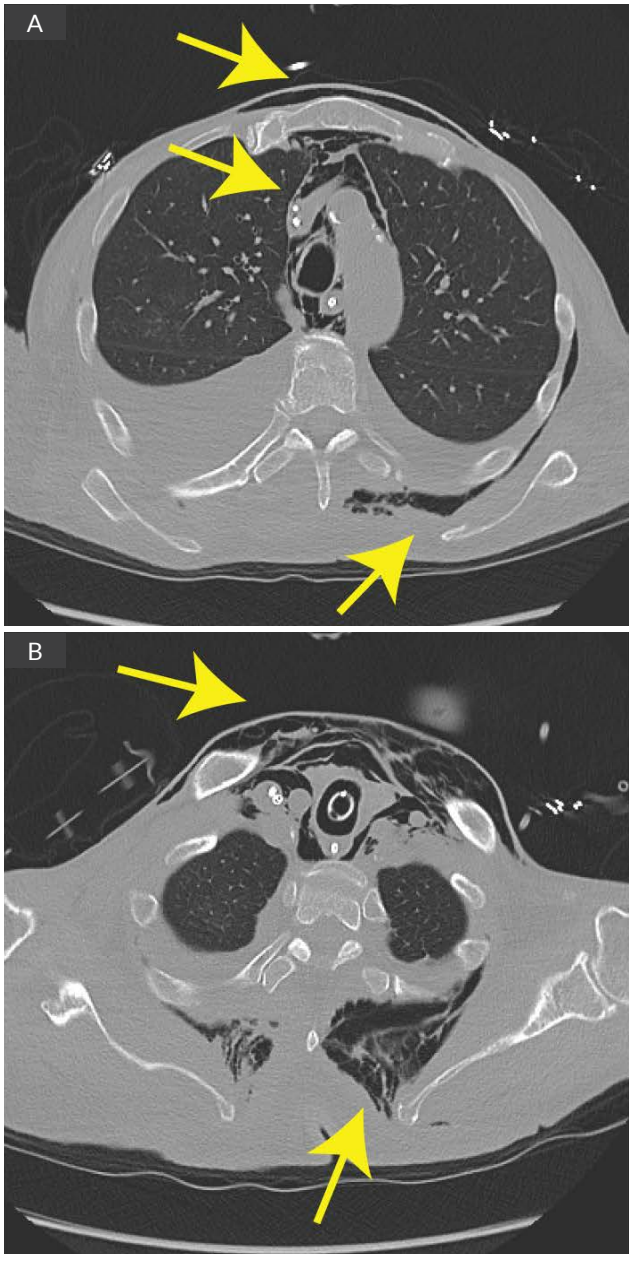


Figure 2. Chest CT showed gas in the neck, chest, and mediastinum. Lower zone (A) and upper zone (B) of the lungs were visualized. Yellow arrows indicate gas.

complicated by septic shock requiring multiple vasopressors and systemic steroids, acute kidney injury necessitating continuous renal replacement therapy, and anemia with thrombocytopenia requiring massive transfusions of packed red blood cells, fresh frozen plasma, and platelets. Following surgery, the patient remained on mechanical ventilator for 6 days and was successfully extubated for about six hours before needing to be reintubated due to airway compromise. A plan was made to perform a tracheostomy for failed extubation and the inability to maintain airway. Seven days after the reintubation, the patient developed upper chest subcutaneous emphysema. Despite the absence of documented traumatic reintubation or oral bloody secretions, a tracheal perforation was suspected, prompting pulmonology consultation.

Physical examination revealed a well-nourished male intubated on the mechanical ventilator with fraction of inspired oxygen (FiO_2) of 24%. His blood pressure was 133/51 mmHg, with a normal temperature and pulse. Neck examination revealed subcutaneous emphysema bilaterally. Cardiac and pulmonary examinations were unremarkable. The abdomen was soft and non-tender, with a Jackson-Pratt drain in place. Bilateral pitting edema was noted. Laboratory analysis (Table 1) was remarkable for hemoglobin level of 7.6 g/d, platelet count of 19 $\times 10^3$/µl, total protein of 4.7 g/dl, total bilirubin of 12.9 mg/dl, and a prothrombin time-international normalized ratio (PT-INR) of 1.75. A chest X-ray demonstrated subcutaneous gas in the neck and left chest wall, along with previously identified airspace disease in the right lung *(Fig. 1)*. Chest CT scan confirmed the presence of gas within the soft tissues of the neck, chest, and mediastinum *(Fig. 2)*.

Bronchoscopy showed multiple punctate mucosal ulcerations, each measuring approximately 0.5 × 0.5 cm, with necrotic center and a whitish surrounding border, distributed throughout the proximal to distal trachea *(Fig. 3A)*. Additionally, a focal area of black discoloration with necrosis was observed on the left lateral wall of the proximal trachea, just below the subglottic region. This lesion measured approximately 1 x 2 cm and was notable for whitish pseudomembranous mucoid center *(Fig. 3B)*. This was presumed to be the cause of subcutaneous emphysema in the left chest. To tamponade the lesion and progression of emphysema, the endotracheal tube was advanced past the proximal tracheal lesion to rest approximately 3 cm above the carina. Subcutaneous emphysema reduced overnight, further suggesting that the lesion was the source of the emphysema. Fungal culture for bronchial washing was positive for *A. fumigatus*, establishing the diagnosis of Aspergillus tracheobronchitis and invasive pulmonary Aspergillosis. Treatment with voriconazole was initiated, and the subcutaneous emphysema remained stable and gradually resolved over time. Given the prolonged hospitalization and a guarded prognosis, the patient and family opted to transition to palliative care, and the patient was discharged to an inpatient hospice program.

DISCUSSION

This is the first reported case of tracheal perforation and subcutaneous emphysema secondary to Aspergillus tracheobronchitis successfully managed with conservative manipulation of the endobronchial tube. We performed a systematic search on MEDLINE and Google Scholar, using the following keywords: "tracheal perforation," "subcutaneous emphysema," "Aspergillus tracheobronchitis," and "endotracheal manipulation." This search yielded two case reports describing tracheal perforation secondary to pseudomembranous Aspergillus tracheobronchitis[1,3] and two case reports of tracheal perforation involving unspecified (non-pseudomembranous) Aspergillus tracheobronchitis[4,5]. Notably, none of these publications documented treatment with endotracheal tube manipulation, and only one case report documented subcutaneous emphysema associated with Aspergillus tracheobronchitis[1]. Tracheobronchitis is a rare but serious manifestation of invasive Aspergillosis, with reported overall mortality rate of 48%[6]. Infection or traumatic disruption of the tracheal mucosa can lead to subcutaneous emphysema[7], and in our case, Aspergillus tracheobronchitis was identified as the underlying cause. *A. fumigatus* is the most common Aspergillus species that

Test	Result
WBC ($\times 10^3$/µl)	3.6
Hemoglobin (g/dl)	7.6
Hematocrit (%)	22.2
Platelet ($\times 10^3$/µl)	19
Na (mEq/l)	144
K (mEq/l)	2.4
Cl (mEq/l)	113
Glucose (mg/dl)	238
Ca (mg/dl)	8
BUN (mg/dl)	64
Creatinine (mg/dl)	1.5
Total protein (g/dl)	4.7
Albumin (g/dl)	3.4
AST (IU/l)	53
ALT (IU/l)	82
ALP (IU/l)	90
Total Bilirubin (mg/dl)	12.9
PT-INR	1.75

Abbreviations: WBC, white blood cell; BUN, blood urea nitrogen; AST, aspartate transaminase; ALT, alanine transaminase; ALP, alkaline phosphatase; PT-INR, prothrombin time-international normalized ratio; ALT, alanine transaminase; ALP, alkaline phosphatase; LDH, lactate dehydrogenase; PT-INR, prothrombin time-international normalized ratio.

Table 1. Laboratory data.

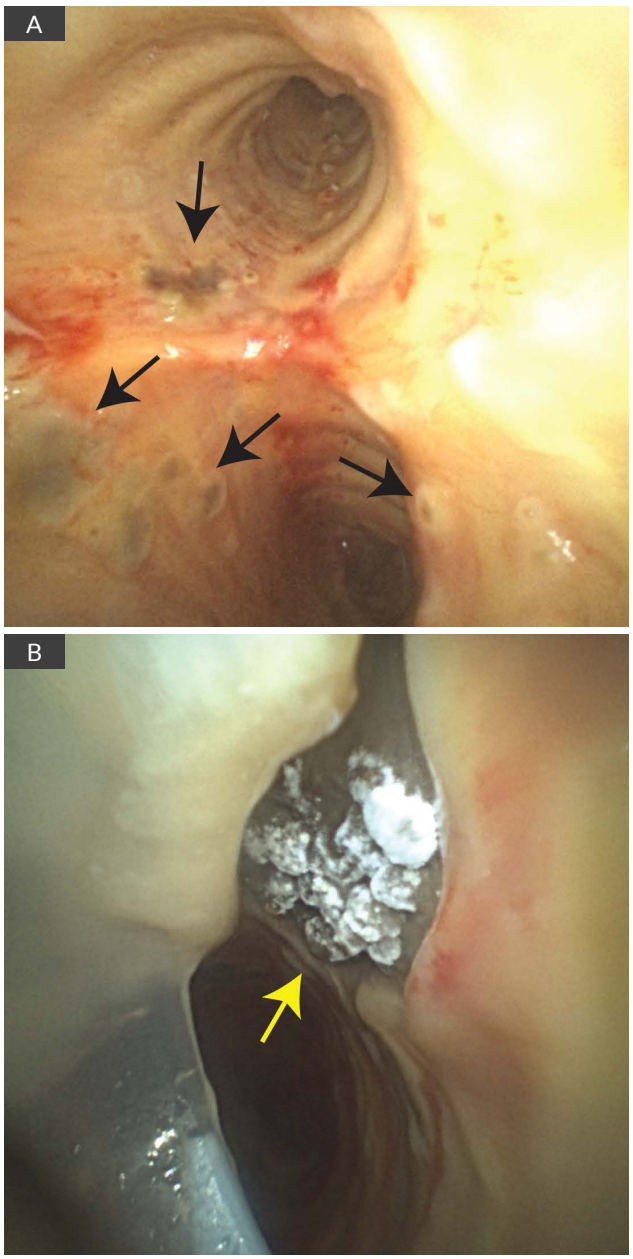


Figure 3. Bronchoscopy revealed multiple mucoid ulcers and a necrotic lesion in the proximal trachea.

A) Multiple punctate mucosal ulcerations, each measuring approximately 0.5 × 0.5 cm, with necrotic centers and whitish borders, are scattered throughout the trachea from the proximal to distal segments. B) Black arrows indicate ulcerations. A necrotic lesion measuring up to 1 × 2 cm is noted on the left lateral wall of the proximal trachea, just below the subglottic region, with a pseudomembranous whitish mucoid center. This lesion was thought to be the cause of subcutaneous emphysema. Yellow arrow indicates necrotic area.

cause tracheobronchitis[8,9], and in our case *A. fumigatus* was detected. Aspergillus tracheobronchitis presents in three forms: ulcerative, pseudomembranous, and obstructive[10]. Our patient had multiple tracheal ulcers as well as a focal area of black necrotic lesion with pseudomembranous mucoid center, the latter was thought to be responsible for the development of subcutaneous emphysema; supported by the observation that the subcutaneous emphysema improved following endotracheal tube adjustment to tamponade the responsible lesion. Managing subcutaneous emphysema caused by a tracheal lesion in a ventilated patient is challenging. In our case, it was successfully managed with endotracheal tube advancing for 3 cm above the carina, effectively to tamponading the air leak, in combination with voriconazole.

Early diagnosis and treatment of Aspergillus tracheobronchitis are crucial due to its high mortality rate, particularly of pseudomembranous and obstructive forms, where mortality can reach up to 80%[11]. Nevertheless, diagnosis remains challenging as Aspergillus tracheobronchitis lacks specific clinical symptoms and distinctive radiological findings. Aspergillus tracheobronchitis is frequently associated with lung transplant[8,12], acquired immunodeficiency syndrome (AIDS)[13], diabetes mellitus[14,15], chronic obstructive pulmonary disease[15], and malignancies[9]. In our case, the patient had diabetes, was receiving systemic corticosteroids for severe sepsis, and required intensive care unit admission with mechanical ventilation; all factors predisposing to invasive Aspergillosis. Early utilization of bronchoscopy in patients with such risk factors is essential for the timely diagnosis of Aspergillus tracheobronchitis.

Despite the current recommendation to use antifungal agents for invasive Aspergillosis[16], no standardized protocol exists for managing tracheal wall perforation and subcutaneous emphysema associated with tracheobronchitis. Most studies on tracheal perforation primarily address the management of tracheobronchial injuries[17], rather than perforations caused by tracheobronchitis. Patients with severe tracheobronchitis frequently have immunocompromising risk factors, which further complicates treatment strategies. Potential management options include tracheostomy, tracheal reconstruction, or the use of tracheal stents, all of which necessitate multidisciplinary discussions. The development of a registry to collect and analyze similar cases is essential for establishing evidence-based treatment protocols.

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