

Fatal E-Cigarette or Vaping Product Use-Associated Lung Injury Secondary to *Streptococcus Constellatus* Empyema

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Abstract

Streptococcus constellatus empyema in e-cigarette or vaping product use-associated lung injury can be fatal. Empyema as a presentation of e-cigarette or vaping product use-associated lung injury (EVALI) is rarely reported. *Streptococcus constellatus* is a known causative pathogen in empyema, but is usually associated with the elderly and immunocompromised states. A 13-year-old male with a history of active e-cigarette use presented to our centre with right lung empyema, which was complicated by suspected bronchopleural fistula. Despite a chest drain, antibiotics, inotropic and ventilatory support, he eventually succumbed to his illness. This case highlights a rarely reported severe complication of EVALI. Clinicians should be alert to the history of e-cigarette use in patients presenting with unexplained empyema.

Keywords: Case Reports, E-Cigarette Use-Associated Lung Injury, empyema, *Streptococcus constellatus*

Introduction

Streptococcus constellatus is a Gram-positive cocci classically reported in subdural empyema, liver abscess, frontal sinus abscess, head and neck infections.¹⁻⁴ While sporadically reported to be the causative organism for pleural empyema, it has never been reported in the context of e-cigarette or vaping product use-associated lung injury (EVALI).⁵ The prevalence of EVALI differs according to region; one large cohort from the United States reports a prevalence rate of 1.4 cases per 100,000 12-64-year-olds.⁶ Here we report a 13-year-old male who succumbed to EVALI complicated by *Streptococcus constellatus* empyema.

Case Report

A 13-year-old male with daily e-cigarette use and no prior medical illness presented to our hospital with a history of intermittent cough and fever for one month, with recent worsening dyspnea for a day. He denied haemoptysis. On physical examination, his blood pressure was 152/82 mmHg, respiratory rate of 35 breaths per minute, heart rate of 150 beats per minute, and oxygen saturation of 89% under room air. Auscultation of the lung revealed reduced air entry over the right lung, while corresponding chest radiograph noted a right-sided pleural effusion (Figure 1). Blood investigations revealed leukocytosis of $19.53 \times 10^3/\mu\text{L}$ ($4 - 11 \times 10^3/\mu\text{L}$) and C-reactive protein of 213.4 mg/L (<5.0 mg/L). Renal function, liver function, and glucose investigations were within normal range. An arterial blood gas taken on rebreather face mask at a flow of 15 liters per minute showed decompensated metabolic acidosis with hyperlactatemia (pH 7.25 pO₂ 249mmHg pCO₂ 30 mmHg HCO₃⁻ 13.2 mmol/L Lactate 8.2 mmol/L). He was subsequently intubated due to worsening respiratory distress and transferred to the high-dependency unit.

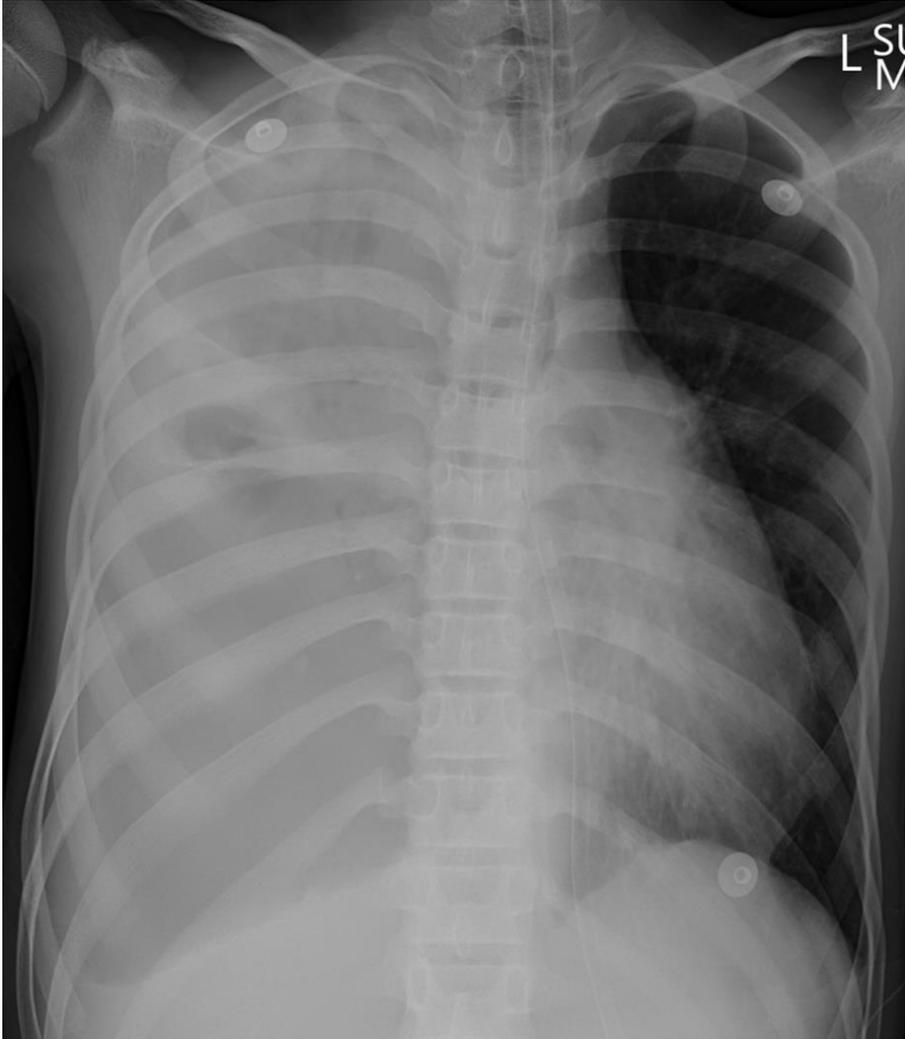


Figure 1: Chest X-Ray on the 2nd August 2022. Frontal chest radiograph shows complete white out of the right hemithorax. There is presence of positive mass effect as evidenced by tracheal and mediastinal deviation to the left. The left lung field is otherwise clear.

Bedside ultrasound revealed a right-sided multiseptated collection. Thoracocentesis revealed frank pus and a chest drain was inserted (Figure 2). Corresponding pleural fluid investigations revealed fluid protein of 16 g/L and lactate dehydrogenase of 5355 u/L. Due to high-ventilator settings and continual bubbling of the chest drain, a bronchopulmonary fistula was suspected and a second chest tube was inserted for better ventilation.



Figure 2: Chest X-Ray on the 3rd August 2022. Frontal radiograph (post intubation) shows lucent areas along the right hemithorax lower zone, in keeping with pneumothorax, causing compression onto the adjacent lungs. Persistent homogeneous opacity of the right upper and mid zone with loss of right heart border, may represent right lung collapse. Otherwise no mediastinal shift to the left. Air space opacity with air bronchogram noted at the left mid and lower zones with blunting of the left costophrenic angle.

The patient received broad-spectrum antibiotics, hemodialysis support, and was hemodynamically supported with three inotropes. Computed tomography of the chest was precluded in view of the patient's unstable clinical condition. Unfortunately, the patient succumbed after two days in the high-dependency unit. Post-demise, the pleural fluid culture isolated streptococcus constellatus. Tracheal aspirate for acid-fast bacilli, mycobacterium tuberculosis culture, Gene Xpert MTB/RIF Assay were all negative. Screening for retroviral disease, hepatitis B and C were all negative. As the patient did not have any predisposing factors for empyema or underlying immunocompromise, the patient was diagnosed with a probable case of e-cigarette or vaping use-associated lung injury (EVALI).

Discussion

Streptococcus constellatus empyema is commonly reported in elderly with comorbidities such as diabetes mellitus. While a small retrospective series demonstrated low mortality rates of 11.1%, more than half developed respiratory failure and a third developed severe pneumonia, including acute respiratory distress syndrome and septic shock. Early diagnosis and timely treatment are essential in reducing mortality due to pleural infection.⁷ Centers for Disease Control and Prevention (CDC) proposed the diagnostic criterion for a "confirmed case" of EVALI as follows: (1) use of an e-cigarette or a related product (e.g., "vaping" or "dabbing") in the previous 90 days; (2) lung opacities on the chest

imaging (radiograph or CT scan); (3) exclusion of lung infection; and (4) absence of a likely alternative diagnosis (e.g., cardiac, neoplastic, and rheumatologic).⁸

This patient did not have a complete pulmonary infectious work-up (example: respiratory viral panel, influenza testing, et cetera.) however met the remaining criteria for EVALI, the CDC definitions label them as a "probable case" of EVALI. Alternatively, if the clinicians involved find themselves faced with a positive result on an infectious work-up but do not believe the presentation to be solely due to underlying infection, the patient may also be called a probable case of EVALI⁹ Ultimately, EVALI is considered a diagnosis of exclusion for which no direct confirmatory testing exists.¹⁰

In cases of bilateral effusion due to pneumonia, the mortality rate can increase by 6.5 times compared to patients hospitalized with only pneumonia. By definition, a parapneumonic effusion is considered any pleural effusion occurring secondary to pneumonia (bacterial or viral) or lung abscess, while an abscess may be termed as an empyema when there is pus in the pleural space.¹¹ Several cases documenting the complications of vaping have been reported in the literature to date. For example, one such report featured a 38-year-old female who had a history of vaping and e-cigarette use, which was complicated by a left-sided empyema and managed with IV antibiotics and fibrinolytics.¹² Another report featured a 26-year-old male with history of vaping who developed loculated empyema requiring surgical decortication.¹² It has been postulated that vape-related empyema is due to precipitate formed from the transformation of phosphatidylcholines, which are a component of surfactant, from a gel to a liquid crystalline phase when exposed to tocopherols such as vitamin E acetate which are found in vape liquid.¹³ This subsequently leads to alveolar dysfunction.¹³

His severe presentation and eventual death were likely due to a delayed presentation. One contributing factor may have been his status as an undocumented foreigner, who may have not wanted to seek medical attention early.

Conclusion

This case reflects the possible risks of vaping, while also highlighting the need for early management of pleural infection. Pleural empyema is a potential complication of EVALI. Clinicians are advised to be alert to seek a history of vape use when non-immunocompromised individuals of younger ages present with severe pleural infection.

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