Vape-associated lung injury in an adolescent

Hannah Wilkerson BS, Ganesh Maniam BA, MBA, Ryan E. Dean BS, MBA, Matthew Goldfinger DO, Preetha Kandaswamy MD, Todd Bell, MD

Abstract

The rise in incidence of e-cigarette or vaping product use associated lung injury (EVALI) and associated deaths has become a growing concern among public health officials. In most cases, the presenting and predominant complaints were respiratory in nature. However, in this case, the chief complaint was gastrointestinal symptoms. A 17-year-old male presented with a two-day history of sore throat, headache, and malaise followed by a one-day history of fever, vomiting, and diarrhea. Additional history revealed that patient was a regular user of THC vape cartridges. Computed tomography (CT) scan of the thorax showed a large right lower lobe consolidation with patchy infiltrates consistent with airspace pneumonia. He was later found to have C. difficile *infection on day 3 and was started on metronidazole. After four days of ceftriaxone and supportive treatment, he showed significant improvement and was discharged on hospital day 5 with metronidazole and amoxicillin-clavulanate. In this case, the clinical picture of respiratory or gastrointestinal symptoms in the context of the patient's using e-cigarettes or vaping products should bring EVALI into the differential diagnosis. Furthermore, this case highlights the need for increased public education regarding the dangers of e-cigarettes and vaping, especially with regard to increasing awareness among adolescent populations.*

Keywords: vaping; EVALI; lung injury; public health; electronic THC delivery systems

Introduction

The rise in incidence of e-cigarette or vaping product use associated lung injury (EVALI) and associated deaths has become a growing concern among public health officials. Though the exact etiology is unknown, the use of e-cigarette and THC vaping products are overwhelmingly implicated in the development of EVALI.[1–3] Rather than being a single process, this condition presents with a high degree of variability and with symptomatology seen across a wide range of disease processes. Respiratory symptoms, such as pleuritic chest pain and shortness of breath, predominate throughout the disease course, but gastrointestinal symptoms are also common.[1] In some cases, the gastrointestinal symptoms can present first and can confound the diagnosis in the absence of good history and physical examination. As demonstrated by this case, the disease's variable presentation requires a high degree of clinical suspicion in the context of patient utilization of e-cigarettes or vaping products.

Corresponding author: **Hannah Wilkerson**
Contact Information: Hannah.Wilkerson@ttuhsc.edu
DOI: 10.12746/swrccc.v8i35.729

Case

A 17-year-old male presented with a two-day history of sore throat, headache, and malaise followed by a one-day history of fever, vomiting, and diarrhea. His fever reached 103.8 F at an outside facility, where he received ceftriaxone and two fluid boluses of normal saline. He was admitted to our facility for dehydration secondary to suspected gastroenteritis. The patient initially appeared to be in mild distress and was tachycardic and tachypneic. Respiratory examination was

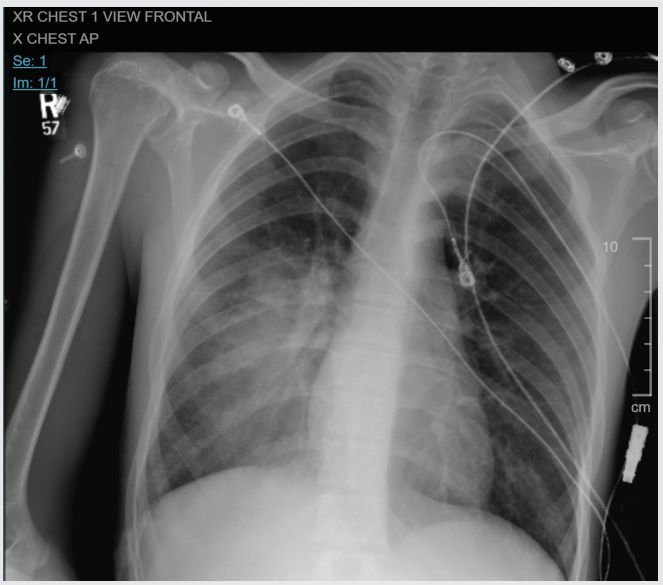

Figure 1A. PA chest x-ray reveals a RLL infiltrate.

significant for faint diffuse crackles, worse on the right side, as well as shallow breathing and a wet sounding cough. The patient confirmed regular use of tetrahydrocannabinol (THC) vape cartridges. Chest x-ray showed consolidation in the right lower lobe; computed tomography (CT) of the thorax showed large right lower lobe consolidation with patchy infiltrates consistent with airspace pneumonia (*see Figures 1A–1D*). The patient continued receiving ceftriaxone, but he needed aggressive intravenous hydration due to continued hemodynamic instability with tachycardia,

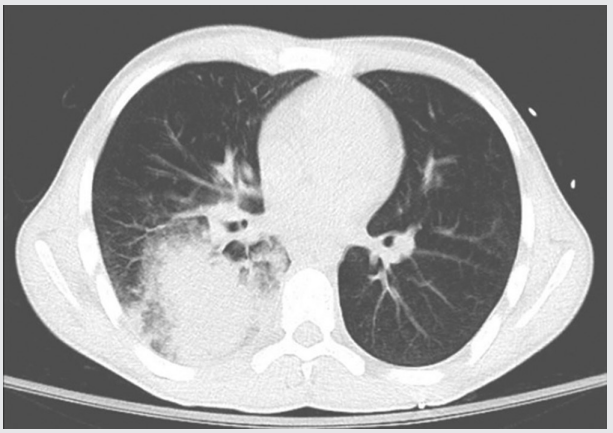

Figure 1B. Computed tomography scan of the chest (axial plane) reveals a RLL infiltrate.

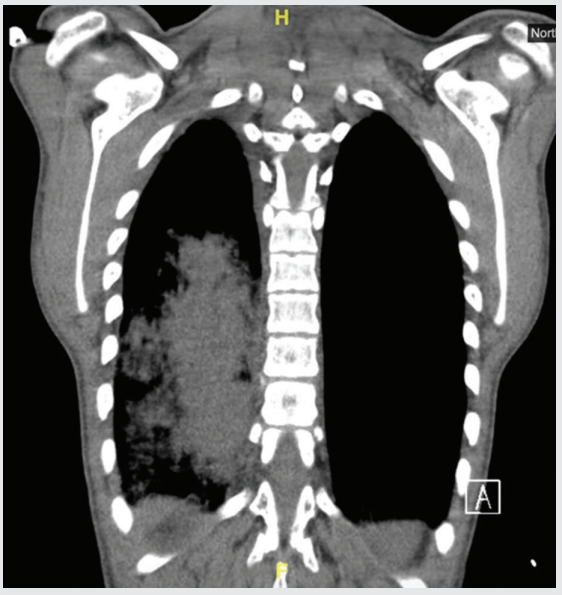

Figure 1C. Computed tomography scan of the chest (coronal plane) reveals a RLL infiltrate.

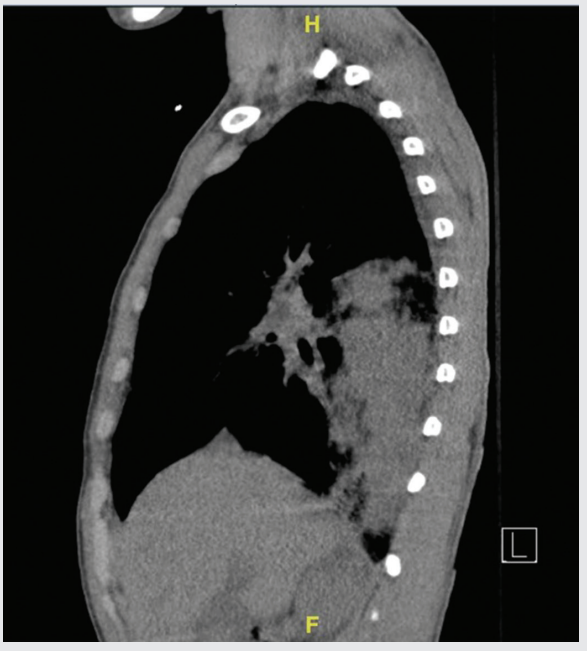

Figure 1D. Computed tomography scan of the chest (sagittal plane) reveals a RLL infiltrate.

tachypnea, and low blood pressures with a minimum of 81/52 mmHg; his oxygenation decreased to 91% despite oxygen administration (15 L at FiO_2 50%). On hospital day 2, he appeared to be in greater distress, and his clinical status appeared to be refractory to multiple fluid resuscitation efforts. He was admitted to the pediatric intensive care unit (PICU) to receive an epinephrine drip, oxygen administration via Ventimask, and continuous maintenance fluids. By the end of hospital day 2, his shortness of breath, hypotension, and fever began to improve, but he continued to experience nausea and diarrhea. On hospital day 3, he was found to have a *C. difficile* infection and was started on metronidazole. While this complicated the diagnosis of his GI complaints, he had initially tested negative for *C. difficile* prior to transfer, even with GI symptoms already present. Stool, throat, blood, and urine cultures were all negative. On hospital day 4 of supportive care and the administration of ceftriaxone (4 days) and metronidazole (1 day), he reported increased oral intake, resolution of vomiting and diarrhea, and increased energy, and had decreased inflammatory markers on laboratory studies (C-reactive protein of 66 mg/L from 183 mg/l). On hospital day 5, the patient was discharged on oral metronidazole and amoxicillin-clavulanate to complete the treatment course for *C. difficile* and airspace pneumonia secondary to vaping-associated lung injury.

Discussion

Due to the widespread nature of vaping-associated lung injuries and associated deaths, the Centers for Disease Control and Prevention (CDC) has released interim guidance to providers for the work-up and management of these cases.[1] Overall, EVALI is considered a diagnosis of exclusion due to the lack of specific testing for the disease.[1] Patients should be specifically asked about initial signs of illness. Respiratory symptoms occur in 95% of reported cases; gastrointestinal symptoms occur in 77% of reported symptoms and occasionally precede the respiratory symptoms as in this case.[1] Assessing the use of e-cigarette or THC vaping products is also necessary, and clinicians should ensure that such questioning is discrete and non-judgmental, especially with adolescent patients.[1] Evaluation of vital signs is particularly important on the physical examination. Patients often present with tachycardia, tachypnea, and an O_2 saturation less than 95% on room air; pulmonary auscultation is typically within normal limits.[1] Appropriate laboratory testing includes a respiratory virus panel and studies to evaluate community-acquired pneumonia; lab work of EVALI patients has often revealed elevated WBC counts, CRP, ESR, and liver transaminases.[1] With patient consent, urine toxicology testing for THC should also be considered.[1] Imaging is vital in the work-up of EVALI, and all patients with a history of e-cigarette or vaping device use should have a chest x-ray (CXR) performed for possible pulmonary infiltrates. In patients with severe clinical symptoms, CT should be used to detect opacities in cases with a normal CXR.[1] Management of these patients is variable; mild cases can be managed as outpatients, while severe cases require hospital admission with possible corticosteroids and empiric antimicrobial administration.[1] Patients can be discharged following significant clinical improvement, and outpatient follow-up can include spirometry or CXR.[1] Finally, all patients with EVALI should be counseled on the cessation of e-cigarette or vaping product use; associated substance use disorders should be addressed appropriately.[1]

Of the confirmed cases of EVALI, vaping products containing THC are overwhelmingly the most commonly implicated.[2] The exact etiology of EVALI is still unknown, but numerous mechanisms have been proposed. Vaping may alter protein expression of bronchial epithelial cells, vapors may induce airway remodeling, substrates may activate alveolar macrophages leading to cellular damage, flavoring substances may disrupting cellular processes or biochemical pathways, and cannabis oils may cause direct lung injury or affect the permeability of alveolar epithelium.[3] Regardless of the exact underlying mechanism of lung injury, vaping has become a public health crisis in the United States, especially among adolescent patients such as in this case.

In this case, the gastrointestinal symptoms with only mild respiratory signs initially confounded the diagnosis. Indeed, the high degree of variability between cases certainly complicates the work-up of vaping-associated lung injury. The clinical picture of respiratory

or gastrointestinal symptoms in the context of patient utilization of e-cigarettes or vaping products should certainly bring EVALI to the differential. Appropriate follow-up with laboratory work and imaging is absolutely necessary to not only assess for EVALI but also to rule out other possible etiologies. Physicians must realize that histopathological findings and radiographic imaging may vary greatly between EVALI cases, and thus the disease is a diagnosis of exclusion without a specific test available. There is a need for increased public education regarding the dangers of e-cigarettes and vaping in adolescent populations.

Article citation: Wilkerson H, Maniam G, Dean RE, Goldfinger M, Kandaswamy P, Bell T. Vape-associated lung injury in an adolescent. The Southwest Respiratory and Critical Care Chronicles 2020;8(35):51–54
From: Department of Pediatrics, Texas Tech University Health Sciences Center, Amarillo, Texas
Submitted: 4/26/2020
Accepted: 7/7/2020
Reviewer: Kenneth Nugent MD
Conflicts of interest: none

References

1. Siegel DA, Jatlaoui TC, Koumans EH, et al. Update: Interim Guidance for Health Care Providers Evaluating and Caring for Patients with Suspected E-cigarette, or Vaping, Product Use Associated Lung Injury—United States, October 2019. *Morb Mortal Wkly Rep* 2019;68(41);919–927.
2. Furlow B. US CDC issues guidance on e-cigarette, or vaping, associated lung injury. *Lancet Respir Med* 2019;8(1):20.
3. Triantafyllou GA, Tiberio PJ, Zou RH, et al. Vaping-associated acute lung injury: a case series. *Am J Respir Crit Care Med* 2019;200(11):1430–1431.