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Vaping-induced diffuse alveolar hemorrhage

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ABSTRACT

There are growing reports of adverse health effects from e-cigarette use or vaping. The U.S. Centers for Disease Control and Prevention has reported 2409 cases and 52 deaths associated with e-cigarette use as of December 10, 2019. Vaping has been associated with acute eosinophilic pneumonia, organizing pneumonia, lipoid pneumonia, diffuse alveolar damage, acute respiratory distress syndrome, hypersensitivity pneumonia, and giant cell interstitial pneumonitis. Here we present a case of vaping-associated diffuse alveolar hemorrhage.

1. Introduction

The use of electronic cigarettes (e-cigarettes) and related devices to vaporize nicotine and flavored solutions has increased in recent years. There are growing reports of adverse health effects from e-cigarette use or vaping. Vaping has been associated with acute eosinophilic pneumonia, organizing pneumonia, lipoid pneumonia, diffuse alveolar damage, acute respiratory distress syndrome, hypersensitivity pneumonia, and giant cell interstitial pneumonitis [1–4]. The U.S. Centers for Disease Control and Prevention (CDC) has reported 2409 cases and 52 deaths associated with e-cigarette use as of December 10, 2019 [5]. Here we present a case of vaping-associated diffuse alveolar hemorrhage (DAH).

2. Case report

A 31-year-old female presented with cough and hemoptysis. Symptoms started with a cough productive of yellow sputum 4 weeks prior to presentation. One day prior to presentation she had hemoptysis productive of one cup of bright red blood over 24 hours. She denied fever, rash, shortness of breath, joint pain, myalgias, dry eyes, dry mouth, chest pain, orthopnea, or paroxysmal nocturnal dyspnea. Her medical history was notable for an uncomplicated vaginal delivery 5 weeks earlier as well as untreated hepatitis C virus, chronic pain, and post-traumatic stress disorder. Family history was notable for a mother with systemic lupus erythematosus and scleroderma. She was a prior one pack-per-day smoker until 4 years prior to presentation when she switched to flavored nicotine e-cigarettes. She vaped 17 ml of 3 mg/ml nicotine-containing fiery cinnamon flavored e-liquid daily. She denied use of tetrahydrocannabinol (THC) or cannabidiol (CBD) products. Household exposures were notable for a dog, cat, and bearded lizard as well as mold. Her medications included buprenorphine/naloxone, prazosin, and venlafaxine.

On physical examination the patient was afebrile (97.9 °F) with a heart rate of 120, a blood pressure of 120/83, a respiratory rate of 22, and an oxygen saturation of 95% while breathing ambient air. She appeared generally well and had no abnormal breath sounds, murmurs, or elevated jugular venous pressure. Chest computed tomography showed nodular ground glass opacities predominantly in the upper and middle lung zones (Fig. 1). The patient was treated for community-acquired pneumonia with ceftriaxone and azithromycin while undergoing a diagnostic evaluation for hemoptysis (Table 1). She underwent flexible bronchoscopy which was notable for progressively more hemorrhagic aliquots on bronchoalveolar lavage (BAL). Over the course of her hospitalization her hemoptysis gradually resolved with cessation of vaping. On follow-up 6 months later, she had no further hemoptysis though she continued to use e-cigarettes.

3. Discussion

DAH is a rare diagnosis that can be caused by infection, rheumatologic disease, or drug effect. To the best of our knowledge there has been

Abbreviations: e-cigarettes, ,; electronic cigarettes, CDC; ,, U.S. Centers for Disease Control and Prevention; DAH, diffuse alveolar hemorrhage; THC, tetrahydrocannabinol; CBD, cannabidiol; BAL, bronchoalveolar lavage; CT, computed tomography.

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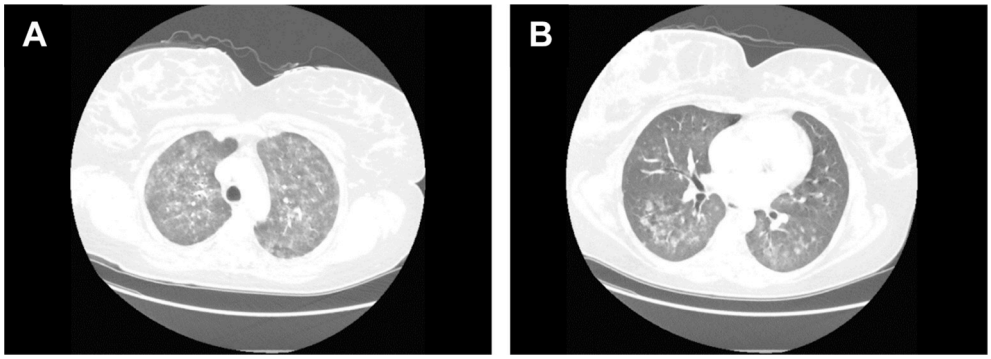

Fig. 1. Chest CT scan on admission showed nodular ground glass opacities in the upper (A) and middle (B) lung zones.

Table 1
Laboratory data.

Complete blood count (CBC) and coagulation studies	WBC 18 × 10^3/μL
	Differential: 67% neutrophils, 23% lymphocytes, 7.6% monocytes, 1.5% eosinophils
	Hemoglobin 14 g/dL
	Hematocrit 40%
	Platelets 201 × 10^3/μL
	International normalized ratio 1.0
	Activated partial thromboplastin time 32 seconds
Complete metabolic panel	Sodium 138 mmol/L
	Potassium 4.3 mmol/L
	Chloride 104 mmol/L
	Bicarbonate 28 mmol/L
	Glucose 90 mg/dL
	Blood urea nitrogen 16 mg/dL
	Creatinine 0.7 mg/dL
	Aspartate aminotransferase 81 U/L
	Alanine aminotransferase 142 U/L
	Alkaline Phosphatase 230 U/L
	Total bilirubin 0.7 mg/dL
Cardiac labs	Pro brain-natriuretic peptide: 31 pg/mL
	Troponin: 0.02 ng/mL
Infectious workup	Sputum culture: normal respiratory flora
	BAL culture: negative AFB, fungal and bacterial culture; negative Gomori-Methenamine-Silver (GMS) staining
	Respiratory viral panel: negative testing for common viral pathogens
	Legionella pneumophila urine antigen: not detected
	Streptococcus pneumonia urine antigen: not detected
	Histoplasma capsulatum urine antigen: not detected
	Aspergillus galactomannan serum: not detected
	1,3 β-D-glucan: not detected
	Human immunodeficiency virus (ELISA): negative
	Hepatitis C virus (HCV): IgG reactive
	HCV RNA 6260 IU/mL
Rheumatologic workup	c-ANCA, p-ANCA and atypical ANCA < 1:20
	Anti-nuclear antibody: negative
	Anti-glomerular basement membrane antibody: negative
	Urinalysis: negative blood, no casts
Drugs and toxins	Urine drug screen: negative for opiates, cocaine, cannabinoids, benzodiazepines, and amphetamines
Malignancy	BAL cytology: no malignant cells

only one prior report of DAH related to e-cigarette use [2]. This case fits the recent CDC definition for a confirmed case of vaping-associated lung injury defined by the use of an e-cigarette 90 days before symptom onset, pulmonary infiltrates on chest computed tomography (CT) scan, absence of viral, bacterial, or fungal infection and no evidence of a cardiac or rheumatologic cause [1,3]. In a recently published case series

Table 2
Demographic and clinical findings of vaping-associated lung injury [1,3].

	Leyden et al. *n* = 53	Maddock et al. *n* = 6
Median age (range)	19 (16–53)	28 (20–47)
Male gender (%)	44/53 (83)	5/6 (83)
Use of both THC and nicotine-containing vape products (%)	18/41 (80)	5/6 (83)
Nicotine-only vape products (%)	7/41 (17)	0/6 (0)
THC-only vape products (%)	15/41 (37)	1/6 (17)
Leukocytosis >11,000/mm^3	45/52 (87)	1/1 (100)
Treatment with steroids	46/50 (92)	6/6 (100)
Mortality (%)	1/52 (2)	0/6 (0)

by Layden and colleagues 80% of patients used THC products [1], and only 17% used nicotine only containing products like our patient (see Table 2). The recent Wisconsin series did not include any cases of DAH. In our case cessation of vaping led to clinical improvement and complete resolution of hemoptysis. Steroids were not administered because hemoptysis had ceased at the time of diagnosis. We present vaping as a cause of diffuse alveolar hemorrhage. The large volume of e-liquid used (~17 ml/daily) may have contributed to the development of DAH in this case. The mechanism of the vaping-associated lung injury remains unknown but has been hypothesized to be related to polycyclic aromatic hydrocarbons, volatile organic chemicals, and oils [1]. This case suggests vaping should be considered as a potential etiology for DAH.

Declaration of competing interest

None.

Disclosures

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Author contributions

All authors met the following conditions 1) Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data; 2) Drafting the work or revising it critically for important intellectual content; 3) final approval of the version to be published; 4) Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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