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Case report

The perfect storm: A case of COVID-19 infection in an adolescent patient with EVALI



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ARTICLE INFO

Keywords:

COVID-19

EVALI

Vaping

Remdesivir

Dexamethasone

ABSTRACT

COVID-19 and EVALI share imaging findings and clinical features, including fever, respiratory, and gastrointestinal symptoms. To our knowledge, the clinical picture in patients presenting with both conditions simultaneously has not been reported. We present the case of a 17-year-old male with COVID-19 and EVALI, his hospital course, and clinical outcome.

1. Introduction

EVALI as an outbreak peaked in the summer of 2019 with 15% of cases reported in children. COVID-19 was declared a pandemic with illness being mostly mild in pediatric patients. EVALI and COVID-19 can both present as interstitial pneumonia leading to acute respiratory distress syndrome (ARDS). Decreased arterial oxyhemoglobin saturation and bilateral pneumonia are seen in both COVID-19 and EVALI, making it challenging to distinguish between these two conditions [1,2].

1.1. Case

RR is a 17-year-old previously healthy Hispanic male who presented to a community emergency room with a 1-week history of progressive worsening of shortness of breath, abdominal pain, diarrhea, and ageusia. Past medical history revealed a 3-months history of dry cough and 9 pounds unintentional weight loss for which he had not sought medical care. Pertinent positives include smoking cigarettes for two years and vaping nicotine and Δ -9-tetrahydrocannabinol for one year. Pertinent negatives include traveling outside of the country, or exposure to known contacts with COVID-19 or tuberculosis. Initial workup included testing for SARS CoV-2, which was undetected by real time-polymerase chain reaction (RT-PCR) from the nasopharynx. He was transferred to our hospital for further evaluation of respiratory distress where repeat SARS CoV-2 by RT-PCR was then detected. Additional laboratory studies revealed a white blood cell count (WBC) of 27,500 mm³ with 84%

neutrophils, 2% bands, and 10.1% lymphocytes. C-reactive protein (CRP) and procalcitonin were elevated to 33 mg/dl and 3.14 ng/ml, respectively. Urine toxicology screen was positive for Δ -9-tetrahydrocannabinol metabolites. The initial chest radiograph demonstrated patchy bilateral opacities without focal consolidation (See Fig. 1).

A diagnosis of e-cigarette, or vaping, product-associated lung injury (EVALI) was also suspected in addition to COVID-19 given his history of vaping in the previous 90 days, respiratory symptoms alongside characteristic radiographic findings, consistent with the Centers for Disease Control and Prevention (CDC) definition. A chest computed tomography (CT) revealed patchy ground-glass pulmonary opacities and scattered opacities throughout both lungs, primarily in a perihilar and peripheral distribution (See Fig. 2).

The patient was admitted to the COVID-19 special isolation unit. Given the presence of oxyhemoglobin desaturation to 88%, the patient was placed on 1.5 L per minute (lpm) of oxygen via nasal cannula during admission with resolution of hypoxemia. Shortly after admission, the pulmonology team was consulted. With growing evidence that patients with COVID-19 with moderate to severe illness may have a favorable response to dexamethasone in association with evidence that patients with EVALI may benefit from glucocorticoid use [1], pulmonology recommended to start the patient on oral dexamethasone 6 mg daily. He demonstrated an excellent response to glucocorticoids with resolution of respiratory symptoms and was weaned to room air and discharged home on the second day of admission.

One day after hospital discharge, the patient returned to the

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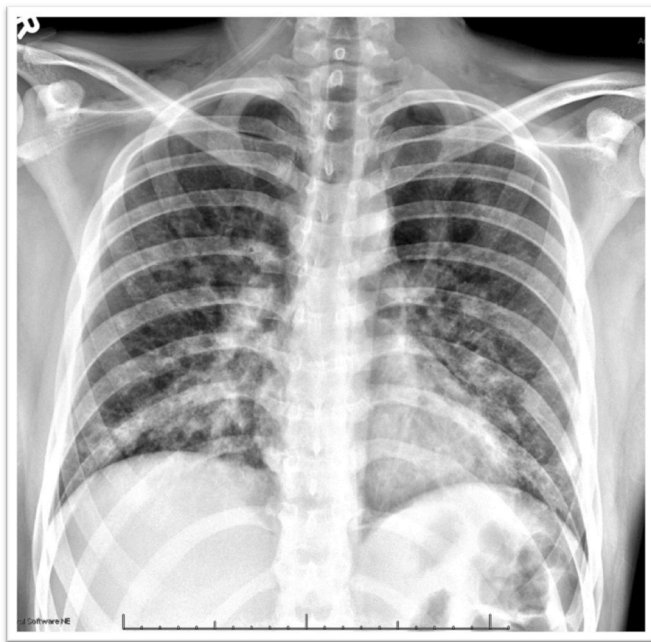


Fig. 1. Chest radiograph demonstrating patchy bilateral opacities without focal consolidation.

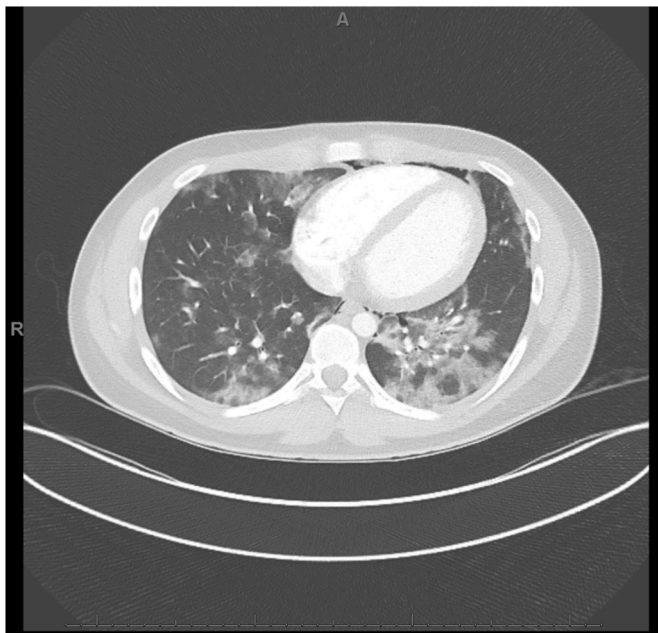


Fig. 2. Chest computed tomography with findings of patchy ground-glass pulmonary opacities and scattered opacities throughout both lungs, primarily in a perihilar and peripheral distribution.

emergency room with worsening chest pain and shortness of breath. Vital signs revealed a temperature of 38.5 °C, respiratory rate of 39 and an oxyhemoglobin saturation of 91%, and the lung exam revealed clear breath sounds. Due to hypoxemia and tachypnea, he was admitted to the intensive care unit and started on 15 L of heated high flow nasal cannula (HHFNC) and supplemental oxygen (0.45 fraction of inspired oxygen). The infectious disease team was consulted and recommended a 5-day course of remdesivir and dexamethasone was continued for a total of 10 days. The patient was weaned to room air on the third day of admission. On day 4 of admission, repeat C-reactive protein level had

decreased to 22.9 mg/dl, and repeat chest radiograph on day 7 showed improvement of patchy opacities. He could subsequently be discharged to home with follow up to his primary care provider and the pulmonary clinic.

2. Discussion

The clinical characteristics of both EVALI and COVID-19 illnesses are nonspecific. Like many other respiratory illnesses, both can present with fever, cough, shortness of breath, and gastrointestinal symptoms. Chest CT imaging findings also overlap with ground glass opacities present in both diseases. Chest CT findings in COVID-19 infection are generally described as bilateral and peripheral ground-glass opacities, whereas in EVALI, ground-glass opacities are more commonly reported as associated with subpleural sparing at least in scattered areas [3–5]. The imaging patterns of EVALI are diverse including patterns characteristic of hypersensitivity pneumonitis, acute eosinophilic pneumonia, diffuse alveolar damage, lipoid pneumonia and organizing pneumonia. Organizing pneumonia is however, the imaging finding that most overlaps with COVID-19 [6].

Although transmission rates for SARS-CoV-2 in pediatric patients are high, progression to severe upper respiratory symptoms requiring intensive care unit admission is low in children [7,8]. Smoking has been associated with an overall increased risk of contracting respiratory infections and it appears likely that pediatric and adolescent patients who smoke or vape are at a higher risk for developing significant respiratory compromise with COVID-19 infection [9]. In a recent study, COVID-19 diagnosis was five times more likely among ever-users of e-cigarettes only (95% confidence interval [CI]: 1.82–13.96) and seven times more likely among ever-dual-users (95% CI: 1.98–24.55) [10]. A Chinese study from Wuhan showed that patients who smoked cigarettes and contracted COVID-19 had an increased risk of severe disease [11]. A meta-analysis from 2020 found that smoking was a risk factor for the progression of COVID-19, with smokers having higher odds of COVID-19 progression than never smokers (OR 1.91, 95% confidence interval [CI] 1.42–2.59, $p = 0.001$) [10].

The exact pathophysiological mechanism for increased COVID-19 risk in e-cigarette users is unclear. There may be increased lipid dysregulation in the airways of e-cigarette users leading to increased risk [10]. In addition, e-cigarette flavorings have been shown to lead to ciliary dysfunction, which would increase the risk for respiratory infections [12,13]. Angiotensin-converting enzyme-2 (ACE-2) expression is high in smokers and although the ACE-2 receptor has been implicated as a route of entry for the SARS-CoV2 virus, the role of this particular receptor in EVALI as a predisposing condition for COVID-19 is unknown [14].

Given current evidence of lower COVID-19 infection risk in children [8,15] we feel that in our patient who did not have any underlying comorbidities the severity of his presentation and readmission for respiratory distress is likely related to a history of smoking and vaping. The pathophysiology and clinical presentation of COVID-19 infection in patients who smoke tobacco, marijuana, or vape, may be different for each exposure. This patient presents the additional challenge of having been exposed to multiple inhalational agents, which have been demonstrated, to lead to lung disease, including but not limited to EVALI.

At our institution, we have noted an increase in adolescents hospitalized with COVID-19 alongside a rise in admissions for EVALI. Although only one of these adolescents with EVALI tested positive for COVID-19, the increase in EVALI cases could be a marker for overall increased prevalence of adolescent vaping and increased risk of COVID-19 infection. During the current pandemic, clinicians should be aware of the overlap in symptoms that characterize both EVALI and COVID-19 and inquire about patients' vaping history, particularly as vaping is often a social activity during which wearing of masks and maintaining social distancing is unlikely.

In summary, we present a novel case of an adolescent with both COVID-19 infection and EVALI with a history of cigarette and e-cigarette use who was successfully treated with both systemic corticosteroids and remdesivir. As teenagers return back to school settings and increase socialization, clinicians should regularly inquire about vaping in adolescents as well as have a heightened suspicion for COVID-19 infection even in the setting of EVALI.

Author statement

Dr. Rivera -Sanchez conceptualized and designed the study, coordinately and supervised data and critically reviewed and revised the manuscript.

Dr. Bozkanat conceptualized and designed the study, collected data, carried out the initial analyses and drafted the initial manuscript Dr. Rao and Dr. Lieu coordinated and supervised data collection, and critically reviewed the manuscript. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Declaration of competing interest

The authors do not have any conflict of interest regarding study design; the collection, analysis, and interpretation of data; the writing of the report; or the decision to submit the paper for publication.

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