Organizing pneumonia related to electronic cigarette use: A case report and review of literature

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Abstract

Background and Objective: Electronic cigarettes (e cigarettes) are battery operated devices that produce aerosol by heating a solution typically made up of nicotine, propylene glycol, glycerin and flavouring agents. The use of e cigarettes has risen dramatically in recent years especially among adolescents and young adults. These devices have been marketed as safer alternatives to tobacco smoking by their manufacturers despite lack of adequate safety data.

Methods: We present a case of 40-year-old female patient who developed significant pulmonary toxicity secondary to e cigarette use and searched existing literature relevant to the case.

Results: To our knowledge this is the second reported case of organizing pneumonia and tenth reported case of pulmonary toxicity related to e cigarette use. Our patient presented with symptoms of worsening dyspnoea and intermittent chest pain for past 1 month. She reported increased use of e cigarettes during this time period to help her quit smoking. Patient developed acute hypoxemic respiratory failure requiring intubation and mechanical ventilation. She was diagnosed with organizing pneumonia on open lung biopsy and was successfully treated with steroids along with abstinence from e cigarette use.

Conclusions: As the current data on health effects of e cigarettes is limited, case reports can serve important piece of information in this regard. The use of e cigarettes has increased exponentially in recent years and continue to rise; therefore, physicians should be aware of adverse effects and toxicity related to its use.

KEYWORDS
aerosols, electronic cigarettes, organizing pneumonia, pulmonary toxicity

1 INTRODUCTION

Electronic cigarettes (e cigarettes) belong to growing class of electronic nicotine delivery systems (ENDS). E cigarettes are electrical devices which produce aerosols (or vapours) by heating a liquid mixture. The liquid mixture (also called as e liquid) consists of varying concentration of nicotine, distilled water, propylene glycol, glycerin and flavouring agents.1 E cigarettes are composed of a battery part (usually a lithium battery), a reservoir that contains the liquid, and an atomizer with a heating element. Electric current from battery heats the metallic coil, aerosolizing the liquid conducted from the reservoir to the coil by a wick generally made up of cotton or silica. These devices have been marketed as safer alternatives to tobacco smoking by their manufactures despite lack of adequate safety data. We present a case of 40-year-old female patient who presented with acute hypoxemic respiratory failure and was...
diagnosed with organizing pneumonia secondary to e-cigarettes use.

2 | CASE REPORT

Forty-year-old African American female presented to the hospital with dyspnoea and intermittent chest pain for past 1 month. She described the pain as sharp, intermittent and on both sides of the chest. Dyspnoea had worsened recently and was present both at rest and on exertion. She smoked half a pack a day for more than 10 years, until recently, about 1 month prior, when she switched to e-cigarettes to help her quit. Vital signs at the time of presentation revealed tachycardia (110 beats/min), tachypnoea (21/min) with normal blood pressure (118/74 mm Hg) and no fever (98.7° F). On physical examination crackles and wheezes were auscultated in bilateral (B/L) lung fields, S1 and S2 were normal with no jugular venous distention. Electrocardiogram at the time of presentation showed sinus tachycardia without any ST or T wave abnormality. Initial laboratory studies showed normal white cell count, hematocrit, kidney and liver functions. Chest radiograph showed scattered bilateral pulmonary infiltrates (Figure 1). Arterial blood gas analysis was consistent with hypoxemia (PO2 of 52 on 3 L of oxygen by nasal cannula). Computed tomography (CT) of the chest showed multifocal discrete and confluent ground glass opacities diffusely involving bilateral lung lobes (Figure 2A). Patient was initially managed as a case of multifocal pneumonia and was started on empiric antibiotics. Next day, patient became more hypoxic with respiratory distress requiring intubation and mechanical ventilation. A diagnostic bronchoscopy was performed which revealed normal tracheobronchial anatomy. Bronchoalveolar lavage and transbronchial biopsy was done and tissue samples were drawn. Extensive workup including gram stain, fungal and bacterial cultures, viral studies, acid-fast stain and immunoassays were negative. An open lung biopsy was performed and histopathological examination showed organizing pneumonia. Antibiotics were discontinued and patient was started on high dose methylprednisolone. Over the course of few days her respiratory status improved and she was extubated successfully. Patient was transitioned to oral prednisone and was discharged to home on a prednisone taper. She was seen as follow up in outpatient clinic and reported significant improvement in her symptoms. A follow up CT was done which showed resolution of ground glass opacities (Figure 2B).

3 | DISCUSSION

The e-cigarettes were first introduced in China, in year 2004. In United States, e-cigarettes became commercially available in year 2007. Since then the popularity of e-cigarettes had risen dramatically, especially in recent years. In 2016, 3.2% adults aged more than 18 years reported regular use of e-cigarettes, while 15.3% adults aged more than 18 years have used an e-cigarette sometime in their lifetime.2,3 Of this, the

FIGURE 1 Chest radiograph showing scattered pulmonary infiltrates in bilateral lung fields

FIGURE 2 (A) CT of the chest showed multifocal discrete and confluent ground glass opacities diffusely involving bilateral lung lobes. (B) Follow up CT of chest 2 months later showing complete resolution of ground glass opacities
highest rate of use of e cigarettes is seen among the young adult population between 18 and 24 years of age, with 4.7% of individuals in this age group reporting regular use of e cigarettes.\(^2,3\) The rate of e cigarettes use in youth and young adults has risen rapidly and e cigarettes now are the most commonly used tobacco product in this population.\(^4\) This increased popularity of e cigarettes may be due to its ability to deal with behavioural component of smoking in addition to providing nicotine. Use of e cigarettes simulates smoking behaviour and is able to provide sensation of traditional cigarette smoking. These features are absent in other nicotine replacement therapies such as oral gums or patches (Figure 3).

Effect of e cigarette use on pulmonary function has been in a number of studies, which have yielded variable results. While some of the studies found that e cigarette users experience increased airway resistance along with compromise in pulmonary function upon exposure to e cigarette vapor,\(^5,6\) others reported that short term use of e cigarettes have no significant changes in lung function.\(^7,8\) Further, two studies reported immediate reduction in exhaled nitric oxide similar to what is seen in tobacco smoking.\(^5,6\) Another study found increase in inflammatory signalling molecules upon inhalation, in resemblance to what is seen in tobacco smoking.\(^9\)

Clinical studies evaluating the safety and risk profile of e cigarette use in humans are limited and most the current data is obtained from in vitro studies on cultured cells and in vivo experiments in animal models. The short-term in-vitro studies using cultured cells have shown that exposure to e liquid or aerosols reduces cell viability, induces cytokine production and causes oxidative stress.\(^10\) Additional information on health effects of e cigarettes use can be gained from case reports. Our search of literature revealed 9 cases reports of adverse effects of e cigarettes on pulmonary system (Table 1).\(^11–19\) Of these, 2 cases were diagnosed with lipid pneumonia and 1 case each of bronchiolitis, acute eosinophilic pneumonia (AEP), pneumonia with bilateral pleural effusion, suspected acute hypersensitivity pneumonitis (AHP), respiratory bronchiolitis interstitial lung disease (RB ILD), bronchiolitis obliterans organizing pneumonia (BOOP) and diffuse alveolar haemorrhage (DAH). All the patients presented with respiratory symptoms of dyspnoea and cough. In 6 cases (including 2 cases of lipid pneumonia, 1 case each of subacute bronchial toxicity, RB ILD, BOOP and DAH) the onset of symptoms was gradual, occurring after more than 1 week of starting e cigarettes use and in 3 cases (1 case each of pneumonia with bilateral pleural effusions, AEP and AHP) the symptoms onset occurred within 3–7 days of e cigarettes use. The patient who developed bronchiolitis had previous history of pulmonary adenocarcinoma with brain metastasis while the patient who developed DAH had history of lung carcinoma with left upper lobectomy and chronic obstructive pulmonary disease. The patient who developed RB ILD had history of germ cell tumour with multiple pulmonary metastasis. About 6 out of these 9 patients had previous smoking history and in 3 cases the smoking history had not been specified. All of them except one had favourable outcome with resolution of symptoms with abstinence from e cigarette use. Mantilla et al.\(^18\) reported first case of organizing pneumonia related to e cigarette use in a 27-year-old male patient with history of tobacco smoking. Imaging with CT of chest in this patient showed multiple small pulmonary nodules in bilateral lung fields unlike in our patient who had bilateral discrete and confluent ground glass opacities and patches of consolidation, which is characteristic of organizing pneumonia. This patient like our patient had favourable outcome after being treated with steroids with resolution of symptoms. Although no definitive association has yet been established between toxins in e cigarettes and organizing pneumonia, this is the most likely aetiology in our case. However, further studies would be needed to establish a definitive causal relationship.
<table>
<thead>
<tr>
<th>Age/sex</th>
<th>Preexisting medical conditions</th>
<th>Smoking history</th>
<th>Duration of e cigarette use before diagnosis</th>
<th>Presentation/sign and symptoms</th>
<th>Diagnosis</th>
<th>Treatment/outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>42/F</td>
<td>Asthma, Rheumatoid arthritis, Fibromyalgia, Schizoaffective disorder, Hypertension</td>
<td>Not specified</td>
<td>7 months</td>
<td>Dyspnoea, cough, fever</td>
<td>Exogenous lipid pneumonia</td>
<td>Recovery with abstinence from e cigarette</td>
</tr>
<tr>
<td>20/M</td>
<td>None</td>
<td>Not specified</td>
<td>3 days</td>
<td>Dyspnoea and cough</td>
<td>Acute eosinophilic pneumonia</td>
<td>Recovery with abstinence from e cigarette and systemic steroids</td>
</tr>
<tr>
<td>43/M</td>
<td>Lung adenocarcinoma with isolated brain metastasis</td>
<td>Smoker, 45 pack year</td>
<td>4 weeks</td>
<td>Dyspnoea and cough</td>
<td>Subacute bronchial toxicity</td>
<td>Recovery with abstinence from e cigarette</td>
</tr>
<tr>
<td>31/F</td>
<td>Not specified</td>
<td>Smoker, unspecified</td>
<td>3 months</td>
<td>Dyspnoea and cough</td>
<td>Exogenous lipid pneumonia</td>
<td>Recovery with abstinence from e cigarette and systemic steroids</td>
</tr>
<tr>
<td>43/M</td>
<td>Hypertension</td>
<td>Smoker, unspecified</td>
<td>3 days</td>
<td>Dyspnoea and pleuritic chest pain</td>
<td>Pneumonia and bilateral pleural effusions</td>
<td>Recovery with abstinence from e cigarette</td>
</tr>
<tr>
<td>60/M</td>
<td>Not specified</td>
<td>Smoker, unspecified</td>
<td>Not specified</td>
<td>Weakness and cough</td>
<td>Suspected acute hypersensitivity pneumonitis</td>
<td>Recovery with abstinence from e cigarette</td>
</tr>
<tr>
<td>33/M</td>
<td>Mixed Germ cell tumour with multiple pulmonary metastasis</td>
<td>Smoker, 10 pack years</td>
<td>3 months</td>
<td>Dyspnoea</td>
<td>Respiratory bronchiolitis interstitial lung disease</td>
<td>Recovery with abstinence from e cigarette</td>
</tr>
<tr>
<td>27/M</td>
<td>None</td>
<td>Smoker, unspecified</td>
<td>7 months</td>
<td>Dyspnoea, cough, fever and hemoptysis</td>
<td>Bronchiolitis obliterans organizing pneumonia</td>
<td>Recovery with abstinence from e cigarette and systemic steroids</td>
</tr>
<tr>
<td>70/M</td>
<td>Lung cancer with left upper lobectomy and COPD</td>
<td>Not specified</td>
<td>4 weeks</td>
<td>Dyspnoea and cough</td>
<td>Diffuse alveolar damage</td>
<td>Death</td>
</tr>
</tbody>
</table>
4 | CONCLUSION

As the clinical data on the health effects of e cigarettes is limited, case reports serve as an important piece of information. To our knowledge, this is the second reported case of organizing pneumonia related secondary to e cigarette use.

AUTHOR CONTRIBUTIONS

All authors performed critical revision of the manuscript for important intellectual content.

Study design: Saud Khan, Khateeb, Hammersley

Data analysis: Khan, Akhtar, Lal

Histopathological details: Kholodovych

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest with the contents of this article.

ETHICS

Not applicable.

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REFERENCES


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