E-Cigarette and Vaping Product Use Associated Lung Injury

Description/Etiology

Vaping is inhaling a vapor produced by an electronic cigarette (also called an e-cigarette, e-vaporizer, mod, tank, vape, or vape pen). Unlike traditional cigarette smoking which requires burning tobacco, e-cigarettes are rechargeable or battery-powered cartridges containing a heating element that is used to vaporize a liquid (called an e-liquid or e-juice) comprised of an aerosolizing agent (propylene glycol, glycerol), nicotine, flavoring, and other chemical additives.

Vaping has recently resulted in an outbreak of serious lung injury cases in the United States, many of which have required hospitalization, and dozens of which have resulted in death. The Centers for Disease Control and Prevention (CDC) is referring to this form of lung disease as e-cigarette or vaping product use-associated lung injury, or EVALI.

Emergency department visits for acute pulmonary signs and symptoms associated with e-cigarette use have been gradually increasing since 2017; however, a sharp increase in visits signaling an outbreak was first reported in June of 2019. The number of reported EVALI cases peaked in September of 2019 and has since decreased. However, EVALI remains a significant public health concern that has prompted a national ban on certain types of e-cigarettes, including flavored e-cigarettes that are popular among teens.

The precise mechanism of injury in EVALI is unknown. One study performed on bronchoalveolar lavage fluid samples in patients with EVALI identified vitamin E acetate, an additive found in some e-cigarettes containing tetrahydrocannabinol (THC; the primary psychoactive derivative of marijuana), in 48 of 51 study participants (Blount et al., 2019). Vitamin E acetate is safe as an oral supplemental and skin treatment, but is believed to cause lung injury when inhaled. However, a direct causal link between vitamin E acetate and EVALI has not yet been established, and multiple other toxicants are being evaluated. EVALI has also presented in patients using e-cigarettes containing cannabidiol (CBD; a non-psychoactive marijuana derivative) and in patients using vaping products that contain neither derivative.

The CDC currently recommends refraining from any and all vaping products to eliminate risk of EVALI. If vaping products are used, the CDC and Food and Drug Administration (FDA) recommend avoiding THC-containing e-cigarettes, particularly those acquired from friends, family, off the street or from online dealers, which may contain unknown substances, and adding additional substances to vaping devices. Both agencies also recommend against the use of vaping products by pregnant women, children and adolescents due to general health risks.

Facts and Figures

- As of January 2020, the CDC has reported a total of 2,561 hospitalizations and 55 deaths from EVALI in the United States (Centers for Disease Control and Prevention, 2020).
- EVALI cases have been reported in 49 states, the District of Columbia, and the U.S. Virgin Islands, and EVALI-related deaths in 27 states (Moritz et al., 2019).
- Vaping is the most common way of using nicotine among teens in the United States (National Institute on Drug Abuse [NIDA], 2020). High rates of vaping among teens are
believed to be due to enticing advertising and wide variety of e-cigarette flavors (NIDA, 2020)

**Risk Factors**

The risk factor for EVALI is a history of e-cigarette use during the previous 90 days, particularly a type containing THC or CBD. A small percentage of patients diagnosed with EVALI have reported using vaping products that did not contain either substance.

Directly applying marijuana oil or wax to e-cigarette heating elements (a practice called “dabbing”) to increase the high produced from vaping likely increases risk of pulmonary injury.

**Signs and Symptoms/Clinical Presentation**

EVALI signs and symptoms begin over hours to days and resemble viral or bacterial pneumonia or influenza. Signs and symptoms include:

› Coughing, tachypnea, cough, hypoxemia, and respiratory distress/failure
› Chest pain
› Fever and chills
› Diarrhea, nausea, and vomiting
› Tachycardia

**Assessment**

› **Patient History**
  * Ask about vaping/use of e-cigarettes within the previous 90 days including eliciting information about frequency, duration, source, method and last time used
  * Ask about use of e-cigarettes containing THC

› **Physical Findings of Particular Interest**
  * Sudden onset of serious pulmonary illness, most commonly in adolescents or young adults
  * Higher risk of hospitalization or death in older patients with comorbid cardiopulmonary disease

› **Laboratory Tests**
  * ABGs can help identify respiratory acidosis caused by hypoxia and help determine whether supplemental oxygen and/or assistive ventilation is required
  * CBC can indicate elevated WBC count associated with infection or inflammation
  * Chemistry can identify electrolyte changes caused by infection, hypoxia or dehydration (in a patient with vomiting or diarrhea)
  * Blood culture can be used to rule out sepsis, and sputum culture to rule out other lung infection
  * Influenza and/or adenovirus testing might be performed to rule out flu or adenovirus infection
  * Toxicology to assess use of THC

› **Other Diagnostic Tests/Studies**
  * Chest x-ray or CT scan is required for EVALI diagnosis (see Treatment Goals, below)

**Treatment Goals**

› **Assess patient status and assist with resuscitation, as appropriate**
  * Identify and manage signs and symptoms of pulmonary illness
  ‒ Administer supplemental oxygen and positive pressure ventilation, as ordered. Assist with intubation, if indicated
  ‒ Monitor vital signs and oxygen saturation, and assess all physiologic systems
  * Facilitate completion of lab tests, as ordered; immediately report abnormalities and treat as ordered
  * Administer prescribed medications, such as empirical antibiotic therapy before bacterial pneumonia is ruled out, antiviral therapy before viral pneumonia or influenza is ruled out, and corticosteroids to reduce pulmonary inflammation

› **Assist with EVALI diagnosis and reporting**
  * Follow facility pre- and post-procedure protocols for patients undergoing diagnostic procedures (e.g., bronchoalveolar lavage)
  ‒ Reinforce pre- and post-procedure education and verify completion of facility informed consent documents
  ‒ Monitor for procedure-related discomfort; treat as ordered
  * Report the following 3 diagnostic criteria to the treating clinician:
– Patient/family report of vaping and/or “dabbing” within 90 days of symptom onset
– Chest x-ray or CT scan report indicating areas of opacity
– Lab/diagnostic test results indicating absence of other types of lung infection, such as pneumonia or influenza
• Report confirmed cases of EVALI to state or local health department, per facility protocol

Promote Emotional Well-Being and Educate
• Assess anxiety level and coping ability of patient/family; provide emotional support, educate, and encourage discussion about EVALI etiology, risk factors, prevention strategies including vaping and e-cigarette cessation, risks and benefits of diagnostic procedures and treatment, potential complications, and individualized prognosis

Food for Thought
› Vaping can exacerbate preexisting pulmonary conditions such as asthma and COPD, but it is not known whether preexisting pulmonary conditions increase risk of EVALI
› Preexisting cardiac disease, pulmonary disease, and diabetes have been associated with readmission and death after successful treatment of EVALI (CDC, 2020)
› Vaping product brands associated with EVALI cases requiring hospitalization include Dank vapes (56%), followed by TKO (15%), Smart Cart (13%), and Rove (12%) (CDC, 2020)

Red Flags
› EVALI can result in rapid deterioration in lung function, lung failure, and death
› Although e-cigarettes are believed to be less harmful than traditional cigarettes, they contain substances that are addictive, carcinogenic and otherwise toxic (CDC, 2020)
› Rehospitalization and death after successful treatment of EVALI can occur. Patients should be clinically stable for a minimum of 24 hours before hospital discharge and follow-up with an outpatient clinical provider (preferably a pulmonologist) within 48 hours after discharge (CDC, 2020)

What Do I Need to Tell the Patient/Patient’s Family?
› Discourage use of any vaping product. If patient will continue to vape, explain that e-cigarettes containing THC have been associated with EVALI and should not be used (CDC, 2020)
› Explain that vaping is not a FDA-approved smoking cessation aid. Encourage patients to try a smoking cessation aid that has been established as safe and effective (CDC, 2020)
› Encourage parents to discuss the harmful effects of vaping with their children, and to monitor children, especially teens, for evidence of e-cigarette use. Inform parents that modern vaping devices can resemble everyday objects such as pens or USB memory cards (National Institute on Drug Abuse, 2020)
› Discharged patients should follow up with their primary care provider or pulmonologist within 48 hours, again at 1-2 weeks, and finally at 2-4 months (Lozier et al., 2019)

References