ASSESSING THE HARMFUL EFFECTS OF VAPING IN ANESTHESIA

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Introduction

Vaping is a quick and easy method of inhaling nicotine that has captivated many of its users (CDC, 2020). Upon its first release, vaping has quickly been deemed as the 'safer' alternative to smoking traditional cigarettes. (Gottschalk et al., 2020).

Nicotine, an active drug in e-cigarettes, has the potential of lowering the effectiveness of certain anesthetic drugs by interfering with their mechanism of action (AANA, 2017). One major complication being slowing down of the healing process, leading to an extended duration of pain.

In recent years, the prevalence of e-cigarettes has escalated to dangerous heights. A study gathered from 2017 to 2019 revealed the number of public-school students that have participated in vaping, within the time frame of a month, have more than doubled (Schaeffer, 2019).

With the intentions of demystifying the assumption that vaping has little to no negative effect on the user's health, investigators have taken steps to prove vaping warrants speculation of their harmful effects.

Effects on Airway

The epithelial cells lining the airway have undergone extensive negative effect of vaping. Being the primary target of any inhalational substance, exposure to vaporized e-liquid led to dysfunction of the ion channels associated with the epithelial cells (Lin et al., 2019). This dysfunction can lead to increase mucus production in the airway leading to a mucus plug and impaired defense against bacterial pathogens (Hobson et al, 2020).

Pulmonary Effects

With the pulmonary effects, vaping may have negative effects in increasing the rate of arterial stiffness. This is detrimental because it can lead to other health issues such as high blood pressure or more severe cardiovascular diseases such as heart failure (Hare et al., 2019).

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Systemic Responses to the Usage of E-cigarettes

System	Change
Pulmonary	• Increased airway hyperreactivity • Increased airway resistance • Increased mucus production • Parenchymal/alveolar inflammation • Increased closing capacity • Interference with lung development • Impaired defense against bacterial and viral pathogens • Nasal airway irritation • Bronchiolitis obliterans
Cardiac	• Hemodynamic instability under GA • Hypertension • Tachycardia • Increased myocardial oxygen consumption • Impaired coronary blood flow • Hyperlipidemia • Atherosclerosis • Impaired cardiac development in pediatric patients • Insulin resistance
Central nervous system	• Impaired brain development in pediatric patients • CNS depression
Immunology	• Antiproliferation of cells • Impaired fibroblast activity • Impaired tissue oxygenation • Decreased collagen
Response to anesthetic agents	• Increased opioid requirement • Decreased sensitivity to NMBDs • Decreased MAC secondary to CNS depression

Anesthetic Implications for E-cigarette Users

Management stage	Strategy
Education	Recommend cessation of e-cigarette use.
Preparation	• Consider PFTs, chest radiographs, and blood gas analysis to get baseline Pa_{O_2} and Pa_{CO_2} in long-standing EC users • Obtain cardiac function testing. • Determine amount of EC nicotine use.
Premedication	• Use a antisialogogue agent such as glycopyrrolate to dry secretions. • Use an anxiolytic agent such as midazolam to negate the psychological effects.
Induction and intubation	• Preoxygenate for 3-5 min. • Use intravenous lidocaine to prevent laryngospasm during intubation. • If performing inhalation induction with volatile agents, sevoflurane is preferred. • Avoid airway manipulation during light anesthesia, which may result in coughing, breath holding, laryngospasm, or bronchospasm. • Before intubation, use LTA to anesthetize the larynx and suppress laryngeal hyperreactivity.
Maintenance	• Avoid light anesthesia, which may result in bronchospasm. • Have bronchodilators available for symptomatic smokers. • Avoid desflurane, which is a respiratory irritant and results in higher blood pressure and heart rate. • A higher dose of benzodiazepine, opioid, and muscle relaxants will be required. • Increase minute volume.
Monitoring	• When using current pulse oximeters, remember that a gross overestimation of oxygenated hemoglobin saturation (Sa_{O_2}) occurs. • Monitor for signs and symptoms of acute nicotine intoxication. • Pay special attention to changes in blood pressure, heart rate. and rhythm, especially in patients with history of coronary heart disease. • Use a peripheral nerve stimulator to monitor the neuromuscular block since there are various reports on the increased requirement of muscle relaxants. • In long procedures, perform intermittent blood gas analysis to check the Pa_{CO_2} since Pa_{CO_2} - $ETCO_2$ gradient is higher than in nonsmoking patients.
Recovery	Do not extubate during light anesthesia because it may result in cough, breath holding, laryngospasm, or bronchospasm.

Drug–Drug Interaction

Vaping and anesthesia have a possible drug-to-drug interactions, specifically with volatile agents, opioids, and neuromuscular blocking agents (Hobson et al. 2020). E-cigarettes, produce volatile organic compounds (VOC) and inhalation at higher concentrations produces sedation, immobility, anesthesia, and unconsciousness; lower concentrations impairs neurological function and behavioral performance (Hobson et al, 2020). Specifically, research has shown that toluene possesses effects like that of central nervous system depressant agents like barbiturates, ketamine, and isoflurane (Hobson et al, 2020).

Discussion

Studies have revealed that e-cigarette usages have negative effects on an individuals' organ systems. These effects on the organ systems along with the effects on drug-to-drug interaction with the chemicals released from vaporized e-liquids have led to anesthetic management implications being devised to ensure a safe and smooth procedure.

Conclusion

While a definite conclusion correlating vaping and systemic illness has yet to be entirely confirmed, the simple presence of nicotine within these devices warrants speculation of their harmful effects. For this reason, anesthesia providers should assess a patient's pre-operative use of vaping with utmost caution; as the lack of a concrete conclusion among the medical community regarding the effects these devices may have in conjunction with the application of anesthesia should not be overlooked.

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