



CASE BASED DISCUSSION

A case report of subacute bronchial toxicity induced by an electronic cigarette

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José Hureauux (JH): I would like to present the case of a 43-year-old patient who presented with bronchial syndrome associated with deterioration of pulmonary function tests (PFTs) after starting to use an electronic cigarette. He had a history of primary lung adenocarcinoma with a documented isolated brain metastasis (stage pT3N0M1b) treated by stereotactic brain radiotherapy, right upper lobectomy and chemotherapy. The patient had been under surveillance for 7 months. This patient, an active smoker (45 pack-years) undergoing smoking cessation with the assistance of his general practitioner based on a reduction strategy accompanied by nicotine replacement therapy (21 mg patch), continued to smoke about 20 cigarettes a day. In order to completely stop smoking, he decided to try an electronic cigarette on the advice of a friend.

Thierry Urban (TU): Smoking cessation is useful in all patients operated for lung cancer, and must be encouraged. The e-cigarette provides nicotine via the inhaled route from which it is rapidly absorbed by a modality corresponding to the usual actions of smoking, while reducing the exposure of individuals to carcinogenic substances present in tobacco smoke. However, the real place of e-cigarettes in the therapeutic aid to smoking cessation is unknown.

JH: He purchased an e-cigarette ('La dynamique' by CIGARTEX) and two 'e-liquids' Kentucky (19 mg/mL of nicotine) and Eastern (19 mg/mL of nicotine) (Conceptarôme). He 'vaped' either of these two e-liquids about 25 times a day, taking 5–6 puffs each time, which enabled him to stop smoking tobacco cigarettes. The electronic cigarette liquids were composed of glycerol (<90%), purified water (<10%), food flavouring, tobacco absolute and nicotine absolute (19 mg/mL) according to the packaging. After 48 h, the patient described onset of cough with whitish secretions. He subsequently developed progressive breathlessness on minimal exertion (Sadoul Stage 5) over a period of 1 week. This breathlessness was constant and unusual. No clinical signs of infection were observed. The patient consulted after 4 weeks. Pulmonary auscultation revealed diffuse wheezing. The chest X-ray was unchanged compared to the previous examination. Reference PFTs were performed before lobectomy in 2012. PFT performed demonstrated a mixed syndrome (table 1).

TU: The clinical features consisted of rapid onset of very severe dyspnoea following use of the e-cigarette in the absence of any signs of infection in a patient with irreversible stage II smoking-related COPD (GOLD 2011). The diagnoses of respiratory

tract infection, exacerbation of smoking-related COPD, heart failure and foreign body inhalation appear unlikely. The diagnosis of PE is plausible and could justify D-dimer assay. However, the history of lung cancer could induce a false-positive result. Acute or subacute hypersensitivity pneumonitis is unlikely because of the absence of fever and systemic signs, excluding an indication for CT scan or bronchoalveolar lavage. The features of severe dyspnoea with recent mixed ventilatory disorder are primarily suggestive of bronchiolitis.

JH: Did this patient 'vape' excessively?

TU: The patient 'vaped' between 125 and 150 puffs per day, that is, less than the mean of 175 puffs per day observed in an observational study.¹ Excessive use of the device did not appear to be responsible for these respiratory adverse effects, especially as the symptoms described by the patient do not correspond to those of overdose or acute nicotine intoxication. However, electronic cigarette liquids have a high nicotine concentration with a risk of serious overdose in the case of ingestion which can be fatal in young children.

JH: He agreed to immediately stop using the e-cigarette. After having stopped for 48 h, he described marked improvement of cough, sputum and breathlessness. After 7 days, all symptoms had completely resolved with no treatment, especially no inhaled corticosteroids, and pulmonary function parameters had already started to improve. Two months later, pulmonary function parameters had returned to usual values.

TU: Avoidance of all inhaled toxins is mandatory in any case of suspected bronchiolitis. If the clinical signs had not rapidly improved, it would have been useful to rapidly perform a more thorough assessment (at least chest CT scan, CO diffusion study, bronchoalveolar lavage). The rapid resolution of this patient's respiratory symptoms is in favour of a role of the e-cigarette.

JH: Allergic skin tests performed with e-liquids and propylene glycerol did not reveal any immediate (prick tests) or delayed (epidermal tests) hypersensitivity.

Martine Drouet (MD): The negative results of these tests eliminate an allergic role with a high probability.

JH: Are there any pathological conditions induced by exposure to mineral oil vapour?

TU: The vapour derived from heated ethylene glycol or mineral oils has been used for many years to create theatrical smokes and fogs. A study conducted among 101 entertainment industry workers demonstrated a significant reduction of FVC and



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Table 1 Pulmonary function tests

	Predicted	Preoperative assessment	During use of the e-cigarette	7 days after stopping the e-cigarette	2 months after stopping the e-cigarette
FVC (L) (%)	5.31 (100)	5.87 (110.0)	3.92 (73.8)	5.13 (96.6)	5.50 (103.5)
Forced expiratory volume in one second (L) (%)	4.13 (100)	3.06 (73.5)	1.87 (45.2)	2.66 (64.3)	2.70 (65.3)
Forced expiratory volume in one second/FVC (%)	79.5	52.1*	47.7	51.8	49.1
Expiratory reserve volume (L) (%)	1.77 (100)	2.73 (184.7)	0.70 (39.6)	2.39 (135.0)	2.36 (160.9)

*Not reversible after inhalation of 200 µg of β₂-mimetic.

FEV₁ in this population compared with a control group.² This study suggested that working adjacent to a fog machine constituted a risk factor for impaired PFTs.

JH: What is known about the potential respiratory toxicity of e-cigarette vapour?

TU: Only a few studies are available and they have reported discordant results. One study showed that inhalation of e-cigarette vapour did not modify short-term pulmonary function evaluated by the FEV₁/FVC ratio.³ Another recent study demonstrated that the use of an e-cigarette for 5 min increased impedance, peripheral airway flow resistance and oxidative stress in healthy adult smokers compared with a control group.⁴ Furthermore, the aerosol produced by this type of device appears to be composed of very small particles, close to 50 nm, that could induce particular adverse effects.⁵ In this patient, it is impossible to formally conclude on the causal role of the e-cigarette in the onset of the clinical features despite the observed temporal correlation.

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JH, TU. Drafting the work or revising it critically for important intellectual content; conducting the work; final approval of the version to be published; 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; reporting the work: JH, MD, TU.

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