



CASE REPORT

## A propulsion injury following a spontaneous electronic cigarette explosion

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**Abstract:** Electronic cigarettes (e-cigarettes) have become increasingly popular at an alarming rate. This coincides with the public perception that they are a safer mean of nicotine consumption. Unregulated devices carry unrecognized safety risks that have led to numerous cases of burns, associating with spontaneous combustions of e-cigarettes.

**Keywords:** E-cigarette; electronic cigarette; spontaneous combustion; burns

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### Introduction

Electronic nicotine delivery systems (ENDS) include electronic cigarettes (e-cigarettes) and personal vaporizers<sup>[1]</sup>. The use of these devices has gained popularity worldwide. The battery-powered electronic nicotine-delivery device resembles a cigarette designed for the purpose of providing inhaled doses of nicotine by way of a vaporized solution to the respiratory system<sup>[2]</sup>. While e-cigarettes have been linked in some preliminary studies to decrease the use of traditional cigarettes, the devices themselves pose unrecognized risks to users<sup>[3]</sup>. There have been documented events in the media of spontaneous combustion events involving the electronic cigarette devices causing thermal, blast and chemical burns<sup>[2]</sup>.

### Case report

We report a case of a 15-year-old girl who sustained a burn injury to the right dominant hand following the spontaneous ignition of an e-cigarette battery that was stored in her bag. The patient was attempting to reach for her e-cigarette, during which she reported a sudden explosion followed by a charred smell and burning sensation to the right hand.

She presented to our department with complains of severe pain to the right hand. On assessment, the ring and middle fingers appeared dusky with a partial thickness burn injury to the flexor zone II region with full thickness burn injuries and a penetrating wound to the right middle and

ring fingers over the distal interphalangeal joint (**Figure 1**). Sensation was reduced to pinprick and light touches over these two fingers. Neurovascular status over the non-affected fingers was normal. An x-ray of the right hand showed radio-opacities over the underlying tissue of the affected fingers (**Figure 2**).

A wound debridement was done under general anesthesia a day after the incident took place. Intra-operatively, noted black liquid substance was embedded in the underlying tissue and along the tendon sheath, extending down to the middle phalanx of the ring and middle fingers (**Figure 1**). Upon exploring, a blast injury was identified involving the tendon sheaths and the radial digital neurovascular bundle at the level of the middle phalanx of the middle finger. Capillary refill time of the right middle finger post-operatively was documented at more than two seconds. Intravenous antibiotics of Cefuroxime and Metronidazole were commenced and dressings with constant milking of the wound for toileting purposes were done.

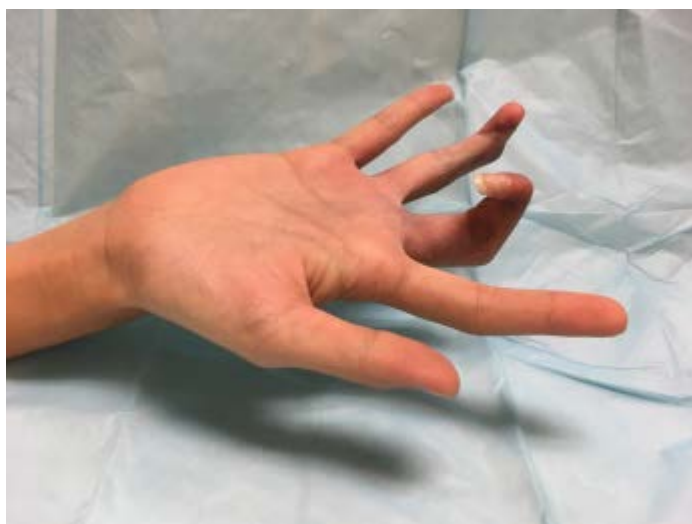
The distal phalanx of the middle finger progressed to dry gangrene and this was treated conservatively. The pulp of the middle finger auto-amputated three months after the initial injury. Patient has currently developed a flexion contracture of the affected distal interphalangeal joint with loss of pulp of the right middle finger and a mallet deformity of the right ring finger (**Figure 3**).



**Figure 1.** Patient's burned right hand and evidence of black liquid noted intraoperatively



**Figure 2.** X-ray of the right hand demonstrating radio-opaque deposits



**Figure 3.** Flexion contracture of the distal interphalangeal joint of the right middle finger

## Discussion

E-cigarettes are vaporized products which include cartridges containing a liquid mixture composed primarily of nicotine, flavoring, water, glycerin and propylene glycol<sup>[4]</sup>. These devices simulate smoking by heating the nicotine-containing solution using a battery-powered heating element, producing an aerosol that the user inhales<sup>[3,4]</sup>.

Lithium batteries are used due to their benefits of portability and storage of large amounts of energy in a compact space; however, it carries a risk of creating a “thermal runaway” whereby the internal battery overheating causes an internal fire or explosion<sup>[4,5]</sup>. The device’s poor design, use of low-quality materials, manufacturing flaws and defects, improper use and handling of the device, combined with the inherent flammability of e-liquid, could lead to a major public health concern<sup>[3]</sup>.

The device’s lack of carcinogenic additives was thought to be a safer means of nicotine consumption and as a tool to aid smoking cessation; however, the unrecognized risks to end-users are still poorly understood<sup>[3]</sup>. In Malaysia, it was reported that the number of users vary from 500,000 to one million as of 2015<sup>[6]</sup>.

There have been reports of electronic cigarettes that have malfunctioned while charging and have exploded when in use, leading to various harm including thermal and blast injuries, which may range from mild to severe burns and may even carry the risk of losing a limb as presented in this case report. Given the blast component here, this has caused a propulsion injury whereby the black liquid, pushed forward by high pressure, causes extensive spread and damages the skin and soft tissue, tendon sheaths and digital neurovascular bundle resulting in the outcome as shown in [Figure 3](#).

## Conclusion

While the public views e-cigarette devices as safer means to consume nicotine, awareness on the potential serious burns injuries from malfunctioned device is important.

The prohibition of sales of e-cigarettes has been implemented in several states in Malaysia as of 1<sup>st</sup> January, 2016. Increasing e-cigarette taxes may also be an apparent effort to reduce smoking<sup>[5]</sup>.

## Conflict of interest

The authors declare no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

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