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Case report

Thigh burns from exploding e-cigarette lithium ion batteries: First case series

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ABSTRACT

E-cigarette (EC) use has risen meteorically over the last decade. The majority of these devices are powered by re-chargeable lithium ion batteries, which can represent a fire hazard if damaged, over-heated, over-charged or stored inappropriately. There are currently no reports in the medical literature of lithium ion battery burns related to EC use and no guidance on the appropriate management of lithium ion battery associated injuries.

We report two individual cases of burn resulting from explosion of EC re-chargeable lithium ion batteries. Both patients required in-patient surgical management. We provide evidence that lithium ion battery explosions can be associated with mixed thermal and alkali chemical burns, resulting from the significant discharge of thermal energy and the dispersal of corrosive lithium ion compounds. We would recommend, as with other elemental metal exposures, caution in exposing lithium ion battery burns to water irrigation. Early and thorough cleaning and debridement of such burns, to remove residual lithium contamination, may limit the risk of burn wound extension and potentially improve outcomes.

1. Introduction

E-cigarettes (ECs) represent a means of avoiding exposure to the carcinogenic products of tobacco combustion. An estimated 2.6 million people in the United Kingdom (UK) now partake in this process of inhaling nicotine vapour, commonly known as 'vaping' [1]. EC's deliver a vaporised mixture of nicotine, propylene glycol, glycerol, water and food flavouring, heated by an atomiser and powered by a lithium-ion battery. Despite experimental concerns regarding safety [2–4], EC use is now considered significantly safer than cigarette smoking [5].

We present two cases of EC lithium ion battery explosion which resulted in burns requiring in-patient surgical management. A search of national media revealed a number of similar injuries, indicating these are not isolated events. To the

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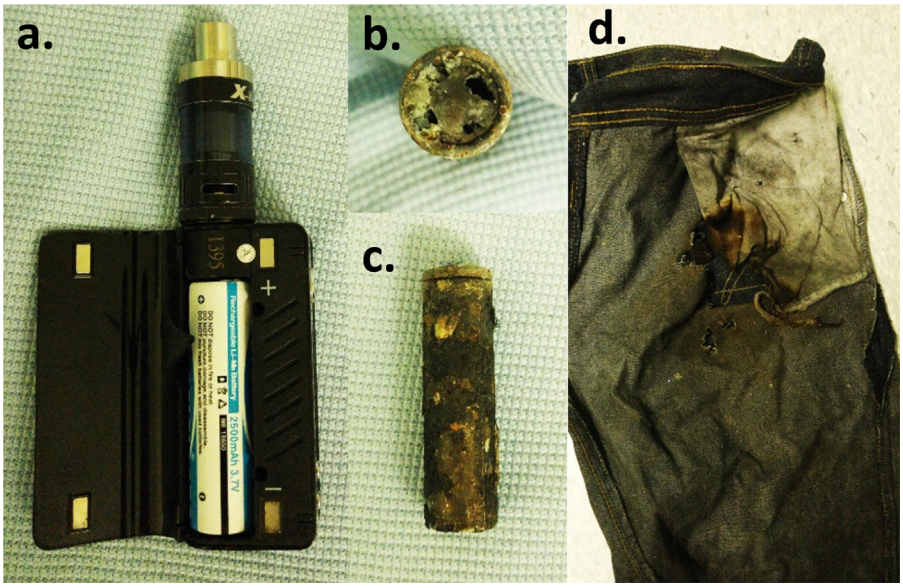
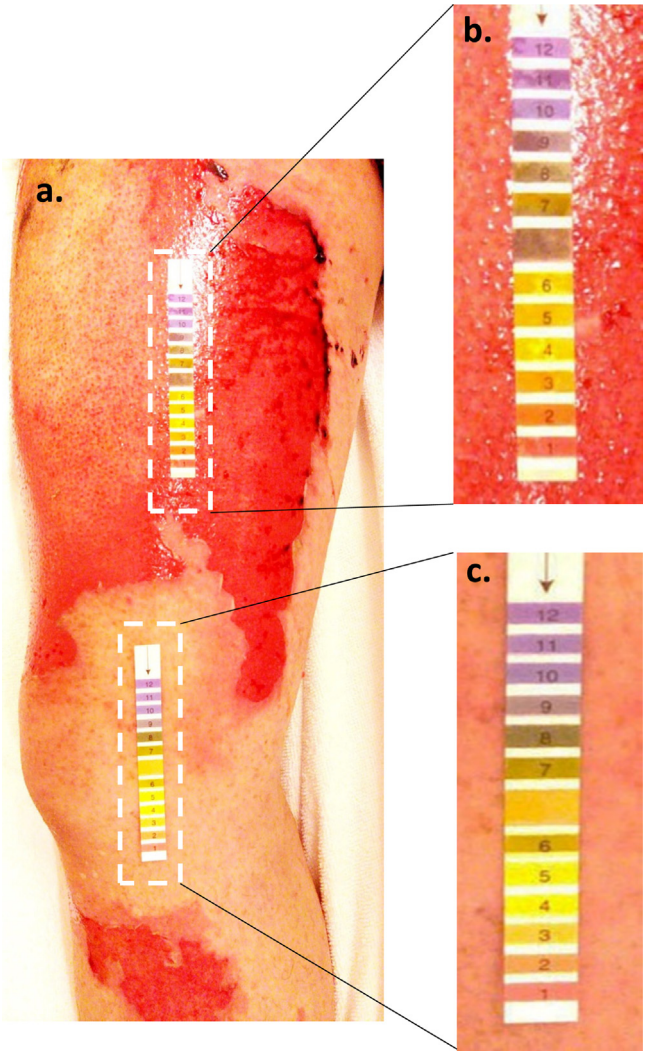


Fig. 1 – Case I – Re-chargeable lithium ion battery commonly used in e-cigarette (EC) device explodes in pocket. (a) Image of EC device with intact cylindrical lithium ion battery in situ. (b) Birds-eye view of battery post-explosion, perforations in top surface of casing were the site of venting of hot flames and gas. (c) Side-on view of damaged battery post-explosion. (d) Image of clothing post-explosion demonstrating burns to inside right jean pocket.



authors' knowledge, no such injuries are currently described in the medical literature. We also provide evidence that lithium ion battery burns result in mixed aetiology thermal and chemical burns. These represent unique descriptions of a mechanism of burn which, as EC use continues rise meteorically, may become more frequent presentations to specialist burn care providers in coming years. There is also a lack of available guidance on the management of lithium ion battery burns. As such, we aim to highlight a potential hazard of lithium ion battery injuries and its implications on immediate care and surgical management.

2. Case I

A 39 year old male steel worker was admitted to the burns unit with a presenting complaint of burns to the right thigh. His injuries were sustained following the explosion of a single cell re-chargeable lithium ion battery which was stored in the right trouser pocket. The battery had been left to charge overnight. It was not engaged with the e-cigarette device and was not noted to be damaged or over-heated prior to this event. He described the explosion as rapid and without warning, with the battery roof venting flames like a ''rocket in my pocket'' (Fig. 1). On examination, approximately 4% total burn surface

Fig. 2 – Mixed thermal and alkali chemical burns caused by lithium ion batteries explosion. (a) Approximately 4% TBSA superficial partial thickness burns to anterior surface of the right thigh following water irrigation. Deeper areas of burn were identified in the trouser pocket position. (b) Litmus paper pH test demonstrating an alkali pH of 9–10 on burn surface. (c) Litmus paper pH test demonstrating normal adjacent unaffected skin.