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Case report

Cellular phone collateral damage: A review of burns associated with lithium battery powered mobile devices

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ABSTRACT

Aim: The spontaneous destruction of lithium battery powered cellphones has raised concern about the safety of these devices. We present a case report and review of the literature of burn injuries sustained in association with cellular phone usage.

Methods: A Medline search was performed to identify articles describing cellular phone associated thermal injuries using key search words including "burn," "burn injury," "cellular phone," "cellphone," "thermal injury," and "telephone." Articles were reviewed for etiology, location, severity and treatment. We also present a case of a burn to the upper thigh resulting from cellular phone battery malfunction.

Results: Six case reports were identified detailing burn injuries obtained from cellphone use. Half of these cases occurred from battery malfunction with second degree being the most common severity. All cases were managed conservatively except one case, which required excision and primary closure.

Conclusion: Lithium powered cellular phones are susceptible to overheating and destruction from inadequate heat dissipation during thermal runaway. This process can be initiated by local short-circuiting from direct contact with a low resistance conductor such as keys or coins. We reinforce the importance of safe cell phone battery practices including avoiding overcharging and direct skin exposure to minimize thermal injury risk.

1. Introduction

It is very clear that cellular phone usage has become increasing popular within the last decade. With such a rapid increase in popularly, there was been little opportunity to witness and study some of the potential hazards of cellular phone usage. Few cases have been reported in the medical literature that document thermal injuries that arise in association with cell phone [1,2]. However, lithium battery powered cellular devices have recently received media attention for an apparent rise in "exploding smartphones" [3]. Here we document the development of a second degree

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partial thickness burn that occured spontaneously from a phone lithium battery being carried within the patient's pants pocket. Additionally, we review the literature for like cases to identify causative factors involved in sustaining these lesions and possible preventive recommendations.

2. Methods

A MEDLINE search was performed for all relevant articles describing burn injuries associated with cellular phones use. The results of this literature review encompass all published data from 1969 to May 2015. Key search words included ''burn,'' ''burn injury,'' ''cellular phone'' ''cellphone'' ''thermal injury'' and ''telephone'' using the PubMed database of the National Center for Biotechnology Information, National Library of Medicine (Bethesda, Md). Articles were reviewed for the context of the burn, the degree, TBSA, location, treatment and sequalae.

3. Results

A total of six case reports were identified involving burn injuries associated with cellular phone use [1,2,4–7] (Table 1). Of these cases, 4 were second degree burn injuries, one was first degree and one was third degree. Three of the identified burn cases were associated with battery malfunction. Only one case was managed with excision while all remaining cases were managed conservatively. Long term sequalae of a left facial palsy was noted in one case after an exploding phone resulting in facial burns, a cervical fracture and a basilar skull facture [1]. No complications were reported for all other cases.

4. Case report

A sixteen year old male present to the Montreal Children's Hospital emergency department in April of 2015. He had sustained a secondary degree burn of TBSA 1% to his left lateral thigh after a Samsung galaxy 4 cellular phone battery placed in his left pocket overheated (Fig. 1). The Samsung phone battery had been placed in the same pocket as a set of keys. While walking, he felt a pain on the surface of his thigh and noted smoke emanating from his pocket. He quickly removed the battery, which resulted in an additional 1 cm circular burn to his lateral palm. He presented to the emergency department shortly afterwards but the phone was no longer available as the patient had disposed of it.

The patient's burn was initially treated with a polysporin and bactigras dressing to the site of the burn. He was treated as an outpatient and follow up one week after the incident in clinic. The patient had been instructed to change the dressing daily however, during the first week after the incident, the patient was non compliant and had left the site exposure. When the patient returned for follow up at one week post initial injury, the burn site had notable central granulation and new epithelization along the circumference of the burn. No new dressing was applied and the patient was instructed to use routine topical polysporin at the site. The patient's burn was followed weekly until the resolution of the burn.

5. Discussion

Current medical literature has few documented cases of cellphone induced burn injuries. However, with the rise in consumer reported spontaneous phone destruction, the potential for thermal injuries sustained from cellular phone use is of increasing concern [2]. Half of the cases identified by our literature review involved thermal injuries sustained from battery malfunction [1,2,5]. Rose et al. reported a cellphone induced breast burn that occurred after the loss of the lithium battery's protective case [2]. They suggested that the cause of the burn was either due to corrosive material leaking from the battery, or that the battery could have overheated secondary to damage or external heating resulting in an exothermic oxidizing reaction known as thermal runaway [2].

Thermal runaway is described as positive feedback process that results in the rapid increase of the core temperature of a battery. This initial rise in temperature generates heat energy at a rate faster than heat can be dissipated and subsequent breakdown of the internal separator components of the battery result in local short-circuiting [8]. Lithium batteries

Table 1 – Summary of literature cases involving burn injuries sustained in association with cellular phone use. NR = data not recorded by original article. Original Table.

Author	Cause	Degree	TBSA	Location	Treatment
Ben et al., 2009 [1]	Counterfeit Battery malfunction	3rd	NR	Left cheek and cervical burn	NR
Rose et al., 2010 [2]	Battery malfunction	2nd partial	NR	Right breast	Burn excision and closure
Gil et al., 2007 [4]	Phone charger spark	2nd partial	NR	Bilateral nostrils and left upper shin	NR
Karabagli et al., 2006 [5]	Battery malfunction	2nd partial	2%	Right malar area, neck and left palm	Lysophilised polyurethane membrane
Potokar et al., 2003 [6]	Radiofrequency induced spark	2nd partial	1.5%	Bilateral hands and forearms	NR
Sharma et al., 2009 [7]	Contact burn	1st	NR	Earlobe	NR
Our Study	Battery malfunction	2nd partial	1%	left lateral thigh	Polysporin and Bactigras