The Hidden Danger of Lithium Battery-Powered Electric Bicycles and Scooters: A Case Series of the Israeli National Burn Center Experience

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Electric-powered bicycles and scooters that use rechargeable lithium batteries are an urban transportation alternative and have become increasingly popular. However, in recent years, there has been an increase in patient admissions to the Israeli National Burn Center with burns associated with their use. In this case series of all patients (n = 9) referred to the Emergency Department (February 2016–October 2020) with lithium-related battery burns from electric-powered bicycles and scooters, we present burn depth, size, treatment, inhalation injuries, and hospitalization. All patients were admitted to the Israeli National Burn Center for treatment. The average TBSA was 27.5% (range 3%–57%). All but one patient had a combination of partial to full-thickness burns affecting the upper and lower limbs. Three patients sustained inhalation injuries and a total of four patients required intubation. Seven patients required surgery that included debridement and, in most cases, skin grafting. The availability and increase in the use of battery-powered bicycles and scooters may lead to an increase in injuries and death if consumers are not aware of the potential dangers related to the safe use of lithium batteries.

INTRODUCTION

The use of lithium batteries is popular as they are low maintenance, have a fast-charging time with longevity, and have high energy density. Yet, the thermal stability is relatively poor making them an inherent fire and combustion risk under certain circumstances.[1] Despite this, electric scooters and bicycles powered by rechargeable lithium batteries are an emerging urban transportation alternative and have become increasingly popular due to their high accessibility and usability in the urban settings.[2–6] In 2015, the sales worldwide from electric bicycles alone were estimated to be greater than 40 million units.[7]

Although these means of transportation have some advantages, their safety and regulations have been questioned.[5] Awareness of the dangers imposed by these mobility devices such as accidents involving self, pedestrians, or vehicles and the risk of burn injuries is overlooked by health professionals and regulators alike. Of these injuries sustained, burn injuries from the explosion of the lithium batteries are a less acknowledged hazard.[8] Lithium batteries contain hazardous and flammable electrolytes and can be overcharged, overheated, or damaged which can lead to fires, combustion, and burns.[9–12]

A report by the Singapore Civil Defense Force[13] showed that fires caused by electric bicycle batteries were the most prevalent cause of fires ignited by consumer product batteries. Fifty percent of these occurred while the batteries were charging.[13] Other risks associated with heating of lithium-powered cells are the production of flammable and poisonous gases which can lead to ignition or over pressurization triggering a rupture or explosion, resulting in deleterious and untoward effects.[12] For these reasons, lithium batteries have the potential to inflict serious harm and importantly, consumers may not be aware of the dangers pertaining to electric bicycles and scooters.

Israel is a country of approximately 9 million people with a long history of cycling, however, the increased use of the electric bike is rapidly growing[7] with an estimated 246,000

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units in use at the end of 2017, and reports estimate that this number will continue to increase in the future.[14] As reported by Magen David Adom, Israel's National Emergency Pre-Hospital Medical and Blood Services Organization, during 2017, two patients injured by lithium-powered mobility devices were transferred to hospitals, in 2018, a total of 35, and in 2019, 64 patients, an increase of over 180% from the previous year. Authorities assume that these numbers underrepresent the actual number of cases caused by lithium battery-associated accidents as many do not report or present to emergency services.

In this report, we present nine cases pertaining to lithium batteries concerning electric bicycles and scooters admitted to the National Burns Center from 2016 to 2020. Our objective was to report the burn-specific properties related to burns sustained by lithium-powered mobility devices as well as raise awareness of the potential dangers involved in the use of electric bicycles and scooters.

METHODS

Ethics Approval

Approval to review the electronic and written medical records data was obtained from the Magen David Adom, Israel National Fire and Rescue Authority, and Sheba Medical Center IRB Committee. Patients provided informed written consent encompassing digital photography for treatment, teaching, and for utilization in academic publications.

Patient Selection

This paper is a retrospective review of all patients who sustained lithium batteries burns from electric bikes and scooters. With the assistance of the Gertner Institute for Health Policy and Epidemiology, we retrospectively reviewed the electronic medical records of patients referred to the Emergency Department (ED) using keywords "burn/s," "battery/ies," "electric bike," or "electric scooter" from February 2016 to October 2020 for lithium batteries-related burns.

Nine patients with burn wounds due to lithium batteries use were identified. Cases were reviewed for burn depth, size, treatment, inhalation injuries, and hospitalization.

RESULTS

Case Series

Our retrospective review of admissions to the National Burns Center identified nine patients who met our inclusion criteria. The majority of patients in this case series were males (89%), a mean age at time of injury 37.8 years (range 23–69 years), a mean TBSA of 27.5% (range 3%–57%), and a mean length of hospital stay of 34.3 days (range 3–89) (Table 1). All but one patient had a combination of partial- and full-thickness burns. The upper and lower limbs were affected in all but one patient. It is important to note that three cases occurred while patients were charging their bicycle/scooter beside their bed whilst sleeping. All nine patients required inpatient admission; three patients sustained inhalation injuries, and four required intubation (one case due to agitation). Two patients underwent tracheal tube placement due to their need for prolonged invasive ventilatory support. Of the nine cases, seven patients required surgery (see Table 1, Figure 1). Infection was observed in five patients with one experiencing severe ventilator-associated pneumonia. Seven patients were discharged home and two were referred to rehabilitation centers. All patients were followed up at our clinics for a minimum of 12-month post-discharge.

DISCUSSION

During the last few years, we have noticed an increase in hospital admissions due to injuries caused by lithium-powered batteries, paralleling the surge in availability of these devices.[9–11,15,16] It is acknowledged that lithium batteries containing highly reactive chemicals have the capacity to spontaneously ignite and result in an explosion because of a phenomenon called thermal runaway (when the temperature rises rapidly and the energy stored in the battery is suddenly released).[17] As with any device that has the capacity to store energy, there is an inherent risk for combustion and ignition. If used as per manufacturer-recommended guidelines, lithium rechargeable battery cell failure rates are reported to be less than 1 in 10 million and some estimating a failure rate of 1 in 40 million cells.[18] Wang et al[1] reported that when lithium batteries are used in conditions outside their intended design or damaged, the batteries may fail by means of rapid self-heating or thermal runaway process resulting in ignition of any surrounding materials. In addition, the explosion of the batteries can cause trauma, burn injuries from the ignition of clothing and from attempting to extinguish the fire, and indirect injury, such as inhalation of toxic fumes/smoke.[9]

In accordance, all battery-powered devices should be appraised as possessing the potential to cause fire and combustion and treated with respect, care, and caution.[17] These include precautions such as but not limited to; storing all batteries and devices in accordance with manufacturers recommendations, avoiding prolonged sun exposure, charging away from flammables in a designated and isolated area, use of only original and approved equipment, avoiding using batteries that have been damaged, avoiding overcharging or leaving charging batteries unattended, and ensuring that the battery is not charged after sustaining damage/shock.

As physicians treating these patients, we believe education to enhance awareness regarding the use of lithium batteries and chargers is essential, as is the requirement to wear a safety helmet. Correct placement of chargers when in use, installation of smoke detectors, and an accessible extinguisher are some easy regulations that can be implemented. Due to the widespread availability and the expected increase in the use of these devices, continuing to ignore the potential dangers involved in the use of electric-powered bicycles and scooters may see a further increase in injuries and death. Finally, it should be noted that not all lithium batteries are made of the same quality throughout the world. Increasing awareness across all sectors including health providers and regulatory officials can be a major determinant with the goal of preventing injury and saving lives.

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Table 1. Patient demographics, injury characteristics, and burn distribution

Patient	Gender	Age	TBSA (%)	LOH (Days)	Intubation Yes/No	Presence of Inhalation Injury	Upper Limbs (%) Thickness	Lower Limbs (%) Thickness	Face/Neck (%) Thickness	Chest/Abdomen/ Back (%) Thickness	Surgery
1	F	26	3	29	No	–	1% Superficial partial	2% Deep partial	–	–	Debridement + STSG
2	M	32	38	47	Yes	Inhalation	14% Deep partial/ full	3% Deep partial/ full	9% Superficial partial/deep partial	12% Deep partial/full	Late scar revisions
3	M	69	5	3	No	–	–	–	5% Superficial partial	–	–
4	M	42	50	31	Yes	Inhalation	11% Deep partial	20% Deep partial	6% Deep partial	13% Deep partial	–
5	M	43	27	41	No	–	9% Superficial/ deep partial	10% Superficial/ deep partial	2% Superficial/ deep partial	6% Superficial/deep partial	Debridement + STSG
6	M	23	38	89	No	–	2% Superficial/ deep partial	36% Superficial/ deep partial	–	–	Debridement + STSG
7	M	33	57	46	Yes	Inhalation	18% Superficial/ deep partial	16% Superficial/ deep partial	5% Superficial partial	18% Superficial/deep partial	Debridement
8	M	35	20	29	Yes (due to agitation)	–	6% Deep partial/ full	12% Deep partial/ full	–	2% Deep partial/full	Debridement + STSG
9	M	46	10	27	No	–	–	10% Deep partial/ full	–	–	Debridement + STSG

LOH, length of hospitalization; *STSG*, split-thickness skin graft; *TBSA*, total body surface area.

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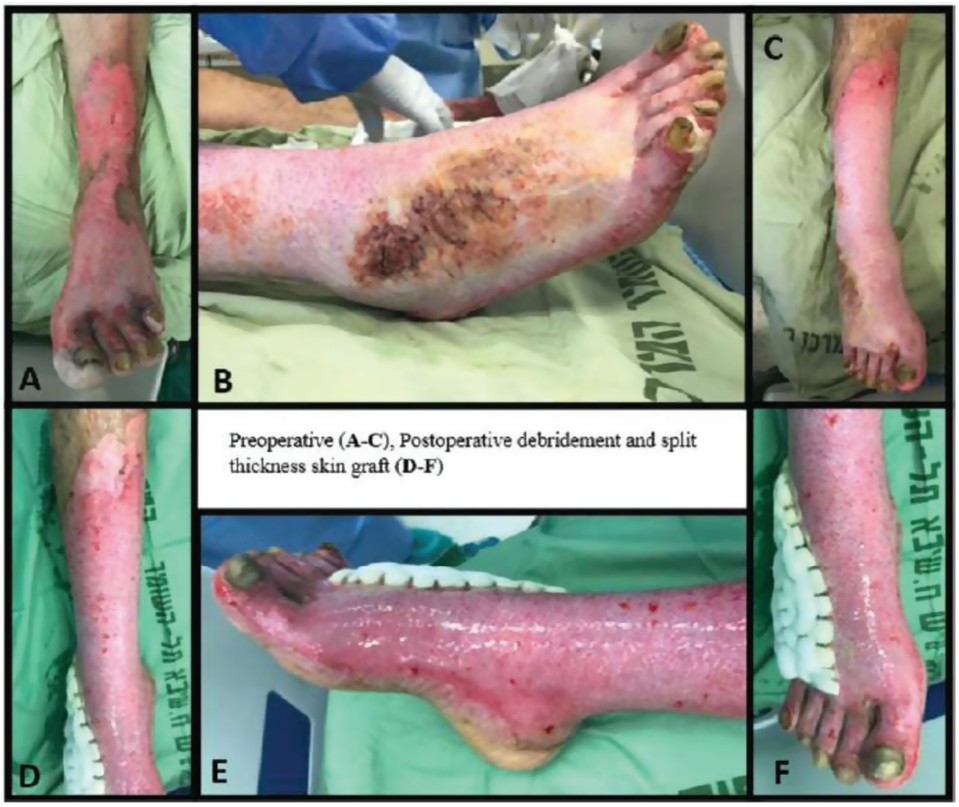


Figure 1. Case 9: 32-year-old male with 10% TBSA burns due to lithium battery explosion.

CONCLUSION

In conclusion, with the increasing popularity of electric mobility devices, there is a need for greater community awareness concerning the potential combustion of the lithium batteries that power these devices. Specifically, electric bicycles and scooters may be a potential burn hazard that may result in significant burns requiring hospitalization and surgical treatment.

REFERENCES

1. Wang Q, Mao B, Stoliarov SI, Sun J. A review of lithium ion battery failure mechanisms and fire prevention strategies. Prog Energy Combust Sci 2019;73: 95–131.
2. Dhillon NK, Juillard C, Barmparas G et al. Electric scooter injury in southern California trauma centers. J Am Coll Surg 2020;231:133–8.
3. Badeau A, Carman C, Newman M, Steenblik J, Carlson M, Madsen T. Emergency department visits for electric scooter-related injuries after introduction of an urban rental program. Am J Emerg Med 2019;37:1531–3.
4. DiMaggio CJ, Bukur M, Wall SP, Frangos SG, Wen AY. Injuries associated with electric-powered bikes and scooters: analysis of US consumer product data. Inj Prev 2020;26:524–8.
5. Siman-Tov M, Radomislensky I, Peleg K; Israel Trauma Group. The casualties from electric bike and motorized scooter road accidents. Traffic Inj Prev 2017;18:318–23.
6. Puzio TJ, Murphy PB, Gazzetta J et al. The electric scooter: a surging new mode of transportation that comes with risk to riders. Traffic Inj Prev 2020;21:175–8.
7. Gitelman V, Korchatov A, Elias W. Speeds of young e-cyclists on urban streets and related risk factors: an observational study in Israel. Safety 2020;6:29.
8. Ragonez D, Mimoun M, Chaouat M et al. Burns caused by exploding standing electric scooters (e-scooters): a new phenomenon. J Burn Care Res 2021;42:348–9.
9. Palmieri TL, Yelon J, Shapiro D, Duncan T, Kuhls D; American College of Surgeons Committee on Trauma, Chicago, IL. Lithium batteries: a technological advance with unintended injury consequences. J Trauma Acute Care Surg 2018;85:406–9.
10. Corazza M, Forconi R, Musmeci D, Toni G, Borghi A. Thermal injury caused by the explosion of a lithium-ion mobile phone battery. J Eur Acad Dermatol Venereol 2018;32:e43–4.
11. Mankowski PJ, Kanevsky J, Bakirtzian P, Cugno S. Cellular phone collateral damage: a review of burns associated with lithium battery powered mobile devices. Burns 2016;42:e61–4.
12. Lisbona D, Snee T. A review of hazards associated with primary lithium and lithium-ion batteries. Process Saf Environ Prot 2011;89: 434–42.
13. Singapore Civil Defense Force, Fires involving batteries of electric bicycles, personal mobility devices, powerbanks and laptops (2008–2015). Fire Analysis Report, 2016;2:1–16; available from https://www.scdf.gov.sg/docs/default-source/scdf-library/far-issue-3---21-feb-2017.pdf. Date Accessed 2 November 2021.
14. Shachak M. Bicycles, electric bicycles and electric scooters: data on accidents, casualties, series and supervision 2018, Center of Research and Information, The Knesset: Israel, p. 1–13; available from https://knesset.gov.il/mmm. Date Accessed 2 November 2021.
15. Cherubino M, Pellegatta I, Sallam D, Pulerà E, Valdatta L. Enzymatic debridement after mobile phone explosion: a case report. Ann Burns Fire Disasters 2016;29:273–5.
16. Görgülü T, Torun M, Olgun A. A cause of severe thigh injury: battery explosion. Ann Med Surg (Lond) 2016;5:49–51.
17. Chen M, Zhou D, Chen X et al. Investigation on the thermal hazards of 18650 lithium ion batteries by fire calorimeter. J Therm Anal Calorim 2015;122:755–63.
18. Doughty D, Roth P. A general discussion of Li ion battery safety. Electrochem Soc Interface 2012;21:37–44.

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