ENZYMATIC DEBRIDEMENT AFTER MOBILE PHONE EXPLOSION: A CASE REPORT

DÉTERSION ENZYMATIQUE APRÈS EXPLOSION DE TÉLÉPHONE MOBILE: À PROPOS D'UN CAS

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SUMMARY. It is estimated that over 90% of people own a mobile phone. Although rare, lithium-ion battery explosions can cause varying degrees of thermal burn injury. Recently, selective enzymatic debridement has gained importance in the management of burn patients, thanks to its simplicity, minimum invasiveness and safety. In this work, we describe a case of a burn injury caused by the explosion of a lithium-ion battery and treated with selective enzymatic debridement in a paediatric patient.

Keywords: burn, thermal injury, mobile phone, lithium battery, Nexobrid®, selective enzymatic debridement

RÉSUMÉ. *On estime que plus de 90% de la population possède un téléphone portable. Bien que rare, l'explosion des batteries lithium/ions peut entraîner des brûlures de gravité variable. La détersion enzymatique a récemment pris plus d'importance dans le traitement des brûlures, grâce à sa simplicité, son invasibilité faible et sa sécurité. Nous exposons ici l'utilisation de cette technique chez un enfant victime d'un accident de batterie de téléphone portable.*

Mots-clés: *brûlure, téléphone portable, batterie, Nexobrid®, détersion enzymatique*

Introduction

Nowadays, communication technologies are widely available in our everyday lives. The United Nations specialized agency for information and communication technologies (ITU) estimates that there are almost seven billion mobile phones worldwide. Damage caused by radiation emitted from mobile phones is well known. Acute burns can be caused, albeit rarely, by the explosion of the lithium battery in the phone.[1-3] The explosion, caused by an exothermic reaction, can result in both thermal and chemical injuries. Conventionally, standard care of a burn injury involves both surgical techniques (surgical debridement, skin graft) and outpatient management (dressing, collagenase ointment). We report a case of enzymatic debridement of a burn injury caused by the accidental explosion of a mobile phone battery.

Materials and methods

Enzymatic debridement of burn injuries has gained more and more relevance in the last few years.[4,5] Nexobrid® (Mediwound Germany GmbH, Russelsheim) is a recent non-surgical, enzymatic tool to treat burn injuries of different degrees. It is specific and selective in the removal of the eschar and other dead tissue without harming surrounding tissue. Its efficacy is based on the activity of bromelain-enriched proteolytic enzymes.

Some preclinical animal studies have been developed to verify the safety and efficacy of this tool.[6,7] The technique is gaining consensus in the treatment of all kinds of thermal injuries and, above all, in circumferential burns on an upper or lower limb.[8] The key features of the product are its minimally invasive modality of application, selectiveness of the action, minor blood loss after debridement compared to standard options and simplicity of use.[4]

Case report

A fourteen-year-old male patient was admitted to our Plastic and Reconstructive Surgery Department after the original lithium-ion battery in his mobile phone accidentally exploded (*Fig. 1*). The explosion occurred while the device was in his trouser pocket, not charging and in standby mode. The lesion covered an area of 35 x 15 cm of the right thigh (6% TBSA). After cleansing and blister removal, a 6 x 8 cm full thickness third degree burn was identified in the central region, a deep second degree burn in the upper part, and superficial second degree burn in the remaining areas (*Fig. 2*). The lesion has the appearance of a thermal burn.

Following standard protocol, enzymatic gel was applied three hours after the thermal injury for four hours. After the trousers were removed, a "wet to dry" dressing was left in place for two hours. The procedure was carried out at the bed-

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Fig. 1 - Mobile phone appearance after battery explosion. The phone was in the trouser pocket, in stand-by mode and not charging.

Fig. 2 - Appearance of the wound before and after washing and removal of blisters, three hours after the phone battery exploded.

Fig. 3 - The lesion in the final stage of wound healing, four weeks after thermal injury. The patient refused any surgical treatment with STSG.

Fig. 4 - Result two months after enzymatic debridement with wound completely healed.

side. Blood loss was minimal and only moderate sedation combined with analgesia was administered. Given the patient's young age and the type of thermal injury (immediate skin grafts have high complication rates), it was decided to medicate the entire burn with paraffin-based gauze and silver sulfadiazine ointment. The patient was discharged from hospital the following day. In the first two weeks, the dressing was changed three times a week, and in the following three weeks, once every 5 days (*Fig. 3*). In the meantime, after the first week and on several occasions, we proposed a Split Thickness Skin Graft to speed up healing but the patient refused any surgical treatment so we continued with wound care. Thirty-seven days after we applied enzymatic gel, the wound was completely re-epithelized (*Fig. 4*). No infection or side effects were detected and the newly formed skin was pliable and elastic. At 12-month follow up, the scar was evaluated with the Patient Observer Scar Assessment Scale, previously used in a randomized study by our group.[9] PSAS was 40. OSAS was 33.

Discussion

We have reported a case of enzymatic debridement after the lithium-ion battery in the mobile phone of a teenage patient exploded. This is a rare event, but it has been reported in the literature before.[2] However, this is the first reported case of mobile phone burns treated with enzymatic debridement. Enzymatic debridement has several advantages, such as simplicity of application, relative low cost and, above all, the ability to differentiate burned tissues and necrotic tissue from viable tissue.[10]

It has been well demonstrated that enzymatic debridement decreases blood loss and avoids the removal of viable and healthy tissue. This reduces both the area of the wound that has to undergo skin grafting and the number of patients that are treated surgically. In our personal experience of using Nexobrid® for enzymatic debridement, we came to the conclusion that it allows a selective and useful discrimination between different grades of burn tissue, facilitating diagnosis. Once debridement is finished, further treatment of the burns can be planned by the surgeon considering the appearance of the burns immediately afterwards. Moreover, enzymatic debridement works well for bed preparation for early skin grafting that, in our opinion, is the best treatment. However, in our case report, enzymatic debridement proved to work egregiously also for chemical thermal injury, allowing the wound to heal completely without any surgical procedure. This feature is useful in patients with age or health issues for whom surgical debridement is not advised. Furthermore, the selectivity and simplicity of the enzymatic method make it possible to treat the burn at the patient's bedside (TBSA<10% and without comorbidities). Use of this drug is painful during the process and suitable painkiller administration is necessary. This is reported in the literature and was confirmed also in our experience. However, it depends on the patient and on the extent of the burn. The main contraindication is sensitivity to pineapple.

Conclusion

We selectively treated a patient with thermal injury at his bedside with light sedation. We completely removed non-viable tissue from a burn of varying degrees in a paediatric patient involved in an accidental explosion of a mobile phone lithium-ion battery. The result two months after second intention wound healing was optimal and management of the patient gave us no particular issue. The procedure was safe and minimally invasive. We did not observe any side effects. Thus, despite the need for a wider number of cases, we recommend the use of bromelain-enriched proteolytic enzyme debridement also in the management of burns caused by a mobile phone battery exploding.

BIBLIOGRAPHY

1. Karabagli Y, Köse AA, Cetin C: Partial thickness burns caused by a spontaneously exploding mobile phone. Burns, 32: 922-4, 2006. doi:10.1016/j.burns.2006.03.009.
2. 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; 0. doi:10.1016/j.burns.2015.10.012.
3. Kumar V, Dayapala A: Mobile phone explosion burn. Burns, 33: 677-8, 2007. doi:10.1016/j.burns.2006.10.391.
4. Rosenberg L, Krieger Y, Bogdanov-Berezovski A, Silberstein E et al.: A novel rapid and selective enzymatic debridement agent for burn wound management: a multi-center RCT. Burns, 40: 466-74, 2014. doi:10.1016/j.burns.2013.08.013.
5. Koller J, Bukovcan P, Orság M, Kvalténi R, Gräffinger I: Enzymatic necrolysis of acute deep burns—report of preliminary results with 22 patients. Acta Chir Plast, 50: 109-14, 2008.
6. Gurfinkel R, Lavon I, Cagnano E, Volgin K et al.: Combined ultrasonic and enzymatic debridement of necrotic eschars in an animal model. J Burn Care Res, 30: 505-13, 2009. doi:10.1097/BCR.0b013e3181a28d89.
7. Singer AJ, Taira BR, Anderson R, McClain SA, Rosenberg L: Reepithelialization of mid-dermal porcine burns after rapid enzymatic debridement with Debrase®. J Burn Care Res, 32: 647-53, 2011. doi:10.1097/BCR.0b013e31822dc467.
8. Krieger Y, Bogdanov-Berezovsky A, Gurfinkel R, Silberstein E et al.: Efficacy of enzymatic debridement of deeply burned hands. Burns, 38: 108-12, 2012. doi:10.1016/j.burns.2011.06.002.
9. Cromi A, Ghezzi F, Gottardi A, Cherubino M et al.: Cosmetic outcomes of various skin closure methods following cesarean delivery: a randomized trial. Am J Obstet Gynecol, 203: 36, 2010. e1–8. doi:10.1016/j.ajog.2010.02.001.
10. Rosenberg L, Lapid O, Bogdanov-Berezovsky A, Glesinger R et al.: Safety and efficacy of a proteolytic enzyme for enzymatic burn debridement: a preliminary report. Burns, 30: 843-50, 2004. doi:10.1016/j.burns.2004.04.010.

Consent. The patient and his parents gave their consent to the use of the images in the paper.

Conflict of interest. The authors have no conflict of interest to report.