Clinics in Surgery

Case Report
Published: 07 Nov, 2024

Burn Injury Caused by Unexpected Explosion of Gunpowder: A Case Report

Akgul EO[1], Bayrak Z[1], Ince M[2], Cirak E[1], Yilmaz MI[3], Tanyuksel M[4] and Yaman H[5]*

[1]Research Center, Phytocenter, Ankara, Turkey

[2]Division of General Surgery, Private 100.Yıl Hospital, Ankara, Turkey

[3]Division of Nephrology, Center for Epigenetic Health Solutions, Ankara, Turkey

[4]Division of Infectious Diseases, University of Virginia, Virginia, USA

[5]Division of Wound Care, Private Bilgi Hospital, Ankara, Turkey

Abstract

Burns are a common condition presenting to the emergency room. Most of them are thermal burns. Burn wound healing is a complex process characterized by inflammation, proliferation, repair, and remodeling stages. A Special Burn Care Cream (SBCC) improves burn wound healing. We report a case of burns after a gunpowder explosion. A 36-year-old male patient was transferred to the burn center of a state hospital in Ankara, Turkey, following a gunpowder explosion on his face and neck. He had showed up with a second- to third-degree burn injury, about 14% total body surface area. He presented to our outpatient clinic 5 days later. Twice surgical debridement was performed to treat burn wounds on the face and neck. All the necrotic tissues were removed. Daily, the burn wound beds were cleaned by irrigation of the wound surface with gauze and saline. Then SBCC was applied to the wound area and left open. On the 10th day of treatment, complete recovery was achieved. No adverse effects were recorded. The SBCC increases the healing rate of burn wounds by promoting cell adhesion, proliferation, and differentiation. The cream promotes the proliferation and differentiation of fibroblasts and keratinocytes. In addition to other treatments, the SBCC application may be an alternative treatment approach for closure of burn wounds that have failed to heal with conventional treatments. Prospective and randomized controlled studies are needed to demonstrate the efficacy of SBCC.

Keywords: Gunpowder explosion; Facial and neck burn; Re-epithelization; Special burn care cream; Wound healing

OPEN ACCESS

Correspondence:
Emin Ozgur AKGUL, Phytocenter Research Center, Batı Bulvarı ATB Is Merkezi I Blok No:249, 06374, Yenimahalle - Ankara, Turkey. Tel: +90 312 227 03 11; +90 544 594 91 21;

Received Date: *07 Oct 2024*
Accepted Date: *23 Oct 2024*
Published Date: *07 Nov 2024*

Citation:
Akgul EO, Bayrak Z, Ince M, Cirak E, Yilmaz MI, Tanyuksel M, et al. Burn Injury Caused by Unexpected Explosion of Gunpowder: A Case Report. Clin Surg. 2024; 9: 3727.

Introduction

Burns are a common condition presenting to the emergency room. Most of them are thermal burns. Most patients experience full-thickness burns that require major surgery and skin autografting for wound management [1]. Currently, early removal and resurfacing of non-viable tissue is considered the principle in acute burn care [2].

A lightning rod (US, AUS, CA) or lightning conductor (UK) is a metal rod mounted on a structure and intended to protect the structure from a lightning strike [3]. Gunpowder explosions have many similarities with thunder and lightning, as they are extremely loud, bright, and often unexpected [4]. Gunpowder is used in some stages of lightning rod installation. Gunpowder explodes when it encounters heat or fire, like a cigarette. Gunpowder explosions at close range are responsible for serious burn injuries and deaths due to high temperature, high velocity airflow and the toxicity of the fumes [5,6]. There are some reports that give details of patients on burns after gunpowder explosion due to occupational accidents. However, a small number of reports belong to patients who were burned by gunpowder explosion following work-related accidents in the fireworks factory [5,7-9]. The most commonly affected areas of the body to be injured in a gunpowder explosion are head and neck, upper extremity, lower extremity, and trunk [5-7]. Gunpowder burns typically involve deep layers of the skin and/or are full skin thickness [10].

Wound healing is a complex process characterized by stages of inflammation, proliferation, repair, and remodeling [11]. Cell proliferation, collagen and elastin synthesis, granulation formation, matrix remodeling and re-epithelialization will be induced by the Special Burn Care Cream (SBCC) placed on the burn wound bed.

This effective SBCC is made from carefully selected ingredients with nourishing and healing properties. More specifically, the SBCC is made with water, Olea Europaea fruit oil, Beeswax, Laurus Nobilis fruit oil, Zinc Oxide, Sodium Borate, Ascorbic Acid, Myrtus Communis leaf oil, Hypericum Perforatum oil, Pistacia Lentiscus Gum, Benzoic Acid and its sodium salt, Nigella Sativa Seed oil, Tocopherol. This unique combination is to aid the healing of acute and chronic wounds and promote skin regeneration in cases of burns. The natural, medical grade ingredients of this cream are compatible with sensitive skin. The trade name of SBCC is Phytocenter Evergreen-Zn Cream. The SBCC is manufactured Zeheri Group Company, Ankara, Turkey. The second author, Ziya Bayrak is a pharmacist with a PhD in pharmaceutical technology, is the R&D director of Zeheri Group Company. The SBCC was formulated and developed by Ziya Bayrak and the R&D team.

In this article, we present a case of burn wound on face and neck after gunpowder explosion. The clinical presentation, management strategies, and outcomes are detailed herein, aiming to contribute to the limited literature available on this particular injury.

Case Presentation

A 36-year-old male patient was transferred to the burn center of a state hospital on June 25, 2021, in Ankara, Turkey, following a gunpowder explosion on his face and neck (Figure 1). Appropriate burn wound care was performed with closed dressings in a hospital for 5 days. Fluid resuscitation is the first important step in the first 24 h to 48 h period for patients exposed to burns. According to the international standard, adequate fluid resuscitation was performed in our patient. He presented to our outpatient clinic 5 days after the burn (Figure 2), and a comprehensive examination was conducted at that time. In our patient, physical examination findings of burns on the nose, face, eyebrows, and hairs were observed, but there was no physical examination findings of inhalation burn injury. He had showed up with a second- to third-degree burn injury, about 14% total body surface area. The patient had stable vital signs on presentation. History revealed no comorbidities, current use of medications or allergy to any substance or material.

Before debridement, the skin was washed with sterile 0.9% saline for 5 minutes, and this procedure was repeated three times

Figure 1: Photograph shows the gunpowder explosion burn injury on the face and neck.

Figure 2: Before debridement, photograph shows burn wound care was performed with closed dressings on the 5th day after the burn.

in succession. The gunpowder on the face and neck. was removed and careful debridement was performed to remove necrotic tissues (Figure 3A, 3B and 3C). Prophylactic antibiotics were begun. Two days after the first surgical debridement, we performed another debridement and covered the wounds with the cream. Afterwards, he was followed up in our outpatient clinic. The cream was applied to the burned areas of the face and neck once a day and the areas where the cream was applied was left open (Figure 4A and 4B). On the 4th day of treatment, healed areas in the burn wound area are visible (Figure 5). The cream application took 10 days in total. On the 10th day of treatment, complete recovery was achieved (Figure 6A and 6B). No adverse effects were recorded. Three months after the wound care was finished, our patient was called to our outpatient clinic and the post-treatment wound appearance was evaluated and recorded. The burn wounds were totally resurfaced and healed well. There is no visible scar on his face and neck (Figure 7). Informed consent was received from our patient to publish him details.

Discussion

Deep thermal burns require excision and grafting. In particular, blisters, bullae, vesicles and necrotic tissue should be debrided [12]. Facial burns remain a complex reconstructive problem. In these cases, poor cosmetic results, a common result of reduced facial animation and facial contractures, are difficult to achieve the goals of plastic surgery to restore form and function [13].

A gunpowder explosion injury is different from other burn injuries that cause a compound injury. The high environmental temperature following gunpowder explosions causes thermal injuries [6]. In our initial examination, there were no physical examination findings of inhalation burn injury. Gunpowder melts the synthetic textile fibers in the injury area. This situation may affect the degree and area of the burn that will occur after the gunpowder explosion. Other injuries from gunpowder explosions can occur. These are inhalation injury, blast injury and bone fractures. Our patient did not have any other injuries due to the gunpowder explosion except burn injuries.

It is vital to inquire into the history of injury in detail and thoroughly examine the patients with other branch physicians to investigate associated injuries. Any life-threatening injury, such as encephalic hematoma, splenic rupture, and intestinal perforation, should be managed immediately after hospitalization, while injuries with little impact on life can be addressed after fluid resuscitation and stable vital signs have been established [5]. When it comes to the

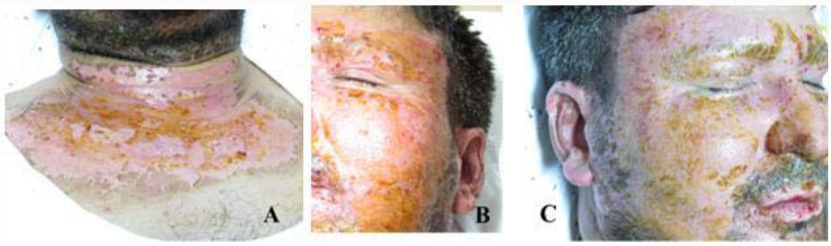

Figure 3: After first debridement (A) Photograph shows front view of the burn injury in a 36-year-old male patient following a gunpowder explosion on his face and neck, (B) Left lateral view of the burn injury, (C) Right lateral view of the burn injury.

Figure 4: (A) After second debridement (B) Photograph shows front view of the burn wound covered with cream on the 3rd day of treatment.

Figure 5: Photographs shows healed areas at the burn wound site on the 4th day of treatment.

face, it is recommended to seek ophthalmological and ENT advice. Once the gunpowder has exploded, the head and neck would be at the highest risk to be injured [5]. Our patient also had both face and neck burn injuries.

Accidents in large industries are rare, as production and use comply with established safety precautions. In order to be protected from such accidents, first of all, safety regulations should be established in closed businesses and in the outdoor environment.

After the initial examination, we do a thorough cleaning of the wounds, debride the devitalized tissues, and try to remove as many foreign bodies as possible. Primary closure is performed when appropriate. If there are doubts about the viability or cleanliness of the tissues, the wounds are left open and frequent dressing changes are made. Leaving the wounds open allows small foreign particles to be eliminated spontaneously. Surgical debridement is performed as often as necessary by assessing the wound, but in many cases, it can be an unpleasant and tedious procedure. In our patient, after cleaning the burn areas with saline daily, the cream was applied to the burn wound areas once a day and left open.

Secondary revisions are not rare, especially to address tattooing caused by gunpowder dust. In our experience, debridement is a useful tool to treat this problem. We also performed a secondary debridement on our patient.

Sepsis from extensive burns following gunpowder explosions causes severe morbidity and high mortality [14]. Our patient did not have extensive and deep burns. There were no signs of sepsis.

Early excision and grafting are another important step in the survival of patients with extensive and deep burns because early removal of deeply burned tissue not only improves the patient's hemodynamic and hemorheological condition, but also reduces the change of infection and stabilizes the patient's condition [15]. The first excision and debridement of the burn wounds in our patient could be performed by us 5 days after the burn. Our patient was debrided

Figure 6: On the 10th day of treatment, complete recovery was achieved (A) Photograph shows front view of his neck, (B) Photograph shows front view of his face and neck.

Figure 7: Three months after the wound care was finished. Photograph shows the totally resurfaced and healed burn wound. There is no visible scar on his face and neck.

twice, but grafting was not applied. The burn wounds were totally resurfaced and healed well after debridement and cream applications.

While superficial burns usually heal with little or no scarring, deeper burns can leave scarring by developing Hypertrophic Scar (HTS) in some patients [12]. HTS is a common complication of burn injury. In response to this thermal injury and the lack of contact inhibition of local cells, burn wounds contract, forming HTS. HTS most predictably develops after prolonged inflammation of slow-healing burn wounds [16], HTS did not develop in our patient after burn treatment. In addition to healing the burn wound, the cream may also play an important role in preventing the formation of HTS by eliminating prolonged inflammation. Early debridement and cream applications prevented HTS formation.

Conclusion

In thermal burns, patients should be ultimately evaluated by a burn specialist for early debridement and skin grafting. This is both necessary and the best way to heal. In this case, our patient was discharged home in a stable condition without the need for skin grafting or other surgical procedures, by surgical debridement as early as possible, followed by cream applications. Healing was completed in 10 days with debridement and cream procedures.

The cream increases the healing rate of burn wounds by promoting cell adhesion, proliferation, and differentiation. The cream promotes the proliferation and differentiation of fibroblasts and keratinocytes. A remarkable finding was that re-epithelialization started after the granulation tissue filled the deep burn area and the burn wound healed completely in a short time. There was no need for an autologous skin graft during the treatment.

In addition, due to the good adhesion of the cream to the wound bed, dressing changes were not required in the areas where the cream was applied, demonstrating the potential to reduce burn patient pain, hospital costs and the overall workload of the healthcare team.

We believe the limitations of analyzing these results in a single patient, but currently the cream itself will secure its place as an option for the treatment of burn wounds with significant therapeutic effect. In addition to other treatments, the SBCC application may be an alternative treatment approach for the closure of burn wounds that have failed to heal with conventional treatments. At the same time, it will make significant contributions to the financial and health system. Prospective and randomized controlled studies are needed to demonstrate the efficacy of SBCC.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

References

1. Lacy AJ, Freeman CL, Sexton MK. Cement burns. J Emerg Med. 2021;61(5):533-5.
2. Hang CK, Bartkova J, Liao YS, Tzeng YS. Successful treatment of lower limb burn wounds with long-term survived human skin allograft in an immunosuppressed patient: a case report. Int J Low Extrem Wounds. 2021;20(2):167-71.
3. Lightning rod.Wikipedia. accessed August 28, 2022.
4. Krider EP. Lightning and Gunpowder in the 18th Century. American Geophysical Union, Fall Meeting 2006, abstract id. HG31A-0, 2006.
5. Chen XL, Wang YJ, Wang CR, Hu DL, Sun YX, Li SS. Burns due to gunpowder explosions in fireworks factory: a 13-year retrospective study. Burns. 2002;28(3):245-9.
6. Uygur F, Oksüz S, Yüksel F. Burn disasters in shooting range areas. Forensic Sci Int. 2008;179(2-3):144-6.
7. Puri V, Mahendru S, Rana R, Deshpande M. Firework injuries: a ten-year study. J Plast Reconstr Aesthet Surg. 2009;62(9):1103-11.
8. Pallantzas A, Kourakos P, Stampolidis N, Papagianni E, Balagoura A, Stathopoulos A, et al. Burns during easter festivities in Greece. Ann Burns Fire Disasters. 2012;25(4):171-7.
9. Sahin C, Karagoz H, Sever C, Kulahci Y, Bayram Y. Burn injury caused by unexpected ignition of rifle cartridge gunpowder. J Burn Care Res. 2012;33(5):e251.
10. Navarro-Monzonis A, Benito-Ruiz J, Baena-Montilla P, Mena-Yago A, de la Cruz-Ferrer LI. Gunpowder-related burns. Burns. 1992;18(2):159-61.
11. Crovetti G, Martinelli G, Issi M, Barone M, Guizzardi M, Campanati B, et al. Platelet gel for healing cutaneous chronic wounds. Transfus Apher Sci. 2004;30(2):145-51.
12. Nguyen ATM, Chamberlain K, Holland AJA. Paediatric chemical burns: a clinical review. Eur J Pediatr. 2021;180(5):1359-69.
13. Jackson SR, Roman S. Matriderm and split skin grafting for full-thickness pediatric facial burns. J Burn Care Res. 2019;40(2):251-4.
14. Chen XL, Wang YJ, Wang CR, Li SS. Gunpowder explosion burns in fireworks factory: causes of death and management. Burns. 2002;28(7):655-8.

15. Guo ZR, Sheng CY, Diao L, Gao WY, Yang HM, Lin HY, et al. Extensive wound excision in the acute shock stage in patients with major burns. Burns. 1995;21(2):139-42.

16. Tredget EE, Levi B, Donelan MB. Biology and principles of scar management and burn reconstruction. Surg Clin North Am. 2014;94(4):793-815.