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) Original Articles

Modified moist occluded burn therapy for the treatment of cervicofacial burns due to splashing molten steel

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ABSTRACT

We present the case of a 35-year-old male foundry worker with painful burns after exposure to splashing 1500°C molten steel. This rare case involves a localized occupational-related molten steel burn on the cervicofacial region. The lesion was induced by hyperthermal contact of the skin with molten steel. This case report highlights a modified moist occluded burn therapy that is applied using a combination of modified chitin wound rehabilitating biogel (AmPoSa (®)) and sterile polyethylene film. The patient in our report achieved favourable aesthetic restoration without residual scars and hyperpigmented areas.

KEY WORDS

modified moist;molten steel;burn

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INTRODUCTION

Increased use of industrial metals augments the rate of exposure to dangerous molten metals. Despite great improvements in basic safety precautions in the metallurgic industry, foundry workers still face the threat of burn accidents^[1]. However, no case has previously been reported of hyperthermal burns of the skin caused by molten steel. We report the first ever case of this type of burn in the cervicofacial region. Debridement and covering with burn cream is the primary choice for emergency management of this type of exposure.

In 1962, Winter studied the effects of keeping the wound surface moist on the skin of young domestic pigs. He found that when the wounds were kept moist and covered with a relatively inert and impermeable film, epithelization of the denuded surfaced occurred approximately twice as rapidly as it occurred on wounds exposed to air^[2]. In 1963, Hinman reported parallel studies performed on healthy adult male

volunteers. The experimental wound was occluded with sterile polyethylene film, while the control wound was left exposed to the air. This study also indicated that re-epithelization occurred more rapidly in the occluded wound than in the air-exposed control^[3]. Based on studies by Winter and Hinman, for the first time, we have combined a modified chitin wound rehabilitating biogel (AmPoSa (®)) with a sterile polyethylene film to create a paradigm for the evolution of moist occluded burn therapy in clinical trials. Using this modified moist occluded burn therapy, the patient achieved favourable aesthetic restoration without reconstructive surgery.

CASE REPORT

A 35-year-old male patient with a molten steel burn injury on the cervicofacial region was admitted to our department for second-degree burns affecting 3% of his total body surface area, including his anterior neck and middle and lower face. A physical examination revealed ulcerations covered by brown eschar, yellow exudates, swelling and intense pain affecting his bilateral cheeks and anterior neck (Figure 1A/1B). Laboratory examinations and chest radiography did not indicate any signs of neurological, respiratory or cardiovascular abnormalities. His face was swollen and hyperpyretic, but no neurovascular involvement was present.

On day 1, the burns were cleaned and debrided using an ultrasonic debridement device after administration of a local anaesthetic (Figure 1C). Following ultrasonic debridement, the wounds were successively covered by modified chitin wound rehabilitating biogel (AmPoSa (®)) and sterile polyethylene film, which was changed every 2 days (Figure 1D). Systemic antibiotics (third generation cephalosporin) were prescribed, and the patient was closely monitored. He was advised to moisturize the area and to use sunscreen protection. The wounds were successfully healed using the modified moist occluded burn therapy. After a 54-day admission, the patient was successfully discharged home. At follow-up visit 1 year after treatment, the patient had achieved a favourable aesthetic restoration and had no wound complications, such as hyper/hypopigmentation, contracture, hypertrophy or deformity (Figure 2).



Figure 1 (A/B) The wound exhibited brown eschar, yellow exudates, swelling and intense pain affecting the patient's bilateral cheeks and anterior neck. (C) Due to the presence of deep second-degree burns, the injuries to the bilateral cheeks were more serious than the injuries to the anterior neck. (D) Following debridement, the wounds were covered by modified chitin wound rehabilitating biogel (AmPoSa (®)) and sterile polyethylene film.



Figure 2 At a follow-up evaluation 1 year after MMOBT therapy, the patient had achieved a scarless and non-pigmented aesthetic restoration without reconstructive surgery.

DISCUSION

Steel is a common iron-carbon alloy consisting mainly of iron, carbon, silicon, manganese, sulphur and phosphorus. It is widely used in the field of industry and construction. Molten steel can be a potential agent of severe and unusual occupational burns. Despite improvements in safety rules and inspections in the metal industry, foundry workers still experience burn accidents. The main mechanisms of burn injuries from molten steel include direct contact of the hyperpyretic molten metal with the skin or through safety apparel. Burn injuries can be classified as minor, moderate or major according to criteria such as depth, extent of injury and age. The depth of a scald injury depends on the temperature, skin thickness and duration of contact^[4]. In this case, the patient presented to our hospital and therefore received appropriate and effective treatment promptly. If this patient had further delayed presenting, the consequences might have been more severe.

However, due to the lack of published literature regarding burn injuries, little is known about their severe consequences. Heat burns are explained by thermal damage, a chemical process that induces the production of alkaline substances and results in destructive effects on the skin.

To the best of our knowledge, this is the first case of such burn injuries published in the literature. Traditionally, two types of therapy, moist occlusive burn therapy (MOBT) and moist exposure burn therapy (MEBT) are commonly used in burn units^[4]. However, the optimal treatment remains controversial. Several studies were designed to compare the effectiveness of occlusive and exposure dressing. In 2012, Mabrouk found that moist occlusive dressing significantly improved the healing rate of partial thickness facial burns with better long-term outcomes than moist exposure dressing. Scar quality was improved in the occlusive group. The frequency of dressing changes, pain and patient discomfort were also reduced in the occlusive group^[5]. Nevertheless, in 2016, Sharifi-Yazdi found that occlusive dressing was more susceptible to microbial contamination and infections than exposure dressing. Although heavy colonization by skin and wound flora is often observed under certain types of occlusion, clinical infection is not a frequent occurrence^[6]. Based on the studies by Winter and Hinman in the 1960s, a new therapeutic concept, that sterile polyethylene film might be used as a type of moist occlusive dressing, was successively proposed.

In our study, for the first time, we have combined a modified chitin wound rehabilitating biogel (AmPoSa (®)) with a sterile polyethylene film to create a paradigm for the evolution of MOBT in clinical trials. To distinguish this method from traditional MOBT, the method that we proposed was called modified moist occlusive burn therapy (MMOBT). MMOBT not only combines the advantages of both MOBT and MEBT, but also eliminates the major disadvantages of both methods. First, compared to MOBT, sterile polyethylene film effectively avoided the avulsion of new granulation tissue and alleviated the

suffering of patients during dressing changes. Second, the transparent film allowed direct and close observation of the changes and healing of wounds. Third, compared to MEBT, the sterile polyethylene film covering could create a relatively closed and moist environment that could accelerate the speed of epithelization.

For first- and second-degree burns, healing is the primary intention and is almost scarless. However, in deep second-degree and third-degree burns, the healing process usually leads to contracture and formation of hypertrophic scars, with patients often requiring reconstructive surgery^[4]. Despite the presence of deep second-degree burns, the patient in our report achieved a scarless and non-pigmented aesthetic restoration without reconstructive surgery.

CONCLUSIONS

This case report confirmed that MMOBT may be a superior therapy for thermal burns. The application of sterile polyethylene film is essential for the modification of MOBT. Further related studies are required to further confirm the superiority of MMOBT.

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