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CLINICAL CASE REPORT: APPLICATION OF A COMBINATION OF ADVANCED TECHNIQUES IN MANAGEMENT OF A SOLDIER WITH SEVERE ORDNANCE BURNS AND CONCOMITANT INHALATION INJURY

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ABSTRACT

Introduction: *The combination of extensive burns, inhalation injury and polytrauma represents one of the greatest challenges in emergency and disaster medicine, associated with high mortality rates due to complications such as shock, acute respiratory distress syndrome (ARDS), multiple organ dysfunction and sepsis. We report a clinical case of the successful resuscitation and management of a soldier who sustained 80% total body surface area (TBSA) ordnance burns (including 50% full-thickness burns), complicated by severe inhalation injury and complex polytrauma.*

Case Presentation: *A 21-year-old male soldier sustained burns and polytrauma from an ordnance-related incident. Following initial resuscitation and aeromedical evacuation to the Le Huu Trac National Burns Hospital, an aggressive, multimodal treatment strategy was implemented. Within the first 48 hours, the patient underwent extensive surgical excision of the burn eschar over 50% of his TBSA. In the subsequent course of treatment, due to unsalvageable crush injuries, the patient required amputation of the distal third of the right lower leg and the distal third of the right arm for source control of infection. Advanced techniques were applied synchronously, including treatment of the inhalation injury with nebulized Heparin and N-Acetylcysteine, invasive hemodynamic monitoring with the PiCCO system, Negative Pressure Wound Therapy (NPWT) and wound coverage using autologous skin grafts combined with a non-cultured autologous cell suspension. After 3 months of treatment and 6 surgical procedures, the patient achieved complete wound coverage. He survived the critical phase, successfully avoiding common high-mortality complications such as acute renal failure, sepsis, multiple organ dysfunction and ARDS and was subsequently transferred to the rehabilitation phase.*

Conclusion: *The coordinated chain of care-from pre-hospital stabilization for airlift to the synchronized application of advanced technologies at a specialized center-was critical for the patient's survival through the critical phase. This case underscores the decisive role of an aggressive, proactive and technology-driven treatment strategy in improving outcomes for patients with catastrophic burn injuries.*

Keywords: *ordnance burn, extensive burn, inhalation injury, early excision, negative pressure wound therapy, autologous cell suspension.*

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1. INTRODUCTION

Extensive burns, particularly those exceeding 50% TBSA, induce a systemic inflammatory response and metabolic derangements, often leading to multiple organ dysfunction and death [1]. The mortality rate increases significantly with concomitant inhalation injury [2]. This condition is further complicated by concurrent polytrauma, especially crush injuries from ordnance mechanisms, which elevate the risk of infection, coagulopathy and compartment syndromes. The management of these patients demands an aggressive approach that integrates multiple advanced techniques in resuscitation, surgery and critical care. This report presents a clinical case of the successful treatment of a soldier who sustained 80% TBSA ordnance burns, with 50% TBSA being full-thickness, accompanied by inhalation injury and polytrauma.

2. CASE PRESENTATION

A 21-year-old male soldier with no prior medical history sustained burns from an ordnance incident at a training ground. Following the accident, the patient received initial emergency care and was transferred to Military Hospital 87. Upon directive, a mobile emergency response team from the Lê Hữu Trác National Burns Hospital was dispatched via air to support initial resuscitation and treatment at the local facility.

Upon assessment, the patient exhibited signs of shock, compartment syndrome due to circumferential burn eschar on the extremities and risk of acute respiratory failure. Urgent interventions were performed on-site, including escharotomies to release constriction on the limbs, a tracheostomy for airway control and aggressive shock resuscitation [3]. After achieving temporary hemodynamic stability, the patient was aeromedically evacuated to the Intensive Care Unit at the Lê Hữu Trác National Burns Hospital.

Figure 1. At the Lê Hữu Trác National Burns Hospital, an aggressive and multifaceted treatment strategy was implemented

Respiratory and hemodynamic management: A protocol for inhalation injury was initiated immediately, featuring protective mechanical ventilation and nebulization via a vibrating mesh nebulizer with Heparin (5000 IU every 4 hours) and

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N-Acetylcysteine (600 mg every 4 hours) [4]. The PiCCO system for invasive hemodynamic monitoring was employed from the outset to guide fluid adjustment, control and balance throughout the treatment course, from the burn shock phase to the post-shock period [5].

Surgical management: Within 48 hours of the incident, a major surgical procedure involving four surgical teams was performed to conduct a total excision of the burn eschar covering 50% of the patient's TBSA [6]. The resulting wound bed was temporarily covered with allografts provided by the Tissue and Cell Bank of the Lê Hữu Trác National Burns Hospital. During subsequent treatment, clinical evaluation revealed complex and unsalvageable crush injuries from the ordnance in the distal third of the right arm and the distal third of the right thigh. Vascular, neural and muscular structures were completely destroyed, with progressive necrosis. To radically eliminate the source of infection, control toxin release and save the patient's life, amputation of the distal third of the right arm and the distal third of the right thigh was performed at a later stage when the patient was more hemodynamically stable.

Wound coverage: Negative Pressure Wound Therapy (NPWT) was applied continuously throughout the treatment. Initially, it was used to prepare the wound bed post-debridement, helping to reduce edema and promote granulation tissue formation [7]. In later stages, NPWT was used to secure and protect skin grafts. Due to the limited availability of autologous skin, widely meshed split-thickness autografts were combined with a spray of non-cultured autologous cell suspension to maximize coverage area and accelerate re-epithelialization [8].

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Supportive care: Early enteral nutrition was initiated, supplemented with parenteral nutrition to meet the high energy demands of hypermetabolism [9]. A comprehensive rehabilitation program, including respiratory and physical therapy, was conducted concurrently from the very first days.

After 3 months of treatment and 6 surgical procedures, complete coverage of the burn wounds was successfully achieved. The patient did not experience the life-threatening complications commonly seen in severe burn patients, such as acute renal failure, sepsis, multiple organ dysfunction, or ARDS. He was subsequently transferred to the Rehabilitation Department to continue treatment for post-burn sequelae.

3. DISCUSSION

The successful outcome in this case was attributable to a series of well-coordinated and timely interventions. Stabilizing the patient at the referring hospital, which included performing a tracheostomy and decompressive escharotomies, was a crucial factor that ensured safety during aeromedical transport. This early intervention prevented acute life-threatening complications.

At the specialized center, the early and extensive total excision of burn eschar within 48 hours was the cornerstone of treatment. Burn eschar is a primary source of inflammatory mediators and a nidus for bacterial growth. Its early removal helps control the systemic inflammatory response, reducing the risk of sepsis and multiple organ dysfunction [6].

The use of supportive technologies played a significant role. Hemodynamic monitoring with PiCCO enabled individualized fluid resuscitation, avoiding complications from both over- and under-resuscitation [5]. For the inhalation injury, a protocol of protective mechanical ventilation combined with nebulized Heparin and N-Acetylcysteine was applied to target the mechanism of fibrin and mucus plug formation in the airways [4].

The greatest post-surgical challenge was covering a vast skin defect with limited autologous donor sites. Negative Pressure Wound Therapy proved effective in preparing an optimal wound bed by enhancing perfusion and reducing edema, thereby improving graft take [7]. The combination of widely meshed autografts with an autologous cell suspension allowed for an "amplification" of the coverage area from a small donor skin sample,

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accelerating re-epithelialization and wound closure [8].

The decision to delay limb amputations until after the patient had passed the shock phase was a strategic move, reflecting careful consideration of radicality versus the patient's physiological tolerance. Performing a major eschar excision concurrently with two major limb amputations during the shock phase could have pushed the patient into a state of more severe physiological decompensation and increased the risk of mortality. Staged surgery allowed the patient to stabilize and also enabled a more accurate assessment of the non-viable limb tissue, leading to a correct and safer indication for amputation.

Finally, supportive measures such as early nutrition and aggressive rehabilitation were indispensable. Early enteral feeding helps combat catabolism and cachexia. Early rehabilitation helps prevent complications of prolonged immobility, such as muscle atrophy and joint contractures and improves long-term functional outcomes.

4. CONCLUSION

The successful management of a patient with 80% TBSA ordnance burns and severe inhalation injury, achieved in a short timeframe and without complications during treatment, is the result of a comprehensive, precisely and timely executed treatment strategy. This outcome demonstrates the importance of a coordinated continuum of care, from effective pre-hospital management and early, extensive eschar excision with advanced resuscitation, to the application of high-tech solutions in critical care, wound coverage, nutrition and early rehabilitation. This integrated approach is key to changing the prognosis for patients with the most severe burn injuries.

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