Reducing Bacterial Infectious Complications from Burn Wounds

A look at the use of Oculus Microcyn60 to treat wounds in Mexico

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Burns are a major problem associated with high morbidity in Mexico. In 2003, 20,330 burn cases were reported, mostly in children.[1] Despite improvements in multidisciplinary treatment, infection remains the leading cause of death among patients who are hospitalized.

Burn wound infections account for 3–7% of all infections in patients with burns in the United States.[2] These occur most frequently in children, followed by elderly patients. The incidence of burn infection can reach >10% for a rate of 5.6/1,000 patient-days in certain specialized burn units in the United States.[3] However, these rates are much higher in other countries, such as Mexico, because of overcrowded facilities, fewer infection control barriers, and less access to immediate wound debridement or antimicrobial therapies (compared to the United States).

Burn Etiology and Other Facts

The risk of burn wound infection is directly correlated to the extent of the burn and is related to impaired resistance resulting from disruption of the skin's mechanical integrity and generalized immune suppression. Infections in burn wounds may be classified as wound cellulitis (ie, unburned skin at the margin of the burn) or as an invasive wound infection (ie, microbial invasion of viable tissue beneath the burn wound eschar). Bacterial burn wound infections are most commonly caused by *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Enterobacter cloacae*, *Klebsiella pneumoniae*, *Enterococcus faecalis*, and *Acinetobacter baumannii*.

Advances in local burn therapies, including the judicious use of antimicrobials, undoubtedly have reduced bacterial infectious complications from burns. Unfortunately, the number of opportunistic infections in burn wounds has risen significantly. Thus, infections with antibiotic-resistant bacteria (eg, methicillin-resistant *S. aureus*) and fungal pathogens (eg, *Aspergillus*, *Candida*, and *Mucor* species) have been steadily increasing in recent years. These kinds of infections are mostly seen in patients sustaining larger burns (>40% total body surface area [TBSA]) who receive multiple doses of broad-spectrum perioperative antibiotics.

Overall, mortality rates from burn wound sepsis remain high. However, independent of the thickness of the wound, the presence of infection could also severely retard the wound healing process, increase the rates of graft loss, deteriorate the cosmetic results, and elevate hospital expenses.[4,5] Therefore, the management of the wound should focus on avoiding infection and preventing the progression of the injury from day 1.

Management of Burns

The management of severe burn wounds is multidisciplinary. Permeable airways, volume repletion, and early removal of necrotic tissue followed by wound closure are the key goals. Effective topical antimicrobial therapy and daily wound inspection are necessary to monitor for infection, which may cause conversion of partial-thickness burns to full-thickness injuries.

It is remarkable that the anti-infective topical treatment of wounds has not significantly changed in the past 50 years. The standard care may vary among institutions, but it usually starts with cleansing of the wounds with saline solution and a surgical detergent (eg, chlorhexidine gluconate), followed by the application of silver sulfadiazine or mafenide acetate burn creams. (Dakin's solution and betadine are alternative agents already in disuse.) Burns are then treated while either open or closed. With the use of this approach, the infection rates were kept in the range of 3–7% in patients treated in the United

States, but the infections rates are higher in poorer countries.[2]

The major drawbacks of all antiseptics, however, have been the narrow antimicrobial spectrum and their known cytotoxicity to the burn area, skin grafts, and dermal substitutes. The opaque quality of betadine precludes the early detection of underlying infection in the wound bed. Silver sulfadiazine and cadexomer iodine require long exposure times to kill a wide range of bacteria and viruses. Additionally, these solutions cannot be used on certain parts of the body, such as around the eyes, and patients sometimes have negative reactions to these products due to their toxicity. Furthermore, silver-based products require exact dosage and close monitoring by trained medical staff to minimize the potential for mutations and bacterial resistance. Several other topical antibiotics and silver-containing dressings have also been used, but they are expensive and not widely available in poorer countries. The emergence of multi-drug-resistant bacteria and fungal infections is yet another important problem to consider if the topical antimicrobial fails.

As an alternative, super-oxidized solution has been used for disinfecting burn wounds and for preventing *Pseudomonas* sepsis in a rat model.[6] The literature also describes the effectiveness of super-oxidized solutions for the treatment of infectious skin defects or ulcers in humans.[7] Late in 2003, a novel super-oxidized solution (Oculus Microcyn60™) was introduced in Mexico as a wound care product. It is a stable, pH-neutral, bactericidal, fungicidal, virucidal, and sporocidal solution.[8] It was shown that this solution was not an irritant, nor was it sensitizing, according to international standards for wound care products (Oculus Innovative Sciences; Stillmeadow, Inc., Sugar Land, Texas, 2004, unpublished data). Oculus Microcyn60 did not alter the normal healing process.[9] Clinical studies with Oculus Microcyn60 also show a favorable outcome in diabetic leg ulcers and chronic venous stasis ulcers (see Dr. Dalla Paola's study on page 14 of this supplement).[10] Because silver-based solutions have not been available in Mexico since 2004, and no side effects have been reported with Oculus Microcyn60, the latter has become the standard topical antimicrobial treatment for partial- and full-thickness burns in pediatric patients at the burn unit of Hospital Civil de Guadalajara in Mexico.

Clinical Cases

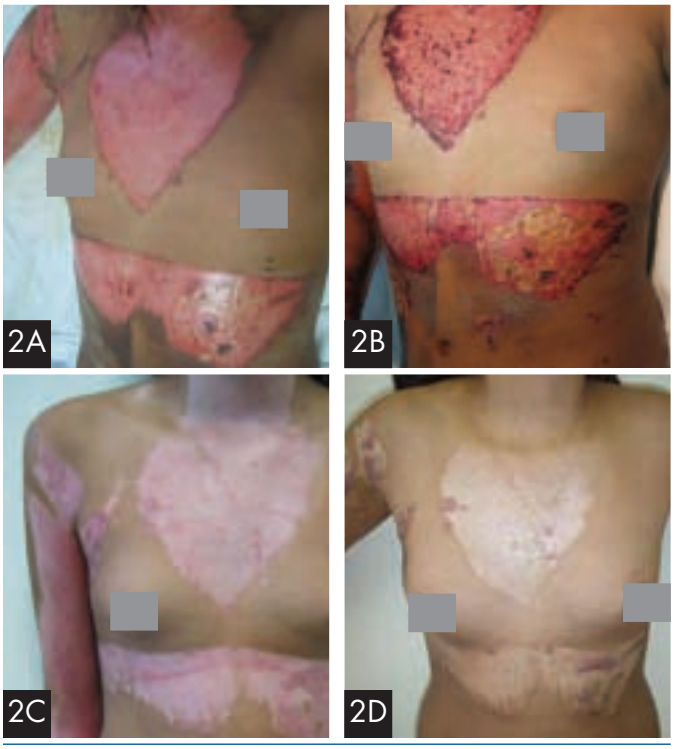
In total, 64 children admitted to the Hospital Civil de Guadalajara in Mexico from March 2004 to March 2005 with a diagnosis of superficial-partial, deep-partial, and full-thickness thermal injuries to the skin have entered the study. Retrospective analysis of paired cases presenting similar burns at that institution during 2003 was undertaken for the control group. The objective of the present study was to evaluate the use of Oculus Microcyn60 in burns by its actions in infection control, healing activity, hospital length of stay, antibiotic use, and final scar evaluation.

Figures 1A–1D. A 2-year-old girl with partial-thickness burns.

In all cases, surgical and/or high-pressure debridement with the JetOx™ system (De Royal, Powell, Tenn.) was conducted under general anesthesia at entry. Partial-thickness burns were left open without gels or dressings. Full-thickness burns with abundant exudate were debrided and covered with dressings. Skin grafts were also used as necessary. Samples for microbial cultures were taken before the excision and at different points in the first 2 weeks. After the initial debridement, the burn wounds were moistened with Oculus Microcyn60 3 times each day using a spray trigger. The final results of this clinical evaluation are now under review for publication. Following are details from 2 of the 64 cases.

Case 1

A 2-year-old girl presented with 33% TBSA partial-thickness burns after exposure to boiling water (Figure 1A). She underwent debridement with the JetOx system and, as in the rest of the cases, the lesion was moistened with Oculus Microcyn60 3 times each day using a spray trigger. The children tolerated the daily cleaning of the lesion without much pain. At day 3, the typical bright red color in the burn area was present (Figure 1B). Aseptic eschars then appeared on weeks 1 and 2 and were not removed (Figure 1C). Re-epithelization of the wounds usually occurred in weeks 3–4 (Figure 1D). At follow up, the characteristics of the new skin were similar to the spared skin, albeit a different color.



Figures 2A–2D. A 12-year-old girl with partial- and full-thickness burns.

Case 2

A 12-year-old girl presented with 43.5% TBSA partial- and full-thickness burns after her clothes were ignited with electrical discharge (Figure 2A). Granulation tissue with aseptic scar formation appeared in all lesions at day 5 (Figure 2B). On day 21, there was complete epithelization in the neck, axilla (Figure 2C), and leg without deforming scars or the use of skin grafts in the leg. Note the excellent cosmetic results after 1 year of treatment (Figure 2D).

Comments and Perspectives

Currently, wide variation exists in the topical treatment for burn patients. The goal remains to identify the most cost-effective measures to prevent outbreaks of infection involving other patients in the unit.

Sulfadiazine is the most commonly used topical anti-infective on burn patients worldwide because it is useful in prevention of infections from second- or third-degree burns. It has bactericidal activity against many Gram-positive and Gram-negative bacteria and a mild antifungal activity. Unfortunately, it is not available in Mexico.

As predicted from previous animal and clinical experience, the use of Oculus Microcyn60 was efficient and safe for the prevention of partial- and full-thickness burn infections in pediatric patients. Treatment with Oculus Microcyn60 reduced the microbial load in 90% of patients with partial- and full-thickness thermal injuries. Children also reported less pain during cleaning procedures. Application was easy and inexpensive. In addition, the length of hospital stay of patients treated with Oculus Microcyn60 was reduced by 50% relative to the control. Considering that the daily hospital cost at this facility is approximately $1,800 US per patient, treatment with Oculus Microcyn60 saved the institution an average of $24,660 US per patient. The results of this study also suggest that burns treated with Oculus Microcyn60 heal with better cosmetic results and less chelation relative to the previous standard burn treatment. Although these results are encouraging, they must be properly evaluated in prospective multicenter clinical trials. Integral to the evaluation of Oculus Microcyn60 must be the impact that its use has on existing infection rates and infectious complications, patient outcomes, costs, and patient satisfaction. Yet, it is encouraging to know that water, even in this advanced form, remains the best method of cleaning a wound. ■

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