Management of burn wounds by a technology lipido-colloid polyacrylate dressing impregnated with silver: a case series from Vietnam

Authors:
Truong Thi Anh Nguyet, Vo Thi Tam Trang, Dang Thi Cam Van, Do Manh Hieu and Emilio Galea

Burn injuries are a mostly avoidable trauma that affect millions of people worldwide every year. Wound healing in burn patients is complex, and infection is one of the main clinical complications associated with wound care in burn patients. Biofilms are mostly associated with chronic wounds, but have also been identified in acute, traumatic wounds. This article shows an evaluation of a TLC-polyacrylate fibre dressing impregnated with silver to manage burn wounds of different severities, in nine patients of different ages from Vietnam. The outcomes show encouraging results in the management of burns when considering healing properties, and also management of infection, desloughing and wound healing outcomes.

***Truong Thi Anh Nguyet** is Registered Nurse, Orthopaedics, Khanh Hoa General Hospital, Nha Trang, Vietnam; **Vo Thi Tam Trang** is Registered Nurse, Orthopaedics Department, Binh Dinh General Hospital, Quy Nhon, Vietnam; **Dang Thi Cam Van** is Registered Nurse, Orthopaedics Department, Khanh Hoa General Hospital, Nha Trang, Vietnam; **Do Manh Hieu** is Doctor of Medicine, 175 Military Hospital, Ho Chi Minh city, Vietnam; **Emilio Galea** is International Medical Director for Australasia, Middle East, and South Africa, Urgo Education and Training Alliance, Singapore.*

Burns are one of the most common causes of morbidity and mortality worldwide, with non-fatal burns being a leading cause of morbidity, including prolonged hospitalization, disfigurement, and disability, often with resulting stigma and rejection (Kartal et al, 2018; World Health Organization [WHO], 2018; Jeschke et al, 2020).

The WHO (2018) states that about 11 million burn cases occur annually worldwide, with burn injuries claiming as many as 180,000 lives, and almost two-thirds occurring in Africa and South-East Asia. The incidence of burn injuries requiring medical care is nearly 20 times higher in the WHO Western Pacific Region (which includes Vietnam) than in the WHO Americas Region (WHO, 2018).

A burn injury is considered to be damage to skin tissue caused by heat, such as scald, flash, flame and contact, as well as exposure to cold, electrical, chemical, radiation, sunlight, or other sources (Kartal et al, 2018). Thermal injury caused by hot liquids, solids or fire makes up most of burn injuries (American Burn Association, 2019).

The amount of tissue damage caused can be burn related (aetiology, temperature and duration of exposure) and/or patient related (skin thickness, age, health status and whether or not first aid was given; McCann et al, 2022).

Infection is one of the main complications associated with wound care, particularly in burn patients (Maslova et al, 2021), where infection still accounts for approximately 75% of all deaths in burn injuries globally (Al-Aali, 2016).

The burn trauma not only affects the first line of defence that the skin offers, but also contributes to the suppression of the immune system, whereas the protein-rich eschar produced offers an ideal environment for microorganisms to proliferate (Valarmathi et al, 2013; Hasan et al, 2016; Dahag et al, 2018).

Furthermore, the avascular zone of coagulation reduces immunological defences, and the subsequent inflammation impairs wound healing due to the release of proteases from macrophages (Pujji et al, 2019). The burn wound itself is a multifarious microenvironment dominated with biological fluids (burn wound exudate). The metabolic and cellular profile of the burn wound exudate creates an optimal environment for pathogens with a high metabolic versatility to proliferate successfully (Gonzalez et al, 2018). Other factors include the type and number, enzyme and/or toxin production and motility of organisms; and superficial bacterial contamination may rapidly lead to invasive infection in these patients (Saaiq et al, 2015).

Burn wound infection predisposes the delay of epidermal maturation and the development of pathologic scars. It also leads to the invasion

of microorganisms into the tissue layers, conditioning bacteraemia, sepsis, and multiple-organ dysfunction (Church et al, 2006).

Biofilms are mostly associated with chronic wounds; however, biofilms have also been identified in acute wounds, albeit at a relatively low frequency (Maslova et al, 2021). Biofilms are complex microbial communities containing bacteria and fungi, where the microorganisms synthesise and secrete a protective matrix that attaches the biofilm firmly to the wound bed (Philips et al, 2010).

Biofilms stimulate a chronic inflammatory response to remove the microbial colony, resulting in abundant neutrophils and macrophages surrounding biofilms. In turn, these inflammatory cells secrete high levels of reactive oxygen species and high levels of matrix metalloproteinases that damage healing tissues, proteins, and immune cells (Philips et al, 2010). *In vivo* evidence indicates that biofilms can form in acute wound models from as early as 3 days post-trauma. *In vivo* experiments in rodents also showed that biofilm formation at the burn eschar can precede systemic infection (Brandenburg et al, 2019; 2021).

Wound dressing evaluation

The dressing evaluated in the following burn cases is composed of cohesive poly-absorbent fibres impregnated with a silver lipido-colloid healing matrix. The technology lipido-colloid with silver ions (TLC-Ag) is supported by high-quality clinical evidence in the management of wounds at risk or with clinical signs of local infection (Dissemond et al, 2020).

The superior efficacy of TLC-Ag (compared with dressings without silver) in managing the wound bioburden and promoting wound healing has been demonstrated in a randomised controlled trial of people with chronic leg ulcers (Lazareth et al, 2008; 2012).

The poly-absorbent fibres support the absorption of wound exudate as well as the trapping of sloughy residue (Meaume et al, 2012; Sigal et al, 2019). Moreover, the desloughing properties of the poly-absorbent fibres have been demonstrated to be superior to a hydrofibre dressing in a European randomised controlled trial involving 159 patients (Meaume et al, 2014). After 6 weeks of treatment, a significantly higher reduction of slough was reported in the cohort of patients treated with the poly-absorbent fibre dressing compared with the cohort of patients treated with hydrofibre.

In another prospective open-label clinical trial, involving 37 patients with chronic leg ulcers, reductions of all clinical signs of local infection were reported and wound healing progression was evident, with decreases in wound surface area and an improvement of the peri-wound skin in addition to a substantial reduction in slough, and increased granulation tissue after 4 weeks of treatment (Dalac et al, 2016).

The efficacy in regard to biofilms has been demonstrated by in vitro investigations that established a synergic action of the TLC-Ag matrix and the poly-absorbent fibres against methicillin-resistant *Staphylococcus aureus* (MRSA) and *Pseudomonas aeruginosa* biofilms (Desroche et al, 2016; Desroche et al, 2017).

A real-life multicentre, observational study of 2,270 patients with acute and chronic wounds of various aetiologies, was conducted in 81 centres in Germany (Dissemond et al, 2020). The patients presented with exuding wounds at risk of infection or with clinical signs of local infection, were treated with the evaluated cohesive poly-absorbent fibres impregnated with a silver lipido-colloid healing matrix for a mean duration of 22 ± 13 days. All clinical signs of local infection and the diagnosed wound infections were substantially reduced at 2 weeks after treatment initiation, and all wound infection parameters continued to reduce until the last visit. Clinical improvement in wound healing was reported in 98.9% of acute wounds, with a wound closure rate of 68.5%. The authors stated that the evaluated dressing promoted the wound healing process, with a substantial wound healing rate in acute wounds, which is of most interest in relation to the evaluations conducted in the following cases. A total of 134 patients included in this German study were burn patients.

Although encouraging results were reported in these European trials, the authors wanted to evaluate the outcomes of the same dressing in patients in Vietnam. Social factors, alteration in expression of different genes and changes in the local cutaneous environment may impair wound healing. It is a reality that social and climate differences may be relevant to outcomes in wound healing (Fayne et al, 2020) and varying temperature and relative humidity may influence on certain key aspects of dressing performance (Thomas, 2012).

Patients were recruited from different hospitals to evaluate the efficacy of the dressing in the management of burn patients in Vietnam.

Case 1

A 31-year-old man presented with a burn over the dorsum of his left arm, caused by gasoline.

Figure 1. On presentation (a); day 3, after three dressing changes (b); day 9, after three further dressing changes (c).

Figure 2. On presentation (a); day 3, after 3 dressing changes (b); day 6, after five dressing changes (c); day 9, after seven dressing changes (d).

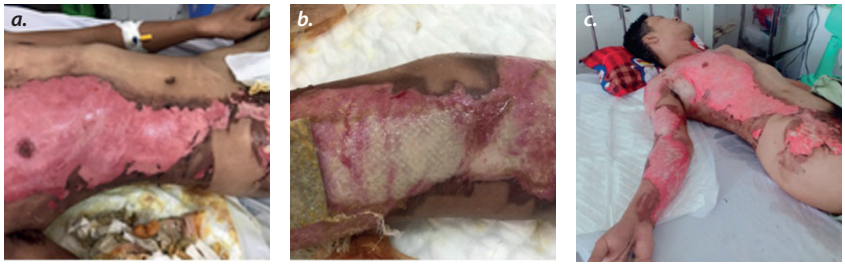

Figure 3. On presentation (a); day 4, after two dressing changes (b); and day 6, after three dressing changes.

The burn extended above the wrist, with high levels of exudate (*Figure 1a*).

The clinician dressed the wound with the TLC-polyacrylate fibre dressing with silver to clear the wound of any debris, prevent infection and enhance epithelialisation. An absorbent secondary dressing was put in place and held *in situ* with a bandage. Normal saline was used to flush the wound. The dressing was changed every day. After 3 days, the swelling and exudate levels had decreased (*Figure 1b*). The same dressing regime was applied, but the dressing was changed on alternate days due to the decrease in exudate levels. After a further three dressing changes (9 days post injury), the wound had improved considerably with signs of epithelialisation (*Figure 1c*).

The application of the dressing under evaluation facilitated healing and not only provided for exudate absorption but also to the considerable reduction of exudate product in a relatively short period.

Case 2

A 28-year-old man presented with a burn over his back and left arm, caused by gasoline (*Figure 2a*).

A TLC-polyacrylate fibre dressing with silver was applied to clear the wound of any debris, prevent infection and enhance epithelialisation. The wound was flushed with normal saline and a secondary absorbing dressing was applied. The dressing was changed daily for three days. By the third day, the wound showed substantial improvement (*Figure 2b*). The same dressing regime was continued, with dressing changes on alternate days. By the day 6 (5 dressing changes) the wound continued to improve (*Figure 2c*). The wound had healed by day 9 after seven dressing changes (*Figure 2d*).

Although the level of exudate was not high in this wound, the dressing under evaluation was used to examine the results in a larger wound.

Case 3

A 33-year-old man presented with extensive electrical burns extending from his left arm to mid-torso and upper thigh (*Figure 3a*).

TLC-polyacrylate fibre dressing with silver was applied to clear the wound of any debris, prevent infection, and enhance epithelialisation. The wound was flushed with normal saline and a secondary absorbing dressing was applied. The dressing was changed on alternate days. By day 4 (two dressing changes), the wound was showing signs of improvement (*Figure 3b*). The same dressing regime was continued and by day 6, after another dressing change, the wound was showing significant improvement with clear signs of epithelialisation (*Figure 3c*).

Again, in the management of this patient, the wound was quite extensive, and the progress seen within only 6 days was quite noteworthy.

Case 4

A 36-year-old man was referred after sustaining an electrical burn on his abdomen. The wound was mostly covered in slough (*Figure 4a*).

TLC-polyacrylate fibre dressing with silver was applied to clear the wound of any debris and

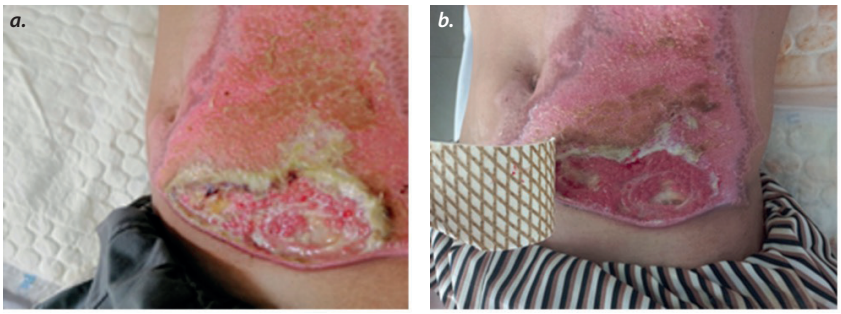

Figure 4. On presentation (a) and after three dressing changes (b).

Figure 5. On presentation (a); after one dressing change (b); and after two dressing changes (c)

Figure 6. On presentation (a); after one dressing change (b); and after three dressing changes (c)

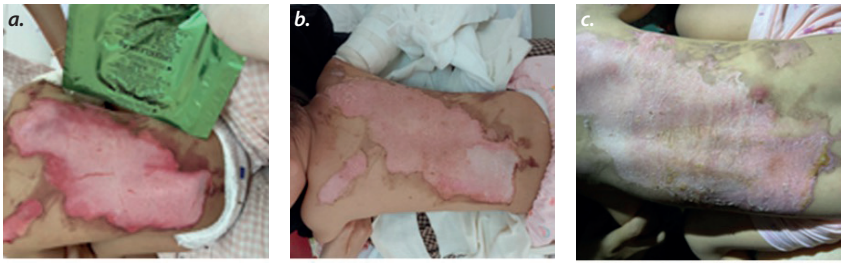

Figure 7. On presentation (a); after two dressing changes (b); and on day 13, after six dressing changes.

reduce slough, prevent infection, and enhance granulation. The wound was flushed with normal saline and a secondary absorbent dressing was applied. The dressing was changed on alternate days. After three dressing changes (6 days), the progress of the wound was substantial, with slough completely eliminated, with clear signs of healthy granulation (*Figure 4b*).

The main challenge of this wound was the sloughy tissue. The clinician opted to use the dressing for desloughing rather than surgical debridement, with elimination of slough within 6 days.

Case 5

A 42-year-old man was referred after sustaining a burn injury to the lower part of his left arm. The wound was mostly covered in slough (*Figure 5a*).

TLC-polyacrylate fibre dressing with silver was applied to clear the wound of any debris and reduce slough, prevent infection, and enhance granulation. The wound was flushed with normal saline and a secondary absorbing dressing was applied. Dressing was changed alternate days. After only one dressing change, the slough was almost completely removed and healthy granulation tissue was present (*Figure 5b*). After a further dressing change, the patient was able to be referred for grafting (*Figure 5c*).

This wound also presented with extensive coverage of sloughy tissue, which was removed by the dressing applications, allowing the patient to be referred for skin grafting.

Case 6

A 3-year-old child was referred with a scald burn on his chest, abdomen, and left arm (*Figure 6a*).

TLC-polyacrylate fibre dressing with silver was applied to clear the wound of any debris, prevent infection, and enhance epithelialisation. The wound was flushed with normal saline and a secondary absorbing dressing was applied. The dressing was changed on alternate days. After one dressing change the wound was already showing signs of improvement (*Figure 6b*) and after a further three dressing changes, the wound was completely healed (*Figure 6c*).

The challenge regarding this wound was the patient's young age, but the dressing fared well, with healing achieved after only three dressing changes.

Case 7

A 3-year-old girl presented with a second degree scald burn over her back (*Figure 7a*).

TLC-polyacrylate fibre dressing with silver was applied to clear the wound of any debris, prevent infection, and enhance epithelialisation. The wound was flushed with normal saline and a secondary absorbing dressing was applied. The dressing was changed on alternate days. The wound was already showing signs of healing after two dressing changes (*Figure 7b*). It was completely healed by day 13 post referral (*Figure 7c*).

The dressing again provided good results in this paediatric patient.

Case 8

A 6-year-old boy was referred after a scald burn to his thigh and scrotum (*Figure 8a*).

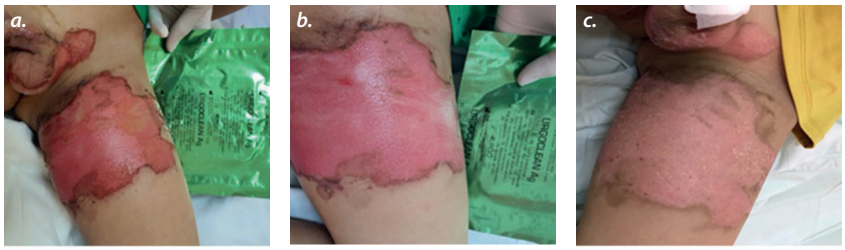

Figure 8. On presentation (a); after one dressing change (b) and after three dressing changes (c)

Figure 9. On presentation (a); after one dressing change (b) and after three dressing changes (c)

TLC-polyacrylate fibre dressing with silver was applied to clear the wound of any debris, prevent infection, and enhance epithelialisation. The wound was flushed with normal saline and a secondary absorbing dressing was applied. The dressing was changed on alternate days. After one dressing change, the wound was showing significant improvement (*Figure 8b*). It was completely healed after three dressing changes (*Figure 8c*).

The dressing provided good results in another paediatric patient, in a very sensitive area.

Case 9

A 46-year-old man was referred with a third degree burn around the inner malleolar region (*Figure 9a*).

TLC-polyacrylate fibre dressing with silver was applied to clear the wound of any debris, prevent infection, and enhance epithelialisation. The wound was flushed with normal saline and a secondary absorbing dressing was applied. The dressing was changed on alternate days. After one dressing change, slough was considerably decreased, and granulation tissue was evident (*Figure 9b*). After another two dressing changes, slough was eliminated, with healthy granulating tissue covering all the wound area (*Figure 9c*). The patient was then referred for skin grafting.

In this wound, the fast elimination of sloughy tissue was key for early referral for closure of the wound with a skin graft.

Conclusion

Burns are one of the most devastating of all injuries, having a great impact on the patients physically, physiologically, and psychologically and are still a noteworthy cause of death and disability in the world (Lee et al, 2014).

A balanced moist wound healing environment has associated with improved healing and reduced pain, while also providing promotion of autolytic debridement of slough and supports migration of epithelial cell (Edwards 2013). The dressing chosen by the clinician in the management of burns should have several properties, including a balanced moist environment, but also providing protection from infection (Hermans, 2019).

In this article, the authors have shared the results obtained in burn wound management by utilising a TLC polyacrylate dressing with silver as the primary contact with the wound bed. The evidence behind the dressing is of high quality and the results achieved in other real-life studies in Europe have similar outcomes to those that were achieved in Vietnam. WINT

Conflict of interest

Emilio Galea is employed by Urgo Medical as the International Medical Director for Australasia, Middle East, and South Africa. The Technology Lipido-colloid polyacrylate dressing with silver discussed in this review is a patented dressing (Laboratoires Urgo, France). All other authors have no conflicts of interest.

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