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Case Report

Atypical usage of chlorhexidine and saline stored split-thickness skin grafts in a case of infected burn wounds

Phong Jhiew Khoo[1,2], *Salmi Mohamed Sukur*[3], *Siew Cheng Chai*[3]

[1] *Plastic and Reconstructive Surgery Unit, Department of Surgery, Hospital Canselor Tuanku Muhriz, Universiti Kebangsaan Malaysia, Malaysia*
[2] *Reconstructive Sciences Unit, School of Medical Sciences, Health Campus, Universiti Sains Malaysia, Malaysia*
[3] *Department of Plastic and Reconstructive Surgery, Hospital Kuala Lumpur, Malaysia*

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ABSTRACT

Introduction: Management of infected burn wounds should include clinical diagnosis, pathogen identification, wound care, surgical debridement, and targeted antibiotic therapy.

Aim: This article highlights the usage of an atypically stored split-thickness skin graft (STSG) in infected burn wounds and affirm that burn wound closure with STSG application is the standard of care.

Case study: We present a case of infected burn wounds in an elderly patient. Intraoperatively, her condition deteriorated and surgery had to be terminated abruptly. We were unable to apply the harvested STSGs. The meshed STSGs were refrigerated at 4°C after being wrapped in chlorhexidine-impregnated paraffin gauze and saline-moisturized gauze. On day 4 of storage, the STSGs were applied to *Pseudomonas aeruginosa* infected wounds, post-debridement. Graft take was 100% during subsequent review.

Results and discussion: If the wounds are debrided thoroughly and targeted antibiotic administered, STSG application on infected burn wounds might not be absolutely contraindicated. When appropriately stored, time sensitive STSGs can still be used to achieve wound closure.

Conclusions: A simple storage method of STSGs using chlorhexidine and saline warrants further research.

Corresponding author: Phong Jhiew Khoo, Plastic and Reconstructive Surgery Unit, Department of Surgery, Hospital Canselor Tuanku Muhriz, Universiti Kebangsaan Malaysia, Jalan Yaacob Latif, Bandar Tun Razak, 56000 Cheras, Kuala Lumpur, Malaysia.
E-mail address: cool87jason@yahoo.com

1. INTRODUCTION

The end point of infected burn wound management is wound closure as soon as attainable through skin autografting.[1–3] Several authors do not recommend grafting on infected wounds as it could increase the likelihood of graft loss.[4–7] However, it has been proven that skin grafts have antibacterial properties.[8] Reduction of keratinocyte viability in skin grafts might hamper graft take, especially in stored skin grafts.[9,10] Various methods of skin graft storage are described including electrolyte solutions and cell culture media.[9,10] We present a case in which successful closure of infected burn wounds was achieved with skin grafts stored in chlorhexidine and saline.

2. AIM

This article highlights the usage of an atypically stored split-thickness skin graft (STSG) in infected burn wounds and affirm that burn wound closure with STSG application is the standard of care.

3. CASE STUDY

We present the case of a 64-year-old female with infected burn wounds. She sustained partial and full thickness flame burns on her lower limbs (Figure 1) when a liquid petroleum gas tank exploded while she was cooking. She was brought to us immediately and appropriate resuscitation was performed. Her wounds were cleaned daily with chlorhexidine solution and dressed using sterile gauze.

Figure 1. Lower limb burn wounds, post wound cleansing, on the day of injury.

Figure 2. Well demarcated lower limb burn wounds without clinical signs of infection on day 5 following injury.

Figure 3. *Pseudomonas aeruginosa* infected lower limb burn wounds with discoloration of eschar on day 14 following injury.

Five days post-burn, the patient underwent tangential excision of the well demarcated burn wounds (Figure 2). However, post-operatively, she was diagnosed with hospital-acquired pneumonia and parenteral antibiotic treatment was initiated. Due to poor lung function, the patient was kept mechanically ventilated.

Twelve days post-burn, she was scheduled for wound debridement and immediate coverage with STSGs. Intra-operatively, she experienced persistent hypotension, hypothermia, and hypoxia. Her surgery had to be terminated prematurely and we were unable to apply the harvested

Figure 4. *Pseudomonas aeruginosa* infected lower limb burn wounds with discoloration of eschar on day 16 following injury, prior to wound debridement and stored STSG application.

Figure 5. Lower limb burn wounds on day 13 post STSG application without any sign of graft loss.

grafts onto the debrided wounds. The meshed STSGs were refrigerated at 4°C after being wrapped in 0.5%-chlorhexidine-impregnated paraffin gauze and saline-moisturized gauze. Post-surgery, her wounds became infected with *P. aeruginosa*, confirmed by tissue culture (Figure 3). Suitable antibiotic therapy was started, based on sensitivity.

Sixteen days post-burn, taking into account the viability of the stored STSGs, we proceeded with wound debridement and immediate wound coverage using the stored STSGs. Clinically, her infected wounds were debrided thoroughly and the stored STSGs were applied (Figure 4). Ultimately, the graft take was 100% despite the presence of *P. aeruginosa* in tissue culture samples taken from the wounds prior to STSG application. Subsequent examinations did not show any sign of graft loss (Figure 5).

4. DISCUSSION

The multimodality approach in treatment of infected burn wounds should include appropriate wound cleansing and dressing; tangential excision and wound debridement; antibiotic therapy; and wound closure.[1–3] According to Braza et al., an infected wound bed is an absolute contraindication to application of STSGs as it leads to subsequent graft failure.[4] Turissini et al. reported that the likelihood of STSG failure in bacteria-positive, pre-debrided wounds is about 2.89 times higher than in culture-negative wounds.[6] They also highlighted that bacteria-positive, post-debrided wounds just prior to grafting did not notably impact STSG failure.[6] They concluded that the specific pathogen strain might be the greater causative effect in STSG failure, and that further studies were indicated.[6] Høgsberg et al. and Turissini et al. identified that *P. aeruginosa*, which produces biofilm, had been isolated in tissue culture despite adequate debridement (down to clinically uninfected viable tissue) prior to grafting.[6,7] Their studies demonstrated that, in wounds infected with *P. aeruginosa*, survivability of STSGs was significantly reduced.[6,7]

In contrast, Lim et al. described that fresh skin grafts and preserved allografts have mild antibacterial properties.[8] The study demonstrated that fresh skin grafts have antibacterial effects against *Staphylococcus aureus*, and *Escherichia coli*.[8] Although their study was unable to positively establish the antimicrobial activity of fresh skin grafts against *P. aeruginosa*, human epidermis is proven to contain antimicrobial peptides such as beta-defensin which is active against gram-negative bacteria.[8] No significant correlation was established between keratinocyte viability of skin grafts and its antimicrobial activities.[8]

The reduction of keratinocyte viability in STSGs might affect graft take.[9,10] The diminishing keratinocyte viability over time is multifactorial, with factors including storage methods and temperature.[9] Meshed STSGs wrapped in saline-moisturized gauze and refrigerated at 4°C is the most common method of storage.[9,10] Other storage media described by Knapik et al. and Li et al. are Hartmann's solution, Dulbecco's Modified Eagle Medium (DMEM), Marshall's solution, and McCoy's 5A medium.[9,10] Studies have yielded varied results of keratinocyte viability in saline stored STSGs.[9,10] One study reported a 50% drop in viability after only 3 days of storage, while other studies have demonstrated preservation of viability upward of 50% after 4 weeks

of storage.[9,10] A few researchers reported only 10% cell viability after 10 days of storage and total graft loss after 5 days of storage.[9,10] Due to notable reduction in keratinocyte viability after 7 days of storage, Li et al. advocated the use of cell culture media such as DMEM over saline storage, and application of the stored STSG within 7 days of storage.[10] Chlorhexidine is proven to reduce bacterial colonization on skin grafts and does not decrease cell viability.[11] In this reported case, we applied the chlorhexidine and saline stored STSGs to debrided wounds after 4 days of storage. Wound closure was achieved without any graft loss. Our literature review did not yield any research on this method of storage.

5. CONCLUSIONS

1. Management of infected burn wounds should follow a multimodality approach with the aim of early wound closure.
2. Application of STSGs to infected burn wounds might not be an absolute contraindication if adequate wound debridement and targeted antibiotic therapy are emphasized.
3. Although cell viability in a stored STSG is not as good as in a fresh STSG, if stored appropriately and used within the specific time frame, optimal graft take should be achievable.
4. The simple STSG storage method using chlorhexidine-impregnated paraffin gauze and saline-moisturized gauze warrants further study.

Conflict of interest
None declared.

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References
1 Cambiaso-Daniel J, Gallagher JJ, Norbury WB, Finnerty CC, Herndon DN, Culnan DM. Treatment of infection in burn patients. In: Herndon DN. *Total Burn Care*. 5th Ed. London: Elsevier. 2018:93–113.

2 Gauglitz GG, Shahrokhi S, Williams FN. Burn wound infection and sepsis. In: Connor RF, ed. *UpToDate*. Wolters Kluwer. Accessed: October 10, 2023.

3 Subramaniam S, Rodzaian WS, Yussof SJ, Ibrahim S, Hayati F. Multimodal management of more than 50% mixed deep dermal and full thickness burns in a child. *Pol Ann Med*. 2023;30(2):144–148. https://doi.org/10.29089/paom/162611.

4 Braza ME, Fahrenkopf MP. Split-thickness skin grafts. In: StatPearls. Treasure Island, FL: StatPearls. 2022

5 Gacto-Sanchez P. Surgical treatment and management of the severely burn patient: Review and update. *Med Intensiva*. 2017;41(6):356–364. https://doi.org/10.1016/j.medin.2017.02.008.

6 Turissini JD, Elmarsafi T, Evans KK, Kim PJ. Major risk factors contributing to split thickness skin graft failure. *Georgetown Med Rev*. 2019;3(1):1–11. https://doi.org/10.52504/001c.7755.

7 Høgsberg T, Bjarnsholt T, Thomsen JS, Kirketerp-Møller K. Success rate of split-thickness skin grafting of chronic venous leg ulcers depends on the presence of Pseudomonas aeruginosa: A retrospective study. *PLoS ONE*. 2011;6(5):e20492. https://doi.org/10.1371/journal.pone.0020492.

8 Lim K, Yoon C, Lee J. Antimicrobial effect of skin for allograft and management in burn wound. *Open J Organ Transpl Surg*. 2017;7:1–11. https://doi.org/10.4236/ojots.2017.71001.

9 Knapik A, Kornmann K, Kerl K, et al. Practice of split-thickness skin graft storage and histological assessment of tissue quality. *J Plast Reconstr Aesthet Surg*. 2013;66(6):827–834. https://doi.org/10.1016/j.bjps.2013.02.003.

10 Li Z, Overend C, Maitz P, Kennedy P. Quality evaluation of meshed split-thickness skin grafts stored at 4°C in isotonic solutions and nutrient media by cell cultures. *Burns*. 2012;38(6):899–907. https://doi.org/10.1016/j.burns.2012.02.002.

11 Mann-Salinas EA, Joyner DD, Guymon CH, et al. Comparison of decontamination methods for human skin grafts. *J Burn Care Res*. 2015;36(6):636–640. https://doi.org/10.1097/bcr.0000000000000188.