Introduction

Large total body surface area burns pose significant therapeutic challenges. Clinically, the extent and depth of burn injury may mandate the temporary use of cadaver skin (allograft) to protect the wound and allow formation of granulation tissue while split thickness skin grafts (STSG) are serially harvested from the same donor areas. However, allografts are not always available and have high cost associated with them, thus the interest in identifying lower cost, readily available products that serve the same function. A second function of allografts is to protect a highly meshed STSG (mSTSG) from desiccation and shearing (1-2).

Objectives/Hypothesis

Objectives: Evaluate omega-3 rich fish skin graft as a temporary covering to prepare the wound bed for mSTSG application and as protection over a highly meshed STSG.

Hypothesis: We hypothesize the omega-3 rich fish skin graft will enhance granulation tissue formation that promotes successful autografting and reduce donor skin requirements by promoting quicker healing of widely meshed autografts.

Methods

Donor site: Meshed Split Thickness Skin Graft (mSTSG)

3-5 cm 2-3 cm

8 mm Biopsy punches

1 strip at end

Day -1
Tattoo and burn

Day 0
Excise necrotic tissue and apply temporary coverings (Cadaver or Kerecis™)

Day 7
Biopsy and apply mSTSG and 2nd treatment of Kerecis

Day 14

Day 21

Day 28

Day 45

Day 60

Biopsy, NIM, rebandage

Figure 1: Pig schematic and timeline

Thirty-six 5x5 cm FT burn wounds were created on the dorsum of anesthetized Yorkshire pigs. The schematic indicates the timeline and methods utilized throughout the study. NIM = non-invasive measurements to include digital and laser speckle imaging, TransEpidermal Water Loss (TEWL), and hydration readings. mSTSG = meshed split thickness skin graft

Results

Figure 2: Representative digital images

Digital images were captured of all wounds during the 60 day study.

Figure 3: Wound contraction and skin barrier functional measurements

A) Wound contraction was calculated by tracing the tattoos, comparing to the initial wound size, and normalizing to the growth of each animal.

B) TransEpidermal Water Loss (TEWL) measures the barrier properties of the epidermal layer of skin. Three measurements were obtained for each wound at each time point and averaged (* = p<0.05 3:1 mSTSG + Kerecis™ (Group 3) vs. other groups; # = p<0.05 for 3:1 mSTSG + Kerecis™ (Group 3) vs. normal).

C) The hydration measures the water content of the wounds. Five measurements were obtained for each wound at each time point and averaged (* = p<0.05 3:1 mSTSG + Kerecis™ (Group 3) vs. other groups).

Figure 4: Laser Speckle Imaging

A) Digital day 14 and laser speckle images (LSI) indicating higher perfusion (red/yellow) in the healing wounds. By day 60, the perfusion within the wound has returned to baseline levels indicated by the blue coloring.

B) Quantitation of LSI measurements represented as a fold change above the normal perfusion around each wound (* = p<0.05 between all groups; # = p<0.05 Kerecis™ treated vs. normal; @ = p<0.05 3:1 mSTSG + Kerecis™ (Group 3) vs. normal).

Figure 5: Day 60 representative digital images

No obvious meshed pattern scarring is present at the day 60 final time point.

Conclusions

- Kerecis™ product created a granulated wound bed that was receptive to application of a mSTSG
- FT burn wounds treated with Kerecis™ had similar outcome measures (contraction, TEWL, conductance, blood perfusion) compared to cadaver skin treated wounds
- 3:1 mSTSG + Kerecis™ resulted in similar healing with the wounds treated with 1.5:1 mSTSG
- This means less graft (~1/2) was necessary to result in similar healing without any meshed pattern being exhibited

Acknowledgements

RC is an employee of the U.S. government and this work was prepared as part of his official duty. This research was supported in part by an appointment to the Postgraduate Research Participation Program at the U.S. Army Institute of Surgical Research administered by the Oak Ridge Institute for Science and Education through an interagency agreement between the U.S. Department of Energy and USAISR. This research was funded by the U.S. Army Medical Research and Materiel Command and Military Burn Research Program.

References


Statement

Research was conducted in compliance with the Animal Welfare Act, the implementing Animal Welfare Regulations, and the principles of the Guide for the Care and Use of Laboratory Animals, National Research Council. The facility's Institutional Animal Care and Use Committee approved all research conducted in this study. The facility where this research was conducted is fully accredited by AAALAC International.