Use of Plant Based Stem Cell Nanotechnology on Diabetic Lower Extremity Wounds

Naz Wahab MD, FAAFP, FAPWCA[1], Jutta A. Guadagnoli[2,3], Kelli Wray APRN, AGNP-C[1], and Kathy Leak TVN[4]

[1]Wound Care Associates, Las Vegas, NV; [2]Department of Clinical Education, Touro University Nevada School of Osteopathic Medicine; [2]Department of Basic Sciences, Touro University Nevada School of Osteopathic Medicine, Henderson, NV; [4]Doncaster and Bassetlaw Foundation Trust; Doncanster, United Kingdom

Touro University Nevada

Introduction

Advanced wound care products for chronically non-healing wounds have been a growing area of wound healing technology. As the science behind wound healing becomes more widely investigated newer stem cell therapies are being brought onto the market. The numbers of non-healing diabetic wounds are growing due to complex multi-organism bio-burden, advancing diabetic co-morbidities, and limitations of cost effective advanced therapies. Stem cell therapy has exploded on the forefront of wound healing products, but most are of human, or other animal origin. Isolating stem cells from animal origins is a complex, and costly approach which leads to difficulty in delivering advanced modalities to patients in need.

An alternative was to isolate undifferentiated plant stem cells from green tea and create a hemicellulose membrane with Nano particulate fibers. This membrane using 100% non-animal ingredients with the small nanotechnology delivery system is a successful approach to delivering stem cells directly to the wound bed.

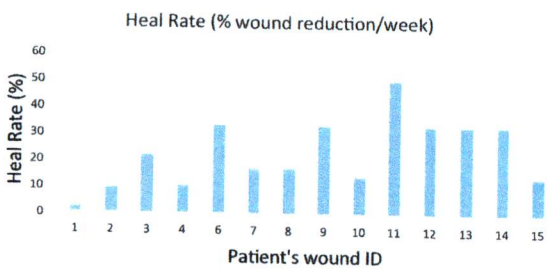
It is known that products that have animal undifferentiated stem cells can be effective in wound healing, but are plant stem cells effective as well? If the chronically stalled diabetic wound could respond by effectively decreasing wound size and volume then it could be a viable treatment option.

Methods

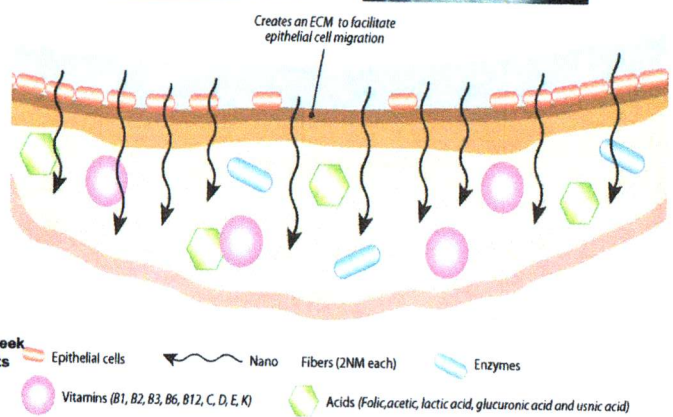
The green tea membrane was applied onto 15 patients with chronic non-healing diabetic wounds that did not improve greater than 30% with decrease in wound size or volume for a minimum of 6 weeks. These patients were identified and serially categorized from the study initiation date. Secondary dressings of untreated guaze or foam were utilized. Wound size and closure rates were monitored over time. Adverse reactions associated with the treatment regime were noted.

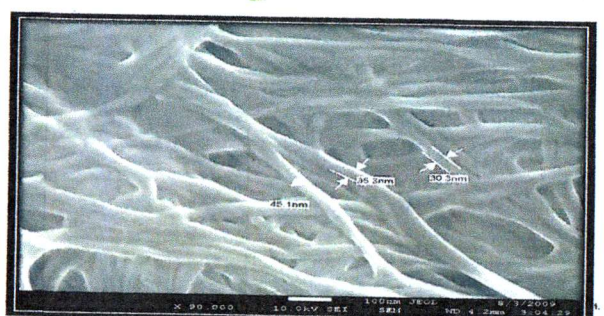
Results

- Total number of wounds 15
- Mean age 65.4 ± 9 years
- One dropped from study due to infection
- Avg. duration of care 5.15 weeks
- Avg. heal rate for patients who healed completely was 24% reduction/week
- Avg. number of weeks to heal with nanogen 4.3 weeks of the 10 patients that did achieve wound closure



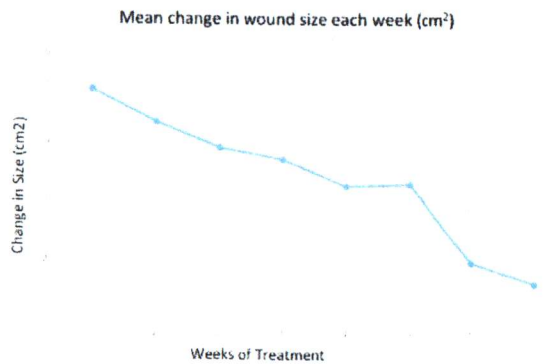
Heal Rate: Of the 15 treated wounds, one was healed by week 2, five more by week 3, and an additional four by week 7. Patients remaining in the study at week 8 had a 45% reduction in wound size





Electron Microscopy of Plant Nanofibers

Results



Discussion

The Plant Stem Cell Nanotechnology is a 100% natural biological hemicellulose membrane. It is a green tea based fiber scaffold of nanometric sized particles creating a plant stem cell nanodevice. This nanodevice is an innovative way of delivering stem cells directly into the wound bed. Stem cell nanoparticles have the ability to enter into the cytoplasmic space across cellular barriers and activate specific transport mechanisms with direct cell to cell signaling based on the combination of both quantum particle size and the on the presence of the undifferentiated plant stem cells. This nanodevice membrane helps to replace the extracellular matrix by regulating growth factors, direct cell signaling, and cell to matrix signaling.

When the green tea nanodevice membrane is applied to the wound bed, deposition of extracellular matrix occurs due to the direct chemotactic signaling of platelets, macrophages, T lymphocytes, and fibroblasts. These cell types in turn produce PDGF, TGF-b, EGF, FGF, and IGF. The initiation of these growth factors then stimulates the proliferative phase of wound healing. More specifically, fibroblasts will release collagen and glycosaminoglycans, which in combination with fibronectin, forms the new extracellular matrix. The body's natural ECM then is the framework for angiogenesis, and continued granulation tissue formation and finally keratinocyte migration and epithelialization.

The green tea nanodevice membrane also carries a positive charge due to the amine groups on the highly pedicled carboxylic acid cellulose. The positive charge creates an electromagnetic attraction with the negatively charged blood byproducts and negatively charged bacteria. Therefore, upon wound bed stimulation by the membrane it is clinically and qualitatively seen that deep-seated bio burden is removed and edema is improved.

The benefits of this wound healing modality are far reaching. The cell signaling is faster and more effective due to the nanotechnology delivery system. The medicinal value of the plant itself can be utilized directly for wound healing. The products are 100% bio-sustainable and biodegradable.

The expense in collection, isolation and purification of the animal based products can be timely and expensive. Utilizing plants instead of animals can be a more cost effective alternative. Plant based products can also be less immunogenic due to lack of species cross reactivity. There is no clinician preparation, no difficult storage limitations, greater shelf life, greater patient selection versatility, and overall more cost effective.

References

1. G.M.Olyveira, D.P Valido, LMM Costa, PBP Gois, LX Filho, P Basmaji. First Otolitha/Collagen/Bacterial Cellulose Nanocomposites as a Potential Scaffold for Bone Tissue Regeneration. J Biomater Nanobiotech;2,239, 2011.
2. Novel antimicrobial peptides bacterial cellulose obtained by symbioses culture between polyhexanide biguanide (PHMB) and green tea Pierre Basmaji, Gabriel Molina de Olyveira,Márcio Luiz dos Santos, Antônio Carlos Guastaldi, Journal of Biomaterials and Tissue Engineering (JBT) 2013.
3. P.Basmaji; G.M.Olyveira; L.M.M .Costa; L.X.Filho. Bacterial Nanocellulose for medicine regenerative. J Nanotech Eng Med 2 034001 2011