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Wound Care Congress 2023



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Agarose-based immunomodulatory and antibacterial nanofibrous mats for addressing chronic cutaneous wounds

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Any disintegrity or rupture of skin architecture leads to a wound, and its repairing process is termed wound healing. Diabetic foot ulcers and chronic wounds take longer to heal than acute wounds due to a disturbed healing cascade leading to prolonged inflammation. The prolonged inflammatory phase results in a large amount of exudate within chronic wounds (fungating wounds, venous leg ulcers, pressure ulcers, burns) and diabetic foot ulcers leading to delayed healing. Approximately 6% of the world population develops chronic wounds, and 37 million suffer morbidity and mortality from these wounds during their lifetime.

As a result, the global wound care market is expected to be 27.8 billion USD by 2026 from 19.3 billion USD in 2021, at a compound annual growth rate (CAGR) of 7.6% during the forecast period. Several biomaterials, including wound dressings, have been used since the rise of Egyptian civilization to treat wounds. However, natural polymer-based nanofibrous wound dressings have gained increased attention because of their high surface area, bioactivity, biodegradability, and resemblance to the extracellular matrix. Agarose and curdlan natural polymers have been used for angiogenesis, cartilage formation, immunomodulation, and wound healing applications. Thus, the present research focuses on fabricating and evaluating agarose-based multifunctional nanofibrous scaffolds.

During these studies, curdlan (an immunomodulator) was blended with agarose to combat inflammation by modulating the expression of pro-inflammatory and anti-inflamma-

tory cytokines. In preliminary results, the fabricated scaffolds exhibited ~550% swelling (in phosphate buffer saline) with enhanced mechanical strength, which is suitable for most wound healing applications.

In vitro studies revealed an increased migration and proliferation of L929 mouse fibroblasts with agarose blends w.r.t to the control. Moreover, the fabricated dressings were effective against *Escherichia coli* (Gram-negative) and *Staphylococcus aureus* (Gram-positive) bacterial strains.

Keywords: Antibacterial immunomodulatory dressings, benign solvent, nanofibrous Agarose, biocompatibility, enhanced swelling and mechanical strength, biopolymeric dressings

Recent Publications

1. Latiyan S, Kumar TSS, Doble M. Fabrication and evaluation of multifunctional agarose based electrospun scaffolds for cutaneous wound repairs. *Journal of Tissue Engineering and Regenerative Medicine*. 2022 Jul;16(7):653-664.

Biography

Sachin Latiyan is an exuberant researcher, holds interdisciplinary research experience in areas like Microfabrication (Photolithography), Biomaterials (Electrospinning, electrospray & freeze drying), Nanomaterials (synthesis and characterization), Polymers and Composites (GO-Magnetite), and Corrosion Engineering (Cathodic Protection and Pipeline Corrosion)

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Risk factors of hospital-acquired pressure ulcer among adult ICU patients in selected tertiary hospitals

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Aim: To identify risk factors and estimate in-hospital mortality rates, and approximate the lengths of ICU stays and health care costs of hospital acquired pressure ulcers (HAPUs) among adult ICU patients.

Method: A retrospective, cross-sectional, nested, case -control design was used to identify the HAPUs' risk factors and health care outcomes for adult ICU patients (n = 214) over 1 calendar year (January 1, 2019, to December 31, 2019) in two tertiary hospitals.

Results: HAPUs' risk factors included male gender (odds ratio [OR] = 0.37, p = 0.023), organ failure (OR = 3.2, p = 0.033), cancer (OR = 3.41, p = 0.049), CVA (OR = 12.33, p = 0.001), mechanical ventilator (OR = 9.64, p = 0.025) and ICU-LOS (OR = 1.24, p < 0.001). The in-hospital mortality rate for patients with HAPUs was 62.8%. HAPUs were associated with a 14-day increased length of stay. The extra direct health care costs due to HAPUs were 2,998 Rial for each HAPU case.

Conclusion: HAPUs among ICU patients constitute a significant healthcare problem associated with severe clinical consequences and result in substantial adverse healthcare out-

comes worldwide. Identifying the risk factors and the impact on the health care system is the foundation for preventing and managing HAPUs. Furthermore, the results of this study can be used as a reference baseline information for future national strategies to prevent HAPUs in ICU and other hospital units.

Recent Publications

1. Fatma Al-Mamari, Alderden, Jenny et al. "Risk Factors for Hospital-Acquired Pressure Injury in Surgical Critical Care Patients." *American journal of critical care : an official publication, American Association of Critical-Care Nurses* vol. 29,6 (2020): e128-e134. doi:10.4037/ajcc2020810

Biography

Fatma Al- Mamari has completed her MCS in adult acute care from Sultan Qaboos University, Oman. She worked as a wound care nurse at Sultan Qaboos University Hospital for the last13 years. She has two articles waiting for publication for a multicenter study about hospital-acquired pressure ulcer among adult ICU patients which conducted from 2021 to 2022.

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Wound debridement: A critical step in wound management

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Chronic wounds are wounds that have failed to successfully proceed along the normal wound healing trajectory of hemostasis, inflammation, proliferation, and remodeling. Chronic wounds are often a manifestation of an underlying health issue in the host. Wound hygiene is a stage strategy for managing these chronic, hard to heal wounds. It consists of several key steps including cleansing, debridement, refashioning the edges and dressing the wound. Of these, debridement plays a critical role and is designed to remove biofilm as well as any non-viable tissue in the wound that can potentially delay the wound healing trajectory and increase the risk for wound infections. There are several categories of Debridement which include Autolytic, Chemical/Enzymatic, Mechanical, Surgical and Biological. The purpose of this presentation is to review the rationale for debridement and to discuss these various modes of debridement in each category. Strategies for each modality as well as pain management are discussed. By participating in this presentation, the learner will gain a better insight into debridement as well as strategies for wound healing success.

Objectives:

1. Identify the concept of wound hygiene
2. Discuss the impact of biofilm and necrotic tissue on the wound healing trajectory

3. Explore the different types of debridement and indications for each
4. Review pain management strategies with debridement

Recent Publications

1. Diana Rudolph, and Christiane Beck et al - Real fasting times and incidence of pulmonary aspiration in children: Results of a German prospective multicenter observational study August 2019 *Pediatric Anesthesia* 29(10) DOI:10.1111/pan.13725
2. Diana Rudolph, Christoph Mahn, Alexander Etspüler et al -Impact of clear fluid fasting on pulmonary aspiration in children undergoing general anesthesia: Results of the German prospective multicenter observational (NIKS) study June 2020 *Pediatric Anesthesia* 30(8)DOI:10.1111/pan.13948

Biography

Dianne Rudolph is a nurse practitioner with more than 25 years of experience in treating wound care patients. She is board certified in wound care and as a gerontological nurse practitioner. She has practiced in acute care, long term/extended care, home health care and clinic settings. She has published and presented on numerous wound care topics and serves as a consultant on medicolegal issues. She has served as adjunct faculty/faculty for the University of Texas Health Science Center School of Nursing in San Antonio Texas and Houston Texas. She recently opened her own wound management practice providing care in home and post-acute care settings.

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Accepted Abstracts

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Curcumin: A novel therapeutic for burn pain and wound healing

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Managing burn injury-associated pain and wounds is a major unresolved clinical problem. Opioids, nonsteroidal anti-inflammatory drugs (NSAIDs), antidepressants and anticonvulsants remain the most common forms of analgesic therapy to treat burn patients. However, prolonged treatment with these drugs leads to dose escalation and serious side effects. Additionally, severe

burn wounds cause scarring and are susceptible to infection. Recent encouraging findings demonstrate that curcumin, a major bioactive component found in turmeric, is a natural pharmacotherapeutic for controlling both severe burn pain and for improved wound healing.

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N-acetyl-6-aminohexanoic acid formulation with cerium-containing nanoparticles promotes wound healing

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The objective of the study was to assess wound-healing efficacy of original N-acetyl-6-aminohexanoate acid formulation containing cerium nanoparticles, and explore critical molecular targets in diabetic animals. Methods: We used cerium-containing N-acetyl-6-aminohexanoate (laboratory name LHT-8-17) in a form of 10 mg / ml water-soluble spray for topical therapy of experimental wound. The substance toxicity was evaluated using human skin epidermal cell culture MTT assay. Linear wound was modelled in 18 outbred white rats with streptozotocin-induced (60 mg/kg i.p.) diabetes mellitus (DM); planar cutaneous wound was reproduced in 60 C57Bl6 mice with streptozotocin-induced (200 mg/kg i.p.) DM and 90 db/db mice with inherited DM. We mechanically assessed the firmness of the forming scar.

Skin regeneration was histologically assessed on days 5, 10, 15 and 20. Tissue TNF- α , IL-1 β and IL-10 level was determined by quantitative ELISA. Oxidative stress activity was detected by Fe-induced chemiluminescence.

Ki-67 expression and CD34 cell positivity were assessed using immunohistochemistry. FGFR3 gene expression was detected by real-time PCR. LHT-8-17 anti-microbial potency was assessed in contaminated by MRSA wound tissues. Results: LHT-8-17 4 mg twice daily accelerated linear and planar wounds healing in animals with type 1 and type 2 diabetes. The formulation topical application depressed tissue TNF- α , IL-1 β level, and oxidative reactions activity along with sustaining both IL-10 concentration and antioxidant capacity.

LHT-8-17 induced Ki-67 positivity of fibroblasts and prokeratinocytes, upregulated FGFR3 gene expression, and increased tissue vascularization. The formulation possessed anti-microbial property. Conclusions: the results allows to consider the formulation as advantageous pharmacological approach for topical treatment of diabetic wound.

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A novel sprayable thermosensitive hydrogel coupled with zinc modified metformin promotes the healing of skin wound

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A novel sprayable adhesive is established (ZnMet-PF127) by the combination of a thermosensitive hydrogel (Pluronic F127, PF127) and a coordination complex of zinc and metformin (ZnMet). Here we demonstrate that ZnMet-PF127 potently promotes the healing of traumatic skin defect and burn skin injury by promoting cell proliferation, angiogenesis, collagen formation. Furthermore, we find that ZnMet could inhibit reactive oxygen species (ROS) production through activation of autophagy, thereby protecting cell from oxidative stress induced damage and promoting healing of skin wound. ZnMet complex exerts better effects on promoting skin wound healing than ZnCl₂ or metformin alone.

ZnMet complex also displays excellent antibacterial activity against *Staphylococcus aureus* or *Escherichia coli*, which could reduce the incidence of skin wound infections. Collectively, we demonstrate that sprayable PF127 could be used as a new drug delivery system for treatment of skin injury. The advantages of this sprayable system are obvious: (1) It is convenient to use; (2) The hydrogel can cover irregular skin defect sites evenly in a liquid state. In combination with this system, we establish a novel sprayable adhesive (ZnMet-PF127) and demonstrate that it is a potential clinical treatment for traumatic skin defect and burn skin injury

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The treatment of burn wounds with hypochlorous acid – two case studies

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Burn wounds are some of the most complicated injuries to manage as control of infection (including biofilm formation) is paramount to limit the depth of thermal injury. Furthermore, control of inflammation is as important, ensuring the wound will heal expediently, with limited scarring. The standard of care in burn wound management has included dressings for control of infection, or the early excision and grafting of the wound, as the removal of damaged contaminated tissue followed by a rapid closure of the wound decreases infectious risk.

We present two cases of deep partial thickness burn wounds treated at home with hypochlorous acid (HOCl)-moistened gauze dressings, retained with crepe bandages. Special reference to the importance of debridement of devitalized tissues, and the control of infection, as well as inflammation of burn wounds are illustrated. This case studies also explores the use of a pure medical-grade solution of HOCl to facilitate wound healing.

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The use of negative pressure wound therapy: Recommendations by the wound healing association of southern africa (WHASA)

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Introduction: Negative pressure wound therapy as a treatment modality is supported by a large body of evidence, including RCTs, cohorts and case series, which have demonstrated the benefits of NPWT in managing chronic and acute wounds. While there is a large body of evidence available on NPWT, even the RCTs are often considered of poor quality, but this has more to do with the known challenges of conducting trials on wound care products usually due, not least of all, to the heterogeneous nature of wounds and patients. This is well known, but such guidelines give greater credence where this “best available evidence” is used with clinical experience, i.e., evidence-based practice.

Problem: As clinical scenarios vary, so do clinical indications for NPWT. Even if it were possible to develop guidelines for the use of NPWT, there would always be cases that fall outside of these guidelines but where its use would be indicated. Similarly, there may be cases for which NPWT is not ideal but that fall within the guidelines for its use. Recommendations embedded in a purely academic perspective might not represent clinical practice and could be problematic to apply in clinical settings.

Purpose: WHASA believes that advanced wound management lends itself toward a genuine “evidence-based medicine” approach, where practitioners should make conscientious, explicit, and judicious use of current best evidence in making decisions about the care of the individual patient. They are integrating individual clinical expertise with the best available external clinical evidence from systematic research. WHASA, as a multidisciplinary organisation incorporating a team approach towards wound healing and the primary resource for healthcare professionals to foster research and education while

advancing wound management, has produced these best practice recommendations to further evidence-based wound care using NPWT in South Africa. These recommendations aim to promote optimum outcomes with NPWT cost-effectively and are the collaboration between wound care specialists across multiple surgical disciplines.

Methods: An expert panel consisting of an interprofessional group of wound care specialists and specialist surgeons were identified. A quick and dirty search of the current literature was done and scrutinised for relevance. Literature assessed for relevance and adapted to the South African (SA) context, drawing from the best available international research and clinical expertise, complemented a South African experience uniquely when making treatment decisions for individual SA patients.

Results: Recommendations follow those of the European Union of Wound Healing Societies and are not the result of a further comprehensive literature review, which had been done extensively for the EWMA guidelines. ([https://ewma.org/fileadmin/user_upload/EWMA.org/Project Portfolio/EWMA_Documents/JWC_EWMA_supplement_NPWT_Jan_2018_appendix.pdf](https://ewma.org/fileadmin/user_upload/EWMA.org/Project%20Portfolio/EWMA_Documents/JWC_EWMA_supplement_NPWT_Jan_2018_appendix.pdf)).

Conclusion: WHASA, therefore, supports the recognition by EWMA that, while the ongoing controversy regarding high-level evidence in wound care, in general, is well-known, there is a consensus that clinical practice should be evidence-based. This can be difficult to achieve due to confusion about the value of the various approaches to wound management; however, we must rely on the best available evidence.

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