Cell Selective Polymer Nanofibers For The Management of Bacteria-Infected Partial Thickness Burns

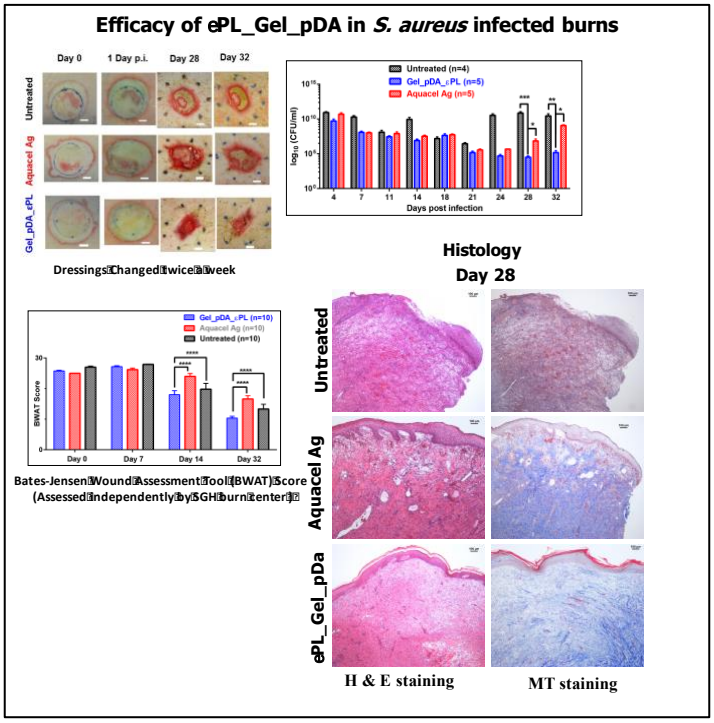
Venkatesh M [1,2], Dhand C [1, 6], Choong ACW [3,4,5], Beuerman RW [1, 6], Zhao-Xun Liang [2], Verma NK[7,8], Chong SJ [3,4,5], Rajamani Lakshminarayanan [1, 6].

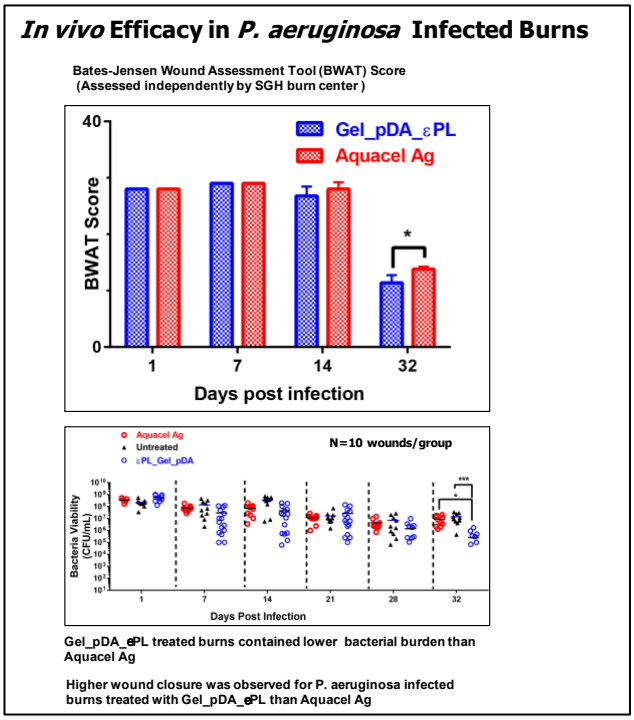
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Abstract

We investigated the antimicrobial and wound healing properties of prototype wound dressings prepared by bio-inspired crosslinking *in vitro* and *in vivo*. We prepared the prototype dressings by electrospinning of gelatin nanofibers containing epsilon-poly-L-lysine (εPL) and dopamine on a cotton bandage gauze. Subsequent crosslinking produced mats of mat density 460 g/m^2 and labelled as εPL_Gel_pDA mats. Antimicrobial properties and antimicrobial durability were studied against panels of bacteria and yeast strains. Mammalian cell biocompatibility and cell proliferative properties were determined for primary human dermal fibroblasts (hDFs) and keratinocytes (HaCaT) cell lines. εPL_Gel_pDA mats displayed potent antimicrobial properties against common wound pathogens. The mats displayed excellent biocompatibility and cell proliferative properties for both the mammalian cells. I*n vivo* biocompatibility of the mats was examined in juvenile pigs after cutaneous partial thickness burn injury. The results suggested comparable wound closure and re-epithelialization of the burns at 32 days post injury with silver based dressings. The antimicrobial efficacy of the mats *in vivo* was further examined by colonizing the partial thickness wounds with *Staphylococcus aureus* and *Pseudomonas aeruginosa*. Digital status of the wounds after treatment and silver dressings were assessed in terms of clinical examination (Bates-Jensen Wound Assessment Tool, BWAT), relative wound closure (SigmaScan Pro5), bacterial enumeration from swab culture and Hematoxylin and Eosin (H & E) /Masson Trichrome staining. Infected burns treated with εPL_Gel_pDA mats showed lower BWAT score and bacterial bioburden (>4log10 reduction), increased wound closure, higher keratinization and faster re-epithelialization when compared to silver dressings.
This study identified the combined utility of bio-inspired crosslinker, biocompatible antiseptic polymer and hydrogel nanofibers as advanced prototype wound dressings and established its superiority over commercial silver based dressings in infected burns. The nanofibre dressings could potentially be useful for treating life-threatening burn injuries and burn-related infections.

Image





Recent Publications

1. Anish P., Rajamani L., Abhishek I., **Venkatesh M.,** Eunice T. L. G., Daniel G L., Madhavi Latha S. C., Navin Kumar V., Stephen H. P., Roger W. B., Annemieke M., Edward J. T., Ishwar S. (2018). Design and syntheses of highly potent teixobactin analogues against Staphylococcus aureus, Methicillin-resistant Staphylococcus aureus (MRSA), vancomycin-resistant Enterococci (VRE) *in vitro* and *in vivo*. Journal of Medicinal Chemistry (IF: 6.259).
2. **M. Venkatesh.,** V. A. Barathi., Eunice T. L. G., Raditya A., M.H. U Fazil., Alice N., S. Harini, T.T. Aung, S.J.Fox, Shouping L., L. Yang., Timothy M. S. B., Xian Jun L., Navin Kumar V., Roger W B., Rajamani L. (2017). Antimicrobial Activity and Cell Selectivity of Synthetic and Biosynthetic Cationic Polymers. Antimicrobial agents and chemotherapy, 61 (10), e00469-17 (IF:4.415)
3. **M. Venkatesh.,** Chetna D., V. A. Barathi., S. Harini, Samiran B., Eunice G.T.L., Nandhakumar M., Kenny Z. W. L., S.J.Fox, Xian Jun Loh, Dinesh Kumar S., Shou Ping L., Roger WB., Navin Kumar V., Seeram R., Rajamani L. (2017). Biomaterials, 138 153-168 (IF:8.402)
4. Chetna D., V. A. Barathi., Seow Theng O., **M. Venkatesh.,** S. Harini, Neeraj D., Eunice T. L. G., M. Nandhakumar, J. R. Venugopal, Silvia M. D., S. J. Fox, Xian Jun L., L Shou Ping, Roger W B., Navin K.V., Seeram R., Rajamani L. (2016). Latent Oxidative Polymerization of Catecholamines as Potential Cross-linkers for Biocompatible and Multifunctional Biopolymer Scaffolds ACS Applied Materials & Interfaces, 8, 32266−32281 (IF:7.504)
5. Stephen J. F., M.H. U Fazil, Chetna D., **M. Venkatesh,** Eunice T. L. G., S. Harini, C. Eugene, Rayne Rui L., Seeram R., Shyam S. C., Roger W B., C. S. Verma, Navin Kumar V., Xian Jun L., Rajamani L. (2016). Insight into membrane selectivity of linear and branched polyethylenimines and their potential as biocides for advanced wound dressings. Acta biomaterialia. 37, 155-164 (IF:6.319)

Biography



Currently working as a **Research Associate I** at **Anti-Infectives Research Group**, in "**Singapore Eye Research Institute**., Long Term Service Award at SERI, Singapore". Hands on experience as a Research Assistant in *Studying cytotoxicity of different natural plant extracts and nanoparticles against various cancer cell lines, also worked* as a Research Assistant in *Design and synthesis of peptides for immuno-modulation.*
Pursuing Ph.D. at School of Biological Science, NTU (Jan 2017); on M.Tech (Masters in Bio- Informatics) and B.Pharm (Bachelor of Pharmacy) professional with 10+ *years* of cross culture experience in Microbiology, Oncology, Cardiovascular and Metabolic Research, Pharmacology, Reproductive Health, Musculoskeletal Biology, Cell and molecular biology, also on Natural plant extracts, Novel Peptide Synthesis for immunomodulation, with hands on in related software and tools. Previous worked as a **Senior Scientist/Study Director** in "**Maccine Pte Ltd.,** Singapore". Long Term Service Award at "Maccine Pte Ltd., Singapore".
Research Interests: Working on durable antimicrobial nano platforms for topical applications. Using different antimicrobial assays and developing animal to understand the antimicrobial efficacy of the different drugs, peptides and nanomaterials. Investigating the efficacy of drug-loaded wound dressings for *S. aureus* and *P. aeruginosa* infected burn wounds.

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