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Sun light exfoliated reduced graphene oxide loaded isabgol scaffolds accelerates collagen synthesis, vascularization and wound healing in diabetic rats

Thangavel Ponrasu[1], **Vignesh Muthuvijayan**[1] and **Lonchin Suguna**[2]
[1]Indian Institute of Technology Madras, India
[2]Central Leather Research Institute - CSIR, India

Statement of the Problem: Diabetes mellitus (DM) is one of the major health concerns with increasing prevalence. Wounds in diabetic patients are slow to heal and persist for few months under proper wound care and management. Pathophysiology of impaired diabetic wound healing is still unclear and it is presumed that delayed healing is due to the persistence of prolonged inflammation and an inadequate angiogenic response. However, an ideal wound dressing material can act as a protective barrier against pathogens, help in cell attachment, proliferation, migration and differentiation during wound healing process.

Methodology: Fabrication of the reduced graphene oxide loaded isabgol (Isab) scaffolds (Isab/rGO) was prepared by freeze drying method using STMP crosslinking. Biocompatibility of the Isab/rGO scaffolds was carried out in NIH 3T3 fibroblast cells. Then, these scaffolds were used as a topical wound dressing material to assess the normal and diabetic wound healing efficacy using 2×2 cm^2 full thickness open excision wounds in Wistar rats. Granulation tissue collected from wounds was used to evaluate the biochemical, biophysical, histopathology and immunohistochemistry analyses.

Results: Isab/rGO scaffolds are biocompatible in NIH 3T3 L1 cells and it also showed significant antibacterial activity. Isab/rGO scaffolds treatment showed increased wound contraction ($p<0.05$) compared to control and isab scaffold both in normal and diabetic wound healing. Period of epithelialization is also significantly reduced in isab/rGO scaffolds treated normal and diabetic wounds compared to isab and control. Histopathology and immunohistochemistry results also revealed that the isab/rGO scaffold dressing accelerated macrophage recruitment and neovascularization to heal the wounds faster.

Conclusion & Significance: These results demonstrated that incorporation of rGO in isabgol can reduce the prolonged inflammation and enhance the wound healing by accelerating the neovascularization and collagen synthesis. Hence, isab/rGO scaffold could be an inexpensive wound dressing material for diabetic wound healing application.

Biography

Thangavel Ponrasu has completed his MSc, MPhil and PhD in Biochemistry. He has expertise in diabetic wound healing. During his PhD, he has gained hands on experience in toxicity evaluation in zebra fish embryos and screening medicinal plants for diabetic wound healing. Currently, he is pursuing his Post-doctoral research in the Department of Biotechnology, IIT Madras, India from July 2014. During his Post-doc, he is developing novel, inexpensive wound dressing materials to enhance diabetic wound healing. He has published 22 papers in peer reviewed journals so far. He has attended many national and international conferences to present his research findings. He is focusing on the development of inexpensive wound dressing materials to heal the diabetic wounds much faster.

tponrasu@gmail.com

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