Thermogel Nanofiber Induces Human Endometrial-Derived Stromal Cells to Neural Differentiation and Improves Motor Dysfunction Following Spinal Cord Injury

Shima Tavakol1,2, Hadi Aligholi1-4, Ali Gorji3,5, Arezou Eshaghabadi3, Seyed Mehdi Rezayat 1,6,7*, Jafar Ai 8,9*

1Department of Medical Nanotechnology, School of Advanced Technologies in Medicine, Tehran University of Medical Sciences, Tehran, Iran.
2Student’s Scientific Research Center, Tehran University of Medical Sciences, Tehran, Iran.
3Shefa Neuroscience Research Center, Khatam Alanbia Hospital, Tehran, Iran.
4Department of Neurosciences, School of Advanced Technologies in Medicine, Tehran University of Medical Sciences, Tehran, Iran.
5Institute of Neurophysiology, Muenster University, Muenster, Germany.
6Department of Toxicology and Pharmacology, School of Pharmacy, Pharmaceutical Sciences Branch, Islamic Azad University (IAUPS), Tehran, Iran.
7Department of Pharmacology, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran.
8Department of Tissue Engineering, School of Advanced Technologies in Medicine, Tehran University of Medical Sciences, Tehran, Iran.
9Brain and Spinal Injury Research Center, Imam Hospital, Tehran University of Medical Sciences, Tehran, Iran.

Published: 18 February, 2015

Abstract

Although spinal cord injury (SCI) is one of the most common injuries after a road accident, there is no definite treatment for it. In this regard, nanotechnology has focused to retrieve damaged tissue function by designing of a biomaterial as a mimicking extracellular matrix to reduce inflammation, scar and lactate dehydrogenase, to fill the cyst and improve the graft integration, cell proliferation and differentiation in site of injury. In this study, the neuronal differentiation potential of termogel nanofiberous Matrigel as a self-assembling nanofiber was investigated. Human endometrial-derived stromal cells (hENSCs) were isolated and encapsulated into nanofiberous termogel and cell viability and cell membrane damage were assessed. Encapsulated hENSCs into Matrigel were treated with neural differentiation medium for 21 days, and then neural genes and protein markers were analyzed using real time-PCR and immunocytochemistry assays. In addition, Matrigel was implanted into an animal model of SCI and followed up for 45 days using Basso-Beattie-Bresnahan (BBB) test. Our results showed higher cell viability and lower cell membrane damage in cells encapsulated into nanofiber as compared to 2D cell culture. Also, it was seen neural differentiation in the level of genes and proteins and significant improvement in motor function of the injured animals. Matrigel with the ability of neural induction and motor function improvement could be as an applied scaffold in tissue engineering for SCI.

Keywords: Matrigel, Nanofiber, Spinal Cord Injury.

*Corresponding Authors: Seyed Mehdi Rezayat and Jafar Ai
E-mail: Rezayat@tums.ac.ir and jafar_ai@sina.tums.ac.ir