Next-Generation Nanoplatforms for Multi-Modal Peripheral Nerve Repair

Anahita Amiri [1], Maliheh Jahromi[2], Alireza Amiri[3]

1. Clinical Research Development Center, Najafabad Branch, Islamic Azad University, Najafabad, Iran .anahitaamiri585@gmail.com
2. Clinical Research Development Center, Najafabad Branch, Islamic Azad University, Najafabad, Iran. malihejahromi64@gmail.com
3. Medical Doctor, School of Medicine, Bam University of Medical Sciences, Bam, Iran. Alirezaamiriph5@gmail.com

THE FIRST INTERNATIONAL CONGRESS ON HEALTH SERVICES TRANSFORMATION

اولین کنگره بین المللی تحول خدمات سلامت

(introduction)

A peripheral nerve injury is associated with long-term sensory-motor deficits. Furthermore, it is linked to neuropathic pain as well as to reduced quality of life. Clinical standard of nerve repair is still autografting.(1) However, there are several limitations with its use including donor site morbidity and limited tissue availability.The growing body of research indicates that nanostructured biomaterials can be used for combined therapeutic delivery. (2)These systems can be linked to regeneration results that can be higher than single-modality systems.(3)

(Methode)

Researchers looked at over 50 studies from the past seven years to see what works best for helping damaged nerves heal. They focused on studies that used rats to test different treatments for sciatic nerve injuries. These treatments included tiny particles made of special materials, like plastics or hybrids, that can help nerves grow back. Some of these particles were designed to carry genes or other helpful materials to the damaged area. The researchers also looked at special scaffolds that can help nerves regrow, and some of these scaffolds were even able to conduct electricity or respond to pressure. The goal was to find the best way to help nerves heal and work properly again.

(Findings)

Researchers looked at over 50 studies from the past seven years to see what works best for helping damaged nerves heal. They focused on studies that used rats to test different treatments for sciatic nerve injuries. These treatments included tiny particles made of special materials, like plastics or hybrids, that can help nerves grow back. Some of these particles were designed to carry genes or other helpful materials to the damaged area. The researchers also looked at special scaffolds that can help nerves regrow, and some of these scaffolds were even able to conduct electricity or respond to pressure. The goal was to find the best way to help nerves heal and work properly again.

(conclusion)

Nanostructure-guided co-delivery is a promising approach for PNI repair which still requires additional large animal studies, long term biosafety and clinical trials.

Keywords:

Peripheral Nerve Regeneration, Synergistic Co-delivery, Nanostructured Biomaterials, Stimuli-Responsive Scaffolds, Neural Tissue Engineering.

(References)

1. Sun X, Wang Y, Guo Z, Xiao B, Sun Z, Yin H, et al. Acellular Cauda Equina Allograft as Main Material Combined with Biodegradable Chitin Conduit for Regeneration of Long-Distance Sciatic Nerve Defect in Rats. Adv Healthc Mater. 2018 Sep;7(17):e1800276.
2. Semmler L, Naghilou A, Millesi F, Wolf S, Mann A, Stadlmayr S, et al. Silk-in-Silk Nerve Guidance Conduits Enhance Regeneration in a Rat Sciatic Nerve Injury Model. Adv Healthc Mater. 2023 Apr;12(11):e2203237.
3. Yu M, Gu G, Cong M, Du M, Wang W, Shen M, et al. Repair of peripheral nerve defects by nerve grafts incorporated with extracellular vesicles from skin-derived precursor Schwann cells. Acta Biomater. 2021 Oct;134:190–203.
4. Hazer Rosberg DB, Mahlapuu M, Perez R, Dahlin LB. Lactoferrin-derived peptide PXL01 impacts nerve regeneration after sciatic nerve reconstruction in healthy and diabetic rats. Front cell Dev Biol. 2025;13:1565285.
5. Amemiya T, Ouchi T, Kimura H, Okuyama K, Phan TQ, Iwamoto T, et al. Enhanced nerve regeneration after transplantation of NCAM-positive neural crest-like cells derived from human iPSC. Inflamm Regen. 2026 Feb;46(1).