

ABSTRACT

Spinal Cord Injury is a very serious trauma which can't be effectively cured at present time. The use of ECM hydrogels as supportive and stimulatory milieu and transplantation of stem cells represent promising approaches for SCI therapy. However, current treatments are limited by inefficient delivery of stem cells into the lesion site. Therefore, the aim of this study was the development of SCI treatment using ECM hydrogels and effective stem cell delivery system. The non-invasive magnetic system was designed and used to accumulate SPION-labelled stem cells at a specific site of a SCI lesion. Decellularized porcine SC and UB tissues, synthetic P(HEMA-AEMA) hydrogel with oriented porosity and modified hyaluronic acid HA-PH-RGD were transplanted into a spinal cord lesion of rats with or without stem cells, followed by histological analysis and gene expression analysis. All types of hydrogels integrated into the lesion and stimulated neovascularization and axonal ingrowth into the lesion. There was no significant difference in the tissue infiltration between the plain hydrogels and those seeded with stem cells. However, a subacute injection HA-PH-RGD/Fibrinogen combined with Wharton's jelly-derived human mesenchymal stem cells enhanced axonal ingrowth into the lesion. Significant down-regulation of genes related to immune response and inflammation was observed in hydrogels. Therefore, combined application of injectable hydrogel scaffolds and effective delivery of stem cells are the key factors for improving survival of cells in lesion site, inhibition of systematic inflammation and *in vivo*-like neural regeneration.

Keywords

Spinal cord injury, injectable extracellular matrix derived hydrogels, hyaluronic acid, mesenchymal stem cells, magnetic field, magnetic stem cell delivery, stem cell transplantation, neuroregeneration, neovascularization, axonal ingrowth.