Enhanced sciatic nerve regeneration by poly-L-lactic acid/multi-wall carbon nanotube neural guidance conduit containing Schwann cells and curcumin encapsulated chitosan nanoparticles in rat

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Abstract

The main aim of this study was to improve the efficacy of peripheral nerve regeneration by an artificial neural guidance conduit (NGC) as a carrier to transplant allogeneic Schwann cells (SCs) and curcumin encapsulated chitosan nanoparticles (nanocurcumin). The conduit was prepared by poly-L-lactic acid (PLLA) and surfacemodified multi-wall carbon nanotubes (mMWCNT) and filled with SCs and nanocurcumin. SCs play an important role in the regeneration of injured peripheral nerve and controlled curcumin release can decrease SCs apoptosis, and enhance the regeneration and functional recovery of injured peripheral nerves. The mechanical properties, contact angle, and cell biocompatibility experiments showed that the optimized concentration of mMWCNT inside PLLA wall of conduits was 0.15 wt%. The drug release experiments showed slower release of curcumin from nanocurcumin samples compared to nanocurcumin encapsulated inside NGC wrapped fibrin gel sample. It was found that simultaneous using of both SCs and curcumin inside NGC had a significant role in sciatic nerve regeneration in vivo. Histological examination revealed a significant increase in the number of axons in injured sciatic nerve following treatment by SCs and nanocurcumin compared to negative control group. Histological evaluation also revealed a significant decrease in the number of vessels in fibrin groups compared to positive control group. The results showed that there was no significant difference between the reaction time and sciatic functional index (SFI) values of rats with injured sciatic nerve treated by NGC/SCs/nanocurcumin sample and autograft sample. In conclusion, our results strongly showed that PLLA/mMWCNT nanofibrous conduit filled with fibrin gel containing SCs and nanocurcumin is a proper strategy for improving nerve regeneration after a nerve transaction in the rat.

Keywords

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