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The application of polymeric composite nanoparticles for treating hepatic fibrosis via specific delivery of gallic acid to hepatic stellate cells

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Gallic acid (GA), a polyphenolic compound, is reported to possess potent antifibrotic effects in experimental animals, but exhibits low bioavailability due to its rapid clearance. Accordingly, we designed polymeric composite nanoparticles (NPs) as specific targeted delivery system for GA into hepatic stellate cells (HSCs); pivotal cells in orchestrating hepatic fibrogenesis. GA-loaded-NPs were prepared by solvent evaporation technique and characterized by different techniques. Cytotoxicity of GA-loaded-NPs was evaluated in rat HSCs cell line and primary hepatocytes using sulforhodamine B (SRB) assay. We also recorded the uptake of GA-loaded-NPs and their effects on cell migration in activated HSCs. The gene expressions of collagen I (col-1α), transforming growth factor (TGF)-β1 and α-smooth muscle actin (α-SMA) in HSCs were measured using qRT-PCR. Thereafter, bio-distribution of GA-loaded-NPs in rats was monitored via confocal laser scanning microscopy (CLSM). Results revealed that GA-loaded-NPs showed mean Particle size= 230nm, zeta potential= -33mV, polydispersity index= 0.22, encapsulation efficiency= 66 %w/w and *in vitro* drug release profile with burst release in the first hours followed by a sustained GA release for 24 hours. GA-loaded-NPs were more cytotoxic on HSCs by 80% than free GA solution without showing any cytotoxic effects on hepatocytes. GA-loaded-NPs exhibited enhanced uptake in activated HSCs and inhibition of migration and fibrogenic genes expression of col-1α, TGF-β1and α-SMA in HSCs. Furthermore, CLSM illustrated higher accumulation of GA-loaded-NPs in liver than other organs. This is the first study that clearly shows the efficacy of GA-loaded NPs targeted delivery for HSC as a promising therapeutic approach for liver fibrosis.