An innovative method of synthesis of polyamidoamine nanoparticles

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Purpose

Polyamidoamines (PAAs) are a family of hydrophilic polymers with positive charge. Many bioactive molecules can be incorporated into polymeric backbones of PAAs to produce biocompatible and biologically active polymers. However, only few studies have been performed to synthesize PAA nanoparitcles (NPs). Here, we report a novel synthesis method of PAA NPs by using photocrosslinking. The final formulation eventually led to NPs having all necessary properties to deliver therapeutic compounds.

Methods

The synthesis was performed in HEPES buffer (10 mM, pH=7.4). PAA oligomers were mixed with human serum albumin (HSA) solution in the presence of fluorescein isothiocyanate (FITC) and Irgacure 2959 photoinitiator. The final mixture was exposed to ultraviolet irradiation (UV, 365 nm) for 10 minutes. The NPs were characterized by confocal laser scanning microscopy (CLSM), scanning electron microscopy (SEM) and dynamic light scattering spectroscopy (DLS). Influence of PAA NPs on cell viability was determined by MTT assay.

Results

When positively charged PAA oligomers and negatively charged HSA molecules were mixed, there were electrostatic interactions between them. In this way nanoggregates were formed. The exposure of these nanoaggregates to long-wave UV light made the double bonds at both ends of PAA oligomers to crosslink to each other and allowed the formation of stable NPs with low polydispersity. DLS characterizations revealed that after the UV exposure there were considerably more NPs having size of 100-300 nm. CLSM images showed that FITC was encapsulated into the NPs. SEM images demonstrated that the NPs were spherical and also confirmed the DLS results. Furthermore, MTT assay showed that the NPs were not toxic.

Conclusions

In this study we describe an innovative way of synthesis of PAA NPs by using a photocrosslinking method. This method is simple and can be easily scaled up. Additionally, it allows avoiding the use of toxic organic solvents making sure that final NPs are completely biocompatible. Further studies are planned to study the PAA NPs in biological systems.