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The effect of different charge ratios of PAMAM dendrimer on the physicochemical and biological properties of pEGFP-C1 nanoparticles

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Background and Amis: The present study was designed to explore the physicochemical properties of prepared nanoparticles of different nitrogen to phosphate (N:P) ratios of generation 5 polyamidoamine (G5 PAMAM) cationic dendrimer (5.4nm) and a double-stranded DNA (pEGFP-C1 plasmid). Moreover, the cytotoxicity and transfection efficiency of these nanoparticles were evaluated in cell culture.
Methods: In order to have deeper understanding of physicochemical properties of self-assembled nanoparticles of different charge ratios of G5 PAMAM dendrimer and pEGFP-C1 plasmid, multiple characterization methods including atomic force microscopy (AFM), zeta potential measurement, photon correlation spectroscopy(PCS) and gel electrophoresis analysis, were applied. The transfection efficiency and toxicity of the complexes at different charge ratios were determined using flurescente microscopy and MTT assay, respectively.
Results: AFM and PCS results revealed that in contrast to lower N/P ratios, higher ones especially N/P=10 and 20, were smaller in size and more homogenous in shape. AFM results also showed that the formed nanoparticles were spherical rather than other shapes. The stability of nanoparticles in different charge ratios was investigated using agarose gel electrophoresis, by which the points higher than neutrality, were needed to obtain stable nanoparticles. Cell uptake of nanoparticles showed that by increasing the charge ratios of PAMAM to DNA, the large number of plasmid will be transfected. The results were comparable to a commercial transfection reagent such as Lipofectamin 2000. Moreover, this investigation showed that the cytotoxicity of nanoparticles was quite dependent on the charge ratio of the PAMAM dendrimer and nanoparticle cytotoxicity was not affected by DNA concentration.
Conclusions: These findings confirm that G5 PAMAM dendrimer exibits acceptable biological and physicochemical properties as a nonviral delivery system to carry genes and drugs to their sites of action.

Keywords: PAMAM dendrimer; Cellular uptake; Transfection