

Preparation and evaluation of transfection efficiency of binding carbon nanotube to aptamer in breast cancer cell line

S. Taghavi^{1,*}, M. Ramezani¹, K. Abnous²

¹*School of Pharmacy, Buali Research Institute, Mashhad University of Medical Science, Mashhad, Iran*

²*School of Pharmacy Mashhad University of Medical Science Mashhad, Iran*

Background and Aims: MUC1 protein is an attractive target for anticancer drug and gene delivery owing to its overexpression in most adenocarcinomas. In this study, a reported MUC1 protein aptamer is exploited as the targeting agent of a nanoparticle-based gene delivery system. MUC1 aptamers were conjugated to the particle surface. These particles were based on single wall carbon nanotube (SWNT). Carbon nanotubes (CNTs) were reported to interact strongly with various biological systems and increase the activity of various drugs used in cancer treatment.

Methods: Nanoparticles based SWNT were synthesized and functionalized with polyethylene glycol (PEG) and then grafted to PEI. A bioconjugate composed of nanoparticles and aptamers was synthesized and examined its efficacy for targeted delivery to breast cancer cells.

Results: The results of EtBr exclusion analysis indicated that all vectors prepared in this study were able to efficiently bind plasmid DNA. There is enough positive charge on all of the nanoparticles. This positive charge facilitates electrostatic association of the nanoparticles with the negatively charged membranes of cells. Bioconjugate composed of nanoparticles and aptamer showed good transfection of pRL-CMV in MCF7 cells and no transfection in negative control cells.

Conclusions: Results showed that by grafting PEI alkylcarboxylate derivatives to f-SWNT-PEG transfection efficiencies increase, which are much greater than 10 kDa PEI. The most probable reasons for the improved transfection efficiency are a more favorable hydrophobic – hydrophilic balance. The assay demonstrated that bioconjugate composed of nanoparticles and aptamer had great transfection in MCF7 cell because of MUC1 receptor on MCF7. In summary, aptamers are quickly emerging as a powerful class of ligands with utility in therapeutic applications. Specialized delivery vehicles that use these molecules for targeted delivery will likely have a role in future therapeutic modalities.

Keywords: Aptamer; Carbon nanotube; Gene delivery