Personalized Medicine: A Novel Quantum Dot Bioconjugate Targeted Cancer Therapy

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A novel nanoparticle (NP) targeted cancer therapy with personalized medicine applications is described. A NP concept, applying biologically compatible quantum dots (QDs), was created for cancer therapeutics. Estimates show that over 14 million new cases of cancer are diagnosed annually worldwide. Aptamer-quantum dot (APT-QD) bioconjugates were synthesized by conjugating cadmium-telluride QDs (semiconductor NPs) to aptamers (nucleic-acid based ligands) by amide crosslinking. Aptamers targeted MUC1, a protein overexpressed on the surface of many cancers, including MCF7 breast cancer cells, and showing low expression in MCF10A non-cancerous cells. APT-QD and unmodified QD treatments (the control) were tested for cellular uptake and cytotoxicity. An MTT assay, which measures viability by assessing mitochondrial activity, was used for dose-response analysis at several treatment concentrations in MCF7 and MCF10A cells. APT-QDs caused a statistically significant decrease in viability in MUC1-overexpressing cells, suggesting internalization by receptor-mediated endocytosis, whereas QDs had a negligible impact. Apoptosis and necrosis were analyzed using an Annexin V/DAPI assay; APT-QD treated cells were early apoptotic after 4 hours, proving effective initiation of programmed cell death. Confocal microscopy was used to analyze aptamer-dependent NP internalization, showing that APT-QDs accumulate outside of nuclei. An aptamer-QD colocalization experiment proved that both components show effective endosomal escape. The NP has applications in RNA interference and personalized medicine, to diversify targeting based on patient-specific panomics analyses. The researcher created a novel quantum dot nanoparticle and has proven many viable applications in targeted cancer therapeutics.

Awards Won:

Fourth Award of $500