Synthesis, Characterization and in vitro Cytotoxicity of Tunable Sized Chemo-PTT Combination Nanomedicines For Cancer Therapy

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Photothermal therapy (PTT) has caught attention as a treatment for cancer due to its high control, noninvasiveness, and negligible side effects. However, PTT drugs require a vessel for nanodrug delivery. This limitation could be addressed through combinational cancer therapy, where more than one mechanism is combined to treat tumors. However, the organic synthesis of combinational cancer drugs is multi-step, expensive, and time consuming. Herein, a facile, single-step ionic exchange method is introduced for the synthesis of two carrier-free combination drugs, [P66614][IR820] and [P66614][IR783], by combining a chemotherapeutic ion (chemo) with a photothermal agent (PTT). After the synthesis of a combination drug, the reprecipitation method was used to synthesize different sized nanoparticles in order to attain selective toxicity and minimum drug resistance as well as to investigate the most ideal chemo-PTT nanoparticle size in terms of cytotoxicity. Characterization of ionic chemo-PTT nanomedicines through singlet oxygen quantum yield and light to heat conversion efficiency suggested that the addition of chemotherapy to PTT enhanced the nanodrug. In vitro cytotoxicity of chemo-PTT nanomedicines investigated in both dark and light conditions in the human breast cancer cell line (MCF-7) showed that combined chemo-PTT nanoparticles displayed lower IC50 values of 3.92 and 2.17 than both the chemotherapeutic (6.41) or photothermal (8.26 and 51.41) parent compounds individually, due to a synergistic effect of the combined therapies and nanoparticle formation. Additionally, the larger ionic chemo-PTT nanodrugs surprisingly exhibited lower cell viability than the smaller nanoparticles, suggesting greater cytotoxic effect.

Awards Won:

Arizona State University: Arizona State University ISEF Scholarship

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