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Hybrid magnetic nanoparticles mediated trimodal lethality: Chemotherapy, photothermal therapy and magnetic hyperthermia

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Hybrid Magnetic nanoparticles (HMNPs) have emerged as one of the significant futuristic nanomaterial for a variety of biological applications. The next generation hybrid MNPs with designer theragnostic functionalities has attracted considerable attention and will greatly improve nanomedicine. Among the nanomaterials, gold and iron oxide are two potential nanomaterials, whose inherent properties offer numerous applications when combined together. In this work, well-dispersed HMNPs based on gold and MNPs encapsulated in PLGA nanoparticles (Au-MNP-PLGA) have been developed and conjugated with three different targeting ligands. Two potential anticancerous drugs (curcumin and gemcitabine) were also loaded into the nanostructure, which can mediate chemotherapy. With the active targeting through three different targeting ligands and the incorporation of two active drugs and Au-MNPs, the nanoconjugate was exploited for three different modes of cancer cell destruction. The first one was action of cytotoxic drugs. Because the NP was triple targeted, it augments the uptake of NP by cancer cells thus resulting in the damage of cancer cells by drug-mediated cytotoxicity. Second mode of cell destruction was the photothermal ablation of cancer cells by the MNP and Au component of HMNP. The cells are pretreated with nanoconjugate and irradiated with NIR, 800 nm, which triggers the generation of heat by MNPs and also owing to the surface plasmon resonance effect of Au, collectively resulting in the photothermal ablation of cancer cells. The third mode of cellular ablation was by MHT, exploiting the magnetic component of HMNP. The exposure of cancer cells in the presence of an external magnetic field; also triggers the release of drug from PLGA NPs and thus MHT can promote drug delivery into tumor, and increase the drug toxicity.

Biography

Balasubramanian Sivakumar has completed his PhD in Bio-Nano Science Fusion Course from Toyo University, Japan. Currently, he is working as Postdoctoral Researcher in Bio-Nano Electronics Research Center, Toyo University, Japan. His area of specialization is magnetic nanoparticles and the application of the same for efficient targeting, drug delivery, imaging, magnetic hyperthermia and photothermal ablation of cancer cells. He has published several papers in reputed journals.

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