Simultaneous delivery of the protein and anti-Cancer drug for the treatment of bone cancer using ceramic-polymer hybrid nanoparticles

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Delivery of multiple drugs has gained considerable attention in recent years especially for the repair and regeneration of hard tissue as in the case of bone tumors. Various kinds of ceramic nanoparticles (NPs) were studied as bone graft substituents and drug delivery vehicles. Among them calcium phosphate ceramic (CPC) NPs were much focused due to their unique advantages such as biocompatibility, bioactivity, affinity to biopolymers and high osteogenic potential. CPC forms the major mineral component of the bone and has been extensively used as a carrier for delivery of small molecules, growth factors and for tissue engineering and orthopedic applications. Local delivery of chemotherapeutic agents is preferred for the treatment of metastatic bone cancer in comparison with systemic administration. Co-delivery of a protein and an anti-cancer drug is a challenging approach in bone tissue engineering as well as drug delivery. Our current study focuses on developing model ceramic-polymer hybrid NPs for the treatment of bone cancer. Ceramic core with polymer corona hybrid NPs were fabricated and evaluated for the combined delivery of an anti-cancer drug and a protein. Hydroxyapatite NPs were loaded with model protein bovine serum albumin (BSA) and subsequently coated with poly(vinyl alcohol)-methotrexate (MTX) conjugate. The synthesized hybrid NPs were extensively characterized by various techniques such as IR, XRD, NMR, TEM and TGA. The coating efficiency was found to be 10-17%. In vitro drug release performed in phosphate buffer for 2 weeks showed simultaneous release of both MTX (88%) and BSA (76%) in a sustained manner. Human osteosarcoma (OMG-63) cell line was used to check the cytotoxicity and cellular uptake of NPs. The NPs were biocompatible and exhibited anti-proliferative activity in a concentration-dependent manner. Moreover, the NPs showed excellent cellular uptake as confirmed by flow cytometry and fluorescence imaging.

Speaker Biography

Ram Prasad S received B. Pharmacy and M. Pharmacy degree from Madras Medical College, Chennai and currently doing PhD under the guidance of Prof. A. Jayakrishnan (Biotechnology) and Prof T.S. Sampath Kumar (Metallurgical and Materials Engineering) from Indian Institute of Technology Madras, Chennai, Tamilnadu, India. His current research is development of bone void filling materials composed of ceramic polymer hybrid nanoparticles for the delivery of therapeutic molecules.

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