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Cancer nanotherapy: Targeted therapy by using nano-immunotechnology

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Background: Today, hyperthermia is one of several biomedical applications that can be applied alone or as an adjunct to radiation and chemotherapy for the treatment of cancer. By using magnetite nanoparticles in this therapy, the side effect of heat in the normal cells of surround tumor can be reduced. Nanotherapy is used as one of therapeutic top methods in the diagnosis and treatment of cancer. In this method of therapy, the suitable design of nanoparticle surfaces increase differentiation between cancerous and normal cells via nanoparticles. Another therapy method to recognize cancer cells is immunotherapy based on a targeted reaction between the antibody and the target antigen on the surface of tumor cells. In this study, the author has used both of these methods (nano-immunotherapy) as a targeted therapeutic strategy against EGFR receptors in cancer cells.

Methods: Nano-CoFe2O4 particles were synthesized by using an inorganic base, by Chemical Co-precipitation method at high temperatures. Copolymeric coating for surfaces of inorganic NPs was used in this method by PEG-g-Chitosan. First, nanoparticles were coated with layers of chitosan polymer by electrostatic bonds. Then, PEG was grafted on nanocomposites by covalent bond between Cs-NPs and PEG. Functional groups of copolymer surface were conjugated with anti-EGFR nanobodies (the existing protein in our laboratory) against the EGFR receptors on cancer cells by heterolinkers of SIA-SATA (Amine-to-Sulfhydryl).

Results: The rapid growth of Superparamagnetic Cobalt Ferrite NPs in very short time was formed by the simple method with the certain molar concentration of Co2+ in 3M NaOH at 100°C. Accordingly, monodisperse particles, high colloidal stability and superparamagnetic properties were observed in 12 nm as-synthesized CoFe2O4 NPs. The modification of NP surface was done by grafting of oxidized PEG onto the Cs backbone based on structure and physiology of tumor cells. In vivo, magnetic nano therapy is successful if the hydrodynamic sizes of NPs between 10 and 100 nm and maximize blood half-life of NPs. The hydrodynamic diameters of synthesized PEG-g-Cs-CoFe2O4 NPs were between 50-100 nm by DLS. Also, the negative and positive charge of copolymer coating improves blood half-life of NPs. Ionic charge of copolymer increases the distribution of nanoparticles throughout the tumor environment and cationic charge improves the uptake of nanoparticles in cancer cells. PEG-g-Cs-CoFe2O4 NPs were conjugated with the nanobody (Anti-EGFR/ the existing protein in laboratory) for the increase of targeted therapy, via iodoacetate and sulfhydryl linkages. TEM, DLS, XRD, IR and VSM analyzed the properties of CoFe2O4 and PEG-g-TMC-CoFe2O4 NPs. BCA protein assay determined the concentration of conjugated nanobodies.

Conclusion: Results showed that, CoFe2O4 with 12 nm were synthesized by appropriate anisotropy and coercivity instead of iron-oxide NPs (made in our laboratory) with low coercivity in the same size. Thus, this nanoparticle can be applied for MRI and thermal therapy. Also, the amino and hydroxyl groups of copolymer can be utilized as a label with fluorescent dye for optical detection or a linker for drug delivery for treatment of tumor types by covalent bonds or by weak interactions. This polymer nanocomposites can be used for selective and targeted therapy of cancer via targeted nanobody that recognize tumor antigens on the cancer cells in early diagnosis, staging, and treatment of cancer.

Biography

Narges Pourbagher is an MSc student of Cellular & Molecular Biology at Islamic Azad University of Iran. She is currently Research Assistant at Biosensor Research Center, Endocrinology and Metabolism Molecular-Cellular Sciences Institute, Tehran University of Medical Sciences, Tehran, Iran. She has experience in synthesis of gold NPs, magnetic NPs, and the design of biosensor. She has synthesized and designed CoFe2O4 and MnFe2O4 to targeted therapy with Magnetic Fluid Hyperthermia (MFH) for her thesis.

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