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FLOWER-SHAPED MAGNETIC NANOPARTICLES FOR THERANOSTIC APPLICATIONS

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Abstract

Iron oxide-based magnetic nanoparticles (MNPs) are promising candidates for dual radiation and magnetic hyperthermia cancer therapy (MHT). Although iron oxide nanoparticles are currently approved by FDA for imaging purposes and for the treatment of anaemia, magnetic nanoparticles designed for the efficient magnetic hyperthermia cancer treatment must respond to specific physicochemical properties in terms of magneto-energy conversion, heat dose production, surface chemistry and aggregation state. In the past few decades, these requirements have boosted the development of a new generation of MNPs specifically aimed for MHT. Between various synthesis pathways, specific assembly of small nanoparticles into flower-shaped structures, achieved in polyol-mediated synthesis opened new avenues for MNPs hyperthermia cancer treatment. High heat generation in MHT was most-probably a consequence of the specific organization and agglomeration of individual cores inside each particle and their interaction in external alternating magnetic field. When we add to that, low cytotoxicity, the possibility of surface modification and further functionalization, then polyol-prepared MNPs emerge as one of the best candidates for combined cancer therapy. In our recent studies, we have coated magnetic nanoflowers prepared by polyol-mediated synthesis with various organic ligands (citric acid, polyethylene glycol, (3-aminopropyl)triethoxysilane) and successfully radiolabelled them with high-energy beta emitters ⁹⁰Y, ¹⁷⁷Lu and ¹³¹I, as well as gamma emitter ^{99m}Tc, which can be used both as therapeutic and diagnostic agents. Finally, we have successfully applied these magnetic nanoconstructs in combined magnetic hyperthermia-radionuclide nanobrachytherapy of CT-26 mouse colon and 4T1 metastatic mouse breast tumours.

Keywords: Magnetic nanoparticles, polyol synthesis, cancer therapy, magnetic hyperthermia, radiolabelling.