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Liposomes loaded with hydrophilic magnetite nanoparticles: Preparation and application as contrast agents for magnetic resonance imaging

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ABSTRACT

Magnetic fluid-loaded liposomes (MFLs) were fabricated using magnetite nanoparticles (MNPs) and n ural phospholipids *via* the thin film hydration method followed by extrusion. The size distribution a composition of MFLs were studied using dynamic light scattering and spectrophotometry. The effect ranges of magnetite concentration in MNPs hydrosol and MFLs for contrasting at both T_2 and T_1 relaxat were determined. On T_2 weighted images, the MFLs effectively increased the contrast if compared w MNPs hydrosol, while on T_1 weighted images, MNPs hydrosol contrasting was more efficient than t of MFLs. *In vivo* magnetic resonance imaging (MRI) contrasting properties of MFLs and their effects tumor and normal tissues morphology, were investigated in rats with transplanted renal cell carcino upon intratumoral administration of MFLs. No significant morphological changes in rat internal org upon intratumoral injection of MFLs were detected, suggesting that the liposomes are relatively safe a can be used as the potential contrasting agents for MRI.

1. Introduction

Theranostics, a new area in biomedical science combining both diagnostic and therapeutic functions in a single entity, is attracting researchers' attention worldwide [1]. Theranostics is focused on fabrication of functional tools combining the diagnostic and therapeutic functions. The concept of theranostics is fully met by nanosized magnetic particles, which have been demonstrated to be a potent means for tumor tissue targeting, local hyperthermia-based therapy [2] and for MRI diagnostics [3–5].

Particularly, the remote heating of magnetic nanoparticles in tissues can be induced by the alternating magnetic field at a few hundreds kilohertz [6]. Among others, magnetite nanoparticles are the promising nanomaterial for biomedical applications, since they exhibit both the high values of magnetic permeability and the relatively high biocompatibility, and have been actively used in inorganic composite fabrication [7]. Noteworthy, the synthesis a surface modification of magnetite nanoparticles can be achiev through the easy and straightforward facile techniques [8]. N mally, the magnetite nanoparticles change transverse relaxati time T_2 and significantly increase the targeted tissue contrast MR images [5,9].

The increase of nanoparticle circulation time in blood wou facilitates the biomedical applications of MNPs through the acc mulation of the therapeutic dose in the target tissue and implementing the targeted and controllable delivery. Incorpo tion of magnetic nanoparticles into liposomes can be an effect route to promote the MNPs-based vehicles for targeted delivery MRI-enhancing agents [10].

Typically, two types of magnetic liposomes are produced: t classical small-sized magnetic liposomes containing the magne "core" (∼15 nm) covered with the (phospho) lipid bilayer, a the large unilamellar magnetic liposomes (∼100–500 nm) beari the magnetic nanoparticles in the internal aqueous compartme (magnetic fluid-loaded liposomes or MFLs) [1,11]. The large un amellar liposomes are more susceptible for directed navigati

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