An anovel multifunctional dendrimer-based nanoparticles for in vivo MRI/CT dual modal molecular imaging of breast cancer

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Abstract: We report a new use of multifunctional dendrimer-based gold nanoparticles as a MRI/CT dual modality contrast agent for in vivo molecular imaging of breast cancer. Amine-terminated generation 5 poly(amidoamine) (PAMAM) dendrimers were multifunctionalized through grafting gadolinium chelate DOTA-NHS and *m*PEG-COOH onto their surface. With this functional dendrimers as templates, gold nanoparticles were prepared with sodium borohydride reduction chemistry, and then Gd(Ⅲ) was chelated into DOTA molecules on the dendrimer surface. Using an acetylation reaction to neutralize the positive surface potential of the remaining amine groups, we got the multifunctional dendrimers containing $\{(Au^0)_{250}$–G5-DOTA$(Gd^{Ⅲ})_{10}$-PEG_{20}-Ac$\}$ nanoparticles (G5-Gd/Au NPs).The formed G5-Gd/Au NPs were used for both in vitro and in vivo MRI/CT imaging of a human breast adencarcinoma cell line (MCF-7 cells). Both MRI and CT images show that MCF-7 cells can be detected after incubation with the synthesized G5-Gd/Au NPs in vitro and the xenograft tumor model can be imaged after introvenous administration of the G5-Gd/Au NPs. Transmission electron microscopy (TEM) data further confirm that the G5-Gd/Au NPs are able to be uptaken dominantly in the lysosomes of the cells. The cell cytotoxicity evaluated by MTT cell viability assay along with cell morphology observation and flow cytometric analysis of cell cycle show that the G5-Gd/Au NPs do not appreciably affect the cell morphology, viability, and cell cycle, indicating their good biocompatibility at the given concentration range. Findings from this study indicate that the G5-Gd/Au NPs are be amenable for a dual modality imaging contrast agent for MRI and CT imaging of cancer cells.