Gold nanoparticles allow detection and photothermal ablation of vascular macrophages

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Introduction: Macrophages are important targets for detection and therapy of vascular inflammation. Gold nanoparticles (GNPs) are available for computed tomography (CT) and photothermal ablation. We have shown that GNPs are taken up by vascular macrophages. We evaluated GNPs for CT imaging and photothermal ablation of vascular macrophages.

Methods: Mouse macrophage cells (RAW 264.7) were incubated with and without 100 μg Au/ml of GNPs (AuroVist™ 15 nm, Nanoprobes, Yaphank, NY) for 24 hours. Ten million cells in each group was exposed to near-infrared (NIR) laser (830 nm, pulse width 200 femtosecond) for 10 or 20 minutes at 400 mW, followed by incubation of cells for 24 hours. Cell viability was evaluated by MTT assay. Male apoE-deficient mice were subject to continuous angiotensin II infusion via subcutaneous implanted osmotic mini-pumps (N=9) for 2 weeks. Mice were injected intravenously with GNPs (5 mice: 10 mg Au/mouse (low dose), 2mice: 20 mg Au/mouse (high dose), 2 mice: no injection (control)) and scanned with micro-CT imaging system (LaTheta LCT-100A, Hitachi-Aloka, Tokyo) up to 48 hours. After in vivo imaging, ex vivo imaging was performed.

Results: Short NIR exposure did not induce cell death of cells with and without GNPs. However, long NIR exposure demonstrated significant reduction of cell viability in cells with GNPs compared to those without GNPs ($p<0.003$). In vivo CT imaging showed that the CT values of adventitia in mice injected with GNPs were significantly greater compared to control at 24 and 48 hours ($p<0.0001$), although the CT values of adventitia were similar in low dose and high dose groups. Ex vivo imaging showed that the CT values of adventitia in mice injected with GNPs (N=4) was higher than those in mice without GNPs (N=2).

Conclusions: GNPs provide a multifunctional platform for CT imaging and photothermal ablation of vascular inflammation.