

Influence of surface coating of gold nanocubes on oxidative stress, mitochondrial injury and autophagy

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Abstract

Nanoparticles have attracted great attention in biosensing, biomedical imaging and therapeutic applications. Among these nanoparticles, gold nanocubes (AuNCs) have been used as imaging probes for biomedical imaging due to their excellent optical properties, such as high photoluminescent quantum yield. More recently, nanoparticles from various sources have been reported to induce a lysosome-based degradative pathway, called autophagy. However, how the physicochemical properties of the nanoparticles influence autophagy is still not clear. In this study, we focus on studying surface chemical modification of AuNCs affecting the induction of autophagy in the macrophage cell line RAW264.7. We synthesized AuNCs (50nm)³ using a CTAB-based synthesis method and coated them with different chain length PEGs to replace the CTAB coating. The AuNCs were characterised with SEM and UV-Vis spectrometry. The effects of CTAB-, short chain PEG-, and long chain PEG- AuNCs on cell viability were compared using the MTT assay, and these data suggested that CTAB-AuNCs are more cytotoxic. Induction of oxidative stress and mitochondrial injury was also observed in CTAB-AuNCs, but such adverse effects were much less pronounced for PEG coated particles. In addition, autophagy markers LC3 and p62 were analysed with confocal microscopy and western blotting. Both increased LC3-II level and blocked p62 degradation indicated increased autophagy by CTAB-AuNCs. In conclusion, CTAB-AuNCs are more toxic to RAW264.7 cells than PEG-AuNCs, and may act through oxidative stress, mitochondrial injury and autophagy. This study has shown the importance of surface modification of AuNCs for biomedical applications.