Potential Medical Applications of Ultra Small Copper Oxide Nanoparticles

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Due to the deficient structure of the cancerous vasculature system, nanoparticles hold a great promise for increased tumor permeability [1]. In the medical imaging arena, several nano-based contrast agents were previously approved for clinical use [2], yielding enhanced detection of the pathological tissue. Extensive efforts are continuously taken to further incorporate nano-based materials for various medical imaging modalities. In the therapeutic arena, a growing field of interest is the utilization of nano-scaled complexes as thermal treatment enhancers [3]. In such procedures, a semi-invasive or an utterly noninvasive energy applicator is used to heat the cancerous tissue. This may improve the efficiency of chemotherapy or radiotherapy, or completely ablate the tumor tissue.

Copper oxide nanoparticles (CuO-NPs) were recently demonstrated as capable of inducing tumor cell death using *in vitro* and *in vivo* models [4]-[6]. Herein, we shall describe our recent efforts to incorporate copper oxide based nanomaterials for additional and multiple medical applications. The main goal of the research was to investigate whether these nanoparticles may also serve as an imaging contrast agent and therefore, be monitored during their therapeutic application. Seven nanometer in diameter CuO-NPs were synthesized and their properties characterized. The particles improved magnetic resonance imaging (MRI) contrast (e.g., in figure 1), based on the longitudinal magnetic relaxation time property. The CuO-NPs were also well visualized using ultrasound, thus, providing a multimodal imaging capability [7]. Using a unique approach, termed through-transmission ultrasonography, the particles were also useful for cancer thermal treatments image monitoring, when performed using a minimal-invasive microwave applicator [8]. In conclusion, CuO-NPs hold a unique potential to serve as an imaging-therapeutic combined nano-material.

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Figures

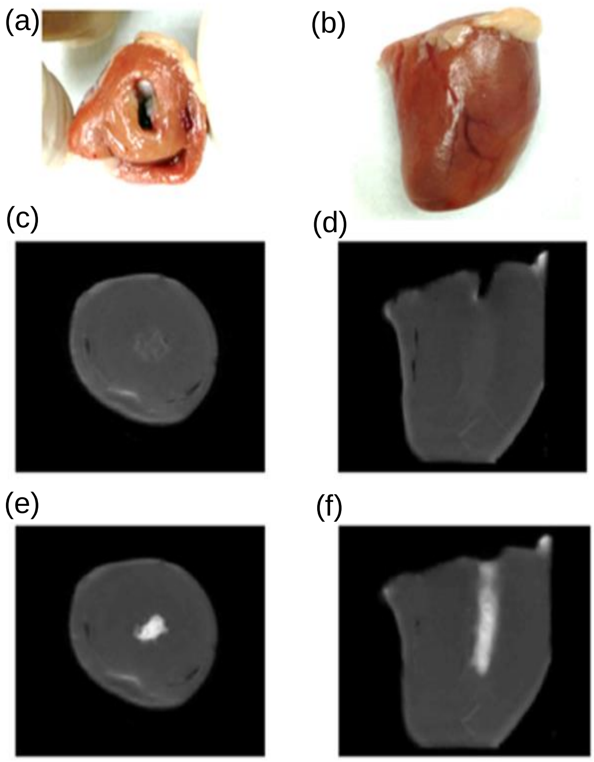

Figure 1. Magnetic resonance imaging (MRI) of an *ex vivo* poultry heart injected with copper oxide nanoparticles. (a)-(b). Top and frontal views respectively of the imaged specimen. (c)-(d). Axial and coronal MRI images respectively of the left ventricle, as the chamber was filled with water. (e)-(f). Axial and Coronal MRI images respectively of the left ventricle, after injecting copper oxide nanoparticles into the chamber.