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Bismuth sulphide nanoparticles as theranostic agents for X-ray computed tomography imaging (CT) and radiotherapy

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The application of nano-materials and nanoparticles for medical imaging, including computed tomography (CT) imaging, promises to overcome many of the shortcomings of traditional contrast media. In addition, nanoparticles have been shown to enhance the delivered dose in external beam radiotherapy. The optimal nano-particulate agents need to have a high X-ray attenuation and absorption coefficients, low toxicity, a long blood circulation time, and be cost effective. The purpose of this research is to develop a nanoparticle theranostic agent and test it in currently used clinical procedures, including: (i) diagnostic CT imaging in order to enhance the device sensitivity and local CT numbers through enhancement of the target absorption, increasing the chance of identifying diseases, and; (ii) radiotherapy in order to enhance the effects of radiations on the target tissue. In this study we use bismuth sulfide nanoparticles ($Bi2S_3$ NPs) that are non-toxic and one of the least expensive heavy metal-based nanoparticles. In addition, Bi2S3 NPs improve X-ray attenuation and absorption, making them promising theranostic agents. In this presentation, we will focus on the synthesis and characterization of the $Bi2S_3$ NPs, as well as their cytotoxicity with lung adenocarcinoma epithelial cells (A549). The $Bi2S_3$ NPs and conventional iodinated contrast agents were evaluated and compared for contrast enhancement at an X-ray tube potential of 140kVp. The dose enhancing effects of $Bi2S_3$ NPs on A549 cells were examined at KV and MV energies. The preliminary results reveal that $Bi2S_3$ NPs possess superior attenuation with CT compared to iodine contrast reagents. The NPs also show radio-sensitization with cells, displaying dose enhancement at the KV range of X-ray energies and also, to a lesser degree, at the MV ranges. Therefore, $Bi2S_3$ NPs can be considered as valuable theranostic agents.

Biography

Merfat Algethami graduated with a Master's degree in Medical Physics from Queensland University of Technology (QUT) in 2012. In 2013, she started PhD degree in the discipline of Medical Radiations at the School of Health and Biomedical Sciences at RMIT University. The focus of her research is radiation dose enhancement by bismuth-based nanoparticles.

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