Cherenkov Luminescence Imaging of ^{90}Y and nanoparticles loaded glass microspheres

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Background: Post- Transarterial Radioembolization (TARE) imaging is usually employed to check the extrahepatic uptake and the quantification of the delivered dose in TARE. ^{90}Y is a pure beta emitter, and post-treatment imaging by nuclear medicine modalities is a significant challenge. Recently, Cherenkov Luminescence Imaging (CLI) have used as a new technique for ^{90}Y imaging. Although this new technique is simple and resolves some limitations with the current nuclear medicine systems, the short penetration range and low light yield limit its application. This work aimed to investigate the possibility of using CLI for post-TARE imaging and overcome CLI resections by incorporating TiO_2 nanoparticles (NPs) into the glass microspheres.

Material and Methods: The Monte Carlo codes GATE (version 9) and GEANT4(version 10.6) were used to simulate the CLI. The TiO_2 NPs (100 nm diameter) at the concentration of 0, 1.2 mol/L, 2.4 mol/L, and 4.8 mol/L were modeled randomly distributed in ^{90}Y-loaded glass microspheres. The emitted Cerenkov radiation spectra from the glass microsphere were calculated using GEANT4(Figure 1). The acquired spectra were distributed uniformly in the liver tumor of the MOBY mouse phantom. The Cherenkov luminescence images of the tumor were acquired using GATE (Figure 1). The quality of acquired images was evaluated by calculating intensity and Coefficient of Variance (CV).

Preliminary results: The *in silico* results showed that intensity values of Cherenkov luminescence images increased significantly as the TiO_2 NPs concentration increased in the glass microspheres. The CV values decreased as the TiO_2 NPs concentration increased in the glass microspheres. The maximum CV reduction was observed at the TiO_2 NPs concentration of 4.8 M (»15%). Our study has provided evidence that incorporating TiO_2 NPs into the glass microspheres improves the quality of Cherenkov luminescence images by increasing the light yield.

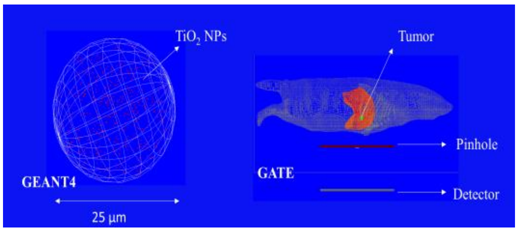

Figure 1: The geometry of the modeled glass microsphere and CLI