Monitoring tumor size using PET with a collimator during boron neutron capture therapy: Simulation study

Department of Biomedical Engineering and Research Institute of Biomedical Engineering, College of Medicine, Catholic University of Korea, Seoul, 06591, Korea

Hye Jeong Yang, Do-Kun Yoon, and Tae Suk Suh

Purpose: The purpose of this study was to demonstrate the feasibility of sensing changes in a tumor during boron neutron capture therapy (BNCT) using a Monte Carlo simulation tool.

Materials and Methods: In the simulation, an epi-thermal neutron source and a water phantom including boron uptake regions (BURs) were simulated. Moreover, this simulation also included a detector for positron emission tomography (PET) scanning and an adaptively-designed collimator (ADC) added to PET's gantry. The projection acquisition was obtained before and during treatment. The modified OSEM reconstruction method was used to reconstruct all images and then the image profiles were collected to analyze quantitatively.

Results: Single prompt gamma rays were collected through the ADC into a neutron beam. Then, single prompt gamma ray-based tomography images were acquired of variably sized tumors by a four-step process. Both the signal-to-noise ratio (SNR) and tumor size were analyzed from each step image. From this analysis, we identified a decreasing trend of both the SNR and signal intensity as the tumor size decreased, which was confirmed in all images.

Conclusions: In conclusion, we confirmed the feasibility of sensing changes in a tumor during BNCT using PET and an ADC through Monte Carlo simulation.

Keywords: Boron neutron capture therapy, PET, Adaptively-designed collimator