AbstractID: 6744 Title: The development and validation of an image-based dosimetry system for ⁹⁰Y microspheres used to treat hepatic tumors

Purpose: To develop and experimentally validate an image-based dosimetry system for determining the three-dimensional (3D) dose distribution from ^{90}Y microspheres used to treat hepatic tumors.

Method and Materials: A rapid, efficient, and stable batch technique was used to label yttrium-loaded microspheres with ^{18}F. These ^{18}F-labeled microspheres served as surrogates for ^{90}Y-labeled microspheres. ^{18}F and ^{90}Y microspheres were coinjected into a gel-based phantom and the ^{18}F activity distribution was determined using a GE Discovery LS PET/CT scanner. The activity distribution was converted from ^{18}F to ^{90}Y by applying a precise activity ratio, which was determined using germanium detection and a low uncertainty ^{90}Y positron branching ratio. To calculate the dose, the image data was convolved with a ^{90}Y dose point kernel using 3D-ID software. This dose was compared to the dose measured in the central plane using HD-810 radiochromic film and a new film protocol. The film protocol and the gel-based phantom were validated using a single ^{90}Sr/^{90}Y source seed. The film was calibrated using two NIST-traceable ^{90}Sr ophthalmic applicators and was analyzed using a flatbed scanner in reflective mode. Additionally, the image-based dose to the entire gel phantom was compared to a Monte Carlo-derived dose.

Results: The image-based (3D-ID) dose in the central plane was 90.20 Gy ± 6% and the film measured dose was 90.64 Gy ± 5%. A mean phantom dose of 74.30 Gy ± 6% and 74.70 Gy ± 2% was determined using 3D-ID and Monte Carlo, respectively. Overall, these results agreed to within 0.5%. The image-based *in vivo* dose volume histogram (DVH) for this study was in excellent agreement with the film measured DVH.

Conclusion: Through the implementation of ^{18}F-labeled microspheres, a precise non-destructive assay of ^{90}Y, and a validated film protocol, a new image-based dosimetry system for ^{90}Y microspheres was experimentally validated.