**AbstractID: 6744 Title: The development and validation of an image-based dosimetry system for $^{90}\text{Y}$ 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 $^{90}\text{Y}$ microspheres used to treat hepatic tumors.

**Method and Materials:** A rapid, efficient, and stable batch technique was used to label yttrium-loaded microspheres with $^{18}\text{F}$. These $^{18}\text{F}$-labeled microspheres served as surrogates for $^{90}\text{Y}$-labeled microspheres. $^{18}\text{F}$ and $^{90}\text{Y}$ microspheres were coinjected into a gel-based phantom and the $^{18}\text{F}$ activity distribution was determined using a GE Discovery LS PET/CT scanner. The activity distribution was converted from $^{18}\text{F}$ to $^{90}\text{Y}$ by applying a precise activity ratio, which was determined using germanium detection and a low uncertainty $^{90}\text{Y}$ positron branching ratio. To calculate the dose, the image data was convolved with a $^{90}\text{Y}$ 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 $^{90}\text{Sr}/^{90}\text{Y}$ source seed. The film was calibrated using two NIST-traceable $^{90}\text{Sr}$ 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 $^{18}\text{F}$-labeled microspheres, a precise non-destructive assay of $^{90}\text{Y}$, and a validated film protocol, a new image-based dosimetry system for $^{90}\text{Y}$ microspheres was experimentally validated.