

AbstractID: 11330 Title: Novel Post-lumpectomy Breast Cancer Brachytherapy with the Capability of Simultaneous Focal Lymph Node Irradiation

Purpose: A new technique of post-lumpectomy breast cancer brachytherapy using beta-emitting therapeutic radionuclides, rhenium-188 (Re-188) and rhenium-186 (Re-186), carried within lipid nanoparticles (liposomes) was investigated. This therapy strategy is advantageous regarding: 1) mm-range focal radiation by beta-particles ensures localized brachytherapy; 2) sustained high local retention within the lumpectomy cavity and accumulation in associated lymph nodes enables simultaneous cavity and lymph node focal radiation therapy; and 3) ease and flexibility of this modality to treat various locations and cavity shapes in the breast with minimal invasiveness.

Method and Materials: Breast cancer surgical model in nude rats, gamma camera imaging, and animal organ dissection were used to study local and lymph node retention of radioactive liposomes. EGSnrc Monte Carlo code system was used to compare dose point kernels (DPK) for Re-188 and Re-186 in breast tissue, water, and other soft tissues. The DPK were then used for dose calculations of uniformly distributed liposomal Re-188 or Re-186 injected to the lumpectomy site within ellipsoid and spherical cavities. The dose calculation for lymph nodes modeled as a disk shape with exponentially decreased activity from the cortex was also performed.

Results: High and sustained intracavitary retention of radioactive liposomes accompanied by lymph node accumulation was observed. Different human tissues showed very similar dose curves for Re-188 and Re-186. The therapeutic ranges in the cavity could be about 5 and 2.5 mm with Re-188 and Re-186, respectively, while radiation doses beyond 1 cm sharply dropped to minimal. Also, the entire lymph node could receive therapeutic dose.

Conclusion: The promise of a new post-lumpectomy breast cancer brachytherapy technique is presented. A rapid fall-off in radiation dose with distance allows this treatment modality to spare substantial healthy tissue with reduced complications. It is also favorable through simultaneous focal treatment of microscopic tumor cells spreading to downstream lymphatics.