AbstractID: 4925 Title: Tumor Brachytherapy Using Intratumoral Injection of Beta-Emitting Therapeutic Radionuclides Carried within Nanoparticles

The use of beta-emitting therapeutic radionuclides carried within nanoparticles for brachytherapy potentially offers significantl advantages over sealed sources. By using an active trapping technique, both therapeutic radionuclides, ^{186}Re and ^{188}Re, and diagnostic radionuclides, ^{99m}Tc, can be encapsulated in liposomes with high efficiency and high specific activity. ^{186}Re and ^{188}Re are beta emitters with appropriate ratio and energies of gamma emission which enable the imaging of in vivo distribution with a clinical gamma camera. The 90% absorbed dose deposit distances in soft tissue of beta ray from ^{186}Re and ^{188}Re are 1.8 mm and 4.2 mm respectively. To study the potential of using therapeutic radionuclides carried within liposomes for tumor brachytherapy, the intratumoral distribution and retention of ^{99m}Tc-liposomes in head and neck squamous cell carcinoma xenografts in nude rats were determined using imaging with a dedicated dual modality animal micro-SPECT / CT scanner. Using an intratumoral administration technique developed in our lab, the volume of administered radioactivity up to over 40 % of tumor volume can be delivered to tumor with a high local retention. The ^{99m}Tc-liposome studies show that about 40 % of injected activity remained in tumor with a very slow clearance. The cleared activity was not retained in the nearby critical organ. Using pin-hole collimators with a spatial resolution of 1 mm, the ^{99m}Tc-activity had a broad diffusion throughout the tumor even though the injection was at one point within the tumor. This study has shown the potential of using beta-emitting therapeutic radionuclides carried within nanoparticles for tumor brachytherapy. The high intratumoral retention enables a high intratumoral radiation absorbed dose, while the penetration of beta-particles within only a few mm decreases the toxicity to nearby critical organs, and the intratumoral diffusion makes the intratumoral administration simpler and provides for a better intratumoral absorbed dose homogeneity.