AbstractID: 14275 Title: Characterization of Cerenkov Optical Irradiation from radioactive probes in phantoms and living subjects

Purpose: Molecular probes labeled with beta emitters within a medium radiate visible light. A series of experiments were carried out to quantify the optical properties of different radiotracers in optical phantoms and in living subjects to evaluate the potential of this new imaging modality.

Method and Materials: A number of commonly used beta emitters such as ^{18}F, ^{131}I, ^{64}Cu, and ^{90}Y, were first put into small vials with known concentrations and imaged using a Xenogen IVIS 200 optical imager. The photon yields and optical spectra of these samples were measured. The radiotracers were also placed into a tissue-mimicking phantom at a depth of 2 mm and the optical spectrum was studied with a Xenogen IVIS Lumina 2. Radionuclide PET and optical Cerenkov imaging were also done in mice with implanted tumors and the two types of images were registered and compared quantitatively.

Results: Cerenkov photons were observed for all beta emitters and no optical photons were recorded for the pure gamma emitters tested. Among different emitters, electron-emitting ^{90}Y had the highest photon yield (~an order of magnitude higher than that of ^{18}F at the same concentration). Depth studies revealed that the optical signal decays rapidly with the depth of tracer placement, due to the dominant blue emission, indicating that this technique is suitable only for applications of superficial diseases. In vivo mice measurements were consistent with phantom studies and showed the potential of the new optical imaging modality for imaging in living subjects.

Conclusion: The data reported here show the characteristic properties of Cerenkov light emission for radioactive probes and demonstrate its potential for molecular imaging. Combined optical / radionuclide imaging provides a new paradigm for molecular imaging and may provide additional information for *in vivo* biological processes.