AbstractID: 9797 Title: Activity Quantitation and Dose Estimation from Nuclear Medicine Imaging

Because of resistance to chemotherapy and multiple sites of disease, internal emitters are being more frequently used in treating advanced cancer patients. This radiotherapy is predicated upon injection of beta- or alpha-labeled antibodies and other agents that target tumor markers. Most clinical success has occurred in the case of B-cell lymphoma and hepatic lesions. For associated treatment planning, estimate of radiation dose (D) to tumors and normal tissues requires application of the equality D = **S** * Ã where **S** is a rectangular matrix and Ã is a set of total decays for each source tissue. While **S** may be determined via Monte Carlo (MC) methods, Ã requires that the observer integrate time-activity curves for each source. Quantitation of activity at depth in patients has been a continuing problem in nuclear medicine. Multiple methods have been developed ranging from direct counting (surface lesions), through geometric mean estimates (GM) to hybrid techniques (SPECT/CT) involving nuclear and CT scans. In the last strategy, attenuation may be taken directly from the CT data set. Quantitative SPECT (QSPECT) studies typically involve such hybrid imaging techniques and correct for attenuation, scatter, collimator geometry and partial volume effects. Accuracy of these methods, as measured by phantom studies, varies from +/- 30% (GM) to as little as +/- 5% for QSPECT. While PET/CT may also be considered, the limited number of positron emitters causes this application to be more problematic. Time considerations make extensive use of QSPECT difficult. Standard clinical procedure follows Koral et al (Cancer Biother Radiopharm. 2000; 15; 347-355) in combining GM at the requisite multiple time points with an overlap of QSPECT at one time point. The latter study is then used to normalize the geometric mean values and improve quantitation of activity. Finally, we must note that two types of dose estimate are being done: phantom (Type I) and patient-specific (Type II). In the former case, a standard geometry is applied assuming; e.g., the OLINDA program. Here, the patient or volunteer activity integral must be corrected for relative mass differences between phantom and patient. With Type II, the patient's own organ geometry is used to generate an **S** matrix. This may be done directly with MC techniques or a phantom value may be corrected by the target organ mass differences between the phantom and patient. If these corrections are not made, errors in **S** may be on the order of several-fold. Uncertainty in resultant D values is estimated by combining errors in **S** and Ã.

Educational Objectives:

1. Know how to estimate internal emitter doses via D = **S** * Ã.
2. Understand various methods to quantify activity at depth in patients.
3. Realize that both phantom and patient dose estimates are needed.
4. Understand the size of errors involved in dose estimation.