AbstractID: 7894 Title: Determination of Dose to Individual Patients in Radionuclide Imaging Procedures including planar, SPECT, and PET

Patient absorbed dose estimation due to internal emitters requires two separate computations prior to using the D = **S***Ã formula. Here, D is the desired vector of target organ doses, **S** is a rectangular matrix of dose per radiodecay and Ã is a vector of cumulated activity curves for the various source organs in the patient. While **S** may be accessed from tabulations such as the OLINDA program from Vanderbilt University, Ã may be computed only by integrating activity curves A(t) out to sufficiently long times. Several methods are available to determine the activity in a given source organ. One may have tissues or lesions near the surface so as to use inverse square computations. At depth, the observer can use gamma cameras and a geometric mean image (GM), CT assisted matrix inversion (CAMI) or quantitative SPECT imaging. In the latter two cases, hybrid imaging devices such as SPECT/CT make the computations easier since image registration is greatly facilitated. There is also a possibility of PET/CT hybrid images being implemented with the SUV value being used to find the activity at-depth. Lack of suitable positron labels makes PET studies problematic in the case of a general radiopharmaceutical, however. Errors in activity quantitation are typically on the order of +/- 30%, although they can be much larger in geometrically complicated cases. Two types of **S** values are commonly used. In type I computations, **S** refers to a phantom of appropriate size; e.g., adult male or female. Such dose estimates are included in applications to regulatory agencies (e.g. FDA). Additionally, type I results may be used to compare similar radiopharmaceuticals with regard to absorbed dose levels. Both diagnostic and therapeutic radiopharmaceuticals may be of interest. Type II calculations usually refer to a specific patient undergoing internal emitter therapy. Generally, alpha or beta emitters are used in this context. One may use Monte Carlo (MC) methods to find the **S** or correct tabulated phantom **S** elements to those approximating the patient. Since therapy involves short-range emitters, **S** becomes diagonal and the correction is done via; **S**(patient) = **S**(phantom)*organ mass (phantom)/organ mass (patient). Such corrections can be very large **–** on the order of factors of two- or three-fold. Finally, the uncertainty in the dose values may be estimated by combining errors in both **S** and Ã.

Educational Objectives:

1. Understand the matrix equation D = **S***Ã for estimating internal emitter radiation doses to target organs.
2. Know the various methods to estimate source organ activity.
3. Realize that there are two types of calculations for dose; standard phantom or patient-specific.
4. Know how to estimate uncertainties in the dose calculation.