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TISSUE DISTRIBUTIONS OF RADIOPHARMACEUTICALS LABELED WITH POSITRON EMITTERS AND PROBLEMS IN RELATING THEM TO HUMAN STUDIES

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INTRODUCTION

As far as organ distribution is concerned, for a given element or compound it of course makes no difference what the decay characteristics of the labeling nuclide may be. The only unusual but general problem in this area, when dealing with positron emitters, is that very few of the commonly-used nuclides have half-lives greater than 1-2 hours. Therefore, unless the compound can be prepared with a different but longer lived nuclide, in an equally stable position chemically and metabolically, one is forced to do the necessary dissections and counting of samples in a short period of time, keeping accurate track of elapsed time. This problem is exacerbated, in many cases, since more often than not the organ distributions themselves are distinctly time dependent. Therefore a time-averaged distribution must be worked out for purposes of dose calculations. None of this need be of surpassing difficulty, but it usually does require more than normal attention to detail.

In addition the calibration of gamma counters for positron emitters is not generally as simple as is that of longer-lived nuclides. Accurately calibrated, pure positron emitting, standards are not commercially available due to their short-half lives. Furthermore, the settings given for the positron emitters on many commercial dose calibrators are generally not more reliable than about $\pm$ 20% (1).

It is possible to obtain reasonable organ distributions from carefully calibrated positron cameras capable of whole-body scanning, but one must be very careful to correlate organ distributions measured directly with the results obtained from such cameras, and to take into account varying body weights and attenuation factors in interpreting such data. An example of such an approach for $^{13}NH_3$, can be cited here (2).

However, assuming that such considerations are understood properly and that correct results are obtainable, we can discuss some results and generalizations in this area without further concern with the technical aspects of the needed data collection.

There is one major difference between positron emitters and pure photon emitting nuclides with respect to the effect on doses to the various organs. Pure photon emitters deposit relatively little energy in the organ in which they are located, especially at higher energies. However, with positron emitting nuclides essentially all of the energy related to the particle itself is deposited in that organ. The average range of the commonly used positron emitters is 1-4 mm before annihilation takes place, and thus

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