nm/ LETTERS TO THE EDITOR

AVERAGE GEOMETRICAL FACTOR IN ABSORBED DOSE CALCULATION

In the past few years, there has been an increased interest in evaluating the absorbed dose (in either the whole body or in some organ of interest) which a patient will receive as a consequence of the administration of radionuclides in diagnostic and therapeutic procedures.

A recent method for the calculation of these absorbed doses (*1*) which makes use of the quantity "absorbed fraction" first introduced by Ellett, et al (*2*), has been adopted by the Medical Internal Radiation Dose Committee of the Society of Nuclear Medicine. While it seems reasonable to accept this "absorbed fraction" method of dose calculation as being both more general and more accurate than previous approaches, the theoretical limitations ascribed to the most well-known method or "classical" method of dose computation (*3,4*) do not appear to be of practical importance in the clinical situation. We would like to focus our attention on one source of difficulty involved in comparing absorbed doses based on these two methods of computation.

Marinelli, et al (*5*) described this "classical" method of calculating dose due to gamma radiation which included the concept of a geometrical factor, g, with the dimensions of a length. The value of this quantity, averaged over a volume, $\bar{g}$, has been calculated for simple geometrical shapes such as spheres and right circular cylinders. However, $\bar{g}$ values for cylinders published in 1956 (*6*), and quoted elsewhere (*7,8*), have been found to be incorrect (*9*). The 1956 table lists not the average value, $\bar{g}$, but rather is based on calculations for a point on the surface of the cylinder at the end of the axis. Dose calculations based on these $\bar{g}$ values would more nearly represent the minimum rather than the average dose. Therefore Focht, et al (*9*) have published revised average geometrical factors for cylinders which differ appreciably from the earlier tabulations. While Seltzer, et al (*10*) have published $\bar{g}$ values for a few organs which can be adequately represented as spheres, there remained a need for determining $\bar{g}$ values for those organs which are better represented as cylinders.

These considerations have prompted us to calculate $\bar{g}$ values (listed in Table 1) for the major organs of a standard man, based on the organ weights, sizes, and shapes as computed by Snyder, et al (*11*). The organs are represented by either spheres or right circular cylinders. In the case of a sphere, $\bar{g}$ is taken to be $3\pi R$ (*12*) while in the case of a right circular

TABLE 1. AVERAGE GEOMETRIC FACTORS FOR ORGANS OF THE STANDARD MAN

Organ	Weight	Shape	$\bar{g}$
Total body	70,036		126
Brain	1,470	Sphere with 7.1 cm radius	67
Kidney	288	Cylinder of 10 cm height and 3 cm radius	33
Liver	1,833	Cylinder of 12 cm height and 7 cm radius	61
Lungs	999*	Cylinder of 10.76 cm height and 10 cm radius	72
Pancreas	61	Cylinder of 8.5 cm height and 1.5 cm radius	17
Spleen	176	Cylinder of 1.5 cm height and 6.1 cm radius	18
Thyroid	19.9	Cylinder of 2 cm height and 1.8 cm radius	11

* Density of the lungs taken at 0.3.

TABLE 2. RELATIVE ACCURACY OF ABSORBED DOSE USING RECOMMENDED $\bar{g}$ VALUES*

			Absorbed dose rate (mrad/hr)		
Organ	$\bar{g}$ value	Nuclide	"Classical"	MIRD	Difference (%)
Brain	67	^{99m}Tc	83.3	81.2	+2.6
		^{131}I	542.0	542.0	0
		^{197}Hg	190.0	196.0	−3.1
Kidney	33	^{131}I	471.0	479.0	−1.7
		^{197}Hg	179.0	177.0	+1.1
Liver	61	^{99m}Tc	79.1	82.1	−3.6
		^{131}I	529.0	533.0	−0.8
		^{60}Co	958.0	942.0	+1.7
Lungs	72	^{99m}Tc	50.8	50.8	0
		^{131}I	446.0	454.0	−1.8
Pancreas	17	^{75}Se	75.0	76.3	−1.7
Spleen	18	^{51}Cr	15.3	15.2	+0.7
Thyroid	11	^{123}I	80.0	79.6	+0.5
		^{125}I	60.4	62.5	−3.4
		^{131}I	425.0	438.0	−3.0

* Absorbed dose rate from a concentration of 1 μCi/gm calculated by "classical" method compared with that calculated by MIRD method.

cylinder, $\bar{g}$ was calculated on the basis of the table prepared by Focht, et al (*9*).

The absorbed dose rate may be calculated by using the $\bar{g}$ values of Table 1 and recently published updated physical constants for the radionuclides (*13*) in conjunction with standard formulas (*6,8,13*). Table 2 shows that the absorbed dose values obtained in this manner are in excellent agreement with those obtained through the use of the absorbed fraction method. The authors believe the former method using Marinelli's formulation is more appropriate for the clinical situation because it is simpler and quicker in application. We think that the accuracy is sufficient for most routine needs in view of the lack of adequate information on the biological variables involved in any organ dose calculation.

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CERTIFICATION OF NUCLEAR MEDICINE TECHNOLOGISTS

In their Letter to the Editor, Zeiss, et al (*1*) provided certain considerations concerning certification and licensure of nuclear medicine technologists.

Of particular interest is their comparison of the registry examinations of the American Registry of Radiologic Technologists and the Board of Registry of Medical Technologists with regard to contents and eligibility requirements. Their proposal for an autonomous Board of Certification represented by various disciplines involved in nuclear medicine is based on what is interpreted to be a gap in the scope and depth of the presently constituted examinations. This consideration is currently under investigation by involved parties.

As early as March 1971 (see *SNM Newsletter,* May 1971), representatives of organizations deeply involved in nuclear medicine held discussions to define the objectives of and necessity for a possible conjoint registry. Many of the issues raised by Zeiss, et al (i.e., eligibility requirements, examination content, distinction between the terms technologist and technician, etc.) were then and still are being carefully explored in an attempt to determine the feasibility of acquiring meaningful certification which will be acceptable to all organizations of nuclear medicine. It is important that nuclear medicine technologists be aware that their interests are uppermost in considerations by allied medical organizations attempting to work together for a common purpose.

Exception is taken to the proposal that current registry in nuclear medicine by the ARRT or the ASCP would serve to qualify an individual to take a proposed autonomous Board of Certification examination. Many technologists, including the undersigned, are adamant in the opinion that if such an examination is formed, individuals now registered by the above-named certification bodies should be given automatic certification without examination. To do less would be a severe indictment of all currently registered technologists by questioning their