TABLE 1
Variation in Ovarian Radiation Dose Depending on Location of Activity, Fractional Uptake (f), and Effective Half-Time (t)

	$f = 0.15, t = 6$ hr	$f = 0.03, t = 0.83$ hr
Activity in ovaries	1.5 mGy/MBq	0.048 mGy/MBq
Activity on surface of ovaries	0.32 mGy/MBq	0.015 mGy/MBq

more variation is due to the kinetic model (factor of 20 to 30), however, than to whether the activity is in or on the ovaries (factor of 3 to 5).

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Disparity in Organ Masses Associated with MIRD "S" Factors

TO THE EDITOR: Since the mid-1970s, the nuclear medicine community has relied upon the relatively simple MIRD method for calculation of absorbed doses. MIRD Pamphlet No. 11 describes the formulation of "S" factors based on an anatomic phantom in which "the masses assumed for the organs and tissues of the body are given in Table 1" (*1*).

"S" (absorbed dose per unit cumulated activity) is defined as

$$S(r_k \leftarrow r_h) = \sum_i \frac{\Delta_i \phi_i r_k \leftarrow r_h}{m_k}$$

WHERE Δ = equilibrium dose constant,

ϕ = absorbed fraction, and

m = organ mass.

For self irradiation from particulate emissions, $\phi = 1$, so the equation can be simplified to

$$S(r_k \leftarrow r_k) = \sum_i \frac{\Delta_i}{m_k}.$$

Hence, for pure beta-emitting radionuclides (i.e., no photon emissions so $\phi = 1$), the organ mass that was originally used in the determination of the "S" factor can be calculated by

$$m_k = \frac{\Delta}{S(r_k \leftarrow r_k)}.$$

The organ masses associated with "S" factors for each of the pure beta-emitting radionuclides listed in MIRD Pamphlet No. 10 (viz., ^{3}H, ^{14}C, ^{32}P, ^{35}S, ^{45}Ca, ^{90}Sr, and ^{90}Y) were calculated in this way. "S" factors were taken from MIRD Pamphlet No. 11 (*1*) and Δ values were taken from MIRD Pamphlet No. 10 (*2*). Organs with walls (i.e., GI tract and bladder), skin, bone, and uterus were not included. The organ masses thus obtained are listed in Table 1 along with the respective organ masses listed for the MIRD phantom (*1*).

Organ masses associated with "S" factors for liver, lungs, muscle, thyroid, and total body are in agreement with those listed for the MIRD phantom. For adrenals, kidneys, ovaries, pancreas, spleen, and testes, however, it is obvious that organ masses associated with "S" factors are equivalent to those described for the ICRP "reference man" (*3*) instead of those listed for the MIRD phantom.

The organ mass associated with "S" factors for the red marrow appears to be variable. Although MIRD Pamphlet No. 11 describes the special case of absorbed dose to the red marrow from a particle emitter deposited in the bone, self-irradiation of the red marrow is not explicitly discussed. It can be reasoned, however, that a fraction of energetic particles may escape from the marrow; thus, the absorbed fraction would be <1.0. Examination of Table 1 demonstrates that the red marrow mass calculated by Δ/S is related to the beta energy; i.e., the higher the energy, the greater the calculated mass. Apparently, however, the red marrow "S" factors for ^{3}H, ^{14}C, ^{32}P, ^{35}S, ^{45}C, ^{90}Sr, and ^{90}Y are based on a constant mass of 1,500 g and incorporate an absorbed fraction of 1.0, 0.94, 0.66, 0.94, 0.88, 0.75, and 0.65, respectively. Thus, the absorbed fraction is inversely related to the beta energy.

TABLE 1
Organ Masses Associated with MIRD "S" Factors
Organ Mass (grams)

Organ	MIRD phantom	Δ/S ^{3}H	Δ/S ^{14}C	Δ/S ^{32}P	Δ/S ^{35}S	Δ/S ^{45}Ca	Δ/S ^{90}Sr	Δ/S ^{90}Y
Adrenals	15.5	14	14	14	14	14	14	14
Kidneys	284	310	310	310	310	310	310	310
Liver	1,809	1,780	1,800	1,800	1,800	1,800	1,800	1,800
Lungs	999	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Marrow (red)	1,500	1,500	1,600	2,280	1,600	1,700	2,000	2,300
Other tissue (muscle)	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000
Ovaries	8.3	11	10.9	11	10.9	11	11	11
Pancreas	60	100	100	100	100	100	100	100
Spleen	174	178	180	180	180	180	180	180
Testes	37	35	35	35	35	35	35	35
Thyroid	20	20	20	20	20	20	20	20
Total body	69,880	70,000	70,000	70,000	70,000	70,000	70,000	70,000

The significance of organ mass disparity can be illustrated with the following example. Suppose a therapeutic radiopharmaceutical demonstrates homogeneous uptake in a 60-g tumor. In order to easily calculate the absorbed dose received by the tumor from self-irradiation due to particulate emissions, it would be tempting to use the "S" factor (source = target) for an organ of similar mass. In this example, one might choose the "S" factor for self-irradiation of the pancreas, since MIRD Pamphlet No. 11 implies that this "S" factor is based on a pancreas mass of 60 g. Since this "S" factor was actually based on a pancreas mass of 100 g, however, the absorbed dose thus calculated will be overestimated by 67%. Similarly, absorbed doses from self-irradiation for masses equivalent to ovaries, adrenals, kidneys, testes, and spleen will be in error by +33%, −10%, +9%, −5%, and +3%, respectively.

In conclusion, the masses of several organs incorporated in MIRD "S" factors differ from those listed for the MIRD phantom. Use of "S" factors for other purposes (e.g., calculation of self-dose to tumor) may result in substantial error if improper organ mass is assumed.

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Model to Evaluate Ventricular Insufficiency Utilizing First-Pass Radioventriculogram Component Analysis

TO THE EDITOR: In the recent article published in Journal of Nuclear Medicine, Philipe et al. presented a novel methodology to detect and quantify left side valvular regurgitations from first-pass radioangiography data (*1*).

Their approach deconvolves the left ventricle radiohistogram via pulmonary input in their valvular patients, thus obtaining unit impulse response functions (UIR) that are multimodal, owing to the long transit time of components associated with regurgitant flows. In order to quantify the degree of valve insufficiency Philipe et al. postulate that the areas under the first two UIR components are proportional to total and regurgitant flows, respectively.

I would like (*1*) to derive the above postulate in the model corresponding to mitral or tricuspid valve insufficiency, and obtain a new formula that enables more accurate regurgitant flow estimates; (*2*) comment on fitting the curves prior to deconvolution, and (*3*) discuss the limits of the method in aortic and pulmonary regurgitation.

1. Suppose N_o indicator particles are injected proximally to an insufficient valve. In each contraction the ventricle ejects EF percent of its diastolic content, with part of EF ejected irreversible forward (FF), and RF as the regurgitant fraction: EF = FF + RF. Suppose that complete mixing of indicator with blood occurs in the ventricular cavity prior to each ventricular contraction. According to the number of ventricular passes N_o particles are discriminated in the following groups:

$$
\begin{aligned}
N_1 &= (FF/EF)\cdot N_o && \text{1 pass, 0 regurgitations} \\
N_2 &= (RF/EF)\cdot(FF/EF)N_o && \text{2 passes, 1 regurgitation} \\
N_3 &= (RF/EF)^2\cdot(FF/EF)N_o && \text{3 passes, 2 regurgitations} \\
&\cdots \\
N_k &= (RF/EF)^{k-1}\cdot(FF/EF)N_o && \text{k passes, (k-1) regurgitations} \\
&\cdots
\end{aligned}
\qquad (1)
$$

The first part of Eq. (1) is easily comprehended if one imagines all particles initially situated in the ventricle, then $N_1 = FF\cdot$