LETTERS TO THE EDITOR

An Algorithm for Calculation of Background Activity in Thallium-201 Myocardial Imaging

We wish to call attention to what we believe to be an important oversight in the method proposed by Beck et al. (*1*) for calculating background in thallium-201 images of the myocardium. The authors have presented a new algorithm to modify the method of Goris et al. (*2*) to avoid excessive background subtraction. Their method for determining background is given by the expression:

BKG = (1 + f) * REF − f * ORIG (1) (Eq. 5 in their paper)

where: REF = reference plane (background as determined by the method of Goris et al.). ORIG = original image; f = 0.64. However, if the corrected image (CORR) is expressed by the following equation:

$$CORR = ORIG - BKG \quad (2)$$

Then, it follows that

$$CORR = ORIG - ((1 + f) * REF - f * ORIG) \quad (3)$$

After combining terms, Eq. 3 yields

$$CORR = (1 + f) * (ORIG - REF) \quad (4)$$

From Eq. 4 it is apparent that the original and reference images are both multiplied by the same constant (1 + f). Accordingly, although the actual count value of the corrected image is changed by this multiplication, the relation between normal and abnormal zones in the heart is not. For instance, if the uncorrected count value of a normal pixel was 200 and that of an abnormal pixel 150 and if their reference values (Goris method) were 100 and 110, respectively, then the corrected (Goris method) normal:abnormal count ratio for the two pixels would be 100:40 or 2.5. Applying the method of Beck et al. would yield background values of 36 and 84, respectively. However, the normal:abnormal count ratio would still be 2.5 (164:66). Accordingly, the net effect of using the algorithm of Beck et al. should be no different in terms of avoiding possible errors related to excessive background subtraction than applying the method of Goris et al. Indeed, simply multiplying the corrected image obtained with the Goris method by a scale factor (in this case 1.64) will produce the same image as that obtained with the method of Beck et al.

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Differences in Gallium-67 Tissue Distribution in Male and Female Mice

Several years ago, Hayes and Brown (*1*) reported that sex affects the distribution of gallium in the tissues of experimental animals. In that report, they found that gallium uptakes per gram of tissue in spleen, bone marrow, and muscle were significantly higher in females than males for several species of rats. They did not identify other tissues demonstrating sex-related differences in gallium uptake, nor did they offer a mechanism for their observations. Since that report, numerous studies have been performed in animals to determine the cellular kinetics of gallium-67 and its mechanisms of localization. The majority of these studies have been controlled for sex. In 1978, Larson (*2,3*) reported that gallium uptake in tumors depends largely upon the initial formation in serum of a gallium/transferrin complex. In this study, we (a) determined the tissue distribution of gallium-67 in tissues of male and female mice, and (b) measured serum unsaturated iron-binding capacity (UIBC) in male and female mice to determine the existence of any differences in ability to form the gallium/transferrin complex.

In our study, adult C_3H mice (12-14 wk, 20-24 g) were given gallium-67 citrate intraperitoneally and killed 24 hr later. Blood and tissue samples from liver, kidney, muscle, and bone (femur and marrow) were removed, weighed, and assayed immediately. Serum was stored at −20°C until assayed for UIBC levels using a commercial kit.* When the levels of gallium-67 in blood and tissues were expressed as percent injected dose per gram of tissue, marked differences were observed between males and females regarding gallium concentration in blood and bone (Table 1). All other tissues failed to demonstrate any such sex-related differences. A comparison of serum UIBC values showed the male UIBC values to be significantly higher than those values measured in the female serum (Table 2). The decreased UIBC values that were measured in the female mice correlated with a previous report (*4*), which noted higher levels of serum iron in female rats. Bradley et al. have shown in mice that decreased serum UIBC values (secondary to increased iron levels resulting from whole-body irra-

TABLE 1. Ga-67 DISTRIBUTION IN FEMALE AND MALE C_3H MICE*

	N	Blood†	Liver	Kidney	Muscle	Bone†
Female	11	1.53 ± 0.5	5.2 ± 0.5	5.4 ± 0.6	0.70 ± 0.16	16.0 ± 2.7
Male	13	3.34 ± 0.42	5.3 ± 0.5	5.1 ± 0.46	0.59 ± 0.06	8.0 ± 1.78

* % injected dose/g tissue ± s.d.
† Statistically significant, $p < 0.05$, Student's t-test.

TABLE 2. SERUM UIBC VALUES FOR FEMALE AND MALE C_3H MICE

	N	UIBC values* μg/dl ± s.d.
Female	38	172 ± 89.6
Male	14	252 ± 29.8

* Statistically significant, $p < 0.05$, Student's t-test.

diation) cause increased urinary excretion of gallium and decreased tumor uptake (*5*). Any decrease in the number of available serum iron-binding sites for gallium could likewise result in decreased levels of gallium in blood and greater availability of "free" gallium for uptake in bone. The administration of stable gallium has been shown to cause similar effects (*6*) while scandium, another competitor for serum binding sites, has also been reported to cause increased urinary excretion of gallium as well as decreased whole-body retention (*7*).

We conclude that the apparent cause of sexual differences in tissue uptake of gallium is the reduced numbers of serum binding sites for gallium in females. This results in a shift of gallium uptake primarily from blood to bone.

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FOOTNOTE

* Res-O-Mat Iron Kit, Mallinckrodt Nuclear.

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Ga-67 Scanning during Peritoneal Dialysis

Radiogallium scanning (Ga-67 citrate) is a clinically useful procedure for identification of suspected occult inflammatory foci (*1,2*). Patients on long- or short-term peritoneal dialysis are more susceptible to infection, which is principally related to the dialysis procedure (*3,4*). Once generalized peritonitis or catheter infection is ruled out, identification of the suspected infection site could become a difficult task, and in such cases, radiogallium scanning may be considered beneficial (*5*).

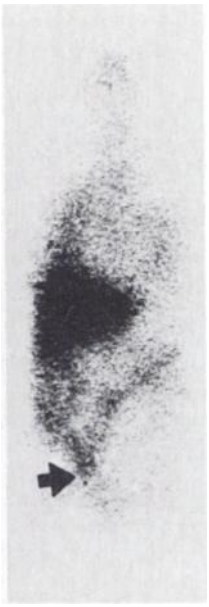

FIG. 1. Anterior view of head and torso at 72 hr after i.v. injection of 3 mCi of Ga-67 citrate, showing diffuse lung uptake, bowel activity, and uptake at dialysis catheter site (arrow).

Before we can use this technique to obtain clinically useful positive or negative information, two questions must be answered. How does peritoneal dialysis affect the tissue distribution of radiogallium? What percentage of the tracer will be dialyzed? We recently had a case that enabled us to provide answers, at least for this patient.

A 64-year-old white woman with otherwise unremarkable medical history was transferred to the University Health Center for the management of acute renal failure secondary to ethylene glycol intoxication. Peritoneal dialysis was started and continued. During the course of the dialysis she became febrile and initially did not respond to antibiotic therapy. A radiogallium scan was performed to rule out an occult infection site. After intravenous injection of 3 mCi of Ga-67 citrate, peritoneal dialysis was interrupted for 6 hr, and during the next 40 hr frequent samples of dialysate and two blood samples were obtained. Total-body scans obtained up to 144 hr after Ga-67 injection showed a good count

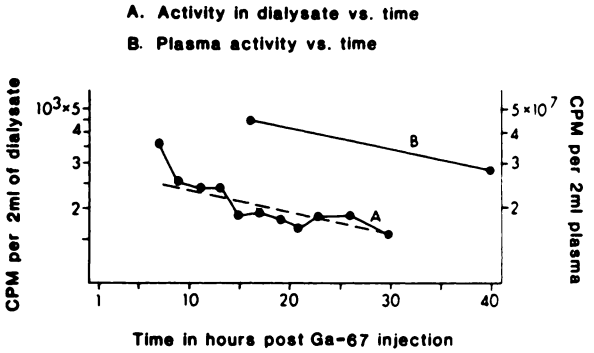

FIG. 2. Time course of Ga-67 activity in dialysate (curve A) and plasma (curve B).