initially," it appears that either the data or the statement are contradictory. Compare the data, lines 2 and 3, which show that 3.0 mCi and 1.5 mCi Tc-99mO_4 were used in the reactions, respectively. Using 3.0 mCi, recovery was 39% Tc-99m HSA and using 1.5 mCi, the recovery was 14.4% (calculation method shown above). This certainly appears to be a direct relationship and not an inverse relationship relative to the quantity of Tc-99mO_4 used initially. Or perhaps I am interpreting the data incorrectly?

HOWARD S. STERN
Temple University
Philadelphia, Pennsylvania

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1. PETTIT WA, DELAND FH, BENNETT SJ, et al: Improved protein labeling by stannous tartrate reduction of pertechnetate. *J Nucl Med* 21:59-62, 1980

Reply

Dr. Stern is correct that Table 1 (*1*) contains a typographical error in the column headed "Specific activity" and should read "μCi/μg."

As Dr. Stern has also pointed out there are apparent discrepancies in the percent incorporation of starting activity (i.e., $^{99m}TcO_4^-$) into protein. The activity used represents the amount of activity drawn and calibrated by the clinical staff for our use. Preparation for and actual labeling often required 2-3 hr before a final reading of the activity associated with protein was obtained and the omission of a decay correction factor is an oversight on our part. In most cases percent incorporation was determined by counting the 0.5 ml fractions obtained from the small column as well as the column itself and summing these readings. The activity in fractions 7-13 (containing the labeled protein) was summed and divided by the total activity (total fractions plus column) to obtain percent incorporation. We would like to clarify that not all labeling results fell within the 20-60% range, but typically this could be expected.

The data presented in Table 1 were selected for potential clinical utility. Results for labeling were variable at all levels of activity. Unfortunately we have not been able to define or control these factors that produce the variability in the labeling results, especially when activity in the mCi range was used. A number of labelings were carried out using 100-500 μCi. The results of these studies, although not included in Table 1, prompted our statement regarding the inverse relationship between the amount of activity used for labeling and the amount incorporated. Again this relationship was not a precise mathematical one but rather a general trend.

The Sephacryl S-200 column assay used has been described elsewhere (*2*) and was routinely performed within 0.5 hr following the labeling procedure. Exceptions to this routine assay were related to binding and stability studies: (a) In order to detect transfer of the radionuclide from one protein to another, IgG was labeled and mixed with a large excess of HSA and allowed to stand for 1 hr before the assay. These results were given in Fig. 2. Figure 1 illustrated a routine assay of our labeled HSA. (b) The serial assays at 0, 4, and 20 hr were performed to estimate the rate of loss of the radionuclide from the protein. Although these results were not depicted by a figure in our paper, a copy of the results can be obtained by writing the senior author.

We thank Dr. Stern for his comments regarding our data and hope that this letter provides sufficient clarification of our results and their interpretation.

WILLIAM A. PETTIT
FRANK H. DELAND
SIDNEY J. BENNETT
DAVID M. GOLDENBERG
Veterans Administration Medical Center and
University of Kentucky Medical Center
Lexington, Kentucky

REFERENCE

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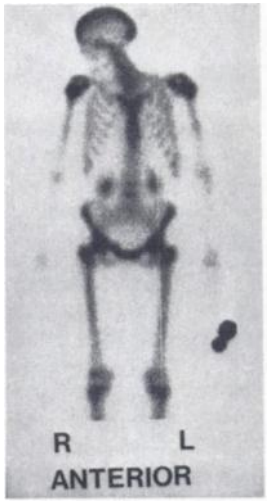
2. PETTIT WA, DELAND FH, PEPPER GH, et al: Characterization of tin-technetium colloid in technetium-labeled aluminum preparations. *J Nucl Med* 19:387-392, 1978

Pitfalls of Absent or Faint Kidney Sign on Bone Scan

Detection of osseous abnormality by bone imaging depends upon the recognition of the areas of above-normal and/or asymmetrical tracer concentration. Diffuse symmetrical involvement of the axial skeleton may not be recognized unless one reviews a radiograph of the axial skeleton at the time the scan is interpreted (*1*). Sy et al. (*2*) observed faint or absent renal activity at the time of bone imaging when there was diffuse metastatic involvement of the axial



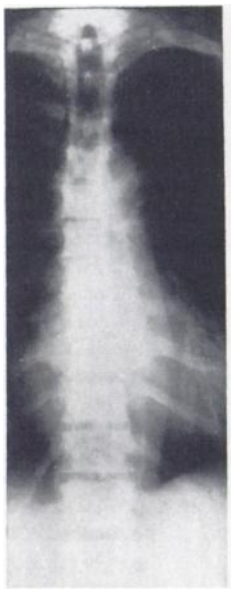


FIG. 1. (left) This 61-year-old white woman was admitted with palpable right breast mass and anemia. For the past 5 yr she had been treated intermittently with Leukeran for chronic lymphocytic leukemia. Breast biopsy revealed infiltrating duct carcinoma. Bone-marrow biopsy showed metastatic adenocarcinoma. Her skeletal survey was consistent with diffuse osteoblastic and lytic metastatic disease of axial skeleton. Technetium-99m MDP bone imaging, performed as part of metastatic workup, demonstrates diffuse increased uptake in axial skeleton, with no abnormal soft-tissue activity. Both kidneys are well visualized. Blood chemistry revealed BUN 15 mg/dl, creatinine 1.1 mg/dl, and alkaline phosphatase 304 U.

FIG. 2. (right) Radiograph of spine and pelvis shows diffuse osteoblastic and lytic lesions consistent with metastatic disease.

skeleton. They suggested that the increased uptake of tracer by the abnormal bone resulted in reduced radionuclide excretion by kidney, thereby making the renal images fainter in the bone scans. They therefore concluded that absent or faint kidney shadows on the bone scan suggest the possibility of widespread bone disease.

Contrary to this assumption, however, our case shows diffuse increased uptake of tracer in the axial skeleton, coupled with good visualization of the kidneys. The patient is found to have diffuse metastatic involvement of the axial skeleton, proved by biopsy and demonstrated on the radiographs.

This case (Figs. 1 and 2) illustrates the point that caution must be used in the interpretation of the bone scan when there is visualization or nonvisualization of the kidney in the so-called "super scan."

Failure to outline the kidney in the bone scan, other than in diffuse metastatic disease, has been described in the chronic hemodialysed patient with generalized osseous changes of secondary hyperparathyroidism, in Paget's disease with extensive bone involvement (*2*), in primary hyperparathyroidism, and in hyperthyroidism (*3*).

SHANTI L. LUNIA
MAHIN HERAVI
VEENA GOEL
AMANDO S. TIU
ROBERT B. CHODOS
Albany Medical College
and Albany Medical Center
Hospital
Albany, New York

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Gray Scale Displays on the MDS Modumed System

The MDS Modumed system has both a color and a gray-scale option. It is not our purpose to enter the "which-one-is-better argument," which has been debated repeatedly in nuclear medicine, in TCT, and in ultrasonography. Rather we want to suggest a reversal of gray-level assignment in the MDS system to those who prefer that presentation for viewing dynamic emission images.

The MDS Modumed system displays 16 colors, of which only about six are appreciated when images are viewed. All count densities are equally distributed across these levels, resulting in considerable flicker in the image field when serial frames are viewed (as in cardiac cines), since background noise controls color changes as well as image data. Such displays appear to assign importance to drastic color changes, which in actuality are arbitrarily assigned and may have no clinical significance.

Changing from color to black and white (using the TELE program on the Modumed system) clarifies the situation considerably, since the eye is then allowed to concentrate on contour motion rather than the highly salient color components. The MDS gray scale has 16 levels, the whitest being assigned to the greatest count density and the darkest to the least. The TV screen, however, provides only about six discriminable shades, the whitest levels all being perceived as essentially alike. This problem is not unique to the MDS display; it is a property of all TV screens that the phosphor intensity does not increase linearly. When, as with the MDS system, equal differences in count density are equated with equal voltage differences to the TV screen, the observed brightness differences are not equal. When 16 levels are chosen, as does MDS, only five or six levels are discerned, and these correspond to the lower count densities of the image. In other words, when the target area is significantly more active than its surroundings, as is generally the case in emission imaging, the discerned levels are in the background and noise areas and not in the areas of interest.

```
TELE

OUTPUT COMPLETE
#RD
ENTER RECORD:  1320

#TY
ENTER TABLE:  1

     LEVEL:   0      RED:  30      GREEN:  30      BLUE:  30
     LEVEL:   1      RED:  28      GREEN:  28      BLUE:  28
     LEVEL:   2      RED:  26      GREEN:  26      BLUE:  26
     LEVEL:   3      RED:  24      GREEN:  24      BLUE:  24
     LEVEL:   4      RED:  22      GREEN:  22      BLUE:  22
     LEVEL:   5      RED:  20      GREEN:  20      BLUE:  20
     LEVEL:   6      RED:  18      GREEN:  18      BLUE:  18
     LEVEL:   7      RED:  16      GREEN:  16      BLUE:  16
     LEVEL:   8      RED:  14      GREEN:  14      BLUE:  14
     LEVEL:   9      RED:  12      GREEN:  12      BLUE:  12
     LEVEL:  10      RED:  10      GREEN:  10      BLUE:  10
     LEVEL:  11      RED:   8      GREEN:   8      BLUE:   8
     LEVEL:  12      RED:   6      GREEN:   6      BLUE:   6
     LEVEL:  13      RED:   4      GREEN:   4      BLUE:   4
     LEVEL:  14      RED:   2      GREEN:   2      BLUE:   2
     LEVEL:  15      RED:   0      GREEN:   0      BLUE:   0
```

FIG. 1. Color translation table for producing black-on-white images.

By simply inverting the gray-level assignment, one shifts the discerned levels of the image to the higher count densities. This allows more discrimination over the areas of interest and, perhaps more importantly, relegates background noise to nondiscriminable gray levels. The result is a bright black-on-white image with clearly defined contours and good contrast. In addition, it takes advantage of the physiological phenomenon that less difference in optical density is needed to be just perceived on a light background than on a dark one (*1*).

The overall significance of this change in display cannot be fully appreciated with static images and the problems inherent in photographic reproduction and printing. Therefore we have not included examples. When the images are displayed dynamically, however, the reduction in background noise and flicker is instantly recognized. Our radiologists and cardiologists all agree that the changing contours of the image are much more readily apparent, whereas random count changes are almost unnoticeable.

It is a simple procedure to change the gray-level assignment on the MDS system. The table for white-on-black is already present; inversion from top to bottom reassigns the gray levels to black on white (Fig. 1) . One still perceives only about six different levels, but they are now in those portions of the image with the higher count densities. We have experimented with scaling the display such that all 16 levels are perceived, but this results in several gray levels being distributed across the background and noise, and our physicians prefer the black-on-white display (inversion of the MDS gray-level table), which artificially emphasizes intensity changes occurring in the higher count densities. Were the noise several orders of magnitude lower, as it is in TCT and ultrasonography, it would be highly desirable to employ the full range of gray levels, assigned in intervals perceived to be equal.

J. FITZSIMMONS
M. URIE
University of Florida and
Veterans Administration Hospital
Gainesville, Florida