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*).

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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.

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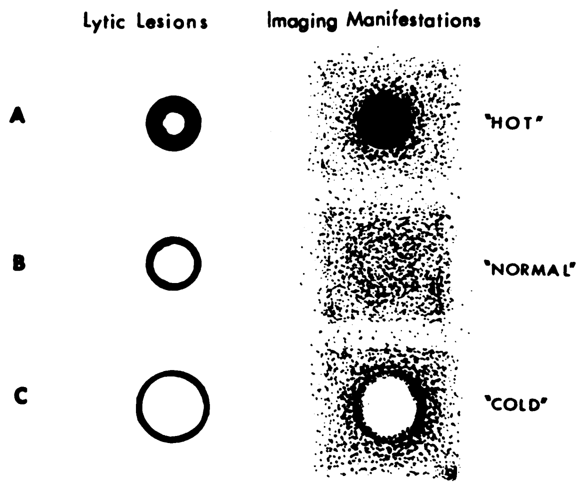
Multiple Manifestations of Osteolytic Lesions on Bone Imaging

While we were looking for articles about "cold" (photon-deficient) lesions seen in bone imaging, we found a very interesting *Journal* article by Sy et al. (*1*), which showed a schema for possible manifestations of lytic lesions in scintigrams (Fig. 1). They postulated that the scintigraphic appearance of a radiographically evident lytic lesion depends largely on the degree of reactive bone formation, changes in local vascularity, and the size of the lytic area.

A 61-year-old man was hospitalized for a week with a history of left hip pain. He had been treated with radiation to the neck for metastatic carcinoma of the lung. There was no history of trauma.



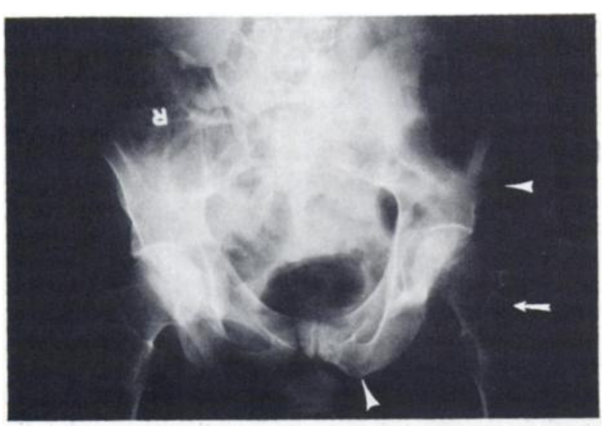


FIG. 1. (Top) Schema of possible manifestations of lytic foci on imaging. (A) 2-cm lesion with very active reactive tissue and vascularity; (B) 2-cm lesion with limited reactive tissue and vascularity, but sufficient to obscure lytic focus; and (C) lesion >2 cm, with limited reactive tissue and vascularity, but sufficient to outline border of lysis. (Reprinted by permission of *J Nucl Med* 16: 1013, 1975.)

FIG. 2. (Bottom) Radiograph demonstrating three lytic lesions: small lesions in left iliac bone and inferior ramus of left pubic bone, and large one in left femoral neck.

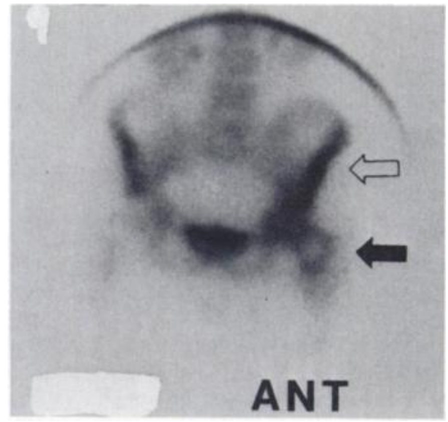


FIG. 3. Bone scintigram revealed small focus of increased activity in left ilium (open arrow) and large lesion of decreased activity surrounded by rim of increased radioactivity in left femoral neck (closed arrow). Radiographically evident lytic lesion in left pubic bone failed to demonstrate any abnormality, and this may well be explained by Dr. Sy's hypothesis.

On physical examination his left hip was slightly swollen and tender. Vital signs were all within normal limits. Serum alkaline phosphatase was markedly elevated at 770 IU/100ml.

Skeletal radiographs demonstrated three lytic lesions in the pelvis and left femur, with a possibly associated fracture (Fig. 2). The following day bone imaging was performed and revealed a large focus of decreased radioactivity in the left femoral neck and a small focus of increased activity in the left ilium (Fig. 3). The lytic lesion in the left pubic bone, seen on the radiograph, was not visible in the scintigram. Five days later the fracture in the left femoral neck was repaired with Richard's orthopedic screw and plate, and the biopsy revealed metastatic bronchogenic carcinoma.

Focal decreased radioactivity on bone imaging can be shown in various conditions, including metastatic and primary tumors, avascular necrosis, osteomyelitis, after radiation therapy, etc. (*1-4*). In our patient the lytic lesions seen by radiograph could produce three different manifestations; increased, "normal" (iso-dense), and decreased activity. Both scintigraphic and radiographic findings in our case agreed well with Dr. Sy's hypothesis.

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