

**BONE MARROW SCANNING IN PAGET'S DISEASE**

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***Four patients with Paget's disease of the bone were studied with bone marrow reticuloendothelial space scanning using  $^{99m}\text{Tc}$ -sulfur colloid. All of the patients demonstrated focal areas of decreased concentration of the radiocolloid material that corresponded anatomically to radiographic evidence of Paget's disease. Three patients were found to have focal areas of decreased-to-absent concentration of the radiocolloid material that corresponded anatomically to areas of increased  $^{99m}\text{Tc}$ -polyphosphate or  $^{18}\text{F}$  uptake on bone scans. Possible mechanisms to explain these focal areas of apparently decreased reticuloendothelial activity are discussed and may include focal marrow replacement or focal arteriovenous shunting. These results would suggest that Paget's disease should be considered as a diagnostic possibility when focal areas of diminished reticuloendothelial activity are observed in bone marrow scanning with radiocolloid material.***

Radionuclide imaging of the bone marrow has been performed with radioiron and radiocolloids (1-3). Although radiocolloids do not demonstrate the erythropoietic marrow directly, their distribution may reflect hematopoietically active areas of the marrow (4,5). For this reason, bone marrow reticuloendothelial space scanning has been used as a diagnostic procedure in various hematologic disorders (6). In addition, alteration of the marrow distribution of radiocolloid material has been reported in cirrhosis, bone infarction, metastatic neoplasms, and following irradiation (7-11). This communication reports the results of bone marrow reticuloen-

dothelial space scanning in four patients with Paget's disease of the bone.

METHODS AND MATERIALS

Technetium-99m-sulfur colloid (Tesuloid from E. R. Squibb) was used as the radiocolloid material. A dose of 3.0 mCi was administered intravenously; 15-30 min later multiple images of the axial and appendicular skeleton were obtained on a Nuclear-Chicago Pho/Gamma III scintillation camera using a low-energy parallel-hole collimator. All scintigraphic views were exposed for 200 sec to allow comparison of radioactivity at different sites. Scintiphotos were evaluated blindly by four independent observers for the delineation of the distribution pattern and presence of focal areas of decreased radioactivity. Radiographs evaluating similar anatomic regions were available in all four patients. Bone scans performed following  $^{99m}\text{Tc}$ -polyphosphate administration were available in two patients, and following  $^{18}\text{F}$  administration in one patient. Results of these varied diagnostic procedures were intercompared.

RESULTS

The relationship of the distribution of the marrow reticuloendothelial space in four patients with Paget's disease to radiographs and bone scans is summarized in Table 1. Comparison of bone marrow scan results with bone scans performed with either  $^{99m}\text{Tc}$ -polyphosphate or  $^{18}\text{F}$  was possible in

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**TABLE 1. COMPARISON OF BONE MARROW SCAN WITH BONE SCAN AND RADIOGRAPHS**

Case No	Bone marrow scan	Bone scan	Radiograph
1	Focal decrease left pelvis and hip	Focal increase left pubic ramus ilium and femoral head	Paget's disease left pelvis
2	Focal decrease right hemipelvis	—	Paget's disease right pelvis
3	Marked generalized decrease in uptake	Extensive areas of increased uptake	Extensive Paget's disease of entire skeleton
4	Focal decrease right hemipelvis and distal right femur	Focal increase right pelvis and right femur ( $^{18}\text{F}$ )	Paget's disease right pelvis and right femur

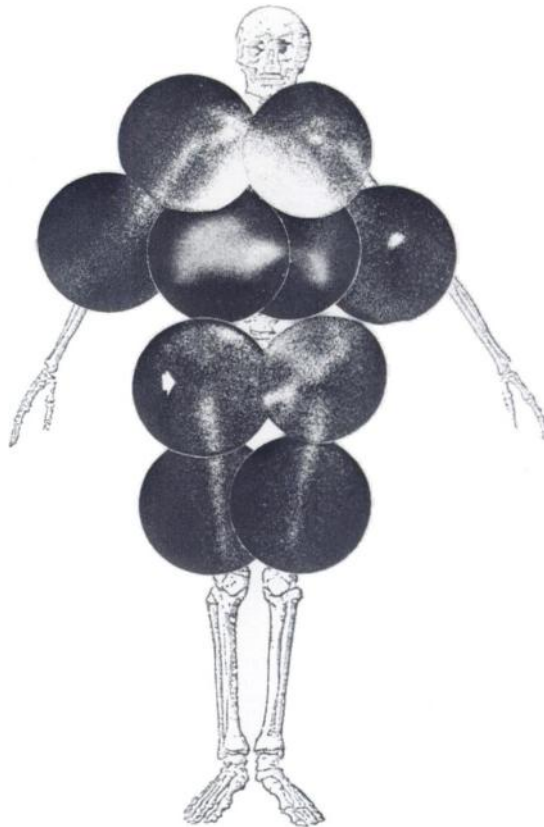
three of the patients. These patients were found to have focal areas of decreased-to-absent concentration of the radiocolloid material that corresponded anatomically to areas of increased  $^{99\text{m}}\text{Tc}$ -polyphosphate or  $^{18}\text{F}$  uptake on the bone scans. In all four patients, areas consistent with Paget's disease, characterized by the skeletal radiographs, demonstrated absent uptake of the radiocolloid on the reticuloendothelial space scan. Examples of the characteristic appearance of the bone marrow reticuloendothelial space scan and radiographs are shown in Figs. 1 and 2 (Case 2).

#### DISCUSSION

Variation in pattern from the normal marrow distribution of radiocolloids has been described in multiple hematologic disorders. The assumption is that the distribution of reticuloendothelial tissue in the marrow usually reflects the distribution of hematopoietic marrow. Abnormal patterns include non-visualization of the axial skeleton, peripheral extension of reticuloendothelial activity, and focal areas of decreased reticuloendothelial activity (12).

Prior reports cataloging the results of bone marrow reticuloendothelial space scanning have indicated the existence of focal areas of decreased reticuloendothelial activity in irradiated bones, bone infarction, metastatic deposits, lymphoma (Hodgkin's disease), and myeloma (7-11,13). Rosenthal, et al (7) in reviewing 150 bone marrow scans performed with  $^{99\text{m}}\text{Tc}$ -sulfur colloid noted one case with a focal decrease in reticuloendothelial activity that corresponded to radiographic evidence of Paget's disease. Van Dyke and Anger (6) have remarked

that the distribution of erythropoietic marrow in Paget's disease corresponded to the distribution of bone involvement. However, no case or specific literature reference was cited.



**FIG. 1.** Composite image of bone marrow reticuloendothelial space scan performed on gamma camera 30 min after administration of 3.0 mCi of  $^{99\text{m}}\text{Tc}$ -sulfur colloid. White arrow indicates area of decreased reticuloendothelial activity in right pelvis that corresponds to area of Paget's disease observed on skeletal radiograph (Fig. 2). "Hot area" seen in left antecubital fossa represents site of injection.



**FIG. 2.** Anterior-posterior view of bony pelvis demonstrating radiographic evidence of Paget's disease in right hemipelvis.

The sequence of pathologic changes that eventually produces the typical coarse-fibered bone of Paget's disease, with total marrow replacement by cellular fibrovascular tissue, are well documented (14). Local increased bone blood flow and high output cardiac failure have long been recognized in patients with Paget's disease and have led some to believe that the circulatory abnormalities seen in extensive Paget's disease were secondary to focal arteriovenous shunting (15). Prior studies by Rhodes, et al (16) have demonstrated that arteriovenous anastomosis greater than 15 microns is not involved in shunting of blood through bone of patients with Paget's disease. However, the estimated particle size range of the  $^{99m}\text{Tc}$ -sulfur colloid preparation is approximately 0.1–1.0 microns in diam, and shunting of these particles through arteriovenous anastomoses less than 15 microns provides a possible explanation for the abnormalities observed. Alternative explanations of the focal areas of decreased marrow reticuloendothelial activity observed in these four patients include marrow replacement or a combination of regional A-V shunting and marrow replacement.

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