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Diffuse splenic Tc-99m MDP uptake in hypersplenic patient

A. Fuat YAPAR, Mehmet AYDIN and Mehmet REYHAN

Department of Nuclear Medicine, Baskent University Adana Teaching and Research Center, Adana, Turkey

A 52-year-old woman with nonspecific left leg pain was examined by Tc-99m methylene diphosphonate (MDP) bone scintigraphy. The patient had been a marble quarry worker for 10 years and had developed chronic congestive heart failure secondary to pneumoconiosis. Her hemoglobin analysis and hematologic findings were interpreted as being consistent with sickle cell beta$^+$ thalassemia and also hypersplenism. Bone scintigraphy showed intense and diffuse MDP accumulation in the enlarged spleen without ultrasonographic or radiologic evidence of calcification.

Key words: Tc-99m MDP, splenic uptake, hypersplenism

INTRODUCTION

MANY DIFFERENT TYPES of nonosseous tissues may accumulate Tc-99m phosphate bone-scanning radiopharmaceuticals, but in none of these is the precise mechanism known.[1] Splenic accumulation of bone seeking agents has been reported in several benign and malignant hematologic disorders,[1–12] hemochromatosis,[13] glucose-6-phosphate dehydrogenase deficiency,[14] metastatic breast carcinoma,[15] splenic hemangioma,[16] subcapsular hematoma[17] and splenic artery calcification.[18] We report a patient with hypersplenism and sickle cell beta$^+$ thalassemia with intense and diffuse MDP accumulation in a markedly enlarged spleen without ultrasonographic or radiologic evidence of calcification.

CASE REPORT

A 52-year-old woman with nonspecific left leg pain was referred to the department of nuclear madicine in our hospital for scintigraphic bone evaluation. She had been a marble quarry worker for 10 years and had developed chronic congestive heart failure secondary to pneumoconiosis. There was no family history of thalassemia or blood dyscrasias. Physical examination showed hepatosplenomegaly and bilaterally two plus positive (++) pretibial edema. Laboratory findings were as follows: hemoglobin 12.60 g/d*l*; hematocrit 39.8%; WBC 6500/mm^3; platelets 64000/mm^3; erythrocyte sedimentation rate 4 mm/hour; serum iron 59 mg/d*l*, TIBC 243 mg/d*l*, saturation index 19%, LDH 361 IU/*l* and SGOT 49 IU/*l*. Direct Coombs' test was negative. Alkaline phosphatase level was normal. Her hemoglobin analysis was 55.7% Hb A, 39.5% Hb S, 4.1% Hb A2 and 1.2% Hb F. Bone marrow aspiration demonstrated significant erythroid hyperplasia and megaloblastic change. No blood transfusion was performed.

Abdominal ultrasonographic and computerized tomographic images showed an enlarged spleen without visible calcifications or focal defects (Fig. 1). A whole body bone scan with Tc-99m MDP (740 MBq) was performed to evaluate the left leg pain. The scintigraphy showed markedly uniform MDP uptake by the enlarged spleen (Fig. 2). There was no hepatic or any other soft tissue uptake.

DISCUSSION

Extraosseous accumulation of bone seeking radiopharmaceuticals occurs fairly commonly.[1] Many different types of nonosseous tissues may accumulate Tc-99m phosphate compounds. Splenic uptake on bone scintigraphy has been reported in patients with wide ranging hematologic abnormalities and metastatic diseases.

The mechanism of splenic uptake of bone-seeking agents in sickle cell anemia has been presumed to be deposition of calcium (microscopic or macroscopic

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For reprint contact: A. Fuat Yapar, M.D., Baskent Universitesi, Adana Uygulama ve Arastirma Merkezi, Nukleer Tip Bl. Dadaloglu Mah., 01250 Yuregir-Adana, TURKEY.

E-mail: fyapar@dr.com
fyapar@veezy.com

calcification). Even microscopic deposits of calcium that could not be detected by radiologic techniques might account for uptake of Tc-99m MDP. Ultrastructural studies have shown evidence of mitochondrial binding of calcium ions in necrotic muscle cells, within a crystalline structure similar to that of hydroxyapatite.[19] In another theory, high concentrations of phosphatese enzyme systems have been indicated to be the cause of splenic uptake of bone agents.[20] These proposed mechanisms could not explain the underlying pathology in our case, because there was no visible splenic infarction and/or calcification in abdominal ultrasonography and CT, and the serum alkaline phosphatase level was normal.

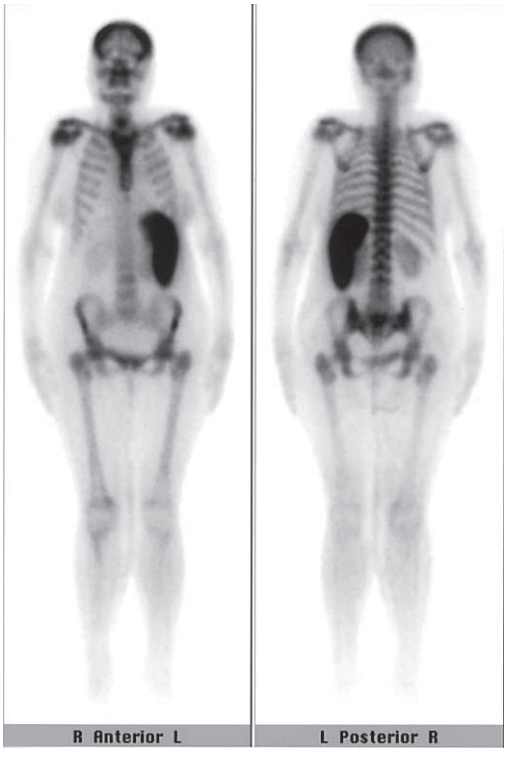

Fig. 1 The anterior and posterior whole-body bone scans showed intense and diffuse Tc-99m MDP accumulation in the enlarged spleen.

Splenomegaly in thalassemia major is caused mainly by extramedullary hematopoiesis, exaggerated by hemosiderosis, reticuloendothelial hyperplasia, and erythrophagocytosis. Hemosiderosis occurs as a result of recurrent transfusion and increased deposition of iron from the increased red-blood-cell sequestration within the spleen.[1] Jones et al.[21] proposed that iron deposits might be responsible for uptake of bone-seeking radionuclides. McRac et al.[22] postulated that excessive iron deposition in the spleen may cause the dissociation of Tc-99m from the ligand carrier, with exchange to another ligand or complex and ultimate local accumulation. Evidence in support of this contention includes the accumulation of Tc-99m phosphates following injection of iron dextran, abnormal splenic intensity and shortening of T_1 and T_2 relaxation times in sickle cell anemia and thalassemia on magnetic resonance imaging, and high CT attenuation values of liver, spleen, and lymph nodes in patients with beta thalassemia.[7] Also, in some cases iron deposition was shown to mimic the CT appearance of calcification possibly relating to its atomic number [26] which is close to that of calcium [20].[23]

No exact explanation for the splenic MDP uptake could be identified for the present case, because the patient refused splenectomy. However, increased iron deposition from the increased red blood cell sequestration within the spleen secondary to hypersplenism seemed the most probable reason to us, because no calcified region at the base of infarction could appear as homogeneous as in this case on Tc-99m MDP images in to our opinion. There was no evidence either of sickling which might cause splenic infarction. Moreover, the patient was never subjected to marked ischemia or blood transfusion which might explain excess iron load in spleen. Hypersplenism is a clinical syndrome of varied etiology. It is characterized by splenomegaly (possibly only moderate), pancytopenia or as reduction in the number of one or more blood cell types (commonly anemia and thrombocytopenia), normal

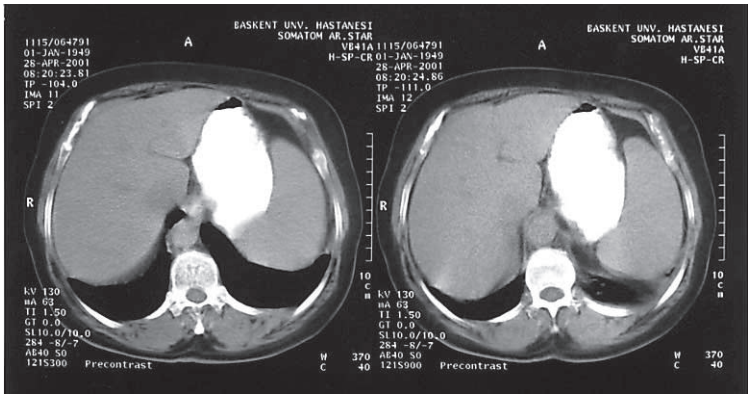

Fig. 2 Axial CT images of the abdomen show an enlarged spleen without visible calcification.

production or hyperplasia of the precursor cells in the marrow and premature release of cells into the peripheral blood, resulting in a mild reticulocytosis. Other features are decreased red-cell and platelet survival, and hypervolemia (i.e. increased plasma volume) if splenomegaly is marked.[24] Congestive heart failure secondary to pneumoconiosis was thought to be the cause of splenomegaly in our case. In addition to splenomegaly, the presence of thrombocytopenia and hyperplasia of the precursor cells in the bone marrow indicated hypersplenism.

Although it was not confirmed histopathologically, the clinical signs and scintigraphic uptake pattern suggest that iron deposition secondary to hypersplenism was the probable cause of splenic MDP uptake in the present case. In our review of the literature, we did not find any evidence of hypersplenism being a factory causing splenic MDP uptake. In the light of the findings in this case, hypersplenism may be considered as a possible cause when evaluating cases with a marked MDP concentration in an enlarged spleen diffusely.

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