Case report

Scintigraphic findings on $^{99m}$Tc-MDP, $^{99m}$Tc-sestamibi and $^{99m}$Tc-HMPAO images in Gaucher’s disease

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Abstract. Gaucher’s disease is an autosomal recessive lysosomal storage disease characterized by the specific deficiency of glucocerebrosidase that leads to accumulation of insoluble glucocerebroside in the reticuloendothelial system, particularly the bone marrow, liver, spleen and lymph nodes. Direct scintigraphic visualization of lipid deposits in Gaucher’s disease has recently been described, based on the use of the lipid-soluble xenon-133. We report here on the use of the lipophilic cationic complex technetium-99m sestamibi ($^{99m}$Tc-MIBI), employed as an indicator of increased cellular density and metabolic activity, to evaluate Gaucher cell infiltrates in the bone marrow; $^{99m}$Tc-hexametazime ($^{99m}$Tc-HMPAO) was also employed, as a pure indicator of lipidic infiltration in the bone marrow. A 67-year-old patient with known type 1 Gaucher’s disease presented with a painful left hip and knee and difficulty in gait subsequent to traumatic fracture of the left femoral neck that had required implant of a fixation screw-plaque. Bone scan with $^{99m}$Tc-methylene diphosphonate revealed reduced uptake at the distal metaphyseal–epiphysial femoral region. In addition, whole-body maps and spot-view acquisitions of the thighs and legs were recorded at both 30 min and 2.5 h after the injection of $^{99m}$Tc-MIBI: the scintigraphic pattern clearly showed increased uptake at several sites involved by Gaucher deposits in the bone marrow (both the hips, with variable intensity in different areas), matching the bone changes detected by conventional x-ray. The target to non-target ratios slowly decreased with time, from an average value of 2.25 in the early scan to an average value of 2 in the delayed scan. The lipid-soluble agent $^{99m}$Tc-HMPAO exhibited a superimposable scintigraphic pattern of accumulation at the involved sites, though with lower target to non-target ratios (1.27–1.48). The results obtained in this patient suggest a potential role of $^{99m}$Tc-MIBI in the scintigraphic evaluation of Gaucher’s lipid deposits in the bone marrow. If the results are confirmed in other patients, this radiopharmaceutical would offer clear advantages over $^{133}$Xe because of its wider availability and greater practicality (i.v. administration of $^{99m}$Tc-MIBI versus inhalation of $^{133}$Xe, and use of a single gamma camera instead of two as with $^{133}$Xe).

Key words: Gaucher’s disease – Scintigraphy – Technetium-$^{99m}$ methylene diphosphonate – Technetium-$^{99m}$ sestamibi – Technetium-$^{99m}$ hexametazime


Introduction

Specific deficiency of the enzyme glucocerebrosidase (glucocerebrosidase) causes Gaucher’s disease, an autosomal recessive lysosome storage disorder characterized by accumulation of the lipid glucocerebroside in cells of the reticuloendothelial system [1]. Type 1, non-neuropathic Gaucher’s disease is the only form compatible with a long survival. Early complications of this disease include dysfunctions due to splenomegaly and bone marrow involvement. Increasing accumulation of Gaucher deposits in bone marrow may lead to various skeletal manifestations such as bone marrow packing, osteonecrosis, osteopenia and osteomyelitis.

Various nuclear medicine procedures can be used to evaluate the presence and extent of Gaucher deposits, or their consequences, in the bone marrow. Lipid infiltration and osteomyelitis have been evaluated by combined technetium-$^{99m}$ methylene diphosphonate ($^{99m}$Tc-MDP) and gallium-67 citrate (review in refs. [2] and [3]), $^{99m}$Tc-sulphur colloid [4], and indium-111 labelled leucocytes [5], while dynamic scintigraphy with the lipid-soluble xenon-133 has been reported as a tool to specifically evaluate the extent of bone marrow infiltration in patients with Gaucher’s disease [6–8].

We report the case of a patient with adult-onset type 1 Gaucher’s disease, in whom discrepant findings were observed on the bone images on the one hand and on the
Fig. 1. Plane radiograph of the knees, demonstrating Erlenmeyer flask appearance and frank cortical thinning of distal femurs; changes linked to involvement by Gaucher deposits are also detected at the proximal epiphyseal–metaphyseal region of both tibiae, although x-ray films cannot identify areas with different levels of disease activity.

\[99mTc\)-sestamibi (\[99mTc\)-MIBI) and \[99mTc\)-hexametazime (\[99mTc\)-HMPAO) images on the other hand; \[99mTc\)-MIBI and \[99mTc\)-HMPAO were utilized in an attempt to visualize lipid Gaucher deposits in the bone marrow, based on the lipophilicity of \[99mTc\)-HMPAO and, for \[99mTc\)-MIBI, on the rationale that uptake of this radiopharmaceutical would also reflect cellular density and metabolic activation at the sites involved by the disease.

Case report

Patient V.E, a 67-year-old man, was diagnosed with type 1 Gaucher’s disease at the age of 36 years, when he underwent emergency splenectomy because of sudden rupture of the spleen. Histopathology revealed lipophagic cell infiltrates typical of Gaucher’s disease, further confirmed in liver biopsy specimens obtained in 1992 when the patient, at the age of 65, underwent partial gastrectomy due to a bleeding gastric ulcer.

In July 1993 the patient suffered from spontaneous, pathological fracture of the left femoral neck, which required surgical implantation of an osteosynthetic fixation screw-plaque (externally to the trochanteric region). The patient continued to suffer from excruciating pain at the left hip with progressive involvement of the left knee and impairment in walking that required crutches. Due to persistence of the above symptoms, in June 1994 the patient was referred to the Rheumatology Unit of the University of Pisa.

Fig. 2. Left: Whole-body skeletal scan with \[99mTc\]-MDP (radioactivity accumulated in the bladder has been masked for better scintigraphic enhancement). The scan shows moderately increased tracer uptake in the entire upper half of the left femur (site of the pathological fracture treated with an osteosynthetic screw-plaque), while in particular the distal portion is relatively photopenic. Diffuse inhomogeneities in tracer distribution are detectable at several skeletal segments, including the tibiae. Right: Whole-body scans recorded after injection of \[99mTc\]-MIBI (radioactivity accumulated in the abdominal area has been masked for better scintigraphic enhancement). The scan demonstrates clear accumulation of radioactivity at the sites involved by infiltration of the bone marrow with Gaucher deposits; this pattern is more evident at the distal extremity of the left femur (perhaps in part due to some scintigraphic enhancement linked with the reduced tracer uptake in the hypotrophic muscles of this side); the scintigraphic pattern remained virtually unchanged between the 30-min scan and the 2.5-h scan.