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Combined use of bone and bone marrow scintigraphies for the diagnosis of active sacroiliitis: A new approach

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Diagnosis of sacroiliitis (SI) with bone scintigraphy may involve difficulties even with a quantitative approach. The aim of this study was to evaluate the combined use of bone and bone marrow scintigraphies for the diagnosis of active sacroiliitis.

Thirty-one patients who were clinically suspected to have SI were included in the study. Bone and bone marrow scintigraphies were done after injections of 740 MBq of ^{99m}Tc-MDP (MDP) and 370 MBq of ^{99m}Tc-sulfur colloid (SC) respectively with a 2-day interval. Both visual and quantitative assessment of MDP uptake and visual assessment of SC uptake in sacroiliac joints were performed. Also sacroiliac joint radiographic findings for each patient were evaluated and graded from 0 to 4 according to the New York grading system. Patients were divided into 2 groups according to their x-ray findings (Group A: grade 0–2, Group B: grade 3–4).

A total of 14 patients (10 bilateral, 4 unilateral) had increased MDP uptake with decreased/normal SC uptake. Twelve of 14 patients had grade 0–2 radiographic changes while only 2 patients had grade 3–4 radiographic changes. Increased MDP uptake with decreased/normal SC uptake is the most common scintigraphic pattern seen in acute phase SI in which radiographic findings are generally found to be normal or slightly changed. In at least in 8 patients the decreased bone marrow uptake of SC was demonstrated, supporting the diagnosis.

Although our results did not reveal any significant superiority of bone marrow scintigraphy to bone scan for the detection of active sacroiliitis, combined use of bone and bone marrow scintigraphies was presented as an alternative method to characterize patients with active sacroiliitis.

Key words: sacroiliitis, bone scintigraphy, bone marrow scintigraphy, skeletal radiography

INTRODUCTION

AS THERE are no specific clinical symptoms and laboratory tests to distinguish sacroiliitis (SI) from mechanical causes of low back pain, the clinical diagnosis of SI may be difficult to confirm especially in the early stages of the disease.[1] Radiographic detection of SI depends on more advanced changes such as erosion, sclerosis and ankylosis of the joints which are usually absent in the early stages.[2] Moreover, roentgenograms and CT scans represent a temporally integrated anatomic record; therefore, being useful only to establish prior damage to the sacroiliac joints. Metabolic "snapshots" of the sacroiliac joints provided by bone scintigraphy have been used for decades as a screening test for active SI[3] but, diagnosis of SI even with a quantitative approach may involve some difficulties because of the low specificity of the method and the overlap between healthy individuals and those with SI, especially in bilateral involvement.[4]

Although the pathologic process of sacroiliac joint inflammation is poorly understood due to the limited number of direct studies, in an open biopsy study it was found that subchondral bone marrow edema and periarticular fat accumulation related to active inflammation are the first histopathological changes in the disease process of SI.[5] If these early histopathological changes can be

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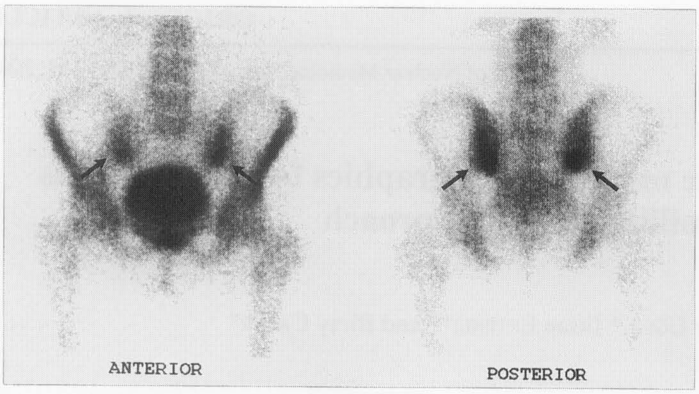

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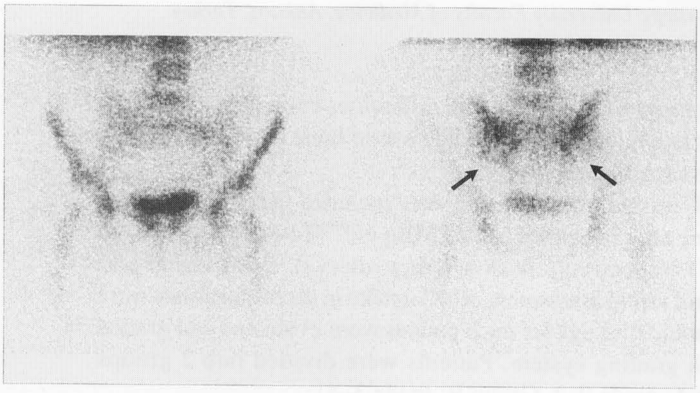

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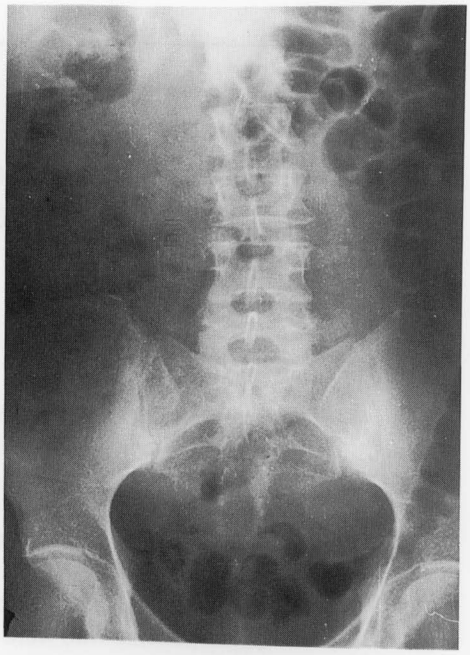

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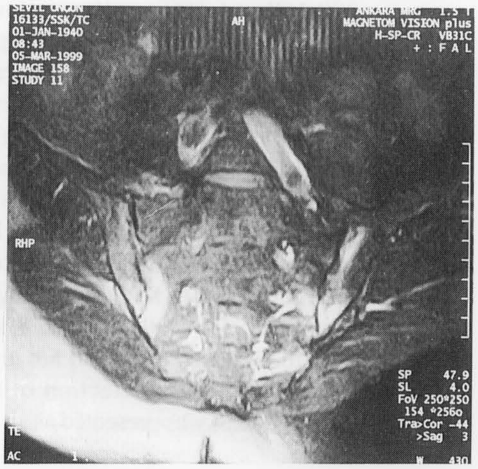

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Fig. 1 Bone and bone marrow scintigraphies with radiographic and MRI correlation of a 55-year-old female with low back pain and morning stiffness. (A) Bone scintigraphy shows bilaterally increased MDP uptake, especially in the lower portion of sacroiliac joints. (B) Bone marrow scintigraphy shows hypoactivity in the corresponding areas. (C) Radiography shows bilateral contour irregularities of both sacroiliac joints and minimal sclerosis (grade 2 changes). (D) MRI demonstrates bilateral hyperintensity in T2 weighted images consistent with SI.

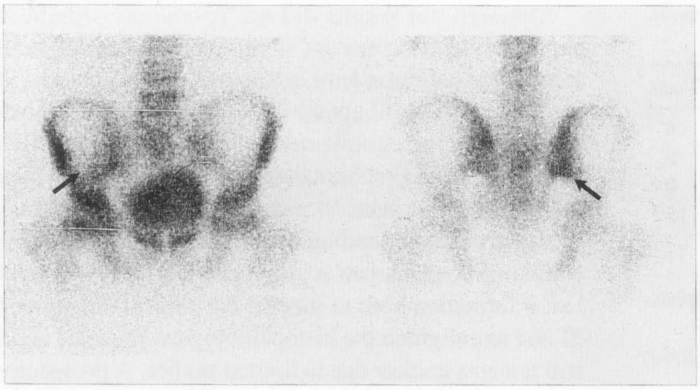
reflected by bone marrow scintigraphy to some extent, a more accurate diagnosis of active inflammatory SI could be possible. The aim of this study is to evaluate the role of combined use of bone and bone marrow scintigraphies for the diagnosis of SI.

MATERIALS AND METHODS

A total of 31 patients (25 females, 6 males; mean age 36 ± 18 y) clinically suspected to have SI were included in the study. Bone scintigraphy was performed 3 hours after i.v. injection of 740 MBq of ^{99m}Tc-methylene diphosphonate (MDP) by obtaining anterior and posterior postvoid pelvic images of 500,000 counts. After a 2-day interval, bone marrow scintigraphy was performed 30 minutes after i.v. injection of 370 MBq of ^{99m}Tc-sulfur colloid (SC) and 250,000 anterior and posterior postvoid pelvic images were obtained. Beside visual interpretation, the quantitation of bone scintigrams by drawing rectangular regions-of-interest over both sacroiliac joints and the sacrum on the posterior pelvic view was done. A sacroiliac joint index (sacroiliac joint/sacrum ratio) for each joint was obtained and an index value above 1.4 was considered positive for SI.[6] Radiographic findings were rated on a 0–4 scale according to the radiologic criteria for SI as follows[7]:

Grade 0: Normal (No change)
Grade 1: Suspicious pathological changes
Grade 2: Minimal changes such as small localized erosions and sclerosis without narrowing of the joint space
Grade 3: Advanced erosions and sclerosis with a narrow joint space.
Grade 4: Total ankylosis and fusion.

Patients were divided into two groups according to their radiographic findings: group A (n = 27) with grade



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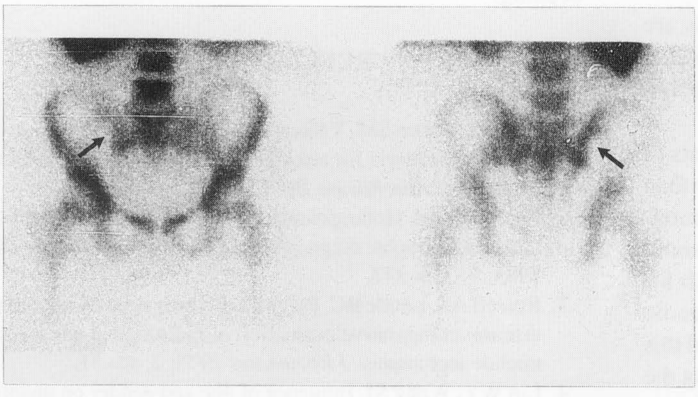

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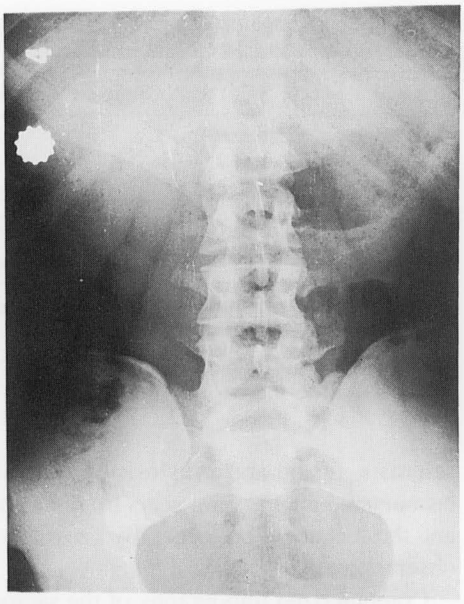

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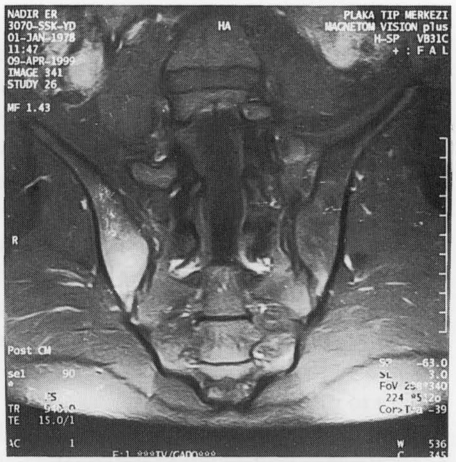

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Fig. 2 Bone and bone marrow scintigraphies with radiographic and MRI correlation of a 21-year-old male with pain localized in the right gluteal region. (A) Bone scintigraphy demonstrates increased MDP uptake in the inferior part of the right sacroiliac joint. (B) Bone marrow scintigraphy shows hypoactivity in the same area. (C) Bilaterally normal sacroiliac joint configuration is seen on radiography (grade 0 changes). (D) Sacroiliac MRI of the same patient represents signal changes related to sacroiliitis in the right sacroiliac joint and in the adjacent parts of the sacrum and iliac bone.

0–2 radiographic changes and as group B (n = 4) with grade 3–4 radiographic changes.

In addition to these, magnetic resonance imaging (MRI) of the sacroiliac joints was done in three cases.

RESULTS

In group A, 12 patients had increased MDP uptake in the sacroiliac joints, suggesting active SI (sacroiliac joint index > 1.4). Fifteen patients had normal MDP uptake in the sacroiliac joints. Among 12 patients with increased MDP bone uptake, 7 had decreased SC bone marrow uptake and 5 had normal SC bone marrow uptake (Figs. 1 and 2).

In group B, 1 patient had increased MDP bone uptake with decreased SC bone marrow uptake. One patient had increased MDP bone uptake with normal SC bone marrow uptake. Two patients had both normal MDP bone and SC bone marrow uptake in the sacroiliac joint region.

A total of 8 patients (7 patients in group A and 1 patient in group B) showed signs of increased MDP bone uptake in accordance with decreased SC bone marrow uptake in corresponding sacroiliac regions.

Scintigraphic findings and their radiographic correlations are shown in Table 1.

Three patients underwent a sacroiliac MRI study. In patient one, MRI demonstrated bilateral hyperintensity in T2 weighted images, consistent with SI (Fig. 1D). MRI represented hyperintensity in the right sacroiliac region suggesting SI in T2 weighted images in patient two (Fig. 2D). In patient three, changes suggesting unilateral SI were demonstrated. The MRI findings of all three patients were in correlation with both bone and bone marrow scintigraphic findings as well as radiographic findings.

DISCUSSION

Radiological evidence of SI is considered necessary for the diagnosis of ankylosing spondylitis by using the New York criteria[7,8] but, radiologic changes such as erosions,

Table 1 Scintigraphic findings and their radiographic correlations

MDP	SC	Group A	Group B	Total
increased	decreased	7	1	8
increased	normal	5	1	6
normal	decreased	0	0	0
normal	normal	15	2	17
Total		27	4	31

MDP: Bone scintigraphy with ^{99m}Tc-MDP (methylene diphosphonate)

SC: Bone marrow scintigraphy with ^{99m}Tc-SC (sulfur colloid)

sclerosis, fusion and ankylosis of sacroiliac joints are encountered after several years from the onset of disease and these changes are generally known to be subject to observer error.[1,2,9]

Computerized tomography of the sacroiliac joints to detect SI is found to be more sensitive and specific than plain radiography[10,11] but, both radiography and tomography represent static images and therefore they cannot detect the activity of inflammation in a patient with SI. MRI is now reported to be a more sensitive and specific diagnostic tool for detecting the early stages of SI, and this method has the potential to provide information about the disease process in SI by demonstrating abnormalities in subchondral bone and periarticular bone marrow.[12] Nevertheless, MRI is usually not the method of first choice for diagnosing SI because of its high cost, at least in our country.[13] Moreover, some of the patients are not suitable candidates for MRI evaluation, due to the artefacts secondary to metallic implants.

To reflect metabolic changes in active inflammation, quantitative sacroiliac joint scintigraphy with ^{99m}Tc-MDP has been used for decades and remains a routine examination worldwide[14] but, the usefulness of quantitative sacroiliac joint imaging for the early diagnosis of sacroiliitis especially in bilateral involvement or to detect activity after the disease has been debated.[4,15] Other conditions such as rheumatoid arthritis, degenerative disease or excessive physical activity can produce an increase in the sacroiliac joint/sacral ratio. It is also recognized that the sacrum may also be involved in the disease process decreasing the ratio.[16]

Histopathological studies showed that subchondral bone marrow edema is the first expected abnormality in the disease process of SI. From this point of view, we designed this study to reflect the subchondral bone marrow changes in the early stages of SI by bone marrow scintigraphy, and correlated the results with bone scintigraphy and radiographic findings. We found that among 8 patients with decreased uptake findings on bone marrow scintigraphy and increased sacroiliac joint index on bone scan, only 1 patient had advanced stage radiographic findings and the others had grade 0–2 radiographic findings.

Although our results did not reveal any significant superiority of bone marrow scintigraphy to bone scan, the former was helpful at least in 8 patients with decreased SC and increased MDP uptake in confirming the diagnosis. Considering the complementary roles of SC and MDP scans, we would recommend the combination of these scans to diagnose acute SI, especially in those with normal or slightly changed radiographic findings. In conclusion, additional bone marrow scintigraphy may provide important information both to support the clinical diagnosis of SI and to enlighten the histopathological process, which still remains unclear due to limited studies. A prospective study in a large population with MRI correlation is proceeding.

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