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INSUFFICIENCY FRACTURES OF THE SACRUM AFTER RADIOTHERAPY FOR GYNAECOLOGICAL MALIGNANCY

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Abstract

An entity is described which is characterized by low back pain and increased radionuclide uptake in the sacrum at bone scintigraphy in postmenopausal women having received radiotherapy towards the pelvis because of gynaecological malignancy. The findings simulate bone metastases, but are in all likelihood caused by insufficiency fractures of the sacrum promoted by bone weakness induced by postmenopausal osteoporosis and radiotherapy combined. The increased radionuclide activity has a characteristic appearance which in the fully developed fracture acquires the shape of an 'H'. In plain radiography, changes are absent or subtle. The proper complementary examination is CT, in which the fractures can be visualized and malignant changes excluded. Awareness of this benign entity is important to avoid overdiagnosis of bone metastases.

Key words: Radiotherapy, pelvis, gynaecological malignancy, bone scintigraphy, insufficiency fracture.

The introduction of megavoltage therapy has drastically reduced the incidence of radiographically evident postradiation atrophic changes of bone (1, 2). Related complications such as spontaneous fractures, pseudarthrosis, aseptic necrosis and bone resorption are today rare. This has resulted in a decrease of attention to such side effects of radiotherapy. However, irradiated bone is known to exhibit deficient elastic resistance to mechanical stress, which also may be present without radiographic changes (1). Consequently, these patients are disposed to insufficiency fractures, especially of weight-bearing bones.

At our department, a number of women have attracted our attention during follow-up after radiotherapy towards the pelvic region for gynaecological malignancy. These patients reported low back pain and exhibited increased radionuclide uptake in the sacral region at bone scintigraphy. This raised a suspicion of bone metastases which, however, was ruled out after repeated investigations and follow-up. Most probably the symptoms and scintigraphic findings were caused by insufficiency fractures of the sacrum promoted by postmenopausal osteoporosis and radiotherapy combined.

Awareness of this entity is important as it may otherwise erroneously be regarded as symptoms and signs of metastases. The purpose of this report is to describe the clinical and radiological characteristics of these cases and to discuss their clinical handling.

Material and Methods

Thirteen females, who had received radiotherapy because of gynaecological malignancy and who later presented with increased radionuclide uptake in the sacral region at bone scintigraphy, but without other signs of disseminated disease, were reviewed retrospectively.

Eleven of the patients had undergone surgical treatment. Chemotherapy had been given in five cases. No patient had received hormonal therapy.

All women had received external radiotherapy with 6, 8 or 21 MV x-rays. The target area was the pelvic region, including sacrum. The total treatment time varied from 3 to 11 weeks. In nine patients complementary intracavitary radiotherapy had been given. Diagnosis, age at onset of back pain, absorbed doses in and CRE-value for sacrum from external radiotherapy, and absorbed doses in sacrum from intracavitary radiotherapy are listed in the Table. The absorbed dose in the sacral region from the intracavitary radiotherapy was, compared to the absorbed dose in the same region from the external therapy, negligible (Table).

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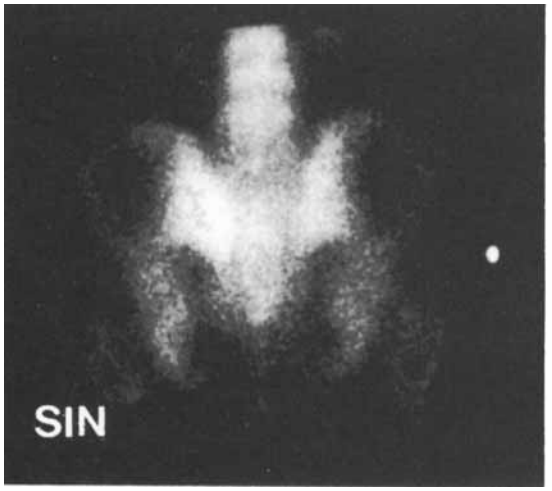

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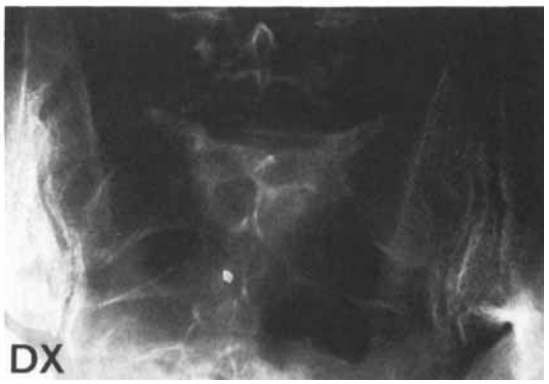

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Fig. 1. a) Bone scintigram of the pelvis (posterior registration) in a 59-year-old woman with a 1-month history of lumbar pain radiating to the left leg which began 10 weeks after starting treatment with 6 MV x-rays towards the pelvis because of endometrial carcinoma. There is moderately increased radionuclide activity of the left sacral ala. b) No changes can be seen in the corresponding radiogram. The symptoms disappeared within 3 months and the patient exhibited no signs of disseminated disease. The symptoms and scintigraphic findings are interpreted as being caused by an insufficiency fracture of the sacrum which healed without complications.

Table

Clinical and radiotherapeutical characteristics of 13 women with radiotherapy induced insufficiency fractures of the sacrum

Age at onset of symptoms (years)	Diagnosis	Sacral absorbed dose		
		External		Intracavitary
		Gy	CRE	Gy
54	Endometrial carcinoma	41	12.5	0.5
59	Endometrial carcinoma	40	12.5	0.5
60	Cervical carcinoma	40	12.5	5
60	Ca of the Fallopian tube	40	11.7	–
61	Ovarian carcinoma	40	11.9	–
62	Mal lymphoma of the vagina	25	9.2	1
68	Endometrial carcinoma	40	12.5	4
70	Endometrial carcinoma	41	12.5	0.5
73	Endometrial carcinoma	40	12.4	0.5
74	Ovarian carcinoma	40	11.9	–
77	Cervical carcinoma	40	12.5	3
78	Endometrial carcinoma	40	12.5	5
78	Ovarian carcinoma	40	12.5	–
Mean 67		39	12.1	1.5

Of special interest were findings at bone scintigraphy and radiography of the pelvic region as well as the history of back pain. Bone scintigraphy was performed with a General Electric 400-T or AT Maxicamera, equipped with a low-energy general-purpose collimator, 3 h after the intravenous injection of 500 MBq $^{99}Tc^{m}$-methylendiphosphonate. The examination was performed as an analogous registration documented on Polaroid prints including anterior and posterior views of the axial skeleton. Ten women underwent, up to three times, complementary radiological examinations including plain radiography of the sacrum and bone scintigraphy. In two cases linear tomography and in one case computed tomography of the sacrum were also performed. In all patients metastases were ruled out as the cause of the symptoms and of the increased radionuclide activity due to the radiological development and/or an obvious clinical course.

The follow-up period from the beginning of external radiotherapy to the last recorded examination varied from 5 to 60 months.

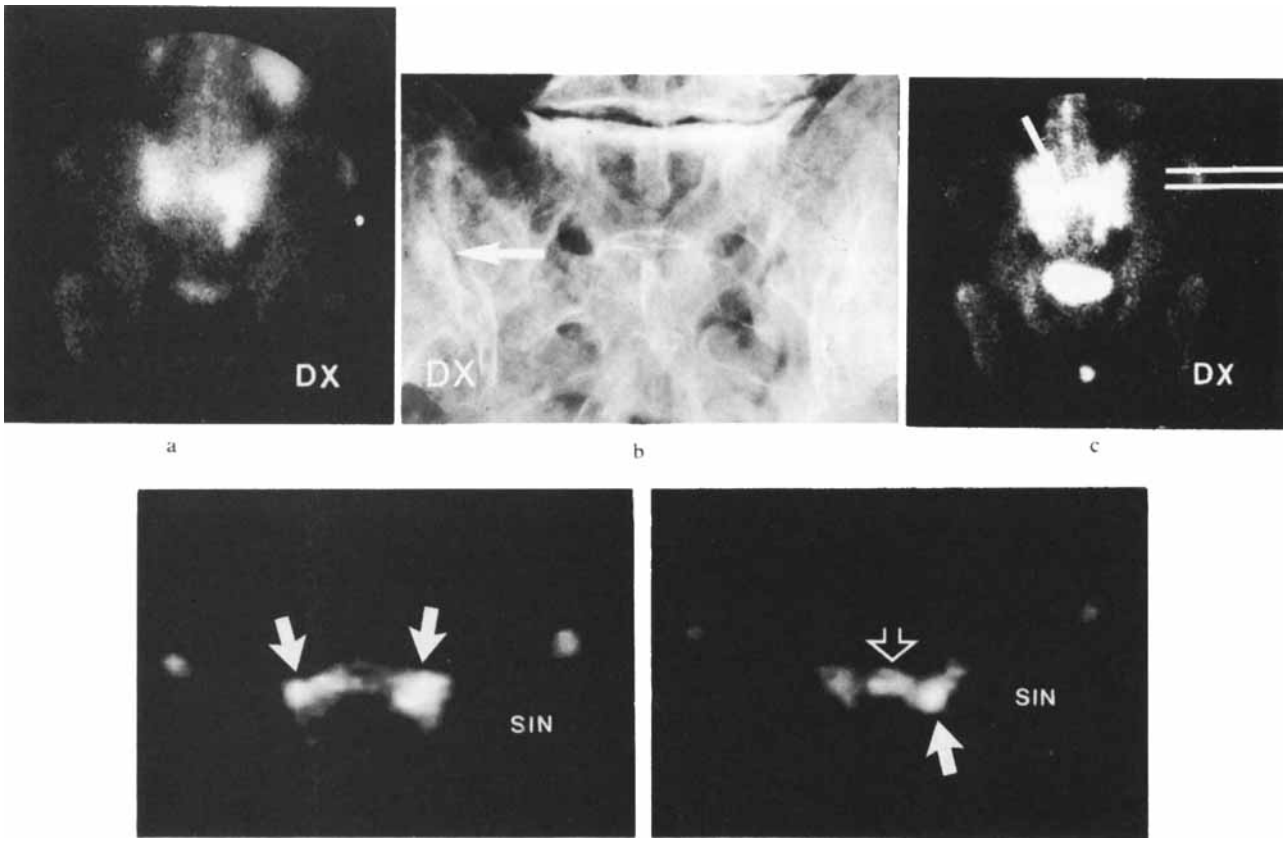


Fig. 2. a) Bone scintigram (posterior registration) of the pelvis in a 74-year-old woman with lumbar pain starting 2 weeks after beginning of radiotherapy with 21 MV x-rays because of cancer of the ovary. There is increased activity in both sacral alae and in the right kidney. b) Corresponding radiograph showing a sclerotic strip in the right sacral ala (arrow). c) Bone scintigram (posterior registration) performed 4 weeks later as a scout view prior to an emission computed tomographic examination in order to rule out the right-sided activity being caused by a dilated ureter. A hot area over the mid-sacrum has appeared (arrow) giving rise to an H-shaped area of increased activity. The activity in the right kidney is normalized. d) Two transversal sections of the corresponding emission tomography. Section level is indicated in c. There is increased activity in both sacral alae (solid arrows) as well as in mid-sacrum (open arrow). The finding is interpreted as representing bilateral vertical and a central horisontal insufficiency fracture of the sacrum.

Results

In all patients back pain started some time after the beginning of radiotherapy. Eleven of them reported no earlier back pain. Two women had a previous history of diffuse back pain, but both experienced a different type of back pain appearing after the radiotherapy. The time from the beginning of the external radiotherapy to the onset of back pain ranged from 2 to 89 weeks, with a median of 26 weeks. Eleven women reported symptoms appearing within 50 weeks. In the remaining two patients longer time elapsed; 88 and 89 weeks respectively. No patient reported a preceding trauma. The back pain was always lumbar and in eleven cases of radiation pain to the gluteal region, pubic region and/or legs was also described.

At the initial bone scintigraphy, five women had unilaterally increased radionuclide uptake oriented vertically in one of the sacral alae (Fig. 1). In four patients it was bilateral and oriented vertically in the sacral alae. Four cases exhibited both bilateral vertical bands of increased activity in the sacral alae and a horizontal band through the central part of the sacrum, giving rise to an H-shaped or 'butterfly' appearance. No patient exhibited a hot area in the shape of an isolated horizontal band.

In three women bone scintigraphy was only performed once. Among the patients with more than one bone scintigraphy, one patient showed progression from unilaterally to bilaterally increased uptake in the sacral alae. In one of the bilateral cases progression to an H-shaped appearance occurred (Fig. 2). At repeated scintigrams the uptake-increase became less pronounced but did not return to normal in three women; in one of these a hot area was still present 43 months after the initial investigation. Five patients eventually had a normal bone scan.

Four women recovered completely from back pain during the time followed. Two of these patients exhibited increased uptake at bone scan more than 1 year after

complete recovery. In one woman who did not recover completely during the follow-up period the back pain had so far lasted for 16 months. In one of the five patients in whom bone scintigraphy eventually normalized, symptoms persisted at least 5 months after a normal bone scan was obtained.

Eight women developed changes in the sacral region at plain radiography. In two of these patients, who both also exhibited an H-shaped hot area, a fracture of the sacrum could be identified. In one of them a horizontal fracture of the sacral body was observed in the lateral view, in the other a vertical fracture was identified in the cranial aspect of one sacral ala in the frontal view (Fig. 3). The other six women with radiographic changes showed areas of diffuse sclerosis in the lateral part of sacrum parallel with and adjacent to the sacroiliac joints (Fig. 2). The location of these changes corresponded to increased radionuclide uptake at bone scan.

Linear tomography in frontal view was obtained in one patient with sclerosis laterally in the os sacrum and in one patient with normal plain radiography but yielded no additional information.

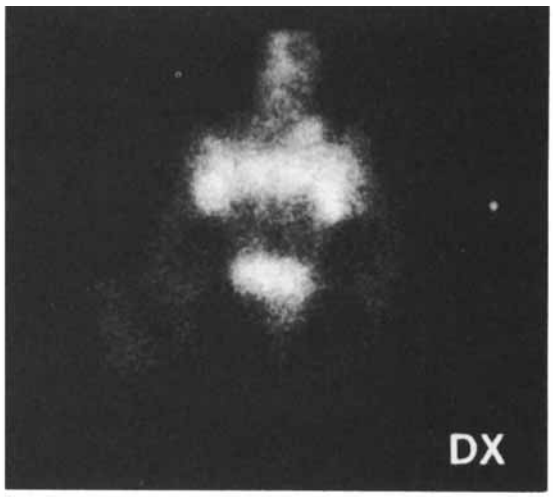
In one women with an H-shaped hot area computed tomography of the sacral bone was performed. This revealed vertical fractures of both sacral alae and a horizontal fracture of the sacral body (Fig. 3).

In four patients increased radionuclide uptake also occurred in other parts of the pelvis. These cases showed increased uptake in os pubis. At radiography corresponding fractures surrounded by sclerosis of variable extent were identified. One woman developed bone erosions along the pubic fracture line. In addition, two of these patients exhibited an elongated area of increased radionuclide uptake running obliquely through one ileal ala which at radiography corresponded to a faint sclerotic streak. These ileal changes were interpreted as being caused by fissures.

Discussion

In the present patients with increased radionuclide uptake usually restricted to the sacral region and with normal, or subtle, findings at radiography the diagnosis was primarily dubious. However, the limited radiographic changes in combination with lack of other signs of disseminated disease encouraged a conservative attitude and the patients were followed by repeated examinations. Although changes in radiographs did not develop in five women and fracture of the sacrum was made visible in only two cases, the diagnosis of insufficiency fractures became highly probable in retrospect.

The interpretation of our findings is in accordance with several recently published case reports describing insufficiency fractures of the sacrum (3–7). By definition, insufficiency fractures occur after normal stress in bone with deficient elastic resistance (8) such as is caused by post-



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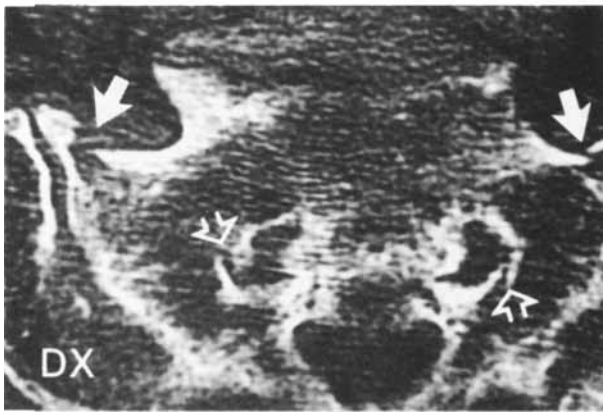

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Fig. 3. a) Bone scintigram of the pelvis (posterior registration) in a 77-year-old woman with a 2-month history of lumbar pain radiating to the left leg which debutated 44 weeks after irradiation over the pelvis with 21 MV x-rays because of cervical carcinoma. An H-shaped area of increased activity characteristic for a 'complete' insufficiency fracture of the sacrum can be seen in the scintigram. b) Radiography reveals only a slightly dislocated fracture in the cranial aspect of the left sacral ala (solid arrow). c) Computed tomography detects bilateral vertical fractures of the sacral alae (solid arrows) as well as cortical defects of the sacral foramina reflecting the horizontal fracture through the sacral body (open arrows).

menopausal osteoporosis (9). In patients receiving radiotherapy an additional reduction of the elastic resistance of the bone could be expected (1). As in previously reported series, the sacral fractures in our series had an invariable location. First in place were fractures running vertically in the lateral part of the sacrum parallel to the sacro-iliac joint either uni- or bilaterally. Vertical fractures were sometimes linked by a horizontal fracture through the mid-sacrum, thus giving rise to the characteristic H-shaped appearance at bone scintigraphy. A striking finding was the lack or faintness of changes corresponding to the sacral fractures at radiography. The fractures of the pubic and iliac bones which also occurred in four patients do not seem to be coincidental. Concomitant parasymphyseal and iliac fractures in cases of insufficiency fractures of the sacrum have recently been described (3, 10–12). Also, as previously experienced (12–15), the pubic fractures, in contrast to the sacral fractures, yielded considerable changes at radiography. This probably reflected delayed healing caused by ineffective immobilization due to the powerful adductor muscles (11, 16).

The actual patients were noticed because of the striking appearance of routine scintigrams and, consequently, they represent a selection precluding statistical conclusions as regards the incidence of this complication after radiotherapy.

All our patients either recovered completely or improved significantly without specific treatment.

Usually bone scintigraphy is the first diagnostic procedure in cases with suspected bone metastases. In patients with an appropriate history, isolated H-shaped increased radionuclide uptake in the sacrum seems to be diagnostic for insufficiency fractures. Metastases would rarely give rise to this symmetrical pattern. Since it is known that the incidence of metastases is decreased in irradiated bone marrow (17, 18), it also seems unlikely that metastases would start in and be restricted to irradiated parts shortly after radiotherapy. In cases with typical symptomatology and bone scintigraphy, additional diagnostic manoeuvres are not necessary (6, 7). In our opinion, and in accordance with other authors (3, 19, 20), the proper complementary examination in unclear cases is CT. By this, either fractures cutting through the compact bone or the vertical bands of sclerosis may be visualized. In addition, bone destruction and soft tissue masses which could be expected in the case of metastases can be excluded. Increased activity of this area could also be caused by sacroiliitis. However, this is a very unlikely condition in elderly women (3).

The diagnostic pitfall in these patients arises from the specific circumstance that the treatment of a malignancy itself promotes the development of a condition which simulates bone metastases. The eldery woman being treated with radiotherapy towards the pelvis is a particular candidate for this illusive condition. Consequently, patients who have received radiotherapy towards weight-bearing bones and who present themselves with pain and increased activity at bone scintigraphy of irradiated structures, but without other signs of disseminated disease, should be dealt with in a conservative manner.

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