Use of Bone Scintigraphy to Select Patients with Multiple Myeloma for Treatment with Strontium-89

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Strontium-89 is an effective agent for palliation of pain due to bony metastases from breast and prostate carcinoma. As a functional analog of calcium, \(^{89}\)Sr is taken up by bone in areas of osteoblastic activity. Since patients with multiple myeloma frequently have osteolytic metastases, \(^{89}\)Sr might not be considered to be a therapeutic option. However, metastases which appear osteolytic by radiographs may demonstrate osteoblastic activity on bone scans. Consequently, the bone scan may be used to identify a subset of patients with osteolytic metastases who may benefit from \(^{89}\)Sr treatment. This report describes a patient with severe rib pain due to multiple myeloma whose chest radiograph showed multiple lucent lesions throughout the bones of the chest wall but whose bone scan showed marked osteolytic activity. The patient was treated with \(^{89}\)Sr and received substantial pain relief. Bone scans may be useful in selecting myeloma patients or other cancer patients with osteolytic radiographic lesions who may benefit from \(^{89}\)Sr therapy.

Key Words: strontium-89; multiple myeloma; bone scintigraphy; pain palliation; lytic metastases


Strontium-89 is an effective agent for the palliation of bone pain from osseous metastasis from breast and prostate cancer with an overall response rate reported in the range of 60%–80% (1–7). Strontium-89 is a beta emitter with a half-life of 50.5 days. It is a functional analog of calcium and is therefore taken up in bone, without being incorporated into bone marrow. It is avidly accumulated in sites of osteoblastic activity and therefore accumulates in osteoblastic sites of tumor invasion. It is retained at metastatic sites for prolonged periods and delivers an estimated 1000–3000-rad dose following administration of doses in the range of 40 \(\mu\)Ci/kg (8–10). Strontium-89 is accepted as an effective palliative measure for patients with metastatic breast and prostate cancer; however, its role in the treatment of bone pain in multiple myeloma is less well defined.

In 1950, Lawrence and Wasserman treated 11 multiple myeloma patients with \(^{32}\)P and nine patients with a combination of \(^{32}\)P and \(^{89}\)Sr (11). Although 5 of 20 patients had a response to treatment as measured by improved pain control, they concluded that “there was no evidence that the combination of \(^{89}\)Sr and \(^{32}\)P proved more effective than \(^{32}\)P alone” and they further concluded that it was “unlikely that radiostrontium will be a valuable therapeutic agent.”

It is well known that \(^{99m}\)Tc-MDP often fails to accumulate in osteolytic bony metastases of multiple myeloma (12–14). Since the biodistribution of strontium is similar to that of \(^{99m}\)Tc-MDP, one might not expect \(^{89}\)Sr to be an effective modality for the treatment of pain due to multiple myeloma. This report describes the use of bone scintigraphy to document osteoblastic activity in sites of bony pain in a patient with multiple myeloma whose chest radiograph showed osteolytic metastases. The patient was treated with \(^{89}\)Sr and a palliative response was obtained.

CASE REPORT

A 62-yr-old female was diagnosed with multiple myeloma in January 1980 and was initially treated with local radiotherapy followed by alkleran and predinone for 10 yr with excellent results. Disease progression was noted in 1990 and treatment with vincristine, busulfan and adriamycin was instituted. Further progression in April 1992 was treated with cyclophosphamide. Over this time period, multiple courses of involved-field radiotherapy were administered. Unfortunately, by the winter of 1992, the patient was requiring large doses of narcotic analgesia and was achieving only modest pain control. The patient was referred for consideration of \(^{89}\)Sr therapy.

At the time of referral in December of 1992, the patient was suffering from severe pain at multiple sites including the midthoracic spine, anterior ribs and lower back. A chest radiograph in January of 1993 showed an expansile lytic lesion of the right sixth rib and multiple lucent lesions throughout the bones of the chest wall consistent with multiple myeloma. At the time of presentation, the patient was asked to rate the severity of her pain on a scale of 1 to 4 (mild to extremely severe). She rated the pain in her midthoracic spine 3 to 4, pain her lower back 2 to 4 and pain in her ribs 3 to 4. Physical examination revealed exquisite tenderness over the mid thoracic spine and severe tenderness to pressure...
over the anterior ribs bilaterally. Her right shoulder was also painful at the time of examination. Pain control was poor despite an average of 240–300 mg of MS Contin and 3–4 g of acetaminophen daily. Sleep was interrupted by pain and Karnovsky score was estimated at 30. A $^{99m}$Tc-MDP bone scan was obtained and showed multiple areas of abnormal activity, including the midthoracic spine and bilateral ribs corresponding to the sites of her most severe pain (Fig. 1). Because there was abnormal uptake of $^{99m}$Tc-MDP corresponding to the sites of bony pain, we treated the patient with 2.6 mCi (40 μCi/kg) of $^{89}$Sr intravenously.

The patient was reassessed at 6 wk post-therapy and reported general overall improvement. Karnovsky score had increased to 45. Mobility was definitely better, analgesic usage had decreased by approximately 25%, pain control was substantially improved and the patient was often able to sleep without being awakened by pain. No hematologic toxicity or other untoward side effects had occurred. The patient continued to fill out pain forms on a daily basis for 3 mo after $^{89}$Sr therapy; at 3 mo, she rated pain in her midthoracic spine as 1–2, pain in her lower back as 0 and pain in her ribs as 1–2. There was a new site of pain in her neck, which she rated 1 to 2.

**DISCUSSION**

Strontium-89 therapy has been extensively investigated for the treatment of painful osseous metastases from cancer of the breast and prostate. Responses in the range of 60%–80% have been consistently reported (1–7). However, bony lesions due to multiple myeloma are commonly lytic and are often associated with poor uptake on the bone scan (12–14). Osteoclastic processes result in decreased tracer accumulation; since the biodistribution of $^{89}$Sr parallels the biodistribution of bone-scanning agents, $^{89}$Sr might not be expected to concentrate at sites of lytic metastases. Acceleration of either an osteoclastic or osteoblastic process, however, is usually associated with an increase in the other (7). When osteoclastic activity exceeds osteoblastic activity, the radiograph may show a lytic lesion. Nevertheless, there may be enough osteoblastic activity at the periphery of lytic lesion to result in increased tracer accumulation with the potential of a palliative response following treatment with $^{89}$Sr.

We describe a patient with advanced multiple myeloma and lytic radiographic lesions whose bone scan demonstrated osteoblastic activity corresponding to the major sites of bony pain. She received substantial palliation following $^{89}$Sr therapy. The bone scan can be used to document osteoblastic activity in patients with lytic lesions and may be useful in identifying a subset of patients with multiple myeloma or other radiographically osteolytic metastases who may benefit from $^{89}$Sr therapy.

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**REFERENCES**