Diffuse Myocardial Uptake of ^{99m}Tc -HDP in Multiple Myeloma

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Received: 22 February 2013 / Revised: 26 April 2013 / Accepted: 29 April 2013 / Published online: 18 May 2013
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Abstract Soft tissue uptake is a rare finding in bone scintigraphy, with an incidence of 2%. Although the mechanism has not yet been fully clarified, several causes have been reported for this unusual uptake pattern. This paper presents a case of diffuse myocardial accumulation of technetium-99m hydroxymethylene diphosphonate (^{99m}Tc -HDP) without either solid/visceral organ or soft tissue with multiple myeloma (MM) in skeletal scintigraphy. A 93-year-old man with hypertension and chronic heart failure for 14 years underwent bone scanning due to a 2-month history of back pain within a 1-year period of MM. Three hours later, ^{99m}Tc -HDP late static images showed diffuse myocardial radiotracer accumulation and there were no other sites of abnormal soft tissue or visceral uptake. Myocardial accumulation had disappeared on 24-h delayed static images. This accumulation was thought to be related with AL-type amyloidosis associated with MM.

Keywords Technetium-99m hydroxymethylene diphosphonate (^{99m}Tc -HDP) · Technetium-99m bone agents · Myocardial uptake · Multiple myeloma

Introduction

Scintigraphy with technetium-99m hydroxymethylene diphosphonate (^{99m}Tc -HDP) is usually performed for the evaluation of skeletal abnormalities, but soft tissue uptake is an unexpected finding with an incidence of approximately 2% [1, 2]. The recognition of specific conditions with extra-

osseous accumulation of bone radiopharmaceuticals provides important clinical information for making an accurate differential diagnosis [3]. However, several causes have been reported for this unusual uptake pattern, the mechanism of which has not as yet been fully clarified [4, 5]. Multiple myeloma (MM) is characterised by neoplastic proliferation of plasma cells [6] and mainly involves bone marrow [7]. A specific subtype of amyloidosis, AL protein type, is associated with MM [8]. Soft tissue uptake of bone radiopharmaceuticals is rarely observed in MM patients, and in these patients, soft tissue uptake has been seen to accompany other visceral uptake [9–12]. The case is reported here of a patient with MM who demonstrated diffuse myocardial accumulation of tracer without either solid/visceral organ or soft tissue during 3-h late static images of ^{99m}Tc -HDP skeletal scintigraphy.

Case Report

A 93-year-old man was referred to our clinic for bone scanning due to a 2-month history of back pain within a 1-year period of MM. His medical history revealed that he had suffered hypertension and chronic heart failure for 14 years. The patient had also been treated with medical therapy for osteoporosis and anaemia due to chronic disease.

The laboratory findings were as follows: haemoglobin was 12.2 g/dl with an increased mean cell volume. Erythrocyte sedimentation rate was high, measuring 62 mm/h (normal, 0–15 mm/h). Alkaline phosphatase levels were elevated to 333 IU/l (normal, 25–100 IU/l) with normal calcium, phosphate and parathormone levels. Renal function tests showed an elevation of blood urea nitrogen (BUN) up to 52 mg/dl (normal, 13–43 mg/dl) and creatinine up to 1.7 mg/l (normal, 0.3–1.2 mg/l).

Bence-Jones protein was positive and immunofixation revealed free kappa and lambda light chains in the urine.

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Fig. 1 ^{99m}Tc -HDP early and late whole-body scan. **a** Early whole-body anterior and posterior blood pool views show increased tracer uptake in the cardiac area. **b** Three-hour whole-body anterior and

posterior views show intense diffuse radioactivity uptake in the myocardium

Also, serum kappa chain was elevated to 876 mg/dl (normal, 90–210 mg/dl) and serum lambda chain was 132 mg/dl (normal, 170–370 mg/dl). IgG kappa light chain monoclonal gammopathy was determined in patient's serum with immunofixation electrophoresis. At the time of diagnosis of MM, bone marrow biopsy had been performed and it was containing 10% plasma cells (normal, no more than 4%).

Chest radiography showed consolidation in the left costophrenic sinus and enlarged cardiothoracic index but no calcification was detected. An electrocardiogram showed a low-voltage pattern with a normal sinus rhythm at a rate of 72 beats/min.

After written informed consent was obtained from the patient, 740 mBq (20 mCi) of ^{99m}Tc -HDP was injected in

Fig. 2 ^{99m}Tc -HDP static images: **a** 3-h anterior static image, **b** 3-h left lateral static image, **c** 24-h delayed static anterior image

the right antecubital fossa. After a further 5 min, early whole-body blood pool images were taken. Three hours after the administration of the radiopharmaceutical, the whole-body bone scan, and anterior and left lateral spot views of the thorax were obtained. ^{99m}Tc -HDP 3-h late static images showed diffuse myocardial radiotracer accumulation (Fig. 1). The bone scan demonstrated that osseous uptake of ^{99m}Tc -HDP was relatively decreased. Increased radiotracer uptake in the T12 vertebral area was evaluated as a compression fracture, given the patient's osteoporotic condition. No other sites of abnormal soft tissue or visceral uptake were detected. On 24-h delayed static spot images, myocardial accumulation had disappeared (Fig. 2). Quality control tests of the radiopharmaceutical did not reveal any abnormality. The possibility of unlabelled radionuclide was also excluded as bone scans of other patients using the same vial did not yield unexpected findings.

Echocardiography revealed pulmonary hypertension (pulmonary arterial pressure was 60 mmHg, normal 15–18 mmHg), left ventricular wall thickening, right atrial enlargement, generalised valvular thickening, increased thickness in intra-arterial septa and the left ventricular ejection fraction was 40% but echocardiography did not show any calcification or amyloid deposition, known as granular sparkling. The patient refused any further work-up, so a myocardial biopsy was not performed. Subcutaneous abdominal fat aspiration was planned for amyloidosis, but the patient deteriorated rapidly and died due to pneumonia and respiratory failure before the examination was possible. His family did not accept post-mortem studies.

Discussion

MM is characterised by neoplastic proliferation of plasma cells within the marrow [6]. The clinical features of MM are variable, and osteopenia, osteolytic bone lesions, pathological fractures, bone pain and renal failure are relatively common presentations [7]. The classic bone presentation of MM is lytic skeletal lesions [13]. Bone scintigraphy is poor at establishing the diagnosis of MM [11] because technetium-99m bone agents have low sensitivity in the determination of osteolytic lesions.

Amyloidosis is the extracellular deposition of insoluble fibrillar protein in various organs [9]. Amyloidoses are classified in five different types by the nature of the amyloid fibrils [14]. AL-type amyloidosis, immunoglobulin light-chain-related type, is often associated with MM as a result of light chain deposition, commonly within the heart, kidney and gastrointestinal tract [9, 11]. Technetium-labelled bone agents have been used to demonstrate visceral or soft tissue involvement in MM patients [8–12]. Diffuse left ventricle uptake on the bone scan can be seen in cardiac amyloidosis

[8, 9]. However, serum amyloid P protein has been thought to react with amyloid fibril protein in a calcium-dependent manner and to increase the affinity of the bone agent for amyloid in locations of elevated calcium depositions, although the mechanism of the bone agent's accumulation in amyloid deposits is still largely unclear [1, 9]. The degree of affinity for bone tracers may vary depending on the light-chain components of the AL-type amyloidosis patients because AL-type amyloid is mainly related to variable regions of the immunoglobulin light chain [9]. As in our case, the accumulation of ^{99m}Tc -HDP still remains unclear, but it is thought to be due to increased immunoglobulin light-chain.

The bone scan in our patient showed diffuse myocardial uptake during 4-h late static images and no apparent radionuclide uptake was noted at 24-h delayed spot views. Similar appearances have been reported but are usually associated with uptake in many visceral organs or soft tissues where amyloid deposits are probably responsible [8–12, 14–17]. In this case, isolated myocardial accumulation of ^{99m}Tc -HDP was observed without either solid/visceral organ or soft tissue involvement. To the best of our knowledge, there are no data in the literature about the disappearance of the accumulation on 24-h delayed images.

Diffuse myocardial uptake can also be seen in heart failure following congestive cardiomyopathy, widened myocardial infarction, myocardial fibrosis or necrosis, and alcoholic cardiomyopathy [18–20]. These diffuse cardiac accumulation possibilities were excluded in our patient with echocardiography findings, medical history and laboratory results. Due to similar cases in the literature, it was thought that this accumulation could be related to AL-type amyloidosis associated with MM.

Conflict of interest None.

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