Multiple extraosseous accumulation of ^{99m}Tc-MDP in acute lymphocytic leukemia and reference to literature

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Keywords: ^{99m}Tc-MDP
- Whole-body bone scan
- Extraosseous accumulation
- Acute lymphocytic leukemia

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Received:
29 July 2010
Accepted revised:
29 August 2010

Abstract

Technetium-extraosseous accumulation of technetium-99m- methyl diphosphonate (^{99m}Tc-MDP) on bone scan is not usual. It was described and in various diseases with solitary spleen or lung uptake. Simultaneous splenic, pulmonary and renal concentration of ^{99m}Tc-MDP has not been illustrated previously. Herein, we present a 17 years old man with acute lymphocytic leukemia (ALL) in whom ^{99m}Tc-MDP was accumulated in the spleen, both lungs and the kidneys. Related literature was mentioned.

Hell J Nucl Med 2010; 13(3):273-276 • *Published on line: 25-11-2010*

Introduction

Extraosseous accumulation of ^{99m}Tc-MDP can sometimes be found in whole-body bone scan. This phenomenon is often attributed to abnormality of calcium metabolism and occurs most usually in the lungs. To our knowledge, concomitant spleen, lung and kidney uptake has not been previously illustrated. Here we presented a case of prominent splenic, diffuse pulmonary and increased renal uptake of ^{99m}Tc-MDP, incidentally observed on a bone scan in a patient with acute lymphocytic leukemia (ALL).

Case description

A 17 years old male was admitted to our hospital with complaint of sacral and bilateral hip pain for three month which increased significantly in the last of 15 days. Pelvis CT was primarily scheduled and showed multiple lytic lesions in the pelvis and sacral vertebrae (Fig. 1a). Laboratory investigations revealed high levels of serum calcium (4.03mmol/L), ALP (248U/L), LDH (1689U/L), urea nitrogen (16.7mmol/L) and creatinine (160umol/L). Phosphate was normal. The patient was referred for a whole-body bone scan using ^{99m}Tc-MDP to evaluate whole-body bone involvement. To our surprise, markedly abnormal uptake in the lungs, spleen, kidneys, pelvis and ribs as found (Fig. 1c, d). Chest CT demonstrated diffuse ground-glass opacity lesions in both lungs (Fig. 1b). Peripheral blood showed red blood cells (RBC) 3.19 x 10^{12}/L (4.0~5.5 x 10^{12}/L), hemoglobin 8.9g/dL (12~16g/dL), white blood cells 11.5 x 10^{9}/L (4~10 x 10^{9}/L) and platelets normal. The patient was suspected of hematologic diseases according to these abnormal findings. Further bone marrow biopsy established the diagnosis of ALL (L1 subtype) in this patient.

Discussion

Acute lymphocytic leukemia is the most prevalent form of leukemia in children and accounts about 75% of patients. Early clinical diagnosis of ALL in a child is usually difficult to make. Sometimes, the primary presenting syndrome is musculoskeletal pain. Children who present in this fashion may be referred for bone scan. Whole-body bone scan has been shown to be useful in the diagnostic work-up of unexplained bone pain [1-3]. Shalaby-Rana E et al. (2001) [4] indicated that uptake of ^{99m}Tc-MDP in the pelvis was strikingly intense on the early phase and strikingly normal on the delayed phase of leukemia. From this point of view, the presented patient may be at the early phase of ALL.

Although accumulation of ^{99m}Tc-MDP in the spleen is exceptional, it was documented in patients with sickle cell disease [5-9], megaloblastic anemia [10], thalassemia major [11], Hodgkin's disease [12], non-Hodgkin's lymphoma [13, 14], waldenstrom's macroglobulinemia [15], chronic lymphocytic leukemia [16], chronic myelogenous leukemia [17], multiple myeloma [18], hemochromatosis [19], metastatic breast carcinoma [20], bronchogenic carcinoma [21], rhabdomyosarcoma [22], angiosarcoma of spleen [23], subcapsular splenic hematoma [24], calcified and noncalcified hemangioma [25,26], splenic artery calcification [27], severe alcoholic cirrhos-

Table 1. *Summary of patients exhibiting extraosseous uptake of ^{99m}Tc-MDP on whole-body bone scan reported in the literature*

No.	Publication time	Age/ Sex	Disease	Extraosseous ^{99m}Tc-MDP uptake					
				Spleen	Lung	Kidney	Liver	Stomach	Muscle
1	1976	56/F	Sickle cell disease[5]	+					
2	1977	26/M	>> >> >>	+					
3	1978	15/M	>> >> >>	+					
4	2004	52/F	>> >> >>	+					
5	2007	27/M	>> >> >>	+					
6	2000	49/F	Megaloblastic anemia[10]	+					
7	1978	19/F	Thalassemia major[11]	+					
8	1976	63/F	Hodgkin's lymphoma[12]	+		+			
9	1982	39/M	Non-Hodgkin's lymphoma[13]	+					
10	2010	40/M	>> >> >>	+			+		
11	2009	62/F	Waldenstrom's macroglobulinemia[15]	+			+		
12	1988	77/M	Chronic lymphocytic leukemia[16]	+					
13	1990	37/F	>> Myelogenous >>	+					
14	2002	Adult/M	Multiple myeloma[18]	+			+		
15	1999	43/M	Hemochromatosis[19]	+					
16	1977	57/F	Breast Carcinoma[20]	+					
17	1984	Adult/M	Bronchogenic carcinoma[21]	+					
18	1999	14/M	Rhabdomyosarcoma[22]	+					
19	1985	Adult/M	Angiosarcoma of spleen [23]	+					
20	1982	5/M	Spleen injury[24]	+					
21	1984	80/M	Calcified hemangioma of the spleen[25]	+					
22	1989	68/M	Splenic hemangioma[26]	+					
23	1988	80/M	Splenic artery calcification[27]	+					
24	2005	57/M	severe alcoholic cirrhosis of the liver[28]	+					
25	1979	Adult/F	Glucose-6-phosphate dehydrogenase deficiency[29]	+					
26	1999	Adult/M	Chemotherapy[30]	+					
27	1988	1/M	Combined immunodeficiency disease[31]	+					
28	1996	65/F	Parathyroid adenoma[32]		+		+		
29	1990	55/M	Parathyroid carcinoma[33]		+				
30	1988	Adult/F	Multiple myeloma[34]	+	+				
31	1977	49/F	Parathyroid adenoma[35]		+	+			
		50/M	Multiple myeloma[35]		+	+		+	
		73/F	Vitamin D intoxication[35]		+			+	
32	1975	52/M	Carcinoma of bladder[36]		+				
33	1985	24/M	T-cell leukemia[37]		+	+			
34	2002	18/F	Acute lymphoblastic leukemia[38]		+	+	+	+	
35	1998	40/F	Melanoma[39]		+	+		+	
36	2000	28/M	Acute renal failure[40]		+			+	
37	1992	49/F	Chronic renal failure[41]		+	+		+	
38	2003	42/F	>> >> >>		+				
39	1996	65/F	Wegener's vasculitis[43]		+				
40	1990	70/M	Primary amyloidosis[44]		+				
41	1989	37/M	Pneumocystis carinii pneumonia[45]		+				
42	1976	68/M	Hodgkin's disease[46]		+				
43	2006	32/M	Ewing's sarcoma[47]		+				
44	2003	66/F	Milk-alkali syndrome[48]		+			+	
		67/M	Glomerulonephritis[48]						+
45	2002	38/M	Waldenstrom's macroglobulinemia[49]		+	+			
46	2008	46/M	Erdheim-Chester disease[52]			+			
47	2004	25/M	Polyostotic fibrous dysplasia[53]				+		
48	2009	78/F	Ovarian papillary serous adenocarcinoma[54]				+		
49	2005	46/F	Polymyositis[55]						+

is of the liver [28], glucose-6-phosphate dehydrogenase deficiency [29], hematologic abnormalities recently treated with chemotherapy [30], severe alcoholic cirrhosis of the liver [28], glucose-6-phosphate dehydro-

genase deficiency [29], hematologic abnormalities recently treated with chemotherapy [30], severe combined immunodeficiency disease [31] (Table 1). This case is the first case demonstrating ^{99m}Tc-MDP accumulation in the spleen in ALL.

Diffuse lung uptake of ^{99m}Tc-MDP has been well described in various diseases. It was reported in patients with parathyroid adenoma [32], parathyroid carcinoma [33], multiple myeloma [34], vitamin D intoxication [35], carcinoma of the bladder [36], T-cell leukemia [37], acute lymphoblastic leukemia [38], melanoma [39], acute and chronic renal failure [40-42], Wegener's vasculitis [43], primary amyloid [44], Pneumocystis carinii pneumonia [45], Hodgkin's lymphoma [46], Ewing's sarcoma [47], milk-alkali syndrome [48] and waldenstrom's macroglobulinemia [49] (Table 1). However, concomitant diffuse lung and spleen uptake of ^{99m}Tc-MDP in ALL has not been described previously.

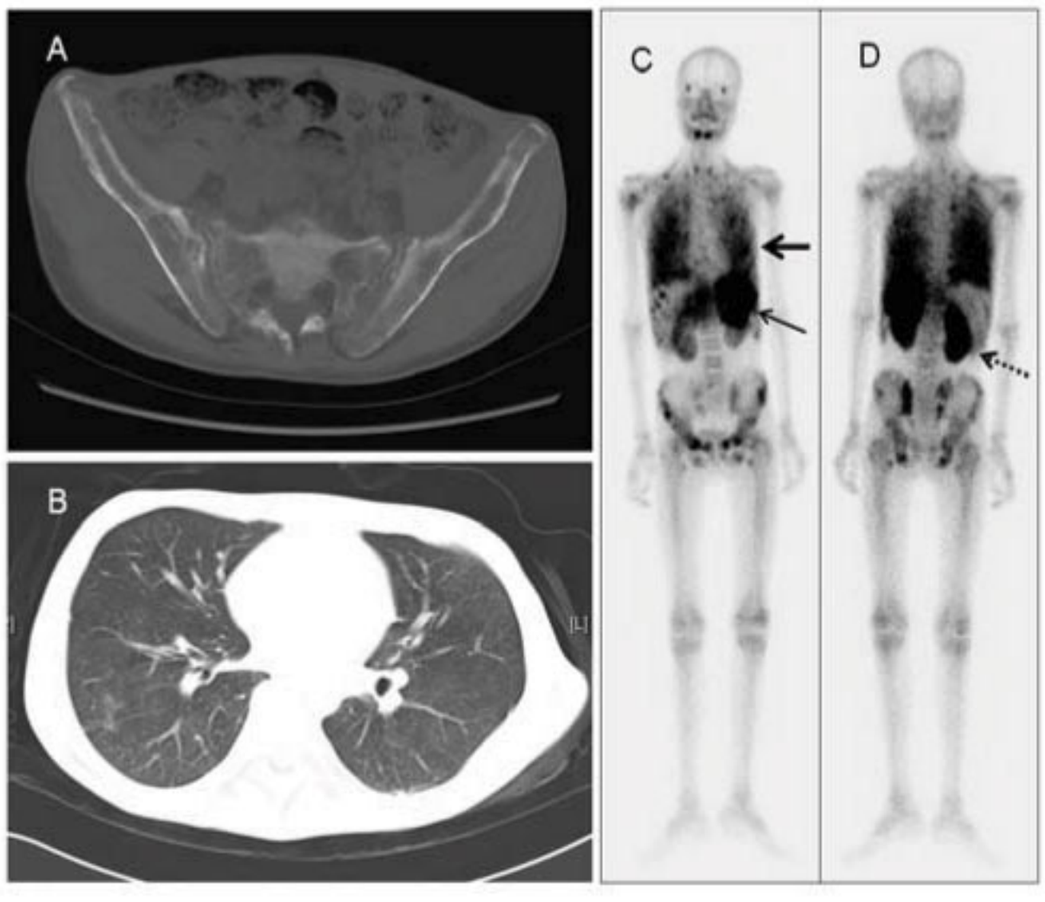

Figure 1. a: Pelvis CT showed multiple lytic lesions in the pelvis and sacral vertebrae. b: Chest CT showed diffuse ground-glass opacity lesions in the bilateral lungs. c,d: Whole-body bone scan showed abnormal uptake in the lungs, spleen, kidneys, pelvis and ribs.

The usual mechanism proposed to explain accumulation of ^{99m}Tc-MDP in extraosseous tissue was related to hypercalcemia [35]. It has been also postulated that ectopic ^{99m}Tc-MDP uptake is secondary to increased blood flow or secondary to dystrophic calcification as a result of tissue necrosis [50]. Hypercalcaemia is a rare feature of ALL. Hypercalcaemia developing in childhood malignancies was studied retrospectively by McKay C et al. [51]. They found that only 0.6% of the patients with acute leukemia had hypercalcaemia over a 29-year period study. Bone destruction results from increased osteoclastic bone resorption which can occur in patients with hematological malignancies. The present case also revealed osteolytic lesions on CT scans and multiple foci of bone repair on whole-body bone scan, suggestive of ongoing osteoclastic activity. The scan pattern of dense uptake of ^{99m}Tc-MDP in the spleen and lungs of this case in general agrees with ectopic calcification. Renal excretion of phosphonate radiopharmaceuticals is a normal finding in bone scan, however, the markedly renal uptake in this case are more likely to be caused by dual effect of decreased excretion of ^{99m}Tc-MDP due to impaired renal function and increased accumulation of ^{99m}Tc-MDP secondary to parenchymal calcification [52].

Diffuse uptake of ^{99m}Tc-MDP seen in the spleen, lungs and kidneys in this case. Accumulation of ^{99m}Tc-MDP may also be visualized in liver, stomach, muscle, etc. in some rare cases [53-57,48,14]. A retrospective review of extraosseous uptake of ^{99m}Tc-MDP is summarized in Table 1. Almost only 54 cases have been previously documented in the literature.

In conclusion, recognition of the patterns of extraosseous ^{99m}Tc-MDP uptake as in our case in the spleen, kidneys and the lungs can significantly enhance the interpretation and diagnostic value of whole-body bone scan.

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