

Bone Scintigraphy in Acute Lymphoblastic Leukemia

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Abstract

Leukemia is the most common childhood cancer and accounts for 30-40% of all malignancies. A retrospective review was performed of the hospital records of 9 children, 6 boys and 3 girls, aged from 2.5 to 15 years with ALL initially referred to Nemazee hospital Nuclear medicine center for whole body bone scanning between 2000 and 2002. Bone marrow pathology established ALL (L1) in two and ALL (L2) in 7 patients. All patients had abnormal bone scans involving both appendicular and axial skeletons. These comprised axial skeleton in one, appendicular in seven and both appendicular and axial in one patient. Knowledge of scintigraphic changes acquired in the setting of ALL will expedite the early diagnosis of leukemia at presentation. The potential use of bone scintigraphy is important in that, the correct diagnosis is made on bone scan and confirmed by the examination of blood film, bone marrow aspirate and trephine.

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Keywords • Bone Scintigraphy • leukemia, lymphoblastic, acute • child

Introduction

Leukemia is the most common childhood cancer and accounts for 30-40% of all malignancies. Acute Lymphoblastic leukemia (ALL) is the most prevalent form of leukemia in children and accounts for 75% of cases.¹ Early clinical diagnosis of leukemia in a child is difficult to make and must be considered for the differential diagnosis of extremity pain in children, especially if bone pain is disproportionate to suspected etiology.

The first clinical manifestation of leukemia may be musculoskeletal symptoms,^{2,3,4} and patients may be referred for bone imaging including radiography or scintigraphy before the diagnosis is made. An understanding of the potential scintigraphic abnormalities is essential, because the changes on bone scan, although not specific, may be the first indication of the possibility of underlying leukemic process. In addition bone involvement may be correlated with some prognostic factors.^{5,6-9} In this study, we evaluated the pattern of bone scan in children with ALL presented with musculoskeletal on initial examination.

A retrospective review of the hospital records of 9 children, 6 boys and 3 girls, with ALL aged from 2.5 to 15 years who were initially referred to Namazee hospital Nuclear medicine center from 2000 to 2002, for whole body bone scan. These patients were visited by pediatricians and subsequently referred for nonspecific musculoskeletal signs and symptoms including bone pain or tenderness, back pain and constitutional

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Table 1. Bone involvement in childhood ALL

Patient no	Age	Sex	Malignancy	Bone scan
1	14	M	ALL (L ₁)	Lower portion of left tibia
2	11	F	ALL (L ₂)	Both femur
3	4	M	ALL (L ₂)	Proximal portion of left humerus
4	2.5	M	ALL (L ₂)	Upper thoracic spine
5	4	M	ALL (L ₂)	Thoracolumbar spine, upper and lower ends of right femur
6	12	F	ALL (L ₂)	Both radius and ulna
7	8	M	ALL (L ₂)	Both femur and ulna
8	8	F	ALL (L ₂)	Left ankle Joint
9	10	M	ALL (L ₁)	Upper half of right humerus

symptoms. The whole body bone scan performed on these patients was abnormal and further work ups led to the diagnosis of ALL. Bone marrow pathology revealed two patients with ALL (L₁) and 7 with ALL (L₂).

Whole body bone scan was performed following intravenous injection of 555 mBq Tc -99m Methylen Di Phosphonate (MDP). The scintigrams were read again while blinded to the patients' findings with an additional review of the plain radiographies.

Bone scans were abnormal in all patients, both appendicular and axial skeletons, with involvement of axial in one, appendicular in seven and both appendicular and axial in one (Table 1). Radiographies taken at the sites of bone pain showed only nonspecific osteoporosis changes.

A newly diagnosed ALL in an 11-yr old boy showed a normal distribution of ^{99m}Tc. The activities of axial skeleton and kidneys were prominently normal with areas of greater activities in the carpal, tarsal and growing epiphyses of long bones.

Musculoskeletal symptoms are common in patients at the time of presentation with ALL. Bone scintigraphy may, therefore, be performed to elucidate the etiology in a child with unknown diagnosis. The potential use of bone scintigraphy is important so that the correct diagnosis is made on bone scan and confirmed by the examination of blood film, bone marrow aspirate and trephine. Scintigraphic changes may be due to bone infiltration, which is usually symmetrical resulting in diffuse reactivity in cortical bones, most commonly in metaphysical regions of lower limbs. Diffuse involvement of long and flat bones may also occur.

In blastic crisis the entire bone scan may show increased uptake of ^{99m}Tc MDP with accentuation at the ends of long bones.¹⁰ Less commonly, focal bone abnormalities occur which reflects infiltration of cortical bone by leukemia. Focal infiltration of bone can also cause photopenic areas as a result of vascular compromise with avascular necrosis or osteonecrosis.^{11,12} Therefore abnormalities can be both focal and diffuse with either increased

or decreased tracer uptake.¹³ All nine patients with scitigraphic abnormalities showed increased uptake in their bones, mostly in lower extremities and in upper extremities and axial skeleton.

The appearance of symmetrically increased blood flow and osteoblastic activity has been stated by Clausen et al who studied a group of 24 patients with newly presented ALL of whom 19 had abnormal bone scans.¹⁴ In their study all patients with scitigraphic abnormalities had increased uptake in the bones of lower extremities, adjacent to the joints, most commonly the knees.¹⁴ The pattern of bone involvement in our study also showed increased activity, mostly in the lower extremity. However, the prognostic significance of bone involvement in ALL has been the subject of controversy for many years. The variable distribution of skeletal pathology in children with ALL is rarely seen in other disease states. Striking associated radiological changes are suggestive of acute leukemia such as diffuse osteopenia, metaphyseal bands and periosteal new bone formation and less commonly generalized osteoporosis and vertebral compression fractures.¹² The prospect for leukemic patients during early bone involvement has been reported to be favorable in some series but not in others.^{5, 6, 7, 8} Also a striking correlation had been found between the expression of common ALL antigen (CALLA) on the leukemic cells and the presence of metaphyseal bands.

Knowledge of scitigraphic changes acquired in the setting of ALL expedites the early diagnosis of leukemia at presentation. Also, the possible prognostic significance of bone involvement in ALL may be important in skeletal survey.

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