ORIGINAL ARTICLE

EARLY BONE SCAN IMAGING PROTOCOL: A PRAGMATIC APPROACH TO MAINTAIN PATIENTS THROUGHPUT IN A BUSY NUCLEAR MEDICINE SECTION

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ABSTRACT

BACKGROUND: Radionuclide bone scan are acquired 3-4 hours after Technetium-99m Methylene Diphosphonate (^{99m}Tc MDP) injection to ensures a better contrast between bone and soft tissue. However, in a busy department with limited gamma cameras this imaging protocol is the limiting factor for reduced patient throughput. **AIM:** Compare the image quality of early (1.5 hr) and delayed (3 hr) acquired bone scans in same patients for image quality and lesion detection efficiency. **MATERIAL AND METHODS:** This prospective study was conducted at Section of Nuclear Medicine, Department of Radiology, Aga Khan University Hospital, Karachi from 1st August 2011 till 15th September 2011. We recruited 12 patients (age range: 18-75 years) with a male: female ratio of 4:8, who were pain free, cooperative and mobile. ^{99m}Tc MDP was injected intravenously. Patients were asked to have at least 250 cc of water after every 15 minutes) and void urine frequently to minimize bladder dose. At 1.5 hour and 3 hour post-injection, whole body imaging were acquired under a double head, gamma camera (ECAM, Siemens, Germany) with same acquisition parameters for both images. These images were read by an experienced nuclear physician who evaluated the scans for over all image quality (subjective) and lesion detection efficiency (estimation of lesion appreciable on a scan). **RESULTS:** The image quality of early (1.5 hr) and delayed scans were labeled as acceptable (fair bone to soft tissue contrast) and good (good bone to soft tissue contrast) respectively by the reader. Twenty three (23) lesions were identified on early scan and all of these lesions were appreciable on delayed studies as well and no discordance was identified. **CONCLUSION:** In a busy nuclear medicine section, to maintain patients' throughput, imaging at 1.5 hour may be used safely in those patients who are cooperative and mobile.

Introduction

Bone scan is one of the most commonly performed nuclear medicine procedure around the globe. Technetium-99m Methylene Diphosphonate (MDP) is the most popular agent due to its better renal clearance as compared with earlier agents like pyrophospahtes and polyphosphates.[1] Approximately 50% of injected MDP is cleared into the urine by the end of 2 hour, with an additional 25% cleared by the kidney over the next 4 hour. It has also been estimated that there is a 70% drop in blood concentration (from 7 to 2%) in normal human volunteers between 2 and 6 hour. There is a trade-off between the bone-to-soft tissue ratios on one hand, and rapidly falling count rates on the other, due to the 6-hr half-life of Tc-99m. This poses problem in a busy nuclear medicine section with limited number of gamma cameras.[2] A possible solution of this real issue is the early acquisition of images (2 hour) instead of recommended 3-4 hour post injection[3] with a theoretical risk of suboptimal image quality and missing abnormality.

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The purpose of this study was to compare the image quality of early (1.5 hour) and delayed (3 hour) acquired bone scans in same patients for image quality and lesion detection efficiency.

Materials and Methods

This prospective study was conducted at Section of Nuclear Medicine, Department of Radiology, Aga Khan University Hospital, Karachi from 1st August 2011 till 15th September 2011. We recruited those patients who were pain free, cooperative and mobile. ^{99m}Tc MDP was injected intravenously (600 MBq to 770 MBq depending upon weight of patient). Patients were asked to have at least 250 cc of water after every 15 minutes) and void urine frequently to minimize bladder dose. At 90 minutes and 3 hour post-injection, whole body imaging were acquired under a double head, large field of view gamma camera (ECAM, Siemens, Germany) with low energy high resolution collimators (LEHR). The camera speed was set at 10 cm per minute for early and delayed acquisitions. The images were processed by a credentialed and senior nuclear medicine technologist (14 years experience) who kept same display parameters for both sets of images. These images were read by an experienced nuclear physician who evaluated the scans for over all image quality (subjective) and lesion detection efficiency (estimation of lesion appreciable on a scan).

Results

The study population is comprised of 12 patients (age range: 18-75 years) with a male: female ratio of 4:8. Seven patients (all females) were referred for metastatic evaluation for breast cancer (5), ovarian cancer (1) and gastric cancer (1). Two patients (1 M, 1 F) had study for evaluation of bony pains, 2 (both males) for evaluation of avascular necrosis of femoral head (AVN) and 01 male for hereditary multiple exostoses (Tab.1). The image quality of early (1.5 hr) and delayed scans were labeled as acceptable (fair bone to soft tissue contrast) and good (good bone to soft tissue contrast) respectively by the reader (Fig. 1-4). Twenty three (23) lesions were identified on early scan and all of these lesions were appreciable on delayed studies as well and no discordance was identified (Tab.2).

Number of Patients	12
Age	18-75 years
Sex (M : F)	04 : 08
Scan Indications	07 Metastatic Work Up
	02 AVN
	02 Bone Pain Evaluation
	01 Exostoses

Table 1: Demographic data of patients.

	Early Scan (1.5 Hr)	**Delayed (3 Hr)**
Quality of Scan	Acceptable	Good
Number of Lesions	23	23

Table 2: Qualitative and quantitative comparison of early and delayed acquired bone scans.

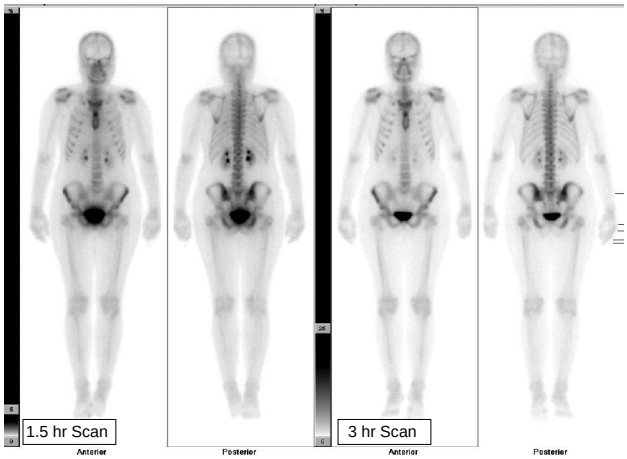

Figure 1: 39 year old women for metastatic work for breast cancer. Scan shows relatively enhanced soft tissue uptake at 1.5 hr image and no mismatch in skeletal findings.

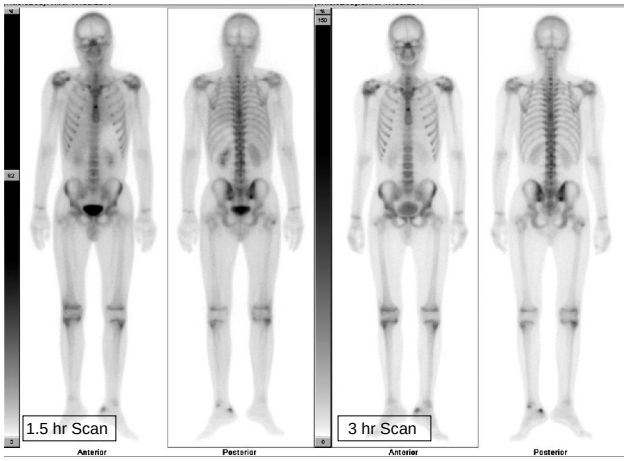

Figure 2: 18 year old male for evalaution of bony pains. Both early and delayed images shows focal uptake over sueprior surface of left calcaneus.

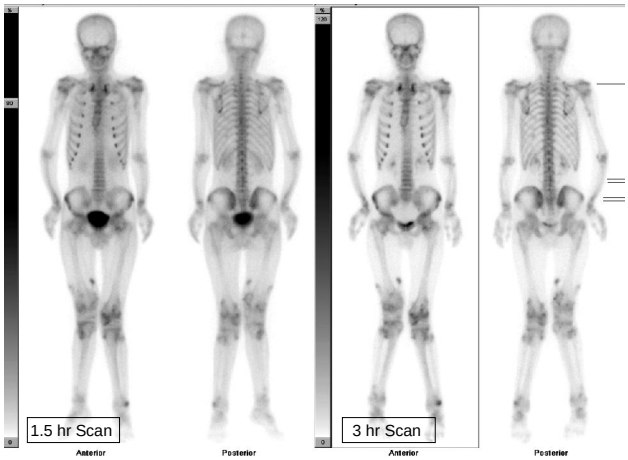

Figure 3: 18 year old male with histrory of multiple exostosis. All lesions are appreciable I both sets of images.

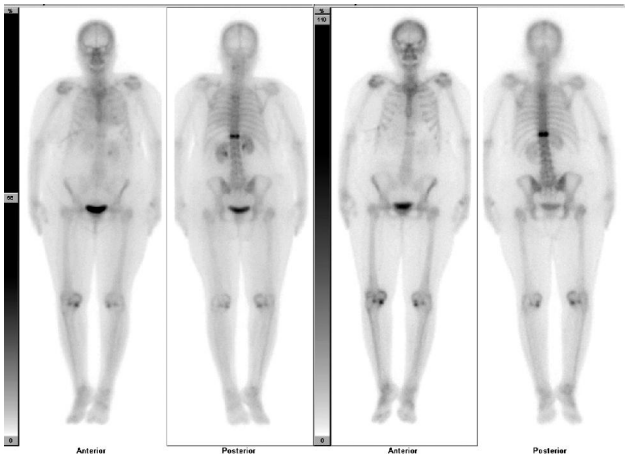

Figure 4: 65 year old female with histrory of fall and backache. Compression fracture over lower dorsal spine is appreciable in both imgaes.

Discussion

Radionuclide bone scan is the most common imaging procedure in general nuclear medicine. Images are acquired 3-4 hours after ^{99m}Tc MDP injection as at this time minimal radiotracer presents in the blood compartment and this ensures a better contrast between bone and soft tissue. However, in a busy department with limited gamma cameras this imaging protocol is the limiting factor for limited patient throughput. This is due to a trade-off between the bone-to-soft tissue ratios and rapidly falling count rates due to tracer decay.A possible solution of this problem is early acquisition of images with a possible compromise on image quality and missing lesion due to reduced bone to soft tissue contrast. In this study we compared the early (1.5 hour) and delayed (3 hour) acquired images in a group of patients. For an optimal comparison we set same imaging parameters for both protocols and to minimize interobserver variability images were acquired and prepared and read by one credentialed and senior technologist and nuclear physician. Results show an acceptable image quality of early scan and importantly there was an excellent agreement in lesion detection in both sets of images. This is in concordance with published data as well3. We conclude that, in a busy nuclear medicine section, to maintain patients' throughput imaging at 1.5 hour may be used safely in those patients who are cooperative and mobile.

References

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