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Scintimetric Evaluation in the Assessment of Delayed Union of Skeletal Fractures

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Abstract:

Aim: This study aims to analyze the utility of the Scintimetric evaluation in the assessment of delayed union of skeletal fractures in our institution.

Materials and Method: This retrospective study consists of 30 patients who had radiological evidence of complications involving healing of the fracture comprising of 16 males in the age range of 10 - 48 with the mean age of 25.31 ± 12.55 and 14 females in the age range of 8 - 56 with the mean age of 27.36 ± 14.35 . Bone scans were done using the Siemens dual head gamma camera. The Triple phase bone scan was done first followed by the Whole Body Bone Scans done at 4 & 24 hours after IV Injection of 10 to 25 mCi of $^{99m}\text{Tc-MDP}$. Using Dynamic and Whole Body Acquisition Protocols both Anterior and Posterior view images were obtained. The focal hot spots in the processed images were identified in the 4hr and 24hr images using the region- ratio protocol. The maximum counts were calculated by drawing the region of interest area over the skeletal hot spots. The 4hr/24hr Dr. V.Siva's retention ratio was calculated, tabulated and analyzed.

Results: Out of 30 cases of delayed /non- union of Skeletal fractures 11(37%) were found to be Metastatic Pathological fractures and 19(63%) turned out to be due to benign fracture complication like Stress fracture and Benign bone tumors. The 4/24hr rDr. V. Siva's retention ratio values obtained for the Metastatic Pathological group had the mean value of 12.5 ± 3.1 with Standard error estimation ± 0.61 and the benign group showed the mean value of 6.68 ± 2.8 error estimation of ± 0.38 . The statistical evaluation revealed that there is a significant difference between the two values with the p value of < 0.0001 .

Conclusion: Thus the Scintimetric evaluation of the complications of fracture healing helps in the differentiation between Metastatic Pathological and Simple benign causes leading to appropriate management in these patients.

Keywords: Skeletal fracture complications, Triple Phase Bone Scan, whole body protocol, Dr. V. Siva's Retention Ratio

1. Introduction

Johansson, S. et al were the first to establish the utility of Radioactive Iodine uptake by the fracture sites as a means of evaluating them (1). The relationship between the bone local blood flow and the uptake of Technetium ^{99m}Tc Methylene di-Phosphonate was reported by Siegel et.al (2). The Dynamics of technetium- ^{99m}Tc methylenediphosphonate imaging of the femoral head after hip fracture was established by Bauer et al(3). The assessment of Femoral head Vitality after intracapsular hip fracture was reported by Stornquist (4). Thus Technetium- ^{99m}Tc methylenediphosphonate scintimetry after femoral neck fracture became a definite investigatory tool and its utility in the pre-operative evaluation in the case of Femoral Neck fractures had been documented by Stronquist (5), Sven Holmberg & Karl-Geran(6) & (7). The fact that modes of Region of Interest selection had very little effect on the scintimetric evaluation of the fracture of the femoral neck(8). Scintimetric Evaluation of Remodeling after Bone Fractures in Man had also been established by

JorgSpitz(9).The role of Scintimetric evaluation in the fracture complication had so far not been investigated. Hence the current study was mooted to evaluate the utility in the assessment of complications relating to union of the fractures.

Israel O et al have shown that 24/4 ratio of 99mTc-MDP uptake in bone metastasis and degenerative changes had significant differences in their values. (10) Later they proved its utility in Osteomyelitis and soft tissue infection also (11). 24hr counts were less than 4hr counts therefore the ratio was in decimal values, failing to reach the clinical utility. Taking the clue 4/24hr retention ratio was devised by Dr. V. Siva et al. (12) resulting in the generation of positive integer values, where malignant (Metastatic) lesion showed the value greater than 10, degenerative lesions showed 5-10, and the benign lesions shows less than 5.

2. Subjects and Methods

This retrospective study of bone scans done in our institute consists of the 30 patients comprising of 16 males in the age range of 10 to 48 with the mean age of 25.31 ± 12.55 and 14 females in the age range of 8 to 56 with the mean age of 27.36 ± 14.35 . Patients with clinical history of Trauma and Trivial injury with radiological evidence of fracture healing complications were taken for study. All the scans were done after IV Injection of 10 to 25 mCi of 99mTc-MDP (BRIT, INDIA). Triple phase bone scan acquisition was followed by Whole Body Acquisition Protocol in both Anterior and Posterior views at 4 & 24 hours. All the scintigrams were stored using the matrix size of 256 x 1024 pixels. The images were processed using the whole body display protocol in the icon software. The Images are analyzed and report is generated. The focal hot spots in the processed images were identified in the 4hr and 24hr images using the region ratio protocol. The maximum counts were calculated by drawing the region of interest area over the skeletal hot spots. The 4hr /24hr Dr. V. Siva’s retention ratio was calculated tabulated and analyzed (12).

3. Results

Out of 30 cases of delayed /non- union of Skeletal fractures 11 (37%) were found to be Pathological fractures and 19(63%) turned out to be due to benign fracture complication like Stress fracture and Benign bone tumors. The 4/24hr rDr. V. Siva’s retention ratio values obtained for the Pathological group had the mean value of 12.5 ± 3.1 with Standard error estimation ± 0.61 and the benign group showed the mean value of 6.68 ± 2.8 error estimation of ± 0.38 . The statistical evaluation revealed that there is a significant difference between the two values with the p value of <0.0001 .The 4/24hr retention ratio values obtained for all the cases were classified into Metastatic pathological, and simple Benignfracture according to the scintimetric characterization of the skeletal hot spots of Dr. V. Siva³ as shown in Table I. The box plot of the t-test evaluation of the Benign causes A against the Metastatic Pathological fractures B is shown in Figure I.

Table I.Scintimetric characterization of the patients on the basis of 4/24 retention ratio values.

CharacterizationNumber of PatientsMean 4/24 value

Met.Pathological fracture11 (37%) 12.5 +/- 3.1

Benign Simple fractures19 (63%) 6.68 +/- 2.8

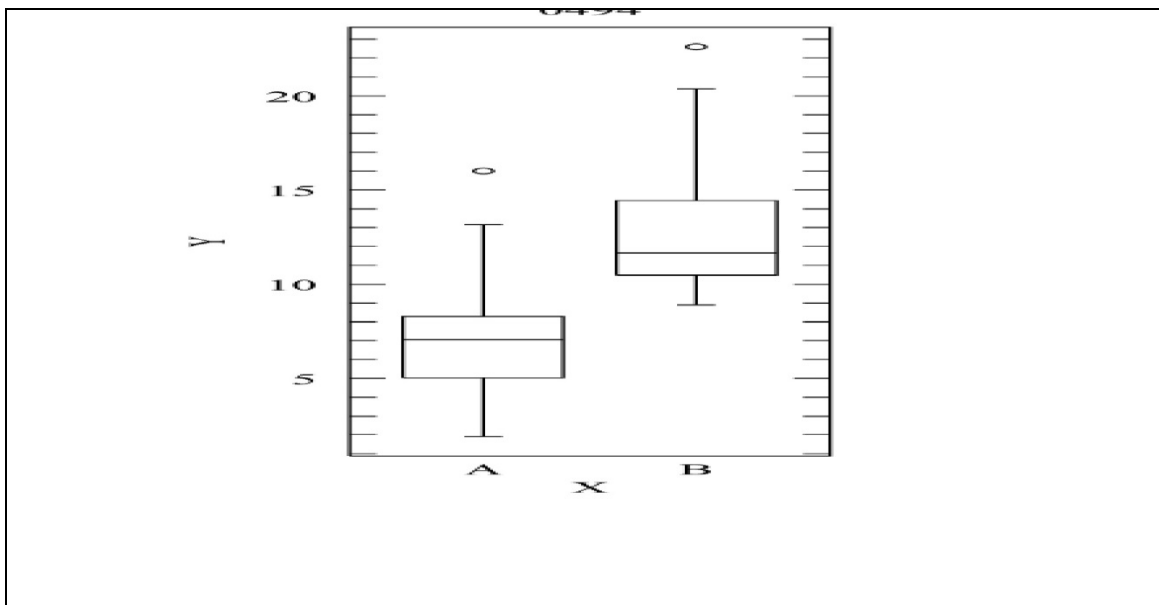


Figure 1: Graph showing the Benign Vs Metastatic retention ratios

The representative images of the Metastatic Pathological Fracture and the benign fracture are shown in Fig.2 and Fig.3.

5. Conclusions

Conclusively, it can be stated that the Scintimetric evaluation and characterization of sites of fracture non-healing helps in the differentiation between Metastatic Pathological fractures even in the absence of multiple hot spots and absence of no known primary situation as well. This is a simple and robust technique which has to be adopted in more institutions for validation and better and appropriate patient management decisions.

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