PATTERN OF PROSTATIC CARCINOMA METASTASES IN BONES DETECTED BY BONE SCANS USING TECHNITIUM ^{99m} METHYL DIPHOSPHATE (TC^{99m} MDP) IMAGING TECHNIQUE

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ABSTRACT

Objective: **T**o determine the pattern of bone secondaries in prostatic carcinoma patients using Technitium ^{99m} Methyl Diphosphate (TC^{99m} MDP) imaging technique.

Design: Retrospective study.

Setting: Ziauddin Hospital, Karachi from 1998 to 2004.

Methods: The study included 135 subjects, which were divided into four groups according to age. Patients with biopsy proven prostate carcinoma under went total body bone scan in different positions, five anterior and five posterior views, skull, chest, pelvis, knee and foot for the evaluation of metastases at the time of diagnosis. Bone scans were interpreted by the nuclear medicine consultant as negative or positive for skeletal metastases, or as intermediate.

Results: 135 subjects were analyzed. They were divided into four groups according to age. Group A comprised of 25 subjects of age 30 to 39 years. Out of them 18 were positive for bone secondaries. Group B comprised of 30 subjects from 40 to 49 years. Out of them 21 were positive for bone secondaries. Third group i.e. C comprised of 50 to 59 years of age. Out of 49 subjects 36 were positive for bone secondaries. Group D was from 60 years and above in which 31 subjects were analyzed. Out of them 23 were positive for bone secondaries. The most common site involved was dorsal vertebrae in which 44 (32%) secondaries were isolated. Shoulder joint 38 (28%) and sacroiliac joint 29 (21%) were the second and third most commonly affected areas respectively. Other sites involved were skull, sacrum, lumber vertebrae, ileum, mandible, femur, sternum, cervical vertebrae, iliac crest, scapula, hip joint, tibia and pelvis.

Conclusion: This study focuses on pattern of prostate carcinoma metastases to various bony sites. Metastases are common in age group 50 to 59 years and above 60 years while the most common site involved is dorsal vertebrae followed by shoulder joint and sacroiliac joint.

KEY WORDS: Bone scan, Prostate cancer, Bone secondaries, Bone metastases.

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INTRODUCTION

Carcinoma prostate is the most common malignancy in males older than 50 years of age, and second most common cause of cancer deaths in United States.[1] Common tumors, such as those of the breast, lung and prostate, frequently metastasize to bone, and in many patients with advanced disease the skeleton is the site of the most significant tumor burden.[2] Bone metastases are a frequent complication of cancer, occurring in up to 70 percent of patients with advanced prostate cancer.[3] The exact incidence of bone metastases is unknown,

but it is estimated that 350,000 people die with bone metastases annually in the United States.[4] Autopsy series have revealed small prostatic carcinomas in up to 29 percent of men of 30 to 40 years of age and 64 percent of men (60 to 70 years of age).[5] Moreover, the risk of prostate cancer is 1 in 6 and the risk of death due to metastatic prostate cancer is 1 in 30.[6] Metastases is often associated with bone destruction and is a major cause of morbidity.[7] The consequences of bone metastases are often devastating. During the course of hematogenous metastases, cancer cells escape from the primary tumor, enter the blood stream, a rest in the vasculature of a secondary organ, and extravasate to form new tumor colonies. Most patients with prostate cancer have osteoblastic lesions.[8] Secondary formation of bone occurs in response to bone destruction. This reactive process makes it possible to detect osteolytic lesions by means of bone scanning, which identifies sites of active bone formation.[9] The bone scan is an important modality to evaluate skeletal pathological condition and is of utmost prognostic significance. The bone scan is the most frequently requested investigation for the evaluation of bone metastases from prostate cancer. Because of its sensitivity and the ability to examine the whole skeleton in a single examination, it still remains the most important investigation in the evaluation of skeletal metastases from prostate cancer in clinical practice. This study was focused to determine the pattern of bone secondaries in prostate carcinoma patients and the common sites involved.

PATIENTS AND METHODS

We conducted a retrospective study of patients referred for bone scan with a diagnosed prostate cancer from year 1998 to 2004. The subjects were recruited from the Ziauddin Hospital, which is a major referral hospital in Karachi, Pakistan. Bone scan reports of all these patients were then retrospectively reviewed, and confirmation of bone metastases was determined by consideration of all available clinical information. The subjects were divided into four groups according to age. Bone scan results with increased skeletal activity were compared with available radiographs. 135 patients which were identified were divided into two groups, i.e. 98 patients with bone metastases, termed bone scan - positive', and 37 patients with no bone metastases, termed bone scan-negative. Number of patients with biopsy proven prostate carcinoma under went total body bone scan in different positions, five anterior and five posterior views skull, chest, pelvis, knee and foot for the evaluation of metastases at the time of diagnosis. The bone scan protocol consisted of I/V injection of 25 mCi of Tc MDP followed by whole body imaging on single head Diacam Siemens Gamma Camera system. Three hours after injection imaging was acquired on word mode, 256 x 256-matrix size, zoom factor 1.0. Images were processed and displayed for analysis in different sections of anterior and posterior views. Bone scans were interpreted by the nuclear medicine consultant as negative or positive for skeletal metastases, or as intermediate.

Statistical Analysis of the Data: Computer package EPI-Info version 6.0 was used for data feeding and analysis. In the results we have shown number, percentage and frequency for bone secondaries in different age groups of case.

RESULTS

This total numbers of patients analyzed were135. Out of them 98 were positive for bone secondaries detected by whole body scan. The subjects were divided into four groups according to age. First group was from 30 to 39 years in which 25 subjects were analyzed. Out of them 18 were positive for bone secondaries and 7 were negative. 30 subjects were analyzed in age group 40 to 49 years i-e second group. Out of them 21 were positive for bone secondaries and 9 were negative. Third group comprising 50 to 59 years of age in which 49 subjects were analyzed. Out of them 36 were positive for bone secondaries and 13 were negative. 31 subjects in age group 60 years and above were analyzed i-e fourth group. Out of them 23 were positive and 8 were negative.

The study was focused on the area most commonly involved. According to our data the most primarily and frequently involved area was dorsal vertebrae in which 44 (32%) secondaries were isolated. Shoulder joint was the second frequently involved area in which 38 (28%) secondaries were present followed by sacroiliac joint showing 29 (21%) secondaries. The other areas involved were skull 22 (16%), sacrum 21 (15%), lumbar vertebrae 20 (14%), ileum 18 (13%), mandible 17 (12%), femur 15 (11%), sternum 14 (10%), cervical vertebrae 11 (8%), iliac crest 9 (6%), scapula 8 (5%), hip joint 7 (5%), tibia 7 (5%), pelvis 7 (5 %), ischium 5 (3%), pubic 4 (3%), Knee joint4 (3%) and clavicle 3 (2%).

DISCUSSION

Metastatic prostate cancer is a leading cause of illness and death among men in the United States and Western Europe.[10] The lifetime risk of prostate cancer in the United States is 16.7 percent, and 28,900 men were expected to die of this disease in 2003.[11] The high rate of mortality from prostate cancer may be due to late detection. Thus, prostate cancer is also a major cause of suffering and of health care expenditures. Prostate cancer is the second leading cause of death from cancer among men; 25 percent of men with prostate cancer die of the disease.[12] Tumor cell migration/invasion is an important factor in the formation of solid tumors, and it is necessary for their spread to distinct organs. The progression of prostate cancer cells to a more invasive phenotype is believed to be influenced by the migration of cells from the primary site of tumor, incorporating the ability of cancer cells to invade through basement membrane and reestablish themselves at distant sites.[13] Bone metastases are the major reason for death caused by prostate cancer.[14]

Bone metastases in prostate cancer are predominantly osteoblastic, with increased numbers of irregular bone trabeculae. However, markers of bone resorption are also increased in metastatic prostate cancer, although there is usually no histologic evidence of increased numbers of osteoclasts.[15] In prostate cancer, levels of bone-resorption markers are higher in patients with bone metastases than in patients without bone metastases and reflect the extent of bone metastases more accurately than does the PSA level.[16,17] Overproduction of urokinase-type plasminogen activator (u-PA) by prostate-cancer cells increases bone metastases, and cells transfected with an anti-sense DNA to u-PA had one third as many metastases as did cells transfected with an empty vector.[18,19]

Our study focused on the area primarily and most commonly involved in the bone metastases. According to our data the most primarily and frequently involved area was dorsal vertebrae in which 44 (32%) secondaries were isolated. Shoulder joint was the second frequently involved area in which 38 (28%) secondaries were present. Sacroiliac joint were the third most frequently affected area showing 29 (21%) secondaries.

Other sites involved were skull, sacrum, lumber vertebrae, ileum, mandible, femur, sternum, cervical vertebrae, iliac crest, scapula, hip joint, tibia, pelvis, ischium, pubic, knee joint and clavicle.

CONCLUSION

Our study concludes that the metastases of prostatic carcinoma are more common in dorsal vertebrae followed by shoulder joint and sacroiliac joint.

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