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The Effect of BMI and Visceral Fat Percentage on the Development of Bone Metastases in Prostate Cancer

Fusun Aydogan[1*]**, Ebuzer Kalender**[1]**, Murat Rifaioğlu M**[2]**, Taner Sümbül A**[3] **and Erhan Yengil**[4]

[1]*Department of Nuclear Medicine, Mustafa Kemal University Faculty of Medicine, Hatay/Turkey*

[2]*Department of Urology, Mustafa Kemal University Faculty of Medicine, Hatay/Turkey*

[3]*Department of Oncology, Mustafa Kemal University Faculty of Medicine, Hatay/Turkey*

[4]*Department of Family Medicine, Mustafa Kemal University Faculty of Medicine, Hatay/Turkey*

[*]**Corresponding author:** Fusun Aydogan, Assistant Professor, Department of Nuclear Medicine, Mustafa Kemal University Faculty of Medicine, Hatay/Turkey, Tel: +90 (505) 657 9710; E-mail: drfusunay@yahoo.com

Abstract

Introduction: Prostate cancer (PCa) second leading cause of cancer-related deaths among men worldwide. There are publications in the literature examining the relation between obesity and PCa, but there is not publication about the relation between obesity and bone metastases in PCa. The aim of this study is to determine whether there is a relation between bone metastasis, PSA, Gleason score, BMI and visceral fat percentage (VFP) in PCa patients.

Methods: Thirty-four patients with PCa who performed bone scintigraphy included to study. Mean age was 71.3 ± 6.9 years. All patients' height, weight, VFP and BMI were calculated. PSA levels, Gleason scores, VFP and BMI of patients with and without bone metastases were compared.

Results: On the bone scintigraphy 14 patients had bone metastasis and there was no metastases in 20 patients. PSA levels and Gleason scores were higher in patients with bone metastases than in patients without bone metastases and this was statistically significant (p= 0.004). While the BMI level was 26.15 kg/m^2 (22.7-33.5) in patients with bone metastasis, it was 26.5 kg/m^2 (20.7-43.9) in patients without bone metastasis. VFP was 11 (6-27) in patients with bone metastasis and 9 (3-17) in patients without bone metastasis. Although the VFP was higher in patients with bone metastases; this was not statistically significant (p=0.15).

Conclusion: Our data suggest that there is a significant correlation between bone metastasis and high Gleason score and PSA level, but there is not significant correlation between bone metastasis and BMI, VFP in PCa.

Keywords: Prostate cancer; Bone metastases; Body mass index; Visceral fat percentage

Introduction

Prostate cancer (PCa) is the second most commonly type of cancer and the second leading cause of cancer-related deaths among men worldwide [1-3]. PCa metastases are seen almost entirely on the bones and they are typically in the osteoblastic forms [4,5]. Bone metastases are commonly detected by bone scintigraphy.

It is widely accepted that obesity increases the risk of several chronic diseases, including type II diabetes, cardiovascular disease, and several types of cancer [6]. The relation between obesity and PCa risk has been studied extensively but remains inconclusive [7]. Several studies reported that higher body mass index (BMI) is related with advanced PCa [8-10]. However we could not find any study in the literature examining the relation between bone metastasis and BMI, visceral fat percentage (VFP) in PCa patients.

The aim of this study is to determine whether there is a correlation between bone metastasis and BMI, visceral fat percentage (VFP), serum total prostate-specific antigen (PSA) level and Gleason score in PCa patients.

Materials and Methods

Thirty-four patients with PCa who performed bone scintigraphy in our clinic included to study. Mean age was 71.3 ± 6.9 years (range 54-85). The patients with renal insufficiency and chronic metabolic disease were excluded from study. Mustafa Kemal University Ethics Committee has approved the study. All patients sent to bone scintigrapy for staging after inital diagnose.

Bone scintigraphy was performed by dual-head gamma cameras (Symbia S, Siemens Healthcare) with low-energy high-resolution parallel-hole collimators. Patients were scanned on anterior and posterior positions. Patients were evaluated with considering their medical histories (trauma, surgery, etc.). The patients with and without bone metastasis were detected on bone scintigraphy. The patients who had metastatic areas less than 3 on scintigraphy, were correlated with other imaging modalities.

All patients' height, weight, body muscle percentage (BMP), body fat percentage (BFP), VFP and BMI were calculated. Measurements were performed by four-terminal hand-foot bioelectrical impedance analyzer (Omron-BF 510).

It was viewed whether there is a relation between the calculated values and Gleason scores, PSA levels and bone metastases.

Statistical Analysis

SPSS for Windows 18.0 (Statistical Package for Social Sciences) package programme was used for statistical analysis. Continuous variables were examined with Kolmogorov-Smirnov test in terms of a normal distribution. Relations between nominal variables were examined by the chi-square test and difference of medians between groups were examined by Mann-Whitney U test. Spearman correlation test was used to determine the relations between continuous variables. All statistical datas with $p<0.05$ were considered as significant.

Results

On the bone scintigraphy 14 patients had bone metastasis and there was no metastases in 20 patients.

PSA levels were higher in patients with bone metastases than in patients without bone metastases and this was statistically significant ($p=0.004$). Also, Gleason scores were higher in patients with bone metastases than in patients without bone metastases and this was statistically significant ($p=0.001$) (Figure 1).
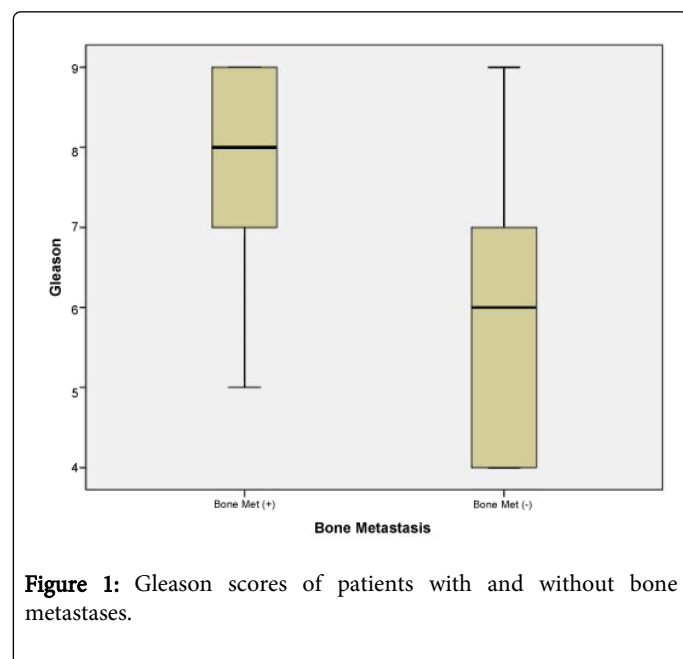

Figure 1: Gleason scores of patients with and without bone metastases.

We found a positive correlation between total PSA level and Gleason score ($p=0.0001$/rho=835); and BMP, BFP, BMI and age values were similar in groups with and without bone metastasis. BMI, VFP, BMP, BFP, PSA levels and Gleason scores of patients with and without bone metastases were given in Table 1.

	Bone Metastasis (+)	Bone Metastasis (-)	p
Age (year)	72,50 (54- 82)	71 (61-85)	0.899
PSA (ng/ml)	100 (100-355)	14 (13-100)	0.004
Gleason	8 (5-9)	6 (4-9)	0.001
BMI (kg/m²)	26.15 (22.7-33.5)	26.5 (20.7-43.9)	1
VFP	11(6-27)	9 (3-17)	0.14
BMP	32.8 (13.2-45.2)	33.6 (24-42)	0.66
BFP	23 (5.8-34.2)	21.7 (7.4-47)	0.84

Table 1: BMI, VFP, BMP, BFP, PSA levels and Gleason scores of patients with and without bone metastases.

While the median BMI level was 26.15 kg/m² (range 22.7-33.5) in patients with bone metastasis, it was 26.5 kg/m² (range 20.7-43.9) in patients without bone metastasis (Figure 2). There was no significant difference between the two groups ($p>0.05$).
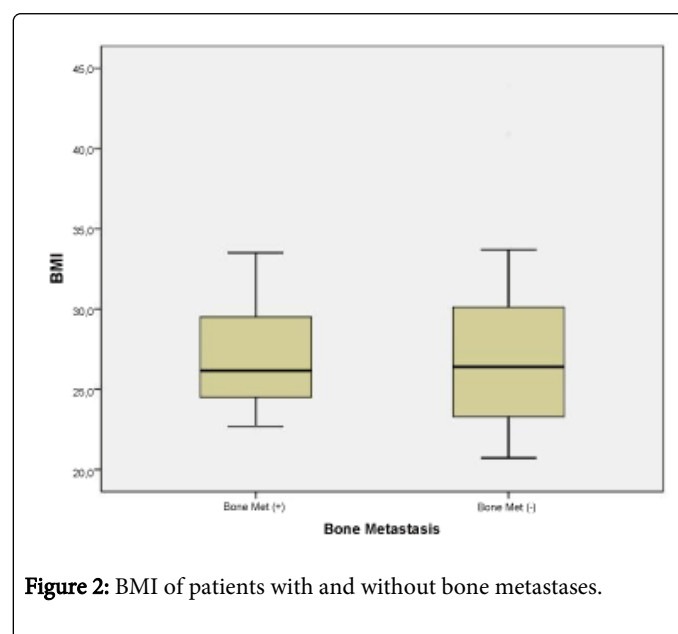

Figure 2: BMI of patients with and without bone metastases.

VFP was 11 (range 6-27) in patients whith bone metastasis and 9 (range 3-17) in patients without bone metastasis. Although the VFP was higher in patients with bone metastases; this was not statistically significant ($p=0.14$).

In patients, BMI was positively correlated with VFP and BFP ($p=0.0001$/rho=716; $p=0.0001$/rho=0.604), and negatively correlated with BMP ($p=0.029$/rho=_-0.380). We found positive correlation between BMI and VFP, BFP; and negative correlation between BMI and BMP.

Discussion

PCa is recognized as one of the major medical problems facing the male population [11]. Advanced prostate cancer is frequently accompanied by the development of metastasis to bone. Bone is the most frequent site of prostate carcinoma metastasis. Bone metastases identified in up to 90% of patients dying from prostate carcinoma at autopsy series [12,13].

The sensitivity of bone scintigraphy is 95% for bone metastases. The most important factor that affecting this sensitivity is tumor type. Bone metastases can be detected easily in PCa as scintigraphically, because the metastases are primarily in osteoblastic form [14].

According to the literature, the increase in serum PSA level is an important indicator for distant organ metastasis in PCa, especially for bone metastasis [15,16]. In our study, in accordance with the literature, serum PSA levels in patients with bone metastasis were

higher than in patients without metastasis and this was statistically significant (p<0.05).

Yigitbasi et al. and Epstein et al. have reported that the Gleason score is strongly related with patient outcome in PCa patients with bone metastases [17,18]. In our study, in accordance with the literature, Gleason scores of patients with bone metastasis were higher than in patients without metastasis and this was statistically significant (p<0.05).

Obesity is an important problem all over the world and its incidence is increasing day by day. On the worldwide more than half of the adults categorized as being overweight (BMI ≥ 25) and up to 30% categorized as obese (BMI ≥ 30 kg/m^2) [19]. Obesity is related with a number of chronic diseases such as diabetes, coronary artery disease, hypertension and some cancers [20,21]. In recent years several studies focus on the relationship between obesity (BMI) and prostate cancer.

The relationship between obesity (BMI) and prostate cancer is variable in epidemiological studies. Positive [10,22], insignificant [23-26] and inverse [27,28] associations were reported between BMI and PCa risk.

Several mechanisms could explain the association of obesity with prostate cancer risk, including the sex steroid hormone, insulin and IGF signaling, and inflammation pathways [7].

Some investigators have reported that higher BMI is related to increased risk of advanced and higher grade-stage PCa [8-10,21,29]. Rodriguez et al reported that obesity increases risk of prostate cancer mortality [21]. Snowdon et al have suggested that animal product consumption and obesity may be risk factors for fatal prostate cancer [29]. Also several studies showed that BMI is inversely associated with a risk of localized PCa and directly associated with a risk of advanced PCa [7-10,30-32]. Hubbard et al reported that BMI is associated with a 16% reduced risk of low-grade PCa but a 22% increased risk of high-grade PCa [32]. Similarly Wright et al reported no association of BMI with low-grade cancer but a positive association with fatal PCa [7]. On the other hand some researchers found inverse association between BMI and PCa risk. Porter and Stanford found that BMI and weight were inversely associated with PCa risk [28].

Beside all of these, we could not reach a publication in the literature examining the relation between BMI and bone metastasis in Pca patients. In our study, there was not significant correlation between bone metastasis and BMI statistically. Also there was no significant correlation between bone metastasis and BMP, BFP.

Although intraabdominal fat makes up only 10% of total body fat, it is metabolically more active than subcutaneous or peripheral fat [33]. There are a limited number of publications on the literature about the relation between PCa and VFP. In these publications the relation between the presence of cancer and VFP was examined, but the relation between VFP and bone metastasis was not investigated. A study by von Hafe et al showed that PCa patients had a significantly higher abdominal fat area [34]. In our study, we investigated whether there is a correlation between VFP and bone metastases in PCa. Although the VFP was higher in patients with bone metastases; this was not statistically significant (p>0.5).

Conclusion

The relation between BMI and PCa is still controversial and there is no consensus on this issue. Positive, inverse and insignificant associations were reported in several studies. The first time in the literature, we investigated the relation between bone metastasis and PSA level, Gleason score, BMI and VFP in PCa. In conclusion our data suggest that there is a significant correlation between bone metastasis and high Gleason score and serum PSA level, but there is no significant correlation between bone metastasis and BMI, VFP in PCa.

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