BONE SCINTIGRAPHY METASTATIC PATTERNS IN PATIENT WITH PROSTATE CANCER AT OCEAN ROAD CANCER INSTITUTE

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By

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A Dissertation Submitted in (Partial) Fulfillment of the Requirement for the Degree of Master of Medicine (Radiology) of the Muhimbili University of Health and Allied Sciences

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October, 2017

CERTIFICATION

The undersigned certify that she has read and hereby recommend for acceptance by Muhimbili University of Health and Allied Sciences a dissertation entitled **"Bone scintigraphy metastatic pattern in patients with prostate Cancer at Ocean Road Cancer Institute"** in (partial) fulfillment of the requirement for the degree of Master of Medicine (Radiology) of Muhimbili University of Health and Allied Sciences

_____

Dr. Hilda Makungu

(Supervisor)

_____

Date

DECLARATION AND COPYRIGHT

I, **Revelian Selestini Iramu**, declare that this **dissertation** entitled is my own original work and that it has not been presented and will not be presented to any other university for similar or any other degree award.

Signature…….. **Date**……..

ACKNOWLEDGEMENT

First and foremost, I thank my Almighty God for being with me and guiding me through the ups and downs of this work.

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Last but not least I thank my wife Mary and daughter Gracias for their support and tolerance on the missed family time.

DEDICATION

To my mother

Winnifrida Kagemuro Bashanzi.

ABSTRACT

Background

Prostate cancer is the second most common malignancy in the world next to lung cancer and it is the leading cause of morbidity and mortality among men. The most common metastatic site in prostate cancer is the bone. Bone scan has been used frequently to assess metastatic bone disease in prostate cancer patients, the common site of distant metastases being the skeletal system with the pelvis and spine most frequently affected. This study is aiming at finding the pattern of bone metastasis among prostate cancer patients attending ORCI, associated factors for metastases to occur and the frequency of bone metastases among all recruited patients.

Broad objective

To determine bone scintigraphy pattern in patients with prostate cancer attending Ocean Road Cancer Institute from June 2014 to June 2016

Methodology

This was a cross section retrospective hospital based descriptive study that was conducted at the nuclear medicine department of the Ocean Road Cancer Institute, Dar es salaam-Tanzania. A total of 139 patients with prostate cancer who were seen from June 2014 to June 2016 at the department for bone scan were included in the study. Whole body scanning was performed 3 h after injection of 700MBq ^{99m}Tc methyldiphosphonate. A structured data collection tool was used to record the demographic information, laboratory and histological information from the patients files. Data analysis was done using SPSS version 20. Cross tabulations and Chi square was used for assessing statistical association and comparing proportions respectively. A p-value of less than 0.005 was considered statistically significant.

Results

The research included 139 prostate cancer patients who were referred to the nuclear medicine department for bone scintigraphic study.

Bone metastases were found in 77 patients (55.4%) The prevalence was higher in the age group between 60 and 79(56.3%) however there was no statistical significance between age and occurrence of bone metastasis [p-0.933]

Patient who had PSA level of more than 20 were noted to have higher skeletal metastasis as compared to those with PSA level of 10-20 and those of less than 10ng/ml. [p-0.0001]

Gleason score level of more than seven was associated with higher skeletal metastasis as compared to those patients who had Gleason score of 7. The difference was statistically significant [p-0.0001]

Spine was the most common site for bone metastasis constituting 72 patients (51.8%) of all the patients followed by ribs metastasis (31.7%), lower limb metastasis (20.1%) and upper limb was the least site for skeletal metastasis (18.7%). Also it was shown that of the spine metastasis, lumbar spine was more frequent affected (48.2%) followed by thoracic and cervical spine (41.0% and 27.3% respectively). The sacrum was the least affected site in the all spine.

Conclusion

The prevalence of skeletal metastasis in patients with Ca Prostate attending Ocean Road Cancer Institute was high (55.4%) There was no statistical significant difference between the age group). The prevalence was higher in patients with PSA level more than 20 and those with Gleason score of more than 7. Spine was the commonest site for metastasis and of the spine metastasis lumbar spine metastasis was most frequent site.

Recommendation

i. Bone scintigraphy should be done as baseline in patients with prostate cancer particularly those with PSA level more than 20ng/ml and those with Gleason score of more than 7

ii. Further multicentre study with a larger sample size is recommended.

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BS	Bone scintigraphy
GS	Gleason score
ORCI	Ocean Road Cancer Institute
PSA	Prostate specific antigen
Tsh	Tanzanian shilling
Fig	Figure

CHAPTER ONE

1.0 INTRODUCTION

1.1 Backgraound

Prostate cancer is the fourth most common cancer worldwide among all sexes combined and the second most common malignancy among men (1). In the US, it is the commonest non cutaneous malignancy among men and the second most common cause of cancer related morbidity and mortality among men in the western hemisphere (2). The incidence of the prostate cancer varies considerably among different groups with highest incidences in Australia and lowest among south central Asia.

In Africa, limited data are available regarding prostate cancer, though the condition appears more prevalent among developed countries when compared to less developed countries with the exception of South Africa which was reported to have incidence of 61.8% (1). In Tanzania the prevalence of prostate cancer is 9.6% among all cancers and is ranked third among all cancers in prevalence (3). Death related to prostate cancer is higher among less developed countries as compared to developed countries due effective screening programs in the developed countries (1).

The most common site for metastases in prostate cancer is the bone with skeletal metastases detected in up to 90% of patients dying from the disease and 22% of the newly diagnosed patients (4, 5).

Prostate specific antigen is an established prognostic marker that as shown correlation with bone scans positivity. A low risk of bone metastasis in bone scintigraphy is related to the low levels of PSA (6, 7)

Gleason score system was developed to assess the level of differentiation of the prostate based on five pattern of cellular differentiation (8,9). It is of prognostic importance and is an independent predictor of bone scan results (7, 10, 11, and 12).
In cancer of the prostate, the most frequent site for skeletal metastases is the spine and pelvis (13). According to the study by Memon AG et al., the most frequently involved areas were thoracic spine 32%, shoulder joint 28% and sacroiliac joint 21%. The other areas involve were skull 16%, sacrum 15%, lumbar vertebra 14% and ileum 13%. Other sites included the mandible, femur, Sternum, cervical spine, iliac crest, scapula, hip joint and tibia (14).

Severe pain, pathological fracture, symptomatic hypercalcemia and cord compression are among the commonest complications associated with skeletal metastasis among prostate cancer patients with 50% of those having bone metastases dying within 30 to 35 months (4, 5).

Bone scintigraphy is the most frequently used, acceptable and standard method for detecting bone metastases with reported sensitivity of up to 95% in patients with PSA value of more than 20ng/ml (2, 5, 15, 16).

Sensitivity of 72 to 77% was reported for planar bone scan in detection of bone metastases in adults and currently is the investigation of choice (17, 18). The high sensitivity of radionuclide bone scan in determining the presence and extent of metastatic disease makes it an extremely important tool in decision making, particularly because survival rate in patients with multiple distant osseous metastases from many tumors are worse than for those patients with localized disease (19). Classically, these positive scans demonstrate markedly increased radiotracer uptake (20).

Bone metastases are present in up to 14% of patients at presentation and in 80 to 85 % of those who die of the disease and they therefore affect morbidity, reflect prognosis and significantly influence decision with regard to patient management (6, 7 21). The sensitivity of bone scan is higher than that of radiography (16).

1.2 Literature Review

Spreading of the prostate cancer can be through local, lymphatic and hematogenous, Bones are the most common sites for hematogenous spread (13)
There are several proposed hypotheses to explain metastatic pathway for prostate cancer. Venous metastasis from the Batsons' plexus to the lower segments of the spine and local spread with predilection of the tumor cells to the bone due to molecular interaction being among them.(13,14)

Several studies done in different parts of the world, reported varying prevalence rate of Bone Metastasis among patient with Prostate Cancer

Lin KP et al., reported a prevalence of bone metastases by bone scan to be 14% at presentation and 80 to 85% of those who die of the disease. The presence of metastases affected morbidity, reflected prognosis and influenced decision with regard to patients' management.

In a study done in Germany by Klatte et al., it was found that 10% of the patient with prostate cancer who had bone scintigraphy done had skeletal metastases while in another study by Carlin BL et al., the prevalence of bone metastases at presentation was 8% in white Americans and 14% in black Americans (25, 26, 27).

Whitemore showed in his study that patients who developed progression of prostate cancer despite attempts at curative therapy frequently develop bone metastases and 85-100% of patients who die of prostate cancer had bone metastases (28)

The pattern of distribution of bone metastasis in prostate cancer varies, however they are generally multiple, mainly involving the vertebra column, shoulder join and sacroiliac bone. (29, 30)

Vahid et al., showed that the pelvis and spine are the main predilection sites of prostate cancer (13). Spreading through the Batson venous plexus explained the hypothesis that prostate cancer cells are directed into the pelvis and spine early in the disease and later metastases to other parts of the skeleton, such as ribs (31)

According to Memon et al., the most primary and frequently involved area was thoracic vertebral 32%, shoulder joint 28% and sacroiliac joint 21% with pubic bones, knee joints and clavicle being the least involved in their descending order (14).

There are several risk factors that are associated with bone metastasis in patients with Prostate cancer. Among them are Prostatic Specific Antigen (PSA) levels and Gleason Score (6, 7, 10, 11, 12,)

Prostate specific antigen is an established prognostic marker that correlated with bone scan positivity. Various studies demonstrate a low risk of positive bone scintigraphy in newly diagnosed patients with low levels of PSA (6, 7, 10). Rudon et al., studied 118 patients and found out that a serum PSA of less than 10ng/ml gave a negative predictive value of 100% whereas as a serum PSA of less than 20ng/ml was associated with a negative predictive accuracy of only 80% for the absence of bone metastases (27).Chybowski et al., found that the negative predictive value for the absence of skeletal metastases on bone scintigraphy for patients with serum PSA of less than 20ng/ml was 99.7%.

The Gleason score system is the most widely utilized histological grading system for prostate cancer and a powerful predictor of cancer behavior (33). Gleason score is also of important prognostic significance and has been shown to be an independent predictor of bone scan results (7, 10, 11, 12,).

O`Sullivan JM et al., indicated in their study done in United Kingdom that, with Gleason score of less than 8, the possibility of having bone metastases is very low and bone scintigraphy should be omitted in such patients unless the major pattern Gleason is 4 (11)

In a retrospective study done by Ritenour et al., which included 800 patients with prostate cancer, it showed that the proportion of positive bone scan was significantly higher in patient with Gleason score of equal to or more than 8 compare to those with Gleason score of less or equal to 7(16.8vs !.9%) (24).

The European Association of Urology guidelines update in March 2009 recommended that staging bone scan may not be indicated in patients with PSA level of less than 20ng/ml with moderately to well differentiated tumors in absence bone symptoms while the American Urologic Association and the American Joint Commission for cancer both recommended that staging bone scan is indicated in patients with Gleason score of more than 7 or prostate specific antigen of more than 20ng/ml prior to treatment (12, 35)

In their study, McArthur et al., concluded that both prostate specific Antigen and Gleason score were statistically significant predictors of bone scan results and their predictive values were additive. Age was not a predictive factor (21)

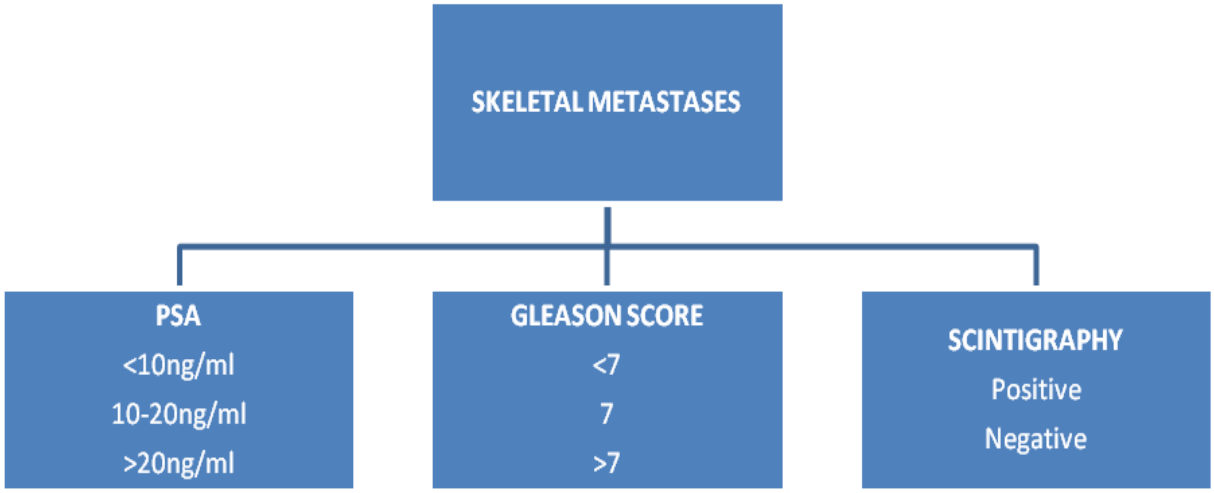
1.4 Statement of the Problem

Prostate cancer is the fourth most common cancer worldwide among all sexes combined and the second most common malignancy among men (1).It is the commonest non cutaneous malignancy among men in the US and the second most common cause of cancer related morbidity and mortality among men in the western hemisphere (2). In Tanzania the prevalence of prostate cancer is 9.6% among all cancers and is ranked third among all cancers in prevalence (3)

Bones are the most common sites for hematogenous spread in Prostate Cancer.(13) They are the major cause of morbidity and present in up to 14% of patients at presentation and in up to 80 to 85% of those who die of the disease thus affect morbidity, reflect prognosis and significantly influence decision with regard to patient management (6, 7, 21).

Radionuclide imaging of the bone skeleton currently is the most widely used modality to diagnose bone metastases inpatient with prostate cancer (20)
It is available, cheaper and sensitivity is higher than that of radiography (16). No documented study has been done in Tanzania to address the magnitude of the problem.
Thus in this kind of situation there is a need to know the bone scintigraphic metastatic pattern in our setting and their relationship to age, PSA and Gleason score so as recent management can be made.

1.5 Conceptual Framework



1.6 Rationale

Prostate cancer is the commonest malignancy in men with preponderance to metastases to the bones causing major morbidity and can lead to mortality. Radionuclide imaging of the bone skeleton currently is the most widely used modality to diagnose bone metastases in patient with prostate cancer. Medical practitioners and radiologists in our country should be aware of the prevalence and bone scintigraphy metastatic patterns and relationship between occurrence of bone metastasis with serum PSA and Gleason score. Also baseline data will be generated that can be used by different authorities in implementation of policies and protocol development with regard to prostate cancer.

1.6 Research Question

1. What skeletal scintigraphy patterns are more common among prostate cancer patient at Ocean Road Cancer Institute

2. What is the relationship between PSA and Gleason score of a patient to presence of skeletal metastases on bone scintigraphy in Tanzania

1.7 Objectives

1.7.1 Broad objective

To determine the scintigraphy metastatic pattern in patient with prostate cancer attending Ocean Road Cancer Institute from June 2014 to June 2016

1.7.2 Specific objectives

1. To determine the prevalence of bone metastasis in patient with prostate cancer who attended Ocean Road Cancer Institute from June 2014 to June 2016
2. To determine the relationship between bone metastasis and prostate specific antigen in patient with prostate cancer who attended Ocean Road Cancer Institute from June 2014 to June 2016
3. To determine the relationship between bone metastasis and Gleason score in patient with prostate cancer who attended Ocean Road Cancer Institute from June 2014 to June 2016
4. To determine the distribution pattern of bone metastasis in patients with prostate cancer who attended Ocean Road Cancer Institute from June 2014 to June 2016

CHAPTER TWO

2.0 METHODOLOGY

2.1 Type of study

The study is a descriptive cross sectional retrospective hospital based study

2.2 Study duration

The study was conducted for six months on which data of patients who were seen from June 2014 to June 2016 were reviewed.

2.3 Study area

The study was conducted at nuclear medicine and medical records departments of Ocean Road Cancer Institute which is the specialized cancer hospital in Tanzania receiving referral from both regional and district hospital in the country.

2.4 Study population

The study included all histological confirmed prostate cancer patient referred to the nuclear medicine department of Ocean Road Cancer Institute for bone scintigraphy during the study period

2.5 Inclusion criteria

Confirmed prostate cancer patients attending ORCI referred to the nuclear medicine department for bone scan

2.6 Exclusion criteria

Patients without either PSA or Gleason score or both (PSA and Gleason)

2.7 Sampling method/technique

Convenience sampling was used

File of the patient were collected on the medical record, screened and those patient who had histological confirmed Prostate cancer were selected and further evaluation was done to see if they fulfill the inclusion the criteria. Bone scan were interpreted in the nuclear medicine department on the next day after the file were screened

2.8 Sample size Estimation

The sample size will be calculated from Fisher's formula;

$n=Z^2P\ (1-P)/E^2$

Where: n= sample size,

Z = point of normal distribution corresponding to the significance level of 1.96

P = prevalence of bone metastasis in prostate cancer patient done in Germany = 10% (25)

95% confidence interval will be used.

E = maximum likely error 5%

Therefore $n= (1.96)^2 \times 0.1\ (1 - 0.1)/(0.05)^2 = 139$

Thus the minimum sample size in this study was approximated to 138 patients.

2.9 Data Collection

Data collection was done retrospectively through data collection tool which was filled by investigator and image evaluated. Data collected (Secondary data) included age, prostate specific antigen, Gleason score and absence or presence of bone metastasis.

2.10 Imaging and Evaluation

Whole body scanning was performed 3 h after injection of 700MBq ^{99m}Tc methyldiphosphonate using a matrix size of 256×1024 at a scan speed of 15 cm min^{-1} and an energy window of 20 % at 140 keV using a dual head Mediso Any Scan system . Images were processed and then displayed in anterior and posterior view for analysis. Reporting of bone scans was performed by the investigator under the supervision of a specialist radiologist at the hospital so as to reduce observation bias and ensure quality.

Bone scan results were recorded as positive, equivocal or negative for the presence of metastases. In equivocal cases a specialist nuclear medicine physician reviewed the initial bone scan. Any outstanding indeterminate cases were treated as equivocal. Standard criteria will be used in defining the abnormalities.

Quality Control

All bone scan images obtained were stored in a system memory and DVD's. The reports were read by the investigator under the supervision of the Consultant Radiologist so as to reduce bias in observations and ensure quality.

Data Management

All filled questionnaires were daily checked for completeness and accuracy by the Investigator and then coded before entering the data into the computer. Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 20 for Windows evaluation. Frequency distribution and cross tables were used to tabulate data. Variables were expressed in percentage and comparison between independent and dependent variables were done by Chi squire and Fishers test. P value of < 0.05 was considered statistically significant.

2.12 Ethical consideration

Ethical clearance was obtained from the Institutional Review board (IRB) of the Muhimbili University of Health and Allied Sciences and permission to conduct the study at Ocean Road using the medical records and imaging facility were obtained from the executive Director of ORCI through the Director of Academic unit of ORCI.

CHAPTER THREE

3.0 RESULTS

Demographic results

There were 139 patients with prostate cancer who participated in this study. Participants ages ranges from 42-90 years with most of participants 103 (74.1%) in the 60-79 years category. The Mean Age was 68.34 years and standard deviation of 9.02. PSA levels of the patients ranges from 0 to 380ng/ml with 53(39%) having a PSA levels of more than 20nanogram. Mean PSA level was 39.89ng/ml. Of the total patient 43(30.9%) had GS of more than 7. (Table 1)

Table 1: Demographic and basic characteristics of the studied population N=139

VARIABLES	n (%)
Age group	
40-59	21(15.1%)
60-79	103(74.1%)
80+	15(10.8%)
Mean age	**68.34**
PSA level	
>20ng/ml	53(38.1%)
Mean PSA level	**39.89**
Gleason score	
>7	43(30.9%)

Prevalence of Bone Metastasis among patients with Prostate Cancer according to age

Seventy seven patients (55.4%) out of 139 patients with Prostate cancer had bone metastasis. Patient with the age group 60-79 had higher prevalence of bone metastasis compared to the other groups however it was not statistically significant (p – 0.933) as shown in table 2 below

Table 2: Prevalence of Bone Metastasis among patients with Prostate Cancer according to age group N=139

		Metastasis			Pearson's X^2	P value
		YES	**NO**	**Total**		
Age group (years)	40-59	11 (52.4%)	10 (47.6%)	**21 (100.0%)**	0.14	0.933
	60-79	58 (56.3%)	45 (43.7%)	**103 (100.0%)**		
	80+	8 (53.3%)	7 (46.7%)	**15 (100.0%)**		
	Total	**77 (55.4%)**	**62 (44.6%)**	**139 (100.0%)**		

Relationship between bone metastasis with PSA and Gleason score

Patients with PSA of more than 20ng/ml had more bone metastasis 88.4% (47/53) as compared to those with PSA less than 10 and those of between10-20. The difference was statistically significant with a p-value of 0.0001. Also fifty five patients (96.5%) of patients with Gleason score of more than seven had more bone metastasis as compared to those of less or equal to 7 (p-0.0001)

Table 3: Relationship between bone metastasis with PSA and Gleason score

		Metastasis			Pearson's X^2	P value at 95%CI
		YES	**NO**	**Total**		
PSA category	Less than 10ng/ml	8 (13.3%)	52 (86.7%)	**60 (100.0%)**	76	**0.0001**
	10 to 20ng/ml	22 (84.6%)	4 (15.4%)	**26 (100.0%)**		
	More than 20ng/ml	47 (88.7%)	6 (11.3%)	**53 (100.0%)**		
	Total	**77 (55.4%)**	**62 (44.6%)**	**139 (100.0%)**		
GS category	Less than 7	4 (9.8%)	37 (90.2%)	**41 (100.0%)**	75.7	**0.0001**
	7	18 (43.9%)	23 (56.1%)	**41 (100.0%)**		
	More than 7	55 (96.5%)	2 (3.5%)	**57 (100.0%)**		
	Total	**77 (55.4%)**	**62 (44.6%)**	**139 (100.0%)**		

The distribution pattern of bone metastasis in patients with prostate cancer

Among all patients with prostate malignancy included in the study 72(51.8%) presented with spine metastasis which was the most frequent followed by ribs metastasis that was present in 44(31.7%) patients included in the study. Only 26(18.7%) patient of these patients presented with metastasis to the upper limb which was the least affected area [P=0.0001] as depicted in the table 4 and figure 1 below.

Table 4: Bone metastasis distribution pattern in patients with prostate cancer attending at Ocean Road Cancer Institute N=139

		Bone Metastasis			Pearson's X^2	P value at 95%CI
		Yes	**No**	**Total**		
Ribs metastasis	Yes	44 (31.7%)	0 (0.0%)	**44 (31.7%)**	51.84	
	No	33 (23.7%)	62 (44.6%)	**95 (68.3%)**		
	Total	**77 (55.4%)**	**62 (44.6%)**	**139 (100.0%)**		**0.0001**
Spine metastasis	Yes	72 (51.8%)	0 (0.0%)	**72 (51.8%)**	120.27	
	No	5 (3.6%)	62 (44.6%)	**67 (48.2%)**		
	Total	**77 (55.4%)**	**62 (44.6%)**	**139 (100.0%)**		
Upper limb metastasis	Yes	26 (18.7%)	0 (0.0%)	**26 (18.7%)**	25.75	
	No	51 (36.7%)	62 (44.6%)	**113 (81.3%)**		
	Total	**77 (55.4%)**	**62 (44.6%)**	**139 (100.0%)**		
Lower limb metastasis	Yes	28 (20.1%)	0 (0.0%)	**28 (20.1%)**	28.23	
	No	49 (35.3%)	62 (44.6%)	**111 (79.9%)**		
	Total	**77 (55.4%)**	**62 (44.6%)**	**139 (100.0%)**		
Other site metastasis	Yes	27 (19.4%)	0 (0.0%)	**27 (19.4%)**	26.98	
	No	50 (36.0%)	62 (44.6%)	**112 (80.6%)**		
	Total	**77 (55.4%)**	**62 (44.6%)**	**139 (100.0%)**		

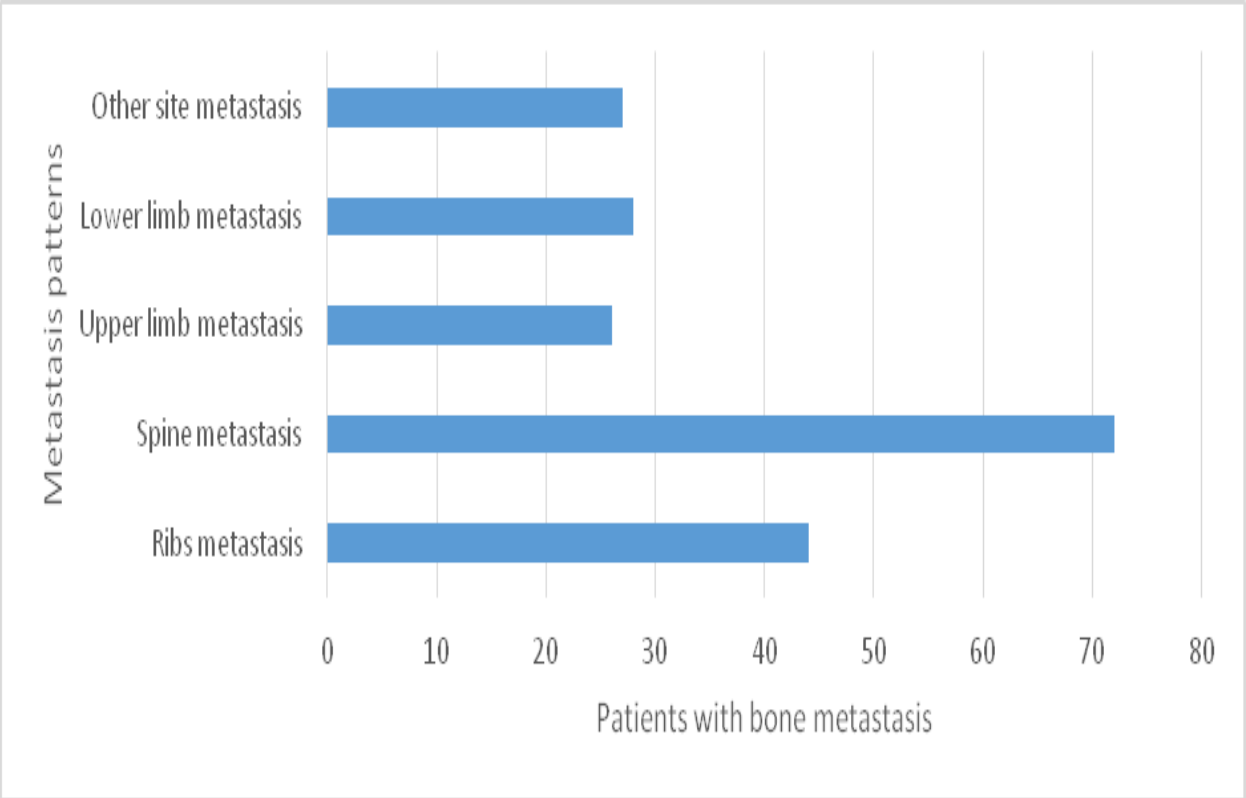


Figure 1: The metastasis patterns with bone metastasis in patient with prostate cancer attending at Ocean Road Cancer Institute. N=139.

Spine metastasis distribution

Lumbar spine was the most frequent site for spine metastasis occurring in 67(48.2%) patients, followed by thoracic spine metastasis 57(41%) and the last was sacral metastasis which was present in 33(23.7%) of all patients with prostate cancer included in the study. [P=0.0001], as shown in the table 6 and figure 2 below.

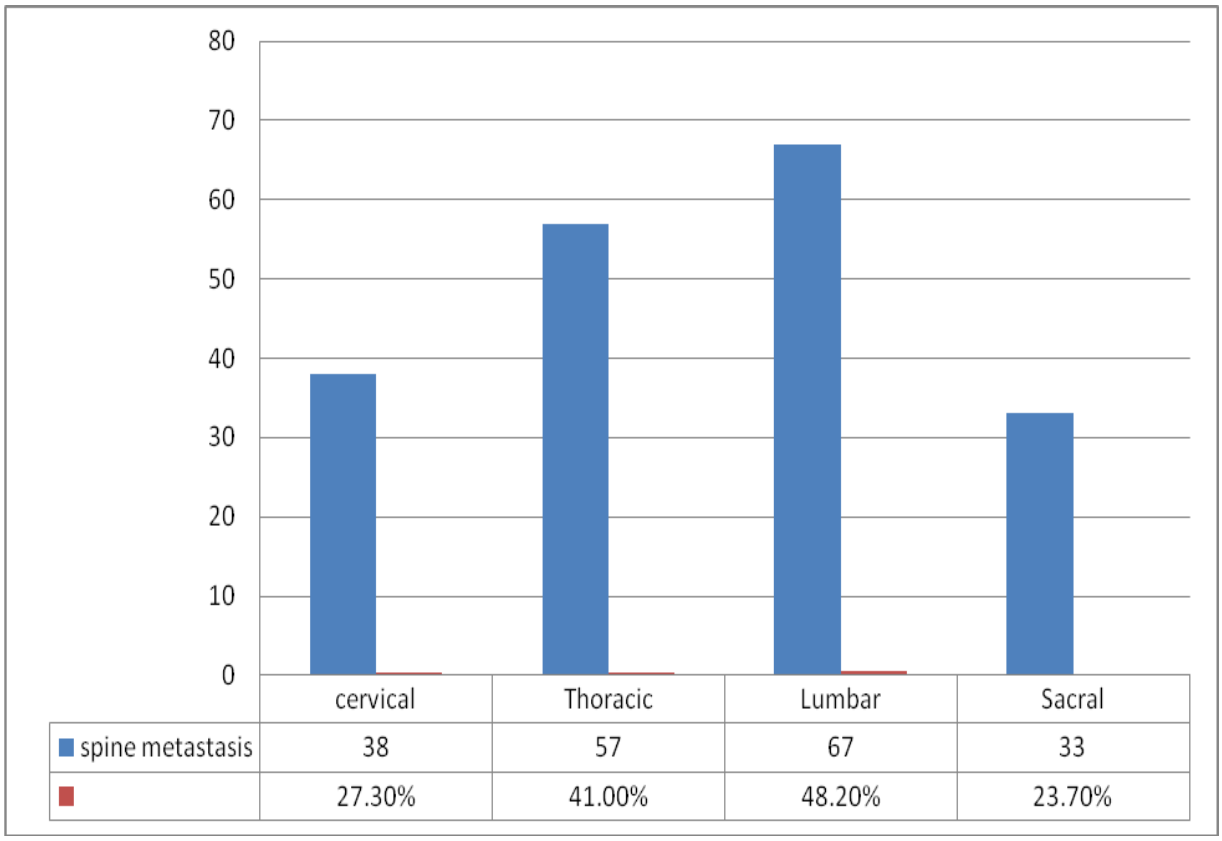


Figure 2: The distribution of spine types of metastasis in patient with prostate cancer attending at Ocean Road Cancer Institute. N=139. [P- 0.0001]

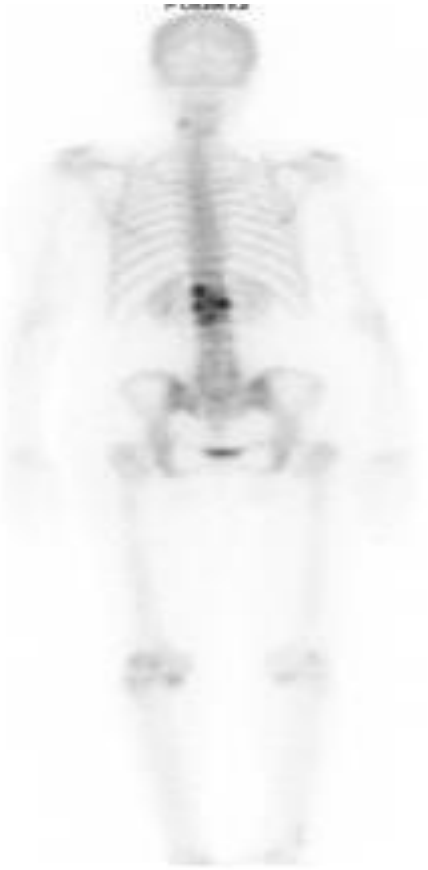


Figure 3: A 60years old male with prostate cancer presenting with with osteoblastic skeletal metastasis in L1, L2 and fourth rib.

CHAPTER FOUR

4.0 DISCUSSION

Bone Metastasis as detected by bone scintigraphy in patient with Prostate Cancer is of remarkable importance as it affect morbidity, reflect prognosis and influence management plan. The aim of this study was to determine the bone scintigraphic metastatic pattern in patient with Prostate cancer and the relationship between bone metastasis with PSA level and Gleason score.

The overall prevalence of bone metastasis as detected by bone scintigraphy was 55.4 %(77 out of 139 patients). This is in contrast to the study done by Lin KP et al and Klatte et al who showed in their researches that the prevalence of bone metastasis in patient to be 14% and 10% respectively (7, 25) Also the prevalence of 8% and 14% in white and black Americans respectively was found in a study done by Carlin BL et at. (27). This could be explained by the fact that, most of the patient in this study came to the nuclear medicine in late stages after having metastatic symptoms contrary to the newly diagnosed patients included in the other studies.

Most of the patients were in the age group between 60 and 79 contributing 74.1% of all participants with the least number of patients were those with 80years and above. The prevalence of bone metastasis was higher in patient with age group between 60 to 79 however the difference was not statistically significant. .This is similar to the study done by Mc Arthur et al in which the age was found not to be a predictor of positive bone scintigraphic findings (21)

The study showed there is an increase in the rate of positive bone scan with increased level of prostate specific antigen which was statistically significant 7 [P=0.0001]. Only 5.1% of participants with PSA level of less than 10ng/ml had positive bone scan for metastasis in comparison with 34.6% in those with PSA of more than 20ng/ml. This is similar to the findings in research done by Pal RP et al which showed that there was a steady increase of rate

of bone metastasis with an increase in the level of PSA and that PSA was an independent prognostic indicator for the positive bone scan.(6). Similar findings were

depicted by Lin K et al showing in their study that low levels of prostate specific antigens were associated with low risk of bone metastasis when compared to high levels.(7)

Low levels were shown to be associated with lower risk of bone metastasis and vice versa. Those with Gleason score of less than 7, only 2.9% had bone metastasis while those with more than 7, 28.1% had positive bone scan the findings similar to the study retrospective study by Ritenour et al which similar trend of increased rate of bone metastasis with an increase in Gleason score.(24)

About fifty two percent of all recruited patients in the study had spine metastasis which proves to be the most common site for metastasis. This is similar to the study done by Memon AG et al and Vahid et al., who both showed that the spine was the most common site for skeletal metastasis in prostate cancer patients. (29, 30, 31). This predilection to the spine can be explain by the venous plexus drainage of the pelvic organ through the Batson plexus.

The lumbar spine was the most affected part of the spine followed by the thoracic spine, 48.2% and 41% respectively. This findings are similar to the study done by Lukas B et al which showed that lumbar spine metastasis was more common than thoracic metastasis and this was explained by the backward flow of metastatic deposits through the venous drainage from the prostate to the lumbar spine and then upwards as it was hypothesized by Batson(35). On the other hand Memon G et al showed in their research that, thoracic vertebra was the most affected part of the spine contributing 42% of the studied patients with prostate carcinoma. (14)

CHAPTER FIVE

5.0 CONCLUSION and RECOMMENDATION

5.1 Conclusion

The overall prevalence of bone metastasis was 55.4%. There was no statistical significance in prevalence of bone metastasis according to age; however the most affected group was between 60 and 79 years

Most bone metastasis was seen in patient with higher PSA and Gleason Score.

The spine was the most affected site by skeletal metastasis with the lumbar spine being the most common site followed by the thoracic spine,

This study showed there is a significant relationship between bone metastasis, PSA levels and Gleason Score.

5.2 Recommendation

i. Bone scintigraphy should be done as baseline in patients with prostate cancer particularly those with PSA level equal to or more than 20ng/ml and those with Gleason score of more than 7

ii. Further multicentre study with a larger sample size is recommended.

5.3 Limitations

The study had limitation of time and resources therefore more researches are required to set the standard local criteria on newly diagnosed patient with prostate cancer

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APPENDICES

Appendix I: Questionnaire

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

SCHOOL OF MEDICINE - DEPARTMENT OF RADIOLOGY

P.O.BOX 65001 MUHIMBILI

DAR ES SALAAM

TANZANIA

Identity number ……. Age ……

Part 1

1. Prostate specific Antigen level (ng/ml)
    i. Less than 10ng/ml
    ii. Between 10 to 20ng/ml
    iii. More than 20ng/ml
2. Gleason score
    i. Less than 7
    ii. 7
    iii. More than 7

Part 2. Image findings

3. Bone metastases present

   i. Yes

   ii. No

   iii. Equivocal

4. If Yes in qn 3

Skull.....

Ribs.....

Spine ……

Cervical spine.....

Thoracic spine.....

Lumbar spine.....

Sacral.....

Upper limbs.....

Lower limbs.....