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Research Article

Detection of Bone Metastasis On Whole Body Bone Scan Among Sudanese Patients with Proven Cancer in Tumours Therapy and Cancer Research Center –Shendi –Sudan

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Abstract: Bony metastasis is one of the most common causes of death in patients with proven cancer, most of the patients present by pathological fracture, and carry poor prognosis. The bone scan is the main investigation for diagnosis. Our objective is to determine the most common cancer that causes metastasis, the commonest site involved in the skeleton, and the metastatic pattern for each cancer. We studied 150 cases collected in tumor therapy and cancer research centers, those who underwent bone scans using a gamma camera. The most age of our patients ranged between (40 and 60) years old. The predominance of females was noticed (68.7%). 90% of the patients were married. The study showed that 35.3% with left breast cancer, 20% with right breast cancer, and 22% with prostate cancer. The study showed that 40% of the participants had bone metastasis, 41.7% with prostate cancer, 21.7% with left breast cancer, and 16.7% with right breast cancer. The study showed that the lumber vertebra involved in 51.7% of bone metastasis, thoracic vertebra involved in (50%) with bone metastasis, the anterior ribs involved in 28.3% with bone metastasis, while posterior ribs in 25%, the right femur involved in 28.3 while the left femur engaged in 25% of bone metastasis and 25% metastasis to the skull. About 40% of the patients had bony metastasis. Breast and prostate are the most common cancers that cause bony metastasis. The spine is the most common site for metastasis. Prostate cancer metastasized mainly to the spine followed by the femur, ribs, skull, and shoulders

Keywords: bony metastasis, bone scan, cancer patient, Shendi –Sudan

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1. INTRODUCTION

Bone metastases are a frequent complication of cancer, occurring in up to 70% of patients with advanced breast or prostate cancer and approximately 15% to 30% of patients with carcinoma of the lung, colon, stomach, bladder, uterus, rectum, thyroid, or kidney. The exact incidence of bone metastasis is unknown, but it is estimated that 350,000 people die from bone metastases annually in the United States.[1-5] Once tumors metastasize to bone, they are usually incurable; only 20% of patients with breast cancer are still alive five years after the discovery of bone metastasis. The consequences of bone metastasis are often devastating. Osteolytic metastases can cause severe pain, pathologic fractures, life-threatening hypercalcemia, spinal cord compression, and other nerve-compression syndromes. Patients with osteoblastic metastases have bone pain and pathologic fractures because of the poor quality of bone produced by the osteoblasts. For all these reasons, bone metastasis is a serious and costly complication of cancer. [6-15] Most patients with cancer do not die from primary cancer, but from secondary metastatic disease. The bone is the most common site of secondary metastases, secondary to the lung and liver. Bone metastasis is a malignant tumor of the extraosseous organ or tissue. These metastatic cells are transferred by the lymphatic blood system to the bone, which then continues to grow and form a tumor. According to the American Cancer Society, about 400,000 new cases of malignant bone metastasis are diagnosed in the United States each year. The incidence of advanced malignant tumors with bone metastasis is 30–75%, prevalent in patients with advanced prostate cancer and breast cancer. Bone metastases often cause limb dysfunction, pathological fractures, spinal cord compression, and severe pain, seriously affecting the quality of life of patients with advanced cancer and poor prognoses. [16-26] Despite the influence of bone metastases on cancer patients, large-scale research studies examining the incidence, prevalence, and outcomes of patients with bone metastases remain lacking. [1, 20- 28] The skeleton of the human being is a unique structure that has adapted to the needs of bipedal locomotion and upright posture. The structural peculiarities of the human skeleton give human beings their characteristic appearance and facial geometry. The bony skeleton provides the shape and framework on which the human body is designed and functions. It houses and protects vital organs, contains bone marrow, which is the functional unit of the hematopoietic system; and it provides attachments and anchorage to muscles, ligaments, and joint capsules. Bones often act as levers, which, in conjunction with muscular contraction, initiate and sustain movement. [2,29-35] When solid tumors metastasize to the skeleton, they cause a variety of alterations in bone cell function that may be represented as discrete osteolysis, diffuse osteopenia, osteoblastic lesions, or a combination of all of the above. All these effects are caused by the effects of tumor products on the normal bone remodeling sequence. The most common of these lesions is the destructive or osteolytic lesion. Osteolysis is characterized by a marked increase in osteoclast formation and osteoclast activity caused by tumor products. There may be a subsequent osteoblastic response, but this is often blunted and sometimes absent. Less commonly, solid tumors cause an increase in osteoblast activity. This may occur without obvious previous desorption; although it may also be associated with prior desorption at the same site, and the formation phase may be relatively exaggerated. [7-9,36-40] Bone imaging continues to be the second-greatest-volume nuclear imaging procedure, offering the advantages of total body examination, low cost, and high sensitivity. Its strength rests in the physiological uptake and path physiologic behavior of 99m technetium (99m-Tc) diphosphonates. The diagnostic utility, sensitivity, specificity, and predictive value of 99m-Tc bone imaging for benign conditions and tumors were established when only planar imaging was available. Currently, nearly all bone scans are performed as a planar study (whole-body, 3-phase, or regional), with the radiologist often adding single-photon emission computed tomography (SPECT) imaging. Here we review many current indications for planar bone imaging, highlighting indications in which the planar data are often diagnostically sufficient, although diagnosis may be enhanced by SPECT. $^{F}18$ sodium fluoride positron emission tomography (PET) is also re-emerging as a bone agent and has been considered alternate with 99m-Tc diphosphonates in the past. In addition to SPECT, new imaging modalities, including 18F fluorodeoxyglucose, PET/CT, CT, magnetic resonance, and SPECT/CT, have been developed and can aid in evaluating benign and malignant bone disease. Because $^{F}18$ fluorodeoxyglucose is taken up by tumor cells and Tc diphosphonates are taken up in osteoblastic activity or osteoblastic healing reaction, both modalities are complementary.[41-45]CT and magnetic resonance may supplement, but do not replace, bone imaging, which often detects pathology before anatomic changes are appreciated. We also stressed the importance of dose reduction by reducing the dose of 99m-Tc diphosphonates and avoiding unnecessary CT acquisitions. Moreover, we propose an approach to image interpretation that emphasizes communication with referring colleagues and correlation with appropriate history to significantly improve our impact on patient care. [8, 46-51]

2. METHODOLOGY

The present study was a prospective, cross-sectional, hospital-based study conducted in tumor therapy and cancer research center - Shendi University Sudan. We used the total coverage technique as the sampling method to collect data from the total number of included participants. Thus, the total number of included participants was 150 patients. The study was conducted between (2010- 2017). The center was established in 2010 to provide chemotherapy, nuclear medicine imaging, endoscopy services, laboratory services, radio-iodine therapy, early detection services, and Radiation therapy for cervical cancer (brachytherapy). The Teletherapy department is under establishment. This is the only center providing these services for the population in the River Nile state of Sudan. The center is located in Shendi town, it is about 150 km northern to Khartoum capital of the Sudan, and about 45 km Southern to the ancient city of Merwe. The center is located about 4km from the center of Shendi town, at the cross of highway road from Khartoum to Atbara across the main road inter center of Shendi town. The inclusion criteria of the patients were: being 18 years of age and older, having proven cancer, and a whole body bone scan was done to them for detecting bone metastasis.

2.1. *Data collection method & tool*

Data were collected using a structured questionnaire. The questionnaire was filled directly from the medical files of the patient's records. For all the patients involved in the study whole body bone scan was done . The questionnaire included items to measure sociodemographic characteristics (gender, age, residence, and marital status .

2.2. Statistical Data Analysis

Data was reviewed, ordered, and coded, and then Statistical Package for Social Sciences (SPSS) version 20 was used for data analysis. Descriptive statistics were used to analyze the participants' data... The data is presented in the form of figures and tables .

2.3. Ethical consideration

Ethical approval for this study was obtained from the scientific research commitment of Shendi University and the Ministries of Health in North Sudan (SMSB-E.C.66.2021), in inconsistency with Helsinki's declaration of the international conference on harmonization, regulations, and laws of Sudan.

3. RESULTS

A total of 150 patients with different types of cancer were included in the study to bone scan was done by using a gamma camera in the tumor therapy and cancer research center at Shendi University Sudan. More than half of the participants were males, more than two-thirds of them were in the age group of 40 to 60 years and most of the females were housewife workers. Nearly two-thirds of them were from Shendi town and the majority of them (90%) were married . Table1

Table1: Distribution of Participants by Gender and Residency

gender	N	%
male	47	31.3
female	103	68.7
Resident		
Shendi	78	52.0
Al matama	11	7.3
Al mesaiktab	6	4.0
Alshagaloa	6	4.0
Al trajma	3	2.0
Kabosheah	5	3.3
Algeliaa	4	2.7
Dem algrai	4	2.7
Alseal	4	2.7
Alkimair	8	5.3
Alsloaab	2	1.3
Ttaibhalkhoad	3	2.0
al mahmeia	2	1.3
Al damar	6	4.0
Atbara	3	2.0
abuhamaed	1	.7
Algraef	2	1.3
Banaga	1	.7
Barbar	1	.7
Occupation		
Housewife	97	64.7
Free business	44	29.3
Employee	9	6.0
Educational level		
Not educate	75	50.0
Primary	40	26.7
Secondary	28	18.7
University	7	4.7
Marital status		
Married	135	90.0
Single	15	10.0

Table 2: type of tumor among participants

Type of tumor	Frequency	Percent%
breast cancer	53	35.3
Ca prostate	33	22.0
Ca ovary	5	3.3
Endometrial carcinoma	3	2.0
Thyroid cancer	3	2.0
Chronic lymphocytic leukemia	1	.7
Burkett's lymphoma	1	.7
Nasopharyngeal carcinoma	1	.7
Colorectal carcinoma	3	2.0

Esophageal carcinoma	2	1.3
Rhabdomyosarcoma	1	.7
Renal cell carcinoma	3	2.0
Synovial sarcoma	1	.7
Cervical carcinoma	2	1.3
Carcinoma of the head of pancreas	1	.7
Right breast cancer	30	20.0
Bilateral breast cancer	4	2.7
Uterine leiomyosarcoma	1	.7
Myxoid chondrosarcoma	1	.7
Ca bladder	1	.7
Total	150	100.0

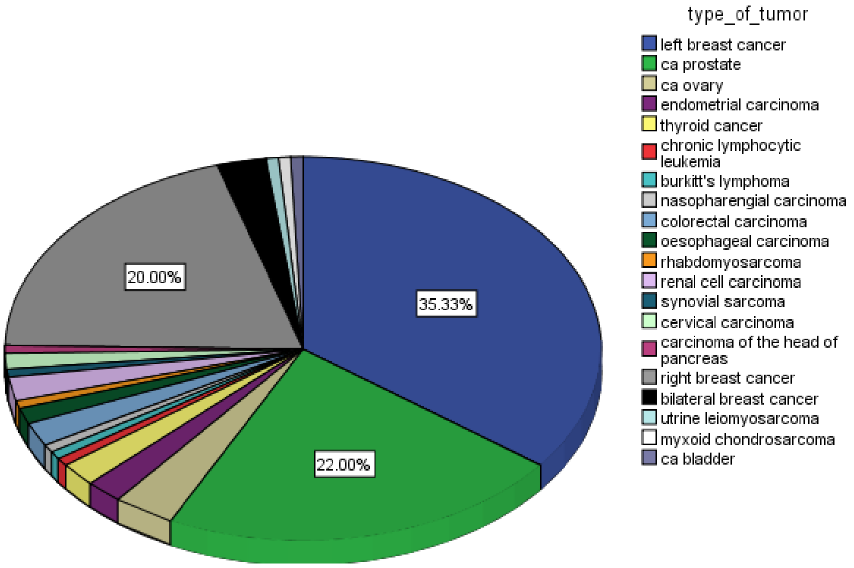


Fig 1: Distribution of study population according to their type of tumor

Table 3: Type of therapy among participants

	Frequency	Percent%
	Chemotherapy	
Yes	107	71.3
No	43	28.7
	Radiotherapy	
Yes	52	34.7
No	98	65.3
	Surgery	
Yes	106	70.7
No	44	29.3
	Hormonal therapy	
Yes	24	16.0
No	126	84.0

Table 4: Frequency of bone metastasis among participants and duration of the disease

Bone metastasis	Frequency	Percent%
Yes	60	40.0
No	90	60.0

Table 5: Frequency of the site of bone metastasis

Duration from diagnosis to metastasis	Frequency	Percent%
no metastasis	90	60
one year	36	24
2 years	17	11.4
3 years	4	2.6
more than 3 years	3	2
Total	150	100.0

Table 6: Frequency and Percentage Distribution of Affected Sites		
Site	**Count**	**percent %**
Skull	15	25.0%
Anterior ribs	17	28.3%
Posterior ribs	15	25.0%
Right shoulder	12	20.0%
Left shoulder	13	21.7%
Right clavicle	0	0.0%
Left clavicle	2	3.3%
Right humerus	6	10.0%
Left humerus	9	15.0%
Right scapula	1	1.7%
Cervical vertebra	10	16.7%
Left scapula	1	1.7%
Thoracic vertebra	30	50.0%
Lumber vertebra	31	51.7%
Sacral vertebra	6	10.0%
Coccyx	5	8.3%
Right sternoclavicular joint	2	3.3%
Left sternoclavicular joint	1	1.7%
Sternum	8	13.3%
Right pelvis	10	16.7%
Left pelvis	11	18.3%
Right sacroiliac	1	1.7%
Left sacroiliac	3	5.0%
Right hip joint	0	0.0%
Left hip joint	3	5.0%
Right acetabulum	0	0.0%
Left acetabulum	2	3.3%
Right femur	17	28.3%
Left femur	15	25.0%
Right knee	6	10.0%
Left knee	7	11.7%
Right tibia	4	6.7%
Left tibia	9	15.0%
Right tarsus	1	1.7%
Left tarsus	1	1.7%
Right toes	1	1.7%
Left toes	0	0.0%

Table 7: Frequency of bone metastasis according to type of cancer		
Type of tumor	**Frequency**	**Percent %**
Left breast cancer	13	21.7%
Prostate cancer	25	41.7%
Ovarian cancer	0	0.0%
Endometrial carcinoma	0	0.0%
Thyroid cancer	0	0.0%
Chronic lymphocytic leukemia	0	0.0%
Burkett's lymphoma	0	0.0%
Nasopharyngeal carcinoma	1	1.7%
Colorectal carcinoma	0	0.0%
Esophageal carcinoma	1	1.7%
Rhabdomyosarcoma	1	1.7%
Renal cell carcinoma	2	3.3%
Synovial sarcoma	0	0.0%
Cervical carcinoma	1	1.7%
Carcinoma of the head of pancreas	0	0.0%
Right breast cancer	10	16.7%
Bilateral breast cancer	3	5.0%
Uterine leiomyosarcoma	1	1.7%

Myxoid chondrosarcoma	1	1.7%
Urinary bladder cancer	1	1.7%

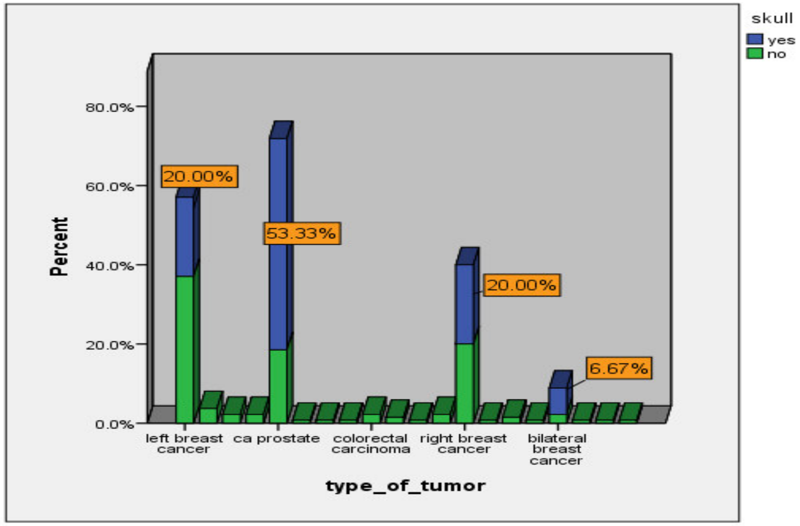


Fig 2: The skull is involved in (25%) of all bone metastases (53.33%) from prostate cancer, (20%) from right breast cancer, (20%) from left breast cancer, and (6.67%) from bilateral breast cancer

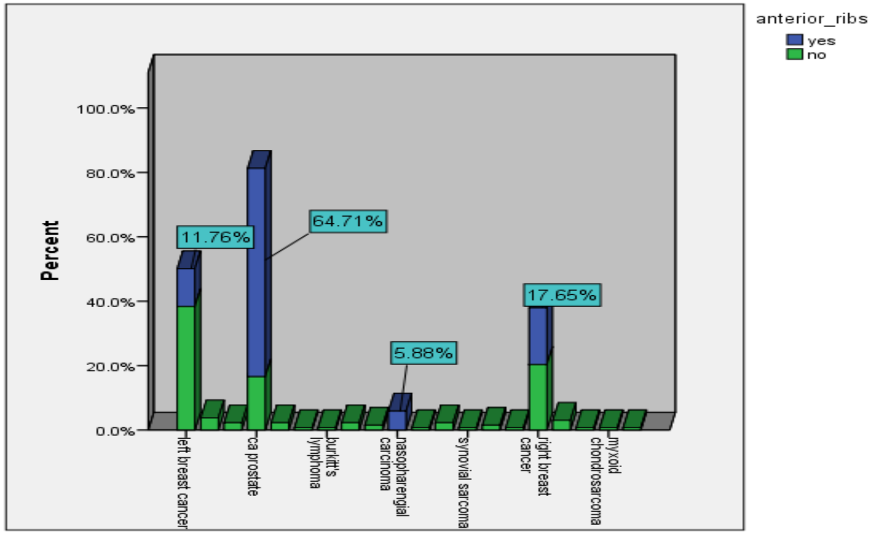


Fig 3: The anterior ribs are involved in (28.3%) of all bone metastasis (64.71%) from prostate cancer, (17.65%) from right breast cancer, (11.76%) from left breast cancer, and (5.88%) from nasopharyngeal carcinoma

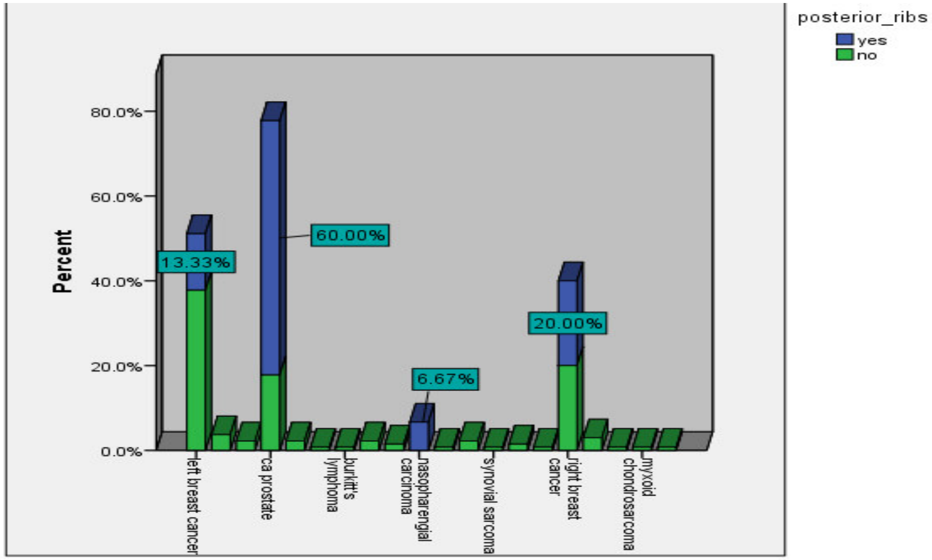


Fig 4: The posterior ribs were involved in (25%) of all bone metastasis (60%) from prostate cancer, (20%) from right breast cancer, (13.33%) from left breast cancer, and (6.67%) from nasopharyngeal carcinoma

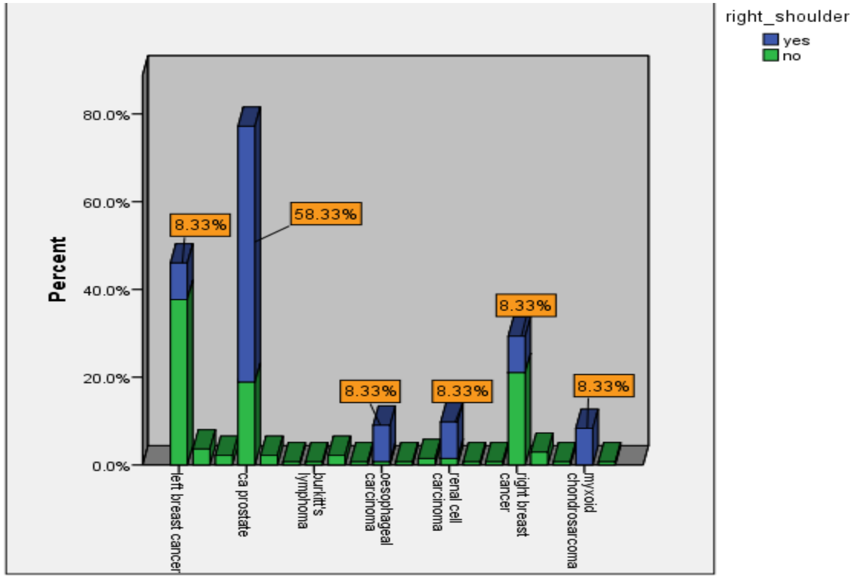


Fig 5: The right shoulder is involved in 20% of all bone metastasis (58.33%) from prostate cancer, 8.33%) from left breast cancer, 8.33%) from right breast cancer, 8.33%) from esophageal carcinoma, 8.33%) from renal cell carcinoma, and 8.33%) from myxoid chondrosarcoma

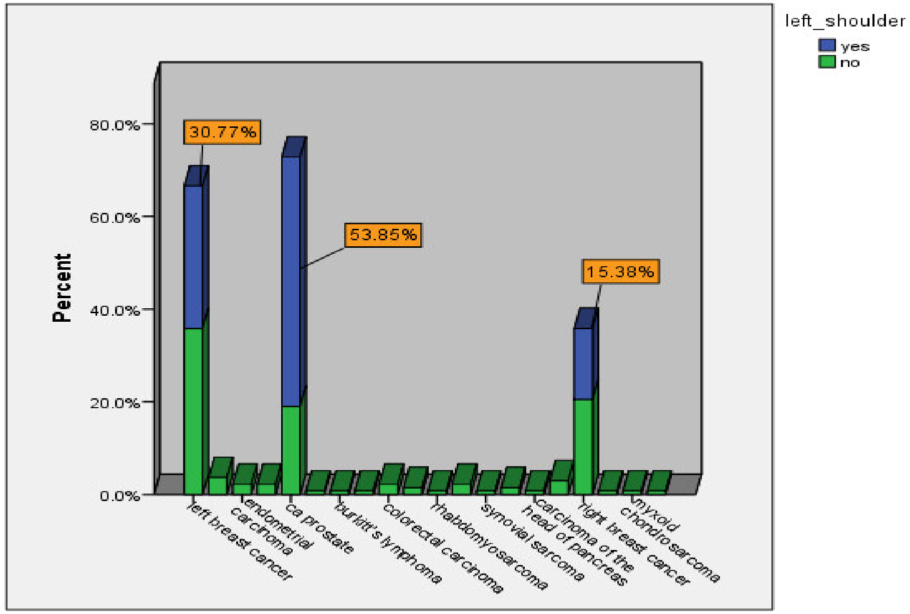


Fig 6: The left shoulder is involved in 21.7% of all bone metastasis (53.85%) from prostate cancer, 30.77%) from left breast cancer, and 15.38%) from right breast cancer

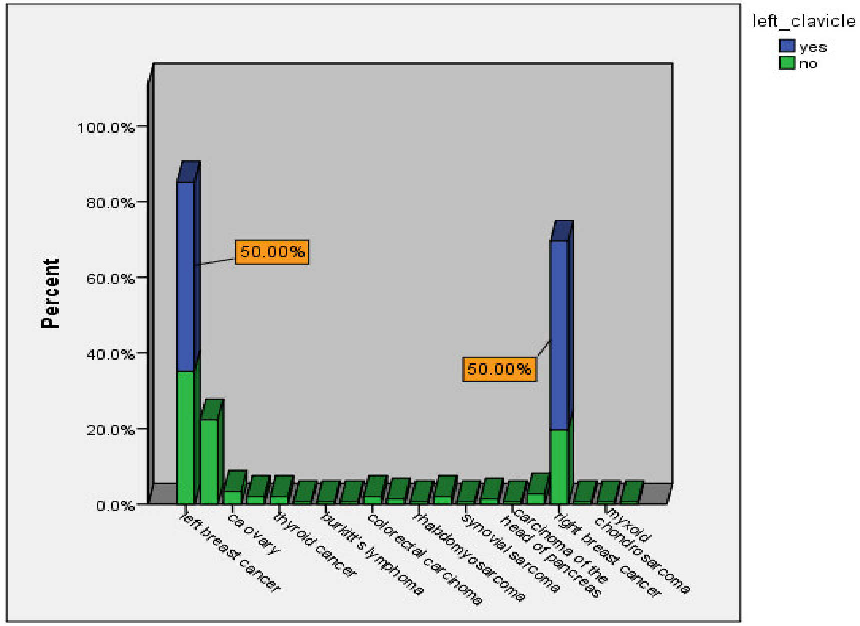
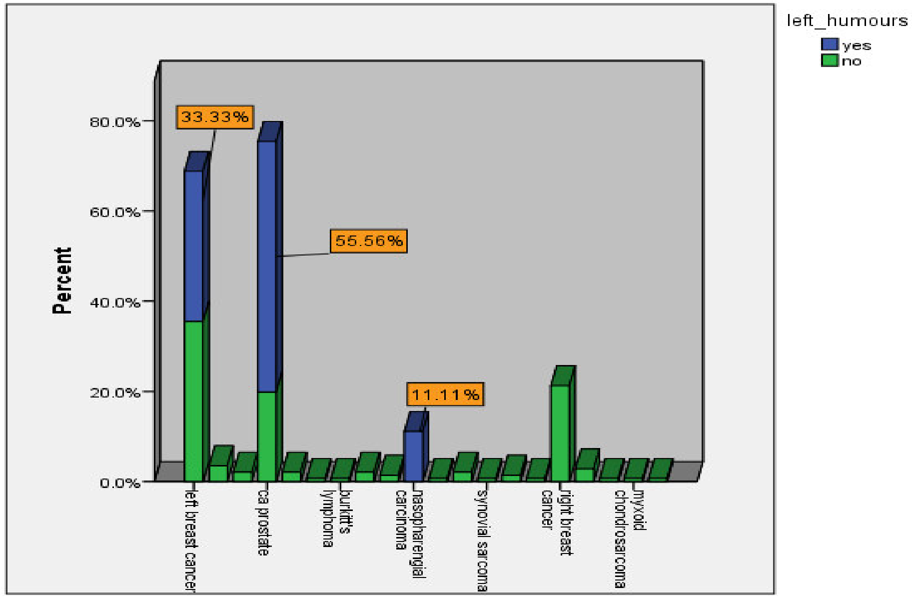


Fig 7: The left clavicle is involved in 21.7% of all bone metastases (50%) from left breast cancer and right breast cancer



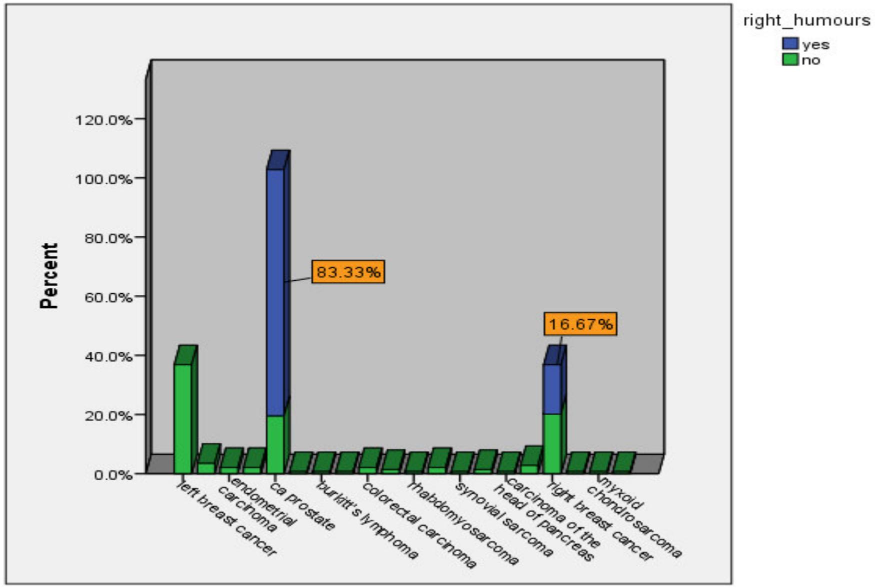


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Fig 8: The left humerus was involved in 55.56% of all bone metastasis (33.33%) from left breast cancer, and 11.11% came from nasopharyngeal carcinoma

Fig 9: The right humerus is involved in (10%) of all bone metastasis (83.33%) from prostate cancer and (16.67%) from right breast cancer

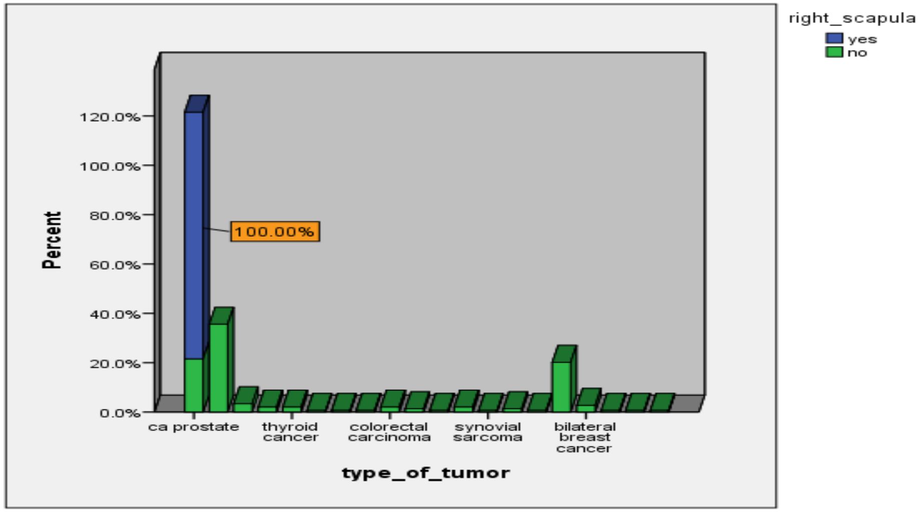


Fig 10: The right scapula is involved in (1.7%) of all bone metastasis (100%) from prostate cancer

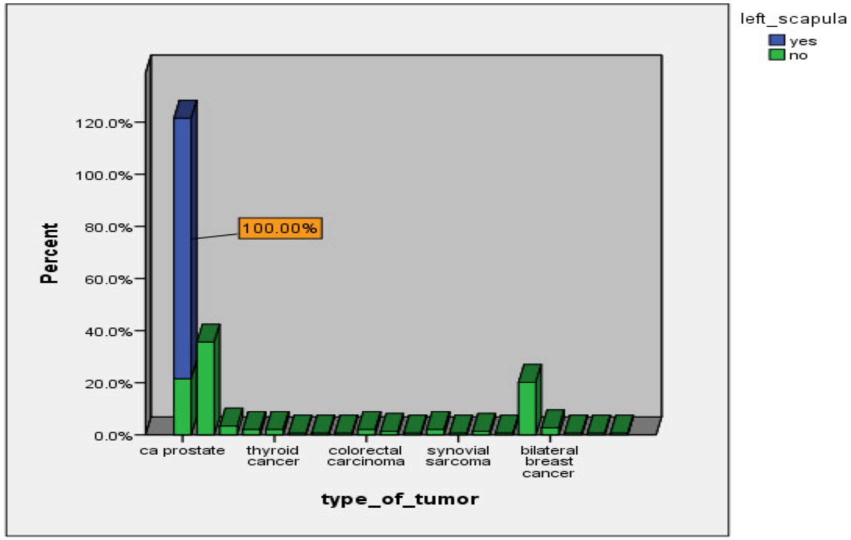


Fig 11: The right scapula is involved in (1.7%) of all bone metastasis (100%) from prostate cancer

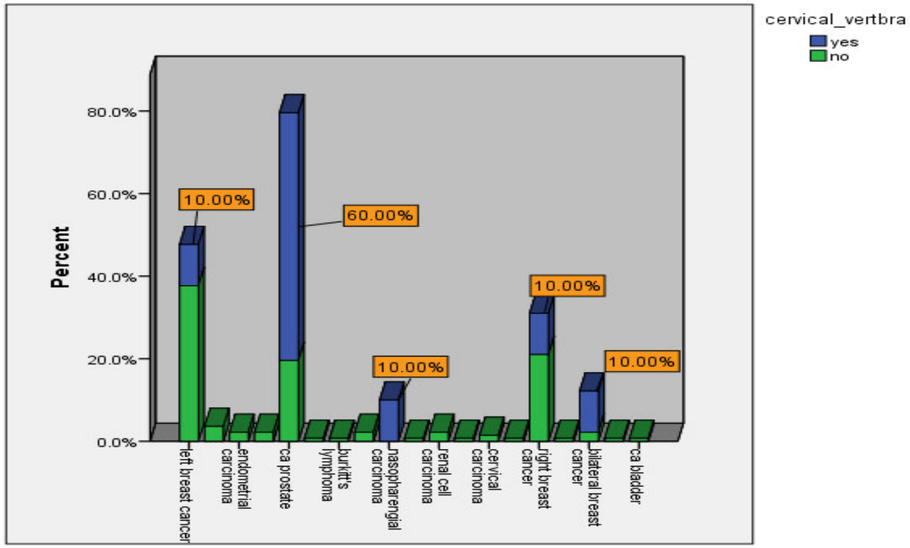


Fig12: The cervical vertebra is involved in 16.7% of all bone metastasis (60%) of patients from prostate cancer, (10%) from left breast cancer, (10%) from right breast cancer, (10%) from bilateral breast cancer, and .(10%) from nasopharyngeal carcinoma

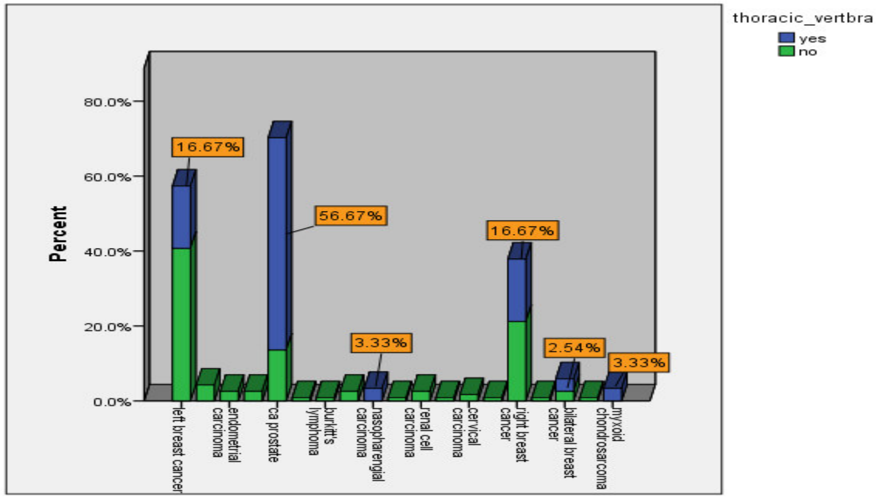


Fig 13: The thoracic vertebra is involved in (50%) of all bone metastasis (56.76%) from prostate cancer, (16.67%) from left breast cancer, (16.67%) from right breast cancer, (3.33%) nasopharyngeal carcinoma, (3.33%) from myxoid chondrosarcoma, and (2.54%) from bilateral breast cancer

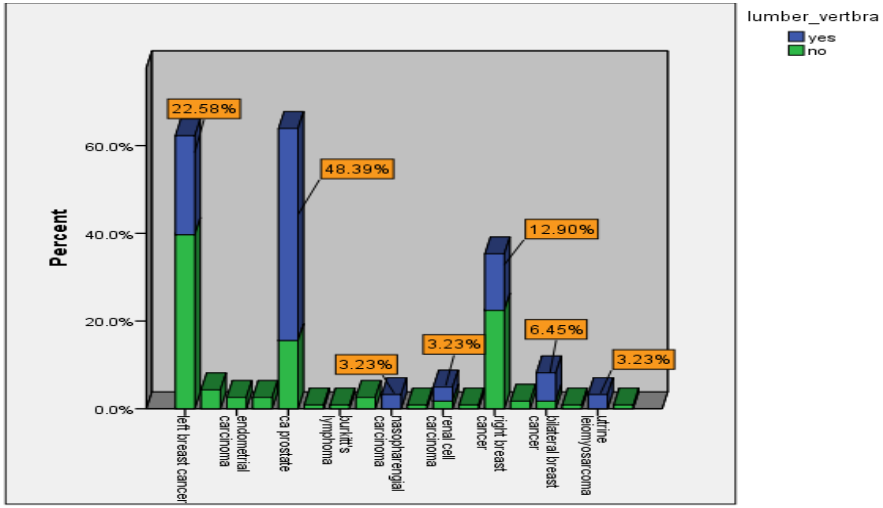


Fig 14: The lumber vertebra is involved in 51.7% of all bone metastases (48.39%) from prostate cancer, (22.58%) from left breast cancer, 12.90% from right breast cancer, 6.45% from bilateral breast cancer, 3.23% from renal cell carcinoma, 3.23% from nasopharyngeal carcinoma, and 3.23% from uterine leiomyosarcoma .

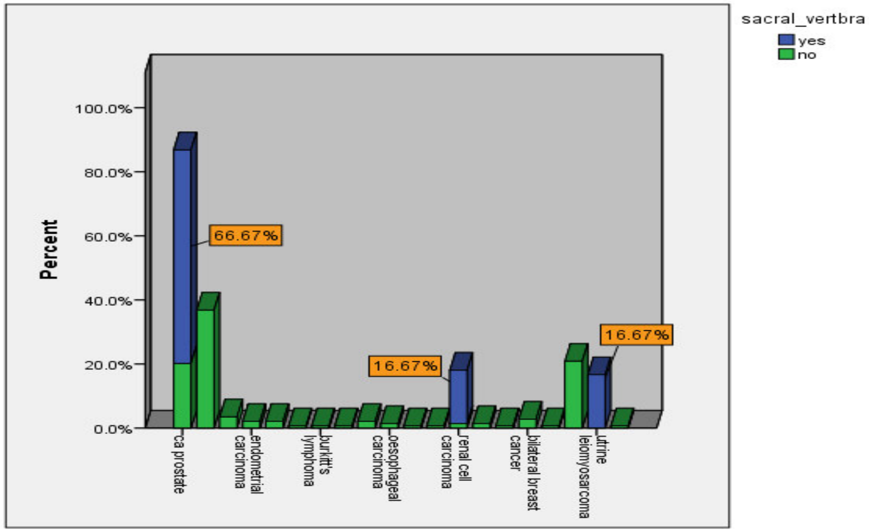


Fig15: The sacral vertebra is involved in 10% of all bone metastases (66.67%) from prostate cancer, 16.67% from renal cell carcinoma, and .16.67% from uterine leiomyosarcoma

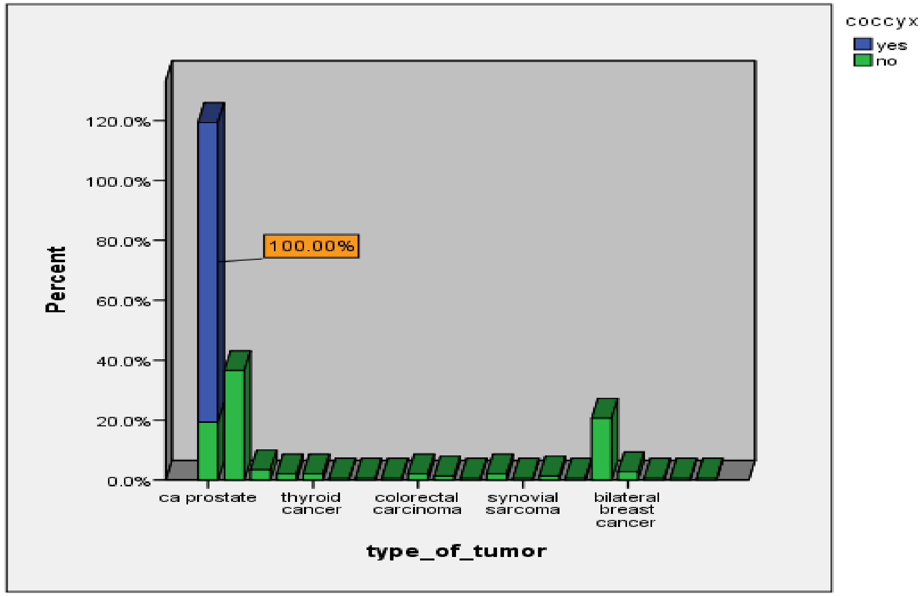


Fig 16: The coccyx is involved in 8.3% of all bone metastasis (100%) from prostate cancer .

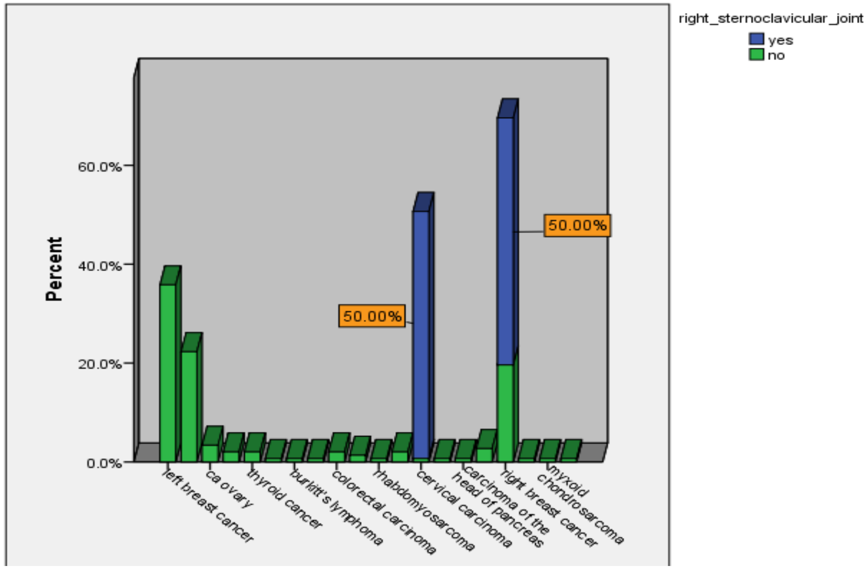


Fig 17: The right sternoclavicular joint is involved in (3.3%) of all bone metastases (50%) from cervical carcinoma and (50%) from right breast cancer

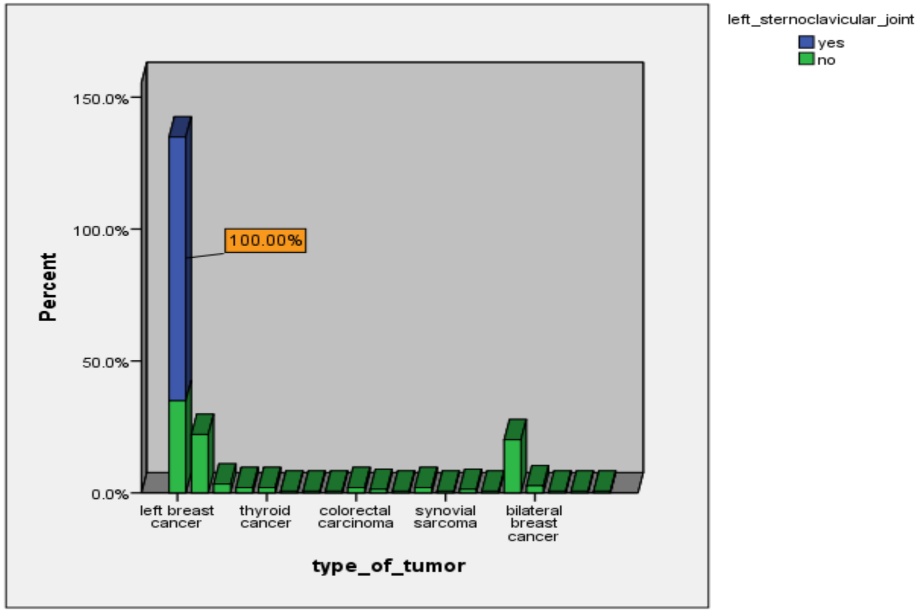


Fig 18: The left sternoclavicular joint is involved in (1.7%) of all bone metastases (100%) from left breast cancer

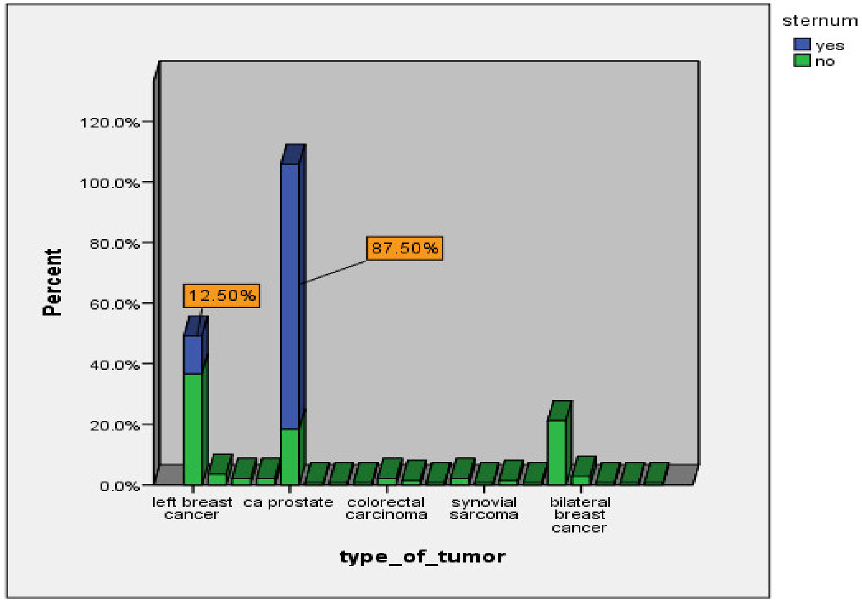


Fig 19: The sternum is involved in 13.3% of all bone metastases (87.5%) .from prostate cancer and 12.50% from left breast cancer

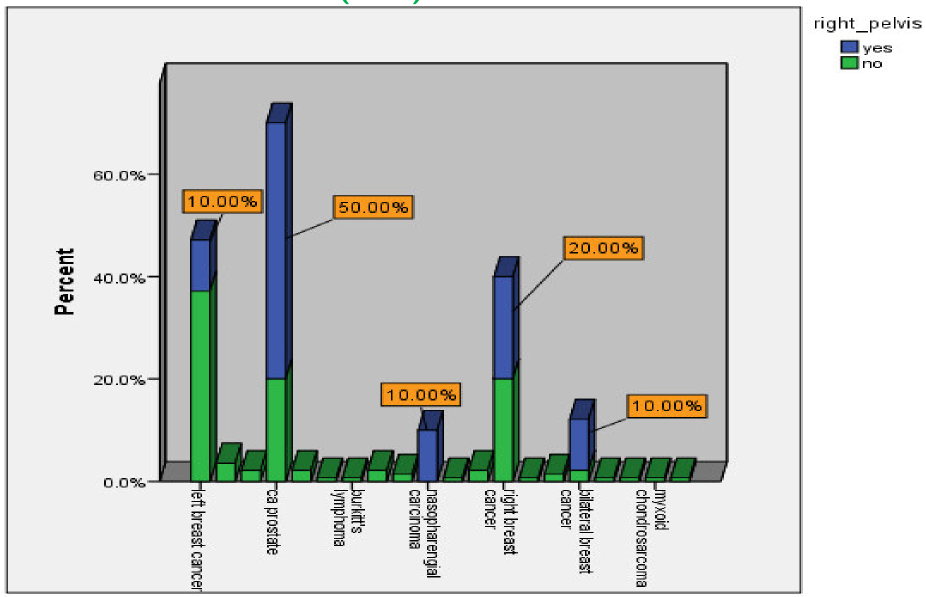


Fig 20: The right pelvis was involved in 16.7% of all bone metastasis (50%) from prostate cancer, (20%) came from right breast cancer, (10%) came from left breast cancer, (10%) from bilateral breast cancer, and (10%) from nasopharyngeal carcinoma.

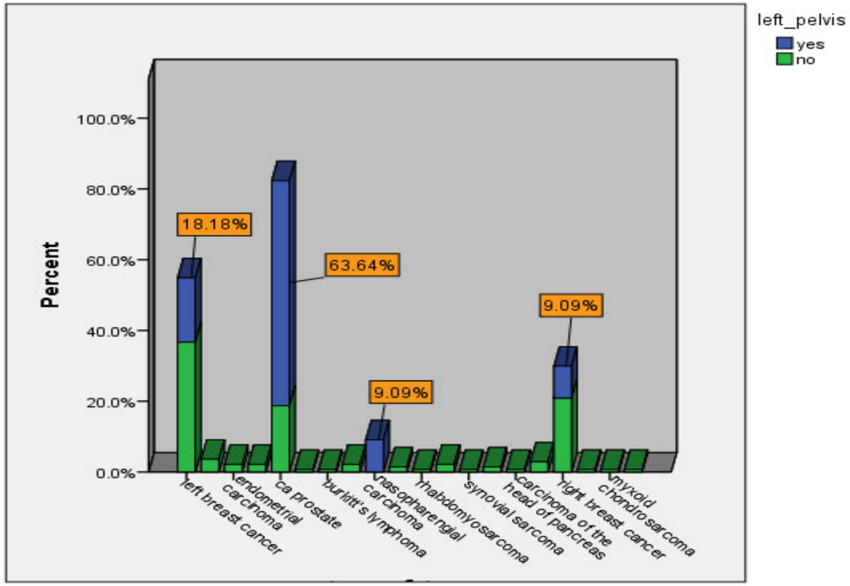


Fig 21: The left pelvis is involved in 18.3% of all bone metastasis (63.64%) from prostate cancer, 18.18% from left breast cancer, 9.09% from right breast cancer, and 9.09% from nasopharyngeal carcinoma .

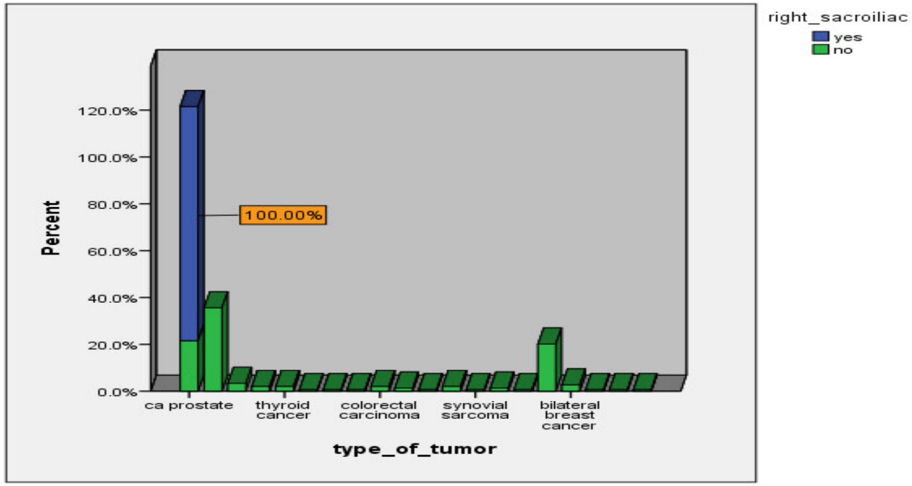


Fig 22: The right sacroiliac joint is involved in (1.7%) of all bone metastasis .(100%) from prostate cancer

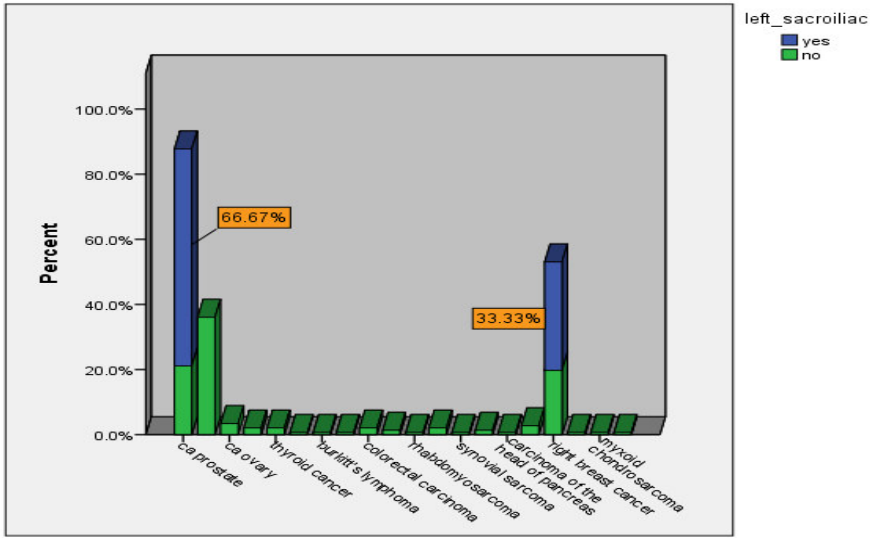


Fig 23: The left sacroiliac joint is involved in (5%) of all bone metastasis (66.67%) from prostate cancer and (33.33%) from right breast carcinoma

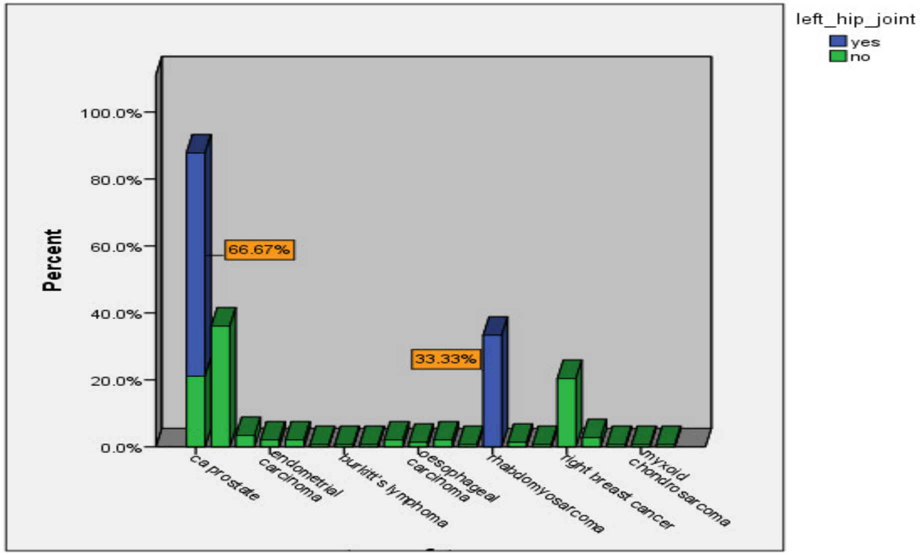


Fig 24: the left hip joint is involved in (5%) of all bone metastasis (66.67%) from prostate cancer and (33.33%) from rhabdomyosarcoma

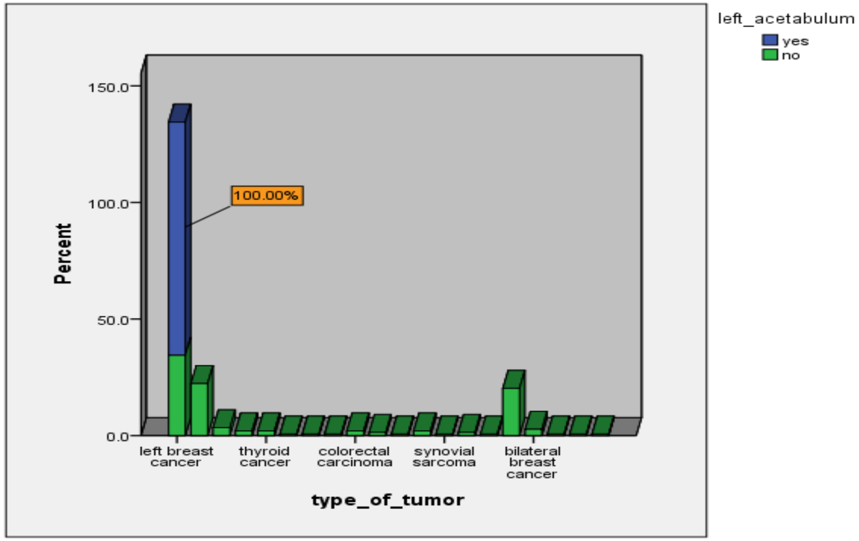


Fig 25: The left acetabulum is involved in (3.3%) of all bone metastasis (100%) from left breast cancer in both cases

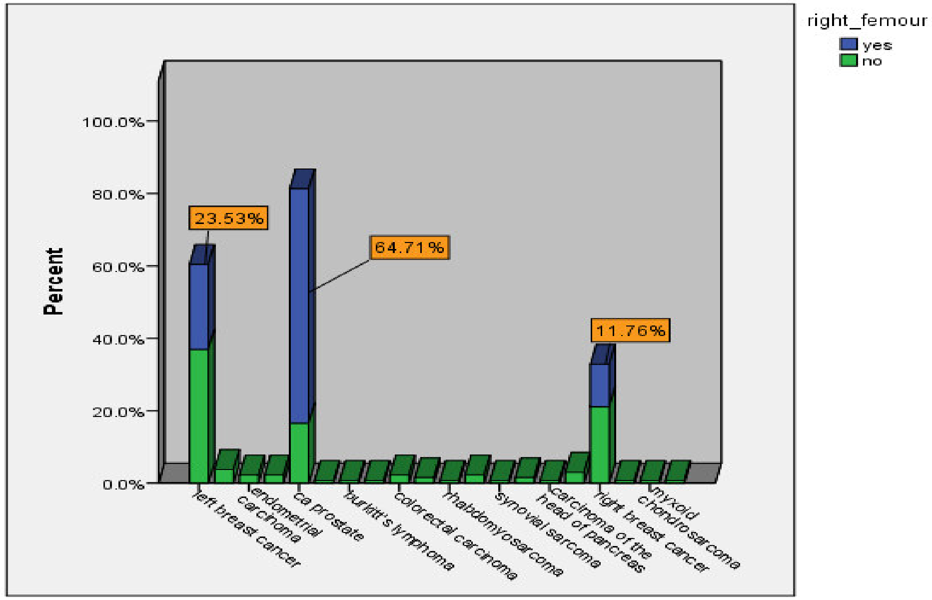


Fig 26: The right femur is involved in (28.3%) of all bone metastases (64.71%) of patient's metastases from prostate cancer, (23.53%) from left breast cancer, and (11.76%) from right breast cancer

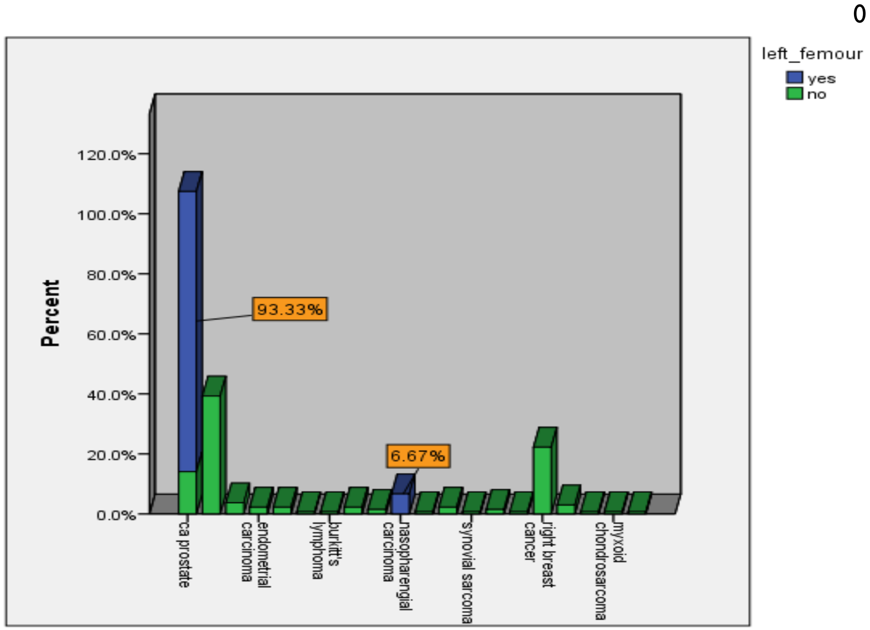


Fig 27: The left femur is involved in (25%) of all bone metastases (93.33%) of patients, the metastases from prostate cancer, and (6.67%) from nasopharyngeal carcinoma .

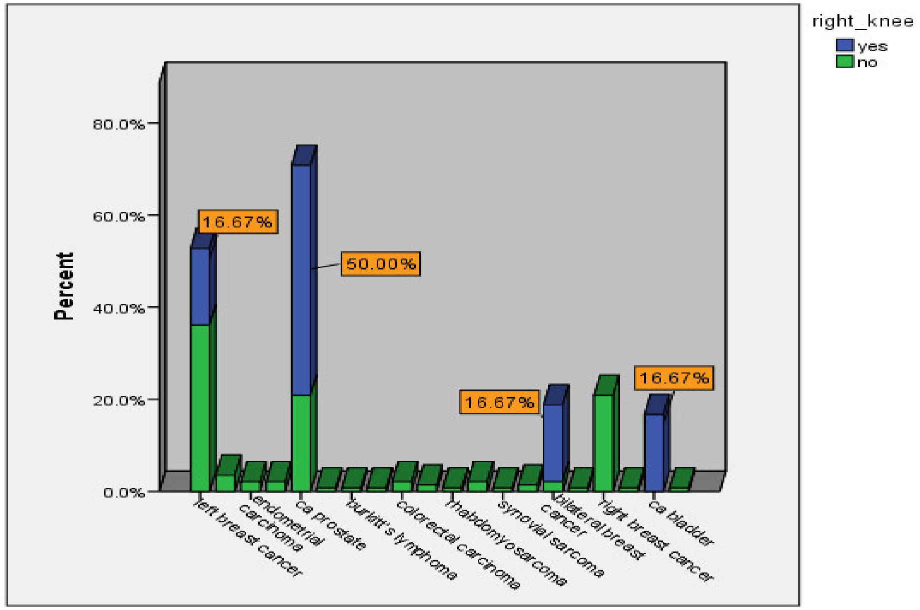


Fig 28: The right knee joint is involved in 10% of all bone metastases (50%) from prostate cancer, 16.67% from left breast cancer, 16.67% from bilateral breast cancer, and 16.67% from the bladder .

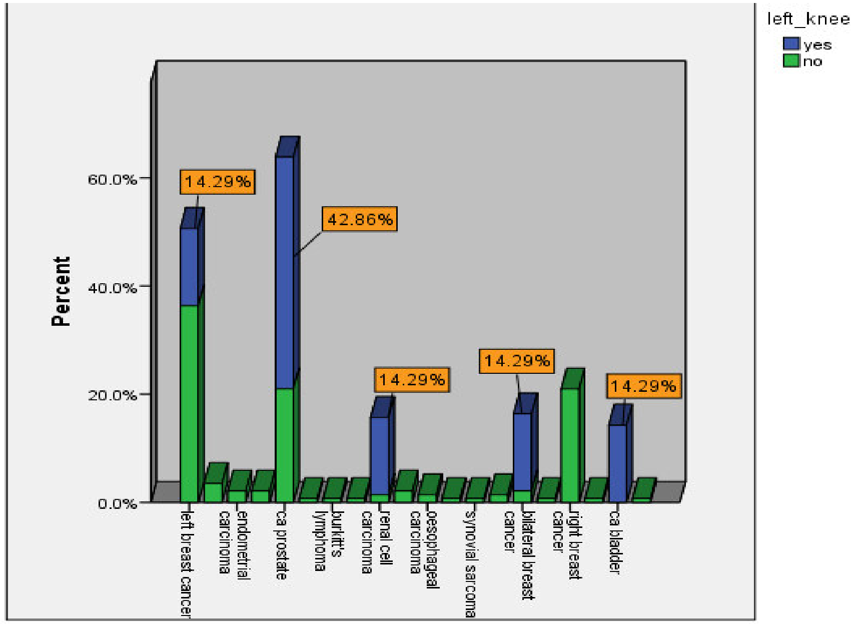
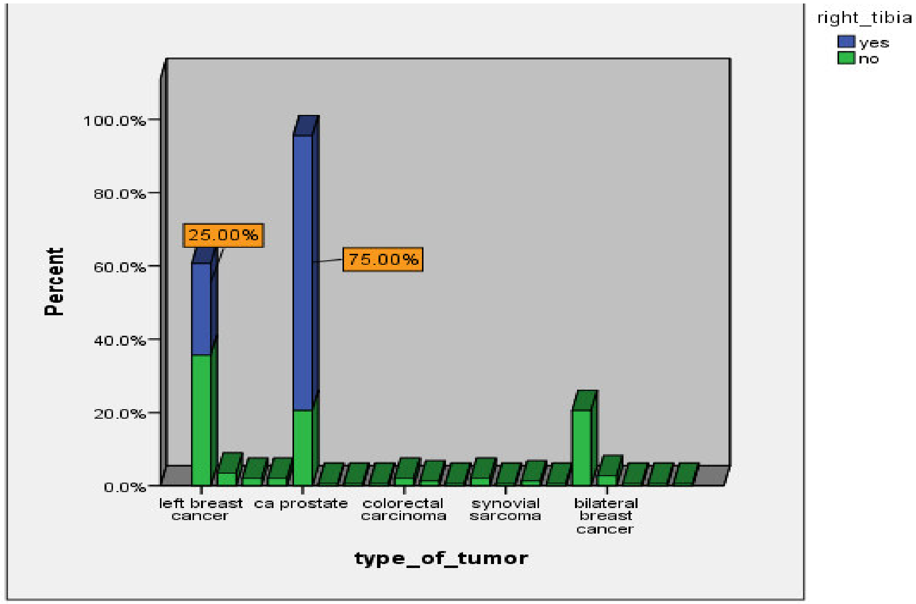
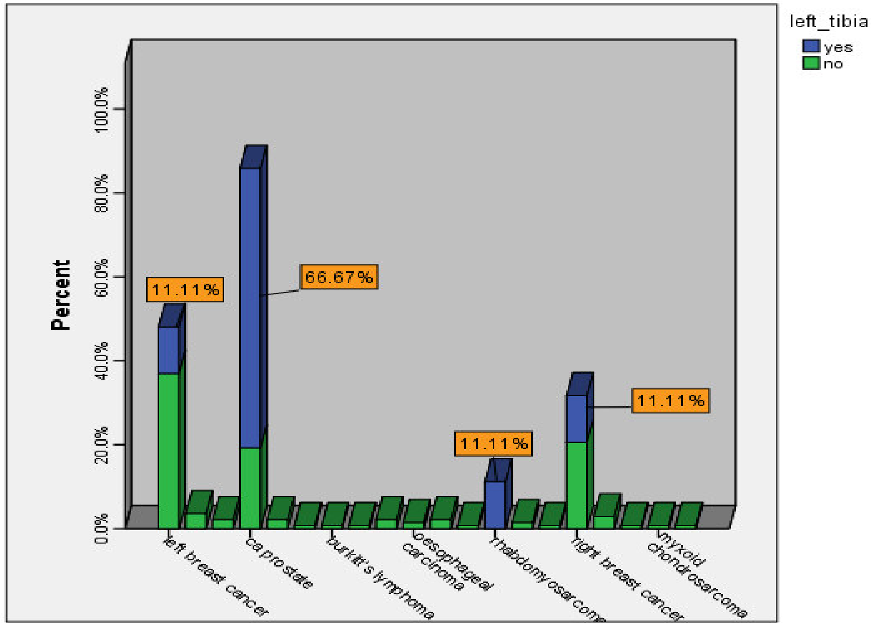


Fig 29: The left knee joint is involved in 11.7% of all bone metastases (42.86%) from prostate cancer, 14.29% from renal cell carcinoma, 14.29% from right breast cancer, 14.29% from bilateral breast cancer, .and 14.29% from urinary bladder cancer





ijtos 2025; doi 10.22376/ijtos.2025.3.1.21-39

Fig 30: The right tibia is involved in (6.7%) of all bone metastasis (75%) from prostate cancer and (25%) from left breast cancer .

Fig 31: The left tibia was involved in (15%) of all bone metastases (66.67%) from prostate cancer (11.11%) from left breast cancer, (11.11%) 87.5 from right breast cancer, and (11.11%) from rhabdomyosarcoma.

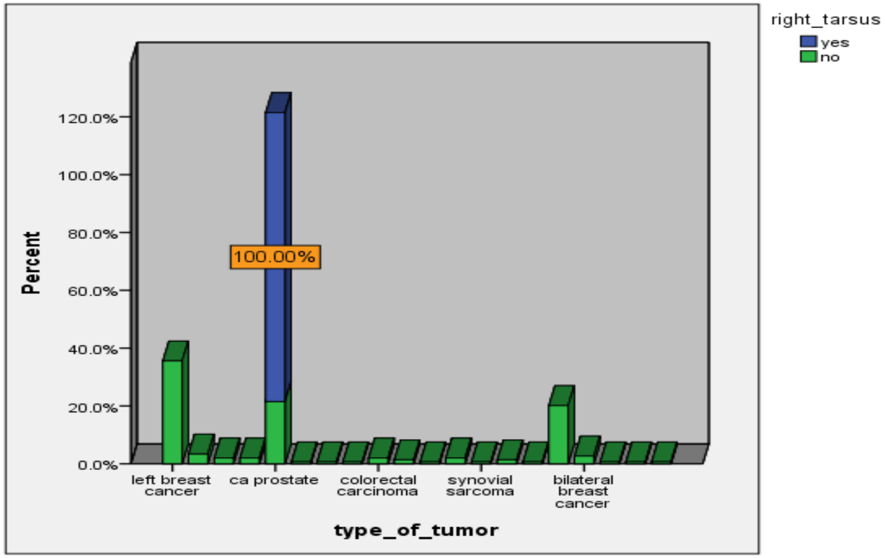


Fig 32: The right tarsus is involved in (1.7%) of all bone metastasis (100%) from prostate cancer .

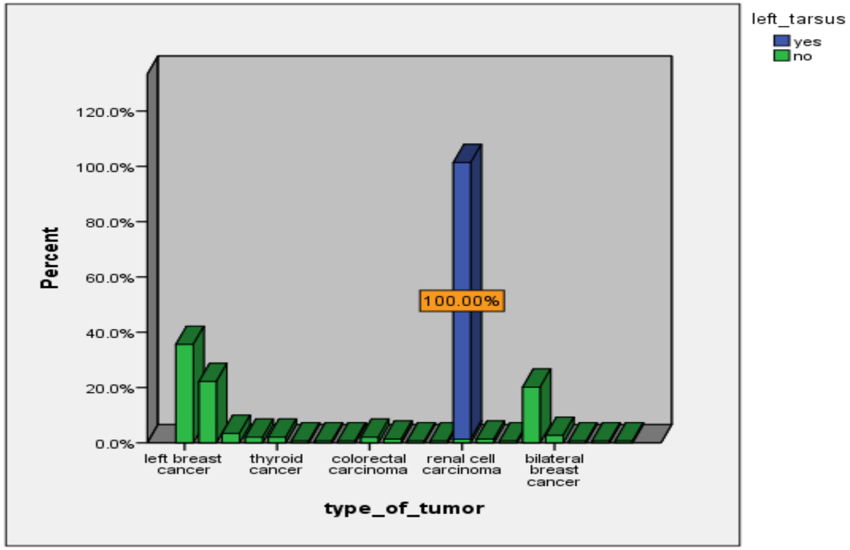


Fig 33: The left tarsus is involved in (1.7%) of all bone metastasis (100%) from renal cell carcinoma.

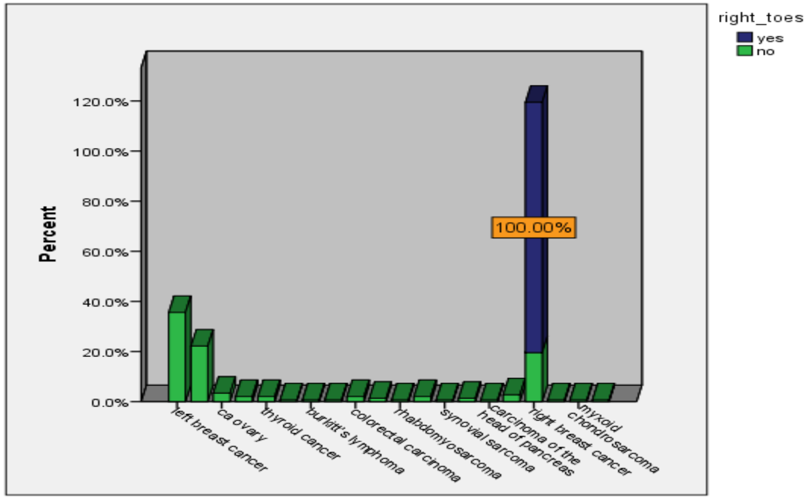


Fig 34: The right toes are involved in (1.7%) of all bone metastases (100%) from right breast carcinoma.

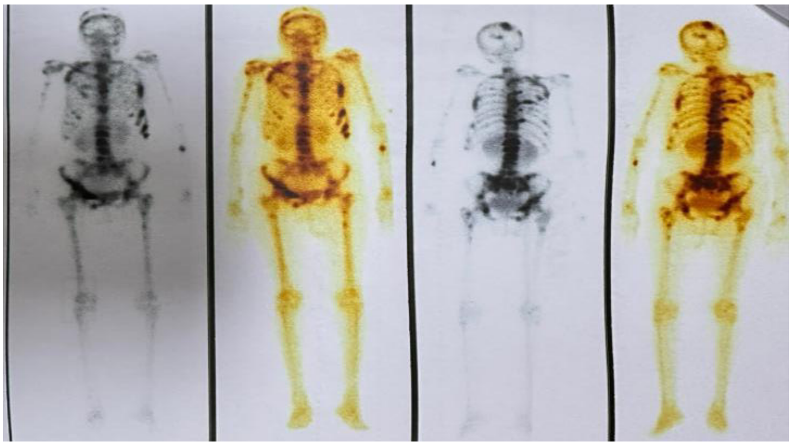


Fig 35: patient with Ca breast: Anterior and posterior views obtained 2 hours after 20 mCi of TC ^{99m}. MDP: Revealed multiples metastasis with active trace uptake is seen involving: skull, sternum, multiple bilateral ribs anteriorly and posteriorly, right humerus, right and left hemipelvis, both femori, and multilevel on vertebral columm.

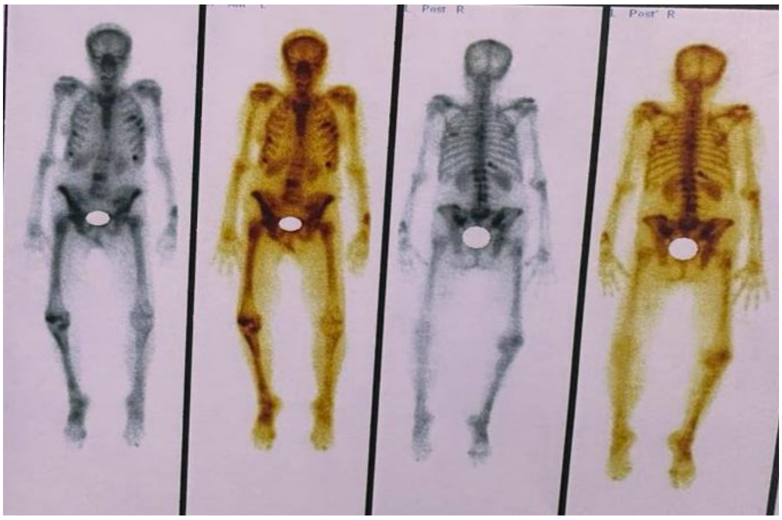


Fig 36: Patient with uterine leiomyosarcoma cancer. Anterior and posterior views obtained 2 hours after 20 mCi of TC ^{99m}. MDP Revealed multiples metastasis with active trace uptake is seen involving: multiple ribs, left iliac bone posteriorly, and multilevel on vertebral columm

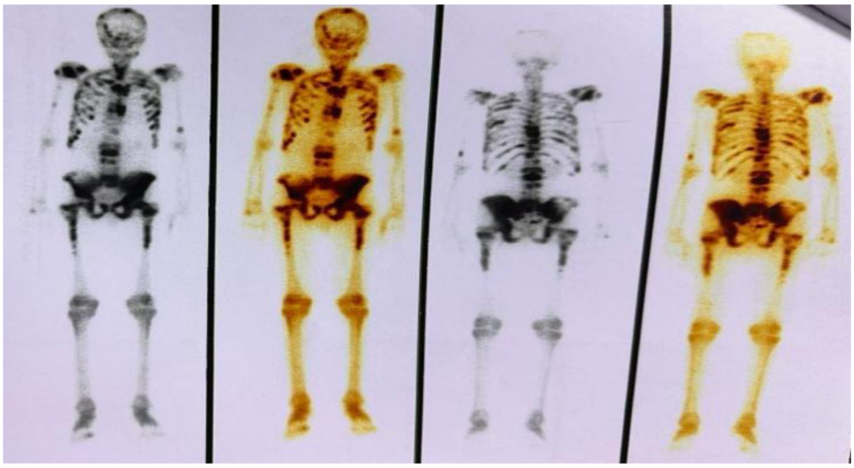


Fig 37: Patient with Ca prostate: Anterior and posterior views obtained 2 hours after 20 mCi of TC ^{99m}. MDP Revealed multiples metastasis with active trace uptake is seen involving: skull, sternum, multiple bilateral ribs anteriorly and posteriorly, both humeri, right and left hemipelvis, both femori, and multilevel on vertebral columm.

3. DISCUSSION

Bone metastases represent a frequent and significant manifestation of distant metastasis in malignancies, with a variety of primary cancers demonstrating a propensity to spread to bone tissue. In the present study, 53.3% of patients presented between the ages of 41 and 60, a demographic peak consistent with the broader clinical profile of metastatic bone disease. A higher incidence of bone metastases was observed in women (68.7%) compared to men (31.3%), aligning with findings from an international study by Vahid et al.[6], where 72.5% of patients were women and 27.5% were men, which has been attributed to the higher incidence of breast cancer in females. This gender disparity in bone metastasis is well-documented, as certain malignancies, particularly breast cancer, have a more frequent predilection for skeletal involvement. In terms of specific malignancies, the prevalence of breast cancer with bone metastasis in this cohort was 43.4%, followed by prostate cancer at 41.7%. This distribution mirrors the findings of Vahid et al. (2016), where breast cancer accounted for 69.1% of cases and prostate cancer for 59.4%. The high frequency of bone metastases in breast and prostate cancers is due in part to their hematogenous spread, which is influenced by the tumor's biology and vascular characteristics. For instance, breast cancer metastasizes predominantly through the venous system, utilizing the posterior intercostal veins and paravertebral venous plexus, facilitating its spread to the spine, ribs, pelvis, and femur. The study found that, among patients with breast cancer, 50.9% had left-sided breast cancer, 46.1% had right-sided breast cancer, and 3% had bilateral breast cancer. This finding, indicating a higher incidence of left-sided breast cancer, is consistent with studies such as that by Magid H. Amer [7], which also noted a higher incidence of left-sided breast cancer. This pattern may be related to anatomical and hormonal factors, although the exact mechanism remains an area of ongoing investigation. Regarding the distribution of bone metastases, lumbar lesions were the most common, representing 51.7% of cases, followed by thoracic lesions at 50%, and cervical lesions at 16.7%. These findings align with the results from Vahid et al., [6] who reported lumbar lesions in 39.6%, thoracic lesions in 34.4%, and cervical lesions in 5.1%. The preferential involvement of lumbar and thoracic vertebrae in metastasis can be attributed to the Batson venous plexus, a network of veins that provides a route for cancer cells to bypass the lungs and directly enter the vertebral column. This phenomenon is particularly relevant in prostate cancer, where the spread to the spine is early and subsequent metastases occur to other skeletal sites, including the ribs and femur. For prostate cancer, the pattern of metastasis observed in this study closely mirrored that of Vahid et al.[6] with the spine being the most common site, followed by the femur, ribs, and pelvis. This is consistent with the hypothesis that prostate cancer cells are early directed into the spine via the Batson venous plexus, before spreading to other parts of the skeleton. Similarly, the spread of breast cancer to the spine, ribs, and pelvis is well explained by the free communication between the posterior intercostal veins and the paravertebral venous plexus, facilitating these skeletal metastases. This study underscores the significant patterns of bone metastasis in breast and prostate cancers, highlighting the need for vigilant monitoring of skeletal involvement in these malignancies. The findings align closely with international studies, offering further evidence of the shared characteristics of metastatic spread in these common cancers. The Batson venous plexus plays a crucial role in this process, explaining the preferential metastasis to the spine and other skeletal sites in both breast and prostate cancer.

4. CONCLUSION

Bone is a common site of distant metastasis in malignancies, with a particular predilection for certain primary cancers, such as breast and prostate cancer. Studies show that the age range for bone metastases typically spans from 41 to 60 years, with a higher prevalence in women. Notably, breast cancer, particularly left-sided breast cancer, is more commonly associated with bony metastasis than right or bilateral breast cancer. In our study, 40% of patients with metastatic breast cancer presented with bony metastases, the most frequent of which was located in the spine. This finding aligns with existing literature, which identifies the spine as the primary site for bone metastases in breast cancer patients. Prostate cancer, which is another malignancy that frequently metastasizes to the bones, shares many of the same sites of metastasis. In addition to the spine, the femur, ribs, skull, shoulders, sternum, pelvis, tibia, humerus, knees, hip joints, scapula, sternoclavicular joints, and tarsus are commonly affected in prostate cancer patients. This pattern of metastasis is critical for clinicians to recognize, as it aids in the timely diagnosis and management of metastatic spread. To advance scientific research and improve cancer care in Sudan, it is essential to address the issue of patient data archiving, which remains a significant barrier. We urge the relevant authorities to prioritize the establishment of more nuclear medicine departments across the nation to facilitate early detection and monitoring of metastases. Furthermore, we recommend that the government implement strategies aimed at enhancing early detection and educating the public on cancer risks and available treatment options. A comprehensive evaluation of cancer patients upon their first visit, coupled with regular follow-ups, is vital to manage and potentially slow the progression of malignancies, thus improving patient outcomes and reducing the burden of cancer in Sudan.

5. AUTHORS' CONTRIBUTION STATEMENT

The idea and design of the study were contributed to by all authors. They took care of the material preparation and data collection. The analysis and final draft were finished by Taha Ali Mohammed Taha, Babekir Hassan Mohammed, and Abdalla Atta Abukleawa Mahmoud. The manuscript was written by Motwakil Imam Awadelkareim in its initial draft. Every author offered feedback on earlier drafts of the work. All authors have read and approved the final manuscript.

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8. CONFLICT OF INTEREST

Conflict of interest declared none.

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