

Evaluation of Diffusely High Skull Uptake in Breast and Prostate Cancer using Bone Scintigraphy

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Background: High skull uptake has a pivotal role in differentiation between normal and abnormal skeletal pathologies (cancer metastasis), is frequently seen in bone scan of some patients especially in females. The aim of this study was to evaluate a diffusely high skull uptake in breast and prostate cancer patients using bone Scintigraphy.

Material and Method: Descriptive, cross sectional study has been applied at Khartoum Oncology Hospital, for total of (100) adult patients of breast and prostate cancer with normal bone scans (39 male and 61 female), the patients were divided into 8 age groups (20-29, 30-39, 40-49, 50-59, 60-69, 70-79, 80-89, 90 and above). The data collected using master data collection sheet, image were processing for the calculation of Skull uptake. The data analyzed using statistical package for social sciences program.

Results: The skull uptake was significantly higher in female patients in the age groups 30-39 and above. While in males the upper age groups (60-69, 70 and above). Whereas 35 of female patients had higher uptake levels compare to 11 male patients. A Pearson correlation was run to determine the relationship between skull uptake and gender and it was strong a significant correlation between them as shown in P-value relation: ($r=.258$, $n=100$, $p<0.01$).

Conclusion: The study concluded that (hot skull), is not necessary an indicator of abnormal finding or pathological feature, especially in elderly women.

Key words: Bone scan; skull uptake; cancer; age; methylendiphosphonate.

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I. Introduction

Bone Scintigraphy is frequently performed to investigate many skeletal abnormalities (such as primary tumors and metastatic involvement of the skeleton, infections of the bone and soft tissue, fractures and other traumatic lesions of the skeleton, etc.) in daily nuclear medicine practice. Age-related changes shown by whole-body bone Scintigraphy with ^{99m}Tc -labeled phosphonates are well known, such as in growth plates, the sternum, and increased uptake diffusely in the skulls of postmenopausal women (Kakhki and Zakavi 2006)(Kigami, Yamamoto et al. 1996). A diffuse increased uptake in the calvarium (a "hot skull") was first attributed to extensive cytotoxic treatment in patients with breast cancer, but studies that are more recent have shown this to be specific neither to breast cancer nor cytotoxic treatment (Kigami, Yamamoto et al. 1996).

The first National Population-based Cancer Registry (NCR) in Sudan found that the most commonly diagnosed cancer among women was breast followed by leukemia, cervix, and ovary, and among men it was prostate cancer followed by leukemia, lymphoma, oral, colorectal, and liver (Intisar E, et al. 2014).

Radioisotope skull images of patients with benign and malignant neoplastic processes, trauma, Paget's disease and drug related increased tracer uptake. The rationale for using phosphonate compounds for bone scanning lies in the composition of the bone matrix containing calcium phosphate that can be exchanged with phosphonate compounds. Two compounds, ^{99m}Tc -MDP and ^{99m}Tc -HDP, are commercially available for bone imaging, of which ^{99m}Tc -MDP. Approximately 10–20 mCi (370–740 MBq) ^{99m}Tc -MDP or ^{99m}Tc -HDP is injected intravenously and scanning is performed with the patient supine 2–3 h after injection (SahaGB, et al. 2006).

When reporting bone scans, it is important to distinguish between normal appearances and abnormal skeletal pathologies; (cancer metastases), involving the skull. The limitations of whole body scan reports at nuclear medicine departments in Khartoum state come because it depends on subjective reporting only, whereas in these cases the metastases occurred at a very sensitive part of human body and it's hard to distinguish for the most of the cases. This study aimed to evaluate diffusely high skull uptake in Breast and Prostate Cancer using Bone Scintigraphy.

II. Materials and Methods

Materials: Medical Imaging System (Mediso) was used for imaging. The manufacturer is Mediso Ltd.H-1022. The unit of processing used was Nucline (SN=ME0064914). 100-250V/50-60HZ. Made in Hungary.

Whole-body scanning is performed by moving the detector from head to toe of the patient using either a single-head or dual-head camera equipped with a low-energy all-purpose parallel hole collimator (N-GK310000-0003V).



Figure 1: SPECT camera used in this thesis

Procedure: All patients underwent whole-body bone scan 2:30- 3 hours after intravenous injection of (phosphonomethyl) phosphonic acid-[99m Tc] technetium ([99mTc]-MDP) .scanning is performed with the patient supine using knee support for patient comfort. Regions of interest (ROIs) were drawn on the anterior and posterior views of both skull and the average counts of each ROI were recorded.



Figure 2: Example of ROI (Region of Interest) drawing on skull.

Methods:The study was a descriptive cross section study conducted at Radiation and Isotope Center of Khartoum, in period from March 2019 until August 2019.The population of this study was data set (normal static bone Images), with patient of breast and prostate cancer. The study included both gender with age ranged from 20 years to 100years old.

This study was excluding all metastatic skull patients less than 20 years old and patients whose above 100 years old in addition to all patients with dynamic bone Scintigraphy.Patients divided to 8 age groups: 20-29,30-39,40-49,50-59,60-69,70-79,80-89, 91 and above.

Ethical Consideration:A permission letter from the head of the nuclear medicine departments of radiation and Isotope Center of Khartoum was taken for the collection of the data. Patients' permission was taken before conducting the study and patients' names was anonymous

III. Results

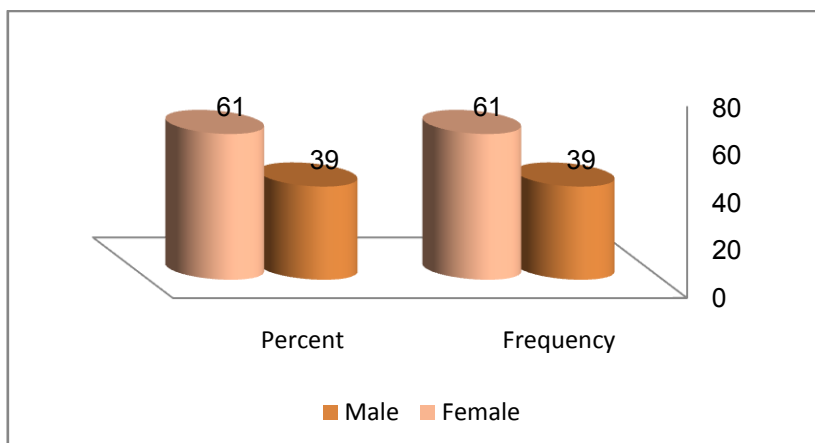


Figure 3: Showed the frequency distribution according to gender.

Table 1: showed cross tabulation of gender and age groups.

Gender*Age groups crosstabulation										
Skull uptake	Age groups	<30Y	<40Y	<50Y	<60Y	<70Y	<80Y	<90Y	Total	
Normal	Gender	Male	1	0	2	4	9	8	4	28
		Female	0	5	8	11	1	1	0	26
High	Gender	Male	1	0	0	3	4	3	0	11
		Female	2	7	9	8	7	2	0	35

Table 2: showed the correlations between skull uptake and gender.

Correlations			
		Skull uptake	Gender
Skull uptake	Pearson Correlation	1	.285**
		Sig. (2-tailed)	0.004
		N	100
Gender	Pearson Correlation	.285**	1
		Sig. (2-tailed)	0.004
		N	100

** Correlation is significant at the 0.01 level (2-tailed).

Table 3: showed the frequency of skull uptake according to the disease.

Skull uptake	Valid	Disease	Frequency	Percent%
Normal	Valid	Ca breast	26	48.1
		Ca prostate	28	51.9
		Total	54	100
High	Valid	Ca breast	35	76.1
		Ca prostate	11	23.9
		Total	46	100

A total of 100 patients of Breast and Prostate cancer were conducted in this study; 39 male, while 61 female patients (figure.3). (Table .1) represents the relationship between the skull uptake, gender and age groups among the study population. The skull uptake was significantly higher in female patients in the age groups 30-39 and above. While in males the upper age groups (60-69, 70 and above) had significantly higher uptake than

the lower age group. According to (Table .2) it showed a Pearson correlation was run to determine the relationship between skull uptake and gender and was result in strong a significant correlation between them as shown in P-value relation: (($r=.258$, $n=100$, $p<0.01$)). The skull uptake according to disease had been showed on (Table .3) 26 Ca-breast patients had normal uptake, while 28 Ca-prostate patients had normal uptake. Also it showed that 35 Ca breast patients had high skull uptake, while 11 Ca prostate had high skull uptake.

IV. Discussion

(Table 1) represents the crosstabulation between the skull uptake, gender and age groups among the study population which agreed with (SadeghiR, et. Al .2008) which reported "Hot skull, or diffuse, increased activity of bone seeking radiotracers, is frequently seen in the bone scans of some patients, especially elderly women". This finding has been attributed to enhanced bone metabolism in old age. Their data showed that "hot skull" is not necessarily an abnormal finding, especially in elderly women. (Table 2) showed a Pearson correlation was run to determine the relationship between skull uptake and gender which agreed with (Susematsu ,et al. 1992) which reported that the sex dependent difference in skull uptake began to develop in different age groups (p less than 0.001). The skull uptake according to disease had been showed on (Table .3) agreed with (RoosJC, et al.1987) results which asserted that in women, the hot skull is clearly related to malignancy and to lesser extent to breast carcinoma.

V. Conclusion

The study concluded that (hot skull), is not necessary an indicator of abnormal finding or pathological feature, especially in elderly women. There is significant correlation between age and skull uptake. In women, the hot skull is clearly related to malignancy and to lesser extent to breast carcinoma. However, another remarkable feature of the hot skull is its predominance in women in general (compared to men) and, therefore, the data suggest that the hot skull can also represent a normal variant of female skull.

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