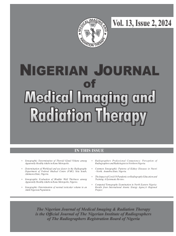
Nigerian Journal of Medical Imaging and Radiation Therapy



ASSESSMENT OF MEAN GLANDULAR DOSE AND ANTHROPOTECHNICAL PARAMETERS IN SOUTH-WEST NIGERIA.

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ABSTRACT

Background: Owing to the increase in the incidence of breast cancer worldwide. It is imperative for women to undergo screening mammography to reduce cases of mortality.
Mammography is the X-ray examination of the breast tissue and it is helpful in early detection and characterization of breast diseases.
Objective: To assess the factors affecting mean glandular dose and in turn dose reference level of mammography in south west Nigeria.
Materials and Methods: The study involve one hundred and fifty women from four major health institutions in South-West Nigeria. The entrance surface dose was measured with the use of thermoluminescent dosimeter chips which were calibrated at the centre for Energy Research Training, Zaria. The following parameters were recorded. Age, kVp, mAs, Anode-filter combination and weight. The mean glandular dose was calculated using the entrance surface dose and conversion factor published by Dance.
Results: The results show a mean glandular dose of 1.25mGy for CC and 1.41mGy for MLO. A correlation of (r=0.325) was gotten between CBT and MGD. There was no correlation between kVp and MGD with r = 0.000. There was a weak positive correlation between mAs (r=0.145), Weight(r=0.301) and Mean Glandular Dose.
Conclusion: A dose reference level of 0.85mGy is proposed for South West Nigeria, CBT and mAs could affect mean glandular dose. There is need for optimization of doses from one center to another due to the variations in doses.
Keywords: Cranio-caudal; Compressed breast thickness, Kilovoltage peak, Medio-lateral Oblique; Mean glandular dose.

INTRODUCTION

Breast cancer is the most common cancer is women worldwide and the second most common cancer overall. It is the leading cause of cancer death in less developed countries. [1]. In Nigeria, breast cancer is the commonest female cancer and the majority of breast cancer occurs in pre-menopausal women with the peak age of the 5th decade. [2] Mammography is the process of using low energy X-ray usually between (25-40kvp) to examine the human breast. [3]

Developing countries experiencing a sharp rise in breast cancer cases. [5-6] It has been well documented that the benefits of screening mammography outweigh the risks of radiation-induced breast cancer. [7]. However, participants in mammography screening program are repeatedly exposed to ionizing radiation therefore mammography is associated with an increased risk of radiation induced breast cancer. [18]. The goal of mammography is the detection, characterization and evaluation of findings suggestive of breast cancer and other breast disease. [9]

Because of the wide variations in exposure array facilities for similar X-ray investigations/procedures the International Commission on Radiological Protection (ICRP) in 1996 introduced the diagnostic reference levels as a quality tool for dose optimization. The ICRP defined DRL as an investigation level applied to an easily measured quantity usually the absorbed dose in air or in a tissue equivalent material at the surface of a standard phantom or representative patient. [10]

In a study carried out in the North-Eastern Nigeria to evaluate the relationship between MGD and anthropotechnical factors. 60 women were recruited from two teaching hospitals. The total MGD was 0.31 and 0.69 for CC and MLO respectively. There was statistical significance between MGD and CBT, Weight and BMI. There was no statistical significance between MGD, mAS and kVp. [11]

Seeing the vital role played by screening mammography in reducing cases of breast cancer, it is therefore pertinent to assess the various anthropotechnical factors that affects the dose delivered during the examination to help in image optimization. MGD is the recommended metric used by many authorities such as ICRP, United States National Council on Radiation Protection and

Measurements, the British Institute of Physics and Engineering in Medicine, the European. Council of Protocol and International Atomic Energy Agency (IAEA).[10-11]

Direct measurement of MGD is impossible but can be assessed with certain standard assumptions that depend on breast characteristics and X-ray Spectra.[10]

Many countries have established DRLs for mammography examination. In Nigeria, DRLs for mammography has been established in the North-East and North-West. It is therefore imperative to establish DRLs for mammography examination in South-Western Nigeria.

MATERIALS AND METHODS.

This is a prospective cross-sectional study carried out in four radiology departments located in South-Western part of Nigeria. Two teaching hospitals, one Federal Medical Centre and a renowned Private Centre.

The data was collected from February 2023 to October 2024. The centers were chosen because they met eligibility criteria for the study having all of them licensed by the Nigerian Nuclear Regulatory Authority. The four centers are referred to as Centre 1,2,3 and 4.

MACHINE SPECIFICATION

Mammography machine for center 1 was manufactured by Metatronica with an automatic exposure control and Rh/Ag anode filter.

Center 2 is a General Electric machine manufactured in France with Mo/Mo, Mo/Rh and Rh/Ag anode filter. Year of manufacture is May 2022.

The machine in center 3 is made by Philips and manufactured in 2010 in Germany with Mo/Mo, Mo/Rh, and W/Rh anode/filter.

Center 4 is made by siemens with Mo/Mo, Mo/Rh, W/Rh anode filter, manufactured in 2004 in Germany

ETHICAL CLEARANCE

In line with Helskinki's declaration (1964) ethical approval has obtained from the Research ethical committee of College of Medicine, University of Lagos, University of Ibadan/University College Hospital and that of Federal Medical Center Owo. Informed consent translated in Yoruba which is the predominant language in the region was filled by each Volunteer/Patient/Participant in compliance with the human research ethics guidelines for patients who do not understand English Language. The first Author/Researcher also underwent web training under the requirement set by center for Bioethics and Research (CBR) in Nigeria.

Dose Determination for mammography

To get the value of the entrance surface dose from the TLD chips that was used to calculate the MGD the value from the control chip was subtracted from the value from the actual TLD chip.

The MGD was calculated using the formula

MGD = K x G x C x S where K = Entrance Surface Dose

G= ESD to MGD conversion factor on the assumption that the entire breast has a glandularity of 50%

C= Conversion factor for difference in breast composition other than 50% glandularity

S= Conversion factor for different X-ray spectrum which can be due to different anode/filter combination for example Mo/Mo, Mo/Rh.

DATA ANALYSIS

Statistical package for social sciences (SPSS) version 25 was used to analyze the mean and standard deviation of the entrance surface dose and technical parameters radiation doses. Using pearson's correlation the relationship between kVp, mAS, CBT and Mean Glandular Dose was determined.

RESULT

TABLE 1: Age/State distribution of women

	Number of Women.	Minimum	Maximum	Mean	Std Deviation
Age	150	40	87	52.56	9.38
State	Lagos	Oyo	Ogun	Ondo	
Number	45	45	30	30	

Table 2: The frequency distribution of CBT, kVp, mAs, ESD and MGD.

	Minimum	Maximum	Mean	Std.Deviation
CBT	20.0	105.0	67.01	22.97
kVp	23	34	29.01	2.69

mAs	21	79	31.29	8.57
ESD (mGy)	0.13	80.60	6.54	12.65
Calculated MGD (mGy)	0.02	21.0	1.82	3062

CBT-Compressed Breast Thickness, kVp-Kilovoltage peak, mAs millampere/sec, ESD-Entrance Surface Dose, MGD-Mean glandular Dose.

Table 3 -Frequency distribution of dose reference level for mammography according to anode filter combination (Rh/Ag and Mo/Rh) in south west Nigeria.

	CENTRE 1	CENTRE 2	CENTRE 3	CENTRE 4	ALL	Rh/Ag	Mo/Rh
Mean	5.033	0.93	0.17	0.21	1.82	3.47	0.20
Median	4.50	0.40	0.13	0.11	0.22	0.85	0.12
Std Deviation	5.16	1.27	0.14	0.26	3.62	4.59	0.23

Rh-Rhodium, Ag-Silver, Mo-Molydeneum.

Table 4: Correlation between kVp, mAs and MGD.

CORRELATIONS		KVP	MAS
CALCULATED MGD (MGY)	Pearson Correlation	0.368**	0.100
	Sig. (2-tailed)	.000	.145
	N	181	213

Table 5- Correlation between Weight and MGD.

CORRELATIONS		WEIGHT(KG)
CALCULATED MGD	Pearson Correlation	.158
	Sig. (2-tailed)	.301
	N	45

DISCUSSION

This study determined the relationship between weight and technical factors (kVp,mAs) used in mammography in South-West Nigeria.

The compressed breast thickness in this study was 67±2mm with average of 20-105mm, this value is different from the one carried out by in Lagos, Nigeria[12] which had a value of 50mm, the difference in CBT could be due to the broad range of CBT in our study, this is also different from a work carried out by in Morocco where the CBT was 55mm for 147 women the difference could be due to the glandularity of the breast and differences in the compression force applied by the radiographer during compression before exposure[12]. However, the range of 20-105mm gotten in this study is similar to the value gotten in a study conducted in Switzerland where data was obtained from 31 Centres and 6 manufacturers, the CBT range was 20-110mm[13].

The mean Entrance Surface Dose(6.54mGy) and Mean Glandular Dose(1.42mGy) gotten from this study is similar to a finding were gotten from a study were ESD of 7.704mGy and MGD was 1. 43mGy[22].Mean Glandular Dose for CC is 1.25mGy and MLO-1.41mGy in this study this is similar finding with a study carried out in north east Nigeria[23]

There was a weak positive correlation between CBT and MGD (with r=0.325, p=0.05). This is a similar finding with a study conducted in Nigeria where a weak correlation was also gotten between CBT and MGD[11,14]. However, this is different from the findings in North Eastern Nigeria where no correlation was gotten between CBT and MGD[16]. This difference could be due to the small size of 60 patients that was recruited in their study. In another study carried out, it was discovered that a strong positive correlation exists between CBT and MGD, this could be due to the division of the women in their study into 3 different age groups which means each age group would have women of similar glandularity and hence similar value of compressed breast thickness[15].

This study found a weak positive correlation (r=0.301, p=0.05) between weight and mean glandular dose. This disagrees with a work carried out in North Eastern Nigeria to evaluate radiation dose in mammography with anthropotechnical parameters, it found no correlation between weight and mean glandular dose[16]. However, in another study, there was a negative correlation between weight and mean glandular dose, this could be due to the conventional mammography used in their study[21].

This study got a Dose Reference Level of 0.85mGy for Rhodium/Silver anode filter and 0.12mGy for Mo/Rh. This disagrees with a study where W/Ag anode filter combination achieved significant low dose when compared to Mo/Rh. This could be as a result of manufacturers' differences[20].

This study reported a weak correlation (r=0.145, p=0.05) between mAs and MGD. This is similar to work carried out to evaluate the factors affecting MGD mammography in Dubai. [17-19], where r=0.282 for MLO and r=0.209 for CC was obtained.

This study agrees with a work carried out to evaluate mammography screening, where a moderate correlation was gotten for kVp and a strong correlation of r=0.879 for mAs.

CONCLUSION

This study establishes a proposed dose reference level of 0.85 mGy for mammography in South-West Nigeria. The findings highlight that compressed breast thickness (CBT) and mAs are significant factors influencing mean glandular dose, while kVp shows no correlation. Given the observed variations in radiation doses across different centers, there is a clear need for dose optimization and standardization to ensure patient safety and improve the quality of breast cancer screening programs in the region.

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