

Relationship of the Mean Glandular Dose with Compressed Breast Thickness in Digital Mammography

Khadka S¹, Jha A¹, Chaudhary RK², Shrestha SL¹

¹Department of Radiology, TU Teaching Hospital, Maharajgunj, Kathmandu, Nepal

²Department of Radiology, University of Texas Medical Branch, Galveston, Texas, USA

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ABSTRACT

Introduction: Mammography is one of the most commonly performed radiological investigations for evaluation of breast cancer. As it involves ionizing radiation, there remains a risk of radiation induced cancer. In this study, we evaluated compressed breast thickness (CBT) and mean glandular dose (MGD) during routine mammography.

Methods: This prospective study was performed in the Department of Radiology and Imaging of TUTH. Data of 500 consecutive patients who underwent mammography over a period of 4 months (June 2018 to September 2018) was collected. The age, CBT and MGD were recorded. Pearson correlation and paired-t tests were performed.

Results: Most of the patients belonged to 41-50 years age group. MGD was significantly higher in patients with increased CBT. The CBT and MGD was higher in MLO view compared to CC views. The mean value of total MGD for four views was 5.1 ± 1.4 mGy. There was significant positive correlation ($r = 0.517$) between CBT and MGD with increase in MGD with increase in CBT.

Conclusions: The MGD and dose equivalent in our routine mammography is within the recommended limits. MGD increases with increasing CBT and vice-versa. Hence, decreasing the thickness of compressed breast, can decrease the amount of radiation absorbed by the glandular tissue of the breast.

Key words: Compressed Breast Thickness, Mammogram, Mean Glandular Dose

Correspondence to: Dr. Anamika Jha, MD
Department of Radiology
TU Teaching Hospital, Maharajgunj
Kathmandu, Nepal
Email: dranamikakasyap@gmail.com

INTRODUCTION

Mammography remains an important screening and diagnostic tool for evaluation of breast lesions and is often the first investigation of choice for evaluation of breast cancers.^{1,2} Current guidelines from the U.S. Preventive Services Task Force recommends screening mammography once in two years for women aged 50-74 years.³ On the contrary,



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the American Medical Association and the American College of Radiology (ACR) recommends annual screening from the age of 40 years.⁴ Screening mammogram leads to early detection of breast cancers, when they are most curable and breast-conservation therapies are available.⁵

Visualization of micro calcification or early non-palpable masses within the normal breast soft tissue requires breast radiography of highest quality. The glandular tissue is radiosensitive with tissue weighting factor of 0.12 and like all other radiological investigations using X-ray, it also has a small stochastic risk of inducing cancer. Hence, it is important to evaluate the risk from the dose delivered to the patient during the imaging process.^{2,6} The life time attributable risk of annual mammography starting at age of 40 years is 1.3 to 1.7 fatal cancer cases per 100,000 women.⁷ Optimum imaging techniques are needed for a balance between high quality images and radiation exposure to avoid increasing risk of radiation related cancer while obtaining diagnosis. It is also necessary to evaluate the dose delivered to the breast to minimize the risk of radiation induced cancer. Absorbed dose is the radiation energy deposited per unit mass of tissue, expressed as milligray (mGy). As the fibroglandular tissue is the radiosensitive part, absorbed dose in breast is referred to as the mean glandular dose (MGD).⁸ These are the recommended measures of radiation risk quantification for mammography.¹ In this study, we evaluated the compressed breast thickness (CBT) and absorbed dose in our patients during mammography.

METHODS

This prospective study was performed in the Department of Radiology and Imaging of Tribhuvan University Teaching Hospital. Data of 500 consecutive patients without prior history of mastectomy who underwent mammography over a period of 4 months (June 2018 to September 2018) were collected. The two basic projections, craniocaudal (CC) and mediolateral oblique (MLO) views were done

for all subjects with the mammographic unit (MAMMOMAT Fusion) using workstation of Syngovia software. Detailed information which included patient's age, CBT and MGD of CC and MLO of each view was recorded in a predesigned data collection sheet. The CBT and MGD were calculated by the machine itself and displayed on the monitor.

MGD is measured in this machine based on the formula, $MGD = K \times g \times c \times s$, where K is the entrance surface air kerma (without backscatter), g corresponds to a glandularity of 50%, c is correction factor for the difference in composition of typical breasts from 50% glandularity and the factor s corrects for differences due to the choice of X-ray spectrum.

Data were presented as mean and standard deviation for all variables. Statistical analyses were carried out with the help of SPSS version 20. The mean, standard deviation (SD) were calculated. Pearson correlation test and paired t-test were performed.

RESULTS

The sample consisted of 500 female patients, most in the 41-50 years age group (Figure 1). The CBT was highest in 31-40 age group in the CC view and in 41-50 age group in the MLO view (Figure 2).

CBT ranged from a minimum of 18 mm in the RCC and maximum of 96 mm in LMLO positions. The mean and SD of CBT for CC and MLO views for both breasts were 50.73 ± 11.11 mm and 59.14 ± 13.52 mm, respectively and that in each view as mentioned in table 1. There was significant difference in means of CBT between CC and MLO views.

The mean and SD of MGD for CC and MLO views were 1.21 ± 0.35 mGy and 1.34 ± 0.37 mGy respectively with significant difference between CC and MLO views, being more in the MLO view. The mean MGD for each view is shown in the table 1. MGD increased with increasing CBT in all the views, as shown in the figure 3.

The mean value of total MGD for four views i.e. per women was 5.1 ± 1.4 mGy. The Pearson's correlation coefficient between the CBT

and MGD for all four views combined was 0.517 and p-value was less than 0.01 suggesting higher MGD with increase in CBT.

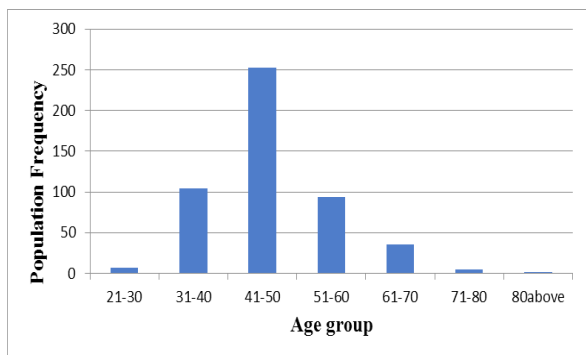


Figure 1: Bar chart of distribution of sample size according to age group.

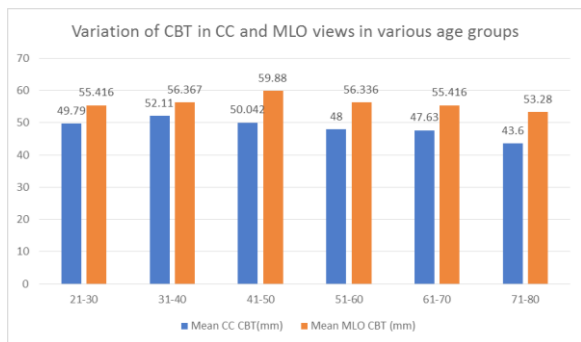


Figure 2: Mean CBT in CC and MLO views with age.

Table 1: Mean and SD of MGD and CBT of right CC (RCC), left CC (LCC), right MLO (RMLO) and left MLO (LMLO).

Variables	MGD		CBT	
	Mean (mGy)	SD	Mean (mm)	SD
RCC	1.22	0.38	51.17	11.61
LCC	1.20	0.37	50.29	11.34
RMLO	1.36	0.40	59.76	13.77
LMLO	1.32	0.38	58.52	13.90

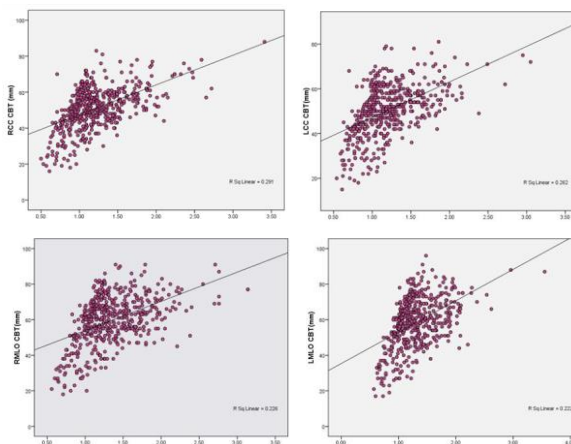


Figure 3: Scatter Plot diagram of CBT and MGD in RCC, LCC, RMLO and LMLO views.

DISCUSSION

ACR recommends MGD of less than 3.0 mGy per view.⁹ Two-view digital mammography and screen-film mammography involve average mean glandular radiation doses of 3.7 and 4.7 mGy, respectively. (7) The mean MGD for each CC and MLO views were 1.21 mGy and 1.34 mGy, respectively, and that per mammogram was 5.1 ± 1.4 mGy which was well within the recommended limits by ACR. Increase in MGD with CBT as in our study, has been documented in multiple other studies.^{7,10,11}

MGD is the exposure to a particular region of the body and depends upon kVp of the x-ray tube; target/filter combination, breast composition and breast thickness. In breast, the fibroglandular tissue is most radiosensitive and this itself may predispose to breast cancer. Radiation weighting factor for breast tissue is one. The current ICRP tissue-weighting factor for breast tissue is 0.12 in 2007, previously being 0.15 in 1977 to 0.05 in 1991.^{6,12,13} In our study, we found that MGD was significantly higher in MLO view compared to CC projection unlike study done by Xiang et al.¹⁴, where there was no significant difference in MGD between CC and MLO views. Other studies have also observed a trend for higher MGD in MLO view compared to CC view.¹⁴ This can be attributed to greater inclusion of pectoral muscle which has higher attenuation and hence higher radiation dose.^{1,9,15} CBT was

significantly higher in MLO view compared to CC view in our studies comparing well to others including study by Xiang et al. This can also be explained by the inclusion of denser pectoral muscle.¹⁴

CONCLUSION

Complying with ACR guidelines for MGD is important to reduce risk of radiation induced cancer in patients. The radiation exposure in our patients per mammogram is within the recommended limits. MGD shows a proportionate variation with the CBT and so, decreasing the thickness of breast by uniform compression, can decrease the amount of radiation absorbed by the glandular tissue of the breast.

CONFLICT OF INTEREST

None

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