Preliminary Studies into the Determination of Mean Glandular Dose During Diagnostic Mammography Procedure in Ghana

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Abstract: The objective of this project was to determine the Mean Glandular Dose (MGD) from Craniocaudal (CC) and Mediolateral Oblique (MLO) views to the breast during diagnostic mammography and the total dose per woman. The study was conducted at the Mammography Unit of Komfo Anokye Teaching Hospital and Peace and Love Hospital, Oduom. Data such as age, weight, height, bust size, compressed breast thickness, time of exposure, milli-ampere second (mAs), kilovoltage peak (KVp) and half value layer (HVL) were recorded from 440 films from 110 women. The MGD per film was 1.17±0.02 mGy and 1.25±0.03 mGy for the craniocaudal (CC) and Mediolateral Oblique (MLO) views, respectively. The mean MGD per woman was 1.80±0.03 mGy. The only factors that were found to affect MGD were mAs and the compressed breast thickness. No significant relationships were seen between MGD per woman with respect to ethnicity and educational background. The dose values obtained fall within the internationally acceptable dose range of 1-3 mGy. This suggests mammography x-ray generators at the two hospitals are capable of achieving acceptable dose levels for patient safety and this prompted us to rule out the fact that all other factors considered, they are not at risk of induced cancer from mammography.

Key words: Compressed Breast Thickness (CBT), Cranio caudal (CC), Half Value Layer (HVL), Mammography, Mediolateral Oblique (MLO), Mean Glandular Dose (MGD)

INTRODUCTION

The Breast (Fig. 1) is an external symbol of beauty and womanhood, but it is unfortunate to note that cancer of the breast is responsible for the deaths of millions of women worldwide. Breast cancer has become one of the most common malignancies in women and is the second leading cause of cancer death (exceeded only by cervical cancer) (National Cancer Institute, 1997). Breast cancer patients in Ghana have not survived long enough compared to their counterparts in more developed countries who enjoy better survival periods.

Early detection of breast cancer is the key to successful long-term control of the disease and good prognosis, while mammography of excellent quality is a fundamental prerequisite (Miller, 2005). There are two types of mammography: screening and diagnostic. Mammography should continue yearly after the age of 40 throughout a woman’s life. The breast is a radiosensitive organ and has a tissue-weighting factor of 0.05 (International Commission on Radiological Protection, 1991). The potential risk of radiation-induced carcinogenesis is increased with such a procedure (Bushong, 1993; Fung and Gilboy, 2001).

The glandular tissues of the breast are more radiosensitive than adipose tissues; therefore estimation of Mean Glandular Dose (MGD) has become an important area of concern (Faulkner et al., 1995). As direct estimation of the MGD is not feasible, it is often estimated from the measurements of the breast entrance skin exposure and converted to MGD by applying conversion factors. The average glandular dose cannot be measured directly, but is calculated under certain assumptions from the experimentally determined entrance surface air kerma or entrance surface dose by the use of conversion factors. (American College of Radiology, 1999; Wu et al., 1991a, b). A number of researches have been done on MGD determination for European females. (Bulling and Nicoll, 1995; Klein et al., 1997; Moran et al., 1994; Thilander et al., 1992; Wall and Roberts, 1992; Young and Burch, 2000). No significant research has been done on the estimation of MGD, the exposure factor used in mammography, and the Compressed Breast Thickness (CBT) for Ghanaian women.

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The objective of this research was to measure the MGD from CC and MLO views in each breast and total dose received per patient whilst undergoing mammography at the two hospitals in the Ashanti Region of Ghana and also to ascertain if the patients were at risk.

**METHODOLOGY**

This study involved 110 women attending mammography examinations in the two mammography units, all in the Ashanti Region of Ghana. Data was collected from women undergoing mammography examinations over the period from December 2006 to March 2007.

Patients' identification with a particular ethnic group was based upon information given by each woman. For each patient, data on age, weight and height were also recorded.

CBT was measured to the nearest 0.05 cm using a tape measure, at a distance of 4 cm from the chest wall, as the distance between the bottom of the compression plate and the table upon which the breast rested as shown in Fig. 2. Measurement of CBT for CC views was made at left and right sides of the compression plate, and the mean value was calculated. For MLO views, however, measurement was made at only one side of the compression plate, opposite to the patient’s arm. For each breast, the compression force applied was also recorded. At both centres radiographers were encouraged to achieve a firm compression in order to optimize radiographic image quality, which may account for some of the low CBT. Figure 3 shows how the breast is compressed before...
RESULTS AND DISCUSSION

The MGD and CBT were collected from 440 films, 220 films each from projection thus CC and MLO views. The mean doses per film and their standard errors were 1.17 mGy ±0.02 for the CC projection and 1.25 mGy ±0.03 for the MLO projection (Table 1). Median age of the study sample was 50 years (range 30-75 years) and coincides with the age of menopause (median 51 years in the UK), during which significant changes in composition of the breast are known to occur. Mean weight of the study sample was 76.5 kg, which is 16.5 kg greater than the weight of the standard woman (60 kg). Mean height is 159.5 cm, which is 0.5 cm shorter than the standard height of 160 cm. 10% of the study sample was in the age range 30-39 years, increasing to 42.1% for the range 40-49, 40% for the age range 50-59, and 5% for the subsequent decade, with 2.9% of women 70-years-old and above. Details of patient information and technique factors can be found in Table 2.

The mean MGD per film for the MLO (1.25 mGy ±0.03) was 1.5% higher than the CC view (1.17 mGy ±0.02). This could be explained by the presence of pectoral muscle in the overlying in the MLO projection causing higher attenuation and hence higher exposure. Mean CBT for CC and MLO films was 5.01±0.05cm and 5.84±0.07 cm, respectively. These two thicknesses correspond closely to the standard breast equivalent thickness as used in the mammography dosimetry

<table>
<thead>
<tr>
<th>Hospital A (KATH) n = 59</th>
<th>Hospital B (P L) n = 51</th>
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<tbody>
<tr>
<td>Mean glandular dose (mGy)</td>
<td>Craniocaudal view 1.11±0.02</td>
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<td></td>
<td>Mediolateral oblique view 1.35±0.03</td>
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<td></td>
<td>Dose per patient 1.79±0.02</td>
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<tr>
<td>Compressed breast thickness (cm)</td>
<td>Craniocaudal view 5.02±0.04</td>
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<tr>
<td></td>
<td>Mediolateral oblique view 5.70±0.08</td>
</tr>
</tbody>
</table>

Each data presents mean±Standard Error (SE)
Table 2: Details of patient information and technique factors used in this study. Mean values and Standard errors are given

<table>
<thead>
<tr>
<th>Patient’s information</th>
<th>Technique factors</th>
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<tbody>
<tr>
<td>Age (Yrs)</td>
<td>49±0.11</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>159.50 ±0.04</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>76.5±0.11</td>
</tr>
</tbody>
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RCC: right craniocaudal; LCC: left craniocaudal; RMLO: right mediolateral oblique; LMLO: left mediolateral oblique; kVp: kilovoltage peak; mAs: milli-ampere per second

CONCLUSION AND RECOMMENDATION

The study of the MGDS in the present study revealed that the mean MGD per film for CC and MLO views were 1.17±0.02 and 1.25±0.03 mGy, respectively, and mean CBTs were 5.01±0.05 and 5.84±0.07 cm, respectively. The mean MGD per woman was 1.80±0.03 mGy. A reference dose for women with breast thickness between 3.0-6.0 cm of 1.5 mGy could be adopted in this part of the country where the study was conducted without any compromise in existing image quality. No significant relationships were seen between MGD per woman with respect to ethnicity or age. However, two factors namely mAs of the X-ray beam and CBT had a significant effect on MGD per woman. Since a constant kVp (28kVp) was used because of the sensitive nature of the breast no correlation was seen to affect the doses received. The mean glandular doses obtained compares favorably with the international standard dose of 1-3 mGy. This suggests mammography x-ray generators at the two hospitals are capable of achieving acceptable dose levels for patient safety.

It is recommended that further studies should be conducted for other breast thicknesses in order to make an appropriate dose reference for all women undergoing such examinations in this part of the country and also further studies should be done for all the mammography units in the country.

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REFERENCES


