

A study of Mean Glandular Dose during diagnostic mammography in hospitals in Hanoi, Vietnam

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Abstract - A mammography examination facilitates the early detection of breast cancer. However, the potential risk of radiation-induced carcinogenesis is also increased with such a procedure. The objective of this research was to determine the mean glandular dose (MGD) from mediolateral oblique (MLO) views in each breast and the total dose per woman (for both breasts) from the exposure factor in patients undergoing mammography in some hospitals in Hanoi, Vietnam. The secondary objective was to evaluate some of the factors affecting MGD. The values of compressed breast thickness (CBT), as well as the MGD calculated from the exposure and tube voltage both mAs and target/filter combination, were collected from over 350 women ranging in age from 24 to 79 year olds. The MGD for the phantom was in range 1.0269–2.052 mGy, while the MGD for patient was in range 0.418 mGy to 2.72 mGy for the mediolateral oblique views. The mean MGD per woman was 1.45 mGy. They are quite far from the limitation of ACR recommendation, 3mGy. This may ensure that the mammography examination in some main hospitals in Hanoi Vietnam was capable of achieving acceptable dose levels for patient safety.

Keywords - Mean glandular dose, Half Value layer, Compressed breast thickness, Mammography.

I. INTRODUCTION

In Vietnam nowadays, breast cancer is the most common malignancy in women according to the statistical number of Hanoi Cancer Hospital – K - in year 2000. 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. However, the breast is a radiosensitive organ [1]. Hence, the potential risk of radiation-induced carcinogenesis is increased with such a procedure [2]. Because the glandular tissues of the breast are more radiosensitive than adipose tissues, the estimation of mean glandular dose (MGD) has become an area of concern [3]. The two main methods for the assessment of MGD from mammography are the use of a standard breast phantom and patient-based measurement. Standard breast or phantom measurement is utilized to define MGD limits [4–6] and is well suited for quality control and inter-system comparison to ensure that all units are capable of achieving acceptable doses. Such measurements, however, do not indicate the actual dose received by the individual

woman. The method for estimating the MGD to the breast of a patient consisted of collecting the data on compression breast thickness for each breast with an indication of the tube voltage, and mAs and target/filter combination for each patient. As direct estimation of the MGD is not feasible, it is often estimated from the measurements of the incident air kerma and converted to MGD by applying conversion factors [9]. The American College of Radiology (ACR) specifies that the MGD should not exceed 3 mGy per view for screen-film image receptors.

The primary objective of this study was to determine the MGD during diagnostic mammography in some hospitals in Hanoi, Vietnam. The secondary objective was to evaluate some of the factors affecting MGD, such as half value layer (HVL) of the X-ray beam, compressed breast thickness (CBT) and age. Such information is necessary in order to formulate recommendations to minimize radiation doses without compromising image quality.

II. MATERIALS AND METHODS

A. Standard breast phantom method

In this method, the Radiation Measurements Inc. (RMI) phantom, model 156 (Radiation Measurements Inc., Middleton, WI) or equivalent, described as equivalent to 50% glandular tissue and 50% adipose tissue with CBT of 45 mm [10], is required. The method involves measuring the incident air kerma, without backscatter to the phantom and applying conversion factors determined by Wu et al [9].

B. Patient-based method

This study collected data from over 350 women attending mammography examinations in two mammography units, at cancer hospital – K - in Hanoi and one in Thaibinh province, in two periods, May 2007 and August 2009. Characteristics and radiographic parameters for the three mammography units are given in Table 1. Only mediolateral oblique (MLO) view was included in this study.

III. RESULT

Table 1 Characteristics and radiographic parameters for the three mammography units

Model	A equipment Metaltronica	B equipment Planmed Sophie	C equipment Melody
SID (mm)	650	650	600
Target	Mo	Mo	Mo
Filter	Mo	Mo	Mo
kV range	20-35	20-35	24-35
mAs range	1-640	100 - 500	1-640

For each woman, data on age, weight and compression breast thickness (CBT) were also recorded. CBT was measured using a ruler, 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 plated. Measurement of MLO views, however, measurement was made at only one side of the compression plate, opposite to the woman's arm. For each breast, the force applied was also recorded. Thereafter, incidence air kerma was measured by using the ionization chamber placed in the x-ray field. The ionization chamber systems employed in this research was SOLIDOSE 300 with an electrometer. The exposure measure (mGy) was converted to the MGD according to ACR recommendations [10]. Figure 1 shows the measurement setting.

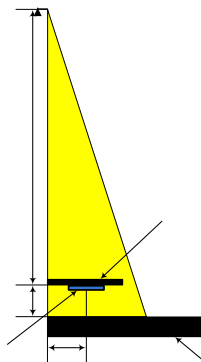


Fig. 1 Measurement of the incident air kerma at the relevant tube loading using a diagnostic dosimeter

A. Mean glandular dose of standard breast phantom

The anode/filter combination of two surveyed mammography is Molybdenum/Molybdenum, focus to image distance is 650mm. The MGD for phantom after calculated was in range 1.0269–2.052 mGy with tube voltage is 25 kV and 30 kV in respectively (as shown in Table 2).

Table 2 MGD of breast phantom PMMA 45mm

Proj	Tube voltage (kV)	Tube loading (mA·s)	Incident Air Kerma (K _i) (mGy)	HVL (mmAl)	Mean Glandular Dose (D _G) (mGy)
CC	25	55	5.491805	0.32	1.026968
CC	28	55	7.8936	0.358	1.62103
CC	29	55	8.71805	0.368	1.826955
CC	30	55	9.56285	0.38	2.052188

B. Mean glandular dose of patients

The value of breast thickness and MGD were collected from over 350 patients (each patient took two MLO projections, one for left breast and one for right breast). The mean glandular dose per breast was in range 0,418 mGy to 2,72 mGy for the mediolateral oblique views. The mean MGD per breast was 1,45 mGy.

The MGDs per MLO films are significantly related to the compressed breast thickness (CBT), tube voltage and tube loading. The MGD and CBT in MLO views are show in Fig. 2.

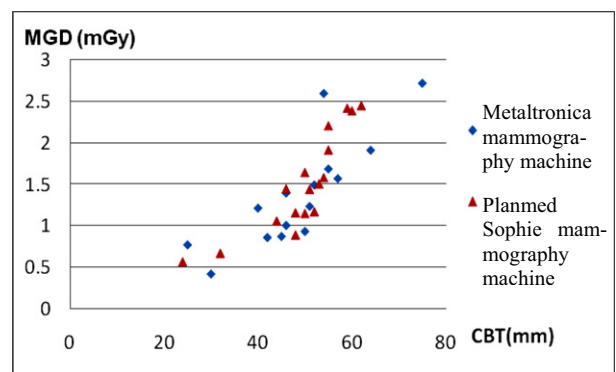


Fig. 2 The MGD for MLO projection according to compressed breast thickness (CBT)

Doses for MLO projections according to the CBT are shown in Fig. 3.

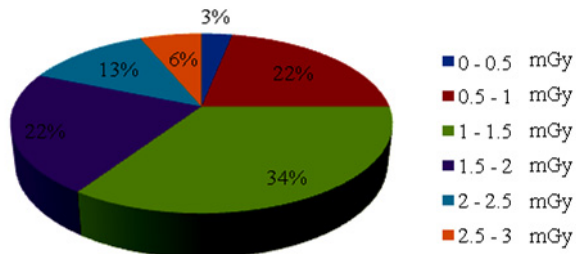


Fig. 3 The distribution of MGD on patient's breasts

The results indicated that doses for 34% of films of MLO projections were in range from 1 to 1.5 mGy, 22% of films of MLO projections were in range from 1.5 to 2 mGy, 13% of films of MLO projections were in range from 2 to 2.5mGy and only 6% of films of MLO projections were in range from 2.5 mGy to 3 mGy, all was less than 3.0 mGy. The ACR recommends that the MGD should not exceed 3 mGy per view and the result from this research showed that all MGD of the films of MLO projections were lower than the standard dose.

This may ensure that the mammography x-ray generators in some main hospitals in Hanoi are capable of achieving an acceptable dose for patient safety. However, the measurement of breast thickness might vary because there was no standard method for measuring the thickness of the breast and the values were obtained from individual practice by each radiation technician.

In this study, the result shown that the MGD per breast was 1.45 mGy for the MLO view with mean CBT was 49.22mm. The MGD estimation in this study were based on the assumption that all breasts had a standard 50:50 ratio of adipose to glandular composition.

IV. CONCLUSIONS

The MGD for the phantom was in range 1.0269–2.052 mGy, while the MGD for patient was in range 0,418 mGy to 2,72 mGy for the mediolateral oblique views. The mean MGD per woman was 1.45 mGy. They are quite far from the limitation of ACR recommendation, 3mGy. This may ensure that the mammography examination in some main hospitals in Hanoi Vietnam was capable of achieving acceptable dose levels for patient safety.

On the multivariate test two factors, namely half value layer of the X-ray beam and compressed breast thickness,

had a significant effect on MGD per woman. No significant relationships were seen between MGD per woman with respect to body mass index or age.

ACKNOWLEDGMENT

This study was supported by the Radiation Safety Center of Institute for Nuclear Science and Technology, K- hospital in Hanoi and BME Department of Faculty of Electronics and Telecommunications at Hanoi University of Technology.

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