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Estimation of Mean Glandular Dose for Patients Who Undergo Mammography and Studying the Factors Affecting it

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Abstract. The objective of this study was to determine mean glandular dose (MGD) during diagnostic mammography. This study was done in two hospitals in Hawler city in Kurdistan –region /Iraq, the exposure parameters kVp and mAs was recorded for 40 patients under go mammography. The MGD estimated by multiplied ESD with normalized glandular dose (Dn). The ESD measured indirectly by measuring output radiation mGy/mAs by using PalmRAD 907 as a suitable detector (Gigger detector).the results; shown that the mean and its standard deviation of MGD for Screen Film Mammography and Digital Mammography are (0.95±0.18)mGy and (0.99±0.26)mGy, respectively. And there is a significant difference between MGD for Screen Film Mammography and Digital Mammography views ($p \leq 0.05$). Also the mean value and its standard deviation of MGD for screen film mammography is (0.96±0.21) for CC projection and (1.03±0.3) mGy for MLO projection, but mean value and its standard deviation evaluated of MGD for digital mammography is (0.92±0.17) mGy for CC projection and (0.98±0.2) mGy for MLO projection. As well as, the effect of kVp and mAs in MGD were studied, shows that in general as kVp and mAs increased the MGD increased accordingly in both of mammography systems.

INTRODUCTION

Mammography refers to the x-ray examination designed especially for detecting human breast pathology, nowadays, it is the most effective and accurate method for early detection of breast cancer. Cancer detection relies on the difference in the X-ray attenuation coefficient between normal and pathological tissue. [1].And according to any examination that includes x-rays, there is always a small stochastic risk of inducing cancer [2]. It is therefore important to evaluate the risk from the dose delivered to the patient during the screening process .In other words, to keep the dose as low as reasonably achievable [3].

Dosimeters and patient dose is an important consideration in radiology and especially in mammography. In general, when radiation dose discussed some quantities and units of measure are required to review: Air kerma is radiation quantity that is sometimes used to express the radiation concentration delivered to a point, such as the entrance surface of a patient's body [4]. Entrance Surface Dose (ESD) is an important parameter for assessing the dose received by a patient in a single radiographic exposure [5]. Also Mean Glandular Dose (MGD) which is the size that have best descriptions of the amount of risk for glandular tissue caused by application of radiation in mammography [6].

The standard mammographic protocol for screening always includes two views, craniocaudal (CC) and mediolateral oblique (MLO). The angle of 45° is usually suitable for the majority of patients in routine daily practice [6].

There are two type of Mammography the Screen-Film Mammography (SFM) and Digital Mammography (DM).Screen-film mammography has been to date is the traditional test for breast screening having been shown its efficacy in reducing breast cancer mortality in large randomized trials. The potential advantages of digital mammography over screen-film techniques have been the subject of several investigations which provides an improved diagnosis in dense breasts and an increase in breast cancer detection rate.[7,8]

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The objectives of this study are to estimations of ESD and MGD, Comparing between doses delivered by a full field digital mammography system and a screen-film mammography unit and Studying factors that affect the dose delivered by mammography radiation.

MATERIALS AND METHODS

The practical study was done in two hospitals in Hawler city. The X-ray facilities were located at the Rzgari Hospital (RH),is the digital mammography(DM) and Maternity and teaching Hospital (MTH), is the Screen-Film mammography(SFM). Table (1), represents the summarized description for each instrument utility which used in this study.

TABLE 1: *Summary of each X-ray Mammography*

Supplier Company	Type of M	Model No.	Serial No.	Country	Filtration	The Voltage rang/kV	Anode/Filter	Hospital
Siemens	Digital	5145113	122747TX9	Germany	0.69Be	25-31	Rh/Rh	(RH)
Siemens	Screen film	1125314	13296	Germany	0.1Be	22-30	Mo/Rh	(MTH)

Technical parameters (tube potential (kVp) and tube current time product mAs) were recorded for 40 patients that undergo mammography. Also, in this work, a PalmRAD 907 as a suitable detector (Gigger detector) and phantom was used, the phantom which is designed to test the performance of a mammography system by a quantitative evaluation of the system's ability to image small structures similar to those found clinically.

The output of radiation in unit of mGy measured in different tube voltage and standard mAs by using ionizing detector PalmRAD 907. The Geiger detector was positioned in the center of the beam axis next to the phantom. The radiation field size was set to just cover the dosimeter to avoid the scatter radiation, the range of data for a tube potential was set on 25 kVp has been increased to up to suitable with optimum mAs value, depending on convenient tube load conditions. The resulting dose was divided by the applied mAs in order to get mGy/mAs and then, these values plotted against the kVp. As shown in Fig (1) and (2) for two mammography units from two Hospitals. And ESD was determined indirectly from this two curve for each patients that undergoing mammography. Finally, the MGD was determined by using normalizing glandular dose (Dn), as in this equation;

$$\boldsymbol{MGD(mGy) = ESD(without\ B.S.F) * Dn}$$

RESULTS AND DISCUSSION

Table 2, show that the results of estimation ESD for both S.F.M unit in MTH and D.M in RH, note that the ESD for S.F.M. in MTH is (6. 5±2.4) mGy and (3.8±2.2) mGy for D.M in RH. It is clear that ESD from S.F.M in MTH hospital is greater than ESD for D.M in RH and there are significant difference views ($p \leq 0.05$).It may be due to exposure parameters which are used in both mammography units .

From Table (3) and Fig.(3), shown that the mean value and its standard deviation of MGD is (0.99 ±0.26)mGy for S.F.M and (0.95±0.18) mGy for D.M. From the results mentioned above, the significant differences ($p \leq 0.05$) were found of MGD values between S.F.M and D.M, and it is found that MGD in S.F.M is greater than MGD in D.M by %4. The results were obtained due to the quality of mammography mechanic as well as dose parameters in which used in both mammography systems, show that the the mean value of mAs and its standard deviation used for S.F.M is (140.2 ± 29.6) and for D.M is (94 ± 16.5), also shown that the mean and its standard deviation for kVp used from S.F.M was (26.6 ±1.9) and for D.M was (29.62 ± 0.82). The results were obtained are in good agreements with the data that obtained by Bjelac etal., of the previous studies [9].Also, the results are in a good agreement with which recommended by ICRP, that the MGD value should not exceed 3 mGy per view [10].

Table (4), show that the mean value and its standard deviation of MGD for S.F.M in MTH is (0.96±0.21) for CC projection and (1.03±0.3) mGy for MLO projection. And Mean value and its standard deviation evaluated of MGD for D.M in RH is (0.92±0.17) mGy for CC projection and (0.98±0.2) mGy for MLO projection.

As well as, the effect of kVp and mAs in MGD were studied, shows that in general as kVp increased the MGD increased accordingly in both of mammography systems, show Figure (5) for S.F.M in MTH and Figure (6) for D.M in RH. Also as mAs was increased in S.F.M and D.M, then M.G.D increased accordingly. This fact is shown from fig (7) for S.F.M and from fig (8) for D.M. Unit.

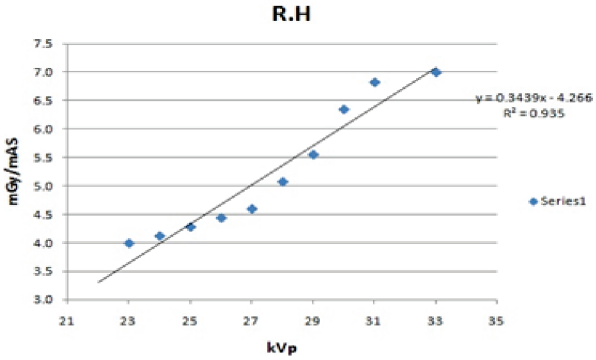

FIGURE 1: mGy/mAs versus kVp in Screen Film mammography (MTH)

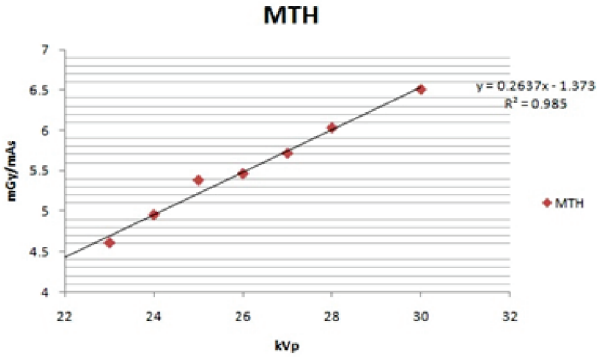

FIGURE 2:mGy/mAs versus kVp in Digital mammography (RH)

TABLE 2: *ESDs for both of S.F.M in MTH and D.M in RH mammography unit*

Mammography System/Hospital	**kVp** **Mean±S.D**	**mAs** **Mean±S.D**	**ESD/mGy** **Mean±S.D**
S.F.M /MTH	29.62±0.82	94±16.5	6. 5±2.4
D.M/RH	26.6±1.9	140.2±29.6	3.8±2.2

TABLE 3: *MGDs for both of S.F.M in MTH and D.M in RH mammography unit*

Mammography System	**kVp** Mean±S.D	**mAs** Mean±S.D	**ESD/mGy** Mean±S.D
RH	29.62±0.82	94±16.5	0.95±0.18*
MTH	26.6±1.9	140.2±29.6	0.99±0.26*

TABLE 4 : *MGDs for both CC and MLO of S.F.M in MTH and D.M in RH mammography unit*

Mammography System/Hospital	**MGD for CC** Mean±S.D	**MGD for MLO** Mean±S.D
S.F.M /MTH	0.96±0.21	1.03±0.3
D.M/RH	0.92±0.17	0.98±0.2

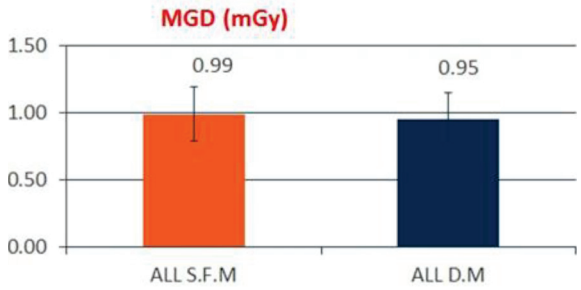

FIGURE 3: MGD for S.F.M in MTH and D.M in RH

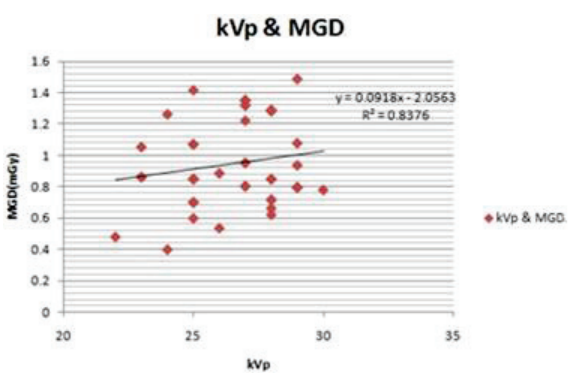

FIGURE 4: MGD (mGy) verses kVp in MTH

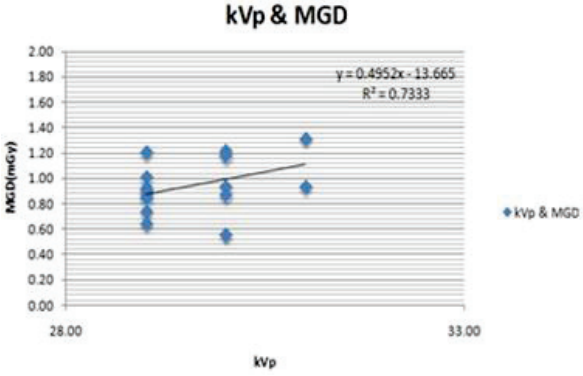

FIGURE 5: MGD (mGy) verses kVp in RH

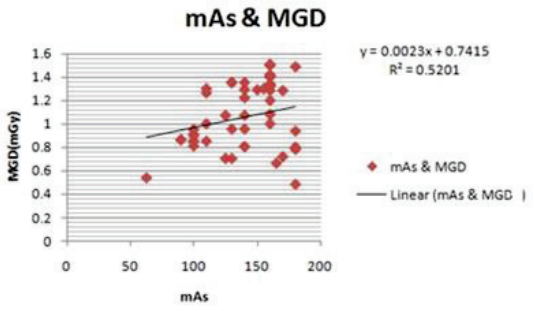

FIGURE 6: MGD (mGy) verses mAs in MTH

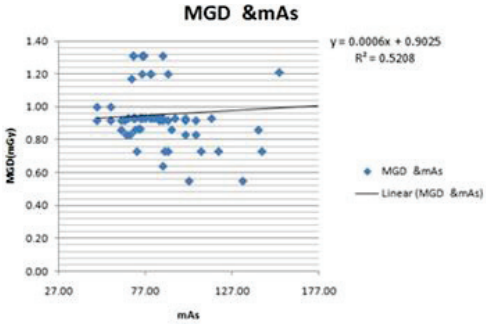

FIGURE 7:MGD (mGy) verses mAs in RH

CONCLUSION

ESD from S.F.M in MTH hospital is greater than ESD for D.M in RH and there is significant difference views ($p \leq 0.05$).The various values of mean±SD of MGD were recorded for two mammography projections CC and MLO in both of mammography units. The minimum values of MGD where recoded for CC projection in RH for DM and maximum MGD was recorded for CC projection in MTH for S.F.M. In both units and projections, the MGD were found to be lower than the recommended guidance value of 3mGy.Significant relationships were seen between MGD and X-Ray parameters (kVpand mAs)views ($p \leq 0.05$) .

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