MEAN GLANDULAR DOSE IN DIFFERENT GLANDULARITY PHANTOMS

Bruno B. Oliveira[1], Lucas Paixão[1], Sibele R. Reynaldo[1], Fernando Leyton[2,3], Márcio A. Oliveira[1], Teógenes A. da Silva[1,2], Maria S. Nogueira[1,2]

[1]Post-graduation in Sciences and Technology of Radiations, Minerals and Materials - CDTN/CNEN
Presidente Antônio Carlos, 6627, Pampulha, Belo Horizonte, Brazil
[2]Nuclear Technology Development Center - CDTN/CNEN
Presidente Antônio Carlos, 6627, Pampulha, Belo Horizonte, Brazil
[3]Tarapaca University, Center for Studies in Radiological Sciences - CECRAD
General Velásquez 1775, Arica, Chile

Teógenes A. da Silva
silvata@cdtn.br

INTRODUCTION

The risk related quantity for mammography is the mean glandular dose (D_G) that is the mean dose to the glandular tissues within the breast. The glandularity of the breast will vary with the age of the woman, the size of the breast and hormonal status, but there remain wide variations in glandularity for women of a given age and fixed breast size. The aim of this work is to present preliminary results of the D_G variation for protocols with different values of tube voltage, target/filter combinations and using different glandularity standard breast phantoms.

MATERIALS AND METHODS

The D_G was derived from measurements of the free-in-air incident air kerma (K_i) and tabulated conversion coefficients that are dependent on the X-ray quality represented by the half-value layer (*HVL*) of the X-ray spectrum. Irradiations were done in a 3000 Nova model Siemens MAMMOMAT mammographic unit in a cranio-caudal view, with the compression plate in position and a load cassette in the bucky. Protocols with 26, 28, 30 and 32 kV were used for Mo/Mo and Mo/Rh combinations. The distance between focus and the 90X5-6M model Radcal ionization chamber was 60.5 cm and the tube loading (P_{It}) used was 50 mA.s.

Set-up for K_i and HVL measurements

Air kerma determination:

$$K_i = \overline{M} N_{K,Q_0} k_Q k_{TP}$$

X-ray tube output:

$$Y(d) = K_i(d) / P_{It}$$

Computerized Imaging Reference Systems, Inc phantoms used for the determination of D_G had 45 mm thick, which approximately simulates a standard breast with glandularities of 0, 30, 50, 70 and 100%.

Set-up for D_G measurements using phantom with glandularity of 70%

Mean glandular dose calculation:

$$D_G = c_{D_{G50},K_i} c_{D_{Gg},D_{G50}} s K_i$$

RESULTS AND DISCUSSIONS

K_i and *Y* values were determined for calculating D_G in different glandularity phantoms. *HVL* values were measured to obtain *c* conversion coefficients from tabled values.

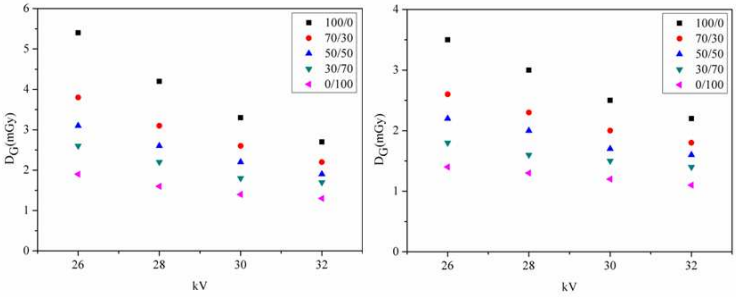
K_i and *Y* values for each tube voltage and target/filter combination

kV	Mo/Mo		Mo/Rh	
	K_i (mGy)	Y (mGy.mA.s^{-1})	K_i (mGy)	Y (mGy.mA.s^{-1})
26	4.73 ± 0.26	0.09 ± 0.01	4.18 ± 0.23	0.08 ± 0.01
28	6.05 ± 0.34	0.12 ± 0.01	5.43 ± 0.30	0.11 ± 0.01
30	7.51 ± 0.42	0.15 ± 0.01	6.79 ± 0.37	0.14 ± 0.01
32	9.08 ± 0.50	0.18 ± 0.01	8.25 ± 0.46	0.17 ± 0.01

HVL values measured in target/filter combinations

kV	*HVL* (mm Al)	
	Mo/Mo	Mo/Rh
26	0.36	0.40
28	0.38	0.42
30	0.40	0.44
32	0.42	0.46

The D_G values ranged from 1 to 6 mGy and 1 to 4 mGy, for Mo/Mo and Mo/Rh combinations, respectively. The preliminary results are in according to the reference level of 3 mGy established by the International Basic Safety Standards (BSS115) to breast of thickness 45 mm and glandularity 50%.



D_G values in 0 to 100% glandularity phantoms for Mo/Mo (*left*) and Mo/Rh (*right*) target/filter combinations

The results showed that the D_G increases with the glandularity. As the voltage increases the mean glandular dose decreases for dense breasts. This feature is more pronounced for phantoms of glandularity 100%.

CONCLUSION

Considering that the most radiosensitive tissue is the glandular, this work contributes to disseminate in clinical practice the optimization of procedure and establish reference levels depending of breast glandularity.

ACKNOWLEDGMENT

The authors are thankful to CAPES and CNEN for the incentive with PhD's fellowships and Margarita Chevalier Del Rio from Madrid Complutense University for providing some phantoms. This work was supported by FAPEMIG and MCT/Brazil, through the Brazilian Institute of Science and Technology (INCT) for Radiation Metrology in Medicine.