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Evaluation of use of thyroid shield in mammography: a preliminary study

Abstract

Purpose: Verify if the use of thyroid shield was effective in reducing the radiation dose received by the thyroid in mammography.

Materials and Methods: Using a General Electric Senograph DMR+mammographer with two bucky's, thermoluminescent dosimeters and two phantoms, one of body and the other of breast, were made measurements in cranio-caudal and medio-lateral oblique views. The variation was made with and without thyroid shield, and in the breast without shield, on both views.

Results: After collecting and analyzing data it was verified an 89% reduction of the entrance skin doses on thyroid with protection.

Conclusion: Given the significant reduction of the dose and the principle ALARA we can conclude that the shield should be used by the Radiology service. However the use of the shield may provide artifacts, making difficult the analysis of the breast tissue and leading to the examination repetition increasing the radiation from the mammary gland, as well as the other organs.

Keywords: mammography, thyroid, thyroid shield, dose

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Abbreviations: CC, cranio-caudal; MLO, medio-lateral oblique; TLD, thermoluminescent dosimeters; ESD, entrance skin dose; GE, general electric

Introduction

The use of mammography as a diagnosis has increased in recent years, being currently, the most sensitive technique and mostly performed for early diagnosis of breast cancer. The mammography included two incidences for breast, the craniocaudal (CC) view and mediolateral oblique (MLO) view. Consequently, there is an increase in the number of exposures to radiation on breast and adjacent organs, appearing the need to evaluate the dose absorbed by risk organs, like thyroid gland.[1–3]

Hatziioannou et al.[1] conducted a study to verify the dose received by various radiosensitive organs in mammography's, using a phamtom and thermoluminescent dosimeters (TLD). They concluded that the thyroid is mostly exposed, being the average dose in all four exposures was 0,05±0,17mGy mAs^{-1}.[1]

Already in 2011 in a study by Kunosic et al.,[2] compare the dose received by the thyroid and gonads. For this comparison used TLD's, placed in the region of thyroid and gonads, proving that the major of the scattered radiation, in mammography, heading mainly for the supramamaria zone. In this way, the dose received by the thyroid was 0,211±0,107mGy and 0,017±0,012mGy, respectively.[2] In this investigation, we also can see that entrance skin dose (ESD) for the thyroid changes according to the thickness of compressed breast. Epidemiologic studies provide strong evidence that thyroid doses as low as 100mGy are associated with increased risk of thyroid cancer.[3–5] Taking into account the mentioned above, with this study our purpose is to verify if there is reduction in the effective dose in thyroid as well as the existence of differences in ESD in both views (CC and MLO), for mammary gland.

Methodology

Classified as a quantitive and experimental study, it was divided into two phases, the first one consisted of a descriptive study, where a statistical survey of the parameters of the test (kV, mAs) was performed. In the second phase, experimental. simulations were carried out in order to verify the dose received on thyroid gland, using a General Electric (GE) Senograph DMR+ mammographer with two bucky's, one thyroid protection, a body phantom (used only for positioning) and PMMA plates (which allowed simulating the breast tissue with a thickness of 4,5cm).

In the experimental stage the phantom of PMMA was placed on potter, having been applied the necessary compression, with posterior placement of phantom orthostatic body, and installed in a manner that simulates the positioning of the view CC Figure 1.

After the correct positioning of the phantoms, were placed three TLD in thyroid region (medial, right lobe and left lobe) and conducted 20 exposures, 10 exhibitions without protection and 10 with protection, with the parameters 27kV and 110mAs. The phantom of body was positioned in order to simulate the view MLO, being the C-arm of mammography equipment was placed to 45degrees, and with 27kV exposure parameters and 125mAs Figure 2.

Again, were placed three top-level regions in thyroid and performed 20 exposures, 10 with protection and 10 without. Finally, an exposure was held at the breast, and was performed only in each view. In this part of the experience was not placed on thyroid shield and was used a 27kV voltage in both views and 110mAs and 125mAs in CC and

MLO views, respectively. It should be noted the fact that took place 10 exposures in the study for thyroid and breast only one, due to the reduced dose thyroid level.

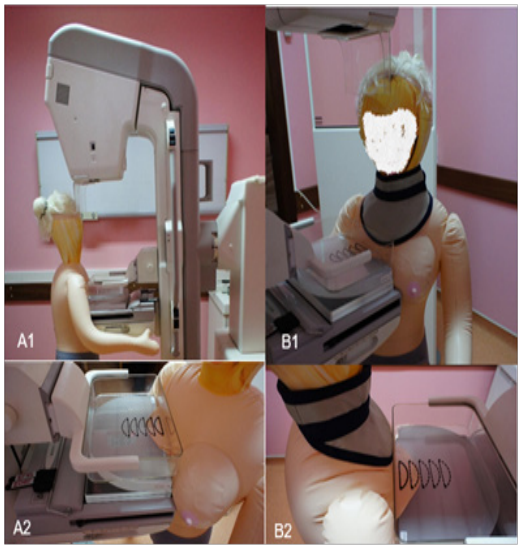

Figure 1 Phatom and PMMA on the projection CC.A1-A2 without shield and B1-B2 with shield.

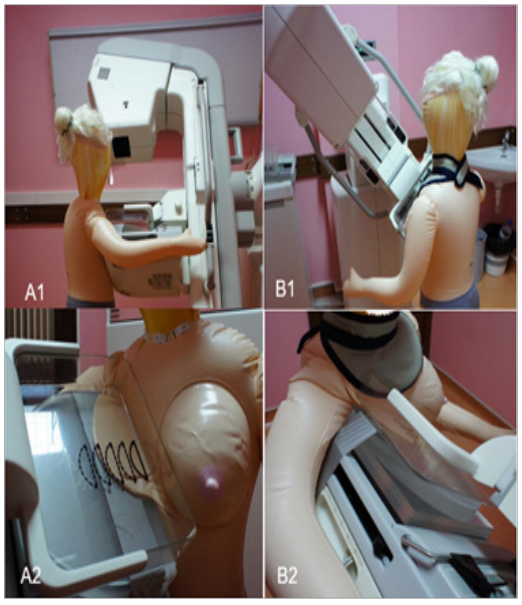

Figure 2 Phatom and PMMA on the MLO view. A1-A2 without shield and B1-B2 with shield.

Results

With the use of the protection, there is reduction of ESD on thyroid Table 1 shows that in both views, with and without the protection, the use of thyroid shield leads to a reduction of the ESD in the thyroid gland. Also occurs a 88.7% reduction in CC view and 95.9% in MLO view, both corresponding to TLD placed on the medial region.

Table 2 demonstrates the full dose mammography exams (two views CC and two views OML), with and without protection. Through the above tabulated data there is a reduction of approximately 88,8%, in the mammography examination ESD, when it refers to the placement of thyroid shield. Table 3 presents the ESD of the breast tissue, in both views, on one breast, received a mammography examination.

Table 1 Percentage of dose reduction with thyroid protection

	ESD without protection (µGy)	ESD with protection (µGy)	Reduction with protection (%)
CC/Right	37	5	86,4
CC/Medial	53	6	88,7
CC/Left	19	6	68,4
Average CC	36	6	83,3
MLO/Right	33	3	90,9
MLO/Medial	74	3	95,9
MLO/Left	25	3	88,0
Average MLO	44	3	93,2

Table 2 ESD in total of mammography

	ESD (thyroid)(µGy)	ESD(%)
Without protection	160	100
With protection	18	11,25

Table 3 ESD on mammary gland

	ESD(mGy)
CC	9,4
MLO	10,7
Total dose on mammography	20,1

Discussion and conclusion

The results show that there is a dose difference in the thyroid in both views. In the MLO view the ESD is 18.1% higher than in the CC view, without protection. With protection, the ESD in the MLO view is 50% higher than in the CC view. As in the studies conducted by Chetlen et al.[6] and Whelen et al.,[7] in which the dose at the MLO view was higher in relation to the CC view.[6,7]

This difference may be due to the fact that in the MLO view there is a slight increase in the tube current – exposure time product. Through the analysis of the results it is possible to verify that in the CC view as in the MLO view there is a reduction of ESD in the thyroid, 83.3% and 93.2%, respectively. In dosimeters located to the right lobe occurred a reduction of 86.4% and 90.9%, in CC and MLO views respectively. On the left lobe, the reduction was 68.4% in the CC views and 88% in the OML views. It is possible to conclude that the use of thyroid protection is effective, with reductions ranging from 68.4% to 95.9%.

In accordance with the comparative study by Hatziioannou et al.[1] which had as objective verification of dose received by various organs radiosensitive, using a phantom and TLD it was concluded that a set of four views dose was 170µGy, which corroborates the results achieved in this study, in which it obtained 160µGy.[1]

In another study performed by Kunosic et al.[2] where they compare

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the dose received by the thyroid and gonads, demonstrates that the results on thyroid gland are among 211±107μGy, showing a range in which the results obtained in this study.[2]

ESD received by the mammary gland, in both views carried out in this study was 10.7mGy in MLO view and 9.4mGy in CC view, featuring a full dose of 40.2mGy, the examination of mammography, the values obtained through this work are similar to those recommended in the document dose values of Quality criteria, in which the European Protocol of Dosimetry in Mammography advises 10mGy to kerma in air on entrance surface as the reference value for patients.[8,9]

Through all the analyzed data it is possible to check that the use of thyroid shield allows a reduction of the effective radiation dispersed, on mammography exams. The use of thyroid protection, allows a reduction of approximately 89%, when compared to a survey without protection. According to this study and others carried out by other authors it is possible to conclude that the dose received by the thyroid is very low, and consequently the probability of cancer induction in thyroid is also extremely low.[6,10]

Finally, and bearing in mind the significant reduction of dose and the ALARA principle is concluded, that the use of thyroid protection should be the practice. However the use can lead to the occurrence of artifacts in the image, difficulty the correct analysis of breast tissue and leading to repetition of examination, leading an increase of radiation for part of the mammary gland, as well as other organs.[11,12] To further investigations, the use of new shields of elastomeric composites containing bismuth, wolfram, and gadolinium as the ones purposed by Staniszewska et al.,[13] could be a solution in order to reduce the artifacts and effective dose reduction in thyroid.[13]

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Conflict of interest

Author declares that there is no conflict of interest.

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