Average glandular dose by a low-dose scanning system for digital mammography: A women-sample evaluation

Poster No.: C-0304
Congress: ECR 2010
Type: Scientific Exhibit
Topic: Breast
Authors: V. Rossetti, A. Peruzzo Cornetto, G. Macchia, R. Ropolo; Torino/IT
Keywords: digital mammography, scanning technology, Average Grandular Dose
DOI: 10.1594/ecr2010/C-0304

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR’s endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys’ fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Purpose

Since the average glandular dose (AGD) is today considered the most convenient indicator to estimate the risk of radiation-induced cancer by mammography, it is important to assess and compare advances in new technologies in the light of their ability to reduce it. The aim of this study is to evaluate AGD delivered by a Sectra Microdose Mammography unit on a large sample of women.

Methods and Materials

The Sectra Mammography Microdoses L-30 C120 (MDM) used in this study is a scanning multi-slit digital mammography system. In this system, image acquisition is produced by a direct photon counting detector formed by a series of boron implanted crystalline silicon Si (B) micro-strips 50 mm width. X-rays are generated by a tungsten anode with aluminium filter (W/Al) tube and are collimated to a fan beam matching a pre-collimator that transforms the beam in several equidistant line-beams. Beneath the breast support, matching the line beams exiting the compressed breast, there are the post-collimator and the detector. Detector and post-collimator move synchronized with beam and pre-collimator, along an arc scanning the compressed breast. Both compression paddle and breast support are slightly concave (fig. 1 on page 3). The field of view is 26 x 24 cm², with a 50 µm image pixel. The whole system is well described elsewhere [1].

Compared to all the other technologies (Flat panel, CR, ...), dose reduction is the main advantage of this technology originally designed for high energy physics experiments [2], called "single photon counting". Dose reduction arises from the fact that every single photon hitting the detector, regardless of its energy, gives rise to a signal contributing to image formation [3]. All photon-matter interaction above a fixed energy threshold are "counted" by the system, the threshold being fixed above the energy level due to detector noise and electronic noise, which are automatically eliminated; as a consequence, the only source of noise is due to the statistical fluctuation in the number of absorbed X-rays. The absence of anti-scatter grid in this system is another characteristic that contributes to dose reduction. The detector quantum efficiency is such that clinical kV are usually higher (29-38 kV) than those used by other technologies.
Kinetic Energy Released in Matter (kerma) measurements necessary for AGD evaluations were performed in clinical automatic modality.

To assess possible dosimetric problems related to the scanning beam irradiation geometry, two dosimeters with different physical characteristics were used:

1) a dedicated ionization chamber, volume 6 cm$^3$ (Radcal 20X6-6M, Monrovia, CA USA), positioned in air;

2) a multi-meter with a solid state mammographic detector (Unfors Xi Platinum, Unfors Instrument AB, Sweden), with W/Al calibration, positioned on dedicated holder.

All measurements were performed with the dosimeters positioned in the reference area, 6 cm far from the chest wall, according to the EC protocol [4].

Mammographic automatic clinical setting parameters were obtained exposing a variable thickness (20 mm - 70 mm) polymethyl methacrylate (PMMA) slab phantom covering the whole scanning area.

Results of air kerma measurements performed with the two different dosimeters were compared and AGD was evaluated for different PMMA phantom thicknesses according to the EC protocol [4].

AGD evaluation was then performed for a sample of 120 patients examined in one month-period (4-projections mammography, 480 exposure data). Data required for AGD calculation (kV, mAs, breast thickness, projection and patient age) were directly extracted from DICOM files and AGD was calculated by an automated home-made program. HVL values used for calculation are those provided by Sectra, in good agreement with those published [5].
Fig. 1: Sectra Mammography Microdose L-30
Results

Air kerma measurements carried out with solid state dosimeter and ionization chamber are comparable (maximum measured difference 5%).

AGD estimated for 20 to 70 mm PMMA thicknesses were extremely low and variable from 0.47 to 1.01 mGy respectively, i.e. 22% to 80% lower than achievable levels suggested by the EC guidelines [4] (Fig. 1 on page 5).

Patients' AGD distribution (Fig. 2 on page 6) showed a low mean value of 0.79 mGy referred to a standard breast thickness distribution, 53 mm-median value (Fig. 3 on page 7). AGD distribution achieved a minimum value of 0.45 and a maximum of 1.54 mGy respectively for 22 and 97 mm compressed breast thicknesses. A recent paper [7] reports, for a sample of digital mammography system, a mean glandular dose of 1.86 mGy for a mean compressed breast thickness of 54 mm.

Images for this section:
**Fig. 1:** AGD values calculated for the Sectra MDM L-30 C120 and EC desirable values for PMMA thicknesses increasing from 20 mm to 70 mm.
Fig. 2: AGD distribution for a 120 woman-sample (4-projections mammography, 480 exposure data) examined on the Sectra MDM L-30 C120 unit.
Fig. 3: Compressed breast thickness distribution for a 120 woman-sample (4-projections mammography, 480 exposure data) examined on the Sectra MDM L-30 C120 unit.

- $N = 480$
- mean = 53 mm
- SD = 14.2
- 1st quartile = 42 mm
- median = 53 mm
- 3rd quartile = 63 mm
Conclusion

The average glandular dose evaluated on a 120 women-sample confirms that this single photon counting mammography unit is able to deliver very low AGDs, also if compared to other commercial technologies, pointing out a possible population dose reduction by increasing its use.

References


**Personal Information**

Veronica Rossetti, Ph.D.

Medical Physics Department,

S. Giovanni Battista University Hospital

Torino, Italy