



A COMPREHENSIVE STUDY OF THE GLANDULAR DOSE TO WOMEN PARTICIPATING IN THE NATIONAL MAMMOGRAPHY PROGRAM FOR EARLY DETECTION OF CANCER OF THE BREAST, IN ISRAEL.

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Introduction

The dose to the Standard Breast and the glandular dose (GD) and Mean Glandular Dose (MGD) to women participating in the Israeli national mammography screening program were evaluated. This is the first time in more than 20 years that a systematic evaluation of the GD in mammography screening procedures was carried out in Israel. The present project complements important data related to the glandular dose involved in mammography carried out using a CR and DR mammography systems.

Methods

For each mammography unit, a Craniocaudal (CC) view was executed, of a 4.5 cm thick PMMA phantom (which simulates imaging of the breast causing similar attenuation and backscatter), and the kerma in air was measured with an ionization chamber placed at a distance of 4.5 cm above the table (on which the phantom was located pre-viously).

The MGD of the so-called 'standard breast' (5.3 cm thick) was calculated from the measured values of the kerma in air K , in the standard breast phantom, for each of the imaging systems, using a formula described in IPEM Report 89 (IPEM 2005).

The MGD to women who attended mammography screening in a certain mammography clinic, was evaluated using the real variables (the breast's thickness in compression and the actual imaging parameters (milliampere-seconds and peak), which were chosen by the system (in automatic mode) for each of 50 women who underwent mammography with the same mammography unit as was recorded by the technician who operated the system. Those recorded milliampere-seconds and peak kilovoltage values were chosen and a manual vertical view imaging executed in those conditions and the radiation kerma in air at a height of 4.5 cm above the table was measured with the ionization chamber. The GD to each woman and the MGD for the group of women attending to mammography in a certain clinic were then evaluated using the above mentioned method and formula. About 15% of the systems are conventional (film screen), 25% are DR and the rest are CR.

The results of the measurements and epidemiological data collected by the Israeli Center for Cancer registration will be used to perform risk-benefit ratio evaluation of the Israeli national mammography program.

Results

Initial results of the measurements and dose evaluation related to 37 mammography machines operating in 32 mammography clinics in Israel are presented in table one and table two below:

Table 1. The kerma in the air at entrance to the phantom and the calculated MGD to a standard breast (based on measurements in 37 mammography systems).

Glandular Dose (mGy)	Air kerma - K (mGy)	HVL (mmAl)	filter	Number of device	Mammography Clinic
0.828	2.74 ± 0.09	0.538	Rh/W	1	(DR) A
1.76	8.43 ± 0.28	0.38	Mo/Mo	2	(CR) B
2.03	10.07 ± 0.33	0.364	Mo/Mo	3	(CR) C
2.00	10.66 ± 0.35	0.334	Mo/Mo	4	(CR) C
1.39	6.83 ± 0.23	0.369	Mo/Mo	5	(CR) D
1.14	5.77 ± 0.19	0.355	Mo/Mo	6	(CR) D
1.29	6.19 ± 0.21	0.376	Mo/Mo	7	(CR) D
1.68	8.03 ± 0.27	0.379	Mo/Mo	8	(CR) E
2.82	13.94 ± 0.46	0.365	Mo/Mo	9	(CR) E
1.98	9.76 ± 0.33	0.366	Mo/Mo	10	(CR) F
2.01	11.76 ± 0.34	0.309	Mo/Mo	11	(film) G
2.29	12.47 ± 0.37	0.325	Mo/Mo	12	(CR) H
4.3	21.84 ± 0.54	0.358	Mo/Mo	13	(CR) I
2.08	10.91 ± 0.31	0.339	Mo/Mo	14	(CR) J
0.77	4.11 ± 0.14	0.334	Mo/Mo	15	(CR) K
1.1	3.39 ± 0.11	0.575	Ag/W	16	(DR) L
1.71	8.84 ± 0.32	0.343	Mo/Mo	17	(CR) M
1.03	4.89 ± 0.14	0.381	Mo/Mo	18	(film) N
1.59	7.75 ± 0.26	0.371	Mo/Mo	19	(DR) O
1.63	8.14 ± 0.37	0.359	Mo/Mo	20	(CR) P
1.60	8.70 ± 0.41	0.324	Mo/Mo	21	(film) Q
1.4	7.45 ± 0.43	0.332	Mo/Mo	22	(film) R
1.1	5.16 ± 0.39	0.390	Mo/Mo	23	(DR) S
1.05	5.17 ± 0.35	0.366	Mo/Mo	24	(DR) S
1.1	3.69 ± 0.26	0.532	Rh/W	25	(DR) T
0.80	2.66 ± 0.16	0.536	Rh/W	26	(DR) U
1.61	8.56 ± 0.44	0.334	Mo/Mo	27	(film) V
1.69	8.69 ± 0.37	0.347	Mo/Mo	28	(DR) W
1.26	6.11 ± 0.31	0.375	Mo/Mo	29	(DR) X
1.32	4.09 ± 0.11	0.577	Ag/W	30	(DR) Y
0.98	3.27 ± 0.15	0.532	Rh/W	31	(DR) Z
0.96	3.19 ± 0.12	0.535	Rh/W	32	(DR) 27
1.21	4.1 ± 0.22	0.526	Rh/W	33	(DR) 28
0.73	2.47 ± 0.11	0.526	Rh/W	34	(DR) 29
2.15	12.33 ± 0.32	0.305	Mo/Mo	35	(film) 30
1.24	4.14 ± 0.23	0.532	Rh/W	36	(DR) 31
1.42	4.7 ± 0.18	0.539	Rh/W	37	(DR) 32

Table 2. The kerma in the air and the calculated average MGD for two views for the 50 patients in each specific mammography system.

Glandular Dose (mGy) Average per woman	Air kerma - K Average (mGy)	Number of device
2.07	6.7 ± 0.9	1
5.25	25.1 ± 3.3	2
6.42	31.7 ± 4.1	3
4.19	22.3 ± 2.9	4
3.95	19.3 ± 2.6	5
2.68	13.5 ± 1.8	6
4.11	19.9 ± 2.7	7
4.69	22.4 ± 2.9	8
6.55	32.4 ± 4.1	9
4.49	22.1 ± 2.9	10
4.02	23.4 ± 3.1	11
4.58	24.9 ± 3.3	12
8.61	43 ± 3.8	13
5.94	31.3 ± 4.1	14
2.38	12.7 ± 1.7	15
2.2	6.9 ± 1.1	16
2.8	14.6 ± 2.3	17
2.65	12.7 ± 2.1	18
3.05	14.9 ± 2.4	19
3.37	16.9 ± 2.5	20
4.78	26 ± 2.3	21
4.44	23.7 ± 2.1	22
2.76	12.2 ± 1.3	23
2.44	12 ± 1.6	24
2.88	9.6 ± 1.1	25
1.76	5.8 ± 0.9	26
5.08	27.0 ± 3.9	27
2.58	13.2 ± 1.8	28
3.09	14.9 ± 1.4	29
2.24	6.9 ± 1.2	30
1.96	6.6 ± 1.1	31
2.26	7.5 ± 1.6	32
2.26	7.7 ± 1.8	33
1.65	5.6 ± 1.1	34
5.55	31.0 ± 3.9	35
2.45	8.2 ± 1.2	36
1.6	5.3 ± 0.9	37

Discussion

This substantial variation in the MGD values for the different clinics can be connected to the fact that (due to legal and financial difficulties) no systematic periodical quality control measurements were carried out in recent years in mammography clinics in Israel (however admission tests and a first set of quality assurance measurements are conducted by a professional team of the Ministry of Health on all new mammography systems).