Scatter Radiation From Diagnostic X-ray Units In Lagos Metropolis

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ABSTRACT

This work studied the level of scatter radiation from conventional x-ray, C.T. and mammography units as a result of differences in voltage wave form and filtration.

Method: Four thermoluminescent dosimeters (TLD) were placed on each wall of 27 (twenty seven) x-ray rooms, 2 (two) C.T. rooms and 1 (one) mammography room at equal distances from the film at a level of about 1.0m from the ground (i.e. at the gonad level in average adult) for a period of about 13 weeks. The background radiation level at these centres were measured graph. Results show that (normal ranges form 0.87mSv to 3.22mSv) the dose recorded with C.T. unit ranges from 0.0062mSv to 0.0009mSv. with mammography, it ranges from 0.0071mSv to 0.00089mSv and with conventional x-ray units, it ranges from 0.0010mSv to 0.018mSv.

Conclusion: The amount of scattered radiation from C.T. unit is higher than from conventional x-ray and mammography units

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INTRODUCTION

The diagnostic applications of x-ray in medicine contributes more to the hazards associated with the use of ionizing radiation in medicine than any other application.[1] These hazards are more from the effects of scattered (secondary) radiation than the primary radiation beam.[2] The amount of scattered radiation produced from the different X-ray equipment has not been established. Since the exposure factors and conditions are different, this work studied the level of scatter within a specific time frame in busy centres and established the level of scatter for a unit examination using each of the x-ray diagnostic tools

MATERIALS AND METHODS

Twenty seven x-ray machines in Lagos metropolis with 3 phase power supply and filtration of 1.5mm AL. (added filters). Two computerized tomography unit and one mammography unit were monitored. The capacity of the x-ray equipments used ranged from 40kv to 125kv. A total of 149 TLD chips were used, out of these, 9 were controls which represented the background radiation levels within the area of placement. The TLD (thermoluminescent disc) were of LIF (lithium floride) crystals 100.

5 chips were placed in hospital 1 mammography unit, 10 were placed in the two C.T. centres and 124 chips placed in the 27 x-ray rooms. The level of scatter in each room was measured using the thermoluminescent discs (TLD). Four TLD chips were placed on each wall of the room at equal distances from the film. The placement on the wall is about 1.0m (Approx. 3ft) from the floor which is about the level of the gonads in average adult. Each chip is put in transluscent polythene envelope and fixed on the wall with masking tapes for about 13 weeks. Within the period, care was taken to ensure that there were no pressures on the chips form touch. Each TLD is coded for easy identification.

The TLDs were read with solaro dual channel TLD reader; model 680 produced by NE Technology LTD, 1991 series (Solaro 1991).

TABLE 1
Distribution of Studied Centers

S/N	AREA	No. of Centres	No. of TLDs
1	Lagos Island	6	34
2	Obalende	1	5
3	Surulere	5	34
4	Ikeja	3	14
5	Victoria Island	1	21
6	Maryland	2	10
7	Ikorodu	2	10
8	Idi-Araba	1	21

RESULTS AND DISCUSSION

The tables below show the TLD readings from the various centers. The average TLD reading is the mean of the reading of the four TLDs in each room. For instance in Lagos Island Hospital one out of the five TLD badges used, was placed outside to read the background level of radiation and 4 were placed in the x-ray room for a period of 13 weeks within which 355 films were used representing 355 exposures. Each of the four TLD chips had a different reading. The average reading is 1.50 mSv. This value excludes the background radiation level measured by the fifth TLD placed outside the room which is 0.92mSv. the difference [1.50 – 0.92]mSv i.e. 0.58mSv is the equivalent dose due to the 355 exposures made in the room. The equivalent dose due to one exposure is 0.58mSv divided by 355 exposures. For this hospital it is equal to 0.0016mSv. This is repeated for all the hospitals and x-ray units and the equivalent dose for each exposure made in all the rooms and imaging modality is established.

The values obtained show that the background level of radiation varies from 0.87mSv in hospital 2 to 3.2mSv in hospital 3. The calculated mean background level within the studied environment in Lagos is 1.42mSv and the measured background radiation level in the centers range from 0.87mSv to 3.20mSv. This falls within the internationally acceptable usual range from 0.40mSv to 4.0 $(mSv)^3$. The scattered radiation from each patient X-ray examination to the environment ranges from 0.0010mSv to 0.018mSv. This means that for every 1000 patient's X-ray examination, a minimum of 1.0mSv and a maximum of 18mSv of radiation scatters into the environment.

TABLE 2

Exposure Pattern for the Eight Districts studied for the Conventional Diagnostic Facility and the Background Radiation Level Conventional Radiography

S/N	Name of Center	No. of Exp	Average No. of TLD	Measured background radiation (mSv)	Approx. Env. Exp.	Exposure per unit exam (mSv)
	Lagos Island					
1.	Hospital 4	355	5	1.50	0.92	0.0016
2.	Hospital 5	344	5	1.49	1.15	0.001
3.	Hospital 6	215	5	1.64	1.01	0.0029
4.	Hospital 2	916	9	1.80	1.26	0.0057
5.	Hospital 7	916	9	1.80	1.26	0.0016
6.	Hospital 8	413	5	8.68	1.76	0.017
	Ikeja					
1.	Hospital 1	381	9	1.74	1.22	0.0014
2.	Hospital 9	518	5	5.82	1.91	0.0075
3.	Hospital 10		1	3.20	3.20	

TABLE 3

Exposure Pattern for the Eight Districts studied for the Conventional Diagnostic Facility and the Background Radiation Level Conventional Radiography

S/N	Name of Center	No. of Exp	Average No. of TLD radiation	Measured background minus (mSv)	Approx. Env. Exp.	Exposure per unit exam (mSv)
	Surulere					
1.	Hospital 11	118	4	1.43	1.05	0.0032
2.	Hospital 12	998	13	1.62	1.09	0.0016
3.	Hospital 13	413	4	1.70	1.04	0.0016
4.	Hospital 14	92	4	1.44	0.74	0.0076
5.	Hospital 15	215	4	1.72	1.16	0.0026
	Others					
1.	Hospital 16	291	5	1.50	1.03	0.0016
2.	Hospital 17	1214	17	1.60	1.19	0.0075
3.	Hospital 18	882	14	1.87	0.96	0.003
4.	Hospital 3	518	8	7.75	3.20	0.018

TABLE 4

Exposure Pattern for CT (Computerised Tomography Units)

S/N	Name of Center	No. of TLDs	Average TLD (mSv) reading	Measured background radiation	TLD reading minus background Level (mSv)
	Surulere				
1.	Hospital 18	5	3.26	0.96	2.30

TABLE 5

Exposure Pattern for Mammography Units

S/N	Name of Center	No. of TLDs	Average TLD (mSv) reading	Measured background radiation (mSv)	Approx. Exp. for Examination (mSv)	TLD reading minus background Level
	Surulere					
1.	Hospital 15	4	1.31	1.22	0.0008	0.09

CONCLUSION

In hospital 7, hospital 9, hospital 8, the scatter radiation is highest i.e. 0.54mSv, 3.91mSv, 6.92mSv respectively. (This means that for each x-ray examination the scatter is 0.0016mSv, 0.0075 and 0.017mSv respectively). The TLD readings for the CT units are comparatively higher than the conventional radiography and the mammography values. This is largely due to the duration of each examination. In addition, the radiographic factors are relatively higher than the factors used for the examination of the same body structure in conventional radiography and mammography.

The scatter level for mammography unit is very low, 1.31mSv. This gives 0.0008mSv per examination. This low value is due to the low energy value of the radiation used, the short FFD (Focus Film Distance) and the absence of filters. These discourage scattering.

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