Measurement of Absorbed Dose of Radiation in Abdominal X-Ray

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This study aims at determining the patient absorbed dose of radiation in plain x-ray examination of the abdomen. Three pairs of thermoluminescent discs (TLD) (LiF-100) were placed on each patient for plain x-ray of the abdomen at the centring point and at the extremes of the beam field margins on the patient. The average value for these three TLD readings represented the entrance skin dose (ESD) and another set of three TLD badges placed randomly at the beam exit field represented the exit dose. A Siemens machine with 125kVp (Kilovoltage peak) and a Toshiba machine of 90Kvp from two different diagnostic centres were used to examine a total of 125 patients. The difference between the ESD and the exit dose (ED) gave the absorbed dose. The results gave a mean ESD Value of 0.99 ± 0.11 mGy; ED of 0.31 ± 0.11 mGy; and AD of 0.68 ± 0.11 mGy. The absorbed radiation dose to the abdomen in these centres is low compared to published values. This dose is directly related to the antero-posterior thickness [APT] and the body mass index [BMI] of the patient. There is no measurable correlation of this dose with age and sex.

1. Introduction

Exposure to radiation could be by natural or artificial sources. The total natural background radiation (NBR) is about 0.8-2.2 mSv/yr [1]. This could be raised by over 50% depending on location [1]. These natural sources could be from radioactivity from within man i.e. presence of potassium 40 and radioactive food and drinks taken, radioactivity from terrestrial bodies and celestial radioactivity. These three are the major contributors of environmental background radiation level. The other radiation exposure to man is man made.

Medical exposure contributes over 75% of the man-made radiation dose to man [1]. These exposures are justified from the medical point of view since the benefit to the exposed person outweighs the risk. A patient for chest x-ray gets about 0.05 mSv as effective dose; in lumber spine x-ray, it is between 2-15 mSv; and in pelvis x-ray it is about 1.2mSv. In barium meal, it is 3.8 mSv and in barium enema, it is about 7.7 mSv [1].

Carlsson et al [2] studied the relationship between the effective dose equivalent Hₑ and the mean dose equivalent D to patients in diagnostic radiology. The results show that Hₑ / D values are in the range of 0.44-2.8 SvGy⁻¹.

In patients CT examination of the abdomen and skull, the effective doses ranged from 1.5 to 6.0 mSv in skull CT and from 3.1 to 5.3 mSv in abdominal CT examinations [3].

2. Materials and Methods

This research was carried out in two centres: Hansa clinic, Uwani, Enugu and Nnamdi Azikiwe University Teaching Hospital, Nnewi. A total of 125 patients were evaluated over a period of six months, comprising 78 females and 47 males of different anthropometric characteristics. The patients chosen for the study were by simple random sampling.

Equipment and accessories used were:
Siemens static x-ray unit of rating 500 mA/ 125 kVp 3 phase, full wave rectified unit with total filtration of 3.00 mmAl.

Stactic Toshiba machine of 90 kVp , Full wave rectification and total filtration of 3.00 mmAl.

Thermoluminescent dosemeters of Lithium Fluoride Crystal [LiF -100]750 chips.

A Solaro dual channel TLD reader model 680 by NE Technology LTD 1991 series

Standard AP (Antero-posterior) X-ray examination of the abdomen in supine position was carried out at FFD of 100cm. Three pairs of TLD chips in cellophane envelopes and properly labelled were placed on anterior and posterior sides of the patient (i.e at the centring point and exit points respectively) to measure the ESD (entrance skin dose) and the ED (exit dose) respectively.

The TLDs were pre annealed to ensure that all previous absorbed radiation had been wiped out. The FFD (film focus distance) used was 100cm. The Hamsons simple bathroom weighing scale was used to measure the weights and the patients heights were measured on a marked wall. The BMI (body mass index) was computed from wt (kg) / h² (m).

3. Results

The data were analysed using the statistical package for social sciences (SPSS) version 14.0. Both descriptive and inferential statistics were carried out. The values were expressed as mean ± standard deviation. Statistical significance was considered at P < 0.05.

<table>
<thead>
<tr>
<th>Table 1: Gender Distribution of Patients</th>
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<tbody>
<tr>
<td>Frequency</td>
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<tr>
<td>----------------</td>
</tr>
<tr>
<td>Male</td>
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<td>Female</td>
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<tr>
<td>Total</td>
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4. Discussion

Lithium floride (LiF) -100 is a good practical device for periodic monitoring of radiation exposure to both staff and patients [4]. The dose meters have only about 10% variation in their readings, with a predictable decay of about 5% in one year [5].
There is direct relationship between the dosimetric values obtained (i.e the exit dose and the absorbed dose) and the BMI as well as the APT (antero-posterior thickness). The larger the APT, the lower the exit dose and the higher the absorbed dose. This is also true for body mass index.

However, the higher the exposure parameters, the lower the absorbed dose and the higher the exit dose. This is particularly true for high kilovoltages. Therefore, high kV techniques ensure radiation protection to the patient. There was no measurable age and gender effect on the exit dose and absorbed dose values. At very low BMI, the exit dose tends towards and almost equal to the entrance skin dose.

Comparing the absorbed dose values calculated from the measurements made with values from other studies, we notice that the range of values obtained -1.12 to 2.11 mGy is lower than the documented value of 3.8 mSv obtained in a similar work for barium meal x-ray examination (Abdominal x-ray for stomach) [1]. This could be attributed to a lower mean APT of the patients studied.

5. Conclusion

The measured radiation dose absorbed by the abdo-

men had a direct relationship with the Antero-

Posterior thickness (APT) and the body mass index

(BMI) of the patient. However, there was no correla-

tion with age and sex of the patient. The mean value

measured is 0.66 mGy. This is slightly lower than
documented measured values in other places. This could be attributed to low average APT for the popu-

lation sampled.

References


