

ENTRANCE SURFACE DOSE MEASUREMENT FOR SOME OF THE RADIOLOGICAL PATIENTS IN BANGLADESH

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Abstract

ESD values were measured for the most common types of X-ray procedures in four of the main hospitals of Dhaka the Capital City of Bangladesh. Patients undergoing a variety of examination protocols such as Chest PA, Lumbar Spine AP and Lateral, Skull AP and Lateral, Pelvis AP were studied in the four hospitals numbered as 1, 2, 3 and 4. Diagnostic Radiology is the largest contributor to the artificial sources of ionizing radiation. Since X-ray is a powerful technique of diagnostic imaging, a large number of patient's (a part of total population) are availing this technique every day in all countries of the world including Bangladesh. But so far no attempt has been made in Bangladesh to find out the doses delivered to the patient undergoing different X-ray procedures. So, in this study Entrance Surface Dose (ESD) values have been measured for about 196 patients undergoing different X-ray procedures. The observed ESD values in the different local hospitals were compared with the values within the hospitals and also with the International Reference ESD Values.

1. Introduction

Though a net benefit to health may be achieved by all increase in the provision of radiation services in medical fields yet it carries some risk. International Atomic Energy Agency has imposed no limit on medical exposures, the aim is to ensure that the doses are not only low enough to justify the particular diagnostic examination but are kept even lower when the objective is reasonably achievable.

Entrance Surface Dose is one of the basic dosimetric quantities for measuring the patient dose. In connection with optimizing patient dose it is also the basic quantity for comparing with the International Reference Values which is also important from the point of view of radiation protection of the patients. Though ESD value measurement for the patient is an essential component of Quality Control programme for individual X-ray radiology departments but comparison of ESD values between different hospitals, showing the variation of ESD values and the ratio of maximum and minimum ESD values can picture out the overall situation of the radiology departments of the country and can help to take protective measures where necessary. So, such an attempt has been undertaken in the present study. The results of the patient dose measurement, presented here are the first reported works that have been done in Bangladesh.

2. Experimental procedure

Since Chest PA patients were easily available in the hospitals, 10 patients for this projection in all the hospitals were taken but the patient sample size had to be lowered because of lower availability of the patients for some of the other procedures. In order to obtain representative values of ESDs for each X-ray procedure at least five patients per type of radiograph has been studied to provide a good indication of typical clinical practice. Only adult patients are included in the sample for the assessment of general diagnostic radiology procedures. Both sexes have been included as long as extremes in physique are avoided. Patients with weight 60 ± 10 kg. were considered in this study [1]. Since effects of field size on radiation output in air has been found to be small and in fact negligible for field sizes used in radiograph [2], the effect of field size has been neglected in this study.

For each diagnostic procedure a batch of three TLD chips were attached to the skin as close as possible to the point where the central axis of the X-ray beam enters the patient. The exposure parameters of the patients such as kVp, mAs, time, FFD etc. were noted down. Following the X-ray procedure the chips were read by the Harshaw 3500 TLD Reader. The average of three chips was taken as the ESD value received by the patient for that particular procedure. For background one batch of chips was kept without exposure every time when the other chips were exposed.

3. Results and discussion

Patient data and exposure parameters are shown in Table I. The mean ESD values in different hospitals together with the reference ESD values and also the range factors (ratio between maximum and minimum ESD values) is shown in Table II.

Table I. Patient Data and Exposure Parameters for ESD Measurement

Serial No. of the hospitals	Type of X-ray Procedure	Range of Age of Patient	Range of Wt. Of Patient	Range of kVp	Range of FFD (cm)
1.	Chest PA	18-36	56-68	50-55	114-138
2.		22-60	55-75	65-80	150-150
3.		24-78	54-65	55-70	150-150
4.		28-65	50-69	55-73	200-200
1.	Lumber Spine AP	21-60	52-71	70-81	90-103
2.		20-55	52-68	70-85	90-90
3.		31-70	50-74	70-90	105-110
4.		20-70	50-70	60-77	90-110
1.	Lumber Spine Lateral	21-60	52-71	77-85	90-110
2.		22-55	52-68	80-90	90-90
3.		31-70	54-65	70-95	105-110
4.		23-70	50-70	73-85	90-110
1.	Skull AP	20-50	53-73	57-70	80-100
2.		22-50	50-65	70-80	90-100
3.		18-68	52-80	75-85	105-110
4.		24-45	50-67	60-75	100-100
1.	Skull Lateral	20-50	53-59	57-81	80-103
2.		34-50	50-65	70-80	90-100
3.		18-68	52-74	65-80	105-110
4.		24-45	50-67	55-70	100-100
1.	Pelvis AP	18-65	50-58	65-77	90-112
2.		32-48	50-66	70-80	90-105
3.		19-75	50-80	65-80	105-110
4.		27-70	52-77	66-73	97-113

A large variation of ESD values for the same type of X-ray procedure even in the same hospital has been observed. The mean ESD values for each procedure was compared with the Internationally Accepted Reference Values. It is observed that in most of the cases the local hospitals delivered ESD values lower than the corresponding Reference Value. In case of Chest PA, the variation between kVp used among the hospitals was large (50-80 kVp), also variation between used FFD was large (114-200), so a large variation of the ratio of 35.9 in the max/min ESD values was observed. This abnormally high variation in the ratio of ESD values indicates wide variation in the dose, delivered to the patient for the same type of examination. Hospitals 1, 3, and 4 delivered ESD values for Chest PA nearly equal to the Reference Value

Table II. Mean and Range of ESD Values for different types of X-ray examinations in different hospitals together with the Reference Value and Range factor

Name of Hospital	Type of Exam.	No. of Patients	Maximum ESD (mGy)	Minimum ESD (mGy)	Mean ESD (mGy)	Reference Value (mGy)	ESD Range Factor Max/Min
1. 2. 3. 4.	Chest PA	10 10 10 10	0.49 ± 0.17 4.67 ± 0.22 0.73 ± 0.21 0.74 ± 0.10	0.14 ± 0.01 0.28 ± 0.04 0.19 ± 0.03 0.13 ± 0.03	0.33 ± 0.07 1.58 ± 0.16 0.44 ± 0.14 0.44 ± 0.13	0.4	35.9
1. 2. 3. 4.	Lumber Spine AP	10 10 9 10	5.67 ± 0.65 25.54 ± 3.66 10.28 ± 0.40 6.22 ± 1.07	2.54 ± 0.15 4.52 ± 0.36 3.51 ± 0.06 1.36 ± 0.09	4.01 ± 0.67 9.71 ± 0.57 7.07 ± 0.55 3.48 ± 0.64	10	18.8
1. 2. 3. 4.	Lumber Spine LAT	10 9 10 10	8.28 ± 0.40 33.68 ± 1.32 23.25 ± 0.41 12.46 ± 0.63	5.89 ± 0.48 7.31 ± 1.00 9.08 ± 0.02 3.03 ± 0.29	7.20 ± 0.66 12.66 ± 1.20 13.82 ± 0.76 6.6 ± 0.69	30	11.12
1. 2. 3. 4.	Skull AP	7 7 10 5	2.58 ± 0.13 15.40 ± 1.5 3.51 ± 0.86 1.64 ± 0.17	1.19 ± 0.28 2.40 ± 0.18 1.34 ± 0.14 0.86 ± 0.10	1.17 ± 0.24 8.6 ± 0.95 2.4 ± 0.45 1.21 ± 0.15	5	17.9
1. 2. 3. 4.	Skull LAT	5 5 10 5	0.93 ± 0.11 10.09 ± 0.8 3.66 ± 0.33 1.56 ± 0.14	1.46 ± 0.08 3.78 ± 0.24 1.52 ± 0.07 0.49 ± 0.02	1.16 ± 0.12 6.96 ± 0.44 2.44 ± 0.34 0.92 ± 0.14	3	20.59
1. 2. 3. 4.	Pelvis AP	5 5 8 6	4.83 ± 0.64 8.04 ± 0.28 9.24 ± 0.52 3.28 ± 0.13	2.07 ± 0.27 4.00 ± 0.15 2.73 ± 0.56 1.91 ± 0.10	3.34 ± 0.55 6.20 ± 0.30 5.15 ± 0.46 2.63 ± 0.66	10	4.8

but hospital 2 delivered higher than Reference Value. In case of Lumber Spine AP hospital 1 delivered dose nearly equal to the Reference Value but all other hospitals delivered lower doses. In case of Skull AP all the four hospitals delivered lower doses than the Reference Value except hospital 1 which delivered higher value. In case of Skull Lateral hospital 3 delivered ESD value nearly equal to the Reference Value. The other two hospitals delivered lower values except hospital 1 which again delivered about 2 times higher value than the Reference Value. In the case of Pelvis, all the hospitals delivered lower mean ESD values than the Reference Value.

From the present study though it is observed that in many cases the mean ESD values are below the Internationally accepted Reference Values, in most of the cases the fluctuation of the ESD values was too large, even in the same type of X-ray examination and same X-ray facility. It was found that the ratio of maximum and minimum ESD values for different X-ray procedures ranged from 2.62 to 77.8, the Chest PA has showed the largest variation. Higher ESD than the Reference ESD values for a particular type of X-ray procedure in general represent an unnecessary over exposure to the patient whereas low ESD values may lead to poor diagnosis and unnecessary repetition of the X-ray procedure. In both cases the chance of

increasing radiation exposure to the patient increases. Also a considerable spread of patient doses between hospitals for similar types of X-ray procedure reflects the need for dose optimization maintaining the relevant appropriate parameters for the radiological X-ray procedures in Bangladesh

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References

- [1] ORESEGUN, M. et, al., "Radiation Protection and Quality Assurance in Diagnostic Radiology an IAEA Coordinated Research Project in Asia and Eastern Europe," Appl, Radiat, And Isotopes, Vol. 50, Pergamon Press (1999) 271–276.
- [2] ROGERS, R. T., "Radiation Dose to the skin in Diagnostic Radiology", British Journal of Radiology, Vol. 42, No. 493 (1969) 511–518.