Biomedical Research 2019; 30 (4)

ISSN 0970-938X
www.biomedres.info

Assessment of radiation dose received chest X-rays for traumatic patients in Majmaah area, Saudi Arabia.

Yousif Mohamed, Yousif Abdallah*

Department of Radiological Science and Medical Imaging, College of Applied Medical Science, Majmaah University, Saudi Arabia

Abstract

Background: Chest trauma or chest injury is a kind of injury to chest that leads to life threatening impact. Radiation imaging is used for trauma assessment, treatment and monitoring.
Objectives: The purpose of this study was to estimate of the radiation dose received in chest x-rays for traumatic patients in the Majmaah area and matched the results nationally and internationally. Furthermore, it aims to determine the reference radiation dose for chest x-rays.
Methods: Sample of 160 patients were evaluated at radiology department of King Khaled Hospital-Majmaah, Saudi Arabia. The average patient age for adults was 34.5 ± 12.9 with the range of (18-80) (years) and for pediatric patients was 7.6 ± 2.5 with range of (1-16) years. The average and range of exposure parameters were 72.8 ± 8.3 (81.8-124.9) and 1.5 ± 0.9 (0.3-2.5) for X-ray tube potential (kVp) and current multiplied by the exposure time(s) (mAs), respectively.
Results: The measured dose for adult patients were (0.20 ± 0.07 (0.13-0.37) and 0.24 ± 0.1 (0.06-0.74) for female and male respectively. The measured dose for pediatric patients were (0.20 ± 0.07 (0.13-0.37) and 0.18 ± 0.03 (0.06-0.23) for female and male respectively.
Conclusion: The study was revealed that 90% of the chest x-rays exposures with normal dose levels. However, precise justification is required, especially for young patients.

Keywords: Radiation, Dose, Chest, Traumatic, Majmaah, Saudi Arabia.

Accepted on April 23, 2019

Introduction

Trauma is an injury that effects and leads life to threatening, psychological and physical impact. Recently, in Saudi Arabia, the number of traffic accidents and their effects has increased significantly [1]. There is no clear protocol to describe radiation exposure of patients during radiation investigations [2,3]. The usual radiation exposure varies between 10-100 mGy, which may increase the possibility of cancer incidence especial among population who high exposed [4-6]. The traumatic x-rays imaging considers as the commonest diagnostic tool used to analyze and identify pathological conditions. It contributes by significant radiation dose amount to patients. Since the applications of traumatic radiology are growing quickly, it is the crucial issue to appraise the radiation dosages during the examination and try to reduce them as much as possible [7-10]. Radiation exposure is the main hazard in medical x-rays imaging. Those exposures are results from improper use of equipment and high exposure factors. The exposure of diverse dose standards for the same medical investigation is a sufficient purpose to draw attenuation to this matter. Radiation exposure can lead to severe injuries and possible cancerous attending. Radiation medical imaging is used commonly for trauma assessment [11,12]. Those imaging examinations are helped in the appropriate analysis of numerous disorders. They provide quick and precise analysis for the emergency GPs for the judgment of the serious grievances in patients, particularly in some patients that their injuries are difficult to diagnose them [13]. There are many hazards associated with the radiation exposure which included the acute (radiation injury) and chronic exposure effects (cancer). The acute effects include organs injuries, which can possibly lead to decease at high dosage. Most of the radiographical investigations do not cause acute injuries to the patients due their low energy less than 10 mGy [14]. The chronic effects of radiation are included the dangerous of cancer and genetic disorders. The measurement of the radiation dose from traumatic radiological examinations was conducted globally [15].

Material and Methods

The examined patients sample consists of 160 patients who were examined at the radiology department of King Khaled Hospital, Majmaah, Saudi Arabia. The ethics and review council approved this research and knowledgeable permission was attained from all patients before collection the data [16-21]. IRB of King Abdelaziz City of Science and Technology (KACST) and Ministry of Health, Saudi Arabia approved all the methods of data collection that were

performed in this study. All patients were undergone the procedure due to medically justified clinical conditions. Patients' demographic data (age (years) and radiographic exposure factors), X-ray tube voltage (kVp), product of time and tube current (mAs), exposure time and X-ray projection were recorded for all patients. The conventional X-ray examinations were conducted using a digital system (Siemens) which equipped with automatic exposure control (AEC). The Estimated Skin Dose (ESD) was measured for each patient. This dose was used to quantify the ionizing radiation for the traumatic patients in radiology department [22]. The measured dose was compared with different previous studies nationally and internationally. Data analyzed for regression by using SPSS software and the results presented in form of graphs and tables (Table 1).

Table 1. *Patient x-rays image acquisition features.*

Adult patients (n=110, 68.75%)			
Female patients n=25 (22.7%)	**Mean ± SD**	**Minimum**	**Maximum**
Age (years)	37.1 ± 13.3	18	63
Tube voltage (kVp)	124.8 ± 0.14	124.5	124.9
Tube current time product (mAs)	1.6 ± 0.79	1	2.2
Male patients n=85 (77.3%)			
Age (years)	33.3 ± 14.4	18	80
Tube voltage (kVp)	117.15 ± 16.5	74.6	124.9
Tube current time product (mAs)	2.13 ± 1.1	0.8	6.1
Pediatric patients (n=50, 31.25%)			
Age (years)	8.60 ± 2.7	1	16
Tube voltage (kVp)	101.72 ± 18.9	72.9	124.9
Tube current time product (mAs)	2.05 ± 0.79	0.3	6.5

Results

This study involved 160 patients undergoing lumbar spine radiographic examinations in radiology departments at King Khalid Hospital in Majmaah. The patient age groups were shown in Table 2. For the pediatric patients, the age groups were shown in Table 3. For the group of patients, the radiation exposure factors (kVp and mAs) were shown in Table 4 and Figure 1. The measured dose was ranged between 0-0.79 mGy. The measured and age group distribution were shown in Table 5.

Table 2. *The age distribution for both gender among adult patients in the study sample.*

Age Group (years)	**Male n (%)**	**Female n (%)**
20-29	4 (3.6%)	37 (33.6%)
30-39	2 (1.8%)	25 (22.7%)
40-49	4 (3.6%)	15 (13.6%)
50-59	4 (3.6%)	5 (4.5%)
60-69	4 (3.6%)	0 (0.0%)
70-79	0 (0.0%)	5 (4.5%)
80-89	0 (0.0%)	5 (4.5%)

Table 3. *The age distribution for both gender among pediatric patients in the study sample.*

Age Group (years)	**Number of patients n (%)**
0-5	22 (44.0%)
6-10	9 (18%)
11-15	14 (28%)
16-17	5 (10%)

Table 4. *The exposure factors used for chest examination for adults patients.*

Age group (years)	X-ray Exposure Factors (Mean ± SD)			
	Female N (%) 25 (22.7%)		Male N (%) 85 (77.3%)	
	kVps	mAs	kVps	mAs
20-29	124.8 ± 0.2	1.9 ± 0.4	117.8 ± 16.2	2.07 ± 1.4
30-39	124.6 ± 0.4	2.15 ± 1.1	121.2 ± 10.8	2.21 ± 0.83
40-49	124.3 ± 0.6	1.7 ± 0.65	122.2 ± 10.3	1.96 ± 0.8
50-59	124.9 ± 0.00	1.5 ± 0.25	124.9 ± 0.00	1.78 ± 0.04
60-69	124.7 ± 0.2	2.8 ± 1.5	_	_
70-79	_	_	87.35 ± 3.6	2.35 ± 0.60
80-89	_	_	87.02 ± 4.1	2.45 ± 0.49

Table 5. *The mean values of ESD (mGy) of chest examination for all age groups of the study sample.*

Age Group (years)	**ESD (mGy)**											
	Present study	**KKUH**	**SFH**	**KACST**	**IAEA**	**European commission**	**IRISH**	**UK**	**Nigeria**	**Turkey**	**Italy**	**Bushra**
0-5	0.018	-	-	-	-	-	0.05	0.09	-	-	-	0.12
6-10	0.040	-	-	-	-	-	0.053	0.15	0.52	-	-	0.18
11-15	0.052	-	-	-	-	-	0.066	-	-	-	-	0.18

16-17	0.024	-	-	-	-	-	0.088	0.1	-	-	-	-
Adults	0.021	0.135	0.220	0.4	0.4	0.3	-	0.16	-	0.346	0.57	-

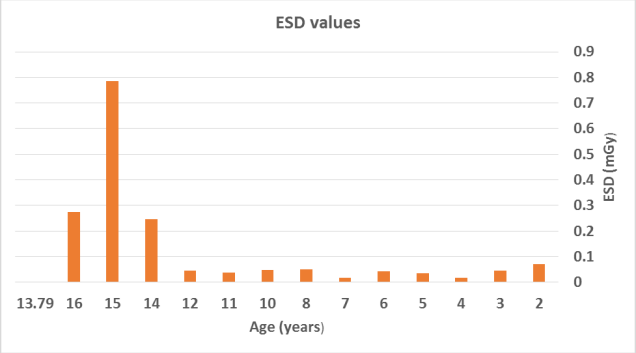

Figure 1. *Disturbation of ESD (mGy) of pediatric patients.*

Discussion

The average patient age for adults 34.5 ± 12.9 with range of (18-80 years) and for pediatric patients were 7.6 ± 2.5 with range of (1-16) years. A considerable number of patients are pediatric (Table 3), signifying that they are more at hazard compared to adult patients, (Table 2). The average patient age for adults 34.5 ± 12.9 with range of (18-80 years) and for pediatric patients were 7.6 ± 2.5 with range of (1-16) years. The average and range of exposure parameters were 72.8 ± 8.3 (81.8-124.9) and 1.5 ± 0.9 (0.3–2.5) for X-ray tube potential (kVp) and current multiplied by the exposure time (s) (mAs), respectively. The measured dose for adult patients were (0.20 ± 0.07 (0.13-0.37) and 0.24 ± 0.1 (0.06-0.74) for female and male respectively. The measured dose for pediatric patients were (0.20 ± 0.07 (0.13-0.37) and 0.18 ± 0.03 (0.06-0.23) for female and male respectively. The mean radiation exposure factors were low as comparable with other similar scientist studies nationally and internationally as shown in Tables 6 and 7. The mean ESD (mGy) were shown in Table 5 for pediatric and adults, respectively. The radiation-induced cancer due to x-rays exposure was estimated to be 178 × 10^6. Table 4 and Figure 1 present show the correlations between exposure variables and dose in the chest procedure. For adult chest examination, the lowermost dosage was 0.135 and 0.16 mGy in KKUH and UK in 2008 respectively, and the peak dose in the present study was 0.194 mGy. This dose was low compared with IAEA, EC KACST, Turkey and Italy levels. However the average dose level for pediatric projection was lower than IRISH UK, Nigeria and Bushra studies. The highest dose level for pediatric were 0.15 mGy and 0.18 mGy in UK and Bushra studies and the present study was 0.20 mGy. This study was accomplished to estimate of dose received in chest x-ray examination. In the emergency department of King Khalid Hospital-Majmaah the patients' chest radiography examination was performed. The measurement of the dose received by the patient can help in improve of the radiation protection condition in the radiology department.

Table 6. *The mean values of ESD (mGy) of chest examination for all age groups of the study sample.*

Age Group (years)	ESD (mGy)		
	(Mean ± SD)	Minimum	Maximum
0-5	0.018 ± 0.002	0.016	0.019
6-10	0.040 ± 0.002	0.038	0.042
11-15	0.052 ± 0.019	0.025	0.078
16-17	0.024 ± 0.009	0.020	0.037
Adults	0.194 ± 0.01	0.031	0.786

Table 7. *Shows the exposure factors used for chest examination for pediatric patients.*

Age Group (years)	X-ray Exposure Factors (Mean ± SD)	
	KVps	mAs
0-5	89.13 ± 8.5	0.4 ± 0.1
6-10	107.35 ± 24.8	0.8 ± 0.14
11-15	104.70 ± 28.1	3.7 ± 1.3
16-17	124.65 ± 0.35	1.9 ± 0.80

Conclusion

This study concluded that the doses for chest is lower than the all the similar studies nationally and internationally. Unlike the previous studies, the dose in chest radiography bin this study was lower in conventional radiography compared to other studies. Recently digital and computed radiography are flattering more popular due to its price, access and good dose adjustments. The study recommended that the dose optimization during conventional radiology imaging must be measured precisely. This study discovered the usage of automatic exposure controller (AEC) in x-rays machine that can be beneficial for dose reduction. This study will help the researchers to uncover the critical areas of diagnostic radiology dosimetry that many researchers were not able to explore.

Acknowledgment

The author is thankful to the Deanship of Scientific Research, at Majmaah University for funding this research (Project No. 38/147).

Conflicts of Interest

No potential conflict of interest relevant to this article was reported.

Ethical Approval

The Institutional Ethics Committees of KACST, KSA with registration number of H-01-R-012, OHRP/NIH, USA with registration number IRB00010471 and Federal Wide Assurance NIH, USA with registration number FWA00018774 were approved the study. The ethical committee of the Deanship of Scientific Research, at Majmaah University also approved this research with registration number MUREC-Nov. 2l/COM-201 8/9.

References

1. Abdallah YM, Hemair MM, Algaddal AS. Valuation of radiation dose in lumbosacral examination. Int J Sci Res 2015; 4:2322-2424.
2. Abdallah YM, Salih AM. Appraisal of radiation dose received in abdominal computed tomography patients. Int J Sci Res 2015; 4:2383-2385.
3. Abdallah YMY, Alamoudi OA, Elgak SNA. Appraisal of mean glandular dose (MGD) during mammography examinations. Int J Sci Res 2017; 4:49-51.
4. Abdallah YMY, Orsid WF. Calculation of radiation dose received in cervical vertebrae (c/s) examination. Int J Sci Res 2016; 5:102-103.
5. Bushberg JT, Seibert JA, Leidholdt EM, Boone JM. The essential physics of medical imaging. (2nd edn.), Lippincott William and Wilkins, USA, 2003.
6. Dowd BS, Tilson ER. Practical radiation protection and applied radiobiology. (2nd edn.), Sunders Company, Pennsylvania, 1999.
7. Dawe EJ, Fawzy E, Kaczynski J, Hassman P, Palmer SH. A comparative study of radiation dose and screening time between mini C-arm and standard fluoroscopy in elective foot and ankle surgery. J Foot Ankle Surg 2011;17:33-36.
8. Compagnone G, Baleni CM, Pagan L, Calzolaio FL, Barozzi L, Ergamini C. Comparison of radiation doses to patients undergoing standard radiographic examinations with conventional screen–film radiography, computed radiography and direct digital radiography. Br J Radiol 2006; 79:899-904.
9. Abdallah YM, Hayder A. Assessment of Mean Glandular Dose (MGD) received in mammography examination in Khartoum. Int J Adv Res 2016; 4:198-203.
10. Abdallah YM, Mohamoud NA. Estimation of radiation dose received in knee joint x-ray examination. Int J Health Rehabil Sci 2015; 4:203-211.
11. Hart D, Hillier MC, Wall BF, Shrimpton PC, Bungay D. Dose to patients from medical x-ray/examinations in the UK-1995 review. Radiat Prot Dosimetry 1996; 28.
12. Henshaw PS, Hawkins JW. Incidence of leukemiain physicians. J Natl Cancer Inst 1944; 4:339-346.
13. Herrmann KA, Bonél H, Stabler A, Kulinna C, Glaser C, Holzknecht N. Chest imaging with flat-panel detector at low and standard doses: comparison with storage phosphor technology in normal patients. Eur Radiol 2002; 2:385-90.
14. Jones DG, Stoddart J. Radiation use in the orthopaedic theater: A prospective audit. ANZ Journal of Surgery 1998; 68:782-784.
15. Abu K, Loogane M, Rana M, Naidoo N. A quantitative analysis of ionising radiation exposure to the hands, thyroid and whole body of orthopaedic registrars At King Edward Viii Hospital during fluoroscopic internal fixation of the lower limbs. J Al Aqsa Unv 2006; 10.
16. Mohamed A. The formulation of local diagnostic reference levels for several diagnostic X-ray examinations at Security Forces Hospital in Riyadh (A survey for the doses received by patients undergoing diagnostic X-ray at Security Forces Hospital in Riyadh and identifying the factors required for lowering the patient doses). AM J Sci 2013; 9. 36-43.
17. Mohamed A, AL Ruqaya D, S. Al-Ayed MS. Assessment of patient doses levels during x-ray diagnostic imaging using tl dosimeters and comparison with local and international levels. Trends in Med Res 2008; 3:72-81.
18. Vañó E, Miller DL, Martin CJ, Rehani MM, Kang K, Rosenstein M, Ortiz-López P, Mattsson S, Padovani R, Rogers A; Authors on behalf of ICRP. ICRP Publication 135: Diagnostic reference levels in medical imaging. Ann ICRP 2017; 46:1-144.
19. ICRP. Education and training in radiological protection for diagnostic and interventional procedures. Ann ICRP 2009; 39:7-68.
20. Valentin J. Avoidance of Radiation Injuries from Interventional Procedures. Ann ICRP 2000; 30:7-67.
21. Papadimitriou D, Perris A, Molfetas MG, Panagiotakis N, Manetou A, Tsourouflis G, Vassileva J, Chronopoulos P, Karapagiotou O, Kottou S. Patient dose, image quality and radiographic techniques for common x-ray examinations in two greek hospitals and comparison with european guidelines. Radiat Port Dosimetry 2001; 95:43-48.
22. https://ec.europa.eu/energy/sites/ener/files/documents/175.pdf

*Correspondence to

Yousif Abdallah

Department of Radiological Science and Medical Imaging

College of Applied Medical Science

Majmaah University

Saudi Arabia