ESTIMATION OF RADIATION DOSAGE FOR TRAUMATIC PATIENTS IN MAJMAAH AREA, SAUDI ARABIA

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Abstract. Radiation Exposure is the main hazard in medical x-rays investigations. The objective of this work was to study the attended radiation dose measured in the Majmaah area. Furthermore, to measure the radiation dose level for different examinations in conventional x-rays. Thus, conventional x-rays examination of traumatic patients. A sample of 700 patients was evaluated using at King Khaled Hospital- Majmaah. The average and range of exposure parameters were 73.5 ± 9.1 (65.9 – 124.9) KVp and 2.7 ± 0.71 (0.2 – 9.6) mAs for X-ray exposure factors, respectively. The measured Entrance Surface Air Kerma (ESAK) dose for chest (PA), skull ((AP) and (LAT.)), Lumbosacral ((AP) and (LAT.)) In addition, knee joints ((AP) and (LAT.)) were 0.20 ± 0.07 with range of (0.13-0.37) mGy, (0.86 ± 0.01) with range of (0.09 – 2.92) mGy and 0.09 ± 0.02 with range of (0.04 -0.17) mGy, (0.10 ± 0.02 with range of (0.04 – 0.17) mGy and 0.1 ± 0.02 with range of (0.03 -0.16) mGy and 0.86 ± 0.01 with range of (0.09 – 2.92) mGy respectively. The study was concluded that most of the procedures were done in King Khalid Hospital-Majmaah were in the permissible limits. In dose measurement techniques, the machine and patient-related factors must be fixed for accurate results.

Keywords: Traumatic patients, Radiology, radiation, protection, Saudi Arabia

1. INTRODUCTION

Trauma is an injury affects and leads to life threaten and psychological and physical impact. Recently, in Saudi Arabia, the number of traffic accidents and their effects has increased significantly [1-3]. There is no clear protocol to describe radiation exposure of patients during radiation investigations. The usual radiation exposure varies between 10-100 mGy, which may increase the possibility of cancer incidence especial among population who high exposed [4-5]. The traumatic x-rays imaging considers one of the commonest diagnostic tools used to analyze and identify the pathological conditions [6-8]. It contributes by significant radiation dose amount to patients. Since the applications of traumatic radiology are growing quickly, it is crucial issue to appraise the radiation dosages during the examination and try to reduce them as much as possible [9-10]. The demographic data and exposure measurements for all patients who admitted for radiology department should be collected. Radiation Exposure is main hazard in medical x-rays investigations [11]. 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 reason severe injuries and possible cancerous attending. Radiation Medical

Imaging is used commonly for trauma assessment [12-14]. 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 [15-16]. 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 [17-18]. Most of the radiographical investigations do not cause acute injuries to the patients due their low energy less than 10 mGy. The chronic effects of radiation are included the dangerous of cancer and genetic disorders [19-20]. The measurement of the radiation dose from traumatic radiological examinations was conducted globally [21-24].

2. MATERIALS AND METHODS

The sample of this work comprised of 700 patients from radiology department of King Khaled Hospital, Majmaah, Saudi Arabia. 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. Patients' data included in this study were patient demographic information and imaging protocols were documented.

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Entrance Surface Air Kerma (ESAK) (mGy) was measured for chest, Skull, lumbosacral joint and knee joint x-rays examination. This dose was used to quantify the ionizing radiation for the traumatic patients in radiology department. The measured dose was compared with different previous studies nationally and internationally. Data analyzed by using SPSS program software version (22; SPSS Inc., Chicago, IL) and the results presented in form of graphs and tables. TLDS devices were used in this study for dose measurement. Those devices were made of different electrodes (LIF: MG and Cu). Those devices have measurement range of .001 rad to 100 Gy. The reading of the devices was made directly after the irradiation. The radiographic equipment used Siemens imaging system.

3. RESULTS

Table 1 shows mean age of the patients for both genders in this study and the exposure factors logged for each patient during the examination of each projection. The exposure factors logged were projection, KVP, mA, time, field size, part under examination and tube to film distance. This study involved 700 patients undergoing chest, skull, lumbosacral and knee joints x-ray examinations in radiology departments at King Khalid Hospital in Majmaah. For the patients in this study, 80% of the patients were males and 30% were females.

Table 2 shows the measured dose in king Khalid Hospital-Majmaah, national and international hospitals. Those doses likened with national and worldwide radiation dose limits. The measured ESAK for chest (PA), Skull (Anteroposterior and lateral), Lumbosacral joint (Anteroposterior and lateral) and knee joint (Anteroposterior and lateral) were recoded (Table 3). Those amounts were dissimilar in king

Khalid-Majmaah and other Saudi hospitals (KKUH, KACST and SFH) and international places (UK, IAEA, UK, China, Greece, HPS, Canada and Italy. The measured dose for chest x-rays in this study was 0.20 ± 0.07 mGy with range of (0.13-0.37 mGy), while the lowermost amount level was 0.02 mGy in Health Physics Society (HPS) while the highest level was 0.69 mGy in Greece. The measured dose for PA projection of skull x-rays in this study was 0.86 ± 0.01 mGy with range of (0.09-2.92 mGy), while the lowest dose level was 0.86 mGy in in king Khalid-Majmaah while the uppermost level was 5.0 mGy in IAEA. Nevertheless, the measured dose for lateral projection of skull x-rays in this study was 0.09 ± 0.02 mGy with range of (0.04-0.17 mGy), while the lowest dose level was 0.69 mGy in Nigeria while the uppermost level was 3.00 mGy in IAEA.

The measured dosage for AP projection of Lumbosacral joint x-rays in this study was 8.27 ± 3.01 mGy with range of (0.20 -22.3 mGy), the lowermost dose level was 0.20 mGy in King Khalid- Majmaah, while the highest level was 40 mGy in KACST. Nevertheless, the measured dosage for lateral projection of Lumbosacral joint x-rays in this study was 10.04 ± 3.43 mGy with range of (2.05-29.21 mGy), which was the lowest dose level was 1.17 in King Khalid University Hospital (KKUH), while the highest level was 44 mGy in Greece (Table 3).

The measured dose for AP projection of knee joint x-rays in this study was 0.10 ± 0.02 mGy with range of (0.02-0.17 mGy), which was the lowest dose level while the highest level was 0.30 mGy in King Khalid University Hospital (KKUH). Nevertheless, the measured dose for lateral projection of knee joint x-rays in this study was 0.1 ± 0.02 mGy with range of (0.03-0.18 mGy), which was the lowest dose level while the highest level was 0.33 mGy in King Khalid University Hospital (KKUH) (Table 3).

Table 1. Patient x-rays image acquisition features

Male patients (male: n=560, 80%, Female: n= 140, 20%), Age : 37.1 + 13.3 years with range of (18-63) years							
Parameters	Chest	Skull		L/S		Knee joint	
	PA	AP	LAT	AP	LAT	AP	LAT
Tube voltage (kVp)	124.8 + 0.14	124.5	124.9	75.8 + 7.8	83.8 + 7.2	56.9 + 5.1	55.7 + 3.2
Tube current (mAs)	1.6 + 0.79	1	2.2	22.5 + 3.9	22.4 + 4.1	4.9 + 1.1	4.9 + 1.06
Tube to patient distance (cm)	178.7 + 11.6			113 + 4.14	114.2 + 5.2	106.2 + 9.9	115 + 11.5
Dose (mGy)	0.20 + 0.07	0.86 + 0.01	0.9 + 0.02	8.27 + 3.01	10.04 + 3.43	0.10 + 0.02	0.1 + 0.02

*AP: anteroposterior, LAT: lateral

Table 2. Shows the mean and standard deviation of radiation dose (ESAK) measured in King Khalid Hospital-Majmaah, national and International hospitals for chest, Skull, lumbosacral joint and knee joint

Projection	Mean + STdev.	Minimum value (mGy)	Maximum value (mGy)
PA Chest	0.20 + 0.07	0.13	0.37
AP Skull	0.86 + 0.01	0.09	2.92
Lateral skull	0.9 + 0.02	0.04	0.17
AP Lumbosacral	8.27 + 3.01	0.20	22.3
Lateral Lumbosacral	10.04 + 3.43	2.05	29.21
AP knee	0.10 + 0.02	0.02	0.17
Lateral knee	0.1 + 0.02	0.03	0.18

Table 3. The mean values of ESAK (mGy) of chest examination for all age groups of the study sample

Exam	Present Study	KKUH	SFH	KACST	IAEA	USA	UK	MAY.*	Nig.
Chest (PA)	0.20	0.135	0.220	0.4	0.4	0.25	0.15	0.9	0.45
Skull (AP)	0.86	0.119	-	5.0	5.0	2.25	1.8	4.8	0.77
Skull (LAT)	0.9	-	-	-	3.0	-	1.1	2.4	0.69
L/S (AP)	8.27	0.655	5.23	40	10.0	6.54	5.7	7.5	0.99
L/S (LAT)	10.04	1.173	8.99	40	30	-	10.0	13.4	1.43
Knee (AP)	0.1	0.305	0.260	-	-	-	0.3	-	0.38
Knee (LAT)	0.1	0.334	0.240	-	-	-	0.3	-	0.69

*MAY.: Malaysia, Nig.: Nigeria, KKHU: King Khalid University Hospital-Riyadh, SFH: Security Force Hospital, IAEA: International Atomic Energy Agency

4. DISCUSSION

This experimental study performed to measure of dose received by organs in chest (PA), skull (AP and LAT), lumbosacral joint (AP, LAT), cervical (AP, LAT) and knee joint (AP, LAT) x-ray examination. A total of 700 patients were examined in two radiology departments in King Khalid-Majmaah hospital. The results of this study was compared with other scientist studies nationally (Saudi Arabia) and internationally. The former studies showed different results in dose of patients such as Abdelhalim, M. (2010). There were many factors that might affect the results of the dose measurement such as patient related factors (BMI), technical factors (projection, techniques and exposure factors selection) and machine factors (machine and TLDs calibration and service). The dose increased with BMI, which was agreed with Inkoom et al (2014) and Freitas et al (2009). This study highlights the importance of the quality control program in check the machine performance and reduction of radiation dosage to both patients and healthcare staff. Recent studies showed that there were large amounts of radiation exposure in diagnostic radiology due to its widely utilization especially in emergency department Pauwels et al, (2015), Al-Abdulsalam and Brindhaban (2014), Tian et al, (2015), Parakh et al (2015) and Lukasiewicz et al (2014). This study recommends selecting the mean radiation dose of chest, skull, cervical spine and knee joints as guidelines for radiation examination in Majmaah area, hospitals, because they were least compared with other studies. Therefore, the calculated dose of the chest x-rays was $0.20 + 0.07$ mGy with range of $0.13 - 0.37$ mGy. The calculated radiation dose for skull was $0.86 + 0.01$ and $0.09 + 0.02$ mGy for AP and lateral projections, respectively. The calculated radiation dose for lumbosacral joint was $8.27 + 3.01$ and $10.04 + 3.43$ mGy with range of $0.20 - 29.21$ mGy for AP and lateral projections, respectively. The calculated radiation dose for knee joint was $0.10 + 0.02$ and $0.1 + 0.02$ mGy with range of $0.02 - 0.18$ mGy for AP and lateral projections, respectively.

The lowest dose for chest x-rays level was 0.02 mGy in Health Physics Society while the uppermost level was 0.69 mGy in Greece. While the lowest dose of AP skull x-rays level was in Health Physics Society (HPS)

while the highest level was in Greece. Nevertheless, the measured dose for lateral projection of lateral skull x-rays in this study was the lowest dose level, while the highest level was in Greece. The lowest dose level for AP projection of Lumbosacral joint x-rays in King Khalid- Majmaah, while the highest level was 40 mGy in KACST. Nevertheless, the measured dose for lateral projection of lateral projection Lumbosacral joint x-rays in this study was the lowest dose level was in King Khalid University Hospital (KKUH), while the highest level was 44 mGy in Greece.

5. CONCLUSION

Finally, in this study, it was found that radiation amounts for chest (PA), skull (AP and LAT), lumbosacral joint (AP, LAT), cervical (AP, LAT) and knee joint (AP, LAT) for the entire examination were higher. The ESAKs for conventional radiology were lower in AP than those for lateral projection and LA/LS respectively. Unlike the previous studies, the dose in L/S radiography was higher in conventional radiography compared to other techniques. Recently digital and computed radiography are becoming more popular due to the important advantage of digital imaging is cost and access. Therefore, the importance of dose optimization during conventional radiology imaging must be considered. This study concluded that the doses for chest, skull, cervical and knee joints were lower than the other alike studies nationwide and globally. The dose in L/S radiography was higher in conventional radiography compared to other techniques. Recently utilization of automatic exposure calculator was more useful and reduces the dose to the patients. Computer radiography is gratifying, more popular due to its value, access and good dose changes. This study will assist the investigators to discover the critical parts of radiation protection in traumatic radiology department that many investigators were not able to explore.

Conflict 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.21/COM-201 8/9.

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