Journal of Research in Medical and Dental Science
2022, Volume 10, Issue 05, Page No: 141-145

Available Online at: www.jrmds.in
eISSN No.2347-2367: pISSN No.2347-2545

Valuation of Radiation Dosage Received in CT scan For Traumatic Patients in King Khalid Hospital-Majmaah, Saudi Arabia

Yousif Abdallah*

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

ABSTRACT

Introduction: Trauma considers one of the most common reasons for morbidity and fatal disease amongst the elderly patient.

Background: The aim of this study is to measure of radiation dose received in computed tomography Majmaah Area, KSA this study conducted to assess the stroke silhouette patients admitted to CT investigations to nationwide healthcare institutes along with appraising issues that might enhance trauma management.

Objectives: The purpose of this study was to estimate the radiation dose received in CT scans for traumatic patients.

Methods: Patient imaging acquisition data were collected from the radiology department. In each centre, CT radiation dose (CTDI) was measured using the ionization chamber. Then the other radiation doses quantities (CTDIW, CTDIvol, and DLP) were calculated. The average patient age for adults was 45.4+14.6 with the range of (30-80 years).

Results: The measured dose (CTDIw and DLP) for brain, chest, and abdomen were (617 mGy-36.3 mGy cm), (8.1 mGy -386 mGy cm) and (11.8 mGy-309 mGy cm) respectively. The DRLs of the brain, chest, and abdomen were 49.7, 8.2 and 10 mGy, respectively.

Conclusion: The study was concluded that computed tomography could expose the patients to high doses in the brain, chest, and abdomen. The measured dose in all centers in this study was lower than the international references limits.

Key words: Severe acute malnutrition, Complications, Children, Nutritional stabilization unit, Weight gain, Marasmus

HOW TO CITE THIS ARTICLE: Yousif Abdallah, Valuation of Radiation Dosage Received in CT scan For Traumatic Patients in King Khalid Hospital-Majmaah, Saudi Arabia , J Res Med Dent Sci, 2022, 10(05): 141-145.

Corresponding author: Yousif Abdallah
E-mail: y.yousif@mu.edu.sa
Received: 23-Feb-2022, Manuscript No. JRMDS-22-49104;
Editor assigned: 25-Feb-2022, Pre QC No. JRMDS-22-49104 (PQ);
Reviewed: 11-Mar-2022, QC No. JRMDS-22-49104;
Revised: 25-Apr-2022, Manuscript No. JRMDS-22-49104 (R);
Published: 5-May-2022

INTRODUCTION

Trauma occurrences might be fatal; they can also have long-lasting psychological and physical repercussions. Traffic accidents have increased dramatically in Saudi Arabia during the last many years [1-6]. There is presently no standard procedure for assessing the amount of radiation exposure received by a patient during radiation testing. Every day, the majority of people are exposed to between 10 and 100 mGy of radiation, increasing their chance of acquiring cancer [7-11]. This is especially true for persons who are frequently exposed to radioactive substances at high dosages. The use of trauma x-ray imaging to diagnose and monitor disease is common. It benefits patients since it is capable of administering a high dose of radiation. With the growing field of traumatic radiology, it is vital to examine and limit exam radiation doses [12-16]. All patients who visited the radiology department were asked to provide demographic information and had their exposure to radiation evaluated. The greatest risk of radiation exposure occurs during a medical x-ray. [17-21]. These types of exposures are caused by inefficient equipment use and high exposure factors. This issue has come to light as a result of the release of multiple dosage guidelines for the same medical condition. Radiation has been linked to the development of cancer and other major health concerns. Medical imaging using radiation is routinely used to check injuries. Doctors use these imaging tests to ensure they are making the correct diagnoses for a variety of conditions. Patients who have difficult-to-diagnose injuries can benefit from their assistance in diagnosing the cause of the injury. Radiation exposure has the potential to cause both immediate and long-term health problems. Excessive doses may result in acute organ damage, and maybe death. Due to the minimal dose of radiation used in radiographic testing, patients are not at risk of being damaged during the treatment (less than 10 mGy). In the long run, radiation exposure may result in the development of cancer and other genetic problems. Radiation doses associated with trauma radiological examinations have been determined worldwide [22].

MATERIALS AND METHODS

Specification of imaging scanner

The CT scanner used in this study was Toshiba Aquilon 128 slice, Toshiba. Including patients, the dose levels of republished radiation were collected by form of examination (head, chest and abdominal CT) and age group.

Study protocol

Identification of cases: ICD-9 procedural codes identify patients who are scanned for CT scan. Patients under 20, people with CT scans and those without registered medical weight in referring facilities were excluded. All patients' data were saved securely in pass-worded PC. The collected data included patient age, weight, sex, and examination time, cause of examination (e.g. trauma), application of contrast, DLS, scan length and automatic scale. Patient imaging protocols and CT scanner information data were collected such as (KVp, mAs, machine type, types of detectors and slice thickness).

Radiation Dose measurement: For computed tomography scan, the CTDIw, CTDIvol, and DLP were measured. The CTDIvol is a standardized radiation output estimation parameter. The CTDI finds the principal principle for dosage measurement in CT to be:

$$\mathrm{CTDI} = \frac{1}{NT}\oint_{-\infty}^{\infty} D(z)dz \quad \text{[Equation 1]}$$

Where:

D (z)=Z-axis radiation-dose profile,

N=number of the tomography parts of the individual axial scan.

N may be equal to or under the full number of system data channels and

T=as shown by a single data channel, the width of the tomographic segment on the z-axis. A single multi-detector data source can be combined with several detector components.

$$\mathrm{CDTI_W} = \frac{1}{C}\left(\frac{1}{3}\mathrm{CDTI_{100,\,C}} + \frac{2}{3}\mathrm{CDTI_{100,\,P}}\right) \quad \text{[Equation 2]}$$

Where:

- C represents the tube current rate (mAs)
- CTDI100, p represents an average of amounts at four different sites everywhere the edge of the phantom [17].

The Dose Length Product (DLP) of the scanned area was collected from the CT scanner. DLP is the resultant of the length of the exposed scan volume and the mean CTDIvol over that distance. DLP calculated as;

DLP (mGy-cm)=CTDIvol (mGy) × scan length (cm)

Patient imaging protocols and CT scanner information data were collected such as (KVp, mAs, machine type, types of detectors and slice thickness).

RESULTS

Table 1 showed the imaging protocol details for the CT scanning in both hospitals. The scan factors are dissimilar form radiology department to another. Although the tubes voltages (KVp) are approximately alike, the variations of rest radiation exposure factors are significant. The KVp of the brain and chest investigation in this study is lower than similar studies. Those KVp cause increasing of patient dose in those examinations. Similar differences were observed for mAs used for brain, chest and abdomen examinations. The scan area lengths for brain, chest examination were 14.9+5.14 and 25.3+7.4.

Table 1 shows the characteristics of patient x-ray imaging for all investigations in King Khalid-Majmaah hospitals. As shown in Table 1, protocols conditions differ from department to department for scanning the same investigations. Although KVps are approximately equal, the variations between mAs are significant.

Table 1: Patient x-rays image acquisition features.

Investigations type	Parameter	Values
Brain CT scan	kVp	120
	mAs	110
	Scan area length (cm)	14.9+5.14
Chest CT scan	kVp	120
	mAs	112
	Scan area length (cm)	25.3+7.4
Abdomen CT scan	kVp	120
	mAs	130
	Scan area length (cm)	43.6+10.6

Table 2: The measured CTDIW (mGy) and DLP (mGy cm) of the study.

Investigations type	CDTIw (mGy	DLP (mGy cm
Brain CT scan	36.3+6.1	617.8+198.8
Chest CT scan	8.1+3.6	386.1+114.6
Abdomen CT scan	11.8+4.3	309.6+101.9

Table 3: The 3rd quartile values of this study compared with international values.

Investigations type	Present study		EC [17]		Karim et al. [14]		UK 2005 [21,22]		Malaysia [18]	
	CDTIw	DLP	CDTIw	DLP	CDTIw	DLP	CDTIw	DLP	CDTIw	DLP
Brain CT scan	49.7	617	60	1050	63	1015	57	690	46.8	1050
Chest CT scan	8.2	386	30	650	15	450	14	400	19.9	600
Abdomen CT scan	10.0	309	35	780	16	590	16	350	12.8	450

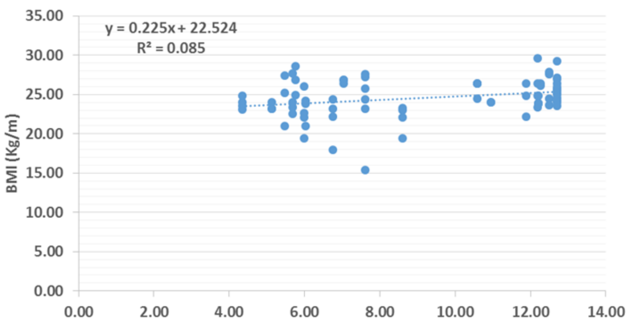

Figure 1: The correlation between the body mass index (BMI and measured dose.

For example, in the case of abdominal imaging, the brain and chest procedure are similar in the kVp, but the mAs are different from hospital to other. For three other examinations, comparable differences were noted. The length of scanning often differs between hospitals, particularly in chest studies (between 13 and 30 cm). Figure 2 revealed the correlation of the Body Mass Index (BMI) and the measured dose for all patients. A correlation exists between BMI and the dose measured. Tables 2 and 3 indicate each of the hospital inquiries assessed CTDIW, CTDIvol, and DLP. The values of CTDIW, CTDIvol, and DLP values in hospitals are very different. The values of CTDIvol are almost the same as the CTDIw values (Tables 2 and 3). In almost all hospitals, this was attributed to pitching level of 1 or almost 1 (0.80 to 1.0).

Table 3 indicates the measured CTDIW and DLP measured. It refers nationally and globally to the CTDI mean value with CT departments. Average CTDI values are smaller than global values for all studies. As illustrated in Table 3, CTDIW used to cover the brain, chest, and abdomen (17.7-51), (4.02-12.3) and (4.23-13.7) respectively. The third quartile of measured dosage is generally accepted as the permissible dose. DRLs for the head, chest and abdomen, values of 49.7, 8.2 and 10 mGy are recommended. The DRL measured in comparison with global reference levels. DRLs were less than global values for all studies in this study. CTDI values of CT procedures include mAs and kVp exposure variables. In addition, the increase in the number of slices and the duration of scans increases DLP. DLPs are therefore lower than head studies in the abdominal and chest trials. On the other hand, as the area under consideration rises, DLP and CTDI increase the mean CTDIw, DLP values of this research have been lower than the European Guidelines (EG), and Shrimpton et al. Overall DRLs were smaller than global values for all research studies. This reference dose is suggested as a recommended dose for the guidelines to be optimized until further studies and details are obtained for all the CT studies.

DISCUSSION

This has been a comprehensive study of CT patient doses in Majmaah, Saudi Arabia and the DRL has been configured for four CT tests. As reported in the reports, the doses for the same tests varied from department to department. This incoherence was perhaps due to different protocol types, user setup parameters such as (slice thickness, pitch, kVp, and mAs) and seller inconsistencies in the CT product design. Studies are performed in Saudi Arabia and some reference dosages have been suggested. As the Saudi DRL for head, chest and abdominal investigations [19], Qurashi et al. reported DRL (CTDI) in Saudi for the same examinations. The chest (17.4 *vs.* 8.2 mGy) and the abdomen (16.71 *vs.* 10 mGy) were higher than those of this study were. For DLP, the values were higher than this study (414 *vs.* 386.1 mGy cm) for chest and the largest difference was found in abdomen (646 *vs.* 309.6 mGy cm). In the current analysis, the values were lower than Qurashi et al [19] study. Foley et al [9] have suggested local DRL (CTDI) in Irish for the same examinations. The head (66 *vs.* 49.7 mGy), chest (9/11 *vs.* 8.2 mGy) and the abdomen (12 *vs.* 10 mGy) were higher than those of this study were. For DLP, the values were higher than this study (940 vs. 617.8 mGy cm) for head, (390 vs. 386.1 mGy cm) and the largest difference was found in abdomen (600 vs. 309.6 mGy cm). In some European countries, national adult DRLs were established [20,23,24,25]. The CTDI DRLs between Majmaah, Saudi Arabia and Greece (49.7 vs. 69.9) and

DLP DRLs between Majmaah, Saudi Arabia and EC (750 vs. 1050) were substantially differentiated in the case of brain examination. The highest disparities in other measurements are also found in Majmaah, Saudi Arabia and EC. While the proposed DRL is smaller than national and foreign benchmarks. The maximum CTDIW and CTDIvol values in this study were above the international minimum values during the brain, chest and abdomen scan. This may have been due to high mAs in this facility. Reducing mA before medical diagnosis is affected is a practical way of reducing radiation exposure. In all cases, the standards of CTDIW and CTDIvol were lesser than the amounts that suggested by international scientists. In all tests, DLP values had significant differences between hospitals. This was because of differences in CTDIW and the length of the hospital scan. Test length affects patient dose and it must be restricted to desired areas. Adjusting the kVp, adjusting the pitch factor, or utilizing the AEC is all possible techniques of regulating exposure. The level of care provided to the patient is affected by training and awareness of the functional requirements of CT scanning. It is believed that the findings of this study would aid hospitals and CT facilities worldwide in their efforts to better understand how they operate and what they do. The dose should be compared to that utilized in the current experiment at the appropriate time. In this study, the evaluation of all three CT pictures required an inordinate amount of time. Additional CT scan research is needed to make sure that the doses of CT scans are the same across the board [26-41].

CONCLUSION

To perform the study, patient CT dose data from King Khalid Hopsital was obtained, including CTDIw, DLP, and effective dosage values. The usage of local DRLs established the EU's 2004 definition of multi-slice CT reference rates as valid. This study included a discussion of CTDIvol in its assessment of MSCT literature, which was published by a third party. In order to account for changes to CT, the CTDIvol must be included in DRLs. This is especially true because newer CT scanners have been introduced.

ACKNOWLEDGEMENTS

The authors are thankful to the Deanship of Scientific Research, at Majmaah University for funding this research. [Porject No: R-2022-129]

REFERENCES

1. McCollough CH, Leng S, Yu L, et al. CT dose index and patient dose: they are not the same thing. Radiology 2011; 259:311-316.
2. Rizzo S, Kalra M, Schmidt B, et al. Comparison of angular and combined automatic tube current modulation techniques with constant tube current CT of the abdomen and pelvis. Amer J Roentgeno 2006; 186:673-679.
3. Kalra MK, Maher MM, Toth TL, et al. Techniques and applications of automatic tube current modulation for CT. Radiology 2004; 233(3):649-57.
4. Treier R, Aroua A, Verdun FR, et al. Patient doses in CT examinations in Switzerland: implementation of national diagnostic reference levels. Rad protect Dosim 2010; 142:244-254.
5. Hodgkinson S, Pollit V, Sharpin C, et al. Early management of head injury: summary of updated NICE guidance. Bmj 2014; 348:104.
6. Ngaile JE, Msaki P, Kazema R. Towards establishment of the national reference dose levels from computed tomography examinations in Tanzania. J Radiolog Protect 2006; 26:213
7. Kalra MK, Maher MM, Toth TL, et al. Strategies for CT radiation dose optimization. Radiology 2004 ; 230:619-628.
8. Brady A, Laoide RÓ, McCarthy P, et al. Discrepancy and error in radiology: concepts, causes and consequences. The Ulst Med J 2012; 81:83.
9. Foley SJ, McEntee MF, Rainford LA. Establishment of CT diagnostic reference levels in Ireland. The Brit J Radiol 2012; 85:1390-1397.
10. Korpela H, Bly R, Vassileva J, et al. Recently revised diagnostic reference levels in nuclear medicine in Bulgaria and in Finland. Rad Protect dosimet 2010; 139:317-320.
11. Karim MK, Hashim S, Bakar KA, et al. Establishment of multi-slice computed tomography (MSCT) reference level in Johor, Malaysia. In Journal of Physics: Conference Series. IOP Publishing. 2016; 694: 012033.
12. Hamblin JD. 'A Dispassionate and Objective Effort:'Negotiating the First Study on the Biological Effects of Atomic Radiation. J Hist Bio 2007; 40:147-177.
13. Coles DR, Smail MA, Negus IS, et al. Comparison of radiation doses from multislice computed tomography coronary angiography and conventional diagnostic angiography. J Ame Coll Cardio 2006; 47:1840-1845.
14. Jurik A, Petersen J, Jessen KA, et al. Clinical use of image quality criteria in computed tomography: a pilot study. Rad Protect dosimet 2000; 90:47-52.
15. Järvinen H, Vassileva J, Samei E, et al. Patient dose monitoring and the use of diagnostic reference levels for the optimization of protection in medical imaging: current status and challenges worldwide. J Med Imag 2017; 4:031214.
16. Palorini F, Origgi D, Granata C, et al. Adult exposures from MDCT including multiphase studies: first Italian nationwide survey. Europ Radiol 2014; 24:469-483.
17. Shrimpton PC, Hillier MC, Lewis MA, et al. National survey of doses from CT in the UK: 2003. Brit J Radiol 2006; 79:968-980.

18. Zarb F, Rainford L, McEntee MF. AP diameter shows the strongest correlation with CTDI and DLP in abdominal and chest CT. Rad Protect Dosimet 2010; 140:266-273.
19. Van der Molen AJ, Schilham A, Stoop P, et al. A national survey on radiation dose in CT in The Netherlands. Insig imag 2013; 4:383-390.
20. Christe A, Heverhagen J, Ozdoba C, et al. CT dose and image quality in the last three scanner generations. World J Radiology 2013; 5:421.
21. Rubin GD, Dake MD, Napel SA, et al. Three-dimensional spiral CT angiography of the abdomen: initial clinical experience. Radiology 1993; 186:147-152.
22. Miller JM, Rochitte CE, Dewey M, et al. Diagnostic performance of coronary angiography by 64-row CT. N Engl J Med 2008; 359:2324-2336.
23. Biesbroek JM, Niesten JM, Dankbaar JW, et al. Diagnostic accuracy of CT perfusion imaging for detecting acute ischemic stroke: a systematic review and m etaanalysis. Cerebrovas dis 2013; 35:493501.
24. Ruzsics B, Lee H, Powers ER, et al. Myocardial ischemia diagnosed by dual-energy computed tomography: correlation with single-photon emission computed tomography. Circulation. 2008; 117:1244-1245.
25. Nakahara T, Toyama T, Jinzaki M, et al. Quantitative Analysis of Iodine Image of Dual-energy Computed Tomography at Rest. J Thorac Imag 2018; 33:97-104.
26. Smith RC, Verga M, McCarthy S, et al. Diagnosis of acute flank pain: value of unenhanced helical CT. AJR. Am J Roentgenol 1996; 166:97-101.
27. Mahesh M. The essential physics of medical imaging. Med physic 2013; 40:077301.
28. Dawe EJ, Fawzy E, Kaczynski J, et al. A comparative study of radiation dose and screening time between mini C-arm and standard fluoroscopy in elective foot and ankle surgery. Foot and ankle surgery. O J Euro Soc Foot Ankle Surgeons 2011; 17:33-36.
29. Compagnone G, Baleni MC, Pagan L, et al. Comparison of radiation doses to patients undergoing standard radiographic examinations with conventional screen–film radiography, computed radiography and direct digital radiography. Brit J Radiol 2006; 79:899-904.
30. Mettler Jr FA, Huda W, Yoshizumi TT, et al. Effective doses in radiology and diagnostic nuclear medicine: a catalog. Radiology 2008; 248:254-263.
31. Henshaw PS, Hawkins JW, Meyer HL, et al. Incidence of leukemia in physicians. J Nat Cancer Inst 1944; 4:339-346.
32. Herrmann K, Bonel H, Stäbler A, et al. Chest imaging with flat-panel detector at low and standard doses: comparison with storage phosphor technology in normal patients. Euro Radiol 2002; 12:385-390.
33. Jones DG, Stoddart J. Radiation use in the orthopaedic theatre: a prospective audit. Aus New Ze J Surg 1998; 68:782-784.
34. Purwantiningsih P. Analisis sebaran dosis paparan radiasi pesawat c-arm terhadap jarak pada ruangan operasi. Sainstek: J Sai dan Teknol 2018; 9:183-189.
35. Henshaw PS, Hawkins JW, Meyer HL, et al. Incidence of leukemia in physicians. J Nat Cancer Inst 1944; 4:339-346.
36. Haenszel W. Cancer mortality among the foreign-born in the United States. J Nat Cancer Inst 1961; 26:37-132.
37. Hsu WL, Preston DL, Soda M, et al. The incidence of leukemia, lymphoma and multiple myeloma among atomic bomb survivors: 1950–2001. Rad res 2013; 179:361-382.
38. Yoshinaga S, Mabuchi K, Sigurdson AJ, et al. Cancer risks among radiologists and radiologic technologists: review of epidemiologic studies. Radiology 2004; 233:313-321.
39. Miller RW. Delayed Radiation Effects in Atomic-Bomb Survivors: Major observations by the Atomic Bomb Casualty Commission are evaluated. Sci 1969; 166:569-574.
40. March HC. Leukemia in radiologists. Radiol 1944; 43:275-278.
41. Dublin LI, Spiegelman M. Mortality of medical specialists, 1938-1942. J Am Med Assoc 1948; 137:1519-1524.