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Research Article

Estimation of Radiation Dose Received By the Patients during Abdomen CT Examination

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Abstract: Computed tomography (CT) is an imaging technique which produces a digital topographic image from diagnostic x-ray. It always considered a "high dose" technique, there is growing realization that image quality in CT often exceeds the level needed for confident diagnosis and that patient doses are higher than necessary. The aim of this study was to Estimate radiation dose received by the patients during abdominal CT examination. In this study, a total of 60 adult patients undergoing the abdominal CT scanning exams were evaluated using effective Dose. The result of this study revealed that the mean effective dose for abdomen in hospital (1) and hospital (2) and hospital (3) was(1.6269)mSv and(1.3696) mSv and (5.7627) mSv respectively. These values were found to be at standard dose reference level. The study concluded that**.**

Keywords: DLP, $CTDI_v$ $CTDI_w$, Effective Dose.

INTRODUCTION

Recent high-speed multi–detector row CT technology creates more defined images in shorter times and has led to increased use of CT. With the introduction of new applications, the overall use of CT continues to grow inside and outside the hospital despite the fact that absorbed doses can be as much as 40% more than those associated with previous technology (Golding, S. J., & Shrimpton, P. C. 2002; Haaga, J. R. 2001) With growing use comes growing concern about risks associated with diagnostic CT. Effective doses with diagnostic CT have been shown to be similar to those received by Japanese survivors of the atomic bomb, who had a small but statistically significant increased risk of developing cancer as a result of the radiation (Pierce, D. A., & Preston, D. L. 2000). Findings in one heavily debated study (Brenner, D. J. *et al.*, 2001) showed that the approximate number of deaths attributable to CT during 1 year in the United States was 700 for head examinations and 1,800 for abdominal examinations. As CT utilization increases, the concern about radiation hazards from CT also increases (Brenner, D. J., & Hall, E. J. 2007). In fact, the worldwide average annual per-capita effective dose from medical procedures has approximately doubled in the past 10-15 years (Mettler Jr, F. A. *et al.*, 2009). A study (Mettler Jr, F. A. *et al.*, 2009) has also found an distribution of medical radiation exposure, which is greater in highly developed countries. For example, the 2006 United States data showed that medical imaging contributed to approximately half (3.0 mSv) of the total radiation dose (5.6 mSv) (Mettler Jr, F. A. *et al.*, 2009; Hricak, H. *et al.*, 2011). The greatest contributor to medical radiation exposure is CT. In the United States, the number of CT scans is increasing by approximately 10% per year (Hricak, H. *et al.*, 2011; Assessments 2006). In South Korea, the increasing rate is even steeper, approximately 11-31% per year (Assessments 2006). In conjunction with the increasing concerns about potential CT radiation hazards, various CT dose-saving strategies have been developed (Kalra, M. K. *et al.*, 2004; Goo, H. W. 2005). Thus, the benefit-risk ratio of CT examinations can be maximized with optimized CT imaging techniques using these strategies. Although there are several uncertainties in quantifying life-time risks from CT examinations, per-capita cumulative CT radiation dose should be minimized particularly in the younger population because they have unequivocally higher radio sensitivity and longer life expectancy than the older population. In this article, currently available CT dose-saving strategies will be reviewed, which will ultimately facilitate our rational use of CT. The local tissue dose from a single slice is not the same as the dose in the very same tissue when additional adjacent

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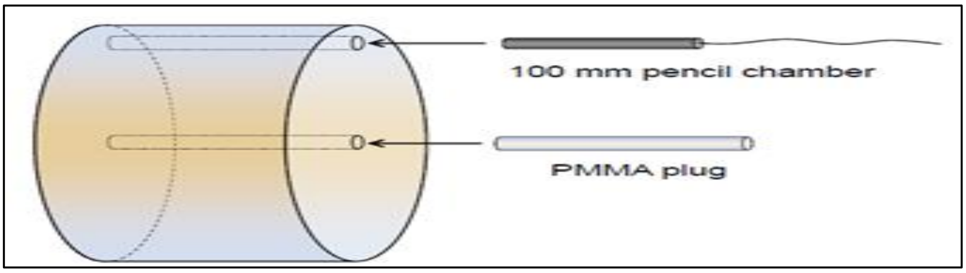
slices are made, because each additional slice scatters radiation into adjacent slices

CTDI is a good measure of dose to a 32 cm diameter, 1.19 g/cm^3 piece of plastic (the phantom). Most patients will be smaller, and have higher doses. Larger patients will have lower doses (at the same techniques).



Also, when the phantom is expose, energy deposited (dose) is not uniform across the whole thickness of the phantom, thus a good estimate of the dose to the whole thickness is obtained using two measurement cites, at the centre ($CTDI_{centre}$) and close to the periphery ($CTDI_{peripheral}$). From the two measurements a weighted computed tomography dose index ($CTDI_w$) is obtained:

$CTDI_w = [(⅓)(CTDI_{centre})] + [(⅔)(CTDI_{peripheral})]$ mGy.

Dose Length Product:

The principle Dose Length Product [DLP]:

DLP = CTDI * L

mGy.cm

DLP = ($CTDI_w$) ,T.N.C mGy.cm

L =T.N.C

Where: Nnumber of slices

T (cm) thickness of each slice

(mAs) radiographic exposure.

(Angel, E. *et al.*, 2008; John M. B. 2007)

MATERIALS AND METHODS

Material:

CT Machines

Three CT machines were used to collect data during this study. These machines are installed in two private radiological departments. All quality control testswere performed to the machine prior any data collection. The tests were carried out by experts from Sudan Atomic Energy Commission (SAEC). All the datawere within acceptable range.

Patient:60 adult were examined for the abdomen 29 of them were female and the others were males there aged ranged 30-75years

Hospital	manufacture	Model	Detected Type
Hospital 1	General electric	Optima	16
Hospital 2	Toshiba	Aquilion	16
Hospital 3	General electric	Optima	64

METHOD:

Data collection sheet: were collected using a sheet for all patients in order to maintain consistency of the information from display. A data collection sheet was designed to evaluate the patient doses and the radiation related factor. The collected data included , sex, and age; tube voltage and tube current–time product settings; pitch; section thickness; and number of sections, In addition, we also recorded all scanning parameters, as well as the CT dose descriptors CT weighted dose index (in millisievert) and dose-length product (in millisievert centimeters). All these factors have a direct influence on radiation dose. The entire hospital was passed successfully the extensive quality control tests performed by Sudan atomic energy commission and met the criteria of this study.

Method of measurement of the Effective Dose:

Effective Dose (E) in CT given by the following

E=DLP *k

Where k is the tissue weighting factor based on region of body scanned

Representative adult values for k are (13)

Head/Neck	.0031
Head	.0021
Neck	.0059
Chest	.014
Abdomen	.015
Trunk	.015

Analysis of data:

All dose parameters were registered down and from the display monitor in CT scan and they use in calculation for the effective dose using conversion factor to the abdomen, then used as input to the statistical software (SPSS) and Microsoft excel for analysis.

Result

Descriptive Statistics (Abdomen)

Table (1): show Patient exposure parameters during CT procedures: Mean±sd deviation andthe range in the parenthesis at constant kVp =120

	N	Minimum	maximum	Mean	Std. Deviation
Effective dose ABD	60	3.53	93.02	22.7334	20.95039

Group Statistics (Abdomen)

Table (2) shows Effective dose for patient in three hospitals:

Hospital	N	Mean	Std. Deviation	Std. Error Mean
Hospital1	40	1.6269	13.04108592	2.06197
Hospital2	10	1.3696	8.367208	2.645943
Hospital3	10	5.7627	21.0018464	6.6413670

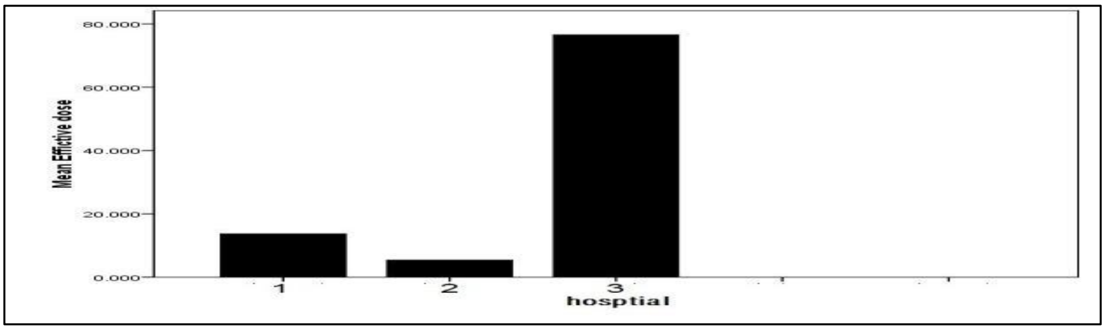


Figure (1) :Shows………………………………………………

Table (3): Comparison of patient dose during CT with previous studies:

Author	No.of pts	Machine model	Pitch	kVp	mAs	Slice thickness	Effective dose
Ali Abdelrazig	31	Toshiba Sensation aquilion 64	1.5	120	242.8		20.05
A.M Nour	83	Siemens Somatom emotion	0.75-1	80-120	42-243		13.5
European Commission1999							11.7
I.I.Suliman	445	Toshiba Somatom sensation 16		120	41±17		11.3
NAIF M OSMAN	48	Toshiba 64		120			67.96
In this study	60	Toshiba16 Ge16 Ge64		120			22.7

DISCUSSION:

The results obtained by the current study which demonstrates that the effective dose for abdomen in hospital (1) and hospital (2) and hospital (3) was (1.6269) mSv and(1.3696) mSv and (5.7627) mSv respectively. The agree with Europe Commi ssion(1999) An, NAIF M OSMAN(2016), A.M Nour and Ali These values were found to be at standard dose reference level.

CONCLUSION

The study concluded that the CT abdominal Examination dose was within the international diagnostic reference level values.

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