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Assessment of the Effect on Radiation Dose of CT Abdomen according to the Gender and Patient Weight

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Abstract: Background: Computed Tomography (CT) is an essential diagnostic technique, particularly for imaging of the abdomen. CT radiation exposure is still a worry, though, especially when it comes to patient-specific factors like gender and body weight.
Objectives: The purpose of this study was to assess how patient gender and body weight affected the radiation dose parameters, Dose Length Product (DLP) and Computed Tomography Dose Index volume (CTDIvol), in abdominal CT scans.
Materials and Methods: A Philips Ingenuity Core 128-slice machine was used to do abdominal CT scans on 100 individuals, 50 of whom were male and 50 of whom were female. Three categories were created for the patients depending on their body weight: 50–60 kg, 61–70 kg, and >70 kg. SPSS v26 was used for the collection and analysis of radiation dose data (CTDIvol and DLP). Dose values were compared among weight groups using a one-way ANOVA, and comparisons between genders were conducted using independent samples t-tests.
Results: CTDIvol ($p = 0.281$) and DLP ($p = 0.117$) did not differ statistically significantly between weight categories. Comparing genders also showed no discernible changes in DLP ($p = 0.169$) or CTDIvol ($p = 0.122$). Although the mean CTDIvol was marginally greater in female patients, these differences were not statistically significant.
Conclusion: The study found no significant impact of body weight or gender on radiation dose in abdominal CT imaging. However, the observed trends suggest a need for continued research with larger, more stratified samples. Emphasis on individualized scanning protocols remains essential for optimizing diagnostic quality while minimizing radiation risk.

Introduction:

Computed Tomography (CT) has revolutionized medical imaging, providing clinicians with invaluable insights into various abdominal conditions. Its capacity to generate cross-sectional images with great resolution facilitates precise diagnosis and treatment planning[1]. However, the advantages of CT imaging are accompanied by the risk of radiation exposure, which may have biological repercussions based on a number of patient-specific parameters, such as body weight and gender. Knowing how radiation dosage variation affects these characteristics has become a crucial topic of research as researchers and medical professionals work to better imaging techniques. Radiation dose in CT abdomen scans is influenced by multiple factors, including machine settings, patient anatomy, and the presence of attenuation materials within the body. One of the primary determinants of radiation exposure is the patient's body weight.[2] Heavier individuals typically require higher radiation doses to achieve adequate image quality, as increased tissue mass leads to greater X-ray attenuation. Consequently, radiologists often adjust the scanning parameters to compensate for this effect, inadvertently increasing radiation exposure.[3] Conversely, lighter patients may receive lower doses, although improper parameter adjustments could result in suboptimal image quality. A number of variables, like as machine settings, patient anatomy, and the presence of attenuation materials within the body, affect the radiation dose during CT abdominal scans.[4] The patient's body weight is one of the main factors that determines radiation exposure. Because more tissue mass results in greater X-ray attenuation, heavier people usually need larger radiation doses to provide satisfactory image quality. In order to counteract this impact, radiologists frequently modify the scanning parameters, unintentionally increasing radiation exposure.[5] On the other hand, lighter patients might get smaller dosages, but incorrect parameter settings might produce less-than-ideal images. Differences in radiation absorption and its biological effects are also influenced by gender. According to studies, the tissue densities and compositions of male and female bodies differ, which causes differences in how much radiation is absorbed by each.[4] Additionally, variations in organ sensitivity and hormonal activity may affect the risk of radiation exposure. For example, because reproductive organs are more sensitive to radiation, female patients may be more susceptible to radiation-induced side effects.[6] These factors emphasize how crucial customized radiation procedures are to preserving diagnostic precision and patient safety. The development of dose-reduction strategies to lessen the hazards of radiation exposure is a result of medical developments.[7] To maximize dosage levels while maintaining imaging quality, technologies such patient-specific protocol modifications, iterative reconstruction techniques, and automatic exposure control (AEC) have been used. In order to balance the trade-offs between radiation dose and diagnostic efficacy, clinicians must continue to be careful in evaluating these factors.[8] This article explores the complex link between patient weight, gender, and radiation exposure in CT abdominal imaging. The study intends to shed light on the best methods for radiation dose optimization by analyzing the data and literature already in existence.[9] Enhancing patient safety, improving imaging procedures, and adding to the continuing discussion about radiation protection in medical diagnostics are the objectives. In order to guarantee that CT imaging remains a useful tool without endangering patient health, it is imperative to comprehend these elements.[10]

MATERIALS & METHODS

This study carried out on Philips Ingenuity Core 128 slice CT Machine. In this study, we included patient who went through CT Abdomen.We used appropriated routinely protocol adult CT Abdomen to identify the patient radiation dose (CTDI & DLP). The consideration population comprised of NCCT abdomen patients discounting who come into exclusion criteria. The size of sample was 100 patients . After the compilation of CT exam, data were recorded & analysed with SPSS software (SPSS Inc; Chicago, IL), version 26.0. One-way ANOVA test was performed to compare radiation doses (CTDIvol & DLP) of CT Abdomen according to patient's body weight and also t-test was performed to compare CTDIvol and DLP according to gender.

RESULT .

A total 100 patients of both sex and different age group were included in the present prospective study. An informed consent was obtained from all the patients before they were subjected for evaluation. Out of the 100 there was 50 males 50 females.

Table: 5.1. Shows Weight & Frequency

Weight	Frequency	%
50-60	25	50%
61-70	15	30%
> 70	10	20%

The above table shows weight & frequency with their percentage, the weight of abdomen was categorized into 50-60 kg (25 patients) with 75%, 61-70kg (15 patients) with 5.6% and more than 70 (10 patients) with 16.2%.

Table: 5.2. Shows CTDI and DLP of Abdomen

Abdomen (n = 100)		CTDIvol (mGy)		DLP (mGy/cm)	
	Mean	S.D.	Mean	S.D.	
Weight	50-60	16.95	3.82	821.87	55.35
	61-70	16.10	1.24	852.59	99.72
	> 70	16.30	0.02	815.66	56.50
"F"	1.287	2.195			
p Value	0.281	0.117			

The One-way ANOVA test was used to compare CTDIvol (mGy) & DLP (mGy/cm) according to weight among abdomen group which includes 100 patients who are categorized in three categories (50-60kg, 61-70kg & >70kg). The mean of CTDIvol of 50-60kg group patients was 16.95 with S.D. 3.82, mean of CTDIvol of 61-70kg group patients was 16.10 with S.D. 1.24 and mean of CTDIvol of >70kg group patients was 16.30 with S.D. 0.02 with the p-value 0.281 (insignificant). And the mean of DLP of 50-60kg group patients was 821.87 with S.D. 55.35, mean of DLP of 61-70kg group patients was 852.59 with S.D. 99.72 and mean of DLP of >70kg group patients was 815.66 with S.D. 56.50 with p-value 0.117 (insignificant). So there was no difference (p > 0.05) in CTDIvol (mGy) and DLP (mGy/cm) according to weight among the abdomen group.

Table: 5.6. Shows CTDI and DLP in abdomen and thorax groups according to gender

Groups	Dose parameters	Gender	Mean	S.D.	"t"	p value
Abdomen	CTDI (mGy)	Male	16.2	1.0	-1.561	0.122
		Female	16.9	3.8		
	DLP (mGy/cm)	Male	842.9	90.0	1.384	0.169
		Female	819.7	56.0		

The above table shows that the independent sample "t" test was used to compare CTDIvol (mGy), DLP (mGy/cm) according to gender for each group. In the abdomen group the mean of CTDIvol in male was 16.2 with S.D. 1.0, in female mean was 16.9 with S.D. 3.8 (p-value-0.122) and the DLP mean in male was 842.9 with S.D. 90.0 and in females 819.7 with S.D. 56.0 (p-value- 0.169) . There was no difference (p > 0.05) in mean CTDIvol (mGy), DLP (mGy/cm) according to gender for each group.

DISCUSSION

The current study sought to determine how the patient's gender and body weight affected the radiation exposure during abdomen CT imaging. The results showed that there were no statistically significant differences in CTDIvol or DLP according to gender or weight categories.

These findings are consistent with prior research that has demonstrated the varying effects of gender and body habitus on radiation dosage, particularly in the presence of automated exposure control systems. It's possible that the study's adoption of standardized scanning techniques reduced dosage variability among patient groups. Nonetheless, some variance in average values, like the marginally greater CTDIvol in women, might be caused by variations in anatomical features, hormones, or body composition.

Individualizing dosage settings is clinically important, even though the observed differences were not statistically significant. Particularly in radiosensitive groups like women and children, even slight increases in radiation exposure can have a cumulative biological impact.

CONCLUSION .

Although there was no statistically significant difference in CT radiation dosage according to gender or weight in this investigation, the trends highlighted highlight the necessity of further attention to dose optimization. Subtle patterns might be shown in future research with bigger sample numbers and more stratified weight categories. Incorporating patient-specific protocols is still a crucial tactic for improving CT imaging's diagnostic efficacy and safety.

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