Determination of radiation dose for Chest During CT scan

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Abstract

Optimizing scanning technique in CT (lowering kV, mA and exposure time, increasing slice thickness and limiting the scan range to only necessary anatomy) the aim of this study are Comparison of Radiation Dose and Image Quality between **16-64** MDCT. sixty-eight patients included in this study divided in to 4 groups,17patients were in each Group.

The parameters were examined kV 120, the mAs values were degraded from **200** to **360** mAs , The slice thickness were 2mm for 16MDCT group**(1)** and 3mm16MDCT group**(2)** ,2mm64CTMD group**(3),** and 3mm for 64CTMD group**(4).** The results illustrated the comparisons of radiation doses for each group were obtained at 200 mAs , There was no significant difference between the group **(1)** and group **(2)** , also between group **(3)** and group **(4)** .The CTDIvol in Group **(1)** was 16.7mGy in group (**2**) was 16.7mGy , while the DLP group **(1)**was 571.7mGy.cm in group **(2)** was 570.3mGy.cm. The CTDI vol in group **(3)** was 11.8 mGy in group **(4)** was also 11.8mGy while the DLP group **(**3**)** was456.6 mGy.cm and group **(4)** was 455.4 mGy.cm and at 350 mAs , The CTDIvol in Group **(1)** was 29.2mGy in group (**2)** was 29.2mGy **,** while the DLP group **(1)**was 1000.9mGy.cm in group **(2)** was 998mGy.cm**.** The CTDI vol in group **(3)** was 20.6 mGy in group **(4)** was also 20.6mGy while the DLP group **3** was799.1mGy.cm and group **(4)** was 797 mGy.cm**, Through the results we noted there are higher significant a difference between group (1-2)more than group (3-4) .** the most radiologists chosen the group **(4)** MDCT64 3mmslice thickness at 250 mAs and 120 kV was the best images with good quality image less noise high resolution.

Key words (High-resolution computed tomography) – (milliampere-second)- volume computed tomography dose index (CTDIvol), and dose-length product (DLP)

Introduction

Increased utilization of CT to answer a plethora of clinical questions has resulted in increasing radiation exposure associated with CT scanning, thereby emphasizing the requirement for

appropriate strategies to optimize and reduce existing levels of radiation exposure. Recent recognition of expanded use of CT scanning has raised serious concerns over the magnitude of radiation exposure to the population. Subsequently, it has been recommended that CT radiation dose can be reduced using various strategies [1-3]. Recommended strategies for radiation dose reduction include: educating referring physicians and radiologists about the magnitude of the problem, adopting guidelines for legitimate indications for CT scanning to avoid overuse and optimizing techniques of CT scanning[1-2]

High-resolution computed tomography (HRCT) imaging of the lungs is well-established for diagnosing and managing many pulmonary diseases Optimal methods of acquisition and interpretation of HRCT images require knowledge of anatomy and pathophysiology [4], as well as familiarity with the basic physics and techniques of computed tomography. This parameter outlines the principles for performing high-quality HRCT of the lungs.[3].The PURPOSE of this study **the** MDCT has some specific scan parameters that may systematically increase or decrease radiation dose to patients. This study explored the scan protocol parameters that impact radiation dose in chest MDCT and determined the optimal scan parameters that balance radiation dose with diagnostic image quality.

Materials & Methods

We collected radiation doses on diagnostic CT of the chest examinations performed between January 1, 2020, to April 30, 2020, at radiation department at **Tripoli new medical center**, CT 64 MD and 16 CT MD Scan Philips, scanners
Computed tomography examinations of the chest were performed using Philips CT machine (USA) Brilliiance CT shown in figure (1)

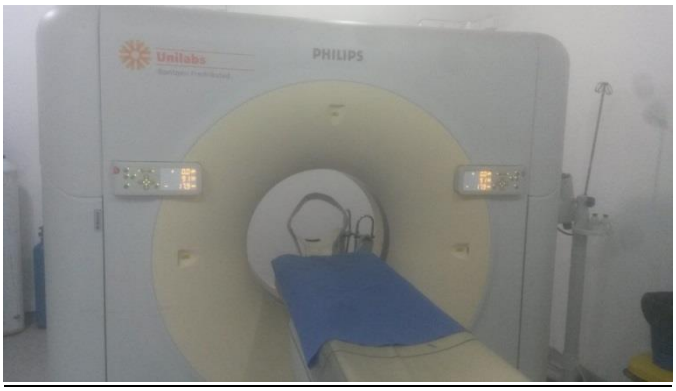


Fig (1) illustrate the CT scan was used in our study department at Tripoli new medical center

The spiral scanner had 16 slice and 64 slices (The tube potentials was 120 kV the tube current used along with dose indices were displayed on the control console of the scanner ranged between 200-360 mAs.
During CT examination of the chest, sequential mode was selected we inserted all information of patient name, weight, Age. technic protocol for chest scan. figure below.

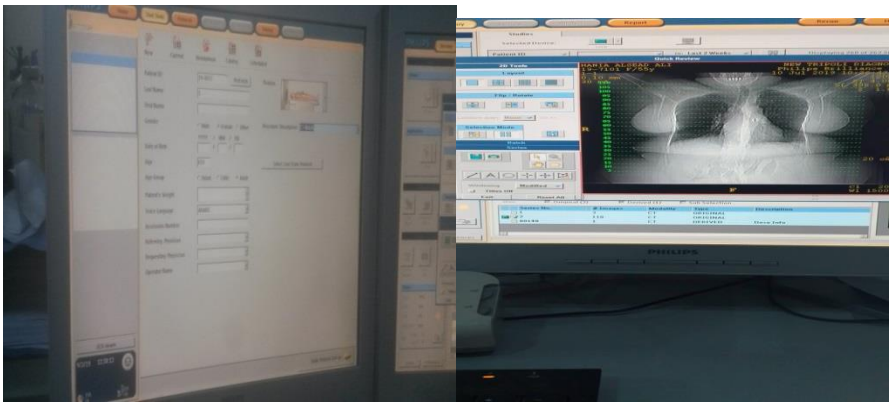


Fig (2) illustrate the window where the information of patient inserted. And parameters of patient

Various other parameters such as the total time duration of the scan, field of view and pitch selection were also displayed on the console.as shown in figure below.

The parameters have been recorded, fixed *X-ray tube voltage (kV):*120, and changed *Tube current and exposure time product (mAs* gradually from 200 to 350 mAs the number of slices acquired was 2mm and 3 mm in CT MD 16 slice and CT MD64 slice, the scanner facilitated preprogrammed protocols designed for quick and easy workflow. to get different measurement doses from CTMD 16 and CTMD64 slice. those scanners were then assessed for head dose using were investigated. Common CT dose descriptors including image quality parameters volume computed tomography dose index (CTDIvol), and dose-length product (DLP) .

The preprogrammed scan protocols used were based on recommended exposure factors specified by the manufacturers as a starting point for clinical work. During the study, optimized exposure parameters set by personnel performing the examination were used. Selection of factors below the set optimized parameters. we collected data from 68 patients, Data was analyzed with the Microsoft Exel 2016 The study was divided into four categories depending upon the dose of mAs of examination and slice thickness, performed on 17 patients each group whom are chest scan done and each one of them measured whit different dose of mAs.

Group 1: 16-MDCT and 2mm slice thickness :17 Patients who underwent non-contrast CT of chest

Group 2 16-MDCT and 3 mm slice thickness 17 Patients who underwent to non-contrast CT of chest

Group 3: 64-MDCT and 2mm slice thickness :17 Patients.

Group 4: 64-MDCT and 3mm slice thickness :17 Patients.

The tables 1-2-3-4 illustrating the parameters for each group.

All images were reviewed by a team of expert radiologists and chosen the best images with good quality image less noise high resolution.

Results and discussion

All examinations reported in this study were performed on adult patients, Of the sixty-eight patients included in this study divided to four groups according to CT MD 16 or 64 and slice thickness, seventeen patients were in each Group. the tube potential of 120 kV was invariably selected during the entire examination whereas the selection of slice thickness 2mm and 3mm and 200 to 360 of mAs were selected for each Group the comparison between the mAs ,mGy and mGy.cm to group 1 for CTMD16 slice thickness 2mm and mAs obtained from 200 to 360 was shown figure (4) .

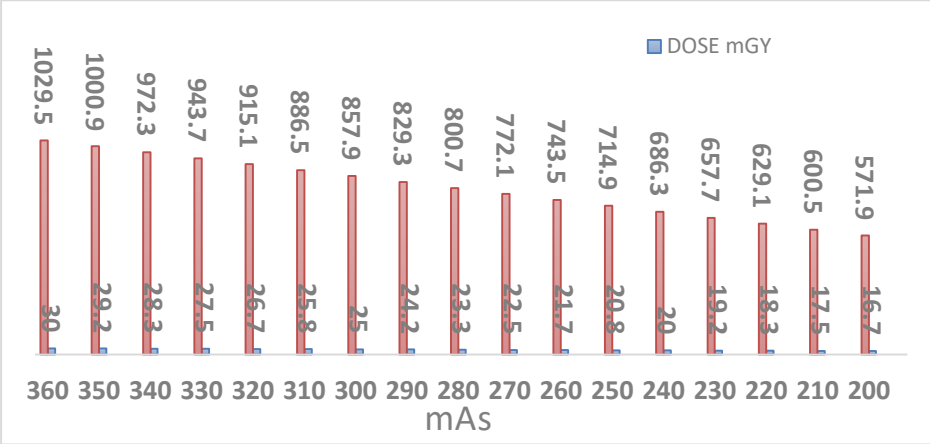


Fig (4) illustrate the group (1) MDCT 16 slice thickness 2 mm, kv

Figure (4) resulted ,The tube potential of 120 kV and the CTDIvol was 16.7 mGy The resultant DLP was 571.9mGy cm. at minimum mAs was 200 while the

CTDIvol was 29.2 mGy and DLP was 1000.9 mGy cm at maximum mAs 350 with slice thickness of 2mm for 16 MDCT scanner were selected for Group 1.

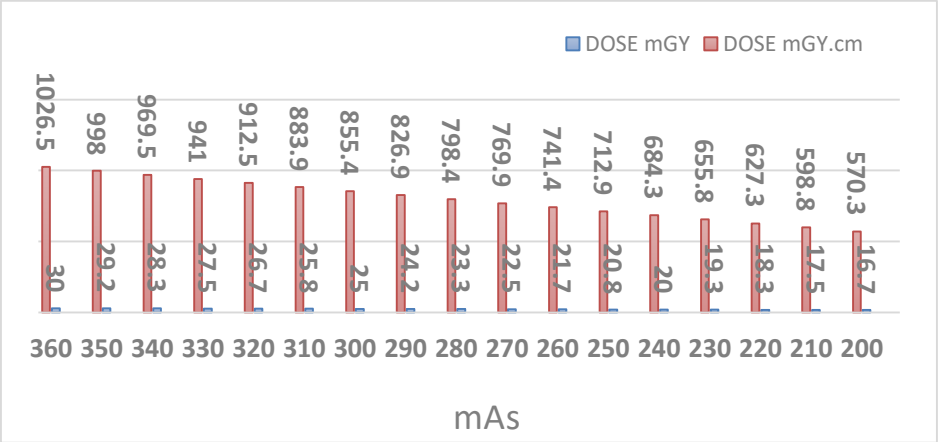


Fig (5) illustrate the group (2) MDCT 16 slice thickness 3 mm, kv120..

The group 2 , Figure (5) resulted ,also The tube potential of 120 kV and the CTDIvol was 16. 7 mGy The DLP was 570.3mGy cm. at minimum mAs was 200 while the CTDIvol was 16.7mGy and DLP was 1026.5 mGy cm at maximum mAs 350 with slice thickness of 3mm for 16 MDCT scanner were selected for Group 2.

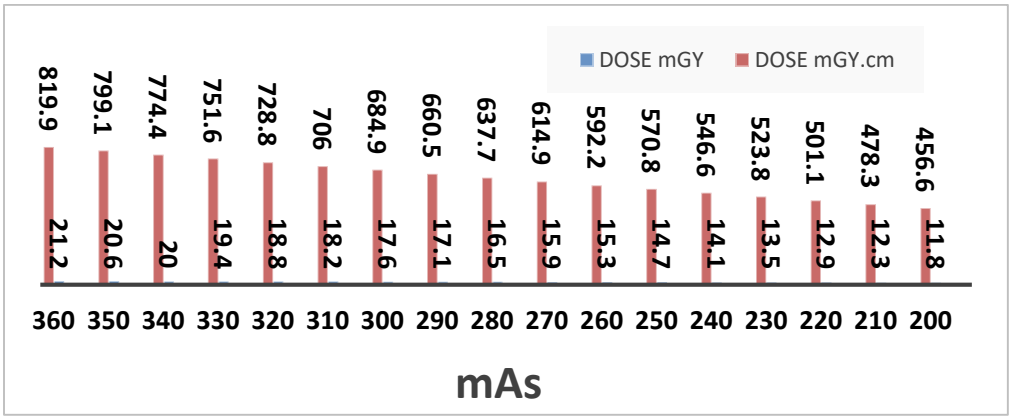


Fig (6) illustrate the group (3) MDCT 64 slice thickness 2 mm, kv120.

The group 3 , Figure (6) The tube potential of 120 kV and the CTDIvol was 11.8 mGy, The DLP was 456.6mGy cm. at minimum mAs was 200 ,while the CTDIvol was 20.6mGy and DLP was 799.1mGy cm at maximum mAs 350 with slice thickness of 2mm for 64 MDCT scanner were selected for Group 3.

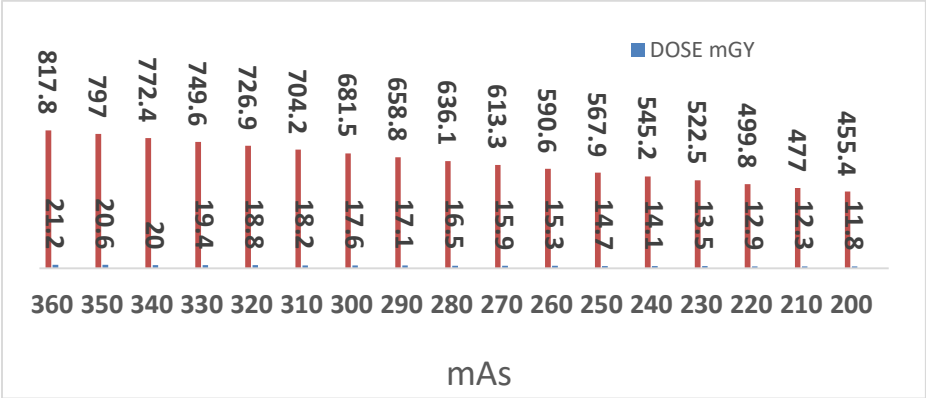


Fig (7) illustrate the group (4) MDCT 64 slice thickness 3 mm at kv120.

The group 4 , Figure (7) The tube potential of 120 kV and the CTDIvol was 11.8 mGy, The DLP was 45

6.6mGy cm. at minimum mAs was 200 ,while the CTDIvol was 20mGy and DLP was 797mGy cm at maximum mAs 350 with slice thickness of 3mm for 64 MDCT scanner were selected for Group 4.

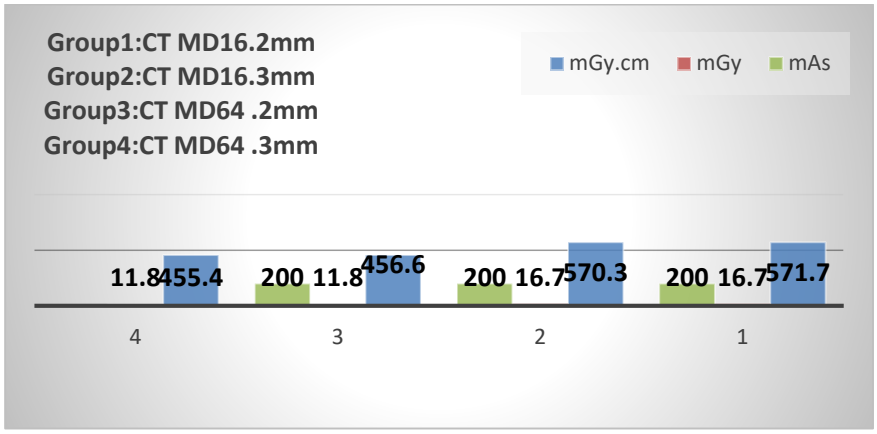


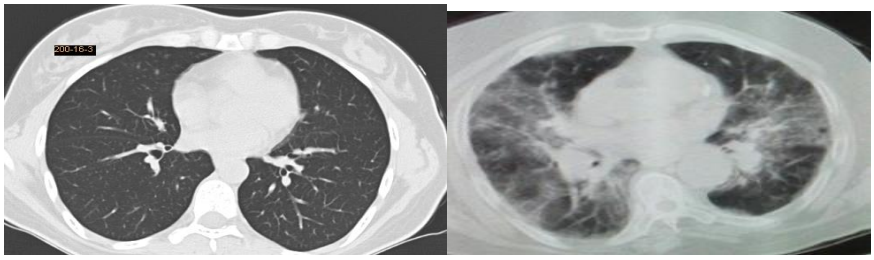
Fig (7) illustrated the Comparisons between the four group were the mAs adjusted at 200 and kV was 120.

The figure 7 illustrated the comparisons of radiation doses for each group were obtained at 200 mAs , There was no significant difference between the group 1 and group 2 , also between group 3 and group 4.

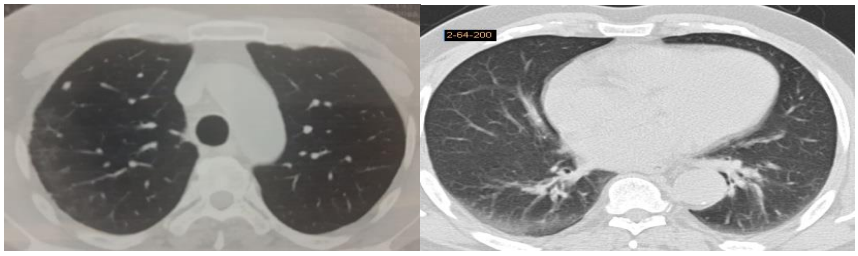
The CTDIvol in Group **1** was **16.7mGy** in group **2** was **16.7mGy ,** while the DLP group **1**was **571.7mGy.cm** in group **2** was **570.3mGy.cm.**

The CTDI vol in group **3** was **11.8 mGy** in group **4** was also **11.8mGy** while the DLP group **3** was**456.6mGy.cm** and group **4** was **455.4 mGy.cm .**

Through the results we noted there are higher significant a difference between group (1-2)more than group (3-4) . The figure (8) below shows the images output **.**



3-16-200 **2-16-200**



3-64-200 **2-64-200**

fig (8) illustrated axial CT chest, Acquisitions were obtained at 120 kV with fixed tube current at 200 mAs all groups

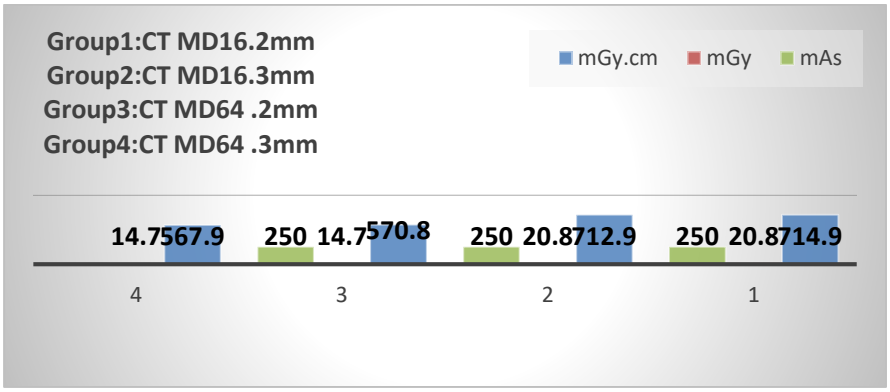
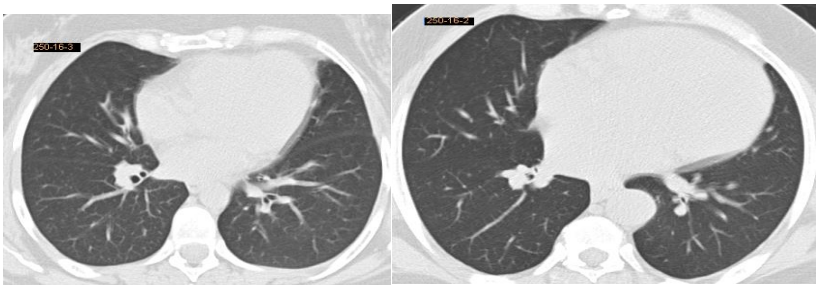


Fig (9) illustrated the Comparisons between the four group were the mAs adjusted at 250 and kV was 120.

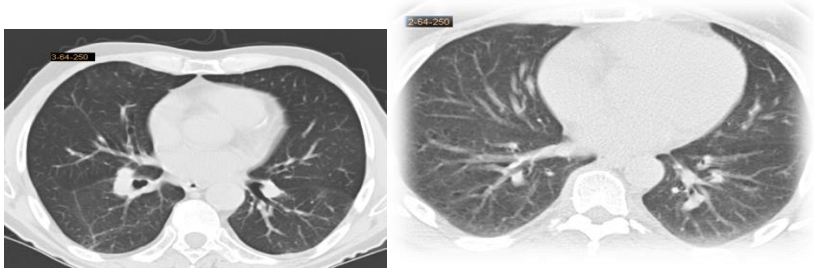
The CTDIvol in Group **1** was **20.8mGy** in group **2** was **20.8mGy ,** while the DLP group **1**was **714.9mGy.cm** in group **2** was **712.9mGy.cm.**

The CTDI vol in group **3** was **14.7 mGy** in group **4** was also **14.7mGy** while the DLP group **3** was**570.8mGy.cm** and group **4** was **567.9 mGy.cm.**

In this result we noted the significant difference the group 4 was lesser radiation exposure dose DLP than group 1-2-3 . The figure (10) below shows the images output **.**



3-16-250 **2-16-250**



3-64-250 **2-64-250**

fig (10) illustrated axial CT chest , Acquisitions were obtained at 120 kV with fixed tube current at 250 mAs all groups.

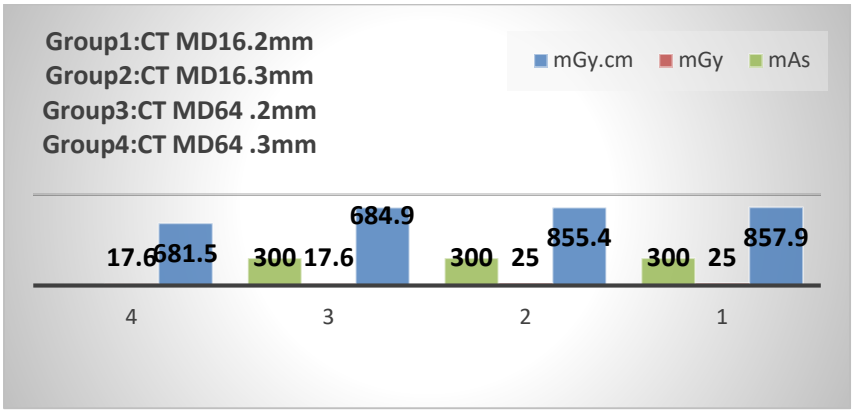


Fig (11) illustrated the Comparisons between the four group were the mAs adjusted at 300 and kV was 120.

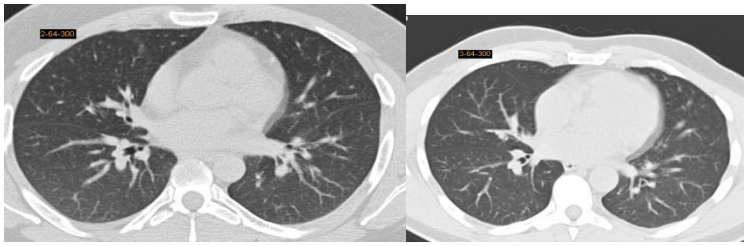
The figure 11 illustrated the comparisons of radiation doses for each group were obtained at 300 mAs , There was no significant difference between the group 1 and group 2 , also between group 3 and group 4.

The CTDIvol in Group **1** was **25mGy** in group **2** was **25mGy ,** while the DLP group **1**was **857.9mGy.cm** in group **2** was **855.4mGy.cm.**

The CTDI vol in group **3** was **17.6 mGy** in group **4** was also **17.6mGy** while the DLP group **3** was**684.9mGy.cm** and group **4** was **681.5 mGy.cm .**

Through the results we noted there are significant a difference between group (1-2)and group (3-4) . The figure (12) below shows the images output **.**

2-16-300 **3-16-300**



3-64-300 **2-64-300**

Fig (12) illustrated axial CT chest, Acquisitions were obtained at 120 kV with fixed tube current at 300 mAs all groups.

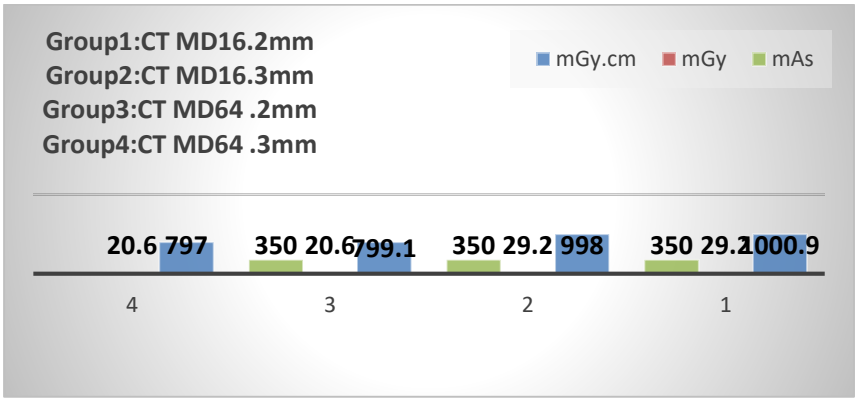


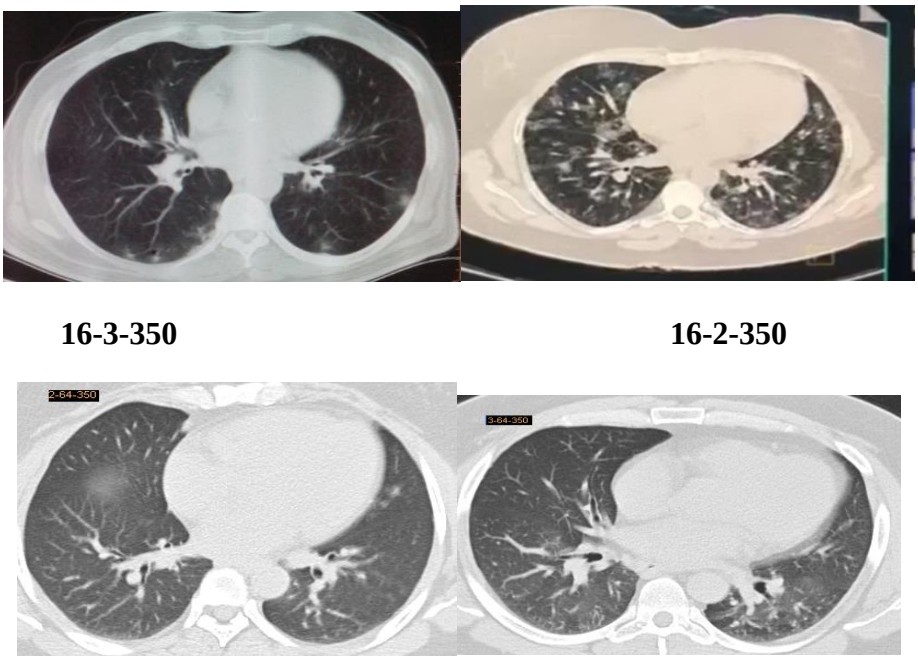
Fig (13) illustrated the Comparisons between the four group were the mAs adjusted at 350 and kV was 120.

The figure 13 illustrated the comparisons of exposure radiation doses for each group were obtained at 350 mAs , There was no significant difference between the group 1 and group 2 , also between group 3 and group 4.

The CTDIvol in Group **1** was **29.5mGy** in group **2** was **29.5mGy ,** while the DLP group **1**was **1000.9mGy.cm** in group **2** was **998 mGy.cm.**

The CTDI vol in group **3** was **20.6 mGy** in group **4** was also **20.6mGy** while the DLP group **3** was**799.1mGy.cm** and group **4** was **797 mGy.cm .**

Through the results we noted there are higher significant a difference between group (1-2)more than group (3-4) . The figure (14) below shows the images output **.**



16-3-350 **16-2-350**

3-64-350 **2-64-350**

Fig (14) illustrated axial CT chest, Acquisitions were obtained at 120 kV with fixed tube current at 350 mAs all groups.

conclusion

we conclude from this study that relationship between radiation dose and image quality. depends on number of x-ray photons contributing to image , X-ray tube amperage: Changing the mAs value changes the beam intensity—and thus the number of x-rays—proportionally. For example ,increase the mAs value will increase the beam intensity and the number of x-rays detected by each measurement and that was significant in our results .

Slice thickness: Changing the thickness changes the beam width entering each detector—and thus the number of detected x-rays—approximately proportionally. For example, compared with a slice

thickness of 2 mm, a thickness of 3 mm or more approximately increase the number of x-rays entering each detector, also The radiation dose is inversely proportional with Multi detectors

CT image quality, as in most imaging, is described in terms of contrast, spatial resolution, image noise, and artifacts .according to this terms the most radiologists chosen the group 4 MDCT64 3mmslice thickness at 250 mAs and 120 kV .

References

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