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Assessment of Automatic Tube Current Modulation Technique of Multi-Detectors Computed Tomography Machine in Multiphasic Examinations:

Computed Analysis

Thesis

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SUMMARY

The recent technical development of multidetector CT (MDCT) machine has contributed to a substantial increase in its diagnostic applications. MDCT plays an important role in the diagnosis of liver lesions. A major drawback of MDCT is the use of ionizing radiation with the risk of inducing secondary cancer. Therefore, justification and optimization of MDCT are of great importance in order to minimize these risks ("as low as reasonably achievable" principle). It is crucial to keep radiation doses as low as possible. By tube current modulation. By using Automatic tube current modulation (ATCM) technique can be modulated tube current which could decrease automatically for regions with lower attenuation while maintaining an acceptable level of image noise and improving radiation dose efficiency. The present study aims to assess the effect of ATCM on image quality, diagnostic acceptability and radiation dose of liver multiphasic CT examinations.

To study the difference in image quality and radiation exposure associated with MDCT for multiphasic examinations performed with ATCM and fixed tube current (FTC) technique regarding measurement of radiation exposure and measurement of image quality as the followed:-

1. Determination of Radiation Exposure outcome by calculation the following parameters:-

- a. Computed Tomography Dose Index Volume (CTDI_{vol}).
- b. Dose-length products (DLP).
- c. Effective dose (ED).
- d. The dose reduction (DR).

2. Determination of Image quality by calculation the following parameters:-

- a. Quantitative Analysis of the following calculations:-
 1. Standard deviation (SD): of attenuation coefficient values
 2. Signal-To-Noise Ratio (SNR)
 3. Contrast-To-Noise ratio(CNR)
- b. Qualitative image scoring was performed independently by two staff radiologists with experience in multiphasic examination Computed Tomography.

The results showed that:

1- Radiation Exposure outcome:-

- The average values of CTDI_{vol} in the protocol using FTC technique was 26.07 mGy while in the protocol using ATCM technique was 13.71 mGy. The values of CTDI_{vol} in ATCM technique showed a reduction by comparing it with CTDI_{vol} in FTC technique.
- The average values of DLP in the protocol using FTC technique were 437.14mGy.cm while in the protocol using ATCM technique were 228.95 mGy.cm. The values of DLP in ATCM technique shown reduced compared it with DLP in FTC technique.

- The average values of ED in the protocol using FTC were 6.56 mSv while in the protocol using ATCM technique was 3.43 mSv. The values of ED in ATCM technique show reduced comparing it with ED in FTC technique. The values of ED showed a difference between two techniques FTC and ATCM technique
- The dose reduction achieved with the ATCM system in use was determined relative to the dose delivered with the FTC system. The dose savings ranged from approximately 23.53% to 57.72% for studied patients. Radiation dose was reduced in the protocol using ATCM technique by comparing with a protocol using FTC technique.
- The mean values of DR in the protocol using ATCM technique was 46.93% comparing it with FTC technique.

2- Evaluation of image quality:-

a. Quantitative analysis

- The average of the background SD of image noise values in the protocol which use FTC technique were 7.80 HU while in the protocol using ATCM technique was 8.72 HU. There were slight differences in the background SD of image noise values between two acquisition techniques. The Similarity of background SD of the image noise between two acquisition techniques was founded in some patient.
- The average of the liver parenchyma SD of image noise values in the protocol FTC technique was 6.83 HU while in the protocol using ATCM technique was 7.81 HU. There was a slight difference in the liver parenchyma SD of image noise values between two acquisition techniques.
- The values of SNR for liver parenchyma with FTC technique ranged from 7.59 to 26.90 HU while SNR for liver parenchyma with ATCM technique ranged from 8.42 to 25.37 HU. The averages of SNR values for liver parenchyma in the protocol using the FTC technique was 15.33 HU while in the protocol using ATCM technique was 13.93 HU. We found slightly difference in the SNR values between two acquisition techniques. There was slightly different in the SNR values between two acquisition techniques
- The values of CNR for liver parenchyma with FTC technique ranged from 13.20 to 51 HU while CNR for liver parenchyma with ATCM technique ranged from 15.84 to 55.37 HU. The averages of CNR values for the liver parenchyma in the protocol which use FTC technique was 28.93 HU while in the protocol using ATCM technique was 29.98 HU. There was a slight difference in the CNR values between two acquisition techniques.

b. Qualitative analysis

In the qualitative assessment of liver CT images, the majority of our patients were graded as good (grade 4) or excellent (grade 5) in both FTC and ATCM acquisition technique, providing satisfactory images for radiological diagnosis. There was no difference in the quality assessment of liver CT images among the two acquisition techniques. No interobserver disagreement existed between the two readers in each two acquisition techniques.