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Radiation dose reduction in abdominopelvic CT using BMI specific low kV protocol

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ABSTRACT

Objective: To evaluate the impact of a body mass index (BMI)-adjusted low kV protocol on radiation dose reduction and image quality in contrast-enhanced computed tomography (CECT) scans of abdomen and pelvis.
Methods: Among the patients referred for CECT abdomen and pelvis scans, 120 were scanned using the standard protocol at 120 kV, whereas 96 were scanned according to a BMI-specific low radiation dose protocol. Patients were categorized into 3 BMI groups, low BMI (<18.5 kg/m^2) scanned at 80 kV, and normal BMI (18.5–24.9 kg/m^2) and high BMI (25–29.9 kg/m^2) at 100 kV. Effective dose (E) was recorded for each group. Image quality was assessed in the arterial and portal venous series. Quantitative image quality analysis was performed to estimate the signal-to-noise ratio (SNR), contrast to noise ratio (CNR), contrast enhancement index (CEI) and image noise. Qualitative analysis was independently assessed using a 5-point scale.
Results: The study reported higher radiation doses with higher BMI, however, low dose protocol achieved significant reduction in radiation dose across all BMI groups, low BMI, (21 ± 2) *vs* (10.0 ± 1.7) mSv ($P < 0.05$); normal BMI, (22.0 ± 2.3) *vs* (14.0 ± 1.3) mSv ($P < 0.05$); high BMI, (25.0 ± 2.8) *vs* (17.0 ± 1.8) mSv ($P < 0.05$), for the standard and low dose protocols, respectively. Low dose protocols reported to have a higher image noise and CEI, lower SNR and comparable CNR across BMI groups in both arterial and portal venous series. Qualitative scores remain within acceptable diagnostic limits across BMI groups.
Conclusion: The BMI-specific low-kV CT protocols significantly reduced the radiation dose across all BMI groups while maintaining acceptable diagnostic image quality, suggesting that tailored low dose scanning may be feasible for clinical use.

1. Introduction

Computed tomography (CT) is an indispensable imaging tool widely used to diagnose various pathologies. Advances in CT scanners have resulted in a surge in CT examinations over the past decades.[1,2] Approximately half of all radiation doses in the medical sector are from CT alone, with the highest radiation dose obtained from CT scans of the chest, abdomen and pelvis.[3,4] The greater degree of radiation exposure in contrast-enhanced CT (CECT) abdomen and pelvis scans can often be due to the multiple phases in CT protocols.[4] Moreover, patients with chronic conditions requiring multiple follow-up scans often undergo CT scans repeatedly.[5] As a result, there is a corresponding increase in radiation exposure. Radiation exposure can increase the risk of developing radiation-induced carcinogenesis.[6] The International Commission on Radiation Protection (ICRP) recommends following principles that include justification, dose optimization and adhering to dose limits to decrease the radiation dose to only what is medically needed. The radiation dose can be optimized by choosing appropriate scanning parameters corresponding to the region of examination, patient age or size, ensuring that the radiation dose given to each patient is maintained as low as reasonably achievable. Using automatic tube current modulation (ATCM) in CT has been shown to reduce the radiation dose by 21%–31% without degrading image quality.[7] Additionally, some studies have shown the greater influence of the tube voltage (kV) compared with the tube current (mA) on the radiation dose.[8,9] Lowering the tube potential facilitates dose reduction and the possibility of reducing the contrast

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