

ABSTRACT

Vika Abidah, 2024, Analysis of Water-Equivalent Diameter (D_w) Based on Localizer Radiograph Images with Tube Voltage Variations

CT has become a widely used modality but contributes significantly to patient radiation doses. High radiation doses pose a risk of inducing cancer several years or even decades after scanning. Several factors influence the radiation dose to patients, including tube current (mA), tube voltage (kV), and rotation time (s). The water-equivalent diameter (D_w) and size-specific dose estimate (SSDE) have been introduced to estimate patient doses while considering patient body size characteristics. The aim of this study was to determine correction factors for calibrating CT localizer radiographs in calculating D_w values using a step-wedge phantom with varying tube voltages. The step-wedge phantom was filled with water before scanning and consisted of five steps with thicknesses of 6, 12, 18, 24, and 30 cm. Scans were performed using a 64-slice Siemens Somatom CT scanner with a tube current of 100 mAs and tube voltage variations of 80, 100, 120, 140, and 160 kVp. The relationship between pixel values (PV) and water-equivalent thickness (t_w) was derived for each step thickness. This relationship was used to determine the correlation between PV and t_w for measuring D_w and SSDE. The results for D_w and SSDE from CT localizer radiographs were compared with those from CT axial images. The relationship between PV and t_w obtained from the step-wedge phantom CT localizer radiographs produced a linear correlation with $R^2 > 0.990$. The linear correlation of D_w and SSDE values from CT localizer radiographs and CT axial images showed $R^2 > 0.94$ with a statistical test P-value > 0.05 . The difference in D_w between CT localizer radiographs and CT axial images was 3.7%, while the difference in SSDE was 4.3%. Based on these results, a step-wedge phantom was successfully developed to determine the correlation between PV and t_w . This phantom can be used to assess the compatibility of CT localizer radiographs for measuring D_w and SSDE. Tube voltage (kVp) variations were found to affect the accuracy of water-equivalent diameter (D_w) measurements in localizer radiograph images.

Keywords: CT, step-wedge, water-equivalent thickness, water-equivalent diameter, SSDE

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