Assessing Image Quality in Mobile Radiography: A Phantom-Based Evaluation of a New Lightweight Mobile X-Ray Equipment

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Abstract : Mobile radiography, employing portable X-ray equipment, has become a routine procedure within hospital settings, with chest X-rays in intensive care units standing out as the most prevalent mobile X-ray examinations. This approach is not limited to hospitals alone, as it extends its benefits to imaging patients in various settings, particularly those too frail to be transported, such as elderly care residents in nursing homes. Moreover, the utility of mobile X-ray isn't confined solely to traditional healthcare recipients; it has proven to be a valuable resource for vulnerable populations, including the homeless, drug users, asylum seekers, and patients with multiple co-morbidities. Mobile X-rays reduce patient stress, minimize costly hospitalizations, and offer cost-effective imaging. While studies confirm its reliability, further research is needed, especially regarding image quality. Recent advancements in lightweight equipment with enhanced battery and detector technology provide the potential for nearly handheld radiography. The main aim of this study was to evaluate a new lightweight mobile X-ray system with two different detectors and compare the image quality with a modern stationary system. Methods: A total of 74 images of the chest (chest anterior-posterior (AP) views and chest lateral views) and pelvic/hip region (AP pelvis views, hip AP views, and hip cross-table lateral views) were acquired on a whole-body phantom (Kyotokagaku, Japan), utilizing varying image parameters. These images were obtained using a stationary system - 18 images (Mediel, Sweden), a mobile X-ray system with a second-generation detector - 28 images (FDR D-EVO II; Fujifilm, Japan) and a mobile X-ray system with a third-generation detector - 28 images (FDR D-EVO III; Fujifilm, Japan). Image quality was assessed by visual grading analysis (VGA), which is a method to measure image quality by assessing the visibility and accurate reproduction of anatomical structures within the images. A total of 33 image criteria were used in the analysis. A panel of two experienced radiologists, two experienced radiographers, and two final-term radiographer students evaluated the image quality on a 5-grade ordinal scale using the software Viewdex 3.0 (Viewer for Digital Evaluation of X-ray images, Sweden). Data were analyzed using visual grading characteristics analysis. The dose was measured by the dose-area product (DAP) reported by the respective systems. Results: The mobile X-ray equipment (both detectors) showed significantly better image quality than the stationary equipment for the pelvis, hip AP and hip cross-table lateral images with AUCVGA-values ranging from 0.64-0.92, while chest images showed mixed results. The number of images rated as having sufficient quality for diagnostic use was significantly higher for mobile X-ray generation 2 and 3 compared with the stationary X-ray system. The DAP values were higher for the stationary compared to the mobile system. Conclusions: The new lightweight radiographic equipment had an image quality at least as good as a fixed system at a lower radiation dose. Future studies should focus on clinical images and consider radiographers' viewpoints for a comprehensive assessment.

Keywords : mobile x-ray, visual grading analysis, radiographer, radiation dose
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