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The Influence of Deep Learning Image Reconstruction in Image Quality and Dose Optimization in Computed Tomography

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Background: The aim of this study is to examine the impact of deep learning-based image reconstruction (DLIR) on image quality across varying dose levels within a Chest-Abdomen-Pelvis (CAP) protocol using a 512-slice CT scanner and an advanced anthropomorphic phantom. Comparative analysis was conducted between DLIR, Adaptive Statistical Iterative Reconstruction (ASIR-V), and conventional Filtered Back Projection (FBP) reconstructions at normal, low, and ultra-low dose levels.

Materials and Methods: The Revolution APEX by GE HealthCare (Waukesha, WI, USA) CT scanner was used for this study. The experiment involved using a dedicated CT whole-body phantom, the PBU-60 by Kyoto Kagaku. A quantitative analysis was conducted, comparing the FBP Normal Dose (ND) and various reconstruction algorithms across three distinct dose levels (normal, low and ultra-low dose) and chest/abdomen/pelvis regions. Furthermore, an additional quantitative assessment was conducted, using ASIR-V60% as a reference due to its widespread utilization, between ASIR-V90% and DLIR-H. Additionally, a qualitative analysis was performed to evaluate the general image quality and overall contrast of ASIR-V60%, ASIR-V90% and DLIR-H. The evaluation was carried out in terms of Signal-to-Noise Ratio (SNR) and Contrast-to-Noise Ratio (CNR).

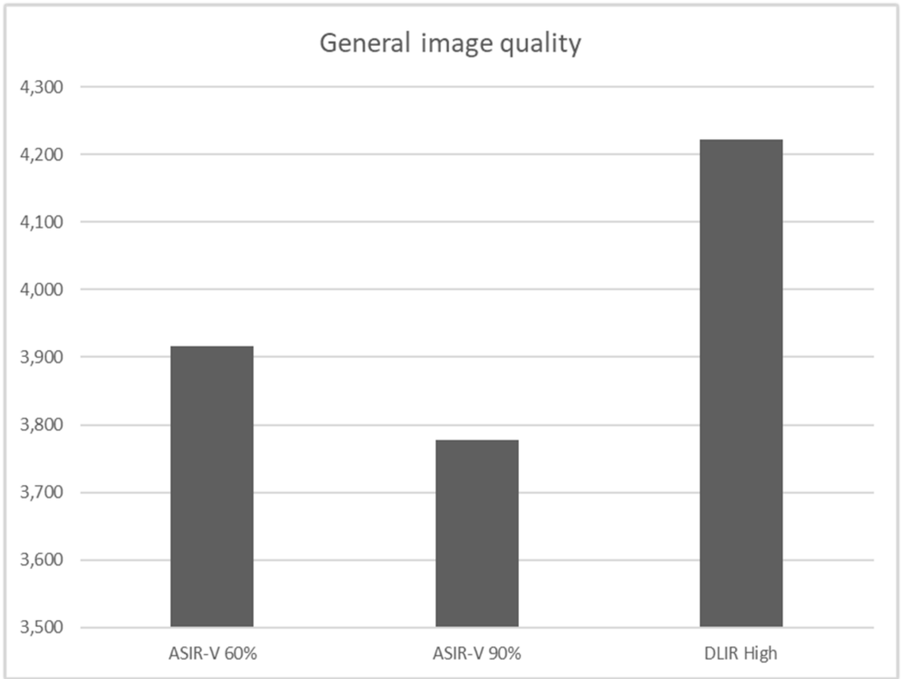

Fig. 1:Qualitative analysis results, by an expert radiologist, regarding general image quality between ASIR-V 60%, 90% and DLIR High

Results: The results demonstrate the feasibility of a low-dose protocol and suggest the potential introduction of an experimental ultra-low-dose protocol for the CAP region. The proposed implementation relies on the use of a deep-learning-based image reconstruction algorithm, which aims to maintain image quality and contrast levels comparable to those typically observed with conventional reconstruction algorithms used in regular and low-dose protocols.

Conclusion: The findings indicate that the employment of ASIR-V and DLIR reconstruction algorithms yields images of non-inferior image quality while allowing CAP imaging at reduced dose levels.