Low-dose computed tomography with deep learning reconstruction versus standard-dose computed tomography for malignant liver tumours: A systematic review and meta-analysis

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Purpose

Radiation dose reduction (RDR) in liver computed tomography (CT) using deep learning reconstruction (DLR) preserves image quality and diagnostic performance compared to standard dose CT (SDCT) with iterative reconstruction (IR). However, the minimum radiation dose reduction without significant image degradation remains contentious. We aim to conduct a meta-analysis to determine the lowest RDR achievable with DLR that maintains comparability to SDCT using IR.

Materials and methods

We searched PubMed, Embase, and Cochrane Central for studies comparing low-dose CT (LDCT) with DLR and SDCT with IR in patients at risk of malignant liver lesions. Main outcomes were image quality and diagnostic performance. Non-inferiority margins were -0.1 for the lower 95% confidence interval (CI) difference in figure of merit (FOM) for diagnostic performance, and -0.5 for mean difference in image quality. Statistical analysis used Review Manager (web version).

Results

We included 826 patients from 8 non-randomized studies. Image quality of 50-76% RDRCT with DLR vs SDCT with IR (MD -0.19; 95% CI -0.4, -0.02; p=0.08) was above the non-inferiority margin of -0.5. Subgroup analysis of 67% RDRCT with DLR vs SDCT with model based iterative reconstruction (MBIR) supported non-inferiority (MD -0.19; 95% CI -0.29, -0.10; p<0.0001). Diagnostic performance for lesion detection using FOM for 50-70% RDRCT with DLR vs. SDCT with IR (MD -0.02; 95% CI -0.05, -0.01; p=0.20) was above the non-inferiority margin of -0.1. Subgroup analysis of 67% RDRCT with DLR vs SDCT with MBIR also showed non-inferiority (MD -0.02; 95% CI -0.05, -0.01; p=0.27).

Conclusion

LDCT using DLR with 67% RDR for patients at risk of liver malignancy showed non-inferior image quality and diagnostic performance. With the growing need for repeated liver CT scans in patients at risk of malignant liver tumours and concerns about radiation exposure, our meta-analysis shows that using DLR, a 67% reduction in radiation dose for liver CT can be safely achieved.

Fig1A

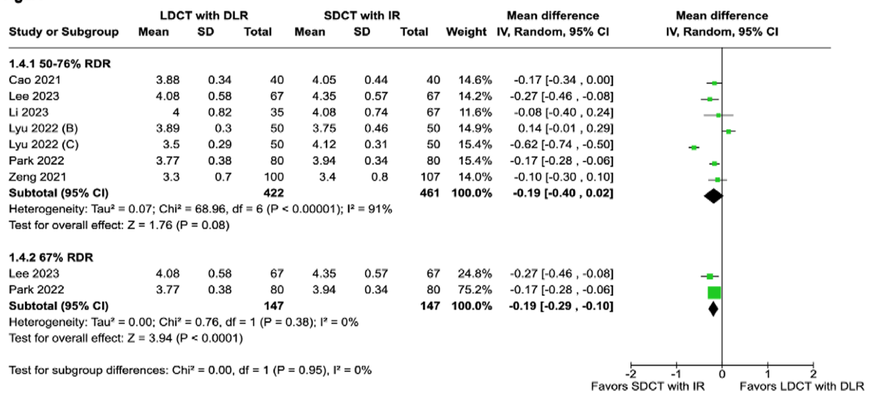


Fig1B

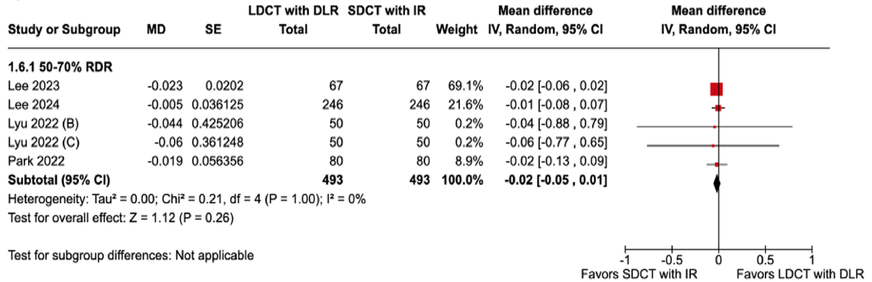


Fig1A forest plot of meta-analysis of mean difference of qualitative overall image quality between 50-76%RDRCT with DLR and SDCT with IR MD of -0.19 exceeding the inferiority margin of -0.5, showing non-inferiority between groups. A subgroup analysis of 67%RDRCT with DLR and SDCT with MBIR also shows non-inferiority. Fig1B forest plot of meta-analysis of mean difference of diagnostic performance (FOM) between 50-70%RDRCT with DLR and SDCT with IR MD of -0.02 exceeding the inferiority margin of -0.1 for FOM and showing non-inferiority between groups.

RDR = radiation dose reduction; LDCT = low dose CT; SDCT = standard dose CT; IR = iterative reconstruction; DLR = deep learning reconstruction
MD = mean difference; IV = inverse variance.

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