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NEWS

Evaluation of Deep-Learning-Based Technology for Reducing Gadolinium Dosage in Contrast-Enhanced MRI Exams

Monday 11:50-12:00 PM | SSC12-09 | Room: N226

PURPOSE

Gadolinium Deposition is one of the most urgent issues facing radiology community. In this work, we further validated a Deep Learning based contrast-boost method, on 200 patients with mixed indications, and demonstrated the generalization and robustness of the deep learning based solution to reducing gadolinium dosage while maintaining diagnostic quality.

METHOD AND MATERIALS

Dataset: A cohort of 200 patients were included in this study, with mixed indications and recieving clinically routine contrast-enhanced MRI (CE-MRI) exams. Sequences: Pre-contrast (zero-dose), post-contrast after 10% dosage administration (low-dose) and post-contrast after 100% dosage administration (full-dose) was collected with 3D T1 IR-FSPGR sequences for each patient. Method: Different series from the same patient wer corregistered and normalized. A deep convolutional neural network (3D U-Net) was trained to learn the approximation of the full-dose CE-MRI using low-dose and zero-dose images. 5-fold cross-validation was used to generate results for evaluation. Evaluation: Quantitatve metrics (PSNR, RMSE, SSIM) were used to evaluate the improvement of the enhanced contrast using deep learning. Qualitative metrics (image quality, contrast enhancement quality) were used to evaluate the result of the DL based enhancement. A non-infereiority test was conducted to demonstrate the performance of the method and validate the capability of reducing dosage without image quality loss.

RESULTS

Quantitative metrics demonstrated consistent (~4dB in PSNR and 10% in SSIM) and significant ($p<0.001$) quality improvement of the deep learning based solution, compared with low-dose CE-MRI. Qualitative ratings showed non-significant differences between the proposed method and acquired full-dose CE-MRI images, which was also verified with the non-inferiority testing. Initial results also demonstrated the possibility of synthesizing full-dose CE-MRI images with zero-dose MR images only.

CONCLUSION

With a large dataset, we demonstrated the DL solution can generalize well, achieving robust and significant quality improvement over the low-dose CE-MRI, using 10% or even less gadolinum dosage. It enables significantly (at least 10x) gadolinium dosage reduction without sacrificing diagnositic quality.

CLINICAL RELEVANCE/APPLICATION

Deep Learning solution is valuable in clinical radiology for fighting against gadolinium deposition.