

Deep Learning Amplifies the Benefits of High Relaxivity in Brain MRI: A Quantitative Assessment of a Contrast Boosting Algorithm Using Gadopichlenol

Authors: *Srivathsa Pasumarthi Venkata,¹ Sonia Colombo Serra,² Josef Vymazal,³ Ajit Shankaranarayanan¹

1. Subtle Medical Inc., Menlo Park, California, USA
 2. Bracco Imaging, Turin, Italy
 3. MRI Department, Na Homolce Hospital, Prague, Czechia
- *Correspondence to srivathsa@subtlemedical.com

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BACKGROUND AND AIMS

Gadopichlenol is a high-relaxivity gadolinium-based contrast agent (GBCA) that enables reduced contrast doses while preserving lesion conspicuity. In parallel, deep learning (DL)-based contrast boosting algorithms have been developed to enhance contrast signals in post-contrast MRI without increasing gadolinium administration. The purpose of this study¹ was to quantitatively assess whether a DL-based contrast boosting algorithm can further amplify the benefits of a high-relaxivity GBCA,

improving lesion visualisation and image quality at reduced dose levels in brain MRI.

METHODS

This retrospective study included T1-weighted pre-contrast and standard post-contrast MRI examinations from 20 patients undergoing brain MRI, comprising both 2D and 3D acquisitions. All patients were administered gadopichlenol at a reduced approved dose of 0.05 mmol/kg. Pre-contrast and standard-contrast (SC) images were processed using an FDA-cleared DL-based contrast boosting algorithm to generate contrast-boosted (CB) images. Regions of interest were manually drawn on the largest contrast-enhancing lesion and on adjacent healthy brain parenchyma. Regions of interest defined on SC images were propagated to pre-contrast and CB images through image registration. Quantitative image quality and lesion conspicuity were assessed using contrast-to-noise ratio, lesion-to-brain ratio, and contrast enhancement percentage (CEP), with CEP calculated relative to pre-contrast images. Mean values and percentage increases from SC to CB images were computed. In addition, the performance of CB images obtained with gadopichlenol was compared with previously reported CB results using a conventional macrocyclic GBCA (gadoterate meglumine) administered at 0.1 mmol/kg.

RESULTS

Contrast-boosted images demonstrated a marked improvement across all quantitative metrics compared with standard post-contrast images. Mean contrast-to-noise ratio increased from 2.52 ± 0.85 in SC images to 10.38 ± 1.56 in CB images. Mean percentage increase result to be equal to a 314.19% increase. Mean lesion-to-brain ratio improved from 2.55 ± 1.85 to 5.12 ± 1.03 . Mean percentage increase result to be equal

to a 118.12% increase. Mean CEP nearly doubled, increasing from 0.99 ± 0.28 in SC images to 1.96 ± 0.35 in CB images. Mean percentage increase result to be equal to a 335.18% increase. Comparative analysis indicated that the percentage increases achieved with gadopicles combined with CB are comparable to those observed for gadoterate meglumine at standard dose,² also showing a noticeable amplification when CB is applied to a high-relaxivity contrast agent.

and image quality when used in combination with gadopicles at a reduced dose. The observed increase in contrast enhancement suggests that CB images obtained with 0.05 mmol/kg gadopicles are quantitatively comparable to a doubled contrast dose (Figure 1). These findings support the synergistic use of high-relaxivity contrast agents and DL-based contrast boosting as a strategy for gadolinium dose reduction while maintaining or improving diagnostic performance.

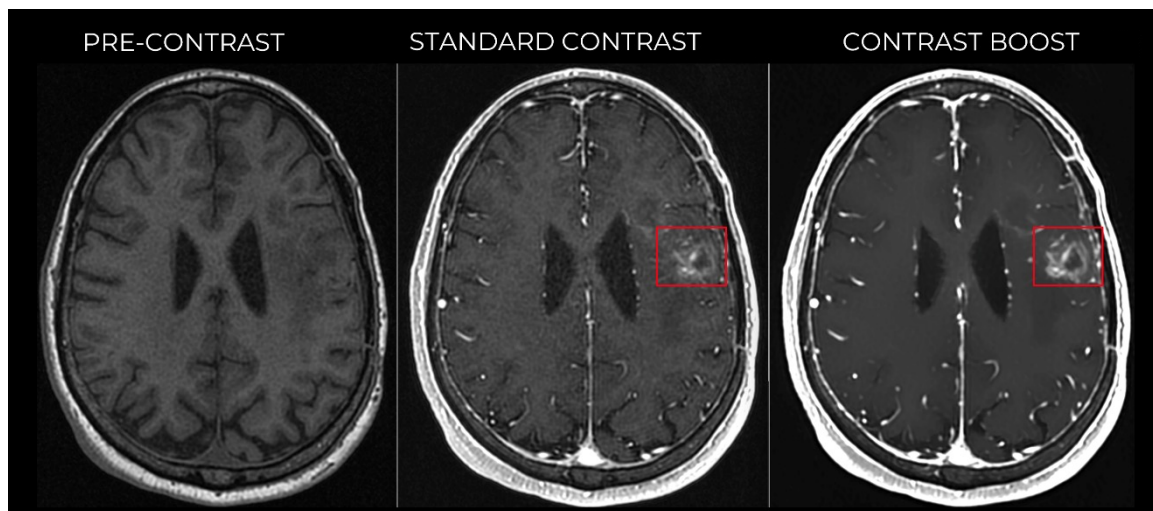
CONCLUSION

Quantitative analysis demonstrates that the DL-based contrast boosting algorithm significantly enhances lesion conspicuity

LIMITATIONS

This study is limited by a relatively small sample size and its retrospective design.

Figure 1: Representative axial T1-weighted brain MRI showing pre-contrast (left), standard post-contrast images acquired with gadopicles at 0.05 mmol/kg (centre), and deep learning-based contrast-boosted images (right).



The enhancing lesion (red square) is more clearly visualised on contrast-boosted images, with improved conspicuity and delineation compared with standard post-contrast imaging.

References

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