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CT to MRI Style Transfer Deep Learning for Enhanced Detection of Brain Metastases

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Introduction/Background

Style transfer is a technique in AI computer vision that generates synthetic images by combining the content of one image with the visual attributes of another [1]. This approach has been employed in various contexts, such as enhancing the resolution of images from portable low-field MRI scanners to resemble those produced by high-field MRI scanners [2]. In this study, we evaluate cross-modality style transfer to assist radiologists in detecting brain metastases on CT. Vasogenic edema surrounding brain metastases can be subtle on non-contrast CT, often appearing as vague hypoattenuation. In contrast, T2 FLAIR imaging provides better visualization, as the edema appears bright with high contrast resolution [3, 4]. However, CT is much more commonly acquired, less expensive, and quicker than MRI. Therefore, we aimed to enhance the conspicuity of brain metastases on CT by style transferring to a virtual T2 FLAIR MRI. We assert that producing this synthetic MRI image may enable more confident detection of brain metastases.

Methods/Intervention

We used a two-dimensional Basic UNet++ model to generate style-transferred synthetic MRI from non-contrast CT head studies. The model was trained on 300 pairs of non-contrast CT and T2 FLAIR MRI images from 280 patients at our institution.

Results/Outcome

Qualitative assessment of the synthetic MRI images was performed by a board-certified neuroradiologist who determined that the synthetic images could improve confidence in detecting brain metastases over non-contrast CT alone.

Conclusion

In future and ongoing work, improved sensitivity for small metastases is being validated by surveying a larger group of board-certified neuroradiologists.

Statement of Impact

By increasing the conspicuity of features of metastases such as edema, synthetic MRI generation through style transfer from non-contrast CT can improve radiologists' confidence in detecting brain metastases and help inform clinical decisions.

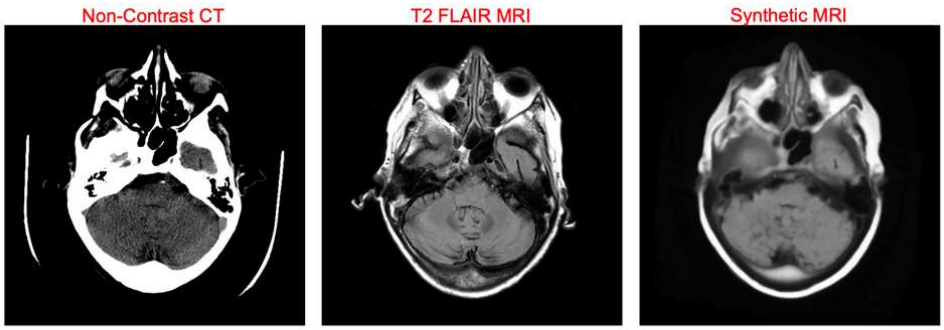

Figure 1. Corresponding non-contrast CT and FLAIR MRI with synthetic MRI produced from CT. Using the CT image as input, the Basic UNet++ generated the style transferred synthetic MRI. The true T2 FLAIR MRI taken from the same patient is shown for comparison.

Corresponding non-contrast CT and FLAIR MRI with synthetic MRI produced from CT. Using the CT image as input, the Basic UNet++ generated the style transferred synthetic MRI. The true T2 FLAIR MRI taken from the same patient is shown for comparison.

Keywords
Artificial Intelligence; Style Transfer; Neuroradiology; Brain Metastases; Deep Learning