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Foreword

A Note from the Editorial Board

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Brain Tumors at 5.0T MRI: Current and Future Research and How it Informs Patient Treatment

A United Imaging article by: Paul Polak & Interview with Haibo Xu

UIH: We are delighted today to be talking to Haibo Xu, MD, PhD, from the Department of Radiology, Zhongnan Hospital of Wuhan University. Dr. Xu's group has recently published a scientific journal paper which examines the use of ultra-high field MRI, specifically United Imaging's Jupiter 5.0T, in the area of brain tumors.

The paper we will be discussing is: "The feasibility of half-dose contrast-enhanced scanning of brain tumors at 5.0T: a preliminary study" [1] published in BMC Medical Imaging. Welcome Dr. Xu!

HX: Thank you! We are happy to discuss our work and what improvements they can make in terms of patient diagnosis and prognosis for brain tumors.

UIH: First, what were your motivations when initiating the research. So tell me a little about "The feasibility of half-dose contrast-enhanced scanning of brain tumors at 5.0T: a preliminary study."

HX: Certainly. For this paper, we wanted to investigate whether we had at least comparable image quality when using a half-dose of contrast at 5.0T, compared to using full dose at 3.0T. While contrast enhancement has become routine in MRI exams, its use does carry some risks, particularly for patients with renal problems. In addition, there is long-term concern for patients who have repeated contrast injections, as there is a risk of accumulation of Gadolinium in brain tissue.

We examined patients with brain tumors – patients with meningiomas, metastases, and glioblastomas – who underwent MRI exams at both field strengths and compared images using qualitative and quantitative measures. We used uMR Jupiter for the 5.0T, and a uMR 790 for the 3.0T images, and the protocols included 3D T1-weighted gradient echo sequences. The regions we were interested in were lesion, or tumor, and healthy appearing white and grey matter.

UIH: What were the major findings?

HX: We found that the images at half-dose at 5.0T were not only comparable to those at 3.0T, but actually superior. We found significant increases in both signal-to-noise and contrast-to-noise at the higher field strength, in some cases more than a 50% increase. While we did expect an increase in signal at 5.0T – approximately 1.7 times more, all things being equal – we also acquired at a higher resolution on the Jupiter. So even with the increased resolution available, there were still highly significant increases in the contrast and signal in the images as shown in Figure 1.

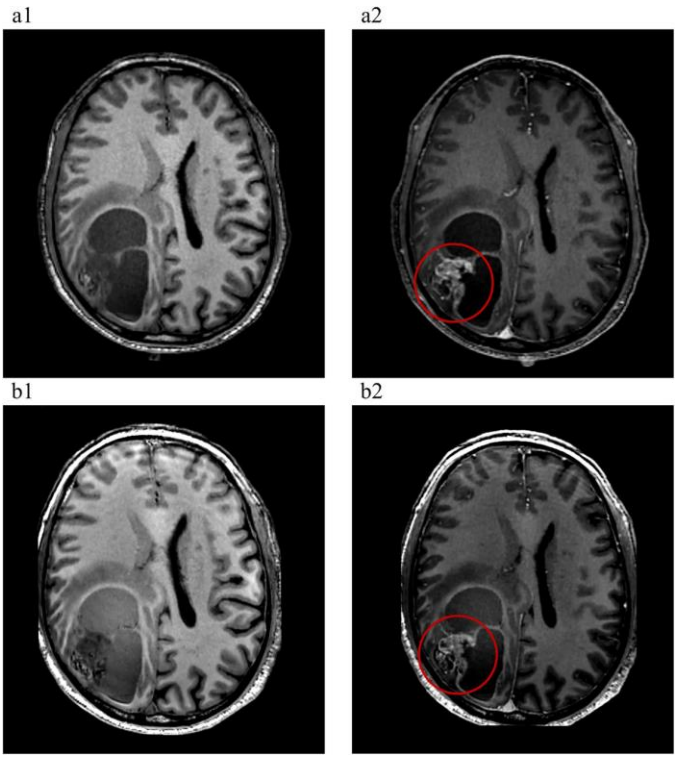


Fig. 1 Brain metastases (lung origin), 64-year-old male. (a1) T1w MRI without contrast enhancement at 3.0T and (b1) T1w MRI without contrast enhancement at 5.0T. (a2) Full-dose enhanced T1w MRI at 3.0T and (b2) half-dose enhanced T1w MRI at 5.0T. As depicted within the red circle, the augmentation of the lesion parenchyma exhibits a slightly greater intensity at 3.0T compared to 5.0T. However, in terms of delineating the intricacies of the lesion, 5.0T surpasses 3.0T due to its employment of a thinner scanning layer thickness and higher resolution, taken from [1]

UIH: What about the qualitative measures? Were they scored by clinical experts?

HX: Yes, Drs. Yu and Jiang – who have 16 years of experience as neuroradiologists between them – scored the images. They used a 10-point Likert scale, and rated the images based on tumor delineation, contrast enhancement, image homogeneity, grey and white matter differentiation, and the presence of artifacts. We found that the tumor structure and borders were significantly enhanced at 5.0T, with the overall sequence quality also significantly better at the higher field strength, although we did not find significant differences in terms of homogeneity or artifacts.

UIH: Those results sound very promising – how would you interpret them, and what are your thoughts about where this research goes next?

HX: The core message of this work is the superiority of imaging at ultra-high field. The increased resolution is very useful in delineating tumor borders, which can inform patient of treatment options, including both radiotherapy and chemotherapy and an example of such case is presented in our article (1) shown below as Figure 2.

The increased resolution, when paired with the increase in image quality and signal after contrast injection, make the case for Jupiter. In addition, from a clinical standpoint Gadolinium contrast enhanced scans are still, and for the foreseeable future, very much part of standard care.

Although this was executed as a pilot study in 12 patients, the fact that we can acquire these superior images at a lower risk to the patient by decreasing the amount of contrast we inject is a very exciting result. In the future, I believe it is worth investigating whether we can further reduce the amount of contrast we inject, which might be particularly important for patients with renal impairment. In addition, we are interested in investigating whether these results translate to tumors in other parts of the body, particularly the abdomen.

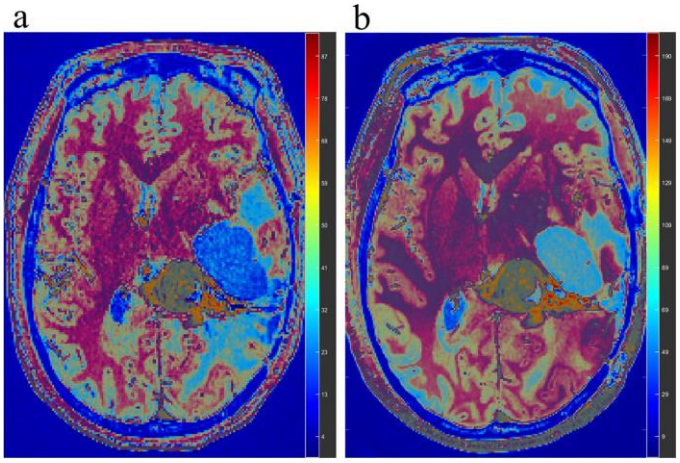


Figure 1. Representative image of a glioma patient (49 years old, female, Patient 10) at 3.0T (a) and 5.0T (b). The 5.0 T images showed a greater SNR than the 3.0 T images, especially for the tumour lesions, adapted from [1].

UIH: Finally, what would you say to your patients about the importance of this work?

HX: I would say that the increased image quality offered on Jupiter allows sharper details to be available to the doctor. This in turn gives the patients better information, which can allow them to make better decisions with their doctor.

UIH: Thank you.

References:

1. Jiang, Z., Sun, W., Xu, D. *et al.* The feasibility of half-dose contrast-enhanced scanning of brain tumours at 5.0T: a preliminary study. *BMC Med Imaging* **24**, 88 (2024). https://doi.org/10.1186/s12880-024-01270-z

Author Biography



Dr. Haibo Xu, MD, PhD,
Department of Radiology,
Zhongnan Hospital of
Wuhan University, CHINA

Dr. Haibo Xu is a Professor of Radiology and Vice President at Zhongnan Hospital of Wuhan University, where he serves as Director of Medical Imaging and a PhD mentor. Trained at Tongji Medical University with postdoctoral work in MRI at Harvard University/Massachusetts General Hospital, he is recognized for his contributions to advanced imaging, particularly MRI and neuroimaging, and played a key role in AI-assisted imaging during the COVID-19 pandemic. He has led major national research projects, published extensively, holds multiple imaging-related patents, and serves in leadership roles within Chinese radiology and medical imaging societies.

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