# Role of Efficient Treatment Guidance Using Volume Transfer Constant (Ktrans) Maps from Dynamic Contrast Enhanced MRI in Volumetric MR-guided High Intensity Focused Ultrasound Treatment of Uterine Fibroids

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## Introduction

Higher tissue perfusion at baseline has been suggested for poor ablation efficacy for MR-guided high intensity focused ultrasound (MR-HIFU) ablation[1, 2], only a few studies[2] have reported on the improvement of this problem. The purpose of the study was to explore the potential clinical values of volume transfer constant ($K^{trans}$) map in HIFU guidance of uterine fibroids with the investigation of $K^{trans}$ value changes after treatment.

## Methods

Twenty-two women with 25 uterine fibroids underwent volumetric MR-HIFU ablation. Dynamic contrast enhanced (DCE)-MRI was performed for screening (baseline), 1 and 3 months follow-up, respectively. Non-perfused volume (NPV) ratio of tissue with high $K^{trans}$ values on screening $K^{trans}$ map was assessed for each fibroid. Regions of interest (ROI) containing the whole fibroid were drawn on the multiple sections of axial plane and $K^{trans}$ values were analyzed by using histogram. Group analysis was conducted according to different $K^{trans}$ values changes. Statistical analysis was conducted in the influence of NPV ratio on the change of $K^{trans}$ value.

## Results

Three groups of various $K^{trans}$ values changes were obtained as follow: (i) For the first group with 6 fibroids, mean $K^{trans}$ values was increased at 1 month follow-up compared with baseline and increased at 3 months follow-up continuously. (ii) The mean $K^{trans}$ values for the second group with 12 fibroids was decreased at 1 month follow-up, but increased at 3 months follow-up. (iii) For the final group with 7 fibroids, the mean $K^{trans}$ values were decreased at 1 and 3 months follow-up continuously. Different vascular changes in these three groups revealed different vascular re-growth rate. NPV ratio of tissue with high $K^{trans}$ values on $K^{trans}$ map showed the significant differences among these three groups with different vascular re-growth rate ($P < 0.05$). Group 1 with poorest NPV ratio showed the rapidest rate of vascular re-growth (Fig 1), while group 3 with highest NPV ratio showed decreased in vascularity at follow-up even fibroids with high perfusion at baseline pre-treatment (Fig 2).

## Discussion

$K^{trans}$ map could display different $K^{trans}$ value distribution inside the fibroid with different colors. It could help to visualize enhancement style more directly than DCE-MR images especially for fibroids with heterogeneous enhancement. In our study, NPV ratio of tissue with high perfusion on $K^{trans}$ map showed significant difference in $K^{trans}$ value changes by follow-up among three groups. Poorer NPV ratio showed more rapid increase in $K^{trans}$ value while higher NPV ratio showed slower increase. Thus, in order to have better guidance of MR-HIFU treatment and therapeutic outcome by determining or modifying treatment strategy during the procedure[3], the high-perfused areas on $K^{trans}$ map could play an important role.

## Conclusion

The $K^{trans}$ maps reflecting vascular distribution during the screening may give better guidance on HIFU therapy, especially for fibroids with hyper-vascularity or heterogeneity inside.

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## References:

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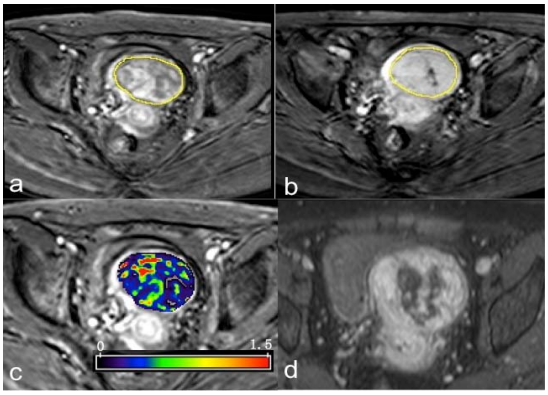


Fig 1: Fibroid with poor NPV ratio showed rapid rate of vascular re-growth after treated with HIFU ablation. Contrast enhanced T1w at baseline (a), 3m follow-up (b). Color map of $K^{trans}$ at baseline (c). Enhanced delayed T1w immediately after HIFU therapy (d)

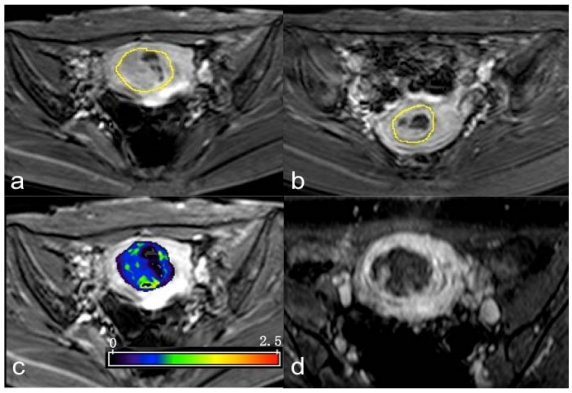


Fig 2: Fibroid with good NPV ratio showed slow rate of vascular re-growth after treated with HIFU ablation. Contrast enhanced T1w at baseline (a), 3m follow-up (b). Color map of $K^{trans}$ at baseline (c). Enhanced delayed T1w immediately after HIFU therapy (d)