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\(^3\) have reported on the improvement of this problem. The purpose of the study was to explore the potential clinical values of volume transfer constant (\(K^{\text{trans}}\)) map in HIFU guidance of uterine fibroids with the investigation of \(K^{\text{trans}}\) 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 \(K^{\text{trans}}\) values on screening \(K^{\text{trans}}\) map was assessed for each fibroid. Regions of interest (ROI) containing the whole fibroid were drawn on the multiple sections of axial plane and \(K^{\text{trans}}\) values were analyzed by using histogram. Group analysis was conducted according to different \(K^{\text{trans}}\) values changes. Statistical analysis was conducted in the influence of NPV ratio on the change of \(K^{\text{trans}}\) value.

Results
Three groups of various \(K^{\text{trans}}\) values changes were obtained as follow: (i) For the first group with 6 fibroids, mean \(K^{\text{trans}}\) values was increased at 1 month follow-up compared with baseline and increased at 3 months follow-up continuously. (ii) The mean \(K^{\text{trans}}\) 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 \(K^{\text{trans}}\) 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 \(K^{\text{trans}}\) values on \(K^{\text{trans}}\) 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
\(K^{\text{trans}}\) map could display different \(K^{\text{trans}}\) 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 \(K^{\text{trans}}\) map showed significant difference in \(K^{\text{trans}}\) value changes by follow-up among three groups. Poorer NPV ratio showed more rapid increase in \(K^{\text{trans}}\) 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 \(K^{\text{trans}}\) map could play an important role.

Conclusion
The \(K^{\text{trans}}\) 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: