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Time-dependent change of blood flow in the prostate treated with high intensity focused ultrasound

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Introduction: The precise feedback of actual effectiveness will contribute the evaluation of effectiveness of HIFU and the technical improvement for surgeon for successful treatment. Avascular areas on contrast-enhanced magnetic resonance imaging (MRI) have been considered to be areas of localized prostate cancer successfully treated by high intensity focused ultrasound (HIFU). However, the optimal timing of MRI has not been discussed.

Methods: In total, 645 patients were treated with whole-gland HIFU for localized prostate cancer in our hospital from April 2007 to March 2014. In Study 1, MRI was performed on postoperative day 1 (POD1) and POD14 in 10 randomly selected patients treated with HIFU monotherapy. The volume of the nonenhanced area at the post-HIFU acquisition was measured using the final dynamic postcontrast image. To evaluate the MRI findings, three-dimensional prostate models were reconstructed. In Study 2, we compared the pathological findings of 17 patients immediately after HIFU without neoadjuvant hormonal therapy and benign prostatic hyperplasia (BPH) resected by TUR-P in 15 randomly selected patients.

Results: In Study 1, the prostatic blood flow was significantly decreased from POD1 to POD14 on contrast-enhanced MRI. Median increase rate of the nonenhanced area of whole gland, TZ (transition zone), and PZ (peripheral zone) were 36% (range 31-62%), 39% (range 21-54%), and 34% (78-98%), respectively. In Study 2, diffuse (>80% of the tissue) coagulative degeneration and diffuse stromal edema were found in all patients with prostate cancer. The median rate of vascular endothelial cell detachment was found in 82% of the prostate cancer tissue and in 0% of BPH (p < 0.0001).

Conclusion: Time-dependent changes in the blood flow in the prostate treated with HIFU were observed on contrast-enhanced MRI. We anticipate that further large-scale studies will investigate the most appropriate timing of contrast-enhanced MRI for evaluation of the effectiveness of HIFU for localized prostate cancer.

Figure 1. Case of definitive change in the nonenhanced area on T1-weighted contrast MRI between POD1 and POD14