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Prospective evaluation of MRI and CT imaging in the follow-up after irreversible electroporation for the treatment of small renal masses

Background

Irreversible electroporation (IRE) is an experimental ablation modality for the treatment of small renal masses (<4cm SRMs). Post-ablation follow-up for SRMs is largely dependent on imaging to detect recurrent- and residual disease. Since data on imaging is lacking, we aim to assess the feasibility of CT and MRI to visualize the ablation zone. Second, we aim to determine the size and contrast enhancement (CE) of the ablation zone and its evolution over time, using MRI and -CT.

Methods

Percutaneous, CT-guided IRE was performed in consecutive patients with a SRM who were candidates for ablation. Ablations were performed with 2-6 electrodes, using clinical treatment settings (i.e. 10 test pulses of 1,500 V/cm, followed by 90 treatment pulses with pulse duration 90 μ s). Imaging at baseline (MRI, CT), 1 week (MRI), 3 months (MRI,CT), 6 months (MRI,CT) and 12 months post-IRE (MRI,CT) was assessed by a urologist and radiologist. Ablation zone volumes (AZVs) were determined using the planimetric analysis of PACS-software and interobserver agreement was calculated using the intra-class coefficient (ICC). A two-tailed Wilcoxon test was used to detect a significance. The CE in Hounsfield units (HU) was measured using PACS-software analysing the region of interest selected by the observer.

Results

9 patients with 10 IRE ablations for 10 SRMs with a median age of 68 years (60-77) were included. The ICC for MRI and CT volumes was 0.92 (CI 0.84-0.96) and 0.86 (CI 0.69-0.94), respectively (Fig 1). The AZV increased immediately after ablation on CT and at 1 week post-IRE on MRI ($p=0.016$ and $p=0.004$, respectively). At 3 months post-IRE, the AZV on CT and MRI decreased back to the planned AZV. CT demonstrated absent CE immediately after ablation ($p=0.0016$) and 3 months post-IRE, which seemed to sustain at 6 and 12 months (Fig 1).

Conclusions

This is the first study to prospectively visualize the AZV post-IRE in SRMs, providing guidance for treatment feedback. Initial study results demonstrate enlargement of the AZV immediately after ablation, persistent until 1 week post-IRE. Decrease of the AZV to the planned AZV at 3 months occurs, suggesting imaging at 3 months would be accurate predictor of treatment success. . CE on CT was absent immediately after ablation which was sustained after 3 months.

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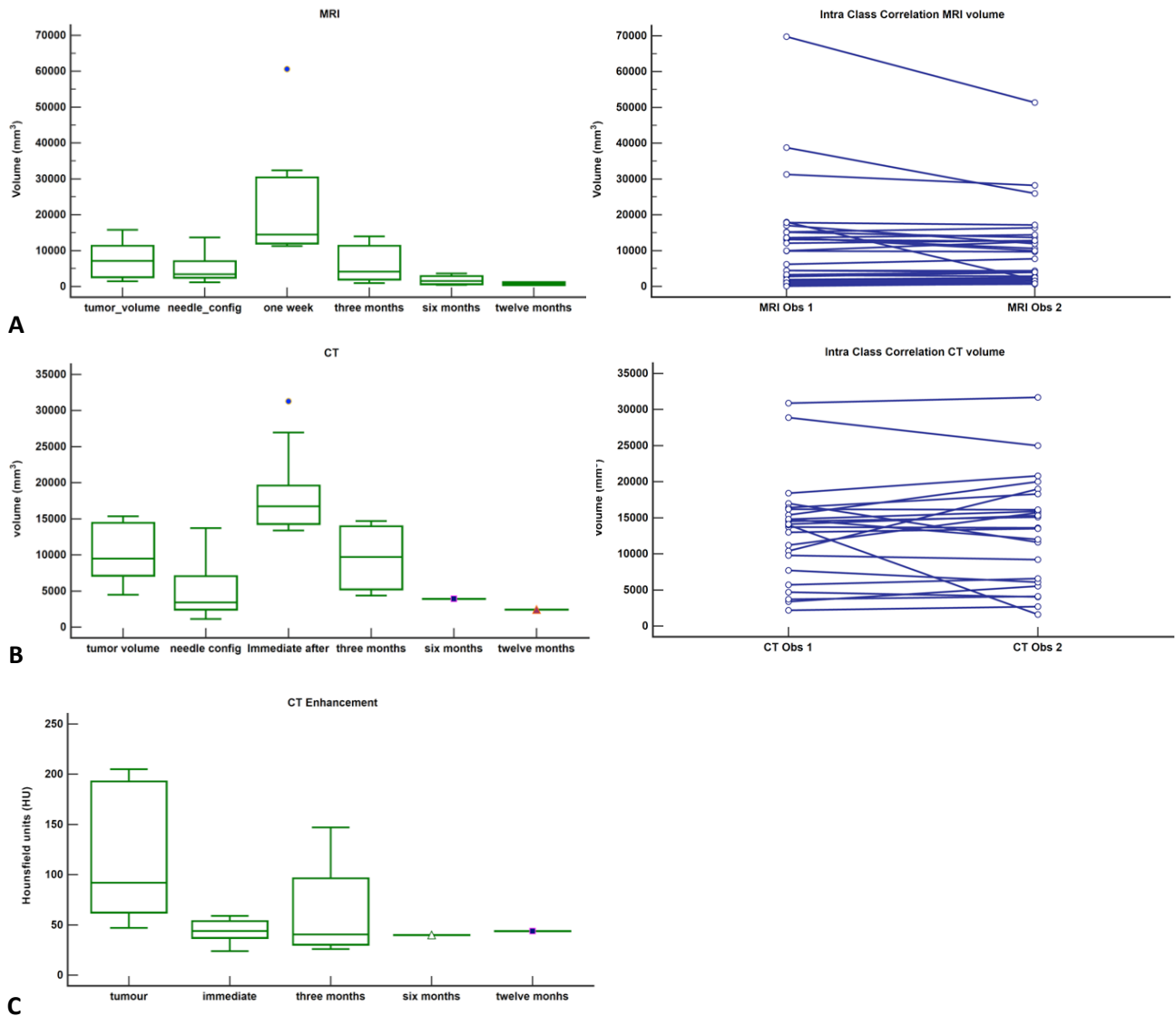


Figure 1: Ablation volume and enhancement after IRE. Planned AZV = Needle configuration

A) Boxplot of MRI volumes and intraclass correlation.

B) Boxplot of CT volumes and intraclass correlation.

C) Enhancement of CT in arterial phase.