

Appearance of rimlike regenerative tissue enhancement after radiofrequency ablation: Postprocedural assessment with different radiological techniques

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Introduction: Radiofrequency (RF) ablation has recently been promoted as a promising minimal invasive technique for the treatment of patients with liver malignancies. Generally, ablation of the entire tumor is considered complete when no foci of enhancement are seen within the tumor or at its periphery. Results from prior studies have suggested the follow-up utility of magnet resonance imaging (MRI), computed tomography (CT) and ultrasonography (US) in distinguishing between adequately and incompletely treated tumor, as necrotic tissue does not enhance in arterial and portal venous phase following administration of contrast material. However, a peripheral enhancing halo surrounding the treated lesion due to hyperaemia, enhancing predominantly in arterial phase, can be depicted several days after treatment and therefore could lead to misinterpretation. The purpose of our study was to assess the peri-lesional rim like regenerative tissue enhancement after radiofrequency ablation using different radiological techniques.

Methods: Two necrotic lesions with a diameter of 3 cm each were created by single-electrode radiofrequency ablation under computer tomography guidance in normal liver parenchyma in fourteen fully anesthetized minipigs. Follow up was performed by contrast enhanced MRI (0.2 mmol/ per kg BW Multihance®, Bracco, Italy), CT (90 ml Xenetix® 300, Guerbet, France), and US (2.4 ml SonoVue®, Altana, Germany) during arterial and venous phases of contrast enhancement. The arterial phase was acquired 20 sec after administration of the contrast agent for MRI and CT. For US dynamic real time phase inversion scanning was performed and recorded on SVHS videotapes.

Imaging was performed immediately as well as 3 days, 10 days, 1, 2, 3 and 6 months after ablation. The degree of contrast enhancement in the arterial phase of the tissue surrounding the induced liver lesion was quantitatively assessed by two radiologists for CT and MRI (ratio SI surrounding tissue/SI normal liver). The extent of the arterial enhancement and the size of the individual liver lesions in the arterial and late venous phase were subsequently assessed on all imaging modalities. Imaging findings were compared with histopathology; for that purpose two minipigs were sacrificed at each date of the follow up imaging examination.

Results: A rim like pattern of increased tissue enhancement in the arterial phase was present for all liver lesions by all imaging modalities immediately after as well as at the different time points of the follow up examination up to 6 months following the radiofrequency ablation. The extent of the arterial enhancement decreased little over time (Fig.1). CT showed in comparison to MRI slightly pronounced patterns of enhancement over time.

Quantitative assessment of the ratio SI surrounding tissue/SI normal liver by MRI and CT showed a good correlation without a significant difference between the two imaging modalities (Fig.2; $p < 0.05$). Overall MRI revealed slightly higher mean ratio values compared to CT. The ratio did not significantly decrease over time.

All three imaging modalities showed a comparable decrease of the lesion size to about 60-70% of the initial size after 6 months (Fig. 3). Histology showed an initial hemorrhagic border converting into a regeneration capsule correlating well with the region of early arterial enhancement.

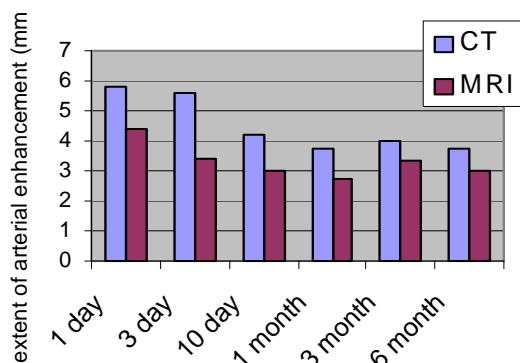


Fig. 1

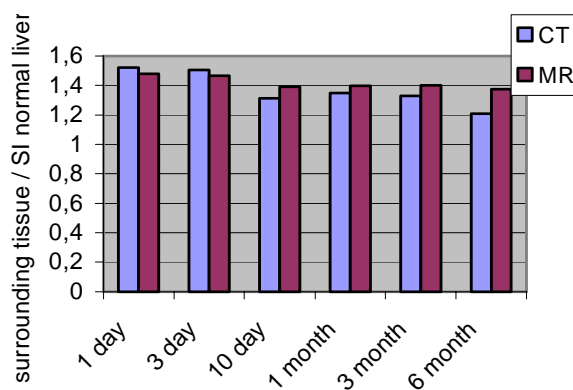


Fig. 2

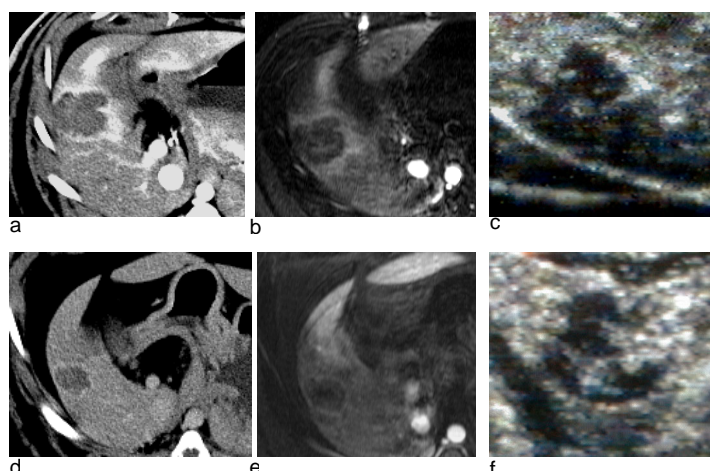


Fig. 3 Rim-like enhancement in the arterial phase observed with CT (a), MRI (b) and US (c) immediately after radiofrequency of normal liver parenchyma.

Follow up examination after 6 month showed lesion size decrease assessed by all three image modalities but rim like contrast uptake in the arterial phase was still detectable (d-f).

Discussion: This study indicates that regenerative tissue enhancement with rim like contrast uptake in the arterial phase due to reactive hyperemia is present immediately after RF ablation, as well as up to 6 months thereafter. Thus the differentiation of regenerative tissue versus tumor enhancement appears to be aggravated even for a longer period of time following the radiofrequency ablation of liver lesions.