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# Predicting local tumor progression after radiofrequency ablation of hepatocellular carcinoma: retrospective quantitative analysis of pre- and post-ablation imaging

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**Background:** Radiofrequency ablation (RFA) is an established first line treatment for very early-stage HCC, and is used for unresectable early stage HCC. Post-ablation contrast-enhanced computed tomography (CECT) with *qualitative* ablation margin assessment is often used to determine technical success. Local tumor progression (LTP) rates of RFA for early-stage HCC are higher than after surgery. The objective of this study was to retrospectively use *quantitative* RFA margin assessment with use of non-rigid CT-CT co-registration, to assess whether there is a correlation of LTP and narrow margins.

**Methods:** Twenty-five patients treated with RFA for HCC between 2009 and 2014 were retrospectively included. Semi-automated co-registration of pre- and post-treatment CECT was done independently by two radiologists, using RTx Mirada Software. The tumor and ablation area were delineated, to identify the side and size of narrowest RFA margin. In addition, a qualitative assessment was performed independently by two other radiologists in which they determined whether the RFA was successful, by what size the RFA area exceeded the tumor boundaries, and the anatomical side of the narrowest margin. The outcome of the quantitative and qualitative margin assessments were compared with the occurrence of LTP, and inter-observer agreement was determined.

**Results:** CT-CT co-registration was technically feasible in 18/25 patients. In these 18 patients, almost perfect inter-observer agreement was found for quantitative analysis with a  $\kappa$  of 0.88 (SE: 0.116 and  $p < 0.001$ ). The inter-observer agreement for qualitative RFA margin analysis was 0.64 (SE: 0.326 and  $p = 0.004$ ). Based on quantitative analysis, the tumors of 12/18 patients were not fully ablated. LTP occurred in 8 (75.0%) of these patients. In 6/18 patients, the RFA area fully encompassed the tumor. None of

these patients developed LTP. In qualitative assessment, 2/18 ablations were considered insufficient. Both patients developed LTP.

**Conclusions:** Quantitative RFA margin assessment using non-rigid CT-CT co-registration is predictive for LTP in HCC patients ( $p=0.013$ ).

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