The therapy response monitoring by DCE-MRI in primary liver cancers

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Introduction: Hepatic arterial infusion (HAI) has been used in regional chemotherapy of primary liver cancers in both hepatocellular carcinoma (HCC) and intrahepatic cholangiocarcinoma (ICC) [1]. Studies have shown improved survival rates in the patient population undergoing HAI treatment. However, there have not been effective quantitative methods for early assessment of response to therapy using HAI [2]. Therefore, in this study, DCE-MRI is being investigated through analysis of pharmacokinetic parameters for the assessment of response to therapy in primary liver cancer patients undergoing regional HAI chemotherapy.

Materials and Methods: 28 patients (5 HCC, 23 ICC) undergoing regional chemotherapy with FUDR through HAI were scanned at baseline (Tx(0)) and at multiple treatment intervals every two months (Tx(i), i=1,2,3, etc.) using DCE-MRI (1.5T, GEMS). A bolus of Gd-DTPA (Magnevist, Berlex) was injected at a constant concentration (0.1 mmol/kg) for all the patients. A series of anatomical images, fat suppressed T_1 and T_2 weighted images, 3D T_1 weighted pre and post contrast images and fast SPGR based perfusion images were acquired using an 8 channel phased array coil. The perfusion images were corrected for respiratory motion manually and analyzed by IDL, Matlab and CineTool (ITT, Mathworks, GEMS) using a two compartmental model of vascular space (VS) and extra-vascular extra-cellular space (EES) and a model vascular input function (VIF) for pharmacokinetic characterization of tumors. Several parameters, K^{trans} (volume transfer constant between VS and EES), k_{ep} (rate constant between EES and VS), v_e (fractional vascular space), CER (contrast enhancement ratio), TTP (time to peak), AUC90 and AUC180 (area under the contrast enhancement curve over 90 and 180 seconds) were measured using the imaging data sets [3]. The pretreatment values and percent change as % (Tx(1)-Tx(0))/Tx(0) (from baseline to 1st treatment cycle) were computed for several parameters using the region of interest (ROI) and voxel (Vx) analysis and used to correlate with other measures of response to therapy, survival and tumor reduction (%R) per RECIST [4].

Results: The calculated maps for several parameters (K^{trans}, k_{ep}, v_e, CER and TTP) at baseline and 1st treatment cycle for a patient with a primary liver cancer (ICC) undergoing regional HAI chemotherapy is shown in Figure 1.

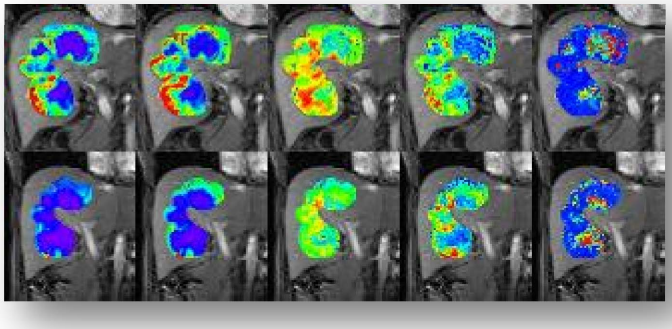

Figure1: Calculated maps for K^{trans}, k_{ep}, v_e, CER and TTP for baseline (top row, left to right) and for the first treatment cycle (bottom row, left to right) in a case of primary liver cancer (ICC) undergoing regional HAI chemotherapy.

The AUC90 and AUC180 stratified at median values at baseline correlated with disease specific survival significantly (35.1 vs. 19.1 months, $p<0.002$) and a decrease in top deciles in K^{trans} and k_{ep} from baseline to 1st treatment also correlated with disease specific survival ($p=0.013$). The results indicate that use of DCE-MRI in pretreatment and therapy response assessment is effective and further analysis of the data relevant to changes in anatomical, morphological and perfusion characteristics of the tumors under treatment may further improve the application of DCE-MRI in treatment response monitoring.

References:

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[3] RECIST – Response Evaluation Criteria in Solid Tumors.