Age related perfusion and vascular permeability characteristics of liver measured by DCE-MRI

David H Gultekin[1], Nancy E Kemeny[2], Lawrence H Schwartz[3], Mithat Gonen[4], Michael I D'Angelica[5], Peter J Allen[5], Yuman Fong[5], Leslie H Blumgart[5], Ronald P DeMatteo[5], and William R Jarnagin[5]

[1]Radiology, Memorial Sloan-Kettering Cancer Center, New York, NY, United States, [2]Medicine, Memorial Sloan-Kettering Cancer Center, New York, NY, United States, [3]Radiology, Columbia University, New York, NY, United States, [4]Epidemiology-Biostatistics, Memorial Sloan-Kettering Cancer Center, New York, NY, United States, [5]Surgery, Memorial Sloan-Kettering Cancer Center, New York, NY, United States

Introduction: Age related changes in perfusion characteristics of tissues are important for diagnosis and therapy response monitoring. Regional chemotherapy through hepatic arterial infusion (HAI) has been used in primary liver cancers of both hepatocellular carcinoma (HCC) and intrahepatic cholangiocarcinoma (ICC) [1,2]. DCE-MRI is investigated in assessment of response to therapy in patients receiving regional HAI chemotherapy and anti-angiogenic therapy. The liver volume and blood flow are found to decrease with age [3]. In this study, we investigate noninvasively the age related perfusion and vascular permeability characteristics of the liver by DCE-MRI.

Materials and Methods: A total of 51 patients (32 female and 19 male) with primary liver cancer, 41 ICC (29 female and 12 male) and 10 HCC (3 female and 7 male) enrolled in two Phase II trials were scanned at baseline and at multiple treatment intervals using MRI (1.5T, GEMS, Waukesha, WI). A bolus of Gd-DTPA (Magnevist, Berlex) was injected at a constant dose (0.1 mmol/kg) for all the patients. The contrast enhanced images were acquired using an 8 channel phased array coil, corrected for respiratory motion and analyzed by IDL, Cinetool and Matlab (ITT, GEMS, Mathworks) using a two compartmental model of vascular space (VS) and extra-vascular extra-cellular space (EES) and a model vascular input function (VIF). The parameters, K^{trans} (volume transfer constant between VS and EES), k_{ep} (rate constant between EES and VS), v_e (fractional vascular space), TTP (time to peak), AUC_{90} and AUC_{180} (area under Gd concentration curve over 90 and 180 seconds) [4] were measured in the normal liver tissue using a region of interest (ROI) and correlated with the age (mean 62, min 39.8, max 85.1, range 45.2 yrs) at the time of baseline scan.

Results: DCE-MRI maps (K^{trans}, k_{ep}, v_e, AUC_{90}, AUC_{180} and TTP) for a patient with a primary liver cancer (HCC) are shown in Figure 1. These measurements in the normal liver tissue are correlated with the age as given in Table 1.

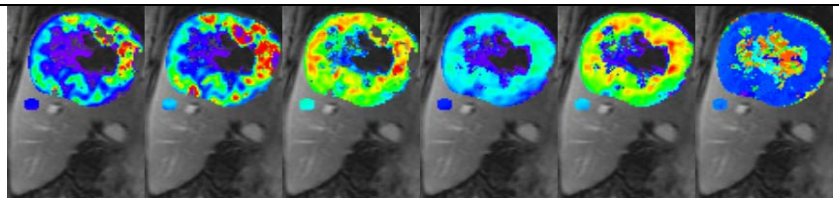

Figure1: Maps of K^{trans}, k_{ep}, v_e, AUC_{90}, AUC_{180} and TTP (left to right) showing a tumor (large ROI) and the liver tissue (small ROI) in a case of primary liver cancer (HCC). These measurements in the normal liver were correlated with age at baseline.

The DCE-MRI parameters (K^{trans}, k_{ep}, v_e, AUC_{90} and AUC_{180}) showed variable degrees of correlation with age at baseline for these patients. The subsets of cancer type (ICC and HCC) and gender (F and M) had effects on the correlations between DCE-MRI parameters and age. Although, the measurements were made of normal liver tissue, the presence of cancer type in the liver had an effect on the subset and its correlation with age. In overall, k_{ep} had a higher correlation with age for subsets ICC (F/M), F (ICC/HCC), F (ICC) and all subsets combined (ICC/HCC/F/M).

Table 1: Correlation coefficients (r) and corresponding p values (p) between DCE-MRI parameters and age.

Parameters		K^{trans}		k_{ep}		v_e		AUC_{90}		AUC_{180}	
Patients/subsets	n	r	p	r	p	r	p	r	p	r	p
All (ICC/HCC/F/M)	51	0.150	0.297	0.340	0.016	-0.147	0.309	-0.182	0.206	-0.213	0.137
ICC (F/M)	41	0.111	0.487	0.333	0.034	-0.196	0.219	-0.260	0.100	-0.265	0.094
HCC (F/M)	10	0.217	0.581	0.183	0.644	-0.033	0.948	0.233	0.552	0.233	0.552
M (ICC/HCC)	19	0.165	0.498	0.167	0.494	0.118	0.631	0.031	0.901	-0.089	0.716
F (ICC/HCC)	32	0.115	0.535	0.418	0.020	-0.272	0.138	-0.367	0.043	-0.344	0.058
F (ICC)	29	0.132	0.493	0.394	0.035	-0.257	0.178	-0.355	0.059	-0.319	0.092

These tumors are large and the choice of ROI in the normal liver tissue is often limited by the tumor. The variation in the location of ROI in the normal liver may cause a variation in the parameters and correlation with age. The results show that DCE-MRI can measure aging related changes in the perfusion and vascular permeability characteristics of the liver in pretreatment and during the therapy. Further investigation may improve the application of DCE-MRI in therapy monitoring.

References:

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