Combined DWI and DCE-MRI of hepatocellular carcinoma: correlation of perfusion and diffusion parameters. Initial experience.

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Target Audience: Radiologists and physicists interested in diffusion and perfusion imaging.

Purpose: DWI and DCE-MRI have shown potential for detecting and characterizing focal liver lesions [1]. The aim of this study is to quantify diffusion and perfusion characteristics of hepatocellular carcinoma (HCC) and background liver parenchyma with both DWI and DCE-MRI and to examine the correlation between the resulting parameters.

Materials and Methods: In this on-going prospective IRB approved study, 10 patients with cirrhosis and HCC underwent DWI (respiratory triggered 16 b-values SS EPI DWI) and DCE-MRI scans at 1.5T (Siemens Aera) or 3T (Siemens Skyra). DCE-MRI protocol consisted of an axial 3D-FLASH sequence covering the whole liver (ranges for TR/TE/FA 2.69-2.74/0.97-1.09/9.5-11.5°, matrix 192x106-179, slice thickness 4-5 mm, temporal resolution 1.9-2.5s, 100 volumes acquired) after IV bolus of 0.05 mmol/kg of Gd-BOPTA (Multihance). ROIs were placed in the liver parenchyma and HCC lesions after image coregistration and mean signal intensity was extracted and converted to gadolinium concentration [2]. Model free parameters including peak concentration (Cpeak), time to peak (TTP), slope, area under the curve at 60 seconds (AUC60), and wash-out were extracted. ROIs were also placed in the DWI images in order to extract the apparent diffusion coefficient (ADC) and IVIM parameters (true diffusion coefficient D, pseudo-diffusion coefficient D* and perfusion fraction PF) using a least-squares fit. Parameter values were compared between liver parenchyma and HCC using the Mann-Whitney U test. Pearson correlation was computed to assess association between IVIM and DCE-MRI parameters.

		Liver	HCC	p*
DCE-MRI	**Cpeak**	0.22 ± 0.05	0.27 ± 0.25	0.6874
	TTP	42.55 ± 5.62	28.34 ± 11.76	**0.0004**
	Slope	5.31 ± 1.79	12.89 ± 13.42	**0.04**
	AUC60	4.65 ± 1.51	12.81 ± 11.40	**0.0031**
	Wash-out	-0.32 ± 0.27	-0.44 ± 0.60	0.5228
DWI	**D**	1.2 ± 0.2	1.4 ± 0.2	**0.0312**
	D*	0.20 ± 0.16	0.14 ± 0.05	0.0929
	PF	16.37 ± 15.82	10.20 ± 11.49	0.1773
	ADC	1.32 ± 0.24	1.48 ± 0.27	**0.0191**

Table: IVIM and DCE-MRI metrics in liver and HCC. *Computed using Wilcoxon test.

Fig: Reference T2 HASTE, TTP, slope, AUC60, D and ADC maps in a 66 year old patient with a 14 cm HCC.
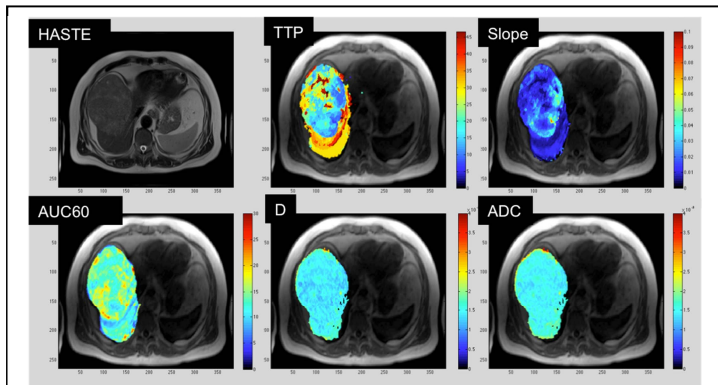
Results: 13 HCCs were evaluated (mean size 6.1 cm, range 1-13 cm). TTP was significantly shorter and slope, AUC60, D and ADC were significantly higher in HCC vs. background liver parenchyma (Table, Fig). There was no significant correlation between IVIM and model free perfusion parameters (Pearson correlation coefficients ranging from –0.28 to 0.20; p> 0.1).

Discussion: There was no significant correlation between DWI and DCE-MRI parameters as previously reported in the liver [3], even though parameters ADC, D* and PF contain perfusion information [4]. Both DWI and DCE-MRI techniques provided parameters that are significantly different in background liver parenchyma vs. HCC and could potentially be used for characterization of HCC.

Conclusion: Liver perfusion parameters extracted from DWI do not correlate with DCE-MRI parameters in HCC. Perfusion and diffusion characteristics are altered in HCC and therefore, the combination of DWI and DCE-MRI in a multiparametric MRI scan provides non-redundant information about HCC tumor biology.

References
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