DCE-MRI and DW-MRI in characterization of spinal metastasis

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Introduction: Patients with metastatic cancer to the spine are often undergoing radiotherapy. There is a need for the assessment of response to therapy in these patients. The combination of DCE-MRI and DW-MRI in the assessment of metastatic cancer of various primaries (breast, prostate, melanoma, colorectal, papillary thyroid, renal cell carcinoma and non-small cell lung carcinoma) to the spine has been evaluated for the characterization of metastasis with potential applications in therapy monitoring in patients undergoing radiotherapy. In this study, DCE-MRI and DW-MRI are being investigated through analysis of pharmacokinetic parameters and apparent diffusion coefficient (ADC) for the baseline assessment in metastatic cancer patients.

Materials and Methods: 13 patients (7 male, 6 female) with metastatic cancers of various primaries (2 breast, 2 colorectal, 1 prostate, 2 melanoma, 3 RCC, 2 NSCLC and 1 papillary thyroid) were studied at baseline by a combination of DCE-MRI and DW-MRI using a 1.5T clinical scanner (GEMS, Waukesha, WI). A bolus of Gd-DTPA (Magnevist, Berlex) was injected at a constant dose (0.1 mmol/kg) for all the patients. A 3D SPGR based DCE-MRI images and SE-EPI based DW-MRI images were acquired using an 8 channel phased array coil. The perfusion and diffusion images were analyzed KinMod software (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) and AUC_{90} (area under the contrast enhancement curve over 90 seconds) were measured using the imaging data sets [1].

Results: The maps for kinetic parameters (K^{trans}, k_{ep}, v_e, and AUC_{90}) and ADC were calculated for thirteen patients with metastatic cancers of various primaries at baseline. The region of interest (ROI) analysis of kinetic maps for a metastasis of RCC primary is shown in Figure 1 (a) and the average ADC values for thirteen patients are given in Figure 1 (b).

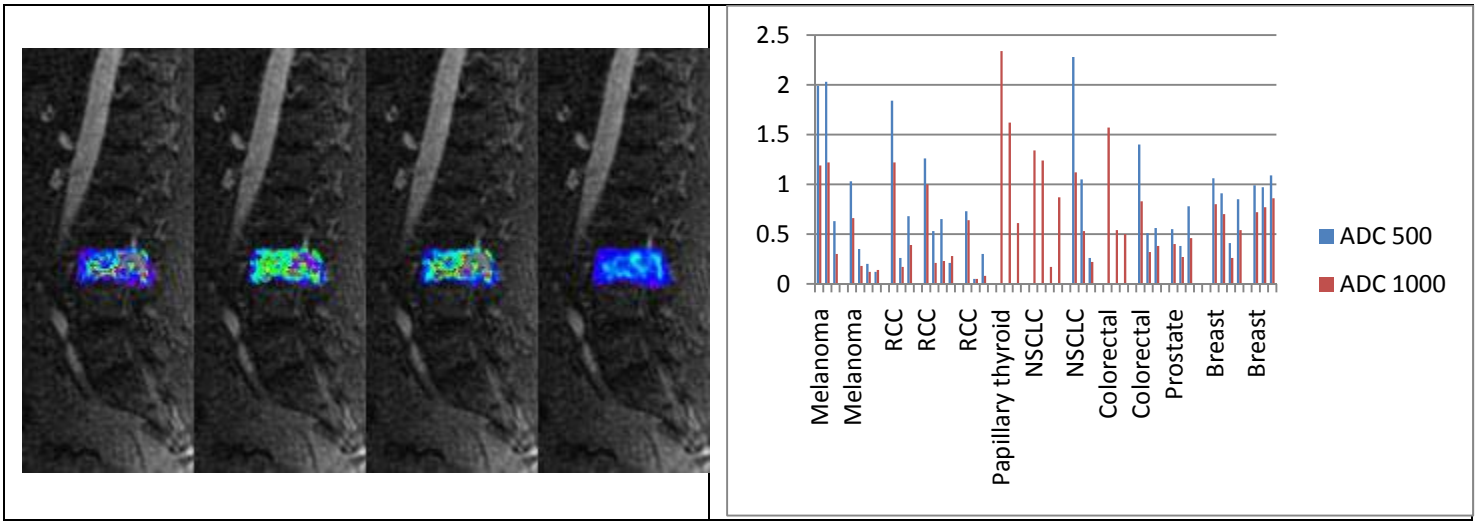

Figure1: (a) Calculated maps for K^{trans}, k_{ep}, v_e, and AUC_{90} for a patient with a primary RCC metastatic to the spine (biopsy confirmed). (b) ADC values (x1000 mm^2/s) (b=500 and b=1000) for patients with metastatic cancers of various primaries at baseline.

The two ADC values calculated by two diffusion encoding values (b=500 s/mm^2 and b=1000 s/mm^2) correlated with each other for the metastasis of various primaries with ADC (b=1000 s/mm^2) being lower than ADC (b=500 s/mm^2). The ADC values corresponding to ROI analysis of DCE-MRI parameters (K^{trans}, k_{ep}, v_e, and AUC_{90}) did not correlate for the spinal metastasis for this patient group. Further analysis involving a larger number of patients is needed to better understand and characterize the metastasis using the DCE-MRI and DW-MRI parameters.

References:

[1] Tofts PS, Brix G, Buckley DL et al. J Magn Reson Imaging 1999; 10(3):223-232.