THE COMPARISON OF ARTERIAL SPIN LABELING PERFUSION MRI AND DCE-MRI IN BONE METASTASIS FROM PROSTATE CANCER

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Target Audience Radiologists, MR technologists and clinicians

Purpose Pulsed arterial spin labeling (PASL) MRI is a non-invasive imaging tool capable of quantitatively measuring the microvascular perfusion characteristics of tissue through tagging arterial water to obtain the blood flow (BF) map[1]. The ASL method has been proved to be effective in detection of prostate cancer with different inversion time.[2,3] Angiogenesis plays a vital role in the metastatic process of prostate cancer, and bone metastasis lesion is hypervascular certificated by dynamic contrast-enhanced (DCE) MRI and histopathologic findings[4-6]. Therefore, in this study we applied the PASL technique to detect bone metastasis from prostate cancer and to compare the differences BF values between the metastatic lesions and normal bone in the pelvis. Then explore the correlation between the BF from ASL and kinetic parameters from DCE-MRI of these regions.

Methods The local ethics committee approved the study and eight patients (median 73 years; range 55-84 years) with clinical significant bone metastasis from pathologically confirmed prostate cancer were recruited. All patients had elevated serum prostate-specific antigen (PSA) level (median 57.6ng/mL, range 6.59-507.9ng/mL). The PASL pulse sequence was performed on a clinical 3.0T MR scanner (Signa HD; GE Healthcare, Milwaukee, Wisconsin). The PASL protocol was performed with FAIR-SSFSE sequence (TI 1000/1200/1400/1600msec; TR 3500ms; TRM0 6000ms; phases 8). ASL post-procession was conducted in the Matlab to acquire the BF mappings. The DCE-MRI used a 3D spoiled gradient echo pulse sequence with a flip angle of 15°, 15 phases and a temporal resolution of 12s. On the second dynamic timepoint, 0.1 mmol/kg of body weight of 0.5 mmol/ml Omniscan (GE Healthcare) was administered through a Spectris power injector (Medrad Inc.) at a rate of 3 ml/s followed by an equal volume of saline flush also at 3 ml/s. The regions of interest (ROIs) were placed in the bone metastasis (n=14) (acetabulum= 6, pubic symphysis=2, ischium=2, femur neck=3, femur head=1) and normal bone regions (n=18), and the average BF and Ktrans, kep , Ve in each region was computed respectively.

Results The mean BFs determined by ASL MRI with different TI in the bone metastasis from prostate cancer were significantly higher than those in noncancerous bone regions ($P<0.05$, Paired T-test) (Table 1,2, Figure 1). Significant positive correlations between BF value and K^{trans}, k_{ep} were observed in all four TI , respectively ($p < 0.05$, Spearman's correlation analysis) (Table 3).

Discussion This study demonstrates that ASL sequence can be used to detect bone metastasis from prostate cancer. The higher BF in the bone metastasis region indicates hypervascular property of metastatic lesion, which significantly correlated with K^{tran}s, k_{ep}, V_e obtained with bolus-tracking DCE-MRI, and is consistent with previous findings based on the pathology and DCE-MRI.

Conclusion ASL is a new non-invasive imaging method with potency in detecting and monitoring therapy efficacy of bone metastasis from prostate cancer.

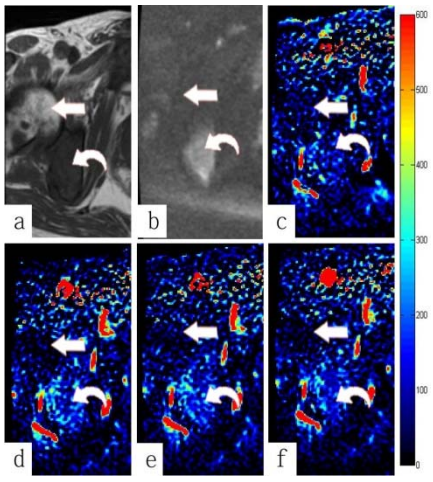

Figure1.(a-b) A 75-year-old man with bone metastasis from prostate cancer. The bone metastasis (right ischium) (curve arrow)showed lower signal in T1 and higher signal in DWI than normal bone (femur head) (straight arrow); (c-f) The corresponding BF mappings with different TI showed higher perfusion characteristics.

TI msec	BF (ml/100g/min)		
	Bone Metastasis	Normal Bone	P
1000	98.6±40.1	31.0±10.4	0.0023
1200	105.1±26.9	28.5±7.2	0.0044
1400	113.4±26.1	24.5±8.7	0.0028
1600	104.8±31.4	26.5±10.4	0.0019

Group	Bone Metastasis	Normal Bone
K_{trans} (min^{-1})	0.102±0.033	0.040±0.015
k_{ep} (min^{-1})	0.169±0.028	0.111±0.041
V_e	0.597±0.167	0.368±0.041

Table 1,2. Results of comparison of perfusion parameter (BF) and DCE parameter (K_{trans}, K_{ep} ,V_e)between bone metastasis and normal bone areas.

TI(msec)		1000	1200	1400	1600
BF-K_{trans}	r	0.766	0.860	0.882	0.927
	P	<0.001	<0.001	<0.001	<0.001
BF- K_{ep}	r	0.595	0.644	0.622	0.695
	P	<0.001	<0.001	<0.001	<0.001
BF-V_e	r	0.687	0.791	0.845	0.829
	P	<0.001	<0.001	<0.001	<0.001

Table 3. Results of correlation between perfusion parameter (BF) and K_{trans}, k_{ep} ,V_e in bone metastasis and normal bone areas.

References

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