PROSENSE Conference on Prostate Cancer Diagnosis
Bath, 12-13 September 2016

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Non-invasive quantification of prostate cancer with VERDICT MRI: A repeatability study

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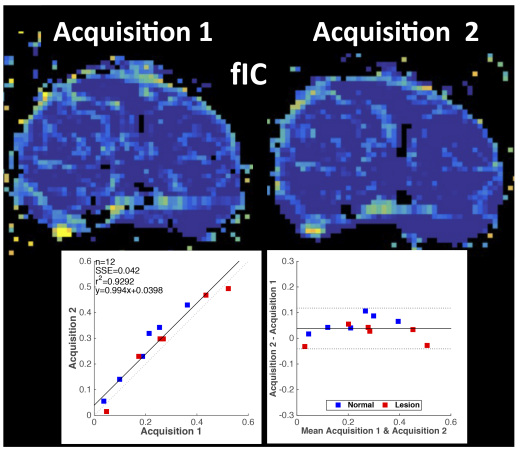
Diffusion-weighted MRI (DW-MRI) is becoming increasingly important in the assessment and characterisation of malignant tumours in the prostate[1]. However most DW-MRI studies use only the apparent diffusion coefficient (ADC) for cancer assessment, which lacks specificity and fails to associate contrast changes to particular microstructure features. Model-based quantitative imaging techniques can ameliorate problems associated with simplistic diffusion-based indices. One such example is VERDICT MRI[2], a model-based DW-MRI technique that has been used to estimate microstructural differences between prostate tumours and normal tissue[2,3]. The aim of this study is to evaluate the VERDICT method in combination with an ultrafast fitting algorithm called AMICO[4] for microstructural prostate tissue characterisation in a test-retest experiment.

Six subjects underwent VERDICT DW-MRI using a 3T scanner (b-values range 90-3000 s/mm)[5]. The scan was repeated after a 2-minute interval. The VERDICT model was fitted to the data with the AMICO framework[4] and microstructural parameter maps were computed. For each subject a board certified radiologist (EJ) contoured two regions of interest in the VERDICT fIC *(Intracellular fraction)* map: a region corresponding to a cancerous lesion and a region for normal tissue on the same slice and their median values were calculated. Bland-Altman plots were used to analyse the agreement between the maps from the two different acquisitions. The rest of the VERDICT parametric maps (fIC, fEES - extracellular extravascular fraction and cellularity) were also computed. All the VERDICT maps were repeatable and maximised lesion conspicuity. Quantitatively, Pearson r^2 coefficients for the 3 maps were 0.929, 0.934, 0.896, respectively. See figure for fIC maps for both acquisitions (one patient) and the corresponding Bland-Altman plots.



To conclude, VERDICT MRI can characterise microstructural differences between lesion and normal prostate tissue in a clinically practical time and a repeatable manner. This represents a significant step towards technical validation of the VERDICT estimates as imaging biomarkers. The method should be further evaluated in larger cohorts and the imaging parameters should be histologically validated.

References and Acknowledgements: [1]Padhani et al., 2009 Neoplasia, [2]Panagiotaki et al, 2015, Invest Radiol, [3]Bonet-Carne et al, 2016, ISMRM. [4]Daducci et al, 2015, NeuroImage, [5]Panagiotaki et al, 2015, ISMRM, PCUK: PG14-018-TR2, CCIC: 515729 GMAJB & BRC: 510419 GMAHD, EP/H046410/01, EP/G007748, EP/K020439/1, EP/M020533/1, EP/N018702/1, EP/N021967/1.

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