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 prostate¹. 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 MRI², a model-based DW-MRI technique that has been used to estimate microstructural differences between prostate tumours and normal tissue²,³. The aim of this study is to evaluate the VERDICT method in combination with an ultrafast fitting algorithm called AMICO⁴ 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/mm⁵). The scan was repeated after a 2-minute interval. The VERDICT model was fitted to the data with the AMICO framework⁴ 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 r² 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.


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