

Evaluation of the prostate after treatment with high-intensity focussed ultrasound (HIFU) therapy using whole prostate diffusion weighted imaging (DWI) analysis

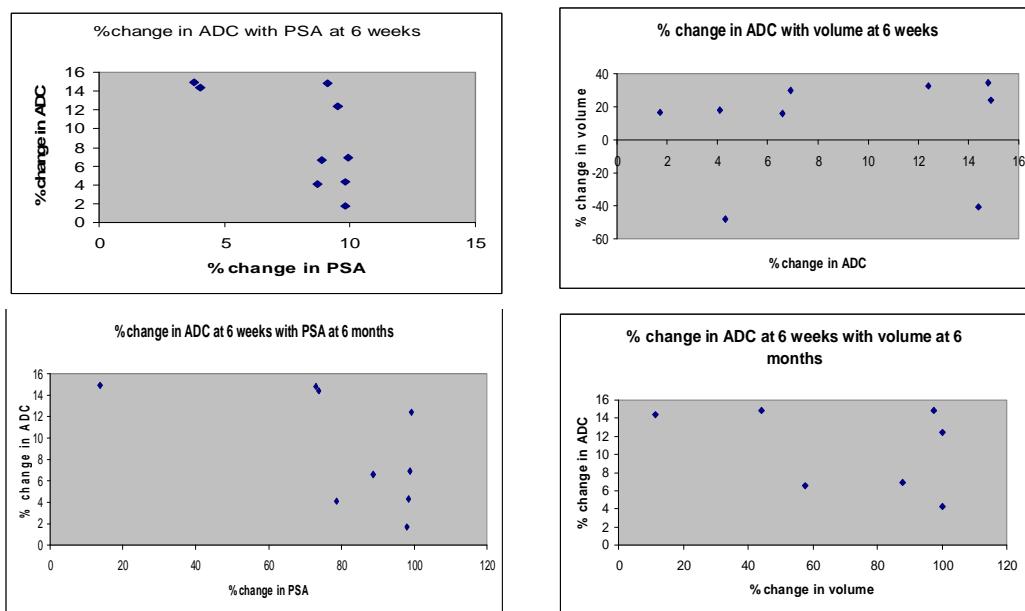
A. Chapman¹, N. Tunari¹, V. Morgan², and N. Desouza¹

¹Institute of Cancer Research, Sutton, Surrey, United Kingdom, ²Royal Marsden Hospital, Sutton, Surrey, United Kingdom

Introduction: Diffusion-weighted MRI (DW-MRI) is being increasingly used in cancer imaging [1]. In treated tumors, it has been shown to predict response to therapy, where an increase in tumor ADC has been found to correlate with cell death [2]. In prostate cancer, high intensity focussed ultrasound (HIFU) is used to treat locally recurrent disease that has failed primary treatment. In these cases it is helpful to establish completeness of the ablative therapy, and get an early indication of longer-term outcome. This study evaluates the use of apparent diffusion coefficients (ADCs), derived from diffusion-weighted images at 6 weeks in determining outcome by correlating them with PSA and gland volume at 6 months.

Method: Nine patients, mean age 68.6 years with recurrent prostate cancer post radiation therapy as demonstrated by raising PSA referred for salvage HIFU between May 2006 and July 2007 were studied using a 1.5T Intera MR scanner (Philips Medical Systems, Best, Netherlands) with an endorectal receiver coil, inflated with 55ml of air, before, after 6 weeks and after 6 months of HIFU treatment. In addition to standard 3-plane imaging (FSE, TR/TE=2000/90, 20 slices, 3mm thickness, 512x512 matrix, 140mm FOV), 12 axial slice diffusion-weighted images (TR/TE 2500/69, 3mm thickness, 200mm FOV, 128x128 matrix, 4 b-values 0,300,500,800 s/mm² in three directions) were acquired and isotropic ADCs were calculated using all b-values. An experienced radiologist drew regions of interest (ROI) on the images around the whole prostate on all slices. ADCs and volumes for the whole gland were obtained for all time points. Correlations between change from baseline in ADC at 6 weeks and PSA and volume at 6 weeks and 6 months were obtained.

Results: PSA at presentation varied from 1.3-8.4 ng/ml (mean + SD 4.7 ± 0.97 ng/ml). ADC values at baseline ranged from 1262 to 1592 mm²/s. There was a rise in ADC at 6 weeks of $8.8 \pm 5.2\%$ (median 6.9%) above baseline. PSA reduced by $8.2 \pm 2.5\%$ (median 9.1%) at 6 weeks and by 80.2 ± 27.2 (median 88.8%) at 6 months. Whole gland volume reduced by $9.3 \pm 31.2\%$ (median 17.9%) at 6 weeks and by $71.2 \pm 34.4\%$ (median 87.8%) at 6 months: 2 patients had no discernible residual prostate at 6 months. There was a weak negative correlation between the change in ADC at 6 weeks and the change in PSA at 6 weeks ($r=-0.64$) and at 6 months ($r=-0.59$), but no correlation between the rise in ADC at 6 weeks and the reduction in gland volume at 6 weeks or 6 months.



Discussion and Conclusion: This pilot study demonstrates that ADC done at 6 weeks is an indicator of subsequent reduction in PSA. A larger patient cohort is required to establish the utility of this technique. In addition, earlier time points for measuring ADC may prove useful in predicting subsequent outcome and warrant further investigation.

References [1] Charles-Edwards Top Mag Res Imag 2008. [2] Lyng Magn Reson Med. 2000

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