

Clinical Impact of Prostate Cancer Detection with Extrapolated High b-value DWI

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PURPOSE

To assess the clinical impact of prostate cancer detection using acquired versus extrapolated high b-value diffusion weighted imaging (DWI) computed using 4 diffusion models.

METHOD AND MATERIALS

50 sequential patients from 2013-2015 with pathologically proven prostate cancer (CaP) were chosen for analysis. 3T Multiparametric prostate MRI exams of the patients included one of 2 low b-value DWI protocols (b=100, 600, 1200 or b=15, 250, 800, 1200) and a high b-2000 DWI. Additionally, high b-2000 DWI was extrapolated from the lower b-value images using 4 diffusion models - Monoexponential, IVIM, Stretched exponential and Kurtosis. All images were scored on subjective quality and readability independently by 2 radiologists and 1 resident. Lesions were identified by consensus on all images by the 3 readers and subjectively graded for lesion conspicuity. Lesion-to-background contrast ratios were computed for each lesion on all images. Pathological ground truth was established using MRI-Ultrasound fusion prostate biopsy of the identified lesions. Logistic regression analysis was conducted to compare the CaP predictive capabilities of acquired b-2000 DWI versus computed b-2000 DWI from the 4 models.

RESULTS

All extrapolated b-2000 series demonstrated unanimously higher ratings for subjective quality and readability than acquired b-2000 except the Kurtosis model (Wilcoxon Rank Test, $p < 0.0001$). All extrapolated DWI (except Kurtosis) also demonstrated better lesion conspicuity in a direct comparison with acquired b-2000 DWI (T-test, $p < 0.0001$). Mathematical computation demonstrated higher lesion to background contrast ratio (LBCR) for all extrapolated DWI compared to acquired b-2000 DWI (ANOVA, $p < 0.0001$). Logistic regression analysis determined that the LBCR of extrapolated b-2000 DWI was a better predictor of CaP than the LBCR of acquired b-2000 DWI (p -value ~ 0.05). Receiver Operator Curve (ROC) analysis demonstrated higher area under the curve for exponential b-2000 DWI (72%) as compared to acquired b-2000 DWI (65%) or PSA (57%) alone

CONCLUSION

The increased lesion conspicuity of extrapolated DWI vs acquired high b-value DWI may be a major advantage in CaP detection.

CLINICAL RELEVANCE/APPLICATION

The increased lesion conspicuity of extrapolated DWI vs acquired high b-value DWI may be a major advantage in CaP detection