

Prostate Cancer Detection Using Computed Very High b-value Diffusion-weighted Imaging: How High Should We Go?

[Andrew B Rosenkrantz](#)¹, [Nainesh Parikh](#)², [Andrea S Kierans](#)², [Max Xiangtian Kong](#)³, [James S Babb](#)², [Samir S Taneja](#)⁴, [Justin M Ream](#)²

Affiliations expand

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Abstract

Rationale and objectives: The aim of this study was to assess prostate cancer detection using a broad range of computed b-values up to 5000 s/mm².

Materials and methods: This retrospective Health Insurance Portability and Accountability Act-compliant study was approved by an institutional review board with consent waiver. Forty-nine patients (63 ± 8 years) underwent 3T prostate magnetic resonance imaging before prostatectomy. Examinations included diffusion-weighted imaging (DWI) with b-values of 50 and 1000 s/mm². Seven computed DWI image sets (b-values: 1000, 1500, 2000, 2500, 3000, 4000, and 5000 s/mm²) were generated by mono-exponential fit. Two blinded radiologists (R1 [attending], R2 [fellow]) independently evaluated diffusion weighted image sets for image quality and dominant lesion location. A separate unblinded radiologist placed regions of interest to measure tumor-to-peripheral zone (PZ) contrast. Pathologic findings from prostatectomy served as reference standard. Measures were compared between b-values using the Jonckheere-Terpstra trend test, Spearman correlation coefficient, and generalized estimating equations based on logistic regression for correlated data.

Results: As b-value increased, tumor-to-PZ contrast and benign prostate suppression for both readers increased ($r = +0.65$ to $+0.71$, $P \leq 0.001$), whereas anatomic clarity, visualization of the capsule, and visualization of peripheral-transition zone edge decreased ($r = -0.69$ to -0.75 , $P \leq 0.003$). Sensitivity for tumor was highest for R1 at b1500-3000 (84%-88%) and for R2 at b1500-2500 (70%-76%). Sensitivities for both pathologic outcomes were lower for both readers at both b1000 and the highest computed b-values. Sensitivity for Gleason >6 tumor was highest for R1 at b1500-3000

(90%-93%) and for R2 at 1500-2500 (78%-80%). The positive predictive value for tumor for R1 was similar from b1000 to 4000 (93%-98%) and for R2 was similar from b1500 to 4000 (88%-94%).

Conclusions: Computed b-values in the range of 1500-2500 s/mm² (but not higher) were optimal for prostate cancer detection; b-values of 1000 or 3000-5000 exhibited overall lower performance.

Keywords: Prostate; diffusion magnetic resonance imaging; imaging; magnetic resonance imaging; neoplasms.

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