Multiparametric MRI Discriminates Between Benignity and Insignificant and Significant Cancers in MRI-Ultrasound Fusion Targeted Biopsy

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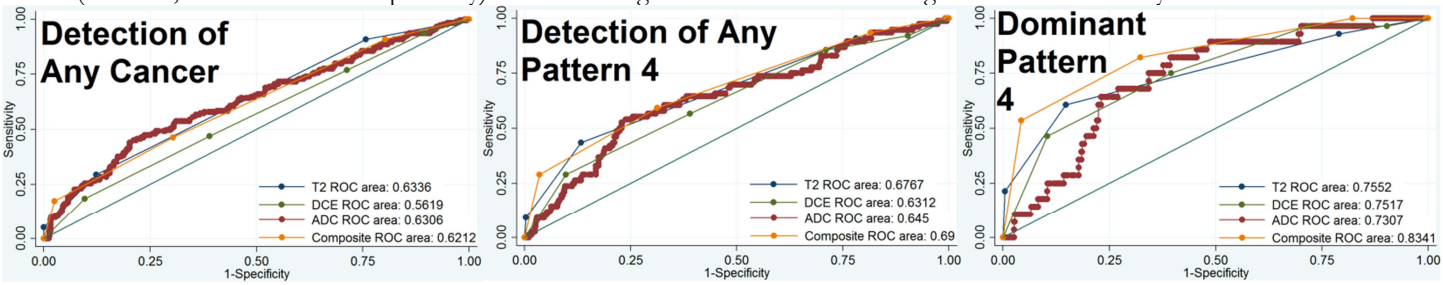
Target Audience: Clinical radiologists with an interest in prostate imaging

Purpose: Determine which components of multiparametric prostate MRI may predict significant cancer

Methods: Investigational Review Board-approved retrospective review of 358 men who underwent multiparametric MRI on a 3.0 T Siemens Magnetom Trio without endorectal coil, including axial 3D TSE T2 (Siemens SPACE, TR/TE 3800-5040/101 ETL 13, 14 cm FOV, 256 x 256 matrix, 1.5 mm contiguous slices), diffusion-weighted imaging (echoplanar, TR/TE 3900/60, 21 x 26 cm FOV, 130 x 160 matrix, 3.6 mm slices, 4 NEX, b-values 0, 100, 400, 800 s/mm^2) and dynamic view-sharing gradient T1 (Siemens TWIST, TR./TE 3.9/1.4 ms, 12º flip angle, 26 x 26 cm FOV, 160 x 160 matrix, 3.6 mm slices, 4.75 s/acquisition over 6 minutes with 15 s injection delay, image analysis using iCAD Versavue), for MRI-ultrasound fusion targeted biopsy (Artemis, Eigen Inc.) of the prostate recorded PSA, age, and calculated prostate volume. For each target, the maximum Gleason score (GS), location, average apparent diffusion coefficient (ADC), and ranked suspicion for T2 appearance, dynamic contrast enhancement (DCE), and composite suspicion based on a reporting template were recorded (1). The composite score was subjective weighted average of the other 3 parameters with ADC given twice the influence. The relationship between the clinical and imaging variables versus GS was investigated dichotomizing GS into any/no cancer, any/no Gleason pattern 4-5, and whether pattern 4/5 was dominant. Receiver operator characteristics and rank-sum tests were performed with STATA.

Score	T2 appearance	Dynamic contrast enhancement
1	No focal perceptible lesion	Progressive (type I breast curve)
2	Faint or linear (peripheral) or Sharply demarcated (central)	Early with plateau (type II curve) or >200% focal enhancement
3	Distinct, uniformly but moderately decreased oval signal with indistinct but not blurred borders	Early with plateau *and* >200% enhancement, or early enhancement with washout (type III curve)
4	Markedly focal decreased signal with blurred margins	Early *and intense* enhancement and washout (type III)
5	Invasion into another zone our through capsule	Early and intense enhancement with *immediate* washout

Results: In 335 men whose scan was not technically compromised, 697 targets were identified. Of these, 180 (26%) had any cancer, 81 (12%, or 45% of all cancerous targets) had at least some Gleason pattern 4 or 5 disease, and 30 (4%, or 17% of all cancerous targets) had predominantly pattern 4 or 5 disease. Average age was 65 years (range, 35-85) and average PSA was 7.1 (range, 0-181) ng/mL. Smaller glands were significantly more likely to have cancer and pattern 4 ($p < 0.005$ for both). PSA was significantly correlated with any cancer and pattern 4 ($p < 0.005$ for both). Age was significantly correlated with pattern 4 ($p = 0.002$) but not any cancer ($p = 0.12$). Increasing T2, DCE and overall suspicion scores were significantly correlated with progressive grades of cancer ($p < 0.008$ for all) and there was a significant difference between GS 3+3 and any pattern 4 ($p < 0.008$) and predominantly pattern 4 vs. lower grades ($P < 0.002$) for all *except* ADC ($p > 0.11$). Targets lay in the peripheral gland in 269 (39%) and were significantly more likely to harbor cancer (48% vs. 35% of benign targets, $p < 0.001$ by Chi-square). Of all targets, 120 (17%) were low (score 1-2) suspicion, very few of which had any or significant cancer (16 and 5, or 2% and 0.7% respectively) with increasing likelihood of cancer for higher scores. ROC analysis follows:



Discussion: The addition of functional parameters improves discrimination mostly for significant (pattern 4) disease, suggesting that low suspicion targets can be safely deferred. However, the analysis of T2 appearance resulted in nearly the same discrimination as with functional parameters and overall suspicion, reinforcing the value of standardized review. The overall composite suspicion performed best. As ADC was the major contributor to selecting targets, it is not unexpected that it had a less significant impact on discrimination.

Conclusion: Multiparametric MRI can identify a minority of targets which can be deferred from biopsy.

References: 1. Barentsz *et al.*, Eur Radiol. 2012 Apr;22(4):746-57. 2. Langer *et al.*, Radiology. 2010 May;255(2):485-94