Addition of MRI Criteria Improves Active Surveillance Determination Accuracy

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Introduction: MRI is sensitive for the detection and grading of *in situ* prostate cancer. However, the standard of care remains definitive treatment with surgery or radiation therapy versus active surveillance (AS) irrespective of imaging findings. This study investigates the additive value of imaging to current active surveillance protocols, with whole mount pathology as the standard of reference.

Materials and Methods: We performed an Instituional Review Board-approved, HIPAA compliant non-concurrent, prospective study of 147 consecutive men who underwent endorectal coil MRI for planned prostatectomy on a Siemens Magnetom TrioTim 3.0 Tesla scanner, including 3-plane T2-weighted imaging (TSE, TR 3800-5040 TE 101 ms, ETL 13, 3 mm, no gap, matrix 256 x 205, 14 x 14 cm FOV), diffusion-weighted imaging with apparent diffusion coefficient (ADC) map (EPI; b = 400,600,1000 s/mm^2; TR 1600-2300 TE 75-90 ms, 5 gap 1.65 mm, 256 x 154 matrix, FOV 35 x 26 cm), dynamic contrast-enhanced (DCE) perfusion imaging using a k-space sharing technique (Siemens TWIST, TR/TE/FA 3.9/1.4 ms/12°, 3.6 mm reconstruction, Matrix 160 x 160, 26 x 26 cm FOV, 70 acquisitions every 6 s, 0.1 mg/kg gadopentetate dimeglumine [Magnevist, Bayer]) and 3-dimensional chemical shift spectroscopic imaging (TR 700ms, TE 120ms, acquisition bandwidth 1300 Hz, 6 averages, 512 spectral data points, FOV 80x80x80 mm^3, matrix 512x12x12). Perfusion analysis was accomplished with CADvue (iCAD Inc, Nashua NH). All images are consensus reviewed by two genitourinary radiologists who identify the index tumor and any secondary tumor(s), for which the size, average ADC and pharmacokinetic parameters, and spectroscopic choline+creatine/citrate ratio (scored normal or abnormal) are recorded. Whole-mount pathology is reviewed for surgical staging and grading. Biopsy (Gleason score [GS]≤6, ≤50% of ≤2 biopsy cores positive) and PSA (≤ 10 ng/mL) Epstein criteria for AS (Ep) alone or with imaging characteristics added, vs. whole mount findings considered appropriate for AS (maximum GS 3+4, organ confined, size <1.5 cm) were compared. Logistic regression analysis was used to identify those parameters which had the highest discriminatory value, which were then added to Ep for 2 x 2 table analysis.

Findings:

Of the initial 147 patients, 43 (29.2%) were excluded because of either significant hemorrhage or lack of one component of the MRI. Of the remaining 104, 55 (53%) had tumors not appropriate for AS at whole mount histology. Descriptive statistics are provided for modified Epstein criteria (Ep) alone and for these criteria in combination with the following imaging parameters: ADC > 0.85×10^{-3} mm^2/s, abnormal spec, and QiAUC and K^{trans} > the 90%ile of those with whole mount findings appropriate for AS.

Parameter	Epstein alone	Ep+ADC	Ep+ADC+Spec+QiAUC	+Ep+AUC+Spec+QiAUC+ K^{trans}
Sensitivity	82%	96.4%	98.2%	98.2%
Specificity	55%	46.9%	42.9%	34.7%
Odds Ratio	5.523	23.4	40.5	28.7
PPV	0.672	0.671	0.659	0.628
NPV	0.730	0.920	0.955	0.944

Additional parameters such as size or perfusion parameters did not improve discrimination. All combinations were highly significant ($p < 0.001$) by Chi-square test.

Conclusion:

Sensitivity for significant disease inappropriate for AS was detected more accurately. The addition of ADC analysis of the index tumor alone at MRI had a marked increase in sensitivity and negative predictive value and only a modest decrease in specificity. The addition of spectroscopic imaging and perfusion analysis improves sensitivity somewhat at the expense of specificity.

Reference: J.I. Epstein, P. Walsh and M. Carmichael, et al. Pathologic and clinical findings to predict tumor extent of nonpalpable (stage T1c) prostate cancer. JAMA, 271 (1994), p. 368