Indolent Prostate Cancer-Prediction by Magnetic Resonance Imaging and Spectroscopy

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Introduction

With increased use of PSA testing, prostate cancer (PCa) has become the most commonly diagnosed cancer in men in the United States (1). Thus, better prediction of low-risk organ-confined prostate cancer (PCa) is needed to confidently identify patients who can be managed with deferred therapy. The present study was designed to assess the value of non-invasive MRI and MRSI in distinguishing pathologically indolent PCa from aggressive disease and to determine whether the addition of MR to the clinical nomograms improves the prediction of pathologically indolent PCa.

Materials and Methods

Retrospective study of 92 patients with clinically low risk PCa (PSA <20 ng/ml, Gleason score ≤6) who underwent combined MRI/MRSI prior to radical prostatectomy. Surgical pathology was used as the standard of reference. Data were acquired on a 1.5 Tesla G.E. Signa scanner (GE, Milwaukee, WI). The study consisted of MR imaging using a pelvic phased array and expandable endorectal coil followed by MRSI with PRESS voxel excitation (2) and BASING water and lipid suppression (3). MRSI data were obtained and processed using software developed at UCSF (4). The 17 minute MRSI scan resulted in a voxel array with in-plane resolution of 6.25 mm and the SI dimension zero filled to 16 slices (3.1 mm resolution). MRSI data were processed on a Sun Ultra 10 Workstation (Sun Microsystems, Mountain View, CA). Processing included 2 Hz Lorentzian apodization in the time domain, 4-dimensional Fourier transform and automated frequency, phase and baseline correction of each voxel (5). Peak areas were calculated by numerical integration. A choline+creatine/citrate (CC/C) ratio >0.5 (2 standard deviations greater than mean normal healthy PZ) was considered suspicious for cancer (4). The criteria for MRI analysis were based on reported MR findings (6). The MRI and MRSI findings were recorded on a 0-3 scale: 0, definitely indolent PCa (no abnormality); 1, probably indolent PCa (small abnormality <0.5cc); 2, indeterminate; and 3, aggressive PCa (definite abnormality >0.5cc). MR scores were incorporated into base and medium clinical nomogram models developed for prediction of small, moderately differentiated confined tumors (7): base model combining PSA, clinical stage, and primary and secondary biopsy Gleason grade, and a medium model combining the base model with percentage of cores positive and prostate volume on imaging. We used receiver operating characteristic (ROC) curves to assess the incremental value of MR to the clinical nomogram.

Results

Thirty seven percent of the clinically low-risk PCa patients had pathologically indolent PCa. The accuracy of MRI in the detection of pathologically indolent PCa was 74.4% and that of combined MRI/MRSI was 84.6%; the difference in accuracy was statistically significant (P<0.004). The addition of MRI significantly improved medium model (P=0.01; area under curve [AUC] 0.837) {Figure 1}, and combined MRI/MRSI findings significantly improved both the medium (P<0.004; AUC 0.862) and base (P<0.008; AUC 0.77) {Figure 2}.

Discussion

The present study shows that the inclusion of MRI/MRSI findings contributed significant incremental value to clinical nomogram for the prediction of pathologically indolent PCa. The increasing incidence of indolent cancers in PSA screening populations and the slow natural history of PCa have raised concerns that too many patients with low-risk disease are being over-treated (8). Considerable progress has been made using nomograms to predict clinically insignificant PCa (9,10). Clinical nomogram developed by Kattan et al states it may be "more useful for ruling out, rather than ruling in, indolent cancer". The incremental value of MR to the nomogram models will aid in patient specific treatment and avoid treatment induced morbidity.

Figure 1. Comparison of ROC curves for clinical nomogram models (base and medium) with and without MRI scores.

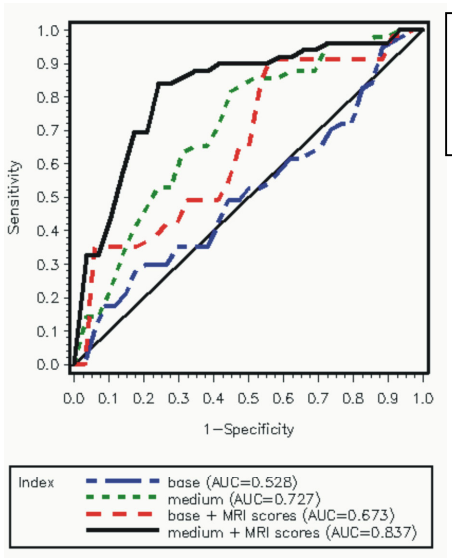
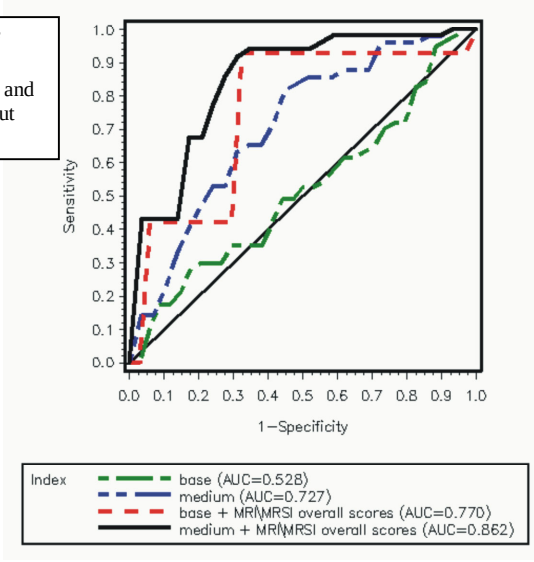


Figure 2. Comparison of ROC curves for clinical nomogram models (base and medium) with and without MRI/MRSI scores.



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