Multiparametric 3-Tesla endorectal MR imaging after external beam radiation therapy for prostate cancer.

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Purpose: The goal of this study was to compare the diagnostic performance of 3-Tesla T2-weighted MR imaging, MR spectroscopic imaging, and diffusion-weighted MR imaging, determining the best combination for the detection of recurrent prostate cancer after external beam radiation therapy.

Methods: Our IRB approved this study with a waiver of informed consent. Twenty-six patients with prostate cancer treated with external beam radiation therapy who underwent 3-Tesla endorectal MR imaging of the prostate for suspected recurrence due to biochemical failure were part of this research. The imaging protocol included T2-weighted images, MR spectroscopic images, and diffusion-weighted MR images. Transrectal ultrasound-guided biopsy was the standard of reference. We used logistic regression to model the probability of a positive outcome and generalized estimating equations to take into account the clustering effect. The diagnostic performance of imaging was described using receiver operating characteristic (ROC) curves.

Results: Recurrent prostate cancer was identified by biopsy in 14 of 26 patients (53.8%), and was unilateral in 9 and bilateral in 5 (total of 35 affected sextants). The median time interval between biopsy and imaging was 16 days (IQR = 5 to 34).

The area under the ROC curve of MR spectroscopic imaging was 83.0% (95% CI = 75.5 to 89.1). The combination of any two or all three MR techniques did not significantly improve the performance of imaging beyond the accuracy of MR spectroscopic imaging alone, but a trend towards improved discrimination with all three parameters was noted (86.9%, 95% CI = 77.6 to 93.4; $P = 0.09$). Visual inspections of the shape of the ROC curves demonstrate that all three modalities together are more sensitive for the detection of recurrent cancer. The specificity of MR imaging, however, does not change to an appreciable extent. These results are summarized in table 1 and figure 1. Figure 2 shows an example of a patient with recurrent disease.

Conclusion: Incorporation of MR spectroscopic imaging to T2-weighted MR imaging and/or diffusion-weighted MR imaging significantly improves the assessment of patients with suspected local recurrence after radiation therapy and a combined approach with all three modalities may have the best diagnostic performance.

Figure 1: ROC curves for detection of locally recurrent prostate cancer after external beam radiation therapy. Lower thin solid line is reference line.

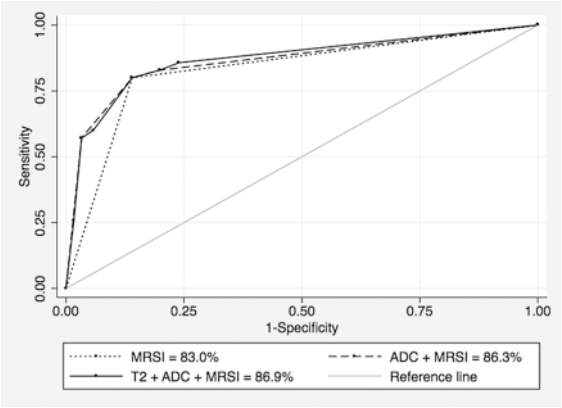

Table 1: Areas under the ROC curve for the detection of recurrent disease after radiation therapy with T2-weighted MR imaging, diffusion-weighted MR imaging, and MR spectroscopic imaging, alone or in combination.

Techniques	Az	95% confidence interval
T2	0.616	0.511 to 0.732
ADC	0.755	0.610 to 0.853
MRSI	0.830	0.755 to 0.891
T2 + ADC	0.774	0.604 to 0.869
T2 + MRSI	0.841	0.765 to 0.909
ADC + MRSI	0.863	0.775 to 0.933
T2 + ADC + MRSI	0.869	0.776 to 0.934

Az = area under the receiver operating characteristic curve

Figure 2: 77 year-old man with biopsy proven recurrent prostate cancer in the left gland. T2-weighted MR image demonstrates a large focal area of mildly decreased signal intensity, consistent with recurrent cancer (A). Grid overlay with corresponding MR spectra depict suspicious metabolism (B). ADC map demonstrates restricted diffusion in the same area (C).