Localization of Prostate Cancer After Hormone Ablation by MRI and 3D 1H MRSI: Case-Control Study with Pathologic Correlation

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Purpose

The goal of this study was to determine the ability of magnetic resonance imaging (MRI) and 3D 1H MR spectroscopy (MRSI) to localize prostatic adenocarcinoma (PCA) to a sextant of the peripheral gland after neoadjuvant hormone ablation (NHA).

Introduction

Initial studies show that patients with localized adenocarcinoma of the prostate who have undergone neoadjuvant antiandrogenic therapy prior to radical prostatectomy demonstrate lower frequencies of positive surgical margins than patients who did not undergo antiandrogenic therapy (1,2). Other findings (3, 4) suggest that neoadjuvant antiandrogenic therapy may decrease tumor stage. In view of these findings, it may prove beneficial to include results of a sensitive and specific staging examination in the clinical decision prior to definitive treatment of localized prostate cancer. Magnetic resonance imaging (MRI), particularly when combined with magnetic resonance spectroscopic imaging (MRSI) has proved to be highly sensitive and specific in the detection and localization of prostate cancer, which represents the initial step in tumor staging (5), and in the diagnosis of extracapsular extension (6). This study compares the ability of MRI/MRSI to localize prostate cancer to a sextant of the gland in patients with and without prior antiandrogenic therapy.

Methods

This retrospective case-control study is based on data gathered during 45 combined endorectal/phased array coil MRI and 3D 1H MRSI examinations performed between February, 1993, and November, 1998, in patients with PCA proven by transrectal ultrasound-guided biopsy who underwent radical prostatectomy within 3 months after MRI/MRSI. Fifteen patients with NHA (<6 weeks, n=9; 7--16 weeks, n=5; >16 weeks n=1) were matched by final tumor stage after radical prostatectomy (T2/T3) and Gleason score (5--9) with 30 patients without therapy prior to radical prostatectomy.

MR Studies were carried out on a GE 1.5 Tesla clinical scanner, applying the body coil for excitation and a combined endorectal/pelvic phased-array coil for signal reception. Axial T1W SE and T2W FSE images were obtained from below the apex of the prostate to above the aortic bifurcation (T1W) or above the seminal vesicles (T2W). All images were analytically corrected for the coils' reception profile. Using a water and fat suppressed double-echo spin echo (PRESS) sequence, optimized for the quantitative reception profile. Using a water and fat suppressed double-detection of both choline and citrate, either an 8x8x8 or 16x8x8 phase encoded spectral array was acquired with a spectral resolution (voxel size) of between 0.24cc and 0.34cc.

peripheral prostate gland tissue with decreased signal intensity on T2W MR images were considered as PCA-bearing when T1W MRI did not show increased signal from hemorrhage in the same location.

For each examination, MRSI voxels from each site were searched for (choline+creatine)/citrate peak area ratios >2SD above mean for healthy peripheral prostate tissue (implying PCA). Cutoff levels for healthy tissue were 0.7 for pre-NHA and up to 6 weeks of NHA, 1.05 for 7--16 weeks of NHA, and 0.83 for >16 weeks of NHA, or (choline+creatine)/mean noise >5 in cases of complete loss of citrate (unpublished data).

Results and Discussion

In the NHA-treated cases, 80 sites were evaluated and compared with histopathologic after radical prostatectomy, and in the controls, 140 sites. Sensitivity (sens), and specificity (spec), for the detection and localization of PCA are shown below (Table 1).

Table 1. Detection and localization of prostate cancers by MRI in patients with (n=80 sites) and without (n=140 sites) neoadjuvant hormone ablation.

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<tr>
<td>NHA no NHA</td>
<td>R1</td>
<td>R1</td>
<td>R2</td>
<td>R2</td>
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<tr>
<td>Sens</td>
<td>93%</td>
<td>78%</td>
<td>76%</td>
<td>88%</td>
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<td>Spec</td>
<td>50%</td>
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Differences in sensitivity and specificity of MRI were not significant between patients with and without NHA for both readers (p>0.25, chi square test). Equal or higher sensitivity and decreased specificity for PCA reflect overestimation of tumor extent after NHA (7). When combined with MRSI, calling PCA in sites positive on both, sensitivity decreased moderately, while specificity increased markedly (Table 2).

Table 2. Detection and localization of prostate cancers by combined MRI and MRSI in patients with (n=80 sites) and without (n=140 sites) neoadjuvant hormone ablation (positive MRI and positive MRSI).

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<tr>
<td>NHA no NHA</td>
<td>R1</td>
<td>R1</td>
<td>R2</td>
<td>R2</td>
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<tr>
<td>Sens</td>
<td>83%</td>
<td>73%</td>
<td>67%</td>
<td>80%</td>
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<tr>
<td>Spec</td>
<td>64%</td>
<td>67%</td>
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Conclusion

MRI signal alterations in the peripheral prostate after neoadjuvant hormone ablation of localized cancer prior to radical prostatectomy lead to an overestimation of tumor prevalence. At a moderate decrease of sensitivity, combining MRI with 3D 1H MR spectroscopy markedly increases specificity. The latter may be helpful in determining lesion extent prior to planning the type and extent of definitive therapy.

References

2. Lee et al. (1997) Anticancer Research 17:1507--1510