Does endorectal coil MRI increase the accuracy of preoperative prostate cancer staging?

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Introduction: *We sought to investigate the association of preprostatectomy magnetic resonance imaging (MRI) and surgical pathologic findings in patients with prostate cancer.*

Materials and methods: *All patients with prostate cancer and preprostatectomy MRI available between 2002 and 2015 were included. Age, prostate-specific antigen at diagnosis, Gleason score at biopsy, MRI technique, radiology report suggestive of prostate cancer, extraprostatic invasion and seminal vesicle involvement, lymphadenopathy and final pathology report were retrospectively reviewed. Data was analyzed for sensitivity, specificity, positive and negative predictive values of MRI findings for predicting T3 disease. Consistency of MRI findings with pathology report was compared between MRIs with or without endorectal coil (ERC).*

Results: *A cohort of 83 patients was identified. Eighty-seven percent of the patients had MRI findings suggestive of prostate cancer. MRI was performed with and without ERC in 21 (25.3%) and 62 (74.3%) patients respectively. Eighty-five percent of patients with ERC and 88.7% of those without ERC had MRI findings suggestive of prostate cancer (p = 0.659). MRI correlated with final surgical pathology stage T3 in 53 patients (64%). MRI findings were consistent with final pathology report in 70% of ERC group and 61.3% of non ERC group (p = 0.482). In terms of extra prostatic invasion or seminal vesicle involvement, MRI had specificity, sensitivity, positive and negative predictive values of 84.44%, 37.84%, 66.67% and 62.3% respectively.*

Conclusions: *MRI was specific but not sensitive in determining extraprostatic or seminal vesicle invasion. MRI was not accurate for lymph node involvement. In addition, using an ERC did not increase the accuracy of prostate MRI in this small cohort.*

Key Words: cancer staging, endorectal coil, MRI, prostate cancer, prostatectomy

Introduction

Magnetic resonance imaging (MRI) of prostate is increasingly being used for detection and management of patients with prostate cancer. Since its introduction in the mid-1980's, MRI of prostate has evolved with several new modifications like use of endorectal coil (ERC), diffusion weighted imaging (DWI), magnetic resonance spectroscopy, and dynamic contrast-enhanced MRI to improve image quality and its diagnostic value.[1] ERC, first described in the literature in the late 1980's,[2] allows a higher signal-to-noise ratio (SNR) that aids the interpreting physician when smaller fields of view are available, such as in DWI.[3] Although there are some imaging benefits of ERC use, it is associated with patient discomfort,[4] increased cost,[5] increased time of testing,[6] and distortion of anatomic landmarks from motion and flare artifact.[7]

The development and increased availability of 3 Tesla (T) MRI has questioned the utility of ERC. A meta-analysis by Rooij et al, found that ERC was useful for field strength of 1.5 T or in the absence of multiparametric MRI, but when higher field strengths or additional functional techniques were used, the use of ERC had lower sensitivity for detection of prostate cancer compared to no ERC use.[1] In contradiction to that, Heijmink et al noted that the addition of ERC

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at 3 T significantly increases performance in several sequence parameters including localization, staging related characteristics, and overall image quality.[8] Currently, there is no consensus among experts regarding the diagnostic benefits of ERC use during MRI for prostate cancer detection.[9] Recently updated PI-RADS v2 neither supports nor opposes its use in prostate MRI.[10]

In this retrospective study, we evaluated if the use of ERC with prostate MRI was associated with improved detection of prostate cancer, prediction of adverse surgical pathology, and identification of stage T3 prostate cancer according to American Joint Committee version 7 (AJCC V7).

Materials and methods

The Institutional Review Board (IRB) at the University of Nebraska Medical Center approved the study protocol. In this retrospective, single institution study we reviewed the medical records from 2002 to 2015, and included patients who had preoperative prostate MRI and then went on to have radical prostatectomy for biopsy proven prostate cancer. Information obtained through retrospective review included age, prostate-specific antigen (PSA) at diagnosis, biopsy Gleason score, MRI technique, findings of MRI, and surgical pathology after prostatectomy. Prostate MRI reports were reviewed for use of endorectal coil, evidence of prostatic adenocarcinoma, extraprostatic and seminal vesicle invasion, and lymphadenopathy.

Surgical pathology from every patient was reviewed. The stage of the disease was determined according to the TNM classification system AJCC v7 and T3 disease was determined as extraprostatic extension or seminal vesicle invasion. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of prostate MRI, irrespective of use of endorectal coil, was calculated for ability to predict stage T3 prostate cancer.

The patient cohort was divided in to two groups consisting of MRI with ERC versus MRI without ERC. Comparative analysis was performed to assess ability of MRI to predict prostate cancer between the two groups. Comparative analysis was then performed assessing MRI consistency with surgical pathology between the two groups. Ability to predict T3 surgical pathology was also assessed comparing use of endorectal coil to non-endorectal coil MRI, although statistical analysis was not deemed reasonable due to small sample size. All the statistical analysis was performed using STATA software (Stata Corp LP, College Station, TX, USA).

TABLE 1. **MRI technique versus imaging findings suggestive of prostate cancer**

Technique	MRI findings suggestive of prostate cancer (number, %)
Endorectal coil	18 (85.7%)
No endorectal coil	55 (88.7%)

Results

A total of 83 patients were identified. The patients included in our study had mean age of 60.8 years (range 43-78) and mean serum PSA at diagnosis of 9.86 ng/mL (range 0.5-99.6). Fifty-five patients (66.3%) had stage T2 surgical pathology, while 28 patients (33.7%) had stage T3 surgical pathology. Of the 83 patients included in this study, 6 patients (7%) had Gleason 6 disease, 59 patients (71%) had Gleason 7 disease and 18 patients (21.6%) had Gleason 8-9 disease in final surgical pathology.

Eighty-eight percent of patients had imaging characteristics of prostate cancer seen on prostate MRI. Within our cohort, 28 patients were found to have pT3 disease. The study population consisted of 21 patients in the ERC group and 62 patients in non-ERC group. In the 21 patients in whom endorectal coil was used, 18 (85.7%) had findings indicative of prostate cancer, while evidence for prostate cancer in the non-endorectal coil group was seen in 55 (88.7%) patients (p = 0.659), Table 1. Surgical staging matched

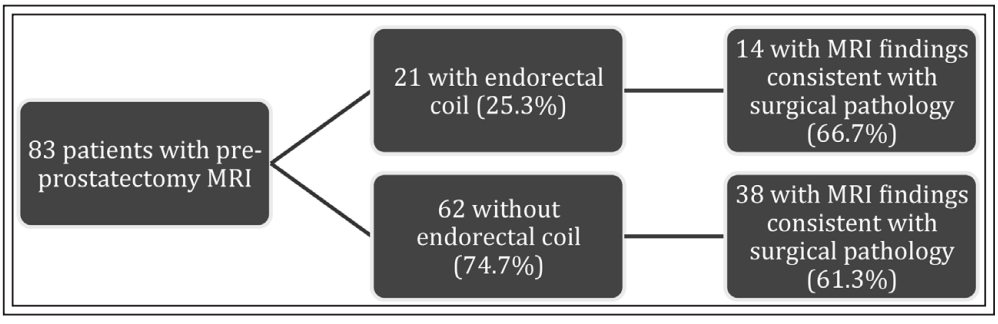

Figure 1. Consistency of MRI findings with final surgical pathologic staging.

TABLE 2. **Statistical measures of performance of the MRI findings to predict final pathologic stage of prostate cancer**

Specificity	84.44%
Sensitivity	37.84%
Positive predictive value	66.67%
Negative predictive value	62.3%

MRI-specific staging in 52 patients (62.7%). This concurrence between surgical staging and MRI-specific staging was seen in 14 of 21 patients (66.7%) in the endorectal coil group and in 38 of 62 patients (61.3%) in the non-endorectal coil group (p = 0.482), Figure 1.

In terms of detection of stage T3 prostate cancer in the entire cohort, prostate MRI had sensitivity, specificity, PPV, and NPV of 37.84%, 84.44%, 66.67%, and 62.3%, respectively, Table 2. Eight patients (37.5%) within the ERC group and 20 patients (32.7%) within the non ERC group had surgical pathology findings of stage T3 disease.

Of the 58 patients who underwent surgical lymph node dissection, 2 (3.4%) had lymph node metastases, neither of which showed lymphadenopathy on prostate MRI preoperatively. A total of 14 (24.1%) patients had evidence of lymphadenopathy on prostate MRI, while 44 (75.9%) had no evidence of lymphadenopathy.

Discussion

The results of our study showed that prostate MRI had high detection rate for prostate cancer regardless of the use of ERC. Even though the sensitivity of the MRI in predicting T3 stage was low, it had high specificity, and the concurrence rate was moderate between MRI prediction and final surgical pathology. The addition of ERC did not improve the ability of MRI to detect T3 stage prostate cancer. In this era where the majority of patients present with organ confined disease, our results were consistent with 66.3% patients presenting with T2 disease and 33.7% patients presenting with T3 disease.

The use of 3 T MRI scanners appears to obviate the need for ERC use. The 3 T MRI scanners produce comparable imaging quality to 1.5 T scanners with endorectal coil. Beyersdorff et al[11] found that a 1.5 T scanner with endorectal coil had better imaging quality. However, this better imaging quality did not necessarily translate in to higher diagnostic accuracy. Torricelli et al in a similar comparison noted no significant difference in the diagnostic accuracy between 1.5 T with endorectal coil and 3 T without endorectal coil for predicting extra prostatic disease.[6] These results led to curiosity about whether the use of ERC would improve the diagnostic accuracy if it was used with higher strength magnets like 3 T scanners. Our study did not show any advantage in detecting prostate cancer or the stage of prostate cancer disease with use of ERC. The sensitivity of MRI in detecting cancer was low in our study and was comparable to findings by De Rooij et al in their meta-analysis showing a sensitivity of 61% and specificity of 88% for prediction of T3 stage disease.[1] In our study population, 65 patients (78.3%) had low or intermediate risk prostate cancer (Gleason 6 and 7) and only 18 patients (21.6%) had high risk prostate cancer (Gleason 8-9) in their final surgical pathology specimen. We believe that low sensitivity of preoperative MRI in diagnosing prostate cancer was partly due to high percentage of low and intermediate risk prostate cancer in our study population.

Brajtbord et al compared preoperative MRI with surgical pathology and also noted that MRI has limited clinical utility in predicting T3 disease with a sensitivity and specificity of 43% and 73% respectively.[12] In their study, they noted sensitivity and specificity of 43% and 73% respectively for predicting T3 disease. As emphasized in the review by Masterson et al, MRI can have important implications in preoperative counselling, treatment planning and treatment expectations.[13] To improve the predictive ability of MRI for T3 staging, the use of ERC has been proposed but the results of our study did not show any such improvements.

There are limitations to our study. This small study is retrospective in nature and thus has selection bias inherent to its design. Also, it is a single institution study and results may not be widely applicable. We included patients who underwent radical prostatectomy after prostate MRI and thus missed the patients who underwent observation, surveillance or other methods of treatment. We relied on the reports of MRI and surgical pathology to collect the data; the radiologist and pathologist did not revisit images and specimen respectively.

Despite these above-mentioned limitations, our study highlights the important finding that addition of ERC does not improve the ability of 3 T prostate MRI to detect prostate cancer or predict adverse pathologic stage at the time of radical prostatectomy. ERC use adds to the time to the imaging procedure, patient discomfort and cost without improving predictive ability of the prostate MRI. Until clear advantages of ERC use are shown to correlate in to improved prostate cancer detection and staging, 3 T MRI of prostate without endorectal coil should be common practice. □

References

1. de Rooij M, Hamoen EH, Witjes JA et al. Accuracy of magnetic resonance imaging for local staging of prostate cancer: a diagnostic meta-analysis. *Eur Urol* 2016;70(2):233-245 .
2. Martin JF, Hajek P, Baker L et al. Inflatable surface coil for MR imaging of the prostate. *Radiology* 1988;167(1):268-270.
3. Hegde JV, Mulkern RV, Panych LP et al. Multiparametric MRI of prostate cancer: an update on state-of-the-art techniques and their performance in detecting and localizing prostate cancer. *J Magn Reson Imaging* 2013;37(5):1035-1054.
4. Powell DK, Kodsi KL, Levin G et al. Comparison of comfort and image quality with two endorectal coils in MRI of the prostate. *J Magn Reson Imaging* 2014;39(2):419-426.
5. Langlotz CP, Schnall MD, Malkowicz SB et al. Cost-effectiveness of endorectal magnetic resonance imaging for the staging of prostate cancer. *Acad Radiol* 1996;3(Suppl 1):S24-S27.
6. Torricelli P, Cinquantini F, Ligabue G et al. Comparative evaluation between external phased array coil at 3 T and endorectal coil at 1.5 T: preliminary results. *J Comput Assist Tomogr* 2006;30(3):355-361.
7. Shah ZK, Elias SN, Abaza R et al. Performance comparison of 1.5-T endorectal coil MRI with 3.0-T nonendorectal coil MRI in patients with prostate cancer. *Acad Radiol* 2015;22(4):467-474.
8. Heijmink SW, Futterer JJ, Hambrock T et al. Prostate cancer: body-array versus endorectal coil MR imaging at 3 T--comparison of image quality, localization, and staging performance. *Radiology* 2007;244(1):184-195.
9. Barentsz JO, Weinreb JC, Verma S et al. Synopsis of the PI-RADS v2 guidelines for multiparametric prostate magnetic resonance imaging and recommendations for use. *Eur Urol* 2016;69(1):41-49.
10. Weinreb JC, Barentsz JO, Choyke PL et al. PI-RADS Prostate imaging - reporting and data system: 2015, version 2. *Eur Urol* 2016; 69(1):16-40.
11. Beyersdorff D, Taymoorian K, Knosel T et al. MRI of prostate cancer at 1.5 and 3.0 T: comparison of image quality in tumor detection and staging. *AJR Am J Roentgenol* 2005;185(5):1214-1220.
12. Brajtbord JS, Lavery HJ, Nabizada-Pace F et al. Endorectal magnetic resonance imaging has limited clinical ability to preoperatively predict pT3 prostate cancer. *BJU Int* 2011;107(9):1419-1424.
13. Masterson TA, Touijer K. The role of endorectal coil MRI in preoperative staging and decision-making for the treatment of clinically localized prostate cancer. *MAGMA* 2008;21(6):371-377.