The Role of Magnetic Resonance Image Guided Prostate Biopsy in Stratifying Men for Risk of Extracapsular Extension at Radical Prostatectomy

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Purpose: Magnetic resonance imaging detects extracapsular extension by prostate cancer with excellent specificity but low sensitivity. This limits surgical planning, which could be modified to account for focal extracapsular extension with image directed guidance for wider excision. In this study we evaluate the performance of multiparametric magnetic resonance imaging in extracapsular extension detection and determine which preoperative variables predict extracapsular extension on final pathology when multiparametric magnetic resonance imaging predicts organ confined disease.

Materials and Methods: From May 2007 to March 2014, 169 patients underwent pre-biopsy multiparametric magnetic resonance imaging, magnetic resonance imaging/transrectal ultrasound fusion guided biopsy, extended sextant 12-core biopsy and radical prostatectomy at our institution. A subset of 116 men had multiparametric magnetic resonance imaging negative for extracapsular extension and were included in the final analysis.

Results: The 116 men with multiparametric magnetic resonance imaging negative for extracapsular extension had a median age of 61 years (IQR 57–66) and a median prostate specific antigen of 5.51 ng/ml (IQR 3.91–9.07). The prevalence of extracapsular extension was 23.1% in the overall population. Sensitivity, specificity, and positive and negative predictive values of multiparametric magnetic resonance imaging for extracapsular extension were 48.7%, 73.9%, 35.9% and 82.8%, respectively. On multivariate regression analysis only patient age ($p=0.002$) and magnetic resonance imaging/transrectal ultrasound fusion guided biopsy Gleason score ($p=0.032$) were independent predictors of extracapsular extension on final radical prostatectomy pathology.

Conclusions: Because of the low sensitivity of multiparametric magnetic resonance imaging for extracapsular extension, further tools are necessary to stratify men at risk for occult extracapsular extension that would otherwise only become apparent on final pathology. Magnetic resonance imaging/transrectal ultrasound fusion guided biopsy Gleason score can help identify which men with prostate cancer have extracapsular extension that may not be detectable by imaging.

Abbreviations and Acronyms

DCE = dynamic contrast enhanced

ECE = extracapsular extension

MP = multiparametric

MRI = magnetic resonance imaging

PCa = prostate cancer

PSA = prostate specific antigen

RP = radical prostatectomy

TRUS = transrectal ultrasound

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In the era of serum PSA testing the majority of prostate cancer diagnoses represent organ confined disease, for which radical prostatectomy is curative.[1] However, certain adverse pathological features on RP pathology are associated with worse postoperative oncologic outcomes. The presence of extracapsular extension is of particular importance as it is associated with higher rates of positive surgical margins and early biochemical recurrence.[2]

Preoperative knowledge of the presence and location of potential ECE allows for a modified surgical technique, which minimizes the risk of positive margins and optimizes the likelihood of complete extirpation via wide resection.[3] However, no preoperative tool reliably detects and localizes ECE in all cases. Traditional anatomical sequences of MRI reliably detect gross ECE. However, MRI is limited by a low sensitivity for microfocal tumor growth invading the capsule, with a reported sensitivity for ECE of 33% to 64%.[4–6] Thus, as prostatic imaging has evolved, attention has turned toward multiparametric prostate MRI.

This technique has a high accuracy for the identification of clinically relevant intraprostatic PCa lesions, leading to hopes of improved staging accuracy as well.[7–9] Somford et al recently published their initial experience with MP-MRI for the detection of ECE.[10] Despite the use of a 3 Tesla (3T) scanner with an endorectal coil and MP-MRI sequences interpreted by experienced radiologists, the sensitivity of MP-MRI for ECE as confirmed by final pathology was only 58.2%. PSA was an independent predictor of ECE while random biopsy Gleason score was not.[10] These findings suggest that even with optimal imaging protocols, MRI under stages disease in men who ultimately choose to undergo RP.

Further adjunct tools are necessary to risk stratify men who are likely to harbor ECE that is not detectable on the highest level imaging.[11] At our institution patients with suspected prostate cancer undergo 3T MP-MRI of the prostate with an endorectal coil. This is followed by MRI/TRUS fusion guided biopsy, whereby MRI suspicious lesions can be targeted and directly sampled. Because this biopsy technique is thought to more accurately represent true prostate tumor burden,[12–14] we hypothesized that targeted biopsy Gleason score could better predict the presence of ECE. Thus, in this study we evaluate the performance of MP-MRI and fusion biopsy for the detection of ECE, and determine which preoperative variables can predict ECE on final RP pathology in cases in which MP-MRI estimates organ confined disease.

MATERIALS AND METHODS

Patient Selection

Patients were enrolled in an institutional review board approved, prospective study of prostate MP-MRI and MRI/TRUS fusion guided biopsy at the National Cancer Institute of the National Institutes of Health. From May 2007 to March 2014, 370 patients underwent RP at our institution (fig. 1). Of these patients 201 were excluded from the study because of an incomplete preoperative evaluation, which in all other cases included MP-MRI, MRI/TRUS fusion guided biopsy and extended sextant 12-core biopsy. The remaining 169 patients were included in the analysis of MP-MRI diagnostic performance for the detection of ECE on final RP pathology.

Of the 169 patients comprising the overall study population 116 had MP-MRI negative for ECE (fig. 1). These patients were included in the analysis of preoperative predictors of pathological ECE in the setting of MP-MRI that is negative for this finding. The 53 patients with MP-MRI positive for ECE were excluded from analysis because of their heterogeneity. Some of these 53 patients had MRI with frank ECE but many reports instead described probable ECE or extracapsular bulge. By excluding all such patients the analysis of preoperative predictors of pathological ECE may be performed on our study's specific target population, that is patients with PCa and no MRI suspicion of ECE.

Imaging and Biopsy Protocols

Diagnostic MP-MRI of the prostate was performed with a 3T scanner (Achieva, Philips Healthcare, Best, The Netherlands) using an endorectal coil (BPX-30, Medrad, Pittsburgh, Pennsylvania) and a 16-channel cardiac surface coil (SENSE, Philips Healthcare) as previously described.[15] The prostate MP-MRI was evaluated by 2 radiologists (BT, PLC) with extensive prostate MRI experience (7 and 15 years, respectively). MP-MRI incorporated triplanar T2-weighted, diffusion weighted, DCE and magnetic resonance spectroscopy sequences in most

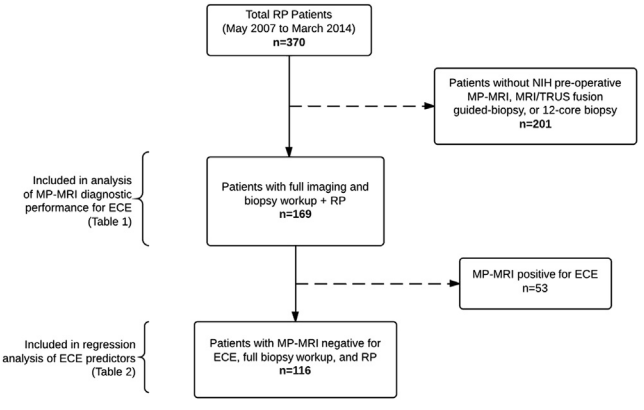

Figure 1. Flowchart illustrating patient selection