Utility of Prostate MRI

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Objectives:

- Discuss the indications for MRI of the prostate
- Describe the different techniques for performing MRI of the prostate
Utility of Prostate MRI
6th Annual Excellence in Urology Seminar

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Wake Forest University School of Medicine
Winston-Salem, NC
Prostate MRI: A word of caution!

Not all prostate MRI is the same

Field strength: 1.5 T vs. 3.0 T
Coil: Body vs. surface vs. endorectal
Technique: T2w, DCE, DWI, MRS
Multiparametric Prostate MRI

- T2W
- DCE
- DWI
- MRS

Difficult to do well
Marginal benefit
Prostate MRI: Potential Roles

- Detection
- Staging
- Surveillance
- Guidance

[Image: MRI scan of prostate]
Prostate MRI: Detection/localization

MRI is not currently a screening tool.

- DRE + PSA → TRUS biopsy

Clinical suspicion of prostate cancer with failed attempts at biopsy.

APICAL TUMOR

CENTRAL TUMOR
Prostate MRI: Detection/localization

MRI can increase biopsy yield for high risk tumors after negative biopsy(ies) in patients with elevated PSA

- MR guided biopsy
- MR/US fusion guided biopsy
- Lesion localization prior to repeat TRUS

Vourganti et al. J Urol 2012;188:2152-7
58 patients with $\geq 1$ negative biopsy(s) and elevated PSA

3T functional (multiparametric) MRI

22/58 pts with suspicious findings on MRI

16/22 underwent repeat targeted biopsy using MRI as roadmap (not realtime guidance)

11/16 had positive repeat biopsy

All 11 patients had high risk prostate ca
Negative biopsy, elevated PSA

Subsequent biopsy positive
Prostate cancer is the most common noncutaneous male malignancy in the United States. The use of serum prostate-specific antigen as a screening tool is complicated by a significant fraction of nonlethal cancers diagnosed by biopsy. Ultrasound is used predominately as a biopsy guidance tool. Combined rectal examination, prostate-specific antigen testing, and histology from ultrasound-guided biopsy provide risk stratification for locally advanced and metastatic disease. Imaging in low-risk patients is unlikely to guide management for patients electing up-front treatment. MRI, CT, and bone scans are appropriate in intermediate-risk to high-risk patients to better assess the extent of disease, guide therapy decisions, and predict outcomes. MRI (particularly with an endorectal coil and multiparametric functional imaging) provides the best imaging for cancer detection and staging. There may be a role for prostate MRI in the context of active surveillance for low-risk patients and in cancer detection for undiagnosed clinically suspected cancer after negative biopsy results.

The ACR Appropriateness Criteria are evidence-based guidelines for specific clinical conditions that are reviewed every 2 years by a multidisciplinary expert panel. The guideline development and review include an extensive analysis of current medical literature from peer-reviewed journals and the application of a well-established consensus methodology (modified Delphi) to rate the appropriateness of imaging and treatment procedures by the panel. In those instances in which evidence is lacking or not definitive, expert opinion may be used to recommend imaging or treatment.

**Key Words:** Appropriateness Criteria, prostate cancer, imaging, detection, staging

**Variant 4:**

Multiple negative prostate biopsies, but there is concern for prostate cancer based upon rising or persistently elevated serum markers suggestive of cancer.

<table>
<thead>
<tr>
<th>Radiologic Procedure</th>
<th>Rating</th>
<th>Comments</th>
<th>RRL*</th>
</tr>
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<tbody>
<tr>
<td>MRI pelvis without and with contrast</td>
<td>7</td>
<td>Should include dynamic contrast-enhanced (DCE) technique. See statement regarding contrast in text under “Anticipated Exceptions.”</td>
<td>O</td>
</tr>
<tr>
<td>MRI pelvis without contrast</td>
<td>5</td>
<td></td>
<td>O</td>
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<tr>
<td>CT abdomen and pelvis with contrast</td>
<td>2</td>
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<tr>
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<td>2</td>
<td></td>
<td>🟢🟢🟢🟢🟢</td>
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<td></td>
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**Rating Scale:** 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative Radiation Level*
<table>
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<tr>
<th>Guidelines</th>
<th>Overall Recommendation</th>
<th>Early detection (screening)</th>
<th>Localisation and targeted biopsies</th>
<th>Staging &amp; Treatment Planning</th>
<th>Active Surveillance/Focal therapy</th>
<th>Recurrence post treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>European Association Urology [1] 2011</td>
<td>MRI is now of a high technical standard, but not sufficiently reliable to make use mandatory.</td>
<td>No comment</td>
<td>If suspicion for PCa persists despite negative biopsies, MRI may be used to investigate a possible anterior PCa, followed by TRUS/ MRI-guided biopsy of the suspicious area.</td>
<td>MRI demonstrates higher accuracy than DRE, TRUS &amp; CT for the assessment of un/biologic disease (T2), ECE/ SVI (T3), and invasion of adjacent organs (T4)</td>
<td>No comment</td>
<td>Pelvic MRI or CT may be used to detect metastases post-treatment, particularly when PSA &gt; 20</td>
</tr>
<tr>
<td>European Society of Urogenital Radiology [2] 2012</td>
<td>mp-MRI should be an integral part of prostate cancer diagnosis and treatment</td>
<td>No comment</td>
<td>In men where repeat biopsy is indicated, MRI-directed TRUS biopsy or real-time MRI-guided biopsy must be used routinely</td>
<td>Surgical planning: MRI helps detect ECE to plan nerve-sparing &amp; continence-preserving surgery Nodal staging: Lymph node staging using MRI is unreliable, and should only be done where probability is &gt;40%</td>
<td>MRI before enrolment in AS allows detection of adverse prognostic features such as high tumour volume/grade, particularly in anterior and apical tumours</td>
<td>MRI can be used to direct further biopsy for more accurate grading and volume assessment of tumour</td>
</tr>
<tr>
<td>National Comprehensive Cancer Network (North America)</td>
<td>Not accepted as essential in the workup of all patients. Optional in specific instances</td>
<td>No comment</td>
<td>Multi-parametric MRI can aid in cancer detection in patients with persistent PSA elevation but negative TRUS biopsy</td>
<td>Primary radiotherapy: MRI may help direct radiotherapy MRI has yet to be accepted as essential in tumour staging MRI is indicated for nodal staging if cT3-4, PSA &gt;20-25 or if the nomogram-derived probability of nodal metastases is &gt;20%</td>
<td>No comment</td>
<td>No comment</td>
</tr>
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Prostate Cancer: Staging

Pre-operative staging is currently the most accepted and utilized role for MRI in prostate cancer management.
Prostate MRI: Pre-operative planning

Help select best candidates for surgical therapy.
Assessment of neurovascular bundles prior to nerve-sparing surgery.
Assessment of the prostatic apex predicting risk of recurrence and incontinence

**Staging accuracies: 50%–92%**.

Extracapsular Extension

- Loss of low SI capsule
- Loss of rectoprostatic angle
- Neurovascular bundle asymmetry
- Low SI seminal vesicle
Role of pelvic phased array magnetic resonance imaging in staging of prostate cancer specifically in patients diagnosed with clinically locally advanced tumours by digital rectal examination

Evangelos Xylinas · David R. Yates · Raphaële Renard-Penna · Elise Seringe · Jean-Claude Bousquet · Eva Comperat · Marc-Olivier Bitker · Philippe Grenier · Morgan Rouprêt

Table 2 Concordance between MRI staging and definitive pathological staging based on prostatectomy specimens

<table>
<thead>
<tr>
<th>MRI stage</th>
<th>Pathological T stage</th>
<th>pT2</th>
<th>pT3a</th>
<th>pT3b</th>
</tr>
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<tr>
<td></td>
<td>pT2</td>
<td>pT3a</td>
<td>pT3b</td>
<td></td>
</tr>
<tr>
<td>T2</td>
<td>9</td>
<td>2</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>T3a</td>
<td>4</td>
<td>33</td>
<td>3</td>
<td>40</td>
</tr>
<tr>
<td>T3b</td>
<td>0</td>
<td>3</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>Total</td>
<td>13</td>
<td>38</td>
<td>19</td>
<td>70</td>
</tr>
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</table>
The role of conventional and functional endorectal magnetic resonance imaging in the decision of whether to preserve or resect the neurovascular bundles during radical retropubic prostatectomy

APOSTOLOS P. LABANARIS¹, VAHUDIN ZUGOR², SAMI TAKRITI¹, ROBERT SMISZEK¹, KARL ENGELHARD³, REINHOLD NÜTZEL¹ & REINHARD KÜHN¹

Departments of ¹Urology and ³Radiology, Martha Maria Medical Center, Nürnberg, Germany, and ²Department of Urology, Salzgitter Medical Center, Salzgitter, Germany

Based on MRI, the operative strategy was changed in 44% of patients (successfully in all based on path).

MRI favored NVB preservation in 67% of patients with a high clinical probability of ECE.

MRI opposed NVB preservation in 33% of patients with a low clinical probability of ECE.

Scandinavian Journal of Urology and Nephrology, 2009; 43: 25-31
Clinical Condition: Prostate Cancer — Pretreatment Detection, Staging, and Surveillance

Variant 3:
Prostate cancer diagnosed on biopsy, patient at high risk for locally advanced disease and metastases (AJCC Groups III and IV). Example: PSA ≥20 or Gleason 8-10 or clinical stage T2c or higher.

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<td>6</td>
<td></td>
<td>O</td>
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<tr>
<td>CT abdomen and pelvis without contrast</td>
<td>6</td>
<td>If contrast contraindicated.</td>
<td></td>
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<td>X-ray area of interest</td>
<td>4</td>
<td>Appropriate if bone scan or symptoms suggest possible involvement.</td>
<td>Varies</td>
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<td>FDG-PET/CT whole body</td>
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*Relative Radiation Level
Tumor Volume

Tumor volume correlates with pathologic stage, pathologic Gleason grade, margin status, and disease progression after radical prostatectomy.

Accurate assessment of tumor volume assists in selecting and targeting appropriate therapy.

Prostate Tumor Volume Measurement with Combined T2-weighted Imaging and Diffusion-weighted MR: Correlation with Pathologic Tumor Volume

**Purpose:**
To retrospectively determine the accuracy of diffusion-weighted (DW) magnetic resonance (MR) imaging for identifying cancer in the prostate peripheral zone (PZ) and to assess the accuracy of tumor volume measurements made with T2-weighted imaging and combined T2-weighted and DW MR imaging by using surgical pathologic examination as the reference standard.

**Materials and Methods:**
The institutional review board issued a waiver of informed consent for this HIPAA-compliant study. Forty-two patients underwent endorectal MR at 1.5 T before undergoing radical prostatectomy for prostate cancer and had at least one PZ tumor larger than 0.1 cm³ at radical pathologic examination.

**Figure 2:** Scatterplots of tumor volume measurements made on basis of MR images (T2-weighted and combined T2-weighted and DW MR images) versus histopathologic measurements. Tumor volume measured on (a) T2-weighted images and combined T2-weighted and DW MR images with ADC cutoff of (b) 0.0014 mm²/sec and (c) 0.0016 mm²/sec. Note 45° line, which corresponds to CCC value of 1.
Tumor Volume

Specimens may shrink and deform during processing.
Orientation of sectioning may differ from imaging.
Tumor margins often indistinct on MRI.
Active Surveillance: Role for MRI?

**The concern:** Many men thought to be appropriate for surveillance on initial biopsy...

1. are re-classified as moderate-high risk at their first or second surveillance biopsy or
2. have high risk disease that is missed on subsequent biopsy.

388 men with low risk PCa on initial biopsy underwent MRI followed by initial surveillance/confirmatory biopsy within 12 months: A negative MRI had a ≥ 95% specificity and ≥ 96% negative predictive value for ruling out Gleason upgrading, while a positive MRI was 87-98% sensitive for Gleason upgrading.

Prostate MRI: Surveillance

MRI might help triage patients to various treatment plans by identifying low risk patients that might be appropriate for surveillance protocols.

- TRUS-guided biopsy alone might miss high risk lesions. MRI can help target high risk lesions.
- MRI has a high negative predictive value for high risk disease.
- The imaging definition of low risk/high risk disease needs to be refined, particularly as imaging evolves and improves.
- Sometimes less is more!

Yerram et al. BJU Int 2012 (epub ahead of print)
Vargas et al. J Urol 2012 (epub ahead of print)
Gleason 4+5

T2  DWI  DCE

Triple match!
Conclusions

MRI has greatest utility for:

- Detection of clinically suspected prostate cancer after multiple negative biopsies.
- Staging of high risk patients.

MRI can directly or indirectly provide guidance for biopsy, although further study is needed to determine the preferred approach.

MRI will likely have a role in surveillance of lower risk patients in the near future.

MRI is not currently considered an appropriate first line screening modality.
Thank you