Prostate MRI: Ready for primetime?

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Outline

• Anatomy
• Basics of the sequences
• Need for rectal coil?
• Basics of reading prostate MRI
• Mimics of prostate cancer/Ddx
• PIRADS
• Reader certification?
Multi-parametric prostate MRI

• Most commonly diagnosed cancer in males
  • Second leading cause of cancer-related death in men

• Accurate assessment of the prostate cancer is essential to management

• Initial role of MRI: Locoregional staging in biopsy proven cancer

• New role MRI: Helpful in localization and staging
  • Good sensitivity, 75%
  • Good NPV for exclusion of prostate cancer, 68%-95%
Multi-parametric prostate MRI

### TABLE 3: Sensitivities and Positive Predictive Values (PPVs) of MRI Detection of All Tumors, Tumors ≥ 1 cm, Tumors With a Gleason Score of ≥ 7, Index Lesions, and Satellite Lesions

<table>
<thead>
<tr>
<th>MRI Detection of</th>
<th>Sensitivity</th>
<th>PPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>All tumors</td>
<td>132/285 (46.3)</td>
<td>132/177 (74.6)</td>
</tr>
<tr>
<td>Tumors ≥ 1 cm</td>
<td>107/154 (69.5)</td>
<td>107/152 (70.4)</td>
</tr>
<tr>
<td>Tumors with a Gleason score ≥ 3 + 4</td>
<td>96/132 (72.7)</td>
<td>96/141 (68.1)</td>
</tr>
<tr>
<td>Index lesions</td>
<td>98/122 (80.3)</td>
<td>98/98 (100.0)</td>
</tr>
<tr>
<td>Satellite lesions</td>
<td>34/163 (20.8)</td>
<td>34/79 (43.0)</td>
</tr>
</tbody>
</table>

Note—Data are presented as no. of tumors detected on MRI/total no. of tumors (%).
Prostate Anatomy
Our protocol: Multiparametric MR

- HASTE (axial, coronal, sagittal)
- High resolution T2 (axial, coronal, sagittal)
- Precontrast high resolution T1 axial VIBE
- Dynamic post contrast imaging
- Post contrast T1 VIBE (axial, coronal, sagittal)

***3T magnet is preferred for better signal to noise ratio***
Standard SS-ETSE T2w – HASTE
Diffusion Weighted Sequences
Dynamic contrast T1-weighted 3D-GE images (VIBE or TWIST) with high temporal resolution
- Temporal resolution is around 4-6 seconds.
- Spatial resolution is low and no fat-suppression is used.
- Total acquisition time is around 4-5 minutes.
- 70-80 datasets are acquired from the prostate and SV.
- Each dataset lasts 4-6 seconds.
Postgadolinium 3D-GE T1w Sequence
Need for a rectal coil?

YES – you need it

• Superior sensitivity
  • Particularly at 1.5 T

• Improves radiologists confidence for the detection of prostate cancer

No – you don’t

• Patient discomfort

• Can optimize sequences to improve sensitivity
  • Especially at 3T

• Can distort anatomy

• Increased cost
At UNC, we don’t use one...
Pre-procedural preparation:

- Enema??
  - Positive – clear out the rectum
  - Negative – Motion
- Evacuate rectum
- Refrain from ejaculation 3 days prior to MR
  - Greatest distention of the seminal vesicles
Prior biopsy?

- Wait 6 weeks to decrease changes from inflammation and hemorrhage

- Caveat: presence of hemorrhage is not likely to be substantially compromised secondary to hemorrhage
The Basics of Reading Prostate MR

- T2
- Diffusion weighted imaging
- Perfusion weighted imaging
The Basics of Reading Prostate MR

- T2
  - The most important sequence
  - Look for dark T2 signal

- Diffusion weighted imaging
- Perfusion
The Basics of Reading Prostate MR

- **T2** is the most important sequence
  - Look for dark T2 signal

- **Diffusion weighted imaging**
  - Dark on ADC
  - Bright on DWI
  - Higher b-values suppress the relatively T2-hyperintense prostate tissue
    - Compute these high b-values (1500-2000) as direct acquisition is complicated by low signal to noise ratios and severe eddy current distortions

- **Perfusion**
The Basics of Reading Prostate MR

• **T2** is the most important sequence
  • Look for dark T2 signal

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• **Perfusion**
  • Rapid enhancement and washout on dynamic contrast enhanced imaging

• **ALL 3 = Prostate cancer**
PIRADS 5 lesion
More specifics...

- ADC value correlates with prostate cancer Gleason score
  - The lower the ADC value = the higher the Gleason score
  - ADC value below 750-900 = more likely to be cancer

- If ADC map is normal in an untreated prostate, prostate cancer is unlikely (even if abnormal T2 signal)

- After radiation therapy, T2 may be limited (entire prostate is low on T2)
  - Rely more on ADC/DWI and perfusion DCE
Mimics of prostate cancer

- Chronic or granulomatous prostatitis
  - Low T2 signal intensity
  - May have mild diffusion restriction
  - NO MASS EFFECT OR CONTOUR DEFORMITY
  - DEGREE OF LOW T2 SIGNAL IS LESS THAN PROSTATE CANCER
    - It’s all about the level of gray
Which prostate cancers do we miss?

- Low Gleason score (6 or less)
- Organ-confined
- Small or very small in size (less than 10% volume)
- Satellite lesions
PIRADS 2

- Promotes standardization of reporting and communication between radiologists and urologists
- Provides assessment categories that summarize levels of suspicion or risk of significant prostate cancer
- Combines the findings on T2, DWI, DCE
# PIRADS 2

## Score  Transition Zone (TZ)

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Homogeneous intermediate signal intensity (normal)</td>
</tr>
<tr>
<td>2</td>
<td>Circumscribed hypointense or heterogeneous encapsulated nodule(s) (BPH)</td>
</tr>
<tr>
<td>3</td>
<td>Heterogeneous signal intensity with obscured margins Includes others that do not qualify as 2, 4, or 5</td>
</tr>
<tr>
<td>4</td>
<td>Lenticular or non-circumscribed, homogeneous, moderately hypointense, and ≤1.5 cm in greatest dimension</td>
</tr>
<tr>
<td>5</td>
<td>Same as 4, but ≥1.5 cm in greatest dimension or definite extraprostatic extension/invasive behavior</td>
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## Score  Peripheral Zone (PZ) or Transition Zone (TZ)

<table>
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<tr>
<td>1</td>
<td>No abnormality (i.e., normal) on ADC and high b-value DWI</td>
</tr>
<tr>
<td>2</td>
<td>Indistinct hypointense on ADC</td>
</tr>
<tr>
<td>3</td>
<td>Focal mildly/moderately hypointense on ADC and isointense/mildly hyperintense on high b-value DWI</td>
</tr>
<tr>
<td>4</td>
<td>Focal markedly hypointense on ADC and markedly hyperintense on high b-value DWI; ≤1.5 cm in greatest dimension</td>
</tr>
<tr>
<td>5</td>
<td>Same as 4 but ≥1.5 cm in greatest dimension or definite extraprostatic extension/invasive behavior</td>
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## PI-RADS Assessment for DCE

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<tr>
<td>1</td>
<td>Uniform hyperintense signal intensity (normal)</td>
</tr>
<tr>
<td>2</td>
<td>Linear or wedge-shaped hypointensity or diffuse mild hypointensity, usually indistinct margin</td>
</tr>
<tr>
<td>3</td>
<td>Heterogeneous signal intensity or non-circumscribed, rounded, moderate hypointensity Includes others that do not qualify as 2, 4, or 5</td>
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<tr>
<td>4</td>
<td>Circumscribed, homogenous moderate hypointense focus/mass confined to prostate and ≤1.5 cm in greatest dimension</td>
</tr>
<tr>
<td>5</td>
<td>Same as 4, but ≥1.5 cm in greatest dimension or definite extraprostatic extension/invasive behavior</td>
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### Score  Peripheral Zone (PZ) or Transition Zone (TZ)

- **(-)**: no early enhancement, or diffuse enhancement not corresponding to a focal finding on T2W and/or DWI or focal enhancement corresponding to a lesion demonstrating features of BPH on T2W
- **(+)**: focal, and; earlier than or contemporaneously with enhancement of adjacent
Can anyone read prostate MR?

• Right now, any board certified radiologist can read prostate MR

• Recent push towards certification
Conclusions

• Prostate MR has come a long way
• Good sensitivity and specificity for prostate cancer
• Not full proof
  • Still miss low grade prostate cancer
  • But these may not be as clinically relevant
  • Certain conditions can mimic prostate cancer
• Recent software allows for MRI fusion biopsy
So, is prostate MRI ready for primetime?
Yes!