ESUR prostate MR guidelines 2012

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1. Introduction
2. Acquisition
3. Technical issues
4. Interpretation/Reporting
5. Indications/Clinical relevance
6. Future perspectives
ESUR Prostate MR Guidelines 2011

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Multi-parametric MRI

- T2-Weighted Imaging: anatomy
- Diffusion Weighed Imaging: biology
- Dynamic Contrast enhanced: vascularity
- MR Spectroscopic Imaging: metabolic
PCa, prostatitis, hematoma, fibrosis: low SI
T2W

- High resolution: cornerstone of imaging
- Low specificity: should be used with
  - 2 functional techniques
    (DWI and/or DCE and/or MRSI)
- Post biopsy haemorrhage artefact:
  - In staging wait 4-6 weeks
  - In detection do not wait
DWI

- Essential component of mp-MRI
- High specificity: aggression
- Low SNR: low spatial resolution
- Susceptibility artifacts
DCE

- High sensitivity: detection
- Essential in "recurrence detection"
- Low specificity: false positives
- Limited standardization
- No standardized calibration & analysis
- Costs
MRSI

- Specificity especially in TZ
  - in PZ: DWI=MRSI
- Expertise is needed
- Time consuming
- Requires ERC
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Acquisition (minimal requirements)

Good, simple, fast

1. Detection  (30 minutes)
2. Staging    (40 minutes)
3. Bone and Nodes  (30 minutes)
Detection

- No ERC, Buscopan/Glucagon
- 2x T2W. ax + sag. (4/3 x 1/.5 x 1/.5): 9’
- DWI ax (b 0/50, 100, ≥800, ADC): 18’
- DCE ax: GRE, time res. <15 sec 30’
- T1-axial: local hematoma (with DCE)
Staging

- ERC, Buscopan/Glucagon 10’
- 3x T2-W. (3 x .3/.7 x .3/.7): 20’
- DWI ax (b 0/50, 100, 800, ADC): 30’
- DCE: GRE, axial, time res. 2-15 sec 40’
- (MRSI) 50’
Node and bone

Recurrence, or PSA>15, GI>7, DRE T3

- 3D T1-WI tSE (.9x.9x.9) 6’
- DWI cor (b 50, 800, ADC): 14’
- C-T-L spine: sag. T1WI and STIR 30’

or better: protocol presented by Padhani
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Technique: MR-coils
“a continuing debate”

- ERC+PPA: state-of-the-art for staging
- Not needed for detection (esp. at 3T)
- Costs time, money, acceptance

Further considerations:
- is knowledge of minimal ECE needed?
- perform comparative studies
Technique: 3T
“Still a research topic”

- High SNR:
  - no ERC, improved DWI, MRSI
- Susceptibility artifacts (esp DWI)
- SAR
- (Shorter T2-RT, longer T1-RT)
- (Inhomogeneity of magnetic field)
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Interpretation / Reporting

PI-RADS
5 point scale: probability of significant PCa
## PI-RADS Classification System

### Score T2W

<table>
<thead>
<tr>
<th>Score T2W</th>
<th>Criteria PZ and TZ separate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>In PZ: uniform high signal intensity; In TZ: heterogeneous transitional zone adenoma with well-defined margins: “organised chaos”</td>
</tr>
<tr>
<td>2</td>
<td>In PZ: linear or geographic areas of lower SI in TZ: areas of more homogeneous low SI, however well marginated</td>
</tr>
<tr>
<td>3</td>
<td>Intermediate appearances not in categories 1/2 or 4/5</td>
</tr>
<tr>
<td>4</td>
<td>In PZ: discrete, homogenous low signal focus/mass confined to the prostate In TZ: ill defined areas of more homogeneous low SI: “erased charcoal sign”</td>
</tr>
<tr>
<td>5</td>
<td>In PZ: discrete, homogeneous low signal intensity focus with extra-capsular extension / invasive behaviour or mass effect on the capsule (bulging), or broad contact (&gt;1.5 cm) with capsule In TZ: same as 4 but involving the AFM or anterior horn of the PZ, usually lenticular or water-drop shape</td>
</tr>
</tbody>
</table>

### Score DWI

<table>
<thead>
<tr>
<th>Score DWI</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No reduction in ADC compared to normal glandular tissue. No increase in signal on any high b-value image (&gt;b800)</td>
</tr>
<tr>
<td>2</td>
<td>Diffuse, hyper intensity on &gt;b800 image with low ADC; No focal features - linear, triangular or geographical features allowed</td>
</tr>
<tr>
<td>3</td>
<td>Intermediate appearances not in categories 1/2 or 4/5</td>
</tr>
<tr>
<td>4</td>
<td>Focal area(s) of reduced ADC (&gt;900-1000) but iso-intense signal intensity on high b-value images (&gt;b 800)</td>
</tr>
<tr>
<td>5</td>
<td>Focal area/mass of hyper intensity on the high b-value images (&gt;b 800) with reduced ADC (&gt;900-1000)</td>
</tr>
</tbody>
</table>

### Score DCE

<table>
<thead>
<tr>
<th>Score DCE</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Type 1 enhancement curve</td>
</tr>
<tr>
<td>2</td>
<td>Type 2 enhancement curve</td>
</tr>
<tr>
<td>3</td>
<td>Type 3 enhancement curve</td>
</tr>
<tr>
<td>+1</td>
<td>For focal enhancing lesion with curve type 2 or 3</td>
</tr>
<tr>
<td>+1</td>
<td>For asymmetric lesion or lesion at an unusual place with curve shape 2 or 3</td>
</tr>
</tbody>
</table>

### Score MRSI

<table>
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<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Citrate peak exceeds choline peak &gt;2 times</td>
</tr>
<tr>
<td>2</td>
<td>Citrate peak exceeds choline peak &gt;1-2 times</td>
</tr>
<tr>
<td>3</td>
<td>Choline peak equals citrate peak</td>
</tr>
<tr>
<td>4</td>
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## PI-RADS: T2WI PZ

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<tbody>
<tr>
<td>1</td>
<td>Uniform high SI</td>
</tr>
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<td>2</td>
<td>Linear, wedge shaped or geographic areas of lower SI, usually not well demarcated</td>
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<td>Intermediate appearances not in categories 1/2 or 4/5</td>
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<td>Discrete, homogenous low SI focus/mass confined to the prostate</td>
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<td>Discrete, homogeneous low SI focus with ECE/invasive behaviour, or mass effect on capsule (bulging), or broad contact with capsule (&gt;1.5 cm)</td>
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T2W: PZ
# PI-RADS: T2WI TZ

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<th>Score T2W TZ</th>
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<tr>
<td>1</td>
<td>Heterogeneous TZ adenoma with well-defined margins: “organized chaos”</td>
</tr>
<tr>
<td>2</td>
<td>Areas of more homogeneous low SI, however well marginated, originating from the TZ/BPH</td>
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<td>4</td>
<td>Areas of more homogeneous low SI, ill defined: “erased charcoal drawing sign”</td>
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<td>5</td>
<td>Same as 4, but involving the anterior fibromuscular stroma or the anterior horn of the PZ, usually lenticular or water-drop shaped.</td>
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PI-RADS: T2WI TZ
Pi-RADS: T2WI TZ

BPH: organised chaos

“Erased Charcoal drawing sign”

Homogeneous low SI
## PI-RADS: DWI

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<td>1</td>
<td><strong>No reduction</strong> in ADC compared to normal glandular tissue. <strong>No increase</strong> in SI on any high b-value images (≥b 800)</td>
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<td>5</td>
<td><strong>Focal area/mass of hyper SI</strong> on the high b-value images with <strong>reduced ADC</strong> (&lt;900-1000)</td>
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PI-RADS: DWI
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# PI-RADS: DCE

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PI-RADS: DCE
Interpretation / Reporting

PI-RADS

Not the sum-score

But the dominant technique determines presence of significant cancer
PSA 6.8 2x neg TRUS Bx

PI-RADS 4-5-5
Interpretation / Reporting

PI-RADS dominant technique:

TZ: T2W

PZ: DWI

Recurrence: DCE
Sum score: 4 + 3 + 2 = 9
Sum score: 2 + 5 + 5 = 12
Post Rth
Extra Capsular Extension (T3a)

Also 5 point score?

1. Abutment
2. Irregularity & NVB thickening
3. Bulge, loss of capsule & capsular enhancement, obliteration recto prostatic angle
4. Measurable extra-capsular disease
ECE
Seminal Vesicle Invasion

Also 5 point scale?

1. Expansion
2. Low SI on T2WI
3. Filling in of angle
5. Restricted diffusion and enhancement in low SI area
Indications

First presentation
TRUS-biopsy
(10-14 cores)

Biopsy positive
# of cores
% of each core positive

Biopsy negative
Clinical follow up
Re-measure PSA

Curative intent
Patient factors: life expectancy, co-morbidities, preference

Active surveillance

Biopsy negative and clinical suspicion PCa

Staging MRI with bone and node MRI in high risk (PSA>15 or Gleason>7, or DRE T3)

Staging MRI to confirm grade and extent T2WI, DWI, DCE, (MRSI)

Detection MRI and then biopsy (TRUS guided by MRI or MR-guided biopsy in some specialist units)
How to be a "winner"

Take an "easy case", in which you will certainly make a success:

- many neg. TRUS-Bx and high PSA (>25), than look for anterior or apex tumor.
Limitations of TRUS-Bx

- Significant cancers are missed
- Insignificant cancers are detected by chance
- High percentage undergrading (46%)
1. Mp-MRI predicts tumor aggression

2. Mp-MRI predicts low vs intermediate/high grade correct in 95%, TRUS in only 54%

3. After neg. TRUS-Bx, mp-MR-Bx is positive in 41%, with 87% significant cancers

4. Standardization guidelines (PI-RADS) are published and will be implemented (ACR)
Patient 62 y, PSA 28
8x neg. TRUS Bx (96 cores)
Patient 62y: Your diagnosis?
MR-guided Bx

Gleason score 4+3
<table>
<thead>
<tr>
<th>Author</th>
<th>No. of patients</th>
<th>Detection rate</th>
<th>Min. previous negative TRUS bx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beyersdorf</td>
<td>12</td>
<td>42</td>
<td>1</td>
</tr>
<tr>
<td>Engelhard</td>
<td>37</td>
<td>37</td>
<td>1</td>
</tr>
<tr>
<td>Anastadiasis</td>
<td>27</td>
<td>56</td>
<td>1</td>
</tr>
<tr>
<td>Hambrock</td>
<td>71</td>
<td>59 (93)</td>
<td>2</td>
</tr>
<tr>
<td>Franiel</td>
<td>54</td>
<td>39</td>
<td>1</td>
</tr>
<tr>
<td>Roethe</td>
<td>100</td>
<td>52 (81)</td>
<td>1</td>
</tr>
<tr>
<td>Hoeks*</td>
<td>438 (256)</td>
<td>41 (86)</td>
<td>1</td>
</tr>
</tbody>
</table>
Why Multi-parametric MRI?

**TAKE HOME MESSAGE**

Advances in Magnetic Resonance Imaging: How They Are Changing the Management of Prostate Cancer

A. Sciarra, J. Barentsz, A. Bjartell, J. Eastham, H. Hricak, V. Panebianco, J.A. Witjes

Published data underline an emerging role for multiparametric magnetic resonance imaging (MRI), in particular with the combination of T2-weighted imaging, magnetic resonance spectroscopic imaging, diffusion-weighted imaging, and dynamic contrast-enhanced MRI, as the most sensitive and specific tool available for imaging prostate cancer.

Sciarrara et al Eur Urol 2011
ESUR Prostate MR Guidelines 2011

Questions?

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