Diagnostic accuracy of biparametric vs multiparametric MRI in prostate cancer local staging

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Aims and objectives

MRI diagnostic performance in detection of prostate cancer is widely demonstrated although MR in local staging is still debated.

Our aim was to compare the performance of biparametric (T2WI+DWI) and multiparametric MRI (T2WI+DWI+DCE) in prostate cancer local staging.
Methods and materials

Fifty-seven patients with pre-operative MR were retrospectively evaluated. Patients were enrolled by using the following inclusion criteria: (a) pre-operative multiparametric MRI (T2WI+DWI+DCE); (b) pre-operative MRI performed at least three weeks after prostate biopsy; (c) radical prostatectomy within maximum of 6 months after MR study.

All imaging studies were performed with a 1.5 Tesla MR scanner (Achieva, version 2.6; Philips Medical Systems, DA Best, Olanda) with a Torso Cardiac phased array 32 channels coil. No endorectal coil were used.

An intramuscular injection of 20 mg of Hyoscine butylbromide (Buscopan; Boehringer Ingelheim, Ingelheim, Germany) was given for suppression of motion artifacts.

The MR imaging protocol included T2-weighted turbo spin-echo in three orthogonal planes, diffusion weighted images (DWI) by using two-dimensional echo-planar imaging with two $b$ values (0 and 1500 sec/mm2) and relative apparent diffusion coefficient (ADC) map and perfusional study (dynamic contrast enhanced - DCE) with 8 seconds temporal resolution after bolus intravenous injection of 0.2 mmol/kg of gadobenate dimeglumine (Multihance, Bracco) followed by a 20-mL flush of normal saline, both injected at a rate of 3 mL/s by Spectris Solaris MRI injection system (Medrad).

The MR acquisition parameters are summarized in Table 1.

<table>
<thead>
<tr>
<th>Sequence</th>
<th>Technique</th>
<th>Repetition Time (ms)</th>
<th>Echo Time (ms)</th>
<th>Flip Angle</th>
<th>Slice Thickness (mm)</th>
<th>Field of View (mm)</th>
<th>Matrix</th>
<th>Parallel Signal Imaging Averages</th>
<th>Signal-to-noise Factor</th>
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<tbody>
<tr>
<td>T2w sagittal</td>
<td>TSE</td>
<td>5200</td>
<td>100</td>
<td>90</td>
<td>3</td>
<td>180 x 180 x 86</td>
<td>256 x 204</td>
<td>3</td>
<td></td>
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<tr>
<td>T2w axial</td>
<td>TSE</td>
<td>4157</td>
<td>100</td>
<td>90</td>
<td>3</td>
<td>180 x 180</td>
<td>256 x 198</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>T2w coronal</td>
<td>TSE</td>
<td>4600</td>
<td>100</td>
<td>90</td>
<td>3</td>
<td>180 x 180 x 66</td>
<td>256 x 198</td>
<td>4</td>
<td></td>
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<tr>
<td>Diffusion Single-Shot echo-planar</td>
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</table>
Tab. 1: MR imaging parameters used in the current study

Five radiology residents with intermediate (6-8 months) experience independently blind reviewed the images obtained with biparametric MRI (T2WI+DWI) and, after 4 weeks, those with multiparametric MRI (T2WI+DWI+DCE) and assigned scores on a five-point scale according with the Prostate Imaging Reporting and Data System version 2 (PI-RADS v2) (1).

The gold standard was the histological examination evaluated by pathologist according with the 2014 consensus conference ISUP protocol (2) and report by Ball MW et al. (3), considering three groups: focal extraprostatic extension (F-EPE, pT3a), defined as a few neoplastic glands outside the prostate on 1-2 slides, nonfocal extraprostatic extension (NF-EPE, pT3b), reported as a greater extent of EPE, and seminal vesicles invasion (SV invasion, pT3c).
Results

The inter-observer agreement was good (#=0.71±0.15). There were no statistically significant differences between biparametric and multiparametric MRI in the performance of MR in local staging.

Sensitivity of biparametric and multiparametric MRI for F-EPE was respectively 65.4% and 55.8% (p=0.32); specificity was 87.8% and 91.1% (p=0.47); positive predictive value (PPV) was 75.6% and 78.4% (p=0.76); negative predictive value (NPV) was 81.4% and 78.1% (p=0.55); accuracy was 79.6% and 78.2% (p=0.77).

The diagnostic parameters of F-EPE are summarized in Table 2 and Figure 1.

<table>
<thead>
<tr>
<th></th>
<th>Biparametric</th>
<th>Multiparametric</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>65.4%</td>
<td>55.8%</td>
<td>0.32</td>
</tr>
<tr>
<td>Specificity</td>
<td>87.8%</td>
<td>91.1%</td>
<td>0.47</td>
</tr>
<tr>
<td>PPV</td>
<td>75.6%</td>
<td>78.4%</td>
<td>0.76</td>
</tr>
<tr>
<td>NPV</td>
<td>81.4%</td>
<td>78.1%</td>
<td>0.55</td>
</tr>
<tr>
<td>Accuracy</td>
<td>79.6%</td>
<td>78.2%</td>
<td>0.77</td>
</tr>
</tbody>
</table>

Tab. 2: diagnostic parameters of F-EPE in biparametric and multiparametric MRI

The same analysis was performed for NF-EPE (sensitivity 87.5% and 81.3%, p=0.99; specificity 75% and 80.6%, p=0.28; PPV 31.1% and 35.1%, p=0.70; NPV 97.9% and 97.1%, p=0.99; accuracy 75.4% and 79.6%, p=0.34) and SV invasion (sensitivity 40% and 30%, p=0.99; specificity 97% and 97.7%, p=0.99; PPV 50% and 50%, p=1; NPV 95.5% and 94.9%, p=1; accuracy 93% and 93%, p=1), with no statistically differences between the two protocols.

The diagnostic parameters of NF-EPE and SV are summarized in Table 3-4 and Figure 2-3.
Sensitivity | 87,5% | 81,3% | 0,99  
Specificity | 75,0% | 80,6% | 0,28  
PPV | 31,1% | 35,1% | 0,70  
NPV | 97,9% | 97,1% | 0,99  
Accuracy | 75,4% | 79,6% | 0,34

Tab. 3: diagnostic parameters of NF-EPE in biparametric and multiparametric MRI

<table>
<thead>
<tr>
<th></th>
<th>Biparametric</th>
<th>Multiparametric</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seminal vescicles invasion (SV)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensitivity</td>
<td>40,0%</td>
<td>30,0%</td>
<td>0,99</td>
</tr>
<tr>
<td>Specificity</td>
<td>97,0%</td>
<td>97,7%</td>
<td>0,99</td>
</tr>
<tr>
<td>PPV</td>
<td>50,0%</td>
<td>50,0%</td>
<td>1</td>
</tr>
<tr>
<td>NPV</td>
<td>95,5%</td>
<td>94,9%</td>
<td>1</td>
</tr>
<tr>
<td>Accuracy</td>
<td>93,0%</td>
<td>93,0%</td>
<td>1</td>
</tr>
</tbody>
</table>

Tab. 4: diagnostic parameters of SV in biparametric and multiparametric MRI
Fig. 1: Diagnostic parameters of F-EPE in biparametric and multiparametric MRI

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**Fig. 2:** Diagnostic parameters of NF-EPE in biparametric and multiparametric MRI

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![Seminal vescicles invasion](image1.png)

**Fig. 3:** Diagnostic parameters of SV in biparametric and multiparametric MRI

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![MRI images](image2.png)

**Fig. 4:** Patient with a focal lesion of 16 mm maximal extension at the mid-level in the left posterior peripheral zone with hypointense signal in T2W images and extraprostatic extension, hyperintense signal on high b-value DW images and positive DCE-MRI
showing a focal well defined contrast enhancement. DWI also show signal hyperintensity of left neurovascular bundle which cannot be noticed in DCE images.

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**Fig. 5:** Patient with a focal lesion of 9 mm maximal extension at the mid-level in the left posterior peripheral zone with hypointense signal in T2W images, hyperintense signal on high b-value DW images and positive DCE-MRI showing a focal well defined contrast enhancement. No evidence of images related to extracapsular tumour extension.

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Conclusion

In our study multiparametric prostate MRI did not increase the accuracy of capsular invasion and extracapsular tumor extension compared to biparametric analysis.

Prostate cancer MR local staging accuracy is higher for extensive "non-focal" extracapsular tumor extension than for limited "focal" capsular invasion and seminal vesicles involvement.
References


2. The 2014 International Society of Urological Pathology (ISUP) Consensus Conference on Gleason Grading of Prostatic Carcinoma Definition of Grading Patterns and Proposal for a New Grading System Jonathan I. Epstein, MD, *Lars Egevad, MD, PhD,w Mahul B. Amin, MD,z Brett Delahunt, MD,y John R. Srigley, MD,8 Peter A. Humphrey, MD, PhD,z and the Grading Committee