Comparison between multiparametric and biparametric MRI protocols for Prostate Cancer detection: a more efficient diagnostic protocol and a viable path toward screening?

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Aims and objectives

Prostate cancer (PCa) is the most frequent cancer in men in Western World [1]. Despite its low mortality, it has high prevalence with an increased incidence in the last years. This epidemiological trend relies in the more and more diffuse use of PSA, although this biomarker has only moderate accuracy [2]. Today, the potential of Magnetic Resonance Imaging (MRI) is well known: it plays an essential role in diagnosis, staging and treatment planning of prostate cancer. However, important drawbacks of this imaging technique relies in high acquisition time and elevated costs that must face a so high prevalence disease [3]. Considering the multiparametric protocol for the diagnosis of Prostate Cancer, many studies indicated the leading role of Diffusion Weighted Imaging (DWI) in tumour detection and aggressiveness assessment, especially in Peripheral Zone (PZ) [4]. Basing on this, the purpose of our study is to evaluate diagnostic performance of biparametric Magnetic Resonance (bp-MR) protocol, considered as the combination of T2 Weighted Imaging (T2WI), Diffusion Weighted Imaging (DWI) and pre-contrast T1 Weighted Imaging (T1WI), compared to multiparametric (mp-MR) protocol which includes Dynamic Contrast-Enhanced imaging (DCE-MRI) for Prostate Cancer (PCa) detection. Fig. 1 on page 3
**Fig. 1:** Multiparametric and Biparametric protocols.

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Methods and materials

Patient selection

84 patients suspected to have PCa on the basis of clinical or laboratory data were enrolled in this retrospective study. The median age of the patients was 69.4 (64.2-72.3) and the median serum PSA level was 8.7 ng/ml. Fig. 2 on page 6

All recruited patients underwent a mp-MRI and a TRUS-biopsy was performed with a time gap not exceeding 2 months or within at last 6 weeks before mp-MRI. No one of the enrolled patients had a MRI/TRUS-fusion biopsy.

Patients under pharmacological treatment for Benign Prostate Hypertrophy (BPH) with 5-alpha reductase inhibitors (Finasterid or Dutasterid) and #1-blockers (Tamsulosin) and patients under treatment for cardiovascular disease were excluded, since these drugs can affect DWI and DCE-MRI, influencing PiRADS assessment. They were also excluded if the images were not satisfactory (multiple artifacts from, for example, total hip replacements, patient movements).

Acquisition Protocol

Each patient underwent mp-MRI on a 3T MRI scanner (Signa EXCITE®HDxT, GE, Milwaukee, USA) according to Prostate Imaging and Reported Data System Version 2 (Pi-RADS v2) guidelines of 2015 [5] with a pelvic coil (Phased Array, 8 channels). To suppress peristalsis of the bowels, intravenous injection of hyoscine butylbromide (Buscopan®, 20 mg, Boehringer, Taiwan) was administered immediately before the examination started.

All patients underwent para-axial T2-WI (Fast Recovery Fast Spin Echo-XL 90) parallel to the short axis of prostate and sagittal and paracoronal T2-WI parallel to the long axis. The diffusion study was then performed by acquiring a single-shot echoplanar imaging sequence (DWI EPI) using two different b values (0, 1000) in a single acquisition. T1 Spoiled Gradient Echo was acquired before and after contrast administration.

Bolus injection of Gd-DTPA (Prohance® 279.3 mg/ml, flac. 15 ml i.v., Bracco, Italy) was performed by a power injector (Medrad®) with an injection rate of 4 ml/sec. followed by a 20 ml flush with saline. Fig. 3 on page 6

Image analysis

Image interpretation was carried out separately by a specialized radiologist (R1) and resident (R2), with respectively 14 years and 3 years of experience in prostate MR
imaging. They were blinded to clinical data (digital rectal exploration: DRE), biological (PSA) and pathological (biopsy and eventual radical prostatectomy specimens) results.

They examined all images, in a first time, using the biparametric protocol (bp-MR) and, 2 months later, using the entire multiparametric protocol (mp-MR).

For each reports they specified Pi-RADS Score and the location of suspicious area by subdividing the glands according to Rothke Classification (27 areas) to allow precise correlation between MRI imaging and histology. Fig. 4 on page 7 Fig. 5 on page 7 Fig. 6 on page 8

**Histological Evaluation**

All sample obtained at biopsy were fixed in paraffin and stained with Ematoxylin-Eosin (EE). Each lesion was graded according to the Gleason Score System. Only 7 patients, after TRUS-biopsy, underwent Radical Prostatectomy and surgical specimens obtained were processed: gross histological sections were fixed in paraffin, stained with EE and then evaluated according to modified Gleason Score System.

**Measurements and Statistical Analysis**

Data from mp-MRI were matched with the prostate biopsy, which was considered as the standard of reference. Only if available, RP was considered. Each pathological sample was matched to a corresponding MR image on the basis of the location. Receiver Operating Characteristic (ROC) curves and the corresponding Area Under the Curve ROCs (AUC) were estimated non-parametrically to evaluate the ability of each imaging protocol for the detection of prostate cancer. These Az values were compared using a pairwise comparison of ROC curves. Sensitivity, Specificity, Positive Predictive Value (PPV), Negative Predictive Value (NPV) and Accuracy for imaging protocols were calculated. A *p* value of 0.05 or less was considered to indicate statistically significant difference between the three protocols. Statistical Analysis was performed using MedCalc® software, version 13.0.6.
<table>
<thead>
<tr>
<th>Pts. Number</th>
<th>84</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (mean)</td>
<td>69,4 years</td>
</tr>
<tr>
<td>PSA (mean)</td>
<td>8,7 ng/ml</td>
</tr>
<tr>
<td>Foci of PCa</td>
<td>68 foci/53 pts</td>
</tr>
<tr>
<td>- PZ</td>
<td>58</td>
</tr>
<tr>
<td>- TZ</td>
<td>10</td>
</tr>
<tr>
<td>- Diameter (mean)</td>
<td>1,4 cm</td>
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</tbody>
</table>

**Fig. 2:** Clinical-pathologic features in the study population.

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<table>
<thead>
<tr>
<th>SEQUENCE</th>
<th>TR (ms)</th>
<th>TE (ms)</th>
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<th>NEX</th>
<th>MATRIX</th>
<th>b VALUE</th>
<th>THICKNESS</th>
<th>TIME (sec)</th>
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<td>5020</td>
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<td>3 mm</td>
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<td>70</td>
<td>36X24</td>
<td>6</td>
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<tr>
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<td>352X256</td>
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</tr>
<tr>
<td>FRFSE XL 90 COR</td>
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<td>32X32</td>
<td>2</td>
<td>512X512</td>
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<tr>
<td>T1 GRE SPGR</td>
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<td>2.1</td>
<td>32X32</td>
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<td>256X256</td>
<td></td>
<td>3 mm</td>
<td>10”x30 ripetizioni</td>
<td>26</td>
</tr>
</tbody>
</table>

**Fig. 3:** Acquisition protocol.
Fig. 4: Prostate gland areas.

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Fig. 5: PI-RADS v2

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PI-RADS 1 – Very low (clinically significant cancer is highly unlikely to be present)
PI-RADS 2 – Low (clinically significant cancer is unlikely to be present)
PI-RADS 3 – Intermediate (the presence of clinically significant cancer is equivocal)
PI-RADS 4 – High (clinically significant cancer is likely to be present)
PI-RADS 5 – Very high (clinically significant cancer is highly likely to be present)
Fig. 6: PiRADS v2

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Results

Using biparametric MR protocol R1 showed sensitivity of 91%, specificity of 56%, NPV of 53%, PPV of 92% and accuracy of 85%; R2 showed sensitivity of 90%, specificity of 47%, NPV of 53%, PPV of 89% and accuracy of 82%.

Using multiparametric MR protocol R1 showed sensitivity of 90%, specificity of 53%, NPV of 53%, PPV of 90% and accuracy of 84%; R2 showed sensitivity of 92%, specificity of 50%, NPV of 65%, PPV of 89% and accuracy of 83%.

All data are showed in Fig. 7 on page 11.

ROC analysis showed no significant difference between bp-MRI and mp-MRI protocol for both readers \( P_{R1}=0,3475 \) e \( P_{R2}=0,7915 \). Fig. 8 on page 11
<table>
<thead>
<tr>
<th></th>
<th>R1</th>
<th></th>
<th>R2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>bp-MRI</td>
<td>mp-MRI</td>
<td>bp-MRI</td>
</tr>
<tr>
<td>SENS</td>
<td>90%</td>
<td>91%</td>
<td>92%</td>
<td>90%</td>
</tr>
<tr>
<td>SPEC</td>
<td>53%</td>
<td>56%</td>
<td>50%</td>
<td>47%</td>
</tr>
<tr>
<td>PPV</td>
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<td>92%</td>
<td>87%</td>
<td>89%</td>
</tr>
<tr>
<td>NPV</td>
<td>53%</td>
<td>53%</td>
<td>65%</td>
<td>53%</td>
</tr>
<tr>
<td>ACC</td>
<td>84%</td>
<td>85%</td>
<td>83%</td>
<td>82%</td>
</tr>
</tbody>
</table>

**Fig. 7:** Statistical data

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![ROC curves](image)

\[ p=0.3475 \]

**Fig. 8:** ROC curves analysis.

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Conclusion

Our study underlines the feasibility of performing biparametric protocol for PCa detection, without significant lack of diagnostic efficacy compared to mp-MR.

Omitting DCE is possible to reduce acquisition time, passing from 45 minutes of multiparametric protocol to 30 minutes of biparametric protocol. In this way MRI would be faster, making this imaging modality suitable for the high prevalence of PCa and facing the growing demand. Moreover, MRI would be cheaper and risk free for patients, reducing adverse reactions.

However, considering our study, we must keep in mind that in the considered population, in most cases, tumours were located in PZ, and many efforts should concentrate on diagnostic performance of bp-MRI for PCa located in TZ. Another limit of this study lies in the fact that it was a retrospective study and population consisted mainly of patients with previous positive biopsy. Consequently, the high prevalence affect NPV and PPV, not allowing to define bp-MRI suitable for a screening program.

In conclusion, this study has shown advantages of performing bp-MRI without effective loss in detecting PCa, but prospective study on a much larger scale is needed before it can be considered as a new standard procedure.
References

1. National Institutes of Health. Prostate Cancer. 2012 National Institutes of Health: Bethesda, MD
3. Penzkofer T, Tempany-Afdhal CM. Prostate cancer detection and diagnosis: the role of MR and its comparison with other diagnostic modalities - a radiologist’s perspective. NMR in biomedicine 2013. DOI: 10.1002/nbm.3002