A review of evidence comparing bi-parametric MRI (bpMRI) to multi-parametric MRI (mpMRI)

Studies ranging from 2015 to 2019

Paper	**Greer et al 2017 Validation of the dominant sequence paradigm and role of dynamic contrast enhanced imaging in PI-RADS version 2**
Level of evidence	Level 2b (retrospective cohort single centre study)
Summary	Number of patients = 163 Treatment naïve patients scanned using MR imaging, lesions detected with PI-RADS V2 and compared to whole-mount prostatectomy findings. Probabilities of cancer detection were calculated in peripheral zone (PZ) and transition zone (TZ). 9 radiologists , 58 patients on average. Level of evidence: Level 2b (retrospective cohort single centre study)
Diagnostic Accuracy	Lesions classified as PI-RADS category 3 at DW MR imaging and as positive at DCE imaging in the PZ showed a higher probability of cancer detection than did DCE-negative PI-RADS category 3 lesions (67.8% vs 40.0%, P = .02). Addition of DCE imaging to DW imaging in the PZ was beneficial (OR, 2.0; P = .027), with an increase in the probability of cancer detection of 15.7%, 16.0%, and 9.2% for PI-RADS category 2, 3, and 4 lesions, respectively.

Limitations	Prospective study, study relied on patients undergoing radical prostatectomy, so younger patients and higher than general population, single centre study.
Conclusions	Value of DCE in adding significant benefit to PI-RADS prostate imagining and reporting and data system category 3 and 4 lesions in the PZ (peripheral zone). Rather than suggesting DCE dynamic contrast enhanced should be eliminated, these data suggest DCE dynamic contrast enhanced should be expanded to other PI-RADS Prostate Imaging Reporting and Data System scores to stratify risk more accurately.
Paper	**Stanzione et al 2016 Biparametric 3T Magnetic Resonance Imaging for prostatic cancer detection in a biopsy-naïve patient population: a further improvement of PI-RADS v2?**
Level of evidence	Level 1b (Prospective cohort study)
Summary	82 untreated patients (mean age 65+/- 7.6 years), biopsy naïve population with clinical suspicion of prostate cancer MRI scans, radiologist reviewed scans, with an interval between 20 and 30 days, both blinded to the clinical indication and to the PSA values. PI-RADS v2 criteria was used. Gold standard comparison considered to be 12-core biopsy.
Diagnostic Accuracy	bpMRI: overall diagnostic accuracy 92.7%, sensitivity 85.3%, specificity 98.1% for PZ, overall diagnostic accuracy of 92.2%, sensitivity 82.8%, specificity 97.9% mpMRI: overall diagnostic accuracy 93.9%, sensitivity 91.1%, specificity 96.2% for PZ, 93.5%, sensitivity 89.7%, specificity 95.8% Diagnostic accuracy using bpMRI and mpMRI was the same for TZ.
Limitations	Small numbers of patients included in the study 3T MRI scanner used, which is not in widespread clinical practice Value of 12-core biopsy as gold standard
Conclusions	MP-MRI showed a slight, but not significantly better performance when identifying true positives
Paper	**Jambor et al 2015: prebiopsy multiparametric 3T prostate MRI in patients with elevated PSA, Normal Digital Rectal Examination and no previous biopsy**

Level of evidence	Level 1b (prospective cohort study)
Summary	Between April 2011 and March 2013, 41 patients at institution A and 14 patients at institution B underwent 3T prostate mpMRI examination followed by 12-core biopsy – with detection undertaken via DCE and non-DCE sequences
Diagnostic Accuracy	bpMRI: sensitivity 61%, specificity 96%, accuracy 87% mpMRI: sensitivity 72%, specificity 89%, accuracy 85%
Limitations	Small study: 55 patients 3T MRI scanner used, which is not in widespread clinical practice
Conclusions	The use of T2W +DWI appears sufficient for the initial prostate cancer detection and biopsy targeting in this patient population.

Paper	**Kuhl et al 2017 Abbreviated Biparametric prostate MR Imaging in men with elevated prostate-specific antigen**
Level of evidence	Level 2b (retrospective study on prospectively acquired data)
Summary	236 patients, who underwent mpMRI of the prostate because of tumor suspicion, were included in this retrospective study.
Diagnostic Accuracy	Diagnostic accuracy for detection of clinically significant cancer of biparametric MR imaging (89.1%, 483 of 542) was similar to that of full multiparametric contrast-enhanced MR imaging (87.2%, 473 of 542). Between-reader agreement of biparametric MR imaging interpretation was substantial ($\kappa = 0.81$).
Limitations	Single centre study Retrospective study, unblinded
Conclusions	bpMRI allows detection of clinically significant prostate cancer missed by transrectal US-guided biopsy. bpMRI offers diagnostic accuracy and cancer detection rates equivalent to those of mpMRI.

Paper	**Junker et al 2019 Comparison of multiparametric and biparametric MRI of the prostate: are gadolium-based contrast agents needed for routine examinations?**
Level of evidence	Level 2b (Retrospective cohort study)

Summary	236 patients, who underwent mpMRI of the prostate because of tumor suspicion, were included in this retrospective study. Histopathological analysis available in 208 of the patients. Image interpretation carried out by one radiologist, with and without DCE sequence.
Diagnostic Accuracy	Of 135 PCas, 127 (94.07%) were scored identically. Only eight (5.93%) PCa lesions were downgraded from PI-RADS 4 to PI-RADS 3 when omitting DCE from PI-RADS v2 If a rating of PI-RADS 3-5 is considered positive for tumor suspicion, the biparametric approach without DCE showed a sensitivity of 98.5% and a specifcity of 38.6%, PIRADS v2 showed a sensitivity of 98.5% and a specifcity of 44.6% and PI-RADS v1 showed a sensitivity of 100% and a specifcity of 43.6%. BpMRI led to 62 (61.4%) false-positive fndings, PI-RADS v2–56 (55.4%) false-positive fndings and PI-RADS v1–57 (56.4%) false-positive findings. It is noticeable that more changes in tumor detection were observed between PI-RADS v1 and v2, than between PI-RADS v2 with DCE and PI-RADS v2 without DCE. Only PI-RADS v1 did not show any PCa in PI-RADS score levels<3.
Limitations	Retrospective study, Patients with a PI-RADS score of 2 and 1 are underrepresented in this study, as they usually neither received a histologic work up nor a follow-up MRI Only one radiologist reviewed images
Conclusions	DCE did not lead to significant differences in diagnostic accuracy or tumour detection rates when using the PI-RADS 2 scoring system. More changes in tumour detection were observed between PI-RAD v1 and PI-RADS V2.
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Paper	**Alabousi et al 2019 biparametric vs multiparametric prostate magnetic resonance imaging for the detection of prostate cancer in treatment-naïve patients: a diagnostic test accuracy systematic review and meta-analysis**
Level of evidence	Level 1a (meta-analysis)
Summary	Meta-analysis looking at articles published after 1 January 2012. Included 25 studies reporting on mpMRI and 12 studies reporting on bpMRI, six studies directly compared mpMRI and bpMRI.

| Diagnostic Accuracy | sensitivity: mpMRI: 86%, 95% confidence interval [CI] 81–90; bpMRI: 90%, 95% CI 83–94)

specificity: mpMRI: 73%, 95% CI 64–81; bpMRI: 70%, 95% CI 42–83. The summary receiver operating characteristic curves were comparable for mpMRI (0.87) and bpMRI |
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| Limitations | There is heterogeneity between studies in this meta-analysis, high numbers of studies with bias or unclear risk of bias |
| Conclusions | No significant difference in diagnostic test accuracy was found between mpMRI and bpMRI in diagnosing prostate cancer in treatment-naïve patients |
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| Paper | **Jambor et al 2019 Validation of IMPROD bi-parametric MRI in men with clinically suspected prostate cancer: A prospective multi-institutional trial** |
| Level of evidence | prospective multi-centre trial (Level 1b) |
| Summary | Between February 1, 2015 and March 31 2017, 364 men with clinical suspicion of prostate cancer were enrolled at 4 institutions in Finland. They were scanned with a locally-developed bpMRI protocol (IMPROD bpMRI). All had systematic biopsy; those with Likert 3-5 had additional targeted biopsy of up to 2 lesions. |
| Diagnostic Accuracy | IMPROD bpMRI: Sensitivity 97% (142/146) [93%–99%] Specificity 37% (71/192) [31%–44%] NPV 95% (71/75) [87%–98%] PPV 54% (141/263) [48%–60%] |
| Limitations | No comparison against mpMRI, potential for missed cancer on biopsy, homogeneous population (Finnish) |
| Conclusions | No significant difference in diagnostic test accuracy was found between mpMRI and bpMRI in diagnosing prostate cancer in treatment-naïve patients |
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| Paper | **Eldred-Evans et al (2019) Added value of diffusion-weighted images and DCE in multiparametric magnetic resonance imaging for the detection of clinically significant prostate cancer in the PICTURE trial** |

Level of evidence	Level 2b (retrospective cohort study)
Summary	Sequential (blinded) reporting of mpMRI sequences from 246 men scanned after ambiguous blind TRUS biopsy. Using a Likert threshold of ≥3 as positive, AUROC values showed no significant difference in accuracy, but each additional sequence included reduced the rate of equivocal lesions
Diagnostic Accuracy	Using the primary definition of clinically significant disease, there was no significant difference in the overall accuracy between T2W, with an AUROC of 0.74 (95% confidence interval [CI] 0.68–0.80), T2W+DWI at 0.76 (95% CI 0.71–0.82), and T2W+DWI+DCE, with an AUROC of 0.77 (95% CI 0.71–0.82; P = 0.55).
Limitations	3T MRI, conducted after prior biopsy therefore not directly applicable to biopsy-naïve population.
Conclusions	Using 3T MRI, a high level of diagnostic accuracy can be achieved using T2W as a single parameter in men with a prior biopsy; however, such a strategy can lead to a higher rate of equivocal lesions.

Paper	**Boesen et al (2019) pre-biopsy biparametric magnetic resonance imagining combined with prostate-specific antigen density in detecting and ruling out gleason 7-10 prostate cancer in biopsy-naive men.**
Level of evidence	1b prospective cohort study
Summary	808 biopsy-naïve men with clinical suspicion of localised prostate cancer. Scanned with bpMRI then combined standard and targeted biopsies. Results analysed for various thresholds of bpMRI scores and PSA densities to determine the best performance in cancer detection and biopsy avoidance.
Diagnostic Accuracy	Using biopsy criteria of Likert ≥4 and PSAd ≥0.15 reduced biopsy numbers by 41% and reduced overdiagnosis by 45%, but missed 5% of significant cancers.
Limitations	This study used bpMRI and PSA density for risk stratification but did not make comparisons against mpMRI.
Conclusions	Restricting biopsies to men with highly suspicious bpMRI findings (score ≥4) or PSAd ≥0.15ng/ml/cc was the best biopsy strategy in this patient cohort.

Paper	**Mussi et al 2017 Are Dynamic Contrast-Enhanced Images Necessary for Prostate Cancer Detection on Multiparametric Magnetic Resonance Imaging?**

Level of evidence	Level 2b (retrospective cohort study)
Summary	3T mpMRI scans of 118 patients were independently read by 2 readers with/without DCE sequences and Likert graded on suspicion of clinically suspicious prostate cancer. A kappa coefficient test compared the accuracy of the readers against fusion biopsy results as a reference standard.
Diagnostic Accuracy	Using the contiguous sextant pattern, we found almost no statistical difference between readers on exams with and without contras (only for reader 2 accuracy's that was better in exams without contrast)
Limitations	Small sample of both patients and readers. MRI fusion biopsy is not a reliable reference standard. 3T MRI is not in widespread clinical use
Conclusions	Contrast-enhanced sequences provide minimal or no increased value for the detection of clinically significant prostate cancer

Paper	**Gatti et al (2019) Prostate cancer detection with biparametric magnetic resonance imaging (bpMRI) by readers with different experience: performance and comparison with multiparametric (mpMRI).**
Level of evidence	2b - retrospective cohort study
Summary	57 patients with diagnosis of prostate cancer who underwent MRI. Images were read by three groups of radiologists - Group A (two senior radiologists with a record of about 1000 cases analyzed), Group B (two junior radiologists with about 300 cases) and Group C (two residents, with about 100 cases). They read bpMRI scans and approx. one month later read mpMRI scans. The results were compared with clinical histology.
Diagnostic Accuracy	The two expert readers performed as well in bpMRI as in mpMRI (SNS=0.91–0.96, AUC=0.86–0.93; $p \geq 0.10$); readers with 300 cases performed well in mpMRI, but significantly worse in bpMR: SNS=0.58 versus 0.91 ($p < 0.0001$) and AUC=0.73 versus 0.86 ($p = 0.01$); the limited experience of readers with 100 cases showed in mpMRI (SNS=0.71; AUC=0.77) and even more in bpMR
Limitations	Small retrospective single centre study
Conclusions	Expert readers with 700+ cases experience performed as well in analysing bpMRI as mpMRI - less experienced readers showed statistically significant improved performance with mpMRI