Comparison of PI-RADS v2 and v1 classification of lesions detected on mpMRI with pathologic correlation

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No disclosures

INTRODUCTION

Score	Criteria
A1. T2WI for the peripheral zone (PZ)	
1	Uniform high signal intensity (SI)
2	Linear, wedge shaped, or geographic areas of lower SI, usually not well demarcated
3	Intermediate appearances not in categories 1/2 or 4/5
4	Discrete, homogeneous low signal focus/mass confined to the prostate
5	Discrete, homogeneous low signal intensity focus with extra-capsular extension/invasive behaviour or mass effect on the capsule (bulging) or broad (>1.5 cm) contact with the surface
A2. T2WI for the transition zone (TZ)	
1	Heterogeneous TZ adenoma with well-defined margins: "organised chaos"
2	Areas of more homogeneous low SI, however well marginated, originating from the TZ/BPH
3	Intermediate appearances not in categories 1/2 or 4/5
4	Areas of more homogeneous low SI, ill defined: "erased charcoal sign"
5	Same as 4, but involving the anterior fibromuscular stroma or the anterior horn of the PZ, usually lenticular or water-drop shaped.
B. Diffusion weighted imaging (DWI)	
1	No reduction in ADC compared with normal glandular tissue. No increase in SI on any high b-value image (≥b800)
2	Diffuse, hyper SI on ≥b800 image with low ADC; no focal features, however, linear, triangular or geographical features are allowed
3	Intermediate appearances not in categories 1/2 or 4/5
4	Focal area(s) of reduced ADC but iso-intense SI on high b-value images (≥b800)
5	Focal area/mass of hyper SI on the high b-value images (≥b800) with reduced ADC
C. Dynamic contrast enhanced (DCE)-MRI	
1	Type 1 enhancement curve
2	Type 2 enhancement curve
3	Type 3 enhancement curve
+1	For focal enhancing lesion with curve type 2–3
+1	For asymmetric lesion or lesion at an unusual place with curve type 2–3
D2. Qualitative magnetic resonance spectroscopic imaging (MRSI)	
1	Citrate peak height exceeds choline peak height >2 times
2	Citrate peak height exceeds choline peak height times >1, <2 times
3	Choline peak height equals citrate peak height
4	Choline peak height exceeds citrate peak height >1, <2 times
5	Choline peak height exceeds citrate peak height >2 times

In qualitative analysis, the relative peak heights of citrate and choline are visually compared (p
apply for 1.5: for at least three adjacent voxels

Score 1 = Clinically significant disease is highly unlikely to be present

Score 2 = Clinically significant cancer is unlikely to be present

Score 3 = Clinically significant cancer is equivocal

Score 4 = Clinically significant cancer is likely to be present

Score 5 = Clinically significant cancer is highly likely to be present

Prostate Imaging and Reporting and Data System: PI-RADS

- Version 1 (v1) published by the ESUR in 2012
- Provided guidelines for multiparametric MRI (mpMRI) indications, acquisition, and a structured reporting system

INTRODUCTION

Overview of PI-RADS Version 1 scoring system

- Each lesion given a score from 1-5 for each of T2, DWI/ADC, T1WI dynamic contrast enhanced (DCE), MR spectroscopy sequences, and extraprostatic disease
- An overall score assigned on Likert scale (1-5) based on likelihood of clinically significant disease

Significant step towards standardizing reporting, however not without limitations

- Overall score subjective and not clearly related to the scoring of individual sequences
- Criteria for scoring within individual sequences somewhat vague
- Heterogeneity of scoring may be confusing for clinicians

INTRODUCTION

Recent Introduction of PI-RADS v2

- Introduced at RSNA 2014 and published on ACR website
- "designed to promote global standardization and diminish variation in the acquisition, interpretation, and reporting of prostate mpMRI"
- Evolving document, work in progress

Highlights of PI-RADS v2 scoring system changes

- Outlines more specific morphologic criteria for T2 and DWI scoring, with images provided as examples
  - Contrast-enhanced scoring now dichotomous
  - Removed scoring MR spectroscopy
- Assigns an overall score based on individual sequence scores
  - More heavily weighted towards T2 and DWI for transition zone and peripheral zone lesions respectively
- Updates recommended MR acquisition parameters

PI-RADS v2

T2: Peripheral Zone (PZ)	
1	Uniform hyperintense signal intensity (normal)
2	Linear or wedge-shaped hypointensity or diffuse mild hypointensity, usually indistinct margin
3	Heterogeneous signal intensity or non-circumscribed, rounded, moderate hypointensity Incl' others that do not qualify as 2, 4, or 5
4	Circumscribed, homogenous moderate hypointense focus/mass confined to prostate and <1.5 cm in greatest dimension
5	Same as 4 but ≥1.5cm in greatest dimension or definite extraprostatic extension/invasive behavior

DWI (PZ and TZ)	
1	No abnormality (i.e. normal) on ADC and high b-value DWI
2	Indistinct hypointense on ADC
3	Focal mildly/moderately hypointense on ADC and isointense/mildly hyperintense on high b-value DWI.
4	Focal markedly hypontense on ADC and markedly hyperintense on high b-value DWI; < 1.5 cm in greatest dimension
5	Same as 4 but ≥1.5cm in greatest dimension or definite extraprostatic extension/invasive behavior

T2: Transition Zone (TZ)	
1	Homogeneous intermediate signal intensity (normal)
2	Circumscribed hypointense or heterogeneous encapsulated nodule(s) (BPH)
3	Heterogeneous signal intensity with obscured margins Includes others that do not qualify as 2, 4, or 5
4	Lenticular or non-circumscribed, homogeneous, moderately hypointense, and <1.5 cm in greatest dimension
5	Same as 4, but ≥ 1.5cm in greatest dimension or definite extraprostatic extension/invasive behavior

DCE	
(-)	no early enhancement, or diffuse enhancement not corresponding to a focal finding on T2 and/or DWI or focal enhancement corresponding to a lesion demonstrating features of BPH on T2WI
(+)	focal, and earlier than or contemporaneously with enhancement of adjacent normal prostatic tissues, and; corresponds to suspicious finding on T2W and/or DWI

Overall PZ

DWI	T2W	DCE	PI-RADS
1	Any	Any	1
2	Any	Any	2
3	Any	+	3
		-	4
4	Any	Any	4
5	Any	Any	5

Overall TZ

T2W	DCE	DWI	PI-RADS
1	Any	Any	1
2	Any	Any	2
3	Any	≤4	3
		5	4
4	Any	Any	4
5	Any	Any	5

INTRODUCTION

Our experience with prostate mpMRI

- Started reporting using PIRADS v2 scoring in December 2014
- Most common indications for MRI
  - previous negative biopsy but clinically concerned
  - on active surveillance
- Many patients undergo subsequent MRI/TRUS guided fusion prostate biopsy
- In general, PI-RADS 1/2 not biopsied, PI-RADS 4/5 biopsied, PI-RADS 3 case dependent (often will be biopsied)

INTRODUCTION

Hypothesis

- PI-RADS v2 scoring system improves specificity and sensitivity for positive fusion biopsy result in MRI detected lesions compared to v1
- Secondary outcomes:
  - Improved inter-rater reliability
  - Extrapolate how it could alter biopsy practices

MATERIALS AND METHODS

Retrospective analysis of MRIs from Nov 2012 – Sep 2014

- 100 consecutive patients who had mpMRI and fusion biopsy

MRI parameters: T2, DWI/ADC (b0, 500, 1000), DCE, 1.5T, no endorectal coil

Each biopsied lesion re-classified using PI-RADS v2 scoring

- 2 readers (1.5 years and 10+ years reading prostate MRI), blinded to pathology, 20% of patients double read by reader 2
- PI-RADS v1 score provided by original reader recorded

Correlation made to biopsy histopathology

- Subgroup of clinically significant cancers (Gleason 7 or greater) also recorded

RESULTS

100 PATIENTS INCLUDED
Nov 2012 – Sep 2014

205 LESIONS BIOPSIED
mean 2.1 per patient

166 (81.1%)
TRANSITION ZONE LESIONS

113 (55.1%)
same or ±1 such that no change in management

7 (3.4%)
upgraded from PI-RADS ≤3 to 4/5

- 5 biopsy +ve *(2 x GI 3+3, 3 ≥GI 7)*
- 2 biopsy -ve

85 (41.4%)
downgraded from PI-RADS ≥3 to 1/2

- 4 biopsy +ve *(all GI 3+3)*
- 81 biopsy –ve

Good interrater reliability
K = 0.611

(PI-RADS v1 reported 0.44-0.526)

RESULTS

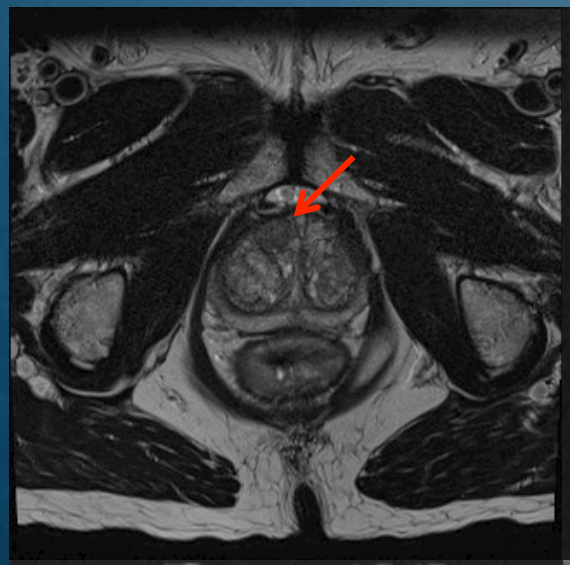
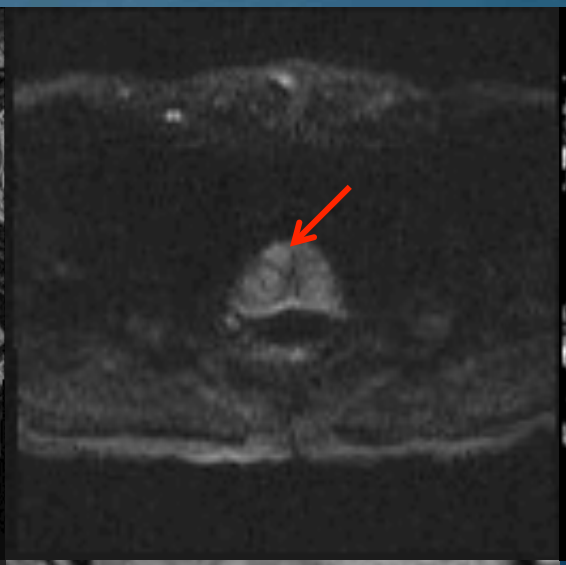
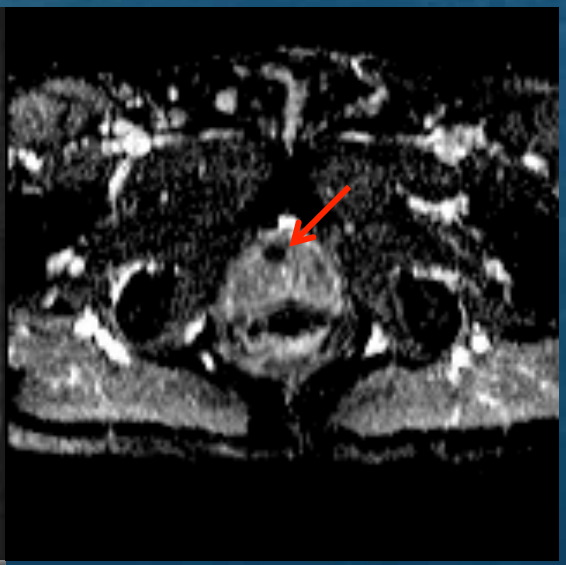
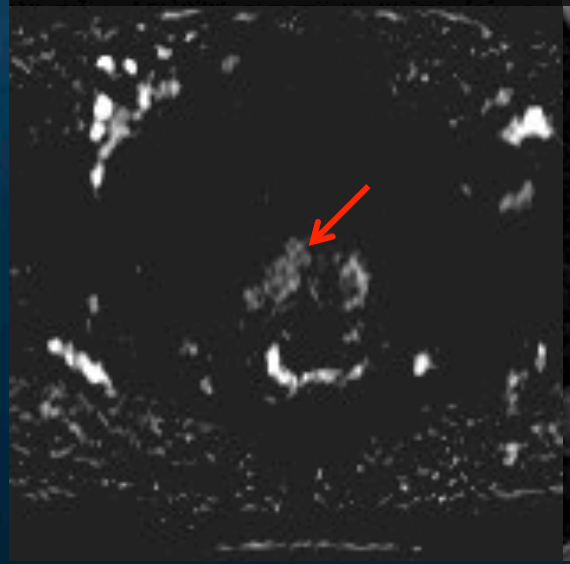
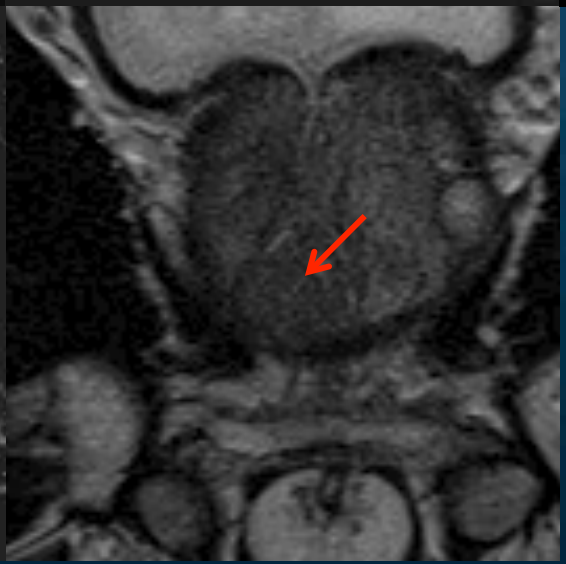
All clinically significant cancers scored ≥PI-RADS 3

- 28/48 were clinically significant (ie. Gleason 7 and greater)
- After rescoring with v2 – 23/28 were PI-RADS 4 or 5, 5 were PI-RADS 3, none were PI-RADS ½
- Preliminary results also suggest increasing PI-RADS score correlates with increasing cancer significance (size and Gleason grade)

Improved specificity and positive predictive value for V2 in a score of PI-RADS 4/5 predicting clinically significant cancer

	PI-RADS V1	PI-RADS V2
Sensitivity	81.5%	82.1%
Specificity	58.4%	85.4%
Positive Predictive Value	22.9%	46.9%
Negative Predictive Value	95.4%	98.8%

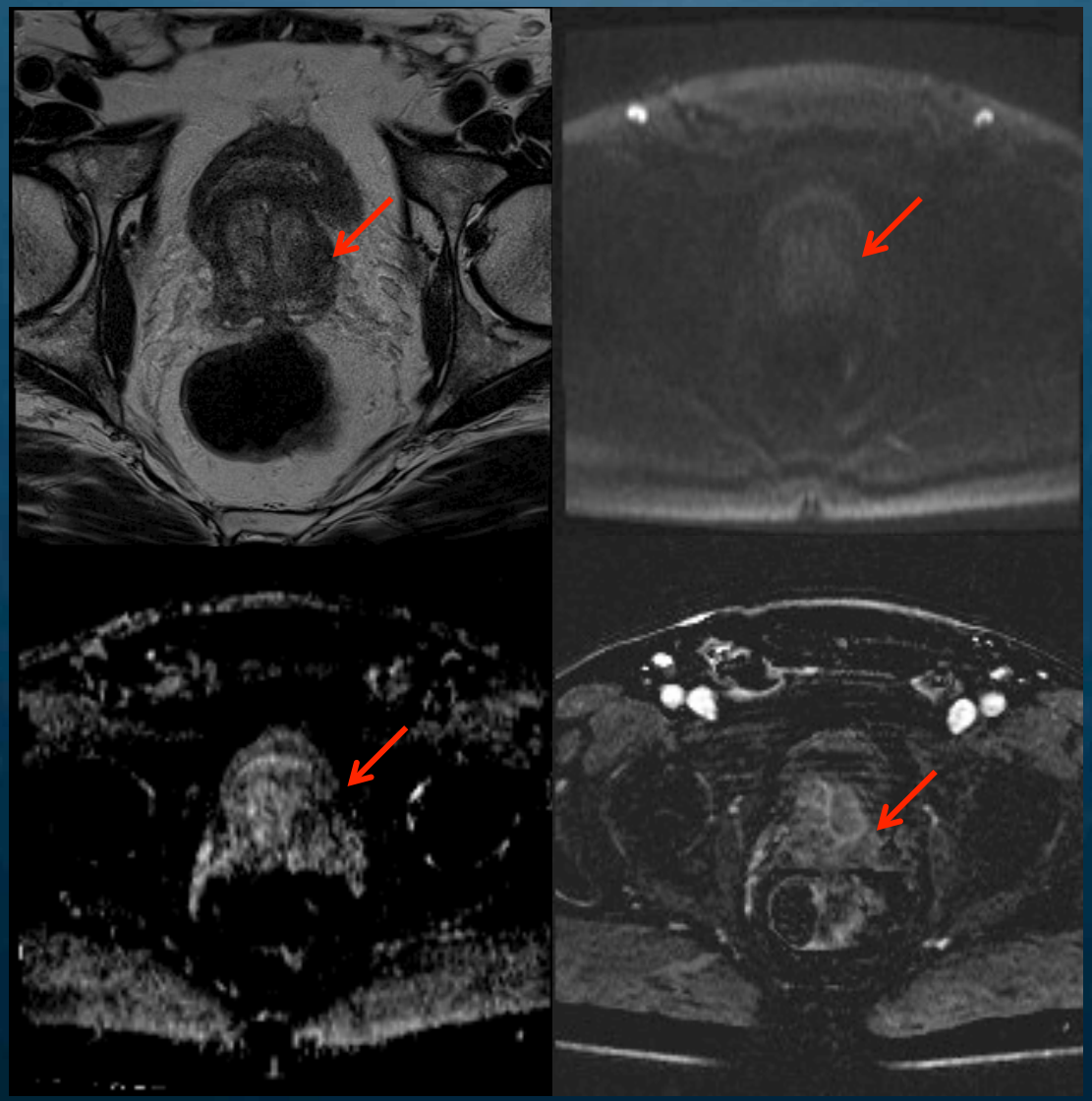
CASE EXAMPLES

Right apex transition zone lesion downgraded from PI-RADS 4 to 2.

Biopsy +ve

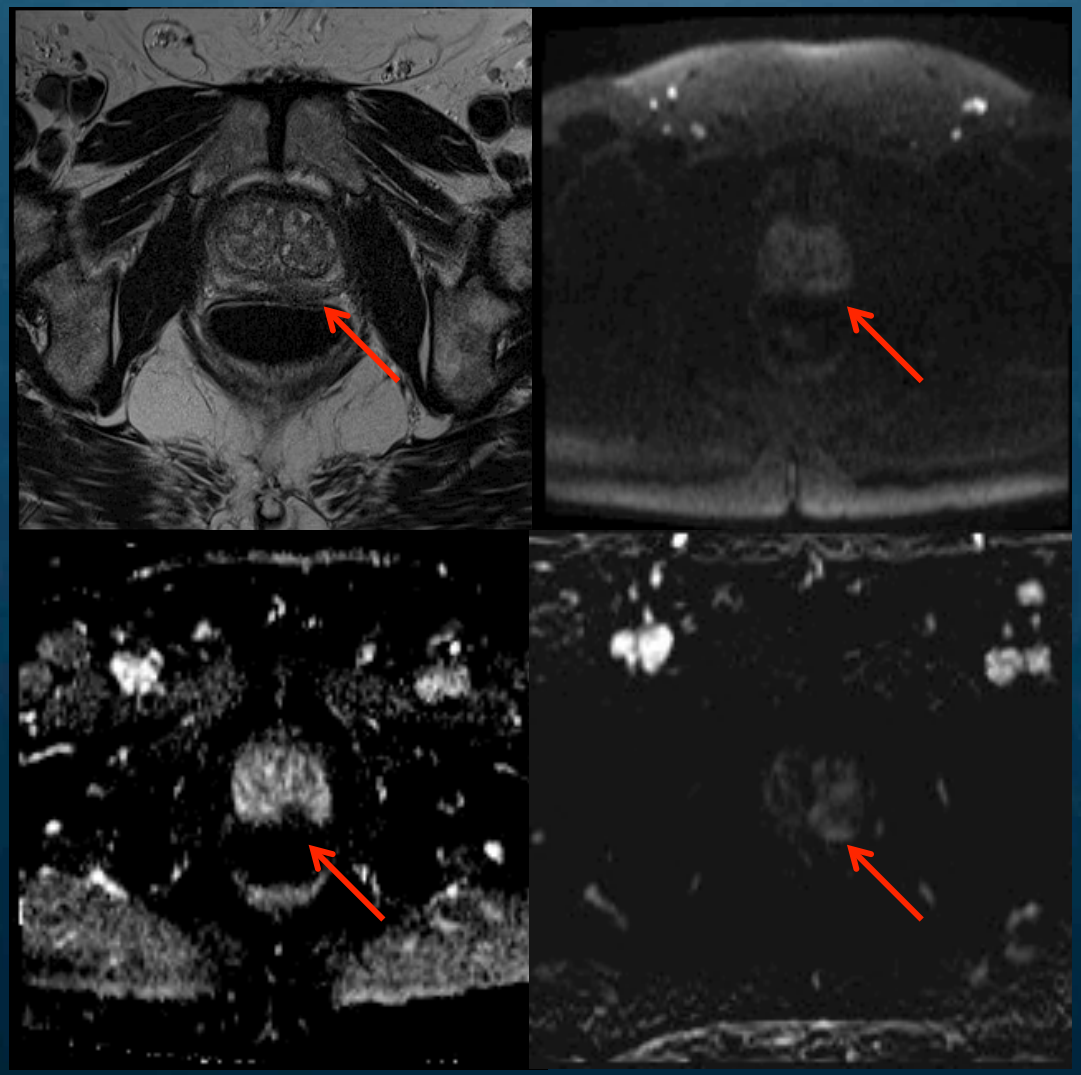
CASE EXAMPLES



Left midgland transition zone lesion downgraded from PI-RADS 4 to 3.

Biopsy -ve

CASE EXAMPLES



Left midgland peripheral zone lesion, unchanged PI-RADS 5

Biopsy +ve

DISCUSSION

Significantly improved specificity and NPV with similar PPV and sensitivity for positive fusion biopsy

- 85 (41.4%) fewer lesions would have been biopsied without missing a clinically significant cancer

Better inter-rater reliability for PI-RADS 2 vs reported for PI-RADS 1 = more consistency between readers, improved standardization of interpretation

Implications for patient care

- More consistency for urologists = MRI more reliable for guiding patient management
- Fewer unnecessary biopsies

DISCUSSION

Limitations

- PPV remains modest (ie. Still many false positives)
  - still overcalling many lesions (perhaps due to being overcautious with regards to indeterminate lesions)
  - Anecdotally, whether to call something 3 or 4 on T2 is the most difficult
- DWI acquired based on PI-RADS 1 technical parameters ("high" b-value 1000)
- Fusion biopsy result does not always accurately reflect underlying pathology
  - Targets can be missed by biopsy, and cancer may exist within the gland not identified on MRI
- Our population mostly consists of anterior and TZ lesions, peripheral zone lesions underrepresented

FUTURE DIRECTIONS

- Further validation needed
  - Larger sample size
  - Correlation to whole mount pathology
  - Other technical parameters (3T, endorectal coil, DWI b 1400)
- Impact on patient outcome and cost-effectiveness.

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THANKS!