Prospective Evaluation of the Value of Dynamic Contrast Enhanced (DCE) Imaging for Prostate Cancer Detection, with Pathology Correlation

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Disclosures

- The authors have no affiliations, sponsorships, honoraria, monetary support or conflict of interest from any commercial source

Background

- Prostate cancer is the 2nd most common cancer in men after non-melanoma skin cancers
- 3rd leading cause of death in adult males in Canada and 2nd leading cause of death in the USA
- ACR appropriateness criteria:
  - TRUS (Transrectal ultrasound guided biopsy): 9
  - MR pelvis without and with IV contrast: 7
  - MR pelvis without IV contrast: 6

Background

- According to Prostate Imaging Reporting and Data System (PIRADS) Version 2:
  - **mpMRI: T2WI, DWI and DCE**
  - PI-RADS™ v2 Assessment Categories
    - PIRADS 1 – Very low (clinically significant cancer is highly unlikely to be present)
    - PIRADS 2 – Low (clinically significant cancer is unlikely to be present)
    - PIRADS 3 – Intermediate (the presence of clinically significant cancer is equivocal)
    - PIRADS 4 – High (clinically significant cancer is likely to be present)
    - PIRADS 5 – Very high (clinically significant cancer is highly likely to be present)

Background

- Clinically Insignificant Prostate Cancer:
  - On Radical Prostatectomy Specimen:
    - a Gleason score 6 without Gleason pattern 4 or 5
    - organ-confined disease (no extraprostatic extension, seminal vesicle invasion, or lymph node involvement
    - a tumor volume <0.5 cc
  - On Core Biopsy:
    - Gleason score less than or equal to 6, fewer than three positive cores
    - <50% of cancer involvement in any core.
- Any lesion exceeding the above criteria is considered Clinically Significant Prostate Cancer.

Background

- According to PIRADS Version 2:
  - DCE used in upgrading a PIRADS 3 lesion to PIRADS 4 in the peripheral zone, but not in the transitional zone
  - DCE can be used in the absence of an adequate DWI sequence to differentiate between PIRADS 3 & PIRADS 4 lesions

Background

Peripheral Zone (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

Transition Zone (TZ)

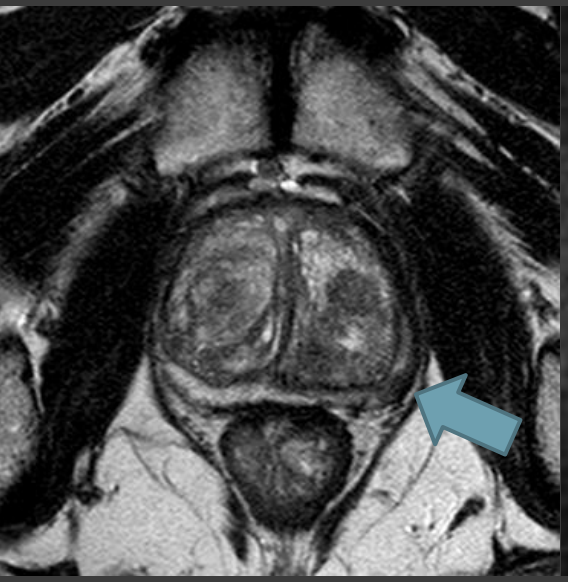
T2W	DWI	DCE	PI-RADS
1	Any*	Any	1
2	Any	Any	2
3	≤4	Any	3
	5	Any	4
4	Any	Any	4
5	Any	Any	5

Background

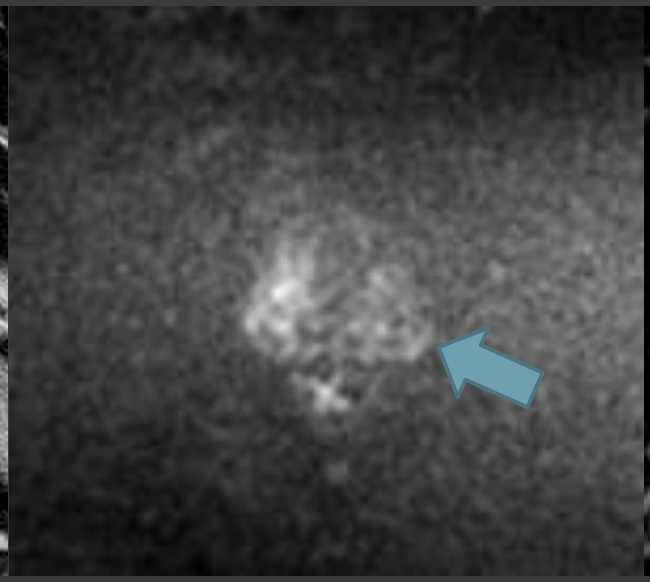
Assessment Without Adequate DWI

Peripheral Zone (PZ) and Transition Zone (TZ)

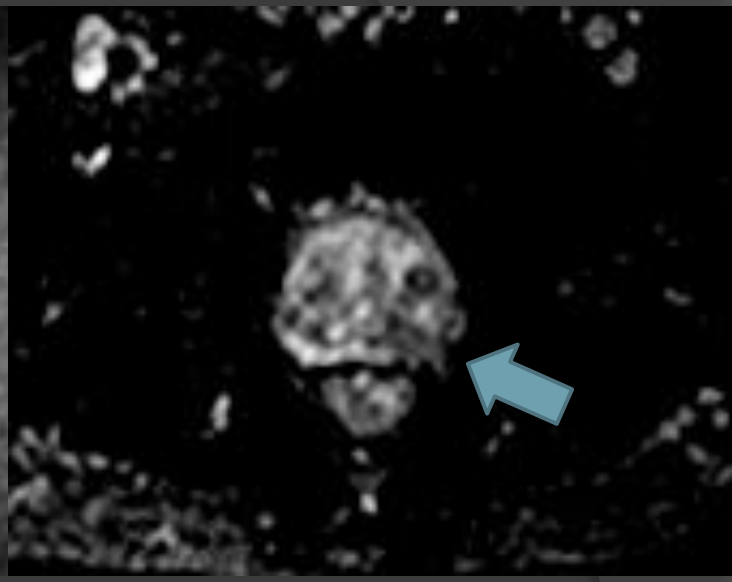
T2W	DWI	DCE	PI-RADS
1	X	Any	1
2	X	Any	2
3	X	–	3
		+	4
4	X	Any	4
5	X	Any	5



T2-WI



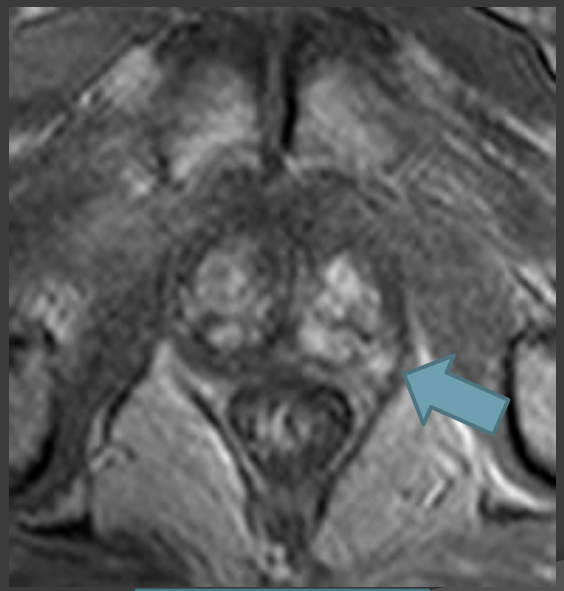
DWI



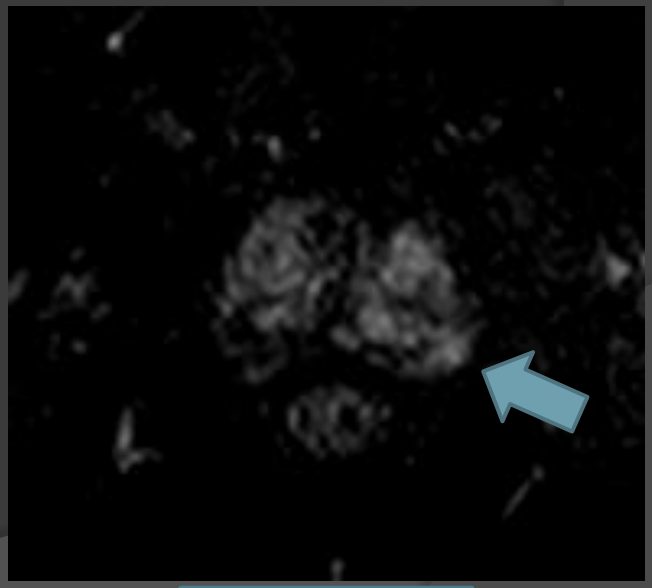
ADC Map

Example:
A small T2 hypointense lesion with mild diffusion restriction (PIRADS 3)

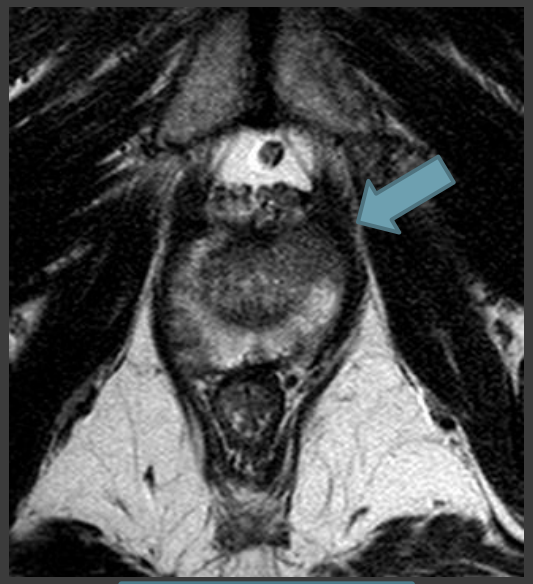
Enhancement on DCE upgraded the lesion to PIRADS 4



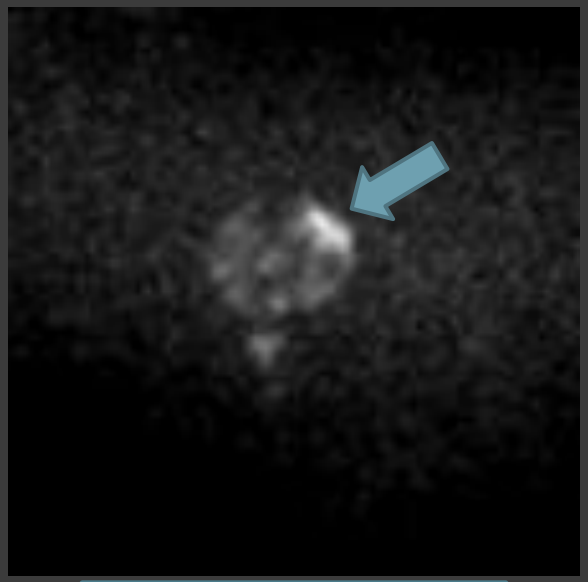
T1+C



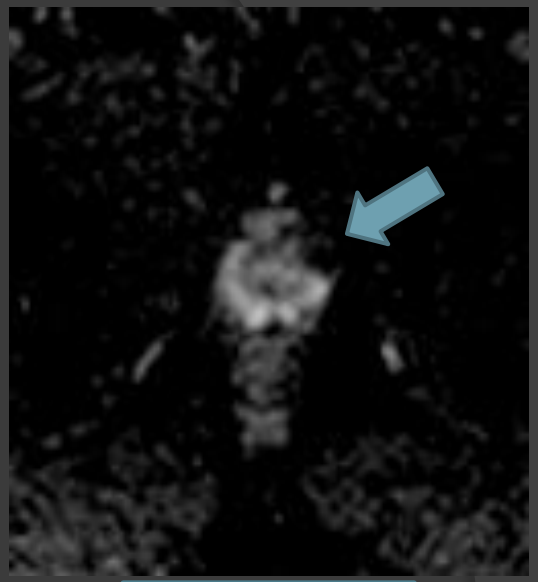
SUB T1+C



T2-WI



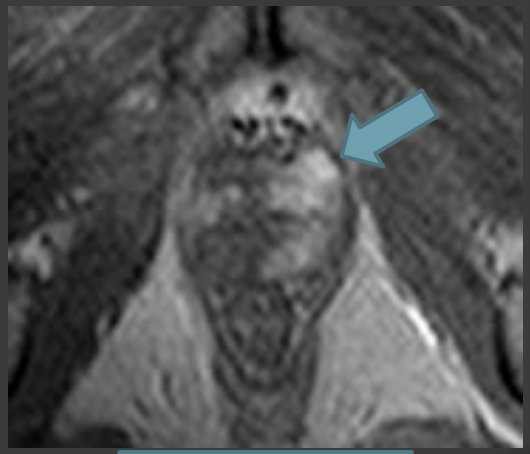
DWI (b-value 1400)



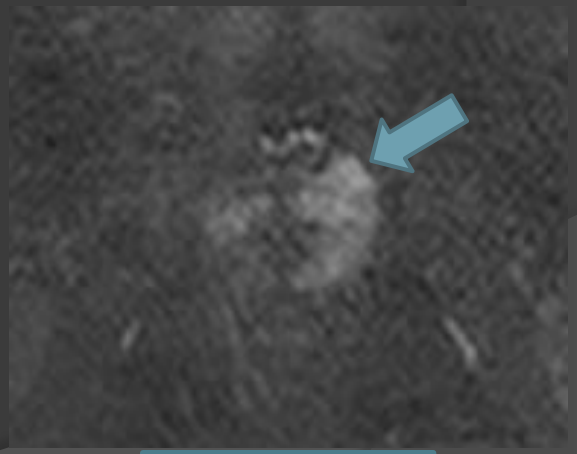
ADC Map

Example:
A small T2 hypointense lesion with diffusion restriction (PIRADS 4)

Enhancement on DCE did not change the PIRADS score in this case (as in many cases in clinical practice)



T1+C



SUB T1+C

Background

mpMRI Prostate

- Longer time
- Expensive
- IV contrast (Gadovist)
- Possible side-effects

bpMRI Prostate

- Shorter time
- Less expensive
- No IV contrast

Objective

The main objective of this study is to evaluate the value of Dynamic Contrast Enhanced (DCE) MRI in the detection and staging of prostate cancer

Hypothesis

Our hypothesis is that DCE imaging does not offer significant added value for treatment-naïve patients

In fact, we suspect that DCE imaging can be omitted in treatment-naïve patients without significant effect on imaging-pathology correlation

Methods

- Research ethics board approval was obtained from our institution.
- Blinded re-interpretation of previously acquired prostate MRIs was performed
- 100 consecutive patients who met the inclusion criteria were included in the study
- Scans performed from June-August 2017

Inclusion & Exclusion Criteria

- Inclusion criteria:
  - Underwent 3T mpMRI of the prostate with no endorectal coil
  - A systematic 14-core transrectal ultrasound (TRUS) guided prostate biopsy, focused TRUS guided prostate biopsy or prostatectomy within a 12-month period from the prostate MRI examination

Inclusion & Exclusion Criteria

- Exclusion Criteria:
  - MRI acquisition was incomplete or exam was non-diagnostic due to artifact
  - Prostate biopsy or prostatectomy was performed beyond 12 months from the prostate MRI
  - No histopathology results were available
  - Patient received prior surgical or non-surgical treatment for prostate cancer

Methods

- Each study independently interpreted by a body-imaging fellow and a staff radiologist
- Each exam was read at two time points (8-10 weeks apart):
  1) mpMRI – initial reading
  2) bpMRI (without DCE) – second reading
- Readers were blinded to the clinical information including the clinical history, PSA level and histopathology results
- PIRADSv2 guidelines were strictly followed for interpreting all studies

Methods

- The results were analyzed as follows:

1) Intra-observer agreement (with and without DCE)
2) Inter-observer agreement (Radiology Fellow and Staff Radiologist)
3) Agreement with Gold standard (Histopathology)

Results

- A total of 100 treatment-naïve patients were included (mpMRI performed June-August 2017)
- Age range: 48-81 (median: 64)
- Mean PSA: 10.3 ng/mL

Results

- 79 Patients underwent TRUS biopsy, 20 patients underwent prostatectomy & 1 patient underwent transurethral resection of the prostate tumor
- Pathology
  - 28 Gleason 6
  - 23 Gleason 7 (3+4) & 8 Gleason 7 (4+3)
  - 2 Gleason 8
  - 2 Gleason 9
  - 37 Benign Biopsies

Results

	Intra-observer agreement (reader 1)	Intra-observer agreement (reader 2)	Inter-observer agreement mpMRI (reader 1 vs reader 2)	Inter-observer agreement bpMRI (reader 1 vs reader 2)
Cohen's Kappa	**0.88**	**0.86**	**0.74**	**0.76**
Level of Agreement	Substantial agreement	Substantial agreement	Substantial agreement	Substantial agreement

Results

Compared with the Gold standard (Histopathology), the sensitivity, specificity, PPV, NPV were as follows:

	Reader 1 mpMRI	Reader 1 bpMRI	Reader 2 mpMRI	Reader 2 bpMRI
Sensitivity	**91.3%**	**91.3%**	**92.0%**	**89.6%**
Specificity	**89.9%**	**81.5%**	**82.0%**	**86.5%**
PPV	**87.5%**	**80.8%**	**83.6%**	**86.0%**
NPV	**92.3%**	**91.7%**	**91.1%**	**90.0%**

Literature Review

Authors	Year	bpMRI accuracy	mpMRI accuracy	bpMRI sensitivity	mpMRI sensitivity
Radtke et al.[20]*	2015	-	-	91.9%	86.4–88.5%
Fascelli et al.[28]	2016	81.4%**	-	95.5%	-
Thestrup et al.[42]	2016	41.5%	39%	94.6%	93–100%
Stanzione et al.[44]	2016	92.7%	93.9%	83.5%	91.1%
Scialpi et al.[24] ***	2017	99.4%	99.4%	98.2%	98.2%
De Visschere et al.[27]	2017	72.2–74.7%	72.9%	61.8–72.2%	72.9%
Kuhl et al.[43]	2017	89.1%	87.2%	93.9%	84.6%

*Anterior lesions GS≥3+4 and GS≥4+3;
**Overall accuracy (bpMRI and PSA);
***index lesions ≥10mm.

Scialpi M, D'Andrea A, Martorana E, Malaspina C, Aisa MC, Napoletano M, et al. Biparametric MRI of the prostate. Turk J Urol 2017; 43(4): 401-9

Conclusion

- The findings of this study confirm our hypothesis that prostate MRI without DCE (bp-MRI) is of comparable diagnostic accuracy to mp-MRI in treatment-naïve patients.

Clinical Relevance

- Performing prostate MRI without DCE (bp-MRI) can:

1) Reduce acquisition time

2) Decrease cost

3) Improve patient safety

Limitations & Future Plans

- Small sample size
  - Consider trial with larger sample size
  - Increase the number of observers
- Gold standard includes TRUS-guided biopsies
  - May not have representative samples
  - Consider limiting the study population to those treated with total prostatectomy

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