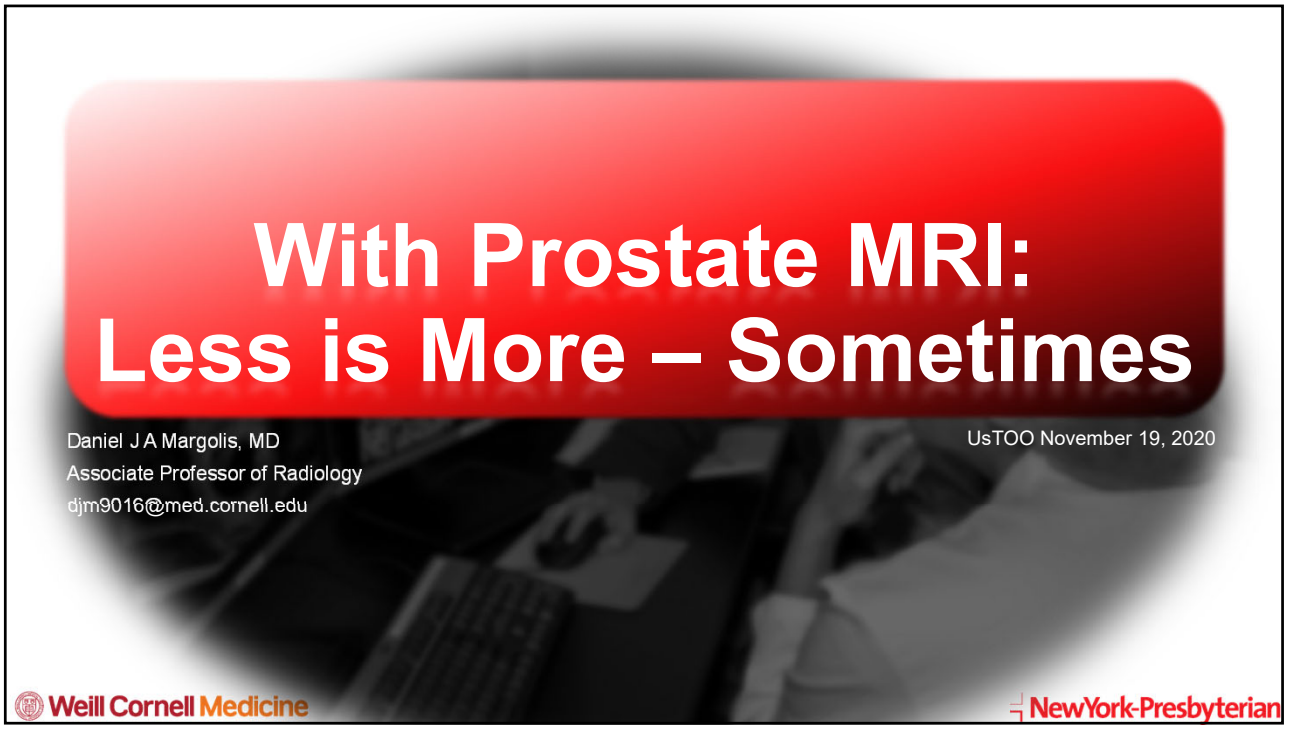

1

Disclosure

Consultant for Blue Earth Diagnostics, Inc., who market fluciclovine (FACBC) as Auxumin

Cornell is the recipient of a research agreement with Siemens Healthineers

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2

Overview

Prostate MRI, Then and Now

Abbreviated Prostate MRI: Why Now? Why Not Sooner?

Why *Not* Now?

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3

"Bi-Parametric Prostate MRI"

- T2- & diffusion-weighted only
- Potentially <15 minutes
  - Requires adequate DWI and calculated high b-value
- Potential pitfalls
  - More category 3
  - Hip replacement
  - Inexperienced readers

AJR Online First Accepted Manuscript

PI-RADS Committee Position on MRI Without Contrast Medium in Biopsy Naive Men with Suspected Prostate Cancer: A Narrative Review

Ivo G. Schoots, MD, PhD, Jelle O. Barentsz, MD, PhD, Leonardo K. Bittencourt, MD, PhD, Masoom A. Haider, MD, Katarzyna J. Macura, MD, Daniel J.A. Margolis, MD, Caroline M. Moore, MD, Aytekin Oto, MD, Valeria Panebianco, MD, Mohummad M. Siddiqui, MD, Clare Tempany, MD, Baris Turkbey, MD, Geert M. Villeirs, MD, Jeffrey C. Weinreb, MD, Anwar R. Padhani, MD

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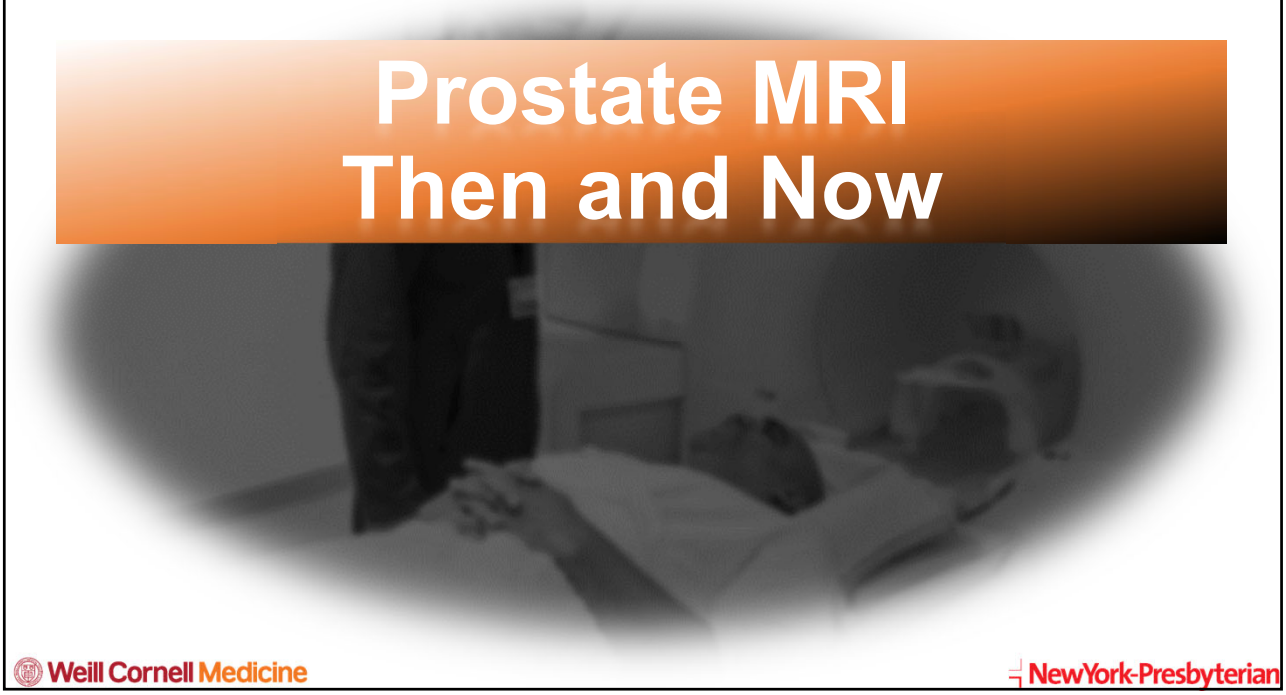
4

Prostate MRI Then and Now



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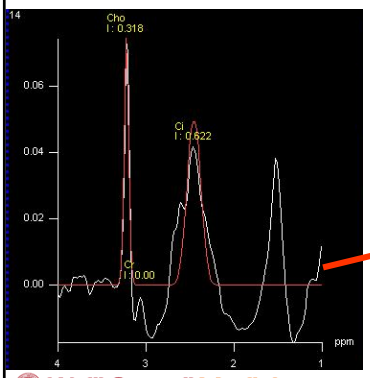
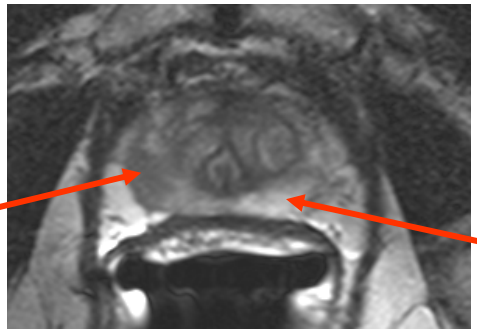
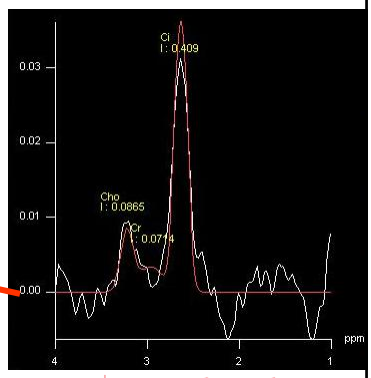
History Lesson: OG bpMRI

- T2-weighted imaging and spectroscopy
- This was bi-parametric prostate MRI in 2010







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Another History Lesson: First "Modern" bpMRI

From the NIH

Controversial

in its time

BJUI
BJU International

Urological Oncology | Free Access

Diagnostic value of biparametric magnetic resonance imaging (MRI) as an adjunct to prostate-specific antigen (PSA)-based detection of prostate cancer in men without prior biopsies

Soroush Rais-Bahrami, M. Minhaj Siddiqui, Srinivas Vourganti, Baris Turkbey, Ardeshir R. Rastinehad, Lambros Stamatakis, Hong Truong, Annerleim Walton-Diaz, Anthony N. Hoang, Jeffrey W. Nix, Maria J. Merino, Bradford J. Wood, Richard M. Simon, Peter L. Choyke, Peter A. Pinto ... See fewer authors

First published: 21 January 2014 | https://doi-org.ezproxy.med.cornell.edu/10.1111/bju.12639 |
Citations: 86

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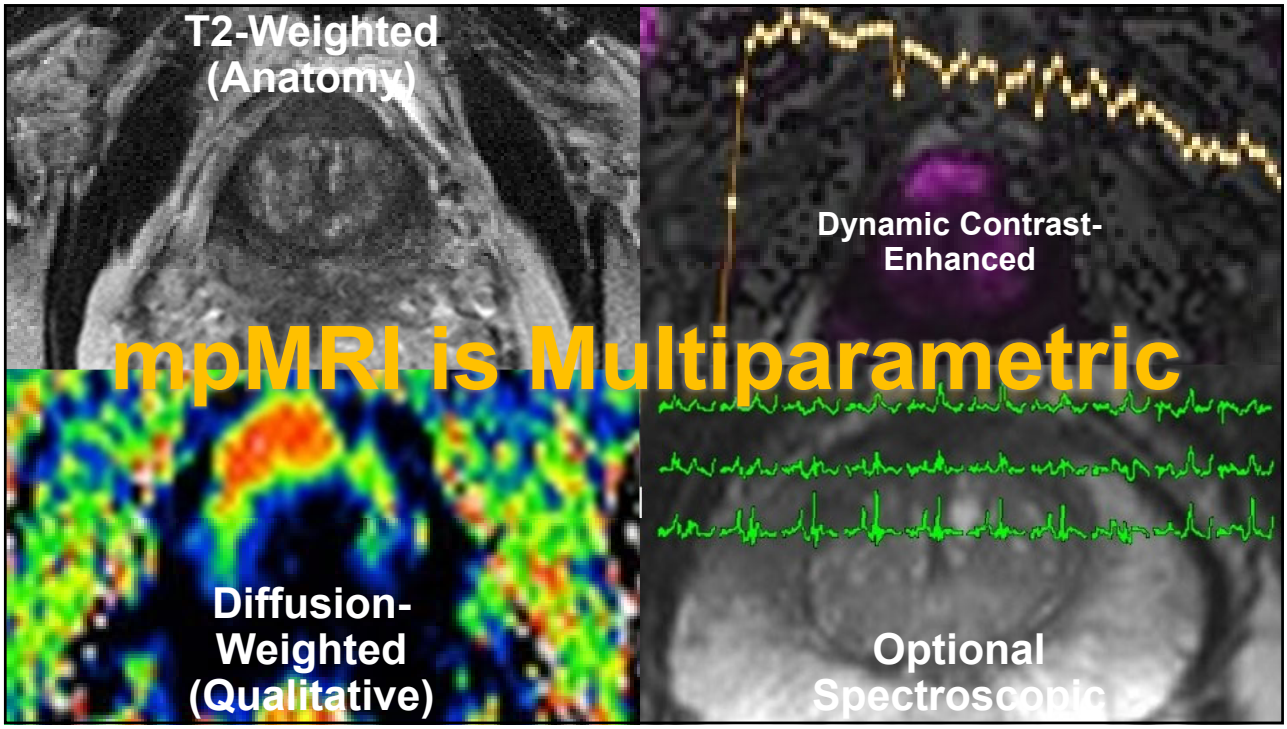
7



8

Prostate Imaging Reporting and Data Systems v2.1:

"PI-RADS"

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>20 publications prove PI-RADS v2 the Standard for Prostate MRI

- ACR website or (updated last month) *European Urology*
- Technique
- Normal appearance
- Assessment and reporting
- Staging

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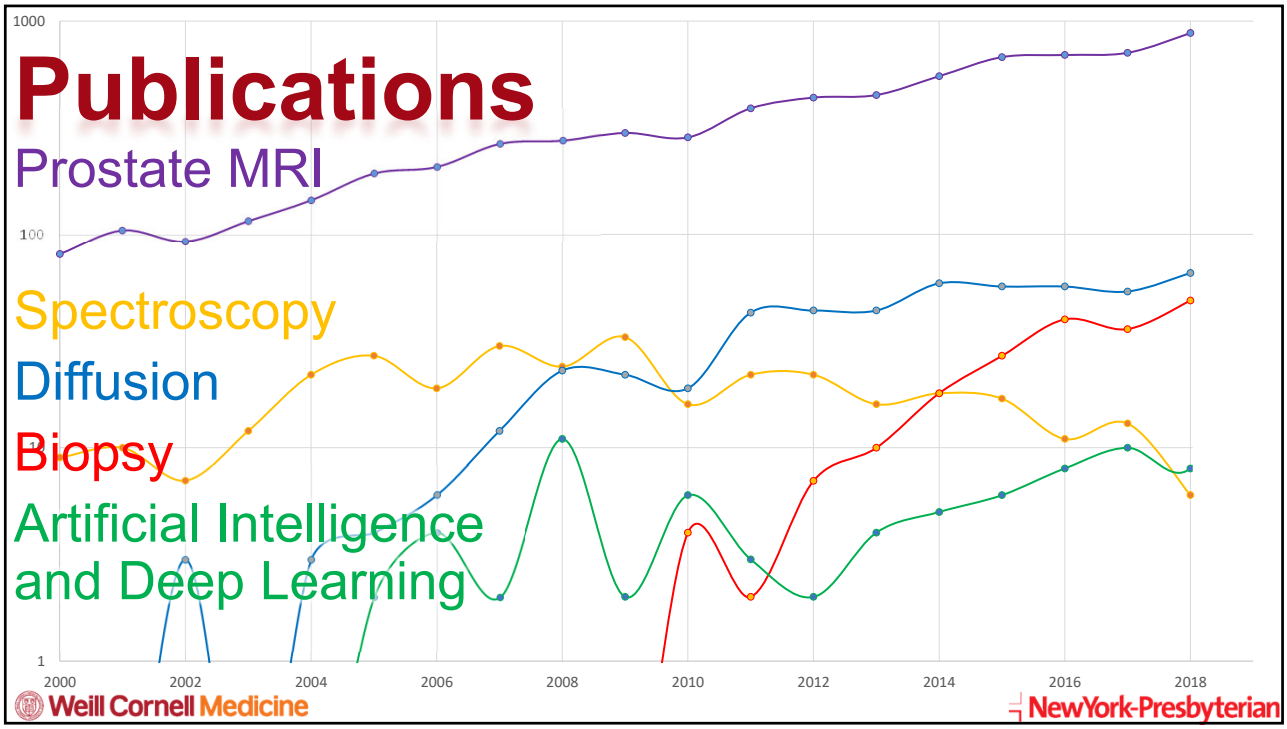
10


Publications
Prostate MRI
Spectroscopy
Diffusion
Biopsy
Artificial Intelligence
and Deep Learning
1000
100
1
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
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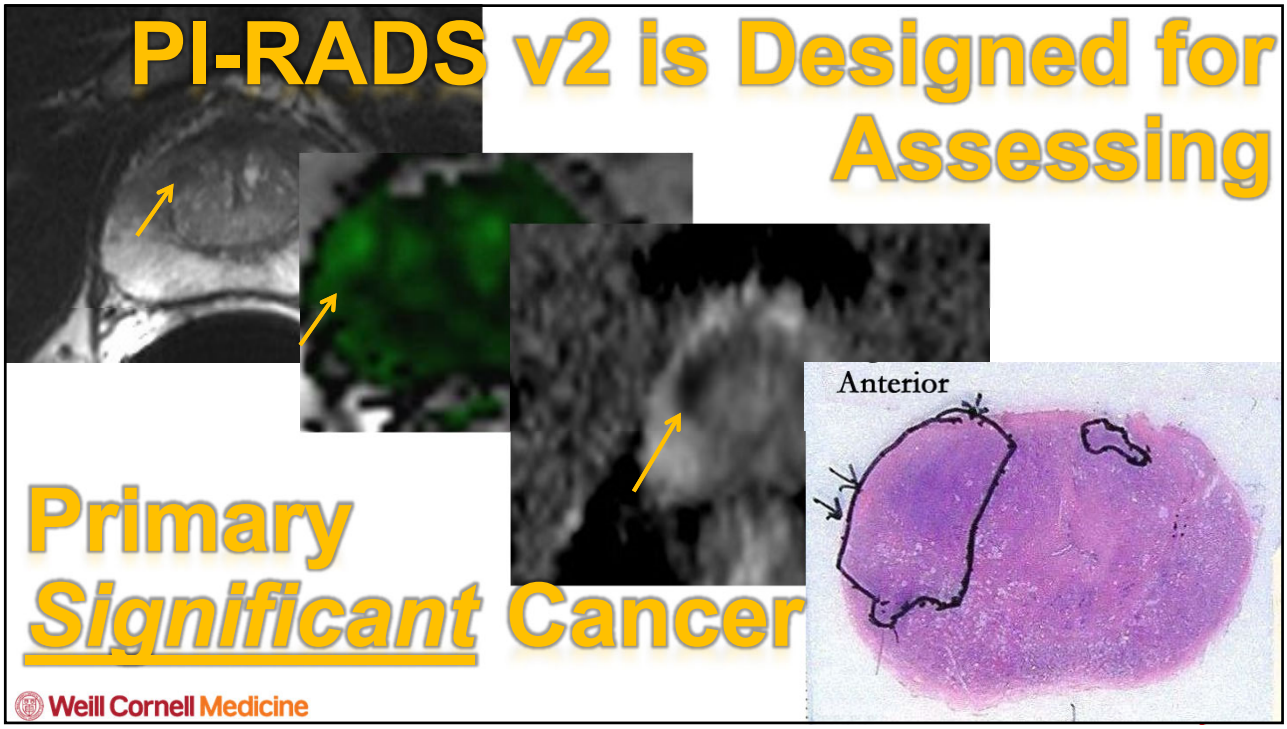
11


PI-RADS v2 is Designed for Assessing
Primary Significant Cancer
Anterior
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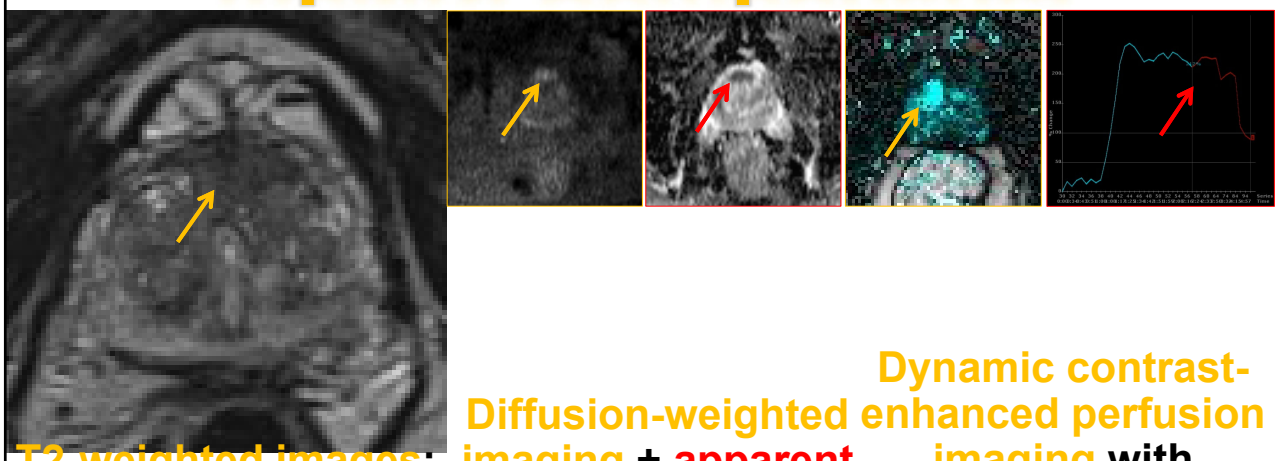
12

mpMRI Components



T2-weighted images: transition zone characterization & staging

Diffusion-weighted imaging + **apparent diffusion coefficient map**: most specific

Dynamic contrast-enhanced perfusion imaging with optional **enhancement curve**: most sensitive

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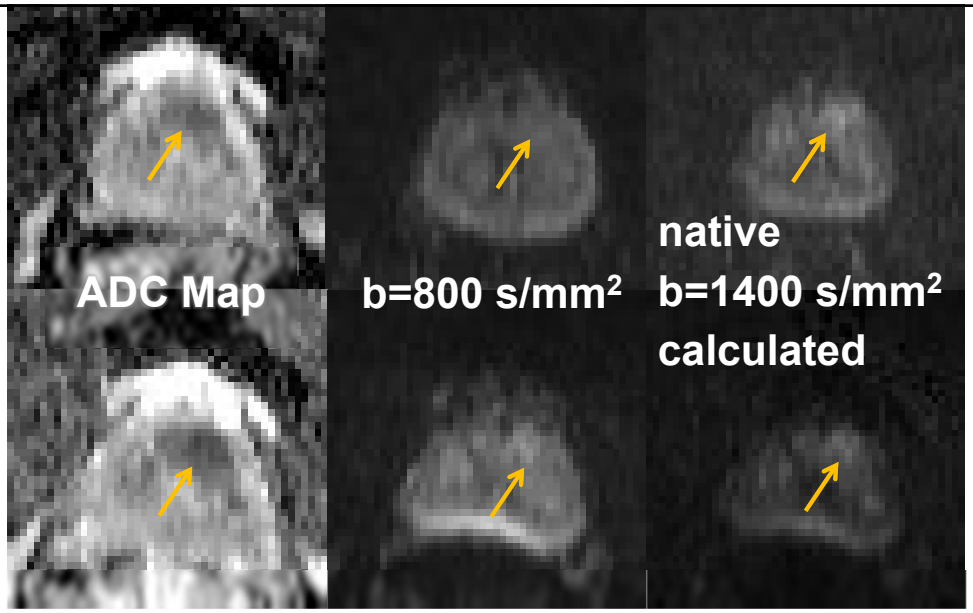
13



High b-value DWI Is Crucial

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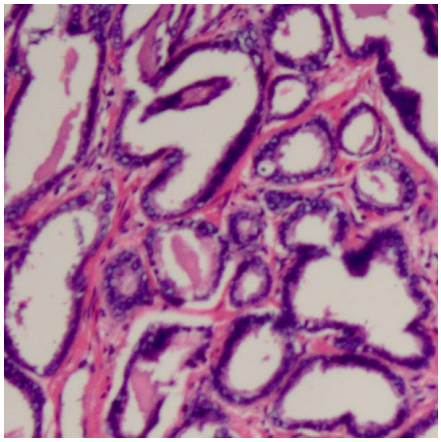
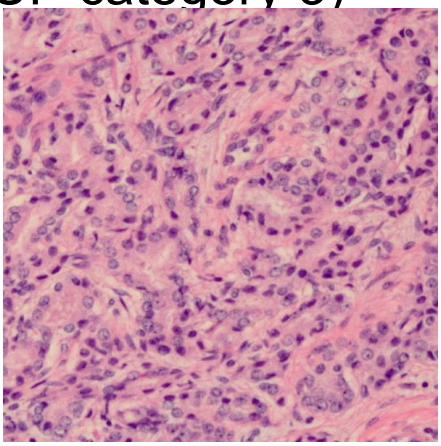
14

DWI Connotes Cellularity

- Low Grade: Gleason 3+3 (ISUP category 1)



- High Grade: Gleason 4+3
- (ISUP category 3)



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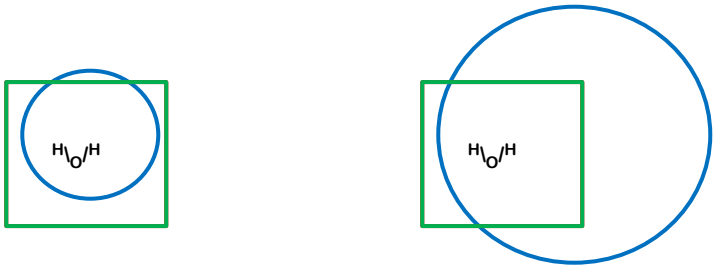
15

Diffusion-Weighted Imaging

Cell Low b-value High b-value



Restricted Unrestricted

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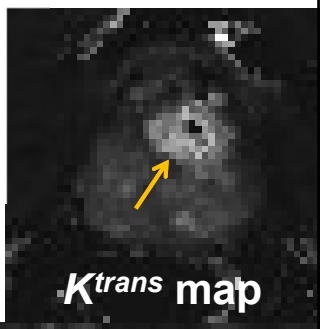
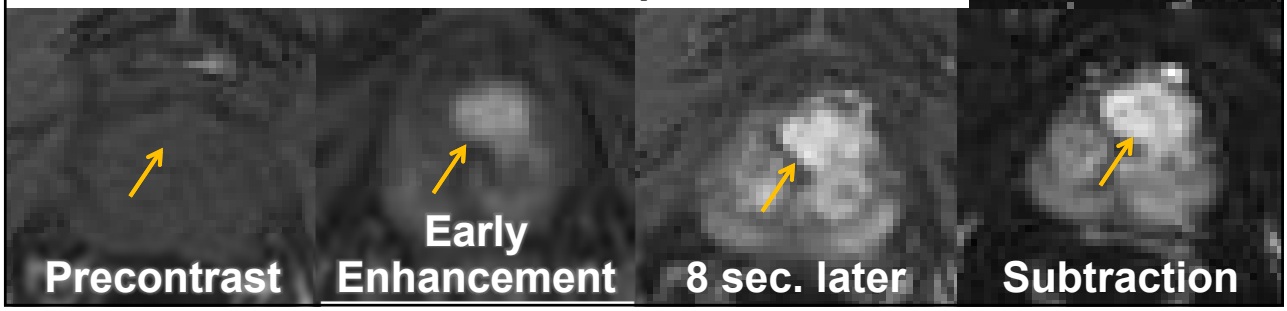
16

Dynamic Contrast Timing Is Also Crucial

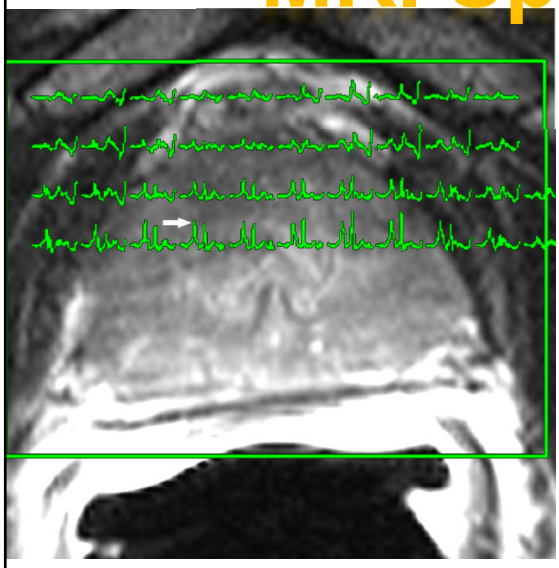
Pharmaco-kinetic maps automatically find the early enhancement time point.





17

MRI Spectroscopy



- Technically very demanding
- Adds least to AUC for cancer characterization
- Poorest spatial resolution
- But – most specific

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18

Quality Standards Defined for Minimum Acceptable Quality

- Endorectal coil may be necessary
  - Resolution of capsule
  - Poor gradient performance
- DWI, DCE parameters
- Artifacts, e.g. hemorrhage

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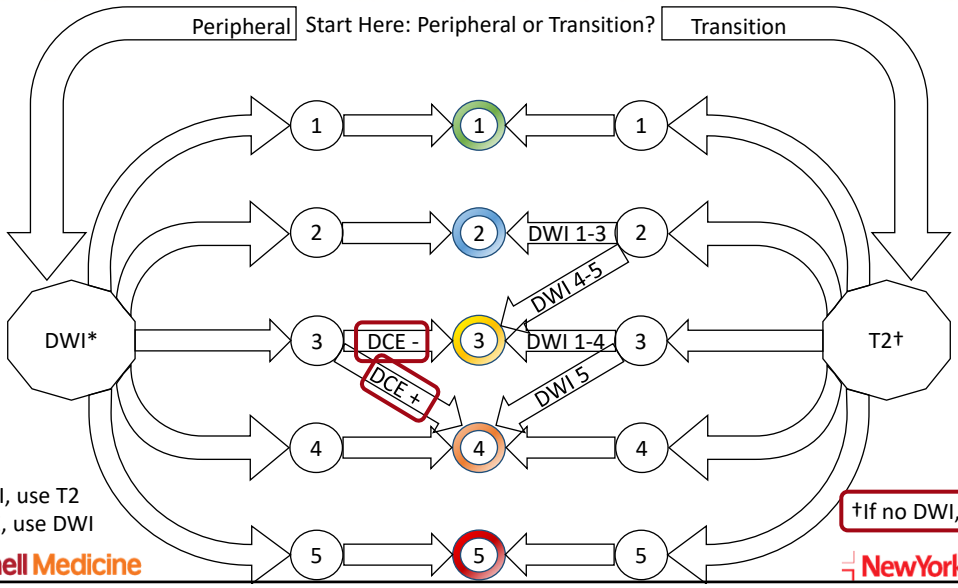
19

Assess Based on Flow Chart



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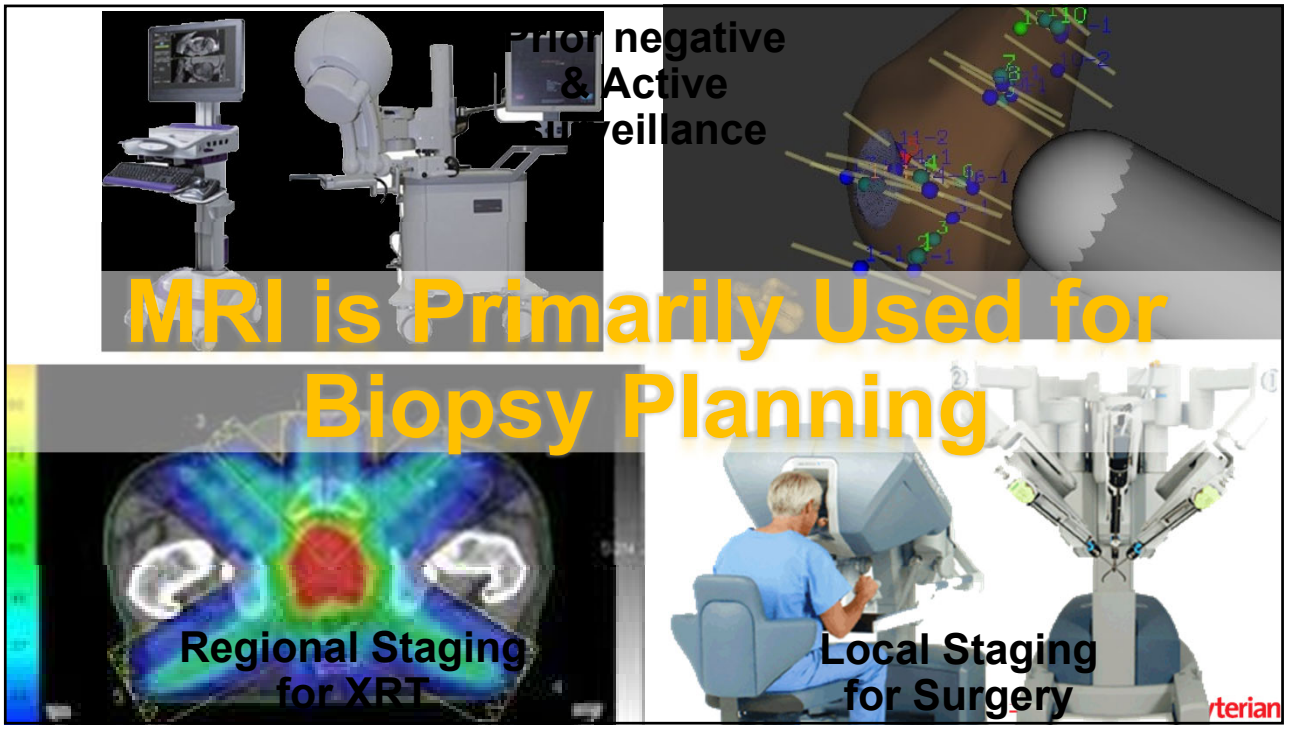
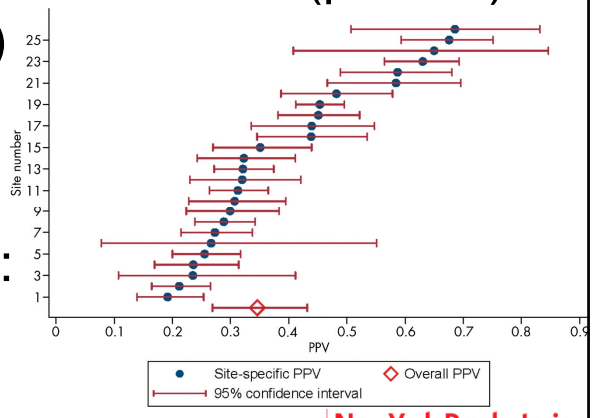
20



21

Level 1 Evidence

- PRECISION: targets 39%, systematic 27% csPCa
- Dutch 4M: targets 25%, systematic 23% (p=0.17)
- MRI-FIRST (intra-individual)
  - Targets only: 20%
  - Systematics only: 14%
  - Both: 66%
- 26-center metanalysis 2020:
  - PI-RADS>2: 35% PPV
  - PI-RADS>3: 49% PPV



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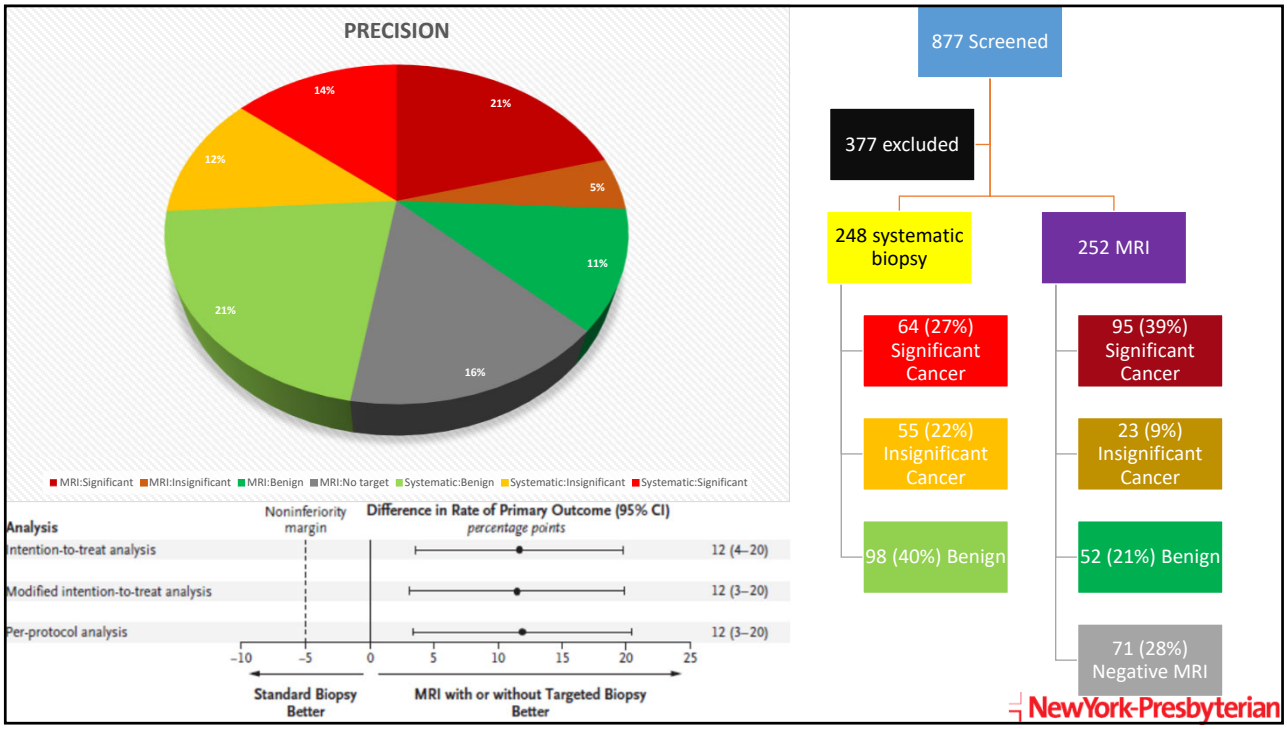

23

AUA+NCCN Recommend Targeted Biopsy After Negative Systematic

National Comprehensive Cancer Network®

NCCN Guidelines Version 2.2015
Prostate Cancer Early Detection

NCCN Guidelines Index
Prostate Early Detection TOC
Discussion

INDICATIONS FOR BIOPSY

PSA >3.0 ng/mL[d] → • Repeat PSA • DRE • Workup for benign disease →

- TRUS-guided biopsy → See Management of Biopsy Results (PROSD-4)
- or
- Follow up in 6–12 mo with PSA/DRE[e]
- or
- Percent free PSA, 4Kscore, or phi[e]

TRUS-GUIDED BIOPSY
Initial and Repeat
Extended-pattern biopsy (12 cores)

- Number of cores:
  - Sextant (6),
  - Lateral peripheral zone (6), and
  - Lesion-directed at palpable nodule or suspicious image
- Anteriorly directed biopsy is not supported in routine biopsy. However, the addition of a transition zone biopsy to an extended biopsy protocol may be considered in a repeat biopsy if PSA is persistently elevated.
- Multiparametric MRI may help identify regions of cancer missed on prior biopsies and should be considered in selected cases after at least 1 negative biopsy.
- For high-risk men with negative biopsies, consideration can be given to a saturation biopsy strategy (including transperineal techniques) and/or the use of multiparametric MRI followed by an appropriate biopsy technique based on the results.
- Local anesthesia can decrease pain/discomfort associated with prostate biopsy and should be offered to all patients.

Prostate Magnetic Resonance Imaging and Magnetic Resonance Imaging Targeted Biopsy in Patients with a Prior Negative Biopsy: A Consensus Statement by AUA and SAR

0022-5347/16/1966-1613/0
THE JOURNAL OF UROLOGY®
http://dx.doi.org/10.1016/j.juro.2016.06.079
Vol. 196, 1613-1618, December 2016
Printed in U.S.A.

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24

AUA+NCCN Recommend Targeted Biopsy After Negative Systematic

National Comprehensive Cancer Network®

NCCN Guidelines Version 2.2019
Prostate Cancer Early Detection

NCCN Guidelines Index
Table of Contents
Discussion

INDICATIONS FOR BIOPSY[h]

- Repeat PSA
- DRE, if not performed during initial risk assessment
- Workup for benign disease

→

- Consider biomarkers that improve the specificity of screening[i]
- Consider multiparametric MRI[j,m]

→

MANAGEMENT

Transrectal ultrasound-(TRUS) or transperineal-guided biopsy with MRI targeting[k,n]

or

TRUS-guided biopsy[k]

or

Follow-up in 6–12 mo with PSA/DRE[i,l]

→ See Management of Biopsy Results (PROSD-4)

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25

PI-RADS Steering Committee: The PI-RADS Multiparametric MRI and MRI-directed Biopsy Pathway

Anwar R. Padhani, MBBS, MRCP, FRCR • Jelle Barentsz, MD, PhD • Geert Villeirs, MD, PhD • Andrew B. Rosenkrantz, MD • Daniel J. Margolis, MD • Baris Turkbey, MD • Harriet C. Thoeny, MD • François Cornud, MD • Masoom A. Haider, MD • Katarzyna J. Macura, MD, PhD • Clare M. Tempany, MB, BAO, BCH • Sadhna Verma, MD • Jeffrey C. Weinreb, MD

Radiology 2019; 292:464–474

About 33% (26-41) have PI-RADS 1-2 scans

No cancer/benign 74% (69-81)

ISUP=1: 18% (14-24)

ISUP≥2: 8% (6-12)

100 biopsy naïve men with PI-RADS 1-2 MRI undergoing systematic biopsies only

About 67% (57-74) have PI-RADS 3-5 scans

No cancer/benign 29% (23-35)

ISUP=1: 21% (17- 27)

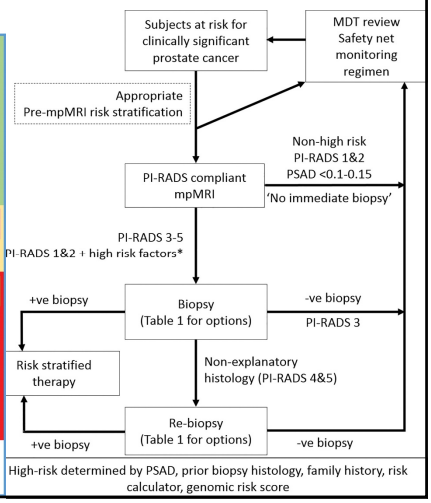
ISUP=1: 4% (2-7)

ISUP≥2: 5% (3-8)

ISUP≥2: 44% (39-50)

100 biopsy naïve men with PI-RADS 3-5 MRI undergoing MRI-directed and systematic biopsy

- No cancer diagnosed after biopsy.
- Insignificant cancers (ISUP grade = 1) detected by MRI-directed and systematic biopsy.
- Proportion of insignificant cancers (ISUP group = 1) found by systematic biopsy cores.
- Significant cancers (ISUP grade ≥ 2) detected by MRI-directed and systematic biopsy.
- Proportion of significant cancers (ISUP grade ≥ 2) found by systematic biopsy; undetected by MRI-directed biopsies.



26

Comparison by Indication

Aspect	Stage	Index	Pulse Sequence	ER Coil
Biopsy	T2	Center	All	**
Surgery	T2>T3	Borders	T2	***
XRT	T2<T3	Mets	DWI	*
Focal	T2	Size	DCE	**

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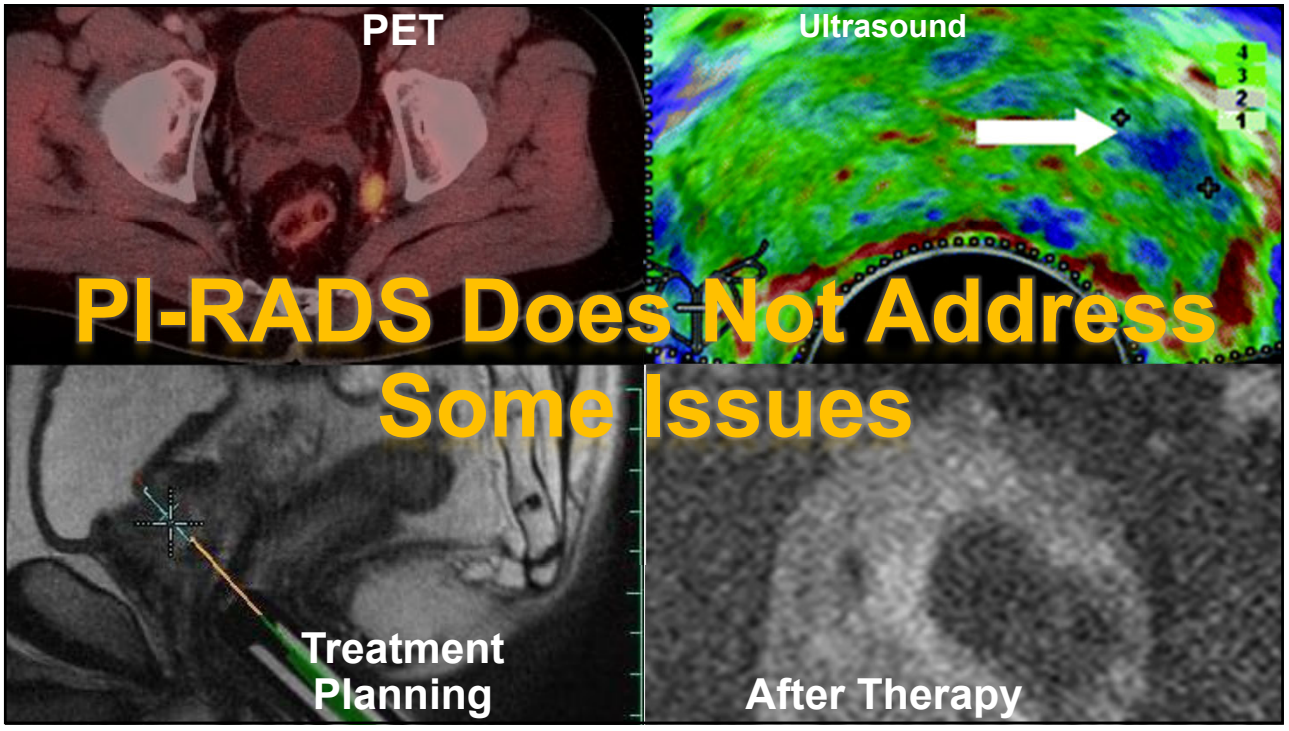
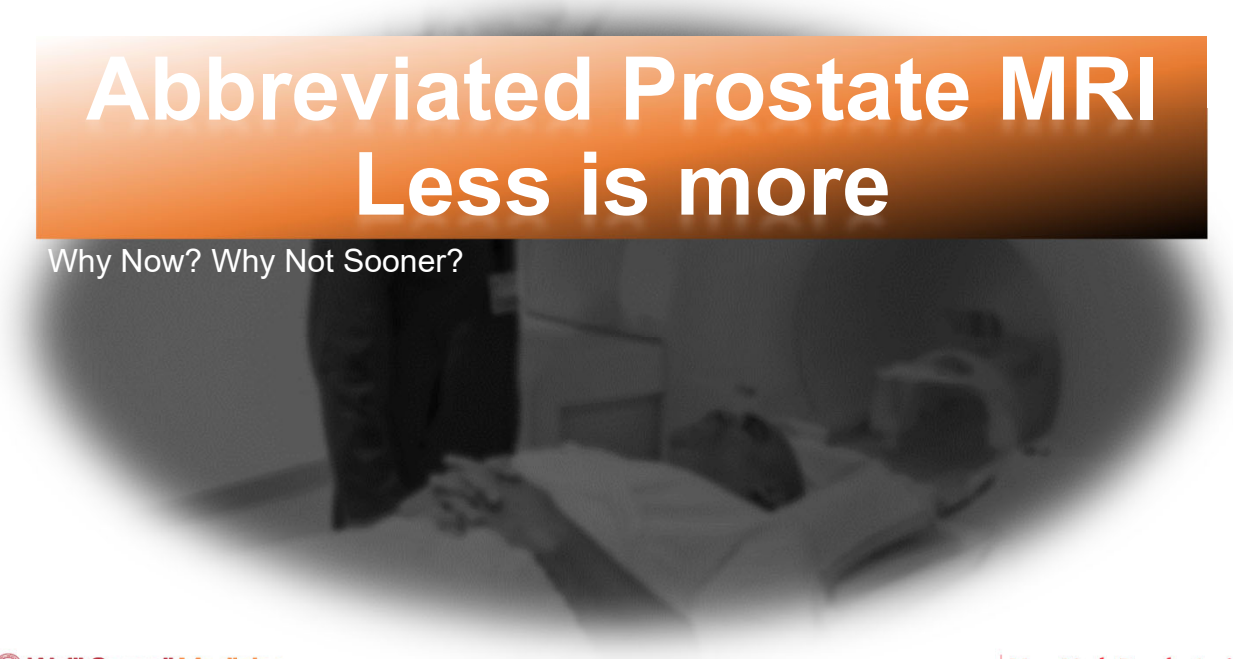
27



28

Abbreviated Prostate MRI
Less is more

Why Now? Why Not Sooner?



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29

Comparison: Process

Aspect	bpMRI	mpMRI
Preparation	Low-residue diet	Low-residue diet, 3 hour fast
Safety screening	Metal	Metal, allergies
Personnel	Intake, technologist	Intake, nurse, technologist
IV placement	No	Yes
Scan time	~15 minutes	~half an hour

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30

Comparison of Timing

Pulse Sequence	bpMRI (min)	mpMRI (min)
Two/Three-plane T2	8	11
Diffusion-weighted	5	5
T1 full pelvis	0.5	0.5
T2 full pelvis		2
Dynamic contrast		5
Post-contrast pelvis		0.5
Total	13.5	24

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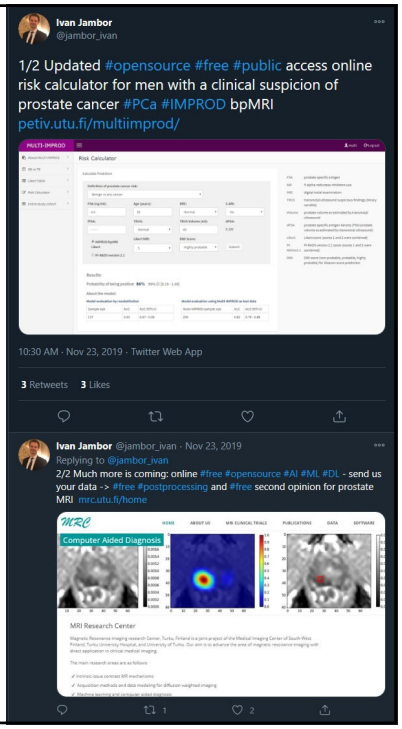
31

Equivalent Detection of Cancer

- Multiple multisite studies show bpMRI = mpMRI for detection of primary cancer
  - Not established for recurrent disease
  - Most studies excluded cases with quality issues
- Online teaching and assessment



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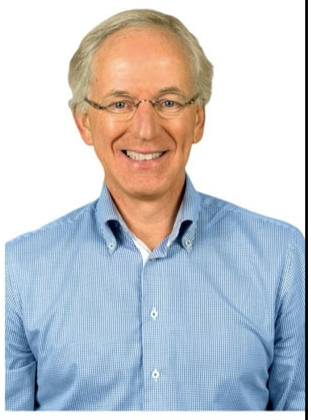
32

Training is Key

- Education stresses mpMRI
- More bpMRI cases available
- Retraining for radiologists and surgeons used to mpMRI

ICIS
International Cancer Imaging Society

FREE November Webinar with Prof. Jelle Barentz
University Hospital Nijmegan



'Pros and cons of bpMRI vs mpMRI in prostate'

Join us on 25 November 2020 at:
NYC 8am / London 1pm / Berlin 2pm / Beijing 8pm / Sydney 11pm
Register at icimagingsociety.org.uk

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33

Why *Not* bpMRI?

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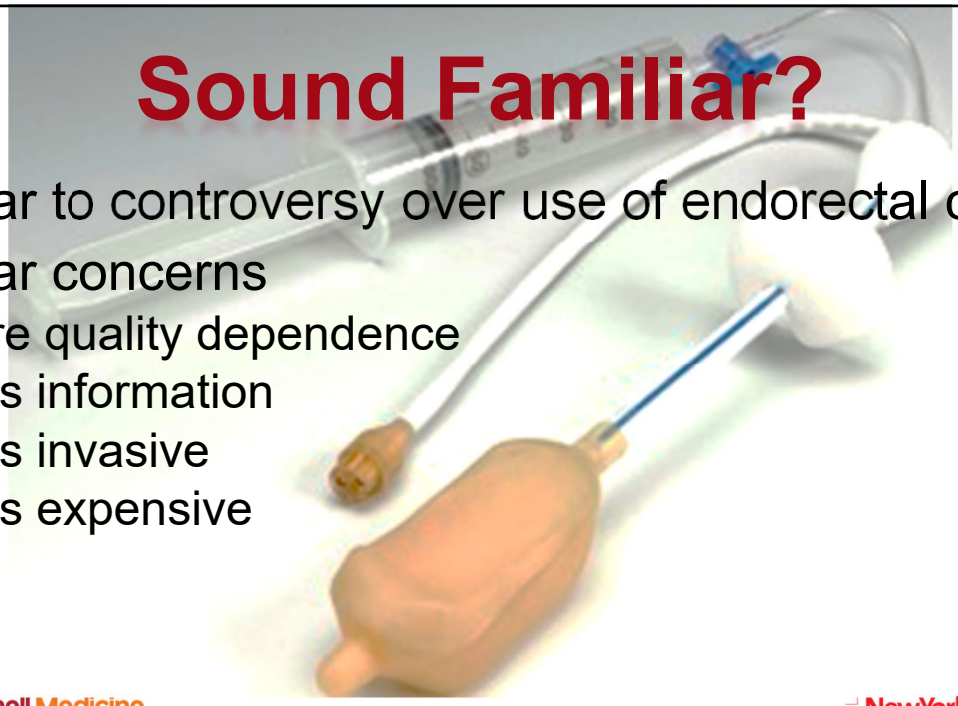
34

Sound Familiar?

- Similar to controversy over use of endorectal coil
- Similar concerns
  - More quality dependence
  - Less information
  - Less invasive
  - Less expensive



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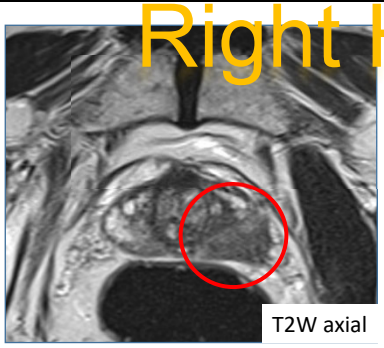
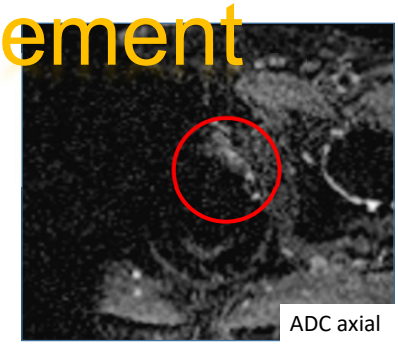
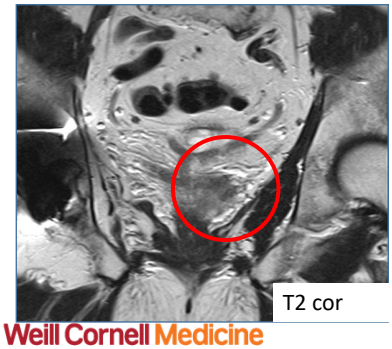
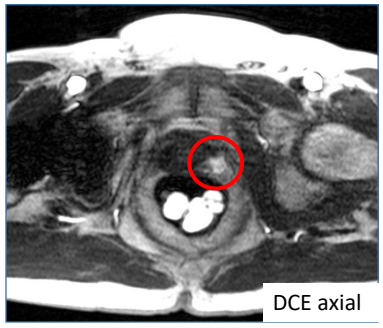
35

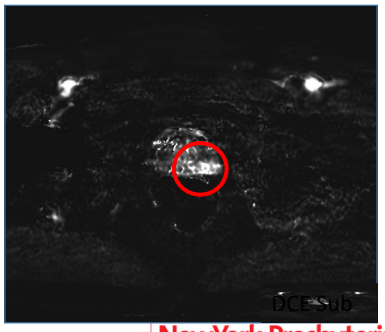
Right Hip Replacement











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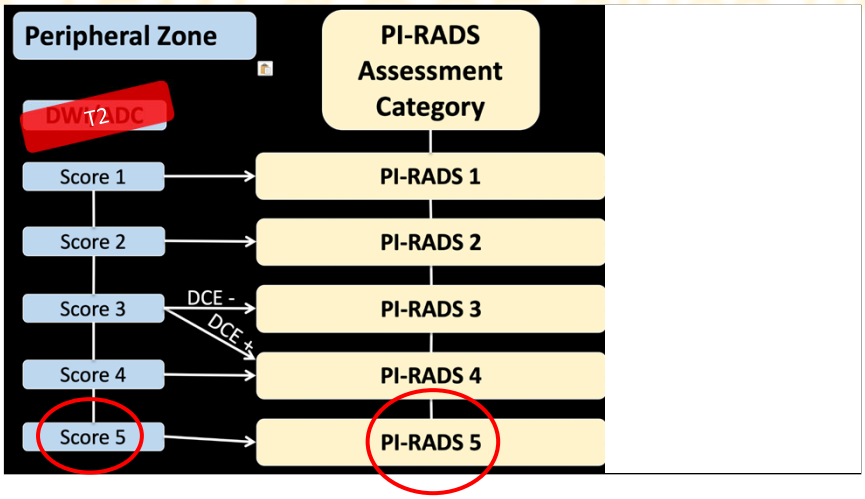
36

Overall PI-RADS Assessment Use T2WI & DCE since no DWI



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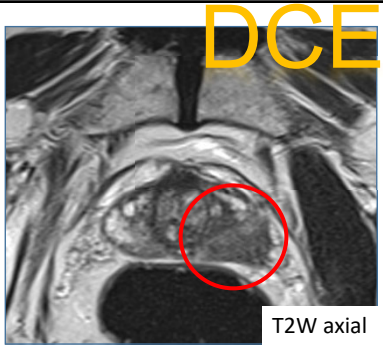
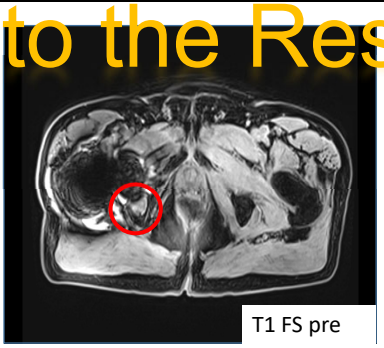
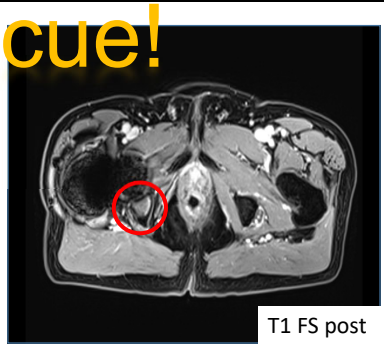
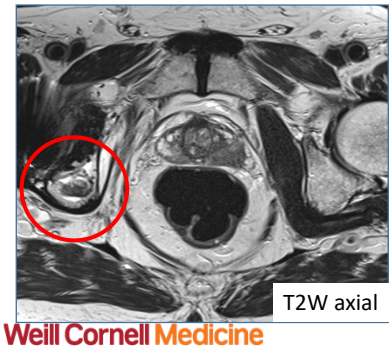
37

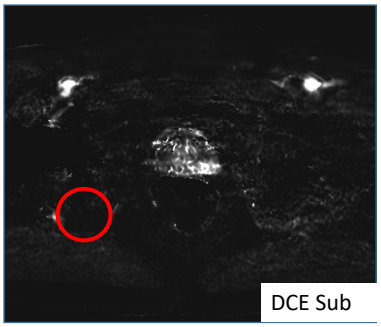
DCE to the Rescue!

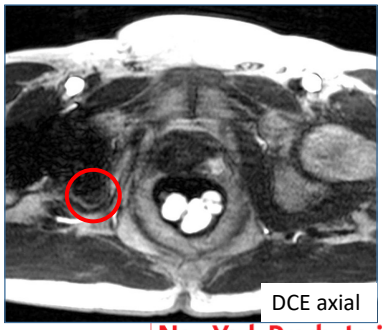

T2W axial


T1 FS pre


T1 FS post


T2W axial


DCE Sub


DCE axial

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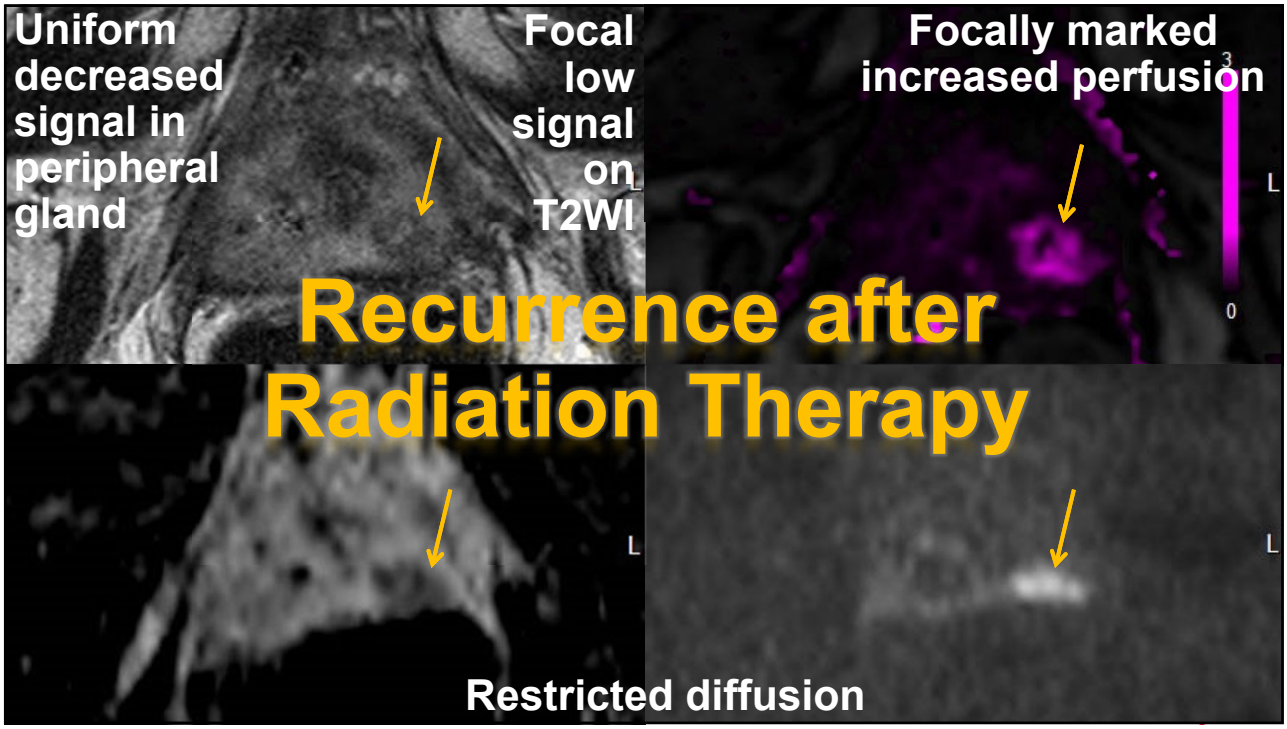
38

Contrast-Enhanced MRI

- Susceptibility artifact from hip replacement
- DWI failed
- T2 category 5 = overall category 5
- DCE confirms but does not modify suspicion level
- Bone lesion without enhancement likely benign

39



40

Before and After Radiation Therapy

- Bilateral foci of restricted diffusion and increased perfusion are inconspicuous on T2-weighted images
- T2 and ADC signal decreases, as does perfusion, the latter showing response
- Catheter defects

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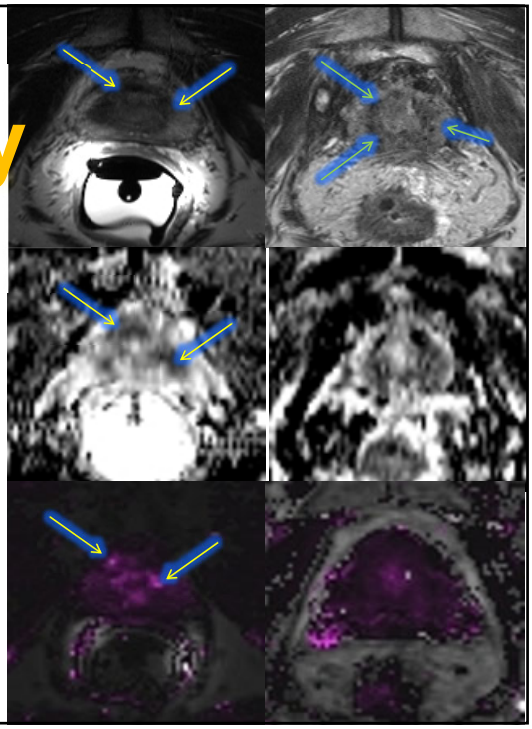
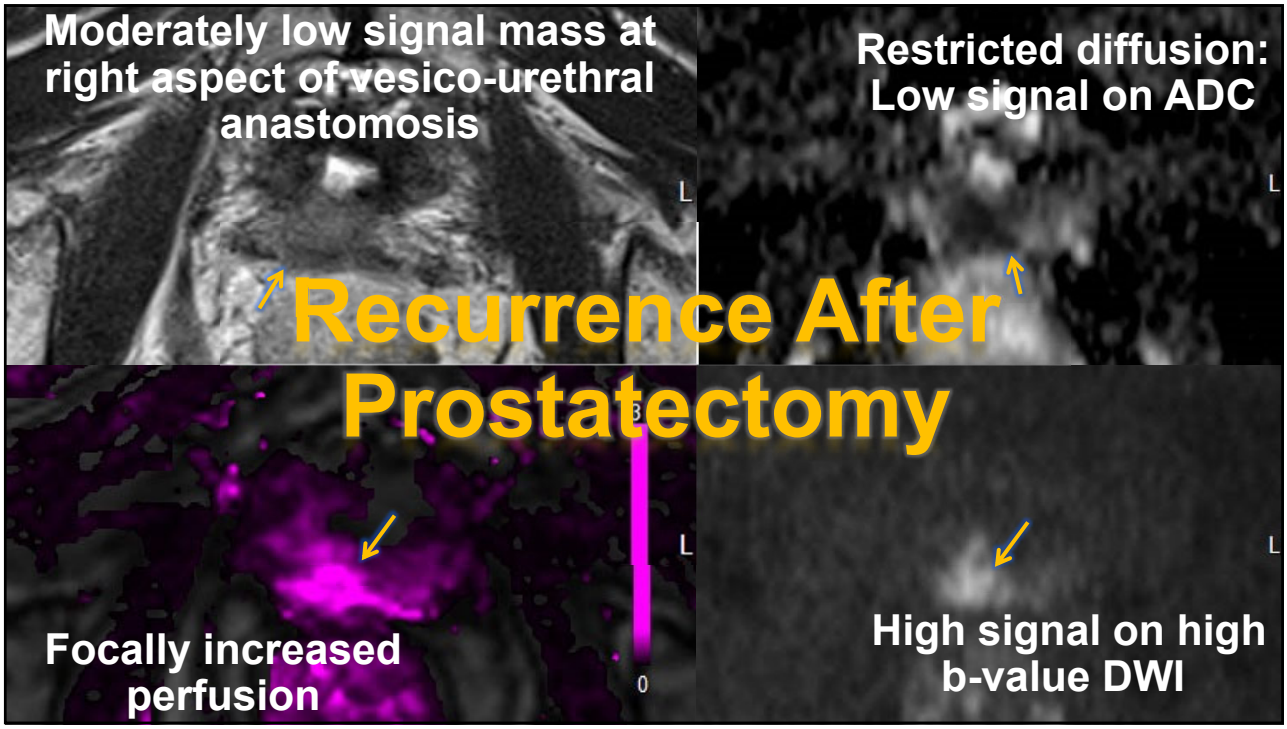
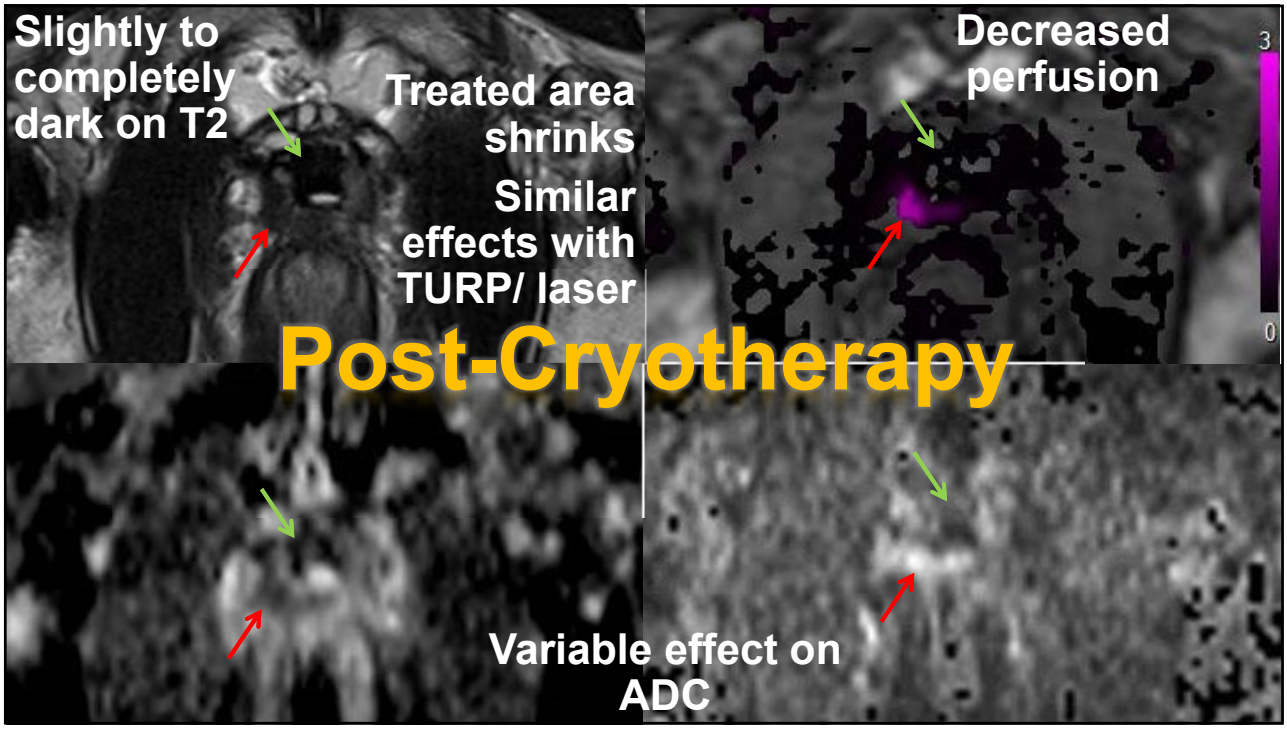


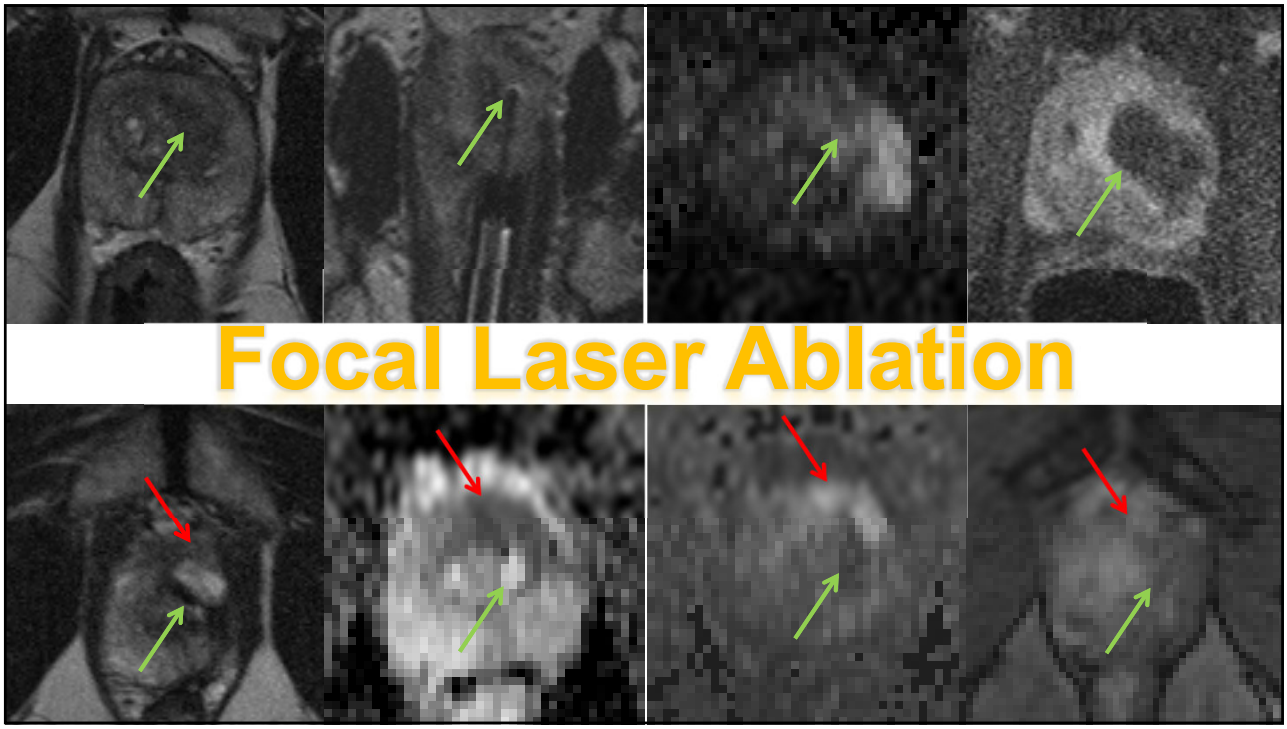
41



42


Slightly to completely dark on T2
Treated area shrinks
Similar effects with TURP/ laser
Decreased perfusion
3
0
Post-Cryotherapy
Variable effect on ADC

43


Focal Laser Ablation

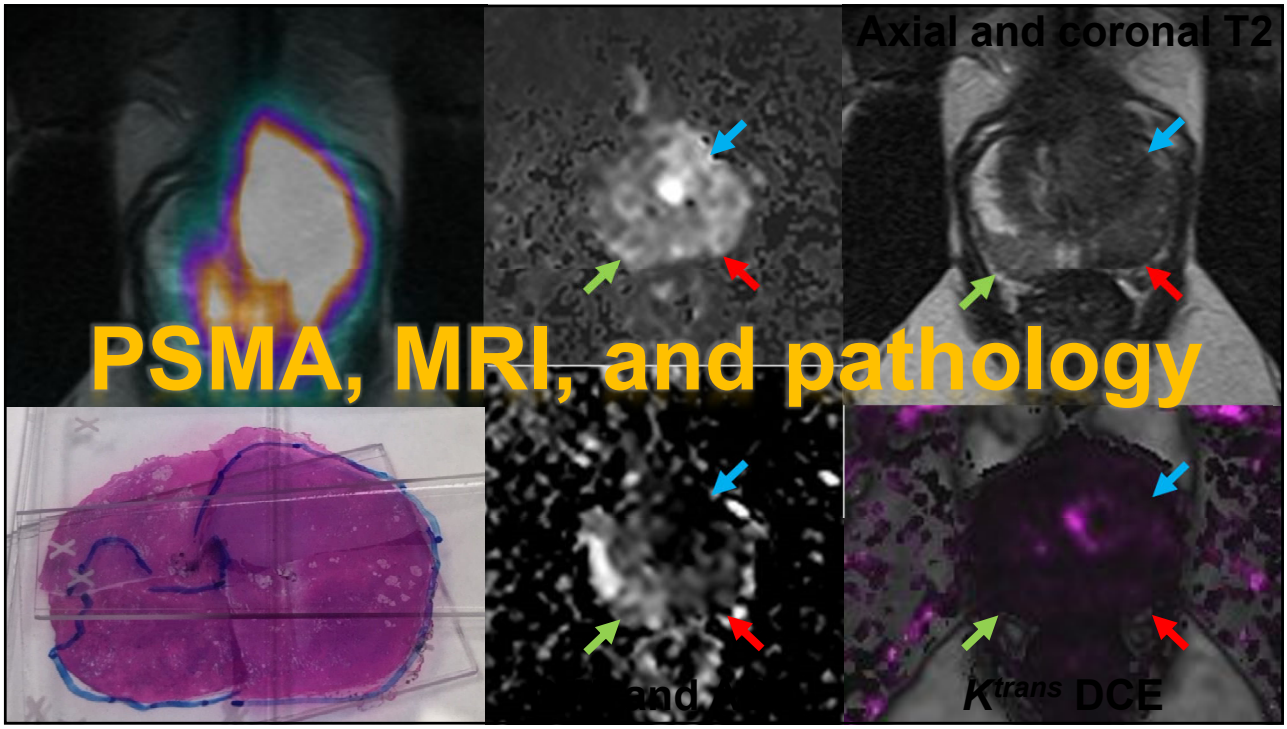
44

Post-Treatment Imaging

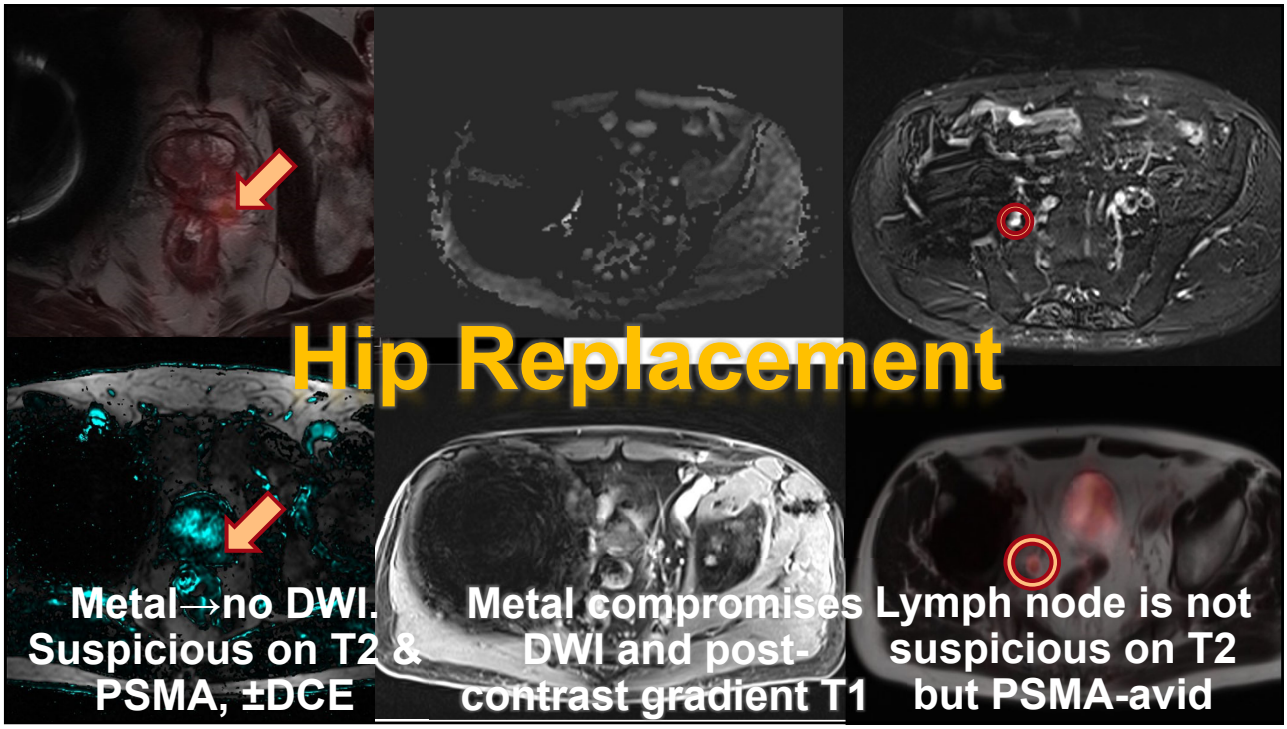
- Radiation, hormones ↓T2 & ADC, also DWI & DCE
- ↓Specificity: entire gland abnormal
- Asymmetry, high-b DWI, DCE→detect
- PI-RADS actual likelihood uncertain
- Focal therapy ≈ focal atrophy
- Prostatectomy: enhancing nodule + restricted diffusion

Multiparametric MRI for Therapy Response

- Assessment and reporting standards forthcoming
- DCE best indicator, difficult to quantify
- ADC quantifies response
  - Protocol-dependent
- T2 can be difficult to interpret


Axial and coronal T2
PSMA, MRI, and pathology
and
Ktrans DCE

47


Hip Replacement
Metal→no DWI. Suspicious on T2 & PSMA, ±DCE
Metal compromises DWI and post-contrast gradient T1
Lymph node is not suspicious on T2 but PSMA-avid

48

Take-Home Points

- ***Bi-parametric*** MRI: T2+diffusion-weighted imaging
  - No contrast-enhanced imaging
- Validated for cancer detection
- Pitfalls
  - Artifacts: hip replacement, motion, rectal distention
  - Post-treatment
  - Requires greater experience
  - More category 3 lesions

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49

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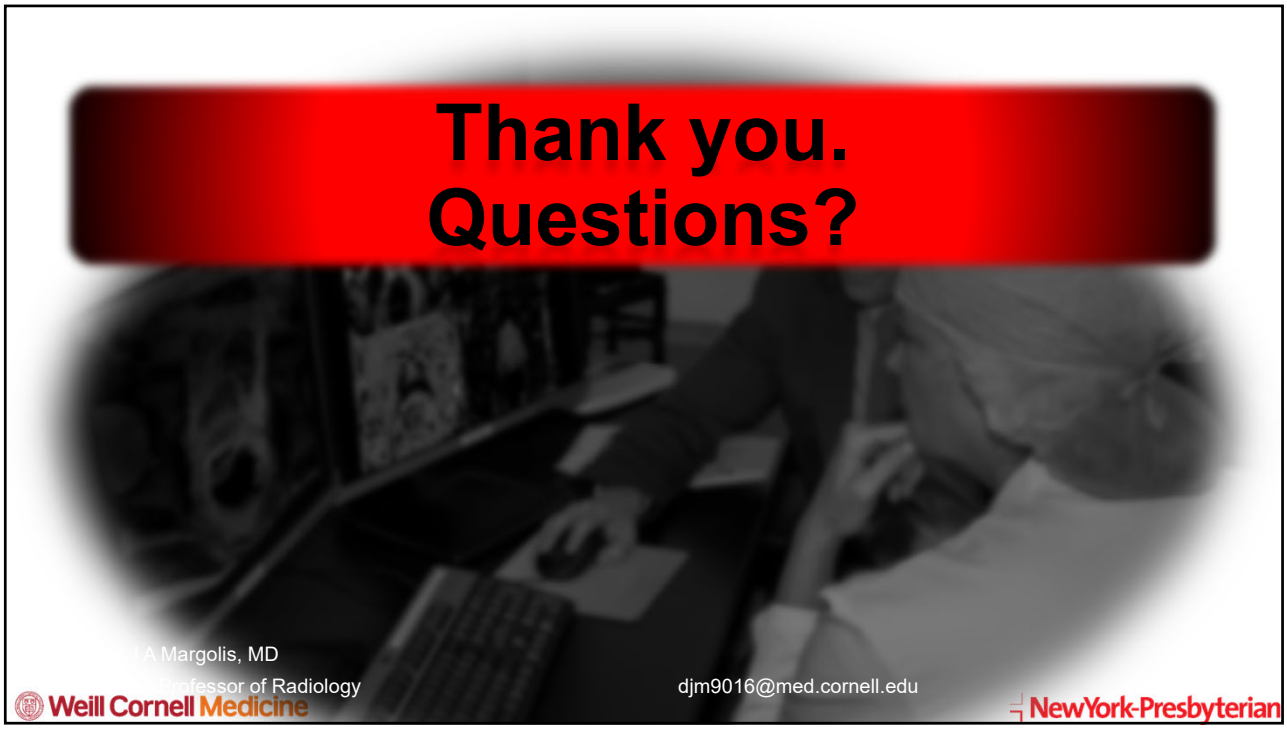
50


Thank you.
Questions?
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51