Optimizing Implementation of Prostate MRI

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Objectives

• To review the basic components of a state-of-the-art mpMRI of the prostate
• To discuss the Prostate Imaging Reporting and Data System (PI-RADS) version 2
• To describe the key components of a Prostate Imaging Program
• To list resources available and under development to assist in the implementation and maintenance of a prostate imaging program
Evolution of Prostate MRI

Magnetic Resonance Imaging of the Prostate\textsuperscript{1}

Radiology 1985; 154: 143–149
Evolution of Prostate MRI

Prostatic Carcinoma: Staging by Clinical Assessment, CT, and MR Imaging

Radiology 1987; 162:331-336

Hedvig Hricak, MD • Georges C. Dooms, MD² • R. Brooke Jeffrey, MD
• Anthony Avallone, MD • Don Jacobs, MD • William K. Benton, MA
• Perinchery Narayan, MD • Emil A. Tanagho, MD
Evolution of Prostate MRI

Prostate: MR Imaging with an Endorectal Surface Coil

Mitchell D. Schnall, MD, PhD
Robert E. Lenkinski, PhD
Howard M. Pollack, MD
Yutaka Imai, MD
Herbert Y. Kressel, MD

Radiology 1989; 172:570-574

0.15 Tesla Magnet
Evolution of Prostate MRI

• State-of-the-art technique
  – 1.5 or 3.0 T
  – Pelvic coil with or without ER coil

• Pulse Sequences:
  – Multiplanar T2
  – DCE
  – DWI/ADC
  – T1 small FOV
  – T1 large FOV post contrast

Multiparametric

Post-Bx “hemorrhage”

Lymph nodes/bone mets
Prostate MRI Pulse Sequences

• T2-WI
  – Detailed anatomic information – staging
  – Dominant parameter for TZ lesions
Prostate MRI Pulse Sequences

- **T2-WI**
  - Detailed anatomic information – staging
  - Dominant parameter for TZ lesions

![PCa](image1.png) ![BPH Nodules](image2.png)
Prostate MRI Pulse Sequences

- DWI /ADC map
  - Tissue microarchitecture and cellularity
  - Inverse correlation with Gleason score
  - Dominant parameter for PZ lesions

No impended diffusion

Markedly impended diffusion
• DWI /ADC map
  – Tissue microarchitecture and cellularity
  – Inverse correlation with Gleason score
  – Dominant parameter for PZ lesions
Prostate MRI Pulse Sequences

- **DCE**
  - Tissue vascularity
  - PCa: poorly formed vessels with ↑ permeability
Prostate MRI Pulse Sequences

- DCE
  - Tissue vascularity
  - PCa: poorly formed vessels with ↑ permeability
Prostate Imaging Reporting and Data System

- Version 1 (2012)
- AdMeTech Foundation’s International Prostate MRI Working Group and the European Society of Urogenital Radiology (ESUR)
- Clinical guidelines for mpMRI based on evidence from the literature and consensus expert opinion
- Included a structured reporting system (PI-RADS)
Prostate Imaging Reporting and Data System

• Version 2 (2014)
• ACR, ESUR, and the AdMeTech Foundation
• Establishing minimum acceptable technical parameters;
  ✓ Standardizing radiology reports to enhance communication among radiologists and referring physicians;
  ✓ Developing assessment categories that summarize levels of suspicion or risk for clinically significant PCa, so that they can be used to triage patients to appropriate management;
  ✓ Promoting research and quality assurance that will ultimately lead to improvement in patient outcomes
• Version 2 (2014)
• Critical components:
  ✓ Standardized lexicon facilitating consistent use of a uniform terminology for describing imaging findings,
  ✓ Revised systems for scoring the level of suspicion with individual MRI pulse sequences,
  ✓ Standardized scheme for deriving an overall assessment category that is based on the scores assigned to the findings from pulse sequences
Prostate Imaging Reporting and Data System
What’s new on V.2?

- **Peripheral zone:**
  - Final score based on ADC/DWI
  - DWI should include high b-value (>1500)
  - P3: mildly low SI on ADC and mildly low on DWI

- **Transition zone:**
  - Final score based on T2

- **DCE:**
  - Decreased role
  - Positive (focal rapid enhancement) or negative

- **MRSI:**
  - Abandoned
Prostate MRI interpretation

Peripheral Zone

Abnormality location

Transition Zone

DWI/ADC

Score 1

PI-RADS 1 – highly unlikely

Score 2

PI-RADS 2 – unlikely

Score 3

PI-RADS 3 – equivocal

Score 4

DCE -

DCE +

Score 5

PI-RADS 4 – likely

DWI ≤ 4

Score 3

Score 5

PI-RADS 5 – highly unlikely

Score 1

Score 2

Score 3

Score 4

Score 5
Prostate MRI interpretation

Peripheral Zone
  → Abnormality location
    → Transition Zone

DWI/ADC

Score 1
  → PI-RADS 1 – highly unlikely

Score 2
  → PI-RADS 2 – unlikely
  → PI-RADS 3 – equivocal

Score 3
  → PI-RADS 4 – likely
  → DCE -

Score 4
  → DCE +
  → PI-RADS 5 – highly unlikely

Score 5

Assessment Category

PI-RADS

Score 1
  → Score 1

Score 2
  → Score 2

Score 3
  → Score 3

Score 4
  → Score 4

Score 5
  → Score 5

T2-WI

DCE - DWI ≤ 4

DCE + DWI 5
Prostate MRI interpretation

Peripheral Zone

Abnormality location

Transition Zone

PI-RADS Assessment Category

Score 1

Score 2

Score 3

Score 4

Score 5

DWI/ADC

DCE -

DCE +

PI-RADS 1 – highly unlikely

PI-RADS 2 – unlikely

PI-RADS 3 – equivocal

PI-RADS 4 – likely

PI-RADS 5 – highly unlikely

T2-WI

Score 1

Score 2

Score 3

Score 4

Score 5

DCE ≤ 4

DWI ≥ 4
PI-RADS 1

DWI | ADC | T2-WI

PI-RADS 2

PI-RADS 3

< 1.5 cm and No EPE

PI-RADS 4

≥ 1.5 cm and/or EPE

PI-RADS 5
Prostate Imaging Reporting and Data System

- PI-RADS v2 document
  - Weinreb et al. (PMID: 26427566)
- PI-RADS Atlas
  - Available online
- Prostate MRI workshop
  - ACR Education Center, Reston VA
  - 2-day hands-on course 100+ cases and lectures
Prostate Imaging Program

• Key components for implementation:
  ✓ Engaged urologist
  ✓ Institutional support
  ✓ Local champion in the radiology department

• “The Director of Prostate Imaging”*

*Westphalen et al. PMID 28396916
• Roles of local champion
  • Collaborate with urologists and other referring physicians on institutional policies for imaging utilization;
  • Informal review and formal case discussions in conferences and tumor boards;
  • Evaluation of outside imaging examinations for quality and potential use in patient management;
  • Discussion of new imaging applications;
  • Troubleshooting individual cases as necessary.
Prostate Imaging Program

- Roles of local champion
- Radiology engagement
  - To assist in the improvement of consistency and accuracy of reports
  - Development and use of report templates
  - Training (baseline and continued)
  - Feedback system
Prostate Imaging Program

• Roles of Local champion
• Technologist engagement
  • Ensure consistent and adequate image quality
  • Development of imaging protocols ensuring they meet or exceed the parameters standardized by PI-RADS
Thank you!