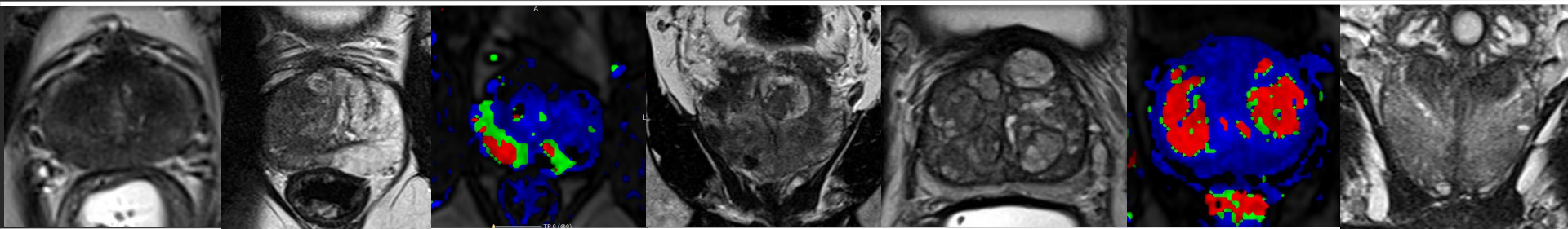


Pitfalls of Prostate MRI Interpretation



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Associate Professor of Radiology, Cleveland Clinic Lerner College of Medicine

Head, Abdominal Imaging Section, Diagnostics Institute

Staff, Nuclear Radiology and Glickman Urological and Kidney Institute

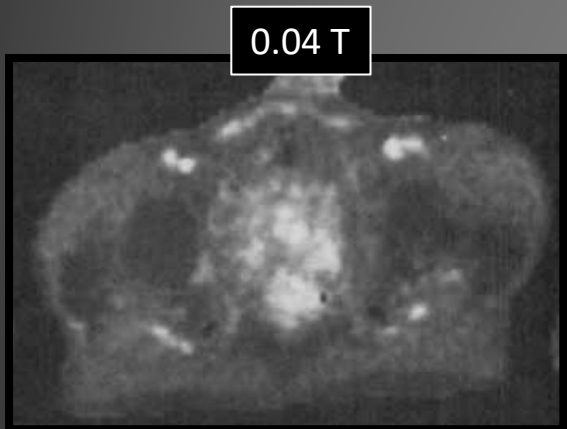
Cleveland Clinic

Disclosures

- Consulting agreement – Koelis
- Research support and consulting agreement with Blue Earth
Diagnostics

Introduction

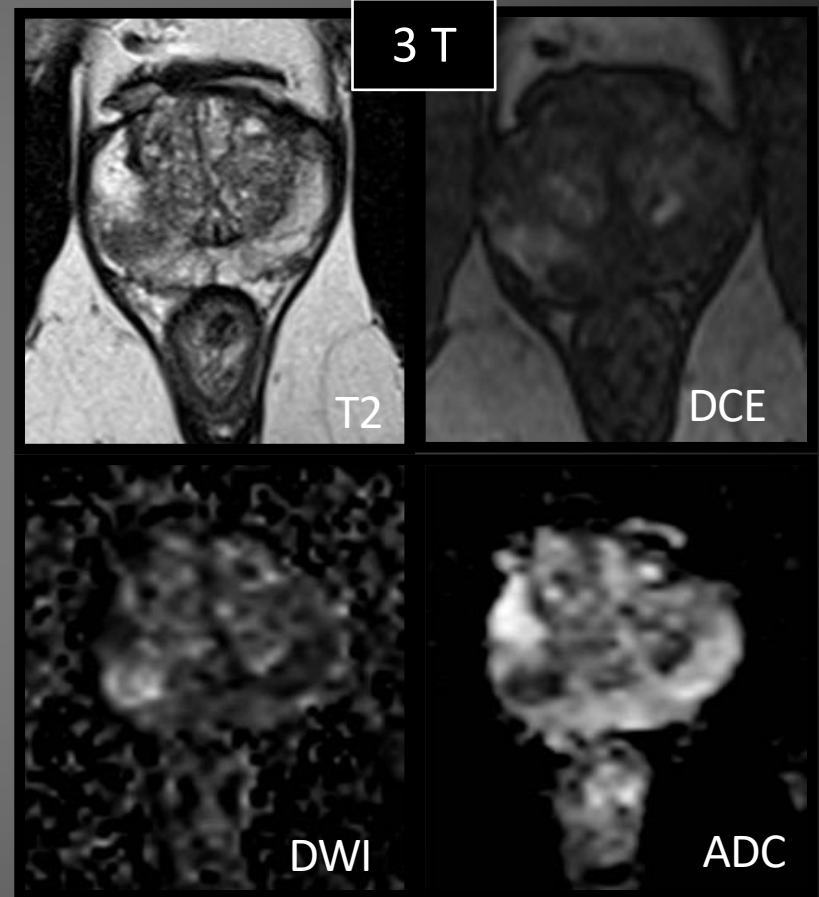
“How it started”



British Journal of Urology (1982), **54**, 726-728



“How it is going”



“PI-RADS 4 Lesion in the right mid posterolateral PZ”
Prostate Image Quality (PI-QUAL) score 5

Objective

- To review some of the important caveats in interpretation of mpMRI of the prostate listed on PI-RADS v2.1

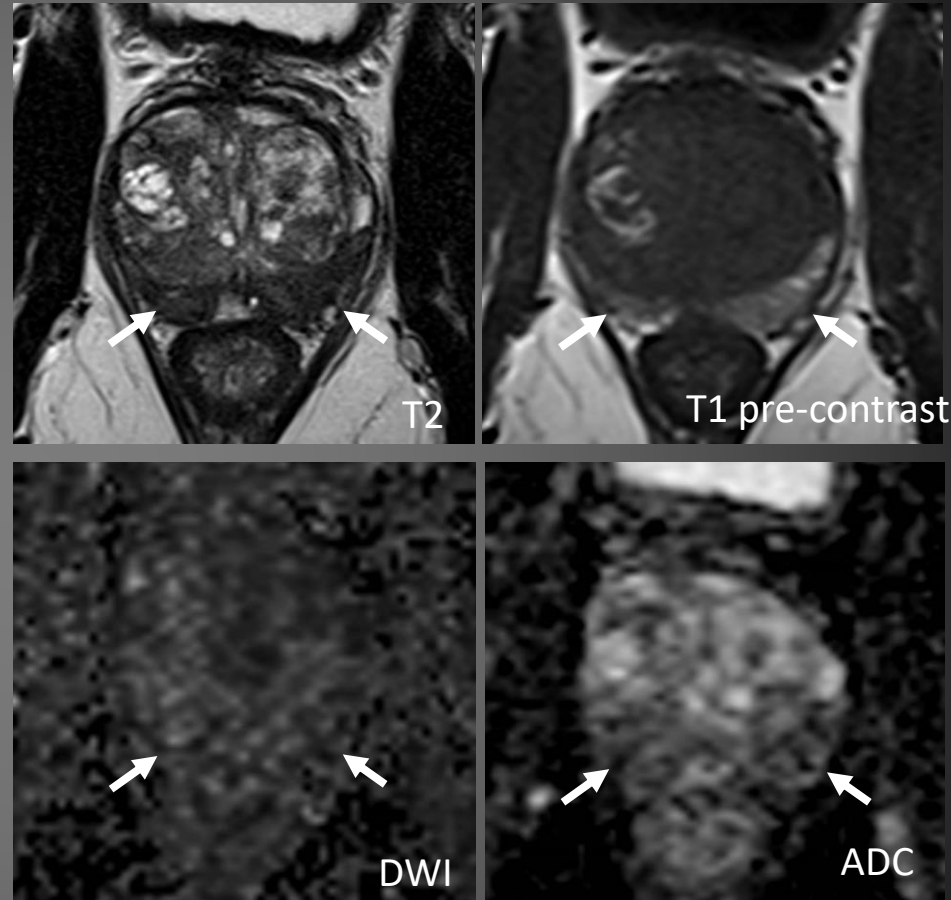
Content

- Post-biopsy hemorrhage
- Prostatitis
- Benign Prostatic Hyperplasia (BPH)
- Central Zone (CZ)
- Anterior fibromuscular stroma (AFS)

Post-biopsy

hemorrhage

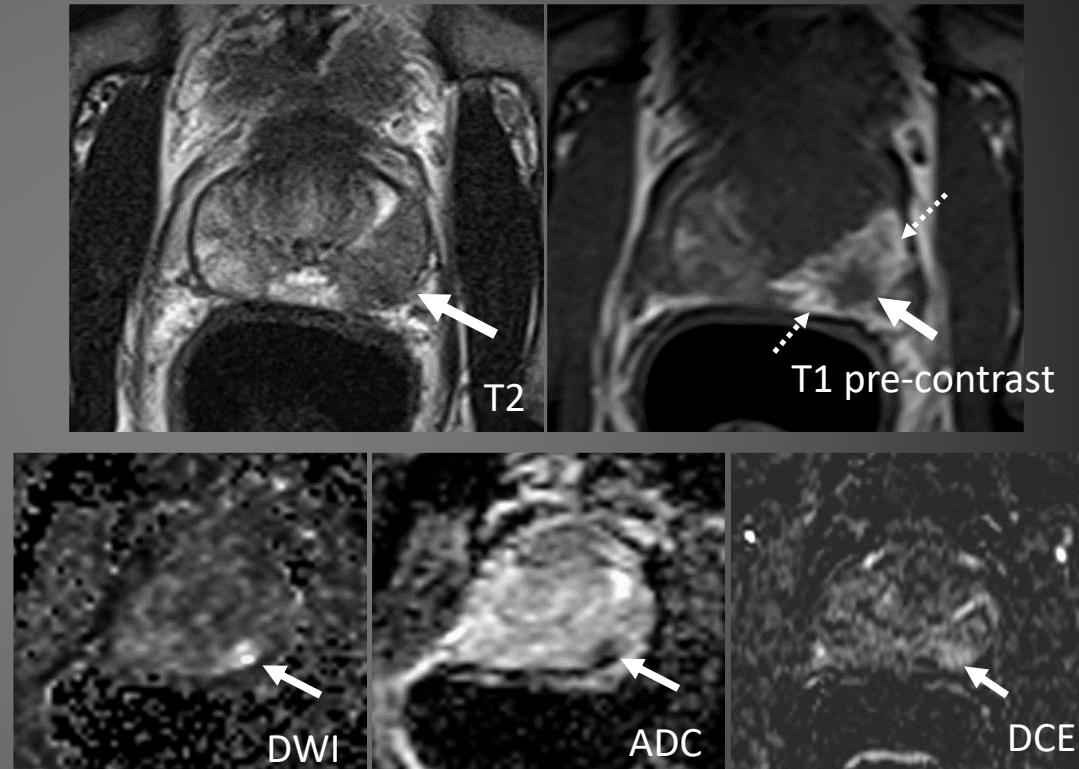
- Can last for weeks to months
- ↑ T1 signal
- Prostate ↑ citrate
- PCa ↓ citrate
 - Hemorrhage exclusion sign
- 6-week interval between bx and MRI is suggested



Post-biopsy

hemorrhage

- Can last for weeks to months
- $\uparrow$ T1 signal
- Prostate $\uparrow$ citrate
- PCa $\downarrow$ citrate
 - Hemorrhage exclusion sign
- 6-week interval between bx and MRI is suggested



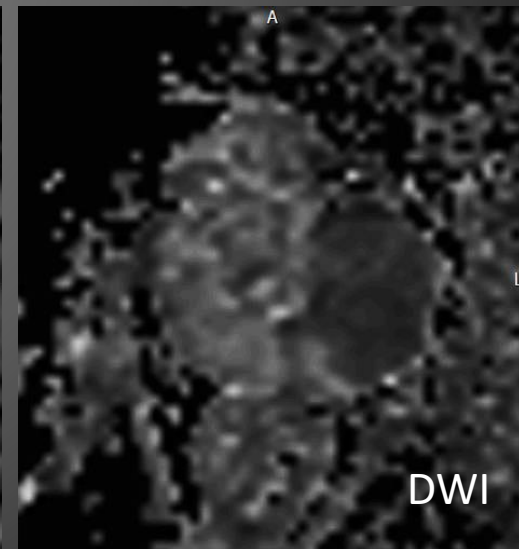
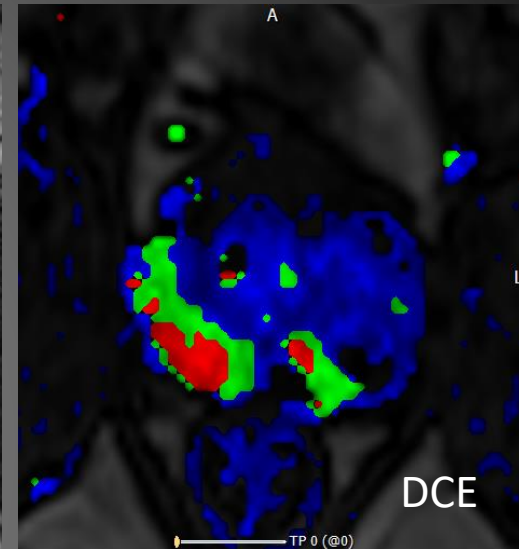
Prostatitis

- Common cause of PSA elevation and LUTS
- Etiologies
 - Bacterial prostatitis
 - Granulomatous prostatitis (GP)
- Can cause signal abnormalities in the PZ and TZ that mimic the appearance of PCa in all pulse sequences
- **Morphology** and **degree of signal abnormality** may be helpful to differentiate from PCa

Prostatitis

- Usually **mild** signal changes on T2 and DWI
- DCE: early arterial enhancement
- Focal
 - **Lobar, wedge-shaped,** linear, indistinct margin
- Diffuse

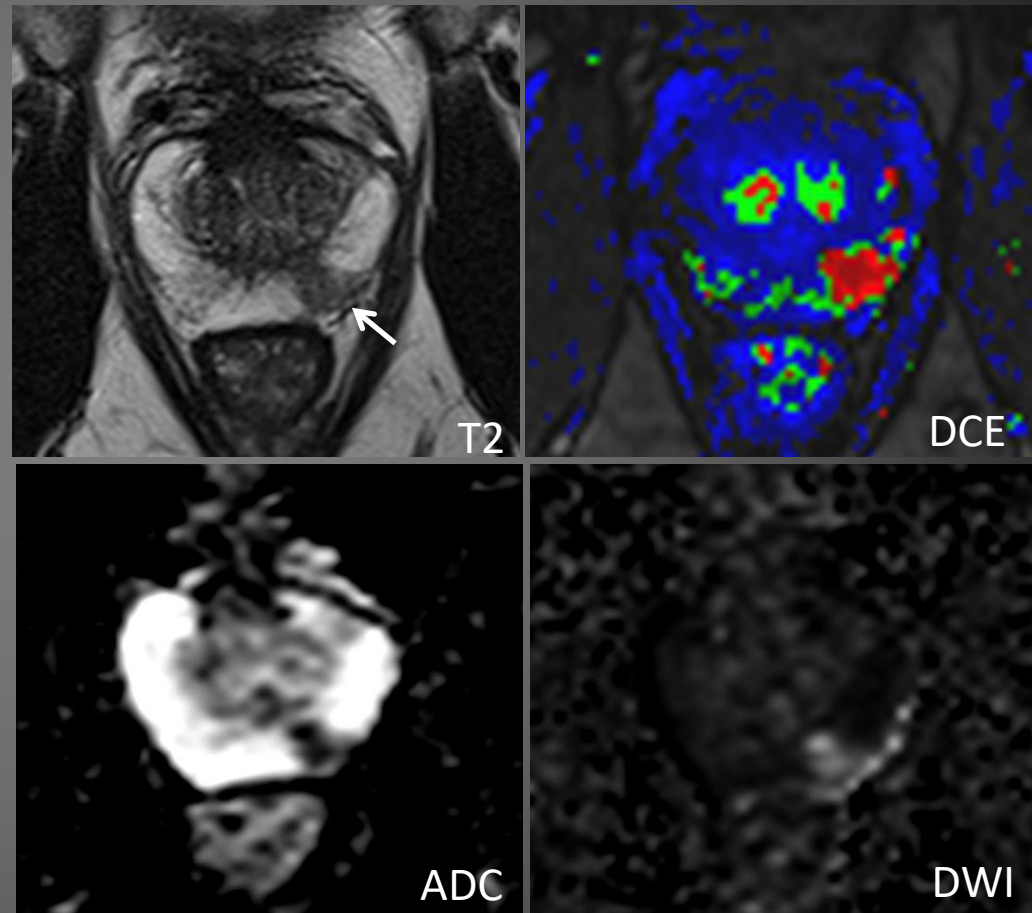
+FH of PCa, PSA 2.9. No prior Bx
SBx: acute inflammation



~~Prostatitis~~

- Usually mild signal changes on T2 and DWI
- DCE: early arterial enhancement
- Focal
 - Lobar, wedge-shaped, linear, indistinct margin
- Diffuse

Elevated PSA, No prior Bx
MRI-targeted Bx: PCa GS 3 + 4

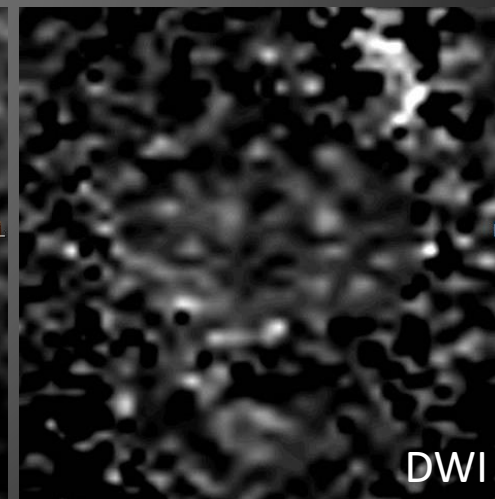
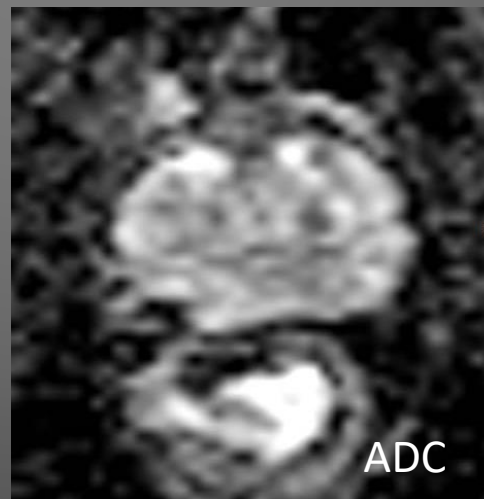
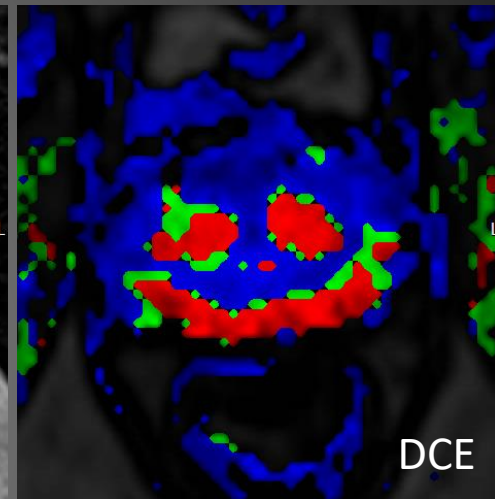
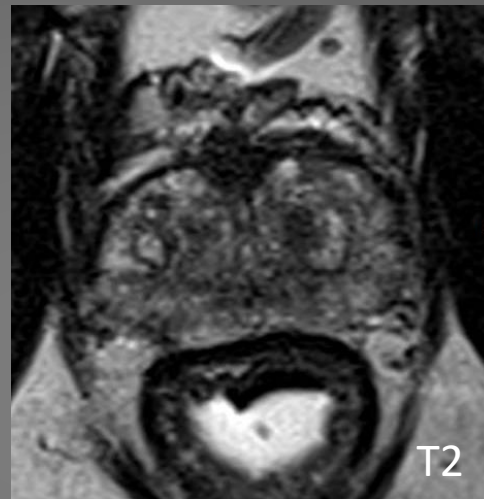


About 10% of cancers had wedge-shaped or linear morphology in an RP series (Abreu-Gomez J et al. AJR 2020 PMID: 32228325)

Prostatitis

- Usually **mild** signal changes on T2 and DWI
- DCE: early arterial enhancement
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 - Lobar, wedge-shaped, linear, **indistinct margin**
- **Diffuse**

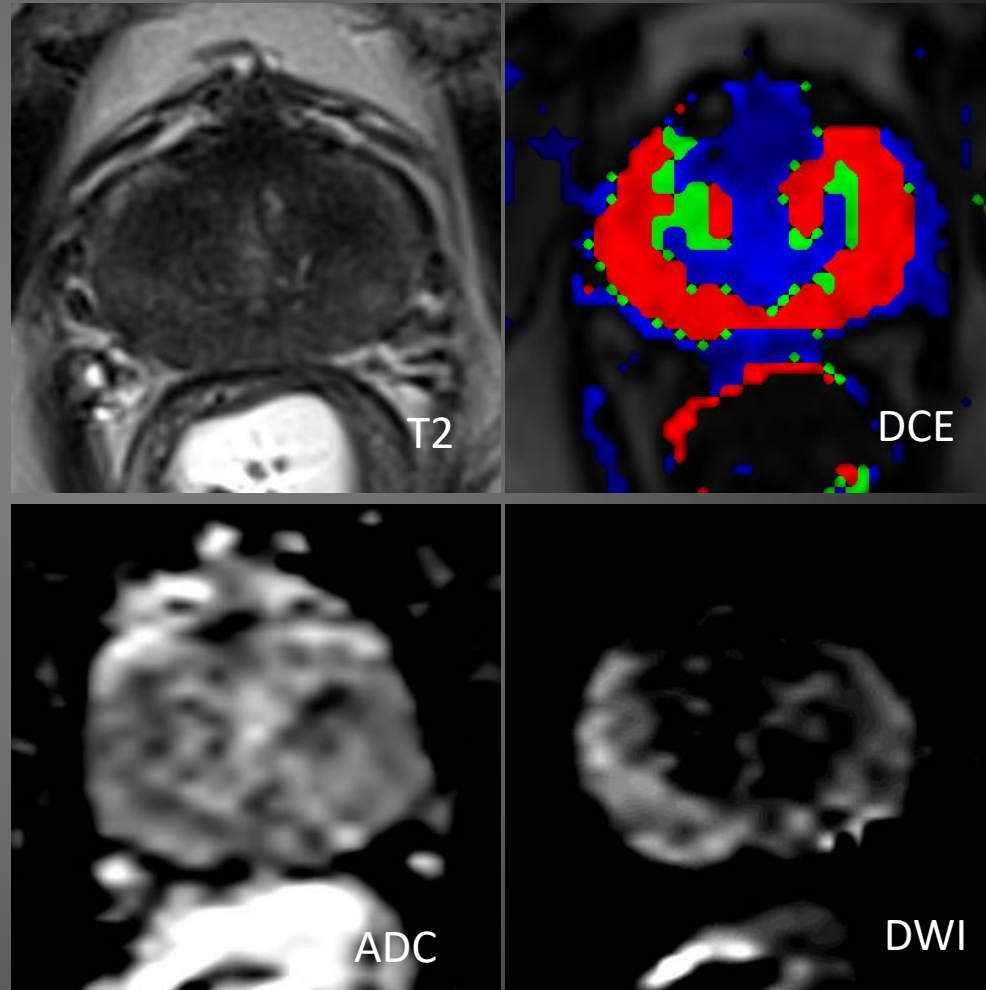
PCA (GS 3 + 3) on AS; PSA: 4.6
SBx: GS 3 + 3; chronic inflammation and atrophy



Prostatitis

- Usually mild signal changes on T2 and DWI
- DCE: early arterial enhancement
- Focal
 - Lobar, wedge-shaped, linear, indistinct margin
- Diffuse

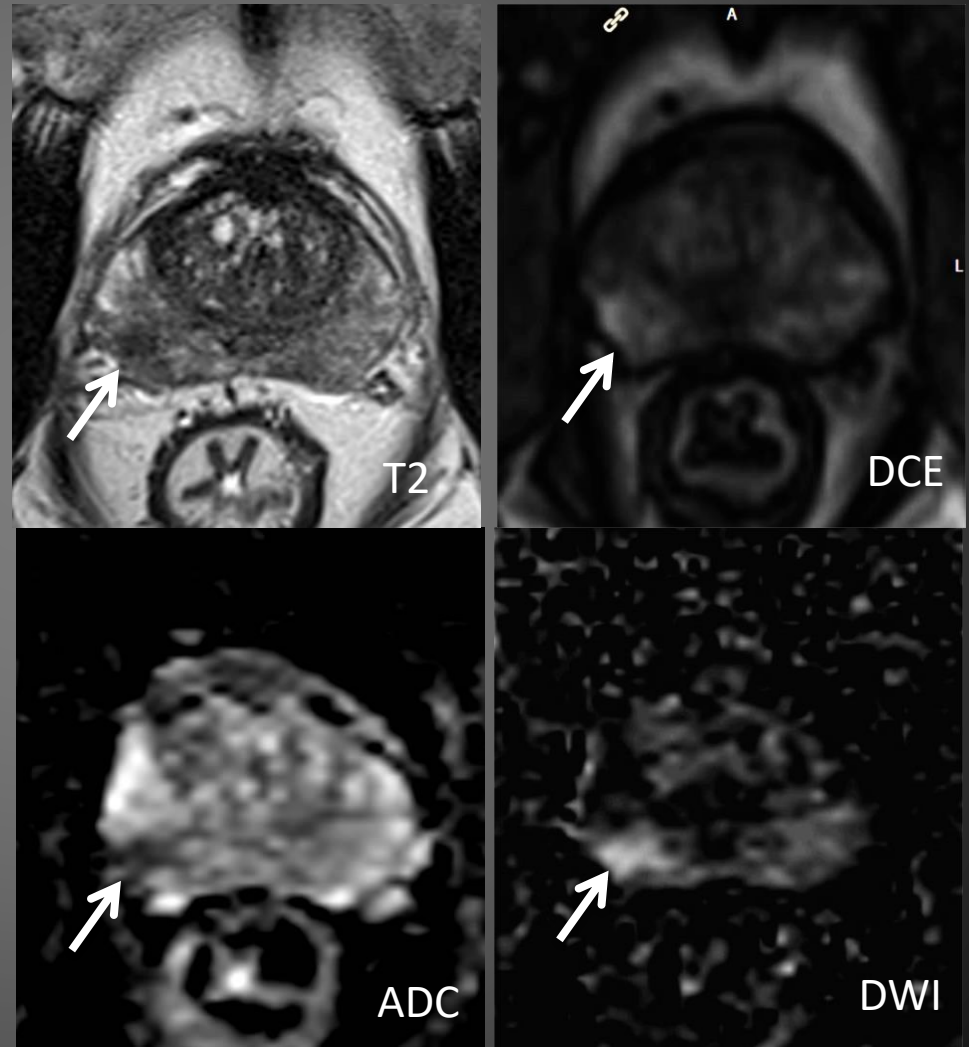
PSA 5.68; No prior bx
SBx: Acute inflammation



~~Prostatitis~~

- Usually mild signal changes on T2 and DWI
- DCE: early arterial enhancement
- Focal
 - Lobar, wedge-shaped, linear, indistinct margin
- Diffuse

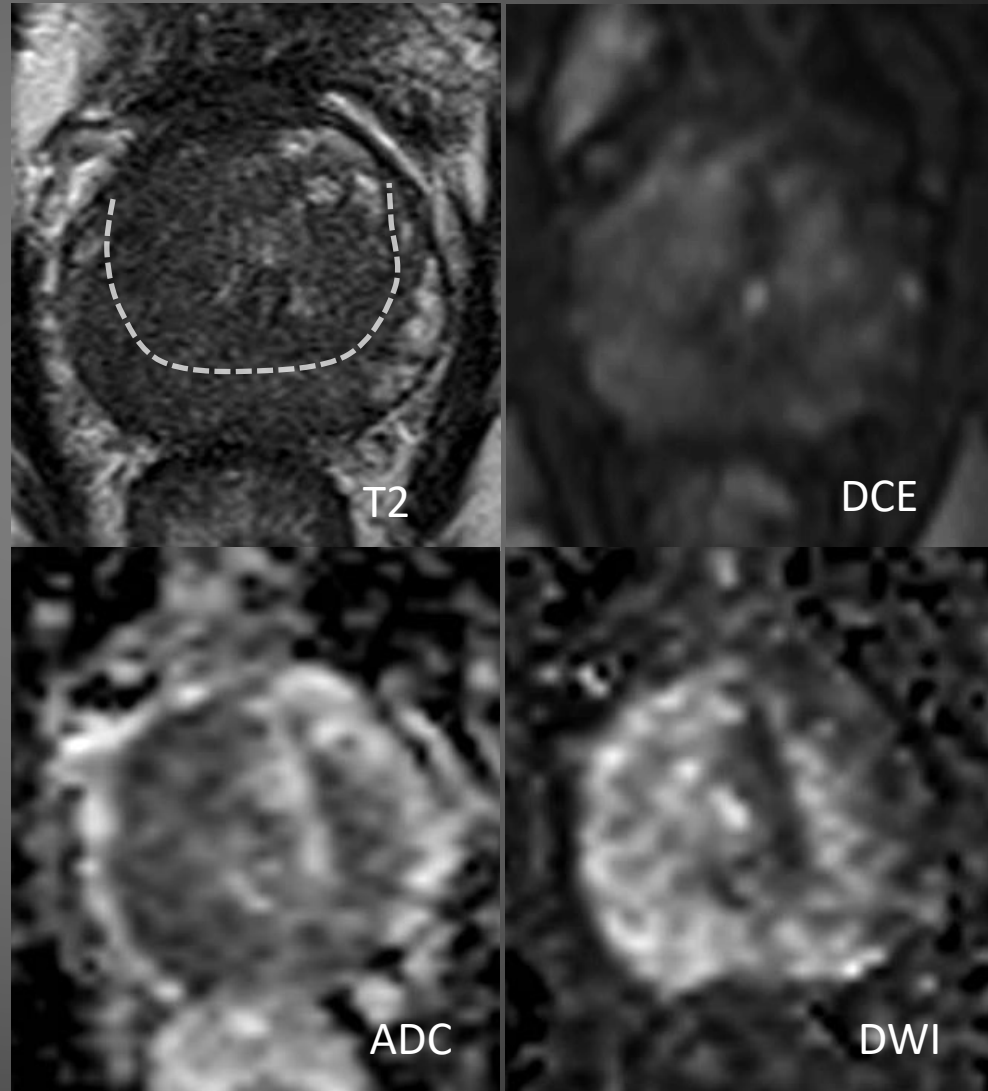
PCa (3 + 3) on AS; PSA 5.2
MRI-targeted Bx: PCa **GS 3 + 4**



~~Prostatitis~~

- Usually mild signal changes on T2 and DWI
- DCE: early arterial enhancement
- Focal
 - Lobar, wedge-shaped, linear, indistinct margin
- Diffuse

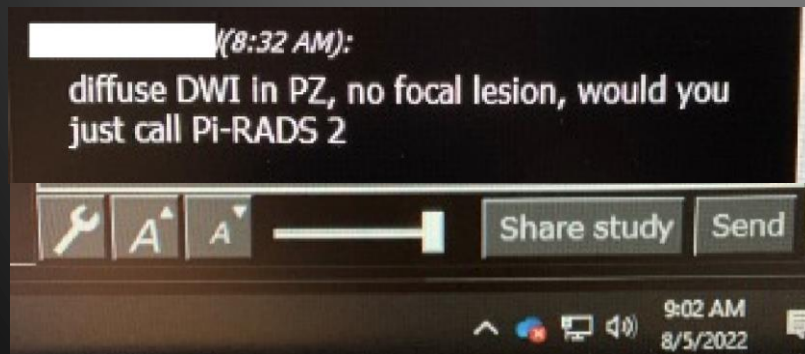
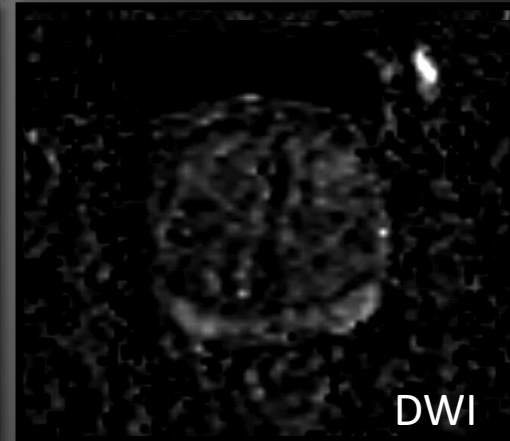
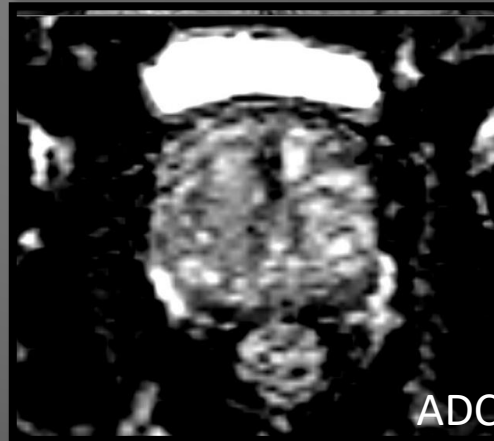
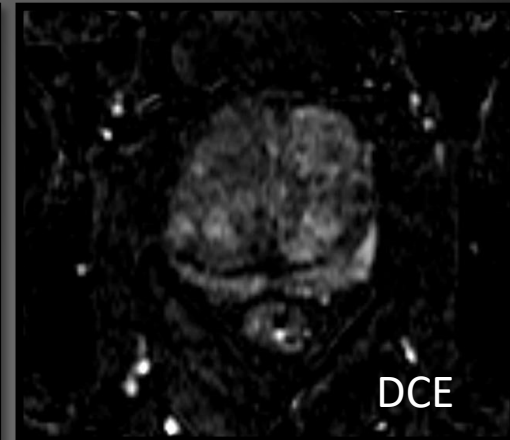
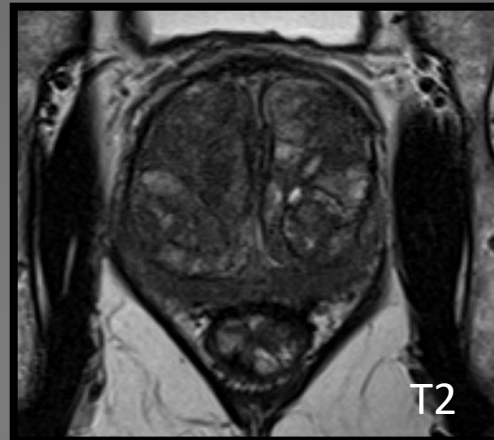
PSA: 122; No prior Bx
SBx: PCa GS 4 + 5 (all sextants)



~~Prostatitis~~

- Usually mild signal changes on T2 and DWI
- DCE: early arterial enhancement
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 - Lobar, wedge-shaped, linear, indistinct margin
- Diffuse

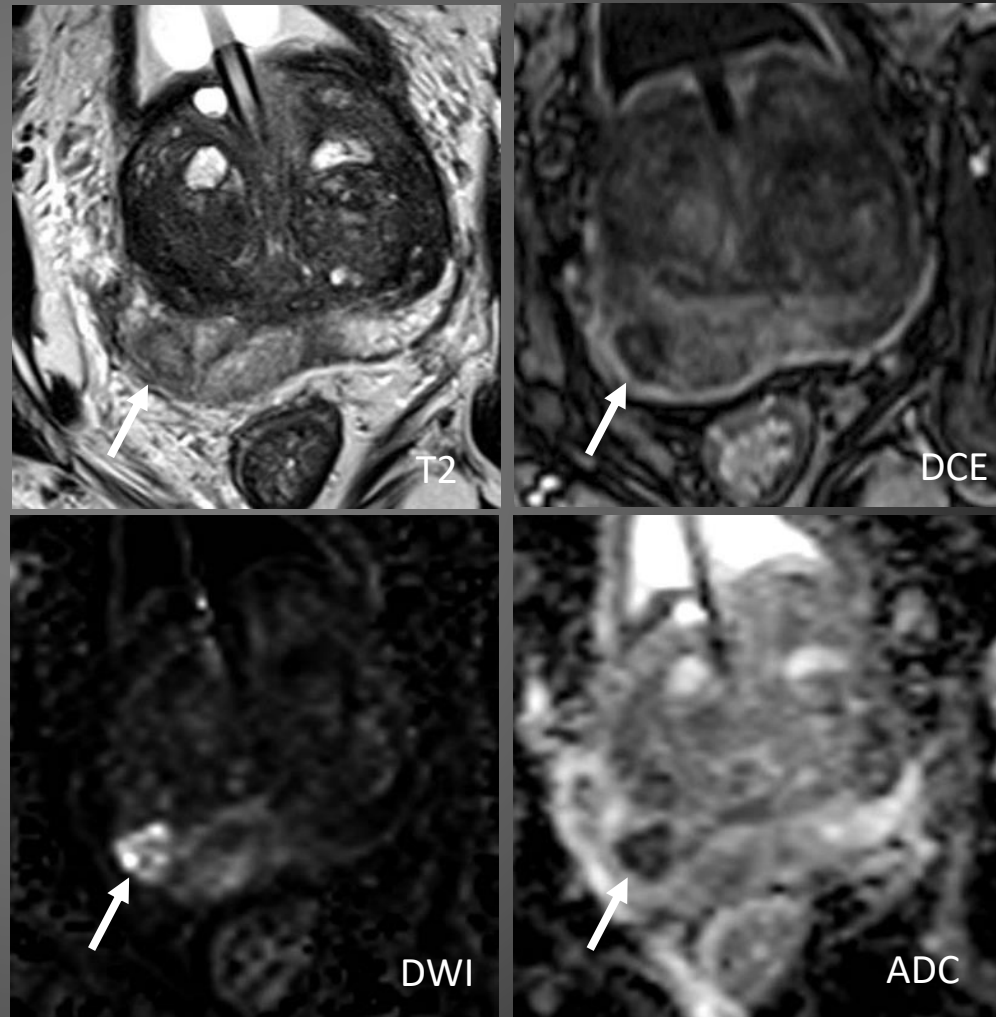
PSA: 6.7; No prior Bx
SBx: PCa GS 4 + 3 (all sextants)



Prostatitis

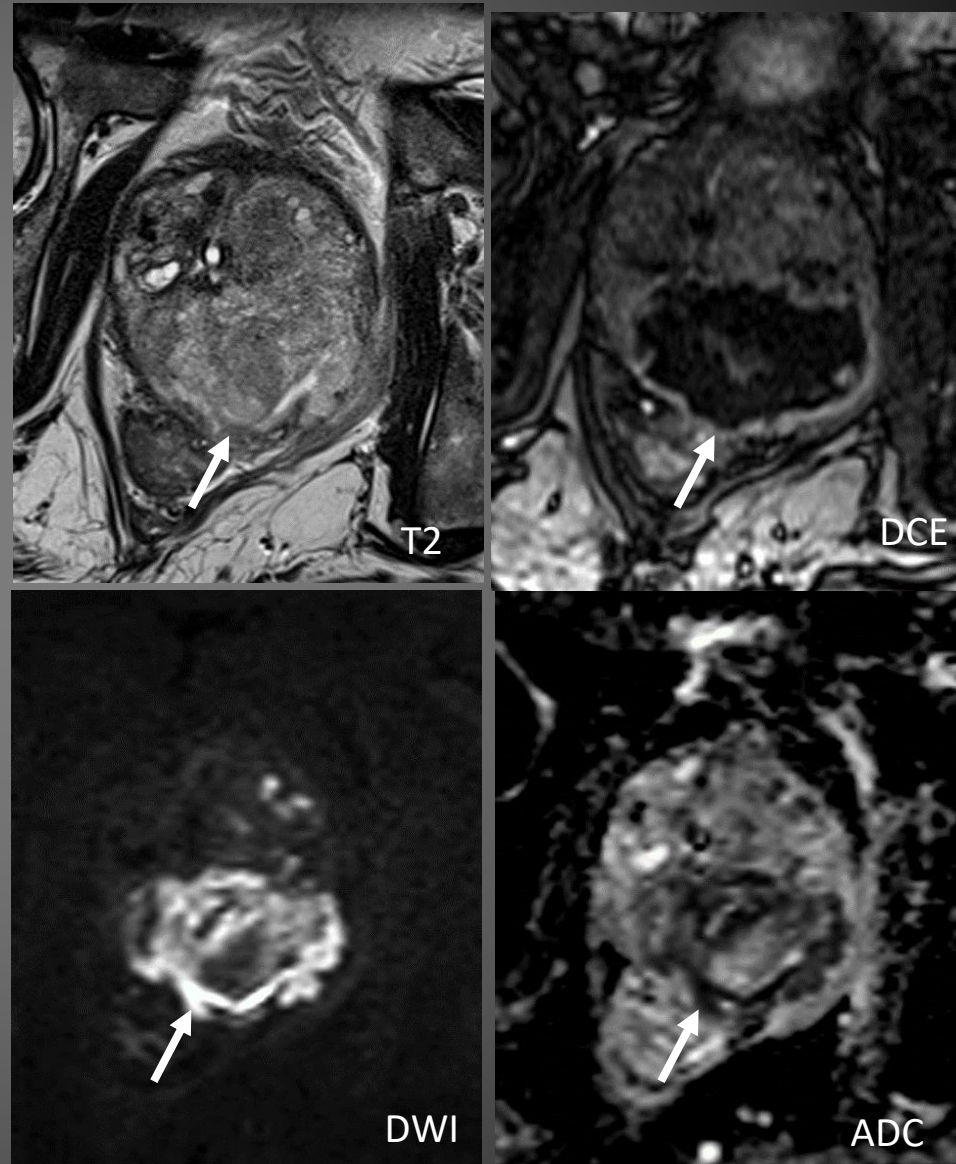
- Abscess:
- Uncommon complication
- Restricted diffusion in areas with high/intermediate signal on T2-WI
- DCE: rim-enhancement
- Single or multiple
- PZ, TZ, or both

PSA 5.68; No prior bx
SBx: Acute inflammation



Prostatitis

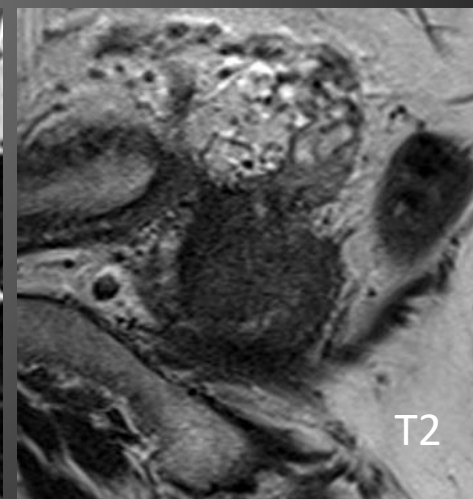
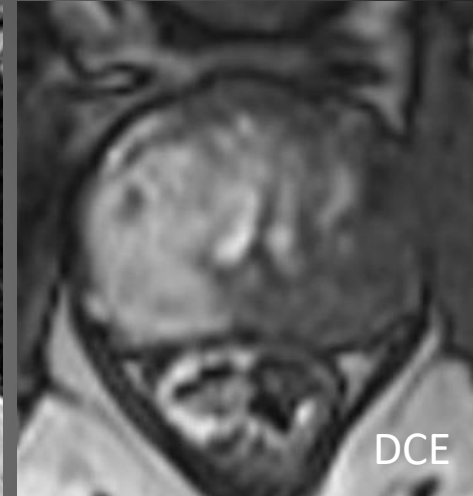
- Abscess:
- Uncommon complication
- Restricted diffusion in areas with high/intermediate signal on T2-WI
- DCE: rim-enhancement
- Single or multiple
- PZ, TZ, or both



Prostatitis

- Granulomatous Prostatitis
 - Idiopathic
 - Granulomatous infection
 - BCG therapy for BCa, fungal infection
 - Other granulomatous diseases (e.g. Sarcoid, Wegner's)
- More intense signal changes
- Small granulomas and “abscesses”
- Bx may be required

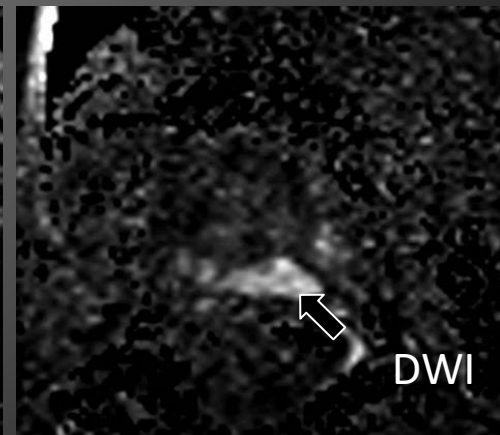
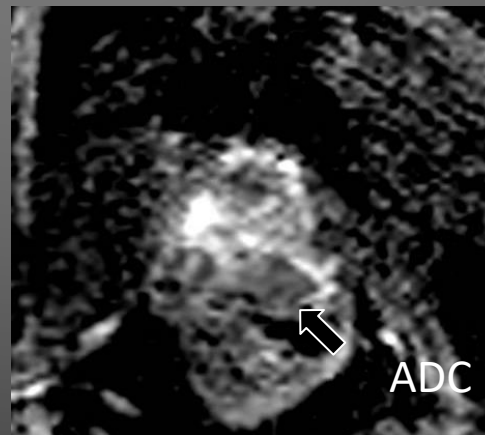
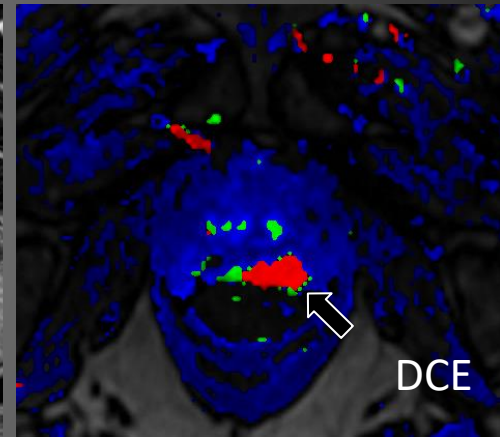
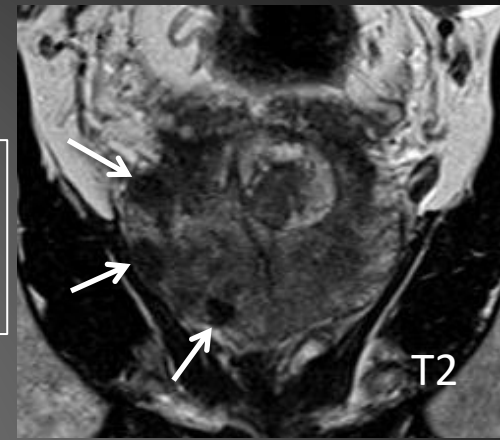
PSA: 7; +DRE; No prior Bx
MRI-targeted Bx: GP



Prostatitis

- Granulomatous Prostatitis
 - Idiopathic
 - Granulomatous infection
 - BCG therapy for BCa, fungal infection
 - Other granulomatous diseases (e.g. Sarcoid, Wegner's)
- More intense signal changes
- Small granulomas and “abscesses”
- Bx may be required

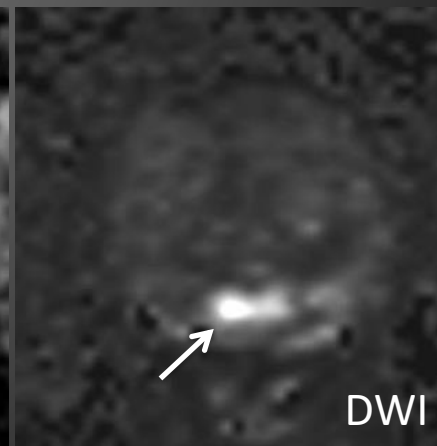
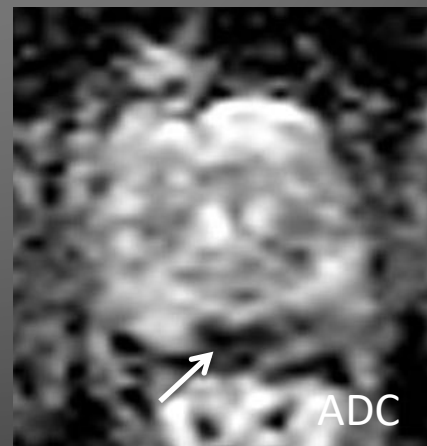
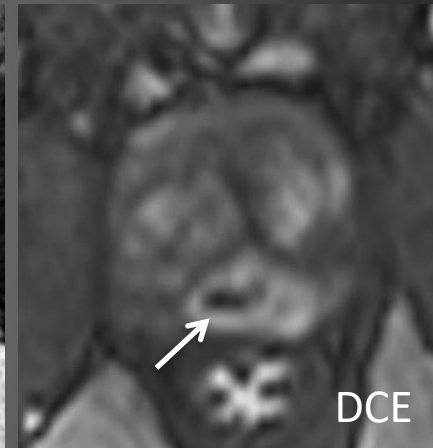
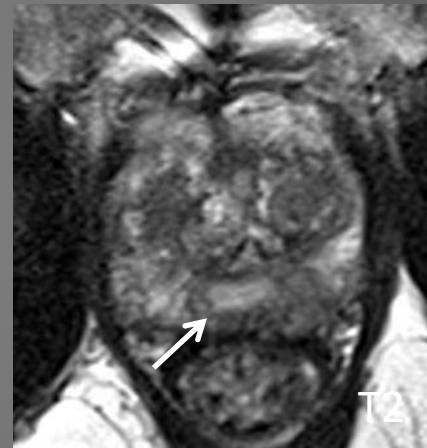
BCa s/p BCG
PSA: 5.8; No prior Bx
MRI-targeted Bx: GP



Prostatitis

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 - Idiopathic
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- More intense signal changes
- Small granulomas and “abscesses”
- Bx may be required

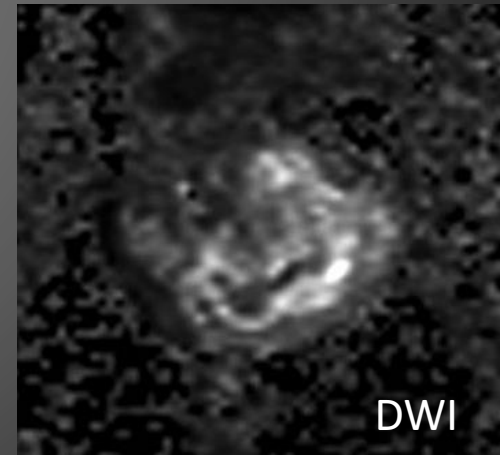
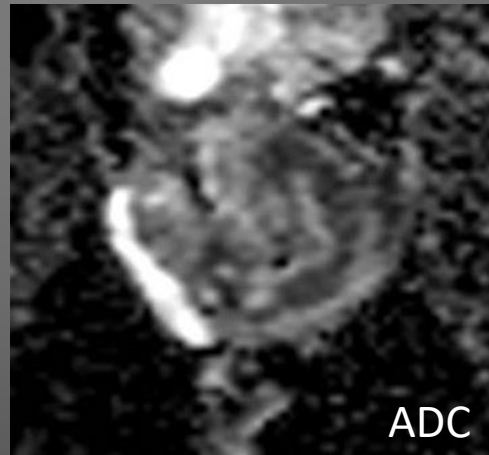
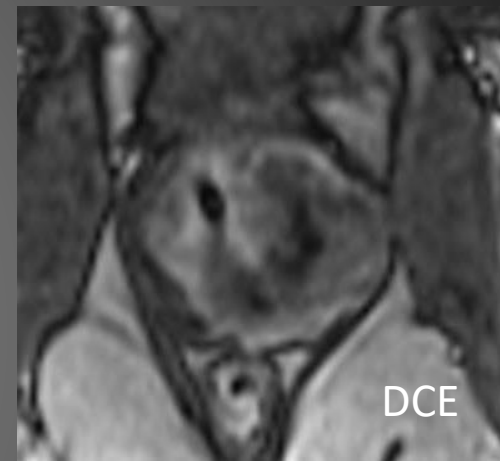
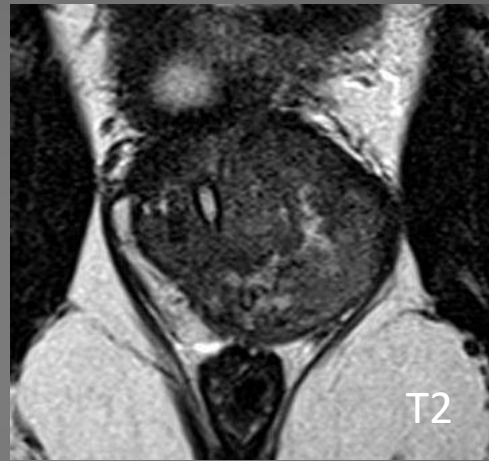
BCa s/p BCG
PSA: 8.1; No prior Bx
MRI-targeted Bx: GP



Prostatitis

- Granulomatous Prostatitis
 - Idiopathic
 - Granulomatous infection
 - BCG therapy for BCa, fungal infection
 - Other granulomatous diseases (e.g. Sarcoid, **Wegner's**)
- More intense signal changes
- Small granulomas and “abscesses”
- **Bx may be required**

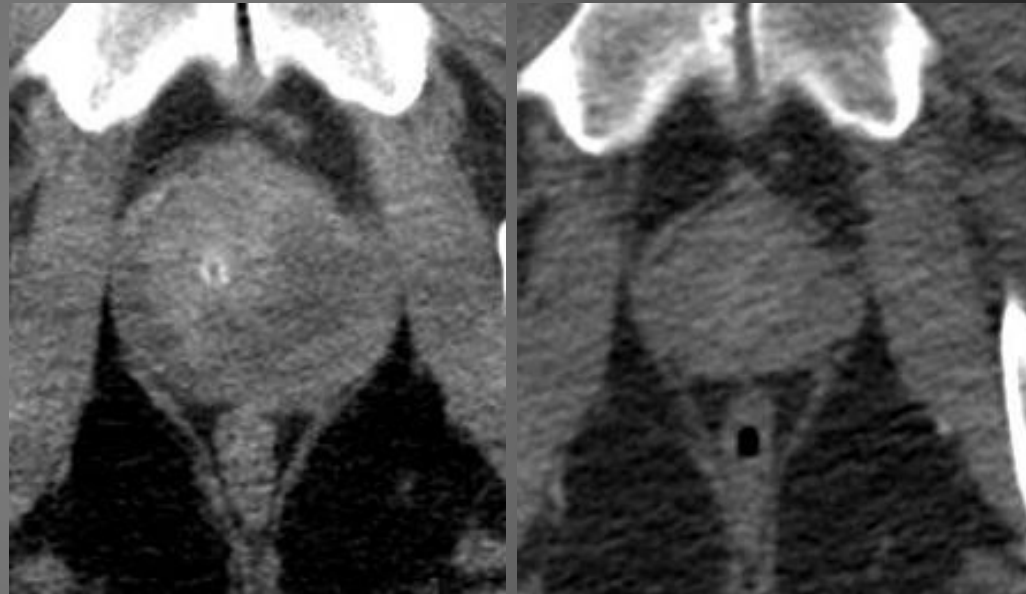
Wegner's; urinary retention
No PSA or prior Bx



Prostatitis

- Granulomatous Prostatitis
 - Idiopathic
 - Granulomatous infection
 - BCG therapy for BCa, fungal infection
 - Other granulomatous diseases (e.g. Sarcoid, **Wegner's**)
- More intense signal changes
- Small granulomas and “abscesses”
- **Bx may be required**

Wegner's; urinary retention
No PSA or prior Bx



Pre- and post-treatment with
Prednisone and Rituximab

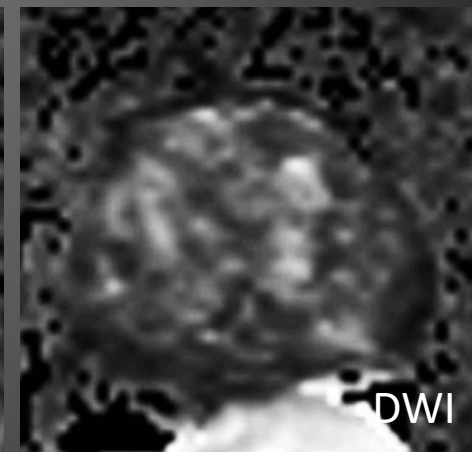
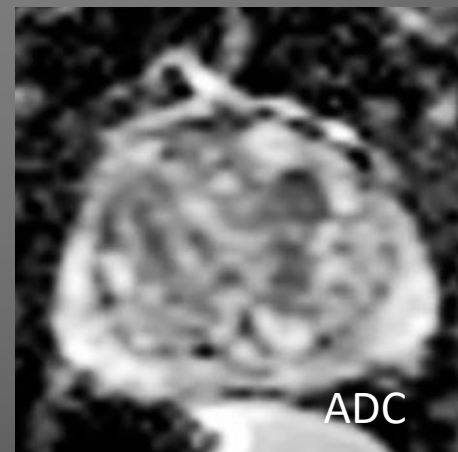
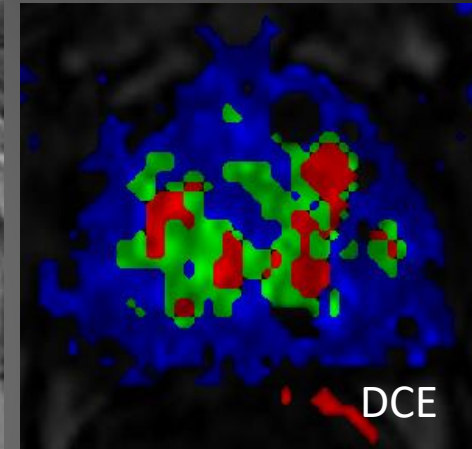
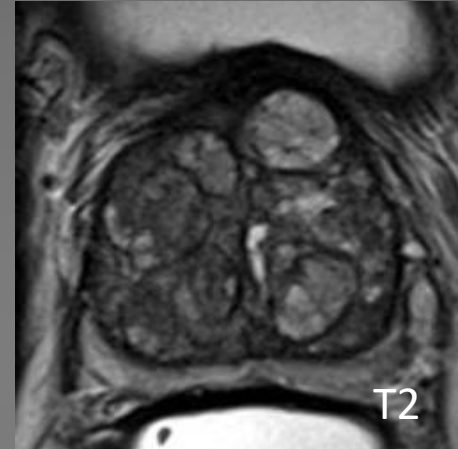
BPH

- Common in men aged 40 and above
- Hyperplasia of TZ with formation of nodules containing variable amounts of:
 - Glandular proliferation
 - **Fibromuscular proliferation of the stroma**
 - Prominent sclerotic, fibrous, or muscular elements
 - **Low T2W SI, Restricted diffusion and/or focal contrast enhancement**
- Rarely may contain foci of clinically significant cancer

BPH

- Homogeneous or heterogeneous T2W signal
- Morphologic features:
 - Round/oval
 - Well-circumscribed
 - **Encapsulated**
 - “Atypical”
 - Symmetric
- May insinuate into the PZ

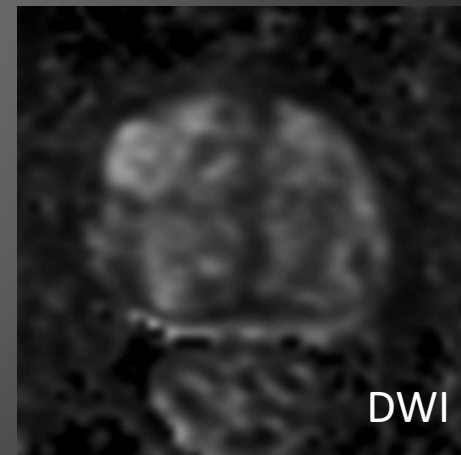
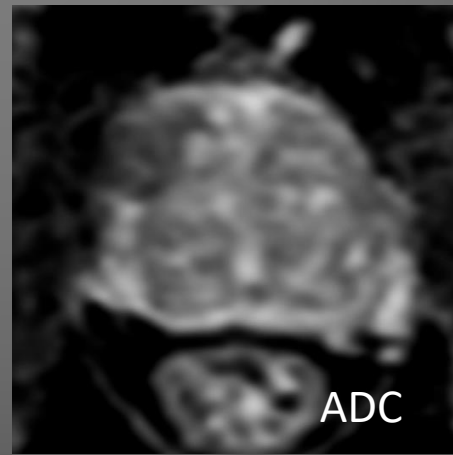
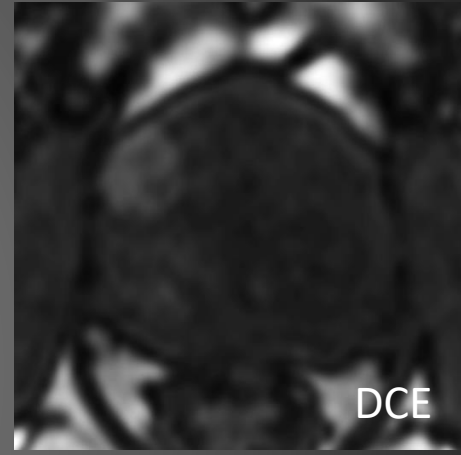
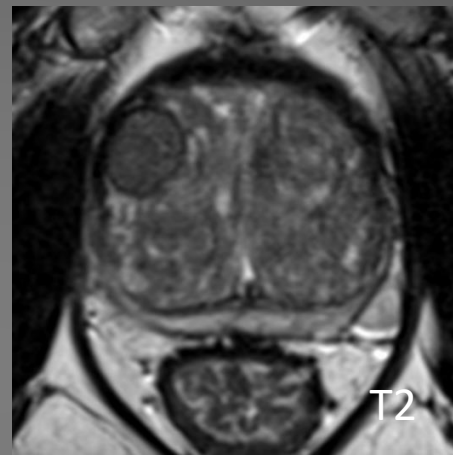
PSA: 8.9; SBx: negative



BPH

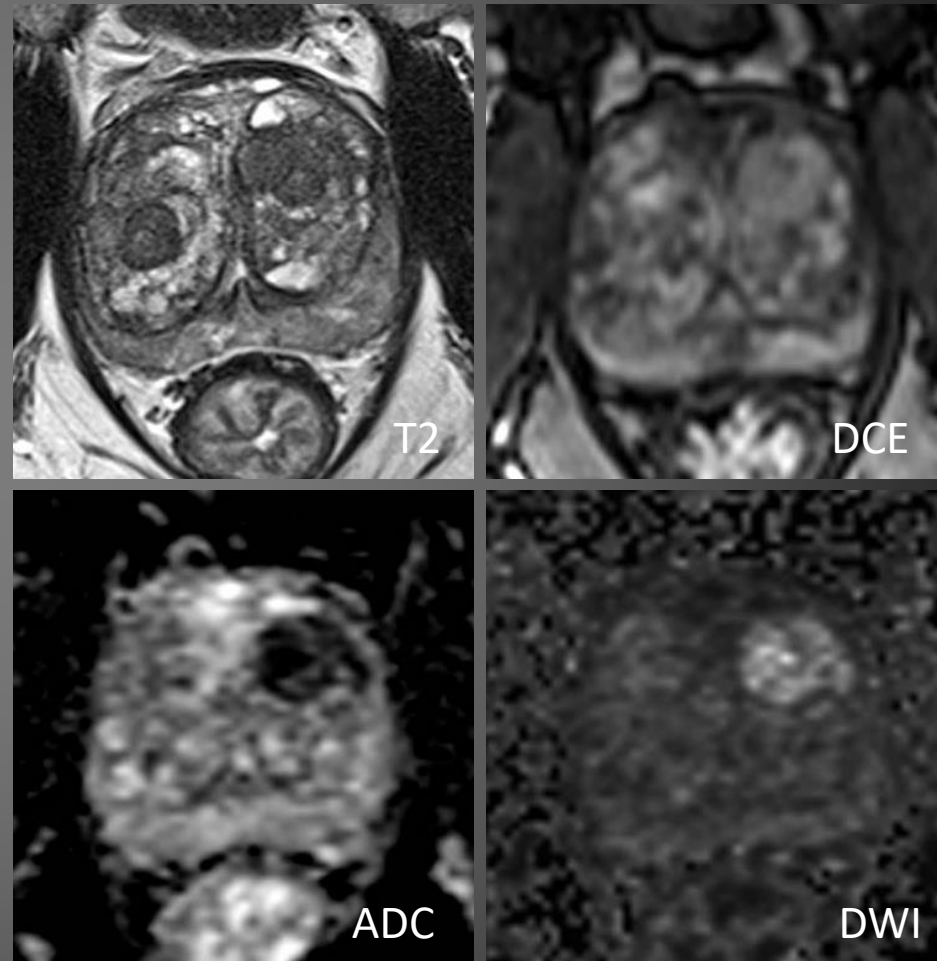
- Homogeneous or heterogeneous T2W signal
- Morphologic features:
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 - Well-circumscribed
 - **Encapsulated**
 - “Atypical”
 - Symmetric
- May insinuate into the PZ

PSA: 12; SBx: negative



- Homogeneous or heterogeneous T2W signal
- Morphologic features:
 - Round/oval
 - Well-circumscribed
 - Encapsulated
 - “Atypical”
 - Symmetric
- May insinuate into the PZ

PSA 11; SBx: negative
MRI-targeted Bx: PCa GS 3 +3

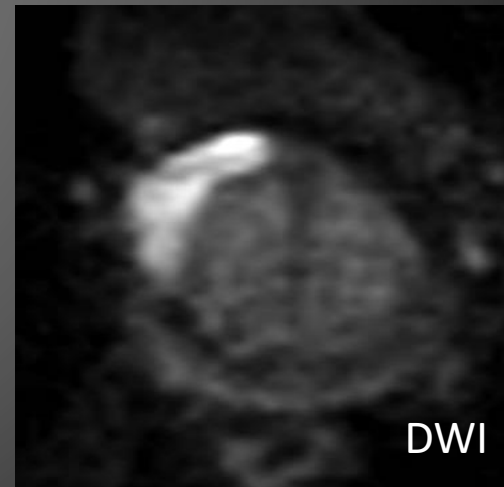
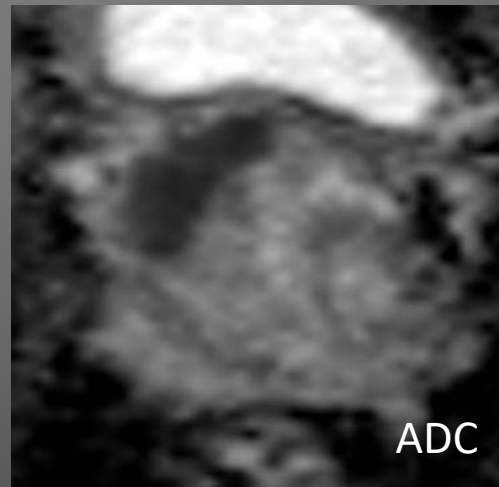
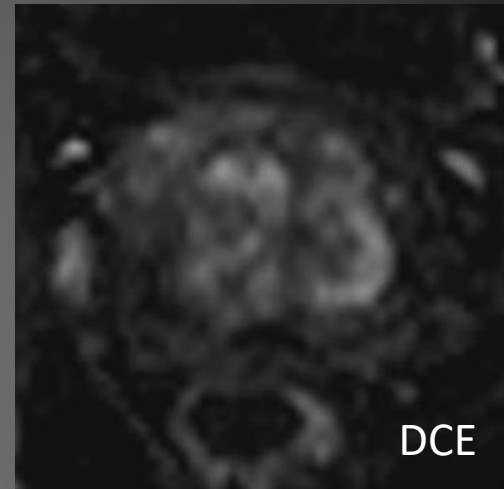


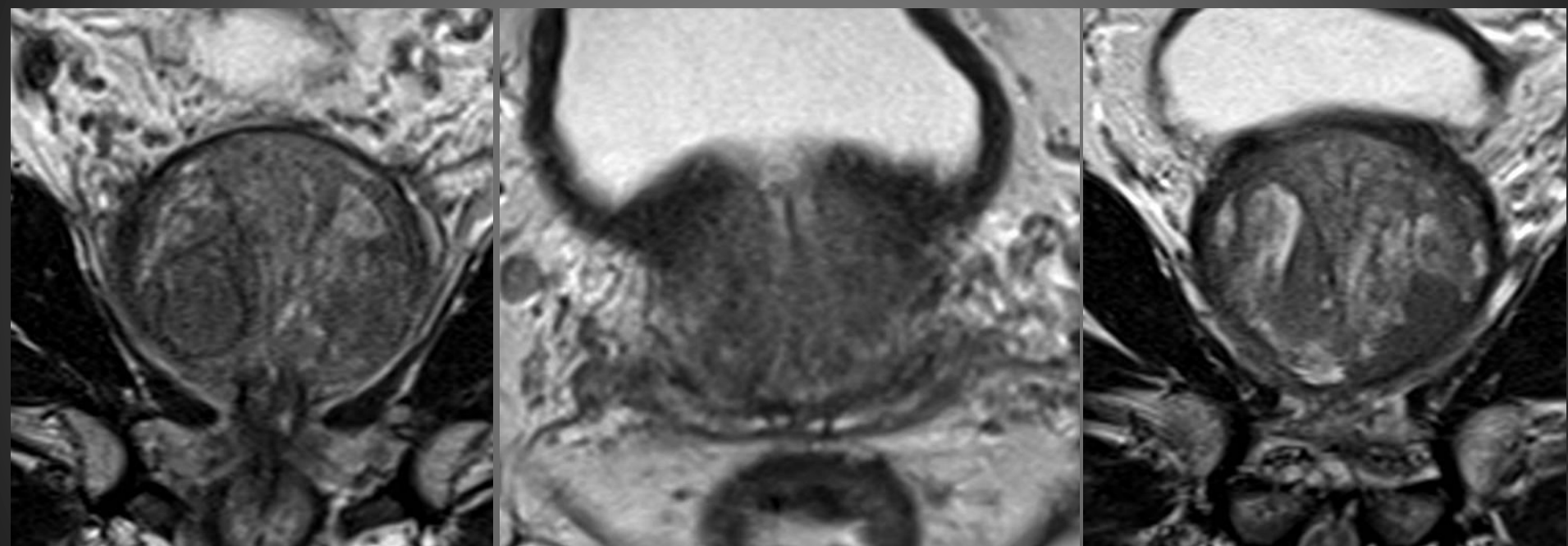
T2 score 2 + DWI score 4 -> PI-RADS score 3

~~BPH~~

- Homogeneous or heterogeneous T2W signal
- Morphologic features:
 - Round/oval
 - Well-circumscribed
 - Encapsulated
 - “Atypical”
 - Symmetric
- May insinuate into the PZ

PSA 6.7; SBx: negative x 2
MRI-targeted Bx: PCa GS 4 +3





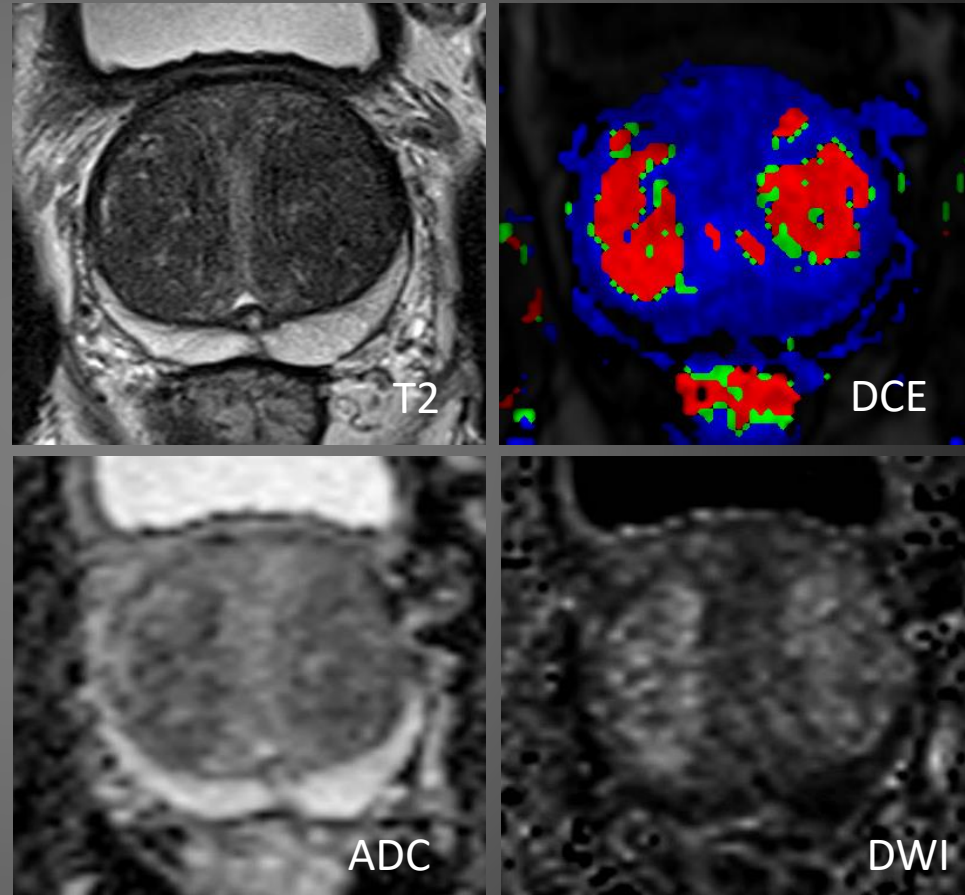
PI-RADS 1

PI-RADS 5

BPH

- Homogeneous or heterogeneous T2W signal
- Morphologic features:
 - Round/oval
 - Well-circumscribed
 - Encapsulated
 - “Atypical”
 - **Symmetric**
- May insinuate into the PZ

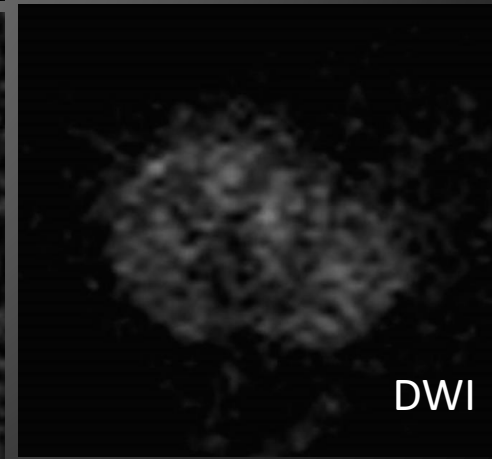
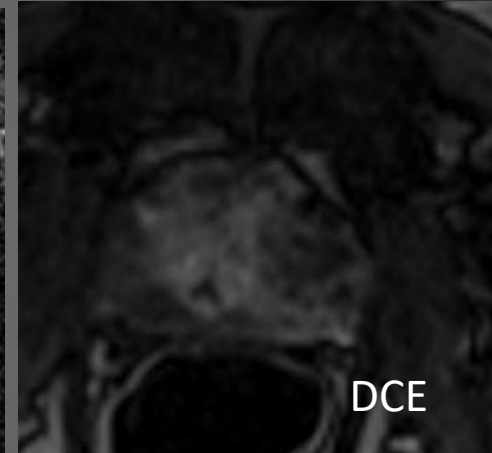
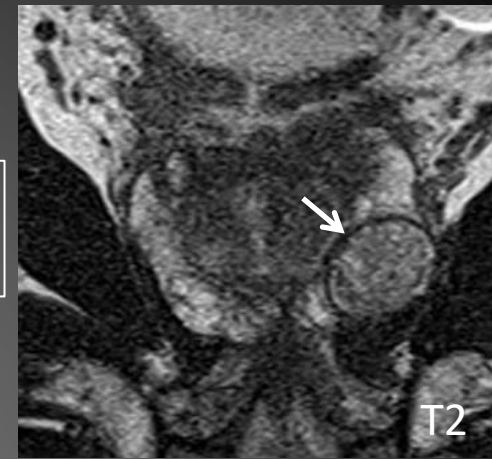
PSA 7.2; SBx: negative



BPH

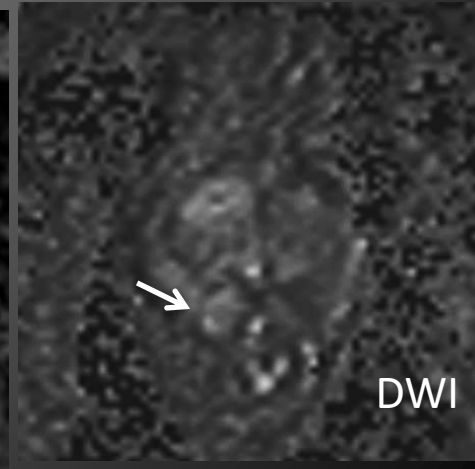
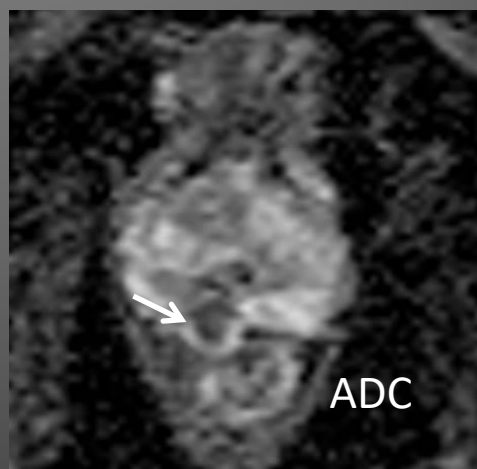
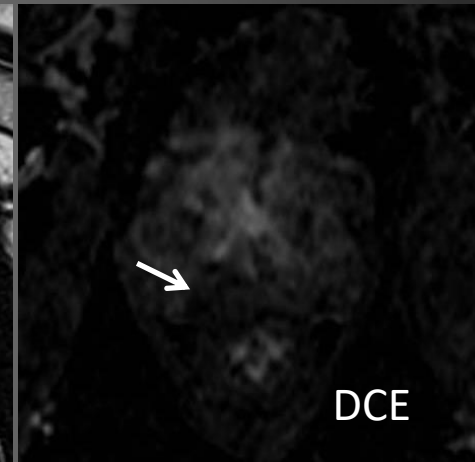
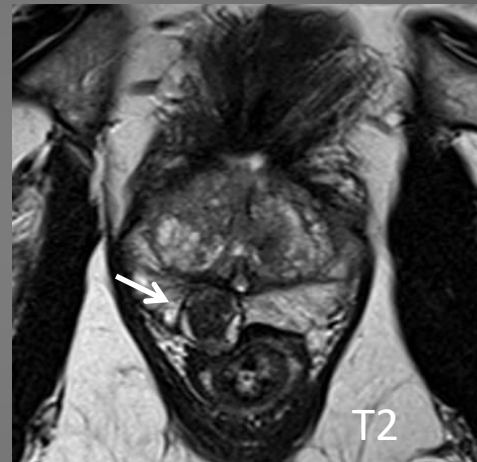
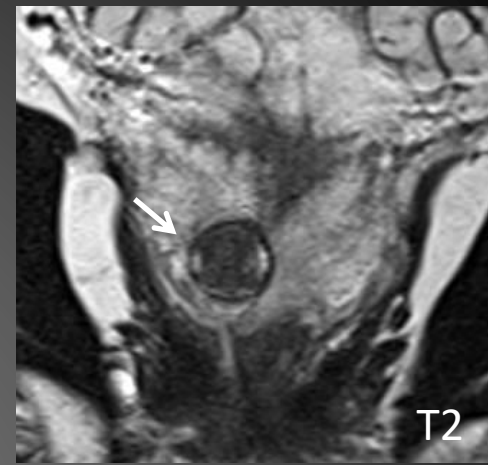
- Homogeneous or heterogeneous T2W signal
- Morphologic features:
 - Round/oval
 - Well-circumscribed
 - Encapsulated
 - “Atypical”
 - Symmetric
- May insinuate into the PZ

Abnl DRE and PSA 5.8
SBx: negative



BPH

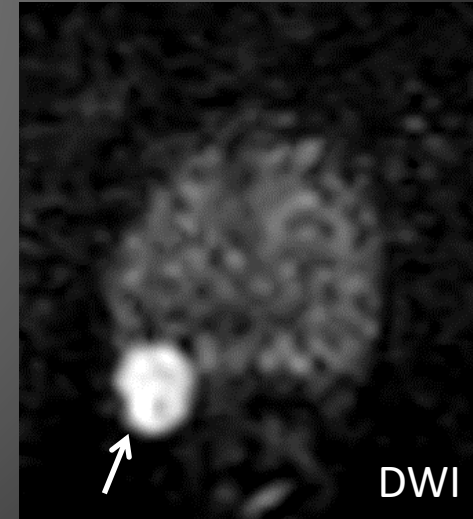
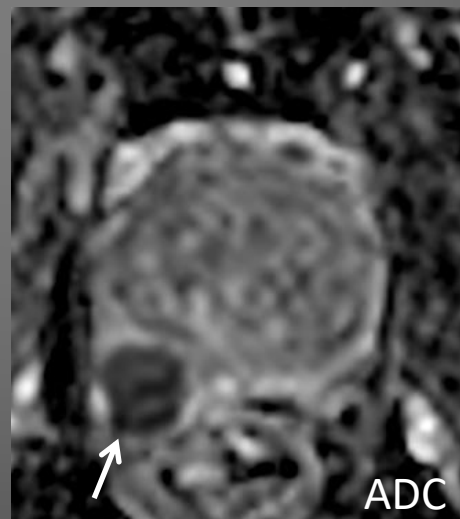
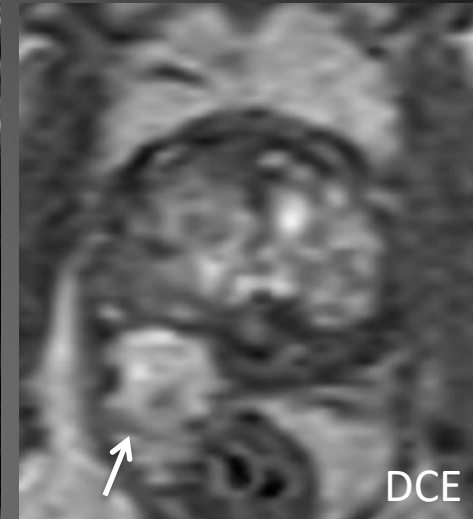
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~~BPH~~

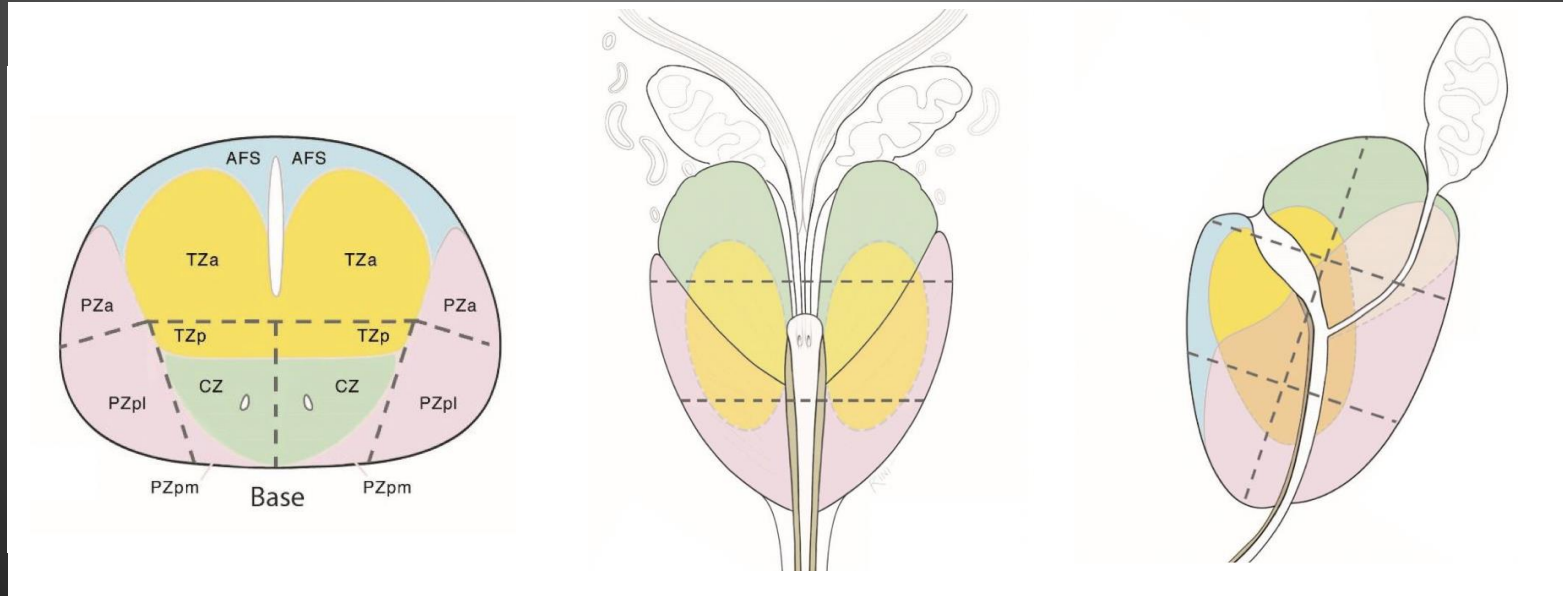
78 yo, PSA 10.0
MRI-guided bx: PCa **GS 4 + 4**

- Homogeneous or heterogeneous T2W signal
- Morphologic features:
 - Round/oval
 - Well-circumscribed
 - Encapsulated
 - “Atypical”
 - Symmetric
- May insinuate into the PZ



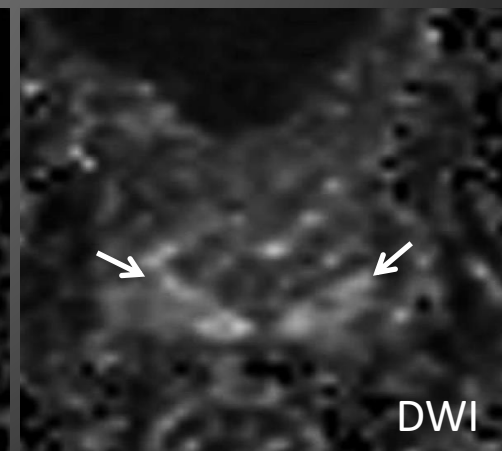
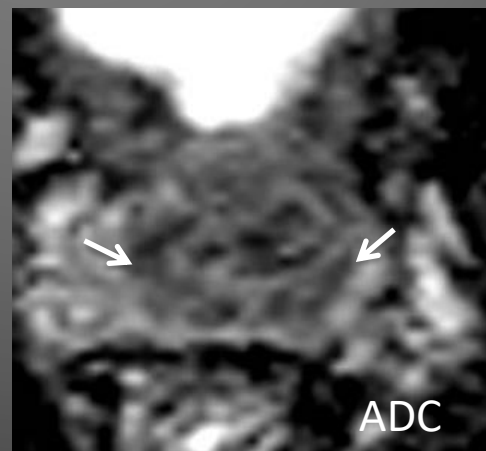
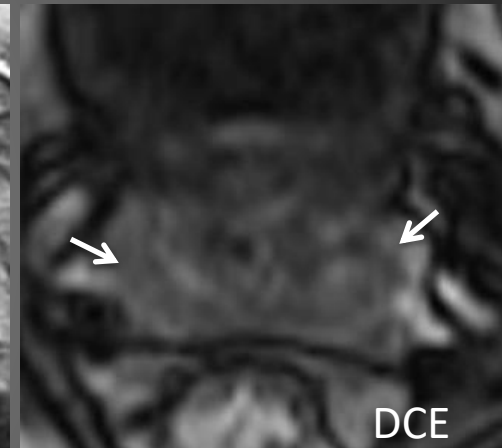
Central Zone

- Conical-shaped layer of tissue **around the ejaculatory ducts** that extends from **base** down to the **verumontanum**
- Contains more stroma than glandular tissue
- Visible on MRI in ~80% of cases



Central Zone

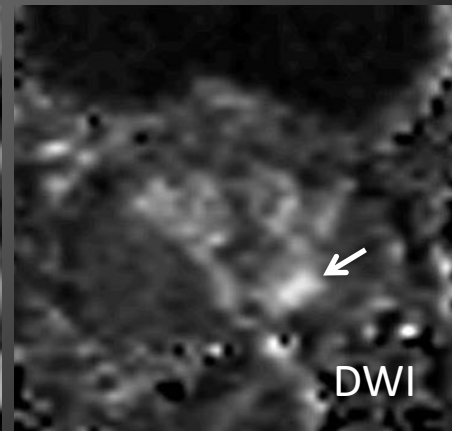
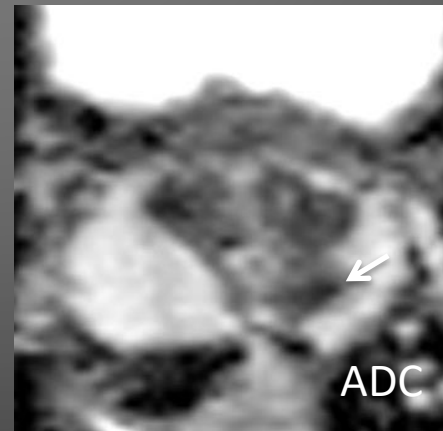
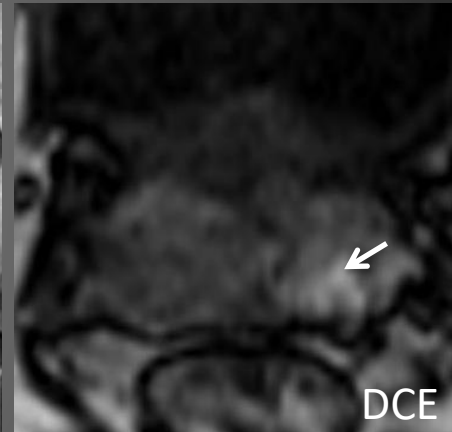
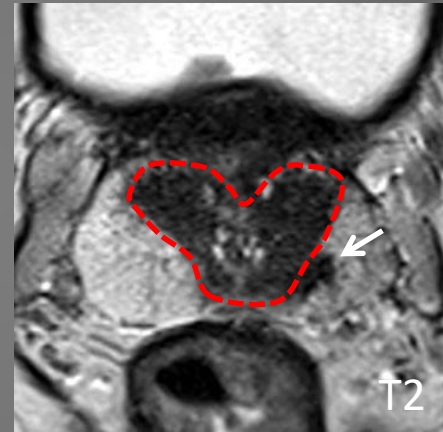
- Low SI on T2-WI and ADC at the base
- **Symmetric** (~80%)
- CZ tumors:
 - Higher PSA, GS, and rates of EPE and SVI
 - Focal asymmetries and early enhancement



~~Central Zone~~

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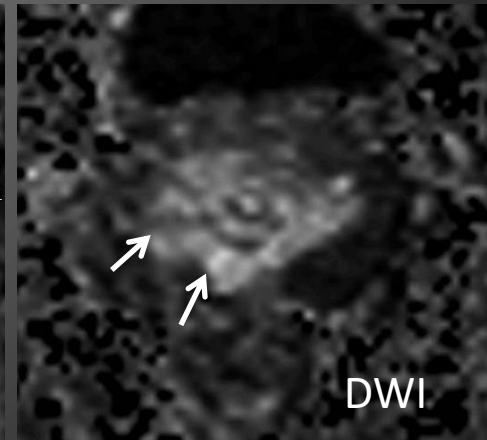
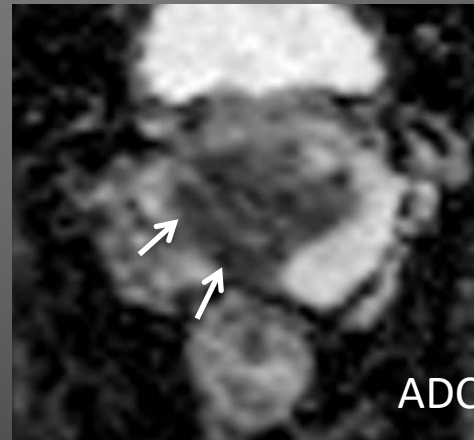
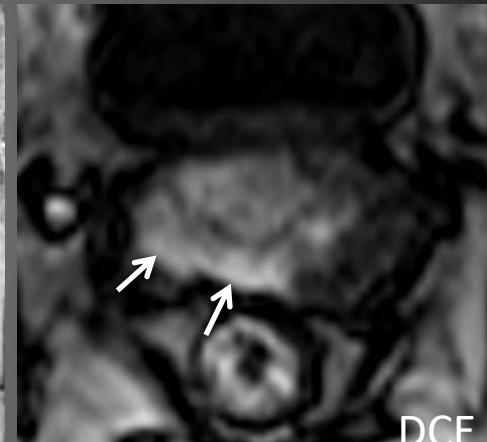
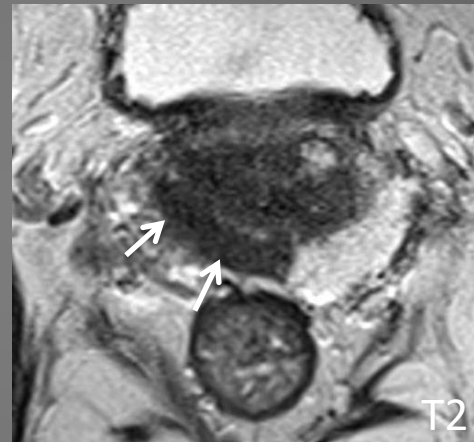
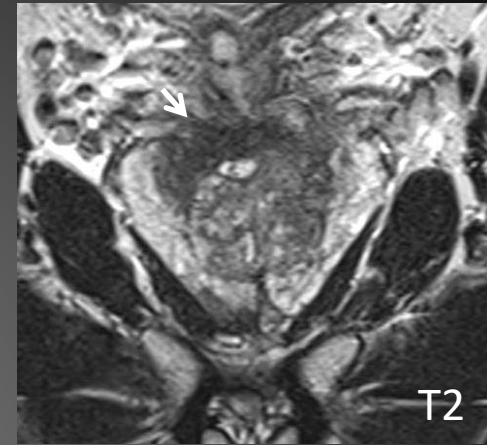
PCa (GS 3 + 3) on AS
MRI-targeted Bx:
PCa GS 4 + 3



~~Central Zone~~

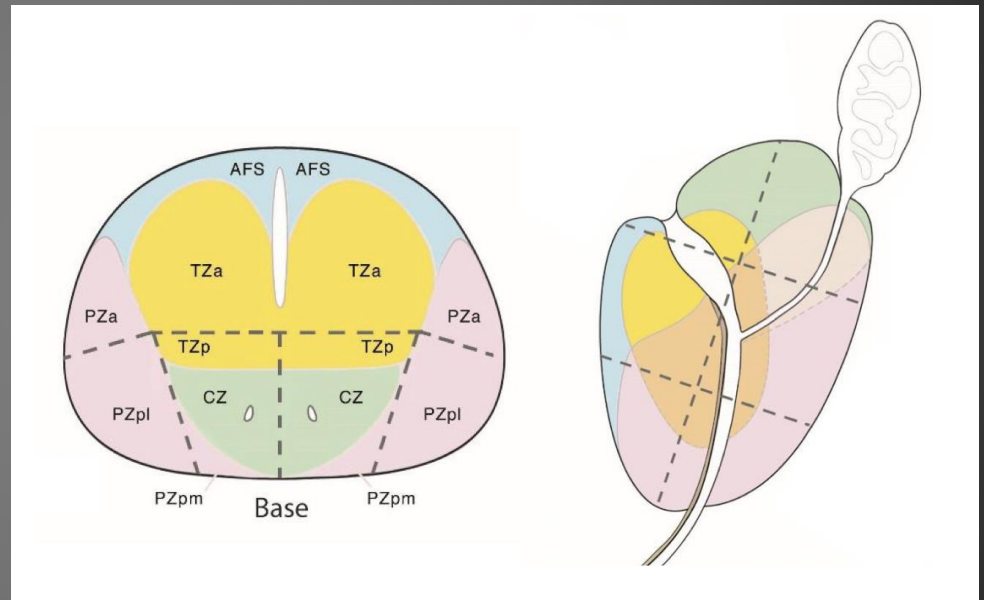
- Low SI on T2-WI and ADC at the base
- Symmetric (~80%)
- **CZ tumors:**
 - Higher PSA, GS, and rates of EPE and SVI
 - **Focal asymmetries and early enhancement**

PCa (GS 3 + 3) on AS
PSA: 26.3
MRI-targeted Bx:
PCa GS 3 + 4



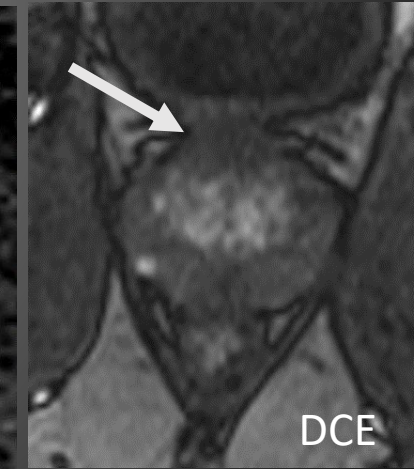
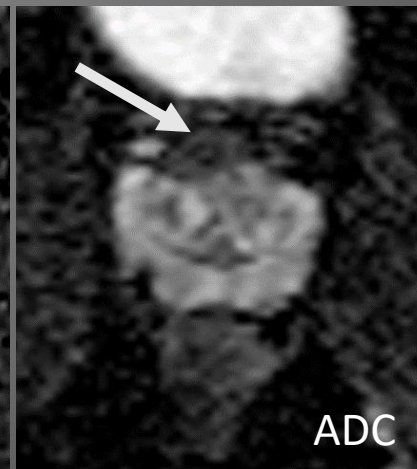
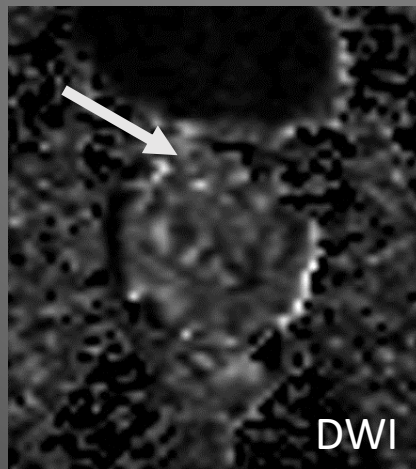
AFS

- Variable thickness according to the degree of BPH.
- Low SI on T2 and ADC
- Low SI on DWI
- No early enhancement
- For cancer in the AFS use criteria from the zone where cancer originates



AFS

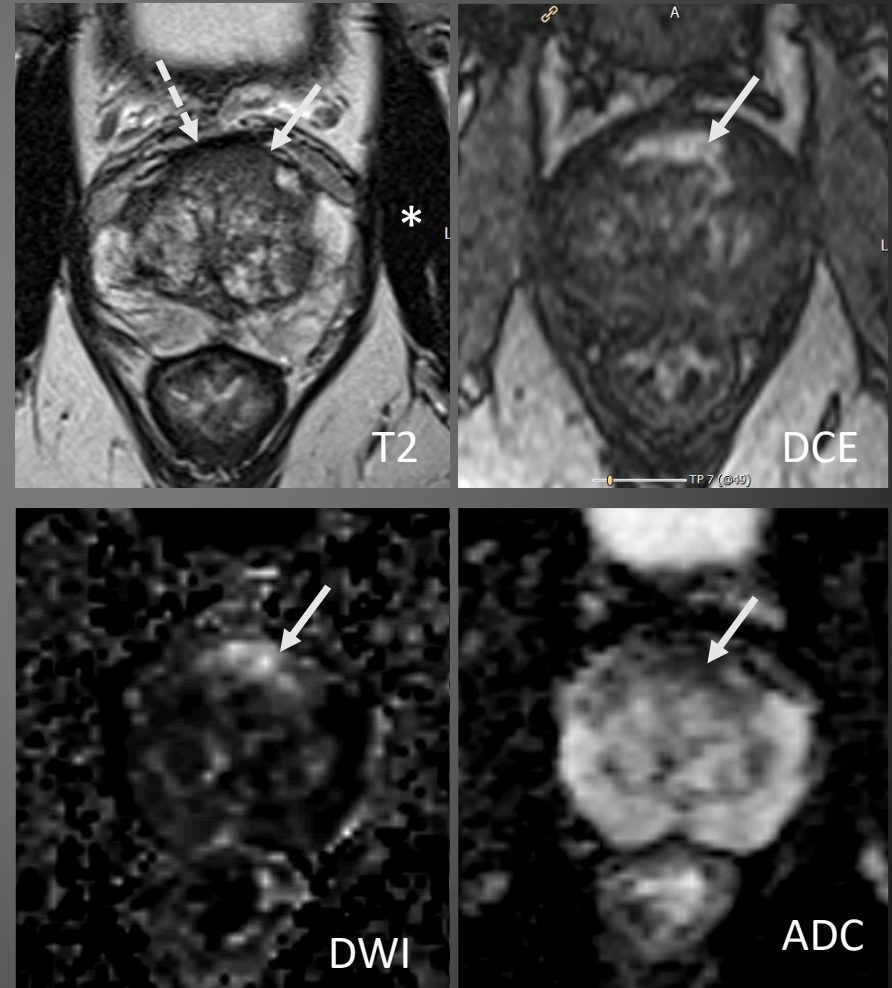
- Variable thickness according to the degree of BPH.
- Low SI on T2 and ADC
- Low SI on DWI
- No early enhancement
- For cancer in the AFS use criteria from the zone where cancer originates



~~AFS~~

- Variable thickness according to the degree of BPH.
- Low SI on T2 and ADC
- Low SI on DWI
- No early enhancement
- For cancer in the AFS use criteria from the zone where cancer originates

MRI-targeted Bx: PCa GS 3 + 4



Summary

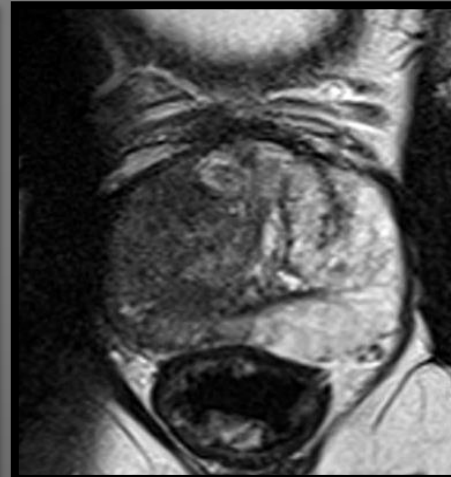
- In the PZ, signal changes on T2W and/or DWI that are **indistinct, linear, wedge-shaped, lobar, or diffuse** are less likely to be malignant



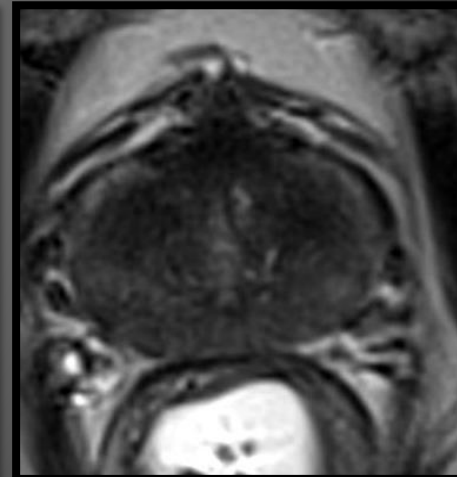
Diffuse/indistinct



Wedge-shaped



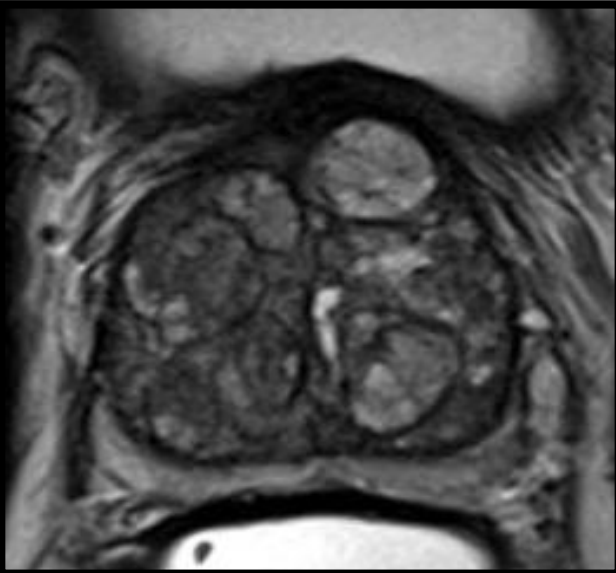
Lobar



Diffuse

Summary

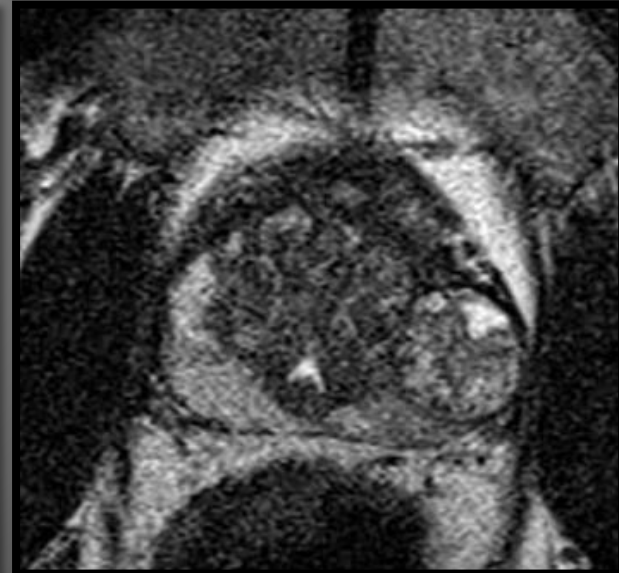
- **Heterogeneous** or **homogeneous** nodules that are **round/oval**, **well-circumscribed**, and **encapsulated** or **symmetric** should be considered to be BPH (PI-RADS 1)



Organized chaos



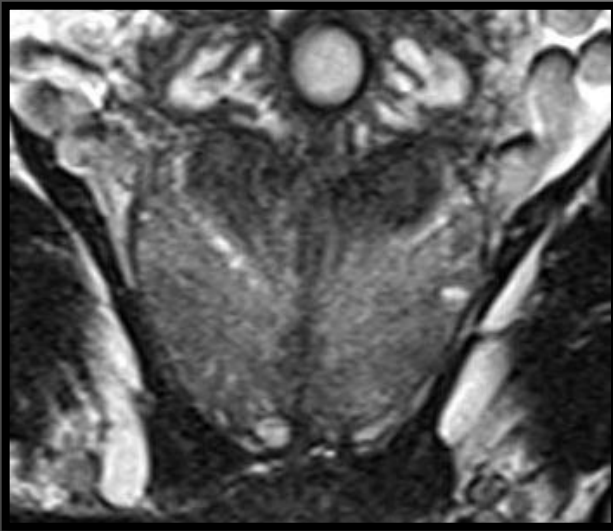
Symmetric



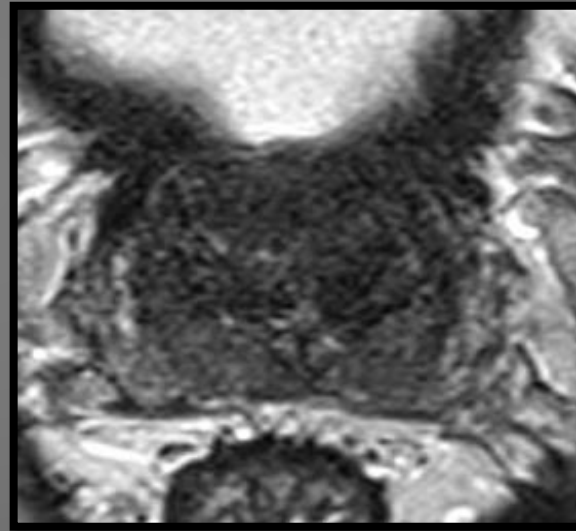
Insinuated BPH nodule

Summary

- CZ: **symmetric** tissue with low SI on T2WI and ADC extending from **base** to the **verumontanum**



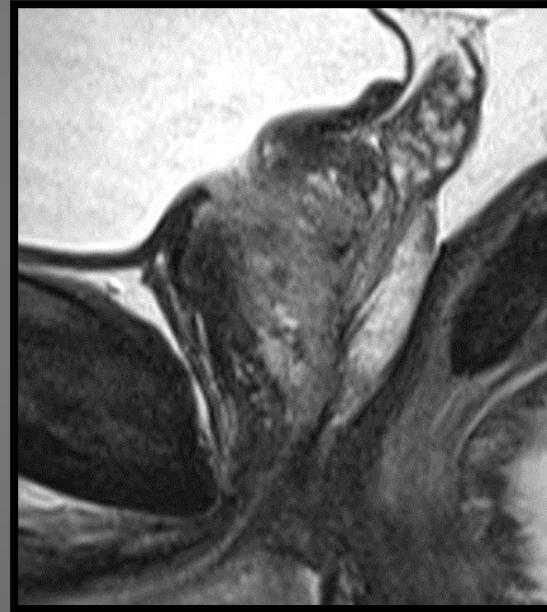
Symmetric



Around ejaculatory ducts

Summary

- AFS: Anterior structure with low SI on T2 but with **no restricted diffusion or early enhancement**



Thank you!