Post Treatment MRI

Prostate Intensive MRI Education Day

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Disclosure

- None

Outline

- Present the expected MRI findings in patients post treatment for prostate cancer
- Demonstrate MR imaging features of recurrent prostate cancer
- Illustrate MR imaging features of mimics of recurrent prostate cancer

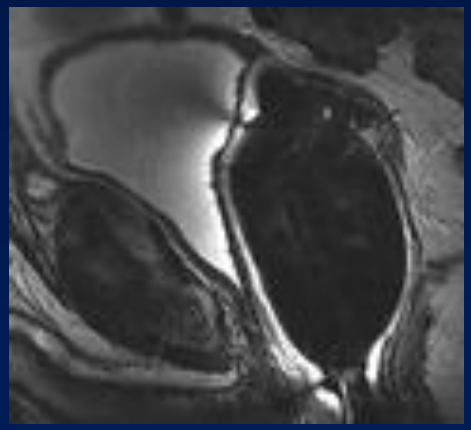
Recurrent Disease

- Biochemical failure with rise in PSA occurs 27-54%.
- Radical prostatectomy: two consecutive PSA levels > 0.2 ng/mL.
- Radiotherapy: PSA increase > 2 ng/mL higher than initial PSA nadir.
- Focal treatment: no established values.
- Local recurrence associated with increased risk for metastasis.
- Without salvage therapy, average time to metastasis is 3 years.

Cookson MS et al. J Urol 2007;177(2):540–545
Roach M et al. Int J Radiat Oncol Biol Phys 2006;65(4):965–974

MRI Radical Prostatectomy

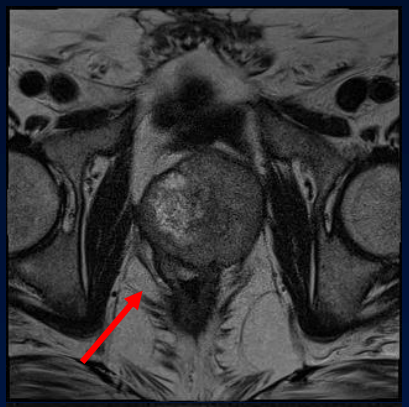
- Surgical resection of prostate and seminal vesicles with vesicourethral anastomosis
- Normal vesicourethral anastomosis: low signal intensity on T2, similar to urinary bladder wall

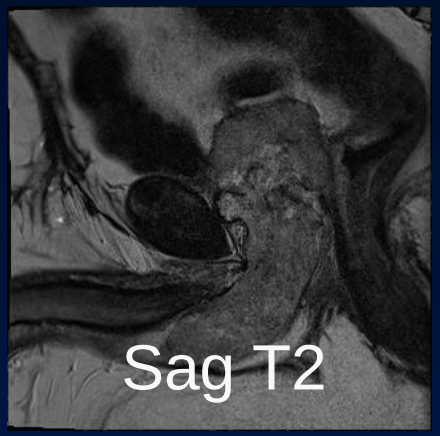


images from Vargas H et al. Radiographics 2012;262:26-42

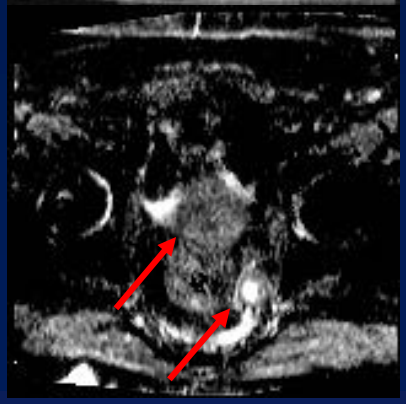
MRI Post Radical Prostatectomy Recurrence

T2





DWI

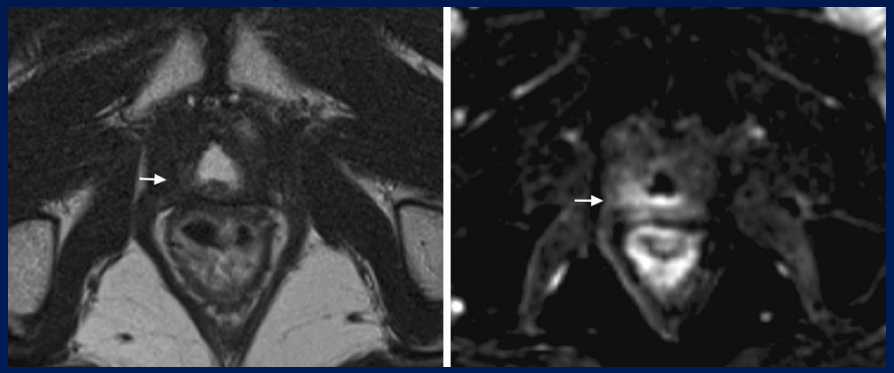


ADC

Large local recurrence with lymphadenopathy and rectal invasion

MRI Post Radical Prostatectomy Recurrence

- Local recurrence occurs 23-43%
- Vesicourethral anastomosis, retrovesical, retained seminal vesicles, anterior or lateral surgical margins of prostatectomy bed
- Soft tissue in the prostatectomy bed
- Isointense to muscle on T1
- Slightly hyperintense to muscle on T2
- Rapid enhancement with washout
- Good response to external radiation



from Lopes Dias J et al. Abdom Imaging 2015;40:2814

from Vargas H et al. Radiology 2012;262:26-42

MRI Post Radical Prostatectomy Recurrence

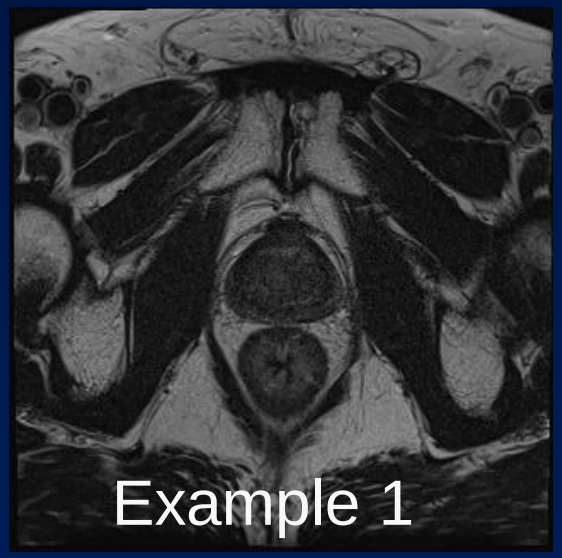
- Sensitivity:48% to 100%
- Specificities: 52% to 100%

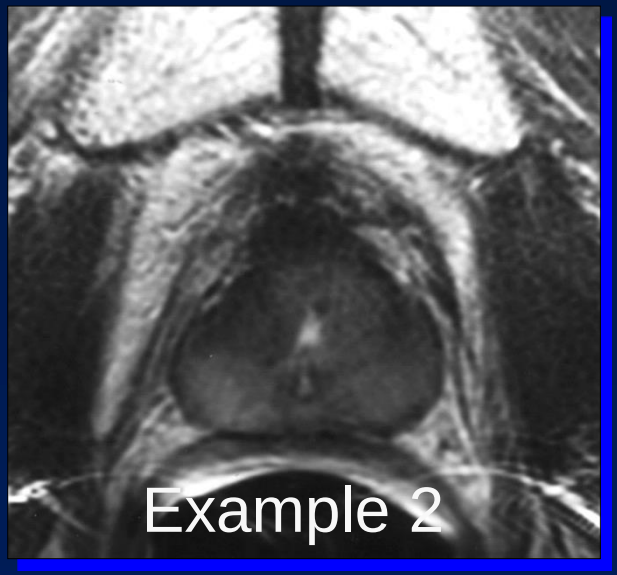
- DCE:
  - Sensitivity 48% to 88%
  - Specificity 52% to 100%

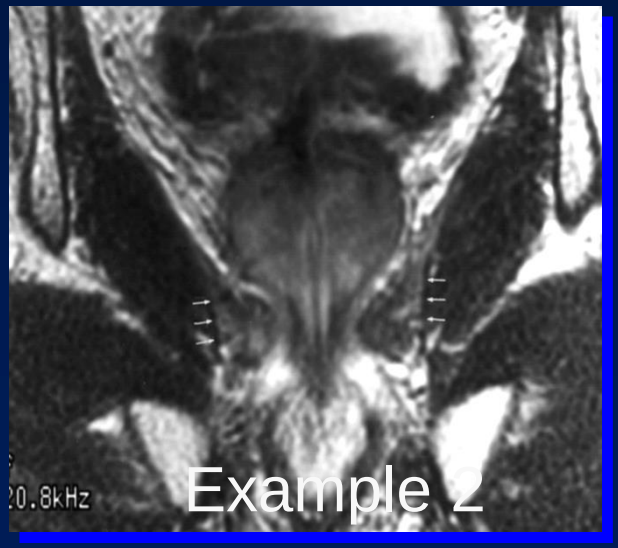
Sella T et al. Radiology 2004;231(2):379–385
Cirillo et al. Eur Radiol 2009;19(3):761–769
Casciani E et al. AJR 2008;190(5):1187–1192

MRI Post Radiation-Expected Findings

- Diffuse atrophy of prostate and seminal vesicle
- Diffusely decreased SI on T2
- Less distinct peripheral and transition zones
- Increase T2 signal in muscle
- Increase T1 signal in bone marrow


Example 1


Example 2

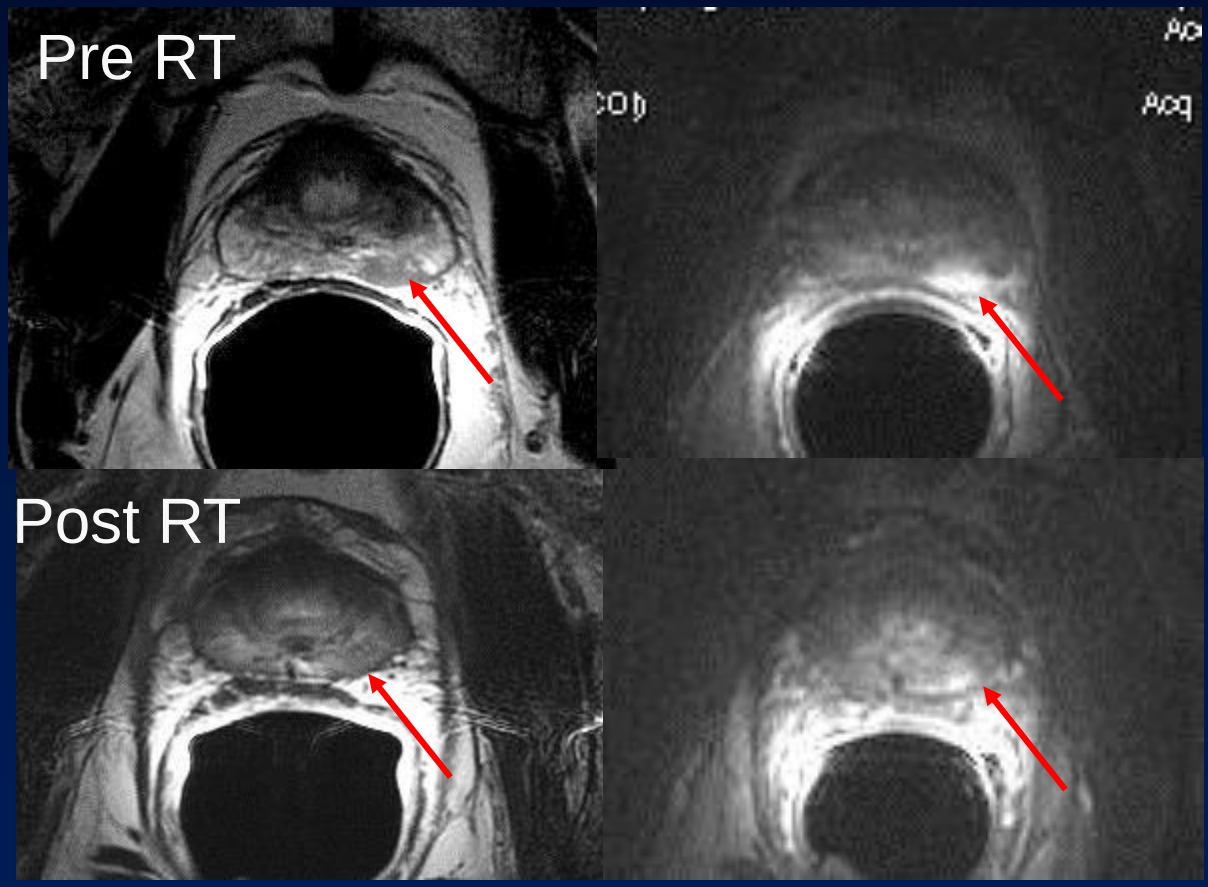


Example 2

Coakley F et al Radiology 2001;219(3):817–821
Sugimura K et al. Radiology 1990;175(3):805–813

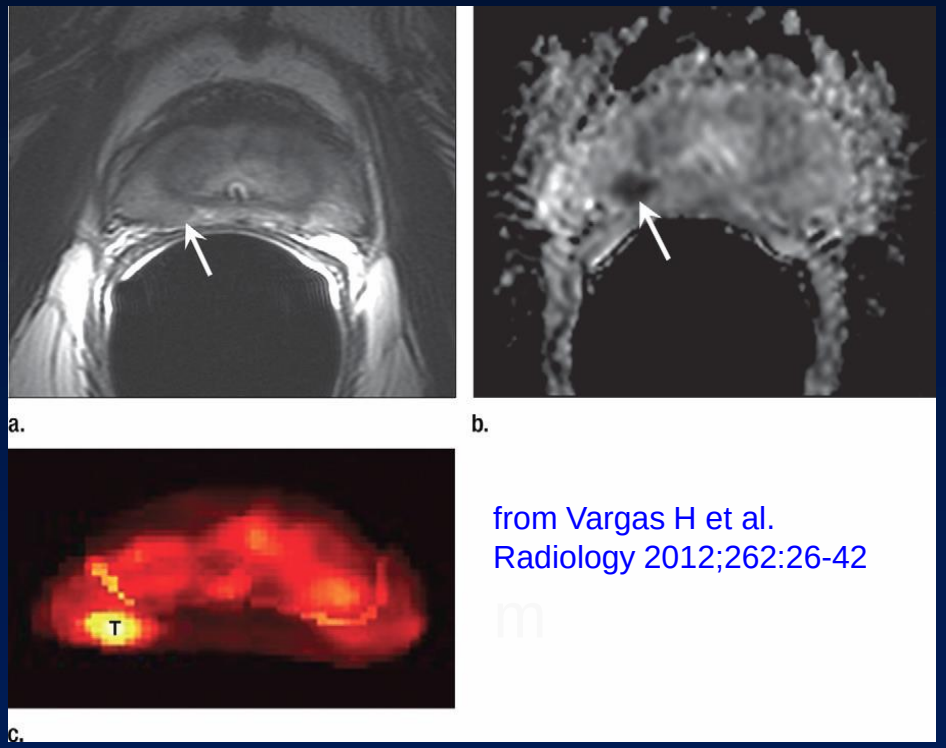
MRI Post Radiation Recurrence

- Tends to occur at the site of the primary (pre-RT) tumour
- Lower SI than surrounding noncancerous prostate tissue
- Restricted diffusion
- Early arterial enhancement of tumour nodules and early washout



Cellini N et al Int J Radiat Oncol Biol Phys 2002;53(3):595–599
Pucar D et al. Int J Radiat Oncol Biol Phys 2007;69(1):62–69
Sala E et al. Radiology 2006;238(1):176–183
Haider M et al. Int J Radiat Oncol Biol Phys 2008;70(2):425–430

MRI Post Radiation Recurrence



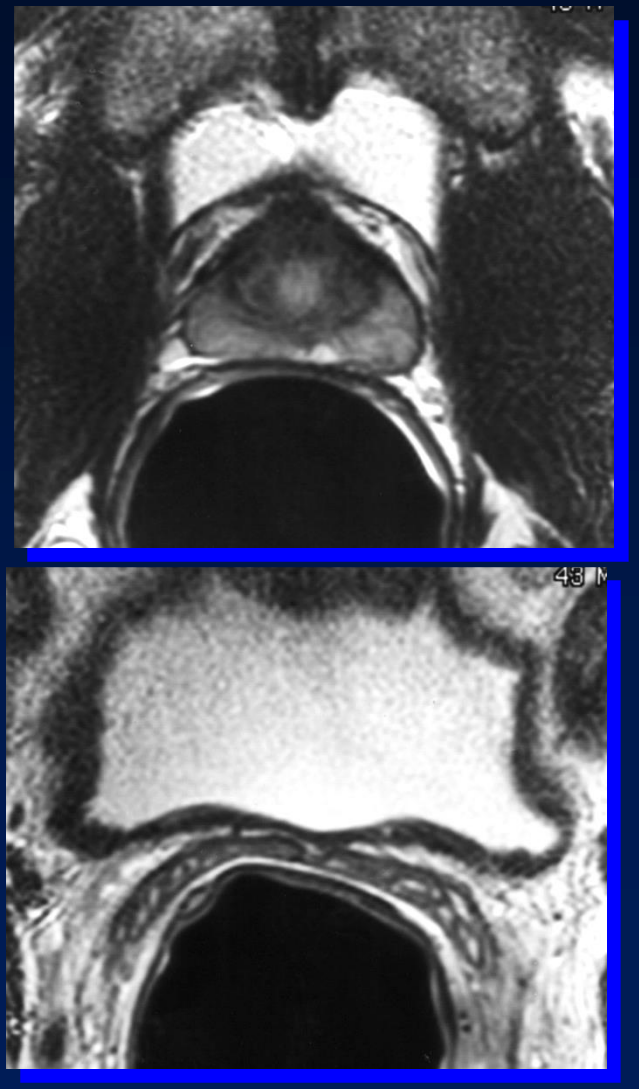
from Vargas H et al.
Radiology 2012;262:26-42

	AUC
T2	0.64/0.54
T2+DWI+DCE	0.95/0.86

Akin O et al Int J Radiat Oncol Biol Phys 2008;70(2):425–430

Androgen Deprivation Therapy

- Usually for advanced PCa cases
- Also used for:
  - increasing PSA levels after local treatment
  - adjunct therapy undergoing RT for locally advanced disease
- Decrease in size PZ>TZ
- SV decrease in size and SI



Bolla M et al. *N Engl J Med* 2009;360(24):2516–2527
Chen M et al. AJR 1996;166(5):1157–1163

Androgen Deprivation Therapy

mp MR imaging demonstrate diverse morphologic and functional responses, with the magnitude of responses depending on the type and duration of therapy.

	Sensitivity	Specificity
Treated Patients Reader1/Reader2	80/69	76/80
Control Reader1/Reader2	73/76	76/70

Mueller-Lisse et al. Mag Res in Med 2001;46:49
Mueller-Lisse et al. Radiology 2001;221:380

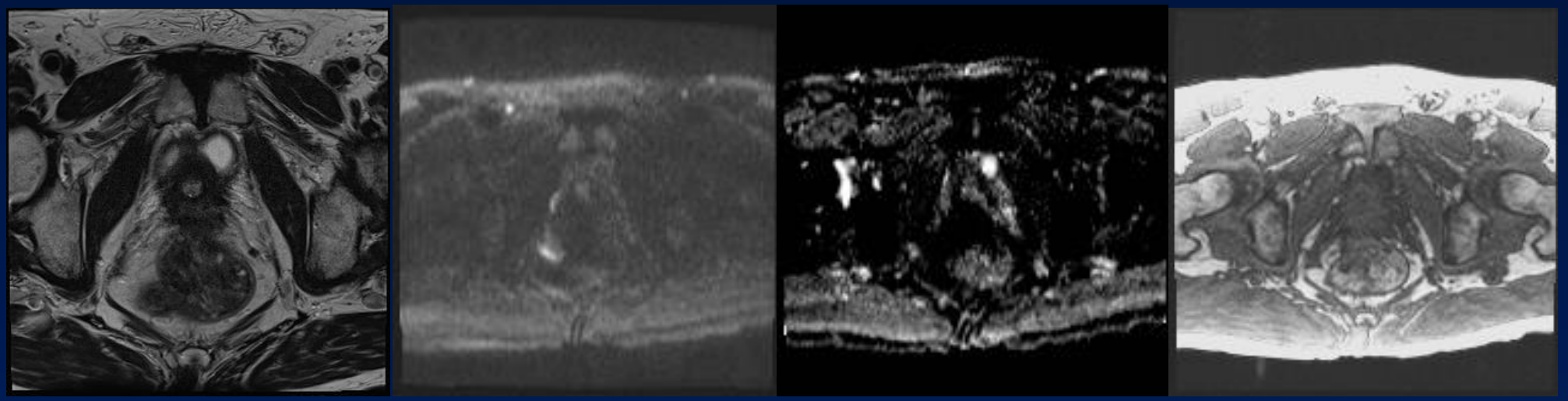
Focal Therapy

- Cryotherapy: ablation of tissue by extremely cold temperatures
- HIFU (high intensity focused ultrasound): causes coagulation necrosis by converting mechanical energy into heat and generating a cavitation effect.
- Photodynamic therapy: photosensitizer absorbs light and transfers energy to adjacent oxygen molecules, creating reactive oxygen species that trigger cell destruction

Bonney WW et al. Urology 1982;19(1):37–42.
Marberger M et al. Urology 2008;72(6 Suppl):S36–S43.
Blana A et al. Eur Urol 2008;53(6):1194–1201.
Gelet A et al. Urology 2004;63(4):625–629.
Vogl TJ et al. Eur Radiol 2004;14(6):1063–1073.
Brown SB et al. Lancet Oncol 2004;5(8):497–508.

MRI of Focal Therapy

- Distortion or decrease in size and SI of gland from focal therapy
- No restricted diffusion or hyperenhancement
- Non-enhancing low-signal-intensity regions at sites of treated tumors representing necrosis

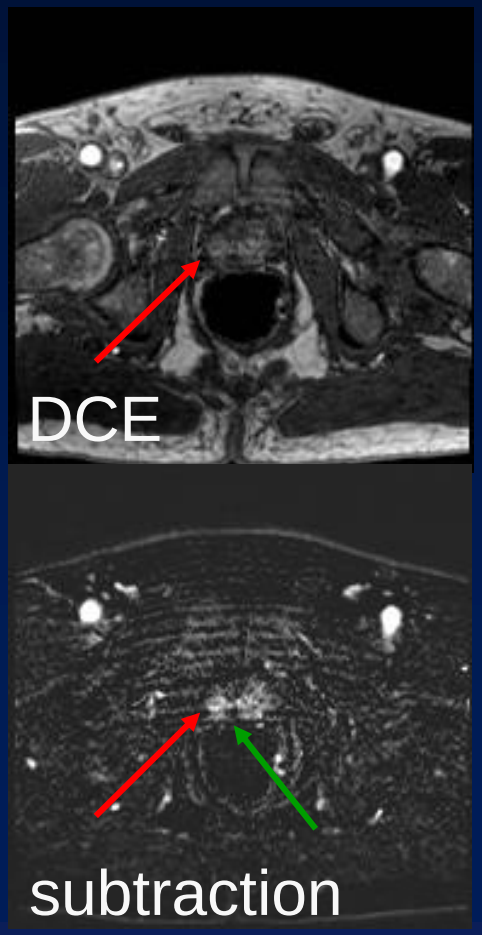


T2 DWI ADC DCE

Kalbhen CL et al. Radiology 1996;198(3):807–811
Kirkham AP et al. Radiology 2008;246(3):833–844

MRI Focal Therapy Recurrence

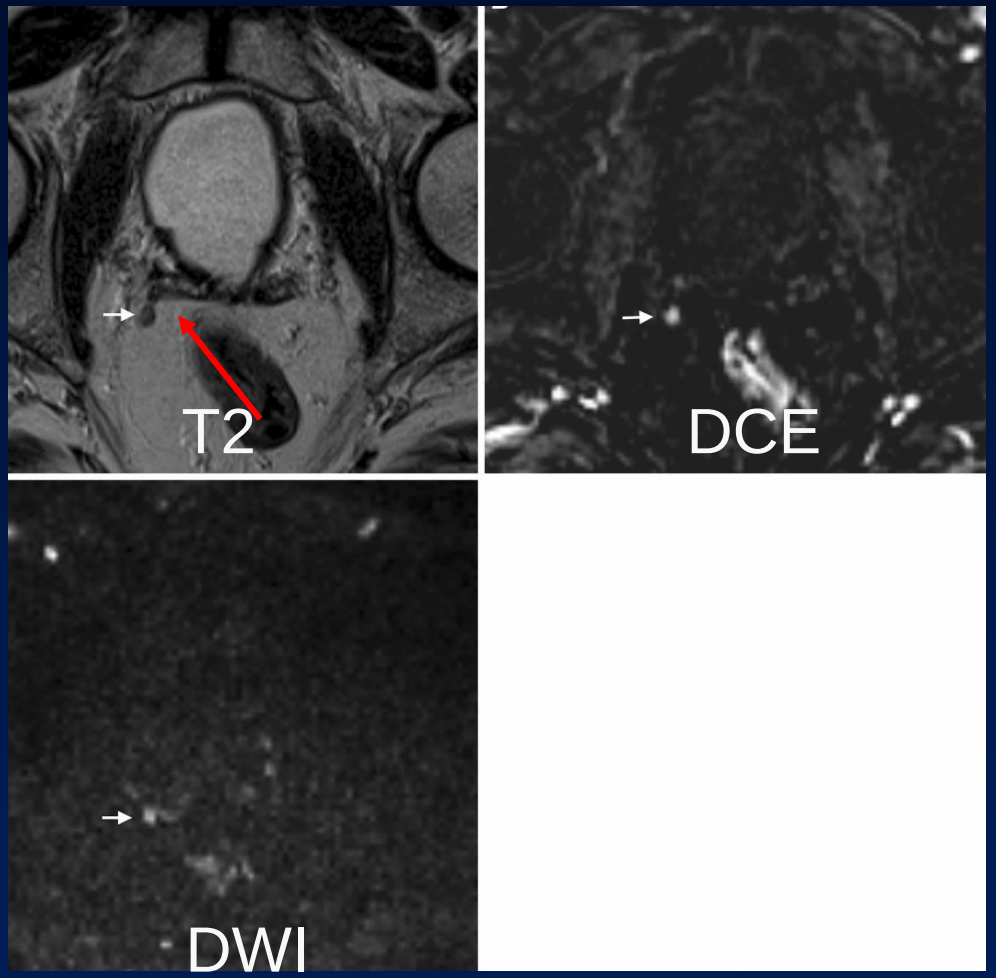
- Low signal on T2
- Restricted diffusion
- Focal area of enhancement representing viable tissue



Kim CK et al. AJR 2008;190(5):1180–1186
Rouviere OG et al. Eur Radiol 2010;20(1):48–55

MRI Mimics of Recurrence

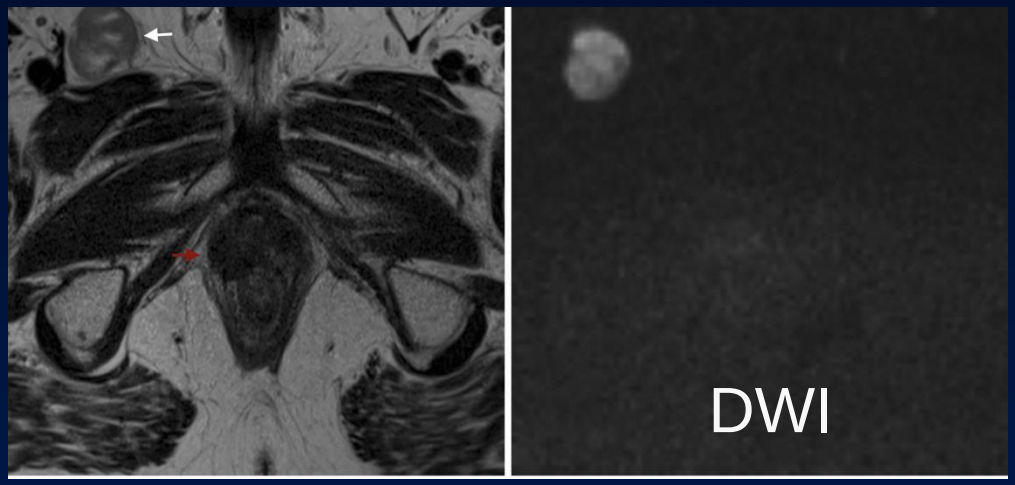
- Retained seminal vesicle
  - Especially on CT
  - Convoluted tubular appearance on T2
  - No rapid enhancement or washout



From Lopes Dias J et al. Abdom Imaging 2015;40:2814

MRI Mimics of Recurrence

- Fibrosis/scar tissue
  - Low signal on T2
  - No restricted diffusion
  - No rapid enhancement or washout
  - No or slightly delayed enhancement



- Granulation tissue
  - High signal on T2
  - No restricted diffusion
  - No enhancement or slight delayed enhancement

from Lopes Dias J et al. Abdom Imaging 2015;40:2814
Vargas H et al. Radiology 2012;262:26-42
Panebianco V et al. Urol Oncol 2016;34(7):303-310

MRI Mimics of Recurrence

- Prominent periprostatic venous plexus
- Focal areas of T2 SI without restriction or enhancement
- Hypertrophic nodule in transition zone
- Hypertrophic fibromuscular stroma

Lopes Dias J et al. Abdom Imaging 2015;40:2814
Vargas H et al. Radiology 2012;262:26-42
Panebianco V et al. Urol Oncol 2016;34(7):303-310

mpMRI Recurrence and Mimics

	T2	DWI	DCE
Recurrence post prostatectomy	Slightly high SI	**Restricted diffusion**	**Rapid wash in and wash out**
Recurrence post radiation	Low SI	**Restricted diffusion**	**Rapid wash in and wash out**
Recurrence post focal therapies	Low SI	**Restricted diffusion**	**Rapid wash in and wash out**
Fibrotic tissue	Low SI	No restricted diffusion	Slightly delayed enhancement
Granulation tissue	High SI	No restricted diffusion	Mild or no enhancement
Retained seminal vesicle	High SI	No restricted diffusion	Delayed wash in and wash out
Residual non-cancerous tissue	High SI	No restricted diffusion	Mild or no enhancement

Panebianco V et al. Urol Oncol 2016;34(7):303-310

Conclusion

- Early detection of recurrence is important for treatment planning and prognosis.
- Detection in the post treatment cases is challenging.
- Advances in mp-MRI helps to differentiate recurrence from mimics.
- Familiarity with imaging appearances of recurrence and mimics helps to make a correct and timely diagnosis.

Thank you

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https://survey.ubc.ca/s/challenges-mri-prostate