Diagnosis of Recurrent Prostate Tumor at Multiparametric Prostate MRI: Pearls and Pitfalls

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Disclosures

- None
Objectives

- Demonstrate important MR features of recurrent prostate cancer (PCa) at multiparametric MR (Mp-MRI)
- Illustrate MR findings of mimics of recurrent PCa
- Present pathologically proven examples
- Emphasize clues for differentiating these mimics from recurrent PCa
Biochemical recurrence after treatment for PCa is a significant issue

Overall recurrent PCa is noted in 23-42% following radical prostatectomy and 25-63% following radiation therapy

Local recurrence is associated with a significantly increased risk for metastatic disease. Without salvage therapy, the average time from development of local recurrence to distant metastasis is approximately 3 years

There is no reliable clinical way to diagnose local recurrence
Recent advances in MR techniques have markedly improved detection of local recurrence.

The proven cases in this poster include local recurrence following:
- Radical prostatectomy
- External beam radiation therapy
- Brachytherapy
- Cryotherapy
- High intensity focused ultrasound (HIFU)
- Laser treatment
A wide variety of entities can mimic recurrent PCa at Mp-MRI. These mimics include:

- Retained seminal vesicles
- Fibrotic scar
- Prominent periprostatic venous plexus
- Granulation tissue
- Focal areas of low T2 signal intensity
- Hypertrophic nodule in the central gland
- Hypertrophic fibromuscular stroma

In this poster, we will discuss MR findings of recurrence and its mimics along with features that help to differentiate these mimics from recurrence.

The target audience for this poster are radiologists.
I. Key Features of Recurrent PCa at Mp-MRI following:
   A. Radical prostatectomy
   B. External beam radiation therapy
   C. Brachytherapy
   D. Cryotherapy
   E. High intensity focused ultrasound
   F. Laser treatment

II. MR Features of Mimics of Recurrence
   A. Retained seminal vesicles
   B. Fibrotic scar
   C. Prominent periprostatic venous plexus
   D. Granulation tissue
   E. Focal areas of low T2 signal intensity
   F. Hypertrophic nodule in the central gland
   G. Hypertrophic fibromuscular stroma

III. Summary and Clinical Implications
I. Key Features of Recurrent PCa at Mp-MRI

A. Following radical prostatectomy

- Recurrent PCa in the surgical bed following radical prostatectomy is common, occurring in 23 to 42%
- Early detection of focal recurrence is crucial because these recurrences can be treated by external radiation with a good response
- The recurrence at T2WI has a slightly higher T2 signal intensity than that of adjacent musculature
- DCE yields important information since the majority of recurrences show rapid contrast wash in and wash out
I. Key Features of Recurrent PCa at Mp-MRI
A. Following radical prostatectomy

Recurrent PCa in the surgical bed. The patient is s/p radical prostatectomy with slowly rising PSA to 2.8. Axial T2 (A) shows a soft tissue mass (arrow) with slightly high T2 signal intensity. DCE (B) demonstrates the lesion in the surgical bed (arrow) with contrast wash in and out.
I. Key Features of Recurrent PCa at Mp-MRI

B. Following external beam radiation therapy

- Recurrent PCa in patients after radiation therapy is common, ranging from 25 to 63%.
- Accurate localization of recurrent local tumor allows for the possibility of reducing the target volume with salvage radiation therapy.
- Diffusely low T2 signal intensity and indistinctness of normal zonal anatomy of prostate create diagnostic difficulty, particularly at T2WI.
- The recurrence is usually:
  - Commonly seen in the same location as the pre-treatment tumor.
  - A mass-like low T2 signal intensity nodule.
  - Diffusion restricted and abnormally enhanced.
I. Key Features of Recurrent PCa at Mp-MRI

B. Following external beam radiation therapy

Recurrent PCa in the left apex. The patient is s/p external beam radiation therapy with recent elevation of PSA to 2.4. Axial T2 (A), DCE (B) and ADC map (C) demonstrate a lesion in the left apex (arrow) with nodular low T2 signal intensity (A), abnormal contrast wash in and out (B) and diffusion restriction (C), concerning for PCa. Targeted biopsy confirmed recurrent PCa Gleason score 7.
I. Key Features of Recurrent PCa at Mp-MRI
C. Following brachytherapy

- T2WI and ADC maps are degraded by the radiation seeds
- In addition, diffusely low T2 signal intensity and indistinctness of normal zonal anatomy of the prostate present diagnostic difficulty, particularly at T2WI
- DCE is the single most important sequence in the diagnosis of recurrence in these patients
  - Demonstrates rapid contrast wash in and wash out in the lesion
I. Key Features of Recurrent PCa at Mp-MRI

C. Following brachytherapy

Recurrent PCa in the anterior aspect of the left central gland. The patient is s/p brachytherapy with recent elevation of PSA to 1.7. DCE (A) demonstrates a lesion in the anterior aspect of the left central gland (arrow) with contrast wash in and out. Axial T2 (B) shows no focal abnormality (arrow). MRI guided biopsy confirmed recurrent PCa Gleason score 7.
I. Key Features of Recurrent PCa at Mp-MRI

D. Following cryotherapy

- Cryotherapy ablates prostate tissue at very low temperatures
- After treatment, marked deformity of the prostate is noted as well as areas of necrosis resulting in a heterogeneous signal intensity on T2WI
- Recurrence following cryotherapy may show
  - Low T2 signal intensity nodule with
    - Diffusion restriction
    - Rapid contrast wash in and wash out
I. Key Features of Recurrent PCa at Mp-MRI

D. Following cryotherapy

Recurrent PCa in the transitional zone. The patient is s/p cryotherapy with recent elevation of PSA to 1.5. Axial T2 (A), DCE (B) and ADC map (C) demonstrate a lesion in the transitional zone (arrow) with soft tissue nodular density on T2 (A), abnormal contrast wash in and out (B) and diffusion restriction (C). Targeted biopsy confirmed recurrent PCa Gleason score 8.
I. Key Features of Recurrent PCa at Mp-MRI

E. Following high intensity focused ultrasound (HIFU)

- HIFU results in a cavitation effect - coagulation necrosis in the targeted prostate tissue
  - Seen as areas of non-enhancing tissue in the treated region

- Residual or recurrent PCa following HIFU will show
  - A region with low T2 signal intensity, diffusion restriction and abnormal enhancement
I. Key Features of Recurrent PCa at Mp-MRI

E. Following HIFU

Recurrent PCa in the anterior aspect of the right central gland. The patient is s/p HIFU with recent elevation of PSA to 4.1. Axial T2 (A), DCE (B) and ADC map (C) demonstrate a lesion in the anterior aspect of the right central gland (arrow) with low T2 signal (A), abnormal contrast wash in and out (B) and diffusion restriction (C). US/MRI fusion biopsy confirmed recurrent PCa Gleason score 7.
After placement of a light-sensitive agent into the prostate tissue, laser of a particular wavelength is applied and is absorbed by the photosensitizer. This process creates reactive oxygen species in the adjacent prostate tissue and results in cell destruction.

The residual or recurrent tumor following laser treatment is usually located in the periphery of the treated lesion and is seen as an area with low T2 signal intensity, diffusion restriction and early contrast wash in and wash out.
II. MR Features of Mimics of Recurrence

A. Retained seminal vesicles

- After radical prostatectomy, retained seminal vesicles are observed in approximately 20% of patients.

- Retained seminal vesicles can be confused with recurrence most notably on CT and T1WI.

- The retained seminal vesicles usually maintain their convoluted tubular appearance and have variable signal intensity on T2WI.

- Retained seminal vesicles will not show rapid contrast wash in and wash out on DCE.
Retained seminal vesicle. The patient is s/p radical prostatectomy with slowly rising PSA to 0.9. Axial T2 (A) shows a homogeneous soft tissue density in the expected location of the right seminal vesicle (arrow). DCE (B) demonstrates no evidence of contrast wash out (arrow). MRI guided biopsy confirmed retained seminal vesicle, not a tumor.
II. MR Features of Mimics of Recurrence
B. Fibrotic scar

- Fibrotic scar is commonly present in the surgical bed and is seen as low signal intensity on T2WI, mimicking a recurrence
- Fibrotic scar shows no or slightly delayed enhancement

Fibrotic scar. The patient is s/p radical prostatectomy with a slowly rising PSA to 0.4. Axial T2 (A) and Coronal T2 (B) demonstrate a soft tissue density with low T2 signal in the left surgical bed. DCE (C) demonstrates no enhancement of the soft tissue density (arrow).
II. MR Features of Mimics of Recurrence
C. Prominent venous plexus

- Prominent venous plexus demonstrates rapid contrast wash-in and wash-out, mimicking recurrence
- Located in the anterior and lateral aspects of the surgical bed
  - Elongated and continuous

Prominent venous plexus. The patient is s/p radical prostatectomy with a slowly rising PSA to 0.4. DCE (A, B) demonstrates an elongated and continuous structure in the lateral aspect of the surgical bed with contrast wash in and out (arrow) consistent with periprostatic vessels.
II. MR Features of Mimics of Recurrence

D. Granulation tissue

- Granulation tissue in the surgical bed may show high signal on T2WI, mimicking local recurrence.
- On DCE, it usually demonstrates no enhancement or only slight enhancement on delayed post contrast phases.

Granulation tissue. The patient is s/p radical prostatectomy with slowly rising PSA to 0.9. Axial T2 (A) shows a soft tissue density with slight high T2 signal (arrow) posterior to bladder. DCE (B) demonstrates no enhancement (arrow). MRI guided biopsy confirmed granulation tissue.
II. MR Features of Mimics of Recurrence
E. Focal areas of low T2 signal intensity

- Following radiation therapy, focal areas of low T2 signal intensity are common due to post radiation changes or treated tumor - mimicking recurrence

- These areas may demonstrate
  - normal diffusion restriction
  - normal DCE
Focal areas of low T2 signal intensity. The patient is s/p external beam radiation therapy with a digital rectal exam demonstrating a nodule at the right mid prostate. Axial T2 (A) demonstrates two focal areas of low T2 signal intensity in the central gland (arrow) mimicking recurrence. DCE (B) and ADC map (C) demonstrate no abnormal enhancement (arrow) and no diffusion restriction (arrow) in these areas excluding recurrence.
II. MR Features of Mimics of Recurrence
F. Hypertrophic nodule in the central gland

- Following radiation therapy, hypertrophic nodules in the central gland may demonstrate diffusion restriction and abnormal contrast wash in and out mimicking recurrence.

- Clues for differentiating these nodules from recurrence include:
  - Well-defined margins
  - Different location from the original tumor
  - Rapid contrast enhancement may be similar to the rest of the central gland
II. MR Features of Mimics of Recurrence

F. Hypertrophic nodule in the central gland

Hypertrophic nodule in the central gland. The patient is s/p external radiation therapy with a digital rectal exam demonstrating a nodule in the right mid prostate. DCE (A) demonstrates a large area of focal enhancement in the right central gland (arrow) mimicking a recurrence. Axial T2 (B) and ADC map (C) demonstrates that the enhancement corresponds to a well-defined nodule in the right central gland (arrow) without diffusion restriction (arrow). Biopsy confirmed benign prostatic tissue.
II. MR Features of Mimics of Recurrence
G. Hypertrophic fibromuscular stroma

- Following radiation therapy, the fibromuscular stroma may be hypertrophic with low T2 signal intensity and diffusion restriction.
- The stroma is usually located at the midline – symmetric or nearly symmetric, without enhancement.

Hypertrophic fibromuscular stroma. The patient is s/p radiation therapy with recent elevation of PSA to 1.0. Axial T2 (A) and ADC map (B) demonstrate a low T2 signal intensity soft tissue mass in the anterior aspect of the central gland (arrow) near the midline with diffusion restriction (arrow). DCE (C) shows no enhancement of the mass. MRI guided biopsy confirmed benign fibromuscular stroma.
Summary and Clinical Implications

- Early diagnosis of local recurrence is important for treatment planning and is strongly associated with the patient’s prognosis.
- Extensive post treatment changes may make the diagnosis of recurrence challenging.
- Advances of mp-MRI often allow for differentiation of local recurrence from many mimics.
- Attention to details of MR imaging features of recurrence and mimics allow one to arrive at a correct diagnosis and to avoid delays in treatment.


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