



## Patients with prostate cancer: pitfalls and challenges of the assessment of response after radiation therapy or prostatectomy

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### Purpose or Learning Objective:

to discuss the role of imaging in assessing response after radical prostatectomy (RP) and radiation therapy (RT) in prostate cancer (PCa), providing practical tips for accurate image interpretation and highlighting pitfalls and challenges

### Methods or Background:

PCa is the most frequently diagnosed noncutaneous cancer in men [1].

RP and RT represent the mainstays of curative-intent treatment.

A rising serum level of prostate-specific antigen (PSA) is the earliest indicator of prostate cancer recurrence.

Biochemical recurrence is defined as a PSA level greater than 0.2 ng/mL (0.2 µg/L) on two consecutive measurements after radical prostatectomy, or as a PSA level  $\geq 2.0$  ng/mL above the nadir after radiation therapy.

Because PSA-based detection is not site-specific, imaging plays a crucial role in this setting by providing valuable information to guide treatment decisions [2].

Clinical guidelines recommend the use of positron emission tomography/computed tomography (PET/CT) and magnetic resonance imaging (MRI) to assess local recurrence and distant metastases [3].

### Results or Findings:

#### 1) Normal Imaging Findings After Radical Prostatectomy

On MRI normal post-radical prostatectomy findings include a conical-shaped bladder neck anastomosed to the extraprostatic distal urethra. Fat stranding and scarring are commonly seen surrounding the bladder base and the vesicourethral anastomosis, respectively [4].

Scarring, granulation tissue, and fibrosis at the vesicourethral anastomosis should not be mistaken for local recurrence as well as low-grade uptake at PSMA PET [2].

Resection of seminal vesicles is also expected and at their site fibrosis may be observed (Fig 1)[5].

A small amount of residual prostate tissue may remain after radical prostatectomy (Fig 2). In these cases, postoperative PSA levels may not decrease to undetectable values due to PSA production by these remnant prostatic cells [2].

## **2) Normal Imaging Findings After after Radiotherapy**

Radiation therapy causes glandular atrophy and fibrosis, resulting in a reduction in prostate size and a diffusely heterogeneous signal intensity, with loss of normal zonal differentiation on MRI (Fig 3). The seminal vesicles also show a reduction in size [6].

On imaging, actinic injury may extend to adjacent structures, manifesting as bladder and rectal wall thickening and thickening of the mesorectal and Denonvilliers fasciae.

Post-treatment changes induced by brachytherapy are comparable to those observed after external beam radiation therapy [2].

## **3) Imaging Findings of Recurrence**

The most common site of local recurrence following RP is the vesicourethral anastomosis. Other typical sites include the seminal vesicle bed, remnants of the ducti deferentia, and the retrovesical region. Recurrence after RT tends to occur at the site of the primary tumor [5].

### **3.1) PSMA PET/CT**

After radical prostatectomy, local recurrence typically presents as focal, ill-defined, hypoattenuating soft tissue with moderate PSMA uptake (Fig 4). In some cases, it may manifest only as focal unilateral radiotracer uptake within fibrotic tissue. In contrast, after radiotherapy, recurrence on PSMA PET/CT usually appears as focal tracer uptake within the prostate gland or, occasionally, in the seminal vesicles.

Various physiological and pathological processes can express PSMA and potentially lead to interpretative errors (Fig 5) [2].

### **3.2 MR and PI-RR score**

Multiparametric MRI (mpMRI) has proven to be an accurate tool for the early detection of local prostate cancer recurrence following radiotherapy and radical prostatectomy [7].

Local recurrence typically appears as an enhancing soft-tissue nodule that is hyperintense relative to muscle on T2-weighted imaging (T2WI).

In 2021, an international expert panel published consensus-based guidelines for the acquisition, interpretation, and reporting of mpMRI examinations performed to detect local recurrence of prostate cancer (PCa) after radiotherapy (RT) or radical prostatectomy (RP). The algorithm is termed the Prostate Imaging for Recurrence Reporting (PI-RR) system whose primary aim is to reduce inter-reader variability through standardization and structured reporting [3,8].

PI-RR provides recommendations regarding MRI equipment, patient preparation, imaging protocols, and specific considerations for the evaluation of local recurrence.

Following RP, T2WI should be acquired in all three anatomic planes, the field of view should encompass the most common sites of recurrence, including the vesicourethral anastomosis, the seminal vesicle or retrovesical bed, and the bladder neck. In addition, PI-RR recommends the inclusion of at least one large-field-of-view sequence (either T1-weighted imaging or diffusion-weighted imaging) to evaluate lymph nodes and bone structures for potential metastatic disease.

For the assessment of recurrence after RT, PI-RR employs separate 5-point scales for findings on T2WI, diffusion-weighted imaging (DWI), and dynamic contrast-enhanced (DCE) imaging. In this setting, DWI and DCE are considered the dominant sequences and jointly determine the overall PI-RR score (Fig 6), whereas T2WI is primarily used to assess anatomical landmarks. The definitive category is determined by the sequence with the highest score.

Similarly, in the evaluation of recurrence after RP, PI-RR applies a 5-point scale to T2WI, DWI, and DCE, with DCE serving as the sole dominant sequence (Fig 7).

Overall, the likelihood of malignancy is expressed using a 5-point scale: a score of 1 indicates a very low likelihood of recurrence; 2, low likelihood; 3, equivocal or indeterminate likelihood; 4, high likelihood; and 5, very high likelihood of recurrence (Fig 8, 9) [8].

## Conclusion:

Imaging is essential for evaluating prostate cancer recurrence, where PSA alone is not site-specific. PSMA PET/CT and multiparametric MRI are tools for detecting local recurrence and metastatic disease.

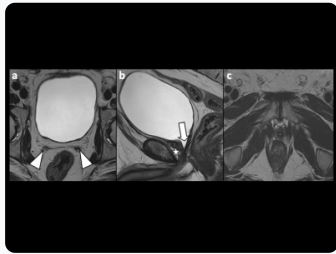
Knowledge of expected post-treatment imaging findings and common pitfalls is crucial to avoid false-positive interpretations. The use of PI-RR is important for a radiologist, as it helps reduce variability in the acquisition, interpretation, and reporting of multiparametric MRI

## Personal Information:

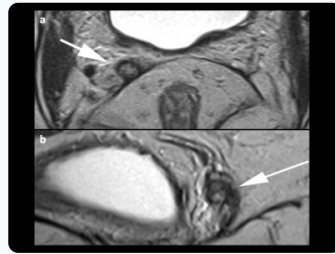
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## References:

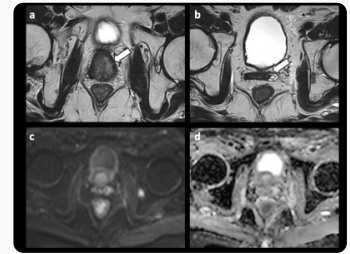
- [1] International Agency for Research on Cancer. Cancer fact sheets: prostate cancer. Lyon, France: IARC Press, 2012;
  - [2] Barbosa FG, Queiroz MA, Nunes RF, Viana PCC, Marin JFG, Cerri GG, Buchpiguel CA. Revisiting Prostate Cancer Recurrence with PSMA PET: Atlas of Typical and Atypical Patterns of Spread. *Radiographics*. 2019 Jan-Feb;39(1):186-212. doi: 10.1148/rg.2019180079. PMID: 30620699;
  - [3] Panebianco V, Villeirs G, Weinreb JC, Turkbey BI, Margolis DJ, Richenberg J, Schoots IG, Moore CM, Futterer J, Macura KJ, Oto A, Bittencourt LK, Haider MA, Salomon G, Tempny CM, Padhani AR, Barentsz JO. Prostate Magnetic Resonance Imaging for Local Recurrence Reporting (PI-RR): International Consensus -based Guidelines on Multiparametric Magnetic Resonance Imaging for Prostate Cancer Recurrence after Radiation Therapy and Radical Prostatectomy. *Eur Urol Oncol*. 2021 Dec;4(6):868-876. doi: 10.1016/j.euo.2021.01.003. Epub 2021 Feb 10. PMID: 33582104;
  - [4] Allen SD, Thompson A, Sohaib SA. The normal post-surgical anatomy of the male pelvis following radical prostatectomy as assessed by magnetic resonance imaging. *Eur Radiol*. 2008 Jun;18(6):1281-91. doi: 10.1007/s00330-008-0867-3. Epub 2008 Feb 13. PMID: 18270715;
  - [5] Lopes Dias J, Lucas R, Magalhães Pina J, João R, Costa NV, Leal C, Bilhim T, Campos Pinheiro L, Mateus Marques R. Post-treated prostate cancer: normal findings and signs of local relapse on multiparametric magnetic resonance imaging. *Abdom Imaging*. 2015 Oct;40(7):2814-38. doi: 10.1007/s00261-015-0473-1. PMID: 26105522;
  - [6] Mertan FV, Greer MD, Borofsky S, Kabakus IM, Merino MJ, Wood BJ, Pinto PA, Choyke PL, Turkbey B. Multiparametric Magnetic Resonance Imaging of Recurrent Prostate Cancer. *Top Magn Reson Imaging*. 2016 Jun;25(3):139-47. doi: 10.1097/RMR.000000000000088. PMID: 27187164; PMCID: PMC5462597;
  - [7] De Visschere P, Standaert C, Futterer JJ, Villeirs GM, Panebianco V, Walz J, Maurer T, Hadaschik BA, Lecouvet FE, Giannarini G, Fanti S. A Systematic Review on the Role of Imaging in Early Recurrent Prostate Cancer. *Eur Urol Oncol*. 2019 Feb;2(1):47-76. doi: 10.1016/j.euo.2018.09.010. Epub 2018 Oct 24. PMID: 30929846;
  - [8] Abreu-Gomez J, Dias AB, Ghai S. PI-RR: The Prostate Imaging for Recurrence Reporting System for MRI Assessment of Local Prostate Cancer Recurrence After Radiation Therapy or Radical Prostatectomy-A Review. *AJR Am J Roentgenol*. 2023 Jun;220(6):852-861. doi: 10.2214/AJR.22.28665. Epub 2023 Feb 1. PMID: 36722763.
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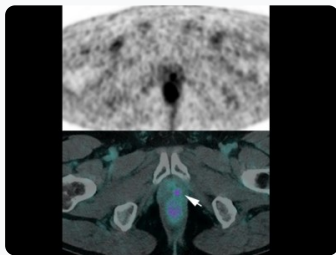
**Fig 1:** T2W images show: a) distal segment of the vas deferens (arrowhead) and no remnant seminal vesicle; b) conical-shaped bladder neck anastomosed to the extraprostatic distal urethra (arrow) and fibrosis at the vesicourethral anastomosis (\*). © Casa di cura Macchiarella



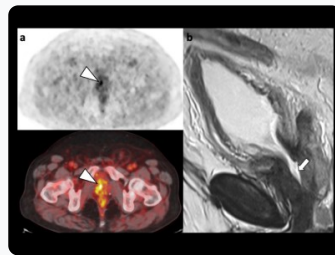
**Fig 2:** Remnant right seminal vesicle in patient with biochemical recurrence after RP. © Casa di cura Macchiarella



**Fig 3:** Atrophy and fibrosis after RT, resulting in a reduction in prostate size and a diffusely heterogeneous signal intensity, with loss of normal zonal differentiation on T2WI. © Casa di cura Macchiarella



**Fig 4:** PSMA uptake at the vesicourethral anastomosis after radical prostatectomy, indicating disease recurrence. © Casa di cura Macchiarella



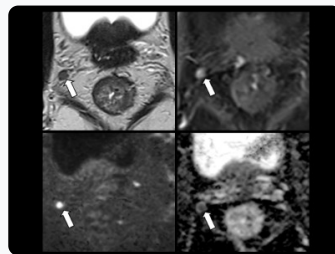
**Fig 5:** PSMA uptake at the level of the prostatic gland in a patient who has undergone partial prostatectomy and RT, attributable to the accumulation of radiolabeled urine in the bladder neck. © Casa di cura Macchiarella

OVERALL PI-RR ASSESSMENT SCORE FOR LOCAL RECURRENCE AFTER RT					
DWI	DCE	OVERALL	DCE	DWI	OVERALL
1-2	1	1-2	1-2	1	1-2
3	1	3	3	1	3
4	1	4	4	1	4
5	1	5	5	1	5

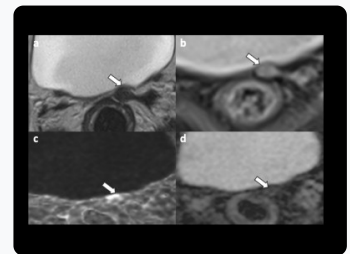
**Fig 6:** Overall PI-RR assessment score for local recurrence after RT. © Casa di cura Macchiarella

OVERALL PI-RR ASSESSMENT SCORE FOR LOCAL RECURRENCE AFTER RP		
DCE	DWI	OVERALL
1-2	1	1-2
3	1	3
4	1	4
5	1	5

**Fig 7:** Overall PI-RR assessment score for local recurrence after RP. © Casa di cura Macchiarella



**Fig 8:** PI-RR score 5 after RT. © Casa di cura Macchiarella



**Fig 9:** PI-RR score 5 after RP. © Casa di cura Macchiarella