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Multiparametric magnet resonance imaging: current role in prostate cancer management

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Abstract (250)

As screening, diagnostic and surveillance tools for prostate cancer digital rectal examination, serum prostate specific antigen screening, and trans-rectal ultrasound guided biopsy are conventionally used. However, they have limited sensitivity and specificity. In recent years, the role of multiparametric magnetic resonance imaging (mp-MRI) has steadily grown and is now part of the standard clinical management in many institutions. In mp-MRI the morphological assessment of T2-weighted imaging is correlated with diffusion-weighted imaging, dynamic contrast-enhanced imaging perfusion and/or magnetic resonance spectroscopic imaging. Mp-MRI is currently regarded as the most sensitive and specific imaging technique for evaluation of prostate cancer, including detection, staging, localization, and aggressiveness evaluation. This article presents an overview of mp-MRI and discusses the current role of mp-MRI in the different fields of prostate cancer management.

Introduction

Prostate cancer is the second most common cause of cancer-related deaths for men in most Western countries, with more than twice as many new cases in 2014 compared to its nearest contender, lung cancer [1]. The incidence of prostate cancer in Japan has also increased due to the westernization of dietary habits [2]. Early detection and accurate characterization of prostate cancer helps to reduce mortality rates. Prostate multiparametric magnetic resonance imaging (mp-MRI), combining the morphological assessment of T2-weighted imaging (T2WI) with diffusion-weighted imaging (DWI), dynamic contrast-enhanced imaging (DCE-MRI) perfusion and/or magnetic resonance spectroscopic imaging (MRSI), has shown to be valuable in the detection, localization and characterization of prostatic tumor [3,4]. In a recent meta-analysis of 7 studies (526 patients) by de Rooji et al. revealed a high overall sensitivity (74%, 95% confidence interval [CI] 0.66–0.81) and specificity (88%, 95% CI 0.82–0.92) of mp-MRI for prostate cancer detection [5]. Although the routine use of mp-MRI has not been established, recently published guidelines from the European Association of Urology (EAU) [6], the American Urological Association (AUA) [7], and the National Comprehensive Cancer Network (NCCN) mention the potential role of mp-MRI in several aspects of prostate cancer management, including prostate biopsy, active

surveillance, and recurrent prostate cancer detection [8]. This review is aimed to present an overview of mp-MRI and discuss the current role of mp-MRI in the different fields of prostate cancer management.

Mp-MRI acquisition

Patient preparation

To avoid any artifactual distortion from stool, bowel gas and bladder the patients should empty the rectum and bladder just prior to the MRI exam. The antispasmodic agent (e.g. scopolamine butylbromide or glucagon) is beneficial to reduce motion artifact from bowel peristalsis [9]. However, due to the cost and potential drug reactions, the use of antispasmodic agent is subject to institutional preference and there is still no consensus for its routine use [10].

MR equipment

Magnetic field of 1.5T is adequate for scanning prostate, although optimized images at 3T are superior [10, 11]. The biggest benefit of 3T is an increased signal-to-noise ratio, which leads to better image quality. The use of endorectal coils (ERC) can improve image resolution on standard 1.5T scanner; however, similar image quality can

be achieved with multichannel pelvic phased-array coil. On 3T, ERC may not provide the same advantages as on 1.5T [10-12]. The benefit of ERC for routine use is not necessarily superior to the cost, patient discomfort, and extra time for examination.

Timing of post-prostate biopsy MRI

There is no consensus over the time period for post-biopsy changes such as hemorrhage and inflammation. These changes can be seen in some patients for several months with diagnostic difficulty and artifact on MRI [10, 13]. The degree of post-biopsy hemorrhage is lower in cancerous lesion than in non-cancerous lesion [13, 14], therefore the detection capability is not likely to be substantially compromised by post-biopsy hemorrhage, and there may be no need to delay MRI after prostate biopsy, if the primary purpose of the exam is staging of the prostate cancer. However, post-biopsy changes may affect the interpretation of prostate MRI for staging in some instances. According to the guideline published by the committee of the American College of Radiology (ACR) and the European Society of Urogenital Radiology (ESUR) in 2015, an interval of at least 6 weeks or longer between biopsy and MRI should be considered for staging [10].

Sequences of mp-MRI

Mp-MRI is composed of high-resolution T2WI, DWI, and DCE-MRI with optional MRSI.

(a) T2WI

T2WI provides the best depiction of the prostatic zonal anatomy and capsule. T2WI is used for prostate cancer detection, localization and staging. Prostate cancer is typically depicted as a round or ill-defined, low-signal-intensity focus in inherently high signal intensity peripheral zone (PZ) [15, 16]. Transitional zone (TZ) cancer is often seen as a homogeneous hypointense signal mass with indistinct margins or can have a lenticular or water-drop shape [16, 17]. However, various conditions such as benign prostatic hyperplasia (BPH), prostatitis, hemorrhage, atrophy, and post-treatment changes can mimic cancer on T2WI. T2WI alone is sensitive but not specific for prostate cancer detection and should be correlated with other functional techniques such as DWI, DCE-MRI, and/or MRSI [16].

(b) DWI

DWI is a powerful functional technique, as it allows apparent diffusion coefficient (ADC) maps to be calculated, enabling qualitative and quantitative assessment of prostate cancer aggressiveness. Cancer shows a higher signal intensity on DWI and a lower ADC value as compared to normal prostatic tissue [16, 18]. For qualitative

assessment, the ACR and ESUR guideline recommended the use of high b-value (≥1400 sec/mm^2) as it suppresses the signal of normal prostatic tissue effectively thus the contrast between cancerous and non-cancerous lesion can be emphasized better on DWI. If MR scanner yields adequate SNR, the use of very high b-value (e.g. 2000 s/mm^2) is more advantageous for cancer detection [19, 20]. For quantitative assessment, a considerable number of studies reported ADC values to correlate with Gleason scores [21-24]. ADC values can be useful for characterization of clinically significant cancer.

(c) DCE-MRI

DCE-MRI allows the evaluation of the enhancement pattern of tumor, which is thought to be related to tumor angiogenesis. Prostate cancer shows early and more pronounced enhancement than surrounding normal prostate tissue on DCE-MRI [16, 25]. In addition, DCE-MRI can also help to monitor treatment effects as well as cancer detection, because tumors are evidently associated with neoangiogenesis that induces an increase in the blood volume and transvascular permeability [25-28]. Tracing the dynamic flow of the contrast agent with DCE-MRI, prostate cancer shows strong and rapid contrast enhancement. Meanwhile, DCE-MRI has a limitation that it is nonspecific because angiogenesis can also be seen in prostatitis in the PZ and in highly vascularized BPH nodules in the TZ [25].

(d) MRSI

MRSI provides information about the specific metabolites within prostatic tissue. It is able to show lower levels of citrate and higher levels of choline in prostate cancer as compared with benign tissue [29]. MRSI can be used for cancer detection and monitoring therapy response [30-32], but does not give staging information owing to its poor spatial resolution. This technique is currently used mainly in a research setting and the latest guideline published by ACR and ESUR no longer suggests its routine use [10].

Prostate Imaging Reporting and Data System (PIRADS)

In 2012, the first Prostate Imaging Reporting and Data System (PIRADS) was introduced by the ESUR to improve the quality and consistency of the MR procedure and reporting [16]. For the purpose of further improving the risk stratification in patients with suspected cancer and improving the communication between practicing radiologists and clinicians, the PIRADS steering committee of ACR and ESUR prostate MRI working group have developed a revised version, PIRADS v2.0, which was made public in 2015 [10, 33]. It described a detailed recommendation on integrating mp-MRI scores according to prostatic zonal anatomy and suggested a simplified approach for the

DCE-MRI interpretation scheme. It also included a pathologic definition of clinically significant prostate cancer, which should be used for comparison with mp-MRI. Integration of MR scores and summary of MRI features on T2WI, DWI, and DCE-MRI in PIRADS v2.0 are shown in Table 1 and 2. A representative case is shown in Fig.1. Recent study by Vargas et al. revealed that the integrated scores suggested by PIRADS v2.0 resulted in correct classification of 94–95 % of the tumors with a pathological volume ≥ 0.5 mL (any Gleason score [GS]), but was limited for the assessment of tumors with volume ≤ 0.5 mL (GS ≥ 4+3) [34].

Clinical applications of mp-MRI

Clinically significant cancer detection

The efforts to reduce prostate cancer mortality by screening and early detection have come with a risk of overdiagnosis and overtreatment of clinically insignificant low-risk prostate cancer. For this reason, there is increasing emphasis on a diagnostic strategy towards detecting only “clinically significant” tumors; such tumors are often defined as those with a pathological volume ≥ 0.5 mL, although other definitions, including the presence of any cancer with a GS ≥ 4+3, have also been proposed [35,36].

The conventional diagnostic pathway using prostate-specific antigen (PSA) screening

and digital rectal exam (DRE) followed by a systematic transrectal ultrasound (TRUS)-guided biopsy is related to the detection of low-risk prostate cancer, leading to overdiagnosis of clinically insignificant cancers, and a potential risk of overtreatment [37,38]. On the other hand, mp-MRI can detect high-grade and larger tumors accurately, which means it may perform particularly well for detection of clinically significant disease [39]. Moreover, the functional techniques may be used to differentiate between low and intermediate to high-grade cancer. Given that, MRI can be a useful tool for detecting clinically significant disease [40]. A recent study reported that negative predictive value of mp-MRI was 89.6% to rule out clinically significant prostate cancer over a longitudinal follow-up period of 5 years [41].

MR-guided prostate biopsy

Conventional systematic TRUS biopsy has been reported to miss approximately 20% of clinically significant prostate cancer [42], especially the anterior tumors until they grow to a substantial size and reach within 15-20 mm from the posterior margin of the prostate, leading to delay in treatment [43]. Systematic TRUS biopsy has also historically shown to underestimate the final Gleason grade of the tumor on histology following radical prostatectomy (RP), leading to inaccurate risk stratification and

selection of therapeutic options. Furthermore, TRUS biopsy is associated with detection of microfocal cancer lesions (tumor volume ≤ 0.5 mL) that may be clinically insignificant and are unlikely to require treatment [38]. To overcome the limitation of standard TRUS biopsy, several prostate targeted biopsy methods using MRI have been introduced. There are three broad categories of targeted biopsy; visual estimation MRI targeted biopsy, in-bore MRI guided biopsy, and MRI/TRUS fusion guided biopsy.

(a)Visual estimation MRI targeted biopsy

Visual estimation MRI targeted biopsy is where the physician performing the transrectal US-guided biopsy reviews the MR imaging results before the procedure and uses this knowledge to select the most appropriate area for targeted biopsy under US guidance. Visual estimation allows the adaptation of MRI targeted biopsy in clinical practice without significant up-front cost [44, 45]. Although this method lacks real-time feedback regarding accuracy, Puech et al. revealed that MRI exam prior to biopsy improved clinically significant cancer detection rate compared to systematic biopsy [38].

(b) In-bore biopsy

This is a targeted biopsy technique directly performed within the MRI bore. The in-bore biopsy approach has the advantages of accurate depiction of needle placement,

fewer sampled cores, and lower likelihood of missed targets if they are MRI-visible [46]. Multiple studies have demonstrated that in-bore MRI guided biopsy is a feasible diagnostic technique in patients with prior negative biopsy. Epstein et al. reported in-bore MRI guided biopsy offered significantly higher cancer detection rate than reported detection rates for repeat systematic biopsy [47]. Pokorny et al. showed an MRI-guided biopsy reduced the diagnosis of low-risk prostate cancer by 89.4% and increased the detection of intermediate-risk/high-risk prostate cancer by 17.7% compared to systematic biopsy [48]. Disadvantages of this method are longer procedure time (1–2 hours) and higher costs for software/devices.

(c) MRI/TRUS fusion guided biopsy

MRI/TRUS fusion biopsy is the method which combines TRUS of the prostate with a pre-procedural MRI overlay showing the suspicious areas delineated by the operator. This method allows operator to visualize the cancer real-time while guiding the biopsy needle to the targeted area via TRUS. This can be performed at the bedside similar to conventional TRUS biopsy. According to the previous reports, MRI/TRUS fusion following initial negative biopsy can detect a clinically significant cancer more precisely than systematic biopsy [49, 50]. Meanwhile, Wysock et al. found MRI/TRUS fusion guided biopsy as compared to visual targeting more often

histologically informative but did not increase cancer detection rate [51]. Potential disadvantages of this method are the indirect approach and the higher cost for the software/device, dependence on the software for accurate image fusion, and operator training.

Management of patients with active surveillance

Active surveillance (AS) is a way of monitoring prostate cancer which involves the postponement of immediate therapy. Definitive treatment is only used if there is evidence that the patient is at increased risk for disease progression. AS is an accepted option for the initial management of carefully selected men with localized, well-differentiated prostate cancer thought to be at low-risk for progression [52]. Challenges in this field include improving patient selection, optimizing follow-up strategies, and identifying appropriate triggers for definitive therapy.

(a) patient selection for AS

Multiple criteria have been proposed for identifying patients with a favorable prognosis who are candidates for AS, which is usually decided based on PSA, clinical stage, amount of cancer in the biopsy, and Gleason grade. Although controversial, several sites have recommended a repeat prostate biopsy before committing to a plan for AS, in

order to identify patients in whom the original biopsy may have missed evidence of increased risk [53]. Mp-MRI may eventually be useful as a supplemental tool to optimize patient selection for AS. Previous studies have indicated that clinically significant prostate cancer could be more precisely excluded before AS enrollment if a lesion is not seen on mp-MRI [54]. In their study, when no cancer was identified on mp-MRI, a confirmatory biopsy was able to reclassify only 3.5% of cases as requiring definitive therapy [54]. An ongoing international study called Prostate Cancer Research International: Active Surveillance (PRIAS), which is the largest prospective study evaluating AS, has commenced recruiting eligible patients to have mp-MRI incorporated into the surveillance data [55]. This study will provide reliable information with regards to the feasibility of mp-MRI in AS.

(b) monitoring AS

For monitoring AS, repeat prostate biopsy is usually recommended based upon the concern that histologic grade might worsen. Siddiqui et al. reported that mp-MRI based nomograms could decrease the number of repeat biopsies in patients under AS by as much as 68% [56]. In addition, Diaz et al. demonstrated that only 2.9 MRI/US fusion biopsies were needed to detect one case of Gleason progression compared with 8.74 systematic biopsies [57]. This study also indicated that stable findings on mp-MRI are

associated with GS stability. If the mp-MRI findings are stable over a time since the prior mp-MRI and the previous biopsy showed low-risk disease, it is reasonable to postpone the biopsy. According to the study reported by Abdi et al., patients with a visible lesion on mp-MRI are reported to be more likely to show radiological progression than patients with no visible lesion [58]. In summary, mp-MRI scans on AS can be a substitute for the biopsy procedure and help to identify low-risk lesions which may have progressed to intermediate/high-grade lesions. A representative case is shown in Fig. 2.

Radical prostatectomy planning

Mp-MRI has a potential to provide useful information to determine whether the tumor has penetrated the capsule. Goals of radical prostatectomy include cancer control and minimization of postoperative complications such as incontinence, and erectile dysfunction [59]. Neurovascular bundle (NVB) sparing technique aims to preserve patient sexual potency. However, sparing the NVB when extracapsular extension (ECE) is present increases the probability of a positive surgical margin with a need for postoperative additional therapy, and chances of local cancer recurrence [60].

McClure et al. reported that preoperative prostate MRI data changed the decision to

use a nerve-sparing technique during robot-assisted radical prostatectomy (RARP) in 27% of patients in this series [61]. In their study, the patients whose surgical plan were changed to a nerve-sparing technique, there were no positive margins on the side of the prostate cancer so there was no need to change the treatment plan. More recently, Petralia et al. found the use of mp-MRI-directed intraoperative frozen section (IFS) analysis can reduce the rate of positive surgical margin in patients undergoing nerve-sparing RARP [62]. Positive surgical margin was found less frequently in the patients who underwent MR imaging and IFS analysis than in control patients (7.5% vs 18.7%).

On MRI, the presence of low signal intensity in the PZ of the prostate with irregular bulging, bowing of the prostate capsule, disruption of the low-signal-intensity periprostatic band on T2WI, direct involvement of the neurovascular bundle or obliteration of the retroprostatic angle are considered as useful findings for ECE [16]. In addition to these visual findings, several studies have indicated that ADC may also be useful for ECE prediction [62-65]. Woo et al. reported the mean ADC values for patients with ECE ($0.77 \pm 0.11 \times 10^{-3}$ mm^2/s) were significantly lower than those of without ECE ($1.01 \pm 0.34 \times 10^{-3}$ mm^2/s) [65].

Local recurrence after therapy

(a) follow up after radical prostatectomy

The diagnosis of local recurrence is generally based mainly on PSA level above a threshold or on PSA kinetic values and it is called biochemical failure (BF). Still, BF does not always mean local recurrence in the prostatic bed, because BF can also be caused by distant metastases. Additionally, if there is a residual normal prostate tissue in the post-prostatectomy bed, a persistently elevated PSA serum level could be observed [66]. BF following RP develops in about 50% of high-risk patients and in about 10% of low-risk patients within 15 years from surgery [67].

In recent years a large number of studies on mp-MRI for the detection of post-RP recurrence have been conducted, and many authors reported DCE-MRI as most useful sequence for the detection of local recurrence [68-70]. Wu et al. in a meta-analysis of the fourteen studies performed to assess the effectiveness of mp-MRI in detecting local recurrent prostate cancer after RP found that DCE-MRI as compared to T2WI, showed higher pooled sensitivity (85%, 95% CI 0.78-0.90), specificity (81%, 95% CI 0.64-0.82), and when it was combined with MRSI had even higher pooled specificity (90%, 95% CI 0.56–1.00) [70]. In addition, several groups revealed DCE-MRI and/or DWI in combination with T2WI were useful in evaluating suspected soft tissue lesion of the

prostatic bed after RP [70-73]. Apart from benefits of DCE-MRI, it should also be taken into account that vascularity and contrast enhancement of the lesion can be reduced in patients who have received hormone therapy. A representative case is shown in Fig. 3.

(b) follow up after radiation therapy

In regard to radiation therapy (RT), BF ranges from 15% for low-risk patients to 67% for high-risk patients during a 5-year period follow up [66, 74]. However, serum PSA concentration does not always decrease in a consistent manner, even if the patient has been successfully treated. PSA bounce which is characterized by a temporary post-treatment increase in PSA concentration is common with all forms of RT. MP-MRI is considered to be additional data to help evaluate whether a suboptimal PSA response or PSA bounce reflects local failure of RT or a false-positive PSA result.

After RT, the entire prostate decreases in size and signal intensity on T2WI because RT causes glandular atrophy and fibrosis [75, 76]. Prostate cancer also shows changes, which may include decreased size, reduced capsular bulging, capsular irregularity, or decreased extracapsular extension. Recurrent prostatic cancer can be recognized as hypervascular early enhancing homogeneous nodule while the normal prostatic tissue will be hypovascular and delayed enhancing [76]. Haider et al. reported that

DCE-MRI performs better than T2WI in the detection and localization of prostate cancer in the peripheral zone after external beam RT [77]. In their study, DCE-MRI had significantly better sensitivity (72% vs 38%), specificity (85% vs 80%), and accuracy (83% vs 74%) than T2WI. Tamada et al. showed that combined T2WI, DWI, and DCE-MRI provide a sensitive method to detect local recurrence after high-dose-rate brachytherapy (sensitivity 77%, specificity 92%, and accuracy of 90%) [78]. It is suggested that DCE-MRI should be performed at least 3 months after RT because an increase in perfusion and blood volume due to inflammatory changes of the tissue to radiotherapy seen immediately after treatment.

Conclusion

Mp-MRI can detect the clinically significant prostate cancer with high accuracy; therefore, risk stratification, treatment planning and follow-up can be better yielded. It can also reduce the unnecessary biopsies and prevent overdiagnosis as well as overtreatment. Based upon the previous studies, we believe that mp-MRI will play a more important role in a wide variety of management for prostate cancer.

Conflicts of Interest

None of the contributing authors have any conflict of interest, including specific financial interests or relationships and affiliations relevant to the subject matter or materials discussed in the manuscript.

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Figure Legends

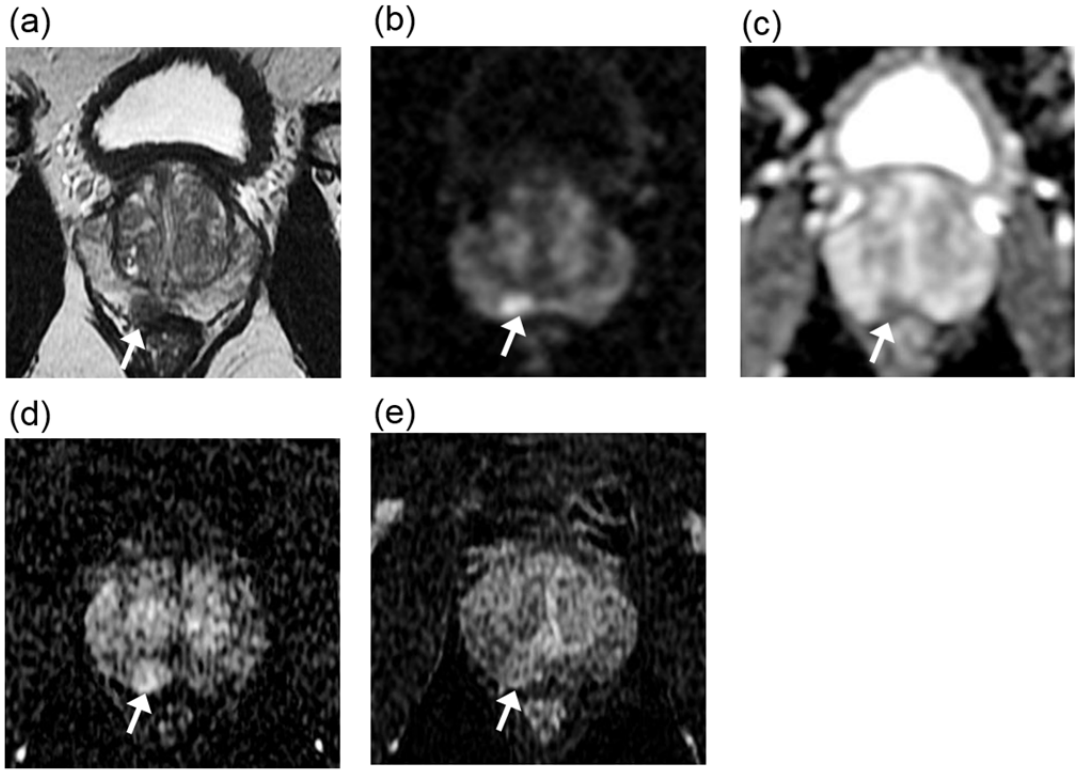

Fig. 1

A 62-year-old patient with a dominant right peripheral zone (PZ) prostate cancer (Gleason 4+3) identified on the radical prostatectomy specimen. T2-weighted images (T2WI) show well circumscribed, homogenous hypointense mass confined to prostate and 0.8cm in greatest dimension in the right PZ (a; arrow). This mass shows hyperintense signal intensity (SI) on high b-value diffusion weighted images (DWI) (b; arrow) and is hypointense on apparent diffusion coefficient map (c; arrow).

Contrast-enhanced T1-weighted images (T1WI) show early enhancement in the right PZ compared to adjacent normal prostatic tissues corresponding to the finding on T2WI and DWI (d; arrow). The lesion shows wash out on delayed contrast-enhanced T1WI (e; arrow). An integrated PI-RADS v2.0 score of 4 was assigned.

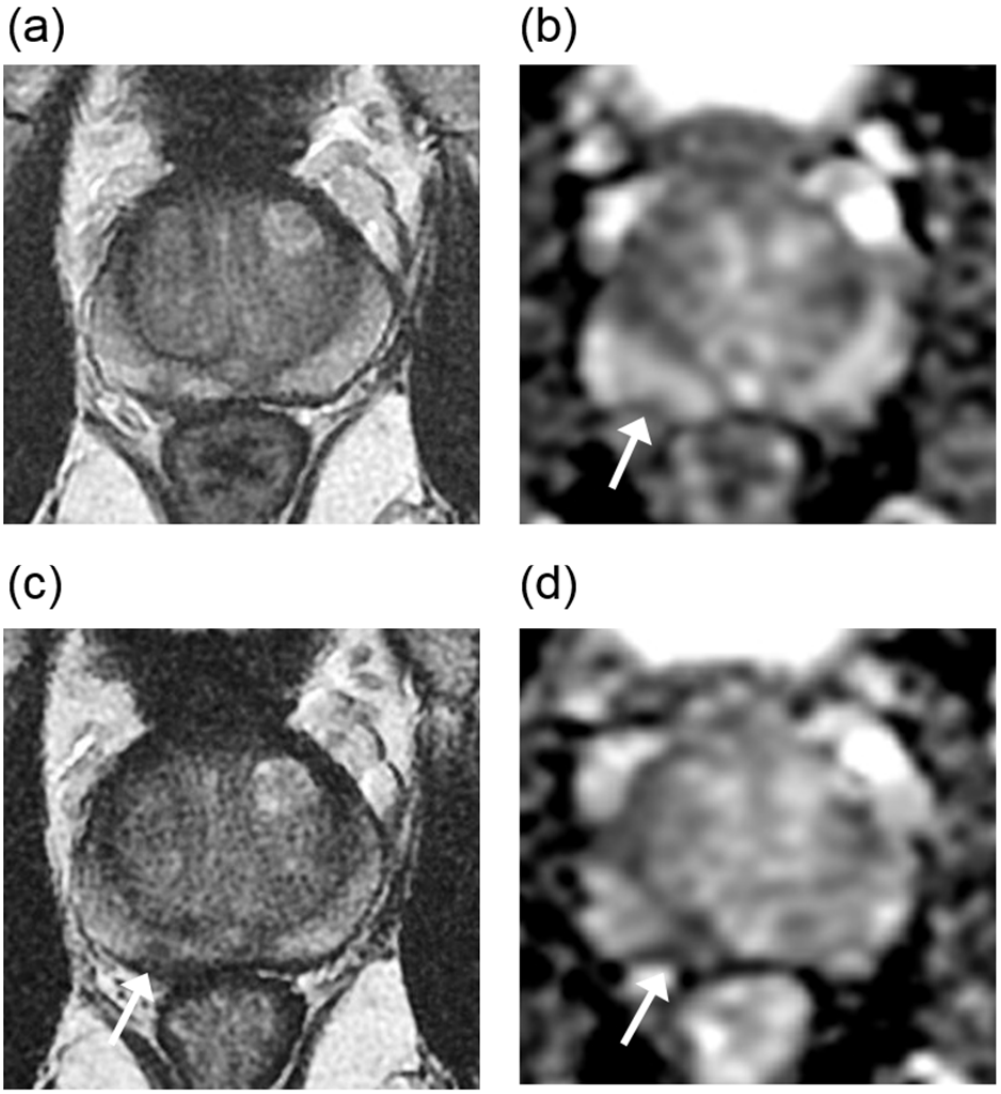

Fig. 2

A 69-year-old patient under active surveillance for prostate cancer. T2-weighted images (T2WI) show the non-circumscribed low signal intensity area in the right peripheral zone (PZ) (a; arrow). The lesion is depicted as indistinct hypointense area on apparent diffusion coefficient (ADC) map (b; arrow). Biopsy after MRI confirmed Gleason score of 3+3 of the lesion in right PZ. Follow-up MRI after 1 year showed increased

size of the tumor on T2WI (c; arrow) and decreased signal on ADC map (d; arrow). A second biopsy performed after MRI revealed that right PZ lesion showing worsening of Gleason score to 3+4.

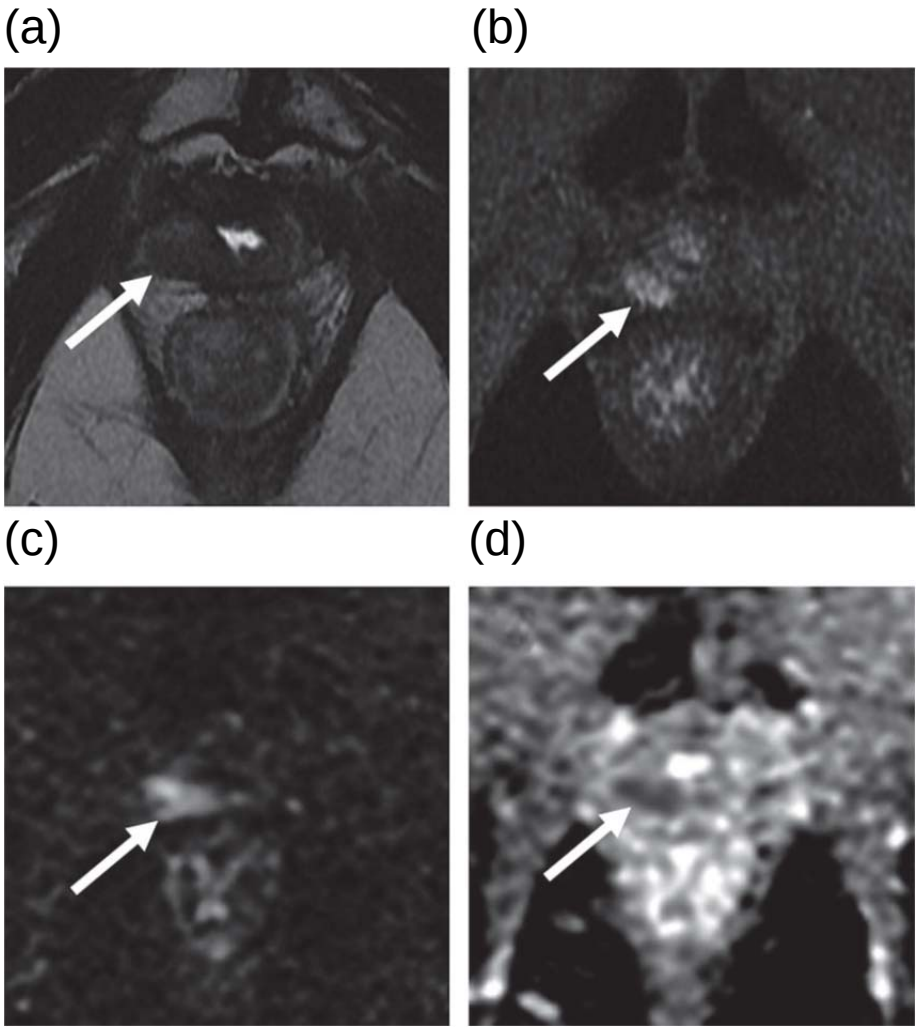

Fig. 3 A 83-year-old patient with recent elevation of prostate-specific antigen level to 2.3 ng/mL at 9 years after radical prostatectomy. On T2-weighted images (T2WI), a focal area with slightly high intensity is seen within right posterolateral bladder neck (a; arrow). Dynamic contrast-enhanced T1-weighted images show early enhancement corresponding to the finding on T2WI (b; arrow). This lesion shows high signal on diffusion weighted images (c; arrow) and low signal on apparent diffusion coefficient map (d; arrow). These findings suggest localized recurrence of prostate cancer.

Table 1. Prostate Imaging Reporting and Data System (PIRADS) v2.0 scoring [8]

Peripheral zone				Transitional zone			
DWI	T2WI	DCE-MRI	Overall PIRADS	DWI	T2WI	DCE-MRI	Overall PIRADS
1	Any	Any*	1	1	Any	Any*	1
2	Any	Any	2	2	Any	Any	2
3	Any	-	3	3	≤ 4	Any	3
		+	4		5	Any	4
4	Any	Any	4	4	Any	Any	4
5	Any	Any	5	5	Any	Any	5

*Any indicates a score of 1–5.

DWI, diffusion-weighted magnetic resonance imaging; T2WI, T2-weighted magnetic resonance imaging; DCE-MRI, dynamic contrast-enhanced magnetic resonance imaging.

Table 2. Summary of MR feature for interpretation in the Prostate Imaging Reporting and Data System (PIRADS) v2.0 [8]

T2WI for peripheral zone (PZ)	
1	Uniform hyperintense signal intensity (normal)
2	Linear or wedge-shaped hypointensity or diffuse mild hypointensity, usually indistinct margin
3	Heterogeneous signal intensity or non-circumscribed, rounded, moderate hypointensity (Includes others that do not qualify as 2, 4, or 5)
4	Circumscribed, homogenous moderate hypointense focus/mass confined to prostate and <1.5 cm in greatest dimension
5	Same as 4, but ≥1.5 cm in greatest dimension or definite extraprostatic extension/invasive behavior
T2WI for the transition zone (TZ)	
1	Homogeneous intermediate signal intensity (normal)
2	Circumscribed hypointense or heterogeneous encapsulated nodule(s) (BPH)
3	Heterogeneous signal intensity with obscured margins (includes others that do not qualify as 2, 4, or 5)
4	Lenticular or non-circumscribed, homogeneous, moderately hypointense, and <1.5 cm in

	greatest dimension
5	Same as 4, but ≥ 1.5 cm in greatest dimension or definite extraprostatic extension/invasive behavior
DWI for PZ and TZ	
1	No abnormality (i.e. normal) on ADC and high b-value DWI
2	Indistinct hypointense on ADC
3	Focal mildly/moderately hypointense on ADC and isointense/mildly hyperintense on high b-value DWI.
4	Focal markedly hypontense on ADC and markedly hyperintense on high b-value DWI; <1.5 cm in greatest dimension
5	Same as 4, but ≥1.5 cm in greatest dimension or definite extraprostatic extension/invasive behavior
DCE-MRI	
Positive	The enhancement is focal, earlier or contemporaneous with enhancement of adjacent normal prostatic tissues, and corresponds to a finding on T2WI and/or DWI.
Negative	Either does not enhance early compared to surrounding prostate or enhances diffusely so that the margins of the enhancing area do not correspond to a finding on T2WI and/or DWI

DWI, diffusion-weighted magnetic resonance imaging; T2WI, T2-weighted magnetic resonance imaging; DCE-MRI, dynamic contrast-enhanced magnetic resonance imaging.