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Review

Future Challenges in Prostate Magnetic Resonance Imaging

Prostat Manyetik Rezonans Görüntülemede Gelecekteki Beklentiler

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ABSTRACT

Prostate cancer poses a significant healthcare challenge. Multiparametric prostate magnetic resonance imaging (mpMRI) has emerged as a valuable diagnostic tool, combining anatomical and functional sequences for enhanced accuracy. Advances in mpMRI techniques, including bi-parametric MRI and radiomics, offer promising improvements for prostate cancer detection and management. Prostate cancer is a major cause of morbidity and mortality. Despite the widespread use of the prostate-specific antigen test for screening, its limitations include overdiagnosis. mpMRI, which integrates anatomical and functional sequences, has demonstrated improved diagnostic accuracy, particularly after updates to prostate imaging reporting and data system (PI-RADS). New techniques such as bi-parametric MRI and computed diffusion weighted imaging are increasingly important, spurring research into MRI-based prostate cancer screening. Efforts to shorten MRI acquisition time have led to the development of short-MRI protocols and quality scores, such as PI-quality. Radiomics has also gained importance in prostate imaging. This article explores these advancements and future prospects in prostate MRI. MpMRI's role in prostate cancer diagnosis is expanding. This article discusses the future potential of spectroscopy, innovations in PI-RADS, new MRI protocols and MRI's role in screening and the challenges and solutions for widespread MRI use.

Keywords: Prostate cancer, multiparametric MRI, MR spectroscopy, PI-RADS, bi-parametric MRI, computed DWI, radiomics

ÖZ

Prostat kanseri önemli bir sağlık sorunudur. Multiparametrik prostat manyetik rezonans görüntüleme (mpMRG), gelişmiş doğruluk için anatomik ve fonksiyonel sekansları birleştiren değerli bir tanı aracıdır. Bi-parametrik MRG ve radyomiks dahil olmak üzere mpMRG tekniklerindeki ilerlemeler, prostat kanseri tespiti ve yönetimi için umut verici gelişmeler sunmaktadır. Prostat kanseri önemli bir morbidite ve mortalite nedenidir. Tarama için prostat spesifik antijen testinin yaygın kullanımına rağmen, sınırlamaları arasında aşırı teşhis de bulunmaktadır. Anatomik ve fonksiyonel sekansları entegre eden mpMRG, özellikle prostat görüntüleme raporlama ve veri sistemi (PI-RADS) versiyonlarındaki güncellemelerle artan doğruluk göstermiştir. Bi-parametrik MRG ve bilgisayarlı difüzyon ağırlıklı görüntüleme gibi yeni teknikler daha önemli hale gelmekte ve MRG tabanlı prostat kanseri taramasına yönelik araştırmaları teşvik etmektedir. MRG çekim süresini kısaltma çabaları, kısa MRG protokollerinin ve PI-kalitesi gibi kalite skorlarının geliştirilmesine yol açmıştır. Radyomiks de prostat görüntülemede önem kazanmıştır. Bu makale, prostat MRG'deki bu gelişmeleri ve gelecekteki beklentileri araştırmaktadır. MpMRG'nin prostat kanseri teşhisinde oynadığı rol giderek genişliyor. Bu makalede spektroskopinin gelecekteki potansiyeli, PI-RADS'deki yenilikler, yeni MRG protokolleri ve MRG'nin taramadaki rolünün yanı sıra MRG'nin yaygın kullanımı için zorluklar ve çözümler tartışılmaktadır.

Anahtar Kelimeler: Prostat kanseri, multiparametrik MRG, MR spektroskopi, PI-RADS, bi-parametrik MRG, bilgisayarlı DWI, radyomiks

INTRODUCTION

Prostate cancer is one of the significant causes of morbidity and mortality (1). Although it has been shown that the prostate-specific antigen (PSA) test can lead to overdiagnosis and consequent overtreatment, it is still used for screening purposes (2). A suspicious digital rectal examination, together with PSA values, may indicate a biopsy; however, the sensitivity and specificity of this

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approach are low. Transrectal ultrasound (TRUS), on the other hand, does not have high sensitivity and specificity for diagnosing clinically significant prostate cancer, but is currently used with magnetic resonance imaging (MRI) to guide biopsy and focal treatments, such as high-intensity focused ultrasound (3). Because prostate cancer can be multifocal, and distinguishing clinically significant disease is important, multiparametric prostate MRI (mpMRI) is currently used in the diagnosis of prostate cancer (4).

Multiparametric Prostate Magnetic Resonance Imaging and the Role of Spectroscopy

The history of mpMRI dates to the late 20th century, when conventional MRI techniques were first applied to prostate imaging. However, in the early 21st century, researchers began exploring the potential of imaging that integrates anatomical and functional sequences to enhance the accuracy of prostate cancer detection. MpMRI includes T2-weighted (T2W) and T1-weighted sequences, and functional sequences such as diffusion-weighted imaging (DWI) and dynamic contrast enhancement (DCE).

Although not routinely used at present, *in vivo* MR spectroscopy (also known as 1H-MR spectroscopy) was used previously. Healthy prostate tissue contains high levels of citrate (5). In cancerous prostate tissue, citrate production and secretion decrease as a result of downregulation of zinc transporters (6). In addition, the levels of spermine (a polyamine) and myo-inositol are decreased in cancerous tissue due to defects in myo-inositol metabolism (7). However, choline levels increase due to elevated phosphocholine and glycerophosphocholine content, and lactate levels increase due to enhanced glycolysis in cancerous tissue (Figure 1) (8). MR spectroscopy can be difficult to evaluate due to the low signal-to-noise ratio (SNR) and strong J-coupling in citrate. In addition, the requirement for an endorectal coil in 1.5-Tesla MR systems and the potential need for the operator to be present during acquisition decrease patient comfort and increase acquisition time. In the new 3.0-T MR technologies, similar SNRs can be achieved without an endorectal coil. Thus, limitations such as prolonged duration and patient discomfort are prevented (9). Another limitation with MR spectroscopy is its high sensitivity to magnetic field inhomogeneities. In prostate MR, the air-tissue interface adjacent to the rectum is generally responsible for this problem. Today, some artificial intelligence algorithms can solve this problem, but further studies are needed in this field (10). MR spectroscopy, in fact, shows promise as a potentially useful tool in prostate MRI, as it allows a more functional assessment by detecting metabolites formed as a result of specific mutations; however, there is still no metabolite detectable by spectroscopy in prostate cancer (11). Currently, gallium-68 (^{68}Ga) prostate-specific membrane antigen positron emission tomography (PET) using ^{68}Ga membrane antigen, a cell-surface antigen is increasingly used for functional imaging (Figure 2).

Bi-Parametric Magnetic Resonance Imaging versus Multi-Parametric Magnetic Resonance Imaging

As discussions about the survival benefit of PSA screening increase, mpMRI has become increasingly important as the first-line imaging modality (12). There are some limitations in mpMRI, which is currently used as the first diagnostic tool after the PSA test and is even considered to be used in screening programs (13).

Among the versions of the prostate imaging reporting and data system (PI-RADS), the term "bi-parametric MRI" was

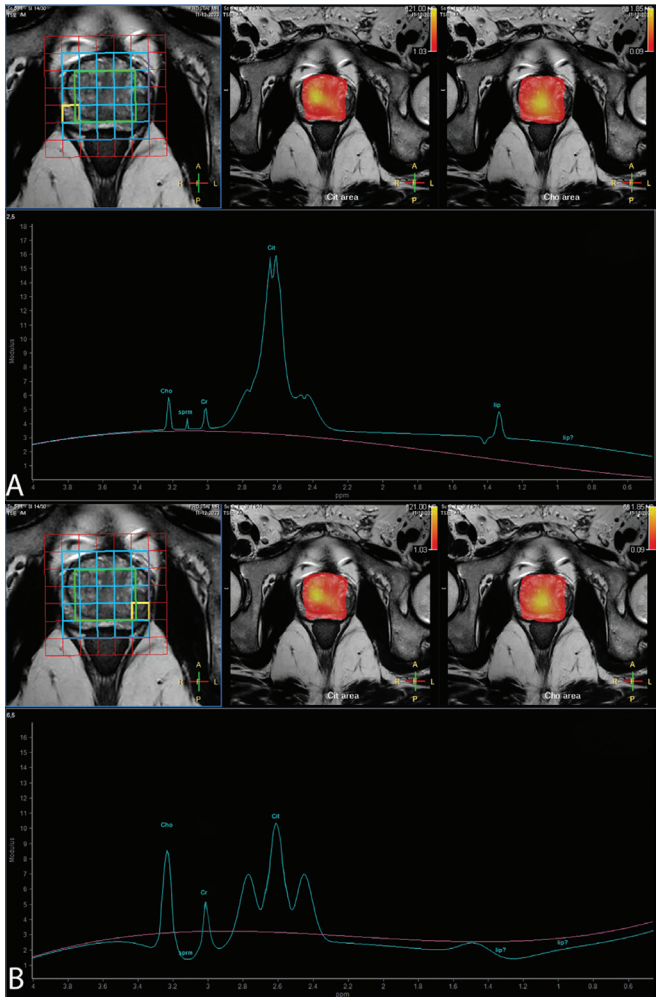

Figure 1. Prostate MRI multivoxel spectroscopy A shows the spectroscopy image of the normal peripheral zone. Note the splitting at the apex at the citrate level. In B, in the spectroscopy image from the suspected cancer area, citrate level is relatively decreased, and choline level is increased

MRI: Magnetic resonance imaging

introduced in PI-RADS v2.1 (14). Studies have shown that the inclusion of DCE images in mpMRI does not result in a statistically significant difference in diagnostic performance between bi-parametric MRI (bpMRI) and mpMRI in the diagnosis of prostate carcinoma (PCa) (15-17). Bosaily et al. (18), who also took transperineal mapping biopsy as the gold standard in the PROMISE trial, reported similar sensitivity and specificity values for bpMRI and mpMRI in their study on 497 patients. However, many of these studies were conducted in academic centers with highly experienced radiologists and standardized protocols, which may not reflect real-world variability. Furthermore, heterogeneity in MRI acquisition parameters, lesion size thresholds, and biopsy techniques complicates direct comparisons. The lack of uniform external validation and limited data from general practice settings call for cautious interpretation. Similarly, Alabousi et al. (19) presented congruent findings in a meta-analysis comprising 31 studies. The area under the receiver operating characteristic curve reached 0.90 for bpMRI and 0.87 for mpMRI. In addition, Christophe et al. (20) showed in a study using radical prostatectomy as the gold standard that mpMRI is not superior to bpMRI for assessing extraprostatic extension. However, readers of the meta-analyses and other studies, who have substantial experience in this field, find these results controversial.

DCE images are sometimes even referred to as "safety-zone" images. Some criteria for biparametric MRI are specified in PI-RADS v2.1 (14). One of the main concerns at this point is that MRI examinations are performed in centers that do not have sufficient technology to obtain adequate DWI. Another reason is that the number of readers with insufficient experience in PI-RADS 3 diagnoses will increase further if DCE series are not available. Hietikko et al. (21) reported that PI-RADS 3 lesions had lower interobserver agreement than PI-RADS 4 and 5 lesions among radiologists with varying levels of experience. Messina et al. (22) showed that lesions with a DWI score of 3 that were DCE-positive and upgraded to PI-RADS 4 did not contribute to the overall diagnosis of clinically significant cancer. However, this study, like other studies, was conducted at an experienced center, and the rate of unnecessary PI-RADS 3 diagnoses may be low.

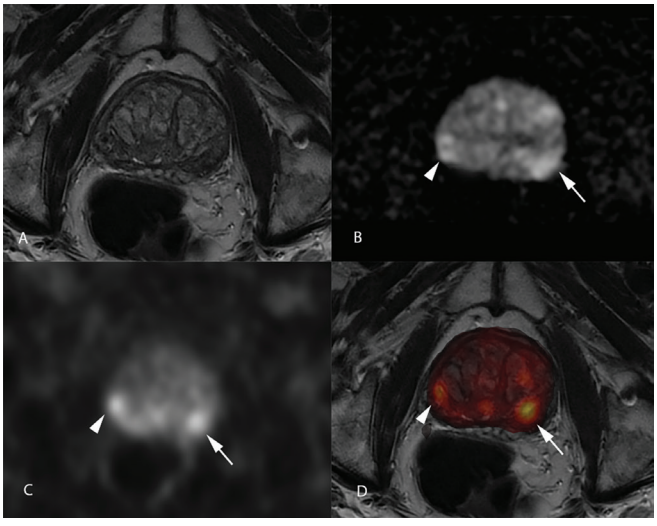

Figure 2. A 76-year-old male patient underwent PET-MR, although the cancer in the left peripheral zone is prominent on DWI (B) (arrow), the lesion in the right peripheral zone is more obscure on DWI (arrowhead). PET (C) and PET-MRI fusion images (D) shows both lesions more clearly. A shows T2W images. The biopsy result of the patient was gleason 4+3 in the left peripheral zone lesion and 3+4 in the right peripheral zone lesion
PET: Positron emission tomography, MRI: Magnetic resonance imaging, DWI: Diffusion-weighted imaging, T2W: T2-weighted

Ideally today, the decision to perform bpMRI should be made by the radiologist at the bedside during the MRI scan. However, this is often not possible under current conditions. Hötker et al. (23) trained and applied an artificial intelligence algorithm to this subject and reported that re-examination was required in only 2% of cases. In addition, a standardized reporting template is required for the development of bi-parametric MRI to eliminate heterogeneity across studies (24). Thus, bi-parametric MRI may become a screening test if adopted at more centers and performed with substantially faster imaging, since DCE is not acquired. Moreover, the implementation of bpMRI may streamline diagnostic workflows by eliminating contrast administration, reducing acquisition time and costs, and improving patient comfort. This may translate into broader accessibility in community settings and reduce patient anxiety. Additionally, streamlined imaging protocols may lower biopsy rates and associated morbidity by improving lesion characterization accuracy. Table 1 summarizes the differences between bpMRI and mpMRI.

Computed Diffusion-Weighted Imaging

Some centers may not have the technology to acquire high-b DWI series. The SNR decreases at high b-values, and longer acquisition times may be required to increase SNR. For these reasons, computed DWI may enable faster prostate MR imaging and improved evaluation in centers lacking sufficient technology (Figures 3 and 4) (25). The software is theoretically based on the the following formulation:

Signal of Computed Image = Signal of Acquired Image ×exp[(-1)×ADC×(B value of Computed Image -B value of Acquired Image)]

In phantom studies, noise decreased for the computed series, and lesion contrast-to-noise ratio increased with

Table 1. bpMRI versus mpMRI

	bpMRI	mpMRI
Sequences used	T2W, DWI	T2W, DWI, DCE
Contrast agent required	No	Yes
Acquisition time	~15-20 minutes	~30-45 minutes
Cost	Lower	Higher
Diagnostic accuracy (csPCa)	Similar in expert centers	Similar
Patient comfort	Higher	Lower due to contrast prep
Ideal settings	Screening, community use	Detailed staging, equivocal cases

bpMRI: Bi-parametric magnetic resonance imaging, mpMRI: Multi-parametric magnetic resonance imaging, T2W: T2-weighted imaging, DWI: Diffusion-weighted imaging, DCE: Dynamic contrast enhancement, csPCa: Clinically significant prostate cancer

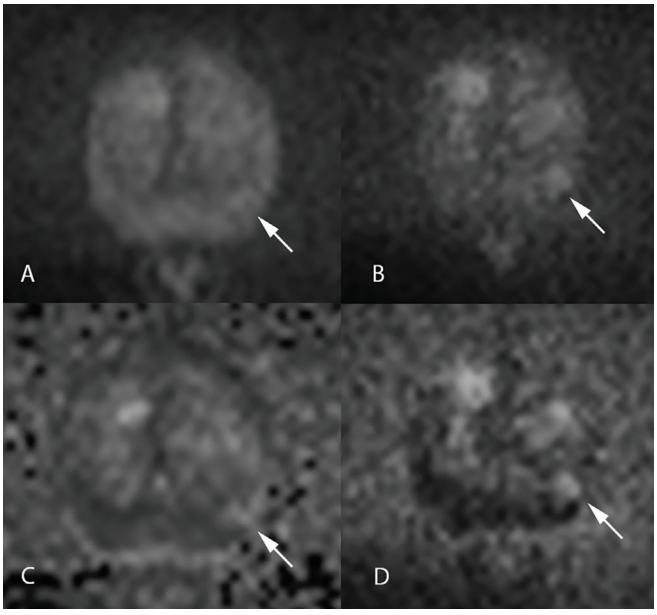

Figure 3. Figure A shows b800, B shows b1400 DWI, C shows computed b1400 and D shows computed b2000 DWI. Although the computed b1400 image is not as good as the original b1400, the computed b2000 DWI demonstrates the lesion better (arrow)
DWI: Diffusion-weighted imaging, 3D: Three-dimensional

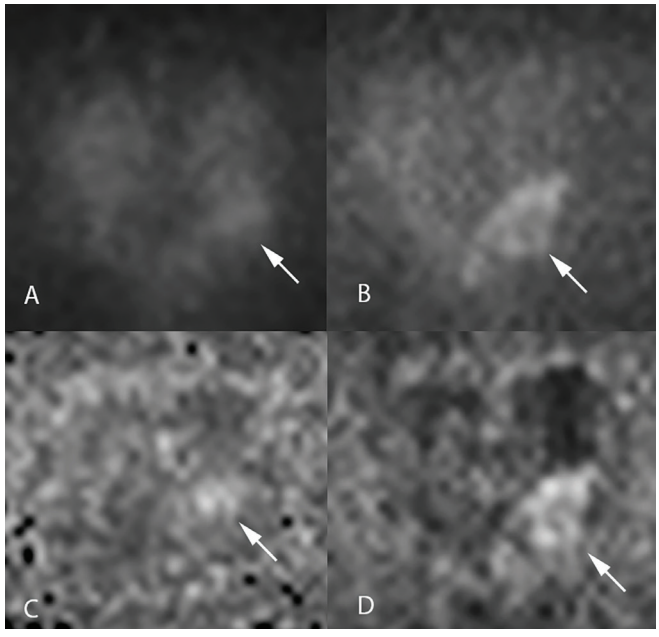

Figure 4. The lesion is not clearly demarcated on b800 DWI (A). In the computed b1400 DWI (C) and computed b2000 DWI (D), the tumour can be seen more clearly (arrow), and it is promising as a technology that can be used in prostate MRI imaging for centres with insufficient MR technology
DWI: Diffusion-weighted imaging, MRI: Magnetic resonance imaging

increasing b value (26). In support of the theory of computed DWI, Ueno et al. (27) found that noise was suppressed in computed images and that the lesion was more easily recognized. While obtaining computed DWI, Ogura et al. (28) showed that the image computed with low b values is not the same as the primary image obtained with high b-values. Therefore, it is recommended to evaluate combinations of b-values, such as 1500-2000 s/mm^2, 0-100 s/mm^2, or 500-1000 s/mm^2, in computed DWI images rather than the slow component of b-values (25). Rosenkrantz et al. (29) showed that a b value of 1500-2500 s/mm^2 is optimal for computed DWI. This occurs because values above 3000-5000 s/mm^2 significantly reduce the total signal. The aforementioned studies were performed using a mono-exponential model, and it is also possible to prepare computed DWI using a bi-exponential model. Computed DWI is a promising software tool particularly for centers with limited technological resources, and is expected to be further developed through additional studies in the field.

Prostate Imaging Quality for Prostate Magnetic Resonance Imaging Quality

Currently, the use of prostate MRI is increasing considerably and is not limited to academic or tertiary referral centers. Due to the issues described above and other imaging-related problems, prostate MRI may be of insufficient quality to contribute to the diagnosis, even if it is not biparametric. Moreover, determining which prostate MRIs cannot be evaluated may be problematic in less-experienced centers and among radiologists who are

not familiar with prostate MRI. For this reason, the prostate imaging quality (PI-QUAL) system was recommended in the multicenter PRECISION trial (30).

The PI-QUAL system can be summarized as follows: PIQUAL employs a 1-to-5 grading scale to evaluate the diagnostic quality of a scan. A score of 1 indicates that all sequences (such as T2W, DWI and DCE) fall below the minimum standard for diagnostic quality. A score of 3 suggests sufficient diagnostic quality, while a score of 5 signifies that all three sequences reach optimal diagnostic quality. Notably, a PI-QUAL score of 4 or higher signifies high MR quality, enabling confident identification or exclusion of all clinically significant lesions. The PI-QUAL score is determined by assessing the mpMRI against specific, objective quality criteria aligned with the PI-RADS v2 guidelines (31). These criteria encompass the adequacy of the execution of all three mpMRI sequences. It's worth noting that the PI-RADS v2.1 guidelines were not available during the PRECISION study, so the evaluation was based on an earlier version. A sheet on the score is also included in the PIQUAL publication; the relevant sheet can be found in the paper published by Giganti et al. (30).

The PI-QUAL system has been published for multiparametric MRI. The radiologist should be familiar with prostate MRI interpretation to evaluate the system. Although the objective criteria in PI-RADS v2 are taken as a reference here, a scoring system with simpler criteria that can be applied by those who are less familiar with prostate MR evaluation may yield more reliable prostate MR imaging in tertiary and non-referral centers. If the PI-QUAL system is applicable to bi-parametric MRI, its adoption may become widespread.

Short Magnetic Resonance Imaging Protocols

Given the increasing use of prostate MRI, abbreviated MRI protocols are being developed to improve patient access and reduce costs. These short protocols may also enhance patient throughput and reduce scheduling bottlenecks, particularly in high-volume institutions, and facilitate inclusion of MRI in population-level screening programs by lowering per-scan costs.

For T2W imaging, PI-RADS v2.1 recommends acquiring an axial image and at least one sagittal or coronal image. van der Leest et al. (32) reported that, when comparing single axial T2W and DWI (which they termed "fast bpMRI") with mpMRI, there was only a slight decrease in specificity for fast bpMRI. This study included 626 patients. In addition, this type of protocol may complicate the evaluation of "encapsulated BPH" in the transitional zone, making prostate MRI evaluation by an inexperienced radiologist even more challenging (Figure 5).

Another method is to acquire only the isotropic three-dimensional (3D) Turbo Spin Echo T2W sequence. In this way, work can be carried out according to the desired plan. Studies have not reported any significant difference in lesion diagnostic accuracy between this method and 2D sequences. In addition, it has been suggested that a 3D sequence may be more useful for assessing extraprostatic extension. However, the T1-weighting of the image may be affected when acquisition time is reduced, and the 3D sequence is more susceptible to motion artifacts (Figure 6) (33).

Recently, using machine learning models, Gassenmaier et al. (34) reduced the T2W acquisition time to almost one-third and did not observe significant changes in PI-RADS scores with these images.

In DWI, three b values (e.g., 50, 700, and 1400) are usually acquired at many centers, while PI-RADS considers it sufficient to acquire two b-values (e.g., 0-50 and 800-1000), provided that b1400 is calculated or obtained separately.

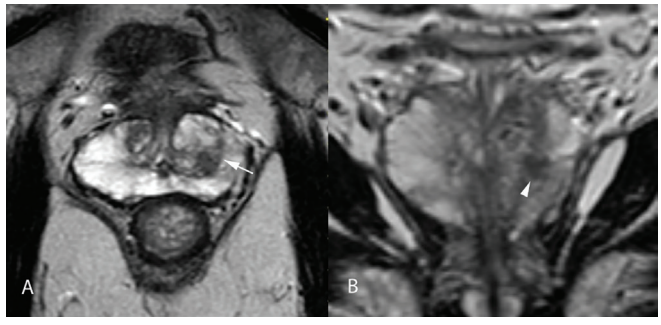

Figure 5. In the axial T2W image (A), a nodular lesion, which is not very suspicious and may belong to a BPH nodule (arrow). In the axial image, this nodule may be thought to be completely encapsulated and misinterpreted as PI-RADS 1 according to PI-RADS v2.1. However, it is clear that the lesion is not encapsulated in the coronal T2W image (B) in the same alignment (arrowhead). The biopsy result of this lesion was gleason 3+4

T2W: T2-weighted, BPH: Benign prostatic hyperplasia, PI-RADS: Prostate imaging reporting and data system

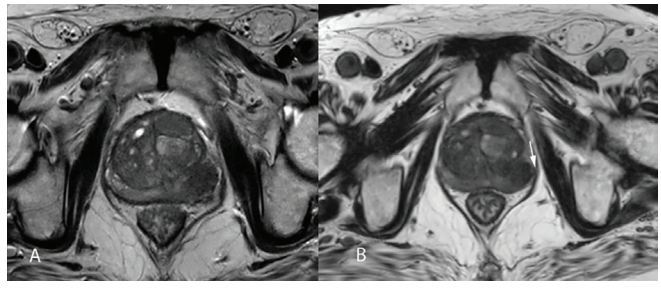

Figure 6. Figure 6 shows T2W series in both images and B was obtained as Isotropic (3D). Extraprostatic extension of the tumoural tissue is not visible in the non-volumetric axial T2W image, but clearly visible in the isotropic image (arrow). Note the increased T1 weighting in the isotropic sequence

T2W: T2-weighted, 3D: Three-dimensional

Recently, new techniques such as reduced field of view have been developed to provide better imaging, but this approach is known to increase acquisition time (Figure 7). In addition, the standard single-shot echo-planar imaging technique used in DWI is susceptible to artifacts, and patients may need to be recalled for DWI, which is a very important sequence in bpMRI. Although antispasmodic agents and enemas are recommended by some authors to reduce motion artifacts, results in the literature are controversial.

Prostate Magnetic Resonance Imaging as A Screening Tool

Given the growing role of MRI in early detection, a structured imaging pathway may aid in standardizing screening protocols. Figure 8 summarizes a proposed algorithm for imaging-based prostate cancer screening and diagnosis (35). A scanning program should be readily accessible, inexpensive, and safe. The screen should be easy to interpret within the program and not vary between observers. PSA testing has been a standard method for prostate cancer screening, but it lacks specificity, leading to overdiagnosis and unnecessary biopsies. As discussed in the background, PSA testing lacks specificity, often leading to unnecessary biopsies. An analysis of five randomized trials that used different biopsy thresholds found that PSA screening did not significantly affect all-cause mortality (36). Although there is no definitive cut-off value for the PSA testclinically significant prostate cancer may occur at PSA values of 3 ng/mL and above (37-39).

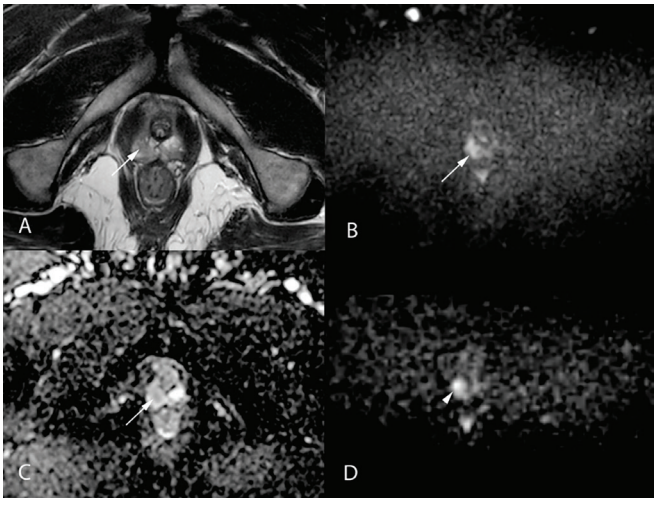

Figure 7. T2W (A), b1400 DWI (B), ADC (C) images of a patient with cancer in the right peripheral zone at the prostate gland apex show tumour tissue (arrows), however, tumour tissue is more prominent in reduced FOV DWI (D) (arrowhead)

T2W: T2-weighted, DWI: Diffusion-weighted imaging, ADC: Apparent diffusion coefficient, FOV: Field of view

Efforts are underway to assess the viability of employing MRI-only applications as a substitute for the PSA test in prostate cancer screening. Preliminary findings indicate a favorable inclination towards this paradigm shift. Despite the higher cost and more limited accessibility of bpMRI compared with the PSA test, particularly as a screening modality, it is imperative to recognize similar paradigms in other medical contexts. For instance, screening tests such as colonoscopy and sigmoidoscopy, which are conducted at longer intervals to optimize cost-effectiveness, have greater sensitivity than the fecal occult blood test (40). This underscores the complexity inherent in evaluating the cost, accessibility, and efficacy of transitioning from traditional screening methods to advanced imaging modalities for cancer detection.

A randomized trial comparing PSA with prostate MRI alone for screening found that prostate biopsy was less likely to be recommended in patients who underwent MRI alone, and that detection of clinically significant prostate cancer among those who underwent biopsy was slightly higher in the MRI-alone group (41). Prostate MRI overcomes this limitation by providing detailed anatomical and functional information, aiding in the identification and characterization of suspicious lesions. In the IP1-PROSTAGRAM trial, PSA and short non-contrast MRI were compared (37). Their results showed that positive MRI screening protocols alone detected more clinically significant prostate cancer than positive PSA examination alone. While this study reinforces the use of bpMRI for screening purposes, it is imperative to

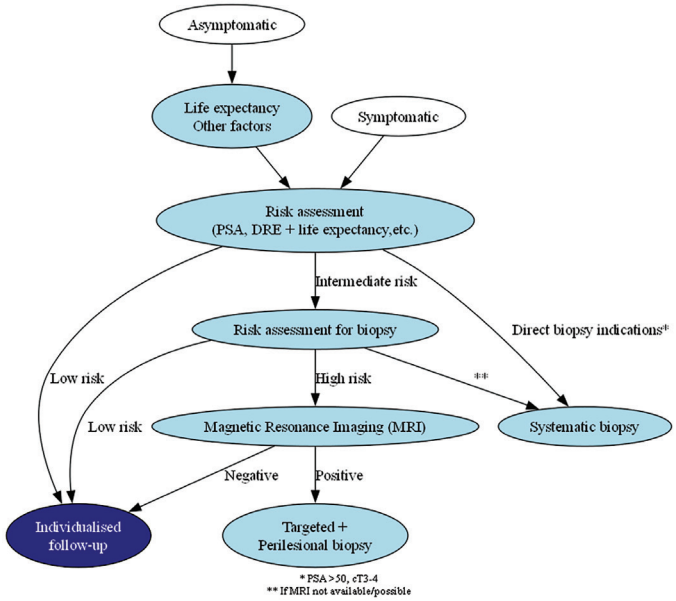

Figure 8. Algorithm for prostate cancer screening and diagnostic decision-making

PSA: Prostate-specific antigen, DRE: Digital rectal examination

acknowledge the need for additional evidence. The current dearth of comprehensive, long-term studies encompassing larger populations necessitates caution in drawing definitive conclusions. Nonetheless, the concurrent use of bpMRI and the PSA test is encouraging and suggests that bpMRI could be included in comprehensive screening programs. Further research is warranted to substantiate these preliminary findings and establish the robustness of bpMRI in the context of population-scale and extended-duration studies.

Radiomics in Prostate Magnetic Resonance Imaging

Radiomics studies in prostate imaging have been performed using many modalities, such as TRUS, computed tomography, and PET. However, most studies have been carried out using MRI. Initially, studies on the detection of prostate cancer were conducted to evaluate radiomics models on MRI for the diagnosis of any prostate cancer. Due to the biological diversity of prostate cancer, clinically significant prostate cancer (csPCa) receives greater focus. For both topics, manual or semi-automatic segmentation methods have been used in most studies. Since segmentation should be performed by a radiologist, its use in screening programs may be limited. However, studies show promise in improving the diagnostic accuracy for suspicious lesions. These algorithms may also allow a less experienced radiologist to interpret prostate MR more confidently.

Recently, the use of machine learning algorithms in bpMRI has increased. Gong et al. (42) reported an area under the curve (AUC) of 0.78, and Li et al. (43) reported an AUC of 0.98 for csPCa detection on bpMRI. Extraprostatic extension is also among the criteria for csPCa according to PI-RADS v2.1, and its detection on MRI may be challenging. Studies using mpMRI have been conducted in this area. Losnegård et al. (44) reported an AUC of 0.75 for radiology interpretation and 0.74 for radiomics. In the triple model combined with clinical nomograms, they obtained 0.79. Ma et al. (45) achieved an AUC of 0.906 for the training group and 0.821 for the internal validation group.

Radiomics studies using MRI are also advancing in the field of prediction. For example, scores such as the Prostate Cancer Risk Assessment score are used to predict biochemical recurrence. In radiomics studies in this area, Shiradkar et al. (46) reported an AUC of 0.84 in the training group and 0.73 in the validation group. Zhong et al. (47) also achieved an accuracy of 77.8% and reported an AUC of 0.73 in the test group.

Deep learning (DL) algorithms and convolutional neural networks enable more automated lesion detection. Ishioka et al. (48) pioneered the development of a DL model to identify biopsy-confirmed PCa. Their model was assessed in two distinct populations, resulting in AUC values of 0.636 and 0.645 for the detection of PCa. Winkel et al. (49) showed that commercial use of the DL algorithm, which has been approved in Europe and the United States of America, improved the radiologist's performance and shortened the reading time for lesions with PI-RADS scores greater than 3. Saha et al. (50) reported a sensitivity of up to 93% in their study of an algorithm developed for csPCa on bpMRI. The promise of artificial intelligence technologies in prostate MRI is becoming increasingly evident.

Despite promising results, radiomics and DL models often suffer from a lack of external validation, limited reproducibility across institutions, and segmentation variability. Many algorithms are trained on single-center datasets, which raises concerns regarding generalizability. Moreover, differing MRI parameters and preprocessing steps affect radiomics feature extraction, highlighting the need for standardization and robust multi-institutional trials. A major barrier remains: the reproducibility of radiomics features across MRI vendors, protocols, and institutions. Automated segmentation, while promising, still faces challenges due to interobserver variability and anatomic ambiguity. Standardization of preprocessing and feature extraction pipelines is lacking. Additionally, very few studies have undergone external validation or prospective evaluation, which raises concerns about overfitting and model robustness. Addressing these issues through transparent reporting standards, multicenter trials, and harmonization initiatives is essential for safe and effective clinical translation.

CONCLUSION

Prostate MRI has significantly evolved, becoming a crucial tool in the diagnosis and management of prostate cancer. While PSA testing remains prevalent, the integration of mpMRI offers a more detailed and functional assessment, enhancing the detection of csPCa. The refinement of techniques, such as bpMRI and computed DWI, provides faster, more cost-effective alternatives without compromising diagnostic accuracy. Additionally, the implementation of standardized systems such as PI-RADS and PI-QUAL ensures consistency and quality in imaging across various centers. Advances in artificial intelligence and radiomics further enhance the potential of prostate MRI, promising improved diagnostic accuracy and better patient outcomes. Continued advancements will likely solidify the role of MRI as a primary screening and diagnostic tool in prostate cancer care.

ETHICS

Ethics Committee Approval and Informed Consent: Not applicable. This article is a narrative review and does not involve original research with human participants. All clinical images are anonymized, and no identifiable patient information is presented.

FOOTNOTES

Authorship Contributions

Concept: H.A., A.T., Ş.M.E., Design: H.A., A.T., Ş.M.E., Data Collection or Processing: H.A., B.E., Analysis or Interpretation: H.A., Literature Search: H.A., B.E., Writing: H.A., A.T., Ş.M.E.

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