
PICTORIAL ESSAY

Pitfalls of Prostate Imaging Reporting and Data System Version 2: a Pictorial Essay

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ABSTRACT

Prostate cancer is a significant health concern in men that is typically investigated by using serum prostate specific antigen and systematic transrectal ultrasound-guided prostate biopsy. Recently, two large prospective multicentre studies have demonstrated that using multiparametric magnetic resonance imaging to triage men with high serum prostate specific antigen levels was a more cost-effective strategy for diagnosing clinically significant cancer, compared with the traditional management pathway. The Prostate Imaging Reporting and Data System (PI-RADS), currently in its second version, was developed to provide technical guidelines on image acquisition and a structured system for reporting of multiparametric magnetic resonance imaging examinations. In this pictorial essay, we will provide an overview of the general technical considerations and guidelines on image interpretation and reporting using PI-RADS version 2, before illustrating the common pitfalls radiologists encounter when applying this system.

Key Words: Magnetic resonance imaging; Prostatic neoplasms

中文摘要

應用第二版前列腺成像報告及數據系統時的常見陷阱：圖像綜述

袁子祐、曹子文、洪曉義

前列腺癌是男性的重要健康問題，一般以血清前列腺特異性抗原和系統經直腸超聲引導的前列腺活檢進行檢查。最近兩項大型前瞻性多中心研究表明，與傳統治療方法相比，使用多參數磁共振成像為血清前列腺特異性抗原高水平男性患者進行分類，對於診斷臨床顯著的前列腺癌症更具成本效益。前列腺成像報告及數據系統（PI-RADS）目前已發展至第二版，提供圖像採集技術指南以及報告多參數磁共振成像檢查的結構化系統。本文概述使用PI-RADS第二版的圖像解釋及一般技術考慮和指南，然後說明放射科醫生在應用該系統時遇到的常見陷阱。

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INTRODUCTION

Prostate cancer is the third most common cancer in men and the fifth leading cause of male cancer deaths in Hong Kong. According to statistics from the Department of Health, it is recorded to have the largest increase in incidence rate among the common male cancers over the past two decades.¹

Traditionally, men with high serum prostate specific antigen (PSA) levels undergo systematic transrectal ultrasound-guided prostate biopsy (TRUS-biopsy) to exclude presence of cancer. However, systematic TRUS-biopsy can miss a proportion of clinically significant cancers as well as over-detecting clinically insignificant cancers.² A clinically significant cancer is defined as a tumour with a Gleason score of ≥ 7 , and / or volume >0.5 cm³, and / or extra-prostatic extension. Cancers with a Gleason score of 6 are considered clinically insignificant and they are often managed with active surveillance.

Recently, two large prospective multicentre studies were performed to investigate the impact of incorporating multiparametric magnetic resonance imaging (MP-MRI) into clinical workflow. The PROMIS trial revealed that using MP-MRI to triage men with high serum PSA levels is a cost-effective strategy, allowing 27% of patients to avoid a primary biopsy and diagnosing 5% fewer clinically insignificant cancers. When subsequent TRUS-biopsies were directed by MP-MRI findings, up to 18% more cases of clinically significant cancer might be detected.^{3,4} The PRECISION Study group has also shown that MRI-targeted biopsy could reduce overdiagnosis of clinically insignificant cancer and improve detection of clinically significant cancers.² Of note, these studies were performed in a largely Western population; the incidence of prostate cancer is much lower among Asian men, and the cost effectiveness of MP MRI for this population is uncertain.

The critical components of Prostate Imaging Reporting and Data System version 2 (PI-RADS v2) are a standardised lexicon facilitating consistent use of a uniform terminology for describing imaging findings, revised systems for scoring the level of suspicion with individual MRI pulse sequences, and development of a standardised scheme for deriving an overall assessment score based on the scores from the dominant sequence.^{5,6} A meta-analysis of 21 studies showed that PI-RADS v2 had a good performance with a high pooled sensitivity of 0.89 and a specificity of 0.73.⁷ Studies comparing interobserver variability have demonstrated moderate reproducibility

among experienced radiologists, with higher variability in the transition zone than in the peripheral zone.⁸⁻¹⁰

Despite the widespread use of the PI-RADS system worldwide and the revisions made with the second version, there remain areas of ambiguity and potential pitfalls when interpreting prostate MRI. The interobserver variability can be substantial, especially amongst less experienced readers. In this pictorial essay, we will describe the general technical considerations, guidelines on image interpretation and reporting using the PI-RADS v2 system, before illustrating the common pitfalls radiologists encounter when applying this system.

TECHNICAL CONSIDERATIONS

Patient Preparation

There is currently no consensus concerning patient preparation. Regarding the timing of MRI following prostate biopsy, an interval of at least 6 weeks is suggested as post-biopsy haemorrhage may obscure a cancer. Antispasmodic agents (such as hyoscine butylbromide or glucagon) may be used to reduce motion artefacts, but these agents are not considered mandatory.¹¹ Presence of air and stool in the rectum may induce artefacts, therefore the patient should evacuate the rectum prior to MRI whenever possible.

Magnetic Field Strength

Both 1.5T and 3T MRI can provide adequate and reliable diagnostic quality when acquisition parameters are optimised. A 3T MRI has the advantage of increased signal-to-noise ratio, which produces better spatial and temporal resolution. A 1.5T MRI should be considered when a patient has an implanted device conditional at 1.5T or if the location of an implanted device may result in artefacts that could compromise image quality, such as metallic hip prosthesis.

Endorectal Coil

When integrated with external phased array coils, an endorectal coil may increase the signal-to-noise ratio at any magnetic field strength. This is particularly useful for patients with large body size. However, an endorectal coil may deform the prostate gland and introduce local magnetic field inhomogeneity and susceptibility artefacts. In addition, the endorectal coil may increase the cost and time of the examination and may be uncomfortable for patients. Although the use of an endorectal coil has been recommended for 1.5T MRI in the past, newer 1.5T MRI models that have a relatively high number of external phased array coil elements and radiofrequency channels

are capable of producing adequate signal-to-noise ratio. Therefore, currently, the use of an endorectal coil is considered optional and is subject to individual machine performance and patient size.^{12,13}

Pulse Sequences

T2-weighted images are fundamental to discern prostate zonal anatomy, to assess abnormalities within the gland, and to evaluate local invasion. The T2-weighted images should be obtained in three planes (axial, coronal and sagittal), commonly using fast-spin-echo or turbo-spin-echo. The field-of-view is generally 12 to 20 cm, to encompass the entire prostate gland and seminal vesicles. Slice thickness should be 3 mm with no gap with in-plane resolution of $\leq 0.7 \times 0.7$ mm. T1-weighted images should also be acquired to determine the presence of haemorrhage.¹⁴

Diffusion-weighted imaging (DWI) is another key component of prostate MP-MRI. High b-value images (≥ 1400 s/mm²) improve the conspicuity and specificity of detecting clinically significant cancers. High b-value images can be obtained either by acquisition, which requires additional scan time, or generating computed DWI by extrapolating the acquired lower b-value data.

The apparent diffusion coefficient (ADC) map is calculated using two or more b-values. It is recommended

that the lowest b-value should be set at 50 to 100 s/mm² and the highest should be 800 to 1000 s/mm² to avoid significant effects from non-Gaussian diffusion behaviour. Additional b-values between these two limits may provide more accurate ADC calculations.⁵

Dynamic contrast-enhanced (DCE) MRI can be used to detect focal early and increased enhancement (wash-in). In order to detect early enhancing lesions, the temporal resolution should preferably be < 7 s per acquisition, with a duration of at least 2 minutes.¹⁵ Longer durations up to 10 minutes can be employed to detect wash-out although this feature is no longer part of PI-RADS assessment. Fat suppression and / or subtractions are recommended.

Magnetic resonance spectroscopy is considered optional as this technique requires expertise in acquisition and post-processing, is time consuming and impractical for widespread use.

IMAGE INTERPRETATION

The overall PI-RADS assessment score determines the level of suspicion for clinically significant prostate cancer.

In PI-RADS v2, the DWI/ADC and T2-weighted images are scored using a 5-point scale. These serve as the dominant parameters to determine the final PI-RADS score, depending on the zonal location. Figures 1 to 3

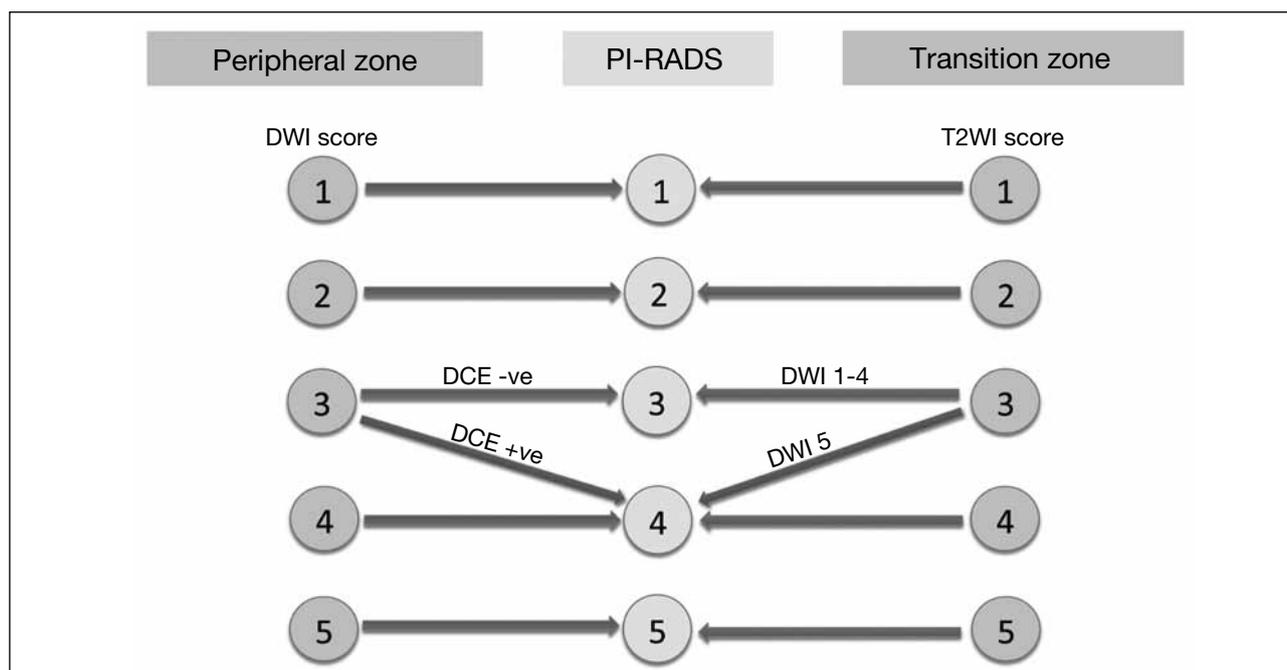


Figure 1. Diagnostic algorithm of peripheral zone and transition zone lesions using PI-RADS version 2. Abbreviations: DCE = dynamic contrast enhancement; DWI = diffusion-weighted imaging; PI-RADS = Prostate Imaging Reporting and Data System; T2WI = T2-weighted image.

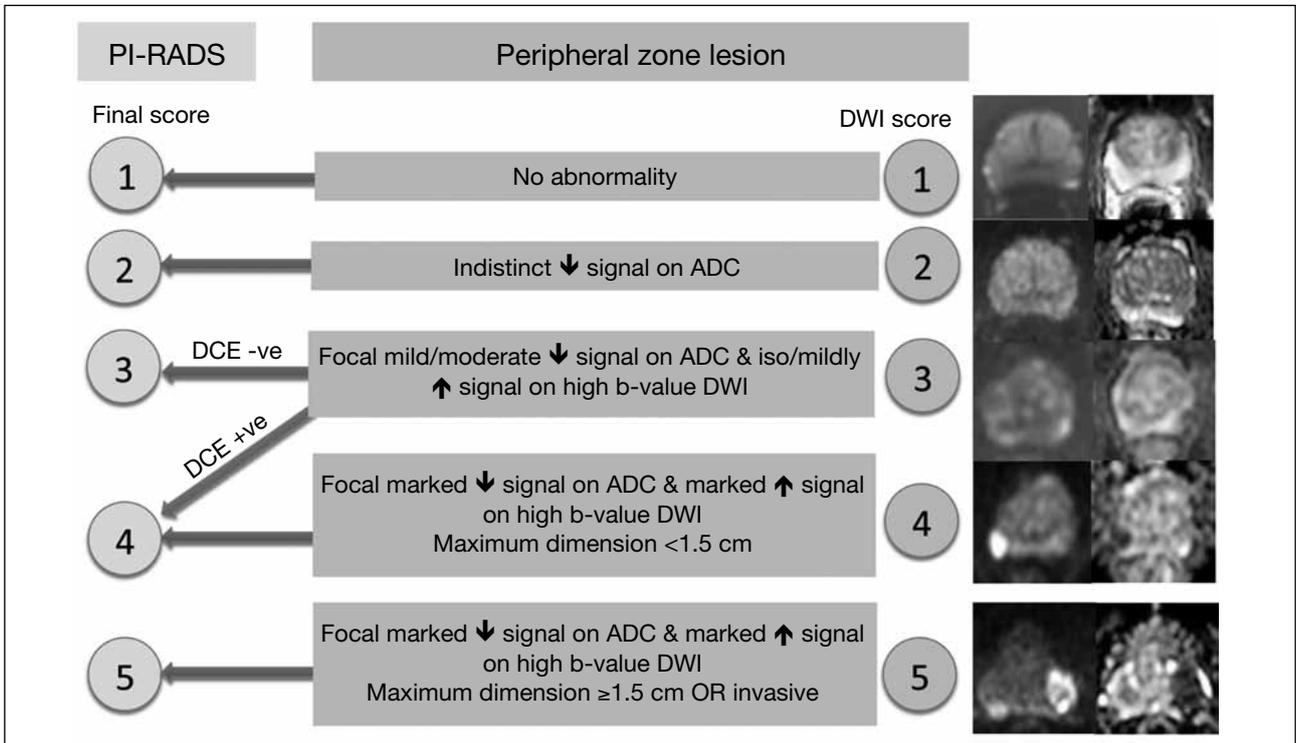


Figure 2. Diagnostic algorithm of peripheral zone lesion based on DWI/ADC. Abbreviations: ADC = apparent diffusion coefficient; DCE = dynamic contrast enhancement; DWI = diffusion-weighted imaging; PI-RADS = Prostate Imaging Reporting and Data System.

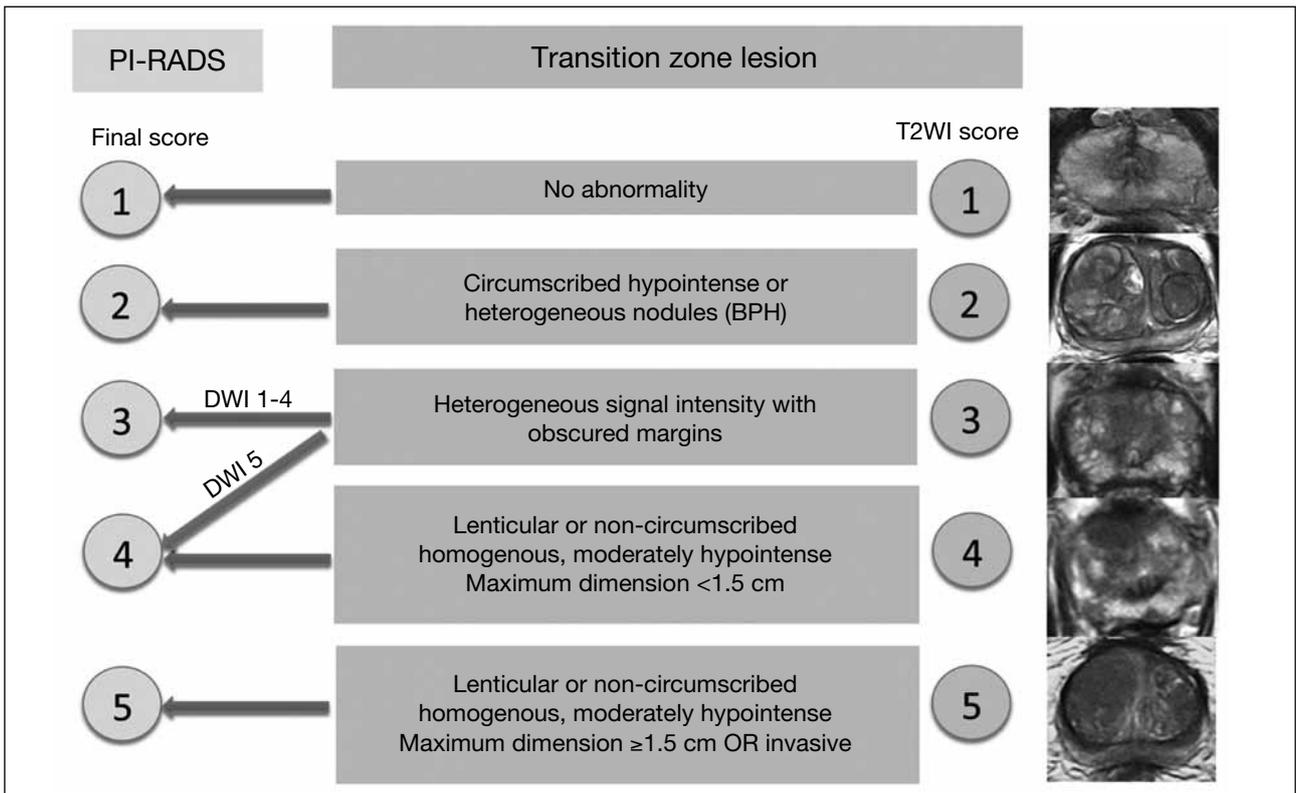


Figure 3. Diagnostic algorithm of transition zone lesion based on T2-weighted sequence. Abbreviations: BPH = benign prostate hyperplasia; DWI = diffusion-weighted imaging; PI-RADS = Prostate Imaging Reporting and Data System; T2WI = T2-weighted image.

show the diagnostic algorithm of peripheral zone and transition zone lesions. Binary scoring of DCE assumes only a secondary role and is used for peripheral zone lesions that are equivocal on DWI/ADC. Unlike PI-RADS version 1, findings from magnetic resonance spectroscopy are no longer incorporated.

Peripheral Zone Lesions

The DWI and ADC maps serve as the dominant parameter for lesions in the peripheral zone, which is where 70% to 80% of prostate cancers arise. The interpretation and scoring of DWI and ADC maps are based primarily on qualitative visual assessment of the signal intensity of a lesion compared with that of the surrounding normal prostatic tissue. However, this may be subject to inter- and intra-observer variability depending on intuitive judgement and grey-scale windowing. Viewing high b-value images (≥ 1400 s/mm²) improve the specificity of detecting clinically significant cancers. Published PI-RADS guidelines also recognise qualitative DWI assessment. Using a threshold of ADC 750 to 900 mm²/s has been suggested for differentiation between benign and malignant lesions in the peripheral zone.⁵ The tumour ADC values have also been shown to correlate inversely with the histologic Gleason score.¹⁶ This can act as an objective reference point, which may be particularly useful for inexperienced radiologists. However, there remains an overlap between the ADC values of benign and malignant lesions. ADC values are also influenced by the choice of b-factors, imaging parameters and vary across vendors. Therefore, each centre should identify its thresholds that are based on internal data and correlation with histopathology.

Prostate cancer demonstrates focal low signal intensity on T2-weighted image although T2 signal, on its own, is not specific for diagnosing cancer in the peripheral zone. T2-weighted imaging primarily provides detailed depiction of zonal anatomy and is the key to lesion localisation, which is imperative for targeted biopsy, as well as assessment of local staging.

As mentioned in the previous section, DCE only serves an ancillary role for lesions deemed equivocal. DCE allows upgrading of equivocal lesions and potentially increases sensitivity of cancer detection. If focal early enhancement is found, the corresponding T2-weighted and DWI images should be carefully inspected for a corresponding abnormality that may otherwise be inconspicuous. In PI-RADS v2, visualisation of early and intense enhancement is based on a qualitative visual

assessment, although facilitation by using colour-coded maps and kinetic curves are also recognised.

Transition Zone Lesions

In the transition zone, the detection of prostate cancer is more difficult because of substantial overlap in imaging characteristics between cancer and benign prostate hyperplasia (BPH). The stromal component of the hyperplastic nodule has low T2 signal, commonly show restricted diffusion and abnormal perfusion. For these reasons, DWI and DCE have limited role in the transition zone. The main features to identify transition zone tumours are the morphologic structure of lesion, including the shape, texture, margins and invasiveness, on T2-weighted image.

Findings on DWI/ADC serve a secondary role in the transition zone. Specifically, abnormalities that would be assigned an equivocal probability (T2 score of 3) could be upgraded to PI-RADS score 4 if they show marked restricted diffusion and measure ≥ 1.5 cm.

REPORTING

In reporting prostate lesions on MP-MRI, the lesion's anatomic location, size, presence and degree of restricted diffusion, DCE positivity (for peripheral zone lesions) and PI-RADS score should be documented. For anatomical localisation, PI-RADS v2 recommends the use of a standardised sector map, which is based on the zonal anatomy originally described by McNeal.¹⁷ This can facilitate subsequent intervention such as targeted biopsy. The largest dimension of the lesion should be measured on ADC map for peripheral zone lesions, and on T2-weighted imaging for transition zone lesions.

As prostate cancer tends to be multifocal, up to four findings with PI-RADS score 3 to 5, can be reported using PI-RADS v2. The index lesion, which is the lesion with highest PI-RADS score, should be indicated. Reporting of PI-RADS score 2 lesions is considered optional.

The presence of invasive behaviour, such as extracapsular extension, invasion of neurovascular bundle, seminal vesicles, distal sphincter and bladder neck, should also be documented. Last, evidence of metastatic disease to lymph nodes or bones should also be recorded.

PITFALLS

The development of PI-RADS v2 has allowed a relatively simple, standardised method for deriving an MRI assessment category corresponding to the

likelihood of clinically significant prostate cancer. However, there are various common findings that may fulfil criteria for PI-RADS 3 or above that may elude the radiologist, especially those who are not versed in urogenital imaging. These pitfalls can be grouped into two main categories: normal anatomical structures and benign conditions that mimic cancer.

Normal Anatomic Structures Mistaken as Cancer

Central zone

The central zone appears as symmetric band of tissue between the peripheral and transition zones at the base, extending from below the seminal vesicles into the verumontanum surrounding the ejaculatory ducts. It is most prominent at the base of the prostate and has a conical shape with its apex at the verumontanum.

Central zone cancers are rare, accounting for 0.5% to 2.5% of all prostate cancers.¹⁸ They are usually associated with a high incidence of seminal vesicle invasion, extracapsular extension, high Gleason grade and early biochemical failure after attempted curative surgery.

Due to the low glandular tissue present in the central zone, the central zone exhibits low signal intensity on both T2-weighted image and ADC map and can be mistaken as cancer. The symmetric appearance of the central zone and its expected location are helpful to differentiate it from prostate cancer. They appear as tear-drop shaped hypointensities on either side of the midline on coronal image, known as the moustache sign^{19,20} (Figure 4). On axial images, it may also appear as a hypointense focus in the posterior midline where the two central zones converge at mid gland level (Figure 5). In 20% of cases the central zone may be asymmetric.²¹ Enlargement of the transition zone can lead to compression of the central zone and increased displacement to the base. It is important for radiologists to be familiar with its normal appearance so as not to overcall it as prostate cancer.

Anterior fibromuscular stroma

The anterior fibromuscular stroma is a band of fibromuscular tissue anterior to the transition zone, contiguous with the bladder smooth muscle and skeletal muscle of the sphincter. It covers the anterior and anterolateral surface of the prostate. Histologically,

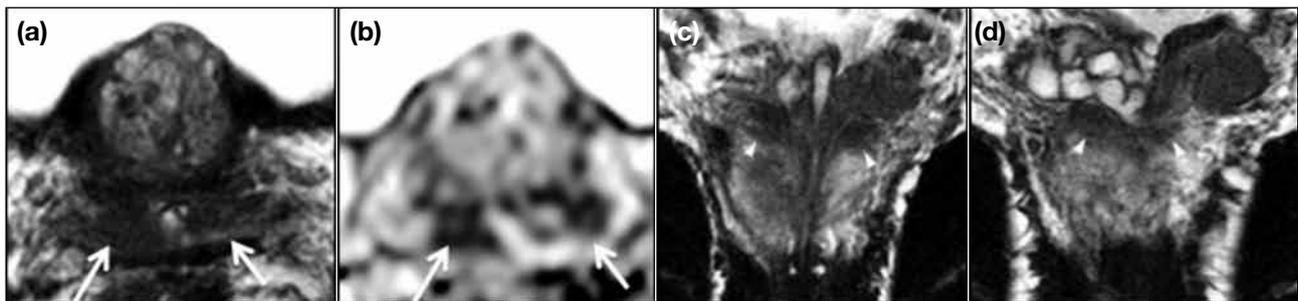


Figure 4. Central zone. Axial T2-weighted image (a) showing bilateral hypointense areas at the base (arrows) with low signal on apparent diffusion coefficient map (b). Consecutive coronal T2-weighted images (c, d) showing the typical tear-drop appearance of the central zone (arrow heads), consistent with the “moustache” sign.

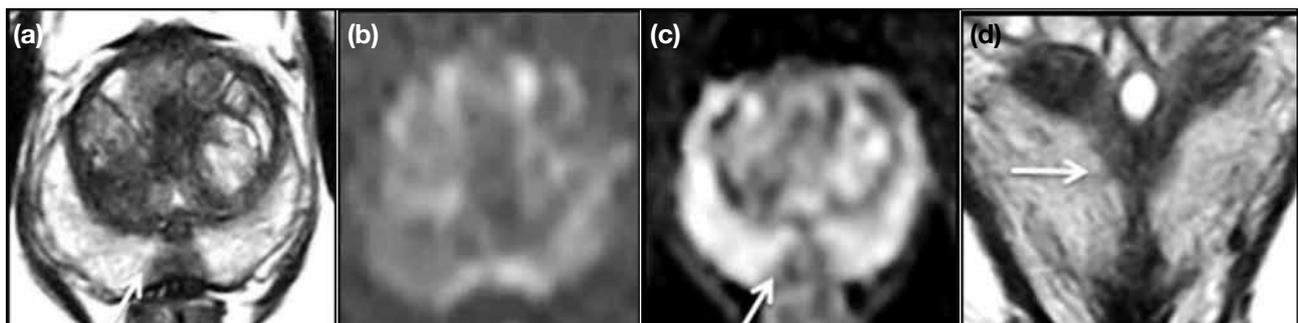


Figure 5. Central zone. Axial T2-weighted image (a) showing a focal hypointensity (arrow) in the midline peripheral zone at mid-gland level. No associated restricted diffusion on diffusion-weighted imaging (b) but there is focal low signal on apparent diffusion coefficient map (c). On coronal T2-weighted image (d), this area corresponds to where the two central zones converge at the midline.

the anterior fibromuscular stroma comprises dense connective tissue with large amount of smooth muscles fibres interposed with adjacent skeletal muscle fibres of the urethra.²² Due to its compact muscle and fibre composition, the anterior fibromuscular stroma has markedly low T2 and ADC signals. When it is bulky, it may mimic anterior transition zone cancer because of its lentiform morphology, homogenous low T2 signal and low ADC value. As PI-RADS v2 assessment of transitional zone lesions is based on T2-weighted imaging appearance, these lesions can easily be assigned PI-RADS score 4 or 5 (Figures 6 and 7). The distinguishing feature is the lack of restricted diffusion and hypervascularity due to its fibrous nature. Be sure to scrutinise the high b-value DWI for the lack of high signal.

Periprostatic vein

The periprostatic venous plexus is closely associated with

the pseudocapsule of the prostate. It lies predominantly anterior and lateral to the prostate. The periprostatic venous plexus can show low signal intensity on T2-weighted image and ADC map depending on the velocity and turbulence of blood movement. When viewed en-face on axial images, this may be erroneously considered to be a lesion within the peripheral zone especially on DWI/ADC images where the spatial resolution is low (Figure 8). Careful examination of the contiguous sections can help demonstrate continuity with the remainder of the periprostatic venous plexus and avoid this pitfall.

Benign Conditions that Mimic Cancer
Stromal nodule

BPH is a common condition characterised by enlargement of the transition zone by hyperplasia of the prostatic stromal and epithelial cells resulting in formation of large discrete nodules. The histologic subtypes of BPH include glandular proliferation and fibromuscular proliferation

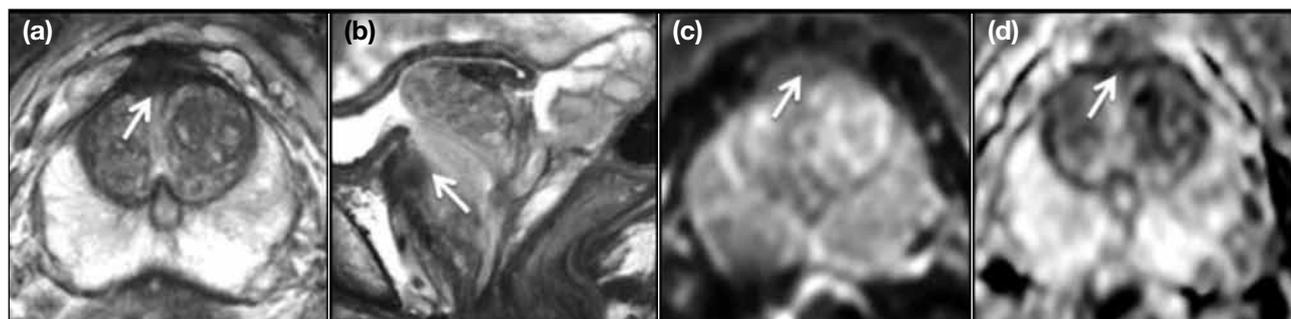


Figure 6. Anterior fibromuscular stroma. Axial and sagittal T2-weighted images (a, b) showing a non-circumscribed moderately hypointense area (arrows) in the anterior aspect of the gland. No diffusion restriction on high b-value diffusion-weighted imaging (DWI) (c) and it is indistinctly hypointense on apparent diffusion coefficient map. According to Prostate Imaging Reporting and Data System (PI-RADS) version 2, the T2 and DWI scores are 4 and 2, respectively. As T2 is the dominant sequence in the transition zone, the overall PI-RADS score is 4. Target biopsy showed no evidence of malignancy.

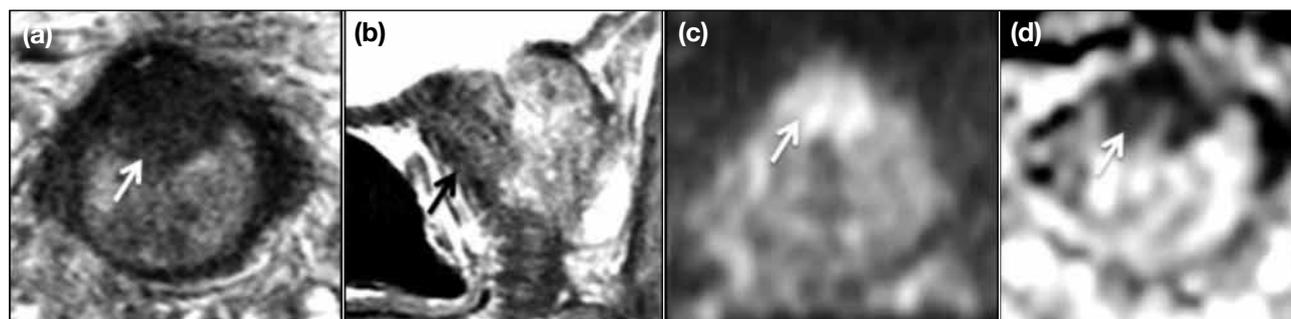


Figure 7. Anterior transition zone cancer (for comparison with Figure 6). Axial and sagittal T2-weighted images (a, b) showing a non-circumscribed homogenous moderately hypointense lesion (arrows) in the anterior transition zone with invasion of the anterior fibromuscular stroma. It is markedly hyperintense on high b-value diffusion-weighted imaging (DWI) (c) and hypointense on apparent diffusion coefficient map (d). According to Prostate Imaging Reporting and Data System (PI-RADS) version 2, the T2 and DWI scores are both 5. Overall PI-RADS score is 5. Biopsy-proven prostate cancer.

of the stroma.²³ BPH gives rise to a heterogeneous appearance of T2-weighted image. BPH nodules may be hypo-, iso- or hyper-intense on T2-weighted image depending on the ratio of glandular to stromal tissue. Glandular elements account for high T2 signal intensity due to the presence of secretions and cystic ectasia. These cystic nodules do not mimic prostate cancer. However stromal BPH nodules demonstrate low T2 signal intensity due to the presence of sclerotic and fibrous elements and they may mimic transition zone cancer (Figure 9). In addition, they also tend to be highly cellular with increased vascularity and can demonstrate restricted diffusion and early enhancement on DCE.

Transition zone cancers may be more difficult to detect by systemic TRUS-biopsy because of anterior location. The detection rate of transition zone cancer on the basis of T2-weighted image alone ranges from 56% to 63%.¹⁹

Homogenous low signal intensity, ill-defined margins, lack of capsule, lenticular shape, and invasive behaviour are the findings suggestive of cancer on T2-weighted image. Stromal nodules tend to be well-defined, more heterogeneous, with a rounded encapsulated appearance. A DWI/ADC score of 5 may upgrade an equivocal lesion to a final PI-RADS score 4, but there is substantial overlap between the ADC value of stromal hyperplasia and cancer. The role of DCE in the transition zone is limited. As stromal hyperplasia is a common finding and share many features with prostate cancer, MRI accuracy of cancer detection in the transitional zone remains limited.

Ectopic benign prostate hyperplasia nodule

Although BPH nodules mostly occur in the transition zone, they may sometimes arise in the peripheral or central zone. They may also demonstrate restricted

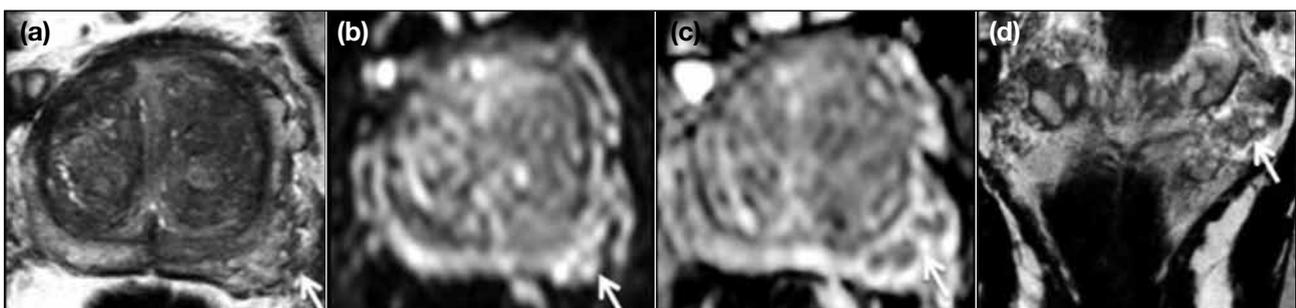


Figure 8. Periprostatic varicosities. Axial T2-weighted image (a) showing hypointensity in left peripheral zone with “extra-capsular extension” (arrow). There is mild hyperintensity on high b-value diffusion-weighted imaging (b) and moderate hypointensity on apparent diffusion coefficient map (c). It could be mistaken as left peripheral zone cancer with extraprostatic extension (ie, Prostate Imaging Reporting and Data System score 5); however, reviewing consecutive images and the coronal T2-weighted image (d) would reveal that the abnormality is located outside the gland and correspond to periprostatic venous plexus.

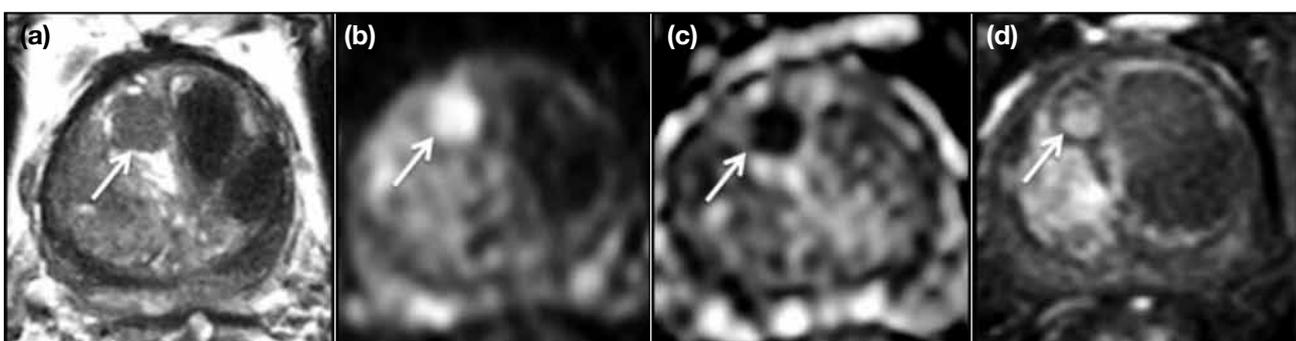


Figure 9. Stromal nodule. Axial T2-weighted image (a) showing a discrete non-circumscribed homogeneous moderately hypointense nodule in the right anterior transition zone, with marked restricted diffusion on high b-value diffusion-weighted imaging (DWI) (b) and markedly hypointense on apparent diffusion coefficient map (c). Dynamic contrast-enhanced imaging (d) shows a discrete nodule. According to Prostate Imaging Reporting and Data System (PI-RADS) version 2, the T2 and DWI scores are both 4; the overall PI-RADS score is 4. Target biopsy showed no evidence of malignancy.

diffusion and positive DCE. Internal heterogeneity and presence of a pseudocapsule are characteristics that can be used to distinguish them from cancer. However, ectopic stromal nodules with restricted diffusion and lacking T2 heterogeneity may easily be misdiagnosed as cancer (Figures 10 and 11).

Bacterial prostatitis

Bacterial prostatitis can be acute or chronic. It has an estimated prevalence of 9.7%.²⁴ Acute bacterial prostatitis is uncommon and more likely to occur in young men, usually caused by *Escherichia coli*, *Enterococcus*, and *Proteus*. The cellular hallmark is an influx of neutrophils. Chronic bacterial prostatitis usually occurs in older men. Routine cultures often do not allow identification of the organisms. Lymphocytes are seen in chronic prostatitis often accompanied by glandular atrophy. In contrast to acute prostatitis, chronic prostatitis tends to be more

indolent and patients are often asymptomatic.²⁵

On MRI, prostatitis often leads to low T2 signal intensity with mild to moderate restricted diffusion in the peripheral zone (Figure 12). In most instances, prostatitis can be readily differentiated from cancer: first, the degree of low T2 signal and diffusion restriction tend to be less than that in prostate cancer; second, the morphology is often linear, wedge-shaped or diffuse with indistinct margin.

Granulomatous prostatitis

Five types of granulomatous prostatitis have been described: idiopathic, infective, iatrogenic, malakoplakia, and associated with systemic granulomatous disease.²⁶

Infective granulomatous prostatitis can be caused by *Mycobacterium tuberculosis* (via haematogenous

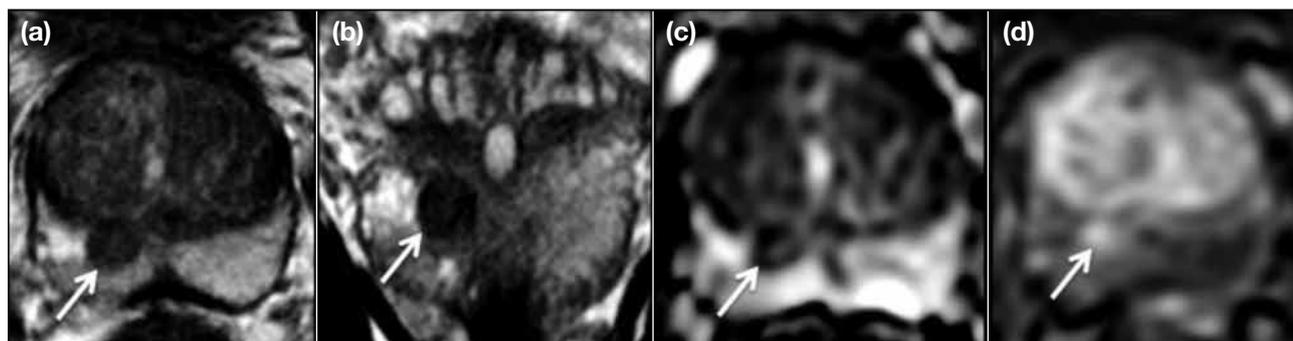


Figure 10. Ectopic benign prostate hyperplasia nodule. Axial and coronal T2-weighted images (a, b) showing a circumscribed, homogeneous moderately hypointense lesion (arrow) in the right peripheral zone, which is markedly hypointense on apparent diffusion coefficient (ADC) map (c) compared with the adjacent peripheral zone and show wash-in on dynamic contrast-enhanced (DCE) imaging (d). According to Prostate Imaging Reporting and Data System (PI-RADS) version 2, the T2, diffusion-weighted imaging, and DCE scores are 4, 4, and +, respectively; the overall PI-RADS score is 4. Target biopsy showed no evidence of malignancy.

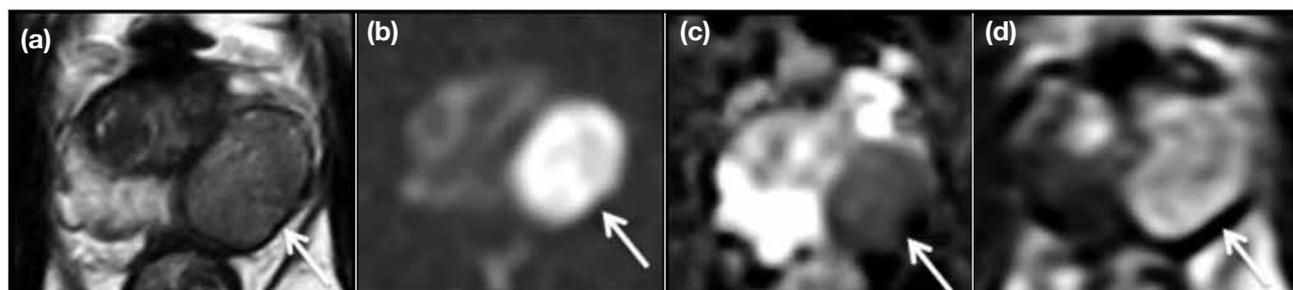


Figure 11. Left peripheral zone cancer (for comparison with Figure 10). Axial T2-weighted image (a) showing a well-encapsulated, homogeneous, moderately hypointense lesion (arrow) in left peripheral zone with extracapsular extension. It is markedly hyperintense on diffusion-weighted imaging (b) and hypointense on apparent diffusion coefficient map (c). It demonstrates rapid wash-in on dynamic contrast-enhanced (DCE) imaging (d). According to Prostate Imaging Reporting and Data System (PI-RADS) version 2, the T2, diffusion-weighted imaging, and DCE scores are 5, 5, and +, respectively; the overall PI-RADS score is 5. The encapsulated border of the lesion is unusual of prostate cancer but the appearance is still suspicious. Target biopsy showed prostate cancer with Gleason score 4+5.

spread or direct extension) or develop after intravesical bacillus Calmette-Guerin therapy for bladder cancer. It is characterised by well-formed granulomas with epithelioid cell and multinucleated giant cell infiltration with or without central necrosis (caseation).²⁶ Non-necrotic granulomatous prostatitis appears as an area of hypointensity in the peripheral zone on T2-weighted image, associated with diffusion restriction because of

its high cellularity, and with marked wash-in on DCE (Figure 13). It therefore closely simulates prostate cancer. In necrotic granulomatous prostatitis, central necrosis has high signal intensity on T2-weighted image, with marked restricted diffusion and lack of enhancement on DCE. Florid granulomatous prostatitis may even demonstrate extraprostatic extension, which warrants PI-RADS score 5.

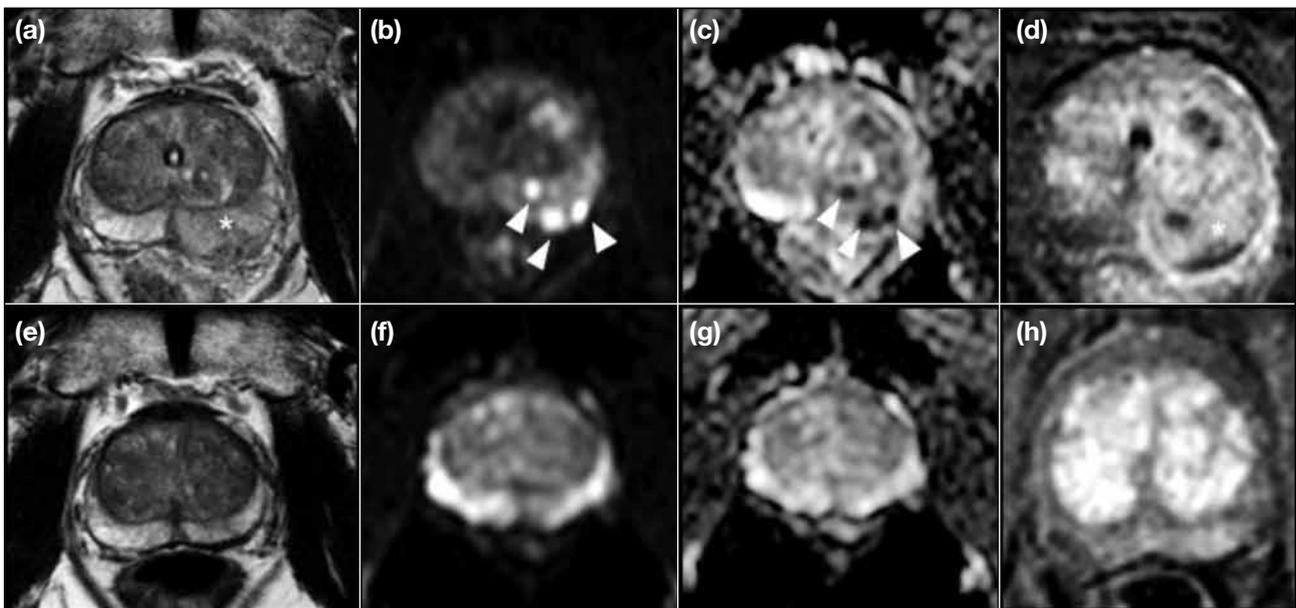


Figure 12. Prostatitis. First row (a to d): axial T2-weighted image (a) showing diffuse mild T2 hypointensity and swelling of the left peripheral zone (asterisk) without a focal lesion. There are 3 foci (arrow heads) of marked restricted diffusion on high b-value diffusion-weighted imaging (DWI) (b) and marked hypointensity on apparent diffusion coefficient (ADC) map (c). Diffuse enhancement of the left peripheral zone on dynamic contrast-enhanced imaging. According to Prostate Imaging Reporting and Data System (PI-RADS) version 2, the T2 and DWI/ADC scores are 2 and 4, respectively. Because DWI is the dominant sequence in the peripheral zone, the overall PI-RADS score is 4. Second row (e to h): Follow-up magnetic resonance imaging with the corresponding sequences in the same patient showing resolution of the signal abnormalities. The spontaneous resolution is suggestive of prostatitis.

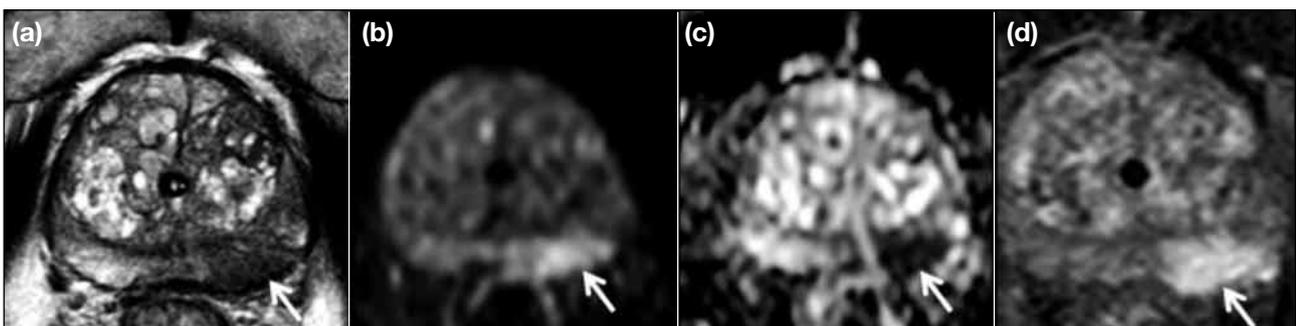


Figure 13. Granulomatous prostatitis. Axial T2-weighted image (a) showing a non-circumscribed rounded moderate hypointensity in the left peripheral zone, with moderate restricted diffusion on high b-value diffusion-weighted imaging (DWI) (b) and marked hypointensity on apparent diffusion coefficient map (c). Dynamic contrast-enhanced imaging (DCE) is positive (d). According to Prostate Imaging Reporting and Data System (PI-RADS) version 2, the T2, DWI, and DCE scores are 3, 4, and +, respectively. Because DWI is the dominant sequence in the peripheral zone, the overall PI-RADS score is 4. Target biopsy of the left peripheral zone lesion shows granulomatous prostatitis.

Atrophy

Atrophy can result from prostatitis, radiation, anti-androgens and chronic ischemia from local arteriosclerosis. It can cause elevation of serum PSA level due to PSA release from damaged epithelial cells.²⁷ Atrophy occurs more frequently in the peripheral zone and appears as a focal or geographic area of low T2 signal intensity with moderate restricted diffusion and enhancement (Figure 14). The degree of diffusion restriction is usually less marked than cancer. On T2-weighted image, volume loss and contour retraction are usually present allowing a distinction from cancer.

Calcification

Calcification can form within the prostate due to concreted prostatic secretions or amylaceous bodies, usually in the transition zone. In most cases they are asymptomatic and an incidental finding. Owing to the diamagnetic effect of calcium, calcification has low signal intensity on all

pulse sequence including T2-weighted and ADC images, as well as DWI at all b-values (Figure 15).

Haemorrhage

Post-biopsy haemorrhage can appear T2 hypointense with or without restricted diffusion leading to false positive result. The signal intensity of post-biopsy haemorrhage depends on the stage of haemoglobin degradation. The presence of hyperintense signal of subacute blood on T1 weighted image is extremely helpful in determining the presence of haemorrhage. There is a lack of agreement regarding the necessary post-biopsy delay but an interval of at least 8 weeks between biopsy and MP-MRI has been recommended.¹⁹

CONCLUSION

Although PI-RADS v2 provides a simple method for deriving the likelihood of clinically significant prostate cancer, there are several normal anatomic

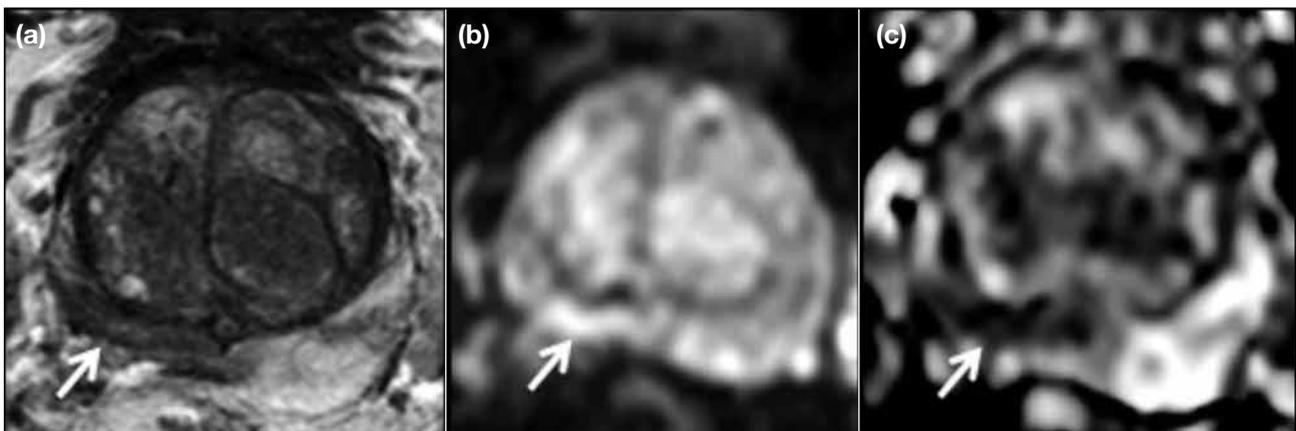


Figure 14. Prostatic atrophy. Axial T2-weighted image (a) showing diffuse mild hypointensity in the right peripheral zone with volume loss and contour retraction (arrow), associated with mild hyperintensity on high b-value diffusion-weighted imaging (DWI) (b) and moderate hypointensity on apparent diffusion coefficient map (c). According to Prostate Imaging Reporting and Data System (PI-RADS) version 2, the T2 and DWI scores are 2 and 3, respectively. Because DWI is the dominant sequence in peripheral zone, the overall PI-RADS score is 3.

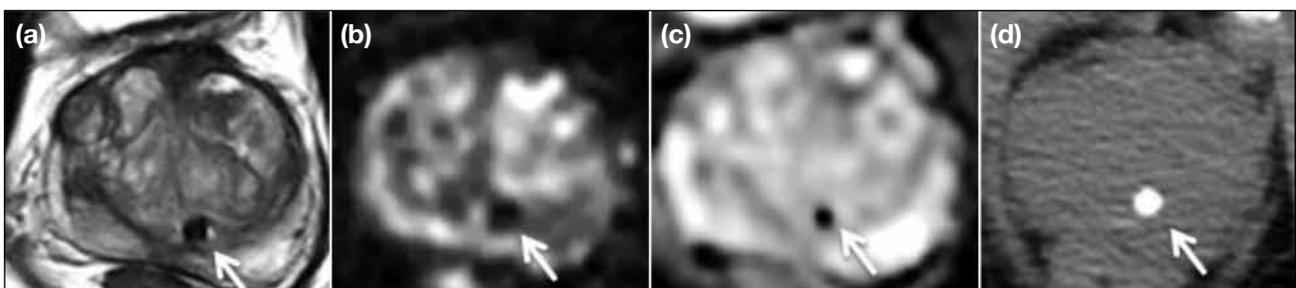


Figure 15. Calcification. A markedly hypointense focus (arrow) is present in the left posterior transition zone on all pulse sequences, including T2-weighted image (a), diffusion-weighted imaging (b) and apparent diffusion coefficient map (c). Computed tomography (d) confirms it to be an intraprostatic calcification.

structures and benign pathologic conditions that have imaging characteristics fulfilling a PI-RADS score 3-5. Radiologists need to be aware of these pitfalls and apply discretion when utilising PI-RADS v2 in order to avoid misdiagnosis.

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