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Canadian Association of Radiologists Prostate MRI White Paper

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Abstract

Prostate cancer is the most common malignancy and the third most common cause of death in Canadian men. In light of evolving diagnostic pathways for prostate cancer and the increased use of MRI, which now includes its use in men prior to biopsy, the Canadian Association of Radiologists established a Prostate MRI Working Group to produce a white paper to provide recommendations on establishing and maintaining a Prostate MRI Programme in the context of the Canadian healthcare system. The recommendations, which are based on available scientific evidence and/or expert consensus, are intended to maintain quality in image acquisition, interpretation, reporting and targeted biopsy to ensure optimal patient care. The paper covers technique, reporting, quality assurance and targeted biopsy considerations and includes appendices detailing suggested reporting templates, quality assessment tools and sample image acquisition protocols relevant to the Canadian healthcare context.

Résumé

Le cancer de la prostate est la tumeur maligne la plus courante et la troisième cause de décès chez les hommes canadiens. A la lumière de l'évolution les voies diagnostiques du cancer de la prostate et l'utilisation accrue de l'IRM, qui inclut désormais son utilisation chez l'homme avant la biopsie, la L'Association canadienne des radiologistes a créé un groupe de travail sur l'IRM de la prostate pour produire un livre blanc afin de fournir recommandations sur l'établissement et le maintien d'un programme d'IRM de la prostate dans le contexte du système de santé canadien. Les recommandations, qui sont fondées sur les preuves

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scientifiques disponibles et/ou sur un consensus d'experts, visentà maintenir qualité dans l'acquisition d'images, l'interprétation, le rapport et la biopsie ciblée pour assurer une prise en charge optimale des patients. Le papier couvre la technique, les rapports, l'assurance qualité et les considérations de biopsie ciblée et comprend des annexes détaillant les rapports suggérés des modèles, des outils d'évaluation de la qualité et des exemples de protocoles d'acquisition d'images pertinents pour le contexte des soins de santé au Canada.

Keywords
prostate cancer, prostate biopsy, magnetic resonance imaging, multiparametric MRI, quality improvement

Background and Rationale

The Canadian Association of Radiologists Prostate MRI Working Group is composed of abdominal and interventional radiologists in academic and community practice with expertise in prostate cancer imaging. Prostate cancer (PCa) is the most common malignancy and the third most common cause of death in Canadian men.[1] In the past decade, the utilization of prostate MRI has been steadily increasing and is anticipated to escalate further as it becomes part of the diagnostic pathway in detecting PCa in men prior to biopsy.[2–7] The introduction of the Prostate Imaging and Data System (PI-RADS) in 2012 with subsequent updates and its current version 2.1 (PI-RADS v2.1) enables standardization in the technique, interpretation and reporting of prostate MRI.[8–10] However, there remain variability and challenges to the practice of prostate MRI.[11–13] This white paper serves as a resource and provides recommendations on establishing and maintaining a Prostate MRI Programme in the context of the Canadian healthcare system. Quality in all the steps from image acquisition, interpretation, reporting and targeted biopsy is important to ensure optimal patient care. The recommendations from the panel are based on available scientific evidence and/or expert consensus (Table 1).

State of the Field in Canada

One in nine Canadian men will be diagnosed with PCa in their lifetime, and 11 Canadian men will die of it each day.[1] Multi-parametric sequences utilizing T2-weighted imaging, diffusion-weighted imaging (DWI) and dynamic contrast enhancement (DCE) have led to increased utilization of prostate MRI for detection, localization, staging, risk stratification, active surveillance, recurrence assessment, guidance for targeted-biopsy and focal therapies for PCa.[14–24] Prostate MRI has become the standard of practice in assessing patients at elevated risk with prior negative systematic biopsies in many practices.[14]

The diagnosis of prostate cancer traditionally has been made with systematic transrectal ultrasound (TRUS)-guided biopsy.[25,26] However, this technique has its limitations with under detecting clinically significant cancer (csPCa) and over detecting clinically insignificant prostate cancer (ciPCa).[27–29] The definition of csPCa is controversial but the most widely adopted criterion is a pathological Gleason score $\geq$ 3+4 also referred to as International Society of Urological Pathology Grade Group (ISUP GG) $\geq$ 2.[30] Patients with ciPCa have indolent disease that is unlikely to result in mortality in their lifetime and thus these patients can be observed expectantly, known as active surveillance (AS).[31]

More recently, multiple randomized control and multicentre studies,[32-36] including a Canadian randomized clinical trial,[36] have shown that prostate MRI detects more csPCa and detects less ciPCa compared to systematic biopsies with fewer biopsies required with MRI. This has resulted in many centres worldwide shifting the paradigm to utilizing prostate MRI in the diagnostic pathway before biopsy in men with risk of having csPCa.[2-7] This change in practice is already in Ontario guidleines[7] and is soon anticipated to expand to the rest of Canada. This surge in demand for prostate MRI will require accessibility to MRI scanners which is already limited and variable depending on location.[37,38] For example, in Ontario, the percentage of cases performed within the targeted time range is 47%.[38]

There is also variability in the acquisition and interpretation of prostate MRI despite the use of PI-RADS.[11-13] Thus, this expansion of prostate MRI should be executed with quality measures in place. These standards are currently lacking in Canada. This is especially prudent, given that suboptimal acquisition and interpretation can result in differing management decisions and treatment plans. Furthermore, MRI-targeted biopsy, wherein a suspicious lesion seen in MRI is subsequently targeted for biopsy, will also grow in demand as the number of prostate MRIs being performed continues to increase. Accessibility and training for MRI-targeted biopsy in addition to prostate MRI acquisition and interpretation should also be addressed.

Patient Pathway and Role of MRI in Prostate Cancer Diagnosis

The aim of multiparametric prostate MRI (mpMRI) early in the diagnostic pathway for PCa is to optimize patient outcomes through early and accurate detection of csPCa, reduction of unwarranted biopsies, reduction of detection of ciPCa and unnecessary intervention.[9,10]

mpMRI in biopsy naïve patients has been shown in multicentre prospective randomized trials to decrease unnecessary biopsy and reduce over-detection of ciPCa in biopsy-naïve

Table 1. Consensus Recommendations for Performing and Interpreting Prostate in Canada.

Image Quality
1 Image quality should be reported
2 10 consecutive representative cases should be reviewed every 6 months to ensure that they meet PI-RADS technical standards and that quality is deemed satisfactory
Interpretation and reporting
3 In addition to PI-RADS score, the PSA, age and indication for the exam should be recorded and included in all reports
4 To evaluate the radiologist's performance, institution-based audits or a mechanism for radiologists to receive feedback should be implemented
5 To evaluate the radiologists' interpretation performance, histopathologic feedback should be integrated, whenever possible. If no regular histopathological feedback is available, MDT rounds are encouraged
6 Radiologists should participate in MDT meetings or attend MDT-type workshops where patient-based clinical scenarios are discussed, if available locally or via remote access
7 Where possible based on local availability, MDT should include urology and radiology, with the optional addition of pathology, medical and radiation oncology as needed
8 The MDT should include MRI review with histology results from targeted biopsy and/or prostatectomy, where available
Training, credentialing and institutional feedback
9 Before interpreting prostate MRI, radiologists should receive training through either core theoretical prostate mpMRI courses and/or hands-on practice at workstations with supervised reporting
10 Radiologists should have read 50 cases with histological confirmation before beginning interpretation of prostate MRI.
11 Double reads should be considered by institutions with limited/preliminary expertise and/or low case volumes
12 Prostate radiologists should compare their performance with histopathological feedback
13 Prostate radiologists should have knowledge of the added value of MRI and the consequences of false-positive MRI.
14 Prostate radiologists should be aware of alternative diagnostic methods (risk stratification in diagnostic/treatment work-up)
15 Hands-on training and/or educational courses may be given by high throughput or highly experienced centres performing at least 500 cases per year

Methodological Note: To determine the consensus statements and recommendations above, the Canadian Association of Radiologists' Prostate MRI working group participated in a Delphi consensus process. The panel, which was comprised of 10 abdominal and interventional radiologists who are experts in prostate cancer imaging, completed two rounds of questionnaires to rate 22 statements across 3 categories: image quality, interpretation and reporting, training and credentialing. Questions were rated for agreement on a 7-point scale, with statements rated 6.0 to 7.0 by ≥60% of panellists reaching consensus agreement in Round 1, and statements rated 1.0–2.9 by ≥60% of panellists being removed due to consensual disagreement. Statements rated 3.0–5.9 were included in the second round of questionnaires, incorporating suggestions for rewording or rephrasing as indicated by anonymous comments from the working group. The same markers of agreements and disagreement were applied to the second round of the questionnaire. After the second round, the working group was convened to discuss the entire set of statements that had been rated 6.0 or higher and to ensure broad consensus on the possible practical and policy-related implications of the consensus statements.

patients compared to systematic biopsy.[34,39,40] The Working Group supports the recommendations made by Cancer Care Ontario,[7] as endorsed by the Canadian Urological Association,[41] that for biopsy-naïve patients at elevated risk of csPCa, mpMRI be used prior to biopsy in patients who are candidates for curative management with suspected clinically localized prostate cancer.

Another common and more widely accepted indication for mpMRI is the evaluation of patients with a prior negative systematic biopsy and persistently elevated risk of csPCa. MRI provides an incremental improvement in the detection of csPCa in this population, particularly at the anterior fibromuscular stroma (AFMS) and apex.[14]

In addition to initial tumour detection, prostate MRI can be utilized to locally stage disease extent, which may be of use for both selections of optimal therapy, as well as surgical and radiation planning.[42,43] The use of prostate MRI for local staging is debated as the sensitivity for detection of extraprostatic disease has been shown to be limited.

Multiparametric prostate MRI has been applied at many centres as a criterion for initial patient enrolment in active surveillance (AS) programmes and as a tool for the longitudinal monitoring need for repeat biopsy in AS. There is a growing body of literature that is improving our understanding of the most reliable imaging parameters to trigger repeat tissue sampling.[31,44,45]

Finally, prostate MRI may be of use for the detection of local disease recurrence in treated patients with biochemical evidence of disease recurrence. MR imaging can be combined with clinical and biochemical parameters to allow for accurate and timely tumour detection.

Prostate MRI Technique

Although mpMRI acquisition protocols for prostate imaging serve as an important guide for end-users,[10] site-, scanner- and patient-specific technical modifications may be required to achieve sufficient image quality. For example, adjustments to voxel volume and acquisition time for optimal signal-to-noise ratios will be required depending on whether prostate imaging is performed at 1.5 or 3T.[46] Sharing of best protocols and practices among radiologists and collaboration between physicists, technologists, vendor application specialists can ensure optimal image quality. For sample protocols for various manufacturers and magnet strengths, please see Appendices A-D

Hardware Considerations

Prostate mpMRI has been widely performed using both 1.5 T and 3T MRI scanners.[47] Although consistent diagnostic image quality can be achieved at 1.5 and 3T when optimized acquisition parameters are applied, the increased signal-to-noise ratio (SNR) afforded by 3T MRI scanners provides an important advantage that can be used to maximize spatial and/or temporal resolution. Disadvantages of 3T scanners include increased power deposition, signal heterogeneity and susceptibility artifacts; however, these technical limitations are readily mitigated by contemporary state-of-the-art 3T MRI systems.[48] Therefore, this Working Group recommends that prostate imaging be performed at 3T whenever possible.[46] Specific indications for imaging at 1.5 T include the presence of implantable devices that are MR conditional at 1.5 T but not at 3T, and devices that may result in degraded image quality due to magnetic susceptibility artifact, for example, a metallic hip prosthesis. Performing prostate mpMRI at lower magnetic field strengths, that is, <1.5 T is not recommended given the current lack of clinical validation. Ultimately, when both 1.5 T and 3T are available, the consensus of the Working Group is that patients should be imaged in the 3T scanner unless contraindicated. If only 1.5 T is available careful attention must be paid to ensuring adequate image quality and gaining access to 3T systems is encouraged.

Recent advances in phased-array surface coil technology, pulse sequence and protocol optimization have reduced the gap in performance between studies acquired with and without an endorectal coil.[51] This Working Group recommends that the use of integrated endorectal coils is not necessary, considering the significant workflow challenges associated with their use including cost, preparation time and patient acceptance. However, it may be advantageous for large patients where the SNR of the centrally located prostate gland may be suboptimal using only surface coils.

Patient Preparation

Currently, there is no consensus amongst prostate MRI experts regarding patient preparation with practices varying worldwide (Table 2). However, most experts agree that evacuation of the rectum prior to MRI is beneficial to minimize artifactual distortion of DWI due to the presence of air and/or stool in the rectum. Rectal enemas are an effective way to decrease rectal distension; however, the reported impact of enema on image quality has been inconsistent.[10,49,50] The use of dietary modification has also been described as a method to reduce rectal gas.[51,52]

The use of antiperistalsis agents such as hyoscine butylbromide has been shown to reduce motion-related artifacts and improve the depiction of anatomical detail of the prostate gland and adjacent structures on T2-weighted imaging.[53] However, the use of these agents increases the cost as well as the complexity of the MRI workflow. Furthermore, these agents have been associated with adverse events in patients with underlying cardiac conditions[54,55]; therefore, the consensus of this Working Group is that antispasmodic agents are optional.[10,46]

Imaging Acquisition Parameters

Standard prostate mpMRI acquisition protocols should include T2-weighted, T1-weighted, DWI and DCE sequences. The field of view (FOV) should be selected to optimize image

Table 2. Summary of described rectal preparation strategies for prostate MRI.

Technique	Mechanism	Results	Recommendation
Enema	Empties the rectum of stool, liquid and gas before MRI	Conflicting data, but, generally reduces the amount of rectal content and improves T2W and DWI image quality[51,52,103,104]	Is recommended approximately 3 hours prior to the MRI. This allows time for the enema to take effect and bowel irritation to resolve
Dietary modification	Low residue, clear fluids or no oral ingestion before MRI reduces the amount of gas in the rectum	Two studies demonstrating incremental benefit compared to enema alone, but inferior results to enema as a standalone method[51,52]	Clear fluids/NPO recommended beginning midnight before or a minimum of 6 hours before the time of MRI in cases of evening and night appointments. Low residue diets should begin 3–5 days prior to the MRI.
Anti-spasmodics	Decrease rectal peristalsis	Conflicting results, may improve T2W and to a lesser extent DWI image quality[52,81]	Dependent on facilities, resources, and staffing; may be considered as an adjunct to an enema, dietary modification
Catheter	Removes rectal gas	Two available studies, both show some benefit[49,104,105]	Not recommended; however, may be considered at time of MRI, if a large volume of rectal gas is identified and noted to be compromising image quality

quality while encompassing the entire prostate gland, adjacent periprostatic tissues and the seminal vesicles. In staging and post-treatment cases, the protocol should include a large FOV imaging through the entire pelvis to assess for lymphadenopathy and bone metastases.

The standard sequences of a mpMRI protocol should be acquired in the same imaging plane and at the same slice levels to facilitate lesion mapping across sequences. However, although using the maximum recommended slice thickness of 3 mm is feasible for T2-weighted sequences and DCE imaging, this may not be achievable with DWI, in particular at 1.5 T where SNR considerations may require an increase in slice thickness.[10,46]

T2-weighted images should be acquired in the axial plane and both sagittal and coronal planes. Oblique axial imaging is not necessary and straight axial imaging is adequate. The coronal plane provides detailed anatomy of the apex, base as well as prostatic-seminal vesicle angle and is preferred over the sagittal plane. A sagittal plane using a rapid T2-weighted sequence can then be performed primarily for prostate volume assessments to save time. Both 2D and 3D T2 sequences provide comparable image quality and achieve similar accuracy for the detection of prostate cancer and extraprostatic extension.[56–58] The choice of 3D vs 2D T2-weighted sequences remains at the discretion of each centre.

T1-weighted images are used primarily to determine the presence of haemorrhage. DWI should be acquired with at least two pre-determined b-values, a low b-value set at 50–100 s/mm^2 and an intermediate b-value set at 800–1000 s/mm^2 to optimize calculation of the apparent diffusion coefficient (ADC) maps and minimize diffusion kurtosis effects. In addition, a high b-value image of > 1400 s/mm^2 is required either as a separate acquisition or as an extrapolated image from the low and intermediate b-value acquisitions.[10,59] Extrapolated images offer the advantage of decreased acquisition time, however, lesion conspicuity has been shown to be variable compared to directly acquired high b-value images.[60,61]

DCE imaging should be performed using 3D T1-weighted gradient echo sequences to exploit the increased SNR afforded by 3D acquisitions techniques. The minimum temporal resolution of DCE acquisition is $\leq 15s$ given the qualitative nature of lesion enhancement assessment and lack of added diagnostic value from the higher temporal resolution.[62,63]

Bi-Parametric MRI (bpMRI)

The use of bi-parametric MRI (bpMRI) refers to the removal of the DCE acquisition from the mpMRI protocol. Although a controversial topic, bpMRI is being considered as an alternative to mpMRI due to the significant savings that can be achieved in MRI time and cost of the contrast agent. This is highly relevant in the context of the expected increase in the volume of prostate MRI requests as it is adopted for biopsy-naïve patients. Although there are both single-centre studies and meta-analysis data showing noninferiority of bpMRI[64-67] to mpMRI, concern remains regarding the retrospective nature of these studies and the potential increase in indeterminate (PI-RADS 3) interpretations using only bpMRI. Prospective multicenter clinical trials or trials comparing the impact on decision making and outcomes between bpMRI and mpMRI are currently lacking. For this reason, mpMRI is still recommended as the standard of care by this Working Group; however, given anticipated resource pressures bpMRI can be performed at the discretion of the radiologist in centres that have demonstrated local bpMRI performance similar to mpMRI. For the population of patients who have undergone treatment, mpMRI with contrast should be used, as contrast is critical in assessing for recurrent disease

Reporting

Advances in speech recognition software in recent years have spurred an increased interest in structured radiology reports to improve consistency of reporting, report quality and a standardized lexicon that can easily be interpreted by other radiologists and non-radiology clinicians. A reporting template will ensure that no vital information needed by a clinician is left out of the report and is particularly helpful for those less experienced in interpreting prostate MRI in that it can serve as a guide to lead the radiologist through key findings required in a report. Structured reports facilitate audits for quality assurance purposes and research.[68–71] A recent survey of the Society of Urologic Oncology showed that urologists overwhelmingly (90%) prefer either completely structured or hybrid structured reports (i.e. using a structured template with some free text fields for description) as well as PI-RADS standardized scoring of any lesions (86%).[72]

Reporting of the nature and location of any lesion of concern in a standardized fashion is particularly critical for biopsy planning, as these procedures are often not performed by the radiologist who authored the original diagnostic report. Structured reporting has been shown to improve the accuracy of tumour localization and reduce the frequency of errors made during the performance of MRI-guided biopsies.[73] The standard localization of any lesions for biopsy on the PI-RADS v2 sector map and with series and image numbers included in the report aids localization in MR/ultrasound fusion biopsy, as do either illustrations, annotated images or 3D contouring.[74]

The Working Group thus recommends either fully structured or hybrid structured reporting (see Appendix E Sample Reporting Template) using the PI-RADS v2.1 reporting system.[10] Specifically, the PI-RADS V2.1 lexicon and sector map should be considered mandatory to facilitate the accuracy of communication between disciplines. Recommended components of the report include:

Clinical History/Indication: Include the provided clinical indication for the exam, patient age, date and PSA level

(if known), dates and results of any prior biopsies and any prior therapies.

Technique: Should state if the MR protocol is PI-RADS v2.1 compliant, field strength and coil used, and sufficient information on the pulse sequences used so that the recipient can determine if the study was biparametric or multiparametric. Reporting the b-value of the high b-value diffusion images is encouraged, along with a statement indicating image quality.

Comparison: Dates of prior studies used for comparison.

Findings: Prostate size should be reported L X W X H (AP and CC measured off midsagittal image and transverse measured off the corresponding axial image) with volume (indicate if calculated off ellipsoid formula or volumetric postprocessing) and PSA density (PSA divided by prostate volume). Utilizing PSA density is important, as patients with elevated PSA density are at an increased risk of malignancy. For example, in patients with PI-RADS 3 lesions, PSA density thresholds of approximately 0.1 to 0.15 have been suggested for biopsy. The presence of any haemorrhage should be reported as well as the degree of nodular hyperplasia, if present, along with any associated bladder changes.

Up to four individual lesions can be reported, in decreasing order of PI-RADS score/suspicion for malignancy. The location of the lesion should be indicated using the PI-RADS v2.1 sector map, and series and image numbers for multiple sequences should be given. The size of peripheral zone lesions should be taken from the ADC map, and transition zone lesions should be measured on the T2-weighted (T2W) images (other sequences where the lesion is best visualized may be used if these are inappropriate due to image quality concerns, and if used should be so indicated). Individual PI-RADS scores for T2W, diffusion-weighted imaging (DWI) and dynamic contrast enhancement (DCE) images should be given along with an overall score. Any evidence of involvement of the prostatic capsule/extraprostatic extension (indicate distance and location), seminal vesicles, bladder neck or neurovascular bundle should be reported or else a pertinent negative statement should be given indicating none of the above. If other incidental findings (e.g. cysts and prostatitis) are present, they can be reported at the end of this section.

Reports should indicate if there is any involvement of the visualized lymph nodes or bones, and if not there should be a pertinent negative statement given indicating no lymphadenopathy or bone lesions within the field of view of the exam. Other incidental findings (e.g. diverticular disease and hernias) can be reported last.

Impression: Any reported lesion of PI-RADS score 3 or greater should be summarized, along with any described disease outside of the prostatic capsule.

See Appendix F for PI-RADS v2.1 Assessment Tables.

Quality Assurance

Prostate mpMRI quality is important and should be both reported and monitored.[75] Image quality is affected by system-level and patient-level factors, both of which should be optimized. System-level factors include magnetic field strength,[53] pulse sequences performed and their parameters, use of endorectal coil,[76] age of equipment[77] and experience of the MR technologists and radiologists who perform and interpret the exams, respectively.[78,79] Patient-level factors that may affect image quality include motion, metallic implants[80] and susceptibility artifact from gas in the rectum.[81] Wide variation in mpMRI quality and compliance with recommendations on acquisition parameters has been observed[77,82,83]; furthermore, what constitutes a poor vs a diagnostic quality examination remains generally undefined due to lack of standardized criteria.[84]

The PI-QUAL system,[85] developed and applied using mpMRI data from the PRECISION trial,[34] is a proposed tool to assess the quality of prostate mpMRI consisting of both objective technical specifications (e.g. PI-RADS v2 technical specifications)[9] and subjective criteria derived from the MR images using a 1–5 Likert scale (see Appendix G: Suggested Image Quality Evaluation Form). The PI-QUAL schema is representative of the type of system needed for ensuring image quality across centres. Advantages of PI-QUAL are that it is straightforward to implement, has no cost and requires little training, making it potentially suitable for performing quality control audits. As the first available scoring system to assess prostate MRI quality, PI-QUAL will probably form the basis for future work and will undergo further refinements.[86] Notably, adherence to PI-RADS v2 minimum technical standards does not guarantee good image quality[87] and some standards may be too stringent.[83] Therefore, there is no single technical standard that can be universally applied, and the technical criteria may need to be modified to ensure diagnostic quality images for each institution and their own MR system. Future application of quantitative or automated assessment of image quality may be better than subjective systems like PI-QUAL, however, require development and validation.

Despite widespread acknowledgment regarding the importance of quality control in prostate mp-MRI, there are no published guidelines indicating the frequency and number of cases required for auditing purposes. Most experts on a recent European consensus panel voted for external and objective image quality assessment regularly at 6 months or longer intervals but there was no consensus on number of exams to be included.[75] Alternatively, image quality checks may be performed on a randomly selected sample of cases, in which case the majority of the panellists agreed that a selection of 5% of exams is most appropriate.[75]

Audits can be performed by a designated radiologist, rota of mpMRI reporting radiologists or by an external audit. Cases should be randomly selected to represent all MRI machines used for prostate mp-MRI at a given centre and a cross-section

of performing MR technologists. Results of the audit should inform ongoing institutional quality control efforts with modification of technical parameters, patient preparation or MR technologist training, as appropriate.

Competency Benchmarking

Competency benchmarks for prostate MRI reporting are challenging to define. Studies establishing numerical thresholds are few and present conflicting results.[88] Moreover, investigators evaluating the importance of reader experience in prostate MRI have used differing endpoints including overall accuracy, inter-observer agreement and positive predictive value (PPV).[88-92] The Canadian Association of Radiologists (CAR) currently suggest that outcome data from mammography reporting should be reported including the date range of audit, total number of exams performed, number of BI-RADS 0, 4 and 5 cases and biopsy results of BI-RADS 4 and 5 lesions.[93] Furthermore, the CAR suggests radiologists supervise/interpret/report ≥150 breast MRI examinations over 36 months (e.g. ∼50 exams per year).[93] A survey of radiologist members of the Society of Abdominal Radiology (SAR) revealed that among mainly abdominal subspecialist radiologists, over 80% of respondents report between 0 and 10 prostate MRIs per week.[13] In a 2021 study, Davenport et al evaluated the performance of 18 subspeciality-trained radiologists who reported prostate MRI with PI-RADS version 2 over a ∼4-year time period. Radiologist years of experience ranged from 1 to 22 years and the median number of MRIs reported was 232 (∼60 exams per year). The outcome evaluated was whole-gland PI-RADS v2 PPV dispersion among radiologists who interpreted ≥30 exams with pathological confirmation. The PPV results and dispersions were: PI-RADS 3 (22.1%; Inter-quartile range [IQR]: 10.0%–28.6%), PI-RADS 4 (49.2%; IQR: 41.4%–50.0%) and PI-RADS 5 (81.8%; IQR: 77.1–84.4%).[91] It was the consensus of the Working Group that Radiologists should have read a minimum of 50 cases[92] with histological confirmation before beginning interpretation of prostate MRI. (see Table 2)

Targeted Biopsy Considerations

The emergence of mpMRI for the detection and localization of PCa has enabled targeted biopsy for prostate cancer diagnosis. Targeted biopsy involves directing biopsy cores at index lesions identified on mpMRI and this can be performed either in addition to or instead of conventional systemic TRUS biopsy sampling.

Targeted biopsy has shown benefit over systematic biopsy with higher rates of detection of significant PCa while reducing insignificant PCa detection.[94,95] The three primary approaches for targeted biopsy are cognitive biopsy, MR-TRUS fusion biopsy (fusion biopsy) and MR in-bore biopsy (MR biopsy).

MR biopsy involves needle insertion within the MR suite using specialized hardware and software. This technique has the benefit of directly visualizing the needle within the lesion on MRI to confirm adequate sampling; however, access is a challenge as most procedures require at least one hour of valuable MRI suite time.

Fusion biopsy systems align the MR lesions to TRUS using specialized software and/or hardware such that the mp-MRI target for biopsy is displayed on the TRUS to allow for targeted biopsy under TRUS guidance. This approach benefits from providing a visible biopsy target outside of the MRI suite; however, the procedures require specialized equipment, are often longer than conventional systematic biopsy and inaccuracy in the MRI-TRUS fusion (including patient motion during the procedure) lead to inaccurate sampling. The optimal number of samples from target lesions remains the subject of investigation, but current data suggest that at least 3 samples should be obtained from index lesions.[96]

Cognitive biopsy is the least expensive option as it uses a conventional TRUS probe to direct biopsies toward the perceived area of the suspicious mpMRI lesion. This technique requires no new hardware/software and does not substantially impact the current clinical workflow; however, it requires the operator to accurately correlate the MRI and TRUS orientations ('cognitive registration'), which risks inaccurate targeting.[97]

Investigating which of the three targeted biopsy approaches is preferred continues without the optimal approach identified; however, some data and expert consensus suggest that fusion and/or MR biopsy might have superior diagnostic yield and be favoured over cognitive biopsy.[98-101]

The route of biopsy is also of clinical importance. Historically, prostate biopsy was performed with a transrectal approach. This technique is familiar to many operators and offers simplicity and speed but has associated rates of urosepsis between .7 and 7% requiring antibiotic prophylaxis.[101] Transperineal biopsy has lower urosepsis rates and may become the future standard. It is performed in lithotomy position and is the default for MR in bore biopsy but also used for fusion biopsy either with a brachytherapy grid as needle guide or freehand. Transperineal biopsy was traditionally performed under general anaesthesia, but recent studies have shown it can be performed under local anaesthesia as well.[102]

Conclusion

The growing demand for prostate MRI has been occurring in the past decade with revised guidelines incorporating prostate MRI earlier in the cancer assessment pathway. There are multiple indications for prostate MRI which now includes men prior to biopsy. This will add to the existing demand for mpMRI. As MRI is challenging to access and an expensive, time-intensive resource, maintaining quality in all the steps from image acquisition, interpretation, reporting and targeted-biopsied is critical in optimizing

patient care. The Working Group encourages optimizing image quality and performing audits on a regular basis. Radiologists planning to interpret prostate MRI should undergo training and use a template for reporting. Obtaining feedback on interpretation of cases with pathology correlation should be performed as well as attending multidisciplinary rounds, if available (Table 1). The Working Group acknowledges the challenges for radiologists in low volume practices. To help maintain interpretation skills for those that have limited access to an adequate volume of cases, the Working Group intends to create a repository of cases that will be housed in the CAR Rad Academy platform for use by CAR members.

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Supplemental Material

Supplemental material for this article is available online.

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