Imaging Recommendations for Diagnosis, Staging, and Management of Prostate Cancer

Nilesh P. Sable¹ Ganesh K. Bakshi² N. Raghavan³ Hemang Bakshi⁴ Rakesh Sharma⁵ Santosh Menon⁶ Prabhash Kumar⁷ Aparna Katdare¹ Palak Popat¹

¹Department of Radiodiagnosis, Tata Memorial Hospital, Parel, Mumbai, Maharashtra, India
²Department of Urosurgery, P.D. Hinduja Hospital and Research Centre, Mumbai, Maharashtra, India
³Department of Surgical Oncology, Apollo Hospitals, Chennai, Tamil Nadu, India
⁴Department of Surgical Oncology, Cancer Centre, Ahmedabad, Gujarat, India
⁵Department of Surgical Oncology, INDO American Basavatarakam Cancer Centre, Hyderabad, Telangana, India
⁶Department of Pathology, Tata Memorial Hospital, Parel, Mumbai, Maharashtra, India
⁷Department of Medical Oncology, Tata Memorial Hospital, Parel, Mumbai, Maharashtra, India

Address for correspondence Nilesh P. Sable, MD, Department of Radiodiagnosis, Tata Memorial Hospital, Parel, Mumbai, Maharashtra, India (e-mail: drnileshsable@gmail.com).

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Abstract

The Prostate Carcinoma Guidelines Panel have formulated these guidelines to assist medical professionals in the evidence-based management of prostate cancer. These guidelines are intended to assist medical professionals in the evidence-based management of prostate cancer. These recommendations present the best evidence available to the clinicians; however, using these recommendations will not always result in the best outcome. They aid in decision making for individual patients; however, these will never replace clinical expertise when making treatment decisions. Taking personal values and preferences or individual circumstances of patients into account is necessary to reach a final decision. The Guidelines Panel consists of an Indian multidisciplinary group of radiologists, uro-oncologists, urologists, radiation oncologists, medical oncologists, and pathologists. These recommendations present the best evidence available to the clinicians; however, using these guidelines will not always result in the best outcome. They aid in decision making for individual patients; however, these guidelines will never replace clinical expertise when making treatment decisions. Taking personal values and preferences or individual circumstances of patients into account is necessary for final treatment decision. Guidelines are not mandatory and should not be referred as a legal standard of care.

Keywords
► mpMRI prostate
► prostate cancer
► prostate cancer imaging guidelines
► prostate cancer imaging recommendations
► PSMA PET/CT
► PSMA PET/MRI

Introduction

The Prostate Carcinoma Guidelines Panel have formulated these guidelines to assist medical professionals in the evidence-based management of prostate cancer (PCa). These guidelines present the best evidence available to the clinicians; however, using guidelines these recommendations will not always result in the best outcome. They aid in decision making for individual patients; however, these guidelines will never replace clinical expertise when making treatment decisions. Taking personal values and preferences or individual circumstances of patients into account is necessary for final treatment decision. Guidelines are not mandatory and should not be referred as a legal standard of care.

The Guidelines Panel consists of an Indian multidisciplinary group of radiologists, uro-oncologists, urologists, radiation oncologists, medical oncologists, and pathologists.

Risk Factors and Etiopathogenesis

PCa remains the second most common cancer in men and the fifth leading cause of death around the globe.

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asymptomatic at the early stages and can be very slow growing which may need only active surveillance. According to the GLOBOCAN 2020 data, 1,414,259 new cases of prostate cancer were reported worldwide in 2020, causing 3,75,304 deaths, with higher prevalence in developed countries.

Family history and racial/ethnic background are associated with an increased incidence of PCa.

Across the globe, incidence and mortality of PCa correlate with advanced age. The mean age at the time of diagnosis is approximately 66 years in most studies. In African-American men, the incidence rates are higher than in White men, and their mortality is approximately twice as that in White men. Elevated plasma levels of prostate-specific antigen (PSA) more than 4 ng/mL, a glycoprotein normally expressed by prostate tissue forms the basis of the diagnosis in most patients. However, as elevated PSA levels can also be found in men without PCa, a tissue diagnosis by biopsy remains the current standard of care to confirm cancer.

Uncertainty still exists about the relation of diet, obesity, and use of some vitamins or minerals as the cause of prostate cancer.

Epidemiology and Clinical Presentation

Significant variation is seen in the incidence of prostate cancer across the regions and populations around the globe. In 2020, 1,414,259 new cases of prostate cancer were registered worldwide, representing 7.3% of all cancers in men. The age-standardized rate (ASR) was the highest in Oceania (443.5 per 100,000 people) and North America (397.9) followed by Europe (328.5). As compared to these developed countries, the Asian and African countries have low incidence (185.2 and 126.8, respectively) with incidence in India up to 95.7, the lowest incidence in Niger being 66.9.

Diet modifications and physical activity are important in prostate cancer development and progression. These are mainly related to the observed worldwide and ethnic differences in the incidence rates of prostate cancer.

Prostate cancer incidence increases with age. Though only 1 in 350 men under the age of 50 years will be diagnosed with prostate cancer, the incidence rate increases up to 1 in every 52 men for ages 50 to 59 years. The incidence rate reaches 60% in men over the age of 65 years.

Clinical presentation: At the early stage, many patients may be asymptomatic, often with an indolent course, who need minimal or even no treatment. In symptomatic patients, the presenting symptoms are difficulty with mic- turition, increased frequency, and nocturia, mimicking benign prostatic hypertrophy. PCa can also present with hematuria, hematospermia, or erectile dysfunction. In advanced stages, patients may present with severe urinary symptoms such as urinary retention and with weakness, back pain, and weight loss. Bony metastases is commonly present in metastatic disease.

Clinical/Diagnostic Work-Up

Digital rectal examination (DRE): PCas are most commonly located in the peripheral zone and easily detected if the tumor volume is more than 0.2 mL. Abnormal DRE remains the first indicator for the PCa (approximately 18% of cases being detected by DRE alone and is an indication of biopsy).

Prostate-specific antigen (PSA): PSA is a serum marker specific to the prostate; however, it is not specific to PCa. Hence, it can be seen elevated in other non-malignant conditions such as benign prostatic hypertrophy (BPH) and prostatitis. PSA seems a better predictor of cancer than either DRE or transrectal ultrasonography (TRUS) as an independent variable. Yet there are no standards defined for measuring PSA. It is a continuous parameter, with higher levels indicating greater likelihood of PCa. However, PCa can also be seen with PSA levels below 4 ng/mL.

In addition to these variables, PSA density (the level of serum PSA divided by the prostate volume) or PSA doubling time and free/total PSA ratio can be also assessed for evaluation of the disease, in clinical settings.

Risk Stratification

Risk stratification is an integral part of PCa treatment and should be performed before starting management.

<table>
<thead>
<tr>
<th>Risk Stratification</th>
<th>Gleason score</th>
<th>PSA Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-risk</td>
<td>≤ 6</td>
<td>≤ 10 ng/mL</td>
</tr>
<tr>
<td>Intermediate-risk</td>
<td>7</td>
<td>&gt; 10 ng/mL</td>
</tr>
<tr>
<td>High-risk</td>
<td>&gt; 8</td>
<td>&gt; 20 ng/mL</td>
</tr>
</tbody>
</table>

Patients are stratified in low-risk, intermediate-risk, and high-risk depending on PSA values, T stage of the disease and Gleason score.

Diagnostic Evaluation

Screening and Early Detection

Screening

Systematic examination of asymptomatic men (at risk) performed by health authorities is called screening, which is aimed at the reduction of mortality as well as maintaining the quality of life in PCa patients. Aggressive screening in USA showed decreased in mortality in PCa patients.

The updated Cochrane review endorsed the following points: Screening is associated with an increased diagnosis of PCa, detection of more localized disease and less detection of the advanced disease. However, no cancer specific survival benefit and overall survival benefit was seen because of screening.

Where screening is considered, a single PSA test is not enough according to the results of a randomized trial of PSA testing “CAP trial”. In this trial, they concluded that single PSA screening intervention detected more number of low-risk PCa cases but had no significant effect on PCa mortality after a median follow-up of 10 years.
Ultrasonography and Biopsy

The transabdominal USG has no defined role in detection of PCa, which cannot characterize the prostatic lesions adequately. Transrectal USG is also not accurate in prediction of an organ-confined disease as compared to DRE. It is commonly used in guidance of prostate biopsies. Alternatively, transperineal route can also be used for biopsy. PCa detection rates are almost similar using both the routes; however, according to a few studies, transperineal route requires more extensive local anesthesia and is associated with decreased infection rates.\textsuperscript{15} Reliability of gray-scale TRUS for detection of PCa is very low;\textsuperscript{16} however, recent innovations in sono-
Role of CT scan in imaging of PCa is limited to nodal and metastatic staging. Although it is not advocated in detection or primary staging of PCa, a few studies show that it has some role in detection of PCAs.

PET CT scan has emerged as an important staging modality for primary as well as recurrent prostate cancer. Previously, NaF was used a radiotracer that showed a high sensitivity but low specificity. Recently, tracers such as choline, fluciclovine, and especially PSMA have shown increased detection for smaller metastatic lesions that are not easily seen on CT or MR imaging.

Clinical implications of these occult PET/CT detected disease may be beneficial to patients. Efforts are now targeted to define their natural history and response to treatment and an overall impact of metastasis-directed therapy detected by these investigations. In comparison, with the conventional staging approach, additional lymph nodal metastases and skeletal/visceral metastases were detected in 25% and 6% of patients, respectively. Thus, PSMA PET/CT is cost-effective and can be considered as a standard modality compared to conventional imaging for initial staging of men with high-risk prostate cancer.

PET MRI

After promising results from the PSMA PET CT, researchers have now added MRI to PET component that provides highly accurate morphological information to the functional information of PET. The first two PSMA agents for PET imaging were 18F-DCFBC and 68Ga-PSMA-11. Two other agents with theranostic capabilities, the chelator-based PSMA-617 and the PSMA inhibitor for imaging and therapy PSMA-I8T are also now used. Some second-generation 18F-labeled PSMA legends were also introduced to overcome the high blood-pool activity and low tumor-to-background ratios of 18F-DCFBC, viz., 18F-DCFPyL, and 18F-PSMA-1007 (most recent), which has very low urine clearance. The MRI component has high soft tissue resolution, hence can be used for accurate delineation of the lesion (local staging, i.e., T staging). In contrast, the PSMA PET component has a higher value in detection of the metastatic lymph nodes and other metastatic lesions (can be used in N staging and M staging). Thus, PSMA PET-MRI overcomes the shortcomings of each modality when used singly. Because of these reasons, it has got higher sensitivity (up to 76%) as compared to mpMRI and PET, when these modalities are used alone.

Recommendations for PCa detections

Recommendations for all patients

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Level of evidence</th>
<th>Strength of recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1.1 Systematic biopsy is an acceptable approach in case mpMRI is not available.</td>
<td>3</td>
<td>Strong</td>
</tr>
<tr>
<td>Do not use multiparametric magnetic resonance imaging (mpMRI) as an initial screening tool.</td>
<td>3</td>
<td>Strong</td>
</tr>
</tbody>
</table>

Recommendations in biopsy naïve patients

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Level of evidence</th>
<th>Strength of recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2.1 Perform mpMRI before prostate biopsy.</td>
<td>1a</td>
<td>Strong</td>
</tr>
</tbody>
</table>

(Continued)
Staging: The extent of PCa is evaluated by DRE and PSA, along with mpMRI, bone scanning and CT scan.

Stage: Can be clinical (cT) or pathological (pT). T staging as per the AJCC 8th cancer staging edition. Complete clinical and pathological T staging is given in Table 1 in detail:

For T staging, only DRE findings are taken into account as of now. TRUS has no value in prediction of an organ-confined disease. Though mpMRI has good specificity for detection of T3 tumors, it is still not recommended for staging of the disease, in view of low sensitivity. However, it can be used for planning of disease treatment.

N Stage: The regional nodes are assessed in N staging, which are defined as the nodes confined to the true pelvis (pelvic nodes below the bifurcation of the common iliac arteries). Detailed N staging in Table 2.

Abdominopelvic CT scan and MRI have been tried for nodal staging in PCa patients, which consider the size of the nodes to label them malignant (short axis more than 8 mm in the pelvic cavity and more than 10 mm outside the pelvic cavity). However, these techniques have very low sensitivity. Choline PET CT also has low sensitivity. According to a few studies, PSMA PET/CT has higher sensitivity for LN metastases as compared to mpMRI, abdominal contrast-enhanced CT or choline PET/CT.

Various imaging modalities are used for M staging including 99mTc-Bone labelled bone scan, Fluoride PET and PET/CT, choline PET/CT, whole body MRI and PSMA PET CT, amongst these PSMA PET CT outperforms the other modalities with sensitivity (33-99%) and specificity (> 90 %). Detailed M staging is shown in Table 3.

Table 1 T Staging (Clinical and Pathological)

<table>
<thead>
<tr>
<th>Clinical T staging (cT):</th>
<th>Level of evidence</th>
<th>Strength of recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tx</td>
<td>Primary tumour cannot be assessed</td>
<td>1a</td>
</tr>
<tr>
<td>T1</td>
<td>A clinically inapparent tumour that is not palpable</td>
<td>2a</td>
</tr>
<tr>
<td>T1a</td>
<td>Tumour incidental histologic finding in 5% or less of tissue resected</td>
<td>2a</td>
</tr>
<tr>
<td>T1b</td>
<td>Tumour incidental histologic finding in more than 5% of tissue resected</td>
<td>2a</td>
</tr>
<tr>
<td>T1c</td>
<td>Tumour identified by needle biopsy found in one or both sides, but not palpable</td>
<td>2a</td>
</tr>
<tr>
<td>T2</td>
<td>Tumour is palpable and confined within the prostate</td>
<td>2a</td>
</tr>
<tr>
<td>T2a</td>
<td>Tumour involves one-half of one side or less</td>
<td>2a</td>
</tr>
<tr>
<td>T2b</td>
<td>Tumour involves more than one-half of one side but not both sides</td>
<td>2a</td>
</tr>
<tr>
<td>T2c</td>
<td>Tumour involves both sides</td>
<td>2a</td>
</tr>
<tr>
<td>T3</td>
<td>Extraprostatic tumour that is not fixed or does not invade adjacent structures</td>
<td>2a</td>
</tr>
<tr>
<td>T3a</td>
<td>Extraprostatic extension (unilateral or bilateral)</td>
<td>2a</td>
</tr>
<tr>
<td>T3b</td>
<td>Tumour invades seminal vesicle(s)</td>
<td>2a</td>
</tr>
<tr>
<td>T4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Guidelines for staging of prostate cancer:

**Follow Up**: Imaging techniques are not recommended in routine follow-up of localized PCa as long as the PSA is not rising. Imaging is only suggested in patients for whom the findings will affect treatment decisions, either in case of biochemical recurrence or in symptomatic patients. PSMA PET CT is better than the other modalities such as TRUS, CT scan, MRI, or choline PET CT as imaging of choice in such patients.

To conclude, we can follow the flow chart for staging, diagnosis, and management of PCa.
**Imaging Recommendations for Prostate Cancer**

**Sable et al.**

**References**


