Using PET/CT in Prostate Cancer
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Purpose and Audience

Provide urologists, surgeons, medical oncologists, radiation oncologists and other prostate cancer specialists with the following information to aid in the diagnosis and management of prostate cancer patients:

- A summary of PET radiopharmaceuticals that are FDA-approved to image prostate cancer
- NCCN Practice Guidelines updates for using PET/CT in prostate cancer
- Recent Report from the National PET Registry (NOPR)
- Impact on patient management
PET/CT in Prostate Cancer

PET/CT plays an important role in the evaluation of prostate cancer on many levels

- Detecting metastatic disease
- Restaging
- Biochemical relapse post-radical therapy
  - A biochemical relapse is one where, after completing treatment (e.g., prostatectomy), PSA begins rising again but the cancer cannot (yet) be detected by CT or MRI
- Treatment monitoring
- Use for primary staging generally limited to only high-risk disease

FDA-Approved PET Radiopharmaceuticals for Prostate Cancer

- Tracers that image metabolism
  - C-11 choline and F-18 fluciclovine
    - Used to localize disease recurrence in men who have rising PSA and inconclusive conventional imaging
  - F-18 FDG
    - Used typically in patients with late-stage recurrent prostate cancer and elevated PSA

- Tracers that image bone
  - F-18 NaF (sodium fluoride)
    - Used to detect bone metastases
PET/CT in Prostate Cancer: NCCN Guidelines

- **C-11 choline**: Radioactive diagnostic agent for PET imaging of patients with suspected prostate cancer recurrence and non-informative bone scintigraphy, CT or MRI. In these patients, C-11 choline-PET/CT imaging may help identify potential sites of prostate cancer recurrence for subsequent histologic confirmation.

- **F-18 NaF**: Newer technology using F-18 NaF for PET scanning can be used as a diagnostic staging study; appears to have greater sensitivity than Tc-99m bone scan for assessing bone metastasis.

- **F-18 FDG**: In certain clinical settings, the use of F-18 FDG may provide useful information; F-18 FDG-PET/CT should not be used routinely since data on its utility in prostate cancer is limited.

- **F-18 fluciclovine**: Indicated for PET imaging with suspected prostate cancer recurrence based on elevated blood PSA levels following prior treatment. *(NOTE: FDA approved fluciclovine May 2016; it is not yet included in the NCCN guidelines.)*

Cancer Guidelines: Overview for Prostate Cancer Evaluation

The NCCN guidelines have specific recommendations when using PET/CT imaging in prostate cancer: (1) primary disease, (2) biochemical recurrence and (3) advanced disease. Below is a sample of information taken from these guidelines. **Please consult the NCCN website for their complete set of guidelines.**

www.NCCN.org/prostate cancer guidelines accessed 3/8/16
PET/CT in Prostate Cancer: Benefits of C-11 Choline Imaging

- CMS may reimburse the use of C-11 choline-PET/CT in biochemical failure (i.e., relapse of prostate cancer with inconclusive bone scan, CT and/or MRI)
  - Contact your local MAC for your area’s coverage decision
- Established tracer to identify progression to support more appropriate treatment options
- Shows soft tissue and osseous metastatic disease
- Availability varies due to half-life of 20 minutes

Ceci F, et al. EJNMMI 2014; 41(12):2222-2231
CASE EXAMPLE: 74-year-old male with history of prostate cancer and definitive therapy now presenting with biochemical recurrence; CT and bone scan were negative.

Results: C-11 choline-PET/CT revealed both soft tissue and osseous multifocal metastases
Recent publication: Ceci et al. 2014

- 150 patients with recurrent prostate cancer
- Subjects having C-11 choline-PET/CT imaging resulted in 46.7% overall treatment change
  - 14% did not undergo radiation due to distant mets
- 18% had a major clinical change (note: paper did not provide information on the reported change)

Ceci F, et al. EJNMMI 2014; 41(12):2222-2231
PET/CT in Prostate Cancer: Benefits of F-18 NaF Imaging

PET/CT in Prostate Cancer: F-18 NaF Imaging Data

F-18 NaF-PET/CT has higher sensitivity and specificity than planar or SPECT bone scan using Tc-99m

- Study compared planar and SPECT bone scan to F-18 NaF imaging in 44 patients with high-risk prostate cancer
- 23 (52%) had bone metastases

<table>
<thead>
<tr>
<th>Test</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
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<tbody>
<tr>
<td>Planar bone scan</td>
<td>70%</td>
<td>57%</td>
</tr>
<tr>
<td>Multi FOV SPECT</td>
<td>92%</td>
<td>82%</td>
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<tr>
<td>F-18 NaF-PET/CT</td>
<td>100%</td>
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PET/CT in Prostate Cancer: F-18 NaF and NOPR

- The National Oncologic PET Registry (NOPR) is a mechanism for CMS Coverage
- A registry for F-18 NaF-PET to identify bone metastasis similar to that now in place for F-18 FDG-PET
- Launched February 7, 2011
- >30,000 scans with complete data submitted to date

Impact of F-18 NaF on Prostate Cancer Management

F-18 NaF-PET changed intended management in 77% of cases
- Initial no treatment decision revised to treatment in 77%
- Switch from initial staging [IS] to primary osseous metastization [POM]
- Therapy management changed in 44% to 52%
- Consideration for coverage request for F-18 NaF still under evaluation by CMS

PET/CT in Prostate Cancer Recurrence: Imaging with F-18 Fluciclovine

PET (A) and PET/CT (B) image of fluciclovine in man with biopsy-proven recurrence in the prostate bed (Schuster et al. J Nucl Med 2007; 48:56–63)

Emission image at 0.12h in healthy adult volunteer following IV administration of F-18 fluciclovine (McParland B, et al. EJNMMI 2013; 40(8):1256–1264)
PET/CT in Prostate Cancer: Image-Guided Radiotherapy Planning

F-18 fluciclovine imaging can be used to plan radiotherapy treatment

A. Original radiotherapy (Rx) treatment plan
B. Fluciclovine imaging results reveal iliac lymph node involvement
C. Revised treatment plan now includes involved LN

The color scale ranges from radiotherapy dose of 0 to 77 Gy.

Impact of Prostate Cancer Imaging on Disease Management

Change in management: a summary review of clinical studies and the literature

- C-11 choline-PET/CT¹
  - 7% in overall treatment change
  - 18% in major changes
- F-18 fluciclovine-PET/CT imaging in subjects undergoing salvage radiotherapy treatment planning²
  - F-18 fluciclovine results changed planning volumes for 46/55 abnormalities: 28(51%) in the lymph nodes, 11(20%) in the prostate bed, 10(18%) in the prostate and 6(11%) in the seminal vesicles

Impact of Prostate Cancer Imaging on Disease Management

Change in management: a summary review of clinical studies and the literature (cont.)

- F-18 NaF\(^3,4\)
  - In specificity and sensitivity vs planar bone scan and multi-FOV SPECT
  - In recognition of bone metastases for high-risk prostate cancer patients (52%)
  - In intended management of NOPR patients (77%)
  - In changes in therapy management (44% to 52%)

Key Messages

- **PET/CT is a powerful non-invasive diagnostic tool**
  - Effective for: Detecting metastatic disease, restaging, identifying biochemical relapse post-radical therapy, monitoring treatment and primary staging generally limited to only high-risk disease
  - F-18 NaF imaging is an important tool for evaluating bone mets

- **Indications for using PET/CT in prostate cancer patients**
  - Negative CT/MRI/SPECT bone scan and rising PSA
  - Radiation therapy planning
  - Staging of aggressive tumor types

- **F-18 FDG and F-18 fluciclovine show utility in detecting local and/or regional and distant recurrence**
References

References

References

Important Safety Information

- Image interpretation errors can occur with PET imaging. A negative image does not rule out recurrent prostate cancer and a positive image does not confirm its presence. Clinical correlation, which may include histopathological evaluation, is recommended.

- The performance of F-18 fluciclovine and C-11 choline seem to be affected by PSA levels. For F-18 fluciclovine, uptake may occur with other cancers and benign prostatic hypertrophy in primary prostate cancer.

- Hypersensitivity reactions, including anaphylaxis, may occur in patients who receive PET radiopharmaceuticals. Emergency resuscitation equipment and personnel should be immediately available.

- PET/CT imaging contributes to a patient’s overall long-term cumulative radiation exposure, which is associated with an increased risk of cancer. Safe handling practices should be used to minimize radiation exposure to the patient and healthcare providers.

- Adverse reactions, although uncommon, may occur when using PET radiopharmaceuticals. Always refer to the package insert prior to use.