Published in final edited form as:
Urol Oncol. 2012 ; 30(6): 938–939. doi:10.1016/j.urolonc.2012.09.008.

Progress in prostate cancer imaging

James L. Gulley, M.D., Ph.D., F.A.C.P.[a,*], **Mark Emberton, M.D., F.A.C.S.**[b], **John Kurhanewicz, Ph.D.**[c], and **Peter Choyke, M.D.**[a]

[a]Center for Cancer Research, National Cancer Institute, National Institute of Health, Bethesda, MD 20892

[b]Division of Surgery and Interventional Science, University College Hospital, London, UK

[c]Department of Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, CA 94143, USA

Abstract

There are multiple new technologies being developed for imaging of advanced prostate cancer. This Seminar article highlights several of these emerging modalities that were discussed at the Society of Urologic Oncology annual meeting in Bethesda, MD. © 2012 Elsevier Inc. All rights reserved.

Keywords

Prostate cancer; Imaging

The prostate cancer imaging session displayed new and emerging technologies that aim to improve the sensitivity and specificity of detecting localized and metastatic prostate cancer, and to provide useful aids for guided biopsy, additional biomarkers of cancer aggressiveness to aid prognostic evaluation, and imaging modalities that may aid in predicting progression in patients on active surveillance. Dr. Clare Tempany, Clinical Director, Magnetic Resonance Imaging, Brigham and Women's Hospital, and Professor, Department of Radiology, Harvard Medical School, first discussed imaging adjuncts to improve prostate biopsy. The traditional transrectal ultrasonography (TRUS) biopsy is limited, and while there are enhanced ultrasound techniques that may improve on this, they are not readily available, and none is FDA-approved. Multiparametric MRI techniques can provide much better anatomic detail and can identify suspicious lesions that may be missed with a typical 12-core biopsy. Either direct MRI-guided or MRI/US co-registration biopsy can be used. Physicians at Dana Farber perform MRI-guided biopsies using an open-source software for image processing called 3D Slicer, which can overlay images obtained with different techniques (e.g., diffusion-weighted images, MR spectroscopy, etc.) and biopsies can be performed using each of these techniques as guidance.

Dr. John Kurhanewicz, Professor of Radiology and Biomedical Imaging, Pharmaceutical Chemistry, and Urology at USCF, then discussed MRI technologies in the staging of prostate cancer. 3D anatomic imaging aided by multiparametric techniques (T2, diffusion-weighted imaging, ADC mapping, spectroscopy) can not only predict tumor focality, size, and stage, but may yield multiple MR-based biomarkers that may correlate with the aggressiveness of prostate cancer (e.g., choline to citrate ratios). Metabolic imaging with

[*]Corresponding author. Tel.: 301-435-2956; fax: 301-480-5094. gulleyj@mail.nih.gov (J.L. Gulley).

hyperpolarized ^{13}C pyruvate can greatly increase the sensitivity of MRI in detecting cancer. Kurhanewicz also discussed the use of ultrasmall superparamagnetic iron oxide (USPIO) compounds, such as ferumoxytal (Feraheme, AMAG Pharmaceuticals, Inc., Lexington, MA), which is FDA-approved for iron replacement in patients undergoing dialysis and is now being studied for use with MRI. Macrophages in normal lymph nodes can take up the iron oxides, which can readily be seen on MRI. Cancer-involved LN will not take up USPIO, making it possible to identify cancer even in normal-size lymph nodes. This technology can be coupled with newly available whole-body MRI to detect metastasis. These MR technologies can add functional and anatomic staging with biomarkers that may add to clinical nomograms.

Dr. Peter Choyke, Head, Molecular Imaging Program, Center for Cancer Research, NCI, then discussed nuclear medicine imaging for prostate cancer. Current nuclear medicine imaging techniques (e.g., technetium-99m bone scan) focus on bone and not tumor, so changes in imaging may lag behind changes in disease. Available imaging modalities are also relatively nonspecific. While ^{18}F-labeled NaF PET scans offer dramatically improved sensitivity and may be useful in identifying patients who may not benefit from local therapy, this too is a bone-targeted technique. Newer techniques utilizing ^{18}F-labeled compounds (FACBC, DCFBC, and DHT) all target the tumor and appear to have high sensitivity for tumor. Several of these techniques still need to be tested in large multicenter studies, but all are quantitative and, with the widespread availability of PET CT, could be translated into clinical practice in the foreseeable future. (Table 1).

Table 1

Emerging PET imaging compounds for prostate cancer

Compound	Target
^{18}F NaF	Calcium mimetic, binds to areas of bone turnover
^{18}F choline	Trapped in cells undergoing membrane synthesis
^{18}F FACBC	Leucine analog
^{18}F DCFBC	Binds to catalytic ectodomain of PSMA
^{18}F DHT	Dihydrotestosterone (DHT) binds to androgen receptor