New Methods for Imaging Prostate Cancer

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MOTIVATION
• Prostate cancer is the most commonly diagnosed cancer in men and third leading cause of cancer death in men.
  • 2017 Estimated New Cases: 161,360 (19% of men)
  • 2017 Estimated Deaths: 26,730 (8% of men)
• The majority of patients diagnosed with prostate cancer have organ-confined disease at diagnosis; however, 20-40% of these patients will ultimately progress to have recurrent disease.
• Therefore, predicting identification of aggressive prostate cancer at the time of initial diagnosis is crucial.

GOAL
• Develop imaging techniques that will help the radiologist, urologist, and pathologist identify aggressive prostate cancer at diagnosis.

BACKGROUND
• Magnetic resonance imaging (MRI) is a commonly used imaging tool to diagnose prostate cancer. However, not every cancer is easily seen on MRI, limiting its ability to detect cancer.
• We used Positron Emission Tomography (PET) as a way to provide additional information about prostate cancer. Radiolabeled copper ATSM is a PET tracer developed to image areas of low oxygen in tumors that correlate with aggressive disease. We performed simultaneous PET/MRI with ATSM to better identify prostate cancer in patients.
• Similarly, current clinical tests to screen for prostate cancer, such as prostate specific antigen (PSA) are inadequate. New biomarkers to predict aggressive prostate cancer are urgently needed.
• We used Matrix Assisted Laser Desorption Ionization (MALDI) imaging of microscope slide sections of prostate cancer to identify new biomarkers of aggressive disease.

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FUNDING
Prostate Cancer Foundation
Caring Together.

IMAGING PROSTATE CANCER WITH PET / MRI

Men with biopsy-proven prostate cancer
Inject copper ATSM radiopharmaceutical for PET
Image with simultaneous PET and MRI for 1 hour
Identify prostate cancer

Figure 1. Copper ATSM-PET may identify invasive prostate cancers. There is a large prostate tumor identified by the open arrows on T2 and diffusion weighted imaging (DWI) portions of the MRI exam. Not only does the PET detect the same area of tumor, but the invasive disease (closed arrow) is much easier to see with PET.

Figure 2. Copper ATSM-PET may overcome technical limitations of MRI. The prostate tumor (arrow) is obscured because of a suboptimal MRI scan due to movement. However, PET is able to better identify the tumor.

IMAGING PROSTATE CANCER ON MICROSCOPE SLIDES

Prostate surgical specimen
Section prostate to make slides
Light microscopy of slides with prostate cancer
MALDI imaging of slides

What is Matrix Associated Laser Desorption Ionization (MALDI) Imaging?

Vaporized molecules
Process is repeated for each spot on the slide. Images are made showing the location of specific molecules in the slide specimen.

Figure 3. MALDI imaging can identify different components within a cancer. Conventional histology using a light microscope identifies a tumor based upon normal cells (red circle). MALDI imaging of the same slide based upon molecules in those cells identifies that the tumor is made up of different components that are not easy to see with conventional microscopy.

MALDI imaging of same slide
Conventional light microscope slide of prostate cancer
Thousands of vaporized molecules in one spot analyzed with MALDI imager

Magnetic Resonance Imaging