Imaging

Minimally Invasive Therapy

As clinicians and collaborators, Peter Choyke, M.D., and Peter Pinto, M.D., have combined their skills in advanced imaging techniques and laser therapy to potentially revolutionize prostate cancer treatment. Their approach, which ultimately aims to remove only cancerous portions of the organ while leaving healthy tissues intact, could result in more men being successfully treated for their illness while retaining normal prostate functioning. A radiologist, Choyke set up CCR's Molecular Imaging Program shortly after arriving at NCI in 2004. Pinto, a Staff Clinician in CCR's Urologic Oncology Branch, pioneers minimally invasive treatments for prostate cancer, including laser ablation and robotic prostatectomy. In a new clinical trial that launched in July 2011, the researchers are testing the safety and effectiveness of magnetic resonance imaging-guided laser therapy in men whose prostate cancer has not yet spread to other parts of the body.

Pinto. The motivating factor for my research is an essential question: How can we offer better prostate treatment? With the standard diagnostic tests of today, that is, the random 12-core biopsy of the prostate, which uses ultrasound guidance to direct a prostate tissue collection needle into the prostate a dozen times, there is always a possibility of missing some cancerous cells, or of misjudging the size of the tumor. So, here at CCR, Dr. Choyke and I are collaborating on testing a platform that aims to tell us more precisely where a tumor is located within the gland, which, in turn, allows me, as a clinician, to operate with more precision, and to identify with more accuracy those patients who need immediate surgery and those who do not.

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Choyke. We use an endorectal coil multiparametric magnetic resonance imaging (MRI) to visualize the prostate. This is different from standard MRI in that we combine

(*Photo: R. Baer*)

Bradford Wood, M.D., and Peter A. Pinto, M.D., perform a prostate biopsy.

multiple MR scans in ways that allow us to stratify lesions by risk category—low, moderate, or high—depending on how many parameters are positive. We can then fuse the MR imaging data—which establishes coordinates for the lesion within the prostate—to an ultrasound device.

Pinto. Again, this is quite different from how urologists typically use ultrasound today. Most urologists use it to define the borders of the prostate, but not to identify specific lesions. What's novel about our approach, which is being developed through a Cooperative Research and Development Agreement with Philips Medical Systems, is that we transfer MRI coordinates for the lesion directly to an ultrasound machine. Then, when I'm performing the biopsy, I use an electromagnetic tracker—which is part of this platform—to guide the biopsy needle in real time towards the tumor. If we locate a well-defined tumor surrounded by healthy tissue, then we treat the tumor only, and leave the rest of the prostate intact. This new trial represents the first time that we have attempted to treat just the tumor nodule based on MRI information. And because of the accuracy of the imaging, we are now able to use a laser to destroy cancer in the prostate while avoiding the nerves that control erectile functioning and continence. The technique is called MR image-guided focal laser ablation.

Choyke. One of the many benefits is that MR-guided laser ablation of the tumor makes it possible to monitor temperature changes in real time—you can see if critical structures, nerves, or the urethra are receiving dangerous levels of heat, and therefore avoid damage to otherwise healthy areas surrounding the prostate.

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Pinto. Another advantage of this technology is that nodule treatment happens under sedation, like a colonoscopy. Patients are comfortable, but they are not under general anesthesia, so they can come in for treatment and go home on the same day. That makes prostate tumor treatment an outpatient

procedure for some patients. It won't replace surgery, but not every patient requires surgery.

Choyke. We have also found that the MR method generates useful clinical information in just about every situation. For some patients, the doctor may look for a trend of rising prostate-specific antigen (PSA) measurements over time rather than a single elevated PSA level. For these patients, you can use MRI to identify lesions before the biopsy. For a patient with a previously negative biopsy who has a rising PSA, the MRI can be helpful in detecting occult lesions.

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(*Photo: R. Baer*)

Bradford Wood, M.D., Jochen Kruecker, Ph.D., Peter A. Pinto, M.D., and Peter L. Choyke, M.D.

Pinto. Alternatively, we could encounter a situation in which the radiologist tells me that a suspicious area might be cancerous, but that the risk level is low. In that case, we could recommend to the patient that we not biopsy immediately but use the imaging data to guide follow-up. So, MRI is also useful for "watchful waiting" in patients who do not want to be treated at all. It defines the volume of cancer and the true extent of disease.

MRI also improves how I perform robotic surgery in patients with confirmed cancer. Nerve sparing is always the goal during surgery—my job is to peel the nerves away from a tumor. This MRI imaging technique improves how I do that procedure, and it gives insights into whether a tumor might break out of the prostate, and if so, on what side. Under current treatment protocols, in patients with high-grade cancer we remove the whole prostate and the surrounding nerves and tissues, which often renders the patient impotent. But if MRI shows that the tumor is far enough away from the nerves, we might not have

(*Photo: R. Baer*)

Peter L. Choyke, M.D., and Peter A. Pinto, M.D., examine an image of the prostate.

(*Photo: R. Baer*)

Peter A. Pinto, M.D., and colleagues in surgery.

to do that. What is significant about this treatment is that it parallels what we've been doing in breast cancer for years. With breast cancer, it is possible to remove a mass by lumpectomy instead of removing the whole breast. For patients with well-defined prostate tumor nodules, in the right location, and with the right shape, we can now offer a similar option.

Of course, what we're undertaking in the clinical trial is at the very early stages of this type of treatment. We're trying to find out first if the approach is feasible, and second, whether it's safe. The protocol is complicated, but in a nutshell, it is offered to patients with a diagnosis of prostate cancer that corresponds with a lesion that we can see on MRI, and that we can also treat with a laser. We do not want to treat the most aggressive cancers at this stage and are, therefore, limiting enrollment to patients with MR-visible nodules confirmed on biopsy to have mild to moderately aggressive tumors.

We are able to offer this type of novel treatment because the imaging method developed by Dr. Choyke allows us to visualize the tumor so precisely. We still need to define the best candidates for the procedure, and this is what we will be working on going forward. It's incredibly exciting for us as clinicians because this really does feel like the dawn of a new treatment era for prostate cancer.

To learn more about Dr. Pinto's research, please visit his CCR Web site at http://ccr.cancer.gov/staff/staff.asp?Name=ppinto.

To learn more about Dr. Choyke's research, please visit his CCR Web site at http://ccr.cancer.gov/staff/staff.asp?name=choyke.

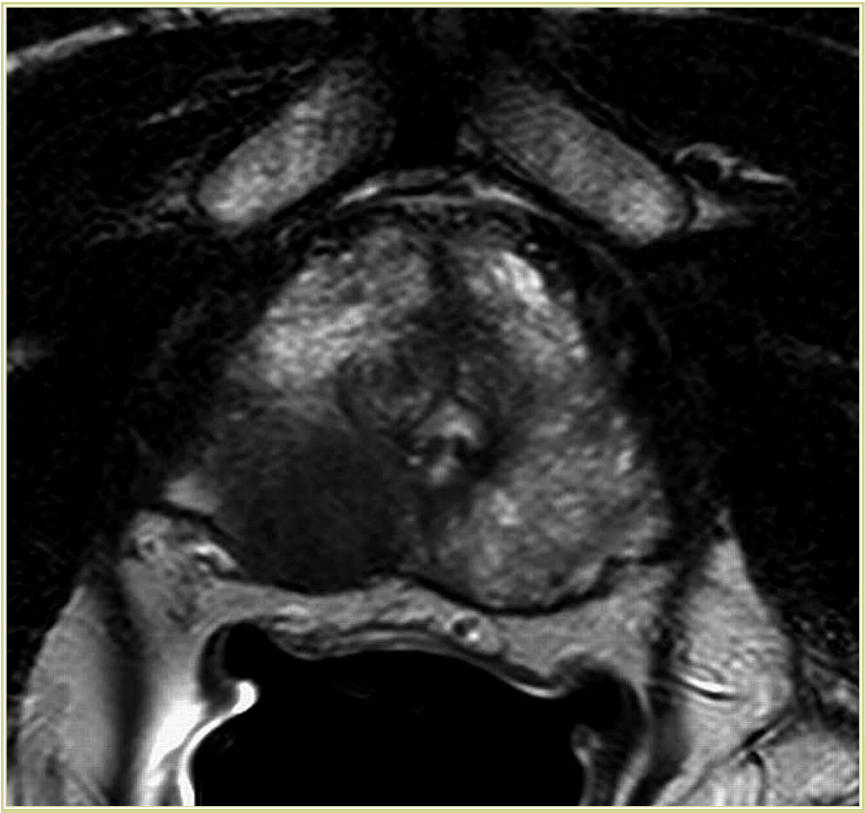
To learn more about the imaging trial described in this article, please visit the following Web site http://bethesdatrials.cancer.gov/clinical-research/search_detail.aspx?ProtocolID=NCI-11-C-0158.

Multiparametric MRI in Action

Gary Fisher, M.D., a cardiologist from Chevy Chase, Md., was 64 years old when, after his annual prostate-specific antigen (PSA) test, he noticed a worrying rise in PSA levels.

Although he more commonly referred his own patients for follow-up, Dr. Fisher referred himself to one urologist who recommended a biopsy, and a second urologist who told him to wait and follow up with a new PSA test in four to six months. Dr. Fisher chose the latter option, and six months later, his PSA levels were higher still. Having heard about the new multiparametric magnetic resonance imaging (MRI) being offered at NCI, Dr. Fisher opted to have his biopsy done using this new technique. Multiparametric MRI integrates traditional T2-weighted imaging with one or more functional techniques. "The procedure was very straightforward," said Dr. Fisher, "and the MRI clearly showed an abnormality, which the biopsy confirmed as cancer."

(*Photo: P. Choyke, CCR*)



An example of a T2 weighted MRI of the prostate showing a prostate cancer on the left side of the image (patient's right). This image guided a targeted biopsy done at NCI.

Dr. Fisher credits the MRI imaging technique pioneered by Peter Choyke, M.D., as contributing to his quick and accurate diagnosis. Of the 14 cores taken at biopsy, 12 random cores came back negative, and only the two cores guided by the multiparametric MRI came back positive. "Were it not for this informative MRI, I may well have left the clinical center with a negative biopsy and a continued recommendation of active surveillance," said Dr. Fisher.

The imaging also helped the clinical team to visualize the unusual placement of the tumor, so that when Peter Pinto, M.D., performed Dr. Fisher's surgery, a robotic radical prostatectomy, there were no surprises.

One year after surgery, Dr. Fisher remains very positive about his experience—he is thankful for the care and attention he received at the clinical center and extremely happy with the cancer-free outcome of the surgery—but it is his continued advocacy and many patient referrals over the last 12 months that are perhaps the most telling example of how he feels about the revolutionary prostate imaging and treatment options being pioneered at CCR.