Advances in the Detection of Prostate Cancer

Aside from skin cancer, the most common site for cancer in American men is the prostate, with an estimated 160,000 new cases last year [ed.—2017]. Prostate cancer is also the third most deadly for American men, with more than 26,000 deaths in 2017. Yet the standard diagnostic method of searching for prostate tumors lags behind technologies used in other cancers. Researchers in the Yale School of Medicine’s Department of Urology are working to change that. They are developing imaging tools to give surgeons and radiologists a clearer picture of prostate cancers. Clearer images translate into more accurate diagnoses and more precise targeting of the tumors.

“We’re working to push the field forward,” said Preston C. Sprenkle, MD, Assistant Professor of Urology and Chief of the Division of Urology at the VA Connecticut Healthcare System. The field needs a push. If a urologist wants to determine whether a patient has prostate cancer, the standard procedure is to use ultrasound to locate the organ and then to insert biopsy needles that take random samples from the prostate.

“It’s as if you can see an apple, and you know there’s a worm in there somewhere, so you put darts in to get it,” said Dr. Sprenkle. “But since you don’t know where the worm is, you have to guess—you evenly space the darts and hope you hit it.” This haphazard method has predictably mediocre results, missing about a third of all prostate cancers.

Until recently, the prostate was the only solid organ where physicians didn’t have access to imaging technology to see inside it. That has started to change thanks to new systems that blend ultrasound with magnetic resonance (MR), a combination known as MR-US fusion. Yale was an early adopter of the technology. Using software algorithms, MR-US fuses the two different images to capitalize on information from both. The resulting 3-D images enable physicians to identify suspicious lesions in specific locations within the prostate.

“By doing that,” explained Dr. Sprenkle, “we know where to place our needle to sample the tissue. These targeted biopsies have increased our detection of higher-risk prostate cancers.”

MR-US fusion isn’t yet the standard for several reasons. First, adding MR to the biopsy adds cost, which some hospitals and insurance companies resist. Second, fusion technology is still new, and data about its benefits and cost effectiveness aren’t yet conclusive. And third, though MR-US is an immense improvement over ultrasound alone, the two images fuse imperfectly, leaving room for errors in diagnosis. Not all practices have the expertise and experience to create the fused images and interpret them correctly.

Making interpretation easier is where Dr. Sprenkle saw an opportunity. He is part of a multidisciplinary group at Yale Cancer Center that collaborates on research related to prostate cancer. He proposed a project to improve the computer system, called Artemis, that does the fusion imagery. He began working with Xenophon Papademetris, PhD, Professor of Imaging Processing and Analysis, who involved the makers of Artemis. The project is funded by the NIH through its Small Business Technology Transfer Program (STTR).

“Part of the challenge is that images from MR and ultrasound look very different,” said Dr. Papademetris. “The second problem is that the prostate doesn’t have the same shape in an MRI as in ultrasound, because the MRI is done with the patient lying on his back in a scanner, and the ultrasound is done by inserting a probe through the rectum, so it’s pushing against the prostate, which causes some compression-deformation. The Artemis system stretches and shrinks and grows one surface to make it fit into the other, and then you cut in the rest of the image.”

The partial deformation of the prostate during ultrasound introduces a degree of imprecision that can lead to missed lesions. Drs. Papademetris and Sprenkle are trying to reduce that imprecision by translating clinical experience—Dr. Sprenkle has done about 800 biopsies using MR-US—and data from previous patients into better software that calculates and corrects for probable deformations, and thus creates a more accurate image.

The new software is now being validated. Drs. Sprenkle and Papademetris expect to test it in a clinical trial early this year [ed.—2018], along with partners at Stanford University. The ultimate goal is to make fusion imaging so precise that it automates interpretation and eliminates errors.

Dr. Sprenkle is also a pioneer in several kinds of “focal therapy,” a targeted approach made possible by MR images, which reveal small lesions that can be treated using a variety of energy sources, saving patients from the severe side effects caused by intensive radiation or removal of the entire prostate.

All of this reflects the commitment of Dr. Sprenkle, Dr. Papademetris, and their colleagues to deploy better ways of finding and defeating prostate cancer. “It takes a multidisciplinary effort,” said Dr. Sprenkle. “We have outstanding nationally-recognized radiologists and outstanding nationally-recognized pathologists. We are very experienced, and experience matters. In biopsies, being a millimeter or two from where the cancer is located can make a significant difference.”

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