MRI-Ultrasound Fusion Guided Biopsy

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Laura Coburn, a 2015 graduate of Emory College researched and wrote the following article about this technology for CancerQuest in the fall of 2014 as part of an undergraduate journalism course in Science and Health writing. The story shows the promise of new technologies to improve patient outcomes.

A GPS for Prostate Cancer?

Seth Terkin had his first prostate biopsy seven years ago. He had increasingly high levels of Prostate Specific Antigen (PSA), a blood test used to screen for prostate cancer. But his ultrasound-guided biopsy came back negative for prostate cancer.

Two years later, Terkin began having problems emptying his bladder. His urologist prescribed him medication to treat his enlarged prostate. This helped, Terkin recalls, until last year when he started developing a sharp pain in his side. He went back to the doctor, who gave him a higher dose of medicine and catheterized him for five weeks. At this point, Terkin says he was fed up and wanted an answer.

"I was out of work for a month and a half." Terkin says. "It was a miserable time in my life, and obviously it was really frustrating not to know what was really going on."

That' s when he decided to see a different urologist, who sent him for an MRI. Terkin then received a new type of biopsy, the MRI-ultrasound fusion biopsy. This ultimately diagnosed his advanced- stage prostate cancer. They found the tumor at the top of the prostate on the surface of the gland, an unusual location for cancer and an area not easily detected by the standard transrectal ultrasound (TRUS) guided biopsy.

"If it wasn' t for the fusion guided biopsy, we would have never diagnosed my prostate cancer appropriately," Terkin says, who had had three more TRUS biopsies show up negative before his diagnosis.

Terkin is one of a growing number of patients being referred for an MRI-ultrasound fusion biopsy. The technology combines MRI and real-time transrectal ultrasound to detect prostate cancer, the second most frequently diagnosed cancer for men in the United States. MRI fusion, which creates a 3-D map of the prostate, is primarily used for patients with repeated negative TRUS biopsies yet ongoing suspicion of prostate cancer, such as a rising PSA. The fusion method yields highly accurate results and increases the likelihood that significant cancer will be found through biopsy.

"With this kind of three dimensional imagining guided biopsy, you will be able to see the target better and more precisely, so hopefully you can improve the detection rate of cancer," says Dr. Baowei Fei, the principal investigator for a National Institute of Health-funded grant to research MRI fusion technology.

Prostate cancer is the second leading cause of cancer deaths for men, and the American Cancer Society predicts that one in seven men will be diagnosed with prostate cancer during his lifetime. While most men do not die from the disease-- about one in 36 die-- patients can suffer serious morbidity, especially with late detection. The new MRI fusion technology addresses these concerns, as it allows more accurate detection of significant prostate cancer than traditional detection methods like the current standard TRUS biopsies.

"If we have early detection we can not only save the life of the patient but also reduce the whole healthcare cost, and that can make a huge difference," says Fei.

The MRI fusion approach improves upon the traditional 12-core TRUS, in which biopsies are taken from twelve areas where cancer is considered likely in the prostate. According to an article in the Urology Times, the TRUS biopsy leaves about 70 percent of men with a negative biopsy but not necessarily free of prostate cancer. Another study published in The Journal of

Urology that compared this method with the new fusion technology determined that the fusion-guided biopsy detected almost twice as many cancers in all stages than the standard TRUS biopsy alone.

"We're basically reaching in the closet and saying this is the shirt I'm going to wear today, and I hope it matches the tie I'm going to have," says Emory Urologist Dr. Peter Nieh, describing the traditional TRUS biopsy. "When you select out the people who have negative biopsies the question is: what did I miss? And the thing is you don't know. So now you're taking…a technology that allows you to actually hit that spot accurately and repeat the process if you need to."

The new, targeted approach only biopsies highly suspicious areas of the prostate displayed by the MRI image. This results in significantly fewer biopsies than the traditional TRUS biopsies, reducing the negative side effects that accompany repeat biopsies. Patients who receive multiple biopsies can experience infection, bleeding, sepsis, urinary retention problems or even death.

Despite fewer biopsies, MRI fusion technology increases the detection rate of aggressive prostate cancer. The MRI imaging conducted prior to the biopsy highlights the intermediate and high-risk cancers that are usually missed in traditional biopsy, according to Dr. Ardeshir Rastinehad, the director of interventional urologic oncology at Hofstra University.

Rastinehad says as the grade of the cancer increases, so does the likelihood of detecting it with MRI fusion. He says that in patients with highly suspicious lesions, the MRI fusion finds cancer nearly 100 percent of the time. Rastinehad says this is important to avoid metastatic disease, or cancer that has spread to other parts of the body.

"Our goal is to miss the least amount of cancers by finding the higher grade and higher volume disease," Rastinehand says. "And I think MRI is a tool that is evolving to offer that to our patients."

The fusion technology allows doctors to determine which cancers should receive treatment and which should undergo active surveillance, or watchful waiting. Because the technology shows the higher-risk cancers rather than insignificant low-grade lesions, it becomes less likely that doctors will overtreat low-grade cancers. Prostate cancer can often be non- aggressive and not lead to any problems at all. Aggressively treating low-grade cancers through radiation, chemotherapy or surgery can greatly impair quality of life or cause death. According to Emory Director of Interventional MRI Program Dr. Sherif Nour, more than 50 percent of prostate cancer patients are receiving unnecessary treatment for low-grade prostate cancer.

While the technology has major benefits, Nieh points out drawbacks. The procedure is currently slower than the standard TRUS biopsy, which takes about ten minutes. Nieh says that the MRI fusion process can take up to an hour to complete and that three biopsies in one afternoon is considered to be a good day. However, Nieh says they're getting quicker with practice and have reduced their average time to thirty minutes. He says that local anesthetic helps the procedure go quickly and without pain for the patient.

Nieh also says there can be problems with the fusion imaging. The patient lies in a different position for the MRI and for the ultrasound biopsy. The 2-D MRI images are then fused with the ultrasound to create the 3-D image for biopsy. Fei says that that there are still technical improvements needed to accurately merge the MRI image into the ultrasound. Nieh says he has struggled with the images appearing fuzzy in some of the procedures he has conducted.

"It sounds easy, that the MRI is beautiful and the ultrasound is beautiful." Nieh says. "Well, the pictures that you see in the books--those are the ones that are preselected. When you look at the images live, some of them are really sharp [but] sometimes they don't match up to what you see in the textbook."

Another issue is the cost of the MRI fusion technology. The cost of the fusion biopsy machine averages $200,000. On top of this, the diagnostic platform costs about $1,000, according to Rastinehad. Rastinehad says that there is currently no standard fee for a patient to receive a fusion biopsy at this time because it is so new. However, the estimated cost of an MRI can range anywhere from $300 to more than $2,000 depending on healthcare coverage, according to Time Money. While Rastinehad acknowledges the cost is high, he emphasizes the long-term benefit.

"Currently the cost is high, but when you look at the benefit if you're able to implement this in the future, you're going to

decrease the cost of biopsies and you’ re going to optimize the number of biopsies you can do in a patient,” Rastinehad explains. “If you can decrease the number of prostate biopsy cores that you take, that saves money on pathology by only targeting the lesion.”

Rastinehad says the fusion technology is being adopted very quickly by major medical centers. He notes that as people do more imaging and become more efficient, the cost will go down and the quality will go up.

“So we’ re really thinking this can be implemented on a larger scale to hopefully change the way we screen and evaluate men for prostate cancer, but we’ re not there yet,” Rastinehad says optimistically.

As with any new technology, Nour says it takes time to work out the kinks in a practical setting. However, he says he does foresee the technology eventually becoming the next gold standard for prostate cancer detection.

“If you’ re doing random biopsies, this is your standard of care, and you don’ t want to shift to fusion, in a year or two your patients will be asking you if you’ re offering fusion biopsy or not,” Nour says. “And if you are not offering it, they will go to somebody who is offering it.”

This is just what Terkin did, and he says he could not be more pleased with the outcome. After the fusion biopsy, he underwent surgery and had his prostate removed. Five months later, Terkin is fully recovered and cancer-free.

“As they say, all is well that ends well, and obviously in this particular case I am very happy and very healthy,” Terkin says with enthusiasm in his voice. “I have a new appreciation for the quality of my life, and my family is very happy to see me walking around with a smile on my face.”

Biopsies can be crucial in detecting cancer and in making treatment decisions. Unfortunately, they are not 100% accurate and it is possible that a biopsy sample may not be taken from the right place. New methods are being used to improve the accuracy of biopsies, and one of them is the combined use of magnetic resonance imaging (MRI) and ultrasound to pinpoint the location of suspicous areas. This method has been applied to prostate cancer, with promising results.1, 2

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