Researcher developing microscope that can shorten time from biopsy to cancer diagnosis

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J. Quincy Brown, PhD, and his team are developing a microscope that can examine biopsied tissues in the operating suite, with a goal of speeding diagnoses and moving toward a 'see-and-treat' paradigm for prostate and other cancers.

"Many men have unfortunately had the experience of getting a prostate biopsy and then waiting a week or two for the results, and only then can their physician determine whether they have cancer and if so, how to treat it," said J. Quincy Brown, PhD, associate professor of Biomedical Engineering.

Shortening the time from biopsy to diagnosis can have many positive results. It can reduce the anxiety the patient and his or her family must endure while they wait for answers, but it can also mean they start their treatment plans sooner, which is extremely important to positive outcomes.

Brown and his team are addressing this issue by creating microscopes that can quickly and accurately provide pathology at the point of care. "If we can start moving the ability to look at the tissue microscopically closer to the patient in space and in time — meaning right into the operating room — then we can move toward a future 'see-and-treat' paradigm for localized prostate and other cancers," said Brown.

The field is called ex vivo microscopy. Brown and his team are at the center of it, having invented and patented a microscope that can image fresh bulk tissue in the operating room within minutes of removal, without the need for histological staining or slicing required by current pathology methods.

"The reason histopathology takes so long is that the tissue must be stained and sliced into microscopically thin sections in order to pass light through it," said Brown. His team's new microscopes don't require light to pass through the tissue. They can isolate images from certain planes of the tissue that they virtually cut with light, providing a clear picture of the surface. The images look like traditional histological images, but they're not. They're captured in minutes and in a totally different way.

"What if a patient who sees their physician for a prostate biopsy could have been a candidate for a localized ablation but we lose them to follow-up while waiting for the pathology results," said Brown. "If you're already doing the biopsy procedure, wouldn't it be better if you could image the tissue in real time, have a pathologist standing by to analyze those images to determine if the tissue is cancerous and then map where the tumor is with a goal of ablating — or removing — the tumor right then and there?"

Localized ablation is an emerging treatment for prostate cancer that minimizes recovery time and preserves healthy function in eligible patients. However, it currently takes a week or two following a biopsy to determine if the patient is a candidate for it.

In their recent publication (*[Rapid On-Site Microscopy and Mapping of Diagnostic Biopsies for See-And-Treat Guidance of Localized Prostate Cancer Therapy. Cancers (Basel), 2023 Feb; 15(3): 792]*), led by Biomedical Engineering PhD candidate Madeline Behr, Brown's team analyzes whether their new microscopic technology would be feasible as an adjunct tool to confirm malignancy in fresh prostate biopsies.

"We utilized tissue samples from 39 patients undergoing diagnostic biopsy at Tulane Medical Center," said Brown. "We asked urologists to give their best guesses using the imaging tools they have now — MRI and ultrasound — if they were going to do a see-and-treat, would they do it on each of the patients biopsied. A comparison of the urologists' suspicions of malignancy to pathologist diagnosis based on biopsy images obtained by our microscope reveals that real-time biopsy imaging could significantly improve confirmation of malignancy over medical imaging alone."

Brown's team is utilizing the same technology to intra-operatively image and examine the surface of surgically removed prostate glands to determine whether margins are clear. "We've developed an automated prostate positioning system that lifts, lowers and rotates the gland while the microscope takes panoramas — thousands of images that are then stitched together to give us a map of the surface of the tissue. If there is any tumor on the surface of the prostate, then by extension you would assume there is also cancer remaining in the patient, and so you could go back to that associated location and take more tissue while the patient is still in the OR."

"The utilization of real-time assessment of the location of prostate cancer could revolutionize therapy for the more than 200,000 men diagnosed with the disease each year," said L. Spencer Krane, MD, Chief or Urology for the U.S. Department of Veterans Affairs, and collaborator on this project. "Understanding where the cancer is, and importantly where the cancer isn't, with this level of specificity could allow surgeons to preserve the vital structures adjacent to the cancer, while still ensuring complete eradication of the disease. This is a game-changing technology when applied to prostate cancer patients."

Next steps are to make both processes even faster and move them toward clinical trials to see if they improve outcomes.

Brown stresses the importance of the interdisciplinary nature of this work. "I really believe in the potential of team science, with engineers and physicians working closely together," he says. In addition to Krane, Dr. Shams Halat, associate professor of pathology, collaborated on this project.

"I look forward to continuing our collaboration with Brown's team, to move this technology from the bench to the bedside in the coming years," said Krane.