Application Note:
Assisting advances in prostate cancer diagnosis

Introduction

Prostate cancer is the most common malignancy among men, accounting for around a third of all new cancer diagnoses each year. When detected early, before the disease has spread, it generally responds well to treatment, such as radiotherapy or prostatectomy. However, currently employed approaches for screening and early diagnosis have several drawbacks and have sometimes been a source of controversy.

For example, the blood test for prostate-specific antigen (PSA), which is widely used for screening, has a substantial false-positive rate, which can result in unnecessary invasive diagnostic procedures and overtreatment. As a result, the test has come in for criticism and, in the USA, the Preventive Services Task Force recommends against its use in screening.

Putting alternatives to the test

Standard TRUS is not sensitive enough to be used for disease detection and, when used for image-guided biopsy, varies substantially according to the particular instrument used, as well as from user to user.

A recent study by Sadeghi-Naini et al (2014) explored whether a quantitative ultrasound (QUS) approach could accurately characterise the disease in 15 prostate cancer patients. The QUS approach eliminates the variability associated with TRUS by normalising the ultrasound signals against a reference in a frequency-dependent manner. In the study, patients underwent QUS prior to radical prostatectomy. Using whole-mount histopathology specimens, the areas of cancer were then identified and correlated to the QUS images.

The researchers found a high level of correlation between the extent of disease identified using QUS and that measured histopathologically. Not only that, but in a model, the extent of disease estimated by QUS significantly predicted the histopathological extent of the disease, while other commonly used markers (PSA

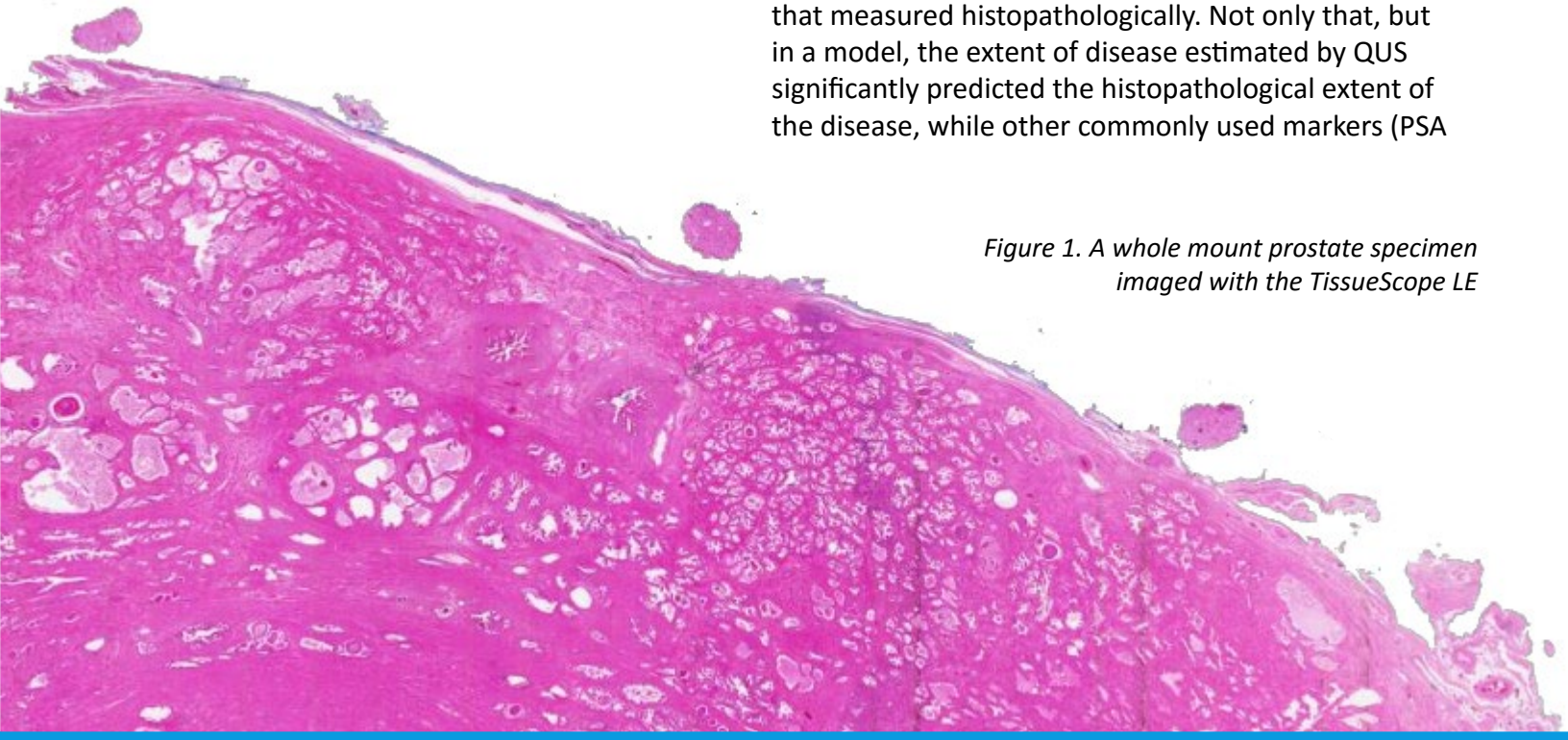

Figure 1. A whole mount prostate specimen imaged with the TissueScope LE

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and Gleason score) did not. The researchers say their findings show that the QUS technique could be used to detect and characterise prostate cancer noninvasively. Such methods, when proven histopathologically, could help diagnose the disease earlier in its course and identify those patients with high-risk forms of the disease, they conclude.

Harnessing elasticity

Another study used a different approach to explore if magnetic resonance imaging (MRI) could be used to guide invasive prostate cancer-related procedures, such as targeted radiotherapy and biopsies. The method uses elastography, which takes advantage of the fact that cancer results in localised tissue stiffening, which can allow it to be distinguished from healthy tissue.

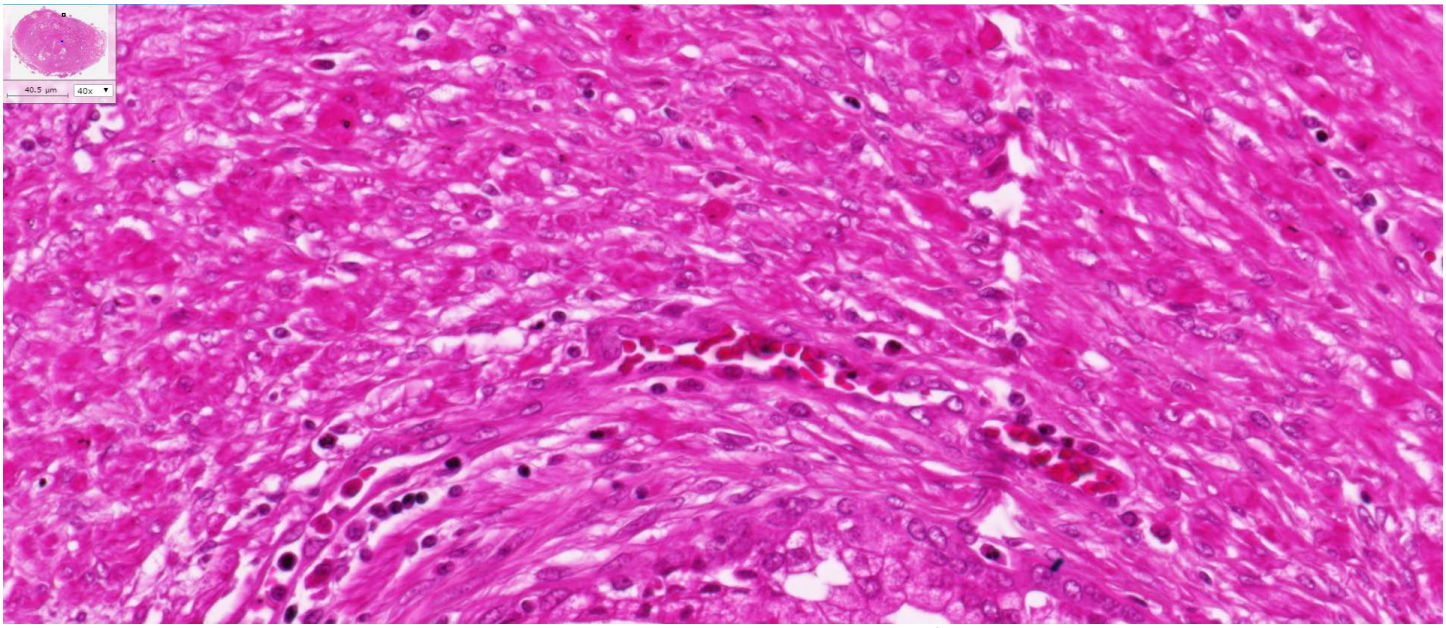

Figure 2. 40X detailed view of Prostate captured with the TissueScope LE

In this study, the researchers looked at a whole-prostate specimen that had been taken from a patient with prostate cancer. The researchers analysed four slices of the specimen histopathologically and compared them to images taken using standard MRI and the magnetic resonance elastography (MRE) technique. They found that standard MRI could only detect some of the regions of tumour. However, the MRE technique was able to detect all of the tumour regions. Additionally, the histological images revealed that, while tumour tissue was significantly stiffer than healthy tissue, so was muscular tissue. Therefore, this has to be accounted for when using the MRE technique to achieve the greatest sensitivity for distinguishing healthy from tumorous tissue.

Elastography can also be used with ultrasound, an approach that was explored in a 2014 thesis by Seyed Reza Mousavi. He showed that the method could be used in vivo in real-time, by comparing images taken from two pre-operative prostate cancer patients with annotated histology images from their operative specimens. He found an 80% overlap between the tumour regions identified by the two methods. Mousavi says that one of the reasons techniques like this have not made it into the clinic is the lack of clinical validation studies, but results such as his suggest good potential for the method.

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Flexible technology accelerates prostate cancer research

The studies above all took advantage of Huron Digital Pathology technology to validate these novel techniques. Huron's TissueScope LE whole slide scanner automates the scanning of any size histology slides from 1" x 3" to 6" x 8" at up to 40x magnification. The scanner is particularly adept at scanning whole mount prostate, breast or brain sections. For larger research projects, the TissueScope LE120 scanner incorporates an autoloader for unattended, continuous higher throughput scanning.

References

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Mousavi SR (2014) Biomechanical Modeling and Inverse Problem Based Elasticity Imaging for Prostate Cancer Diagnosis. PhD thesis. Western University, Ontario.

Mousavi SR et al. (2014) Prostate clinical study of a full inversion unconstrained ultrasound elastography technique. Proc SPIE; 9040: 904004. doi: 10.1117/12.2043086.

Sadeghi-Naini A et al. (2015) Quantitative Ultrasound Spectroscopic Imaging for Characterization of Disease Extent in Prostate Cancer Patients. Translational Oncology; 8: 25-34. doi: 10.1016/j.tranon.2014.11.005.
sensitivity for distinguishing healthy from tumorous tissue.

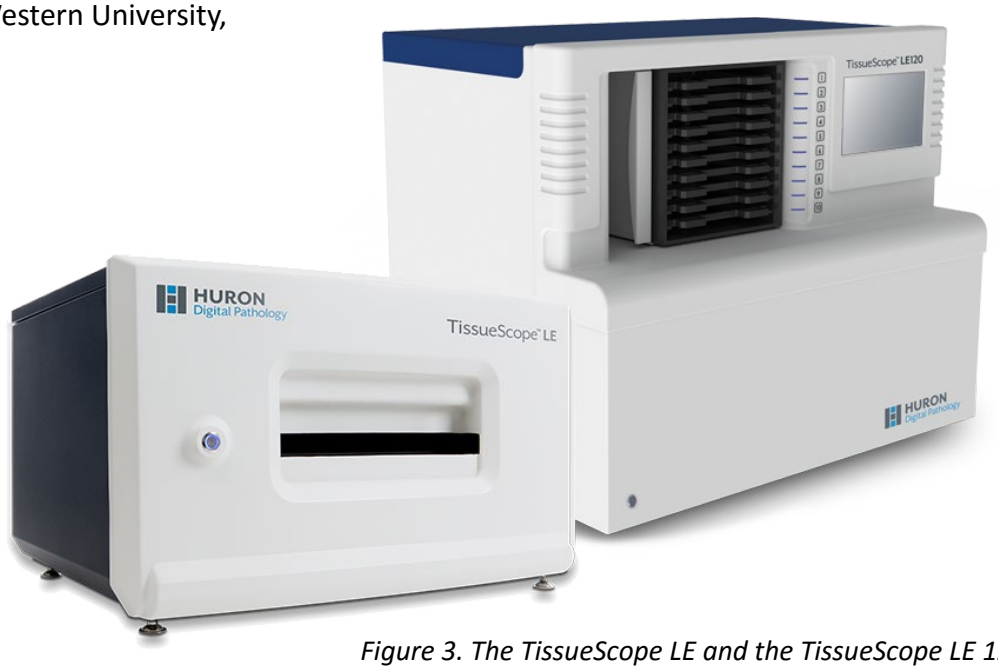

Figure 3. The TissueScope LE and the TissueScope LE 120

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