Synchrotron Radiation Inline Propagation Based Phase Contrast Computerized Tomography (PC-CT) Of Human Prostate Tissue

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The human prostate is an accessory male reproductive gland located below the neck of the urinary bladder. Prostatitis, benign prostatic hyperplasia (BPH) and prostate cancer are the most frequently encountered pathological conditions of the prostate. It is estimated that 50% of men will develop BPH by age 50 with the incidence increasing to 90% by age 90. Prostate cancer is the second most common cause of cancer in men worldwide after lung cancer.

Non-invasive diagnostic techniques for prostate cancer include assessing blood prostate-specific antigen (PSA) levels as well as medical imaging modalities such as ultrasound (US), computerized tomography (CT) and magnetic resonance imaging (MRI). Each of the above techniques have considerable limitations rendering low diagnostic accuracy. Elevated PSA levels are used for the initial screening for prostate cancer. However, elevated PSA levels are also detected with prostatic inflammation and BPH and after recent digital examination or ejaculation. Approximately 15% of prostate cancer cases are missed with PSA screening. Similarly, MRI has high sensitivity (93%) but low specificity (41%) and US has high specificity (96%) but low sensitivity (48%).

The gold standard technique for prostate cancer diagnosis is histopathological examination of the prostate. Multiple invasive puncture biopsies of the prostate are required for accurate diagnosis. Complications include bleeding, infection, pain in the hypogastrium, perineum or urethra and the need for bladder catheterization due to post-biopsy prostate swelling and clogged urethra with blood clots. Improved non-invasive diagnostic procedures may offer better patient care and reduced complications.

In this study, we examined the ability of synchrotron radiation-based phase contrast computerized tomography (PC-CT), in comparison to US, MRI and histology, to characterize and differentiate various structural features and pathological lesions in 61 prostate tissue from 13 human patients collected during trans-urethral resection of the prostate. Comparisons of the PC-CT images with those collected using US and MRI and also with histology slices of the same tissues are underway.

Preliminary findings indicate that PC-CT images are far better than the other non-invasive imaging modalities but are of a lesser quality than histology. Synchrotron radiation based inline PC-CT is currently not available for regular clinical use, but this promising non-invasive imaging technique may offer superior diagnostic accuracy of prostate conditions in the future.

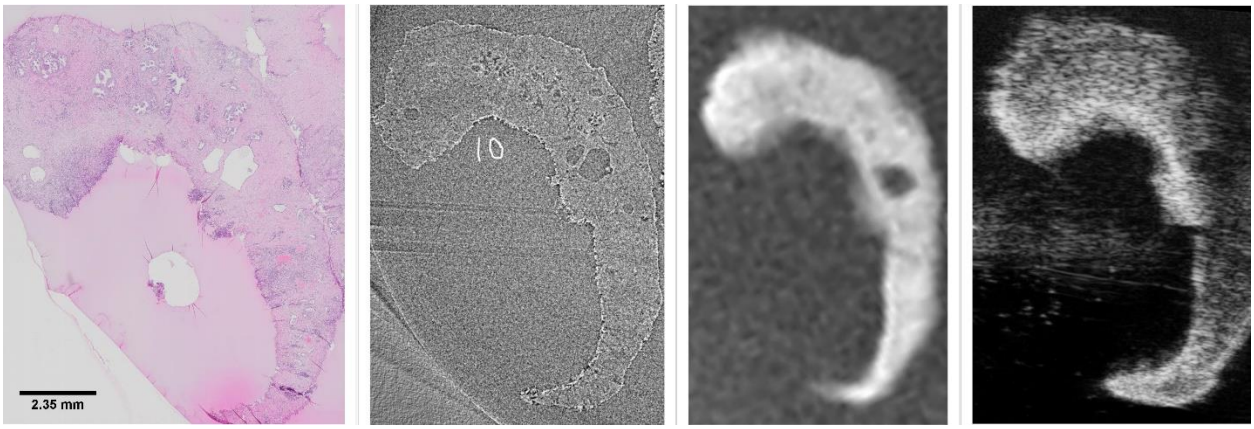

Figure: Histology, PC-CT, MRI and US images of a prostate tissue serially from left to right. The Glandular areas and dilated acini in PC-CT image are clearly visible compared to MRI and US images.