MRI-US Fused Targeted Prostate Biopsy Detects Clinically Significant Cancer in Active Surveillance Patients Better than 12 Core Random Biopsy with less than 4 Cores

Michael Da Rosa[1,2], Laurent Milot[1,3], Linda Sugar[3,4], Danny Vesprini[3,5], Hans Chung[3,5], Andrew Loblaw[3,5], Laurence Klotz[3,6], and Masoom A Haider[1,3]

[1]Department of Medical Imaging, University of Toronto, Toronto, ON, Canada, [2]Institute of Medical Science, University of Toronto, Toronto, ON, Canada, [3]Sunnybrook Health Sciences Centre, Toronto, ON, Canada, [4]Laboratory Medicine and Pathobiology, University of Toronto, Toronto, ON, Canada, [5]Radiation Oncology, University of Toronto, Toronto, ON, Canada, [6]Division of Urology, University of Toronto, Toronto, ON, Canada

Purpose: Low risk prostate cancer is associated with a 2-3% incidence of metastatic disease or prostate cancer-related death, yet 90% of men elect definitive treatment at the time of diagnosis [1,2]. Active surveillance (AS) protocols were established to address overtreatment, carefully observing then curatively treating those with low risk disease [3]. For AS to be successful, it relies on appropriate patient selection, and once enrolled, accurate regognition of disease progression. Random transrectal ultrasound (TRUS) guided biopsies are regularly performed in these patients to monitor cancer grade, yet the reported cancer detection rate for this technique is 36% [4]. MRI-TRUS fusion systems allow for guided-biopsy of targeted lesions identified on MRI outside of the MRI suite, making it a more cost-effective and practical option than true MRI-guided biopsy. Prospective studies with MRI-US fusion systems in active surveillance patients are required. The purpose of this study was to determine the ability of an MRI-US fusion biopsy system to detect clinically significant (CS) disease in AS patients compared to random transrectal ultrasound (TRUS) guided biopsy. Here we present an update of the study findings.

Methods: In this prospective study all patients were on AS and referred for biopsy. 3T MR imaging was performed (Achieva, Philips Healthcare) without endorectal coil. Multiparametric MRI (T2-w, DWI, DCE) was used to prospectively assess the likelihood of cancer. Up to 4 targets were identified in each patient, each having been scored as probable or highly suspicious on a 5-point scale. Targets were hierarchically labeled T1-T4, with T1 being the largest, most suspicious lesion. Only 1 target was identified in each of the 12 zones of the prostate to limit sampling bias. Biopsy was performed using an MRI-ultrasound navigation system for targeted biopsy (UroNav™, Philips Healthcare). Targeted lesions were semi-automatically superimposed on the real-time US image, permitting fused biopsy. To minimize operator bias, one operator performed UroNav biopsy (UroNavBx), and another, blinded to MRI results, performed random TRUS biopsy (R-TRUSBx) in the same sitting. A maximum of two cores were allowed through the primary target (T1), while only 1 was permitted for each additional target. CS cancer was defined as Gleason score (GS) > 6 or GS=6 with >50% involvement in any 1 core.

Results: Fifty-six patients with a mean age of 65.7 (range 45-79) and median PSA 5.0 ug/L (range 1.1-13.15) were included in the final analysis. Forty-six of 56 patients (82%) had MRI targets (mean 2, range 1-4). In those without targets, none had clinically significant disease on biopsy. Biopsy identified cancer in 46/56 (82%) patients, 26 of which were CS. UroNavBx detected 22/26 (85%) CS tumors, while R-TRUSBx detected 17/26 (65%, $p = 0.267$). UroNavBx missed 4 CS tumors, all of which were Gleason 6 (% core positive R-TRUS vs. UroNavBx: 90 vs. 0, 80 vs. 10, 70 vs. 10, 60 vs. 0). R-TRUSBx missed 9 CS tumors (3 GS=6, 7 GS=7, 2 GS>=8). These 9 CS tumors were detected by UroNavBx with a mean of 3 targeted cores per patient (range 1-4), significantly lower than the mean of 12 cores required for detection of CS disease by R-TRUSBX ($p<0.001$). Following biopsy, GS upgrading occurred in 12/56 patients (21%), 11/12 (92%) detected by UroNavBx and 8/12 (67%) detected by R-TRUSBx. UroNavBx upstaged cancers also detected on R-TRUSBx in 7/56 men (13%).

Discussion: MRI-US fusion biopsy can detect more CS cancers with fewer biopsy cores than random biopsy in AS patients. In addition, MRI in AS patients has a high negative predictive value for the presence of CS disease on subsequent biopsy. These findings may in the future lead to more accurate identification of those on AS at risk for disease progression, and by reducing the number of cores required for confirmation, reduce patient discomfort, morbidity, and associated histopathological interpretive costs.

References: [1] Cooperberg et al. J Natl Cancer Inst. 101(12):878-87 (2009). [2] Anandadas et al. BJU Int.107(11):1762-8 (2011) [3] Choo et al. J Urol 167:1664-1669 (2002). [4] Elabbady et al. Eur Urol 49(1):49-53 (2006).

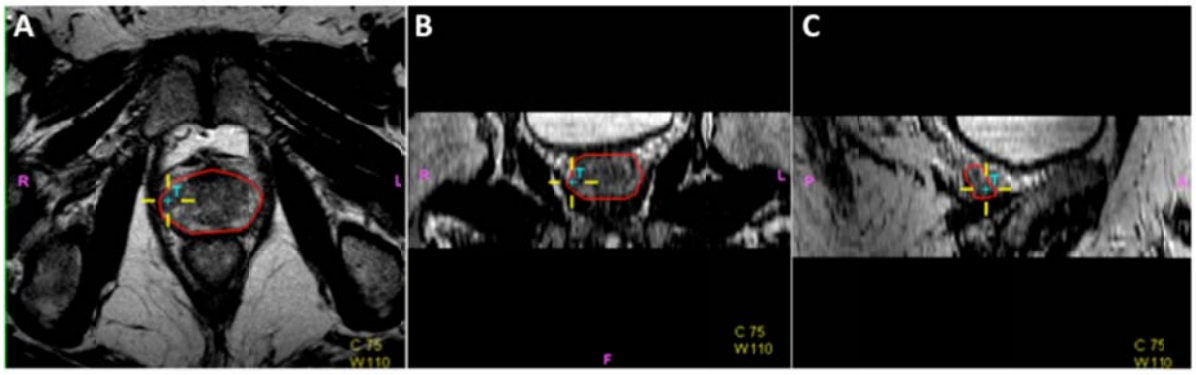

Figure 1: Axial T2-w (A), coronal T2-w (B), and saggital T2-w (C) planning images used to guide MRI-US fusion biopsy in a patient with prostate cancer. Red line represents prostate contour. Crosshairs identify target for biopsy.