Investigation of reduced FOV CEST in probing prostate cancer

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Target audience Radiologists who pay attention to the diagnosis of prostate cancer or application of CEST imaging.

Introduction Prostate cancer has been a leading disease in elderly population. However its early stage diagnosis using MR has been difficult as conventional contrast offers limited sensitivity and accuracy in some cases. Amide proton transfer (APT) in chemical exchange transfer (CEST) has been identified as a sensitive tool for detecting cancer cells [1]. However, only very limited spatial resolution can be obtained in conventional CEST imaging due to the dimensions of the prostate region within the FOV. In this study, we investigate the use of a novel reduced FOV CEST method that allows us to zoom in the prostate region that helps delineating the tumor region from the benign region and improves accuracy in grading using CEST.

Methods Patient diagnosed with prostate cancer and healthy controls have been recruited in this ongoing study, consent forms have been obtained prior to MR scan. Conventional CEST and reduced FOV CEST were performed on healthy controls for comparison, and reduced FOV CEST was performed on the patients who were performed with biopsy for pathological confirmation. In reduced FOV a 2D excitation RF was used to allow small FOV imaging without wrap around, and a FOV of 8cm was used compared to that of 22cm used in conventional CEST. With an acquisition matrix of 64x64 using a single shot spin echo EPI, the resulting spatial resolution of were respectively 1.25mm and 3.5mm. CEST covered a spectrum range of $\pm 5\ ppm$ with an interval of 0.2ppm. With a TR of 3s, the total acquisition time for WASSR [2] and CEST was 3:39. APT map and asymmetric MTR (MTR_{asym}) were calculated.

Results **Fig.1** shows the APT map at +3.5ppm overlaid on T2 image as well as the MTR_{asym} curve of the prostate regions. It is seen that for heathy control, the APT maps within the prostate are largely homogenous in both conventional and reduced FOV CEST; and the averaged MTR_{asym} within the ROIs covering over 70% the prostate region show a flat profile as expected. On the other hand, the APT map of the patient is inhomogeneous that the left side of the prostate shows considerably higher values (**Fig.2a**); the averaged MTR_{asym} of the ROI (rectangle) on the left side also shows an obvious peak around +3.5ppm of about 9%, as compared to the 5% of obtained in the healthy control (**Fig.2b**). HE stain from the Biopsy (**Fig. 2c**) confirms the presence of cancer cell, and the rated Gleason score was 4+3 = 7. The DWI image in **Fig.2d** shows hyperintense signal on the left part of the prostate, which in general indicates presence of tumor cell, is in good agreement with the observation in reduced FOV CEST.

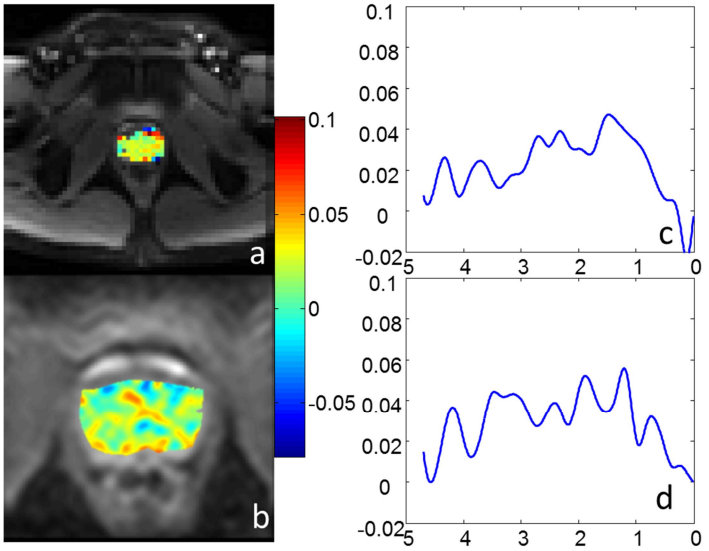

Figure1 (a) APT map and MTR_{asym} obtained in (a,c) normal and (b,d) reduced FOV CEST in a heathy control were highly consistent

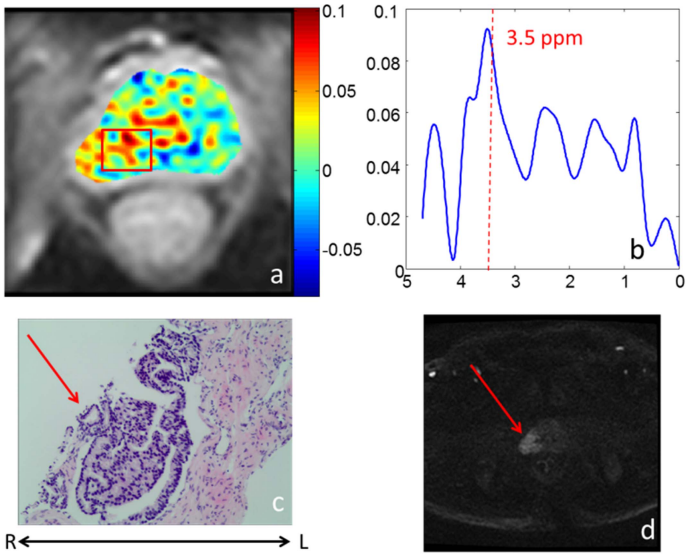

Figure 2 (a) APT map and (b) MTR_{asym} plot of a patient; (c) HE stain image showing the tumor region; (d) hyperintense signal in DWI image

Discussion and conclusion In this work, the use of reduced FOV CEST in prostate was validated by comparing the APT map and MTR_{asym} to those obtained using normal CEST, highly consistent results were obtained despite its lower intrinsic SNR. Reduced FOV CEST has the advantage of revealing the heterogeneity of the prostate, which may be difficult due to the constrained portion of the prostate region in normal FOV image (**Fig.2a**). This utility was demonstrated in the case of a prostate cancer patient, the tumor region was distinguished from the benign region, and the results were also confirmed by biopsy and diffusion weighted image. At the present, pathological confirmations still need to resort to biopsy in some cases; and we are investigating if reduced FOV CEST may be a viable means to improve the detection sensitivity and staging accuracy of prostate cancer in addition to conventional MR contrast.

References [1] J.Guo, et al, JMRI, 2011; [2] M. Kim, et al. MRM 2009.