Reduced FOV chemical exchange transfer saturation

Bing Wu[1], Chunmei Li[2], Min Chen[2], and Zhenyu Zhou[1]
[1]GE healthcare China, Beijing, Beijing, China, [2]Beijing hospital, Beijing, China

Purpose To improve image spatial resolution and reduce image distortions in Chemical exchange transfer saturation (CEST).

Introduction CEST labels endogenous chemical compounds and has been applied in a wide range of clinical applications [1]. CEST acquisition usually consists a series of frequency saturation, which constraint the acquisitions to be single shot for achieving feasible scan time. Hence the resulting images are associated with limited resolution as well as image distortions. However the region of interest (ROI) of CEST study is often spatially limited and known at prescription. In this study, a reduced FOV excitation method is used to exploit this knowledge, and its benefits are demonstrated in a prostate CEST acquisition.

Method An SE-EPI based acquisition pulse sequence that employs a 2D excitation and a frequency selective refocus 180 as shown in **Fig. 1** is implemented for CEST acquisition and offers three benefits: 1) increased spatial resolution in ROI; 2) reduced image distortion due to improved bandwidth per pixel and avoiding susceptibility or motion source; 3) the 180 pulse only refocus water signal hence no additional fat sat is needed. A Type-I type design 2D RF [2] was used to achieve spatial selection on both phase encoding and slice direction. CEST saturation module consists of Fermi pulse(s) followed by gradient crushers. As a comparison, a conventional excitation CEST that employs an SLR excitation pulse and a frequency selective fat-sat is also implemented. Reference images M0 were acquired with saturation RF turned off. WASSR [3] acquisitions were performed for B0 correction.

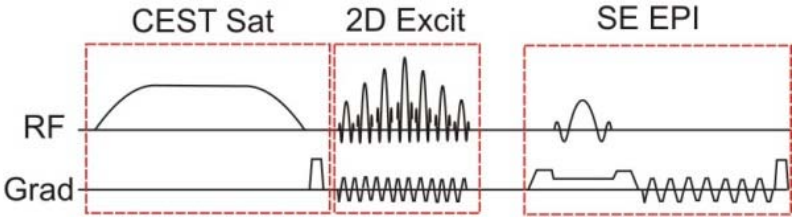


Figure 1 pulse sequence used for reduced FOV CEST acquisition

Experiment APT-CEST of prostate of both healthy volunteer and patients were performed using the reduced FOV and conventional excitation CESTs (please see another submitted abstract for the details of this clinical study). Content forms were obtained prior to the study. The acquisition FOV (matrix size) for the two cases were 24cm (128x128) and 7cm (64x64) respectively, which gave roughly 2mm and 1mm in-plane resolution. WASSR acquisition covered a spectrum from -1ppm to 1ppm in step of 0.1ppm; CEST acquisition covered a spectrum from -5ppm to +5ppm in step of 0.2ppm. With a TR of 3s and single average, WASSR and CEST acquisition were 1:03 and 2:36 in length.

Results CEST acquisitions using the two methods are summarized in **Fig.2**. **Fig.2.a** depicts the slice prescriptions for the two cases, where dotted lines and solid lines show the coverage of conventional and reduced FOV excitation respectively. It is seen that lipid signal is present in both R/L and A/P direction. If the frequency direction is placed in R/L, lipid in A/P direction is inevitably excited, and vice versa. As a result, chemical shift artifacts may exist when conventional excitation is used as illustrated in **Fig.2.b** (arrowed). On the other hand, using a FOV of 7cm provides coverage for the prostate as well as avoiding the fat (solid line in **Fig.2.a**), as seen in **Fig.2.c**. The calculated MTR curve for a healthy volunteer is shown in **Fig.2.d**, which agrees well for the established results [3].

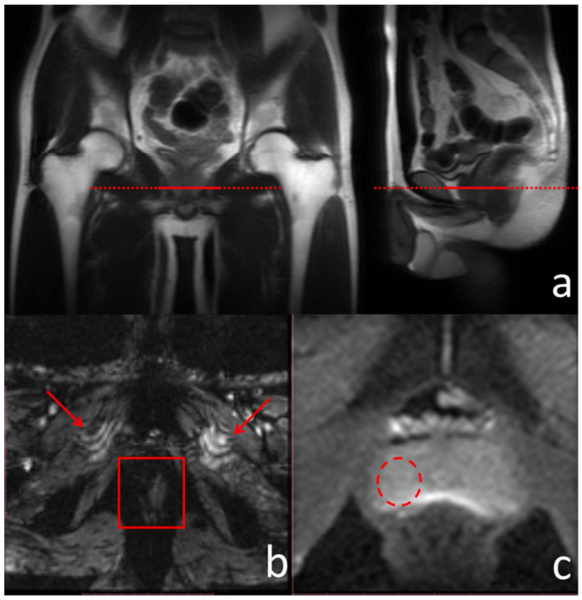
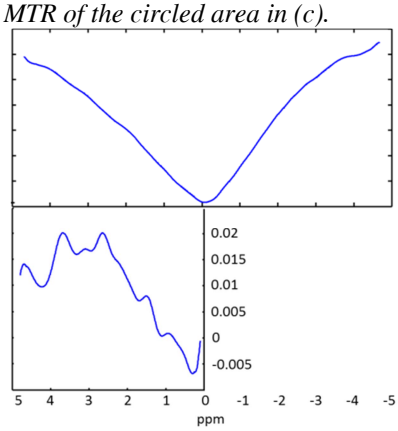


Figure 2 (a) prescription of rFOV (solid) and normal (dashed line) CEST; (b) fat artifacts (arrowed) and the rectangle shows the rFOV selection (c); (d) Z-spectrum and MTR of the circled area in (c).



Discussion and conclusion Comparing to MRS or PET, MRI based CEST is able to provide a much improved spatial resolution. However its image quality is still limited in practice as single shot acquisition is usually made. In this work, reduced FOV CEST has been applied in a prostate study to address the challenges of conventional CEST imaging: limited resolution due to limited subject size and potential artifacts due to fat or motion. Only exciting the prostate region led to 1mm in-plane resolution as well as avoiding the lipid region (the refocus RF also avoids lipid signal excitation). The downside of rFOV excitation is the lowered SNR, which seemed to be tolerable by verifying the MTR of volunteers and patients (details in another abstract).

Reference [1] P. Zijl, et al. MRM. 2011; [2] E. Saritas, et al. MRM 2008; [3] G. Jia, et al. JMRI 2011.