Improved DCE-MRI in bilateral breast imaging with fat suppressed TRICKS

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Introduction

The need for both higher spatial and temporal resolution is well known for all DCE-MRI pharmacokinetic analysis methods. The quality of the pharmacokinetic parametric map is highly dependent on the temporal resolution in the base data relative to the arterial input function. In order to characterize the transfer rate constants accurately it is essential to sample faster than the expected transit times through the respective compartments. For highly permeable angiogenic regions adjacent to fast growing cancers, the sampling rate should be as fast as possible while still preserving the resolution necessary for spatially localizing the suspicious regions of interest.

There are several strategies for achieving this goal based on view sharing. Keyhole imaging is one simple method where the center of **k**-space is updated at a faster rate than the periphery allowing faster dynamics. This is possible since data at the center of **k**-space are primarily responsible for the majority of contrast while data at the edges of **k**-space contribute to the finer details in the image. The TRICKS technique is a similar strategy with a more sophisticated algorithm for updating the edge of **k**-space to better preserve the edge detail dynamics [1].

The new technique acquired **k**-space using the TRICKS algorithm with elliptic-centric **k**-space filling and parallel imaging to reduce motion and pulsatile flow artifacts. In addition, a fat suppression technique that is compatible with elliptic-centric view ordering was incorporated into the sequence [2]. This eliminated the need for data subtraction which can lead to errors. As a first step in incorporating the new sequence in our standard screening MRI protocol, we scanned several asymptomatic cases and report the results below.

Materials and Methods

Seven consecutive patients at high genetic risk for breast cancer were studied under an IRB approved protocol. We first performed a standard 3D fast gradient echo based DCE-MRI. This was followed by a second DCE-MRI acquisition with an enhanced version of TRICKS (after a second bolus of contrast was injected) to evaluate the comparable kinetic parameters. Although the second exam was done when the contrast from the earlier scan was still present, we expect that this would not significantly alter the transfer rate pharmacokinetic rate constants.

For the results shown below, the following scan parameters were used:

Standard sequence TE/TR=4.2/7.5ms, 256×192 acquisition matrix, NEX=0.5, flip angle (α)=25, slice thickness=5.2mm, 30 slices. The temporal resolution (time to acquire one phase) was 28.6s. The enhanced technique The scan parameters for the new sequence were TE/TR=1.1/3.8ms, 320×320 acquisition matrix, α=20, slice thickness=3.8mm, 40slices, Asset acceleration factor of 2. The time to acquire one phase was 13.6s, thus yielding a temporal resolution more than twice that of the standard protocol. All data was subsequently post-processed using a GE Cinetool General Kinetic Model (GKM) analysis module to obtain parametric maps.

Results

Figure 1 below shows an image obtained with the standard and the enhanced TRICKS technique. Both show an enhancing region of interest (suspicious nodule) in the inferior part of the left breast (ROI in red). However, the contrast-enhanced nodule is more apparent on the image obtained with the new technique due to fat suppression. In addition, spatial resolution is higher and motion artifacts lower with the new technique helping us resolve finer details more accurately. Figure 2 shows the signal intensity curves for contrast uptake while Figure 3 shows maps for inflow transfer rate constant (K^{trans}) for the standard (above) and new (below) techniques. As can be seen, both techniques show similar qualitative behavior in the region of interest.

Figure1(a) 3D FSPGR

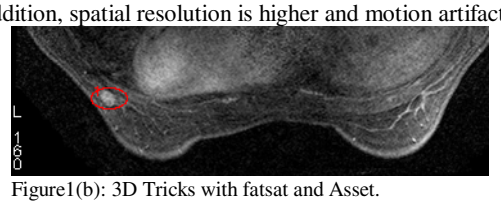

Figure1(b): 3D Tricks with fatsat and Asset.

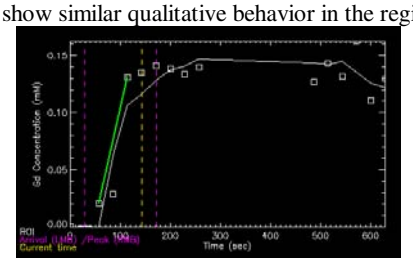

Figure2(a) 3D FSPGR

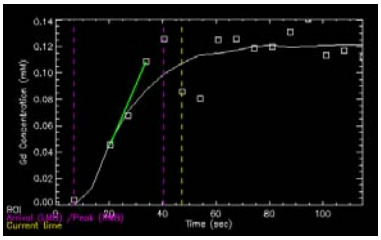

Figure 2(b): 3D Enhanced Tricks

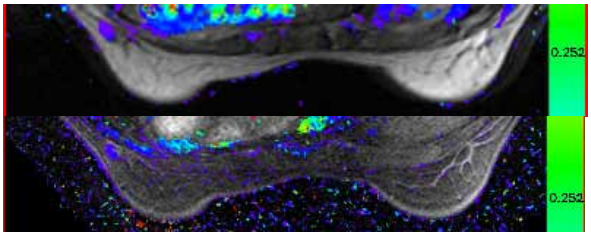

Figure 3

Discussion

Our results indicate that there are no significant qualitative difference between the parametric maps with the two techniques. The new technique provides the added benefit of higher spatial and temporal resolution in addition to improved visualization of regions of higher contrast uptake. Future work involves comparing the accuracy of the kinetic parameters and correlation with results from biopsies of breast tissue.

References

[1] F. Korosec, R. Frayne, T. M. Grist, CA Mistretta, *MRM*, 36: 345-351, 1996.

[2] M. Saranathan, V. Ramanan, R. Venkatesan, V. Rammohan, P. Choyke, *Proc. ISMRM* 2005, 2721.