Left Atrial Scar Imaging Using 3D Dixon Late Gadolinium Enhancement

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Introduction: Left atrial (LA) scar imaging using late gadolinium enhancement (LGE) is important for assessment of post-ablation injury and pre-ablation arrhythmic substrate (1-3). The LA is encased in fat and current clinical techniques employ fat-saturation prepulses which require centric profile ordering and allow fat signal to regrow during the acquisition window. This centric ordering requires NAV-monitoring prior to the acquisition window to optimize respiratory compensation of central k-space, which can generate inflow artifacts in the right pulmonary veins (PV) (4,1). The standard fat-saturated LGE technique does not always suppress all of the fat, causing misleading enhancement which may be misidentified as scar. A Dixon technique applied to LA LGE method would: i) provide excellent fat-saturation, ii) permit sequential view-ordering since a fat-saturation pre-pulse is not required, and thereby iii) permit a trailing NAV which would eliminate inflow artifacts. Here, a Dixon LGE method, similar to those proposed for imaging LV scar and pericarditis (5,6), is investigated.

Methods: All scanning was performed on a 1.5T Philips Achieva scanner (Philips Healthcare Best, NL), 15-25 minutes after injection of 0.2mmol/kg Gd-DTPA (Magnevist). 3D inversion recovery echo-planar LGE scans (fly-back with 3 echoes: opposed-phase, in-phase, opposed-phase) were obtained using a sequential ky-order and trailing NAV with 1RR between inversions. Scan parameters were: TR/TE1/ΔTE/θ = 8.4ms/2.3ms/2.3ms/25º, 320 FOV, 200 ms window. Spatial resolution was 2 x 1.4-2 x 3mm^3, zero-filled to 1.4 x 1.4 x 1.5 mm^3. Compared with the clinical standard LGE method, the TR was 50% greater with scan time increasing accordingly. Raw data were exported and reconstructed and processed off-line in Matlab (v7.1). Imaging was perfomed on phantoms, healthy subjects and patients with atrial fibrillation (AF). Data were processed using the method of Glover and Schneider (7) to produce water only and fat only images. Semi-automated phase unwrapping was performed using regions of interest to identify regions of correct and incorrect phase.

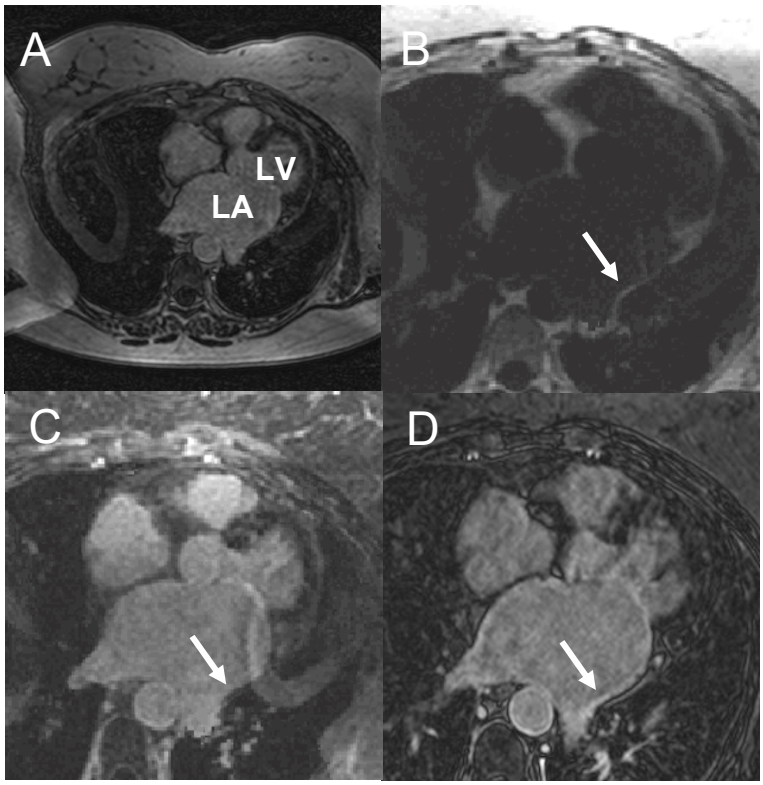

Figure 1: *Images acquired from a pre-ablation AF patient. (A) Third echo from Dixon LGE scan at TE=6.9ms with water and fat opposed-phase. (B) Reconstructed Fat-only Dixon LGE image. (C) Reconstructed Water-only Dixon LGE image. (D) Standard fat-saturated LGE image. Note possible artifactual enhancement in D, which coincides with fat in B, and is not visible in the water only image (C).* ***LV*** *= Left Ventricle,* ***LA*** *= Left Atrium.*

Results: Figure 1 compares the clinical fat-saturated LA LGE (D) imaging to the Dixon LGE method (C), showing improved fat-saturation, and better visualization of the LA wall. Note in Figure 1B (arrow) the prominent fat surrounds the LA which may be the cause of the apparent enhancement in Figure 1D (arrow). This enhancement is not seen in Figure 1C.

Conclusions: Dixon LGE is a highly promising method for LA scar imaging compared to the standard fat-sat LGE method. Though moderately increasing scan time, this approach reduces enhancement artifacts, removing fat, and permitting a trailing NAV/sequential acquisition order approach. Future work will compare the strengths of Dixon LGE versus standard LGE for detecting LA scar.

References: 1) Peters et al. Radiology 2007; 243:690-695. 2) McGann et al. JACC 2008; 52:1263-1271. Mahnkopf et al. Heart Rhythm 2010 7:1475-1481. 4). Spuentrup et al. Rofo 2002; 174:562-567. 5) Goldfarb JW MRM 2008; 60:503-509. 6) Glockner et al. ISMRM 2010, p. 491. 7) Glover and Schneider MRM 1991; 18:371-383.

Acknowledgements: This work is supported by grants from the NIH: NHLBI HL098573-01 and NIBIB K01EB004434-01A1.