Non-contrast Enahanced MR angiography combined with peripheral cardiac gating at 3T: Comparison of respiratory triggered and breath held technique

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Introduction: Non-contrast MR Angiography (NC MRA) using Inflow Inversion Recovery (IFIR) technique with 3D SSFP (FIESTA: GEHC) at 1.5T has been introduced (Ref1). MR imaging at 3T may provide higher signal intensity than at 1.5T with improvement of B0 and B1 homogeneity. In MRA using SSFP without cardiac gating at 3T, we may find signal inhomogeneity in the aorta due to systolic flow effects. To minimize them, peripheral cardiac pulse gating (PG) may be used to obtain the data in diastole. The purpose was to evaluate feasibility of NC MRA at 3T in a coronal plane with PG for evaluation of the renal artery using respiratory triggered (RT) or breath held (BH) technique and to compare image qualities for demonstration of the renal arteries in reference to dynamic contrast MRA (C MRA).

Materials and Methods: _Population:_ 33 patients were involved, undergoing C MR imaging for evaluation of kidneys and arteries (Men:Women, 18:15, median age 61years). _MR imaging:_ Both NC MRAs were obtained at 3T (Discovery MR750, GEHC) with 32 channel body array coil using investigational version of IFIR with fan beam k-space view ordering (Ref2). PG was used with RT or BH technique in a coronal plane. 1) RT NC MRA: 3D FIESTA was obtained with TR 4.3ms/STIR TI 1800ms/ARC factor 3/data acquisition window (DAW) 400ms, slice thickness 2mm, matrix 256x224-256, RR interval 5 (Fig1) and imaging time 3-4min. 2) BH NC MRA: 3D FEISTA was obtained with DAW 800ms, slice thickness 3.4-4mm, matrix 256x192, RR 4 to 5 and imaging time 24-30s. 3) BH C MRA was obtained with 3D EFGRE using smart prep with central k-space ordering [0.1mmol/kg Gd-chelate, injection rate 3ml/sec]. _Data analysis;_ Image quality and artifacts (blurring, background suppression) (1 undiagnostic-5 excellent) and visualization of the aorta and renal arteries (proximal, middle, distal, 1st-3rd order branches) (1 bad-5 excellent) were ranked with 5-point scale. Contrast was calculated (SI artery / SI surrounding tissue). The data were statistically evaluated using Wilcoxon signed rank test and Student's test among three MRAs with Bonferroni correction.

Results: ALL NC MRAs were diagnostic. Scores for image quality and artifacts of RT NC MRA (Fig5) were better than those of BH NC MRA (Fig6) although visualization of the aorta was slightly better with BH than RT NC MRA (Fig 2). NC MRA especially RT NC MRA provided better visualization of distal renal arteries without overlap of structures and better contrast than those with C MRA(Fig 3, 4, 5-7). Contrasts of the aorta and proximal renal arteries were better in C MRA than those in NC MRAs (Fig 4, 7).

Discussion and Conclusion: With fan-beam k space view ordering and ARC, MRA can be obtained in shorter imaging time. NC MRAs with IFIR using PG at 3T demonstrated abdominal arterial anatomy well in both RT and BH technique. RT NC MRA with PG provides better visualization of the peripheral renal arteries. Generally with PG, homogenous SI in the aorta was obtained in the aorta due to suppression of systolic flow effects although in some cases, signal inhomogeneity in the aorta were still noted in RT NC MRA provably due to some contamination of systolic flow effects. When image quality of RT NC MRA is not enough to evaluate arteries, BH NC MRA can be used as substitute.

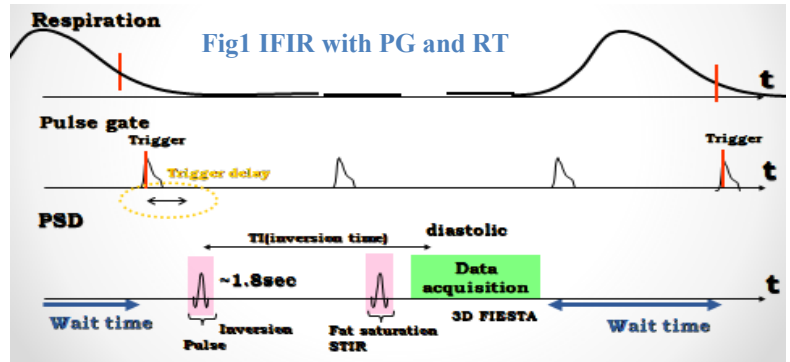**Reference** (1) Glockner JF JMRI 2010 31 1411, (2) Takei N, ISMRM 2010

Fig1 IFIR with PG and RT

Fig2 Image Quality, Artifact Visualization: Aorta

p<0.0167 * Res vs. BH, # C MRA vs. BH • N=33
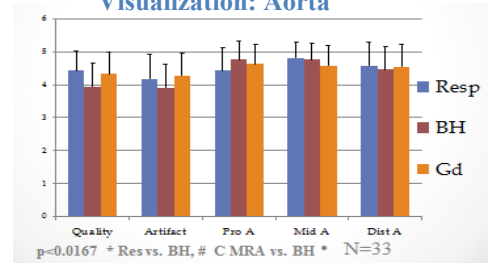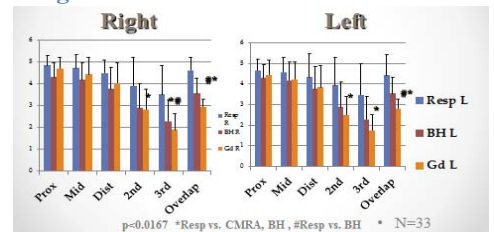

Fig3 Visualization: Renal Arteries

p<0.0167 *Resp vs. CMRA, BH , #Resp vs. BH • N=33

Fig4 Contrast of Vasculature

p<0.0167 * Res vs. BH, # C MRA vs. BH • N=33

Fig 5 RT NC MRA

Fig 6 BH NC MRA

Fig 7 C MRA