

# Non-Contrast Enhanced Renal Artery Angiography with a Respiratory Triggered 3D balanced SSFP Sequence: Comparison of Optimized Repetitive Arterial or Vein Labeling (RAVEL) Method with and without T2prep

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## PURPOSE

Due to recent association of gadolinium contrast agents and nephrogenic systemic fibrosis (NSF) disease [1], there have been increasing interests in non-contrast MRA techniques as an alternative. Based on arterial spin labeling (ASL) techniques, mainly two types of techniques are reported for depiction of renal arteries, one with navigator echoes and the other with respiratory triggering [2,3]. Balanced steady-state free-precession (SSFP) is based on a gradient-echo sequence which can obtain relatively high signal-to-noise ratio without the use of contrast agents. In a clinical 3.0 T MR systems, SAR limitations and B1 inhomogeneity can be problematic in a clinical setting [4]. The respiratory-triggered ASL technique, called Repetitive Arterial or VEin Labeling (RAVEL) with three-dimensional (3D) balanced SSFP, was developed with excellent contrast between renal arteries and cortex/muscle at 3.0 T MR imaging. The purpose of our study was to optimize imaging parameters of the respiratory-triggered RAVEL method with selective inversion pulse for the renal arteries and to apply optimized non-contrast MR renal angiography for normal volunteers. Moreover, we evaluated the utility of T2prep to suppress a background signal for the RAVEL method.

## MATERIALS and METHODS

Ten healthy volunteers were examined in this study on a 3.0T clinical MR scanner (Philips, Achieva 3.0T X-series TX). The RAVEL method was performed (Fig. 1). Imaging parameters were as follows: TR/TE=4.3 / 2.1 msec, slices thickness = 1.5 mm, number slices = 80, field-of-view = 36x 36 cm<sup>2</sup>, acquisition matrix = 256 x 256, NSA = 1, fat suppression = SPIR. In the RAVEL method, a spatially selective inversion pulse was placed on the both kidney. Among several key factors that affect the image quality and contrast of this protocol, some of important factors are the flip angle (FA) and inversion time (TI). At the various FA and TI, we calculated to contrast ratio (CR) between blood (aortic and renal artery) and background (cortex/muscle) signals for all volunteers with free respiratory cycle to detect the optimal FA and TI. Subsequently, we evaluated the CRs of the optimized RAVEL method with or without T2prep for all volunteers fixed a respiratory cycle by 3000, 4000 and 5000 msec. Statistical analyses (paired t-test) were performed after the quantitative evaluation.

## RESULTS

The maximum CRs of FA and TI were  $18.74 \pm 8.09$  (mean  $\pm$  SD) at 50 degree and  $20.00 \pm 5.39$  at 1200 msec, respectively. The mean CRs were  $10.07 \pm 2.70$  with T2prep and  $4.62 \pm 1.79$  without T2prep (Fig. 2, 3). In quantitative analysis, there were significant differences between the CR with/without T2prep ( $P < 0.01$ ).

## CONCLUSION

Non-contrast MRA using the respiratory-triggered RAVEL with 3D balanced SSFP was available to visualize renal arteries especially when the FA and TI were optimized. Furthermore, T2prep improves vessel/background contrast and image quality of the aorta and renal artery without the use of contrast media.

## REFERENCE

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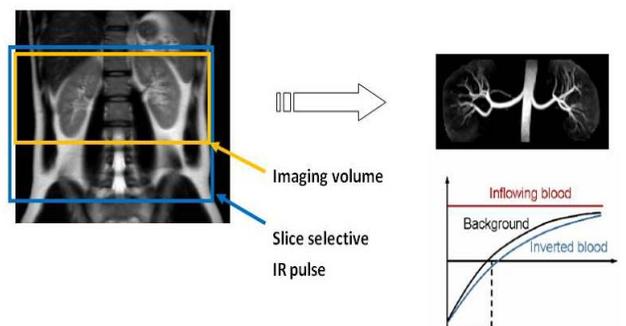


Fig. 1 Diagram of the RAVEL method.

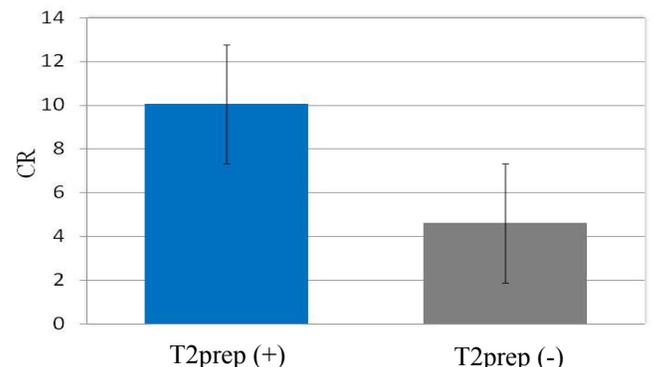


Fig. 2 Contrast ratio (CR) of between renal artery and cortex.

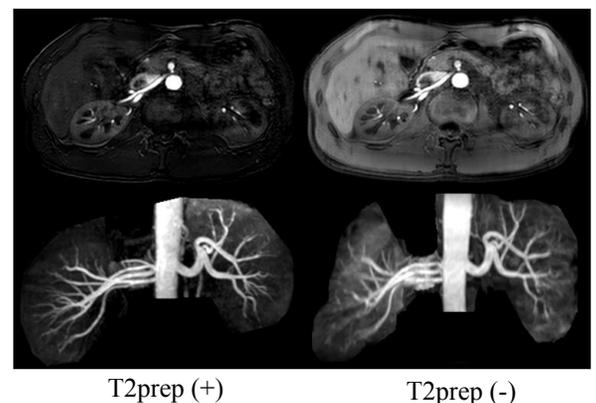


Fig. 3 Volunteer images.