CORTICOMEDULLARY DIFFERENTIATION OF THE KIDNEY: EVALUATION WITH NON-CONTRAST-ENHANCED STEADY-STATE FREE PRECESSION (SSFP) MR IMAGING WITH TIME-SPATIAL LABELING INVERSION PULSE (TIME-SLIP)

A. Kanki[1], T. Tamada[1], Y. Noda[1], A. Higaki[1], S. Okamoto[1], and K. Ito[1]

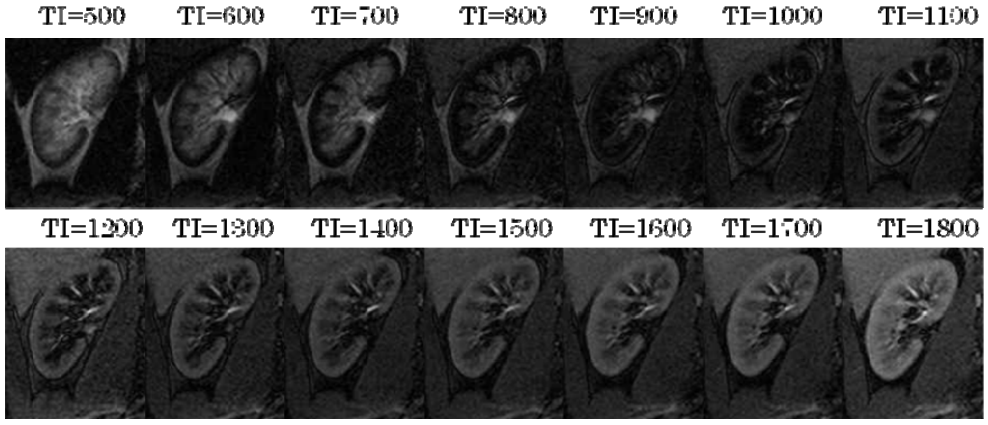
[1]**Radiology, Kawasaki Medical School, Kurashiki, Okayama, Japan**

Purpose: A recent study showed that renal cortical volume or cortical thickness had a strong positive relationship with renal function. However, diminished corticomedullary differentiation in unenhanced MRI and CT has been observed in patients with renal insufficiency such as glomerulonephritis, acute tubular necrosis, and acute allograft rejection, preventing proper measurement of renal cortical thickness or volume. The purpose of this study was to assess whether non-contrast-enhanced steady-state free precession (SSFP) MR imaging with time-spatial labeling inversion pulse (Time-SLIP) can improve the visibility of corticomedullary differentiation of the normal kidney, and to discuss the feasibility of applying to the measurement of renal cortical thickness or volume.

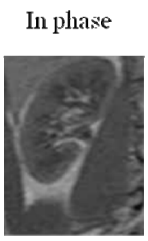
Materials and Methods: A total of 13 healthy volunteers (mean age,39 years; range, 23-54 years) who had no history of renal disease, hypertension, or other vascular disease were included. MR imaging was performed using non-contrast-enhanced steady-state free precession (SSFP) sequence with Time-SLIP. Imaging parameters were as follows: TR/TE=4.2/2.1msec, slices thickness = 7mm, field-of-view = 40x 40cm^2, acquisition matrix = 256 x 256. In the Time-SLIP examination, a spatially selective inversion labeling pulse was placed on the both kidney. A series of SSFP sequence with Time-SLIP were performed topographically identically to observe the signal changes of the labeled renal cortex and medulla using various inversion recovery times (TIs); 500 - 1800 msec in increments of 100 msec. In-phase (IP) T1-weighted gradient echo MR images (TR/TE=130/4.8msec) were also obtained to compare with SSFP images with regard to corticomedullary differentiation. The signal intensity (SI) of the renal cortex and medulla were measured using region-of-interest (ROI) by two reviewers in consensus. Corticomedullary contrast ratio ($SI_{cortex}/SI_{medulla}$) was calculated to determine the optimal TI for the visualization of renal coriticomedullary junction. The relationship between the age and corticomedullary contrast ratio was also analyzed. Additionally, the corticomedullary contrast ratio as well as the visibility of corticomedullary differentiation was compared between the SSFP images with Time-SLIP and IP MR images. The visibility of coriticomedullary differentiation was categorized as one of four grades (1=poor; 2=fair; 3=good; 4=excellent).

Results: In SSFP with Time-SLIP, corticomedullary contrast ratio was highest in TI of 1200 in 7 subjects (54%), followed by TI of 1100 in 4 (30%), TI of 1000 in 1 (8%) and TI of 1300 in 1 (8%). There was no significant correlation between the age and corticomedullary contrast ratio (p = 0.346) although there was a slightly negative correlation between them (r = -0.285). The corticomedullary contrast ratio of SSFP with Time-SLIP (5.71 +/- 1.77) was significantly higher (p=0.001) than those of IP (1.39 +/- 0.10), indicating better delineation of corticomedullary junction in SSFP with Time-SLIP. The visibility of corticomedullary differentiation was significantly better (p = 0.006) in SSFP images with Time-SLIP (averaged grade=4.0) than in IP images (averaged grade=2.46).

Conclusions: SSFP MR imaging with Time-SLIP can improve the visibility of renal corticomedullary differentiation without using contrast agents. This technique may have a potential to help evaluate the renal function in patients with diminished renal corticomedullary differentiation.



A series of unenhanced SSFP MR images with Time-SLIP (TI = 500-1800msec). Renal corticomedullary differentiation is best seen in TI of 1100 msec.



IP image