AGE-RELATED CHANGE IN RENAL CORTICOMEDULLARY DIFFERENTIATION: EVALUATION WITH NON-CONTRAST-ENHANCED STEADY-STATE FREE PRECESSION (SSFP) MR IMAGING WITH TIME-SPATIAL LABELING INVERSION PULSE (TIME-SLIP)

Yasufumi Noda[1], Akihiko Kanki[2], Tsutomu Tamada[2], Akira Yamamoto[2], Atsushi Higaki[2], Tomohiro Sato[2], Daigo Tanimoto[2], and Katsuyoshi Ito[2]

[1]KAWASAKI MEDICAL SCHOOL, KURASHIKI, OKAYAMA, Japan, [2]KAWASAKI MEDICAL SCHOOL

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 MR imaging has been observed in patients with renal insufficiency, causing difficulty in precise measurement of renal cortical thickness and volume. Our preliminary study showed that distinct renal corticomedullary differentiation can be observed in non-contrast-enhanced steady-state free precession (SSFP) MR imaging with time-spatial labeling inversion pulse (Time-SLIP) in young adults since the differences in T1 values between the renal cortex and the medulla could be emphasized by acquiring images with an optimal inversion recovery (IR) time using a spatially selective IR pulse placed on the kidney. However, it is not well known whether corticomedullary differentiation and cortical thickness in normal kidneys diminish with aging. The purpose of this study was to evaluate age-related change in renal corticomedullary differentiation and renal cortical thickness by means of non-contrast-enhanced SSFP MR imaging with Time-SLIP, and to discuss the feasibility of this technique to apply for the measurement of renal cortical thickness and volume even in patients with renal insufficiency without considering influence of the aging.

Materials and Methods: This study included a total of 38 patients (27 men, 30 women; mean age, 50 years; age range, 23-84 years) who had no history of renal disease, hypertension, or other vascular disease. All patients underwent non-contrast-enhanced MR imaging with steady-state free precession (SSFP) sequence using Time-SLIP technique. Imaging parameters were as follows; TR/TE=4.2/2.1msec, number of acquisition = 1, flip angle = 90°, slice thickness = 7mm, field-of-view = 400x 400mm^2 , and acquisition matrix = 256 x 256. A series of topographically identical SSFP sequences with Time-SLIP were performed using various inversion times (TI) (500, 600, 700, 800, 900, 1000, 1100, 1200, 1300, 1400 and 1500 msec). The signal intensity (SI) of the renal cortex and medulla were measured using region-of-interest (ROI) to calculate the renal corticomedullary contrast ratio (SI cortex/SI medulla). Then, optimal TI value to best visualize the corticomedullary differentiation was determined from a series of Time-SLIP SSFP images with variable TI. Additionally, maximal transverse renal width and renal cortical thickness were measured to calculate the renal cortical width ratio (cortical thickness / maximal renal width). For statistical analysis, Spearman's correlation test, Kruskal-Wallis test, and Mann-Whitney test were used.

Result: The renal corticomedullary junction was clearly depicted in all patients. Mean cortical thickness was 3.9 mm (range, 2.5–5.7 mm). Mean maximal renal width was 53.0 mm (range, 43.0–58.6 mm). The distribution of optimal TI values according to an age group was showed in Table.1. There was negative correlation between Optimal TI for the best visualization of renal corticomedullary differentiation and the age (P= 0.001). However, there was no significant correlation between renal corticomedullary contrast ratio and the age. Similarly, no significant correlation was observed between the renal cortical width ratio and the age.

Conclusion: In normal kidney, non-contrast-enhanced SSFP MR imaging with Time-SLIP can be used to assess the renal corticomedullary differentiation and cortical thickness without influence of the aging although optimal TI value for the best visualization of renal corticomedullary junction should be shortened with aging. This fact suggested that SSFP MR imaging with Time-SLIP has a potential to evaluate the renal function based on renal cortical thickness or volume without considering an age-related change.

Figure. 1

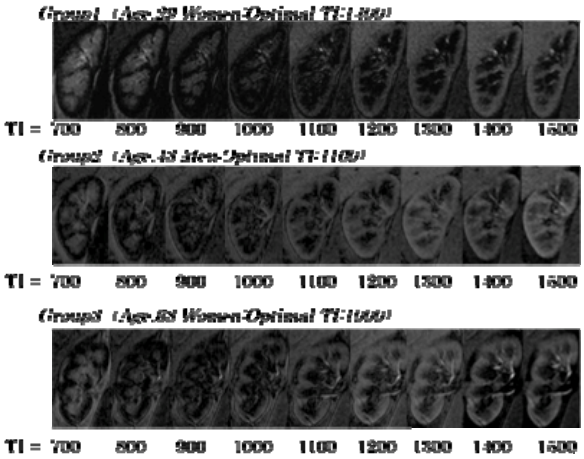

Figure1. A series of Time-SLIP SSFP images with variable TI (700-1500) obtained from 3 patients with different age. Optimal TI in an older patient (68 years old, TI=1000) was shorter than that in a younger patient (29 year old, TI=1400).

Table. 1

	Optimal TI (msec)					
Age	900	1000	1100	1200	1300	1400
23-39 y.o. (n=11)			4	4	2	1
40-59 y.o. (n=16)	1	5	7	3		
60-89 y.o. (n=11)	1	6	3	1		