Noncontrast MRA of Renal Artery using Flow-prep FIESTA for Evaluation of Patients with suspected Renal Tumor: Comparison of Dynamic Contrast MRA

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Introduction; Dynamic contrast MR angiography (C MRA) has made a major role for evaluation of cardiovascular diseases. For surgical treatment of the renal tumors, anatomical evaluation of vascular structures with MR is essential. For evaluation of patients with renal insufficiency or history with adverse reactions, MR contrast media cannot be used. So far, Non-contrast (NC) MRA with several techniques has been introduced. We used FIESTA combined with flow preparation pulse (Flow-Prep) based on bipolar velocity encoding to distinguish artery from vein and background (Miyoshi, #1932 ISMRM 2006). Accordingly, the purpose was to evaluate abilities of NC MRA using Flow-Prep for demonstration of renal arteries in cases of renal tumors for attempt of surgery compared with C MRA.

Materials and Methods: _Population_: 63 patients (37 men, 26 women, mean age 59.4 years) were included, who underwent contrast enhanced MR imaging for evaluation of renal tumor and renal arteries. Pathologies were renal cancer in 12, pelvic tumor in 5, renal benign lesions in 20, unspecified renal tumor in 6, miscellaneous in 6, post renal resection in 1 and normal in 13. _MR imaging:_ All images were obtained on a 1.5T MR (TwinSpeed HD, GE, Milwaukee) with 8 channel phased array multicoils. NC MRA was obtained with two steps: Firstly, ECG gated axial 2D PC cine MR imaging of the aorta was obtained above the renal artery in 15-seocnd's breath-hold and the aortic peak flow velocity and its delay time after R wave on ECG were measured. With use of obtained data, respiratory triggered ECG gated Flow-Prep 3D FIESTA was obtained in the coronal plane with TR/TE/ Flip angle/ FOV/slice thickness/matrix;3.8ms/1.9ms/ 90 deg/35cm/2mm/256x224-256, 0.75NEX with Spec IR and reduction factor (RF) 2. Imaging time was 2.5 to 4 min. C MRA was obtained with 3D gradient echo sequence (EFGRE) using 2.9ms/0.9ms/20 deg/35cm/2mm/256x192 /one NEX/Spec IR/RF2, centric k space ordering. 0.1mmol/kg of gadolinium was injected (0.3ml/sec) and five seconds after arrival of contrast with smart prep (GE), breath-hold 3D EFGRE was obtained in 24 seconds. _Data analysis: Subjective:_ Image quality, artifacts (blurring), and overlap of the renal artery and veins were ranked with 5-point scale (form 1 undiagnostic, bad to 5 excellent, no artifacts). Recognitions of aorta at upper (diaphragm to renal artery) and lower (renal to bifurcation) levels, renal arteries at five levels (proximal, middle, distal, 2nd, and 3rd order) were ranked with 5-point scale (1 bad to 5 good). Subjective evaluations were performed by two radiologists. Wilcoxon signed rank test was used for comparison between two MRA. _Objective:_ ROI was placed on the aorta at three different levels (diaphragm, renal artery, and bifurcation), left and right renal arteries at four different levels (proximal, middle, distal, 2nd order), renal veins, renal cortex and medulla, IVC, and great lumbar muscle as background. All evaluations were made on workstation (Advantage workstation 4.4, GE) and MIP images were generated from each data using MPVR under flexible volume thickness and its orientation changeable by readers.

Results: Subjective: In four of 63 patients, NC MRA was not diagnostic due to ECG failure. Overall image quality and artifacts were not significantly different between two, respectively (NC:C=4.3-4.4: 4.5). Range of mean peak velocity of aorta was 40-80ms/sec. The results were summarized in Figs 1 and 2. Recognition of aorta from diaphragm to bifurcation was well made on both MRAs (Fig 1, 3, 4). In 59 of 63 patients, the number of recognized right and left renal arteries was identical on NC and C-MRA. Proximal to mid renal arteries were equally detected on both MRA. Peripheral renal arteries were better detected on NC MRA than C-MRA (Fig 1). Overlaps of veins and soft tissues were less recognized on NC MRA than C MRA (Fig 1, 3). Overall contrasts were higher on C MRA than NC MRA (Fig 2).

Summary: NC MRA based on "Flow-Prep" FIESTA could demonstrate renal arteries and abdominal aorta from diaphragm to bifurcation with successful ECG triggering. Overall calculated contrast against background was higher on C MRA than NC MRA. Subjectively, NC MRA provided identical information. Regarding distal portions of renal arteries, NC MRA gave clear views of vascular anatomy without overlaps. Besides no risk of side effects related contrast agents, one of the advantages of NC MRA is feasibility of repeated acquisition of MRA even in single study with different parameters for better quality of images. In conclusion, for the preoperative evaluation of the renal arteries, anatomical information can be successfully obtained with NC MRA using Flow-Prep FIESTA.
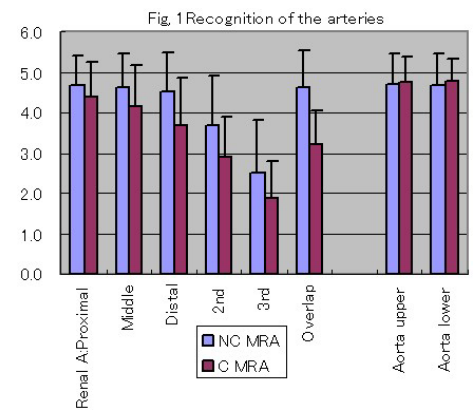

Fig. 1 Recognition of the arteries

Fig. 2 Contrast of the vasculatures

Fig 3a NC-MRA

Fig 3b C-MRA

Fig 4a NC MRA

Fig 4b C MRA