Evaluation of the renal arteries: Comparison of two types of Non-contrast MRA and 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 evaluation of patients with renal insufficiency or history with adverse reactions, MR contrast media cannot be used. Non-contrast (NC) MRAs with several techniques have been introduced. Currently, we used two types of MRA; FIESTA with flow preparation pulse (Flow-Prep) based on bipolar velocity encoding to distinguish artery from vein [1,2] and FIESTA with Inherent Enhancement (Inhance) Inflow IR. Accordingly, the purpose was to evaluate abilities of NC MRA using Flow-Prep and Inflow IR for evaluations of renal arteries in comparison with C MRA.

Materials and Methods: _Population_: 33 patients (19 men, 14 women, mean age 59 years) were included, who underwent contrast enhanced MR imaging for evaluation of renal tumor and renal arteries. Pathologies were renal cancer in 8, pelvic tumor in 1, renal benign lesions in 4, renal artery stenosis in 4, renal artery aneurysm in 2, miscellaneous in 8, post renal resection in 1 and normal in 5. _MR imaging:_ All images were obtained on a 1.5T MR (HDx, GE, Milwaukee) with 8 channel phased array multicoils. 1)NC MRA using Flow-Prep: after acquiring aortic peak flow velocity and its delay time after R wave with breath-held PC cine technique, 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. 2)NC-MRA using an investigational version of Inflow IR; respiratory triggered 3D FIESTA was obtained in the axial plane with 3.8ms/1.9ms/90deg/35cm/2mm/256x224-256/ZIP2 110-180 slices/ 0.75NEX with Spec IR and inversion time of 1300ms/RF 2. 3) C MRA was obtained with 3D gradient echo sequence (EFGRE) using 2.9ms/0.9ms/20 deg/35cm/2mm/256x192 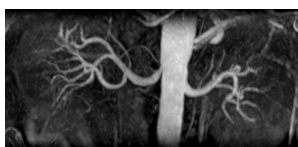/one NEX/Spec IR/RF2, centric k space ordering. 0.1mmol/kg of gadolinium was injected (0.3ml/sec) and five seconds after arrival of contrast with smart prep (GE), breath-hold 3D EFGRE was obtained in 24 seconds. _Data analysis:_ Image quality, artifacts (blurring), and overlap of the renal artery and veins were ranked with 5 -point scale (form 1 undiagnostic, bad to 5 excellent, no artifacts). Recognitions of aorta at upper (from diaphragm) and lower (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 among three MRA using Bonferoni Correction (P<0.0167). All evaluations were made on workstation (Advantage workstation 4.4, GE) by two radiologists and MIP images were generated from each data using MPVR by readers.

Fig1

Fig2

Results: In 33 patients, all NC MRAs were diagnostic with repeated measurements in three cases for Flow prep and in four for Inflow IR. In one case, C MRA missed optimal timing. Overall image quality and artifacts were not significantly different among three MRAs (NS, Fig 1). Peripheral renal arteries were better detected on NC MRA than C MRA(p<0.016). Overlaps of veins and soft tissues were less recognized on NC MRA than C MRA (Fig 2, 3-5, p<0.016)). Recognition of aorta from diaphragm to bifurcation was well made on NC MRA with Flow prep and C MRA but not in NC MRA with Inflow IR due to limited field of view (Fig 3-5). In 33 patients, single renal arteries were correctly identified on NC-MRA, but one of double renal arteries in 4 of 9 cases, and, one of triple left renal arteries in one case were missed on Inflow IR, respectively (Fig5). In two cases, MRA with Flow-Prep missed one of double renal arteries. Proximal to mid renal arteries were equally detected on NC and C MRA. In all the four cases, stenosis of the renal artery was correctly identified on NCMRA (Fig 3). In all the two cases, aneurysmal change of the peripheral renal arteries was also correctly identified (Fig 4).

Summary: NC MRA based on "Flow-Prep" FIESTA could demonstrate renal arteries and abdominal aorta from diaphragm to bifurcation. NC MRA with Inhance Inflow IR visualized peripheral renal arteries in detail although covering area for imaging was limited. With capability of repeated measurements for more optimal imaging parameters if failed, NC MRA can reliably provide information of renal arteries. C MRA might miss the optimal timing for selective visualization of the renal arteries. In conclusion, for evaluation of renal arteries and aorta, use of two types of NC MRA can provide excellent information, which might be competitive or better than that obtained with C MRA.
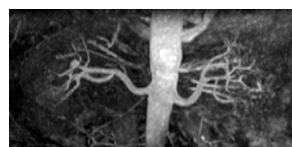
[1]Masui T. et al., the proceeding of ISMRM, 731 (2008) [2] Miyoshi M. et al., the proceeding of ISMRM 1932 (2006)
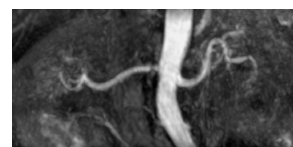
Fig 3a InflowIR Stenosis: Right RA   **Fig 4a InflowIR Aneurysm: Right-RA**   **Fig 5a InflowIR Double Right-RA**

b Flow Prep   c C MRA   **b Flow Prep   c C MRA**   **b Flow Prep   c C MRA**