Non-Contrast-Enhanced Abdominal Venography Using Inflow Spin Labeling in Combination with Flow Dephased Background Suppression

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Introduction

Abdominal veins disorder can be associated with several diseases, such as renal vein thrombosis, portal vein hypertension and Budd-Chiari syndrome. For organ transplantation, both patients and donors' abdominal venous systems shall be evaluated prior to the operation. The existing MRI technique for abdominal venogram is delayed Gd^{+} enhanced MRA. The contrast enhanced technique has its limitations: 1: the risk of causing the nephrogenic systemic fibrosis (NSF); 2: the arterial contamination; 3: the enhancement of background tissues; 4: the dilution of the contrast in venous phase. Therefore, it is desirable to develop a non-contrast-enhanced (NCE) MR venography (MRV), especially for those patients with renal malfunction. In this study, we propose a new NCE method to image the abdominal veins using the combination of inflow spin labeling (ISL) and flow dephasing preparation (FDP) to achieve better vessel contrast.

Materials and Methods

The method we developed in this study was a continuation of our previous work [1]. The major modification was to add an additional FDP prepared FIESTA acquisition. Two datasets were acquired to generate the final subtraction venography as shown in Fig. 1. In both acquisitions, the same TI was selected to null the inflow arterial blood signal, and Adiabatic SPIR chemical saturation pulse was applied for fat saturation. The difference between the two acquisitions was: One dataset was acquired when FDP's gradients off, and the other one was acquired when FDP's gradients on.

The new NCE-MRV sequence has been evaluated on three volunteers with a 1.5T MR scanner (EXCITE HDxt, GE Healthcare, Milwaukee) using an 8-channel phased-array coil under RT-gating. Parameters were: TE = 2.1ms, TR = 4.4ms, Flip angle = 75, TI = 1100ms, slice thickness = 2mm, FOV = 38cm x 30.4cm, matrix = 256 x 256, receiver bandwidth = ±125kHz, NEX = 0.79, sense factor = 2, respiratory interval = 1, 48 sections acquired in coronal view. For subjects with respiratory rate = 16BPM, the total scan time of the two acquisitions was around 6 minutes. M1 was selected at ~500mT·ms^2/m to phase out the venous signal in FDP.

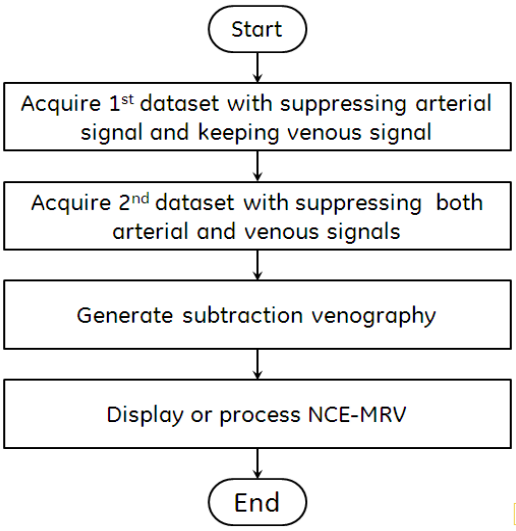

Fig 1: Workflow of the NCE-MRV.

Results and Discussion

Bley et al. [2] imaged renal arteries with inflow-enhanced inversion-recovery technique, which is similar to ISL except that ISL was employed here to suppress the inflow arterial blood. Fan et al. [3] applied a FDP with proper m1 before data acquisition to distinguish peripheral arteries from veins. Shen et al. [1] evaluated a preliminary NCE-MRV for renal veins, but suffered from unsuppressed background for flowing-out vessels. In this study, we combined ISL and FDP in one sequence to achieve a background suppressed NCE-MRV.

Abdominal veins were successfully obtained in two out of three volunteers. One volunteer failed because of different levels of fat saturation in two datasets. Figure 2 and 3 demonstrate some abdominal veins reformatted from NCE-MRV. Compared with our previous work [1], the new NCE-MRV method can generate better renal veins (RV), splenic vein (SV) and superior mesenteric vein (SMV). It can efficiently suppress the background signal, therefore improve the vessel visibility. The major drawback of this method is the acquisition time penalty and the possible mismatch due to motion between acquisitions.

References

[1] Shen H. et al. ISMRM 2010, #1424 [2] Bley T. A. et al. ISMRM 2009, #1881 [3] Fan Z. et al. MRM 2009;62:1523-1532

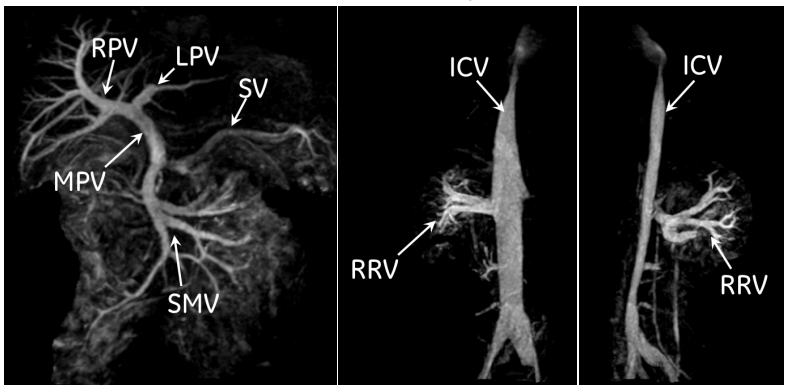

Fig 2: NCE-MRV from Volunteer#1.

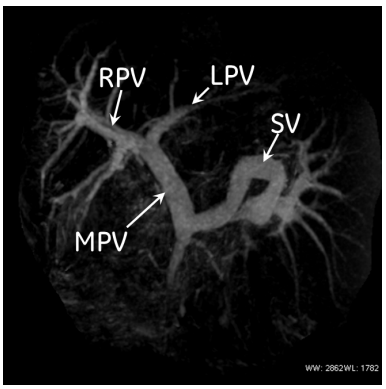

Fig 3: NCE-MRV from Volunteer#2.