Non-contrast-enhanced Whole-body MR angiography

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INTRODUCTION

Vascular diseases typically affect the entire arterial systems, from the intracranial down to the pedal vessels. However, it is not easy to evaluate the whole-body vascular systems noninvasively within a reasonable time. Up until now, many non-contrast-enhanced MR angiography (MRA) methods have been developed based on variable principles or MR phenomena; then select the appropriate method for the targeted imaging region. However, it is extremely difficult to comprehensively study an entire vascular system through the separate methods in the targeted regions. The purpose of this study is to evaluate the feasibility of non-enhanced whole-body MRA (NE-Whole-Body MRA) combined with several optimized non-enhanced MRA methods appropriate for the various body sections.

METHODS

All MR examinations were performed using a 1.5-T clinical imager (EXCELART Vantage^{TM} XGV PPP powered by Atlas, Toshiba, Tokyo). An Atlas SPEEDER head, An Atlas SPEEDER body, and an Atlas SPEEDER spine coil were utilized. MRA methods for each body part and typical acquisition parameters as follows; 1) Head-cervical region; time-of-flight, TR36msec, TE 6.8 msec, 1.4 mm thickness, FOV 20×20cm, matrix 160×256, SPEEDER parallel imaging factor 2; 2) Thoracic region; FBI(fresh blood imaging), 3D-FASE; TR 3-4RR, TE 32 msec, 3 mm thickness, FOV 47×47cm, matrix 256×256, SPEEDER factor 2; 3) abdominal region; time-SLIP with balanced SSFP, TR 5 msec, TE 2.5 msec, 3.5 mm thickness, FOV 40×40cm, matrix 256×256, SPEEDER factor 2, TI 1300msec; 4) Pelvis-leg region; FBI, 3D-FASE; TR 3-4RR, TE 64 msec, 4 mm thickness, FOV 40×40cm, matrix 256×256, SPEEDER factor 2.

Whole-body phased-array coil coverage

The Atlas SPEEDER coil system includes up to 128 dedicated phased-array RF surface coils elements, and a range of up to 205 cm, which provides coverage of most patients from head to foot. Appropriate surface coil elements were selected to adapt to the respective examination region, taking advantage of all of the achievable SNR. The Atlas SPEEDER coil system eliminates the actions of reposition of patients and replacement of surface coils for each station, improving examination throughput.

NE- Whole-Body MRA using FBI

Fresh blood imaging (FBI) is a nonenhanced MR angiography technique that collects the arterial signal difference between systole and diastole during the cardiac cycle. Figure 1 shows the NE-Whole Body MRA using FBI (carotid, thoracic, abdomen, and lower extremity), showing excellent visualization from pelvis to the lower leg arteries, and good visualization of the arteries in thoracic region. However, visualization of the carotid arteries, intracranial arteries, and abdominal aortic branches was not as good as in the other regions due to the limitation of spatial resolution.

NE- Whole-body MRA with combination of optimized methods

The intracranial arteries can be imaged excellently using TOF angiography. A time-SLIP technique with balanced SSFP (bSSFP) depicts multidirectional vessels like the renal and hepatic arteries. Therefore, TOF was utilized for the intracranial and carotid arteries, and time-SLIP with bSSFP was utilized for the abdominal arteries. Figure 2 shows NE-Whole-Body MRA with the combined methods complete arterial images from head to foot with high spatial resolution. The image demonstrates two significant stenotic segments at the left internal carotid artery and the left external iliac artery due to atherosclerosis. Although there is slight signal intensity fall off at the margins of the FOV's in the multi-station MRA techniques in the resulting combined overview images, it did not affect the clinical diagnosis.

DISCUSSION

NE-Whole-Body MRA appears to be an optimal, non invasive and an all-encompassing approach to systemic arterial imaging without radiation exposure or adverse effects of contrast medium. NE-Whole-Body MRA clearly demonstrates the systemic nature of atherosclerotic disease and allows the depiction of relevant concomitant disease affecting discrete arterial territories. In conclusion, NE-Whole Body MRA with combined methods provides extended coverage, high spatial resolution, and high contrast conspicuity of arteries.

Reference

1) Miyazaki M, Lee VS. Nonenhanced MR angiography. Radiology 248(1):20-43, 2008.

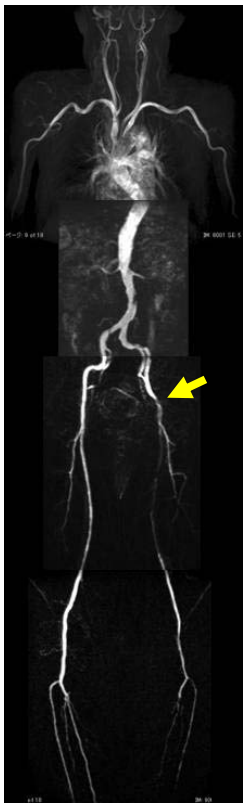

Fig.1 NE-whole-body MRA using FBI. The arrow indicates stenosis at Lt ext. iliac artery.

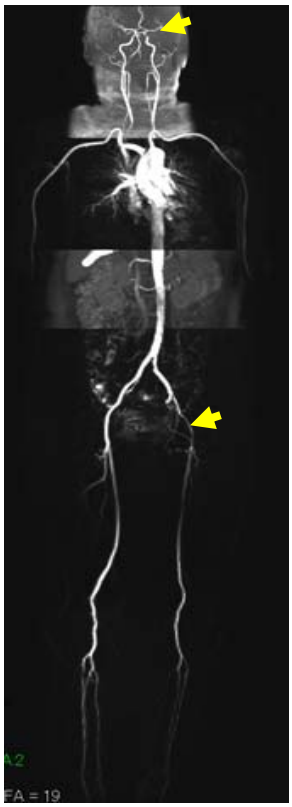

Fig.2 NE-whole-body MRA with optimized methods. There are two stenoses at Lt int carotid and Lt ext. iliac arteries.