Contrast-enhanced supraaortic MRA at 3.0T using 8-channel and 16-channel neurovascular coils and parallel acquisition with acceleration factors ranging from 1 to 9

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Introduction:

High spatial resolution contrast-enhanced 3D MRA has become a routine application in the assessment of supraaortic steno-occlusive disease and has replaced purely diagnostic DSA in many institutions [1-3]. However, spatial resolution is often obtained at the cost of acquisition time and / or the number of slices, i.e. the anatomic coverage. With parallel imaging, acquisition time can be reduced while maintaining spatial resolution, but at the expense of signal-to-noise ratio [4-5]. The signal-to-noise increase at 3.0T theoretically holds promise to use higher acceleration factors (i.e. >2) in parallel imaging while maintaining image quality.

Aim:

To implement and evaluate supraaortic MRA with SENSE at 3.0T using high parallel imaging acceleration factors up to 9.

Material and Methods:

Contrast-enhanced (CE) MRA of the supraaortic arteries with randomly segmented central k-space ordering (CENTRA) [6] and SENSE was performed in 19 patients and 4 volunteers on a clinical whole body 3.0T MR system (Achieva, Philips Medical Systems, Best, NL) using 8-channel and 16-channel neurovascular coils (Philips Medical Systems, Best, NL). CE MRA protocols were created using SENSE factors (SF) ranging from 1 to 9 (SF 1, n = 1; SF 2, n = 2; SF 4, n = 15; SF 9, n = 5). An acquired matrix of 512 x 512 (SF 2, SF 4; coronal) and 656 x 656 (SF 9; sagittal) were acquired over a 320 to 350 mm FOV with 0.98 and 0.90 mm thin slices (0.49 and 0.45 mm overcontiguous) yielding an acquired sub-millimetre spatial resolution ranging from (0.63 x 0.63 x 0.90) to (0.53 x 0.53 x 0.98) mm^3 as compared to (0.81 x 0.81 x 1.0) mm^3 with SF 1 (matrix 432 x 432). Acquisition time was reduced from 2:09 min. (SF 1) to 1:37 min., 1:24 min. and 0:58 min. (SF 2, SF 4 and SF 9), respectively, while increasing the number of slices substantially from 150 slices (SF 1) up to 365 slices (SF 4 and SF 9).

Results:

Supraaortic MRA with SENSE at 3.0T was successfully performed in 23/23 (100%). Despite of shorter acquisition times, the added number of slices (i.e. bigger scan volume) and the higher spatial resolution in supraaortic MRA with high SENSE acceleration (SF 2, 4, 9) allowed for visualization of vascular structures of the head and neck arteries that were not covered by standard protocol with SF 1. In addition, the increased scan volume simplifies the planning of the sequence and potentially helps to cover the distal portions of the vertebral arteries (V3 – V4 segments) as well as the peripheral segments of the intracranial arteries.

Conclusion:

Supraaortic MRA with high SENSE acceleration factors up to 9 is clinically feasible at 3.0T and a very useful technique to provide additional anatomic information and higher spatial resolution while reducing acquisition time. Compared to standard imaging (SF 1), it simplifies the positioning of the scan volume, which therefore makes it even more beneficial for clinical application.

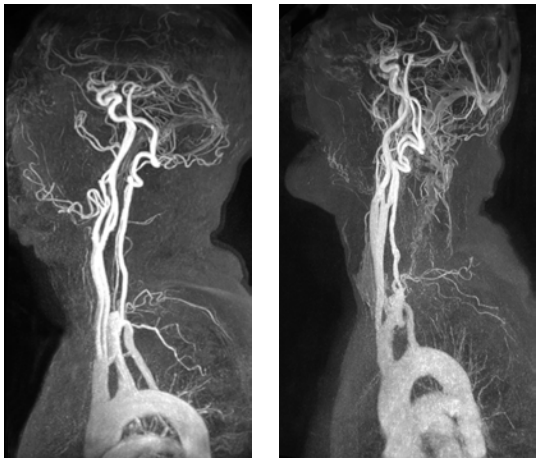

Figure 1: Supraaortic MRA at 3.0T using SENSE acceleration 4 (left image) and 9 (right image) in 61 and 64 year-old patients. Please note that the 365 slices include the entire head and neck arteries from the aortic arch up to the circle of Willis.

References

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