

Natural Course of Intracranial Vessel Wall Lesions in Stroke- and TIA Patients at 7.0 Tesla MRI

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Introduction

Intracranial atherosclerosis is an important cause of ischemic stroke and transient ischemic attacks (TIAs). Using intracranial vessel wall imaging techniques, like the Magnetization Preparation Inversion Recovery (MPIR)-TSE sequence at 7.0 Tesla MRI¹, both healthy and pathological vessel wall can be assessed. A previous study using the MPIR-TSE sequence has shown that, in patients with ischemic stroke or TIA, more than half has one or more intracranial vessel wall lesions.¹ The question arises whether these are stable lesions, or changing over time, possibly reflecting their more 'vulnerable' state. Also, it is not clear whether possible changes in these lesions are associated with clinical symptoms. We have therefore compared MPIR-TSE scans, obtained within 1 week of symptom onset, with MPIR-TSE scans acquired approximately 1 month after symptom onset, in patients with ischemic stroke or TIA.

Methods

This study was approved by the institutional review board of our institution. All patients gave written informed consent. Between December 2009 and October 2012, 64 consecutive patients were included who presented with arterial ischemic stroke or TIA of the anterior cerebral circulation at the neurology ward of our institution. In 42 patients both 1-week and 1-month MPIR-TSE scans were available. The datasets of 35 of these patients were used for analysis, as motion artifacts made the data of 7 patients unsuitable for analysis. Imaging was performed on a 7.0 Tesla whole body system (Philips Healthcare, Cleveland, OH, USA) with a 32-channel receive coil and volume transmit/receive coil for transmission (Nova Medical, Wilmington, MA, USA). Scan parameters of the MPIR-TSE sequence have been described previously¹; briefly, the following parameters were used: field-of-view (FOV) 220x180x13mm³ in the transverse plane, acquired resolution 0.8x0.8x0.8mm, TSE factor = 60, TR/TI/TE 6050/1770/23ms, NSA = 2, scan duration approx. 12 minutes. During enrollment in the study, a whole-brain T₁-weighted MPIR-TSE sequence was developed, and was used in 7 of the included patients. Scan parameters of the whole-brain T₁-weighted MPIR-TSE sequence were: FOV 250x250x190mm³ in the sagittal plane, acquired resolution 0.8x0.8x0.8mm, TSE factor = 158, TR/TI/TE 3952/1375/37ms, equivalent TE 19ms (given the used T₁, T₂ and refocusing sweep, an equivalent TE is derived in case of full refocusing angles), NSA = 2, scan duration approx. 11 minutes. Scans were assessed individually on an offline workstation by two observers blinded for the MPIR-TSE scan at the other time point. For assessment of contrast enhancement of the vessel wall, co-registration and subtraction of pre-contrast from post-contrast images was performed as described elsewhere¹. In case of differences between the 1-week and 1-month scan, both scans were assessed again and differences noted. Finally, National Institutes of Health Stroke Scale (NIHSS) scores at 1 week and 1 month were compared for possible increased neurological symptoms.

Results

Mean time between the first and second MRI-scan was 47 days (range 21 - 104 days). Of the 35 patients analyzed, 26 patients (74%) showed a stable situation: 7 patients had no intracranial vessel wall lesions on either 1-week or 1-month scan, and 19 patients had identical lesions on both scans (Figure 1). The other 26% showed either a change in lesion enhancement pattern (3 patients), one or more new lesions (1 patient), one or more resolved lesions (2 patients; Figure 2) or a combination of these three (3 patients). In only three patients, the NIHSS scores had changed during the follow-up time period: one patient had new mild-to-moderate sensory loss and 1 new vessel wall lesion on the MPIR-TSE sequence; one patient had new partial hemianopsia and a resolved vessel wall lesion (resulting in no lesions visible); and one patient had both new mild-to-moderate sensory loss and mild-to-moderate dysarthria and no change in vessel wall lesions.

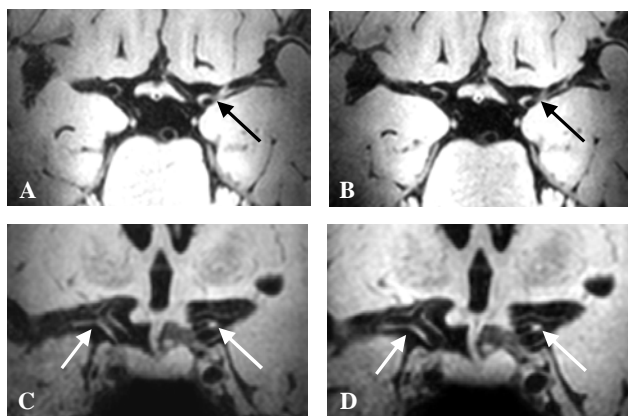


Figure 1 Example of stable intracranial vessel wall lesions at 1 week (A & C) and after 1 month (B & D) in a 65-year-old female with a transient ischemic attack (TIA) of the left middle cerebral artery (MCA) territory. A and C, transverse resp. coronal MPIR-TSE images showing vessel wall lesions of the distal internal carotid arteries and MCAs (black and white arrows), unchanged on the 1-month images (B & D).

Conclusion

26% of all patients showed changes in intracranial vessel wall lesion pattern, comprising mainly of enhancement changes, resolved lesions or a combination of these two. Only three patients showed increased neurological symptoms but in this relatively small patient sample no apparent correlation was found between these symptoms and lesion (in)stability. Overall, lesions were found to be relatively stable, indicating a prolonged cerebral atherosclerotic process. The used MPIR-TSE vessel wall sequence at 7.0 Tesla may allow for assessment over time of intracranial atherosclerotic plaques, possibly identifying the presence of high-risk groups with progressive intracranial atherosclerosis.

Acknowledgements

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References

¹van der Kolk AG, Zwanenburg, JJM, Brundel M, et al. *Stroke* 2011;42(9):2478-84.

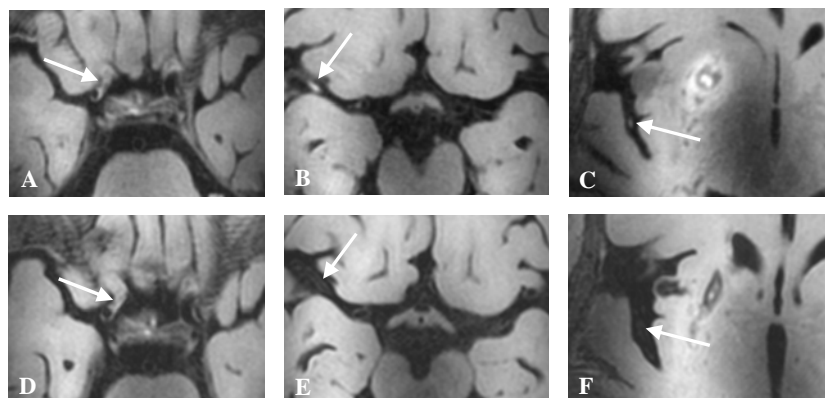


Figure 2 Example of changing intracranial vessel wall lesions at 1 week (A-C) and after 1 month (D-F) in a 75-year-old female with a lacunar infarct of the right middle cerebral artery (MCA) territory. The vessel wall lesions in the distal M1 segment (arrows in B & E) and M2 segment (arrows in C & F) of the MCA on the right have disappeared on the 1-month scans, while the lesion of the distal internal carotid artery remains visible (arrows in A & D).