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The Microbleed Anatomical Rating Scale (MARS)

Reliability of a tool to map brain microbleeds

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Abstract

Objective: Brain microbleeds on gradient-recalled echo (GRE) T2*-weighted MRI may be a useful biomarker for bleeding-prone small vessel diseases, with potential relevance for diagnosis, prognosis (especially for antithrombotic-related bleeding risk), and understanding mechanisms of symptoms, including cognitive impairment. To address these questions, it is necessary to reliably measure their presence and distribution in the brain. We designed and systematically validated the Microbleed Anatomical Rating Scale (MARS). We measured intrarater and interrater agreement for presence, number, and anatomical distribution of microbleeds using MARS across different MRI sequences and levels of observer experience.

Methods: We studied a population of 301 unselected consecutive patients admitted to our stroke unit using 2 GRE T2*-weighted MRI sequences (echo time [TE] 40 and 26 ms). Two independent raters with different MRI rating expertise identified, counted, and anatomically categorized microbleeds.

Results: At TE = 40 ms, agreement for microbleed presence in any brain location was good to very good (intrarater κ = 0.85 [95% confidence interval (CI) 0.77–0.93]; interrater κ = 0.68 [95% CI 0.58–0.78]). Good to very good agreement was reached for the presence of microbleeds in each anatomical region and in individual cerebral lobes. Intrarater and interrater reliability for the number of microbleeds was excellent (intraclass correlation coefficient [ICC] = 0.98 [95% CI 0.97–0.99] and ICC = 0.93 [0.91–0.94]). Very good interrater reliability was obtained at TE = 26 ms (κ = 0.87 [95% CI 0.61–1]) for definite microbleeds in any location.

Conclusion: The Microbleed Anatomical Rating Scale has good intrarater and interrater reliability for the presence of definite microbleeds in all brain locations when applied to different MRI sequences and levels of observer experience.

Glossary

BOMBS = Brain Observer Microbleed Scale; **CAA** = cerebral amyloid angiopathy; **CI** = confidence interval; **DPWM** = deep and periventricular white matter; **FA** = flip angle; **FLAIR** = fluid-attenuated inversion recovery; **FOV** = field of view; **GRE** = gradient-recalled

echo; **ICC** = intraclass correlation coefficient; **MARS** = Microbleed Anatomical Rating Scale; **NEX** = number of excitations; **NHNN** = National Hospital for Neurology and Neurosurgery; **TE** = echo time; **TR** = repetition time.

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