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Association Between Quantitative Vessel Wall MRI Metrics and Acute Stroke Across Intracranial Vascular Pathologies

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Purpose

High-resolution vessel Wall Magnetic Resonance Imaging (HR-VW MRI) enables detailed visualization of vessel wall abnormalities. This study investigates the association between quantitative vessel wall measurements and acute stroke across diverse vascular intracranial pathologies.

Materials and Methods

We retrospectively reviewed 179 patients who underwent 3T HR-VWI using a standardized protocol that included DWI, 3D TOF MRA, and pre- and post-contrast 3D HR-VWI. Among them, 97 patients (54.18%) had adequate imaging quality amenable to quantitative assessment. Curved multiplanar reconstructions of HR-VWI were used to measure vessel and lumen areas at maximum stenosis and disease-free levels. The remodeling index (RI) was calculated as stenotic vessel area/reference vessel area, with positive remodeling defined as RI> 1.05, negative remodeling as RI <0.95, and absence of remodeling as RI= 0.95-1.05. Vessel wall pathology burden was calculated as (stenotic wall area/stenotic vessel area) * 100%. Additionally, the vessel wall area was measured.

Results

Based on HRVW MRI, 47 patients (48.4%) were diagnosed with intracranial atherosclerotic disease (ICAD), 10(10.3%) with vasculitis, 17 (17.5%) with dissection, 1 (1%) with Moyamoya, 4 (4.12%) with vasospasms, 10 (10.3%) were identified as normal (controls) and in 8 patients (8.2%) other diagnostic considerations were determined. Acute stroke was identified in 36 patients with ICAD (76.6%), 8 patients with vasculitis (80%), and 12 patients with dissections (70.5%). Among patients with ICAD and acute stroke, larger plaque burden (median 79%, interquartile range [IQR] 66.8-90.8% versus 63.3%, IQR 55.4-73.8% [p=0.02]), and positive remodeling (median 1.29, IQR 0.97-1.8 versus 0.91, IQR 0.56-1.36 [p=0.01]) were associated with acute stroke. Among patients with vasculitis, the absence of remodeling (mean 0.97, standard deviation [SD] +/- 0.5 versus 1.6, SD +/- 0.2 [p=0.04]) was associated with acute stroke. Pathologic burden (mean 76%, SD +/- 17.5% versus 44.3% SD +/- 26.1% [p=0.05]) showed marginally significant association. None of the quantitative parameters demonstrated a significant association with stroke.

Conclusion

Quantitative HR-VWI metrics demonstrate a significant association with acute stroke across diverse intracranial vascular pathologies. In patients with ICAD, positive remodeling and increased plaque burden are significantly associated with stroke occurrence. Among patients with vasculitis, absent remodeling and elevated pathologic burden showed a trend toward stroke, suggesting a distinct remodeling phenotype.

References

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Figures