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Editorial for “The Occurrence and Outcome of Mild Intracranial Atherosclerotic Stenosis: A Prospective High-Resolution MRI study”

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Stroke related mortality has been steadily declining since the early 20th century [1], and despite the growing aging population, the mortality rate was stabilized over the last 10 years [2–3]. More knowledge about the risk factors and management methods, the early sign of stroke, better treatment and care strategies, all contributed to the progress, not only in decreased mortality but also in improved functional outcome after treatment. Hypertension is one of the major risk factors associated with both hemorrhagic and ischemic stroke. For patients diagnosed with ischemic stroke, they may not present luminal stenosis >50%. Many imaging studies have been performed to investigate the features related to stroke, and among them, the advanced high resolution MRI (hrMRI) has been shown capable of visualizing the morphological and compositional features of the atherosclerotic plaque on the vessel wall that is associated with a high risk of rupture causing the ischemic stroke, including lipid-rich necrotic core, intraplaque hemorrhage (IPH), thin/ruptured fibrous cap, and lesion inflammation. In addition to qualitative assessment, quantitative analysis methods have also been developed to characterize various aspects of the lesion, including the degree of stenosis (%), minimal luminal area (mm²), plaque volume (mm³), plaque burden (%), remodeling ratio (%) that can be separated into positive and negative, eccentricity index, and enhancement ratio (%) related to tissue inflammation that can be further classified as grade 0 (<15%), grade 1 (15–50%), and grade 2 (>50%).

In this article by Shi et al. [4], a large prospective study was performed to recruit patients presenting acute stroke symptoms but with mild luminal stenosis (<50%) to receive an advanced hrMRI examination. The presence of IPH and the quantitative features were measured. Besides, the hypertension history and management methods were considered. There were three objectives: 1) to differentiate between culprit and non-culprit lesions; 2) to predict the treatment outcome of patients based on the modified Rankin Scale (mRS) at day 90 as favorable 0–2 or unfavorable 3–6; and 3) to further examine the hypertension management methods and the imaging features in patients with unfavorable outcome. Previous imaging studies have been performed to identify the characteristics of clinically significant culprit lesions [5–9]. For example, Qiao et al. [6] defined culprit, probably

culprit, or non-culprit lesion according to its likelihood of causing the stroke, and found that grade 2 contrast enhancement was associated with culprit plaques, while grade 0 was associated with non-culprit plaques. Another study by Wu et al. [8] found a high signal on T1-weighted images, grade 2 (enhancement ratio of plaque pituitary) contrast enhancement, and type 2 (50% cross-sectional wall involvement) enhancement pattern, were independently associated with culprit lesions. In this article by Shi et al. [4], a much larger patient cohort of 293 patients was analyzed, and in each patient, only one most significant culprit or one non-culprit lesion was identified based on the infarct determined by DWI or FLAIR. In 233 patients, there was a culprit plaque, which was identified as a lesion arising on the ipsilateral side to a fresh infarction on the DWI images. Based on this definition, the results showed that culprit lesions were more likely to occur in patients with hypertension history, and had a higher contrast enhancement compared to non-culprit lesions. The higher enhancement ratio in culprit lesions indicated they had more pronounced tissue inflammation.

For the second objective to predict outcome, 221 had mRS 0–2 and 72 had mRS 3–6. Multivariate logistic regression analysis showed that 3 parameters: hypertension duration, hypertension management, and enhancement ratio were independent factors. Patients with unfavorable outcome had a longer hypertension duration, more likely to have strict control, and had a lower enhancement ratio. While the association between a longer hypertension history and poor outcome was highly anticipated, the other two factors which were considered independent were puzzling. A low contrast enhancement indicated low inflammation, but it was a predictor for poor outcome. To further examine these results, it was found that patients who had no hypertension control were 10 years younger than patients with partial or strict control, which might explain their favorable outcome (54/63 had mRS 0–2 at 90 days). Since these patients had never been treated, they might respond well to the standard blood pressure-lowering therapy and had a good outcome. The patients with strict control had the worst outcome (only 6/28 had mRS 0–2 at 90 days), which might be due to their much severe condition, and unidentified high-risk factors developed within the period when the blood pressure management was applied. About the low enhancement, of the 43 patients who had partial or strict control and poor outcome, 25 of them showed no enhancement, which was interpreted as the medication effect that decreased the tissue inflammation. For a better understanding of the effect of the blood pressure-lowering treatment on the change of plaques, longitudinal imaging studies can be designed to measure changes.

In summary, while the hrMRI features were related to the significance of the lesion as culprit or non-culprit during the onset of acute ischemic stroke, they were not good treatment outcome predictors. Since the functional outcome is highly related to the degree of tissue damage, treatment methods, and each individual patient's response, many factors will be involved, and difficult to build a predicting model. More research similar to the study presented in this article that considers all clinical factors, comorbid conditions, carefully evaluated imaging findings, prior medications, etc. is needed in the future to build a reliable and widely applicable model to predict outcome in patients with acute ischemic stroke.

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