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DOI: [10.1159/000354813](https://doi.org/10.1159/000354813)**Risk Assessment for Cerebral Microbleeds and Intraventricular Hemorrhage in Patients with Moyamoya Disease by Multivariate Analysis**

Tomoyuki Kawada

Department of Hygiene and Public Health, Nippon Medical School, Tokyo, Japan

Sun et al. [1] reported that dilation and extension of anterior choroïdal and posterior communicating arteries became a risk for cerebral microbleeds (CMB) in patients with moyamoya disease having deep and periventricular white matter (DPWM) by multinomial logistic regression analysis, presenting an odds ratio of 3.39 (95% CI: 1.03–11.19; $p = 0.045$). In addition, they also reported that CMB with DPWM had a risk for intraventricular hemorrhage (IVH) by adjusted Cox proportional hazards model, presenting a hazard ratio of 5.53 (95% CI: 1.20–25.41; $p = 0.028$). The number of CMB-positive patients was 24, and 15 patients had DPWM in their study.

I have a concern about their study with special reference to statistical validity. The authors prepared 24 CMB-positive cases and 61 controls to explore risk factors for CMB. In addition, 10 patients with IVH were observed during the follow-up period. Although the authors used limited risk factors as independent variables to keep statistical power, the 95% CI presented unstable estimates for CMB or for IVH in their study. The minimum number of events per independent variable by multivariable logistic regression analysis was set as 10 [2, 3], and the same number of events was also recommended when Cox's proportional hazards regression analysis was applied [4, 5].

I suppose that several risk factors for IVH, presented in their table 3, were simultaneously included for the adjusted Cox proportional hazards model. They described procedures of selecting independent variables for multinomial logistic regression analysis by setting $p < 0.25$ from one-way ANOVA. But there was no clear

description for the procedure of selecting independent variables for Cox's proportional hazards model, and their conclusion of CMB in DPWM as the predictor of subsequent IVH should be verified according to the following recommendation. They conducted a follow-up study over a median period of 23 months, but continuous follow-up is ineffective as the number of total patients at baseline were also limited in their study. To keep a high enough number of events, more extensive baseline data should be set for a stable estimate in the risk assessment of IVH.

As they planned an important clinical study on the risk assessment of IVH in patients with moyamoya disease, definite contributing factors should be determined.

Disclosure Statement

There are no conflicts of interest and no financial disclosure in this study.

References

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