Anemia Is a Risk Factor of New Intraoperative Hemorrhagic Stroke During Valve Surgery for Endocarditis

Daisuke Yoshioka, MD, Koichi Toda, MD, PhD, Shuhei Okazaki, MD, PhD, Taichi Sakaguchi, MD, PhD, Shigeru Miyagawa, MD, PhD, Yasushi Yoshikawa, MD, PhD, OSCAR Study Group, and Yoshiki Sawa, MD, PhD

Departments of Cardiovascular Surgery and Neurology, Osaka University Graduate School of Medicine, Osaka, Japan, and the Osaka Cardiovascular Research Group, Osaka, Japan

Background. Infective endocarditis is often associated with cerebral complications, the most serious of which is intraoperative hemorrhagic stroke owing to anticoagulation for cardiopulmonary bypass. However, its prevalence and risk factors are unknown. We evaluated the prevalence and risk factors of intraoperative hemorrhagic stroke in patients with infective endocarditis.

Methods. In 246 patients who underwent valve surgery for active endocarditis between 2005 and 2012, 127 patients had both preoperative and postoperative intracranial neuroimaging. The prevalence and risk factors of intraoperative stroke were analyzed in those 127 patients.

Results. Valve surgery was performed in 127 patients 19.6 ± 27.1 days after infective endocarditis diagnosis. Fourteen experienced intraoperative hemorrhagic stroke, and 1 died. None of 29 patients with preoperative hemorrhagic stroke showed exacerbation of hemorrhagic lesions, whereas 1 of 57 patients with preoperative cerebral infarction showed hemorrhagic transformation of infarct lesions. Thirteen of 14 hemorrhagic complications were new ectopic intracranial hemorrhage. Multivariate analysis showed not preoperative cerebral lesions but preoperative low hemoglobin level as the only risk factor for intraoperative hemorrhagic stroke (odds ratio, 0.51; 95% confidence interval, 0.26 to 0.87; $p = 0.03$). A preoperative hemoglobin cutoff value of 9.2 g/dL was determined by receiver operating curve analysis. Of 41 patients with preoperative hemoglobin level less than 9.2 g/dL, 9 (22%) had intraoperative new hemorrhage, whereas 4 (5%) of 86 patients with hemoglobin level of at least 9.2 g/dL had ectopic new hemorrhage.

Conclusions. Intraoperative hemorrhagic stroke was not rare, and ectopic hemorrhagic stroke, associated with preoperative anemia, was more prevalent than hemorrhagic transformation of existing cerebral lesions.

(Ann Thorac Surg 2015;100:16–23)

Infective endocarditis (IE) is frequently associated with bacterial cerebral infarction, with prevalence ranging from 40% to 80% [1–3]. Several guidelines recommend delaying surgery for IE patients with cerebral complications except in cases of transient ischemic attack [4–6]. On the other hand, several studies have shown that early surgical intervention does not increase the risk of neurologic deterioration in patients with cerebral infarction [7–11]. In addition, we recently showed that IE patients with preoperative hemorrhagic stroke who required early surgery within 2 weeks had a favorable postoperative neurologic outcome [12]. Furthermore, in previous studies, the prevalence of intraoperative new ectopic hemorrhagic stroke was higher than that of hemorrhagic transformation or enlargement of existing cerebral lesions [11]. To prevent neurologic deterioration during valve surgery in active IE patients, it is important to avoid risk of new intraoperative ectopic hemorrhagic stroke, although the prevalence and risk factors remain unknown. Therefore, we evaluated the prevalence and risk factors of intraoperative new ectopic hemorrhagic stroke in IE patients.

Patients and Methods

Patient Population

This retrospective multicenter study was approved by the institutional review board of Osaka University Hospital, and application of the Osaka Cardiovascular

Accepted for publication Feb 18, 2015.

Address correspondence to Dr Yoshioka, Yamadaoka, 2-2, Suita-city, Osaka 565-0871, Japan; e-mail: yoshioka@surg1.med.osaka-u.ac.jp.

0003-4975/$36.00
http://dx.doi.org/10.1016/j.athoracsur.2015.02.056

Research Group (OSCAR) database was approved by each affiliated hospital. Data for 246 patients in 11 hospitals who underwent valve surgery for active endocarditis between 2005 and 2012 were extracted from the OSCAR database. Active endocarditis was defined as endocarditis requiring antibiotic therapy until surgery. Exclusion criteria were cured IE and right-sided endocarditis without left-sided valve involvement. This population is the same as in our previous report [12].

In these 246 patients, 61 had preoperative neurologic symptoms including transient ischemic attack or headache. A schema of patients and the circumstances of neuroimaging or the lack of neuroimaging in the 246 patients is shown in Figure 1. In these hospitals, routine preoperative neuroimaging was usually performed regardless of neurologic symptoms. Of the 246 patients, 12 patients without neurologic symptoms could not undergo preoperative neuroimaging by computed tomographic (CT) scanning or magnetic resonance imaging (MRI) because of emergent status, cardiogenic shock in 1, intubation in 3, or difficulty maintaining a supine position because of heart failure in 8. The decision of postoperative neuroimaging in patients without postoperative neurologic signs depended on the strategy of each hospital. In 6 affiliated hospitals, postoperative neuroimaging was routinely performed regardless of the existing postoperative neurologic deficit. Of 234 patients who underwent preoperative neuroimaging, 107 did not undergo postoperative neuroimaging, including 10 who died in the acute phase.

The 127 patients who underwent valve surgery for active endocarditis underwent both preoperative and postoperative intracranial neuroimaging. We analyzed prevalence and risk factors of intraoperative hemorrhagic stroke in these 127 patients.

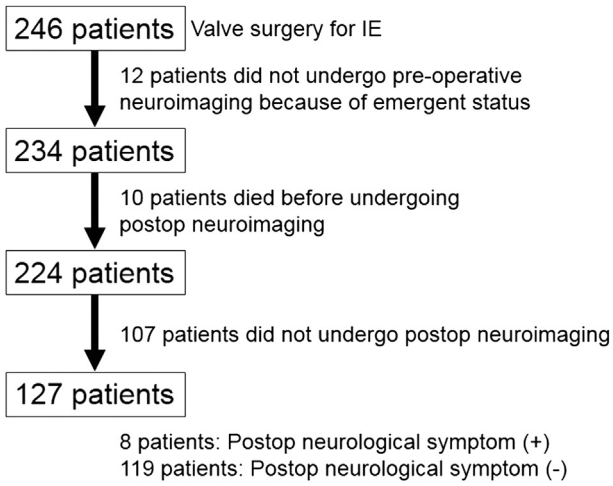

Fig 1. A schema of patients and the circumstances of neuroimaging or the lack of neuroimaging in the 246 patients, including the 127 study cohort patients. (IE = infective endocarditis; Postop = postoperative.)

Echocardiography, Laboratory Values, and Cardiac Operation

Vegetation size was determined by maximal length measured by echocardiography performed at IE diagnosis. Laboratory values were obtained from data collected immediately before valve surgery to identify factors predictive of intraoperative intracranial hemorrhage. All surgical records were reviewed, and we confirmed that all patients underwent valve surgery with systemic heparin anticoagulation during cardiopulmonary bypass (CPB). Body temperature during CPB varied from 20° to 37°C, depending on the procedure, including 2 patients who underwent cardiac surgery using temporal hypothermic circulatory arrest.

Neurologic Evaluation

Existing neurologic symptoms were defined as a neurologic deficit lasting more than 24 hours. Transient ischemic attack and disordered consciousness without any focal symptoms were not considered as preoperative neurologic symptoms. Postoperative neurologic deterioration was defined as occurrence of previously undetected neurologic deficit lasting 24 hours after surgery. Postoperative transient convulsion was not regarded as postoperative neurologic deterioration.

Acute infarcts were defined as lesions with increased signals in diffusion-weighted MRI or low-density lesions on CT, which were accompanied by edema or neurologic symptoms.

In postoperative neuroimaging examinations, hemorrhagic stroke included cerebral bleeding, subarachnoid hemorrhage, and subdural hemorrhage, which were visualized as high-density areas on CT or low-density areas on T2-weighted MRI. Intracranial small low-density lesions in gradient echocardiographic MRI were considered as microbleeding and not considered to be hemorrhagic stroke if not evident in CT images.

Statistical Analysis

Continuous variables are presented as mean ± standard deviation values, and categorical variables are given as frequencies. Fisher's exact test was used to evaluate categorical variables for univariate analysis, and Student's t test was used to compare continuous variables. Univariate analysis was first applied using logistic regression for continuous variables, then Fisher's exact test for categorical variables. Factors with a probability value of less than 0.1 were considered in the multivariate logistic model. For all analyses, a probability value of less than 0.05 in a two-sided test was considered to be statistically significant. All statistical analyses were performed using JMP version 10.0 (SAS Institute, Cary, NC).

Results

Preoperative Patient Characteristics

Preoperative patient characteristics are shown in Table 1. Preoperative echocardiographic variables including