Relationship between Hemorrhagic Complications and Target Vessels in Acute Thrombectomy

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Purpose: Intracranial hemorrhage after thrombectomy using a catheter to treat acute major cerebral artery occlusion is known to exacerbate patient outcomes. This study was performed to determine the relationship between middle cerebral artery (MCA) tortuosity and postoperative hemorrhage. *Methods:* We examined 111 consecutive patients who underwent acute thrombectomy for major intracranial artery occlusion in the anterior circulation at our hospital between September 2013 and June 2016. Patients in whom intracranial hemorrhage or subarachnoid hemorrhage was seen on head computed tomography 12-24 hours after surgery were assigned to the hemorrhagic group, whereas all the other patients were assigned to the nonhemorrhagic group. The groups were compared for tortuosity of the MCA, which was evaluated by finding the top-to-bottom (TB) distance of the M1 segment on anterior–posterior view angiograms. A modified Rankin scale score of 0-2 at 3 months after onset was considered a favorable prognosis. *Results:* The hemorrhagic group comprised 28 patients (25.2%) and the nonhemorrhagic group comprised 83 patients (74.8%). No significant difference in patient characteristics was seen between the groups. The hemorrhagic group displayed significantly fewer patients with a favorable prognosis (17.9% versus 43.4%, $P = .016$). The TB distance was significantly greater in the hemorrhagic group (hemorrhagic group, 9.7 mm; nonhemorrhagic group, 7.6 mm; $P = .002$); multivariate analysis also identified a TB distance over 8.8 mm as a factor independently associated with postoperative intracranial hemorrhage ($P = .001$). *Conclusions:* Post-thrombectomy hemorrhage was significantly correlated with TB distance. A solution is needed for selecting and combining devices used in patients with a TB distance over 8.8 mm. **Key Words:** Thrombectomy—intracranial hemorrhage—stent retriever—tortuosity.

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Introduction

The recanalization rate of thrombectomy for acute major artery occlusion has risen with the advent of stent retrievers, leading to the establishment of clinical evidence for this therapy.[1-4] However, a considerable amount of intracranial hemorrhage is sometimes seen after this therapy. In intravenous (IV) recombinant tissue plasminogen activator (rt-PA) therapy, the rate of hemorrhagic complications after dosing is 3.3% and has been reported as a poor prognostic factor. Old age, high National Institutes of Health Stroke Scale (NIHSS) score, diabetes, hypertension, and other attributes have also been reported as factors associated with hemorrhage.[5] Meanwhile, the rate of hemorrhagic complications after thrombectomy ranges from 7.4% to 31.2%,[6-9] higher than that of IV rt-PA therapy. Hemorrhagic complication is also a poor prognostic factor in thrombectomy, and diabetes and a high NIHSS score are occasionally reported as risk factors for hemorrhage.[7,10]

Two types of devices are used in thrombectomy: stent retrievers and aspiration catheters. However, the appropriate selection and combination of these devices could reduce postoperative hemorrhage if factors predictive of hemorrhage would be identified. Post-thrombectomy hemorrhage is the result of a thrombectomy device introduced to an intracranial blood vessel pulling at the vessel and greatly changing the course, damaging the parent vessel and surrounding blood vessels, including perforating branches. More postoperative hemorrhages are thus assumed to occur when the target vessel is severely contorted.

The aim of the present study was to investigate the relationship between middle cerebral artery (MCA) M1 segment tortuosity and hemorrhagic complications after thrombectomy.

Methods

We examined 111 cases of occlusion from the distal internal carotid artery (ICA) to the M1 and M2 segments of the MCA, chosen from among 159 consecutive patients who underwent thrombectomy for acute major cerebral artery occlusion at our hospital between September 1, 2013, and June 30, 2016. Outcomes at 3 months after the procedure were evaluated using the modified Rankin Scale (mRS), with an mRS score of 0-2 defined as representing favorable prognosis. All patients underwent head computed tomography (CT) 12-24 hours after the procedure, and postoperative hemorrhage was evaluated by 2 independent neuroradiologists with no knowledge of the therapy content. Hemorrhage on head CT was evaluated using the European Cooperative Acute Stroke Study classification.[11] Patients in whom intracranial hemorrhage (with the exception of hemorrhagic infarction) or subarachnoid hemorrhage was seen were assigned to a hemorrhagic group, whereas patients in whom hemorrhagic infarction was seen with no high-density regions on CT were assigned to a nonhemorrhagic group. The 2 groups were compared according to the following characteristics: age, sex, preoperative NIHSS score, Albert Stroke Program Early CT Score (ASPECTS), performance of IV rt-PA therapy, atrial fibrillation, history of ischemic heart disease, hypertension, diabetes, and hyperlipidemia. The groups were also compared according to factors related to therapy, including the device used, the time from onset to recanalization, the duration of the surgery, the level of recanalization (thrombolysis in cerebral infarction [TICI]), and favorable prognosis.

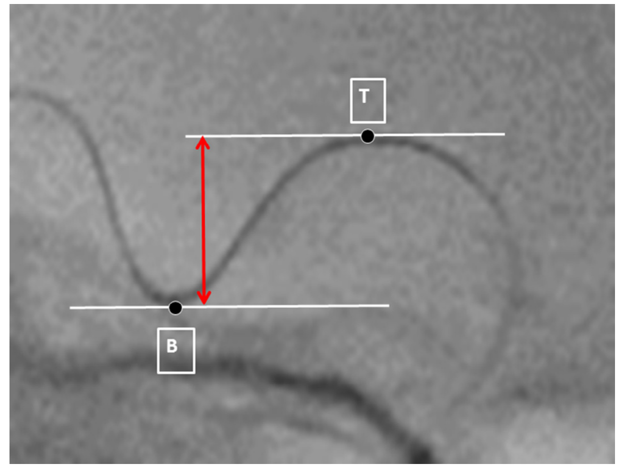

Figure 1. *Methods of measuring TB distance. TB distance of the middle cerebral artery M1 segment is measured once the microguidewire has been introduced through the occlusion. Abbreviation: TB, top-to-bottom.*

Blood vessel tortuosity was evaluated from the only anterior–posterior view images on which the supraorbital margin lined up with the anterior cranial base. The lateral view was not used for measuring tortuosity in the present study because it was unsuitable for measuring the MCA MI segment due to the overlapping of the MCA branches. Images were taken on insertion of the guidewire into the target vessel, and the linear distance between the top and bottom of the MCA M1 segment (top-to-bottom [TB] distance, Fig 1) was measured on these images.

Statistical analysis was performed using the fissure test, the Student *t*-test, the chi-square test, and the Wilcoxon signed-rank test using JMP version 12 software (SAS institute Inc., Cary, NC). Multivariate analysis was performed using items with a P value of .20 or lower on univariate analysis, and P values lower than .05 were considered to be statistically significant.

The study protocol was approved by the Institutional Review Board of Hyogo college of Medicine (identification number: 2536).