Predictors of Good Outcome After Stent-Retriever Thrombectomy in Acute Basilar Artery Occlusion

Woong Yoon, MD; Seul Kee Kim, MD; Tae Wook Heo, MD; Byung Hyun Baek, MD; Yun Young Lee, MD; Heoung Keun Kang, MD

Background and Purpose—Factors related to prognosis after a modern mechanical thrombectomy in patients with acute basilar artery occlusion remain unclear. This study investigated the prognostic factors for patients with acute basilar artery occlusion who underwent a stent-retriever thrombectomy.

Methods—We analyzed clinical and pretreatment diffusion-weighted imaging (DWI) data in 50 consecutive patients with acute basilar artery occlusion treated with stent-retriever thrombectomy. A good outcome was defined as a modified Rankin Scale score of 0 to 2 at 3 months. The association between clinical and DWI parameters and functional outcome was evaluated with logistic regression analysis.

Results—In a univariate analysis, the following variables were significantly associated with outcome: age, hypertension, baseline National Institutes of Health Stroke Scale, posterior circulation Acute Stroke Prognosis Early CT Score on a pretreatment DWI, posterior circulation Acute Stroke Prognosis Early CT Score of ≥7 (versus <7), thalamic infarction, and bilateral thalamic infarction. In a multivariate model, only a low initial National Institutes of Health Stroke Scale score (odds ratio, 0.82; 95% confidence interval, 0.709–0.949; P=0.008) and high DWI posterior circulation Acute Stroke Prognosis Early CT Score (odds ratio, 1.854; 95% confidence interval 1.012–3.397; P=0.045) were significant independent predictors of good outcome. In a univariate analysis, bilateral thalamic infarction was associated with a poor outcome (odds ratio, 1.993; 95% confidence interval, 1.187–3.346; P=0.035) but not with a unilateral thalamic infarction (P=0.525).

Conclusions—This study suggested that initial infarction severity and posterior circulation Acute Stroke Prognosis Early CT Score on a pretreatment DWI are independent predictors of clinical outcome after stent-retriever thrombectomy in patients with acute basilar artery occlusion. (Stroke. 2015;46:00-00. DOI: 10.1161/STROKEAHA.115.010840.)

Key Words: basilar artery □ confidence intervals □ diffusion magnetic resonance imaging □ infarction □ thrombectomy

Poor clinical outcomes, despite successful revascularization, are more common in patients with acute basilar artery occlusion (BAO) than in patients with anterior circulation stroke.1 Thus, patient selection is of paramount importance when considering endovascular treatment for patients with acute BAO. Several clinical and imaging factors are known to be associated with functional outcomes after intravenous or intra-arterial pharmacological thrombolysis for acute BAO.2–6 However, few studies have investigated prognostic factors that predict outcome after modern mechanical thrombectomy in patients with acute BAO. Moreover, the prognostic significance of thalamic infarctions on pretreatment diffusion-weighted imaging (DWI) in patients undergoing mechanical thrombectomy has not been reported. Thus, this study aimed to investigate prognostic factors for patients with acute BAO who received stent-retriever thrombectomy and to investigate the prognostic implication of a thalamic infarction observed on a pretreatment DWI.

Materials and Methods

Patients

From December 2010 to February 2015, a total of 50 consecutive patients who presented with acute stroke due to acute BAO were treated with stent-retriever thrombectomy as the first-line endovascular therapy at a comprehensive regional stroke center. This retrospective study analyzed the clinical and radiological data for these 50 patients. The institutional ethics committee approved this retrospective analysis and waived informed consent based on the study design. All patients underwent an initial imaging protocol that included nonenhanced computed tomographic (CT) scan and multimodal magnetic resonance imaging (MRI) before commencing endovascular thrombectomy procedures. The inclusion criteria for stent-retriever thrombectomy were as follows: (1) baseline National Institutes of Health Stroke Scale (NIHSS) score of ≥4, (2) no intracerebral hemorrhage detected on the cranial CT or MRI, (3) BAO detected with MR angiography, (4) no bilateral diffuse pontine ischemia on the DWI (DWI lesions that occupied >80% of the pons based on visual estimation), and (5) the procedure started within 12 hours of the estimated time of the BAO.7

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Endovascular Treatment

Endovascular therapy was performed under conscious sedation with midazolam. Stent-retriever thrombectomy with a Solitaire stent or Trevo stent was performed as the first-line endovascular treatment. When stent-retriever thrombectomy was unsuccessful, additional mechanical approaches were performed, including manual aspiration thrombectomy and intra-arterial urokinase infusion. Details on techniques used for mechanical thrombectomy were previously described. Intracranial angioplasty with or without stenting was performed when severe (>70%) underlying intracranial atherosclerotic stenosis was observed.

The time to endovascular therapy was defined as the interval between the estimated time of the BAO and the start of endovascular therapy. The site of the BAO was recorded according to previously published criteria. Successful revascularization was defined as a modified thrombolysis in cerebral infarction grade of 2b or 3. A good clinical outcome was defined as a modified Rankin Scale score of ≤2.

MRI Analysis

MRI examinations were performed with a 1.5-T unit (Signa HDxt; GE Medical Systems, Milwaukee, WI). Two readers assessed the posterior circulation Acute Stroke Prognosis Early CT Score (pc-ASPECTS) on the DWI, according to the method described by Tei et al. Then, readers determined the presence or absence of a thalamic infarction, and they classified thalamic infarctions into 4 categories, according to arterial territories: (1) anterior, (2) posteromedial, (3) ventrolateral, or (4) posterolateral infarction.

Statistical Analysis

Statistical analyses were performed with SPSS software (Version 21.0; SPSS, Chicago, IL). First, the relationship between each characteristic and the 3-month outcome was determined. For analysis, we categorized patients into 2 groups, based on pc-ASPECTS (≥7 and <7). The chi-squared test or Fisher exact test was used for comparing categorical variables, and the Mann–Whitney U test was used for comparing continuous variables. Second, a logistic regression analysis was performed to identify independent predictors for clinical outcome. Variables with a P value of <0.05 in the univariate analysis on clinical outcome were included in a multivariate logistic regression, performed with the forward selection and backward elimination method. A P value of <0.05 was considered significant.

Results

The clinical and radiological characteristics of the patients are shown in Table 1. Overall, a good outcome was achieved
in 54% of patients (n=27/50). Mortality was 12% (n=6/50) at 3 months. No patient had symptomatic hemorrhage during the hospital stay. Of 50 patients, 6 received manual aspiration thrombectomy as a rescue therapy. Two patients received an intra-arterial urokinase (80,000 IU) infusion. Of 15 patients with underlying intracranial atherosclerotic stenosis, 13 received intracranial angioplasty with or without stenting after mechanical thrombectomy.

On the pretreatment DWI, the median pc-ASPECTS was 7 (interquartile range, 6–8; range, 3–9). None of the patients with a pc-ASPECTS of 3 to 5 (n=7) displayed a good outcome at 3 months; in contrast, all patients (n=6) with a pc-ASPECTS of 9 displayed a good outcome (Figure). When dichotomized into groups with pc-ASPECTS of ≥7 and <7, the rate of good outcome was significantly higher in patients with the pc-ASPECTS of ≥7 than in those with the pc-ASPECTS of <7 (66.7% versus 29.4%; P=0.012).

Thalamic infarction was identified in 36% of patients (n=18/50) on the DWI. Nine patients had bilateral infarctions (n=5 anterior territory; n=4 posteromedial), and 9 had unilateral infarctions (n=4 posterolateral territory, n=2 ventrolateral, n=2 anterior, and n=1 posteromedial). All 9 bilateral thalamic infarctions were located in the paramedian region. The presence of a thalamic infarction was significantly associated with a poor outcome at 3 months (odds ratio, 1.939; 95% confidence interval, 1.086–3.462; P=0.028). When categorized into bilateral and unilateral infarction, the bilateral thalamic infarction was associated with a poor outcome (odds ratio, 1.993; 95% confidence interval, 1.187–3.346; P=0.035) but not with the unilateral thalamic infarction (P=0.525).

In a univariate analysis, the following variables were identified as predictors of a good outcome: young age, the absence of hypertension, low baseline NIHSS, high pc-ASPECTS on the pretreatment DWI, a pretreatment DWI pc-ASPECTS of ≥7, the absence of thalamic infarction, and the absence of a bilateral thalamic infarction on the pretreatment DWI (Tables 1 and 2). In a multivariate analysis, a low initial NIHSS score (odds ratio, 0.82; 95% confidence interval, 0.709–0.949; P=0.008) and a high DWI pc-ASPECTS (odds ratio, 1.854; 95% confidence interval, 1.012–3.397; P=0.045) were significant independent predictors of good outcome at 3 months (Table 2).

**Discussion**

This study showed that the initial stroke severity and the pc-ASPECTS on a pretreatment DWI were independent predictors of functional outcome in patients with acute BAO who received stent-retriever thrombectomy. Only few studies have evaluated independent predictors of clinical outcome after stent-retriever thrombectomy in patients with acute BAO.1,11

**Table 2. Logistic Regression Analysis for Predictors of Good Outcome**

<table>
<thead>
<tr>
<th>predictor</th>
<th>Unadjusted OR</th>
<th>95% CI</th>
<th>P Value</th>
<th>Adjusted OR</th>
<th>95% CI</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, per 1-y increase</td>
<td>0.945</td>
<td>0.897–0.997</td>
<td>0.037</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Hypertension</td>
<td>0.168</td>
<td>0.045–0.630</td>
<td>0.008</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Baseline NIHSS, per 1-point increase</td>
<td>0.790</td>
<td>0.687–0.909</td>
<td>0.001</td>
<td>0.820</td>
<td>0.709–0.949</td>
<td>0.008</td>
</tr>
<tr>
<td>pc-ASPECTS, per 1-point increase</td>
<td>2.239</td>
<td>1.300–3.855</td>
<td>0.004</td>
<td>1.854</td>
<td>1.012–3.397</td>
<td>0.045</td>
</tr>
<tr>
<td>pc-ASPECTS ≥7 vs &lt;7</td>
<td>4.800</td>
<td>1.348–17.088</td>
<td>0.015</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Thalamic infarction</td>
<td>0.262</td>
<td>0.077–0.889</td>
<td>0.032</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Bilateral thalamic infarction</td>
<td>0.183</td>
<td>0.034–0.993</td>
<td>0.049</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

CI indicates confidence interval; NIHSS, National Institute of Health Stroke Scale; OR, odds ratio; and pc-ASPECTS, posterior circulation Acute Stroke Prognosis Early CT Score.
Singer et al. reported that a low initial NIHSS score, the use of MRI before endovascular therapy, and a better collateralization status were independent predictors of good outcome. They suggested that patient selection based on an MRI could achieve a better clinical outcome than selection based on a CT, for patients with acute BAO. This finding may be because of exclusion of patients with extensive ischemic damage to brain stem by DWI. Mourand et al. developed a DWI score for the brain stem to evaluate the extent of brain stem ischemic damage. In their multivariate analysis, a mild brain stem ischemic lesion on the DWI (brain stem score of <3) and a young age were independent predictors of good outcome.

Studies that tested the use of DWI pc-ASPECTS for predicting outcome in patients with acute BAO showed conflicting results. Tei et al. reported that the DWI pc-ASPECTS was one of the independent predictors of outcome in patients with posterior circulation stroke. Similarly, Nagel et al. reported that a DWI pc-ASPECTS of ≥8 was the only independent predictor for a favorable outcome in patients with acute BAO. Recently, Möhlenbruch et al. reported that patients with a pc-ASPECTS (by the use of CT angiography source images or DWI) of ≥9 had a significantly better outcome than those with a pc-ASPECTS of <9 after stent-retriever thrombectomy in patients with acute BAO. In contrast, in the study by Karameshev et al., the DWI pc-ASPECTS was not significantly associated with outcome after adjusting for NIHSS, Glasgow Coma Scale, and other DWI scoring systems. Mourand et al. also reported that a DWI pc-ASPECTS of ≥7 was not statistically relevant for predicting good outcome in a univariate logistic regression analysis. These discrepancies might be because of differences among studies in patient selection criteria, treatment methods, recanalization results, or the time windows between onset and treatment.

This study demonstrated that a thalamic infarction on the pretreatment DWI was significantly associated with outcome in a univariate analysis. Interestingly, only a bilateral thalamic infarction was significantly associated with a poor outcome. This finding might be related to the location of thalamic infarctions. In our study, all bilateral thalamic infarctions were located in the paramedian region. It is known that recovery is typically poor after a bilateral paramedian thalamic infarction.

Our study had several limitations, including the retrospective, noncontrolled study design and the limited number of patients. In addition, rescue treatments might have affected the outcomes in this study. In this study, 6 patients were treated with manual aspiration thrombectomy and 13 patients received intracranial angioplasty with or without stenting to treat the intracranial atherosclerotic stenosis.

Conclusions

In conclusion, this study suggested that the initial infarction severity and the pc-ASPECTS based on a pretreatment DWI were independent predictors of clinical outcome after stent-retriever thrombectomy in patients with acute BAO. In addition, a bilateral paramedian thalamic infarction observed on a pretreatment DWI seemed to be associated with poor outcome in patients with acute BAO.

Disclosures

None.

References

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