碩士學位論文

Predicting Outcome after Endovascular Reperfusion Therapy for Acute Basilar Occlusion in Patients with Pretreatment DWI-ASPECTS (Diffusion-Weighted Imaging-Alberta Stroke Program Early Computed Tomography Score) ≤6

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Predicting Outcome after Endovascular Reperfusion Therapy for Acute Basilar Occlusion in Patients with Pretreatment DWI–ASPECTS (Diffusion-Weighted Imaging–Alberta Stroke Program Early Computed Tomography Score) ≤6.

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Table 1. Baseline characteristics of BAO patients with DWI-pc-ASPECTS ≤ 6

Table 2. Clinical and imaging outcomes in groups of patients with DWI-pc-ASPECT ≤ 6

Table 3. Predictors of poor clinical outcome at 90 days in BAO patients with DWI-pc-ASPECT ≤ 6

Figure 1. Flowchart of the patient selection process

Figure 2**.** Clinical outcome (modified Rankin Scale, 0–6) of acute basilar artery occlusion in patients who had DWI-pc-ASPECT (Diffusion-Weighted Imaging–Alberta Stroke Program Early Computed Tomography Score) ≤ 6 according to their age. The proportion of outcomes (modified Rankin scale, 0–2 vs. 3–6) within each age group is shown.

Figure 3. Modified Rankin scale at 3 months between age ≥70 and <70 in acute BAO patients treated by endovascular reperfusion treatment.

Abstract

Background and Purpose: The prognosis of patients with acute basilar arterial occlusion (BAO) after endovascular reperfusion therapy (ERT) with diffusion-weighted imaging (DWI)-Alberta Stroke Program Early Computed Tomography Score (ASPECTS) ≤ 6 remains unclear.

Aims: We aimed to assess the characteristics and prognosis of ERT in patients with acute BAO and DWI-pc-ASPECT ≤ 6.

Methods: We analyzed data collected from January 1, 2012, to January 31, 2018, in a prospective neuro-interventional registry of consecutive patients treated with ERT. Clinical and imaging data patients with DWI-pc-ASPECT ≤ 6 who underwent ERT for acute BAO were collected for this study. A good clinical outcome (GCO) was defined as a modified Rankin Scale score ≤ 2 at 90 days.

Results: Forty-five acute BAO patients with DWI-pc-ASPECT ≤6 were included. Among them, 11 (24.4%) patients had GCO at 90 days. Patients with GCO had mild neurologic symptoms at presentation [National Institutes of Health Stroke Scale (NIHSS) 19.0 (12.0–25.0) vs. 8.0 (6.0–11.5); P = 0.003] and were younger patients[72.5 (57.0–80.0) vs. 63.0 (55.5–69.0), P = 0.096] than those with poor clinical outcome (PCO). In a multivariate model, low initial NIHSS score (odds ratio, 1.21; 95% confidence interval, 1.07–1.44; P = 0.0093) and age over 70 years (odds ratio, 15.27; 95% confidence interval, 1.85–379.79; P = 0.0321) were independent predictors of PCO.

Conclusions: Even with DWI-pc-ASPECT ≤ 6, GCO can be achieved after ERT. Mild initial symptoms and below the 70 years old can predict a better clinical outcome.

Introduction

Recent trials of endovascular reperfusion therapy (ERT) have proven it as an effective treatment for patients with acute ischemic stroke (AIS) with a large-vessel occlusion involving the anterior cerebral circulation.[1-4] However, little is known about the effectiveness of ERT for AIS involving the basilar artery occlusion (BAO). BAO is associated with high mortality (85%–95%) if recanalization does not occur.[5, 6] Thus, successful recanalization is the best predictor of a good outcome among patients with BAO.[7, 8] However, the improvement of interventionist's techniques and rapid advancements in thrombectomy devices have dramatically increased the rate of successful recanalization.[6]

Nevertheless, successful recanalization alone cannot be expected to improve the clinithe cal outcome without appropriate patient selection.[9] Although the optimal patient selection for ERT in BAO is controversial, there are few proven and readily-available clinical indicators. Among the factors associated with predicting the clinical outcomes for BAO, diffusion-weighted an imaging-based posterior circulation-Acute Stroke Prognosis Early CT Score (DWI-pc-ASPECT) had suggested commonly relevant.[10, 11] Several studies reported that compared with patients with DWI-pc-ASPECT > 6, those with DWI-pc-ASPECT ≤ 6 benefits lesser from ERT for BAO, with a lower rate of good clinical outcome despite successful recanalization.[12-15]

However, in real-world practice, even some patients with DWI-pc-ASPECT ≤ 6 with acute BAO can achieve a good prognosis after successful ERT. It is critical to evaluate if the treatment would benefit the patient and to understand patient characteristics within population with DWI-pc-ASPECT ≤ 6; these aspects may critically influence the treatment decision-making for ERT. In addition, several studies have recently reported that the prognosis of mechanical thrombectomy is superior to that of medical treatment alone in patients with a low DWI-pc-ASPECT score in the anterior circulation.[16-18] However, the characteristics and prognosis of acute BAO in patients with DWI-pc-ASPECT ≤ 6 have not

been studied.

Aims

We aimed to investigate the clinical characteristics and predictive prognostic factors for better clinical outcomes in acute BAO patients with DWI-pc-ASPECT ≤ 6 who performed ERT.

Methods

Study population

Consecutive acute ischemic stroke patients with BAO were treated with first-line endovascular therapy at the Asan Medical Center and Jeju National University Hospital, between January 1, 2012, and January 31, 2018. They were retrospectively selected from a prospective neuro-intervention database and stroke registry. Clinical and radiologic data were reviewed for these patients. We collected information pertaining to patient demographics, vascular risk factors, imaging findings, time from onset to femoral puncture, door to puncture, onset to recanalization, procedure time, baseline National Institutes of Health Stroke Scale (NIHSS), modified Rankin Scale (mRS) at three months, and the length of hospital stay. Patients were classified according to the Trial of ORG 10172 in Acute Stroke Treatment (TOAST) criteria. In addition, cerebral angiograms were reviewed for the location of occlusion and the reperfusion status after ERT. The inclusion criteria for thrombectomy for acute BAO were as follows: (1) Patients with complete occlusion of the basilar artery who had pretreatment DWI-pc-ASPECT ≤ 6, (2) Patients for whom performing ERT for acute BAO was judged to be beneficial by discussion between neurologist and neurointerventionist about onset-to-door time, symptoms, patient information, and initial neuro-image. We excluded patients with 1) the onset to puncture time > 24 h, (2) severe stenosis without

complete occlusion, (3) other causes of stroke, such as arterial dissection, Moyamoya disease, and vasculitis, (4) pre-morbid mRS > 2, (5) combined ischemic stroke of anterior circulation, and (6) any symptomatic intracerebral hemorrhage detected on the initial computed tomography (CT) or magnetic resonance imaging (MRI) (Figure 1).

The history of all ischemic events was obtained, and the physical and neurologic status of each patient was evaluated by stroke neurologists from our institution. This study was approved by the institutional review board of the Asan Medical Center, and the need for written informed consent was waived because of the retrospective nature of the study. According to our management protocol for acute stroke, all patients underwent nonenhanced CT scan and multimodal MRI before undergoing endovascular thrombectomy procedures.

Intervention procedures

All procedures were performed via the percutaneous transfemoral route under local anesthesia. All endovascular treatments were performed by two neuro-interventionalists in our institution who treat all patients with large-vessel occlusion. After placement of a sheath introducer, unfractionated heparin was intravenously administered to maintain the activated clotting time at >2 times normal. If stenting was predicted before the procedure, loading doses of clopidogrel (300 mg) with aspirin (300–500 mg) were prescribed.[19]

Typically, a 6-French guide catheter (Envoy or Envoy DA; Codman Neurovascular, Miami Lakes, FL, USA) or a 5–6 French long sheath (Shuttle-SL; Cook Medical, Bloomington, IN, USA) was employed for the procedure. A microcatheter with an internal diameter of 0.021 inches or 0.027 inches was navigated distally to the point of occlusion over a 0.014-inch steerable microwire. A microcatheter angiographic run was performed to define the vascular bed distal to the thrombus. Available thrombectomy methods, such as a stent retriever and suction thrombectomy, were used to achieve reperfusion in the direct thrombectomy group.

Endovascular therapy was performed without sedation or under conscious sedation. The thrombectomy procedure was chosen at the discretion of a neurointerventionist; it involved the use of a stent retriever or a direct aspiration first path technique in the first instance. When stent-retriever or aspiration thrombectomy was unsuccessful, additional mechanical approaches were alternatively performed. Intracranial angioplasty with or without stenting was performed when severe (>70%) underlying basilar artery atherosclerotic stenosis with the flow-limiting pattern was observed after ERT according to the NASCET criteria.[13] The time to endovascular therapy was defined as the interval between the estimated time of the BAO and the start of endovascular therapy.

Imaging protocol

All patients underwent conventional MRI, including time-of-flight magnetic resonance angiography (MRA) of the circle of Willis and contrast-enhanced MRA or CT angiography (CTA) of the circle of Willis and carotid vessels. A final diagnosis of complete occlusion of the intracranial or extracranial vessels was based on conventional angiography with sufficient contrast medium and a prolonged run. Imaging follow-up within 72 h after endovascular treatment comprised 3-dimensional time-of-flight or CTA and MRI, including T2*, fluid-attenuated inversion recovery, and DWI. The basilar artery was divided into three segments according to the Archer's method.[20] The proximal third of the basilar artery from the vertebral artery junction to the anterior inferior cerebellar artery is the proximal segment; the middle third of the basilar artery from the origin of the anterior inferior cerebellar artery to the origin of the superior cerebellar artery is the middle segment, and the area above the origin of the superior cerebellar artery is the distal segment. The location of occlusion was defined as the site of the most inferior extension of the filling defect of the basilar artery.

Two neuroradiologists independently assessed the DWI-pc-ASPECT on the DWI, according

to Tei's method.[15] Discrepancies were resolved by consensus.

Outcome evaluations

For this study, the patients with DWI-pc-ASPECT ≤ 6 were dichotomized into two age groups based on median values. Neurologic status after revascularization was re-evaluated by stroke neurologists, and the patients were monitored in the neuro-intensive care unit. Patients with a >2-point increase on the National Institutes of Health Stroke Scale (NIHSS) score were evaluated by MRI except for the patients who contraindicated or poor cooperation. Clinical outcome was assessed by mRS at 90 days, with scores ≤2 indicating functional independence and suggesting good clinical outcomes (GCO). Other clinical and imaging outcomes evaluated mortality at 3 months, length of hospital stay, the occurrence of any cerebral hemorrhage (was defined as any hemorrhagic transformation or subarachnoid hemorrhage based on the follow-up images), symptomatic intracranial hemorrhage (was defined as any parenchymal hematoma, subarachnoid hemorrhage, or intraventricular hemorrhage associated with a worsening of the NIHSS score by ≥4 within 24 h from ERT) [21], postprocedural infarct extension, and newly detected infarction. The degree of recanalization was classified based on modified Thrombolysis In Cerebral Infarction (mTICI) perfusion categories.[22] The rate of successful recanalization was defined as mTICI grade 2b or 3. The recanalization time was defined as the time interval from the puncture to the first reperfusion with more than mTICI ≥2a.

Statistical Analysis

Differences in baseline categorical variables were compared using the Pearson chi-square test or Fisher's exact test, and differences in continuous variables were compared using Student's

t-test or the Mann–Whitney U-test, as appropriate. Multivariate logistic regression analysis was performed to identify the independent variables contributing to poor clinical outcomes. Variables with a P value < 0.2 in univariate analysis were included as candidate variables in the multivariate analysis and were removed by backward stepwise selection. Additional analysis using forward selection confirmed the final model. A two-tailed P-value < 0.05 was considered statistically significant. All statistical analyses were performed using SPSS version 21.0 (IBM, Armonk, NY, USA).

RESULTS

Between January 1, 2012, and January 31, 2018, a total of 82 acute ischemic stroke patients with BAO were consecutively treated by ERT in the Asan Medical Center. During the study period, 45 patients met the inclusion criteria for the current study (Figure 1). The median patient age was 67 years [interquartile range (IQR), 56–76 years], and 32 (70.1%) were men. The mean interval between onset to femoral puncture was 547.0 min (IQR, 250–892.0 min). The mean initial NIHSS was 13 (IQR, 9.0–22.0 days) (Table 1).

PCO and GCO Patients with DWI-pc-ASPECT ≤ 6

When dichotomizing our cohort, 34 of 45 (75.6%) were poor clinical outcomes (PCOs), and 11 of 45 (24.4%) were GCOs. Baseline characteristics of the two groups are shown in Table 1. There was no significant difference in baseline characteristics between patients with PCO and GCO. There was a significant difference in the initial mean NIHSS scores (P < 0.001) between the two groups. In the PCO group, the patients presented with proximal basilar occlusion (29.4 %), mid-basilar occlusions (23.5 %), and distal basilar occlusion (47.1%), whereas the respective values for the GCO group were 45.5%, 0%, and 54.5%. No differences in the proportion of patients receiving intravenous tissue-type plasminogen

activator, angioplasty, and stent placement were noted between the groups.

Procedural and Angiographic outcomes

No differences between the PCO or GCO groups were observed in terms of the mean time from onset to femoral puncture [551.0 min (IQR, 255.0–892.0 min) vs. 673.0 min (IQR, 190.0–1164.0 min); P = 0.663)], onset to first revascularization [648.0 min (IQR, 390.0–944.0 min) vs. 737.0 min (IQR, 242.0–1208.0 min)]; P = 0.606), or the mean duration of procedure [77.0 min (IQR, 47.0–108.0 min) vs. 52.0 min (IQR, 42.0–63.5 min); P = 0.119)], respectively (Table 1). Regarding revascularization, there was no difference in successful recanalization [30 (88.2%) vs. 11 (100.0%); P = 0.56] between the PCO and GCO groups. The balloon angioplasty and the use of rescue stent placement were comparable in the groups. Infarct volume on follow-up imaging was comparable in both groups (Table 2).

Clinical Outcome

NIHSS at discharge [NIHSS 22.0 (IQR, 12.0–30.0) vs. 3.0 (IQR, 1.5–3.0); P < 0.001] was significantly higher in PCO of age than GCO. Early neurological improvement after ERT [ΔNIHSS −1.0 (IQR, −8.0–2.0) vs. 5.0 (IQR, 3.0–10.5); P=0.004] was significantly lower in PCO of age than GCO, respectively. On univariate analysis, follow-up imaging showed significantly higher infarct volume in the PCO group than in the GCO group [13 (38.2%) vs. 0 (0.0%); P = 0.045]. Mortality did not statistically differ [10 (29.4%) vs. 0 (0.0%); P = 0.105] at 90 days; however, there were no deaths in the GCO group. Regarding hemorrhagic complications, there were no significant between-group differences, with an overall rate of any hemorrhage and symptomatic hemorrhage of [16 (47.1%) vs. 2 (18.2%), and 6 (17.7%) vs. 2 (18.2%); P = 0.179] in the PCO and GCO groups, respectively (Table 2).

Predictors of Clinical Outcome

On multivariate analysis, being over the age of 70 years and the high initial NIHSS score were independent predictors of PCO on adjusting for variables. (Table 3).

Discussion

To our knowledge, this study was the first to evaluate the characteristics and effects of ERT in acute BAO patients with DWI-pc-ASPECT ≤ 6. In acute BAO patients with DWI-pc-ASPECT ≤ 6, GCO was present in 24.4%, and overall mortality was only 10%. There was a large difference between the GCO and PCO groups in terms of mortality, infarct volume on follow-up imaging, and hemorrhagic complications; however, the difference was not statistically significant because of the small number of patients. The successful rethe canalization was not associated with a favorable outcome but did not aggravate the hemorrhage or increase the 90-day mortality rate. The patients with high initial NIHSS had a a poor prognosis despite the fast door-to-puncture time and even successful revascularization. Importantly, in patients with acute BAO with DWI-pc-ASPECT ≤ 6, the functional outcomes at 90 days were worse in over 70 years old. Although the number of patients was small, there was no favorable outcome (mRS ≤ 2) in patients over 80 years of age.

There are several small studies on ERT performed in acute BAO which suggested the patient's age, reperfusion status, and initial thalamus involvement were associated with clinical prognosis.[12, 23, 24] However, there is no well-designed prospective trial about ERT for BAO. It was difficult to perform the randomized clinical trials probably because of the relatively low incidence, and the varied presentation of acute BAO. Thus, optimal patient selection for ERT in acute BAO remains challenging. Treatment decision is based on recommendations derived from subgroups of large retrospective studies or based on anecdotal expert opinions.[25, 26] Therefore, making prompt treatment decisions in an emergency situation for acute BAO patients has been difficult because there is no strict indication for performing ERT.

For optimal patient selection for ERT in acute BAO patients, it is important to choose an

appropriate initial imaging technique among other things. In this regard, DWI-pc-ASPECT has higher sensitivity than non-contrast CT for detecting brain infarction volume and location in the posterior circulation. Typically, most conservative studies have reported that DWI-pc-ASPECT had a poor prognosis at 6 points.[12, 13, 15] However, it is doubtful whether the cutoff value of 6 points is robust. Recent reports have shown that even DWI-pc-ASPECT ≤ 6 in an anterior circulation ischemic stroke has a better prognosis than medical treatment alone. [16-18] The evidence suggests that lesions seen in DWI are not irreversible and that DWI reversal can occur after ERT. In addition, despite DWI-pc-ASPECT ≤ 6, mild initial symptoms were predictors of good clinical outcome, which may be related to the local energy metabolism requirements, hemodynamic factors, and excitatory reflecting local neurotransmitters.[27] Posterior circulation is considered to be highly developed, with a robust collateral arterial network and involves reverse filling of the distal basilar artery which results in resistance to the tissue clock characterizing the rapid necrosis.[5] However, when ischemia exceeds the threshold of resistance, serious irreversible damage occurs. Recent large randomized trials have shown the "late window paradox" presented in the anterior circulation stroke: if the adequate patient selection by advanced image tools, better results can be obtained even if late ERT is performed.[28-30] Therefore, more sophisticated patient selection will be needed through the perfusion image in determining whether ERT should be performed in BAO patients with DWI-pc-ASPECT ≤ 6.

In addition, the results of this study showed that death or functional impairment was found in 94.7% of patients at three months after ERT for BAO in patients with DWI-pc-ASPECT ≤ 6 and aged >70 years. ERT in octogenarian patients showed a severe presentation with worse clinical outcome and mortality ratios than in younger patients.[31] Although posterior circulation is known to be well tolerated by ischemic insult, older patients have a relatively small penumbra, thus leading to a faster progression of penumbra to the ischemic core due to

the insufficient vascular reserve.[25, 32, 33].

The limitation of this study is the small number of patients. Currently, studies on BAO are limited regarding the number of patients they include, and thus, meaningful results are limited. Therefore, prospective, large-scale studies are needed to establish treatment guidelines for acute BAO. However, this is the first study to provide clinical information for determining the suitability of ERT in patients with posterior circulation stroke having DWI-pc-ASPECT ≤ 6. We also did not compare patients with DWI-pc-ASPECT ≤ 6 in whom ERT was not performed. However, previous studies report a mortality rate of approximately 40% and severe neurologic disability in more than 65% of survivors.[34] Therefore, in this study, the outcomes of ERT performed in patients with DWI-pc-ASPECT ≤ 6 is considered acceptable. In conclusion, to our knowledge, this is the first study investigating the clinical characteristics and prognosis of acute BAO patients with DWI-pc-ASPECT ≤ 6 who arrived at the hospital within a therapeutic time window. The purpose of the current study is to help guide the clinical decision-making and to encourage the practical conversation between stroke neurologist (or neuro-interventionist) and patients (or family) about ERT as a treatment option for acute BAO in patients with DWI-pc-ASPECT ≤ 6. Even if DWI-pc-ASPECT ≤ 6 in acute BAO, ERT should be considered if the patient is under 70 years of age and the initial symptoms are relatively mild.

List of abbreviations

AIS: acute ischemic stroke

BAO: basilar artery occlusion

ASPECTS: Alberta Stroke Program Early CT Score

CI: confidence interval

CT: computed tomography

DWI-pc-ASPECT: Diffusion-weighted imaging based posterior circulation-Acute Stroke Prognosis Early CT Score

ERT: endovascular reperfusion therapy

IQR: interquartile range

MRI: magnetic resonance imaging

mRS: modified Rankin scale

mTICI: modified Thrombolysis In Cerebral Infarction

NIHSS: National Institutes of Health Stroke Scale

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Table 1. Baseline characteristics of BAO patients with DWI-pc-ASPECTS ≤ 6

	All (N = 45)	Poor Clinical Outcome (N = 34)	Good Clinical Outcome (N = 11)	p
Age, years	69.0 (57.0–78.0)	72.5 (57.0–80.0)	63.0 (55.5–69.0)	0.096
Sex, male	32 (70.1%)	24 (70.6%)	8 (72.7%)	1
Comorbidities				
Hypertension	28 (62.2%)	19 (55.9%)	9 (81.8%)	0.236
Diabetes mellitus	12 (26.7%)	6 (17.6%)	6 (54.5%)	0.044
Smoking	12 (26.7%)	6 (17.6%)	6 (54.5%)	0.044
Alcohol	3 (6.7%)	2 (5.9%)	1 (9.1%)	1
Hypercholesterolemia	11 (24.4%)	7 (20.6%)	4 (36.4%)	0.513
Atrial fibrillation	15 (33.3%)	11 (32.4%)	4 (36.4%)	0.833
History of Stroke	10 (22.2%)	9 (26.5%)	1 (9.1%)	0.431
Coronary artery disease				
Valvular heart disease				
Cancer	6 (13.3%)	5 (14.7%)	1 (9.1%)	1
Acute management				
Tissue plasminogen activator	9 (20.0%)	6 (17.6%)	3 (27.3%)	0.795
Angioplasty	22 (48.9%)	15 (44.1%)	7 (63.6%)	0.436
Stent	16 (35.6%)	9 (26.5%)	7 (63.6%)	0.061
Location of Occlusion				0.19
Proximal	15 (33.3%)	10 (29.4%)	5 (45.5%)	
Mid	8 (17.8%)	8 (23.5%)	0 (0.0%)	
Distal	22 (48.9%)	16 (47.1%)	6 (54.5%)	
TOAST classification				0.368
Atherosclerosis	24 (53.3%)	17 (50.0%)	7 (63.6%)	
Cardioembolism	13 (28.9%)	9 (26.5%)	4 (36.4%)	
Other determined etiology	2 (4.4%)	2 (5.9%)	0 (0.0%)	
Undetermined etiology	6 (13.3%)	6 (17.6%)	0 (0.0%)	
Onset to Puncture (min)	555.0 (223.0–954.0)	551.0 (255.0–892.0)	673.0 (190.0–1164.0)	0.663
Onset to Recanalization (min)	668.0 (346.0–994.0)	648.0 (390.0–944.0)	737.0 (242.0–1208.0)	0.606
Mean duration of procedure (min)	68.0 (47.0–104.0)	77.0 (47.0–108.0)	52.0 (42.0–63.5)	0.119
Initial NIHSS	15.0 (10.0–24.0)	19.0 (12.0–25.0)	8.0 (6.0–11.5)	0.003
Pre-stroke mRS				0.326
0	39 (86.7%)	28 (82.4%)	11 (100.0%)	
−1	2 (4.4%)	2 (5.9%)	0 (0.0%)	
−2	4 (8.9%)	4 (11.8%)	0 (0.0%)	

Abbreviations: TOAST = Trial of ORG 10172 in Acute Stroke Treatment; FAT = first abnormal time; NIHSS = National Institutes of Health Stroke Scale; mRS = modified Rankin scale

Table 2. Clinical and imaging outcomes in groups of patients with DWI-pc-ASPECT ≤ 6

	All (N = 45)	Poor Clinical Outcome (N = 34)	Good Clinical Outcome (N = 11)	p
Age > 70 years	19 (42.2%)	18 (52.9%)	1 (9.1%)	0.027
NIHSS at discharge	13.5 (3.0–29.0)	22.0 (12.0–30.0)	3.0 (1.5–3.0)	<0.001
Recovery after ERT (Δ NIHSS)	0.0 (−6.0–6.0)	−1.0 (−8.0–2.0)	5.0 (3.0–10.5)	0.004
Mortality at 90 days	10 (22.2%)	10 (29.4%)	0 (0.0%)	0.105
Length of hospital stay, days	11.0 (7.0–15.0)	12.5 (8.0–17.0)	8.0 (7.0–11.0)	0.103

mTICI, 2b–3	41 (91.1%)	30 (88.2%)	11 (100.0%)	0.56
1	2 (4.4%)	2 (5.9%)	0 (0.0%)	
2a	2 (4.4%)	2 (5.9%)	0 (0.0%)	
2b	23 (51.1%)	20 (58.8%)	3 (27.3%)	
3	18 (40.0%)	10 (29.4%)	8 (72.7%)	
Any hemorrhage on follow-up imaging	18 (40.0%)	16 (47.1%)	2 (18.2%)	0.179
HI-1	10 (22.2%)	10 (29.4%)	0 (0.0%)	
HI-2	2 (4.4%)	0 (0.0%)	2 (18.2%)	
PH-1	0 (0.0%)	0 (0.0%)	0 (0.0%)	
PH-2	4 (8.9%)	4 (11.8%)	0 (0.0%)	
Subarachnoid hemorrhage	2 (4.4%)	2 (5.9%)	0 (0.0%)	
Symptomatic intracranial hemorrhage	13 (28.9%)	13 (38.2%)	0 (0.0%)	0.045

Abbreviations: NIHSS = National Institutes of Health Stroke Scale; ERT = endovascular reperfusion therapy; mTICI = modified treatment in cerebral ischemia; HI = hemorrhagic infarction; PH = parenchymal hematoma

Table 3. Predictors of poor clinical outcome at 90 days in BAO patients with DWI-pc-ASPECT ≤ 6

	Unadjusted OR (95% CI)	***p* Value**	**Adjusted OR (95% CI)**	**P**
Age > 70 years	11.25 (1.85–218.28)	0.0283	15.27(1.85–379.79)	0.0321
Symptomatic hemorrhage	4.00 (0.87–28.88)	0.1045		
Initial NIHSS	1.19 (1.06–1.37)	0.0075	1.21(1.07–1.44)	0.0093

OR = Odds ratio; CI = Confidence interval; NIHSS = National Institutes of Health Stroke Scale