The efficacy and safety of mechanical thrombectomy in acute basilar artery occlusion

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Summary

Objective: To evaluate the efficacy and safety of mechanical thrombectomy in revascularization of patients with acute basilar artery occlusion (ABAO). *Subject and method*: This study included 22 patients with acute ischemic stroke attributable to ABAO treated within the first 12 hours after onset of symptoms. The clinical outcome and mortality rate were assessed 180 days after treatment. *Result:* The mean ± SD age of the patients was 66.14 ± 14.37 years (range: 29 - 86 years), the mean NIHSS on admission was 21.86 ± 9.05 (range: 2 - 35) and the mean GCS was 10.36 ± 3.58 (range: 5 - 15). None patients simultaneously received intravenous thrombolysis. A favorable outcome, defined as a modified Rankin Score (mRS) of 0 - 2 was observed in 31.8% of patients (7/22). Overall mortality rate was 40.9% (9/22). No symptomatic intracerebral hemorrhages and no procedure-related complications occurred. *Conclusion:* Mechanical thrombectomy with the stent retriever device can rapidly and improve functional outcome in patients with ABAO and these strategies have a low incidence of complications.

Keywords: Acute basilar artery occlusion, revascularization, ischemic stroke.

1. Background

The prognosis of acute basilar artery occlusion (ABAO) is generally accepted to be poor, with a mortality rate up to 90% and a severe residual deficit in more than 65% of survivors. Intravenous recombinant tissue plasminogen activator (rtPA) is the only approved treatment for acute stroke, but its efficacy is limited in large intracranial vessel occlusion. Early recanalization remains the main prognostic factor for an improved outcome, but the optimal strategy and most effective time window for treatment have not yet been established. More than half of patients with ABAO treated with intravenous or intra-arterial thrombolysis recanalize, but only 22 - 24% of these regain functional independence [2], [3]. Endovascular mechanical thrombectomy improves the recanalization rate and thus the patient outcome. Recently, mechanical thrombectomy is an acceptable management technique for ABAO with a longer therapeutic window and a higher recanalization rate. Controlled trials and different personal series showed that stent retrievers can achieve a very high rate of recanalization of up to 90%, improving clinical outcome in patients with acute intracranial large-vessel occlusion [7], [8]. Despite these findings, in BAO clinical data and detailed analyses of mechanical thrombectomy with stent retrievers are still sparse. Our study aimed to analyze the efficacy and safety of mechanical thrombectomy in patients with ABAO within 12 hour of symptom onset.

2. Subject and method

2.1. Subject

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This respectively analyzed 22 patients with a clinical syndrome of ABAO subsequently confirmed by computed tomography angiography (CTA) who had been treated by mechanical recanalization from January 2018 to July 2018, in the Stroke Center of 108 Military Central Hospital. The patients' demographics, risk factors, stroke presentation and severity, time of symptom onset and imaging data were collected. National Institute of Health Stroke Scale (NIHSS) and Glasgow Coma Scale (GCS) were assessed on admission.

Patient selection

Patients were eligible for mechanical thrombectomy if they: (1) Had a clinical diagnosis of acute stroke in the posterior circulation. (2) Were admitted within 12 hour after onset of symptoms. (3) Had an ABAO confirmed on CTA and matched the clinical symptoms.

Patients were excluded if they: (1) Were aged < 18 years. (2) Had cerebral imaging that revealed an intracranial hemorrhage.

2.2. Outcome measures

The NIHSS score was assessed on admission and at discharge. Assessment of the modified Rankin Scale (mRS) was performed 3 months after treatment. A mRS of 0 to 2 was defined as a good neurological outcome, and a mRS of 3 to 6 was defined as a poor outcome. The follow-up of patients at 90 days was assessed by telephone or clinical visit.

Computed tomography was performed at 24 hours after the therapy, or earlier if neurologic worsening was more than 4 points on NIHSS to detect the presence of ICH (intracranial hemorrhage) or reocclusion.

In-hospital neurological complications were recorded, including postprocedure hemorrhage and reocclusion.

2.3. Statistical analysis

Descriptive analysis included frequencies and percentages for categorical variables and mean ± SD for continuous variables. Patients with a favorable outcome were compared with those with a poor outcome using the Student t test or Wilcoxon rank test for continuous variables and the χ^2-test or Fisher exact test for categorical variables. Univariate logistic regression was used to identify predictors of clinical evolution. Statistical analyses were performed using SPSS 16.0.

3. Result

3.1. Baseline characteristics

From January 2018 to July 2018, 22 patients with ABAO were treated by mechanical recanalization in our center.

Table 1. Characteristics of the basilar occlusion patients

Baseline characteristics	Value
Age (mean ± SD, years)	66.14 ± 14.37
Male sex, (n, %)	18 (81.8)
Hypertension, (n, %)	17 (77.3)
Diabetes mellitus, (n, %)	6 (27.3)
Smoking, (n, %)	2 (9.1)
Atrial fibrillation, (n, %)	5 (22.7)
Heart valve disease, (n, %)	1 (4.5)
Prior stroke, (n, %)	6 (27.2)
Admission NIHSS score (mean ± SD)	21.86 ± 9.05
Admission GCS score (mean ± SD)	10.36 ± 3.58
Tetraplegia	8 (36.4)
Coma	8 (36.4)
Vertebral artery (VA) occlusion	2 (9.1)
Junction of VA and BA occlusion	3 (13.6)
Proximal BA occlusion	5 (22.7)
Distal BA occlusion	5 (22.7)
Complete BA occlusion	7 (31.9)
Stenting or balloon angioplasty	8 (36.4)
Onset to recanalization time (minutes), mean ± SD	427 ± 224

Mean age was 66.14 ± 14.37 (range: 29 - 86) years old. There were 18 men (81.8%). The mean NIHSS on admission was 21.86 ± 9.05 (range: 2 - 35) and the mean GCS was 10.36 ± 3.58 (range: 5 - 15). Their baseline clinical and radiological features are presented in Table 1. Seventeen patients with hypertension, six with diabetes, and one with heart valve disease, five with atrial fibrillation were reported.

All patients showed complete occlusion of the BA. Sites of occlusion were confirmed angiographically: 2 had V4 segment occlusion (9.1%), 3 had junction of V4 segment and basilar occlusion (13.6%), 5 (22.7%) had proximal BAO, 5 (22.7%) had distal BAO, 7 had complete BAO (31.9%). The mean ± SD time from symptom onset to recanalization was 427 ± 224 mins.

3.2. The factors associated with 3-month outcome of patients with acute basilar artery occlusion

Table 2. The factors associated with 3-month outcome of patients with acute basilar artery occlusion at 90 days

Baseline Variable	Favorable outcome (mRS ≤ 2) (n = 7)	Poor outcome (mRS > 2) (n = 15)	p
Age, mean (SD)	59.29 ± 19.10	69.33 ± 10.91	0.13
Male sex, (n, %)	7 (100.0)	11 (73.3)	0.13
Hypertension, (n, %)	4 (51.7)	13 (86.7)	0.12
Diabetes mellitus, (n, %)	1 (14.3)	5 (33.3)	0.34
Smoking, (n, %)	1 (14.3)	1 (6.7)	0.54
Atrial fibrillation, (n, %)	0 (0.0)	5 (33.3)	0.11
Heart valve disease, (n, %)	0 (0.0)	1 (6.7)	0.68
Prior stroke, (n, %)	1 (14.3)	5 (33.3)	0.36
Admission NIHSS score (mean ± SD)	16.29 ± 7.52	24.47 ± 8.70	0.04
Discharge NIHSS (mean ± SD)	5.14 ± 2.96	27.93 ± 14.61	0.001
Admission GCS score (mean ± SD)	12.57 ± 3.21	9.33 ± 3.35	0.04
Location of occlusion			0.23
VA	1 (14.3)	1 (67.0)	
Junction of VA and BA	3 (42.9)	0 (0.0)	
Proximal BA	0 (0.0)	5 (33.3)	
Distal BA	3 (42.9)	2 (13.3)	
Complete BA	0 (0.0)	7 (46.7)	
pc-ASPECT	8.86 ± 1.21	8.87 ± 1.80	0.99
Stenting or balloon angioplasty	5 (71.4)	3 (20.0) (Die: 2 patients)	0.05
Onset to recanalization time (minutes), mean ± SD	424.86 ± 170.21	428.20 ± 252.02	0.64

Tetraplegia	0 (0.0)	8 (53.3)	0.02
Coma	1 (14.3)	7 (46.7)	0.16

Mean NIHSS scores on admission (16.29 ± 7.52 versus 24.47 ± 8.70, p<0.04) and at discharge (5.14 ± 2.96 versus 27.93 ± 14.61, p<0.001) were significantly lower in patients with a good outcome. Other variables including age, sex, risk factors other than hypertension, diabetes mellitus, smoking, atrial fibrillation, heart valve disease, time to treatment, were not statistically associated with a good clinical outcome (Table 2).

4. Discussion

In our study, mean age was 66.14 ± 14.37 (range: 29 - 86) years old. There were 18 men (81.8%). The mean NIHSS on admission was 21.86 ± 9.05 (range: 2 - 35) and the mean GCS was 10.36 ± 3.58 (range: 5 - 15). Seventeen patients with hypertension, six with diabetes, and one with heart valve disease, five with atrial fibrillation were reported. All patients showed complete occlusion of the BA. Sites of occlusion were confirmed angiographically: 2 had V4 segment occlusion (9.1%), 3 had junction of V4 and basilar occlusion (13.6%), 5 (22.7%) had proximal BAO, 5 (22.7%) had distal BAO, 7 had complete BAO (31.9%). The mean ± SD time from symptom onset to recanalization was 427 ± 224 minutes.

In a series of 106 patients with ABAO treated with IA thrombolysis from 1992 - 2010, Jung et al found that lower NIHSS score on admission was an independent predictor of good or moderate clinical outcome (mRS: 0 - 3) (p<0.0001) and survival (p<0.012) at 3 months. The results of our study are in line with Jung's study. In our study, the median NIHSS score at admission was significantly lower in patients with a good outcome (mRS: 0 - 2) than in those with a poor outcome (16.29 versus 24.47, p<0.005). With regard to baseline NIHSS score, the mean NIHSS score on admission in our study population was 16, which was higher than those of previous studies. Higher baseline NIHSS score could also be one of the factors that contributed to the results obtained in our study.

The extent of early ischemic changes on pretreatment imaging studies can be used as a prognostic factor of clinical outcome in patients treated with recanalization therapy. Puetz et al showed that the posterior circulation ASPECTS on CTA source images predicts good outcome or death within 1 month in the subgroup of the BASICS registry population. Of 158 patients, 23% (18/78) of patients with a posterior circulation ASPECTS ≥ 8 had a good outcome, whereas 11% (9/80) of those with a posterior circulation ASPECTS < 8 had a good outcome. The mortality rate was 32% (25/78) in patients with a posterior circulation ASPECT ≥ 8 and 55% (44/80) in patients with a posterior circulation ASPECTS < 8. In our study, pc-ASPECT was not statistically associated with a good clinical outcome (8.86 ± 1.21 versus 8.87 ± 1.80, p>0.05).

Acute BAO is an infrequent type of acute stroke, often associated with high morbidity and high mortality even when treated with antiplatelet agents and systemic anticoagulation. There is a close association between revascularization and prognosis. According to a systematic analysis by Lindsberg et al, the likelihood of survival is only 2% without revascularization; hence, the recanalization of ABAO is by far the best way to preserve life.

In our study, a favorable outcome (mRS: 0 - 2) was seen in 7 patients, which represented 31.8% of all patients and 53.8% of the survivors. The mortality rate was 40.9% (9/22) at 90 days. Eight patients died in hospital because of extensive brain stem infarction. One patient with mRS score of 5 at discharge died 90 days after an initial stroke. There are still only a few studies that have investigated the clinical results of mechanical thrombectomy with stent retrievers in

patients with ABAO. These previous studies included patients treated within 24 hours of stroke symptom onset. In a series of 14 patients treated with a Solitaire thrombectomy, Mordasini et al, reported that 28.6% (4/14) had a good outcome (mRS: 0 - 2), and the mortality rate was 35.7% (5/14). Most recently, in a series of 31 patients treated with Solitaire thrombectomy as the first-line endovascular treatment, Mourand et al, reported that 35% (11/31) had a good outcome, the mortality rate was 32% (10/31), and mean time from symptom onset to recanalization was 512 minutes.

We performed a post procedural CTA, one patient had a post-procedural BA reocclusion. Twenty patients developed infarction (cerebellar (n = 7), brain-stem (n = 1) and occipital lobe (n = 2)). No patient had symptomatic hemorrhage during their hospital stay.

Our study confirms the safety of mechanical thrombectomy with using stent retriever in patients with ABAO. There was no symptomatic hemorrhage after mechanical thrombectomy in this study, and no vessel ruptured or arterial dissections related to the stent retriever device occurred. A recent study suggested that SAH might occur after mechanical thrombectomy because of angiographically occult ruptures of small vessels caused by mechanical stretch during stent retrieval and that this had a benign clinical course. Mordasini et al reported no device-related complications or symptomatic hemorrhage. The present study focused on BAO, and no surgical errors or intracranial hemorrhages were observed during surgery. Although twelve patients developed infarction and one patient had a post-procedural BA reocclusion on post-procedural CTA.

All 22 patients were treated with mechanical thrombectomy only. Angioplasty and stenting of the BA were performed following thrombectomy failure in 3 patients and 5 patients were treated with emergent stent placement in VA.

In cases of obvious vascular stenosis in which recanalization could not be achieved by thrombectomy. However, we tried to avoid emergency stenting in our treatment process, as it may increase the risk of hemorrhage and occlusions. In the present study, eight patients were treated with emergent stent placement, two of whom died and five of whom achieved a good outcome. It may be that these patients who needed emergent stent placement were all in a serious condition, and their vessels were already in poor condition. It is critical to perform follow-up treatment after stent placement, including anticoagulant and antiplatelet treatment. No patient developed symptomatic intracerebral hemorrhage. Emergent stent placement remains controversial and needs to be verified through further investigation.

5. Conclusion

Data from 22 patients in our hospital showed that a favorable outcome (mRS) of 0 - 2 was observed in 31.8% of patients (7/22). Overall mortality rate was 40.9% (9/22). No symptomatic intracerebral hemorrhages and no procedure-related complications occurred. This study demonstrates that mechanical thrombectomy are safe and effective for the treatment of patients with acute BAO and may reduce mortality and prevent reocclusion of the basilar artey, can be an effective strategy to restore blood flow and save the patient's life.

The limitations of our study included the small number of patients and the lack of a control group.

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