Clinical Study

Mechanical thrombectomy with the Solitaire AB stent for treatment of acute basilar artery occlusion: A single-center experience

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ABSTRACT

Basilar artery occlusion (BAO) remains one of the most devastating subtypes of ischemic stroke, and prognosis is poor if early recanalization is not achieved. The purpose of this study was to evaluate the safety and technical feasibility of mechanical thrombectomy with the Solitaire AB stent (Covidien, Irvine, CA, USA) for the treatment of acute BAO through a single-center experience. Twenty-one patients with acute BAO were treated with mechanical thrombectomy with the Solitaire AB stent device between 1st September 2011 and 1st December 2014. Recanalization was assessed using the Thrombolysis in Cerebral Infarction (TICI) scale system. Clinical outcome was established at discharge by The National Institute of Health Stroke Scale (NIHSS), and the mean time from symptom onset to recanalization determined. Authors had access to identifying information during or after data collection. The clinical status of patients on admission was severe, with a mean NIHSS score of 25.57 ± 5.20 (range: 16–38), and the number of patients with TICI 2b or 3 was 0. The mean time from symptom onset to recanalization was 579.00 ± 188.78 min (range: 360–960 min). At 3-month follow-up, eight (38.1%) patients had a good clinical outcome. At follow-up, the trial of ORG 10172 in acute stroke treatment (TOAST) classification was large-vessel atherosclerosis in 13 patients (61.9%), cardioembolic in seven patients (33.3%), and undetermined in one patient (4.8%). In our series, application of the Solitaire AB stent retriever in acute BAO resulted in a high recanalization rate without procedural complications, and with good clinical outcome. Further prospective trials are needed to confirm the potential clinical benefit of this treatment approach.

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1. Introduction

Acute basilar artery occlusion (BAO) is an uncommon cause of ischemic stroke, accounting for 6–10% of intracranial large-vessel occlusion, and is associated with a very poor outcome. BAO also has the highest mortality rate of all types of ischemic stroke [1], with a morbidity and mortality rate of acute BAO of 80–90% without active intervention [2].

Intravenous thrombolysis (IVT) within 4.5 hours after symptom onset remains the first choice for acute BAO [3]. However, the narrow time window and various devastating clinical symptoms of acute BAO have limited the application of IVT [4]. Intra-arterial thrombolysis (IAT) is another pharmacologic thrombolysis method. However, the efficacy of IA compared with IV therapy

for treatment of acute BAO remains unclear owing to a lack of randomized controlled trials (RCT) [2]. According to a systematic review of BAO, the incidence of mortality or dependency are similar after IVT or IAT treatment [5]. Further, the clinical outcomes following IVT or IAT for treatment of acute BAO remain unsatisfactory.

More recently, the introduction of mechanical thrombectomy (MT) has provided marked advantages for revascularization of large intracranial artery occlusion [6]. The most common MT devices include the Merci (Concentric Medical, Mountain View, CA, USA) and Penumbra (Penumbra, Alameda, CA, USA) aspiration catheters, and the Solitaire (Covidien, Irvine, CA, USA) and Trevo (Stryker Neurovascular, Fremont, CA, USA) stent retrievers [7]. For example, recent RCT of endovascular MT treatment with stent retrievers showed increased rates of successful recanalization and improved clinical outcomes in acute intracranial large-vessel occlusion [8–12]. However, most RCT focusing on the efficacy of stent retrievers were performed in large vessel occlusions of the

anterior circulation, with only a few retrospective case series on BAO treated with stent retrievers. Hence, the safety and efficacy of stent retriever MT remain unclear in patients with ischemic stroke caused by acute BAO.

The aim of the present study was to evaluate the feasibility, efficacy, and safety of mechanical thrombectomy with the Solitaire AB stent, a type of self-expanding and fully retrievable stent, as a first-line endovascular therapy in patients with acute BAO [13,14]. The Solitaire AB stent was originally used for the treatment of intracranial aneurysms, and has the same structure as the Solitaire FR (Covidien), a classic stent retriever for MT.

2. Materials and methods

Consecutive patients who underwent MT for acute BAO with a Solitaire AB stent with or without combined treatment between 1st September 2011 and 1st December 2014 in our center were retrospectively analyzed in this study.

The time window was 24 hours. Each patient was assessed by the senior stroke neurologist with the National Institute of Health Stroke Scale (NIHSS), followed by an urgent CT scan to rule out intracranial hemorrhage. NIHSS was ascertained on admission and at discharge. Successful recanalization was defined as a Thrombolysis in Cerebral Infarction (TICI) grade of 2b or 3. The modified Rankin Scale (mRS) was determined at 90 days after treatment. An mRS score of 0–2 was adopted as good functional outcome, and a score of 3–6 was adopted as poor functional outcome. Stroke etiology was classified according to the trial of ORG 10172 in acute stroke treatment (TOAST) criteria.

2.1. Intervention procedure

All interventions were performed by senior neuro-interventionalists under local or general anesthesia depending on patient condition. All patients were treated via femoral access. Aortic arch angiography was performed to clarify the location and length of the BAO lesion and collateral compensatory capacity. After confirmation, a 6F guiding catheter was placed into the dominant or most accessible vertebral artery.

MT was performed with the Solitaire AB stent. A microcatheter (Rebar-18; Covidien) with a 0.014-inch microwire (Synchro-14; Stryker neurovascular) was carefully advanced through the occluded segment under roadmap guidance. Digital subtraction angiography (DSA) was subsequently performed through the microcatheter to confirm the microcatheter tip was totally beyond the distal end of the thrombus and to assess the circulation of the distal artery. If the microwire could not advance through the occluded segment smoothly, low-dose local IA pharmacologic thrombolytics—usually urokinase or recombinant tissue-type plasminogen activator (r-tPA)—were often used.

Once the ideal position of the microcatheter tip was identified, the Solitaire AB stent was advanced through the microcatheter until the distal stent markers coincided with the tip marker of the microcatheter. The stent was unsheathed completely with the microcatheter being pulled back, and DSA was performed to observe flow restoration. The duration of stent deployment before the MT maneuver varied between 3–5 min. The microcatheter was withdrawn with the unsheathed Solitaire AB stent, guided gently into the guide catheter and out of the body, and simultaneous aspiration with a 50 mL syringe was performed at the guide catheter. DSA was re-performed to evaluate the MT result. The procedure was repeated if DSA showed persistent occlusion or incomplete vessel recanalization, although the MT maneuver did not normally exceed five times. After recanalization, a 15–30 min observation period was necessary to ensure no re-occlusion occurred, and the MT procedure was then complete.

We used low-dose IA urokinase or r-tPA infusion with stent deployment (Solitaire AB) as a supplement to MT when there was an underlying stenosis or insufficient recanalization. Once stent permanent deployment was performed, 10 µg/kg tirofiban (100 mL, 5 mg; Grandpharma Co., Ltd., Wuhan, China) was immediately administered by IV bolus and continued at 0.15 µg/kg/min. At 24 h post-procedure, 100 mg of aspirin and 75 mg of clopidogrel were administered. Tirofiban was stopped after overlapping medicine treatment for 6 hours at least. Aspirin and clopidogrel were administered per day for 3 months.

2.2. Statistics

Means with standard deviation (SD) were calculated for the numeric variables. Fisher's exact test was used for categorical data, and an independent-samples t-test was used for continuous data. All statistical analyses were performed with SPSS 10.0 (SPSS, Chicago, IL, USA). A value of $p < 0.05$ was considered statistically significant.

3. Results

Between 1st September 2011 and 1st December 2014, 21 patients with acute BAO received MT therapy using Solitaire AB stent in our center. The basic characteristics and clinical results are shown in Table 1. The mean age of the patients (14 males, 7 females) was 58.19 ± 12.79 years (range: 42–86 years).

The clinical status of patients on admission was severe, with a mean NIHSS score of 25.57 ± 5.20 (range: 16–38), and the number of TICI 2b or 3 patients was 0. The mean time from symptom onset to recanalization was 579.00 ± 188.78 min (range: 360–960 min). No patients received IV r-tPA before MT. Twenty (95.2%) patients achieved successful recanalization. The mean number of MT per patient was 1.90 ± 1.17 (range: 1–5). Fourteen (66.7%) patients also received low-dose IA urokinase or rt-PA infusion. Nine solitaire AB stents were permanently deployed to treat underlying stenosis after MT.

One patient had an intracranial hemorrhage after successful one-time-stent-passing recanalization. Basilar artery dissection occurred during the MT procedure in one case and caused recanalization failure. Seven (33.3%) patients died and the mean NIHSS score was 9.93 ± 7.12 (range: 2–21) at discharge. At 3-month follow-up, eight (38.1%) patients showed a good clinical outcome. TOAST classification was large-vessel atherosclerosis in 13 (61.9%) patients, cardioembolic cause in seven (33.3%) patients, and undetermined in one (4.8%) patient.

4. Discussion

Timely recanalization is a strong predictor of good outcomes in acute ischemic stroke. A recent meta-analysis examined the relationship between recanalization of acute BAO and clinical outcomes from 45 studies (n = 2056), and reported a 2-fold and 1.5-fold reduction in mortality and risk of death or dependency, respectively [15]. The technical feasibility of MT with stent retrievers has been previously reported [16], with the greatest advantage being the high recanalization rate compared with intravenous thrombolysis. Recently, several RCT [8–12] showed that stent retrievers could achieve a high rate of successful recanalization of acute anterior circulation large-vessel occlusion and improve clinical outcomes and survival rates. However, those studies all focused on anterior circulation acute stroke; there are no RCT, to our knowledge, on the safety and efficacy of using stent retrievers MT for acute BAO. Further, only a few small-sample-sized