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Emergent intracranial stenting for acute M2 occlusion of middle cerebral artery

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ABSTRACT

Objective: Intracranial stenting is a possible option as a rescue strategy for acute secondary division (M2) occlusion of middle cerebral artery (MCA) when intravenous thrombolysis is ineffective or contraindicated.
Methods: We reviewed 10 patients of acute M2 occlusion treated by intracranial stenting who were ineligible for intravenous thrombolysis or resistant to intravenous thrombolysis. All patients underwent intracranial stenting with the Wingspan stent system. We analyzed clinical and angiographic outcomes.
Results: The mean NIHSS score on admission was 13.8 points (range 6–23). The occlusion sites were located in the superior division ($n=4$, left: 3, right: 1), the middle division ($n=1$, right) and the inferior division ($n=5$, all: right) of MCA. The mean time interval from stroke symptom onset to stenting was 348.9 ± 90.4 min. Successful recanalization was achieved in all patients. No intracranial hemorrhage, vessel perforations or dissections occurred in any patient. One patient developed acute thrombosis in distal ICA of the stented side at 4 days after a stent placement and was managed with mechanical thrombectomy. All patients improved on the NIHSS (mean amount: 8.8) and to the NIHSS score of 5 ± 4.6 (median 4.5, range 0–15) at 7 days. At discharge, an mRS of ≤ 3 was achieved in 8 patients (80%) and an mRS of ≤ 2 was achieved in 6 patients (60%).
Conclusions: Endovascular recanalization with a Wingspan stent can be a safe and feasible procedure for acute M2 occlusion when intravenous thrombolysis is ineffective or not available.
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1. Introduction

Successful recanalization is an important factor in determining good outcome in acute ischemic stroke [1]. However, the efficacy of intravenous tPA for complete recanalization is relatively low, and the recanalization rate for acute M2 occlusions after intravenous tPA is approximately 30% [2]. Intra-arterial thrombolysis alone, or in combination with intravenous thrombolysis may be more effective. However, the rate of recanalization of chemical intra-arterial and intravenous thrombolysis is still unsatisfactory. The rates of symptomatic intracranial hemorrhage were 6.4% in NINDS [3] and 10% in PROACT II studies [4]. There are several exclusion criteria of intravenous and intra-arterial thrombolysis. Main exclusion criteria are (1) significant head trauma or prior stroke in previous 3 months. (2) Symptoms suggesting subarachnoid hemorrhage. (3) History of previous intracranial hemorrhage. (4) Elevated blood pressure (systolic > 185 mm Hg or diastolic >110 mm Hg). (5) Platelet count <100,000/mm^3. (6) Current use of anticoagulant with INR > 1.7 or PT > 15 s. (7) Current use of direct thrombin inhibitors or direct factor Xa inhibitors with elevated sensitive laboratory tests (such as aPTT, INR, platelet count, and ecarin clotting time; TT; or appropriate factor Xa activity assays). (8) Blood glucose concentration <50 mg/dL (2.7 mmol/L). (9) CT demonstrates multilobar infarction (hypodensity > 1/3 cerebral hemisphere) [5]. Recent case series reported acceptable safety, good outcomes and good recanalization rates with intracranial stenting in patients with acute MCA occlusion if other recanalization modalities have failed or in patients who have been ineligible for intravenous tPA [6–12]. However, there has not been much reported regarding the use of intracranial stents for recanalization of acute M2 occlusions.

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We report recanalization rates, complications, and outcomes of patients treated with intracranial stenting as a rescue procedure for acute M2 occlusion.

2. Materials and methods

Ten patients with acute M2 occlusion were treated by intracranial stenting in our stroke center between May 1, 2010 and September 31, 2011. Our Institutional Review Board approved collection of interventional and clinical data for this study. Informed consent was obtained from the patient or the next of kin in this off-label stenting for recanalization. We treated patients in whom recanalization was not achieved with intravenous thrombolysis, patients who were ineligible for intravenous thrombolysis or who presented after 3 h of symptom onset. Stenting was completed within 8 h from stroke symptom onset. Diffusion-weighted image (DWI), computed tomography (CT), CT perfusion (CTP), and CT angiography were performed to assess for arterial occlusion and diffusion/perfusion mismatch. DWI was done in all patients and CTP was done in 8 patients. We analyzed demographic features, clinical characteristics, location of occlusion, symptom onset to arrival time, symptom onset to stenting time, use of adjunctive chemical therapies (urokinase or glycoprotein IIb/IIIa inhibitors), and procedural complications. National Institute of Health Stroke Scale (NIHSS) was checked before and at 7 days after stenting. The modified Rankin Score (mRS) was also checked at discharge. Outcome was stratified to "good" (mRS 0–2), "moderate" (mRS 3), and "poor" (mRS 4–6). Recanalization result was evaluated by the Thrombolysis in Cerebral Infarction (TICI) score (graded as 0 for absent perfusion, 1 for minimal distal perfusion, 2 for partial perfusion, and 3 for complete perfusion).

Interventional procedures were performed in the neuroangiography room equipped with a digital subtraction angiography system (Axiom Artis, Siemens, Germany). All stents were deployed under local anesthesia. Percutaneous access using 6-French sheath was gained via the common femoral artery. Diagnostic angiography including all cerebral arteries was performed to evaluate the site of vessel occlusion and collateral circulation.

After angiographic confirmation of acute M2 occlusion, a 6F guiding catheter (Envoy, Cordis Endovascular Corporation, USA) was positioned in the distal cervical or petrous internal carotid artery (ICA). A microcatheter (Echelon 10, Micro Therapeutics, USA) was used to cross the occlusion segment over a 0.014-in. microwire (Transend, Boston Scientific Corporation, USA). The lesion length was estimated from the proximal vessel occlusion to the beginning of the normal vessel distal to the clot on microcatheter angiography. A slightly oversized (0.5–1.0 mm) stent was used to allow complete apposition to the vessel wall. A Wingspan stent catheter was advanced across the lesion using the road map, and the stent was slowly deployed. If an in-stent stenosis was found on post-stenting angiography, balloon angioplasty using a Gateway balloon (Boston Scientific Corporation, USA) was performed within stent with slow balloon inflation to prevent vascular dissection or rupture. If a residual thrombosis was seen on post-stenting angiography, a microcatheter was navigated into the thrombotic segment, and then immediate thrombolysis with urokinase was given to dissolve the thrombosis. If recurrent thrombosis or reocclusion was identified on post-stenting angiography, intra-arterial injection of 6 mg abciximab (Reopro; Centocor, Leiden, Netherlands) through a guiding catheter was administered, and repeated 2 mg abciximab bolus was administered until a complete thrombolysis was achieved. Angiographic recanalization result was assessed according to the Thrombolysis in Cerebral Infarction (TICI) score [13].

After the procedure, a complete neurological examination was performed on all patients by a vascular neurologist, and all patients underwent non-enhanced brain CT for detection of possible hemorrhagic complications. MR diffusion imaging was performed on the first post-procedural day. After the procedure, daily aspirin 100 mg and clopidogrel 75 mg were administered; 2850 IU of low-molecular-weight nadroparin calcium (Fraxiparine; Glaxo-SmithKline, Notre Dame De Ville, France) was also administered subcutaneously 2 or 3 times a day for at least three days. All patients were reevaluated in follow up 90 days after stenting (Figs. 1 and 2).

3. Results

Ten patients (4 men and 6 women, mean age 68.4 ± 14.4) were included in this study from May 2010 until September 2011. The patients' mean NIHSS score on admission was 13.8 points with standard deviation of 5.2 points. (range 6–23) The occlusion sites were located in the superior division ($n = 4$, left: 3, right: 1), the middle division ($n = 1$, right) and the inferior division ($n = 5$, all: right) of MCA. The mean time interval from stroke symptom onset to arrival at emergency department was 141 ± 116 min (Table 1). Two patients were taking 100 mg of aspirin daily prior to the ischemic stroke (patient 8 and 9). Four patients received a standard intravenous tPA (0.9 mg/kg body weight). Two patients (patient 3 and 6) arrived in our center beyond the 3-h time window. Another 4 patients were not able to receive an intravenous rtPA because patient 5 had the gastric polypectomy 12 days ago before he admitted to the emergency department, patient 7 had the Ventriculo-Peritoneal shunt after intracerebral hemorrhage, patient 8 was taking warfarin for atrial fibrillation and patient 10 had another acute ischemic stroke 2 days ago before referral to our center. Successful stent deployment and recanalization were achieved in all patients (TICI 2a: 1, TICI 2b: 6, TICI 3: 3) (Table 2). The mean time interval from stroke symptom onset to stenting was 348.9 ± 90.4 min. In 5 patients (50%), an in-stent stenosis was found on post-stenting angiography and was dilated with balloon angioplasty using a Gateway balloon. Additional post-stenting intra-arterial chemical thrombolysis was used in 9 patients. These included glycoprotein IIb/IIIa inhibitor ($n = 3$, mean dose; 11 mg) and urokinase ($n = 7$, mean dose; 292,857 U). We had no perforations or dissections at the target artery in any of the patients. One (patient 9) developed acute thrombosis in distal ICA of the stented side at 4 days after a stent placement and was managed with mechanical thrombectomy. None of the patients had intracranial hemorrhage on control CT. Table 2 shows the lesion location, the stent used, the angiographic results and the complications of stenting. Neurologic improvement on the NIHSS (mean improvement: 8.8 points) at 7 days after stenting occurred in all patients. At 7 days, patients' NIHSS score was 5 ± 4.6 (median 4.5, range 0–15). Table 3 shows interval improvement in main neurological functions at 7 days after stenting. An mRS of ≤ 3 was achieved in 8 patients (80%) and an mRS of ≤ 2 was achieved in 6 patients (60%) at discharge. No ischemic events developed within 90 days follow up after stenting.

4. Discussion

The European Cooperative Acute Stroke Study (ECASS) III trial allows the window for thrombolysis to extend to 4.5 h from the time of stroke symptom onset [14]. This extended time window may slightly increase the number of patients who receive intravenous tPA, but is unlikely to increase the rate of recanalization. There will still remain a portion of acute ischemic stroke patients who have contraindications to intravenous tPA, and only a small number of patients are still admitted in this time window. Also, the efficacy of intravenous tPA for recanalization is not sufficient. The recanalization rate with intravenous tPA is only 30% for M2

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