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Clinical Study

Excellent rates of recanalization and good functional outcome after stent-based thrombectomy for acute middle cerebral artery occlusion. Is it time for a paradigm shift?

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ABSTRACT

The natural history of untreated acute middle cerebral artery (MCA) occlusion is poor, with high rates of mortality (5–33%) and severe long-term disability (40–80% of survivors), despite therapy with intravenous tissue plasminogen activator. We analyzed outcomes in 31 consecutive patients with major ischemic stroke due to acute proximal MCA occlusion who were treated at the Hadassah-Hebrew University Medical Center from February 2010 to October 2012 by endovascular means, using the Solitaire stent (Covidien, Irvine, CA, USA) as a thrombectomy device. Patients had a mean age of 63.3 ± 16.2 years (range, 26–92). The admission National Institutes of Health Stroke Scale score was 19.5 ± 4.3 (median 20). Mean time from symptom onset to femoral artery puncture was 3.8 ± 1.1 hours (median 4 hours). Mean time to recanalization was 46.9 ± 11.1 minutes. Successful recanalization by means of stent-based thrombectomy alone was achieved in 90% of cases and reached 100% after combining definitive stent implantation in three patients. There was no arterial rupture or subarachnoid hemorrhage. Hemorrhagic transformation developed in seven patients (23%), but was symptomatic in only one. Post-procedure CT scan or MRI demonstrated >90% sparing of cortex at risk in all patients. Functional outcome at 90 day follow-up was modified Rankin Score 0–2 in 77% of all patients and 88% of patients younger than 80 years. Three patients (10%) died during hospitalization due to mesenteric event, sepsis, or pulmonary embolism. Our experience suggests that stent-based thrombectomy in selected patients for acute MCA occlusions is safe, very effective in terms of arterial recanalization, and associated with improved neurological outcome. If validated by other groups, endovascular treatment may be proposed as the therapy of choice for MCA occlusion.

1. Introduction

Acute middle cerebral artery (MCA) occlusion is among the most common occlusion patterns observed in stroke patients. MCA occlusion is often caused by cardioembolism, or less frequently by large artery disease. The natural history of untreated acute MCA occlusion is poor, with mortality rates ranging between 5% and 33% and severe long-term disability in 40% to 80% of survivors.[1–4] Patients who develop space-occupying hemispheric infarctions have a fatality rate of up to 80%.[5] Although different therapeutic options are available for acute MCA occlusion, most stroke centers provide only intravenous (IV) thrombolysis with only a minority offering endovascular alternatives. However, a significant proportion of patients with acute MCA infarction have poor outcomes despite therapy with IV tissue plasminogen activator (t-PA),[6–8] primarily because IV thrombolysis achieves recanalization in only about one-third of patients with MCA occlusion.[9] Thus, endovascular therapy is a very reasonable alternative for these cases, especially considering the unprecedented rates of rapid recanalization recently shown with stent-based thrombectomy.[10–13]

This study aims to analyze a series of consecutive patients with major ischemic stroke due to acute proximal MCA occlusion who were treated using stent-based mechanical thrombectomy techniques, and to compare these results with other available therapeutic alternatives.

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2. Material and methods

This study included 31 consecutive patients with acute ischemic stroke secondary to proximal MCA occlusion who were treated with self-expanding neurostents used as a thrombectomy device (Solitaire; Covidien, Irvine, CA, USA), at a single institution (Hadassah-Hebrew University Medical Center) between February 2010 and October 2012. Demographic and clinical data are presented in Table 1. All patients presented with major ischemic stroke secondary to MCA occlusion shown on admission cranial CT scans, including CT angiography. Stent-thrombectomy was performed in acute ischemic stroke within 8 hours of symptom onset in patients with a National Institutes of Health Stroke Scale (NIHSS) score >12, who had no cerebral hemorrhage and no signs of clear early cerebral infarction involving more than one-third of the endangered territory. Patients with major intracranial occlusions associated with underlying atherosclerotic stenoses requiring permanent stent implant were excluded from this study population.

Collateral supply was evaluated according to the American Society of Interventional and Therapeutic Neuroradiology/Society of Interventional Radiology Collateral Flow Grading System on pretreatment angiography, where a good collateral supply corresponds to Grade 3-4, fair corresponds to Grade 2-3 and poor to 0-2.[14] Time to therapy (TTT) was defined by the latency between symptom onset and arrival to the angiosuite. Time to recanalization (TTR) was defined as the latency from femoral access until the first angiographic run showing recanalization. The number of stent passes required to recanalize the artery was registered. Degrees of baseline occlusion and final revascularization were assessed using the Thrombolysis in Myocardial Infarction (TIMI) flow classification.[15]

Assessment of hemorrhagic transformation (HT) was based on evaluation of follow-up CT scans by experienced neuroradiologists. The presence and type of HT were defined according to previously published criteria.[16,17] Hemorrhagic infarction (HI) was defined as petechial infarction without space-occupying effect, and parenchymal hematoma (PH) was defined as hemorrhage with mass effect. HI was categorized as HI1 (small petechiae) or HI2 (more confluent petechiae). PH was categorized as PH1 when hematoma involved <30% of the infarcted area with mild space-occupying effect and as PH2 when hematoma involved >30% of the infarcted area with significant mass effect or clot remote from the infarcted area. Symptomatic intracerebral hemorrhage was defined as any PH on follow-up imaging associated with clinical deterioration of >4 points on the NIHSS score within 36 hours. Patient outcome was defined by NIHSS at 7 days and modified Rankin Scale (mRS) at 3 months.[18] Good outcome was defined as mRS 0-2. Early dramatic recovery after thrombectomy was defined as NIHSS $\leqslant$5 at 24 hours. Ischemic stunning of the brain or stunned brain syndrome was defined as failure to improve clinically during the early post-procedural period despite rapid endovascular recanalization and limited irreversible damage on CT scans, with slow clinical improvement leading to good outcomes at 3 months.

Table 1
Baseline clinical characteristics of 31 patients undergoing stent-based MCA thrombectomy

Characteristic	*n* (%), unless otherwise specified
Demographics	
Age in years, mean ± SD	63.3 ± 16.2
Female sex	17 (55%)
NIHSS score on admission, mean ± SD	19.5 ± 4.3
NIHSS score on admission, median	20
Cerebrovascular risk factors	
Hypertension	15 (48%)
Atrial fibrillation	13 (42%)
Ischemic heart disease	13 (42%)
Dyslipidemia	13 (42%)
Diabetes mellitus	7 (23%)
Current smoker	5 (16%)
Prosthetic valve	5 (16%)
Postpartum	1 (3%)
Target vessel occlusions	
Proximal R-MCA	17 (55%)
Proximal L-MCA	14 (45%)
Baseline occlusion	
TIMI 0	29 (94%)
TIMI 1	2 (6%)
Angiographic collateral flow grading[13]	
Grade 0-1	16 (52%)
Grade 2	11 (35%)
Grade 3	4 (13%)
ASPECT score	
Admission CT score, mean ± SD	8.3 ± 1.1
Admission CT score, median	8

SD = standard deviation, NIHSS = National Institutes of Health Stroke Scale, MCA = middle cerebral artery, TIMI = thrombolysis in myocardial infarction, ASPECT = Alberta Stroke Program Early Computed Tomography, R = right, L = left.

3. Patient management strategy

Every patient with suspected major artery acute stroke (NIHSS >10) is admitted through the Emergency Department after a rapid stroke anamnesis, neurological evaluation, blood tests, and head CT scan with CT angiogram are obtained. Even before CT scanning is performed, the neurointerventional team is routinely alerted for the possibility of an endovascular procedure. If the patient is diagnosed with a major intracranial artery occlusion within 3 hours of symptom onset and the neurointerventional team can take the patient within the following 30 minutes, intravenous thrombolysis is not administered and the patient is treated with primary endovascular therapy. If the neurointerventional team cannot take the patient within that time, then intravenous thrombolysis precedes the endovascular procedure. Patients with ischemic stroke admitted within 3–6 hours after symptom onset are transferred to the angiographic suite only if the CT scan does not show significant ischemic changes (more than one-third of the MCA territory rule). Borderline cases, wake-up strokes, and patients admitted after 6 hours are routinely evaluated with MRI studies for assessment of diffusion-perfusion mismatch.

4. Surgery

The stent-thrombectomy endovascular technique used in these patients has been previously described and is briefly presented here, with minor variations.[10–13] Every patient was intubated and a 6-French femoral introducer was placed into the right femoral artery. After access was obtained, a single bolus dose of 2500 units of IV heparin was administered. Diagnostic angiogram was used to assess the MCA occlusion pattern, vessel tortuosity, concomitant stenosis, and collateral supply. Either an 8-French 90 cm Concentric Merci balloon guiding catheter (Concentric Medical, Mountain View, CA, USA) or a Cello Balloon Guide Catheter (Covidien) was then placed at the appropriate internal carotid artery beyond the carotid bulb. Under road mapping, the MCA occlusion was crossed with a Transcend or Synchro 0.014 inch microguidewire (Boston Scientific, Boston, MA, USA) and a Rebar 18 microcatheter (Covidien). Lesion length was estimated as the distance between the vessel cut-off on the initial catheter angiography and the beginning of the normal vessel distal to the clot on microcatheter angiography. Routinely, a 4 $\times$ 20 mm Solitaire AB stent (Covidien) was fully deployed, extending across the entire occluded segment. Repeat angiogram was performed to evaluate the reconstituted flow through the occluded segment (transient endovascular bypass