Stentriever Thrombectomy Failure: A Challenge in Stroke Management

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■ BACKGROUND AND OBJECTIVE: **Stentriever thrombectomy failure in patients with acute ischemic stroke caused by anterior circulation large artery occlusion is not a rare event. The purpose of this study was to investigate whether other procedures (tirofiban, permanent stenting) are able to recanalize the occluded vessel and determine a better outcome without increasing mortality and intracranial hemorrhage rates.**

■ METHODS: **Among 513 patients consecutively admitted with anterior circulation stroke, 109 underwent stentriever thrombectomy. Modified Thrombolysis in Cerebral Ischemia (mTICI) 2b-3 recanalization was achieved in 60 patients (55.0%, group 1). Only 3 of 19 patients (group 2) obtained additional recanalization with intra-arterial infusion of tirofiban. The remaining 46 either underwent permanent stenting ($n = 23$, group 3) or were left non-recanalized ($n = 23$, group 4). The rate of mTICI 2b-3 and clinical outcomes were analyzed in the different groups.**

■ RESULTS: **A successful recanalization (mTICI 2b-3) was achieved in 17 patients of group 3 (73.9%). A significantly better outcome was observed in group 3 (modified Rankin Scale [mRS] score, 0–2) than in group 4 at 3 months (56.5% vs. 17.4%). Symptomatic intracranial hemorrhage rates were not different between group 3 and group 4 (4.3% vs. 4.3%), whereas there was a significantly higher mortality in group 4 than in group 3 (39.1% vs. 4.3%). On multivariate analysis, permanent stenting was the only factor independently associated with favorable outcome and mortality.**

■ CONCLUSIONS: **Permanent stenting might be a feasible solution in patients with acute large artery occlusion after stentriever thrombectomy failure.**

INTRODUCTION

Endovascular mechanical thrombectomy combined with intravenous thrombolysis has recently been shown to be superior to thrombolysis alone in the treatment of patients with acute ischemic stroke with large artery occlusion (LAO) of the anterior circulation.[1] In particular, stentriever thrombectomy has been recommended as a first-line method for intra-arterial recanalization, although other thrombectomy or aspiration devices approved by local health authorities may be used at the discretion of the neurointerventionist if rapid, complete, and safe revascularization of the target vessel can be achieved.[2] Stentriever thrombectomy does not guarantee a successful recanalization (modified Thrombolysis in Cerebral Ischemia [mTICI], 2b-3) in all patients as already reported.[3] In these cases, additional treatment with glycoprotein IIb/IIIa antagonists such as tirofiban and/or permanent stenting might represent a possible solution to achieve a better prognosis, because recanalization is known to be a strong predictor of good outcome in cerebral ischemia secondary to LAO.[4] Glycoprotein IIb/IIIa inhibitors have been associated with increased risk of fatal intracerebral hemorrhage (ICH) and poor outcome,[5] but not in all studies,[6] and it has been shown that mechanical thrombectomy with stentrievers does not cause relevant endothelial damage.[7] Permanent stenting has been suggested as another primary approach or as

Key words
- Mechanical thrombectomy
- Stent
- Stroke
- Tirofiban

Abbreviations and Acronyms
CT: Computed tomography
CTA: Cerebral tomography angiography
CTp: Perfusion computed tomography
DSA: Digital subtraction angiography
ICA: Internal cerebral artery
ICH: Intracerebral hemorrhage
LAO: Large artery occlusion
MRI: Magnetic resonance imaging
mRS: modified Rankin Scale
mTICI: Modified Thrombolysis in Cerebral Ischemia
NIHSS: National Institutes of Health Stroke Scale
rt-PA: Recombinant tissue plasminogen activator

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a rescue tool for recanalization of acute intracranial LAO,[8-10] even though safety is an important issue here as well, because these procedures might increase the rates of symptomatic ICH and death. For this reason, we decided to conduct an observational study in patients with acute stroke caused by an anterior circulation LAO with the aim of investigating whether tirofiban and/or permanent stenting after mechanical thrombectomy failure are able to recanalize the occluded vessel and determine a better outcome without increasing mortality and ICH rates.

METHODS

General Study Protocol

Patients consecutively admitted to the Stroke Unit of the University Hospital of Padua (Italy) from January 2014 to July 2016 for their first-ever acute ischemic stroke caused by anterior circulation LAO (defined as occlusion of the intracranial internal carotid artery [ICA] and/or middle cerebral artery [M1 segment and/or proximal M2 segment]) were prospectively assessed according to standardized diagnostic and therapeutic procedures as recommended by the European Stroke Organization,[11] including treatment with intravenous recombinant tissue plasminogen activator (rt-PA) and/or mechanical thrombectomy in eligible patients. All patients details were entered in a computerized database, recording their demographic characteristics, routine blood tests, and vascular risk factors such as arterial hypertension (systolic blood pressure ≥140 mm Hg or diastolic blood pressure ≥90 mm Hg or current/past use of antihypertensive medication), diabetes mellitus [fasting serum glucose level ≥7.0 mmol/L (≥126mg/dL), nonfasting serum glucose level ≥11.1 mmol/L (≥200mg/dL), glycated hemoglobin (HbA_{1C}) level ≥48 mmol/mol or the use of glucose-lowering drugs], hypercholesterolemia [total cholesterol level >6.2 mmol/L (>240 mg/dL) or use of lipid-lowering drugs], smoking (current or stopped within 5 years), cardiac disease [history of angina pectoris, myocardial infarction, coronary treatment (angioplasty/stenting, or bypass surgery), any cardiac arrhythmia such as atrial fibrillation], peripheral arterial disease, or previous transient ischemic attack. Clinical and functional status was assessed with the National Institutes of Health Stroke Scale (NIHSS) and the modified Rankin Scale (mRS), respectively, both on admission and at discharge. Territorial distribution was evaluated in all patients with magnetic resonance imaging (MRI) or repeat computed tomography (CT) and with the Oxfordshire Community Stroke Project classification system.[12] In all patients, the extracranial and intracranial vessel status was assessed by noninvasive imaging and specifically the diagnosis of anterior circulation LAO was made by transcranial color-coded Doppler sonography[13] and confirmed by CT angiography (CTA) or magnetic resonance angiography if CTA was contraindicated and also by digital subtraction angiography (DSA) for patients undergoing endovascular treatment. Further diagnostic workup included standard blood tests, routine electrocardiography, transthoracic echocardiography, and 24-hour electrocardiography monitoring, plus coagulation studies, and transesophageal echocardiography, if appropriate. Patients with anterior circulation LAO as a result of intracranial dissection were excluded from this study.

Interventional Protocol

Endovascular treatment was decided on the basis of a direct cerebral CT scan (ASPECT [Alberta Stroke Program Early CT] score >5), CTA (anterior circulation LAO), and clinical characteristics (NIHSS score >6 or evolution of stroke symptoms) and was performed within 6 hours of symptom onset, under conscious sedation or general anesthesia depending on clinical neurologic conditions by 2 experienced neuroradiologists (F.C. and G.C.), who shared the same interventional protocol.

The occluded target vessel was the first vessel to be studied with DSA when perfusion CT (CTp) and CTA guaranteed an adequate information on the collateral circulation; otherwise, contralateral carotid and vertebral arteries were studied before reaching the occluded site.

Until 2015, an 8-F balloon guiding catheter (Merci 8F, Penumbra, Alameda, California, USA) or a peripheral guiding sheath (Destination 6F, Terumo, Elkton Maryland, USA) was positioned in the common carotid artery or, if possible, in the cervical ICA. The arterial occlusion was crossed with a 0.53 mm microcatheter (Prowler sel 2,3 F, Codman J&J, Raynham, Massachusetts, USA) and a stentriever thrombectomy was performed; this procedure was attempted for a maximum of 3 times, to minimize the time to recanalization (each attempt lasts about 10–15 minutes) and to reduce the risk of endothelial damage with possible hemorrhagic complications.

Since 2015, an 8-F guiding catheter (Destination 6F Terumo, Elkton, Maryland, USA or Neuron Max Penumbra 2,24 mm, Alameda, California, USA) has been positioned in the cervical ICA and a distal aspiration catheter (5Max Penumbra, Alameda, California, USA; Catalyst 6F Strycker, Freemont, California, USA; Sofia Plus Microvention 2,1 mm, Tustin, California, USA) was advanced to the occlusion site. A distal aspiration was then attempted; in case of failure, a stentriever thrombectomy with distal aspiration was performed.

In all cases of stentriever thrombectomy failure, we evaluated the opportunity to deploy a permanent stent in the occluded segment. The main indications for permanent stenting were: 1) Effectiveness of stentriever bypass when the device was in place but reocclusion or severe stenosis occurred immediately after its retrieval. In such cases, perfusion status is partially or completely recovered immediately after deployment but stops when the device is withdrawn. This situation happened in cases of an underlying stenosis as a result of atherosclerotic plaque, or clots that extended to the M2 segment and could not be completely removed, or in cases of a hard clot that did not penetrate the retriever struts. Extent and burden of the clot can be assessed by CTA and superselective angiography, and the quality of the clot or mural plaque is evaluated on the basis of the degree of hardness detected by a microguidewire and microcatheter, while passing through the thrombus, and observing opened struts after 3–5 minutes from deployment. 2) Presence of a calcified plaque or a distal occlusion that contraindicated multiple retrieve maneuvers. The detection of a calcified plaque visible on CT and CTA or the presence of a clot in an M2 segment contraindicates thrombectomy by means of stentriever, which might cause endothelial damage, dissection, or perforation and retriever encasement. In such cases, the delivery of a stent might be effective in restoring distal perfusion. Distal aspiration if possible