Intravenous Thrombolysis Facilitates Successful Recanalization with Stent-Retriever Mechanical Thrombectomy in Middle Cerebral Artery Occlusions

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Aim: Several factors influence the outcome after acute ischemic stroke secondary to proximal occlusions of cerebral vessels. Among others, noneligibility for intravenous thrombolysis (IVT) and incomplete revascularization have been identified as predictors of unfavorable outcome. The aim of this study was to investigate whether concomitant IVT influences the revascularization efficacy in mechanical thrombectomy (MT). *Methods:* This study conducted a retrospective analysis of all consecutive patients presenting with an anterior circulation stroke due to large-artery occlusion with imaging evidence who were treated with MT between July 2012 and December 2013 at 2 high-volume stroke centers. Imaging data were regraded and re-evaluated according to the modified Treatment in Cerebral Ischemia scale and its respective vessel occlusion site definitions. Clinical end points included National Institutes of Health Stroke Scale (NIHSS) and modified Rankin Scale; imaging and procedural measures were technical end points. *Results:* We identified 93 patients who presented with an occlusion of the middle cerebral artery (MCA): of these patients, 66 (71%) received IVT. We did not find statistically significant differences in the baseline NIHSS score, time from symptom onset to groin puncture, and age when comparing the IVT group with the non-IVT group. The rate of successful recanalizations (modified Treatment in Cerebral Ischemia score ≥ 2b) was significantly higher in patients with MCA occlusion and concomitant IVT ($P = .01$). Stepwise logistic regression identified IVT and thrombus length as predictive factors for successful mechanical recanalization ($P = .004$, $P = .002$). *Conclusion:* IVT and thrombus length are predictive factors for a successful

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recanalization in MT for acute ischemic stroke with underlying MCA occlusion.
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Intravenous thrombolysis (IVT) with tissue plasminogen activator (tPA) within 4.5 hours of symptom onset has been the standard of care in acute ischemic stroke since 2008.[1] Alas, IVT is less efficient in cases of large-artery occlusions. Revascularization rates of about 35% have been reported for middle cerebral artery (MCA) occlusions; in case of a carotid-T occlusion, the chances of a successful revascularization are substantially lower, down to about 6%.[2,3]The tPA failure rate in these cases correlates with the length of the thrombus. A thrombus length longer than 8 mm is a strong predictor for tPA failure.[4] These limitations have, among others, driven the evolution of endovascular therapies over the past years.[5,6] Several case series and recent randomized trials have analyzed the efficacy of mechanical thrombectomy (MT) and have shown favorable results whenever modern stent-retriever devices were used.[7,8] Many studies have investigated different peri-interventional parameters that might help to predict outcome after MT. Variables such as age, time from groin puncture to recanalization, site of occlusion, baseline Alberta Stroke Program Early CT Score (ASPECTS), and ineligibility for IVT were identified as predictors of unfavorable functional outcome at 90 days.[9-11] The final angiographic recanalization result graded either by the Thrombolysis in Myocardial Ischemia (TIMI) or the modified Treatment in Cerebral Ischemia (mTICI) score was also identified as a strong predictor of functional outcome; a TIMI score lower than 2 or an mTICI score of 2a or less is associated with a poor functional outcome at 90 days.[12] Most MT studies included both patients with and without concomitant IVT; nevertheless, the influence of tPA-based IVT on the final recanalization result after MT is not yet fully understood. Regarding the risk for intracranial hemorrhage after MT, IVT was not found to go along with a higher rate of complications (e.g., symptomatic intracranial hemorrhage) in MT.[13]

The primary aim of the present study was to investigate whether IVT with tPA does have an influence on the recanalization result of MT in anterior circulation stroke and secondarily whether IVT in combination with MT leads to better recanalization results compared to MT alone.

Materials and Methods

We screened the prospectively kept neurointerventional databases of 2 German stroke centers for all ischemic stroke patients presenting within 6 hours from symptom onset who underwent MT for an imaging-proven large-artery occlusion in the anterior circulation between July 2012 and December 2013. The administration of IVT was independent from the indication for MT and was performed by the treating stroke neurologist on the basis of the national guidelines of the Deutsche Gesellschaft für Neurologie (DGN). Study approval of the ethics committees of both centers was not necessary for this retrospective analysis. We excluded all patients who presented with additional ipsilateral extracranial carotid stenosis or occlusion who received emergency stenting of the internal carotid artery. No other exclusion criteria were applied. All patients had been included in other recent studies on stent–retriever-based MT that did not focus, however, on the effect of IVT as presented herein[14] (and unpublished work).

Endovascular Procedure

The technique has been described previously.[14-16] In brief, both centers relied on the principle of lesional aspiration with an intermediate catheter (triaxial approach); there was no balloon-guide occlusion of the internal carotid artery. Center A utilized the 054 and 5MAX aspiration catheter and the Separator 3D (Penumbra, Alameda, CA), and Center B used the DAC (DAC, Mountain View, CA) as intermediate aspiration catheter in concert with the TREVO ProVue (Stryker, Kalamazoo, MI) thrombectomy device.

Imaging Evaluation

All angiographic images were reanalyzed and regraded according to the Cerebral Angiographic Revascularization Grading CARG collaborators consensus statement modified Treatment in Cerebral Ischemia (mTICI) scale by 2 experienced interventional neuroradiologists who were blinded to the clinical and demographic data.[17] An angiographic recanalization result of mTICI 2b or 3 was defined as "successful" recanalization. The clot length was evaluated manually using thin-slice (1 mm) reconstructions with 5-mm maximum intensity projection images of nonenhanced computed tomography scans.

Clinical Assessment

A consultant neurologist assessed National Institutes of Health Stroke Scale (NIHSS) scores on admission and discharge. The follow-up modified Rankin Scale was graded by a board-certified neurologist either in an outpatient clinic consultation or at the treating stroke rehabilitation center. An improvement in the NIHSS score at