Intravenous Thrombolysis and Passes of Thrombectomy as Predictors for Endovascular Revascularization in Ischemic Stroke

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Background: Patient selection for endovascular revascularization treatment (ERT) in acute ischemic stroke depends on the expected benefit–risk ratio. As rapid revascularization is a major determinant of good functional outcome, we aimed to identify its predictors after ERT. *Methods:* Consecutive stroke patients from a single stroke center with distal internal carotid artery-, proximal middle cerebral artery- or T-occlusions treated with ERT were retrospectively selected. We assessed admission noncontrast computed tomography and computed tomography angiography for thrombus location, thrombus load (clot burden score), and collateral status. Clinical data were extracted from medical charts. Univariate and multivariate regression analyses were performed to identify predictors of revascularization (thrombolysis in cerebral infarction ≥2b) after ERT. *Results:* A total of 63 patients were identified (median age, 73 years; interquartile range: 62-77; 40 females). Sixteen patients (25.4%) underwent intravenous thrombolysis (ivT) before ERT. Twenty-two patients (34.9%) had additional intra-arterial application of recombinant tissue plasminogen activator. The overall recanalization rate was 66.7%, and 9.5% had symptomatic intracranial bleeding. In-hospital mortality was 15%, and 30% reached good functional outcome at discharge. In the univariate analysis, preceding ivT and the number of passes for thrombectomy (dichotomized ≤2 versus >2) were associated with recanalization. There was a trend for number of thrombectomy passes (as continuous variable) and multimodal ERT. In the multivariate regression analysis, ivT prior to ERT and passes of thrombectomy were identified as independent predictors for recanalization. *Conclusion:* ivT and lower passes of thrombectomy are associated with recanalization after ERT for ischemic stroke with proximal vessel occlusions. **Key Words:** Acute ischemic stroke—cerebrovascular occlusion—thrombectomy—thrombolytic therapy—tissue plasminogen activator.

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Introduction

Patient selection is a critical issue for revascularization approaches in acute ischemic stroke, especially in endovascular treatment. Besides longer treatment intervals and old device technology, inappropriate patient selection may have contributed to the neutral results between intravenous thrombolysis (ivT) alone compared with combined ivT and endovascular revascularization treatment (ERT) in Interventional Management of Stroke III Trial (IMS III), Intra-arterial Versus Systemic Thrombolysis for Acute Ischemic Stroke (SYNTHESIS EXPANSION), and Mechanical Retrieval and Recanalization of Stroke Clots Using Embolectomy Trial (MR RESCUE).[1-3] In particular, proof of an intracranial occlusion was not a required criterion, resulting in absence of ERT in many patients randomized to the interventional group.[4,5] Based on these experiences, the latest randomized trials of ERT versus ivT—which were all in favor of ERT in addition to ivT—only included patients with proven intracranial proximal vessel occlusion.[6-10] Despite this improved selection criteria, other selection parameters varied widely, and the number of patients who need to be treated varied between 3 and 8. We therefore aimed to find independent predictors for revascularization in patients undergoing endovascular recanalization approaches.

Methods

Patient Selection and Treatment

We retrospectively included patients from a single stroke center in the present study if they fulfilled the following criteria: (1) occlusion in the distal internal carotid artery (ICA), carotid T, M1, or M2; (2) National Institutes of Health Stroke Scale (NIHSS) score of 5 or higher; (3) age above 18 years; (4) admission imaging involving at least noncontrast computed tomography (NCCT) and computed tomography angiography (CTA); (5) ERT using stent retriever technology within 6 hours after symptom onset; and (6) availability of the modified thrombolysis in cerebral infarction (mTICI) score for revascularization[11,12] at the end of the procedure. Patients with posterior circulation ischemic stroke were excluded.

If initial NCCT excluded intracranial hemorrhage and hypodensity of more than one third of the middle cerebral artery territory, and CTA revealed proximal vessel occlusion as described above, ERT was performed. ERT consisted of mechanical thrombectomy (MT) or a combination of MT with preceding intra-arterial thrombolysis (iaT), which was at the discretion of the interventional neuroradiologist. For iaT, a microcatheter was placed within the proximal part of the thrombus without penetration, and recombinant tissue plasminogen activator (rt-PA) (Actilyse; Boehringer Ingelheim, Ingelheim, Germany) was administered. Angiographic assessments were undertaken every 5 minutes via the guiding catheter and iaT was stopped in case of revascularization. Otherwise, it was continued up to a maximum total dose of .9 mg/kg body weight but not exceeding 90 mg.

MT was started exclusively with pREset stent retriever (phenox GmbH, Bochum, Germany) according the manufacturer's guidelines. In case of distal emboli during MT, intra-arterial application of 2 mg bolus of rt-PA was also possible but not exceeding the total maximum dose of rt-PA of 90 mg or .9 mg/kg body weight.

In patients admitted within 4.5 hours after symptom onset, ivT was given for eligible patients according to current guidelines.

The current study was approved by the ethics committee of University Medicine Greifswald (Reg. Nr.: BB 093/14) without requiring individual informed consent, in accordance with the local state and federal laws.

Imaging methods and predictors

All acute imaging examinations were carried out on a 16-row multislice CT scanner (Somatom Sensation 16; Siemens Medical System, Erlangen, Germany). Scanning parameters for the initial NCCT were 4.5-mm section thickness, 120-kV tube voltage, 360-mAs tube current, and a pitch of 1. CTA (120-kV tube voltage, 200-mAs tube current, and a pitch of .5) of the cervicocranial arteries was acquired from the level of the sixth cervical vertebra up to the vertex as described previously.[13] Revascularization grade after ERT was assessed in postinterventional digital subtraction angiography by a board-certified neuroradiologist not involved in the intervention using the mTICI classification.[11,12] Successful revascularization was defined as mTICI 2b or mTICI 3. Thrombus burden was graded in CTA source images using the clot burden score (CBS).[14] The CBS is an ordinal score based on intravascular contrast opacification. No absence of opacification (=no visible occlusion) is indicated by 10 points. Two points each are subtracted for absence of contrast opacification in the complete cross section of any part of the proximal M1 segment, distal M1 segment, or supraclinoid ICA; and 1 point each for M2 branches, A1 segment, and infraclinoid ICA. A score of 0 indicates occlusion of all major intracranial anterior circulation arteries. Collateral circulation was analyzed by the CTA collateral score as described by Tan et al.[15] This score quantifies collateral circulation by comparing the collateral circulation in the ischemic to the contralateral hemisphere: 0, absent; 1, 0%-50%; 2, 50%-100%; and 3, 100%. For further analysis, the score was dichotomized into good (2,3) and poor (0,1) collateralization.

Clinical predictors

Retrospective analysis of medical charts was done to assess the following parameters: stroke severity by using the NIHSS score on admission; clinical outcome by using the NIHSS score at discharge from the stroke unit, and the modified Rankin Scale (mRS) score at discharge