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ORIGINAL ARTICLE **ÖZGÜN ARAŞTIRMA**

PREDICTORS OF GOOD CLINICAL OUTCOME IN ACUTE ISCHEMIC STROKE PATIENTS AFTER MECHANICAL THROMBECTOMY

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ABSTRACT

INTRODUCTION: Mechanical thrombectomy (MT) is recommended treatment for acute ischemic stroke patients due to large vessel occlusions. Despite successful recanalization, patients may not have a good clinical outcome. This study aims to identify the predictors of good clinical outcome in acute stroke patients treated with MT.
METHODS: This study was designed retrospectively. Acute ischemic stroke patients treated with mechanical thrombectomy because of the internal carotid artery or M1 segment of the middle cerebral artery occlusion between 2018 and 2022 were included in this study. mRS score ≤2 on the 90th day was defined as a good clinical outcome.
RESULTS: A total of 110 patients were treated with MT. Good clinical outcomes occurred in 56 (50.9%) of patients. Good clinical outcome group had decreased levels of age (p<0.000), glucose (p=0.018), neutrophil-lymphocyte ratio (NLR) (p=0.010), C-reactive peptide (CRP) (p=0.004) and diastolic blood pressure (DBP) (p=0.009). The poor clinical outcome group had increased NIHHS scores at onset (p<0.001) and 24th hour (p<0.001). The good clinical outcome had higher rates of good collaterals (p<0.001) and successful recanalization (p<0.001). The rate of intracerebral hemorrhage was significantly low in the good clinical outcome group (p=0.007).
DISCUSSION AND CONCLUSION: Good collaterals and successful recanalization are predictors of good clinical outcomes. ICH is a predictor factor of poor clinical outcomes. Younger age, decreased glucose, NLR, CRP, NIHSS score at onset and 24th hour, DBP, and procedure time are other predictors of good clinical outcome.
Keywords: Good clinical outcome, ischemic stroke, mechanical thrombectomy, predictors.

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MEKANİK TROMBEKTOMİ YAPILAN AKUT İSKEMİK İNME HASTALARINDA İYİ KLİNİK SONUCU BELİRLEYEN FAKTÖRLER

ÖZ

GİRİŞ ve AMAÇ: Mekanik trombektomi (MT), büyük damar tıkaniklığına bağlı iskemik inme tedavisinin en etkili yöntemidir. Başarılı rekanalizasyona rağmen bazı hastalarda iyi klinik sonuç elde edilememektedir. Bu çalışmanın amacı akut iskemik inmeli hastalarda MT sonrası iyi klinik sonuç üzerine etkili faktörleri saptamaktır.

YÖNTEM ve GEREÇLER: 2018-2021 yılları arasında mekanik trombektomi yapılan hastaların dosyaları retrospektif olarak tarandı. İnternal karotid arter ya da orta serebral arterin M1 segment oklüzyonu olan ve mekanik trombektomi yapılan hastalar çalışmaya dahil edildi. Modifiye Rankin Skalası skorunun 0-2 arasında olması iyi klinik sonuç olarak tanımlandı.

BULGULAR: Toplam 110 hasta çalışmaya dahil edildi. İyi klinik sonuç 56 (%50,9) hastada izlendi. İyi klinik sonuç grubunda daha düşük yaş (P=0,000), kan glukozu (p=0,018), nötrofil-lenfosit oranı (NLR) (p=0,010), C-reaktif peptid (CRP) (p=0,004) ve diastolik kan basıncı (p=0,009) izlendi. Kötü klinik sonuç grubunda ise daha yüksek giriş ve 24. saat NIHSS skoru izlendi (sırasıyla p=0,000, p=0,000). İyi klinik sonuç grubunda daha fazla iyi kollateral (p=0,000) ve başarılı rekanalizasyon (p=0,000) oranları izlendi. İntraserebral kanama iyi klinik sonuç grubunda daha düşük oranda izlendi (p=0,007).

TARTIŞMA ve SONUÇ: İyi kollateral dolaşım ve başarılı rekanalizasyon iyi klinik sonucun en önemli belirleyicileridir. İntrasereral kanama ise kötü klinik sonuç ile ilişkilidir. Genç yaş, düşük kan glikozu, NLR, CRP, girişteki ve 24. saatteki NIHSS skorları, diastolik kan basıncı ve işlem süresi iyi klinik sonucun diğer belirleyici faktörleridir.

Anahtar Sözcükler: İyi klinik sonuç, iskemik inme, mekanik trombektomi, prediktörler..

INTRODUCTION

Stroke is the second most common cause of mortality and the most common cause of disability worldwide (1). Previously, intravenous thrombolytic was the first choice for treating acute ischemic stroke (AIS). Recent randomized trials showed the superiority of mechanical thrombectomy (MT) to other medical treatments in large vessel occlusions (LVO) (2-6). In a meta-analysis evaluating five randomized controlled trials, Goyal et al reported that AIS patients treated with MT had better clinical outcomes (7). After these trials, MT was recommended to AIS patients with the internal carotid artery (ICA) or M1 segment of the middle cerebral artery (MCA) within six hours by the American Heart Association/American Stroke Association (8). The time window for MT was extended to 24 hours after the DAWN and DEFUSE 3 trials (9,10).

Achieving successful recanalization after MT has been related to improved functional outcomes (6,9,11). In the Hermes meta-analysis, 71% of patients had successful recanalization after MT; however, good clinical outcomes occurred in 46% of patients (7). This dissociation shows that other factors may have a role in determining clinical outcomes. Recent studies showed that younger age, low baseline National Institutes of Health Stroke Scale (NIHSS) score, short symptom onset-reperfusion time, and favorable baseline Alberta Stroke Programme Early CT Score (ASPECT) were predictors of good clinical outcome (12,13). Increased thrombectomy passes, intracerebral hemorrhage, and diabetes mellitus have negative effects on clinical outcomes (12). There are many studies about predictors of good clinical outcomes in the literature. Most of these studies included patients who were treated within 6 hours, and excluded patients over 80 years old. In contrast other studies, this study included the patients treated afer 6 hours and over 80 years old. Aim of this study is to identify the predictors of good clinical outcome in AIS patients with anterior LVO treated with MT.

METHODS

The study was conducted in accordance with the ethical standards of the Declaration of Helsinki and the study was approved by Clinical Researches Ethical Committee of Heatlh Sciences University, Kocaeli Derince Training and Research Hospital (Number: 2021/127, Date: 11.11.2021). AIS patients treated with MT between 2018 and 2021 were included in to study. Data of patients were collected retrospectively from patient files. Demographic data, medical histories of patients, risk factors, symptom-groin puncture time, symptom-recanalization time and procedure time, NIHSS scores at onset and 24th hour, laboratory findings, systolic blood pressures (SBP), diastolic

blood pressures (DBP), ASPECT score (14), collateral circulation levels on computed tomography angiography (CTA), brain computed tomography (CT) findings at 24th hour, modified Rankin score (mRS) at the third month, and mortality data were collected.

Patient Selection: A stroke neurologist evaluated all patients. Brain CT without contrast and CTA were performed on all patients. Patients, who arrived more than 6 hours after the appearance of symptoms, underwent diffusion-weighted magnetic resonance imaging (MRI). Early infarct signs were evaluated with ASPECT score on brain CT. Patients with evidence of intracranial hemorrhage or <6 ASPECT score were excluded from the study. Intravenous thrombolysis (alteplase 0,9 mg/kg) was administered to patients without contraindication. MT was performed on patients with age ≥18 years, pre-stroke mRS score of 0 or 1 point, MCA M1 or intracranial ICA occlusion, NIHSS score ≥6 points, ASPECT score ≥6 points within 6 hours from the onset of symptom (8). Patients filling the criteria of the DAWN study (age ≥80 years, NIHSS ≥10 and infarct volume <21 ml; or age <80 years, NIHSS ≥10 and infarct volume <31ml; or age <80 years, NIHSS ≥20 and infarct volume <51 ml) were treated with MT between 6-24 hours (10). Infarct volume was calculated by ABC/2 method (15). The DWI image with the largest infarction was selected then the longest axis on the image (A) was measured with the ruler tool. A perpendicular line through the widest dimension (B) was measured. The third axis (C) was calculated by mulplying number of images with visible ischemic lesions by slice thickness. The formula of AxBxC/2 was applied for volume calculation. If there are multiple ischemic lesions, ABC/2 was used for each lesion. Inclusion and exclusion criteria were summarized in Table 1.

Endovascular Treatment: All procedures were performed on a monoplane flat detector angiography machine under conscious sedation. A dose of 2500 IU heparin was administered to patients after sheath placement. A 6 French (F) long sheath (Destination, Terumo, Tokyo, Japan) was placed on cervical segment of the ICA or the common carotid artery. A distal access catheter (Sofia 6F Microvention, Tustin, California, USA; Navien 5F-6F, Medtronic, Minneapolis, USA), 0.027-inch microcatheter (Headway, Microvention, Tustin, California, USA; Rebar, Medtronic, Minneapolis, USA), and 0.014-inch microwire were advanced to the cavernous segment of ICA. A microwire and microcatheter passed the occluded segment. Then, stent retriever thrombectomy (Isolated stent retriever, SAVE, ARTS) or direct aspiration (ADAPT) was performed on all patients. In the stent retriever thrombectomy, a stent retriever (Eric, Microvention, Tustin, California, USA; Trevo, Stryker, Kalamazoo, Michigan, USA; Aperio Hybrid, Acandis, Pforzheim, Germany; Thrombite, Zylox-Tonbridge, Hangzhou, China) was placed on the occluded segment, and it was withdrawn with manual aspiration by a 50 mL syringe. A distal access catheter (Sofia 6F, Microvention, Tustin, California, USA) was advanced to the occlusion site in the direct aspiration technique. Then, manual aspiration was performed with a 50 mL syringe. The thrombectomy technique was changed after two unsuccessful attempts. The treatment was considered a failure if the vessel was not successfully recanalized after five passes. Balloon angioplasty was applied in tandem occlusions. Carotid artery stenting (CAS) was performed in persistent cervical carotid occlusion despite angioplasty.

Acetylsalicylic acid (ASA) 300 mg and clopidogrel 300 mg were administered before CAS. Antiaggregant and anticoagulant treatment was not administered within 24 hours of treatment. Brain CT was performed 24 hours after the procedure. If there was no hemorrhage in the control brain CT, ASA 300 mg was given.

Table 1. Patient selection criteria.

Inclusion Criteria
<6 Hours
Age ≥18 years
Prestroke mRS 0-1
NIHSS ≥6
ASPECT≥6
MCA M1 segment or intracranial ICA occlusion
6-24 Hours
Age ≥18 years
Prestroke mRS 0-1
Involvement of <1/3 MCA territory in brain CT or MRI
MCA M1 segment or intracranial ICA occlusion
Clinical-imaging mismatch on diffusion weighted MRI
-Age ≥80 years, NIHSS≥10 points, infarction core<21 ml
-Age <80 years, NIHSS≥10 points, infarction core<31 ml
-Age <80 years, NIHSS≥20 points, infarction core<51 ml
Exclusion Criteria
Evidence of intraparenchimal tumor
Evidence of intracranial hemorrhage
Hypodensity on 1/3 of MCA territory or having ASPECT≤6 points on baseline CT

Clinical Assessment and Outcome Measures: The severity of clinical findings at baseline and 24th hour were assessed with NIHSS score. Early infarct signs of AIS on brain CT were evaluated with ASPECT score. Collateral levels on CTA were assessed according to the modified Tan scale. Collaterals ≥50% in MCA territory were defined as good collaterals (16). The recanalization level was evaluated using the modified Treatment In Cerebral Ischemia (mTICI) classification (17). mTICI 0 was defined as no perfusion or anterograde flow beyond occlusion; mTICI 1 was defined as penetration but not perfusion beyond occlusion site; mTICI 2a was defined as perfusion with distal branch filling of <50% of MCA territory, mTICI 2b was defined as perfusion with distal branch filling of ≥50% of MCA territory, mTICI 2c was defined as near-complete reperfusion except for slow flow in a few distal cortical vessels or presence of small distal cortical embolism, and mTICI3 was defined as complete perfusion of MCA territory. Intracerebral hemorrhage (ICH) was determined according to ECASS criteria (18). Small petechial hemorrhages in the infarction zone were defined as hemorrhagic infarction type 1, confluent petechial hemorrhages in the infarction zone without mass effect were defined as hemorrhagic infarction type 2, hematoma less than 30% with mild mass effect was defined as parenchymal hematoma (PH) type1 and hematoma more than 30% with substantial mass effect was defined as PH type 2. Symptomatic intracerebral hemorrhage (SICH) was defined as any hemorrhagic transformation causing an increase of≥4 points on NIHSS at the 24th hour compared with onset. A good clinical outcome was described as an mRS score of ≤2 on the 90th day.

Statistical Analysis: Statistical analyzes were made with SPSS 15. Categorical variables were expressed as frequencies and percentages. Continuous variables were expressed as mean (SD) or median (interquartile range [IQR]) for non-normal distribution. The Kolmogorov-Smirnov test was used to assess the normality of distribution. We used Mann-Whitney U, paired T, and independent T-tests for continuous data and $\chi 2$ for binary and categorical data. Binary logistic regression analysis was performed to evaluate categorical data. All p values <0.05 were considered significant.

RESULTS

A total of 110 patients were treated with MT. Forty-six (41.8%) patients were male. These patients had a median age of 68 (56-74) years. Median NIHSS scores at onset and 24th hour were 16 (14-18) and 10 (4-16) points, respectively. A significant decrease in NIHSS score was observed after MT (p=0.000). Seventy-seven (70%) patients had MCA M1 occlusion, 20 (18.2%) patients had intracranial ICA occlusion, and 13 (11.8%) patients had tandem carotid occlusion. Eighty-three (75.5%) patients achieved successful recanalization (mTICI 2b-3). Seventeen (15.5%) patients had ICH, and 4 (3.6%) patients suffered from SICH. Twenty-six (23.6%) patients died within three months of follow-up. Table 2 shows demographic, clinical, radiological, and laboratory findings. A total of 56 (50.9%) patients had good clinical outcome. The good clinical outcome group had decreased median age (p<0.001), glucose (p=0,002), CRP (p=0,001), and neutrophil-lymphocyte ratio (NLR) (p=0.017). The good clinical outcome group had significantly decreased NIHSS scores at onset and 24th hour (NIHSS at onset: p<0.000; NIHSS at 24th hour: p<0.001), and increased ASPECT score (0.022). SBP (p=0.034) and DBP (p=0.006) levels were lower in the good clinical outcome group. The rate of good collaterals was significantly high in the good clinical outcome group (p=0.000). Good clinical outcome group had lower symptom-recanalization time (p=0.016), procedure time (p=0.000), and decreased thrombectomy pass counts (p=0.012). Successful recanalization rate was significantly high in the good clinical outcome group (p=0.001). Good clinical outcome group had a lower ICH rate (p=0.003). Table 3 shows the findings of good and poor clinical outcome groups. The rate of good clinical outcome was high in patients under 75 years old (OR: 3.000, 95% CI: 1.174-7.667, p=0.022). Good clinical outcome rate was similar between patients treated within 6 hours and after 6 hours (OR: 1.250, 95% CI: 0.453-3.451, p=0.798).

In logistic regression analysis, age, serum glucose, NLR, CRP, NIHSS score at onset and 24th hour, DBP, good collaterals, punction-recanalization time, and successful recanalization after MT were predictors of good clinical outcome. ICH was a predictor of poor clinical outcome. Good collateral level was the strongest predictor of

good clinical outcome (OR:14.875, 95% CI:4.389-47.191, p=0.000). Table 4 summarizes the results of the logistic regression analysis.

Table 2. Demographic, clinical, radiological, and laboratory findings.

Total Patients	110
Male(%)	46 (41.8)
Age (IQR)	68 (56-74)
Hypertension(%)	72 (65.5)
Atrial Fibrillation (%)	53 (48.2)
Diabetes Mellitus (%)	29 (26.4)
Coronary Artery Disease (%)	23 (20.9)
Stroke (%)	3 (2.7)
Glucose(mg/dL) (IQR)	128.5 (107.8-161.3)
Leucocyte (/mm^3) (IQR)	8500 (7000-10225)
Neutrophil-lymphocyte ratio (IQR)	3.75 (1.84-6)
Platelet (/mm^3) (IQR)	233500 (182000-279000)
Hemoglobin(g/dL) (IQR)	13.2 (11.6-14.1)
RDW* (IQR)	14.6 (14.1-15.7)
CRP† (mg/L) (IQR)	5.3 (2-12.9)
Systolic Blood Pressure (mmHg)(IQR)	150 (131.5-170)
Diastolic Blood Pressure (mmHg)(IQR)	80 (80-100)
NIHSS Score at Onset (IQR)	16 (14-18)
NIHSS Score at 24th Hour (IQR)	10 (4-16)
ASPECT (IQR)	9 (7-10)
MCA M1 Occlusion (%)	77 (70)
Intracranial ICA Occlusion (%)	20 (18.2)
Tandem Occlusion (%)	13 (11.8)
Iv thrombolytic	51 (47,4%)
Symptom-groin Puncture Time (min) (IQR)	228 (179-300)
Symptom-recanalization Time (min) (IQR)	283 (215-371)
Procedure Time (min) (IQR)	45 (30-70)
Neuroaspiration (%)	34 (30.9)
Stent Retriever Thrombectomy (%)	76 (69.1)
mTICI 2b-3 Recanalization (%)	83 (75.5)
Intracerebral Hemorrhage (%)	17 (15.5)
Symptomatic Intracerebral Hemorrhage (%)	4 (3.6)
Good Collaterals (%)	75 (68.2)
Good Clinical Outcome (%)	56 (50.9)
Mortality (%)	26 (23.6)

* Red-cell distribution width, † C-reactive peptide,

DISCUSSION AND CONCLUSION

This study evaluated the predictors of good clinical outcomes in patients treated with mechanical thrombectomy. Younger age, low NIHSS scores at onset and 24th hour, DBP, glucose, NLR, CRP, and procedure time were predictors of good clinical outcome. Good collateral status in CTA and successful recanalization were major predictors of a favorable outcome in AIS patients. Good collateral status in CTA had an association with increased good clinical outcomes.

A meta-analysis showed good collaterals before endovascular treatment was associated with favorable clinical outcomes and decreased 3-month mortality (19). Nambiar et al reported that good collateral circulation was associated with a good clinical prognosis (20). In the IMS III trial, Liebeskind et al found an increased good clinical outcome rate and decreased mortality rate in patients with good collateral status (21). Elijovich et al showed that good collateral status predicts favorable clinical outcomes and reduced infarct volume in patients with LVO and treated with MT (22). In another meta-analysis, Wufuer et al reported that good collaterals might lead to favorable 3-month clinical outcomes and low mortality risk (23). Our findings are compatible with these trials. Good collaterals may provide adequate preservation of the penumbra until effective reperfusion is reached, and patients with poor collaterals may have a low volume of salvageable tissue (23,24). Better collaterals were associated with more considerable penumbral salvage and decreased infarct growth in untreated stroke patients within 24 hours (25). Decreased infarct volume may explain the rate of increased good clinical outcomes in patients with good collateral circulation.

Successful recanalization was another factor of good clinical outcomes. Bhaskar et al reported that successful recanalization was associated with favorable clinical outcomes and decreased mortality rates in AIS (11). The SWIFT and TREVO II trials compared the second-generation thrombectomy devices with the MERCI device. They showed significantly high rates of successful recanalization and better clinical outcomes than the MERCI device (26,27). Fanuos et al reported that MT provides higher revascularization rates and reduced rates of functional independence in AIS patients with LVO compared with iv tPA (28). A meta-analysis of 53 studies reported that successful recanalization was strongly associated with good functional outcomes and reduced mortality at three months (29). Recanalization provides the restoration of cerebral blood flow to the penumbra, the brain tissue, with reversible ischemia surrounding the ischemic core (30). Our findings are compatible with the literature.

Table 3. Comparison of good and poor clinical outcome groups.

	Good Clinical Outcome	Poor Clinical Outcome	p
N (%)	56 (50.9)	54 (49.1)	
Male (%)	26 (46.4)	20 (37)	0.211
Age (year) (IQR)	62.5 (52.3-69.8)	72 (66-77.3)	<0.001
Hypertension (%)	36 (64.3)	36 (66.7)	0.843
Atrial Fibrillaton (%)	24 (41.1)	30 (55.6)	0.181
Diabetes Mellitus (%)	11 (19.6)	18 (33.3)	0.131
Coronary Artery Disease (%)	8 (14.3)	15 (27.8)	0.103
Glucose (mg/dL)(IQR)	119.5 (104-141.5)	144 (114-175)	0.002
Leukocyte (/mm^3) (IQR)	8800 (7000-9975)	8300 (7000-10350)	0.783
Neutrophil-lymphocyte ratio(IQR)	3.21 (1.69-5.07)	4.92 (2.46-7.25)	0.017
Platelet (10^3/mm^3) (IQR)	250 (184-291)	225 (182-270)	0.524
Hemoglobin (gr/dL) (IQR)	13.4 (11.9-14.4)	12.8 (10.9-13.7)	0.057
RDW* (IQR)	14.6 (14.1-15.7)	14.8 (13.8-15.8)	0.905
CRP† (mg/L)(IQR)	3.5 (1.8-8)	9.5 (2.6-27.5)	0.001
NIHSS Score at Onset	15 (12-17)	18 (16-19)	<0.001
NIHSS Score at 24th Hour	4 (2-7)	16 (13-18)	0.000
ASPECT	9 (8-10)	8 (7-9)	0.022
Systolic Blood Pressure (mmHg) (IQR)	140 (130-170)	160 (140-180)	0.034
Diastolic Blood Pressure (mmHg) (IQR)	80 (80-90)	90 (80-100)	0.006
Iv Thrombolytic (%)	27 (48.2)	24 (44.4)	0.707
Good Collaterals (%)	51 (92.7)	24 (46.2)	<0.001
Symptom-groin Puncture Time (min) (IQR)	207.5 (171.3-288.8)	265 (195-317)	0.138
Symptom-recanalization Time (min) (IQR)	240 (210-330)	315 (262.5-390)	0.016
Procedure Time (min) (IQR)	35 (25-50)	60 (40-90)	<0.001
MCA M1 Occlusion (%)	40 (71.4)	37 (68.5)	0.836
Intracranial ICA (%)	7 (12.5)	13 (24.1)	0.142
Tandem Occlusion (%)	9 (16.1)	4 (7.4)	0.238
Neuroaspiration (%)	21 (37.5)	13 (24.1)	0.151
Stent Retriever Thrombectomy (%)	35 (62.5)	41 (75.9)	0.151
Change of Technique (%)	16 (28.6)	17 (31.5)	0.836
Thrombectomy Pass Count (IQR)	2 (1-3)	2 (1-3)	0.012
MTICI 2b-3 Recanalization (%)	50 (89,3)	33 (61.1)	0.001
ICH (%)	3 (5.4)	14 (25.9)	0.003

*Red-cell distribution width, †C-reactive peptide.

Table 4. Results of logistic regression analysis.

Factor	OR	95% CI	p
Age	0.928	0.893-0.965	<0.001
Glucose	0.989	0.980-0.998	0.018
Neutrophil-lymphocyte ratio	0.827	0.715-0.956	0.010
CRP *	0.935	0,892-0.979	0.004
NIHSS at Onset	0.776	0.664-0.885	<0.001
NIHSS at 24th Hour	0.659	0.575-0.757	<0.001
Diastolic Blood Pressure	0.954	0.921-0.988	0.009
Good Collaterals	14.875	4.689-47.191	<0.001
Procedure Time	0.966	0.950-0.983	<0.001
mTICI 2b-3 Recanalization	5.303	1.935-14.533	0.001
Intracerebral hemorrhage	0.162	0.044-0.601	0.007

* C-reactive peptide.

This study showed that older age was a predictor of poor clinical outcomes. In the Hermes meta-analysis, endovascular treatment was effective in all age groups, including octogenarians, but older age had a positive correlation with mRS score at 90 days. This meta-analysis showed that although older age does not modify the effect of treatment, it remains a strong predictor of good clinical outcomes (7). In RECOST study, authors reported that odd's ratio of poor clinical outcomes increases significantly every five years increase in age (31). Ozdemir et al reported that every ten-year increase in age was associated with a 3.6-fold decrease in the possibility of good clinical outcomes (12). Another study showed that MT in elderly (>80 years) patients with AIS was safe and effective, but the rate of good clinical outcomes was significantly high in younger patients (13).

In a recent study, authors reported that MT in patients >90 years had an association with high mortality rates and less frequent good functional outcomes, but MT should not be withheld from patients >90 years (32). Although advanced age has a negative effect on clinical prognosis after MT, patients should not be excluded from MT because of advanced age.

Decreased procedure time was another predictor of good clinical outcomes. A recent study showed that increasing procedure time was associated with decreasing rates of good clinical outcomes (33). In another study, Hassan et al reported that patients with <60 minutes of procedure time had significantly better clinical outcomes (34). Patients with longer procedure times may have occlusions that are difficult to recanalize. Multiple MT attempts may be applied to achieve a good mTICI score with a possible increase in the risk of periprocedural and postprocedural complications. Spiotta et al found that longer procedural times are associated with a lower likelihood of successful recanalization and higher rates of intraprocedural complications (35).

Increased glucose level was a predictor of poor clinical outcomes. A post hoc analysis of the SWIFT trial showed that >140 mg/dL blood glucose level was independently associated with a decreased rate of good clinical outcomes (36). Sanak et al reported that lower glucose levels might be associated with better functional outcomes after three months (37). A recent meta-analysis showed that patients with hyperglycemia had decreased rates of mRS score <3, increased risk of SICH, and mortality (38). Hyperglycemia may cause extracellular glutamate accumulation, blood-brain barrier disruption, brain edema, and inhibited fibrinolysis (36). Experimental studies showed that hyperglycemia is associated with increased infarct volume compared with normoglycemia (39,40). So, hyperglycemia may accelerate the infarct progression in the penumbra tissue.

This study showed that increased NLR and CRP levels were predictors of a 3-month poor clinical outcome. Brooks et al showed that high admission NLR values had an association with poor clinical outcomes in LVO patients after MT (41). Goyal et al reported that high admission NLR values are independent predictors of SICH and mortality (42). A recent study showed that higher NLRs tested 24 hours after MT were independent predictors of poor clinical outcomes (43).

Kim et al. reported that patients with higher CRP levels had more poor clinical outcomes, higher SICH, and hemorrhagic transformation (44). AIS is a potent activator of the immune system. Inflammation occurs in brain tissue after a stroke. Post-stroke inflammation causes the activation of immune cells. Neutrophils indicate an active inflammatory reaction, and lymphocytes may regulate inflammation (45). In addition, CRP levels may reflect the inflammation severity, which might aggravate tissue damage with the conversion of the penumbra to an infarction area (46).

Decreased NIHSS scores at symptom onset were predictors of good clinical outcomes. Similar findings were reported in previous studies. A recent study showed that a lower baseline NIHSS score was a predictor of 3-month independence (47). Ohba et al reported that patients with 0-2 mRS scores in the third month had decreased baseline NIHSS scores (48). In addition, a high NIHSS score at admission was spotted as a predictor of poor clinical outcomes (49). Another study showed that an increase in NIHSS score on admission led to higher rates of futile recanalization (50). However, this does not mean patients with high NIHSS scores should be excluded from treatment. The good clinical outcome group had lower NIHSS scores at the 24th hour in this study. Mistry et al reported that lower NIHSS scores at 24th hour were strong predictors of favorable clinical outcomes (51). In addition, a ≥4 points decrease in NIHSS score at 24th hour was associated with good clinical outcome (52).

High DBP level was another predictor of poor clinical outcomes. High SBP levels were spotted in the poor clinical outcome group, but there was no association between SBP and clinical outcome in regression analysis. Increased SBP is a well-known predictor of poor clinical outcomes after MT. Only a few studies found an association between DBP levels and clinical outcomes. Malhorta et al reported that maximum DBP levels were independently associated with a lower rate of 3-month functional independence (52). Another recent study showed that higher DBP levels after MT were associated with increased mortality rates (53). Ding et al reported that every ten mmHg increase in maximum DBP levels was associated with increased rates of poor clinical prognosis (54). Our findings were compatible with the

literature. This study showed that ICH is a predictor of poor clinical outcomes. Previous studies reported the same findings as this study. Boisseau et al showed that parenchymal hemorrhage was associated with a decreased rate of good functional outcomes and an increased mortality risk (55). Hao et al reported that SICH was associated with increased mortality and a less favorable clinical prognosis (56).

This study has some limitations. It was designed as a retrospective study. The study's small sample size may decrease the significance of statistical analysis. Different thrombectomy devices were used. The thrombectomy technique was changed in 30% of patients due to failed attempts. This may limit the evaluation of the effectiveness of stent-retriever thrombectomy or aspiration techniques. Infarct volume was calculated by RADID share in DAWN study, but it is hard to achive due to high cost. So, infarct volume was calculated by ABC/2 formula. A recent study showed that, ABC/2 method had a high accuracy for the measurement of infarct volume compared with RAPID share (57).

In conclusion, good collaterals and successful recanalization (mTICI 2b-3) are major predictors of good clinical outcomes. Younger age, decreased glucose, NLR, CRP, NIHSS score at onset and 24th hour, DBP, and procedure time are other predictors of good clinical outcome. ICH is the most potent predictor factor of poor clinical outcomes.

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Ethics

Ethics Committee Approval: The study was approved by Clinical Researches Ethical Committee of Heatlh Sciences University, Kocaeli Derince Training and Research Hospital (Number: 2021/127, Date: 11.11.2021).

Informed Consent: The author declared that it was not considered necessary to get consent from the patients because the study was a retrospective study.

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