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ORIGINAL RESEARCH

Effects of emergent carotid stenting performed before or after mechanical thrombectomy in the endovascular management of patients with tandem lesion: a multicenter retrospective matched analysis

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ABSTRACT

BACKGROUND AND PURPOSE: Mechanical thrombectomy (MT) along with emergent carotid stenting (eCAS) have been suggested to have a greater benefit in patients with tandem lesion (TL), compared to other strategies of treatment. Nonetheless, there is no agreement on whether the intracranial occlusion should be treated before the cervical ICA lesion, or vice versa. In this retrospective multicenter study, we sought to compare clinical and procedural outcomes of the two different treatment approaches in patients with TL.

MATERIALS AND METHODS: The prospective databases of 17 comprehensive stroke centers were screened for consecutive patients with TL who received MT and eCAS. Patients were divided in two groups based on whether they received MT before eCAS (MT-first approach) or eCAS before MT (eCAS-first approach). Propensity score matching (PSM) was used to estimate the effect of the retrograde versus the anterograde approach on procedure-related and clinical outcome measures. These included the mTICI score 2b-3, other procedure-related parameters and adverse events after the endovascular procedure, and the ordinal distribution of the 90-day mRS scores.

RESULTS: A total of 295 consecutive patients were initially enrolled. Among these, 208 (70%) received MT before eCAS. After PSM, 56 pairs of patients were available for analysis. In the matched population, the MT-first approach resulted in a higher rate of successful intracranial recanalization (91% versus 73% in the eCAS-first approach, p=0.025) and shorter groin-to-reperfusion time (72 ± 38 minutes versus 93 ± 50 minutes in the anterograde approach, p=0.017). Despite a higher rate of efficient recanalization in the MT-first group, we did not observe a significant difference concerning the ordinal distribution of the 90-day mRS scores. Rates of procedure-related adverse events and occurrence of both parenchymal hemorrhage type 1 and type 2 were comparable.

CONCLUSIONS: Our study demonstrates that in patients with TL undergoing endovascular treatment, prioritizing the intracranial occlusion is associated with an increased rate of efficient MT and faster recanalization time. However, this strategy does not bring an advantage in long-term clinical outcome. Future controlled studies are needed to determine the optimal treatment technique.

ABBREVIATIONS: AIS = acute ischemic stroke; eCAS = emergent carotid stenting; ICA = internal carotid artery; GTR = groin-to-recanalization; IVT = intravenous thrombolysis; LVO = large vessel occlusion; MCA, middle cerebral artery; MT = mechanical thrombectomy; PSM = propensity score matching; SMD = standardized mean difference; STROBE = STrengthening the Reporting of OBservational studies in Epidemiology; TL = tandem lesion.

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The authors declare no conflicts of interest related to the content of this article.

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SUMMARY SECTION

PREVIOUS LITERATURE: Tandem lesions account for 10-15% of all acute ischemic strokes due to large vessel occlusion. Data from retrospective studies and registries have suggested that mechanical thrombectomy along with emergent carotid stenting may have a greater benefit in such patients. However, there is no agreement on whether the intracranial occlusion should be treated before the cervical internal carotid lesion, or vice versa.

KEY FINDINGS: Patients receiving mechanical thrombectomy as first showed a higher rate of efficient recanalization but not a more favorable 90-day clinical outcome. Rates of procedure-related adverse events and occurrence of both parenchymal hemorrhage type 1 and type 2 were similar with those of patients receiving carotid stenting as first.

KNOWLEDGE ADVANCEMENT: Based on the available data, none of the two techniques can be unequivocally recommended. The sequence of endovascular treatments for tandem lesion remains within the judgement of the neurointerventionalist after a case-by-case evaluation of patient's features. Future controlled studies are warranted to determine the optimal treatment technique.

INTRODUCTION

Tandem lesions (TL), defined as high-grade stenosis or occlusion of the cervical internal carotid artery (ICA) and concurrent ipsilateral intracranial occlusion in the anterior circulation, account for 10-15% of all acute ischemic strokes (AIS) due to large vessel occlusion (LVO) (1). In the majority of cases the intracranial occlusion involves the middle cerebral artery (MCA).

Data from retrospective studies and registries have suggested that mechanical thrombectomy (MT) of the intracranial LVO along with emergent carotid stenting (eCAS) may have a greater benefit compared to other strategies of treatment (2–5). Nonetheless, in this scenario there is incomplete agreement on whether it is more appropriate to address the intracranial occlusion with MT as first step and then treat the ICA lesion with eCAS, or vice versa (6–8). Despite different opinions, both techniques are employed and mainly dependent on the preference of the neurointerventionalist, except for cases where a highly calcified and severely stenotic ICA lesion requires the initial placement of a stent to facilitate the advancement of large-bore intermediate aspiration catheters into intracranial vessels. To date there is no clear indication regarding the more effective timing for the two steps of the procedure and results from previous studies are uneven (9–12). It has been shown that prioritizing the intracranial occlusion usually results in shorter groin-to-reperfusion time but not always in a more favorable clinical outcome (6,7,12).

In this retrospective multicenter study, we sought to compare clinical and procedural outcome measures of the two different endovascular treatment strategies in patients with high-grade stenosis or occlusion of the cervical ICA and concurrent ipsilateral MCA occlusion. The analysis was conducted in adherence with the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) statement.

MATERIALS AND METHODS

Patients

The prospective databases of 17 comprehensive stroke centers (15 located in Italy, 1 in France and 1 in Switzerland) were screened for consecutive patients with TL who received MT and eCAS between January 2016 and June 2023. This work was conducted within the framework of a nonprofit study protocol approved by the ethics committee of the coordinating center. The local ethics committees approved the use of patients' data.

Demographic data, cardiovascular risk factors, medications at baseline, imaging data as well as data related to the procedures of the acute phase were collected. All patients were diagnosed with an initial plain CT scan, with determination of the ASPECTS (13), followed by CTA to locate sites of occlusion. TL was defined as a severe stenosis or occlusion of the extracranial ICA and concurrent occlusion of the M1 segment or proximal M2 segment of the MCA, according to the criteria reported in the NASCET and the Thrombectomy in Tandem Lesion (TITAN) trials (14,15). Patients with simultaneous extracranial and intracranial occlusion of ICA were not considered. Intravenous thrombolysis (IVT) was performed when appropriate and according to current protocols.

Endovascular Procedure

The treatment strategies for TL were defined as eCAS-first, when stenting of the cervical ICA lesion preceded the treatment of the intracranial occlusion, or MT-first, when treatment of the intracranial occlusion was the iniatial step of the endovascular procedure. If necessary, balloon dilation was carried out before stenting. All patients received intra-procedural antiplatelet therapy to grant stent patency immediately before its placement and according to local protocols. MT was conducted using a stent-retriever, direct contact aspiration or a combined technique. Recanalization grade was assessed after first pass and at the end of the procedure with a dedicated final angiographic run. A score of 2b-3 in the mTICI scale was the measure of successful recanalization after MT (16). All procedure were conducted under general anesthesia or local anesthesia/conscious sedation, according to the local protocol or at the discretion of the managing physicians. In each participating center, two neuroradiologists with more than five years of experience and blinded to clinical outcome records, reviewed all radiological and angiographic data of their patients. In cases of doubt or disagreement, re-evaluation and adjudication were performed through consultation in a subsequent common session.

Clinical and radiologic variables and measures of outcome

Demographic data (age and sex), cardiovascular risk factors, pre-event therapies and baseline radiologic features were collected. Acute clinical assessment used the NIHSS, whereas long-term clinical outcome was measured with the mRS score acquired at 90 days after stroke, either in person or through a telephone interview by a trained neurologist. Presence of hemorrhagic transformation was assessed by CT or MRI between 24 and 72 hours after the endovascular treatment and defined according to the Heidelberg classification of bleeding events after reperfusion therapies (17).

Primary outcome measures were 1) the mTICI score 2b-3 after MT and 2) the ordinal distribution of the 90-day mRS scores. Secondary outcome measures were 1) rates of mTICI scores 2b, 2c and 3, 2) time elapsed from groin puncture to recanalization (GTR), 3) procedure-related adverse events that included arterial dissection and embolism in a new territory, 4) stent thrombosis occurring within 24 hours after eCAS, 5) rates of parenchymal hemorrhage (PH) type 1 and type 2 on follow-up scans, and 6) the 90-day mRS score 0-2.

Statistical Analysis

Standard descriptive statistics were used to define baseline characteristics. The study population was divided into two groups based on the type of endovascular strategy that was adopted (eCAS-first versus MT-first). Differences between categorical variables were compared with the Fisher's exact test, whereas continuous variables were compared with the Welch two-sample t-test or the Mann-Whitney U test according with their distribution. Shapiro-Wilk test was used to test normality of continuous variables. Missing values were not imputed. Significance threshold was set at p-value < 0.05.

Since our patients were not randomized, we used propensity score matching (PSM) to estimate differences in outcome measures between patients subjected to the MT-first protocol versus those treated using the eCAS-first strategy. Covariates for PSM included age, baseline NIHSS score, baseline ASPECTS, site of intracranial occlusion (M1 or M2 occlusion), and all other variables that were imbalanced in the univariate analysis of the raw population. The greedy nearest-neighbor method was used to create 1:1 pairs of patients that had very similar propensity scores, setting a caliper width of 0.02 on the propensity score scale. PSM balance was assessed by checking standardized mean differences (SMD) between covariates, with a value < 0.1 indicating negligible imbalance (18). Fisher's exact test, Welch two-sample t-test or the Mann-Whitney U test were used as appropriate to compare outcomes measures between the two matched groups of patients.

All analyses were performed using the R software v.4.3.2 with cobalt package (https://www.r-project.org).

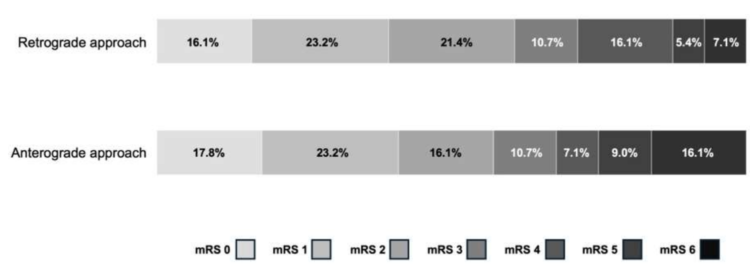

FIG 1. Ordinal distribution of 90-day mRS scores in patients receiving eCAS-first versus MT-first treatment, after propensity score matching.

RESULTS

A total of 295 consecutive patients (88 females, 30%) with TL subjected to MT and eCAS were enrolled. Among these patients, 208 (71%) received the endovascular treatment using the MT-first approach. The two treatment groups were homogenous, except for the rates of atherosclerotic (versus dissection) type of lesion of cervical ICA (86% in the eCAS-first group versus 74% in the MT-first group, p = 0.022), the median baseline ASPECTS [median (interquartile range – IQR) ASPECTS = 8 (7-9) in the eCAS-first group versus 7 (7-9) in the MT-first group, p = <0.001] and the use of local anesthesia/conscious sedation (74% in the eCAS-first group versus 46% in the MT-first group, p = <0.001) (Table 1). Except for a significantly shorter GTR time (77□52 minutes in the MT-first group versus 89□45 minutes in the eCAS-first group, p = 0.018), there was no difference between the two raw groups concerning rates of efficient recanalization, procedure-related adverse events, rates of PH type 1 and type 2 and long-term clinical outcome (Table 2).

The PSM algorithm, based on the set of covariates indicated above plus variables that were not balanced in the preliminary analysis (atherosclerotic ICA lesion and type of anesthesia), generated 56 matched couples. The SMD between covariates before and after PSM is shown in Supplementary Table 1. Univariate analysis of baseline clinical features, pre-event therapies and procedural data of the matched groups of patients is reported in Supplementary Table 2.

The MT-first approach resulted in shorter GTR time (72±38 minutes versus 93±50 minutes in the eCAS-first approach, p=0.017) and a higher rate of successful intracranial recanalization after MT (rate of mTICI 2b-3 = 91% versus 73% in the eCAS-first approach, p=0.025). The difference in rates of successful recanalization was mainly due to a higher proportion of the mTICI grade 2b (30% versus 18%) with similar rates of mTICI 2c and mTICI 3 (25% versus 21% and 36% versus 34%, respectively). There was no difference between the two matched groups concerning rates of procedure-related adverse events and occurrence of both PH type 1 and type 2. Despite a higher rate of efficient recanalization in the MT-first group, we did not observe a significant difference concerning the ordinal distribution of the 90-day mRS scores, the rates of patients with a composite mRS score 0-2 and in mortality of any cause (Table 3 and Figure 1).

DISCUSSION

In this multicenter study we evaluated the effect of the two different endovascular strategies for TL treatment. Our results indicate that the MT-first approach is associated with a higher rate of successful recanalization and a shorter GTR time. However, this evidence does not translate into a more favorable clinical outcome.

Results of previous studies have shown incomplete agreement concerning clinical and procedural outcome measures when the two different approaches were compared. In some of them, the MT-first approach was associated with a shorter GTR time, increased rates of successful recanalization and better clinical outcome (10,19,20). In others, despite a shorter GTR time, there was no significant difference in rates of successful recanalization and favorable clinical outcome between the two treatment strategies (6,7,12). Large meta-analyses of retrospective studies have also provided uneven results (8,9,11).

In real-world practice, there is an operating variability on the acute management of TL, mainly concerning the most appropriate sequence of MT and eCAS and intra-procedural antiplatelet regimen. Indeed, an international survey has shown that a MT-first approach is preferred by the majority of neurointerventionalists but still the eCAS-first treatment is adopted in more than 1/3 of cases (21). Our data on the raw population of patients confirms that the MT-first approach is preferred (71%). Both techniques can offer different advantages on the base of the patient's specific necessities. The MT-first approach allows a prompter intracranial vessel recanalization, possibly limiting the progression of the ischemic core, but at the same time brings along the risk of re-occlusion due to distal embolization from the untreated ICA lesion. On the other hand, in cases with a severely stenotic or occluded cervical ICA, the eCAS-first approach may be the only feasible treatment strategy, given the difficulty to navigate even the most flexible microcatheters through the atherosclerotic lesion (22,23). Besides reducing the risk of further embolization or occlusion of intracranial vessels because of a sluggish flow, other advantages of the eCAS-first strategy include the possibility of allowing a better representation of intracranial vessels (5,11,24). Moreover, spontaneous recanalization of the intracranial occlusion following ICA stenting has been documented in some reports with rates ranging from 6% to 23% (20,25). However, this latter data has not been confirmed by other authors (26).

Apart from these considerations, our study on matched cohorts confirms that addressing the intracranial occlusion before the ICA lesion results in shorter GTR time and better MT results. Importantly, the rate of embolism in new intracranial territories is not higher than what observed in patients in whom the cervical ICA lesion is addressed as first step. While it is intuitive that a MT-first approach is associated with a shorter GTR time, there is no clear-cut explanation on why it may also lead to a more efficient recanalization. It has been proposed that a time-dependent change in clot composition, with a progressively increased proportion of fibrin and platelets, results in a less easily retrievable clot when MT is delayed (27). However, It may be argued that it is unlikely that the difference in mean GTR time in favor of the MT-first group, may result in change in clot composition capable of affecting its interaction with the stent-retriever. Nonetheless, this data need to be confirmed in forthcoming dedicated studies. On the other hand, in our MT-first matched cohort, better procedural features were not associated with a more favorable clinical outcome. One possible explanation could be that the difference in rates of successful recanalization was mainly due to a higher proportion of mTICI 2b grade rather than mTICI 2c and 3 in the MT-first group. It is possible that such difference would not be enough to grant a significant difference in clinical outcome given the limited number of patients after PSM. We also cannot exclude a suboptimal quality of the mRS scores collected in our patients that may have limited the possibility of detecting differences between groups.

Overall, our results suggest that the more suitable sequence of endovascular treatment for TL should be defined on a case-by-case basis according to the patient-specific vascular characteristics, as procedure-related adverse events are comparable and clinical outcome does not appear to be affected.

The main limitation of our study derives from its retrospective nature and non-controlled design. Although clinical and procedural records were carefully reviewed, the results could have been affected by the quality of data collected outside the rigid criteria of a randomized trial. For example, we have no information on whether the proximal lesion was treated as first due to the inability to pass through the cervical carotid lesion or because of the neurointerventionalist's preference, nor of other anatomical variations or vessel tortuosity, that could have affected procedural and clinical outcome measures. Uncontrolled biases may also derive from the variation of endovascular devices and type of treatment protocols over the relatively long time of observation. These include, for example, the different use of balloon-guiding catheter, different first-line MT strategies and the specific intra-procedural antiplatelet regimens that was adopted. Moreover, the clinical and imaging data provided by individual centers were not assessed by a central core image laboratory, potentially leading to reporting bias in clinical and angiographic outcomes, including rates of successful recanalization. The PSM algorithm applied in our study was centered on a set of covariates that we believe can be relevant for the selected outcome measures, but it is possible that other factors may have been overlooked or missing.

Table 1: Baseline, imaging and procedural data of the raw population of patients after division for type of endovascular approach

	eCAS first approach	**MT-first approach**	**p-value***
Number of patients (N)	87	208	
Demographics			
Female, n/N (%)	27/87 (31%)	61/208 (29%)	0.781
Age in years, mean (± SD)	65 (± 14)	64 (± 14)	0.315
Baseline clinical features			
Hypertension	51/87 (59%)	113/208 (54%)	0.523
Atrial Fibrillation, n/N (%)	4/87 (5%)	13/208 (6%)	0.785
Diabetes, n/N (%)	8/87 (9%)	36/208 (17%)	0.106
Dyslipidemia, n/N (%)	32/87 (37%)	60/208 (29%)	0.215
Coronary artery disease, n/N (%)	11/87 (13%)	23/208 (11%)	0.692
ICA atherosclerotic lesion, n/N (%)	75/87 (86%)	153/208 (74%)	**0.022**
Previous stroke, n/N (%)	3/87 (3%)	6/208 (3%)	0.726
Antiplatelet therapy, n/N (%)	22/87 (25%)	6/208 (30%)	0.433
Anticoagulant therapy, n/N (%)	2/87 (2%)	17/208 (8%)	0.163
Therapy with statins, n/N (%)	21/80 (26%)	45/208 (22%)	0.518
Pre-event mRS score, median (IQR)	0 (0-0)	0 (0-0)	0.447
NIHSS score, median (IQR)	16 (11-20)	16 (11-20)	0.382
Baseline imaging data and procedural features			
Left side	46/87 (53%)	125/208 (60%)	0.252
ASPECTS, median (IQR)	8 (7-9)	7 (7-9)	**0.003**
ICA + M1 occlusion, n/N (%)	61/87 (70%)	158/208 (76%)	0.295
ICA + M2 occlusion, n/N (%)	26/87 (30%)	50/208 (24%)	0.616
IVT, n/N (%)	47/87 (54%)	125/208 (44%)	0.107
LA/CS, n/N (%)	64/87 (74%)	96/208 (46%)	**< 0.001**

eCAS, emergent carotid stenting; MT, mechanical thrombectomy; SD, standard deviation; IQR, interquartile range; IVT, intravenous thrombolysis; LA, local anesthesia; CS, conscious sedation; * Statistical significance was considered at $p < 0.05$.

Table 2: Outcome data of the raw population of patients after division for type of endovascular approach

	eCAS-first approach	MT-first approach	p-value*
Number of patients (N)	87	208	
Procedural and post-produral outcome data			
mTICI score 2b-3, n/N (%)	69/87 (79%)	179/208 (86%)	0.149
mTICI score 2b, n/N (%)	26/87 (30%)	57/208 (27%)	0.666
mTICI score 2c, n/N (%)	14/87 (16%)	46/208 (22%)	0.270
mTICI score 3, n/N (%)	29/87 (33%)	76/208 (37%)	0.689
GTR time - mean (± SD), minutes	89 (± 45)	77 (± 52)	**0.018**
New territory embolism, n/N (%)	10/87 (12%)	32/208 (15%)	0.383
Intraprocedural dissection, n/N (%)	2/87 (2%)	7/208 (3%)	0.627
Early stent thrombosis, n/N (%)	9/87 (10%)	25/208 (12%)	0.558
Parenchymal hemorrhage type 2, n/N (%)	2/87 (2%)	14/208 (7%)	0.163
Parenchymal hemorrhage type 1, n/N (%)	27/87 (31%)	53/208 (26%)	0.389
Clinical outcome data			
90-day mRS score, n/N			0.149
0	16/86 (19%)	30/207 (15%)	
1	23/86 (27%)	42/207 (20%)	
2	16/86 (19%)	39/207 (19%)	
3	8/86 (9%)	35/207 (17%)	
4	5/86 (6%)	29/207 (14%)	
5	7/86 (8%)	16/207 (8%)	
90-day mRS score = 0-2, n/N	55/86 (64%)	111/207 (54%)	0.076
90-day mortality of any cause, n/N	11/86 (13%)	16/207 (8%)	0.187

eCAS, emergent carotid stenting; MT, mechanical thrombectomy; GTR, groin-to-recanalization; SD, standard deviation; * Statistical significance was considered at $p < 0.05$.

Table 3: Univariate analysis after propensity score matching of clinical and angiographic outcome measures

	eCAS-first approach	MT-first approach	p-value*
Number of patients (N)	56	56	
Procedural outcome data			
mTICI score 2b-3, n/N (%)	41/56 (73%)	51/56 (91%)	**0.025**
mTICI score 2b, n/N (%)	10/56 (18%)	17/56 (30%)	0.185
mTICI score 2c, n/N (%)	12/56 (21%)	14/56 (25%)	0.823
mTICI score 3, n/N (%)	19/56 (34%)	20/56 (36%)	1.000
GTR time - mean (± SD), minutes	93 (± 50)	72 (± 38)	**0.017**
New territory embolism, n/N (%)	8/56 (14%)	9/56 (16%)	1.000
Intraprocedural dissection, n/N (%)	2/56 (4%)	0/56 (0%)	0.496
Early stent thrombosis, n/N (%)	8/56 (14%)	7/56 (13%)	1.000
Parenchymal hemorrhage type 2, n/N (%)	2/56 (4%)	3/56 (5%)	1.000
Parenchymal hemorrhage type 1, n/N (%)	21/56 (38%)	13/56 (23%)	0.150

Clinical outcome data			
90-day mRS score, n/N			0.769
0	10/56 (18%)	9/56 (16%)	
1	13/56 (23%)	13/56 (23%)	
2	9/56 (16%)	12/56 (21%)	
3	6/56 (11%)	6/56 (11%)	
4	4/56 (7%)	9/56 (16%)	
5	5/56 (9%)	3/56 (5%)	
90-day mRS score = 0-2, n/N	32/56 (57%)	34/56 (60%)	0.848
90-day mortality of any cause, n/N	9/56 (16%)	4/56 (7%)	0.237

eCAS, emergent carotid stenting; MT, mechanical thrombectomy; GTR, groin-to-recanalization; SD, standard deviation; * Statistical significance was considered at $p < 0.05$.

CONCLUSIONS

Our study demonstrates that in patients with TL undergoing endovascular treatment, prioritizing the intracranial occlusion results in faster recanalization time and an increased rate of efficient MT. However, this strategy does not bring a clear advantage when long-term clinical outcome measures are considered and cannot be unequivocally recommended. Based on the available data, the sequence of endovascular treatments for TL remains within the judgement of the neurointerventionalist after a case-by-case evaluation of patient's features. Future controlled studies are warranted to determine the optimal treatment technique.

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SUPPLEMENTAL FILES

Table 1. Standardized mean difference of covariates before and after propensity score matching

	Pre-match population			Post-match population		
Covariates	**eCAS-first approach (N=87)**	**MT-first approach (N=208)**	**SMD***	**eCAS-first approach (N=56)**	**MT-first approach (N=56)**	**SMD***
Age in years, mean (± SD)	65.4 (±13.5)	63.8 (±13.5)	-0.113	65.2 (±14.1)	63.8 (± 14.1)	**-0.098**
NIHSS score, median (IQR)	16 (11-20)	16 (11-20)	**0.081**	16 (10-19)	16 (10-19)	**0.006**
ASPECTS, median (IQR)	8 (7-9)	7 (7-9)	-0.311	8 (7-9)	8 (7-9)	**0.030**
ICA+M1 occlusion, n/N (%)	61/87 (70.1%)	158/208 (76.0%)	**0.024**	40/56 (71.4%)	42/56 (75.0%)	**0.036**
ICA Atherosclerosis, n/N (%)	75/87 (86.2%)	153/208 (73.6%)	0.121	45/56 (80.4%)	43/56 (76.8%)	**0.035**
LA/CS, n/N (%)	64/87 (73.6%)	96/208 (46.1%)	-0.197	34/56 (60.7%)	34/56 (60.7%)	**0.000**

SMD, Standardized mean difference; SD, standard deviation; IQR interquartile range; LA, local anesthesia; CS, conscious sedation; *, bold type indicates negligible imbalance of the covariate between the two groups.

Table 2. Baseline, imaging and procedural data of the raw population of patients after propensity score matching

	eCAS-first approach	**MT-first approach**	**p-value***
Number of patients (N)	56	56	
Demographics			
Female, n/N (%)	17/56 (30%)	17/56 (30%)	1.000
Age in years, mean (± SD)	65 (± 14)	64 (± 14)	0.617
Baseline clinical features			
Hypertension	34/56 (61%)	28/56 (50%)	0.342
Atrial Fibrillation, n/N (%)	3/56 (5%)	2/56 (4%)	1.000
Diabetes, n/N (%)	3/56 (5%)	9/56 (16%)	0.124
Dyslipidemia, n/N (%)	17/56 (30%)	19/56 (34%)	0.840
Coronary artery disease, n/N (%)	4/56 (7%)	6/56 (11%)	0.742
ICA atherosclerotic lesion, n/N (%)	45/56 (80%)	43/56 (77%)	0.818
Previous stroke, n/N (%)	1/56 (2%)	1/56 (2%)	1.000
Antiplatelet therapy, n/N (%)	12/56 (21%)	17/56 (30%)	0.389
Anticoagulant therapy, n/N (%)	0/56 (0%)	7/56 (13%)	**0.013**
Therapy with statins, n/N (%)	12/53 (23%)	12/51 (24%)	1.000
Pre-event mRS score, median (IQR)	0 (0-0)	0 (0-0)	1.000
NIHSS score, median (IQR)	16 (10-19)	16 (10-19)	0.944
Baseline imaging data and procedural features			
Left side	30/56 (54%)	35/56 (63%)	0.444
ASPECTS, median (IQR)	8 (7-9)	8 (7-9)	0.666
ICA + M1 occlusion, n/N (%)	40/56 (71%)	42/56 (75%)	0.831
ICA Atherosclerosis, n/N (%)	45/56 (80%)	43/56 (77%)	0.818
IVT, n/N (%)	32/56 (57%)	29/56 (52%)	0.705
LA/CS, n/N (%)	34/56 (61%)	34/56 (61%)	1.000

SD, standard deviation; IQR, interquartile range; IVT, intravenous thrombolysis; LA, local anesthesia; CS, conscious sedation; * Statistical significance was considered at $p < 0.05$.