Magnitude of blood pressure change and clinical outcomes after thrombectomy in stroke caused by large artery occlusion

Mohammad Anadani1 | Marius Matusevicius2,3 | Georgios Tsivgoulis4 | André Peeters5 | Ana Paiva Nunes6 | Michelangelo Mancuso7 | Christine Roffe8 | Adam de Havenon9 | Niaz Ahmed2,10

1Department of Neurology, Washington University in St. Louis, St. Louis, MO, USA
2Department of Clinical Neuroscience, Karolinska Institutet, Stockholm, Sweden
3Department of Research and Education, Karolinska University Hospital, Stockholm, Sweden
4Second Department of Neurology, National & Kapodistrian University of Athens, Athens, Greece
5Cliniques Universitaires St Luc, Brussels, Belgium
6Stroke Unit Centro Hospitalar Universitário de Lisboa Central – Hospital São José, Lisbon, Portugal
7Department of Clinical and Experimental Medicine, Neurological Clinic, University of Pisa and Azienda Ospedaliera Universitaria Pisana, Pisa, Italy
8Stroke Research in Stoke, University Hospitals of North Midlands NHS Trust, Stoke-on-Trent, UK
9Department of Neurology, University of Utah, Salt Lake City, UT, USA
10Department of Neurovascular Disease, Karolinska University Hospital, Stockholm, Sweden

Abstract

Background: Extremes of both high and low systolic blood pressure (SBP) after mechanical thrombectomy (MT) in large artery occlusion stroke are known predictors of unfavorable outcome. However, the effect of SBP change (ΔSBP) during the first 24 h on thrombectomy outcomes remains unclear. We aimed to investigate the association between ΔSBP at different time intervals and thrombectomy outcomes.

Methods: We analyzed MT-treated patients registered in the SITS International Stroke Thrombectomy Registry from January 1, 2014 to September 3, 2019. Primary outcome was 3-month unfavorable outcome (modified Rankin scale scores 3–6). We defined ΔSBP as the mean SBP of a given time interval after MT (0–2, 2–4, 4–12, 12–24 h) minus admission SBP. Multivariable mixed logistic regression models were used to adjust for known confounders and center as random effect. Subgroup analyses were included to contrast specific subpopulations. Restricted cubic splines were used to model the associations.

Results: The study population consisted of 5835 patients (mean age 70 years, 51% male, median NIHSS 16). Mean ΔSBP was −12.3, −15.7, −17.2, and −16.9 mmHg for the time intervals 0–2, 2–4, 4–12 h, and 12–24 h, respectively. Higher ΔSBP was associated with unfavorable outcome at 0–2 h (odds ratio 1.065, 95% confidence interval 1.014–1.118), 2–4 h (1.127, 1.081–1.174), 4–12 h (1.145, 1.087–1.203), and 12–24 h (1.145, 1.089–1.203), for every increase of 10 mmHg. Restricted cubic spline models suggested that
INTRODUCTION

Blood pressure (BP) management is a key part of post-mechanical thrombectomy (MT) care in large artery occlusive stroke and requires taking multiple factors into consideration such as reperfusion status, infarct size, and comorbidities. Multiple studies demonstrated an association between elevated BP post-MT and unfavorable outcome and hemorrhagic complications, a finding that was further supported by a meta-analysis. However, the association between systolic BP change (∆SBP) post-MT and outcome of MT has not been well studied.

Studies from the pre-thrombectomy era demonstrated an association between BP reduction and unfavorable outcome, suggesting detrimental effect of BP reduction after acute stroke. However, those studies did not take into account the presence of large artery occlusion or reperfusion status. Therefore, their results cannot be reliably applied to patients with large artery occlusion stroke treated with thrombectomy.

Previous study of patients with large artery occlusions treated successfully with MT demonstrated an inverse association between ∆SBP and unfavorable outcome, suggesting a potential benefit from altering BP post-MT. In contrast, a subsequent study of patients treated with MT failed to demonstrate an association between ∆SBP and functional outcome or hemorrhagic complications. However, these studies lacked analysis on time-stamped BP data and were unable to investigate the association between ∆SBP and outcome at different time points and with regard to reperfusion status.

It is possible that the association between ∆SBP and outcomes is time-dependent as it was demonstrated by preclinical studies; therefore, it is imperative to understand the difference in the association between ∆SBP and outcome between different time intervals.

In this study, we aimed to study the association between ∆SBP during different time periods post-MT with the efficacy and safety outcomes.

METHODS

Study population

We analyzed MT-treated patients registered in the Safe Implementation of Treatments in Stroke International Thrombectomy Registry from January 1, 2014 to September 3, 2019. Inclusion criteria were: (1) ischemic stroke due to anterior circulation large vessel occlusion strokes treated with MT using modern generation devices with and without intra-arterial thrombolysis and (2) pre-stroke modified Rankin Scale (mRS) score 0–2. In order to maintain high data quality, we only included data from centers which registered at least 10 patients and had 3-month follow-up data on at least 70% of patients.

Blood pressure parameters

Systolic BP (SBP) was recorded on admission, end of procedure (0 h) and at 2, 4, 6, 12, and 24 h post-MT. There was no standardized BP measurement method; however, most centers included in the study use non-invasive cuff for BP measurement post-MT as their standard practice. ∆SBP was defined as mean SBP at different time points (0–2, 2–4, 4–12, 12–24 h) post-MT minus baseline SBP. We first considered admission SBP as baseline SBP. Then we repeated the analysis by considering end of procedure BP as baseline SBP and the resulting ∆SBP was named ∆eSBP.

Outcome measures

Primary outcome was 90-day unfavorable functional outcome. Unfavorable outcome was defined as 90-day mRS scores of 3–6. Secondary outcomes included 90-day all-cause mortality, neurological deterioration within 24 h (defined as worsening National Institutes of Health Stroke Scale [NIHSS] by four or more points from baseline), and symptomatic intracerebral hemorrhage (SICH) within 24 h as diagnosed according to modified SITS-MOST definition. Successful reperfusion was defined using modified Treatment in Cerebral Ischemia (mTICI) scores of 2b-3. All outcomes were reported by local investigators without central adjudication.

Statistical analysis

Comparison between unfavorable outcome and favorable outcome groups was performed using Student’s t-test for continuous variables (variables expressed as mean ± standard deviation [SD]), Mann-Whitney U test for non-Gaussian continuous or ordinal variables.
(variables expressed as median [interquartile range], and \( \chi^2 \) test for categorical variables (variables expressed as n [%]).

We assessed the association between \( \Delta SBP \) and primary and secondary outcomes using mixed effects logistic regression models considering center as random effect. In addition to center, the mixed model was adjusted for the following pre-specified confounders: age, pre-treatment NIHSS, successful reperfusion, onset to reperfusion time, sex, history of diabetes, history of hypercholesterolemia, history of congestive heart failure, intravenous thrombolysis, admission SBP, and history of hypertension. Odds ratios (ORs) of each outcome with their corresponding 95% confidence intervals (CIs) were calculated for 10 mmHg change.

Subgroup analyses were performed based on reperfusion status (successful vs. unsuccessful), history of hypertension (yes vs. no), use of antihypertensive medications after MT (yes vs. no), admission SBP (<140, 140–160, and ≥180 mmHg), and age (70 vs. ≥70 years). The significance of stratifying by these subgroups was tested through adjusting the regression models with an interaction term between the subgroup and \( \Delta SBP \), using the \( p \) value for the interaction as indicator of significance.

Finally, to assess the shape of the association between \( \Delta SBP \) and \( \Delta eSBP \) and outcomes we created restricted cubic spline models for the association between both measures and each outcome as a sensitivity analysis in order to visualize the trend for \( \Delta SBP \).

The current study was approved by the Stockholm Regional Ethical Board through the framework of SITS-Monitoring Study II. Ethical and other approvals for sharing aggregate data were the responsibility of the principal investigators of the studies asked to provide the data. The trial was conducted in accordance with the good clinical practice guidelines of the International Conference on Harmonization and the principles of the Declaration of Helsinki.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

RESULTS

A total of 14,873 patients treated with MT were registered in the Safe Implementation of Treatment in Stroke Thrombectomy registry (SITS-TBYR) during the study period. Of these, 5835 patients fulfilled our inclusion criteria (Figure 1). Our study population had a mean age of 69.9 years, were 51.0% male, and presented with median NIHSS score of 16 (Table 1). Baseline SBP showed a normal distribution (Figure S1). Our inclusion criteria led to 38 centers providing the study population, with patient numbers per center ranging from 942 to 10. A total of 2671 (52.1%) patients achieved mRS scores of 3–6 at 3-month follow-up (Table 1). Patients that achieved mRS 3–6 differed vastly from those that achieved mRS 0–2, including the proportion of mTICI 2b-3 (77.6% vs. 94.6%, \( p < 0.001 \)) and SICH (5.2% vs. 0.6%, \( p < 0.001 \)).

\( \Delta SBP \) and clinical outcomes

Mean \( \Delta SBP \) was −12.3, −15.7, −17.2, and −16.9 mmHg for time intervals 0–2, 2–4, 4–12, and 12–24 h, respectively (Table S1). \( \Delta SBP \) was normally distributed at all time intervals (Figure S2). After adjusting for potential confounders, \( \Delta SBP \) showed significant associations with mRS 3–6 for increasing \( \Delta SBP \) at all time intervals (OR 1.065, 95% CI 1.014–1.118; OR 1.140, 95% CI 1.081–1.203; OR 1.145, 95% CI 1.087–1.207; OR 1.145 with 95% CI 1.089–1.203 for time intervals 0–2, 2–4, 4–12, 12–24 h, respectively, for every increase of 10 mmHg \( \Delta SBP \)) (Table 2).

In the subgroup analysis, only the categorization of baseline SBP showed a significant interaction with \( \Delta SBP \) at 12–24 h for unfavorable outcome (\( p \) for interaction = 0.028) (Figure 2). No significant interactions were found with the subgroups for death at 3 months (Figure S3). History of hypertension showed a significant interaction with \( \Delta SBP \) at 0–2, 4–12, and 12–24 h for SICH (Figure S4). Baseline SBP subgroups at 0–2 h and reperfusion status at 4–12 h showed a significant interaction with \( \Delta SBP \) for NIHSS worsening (Figure S5).

In the sensitivity analysis, we found that \( \Delta SBP \) had linear-like associations with unfavorable outcome (Figure 3). Steeper slopes were seen with higher values of \( \Delta SBP \) for most time intervals and outcomes, suggesting an even stronger association with unfavorable outcomes with higher values of \( \Delta SBP \).

\( \Delta eSBP \) and clinical outcomes

Mean \( \Delta eSBP \) was −4.8, −7.1, and −8.1 mmHg for time intervals 2–4, 4–12, and 12–24 h, respectively (Table S1). Mixed effects logistic regression models of \( \Delta eSBP \) largely followed the same results as \( \Delta SBP \).
Higher values of $\Delta$SBP were significantly associated with mRS 3–6 for all time intervals (OR 1.114, 95% CI 1.058–1.174; OR 1.107, 95% CI 1.054–1.162; OR 1.060, 95% CI 1.014–1.109 for time intervals 2–4, 4–12, 12–24 h, respectively, for every increase of 10 mmHg $\Delta$SBP) (Table 2).

The association of $\Delta$eSBP in the sensitivity analysis was also linear-like (Figure 4). Again, there was a trend towards unfavorable outcome with higher values of $\Delta$eSBP for all outcomes at all time intervals. Negative $\Delta$eSBP values showed varying associations for the time intervals in both direction and steepness.

**DISCUSSION**

To our knowledge, this is the first study investigating the association between $\Delta$SBP at different time intervals post-MT and clinical
outcomes. Our study demonstrated a direct association between ∆SBP and unfavorable outcome, death, SICH, and neurological deterioration. The results were consistent across all time intervals. The association between ∆SBP and outcomes were independent of age, reperfusion status, stroke severity, baseline SBP, and history of hypertension. When we examined the shape of the relationship between ∆SBP and outcome, we found that the greater the SBP increase post-MT, the higher the risk for unfavorable outcome, death, SICH, and neurological deterioration after MT. Conversely, the greater the SBP reduction post-MT, the lower the odds for unfavorable outcome. Although it should be noted that the association between positive ∆SBP (i.e., SBP increase) and outcomes was more pronounced than the association between negative ∆SBP (i.e., SBP reduction) and outcomes, as seen in the restricted cubic spline models.

Previous studies assessing the association between SBP change and outcomes of MT reported inconsistent results. A previous study of patients with successful reperfusion demonstrated a weak negative association between SBP change in the 24 h following reperfusion and unfavorable outcome.[10] However, when the authors compared SBP increase to different categories of SBP decrease post-MT, SBP reduction had lower odds of unfavorable outcome, though the difference did not reach statistical significance. In a subsequent analysis of the BEST (Blood Pressure after Endovascular Stroke Therapy) prospective study, ∆SBP was associated with unfavorable outcome in the unadjusted model; however, the association became insignificant after adjusting for potential confounders.[11] The difference in the study design and the definition of SBP change between the previous studies likely contributed to the difference in the results. Unlike previous studies, the present study assessed the association between ∆SBP and outcomes at different time intervals.

Underlying hypertension is an important factor that may modify the relationship between BP and outcome. In the present study, ∆SBP in the 0–4 h period was associated with unfavorable outcome only in patients with underlying hypertension but not in those without hypertension. This is not surprising given that the autoregulation curve is shifted rightward in patients with underlying hypertension which makes them more sensitive to BP change (especially BP reduction) than patients without underlying hypertension.[1] Additionally, underlying hypertension interacted with ∆SBP at all time intervals for an increased risk of SICH and only patients with hypertension had higher odds of SICH with higher values of ∆SBP. This is an important finding and highlights the importance of taking into account underlying hypertension when managing BP post-MT.

There is overwhelming evidence suggesting a link between elevated SBP acutely after ischemic stroke and unfavorable outcome,[1–5,16 yet altering BP has not been found to be beneficial.[17] The ENCHANTED (intensive blood pressure reduction with intravenous thrombosis therapy for acute ischaemic stroke) randomized controlled clinical trial compared intensive BP treatment approach (SBP goal 130–140 mmHg) to the guideline-recommended SBP goal (180 mmHg) after intravenous thrombolysis treatment.[18] The trial found no difference in functional outcome between the two groups, although the rate of any intracranial hemorrhage was lower in the intensive group. The ENCHANTED trial did not routinely assess reperfusion status and only 1.9% of patients received MT; therefore, its results cannot be generalized to MT patients. Due to lack of randomized trials, the American Heart Association/American Stroke Association (AHA/ASA) guideline recommends a BP goal of 180/105 mmHg or below post-reperfusion therapy, a recommendation that was mostly extrapolated from the intravenous thrombolysis literature.[19] Despite the AHA/ASA recommendations, SBP goals of <140 and <160 mmHg have been widely utilized due to concern of reperfusion injury post-MT.[20] A recent multicenter study compared different SBP goals post-successful MT and found that patients treated for SBP goal of <140 mmHg had higher odds of functional independence compared to those treated according the guideline-recommended SBP goal (<180 mmHg).[20]

Our results show a strong association between BP increases after thrombectomy and poor outcome after thrombectomy regardless of

### Table 2: Odds ratios for the outcomes from the mixed effects logistic regression models of baseline systolic blood pressure change (∆SBP) and end of procedure systolic blood pressure change (∆eSBP) for every increase of 10 mmHg

| Parameter | mRS 3–6 at 3 months | Death at 3 months | SICH by mSITS | Neurological deterioration |
|-----------|---------------------|-------------------|--------------|---------------------------|
| ∆SBP      |                     |                   |              |                           |
| 0–2 h     | 1.065 (1.014–1.118) | 1.071 (1.009–1.137)| 1.131 (1.018–1.256) | 1.075 (1.010–1.144) |
| 2–4 h     | 1.140 (1.081–1.203) | 1.135 (1.065–1.210) | 1.294 (1.157–1.446) | 1.163 (1.088–1.243) |
| 4–12 h    | 1.145 (1.087–1.207) | 1.136 (1.069–1.208) | 1.199 (1.086–1.323) | 1.161 (1.091–1.236) |
| 12–24 h   | 1.145 (1.089–1.203) | 1.121 (1.055–1.191) | 1.123 (1.001–1.260) | 1.163 (1.092–1.238) |
| ∆eSBP     |                     |                   |              |                           |
| 2–4 h     | 1.114 (1.058–1.174) | 1.076 (1.012–1.143) | 1.141 (1.026–1.267) | 1.129 (1.062–1.201) |
| 4–12 h    | 1.107 (1.054–1.162) | 1.064 (1.004–1.128) | 1.140 (1.031–1.261) | 1.139 (1.074–1.208) |
| 12–24 h   | 1.060 (1.014–1.109) | 1.019 (0.966–1.075) | 1.037 (0.942–1.141) | 1.088 (1.029–1.150) |

Neurological deterioration defined as an increase of NIHSS score by ≥4 points.
∆eSBP, end of procedure systolic blood pressure change; mRS, modified Rankin scale score; mTICI, modified Treatment in Cerebral Infarction score; NIHSS, National Institutes of Health Stroke Scale score; ∆SBP, baseline systolic blood pressure change; SICH by mSITS, symptomatic intracerebral hemorrhage by the modified SITS-MOST criteria.
success or failure of recanalization. It remains unclear whether this association is causative, and if effective and early treatment of BP after thrombectomy improves outcome. This question is being addressed by ongoing clinical trials (NCT04140110, NCT03160677).[21]

Limitations

Despite the large sample size and the multicenter design, our study has multiple limitations that need to be considered while interpreting our results. First, the retrospective design of the study is an inherit limitation. Second, there was no standardized BP measurement or management protocols across centers that may have affected our results in an unpredictable manner. Third, we did not have information regarding the type and timing of antihypertensive medications; therefore, we limited our analyses to whether patients received antihypertensive treatment post-MT. Fourth, the outcome measures were reported by participating centers without central adjudication. SITS lacks information on how mRS was performed at each center and certification status of the assessor for mRS. Fifth, we did not have detailed information on SBP during the endovascular thrombectomy (EVT) procedure, other than eSBP. Sixth, we did not...
have data specifying if a patient was admitted to the intensive care unit during their hospital stay or what type of specialist treated the patient. Finally, we did not have data regarding the infarct volume or extension; therefore, we could not assess the relationship between ∆SBP and infarct extension.

**CONCLUSIONS**

In acute ischemic stroke patients treated with MT, ∆SBP is associated with poor functional outcome. The association between ∆SBP and poor outcome was mostly linear; however, increasingly worse outcomes...
were observed for higher values of ∆SBP. The non-linear association of ∆SBP may be an interesting target for future studies and trials.

ACKNOWLEDGMENTS
We thank all Safe Implementation of Treatments in Stroke (SITS) International Stroke Thrombolysis Registry investigators and their centers for their participation. We also thank all the patients who participated in SITS. The current registry is developed, maintained, and upgraded by Zitelab, Copenhagen, Denmark in close collaboration with SITS.

DISCLOSURES
A.H. receives investigator-initiated funding from AMAG and Regeneron Pharmaceuticals. N.A. is the Chairman of SITS International, which receives a grant from Boehringer Ingelheim for the SITS International Stroke Thrombolysis Register and from Stryker, Covidien, and Phenox in collaboration with Karolinska Institutet for the SITS-OPEN study. The remaining co-authors have no relevant disclosures.

AUTHOR CONTRIBUTIONS
Mohammad Anadani: Conceptualization (equal); Formal analysis (equal); Investigation (equal); Methodology (equal); Writing-original draft (equal); Writing-review & editing (equal). Marius Matusevicius: Conceptualization (equal); Data curation (equal); Formal analysis (equal); Funding acquisition (equal); Investigation (equal); Methodology (equal); Project administration (equal); Software (equal); Writing-original draft (equal); Writing-review & editing (equal). Georgios Tsivgoulis: Data curation (equal); Methodology (equal); Writing-original draft (equal); Writing-review & editing (equal). Andre Philippe Peeters: Methodology (equal); Project administration (equal); Writing-original draft (equal); Writing-review & editing (equal). Ana Paiva Nunes: Data curation (equal); Methodology (equal); Writing-original draft (equal); Writing-review & editing (equal). Michelangelo Mancuso: Data curation (equal); Methodology (equal); Writing-original draft (equal); Writing-review & editing (equal). Christine Roffe: Data curation (equal); Methodology (equal); Writing-original draft (equal); Writing-review & editing (equal). Adam de Havenon: Conceptualization (equal); Formal analysis (equal); Investigation (equal); Methodology (equal); Writing-original draft (equal); Writing-review & editing (equal). Niaz Ahmed: Conceptualization (equal); Data curation (equal); Formal analysis (equal); Investigation (equal); Methodology (equal); Project administration (equal); Resources (equal); Supervision (equal); Writing-original draft (equal); Writing-review & editing (equal).

ORCID
Marius Matusevicius https://orcid.org/0000-0002-2868-127X
Georgios Tsivgoulis https://orcid.org/0000-0002-0640-3797
Michelangelo Mancuso https://orcid.org/0000-0003-2738-8562

REFERENCES
1. Regenhardt RW, Das AS, Stapleton CJ, et al. Blood pressure and penumbral sustenance in stroke from large vessel occlusion. Front Neurol. 2017;8:317. https://doi.org/10.3389/fneur.2017.00317
2. Anadani M, Orabi MY, Alawieh A, et al. Blood pressure and outcome after mechanical thrombectomy with successful revascularization. Stroke. 2019;50(9):2448-2454. https://doi.org/10.1161/strokeaha.118.024687
3. Mistry EA, Sucharew H, Mistry AM, et al. Blood pressure after endovascular therapy for ischemic stroke (BEST): a multicenter prospective cohort study. Stroke. 2019;50(12):3449-3455. https://doi.org/10.1161/strokeaha.119.026889
4. Matusevicius M, Cooray C, Bottai M, et al. Blood pressure after endovascular thrombectomy: modeling for outcomes based on recanalization status. Stroke. 2020;51(2):519-525. https://doi.org/10.1161/STROKEAHA.119.026914
5. Anadani M, Orabi Y, Alawieh A, et al. Blood pressure and outcome post mechanical thrombectomy. J Clin Neurosci. 2019;62:94-99. https://doi.org/10.1016/j.jocn.2018.12.011
6. Goyal N, Tsivgoulis G, Pandhi A, et al. Blood pressure levels post mechanical thrombectomy and outcomes in large vessel occlusion strokes. Neurology. 2017;89(6):540-547. https://doi.org/10.1212/2000000000004184
7. Malhotra K, Goyal N, Katsanos AH, et al. Association of blood pressure with outcomes in acute stroke thrombectomy. Hypertension. 2020;75(3):730-739. https://doi.org/10.1161/HYPTENSIONAHA.119.14230
8. Castillo J, Leira R, Garcia MM, Serena J, Blanco M, Davalos A. Blood pressure decrease during the acute phase of ischemic stroke is associated with brain injury and poor stroke outcome. Stroke. 2004;35(2):520-526. https://doi.org/10.1161/01.STR.000009769.22917.B0
9. Oliveira-Filho J, Silva SC, Trabuco CC, Pedreira BB, Sousa EU, Bacellar A. Detrimental effect of blood pressure reduction in the first 24 hours of acute stroke onset. Neurology. 2003;61(8):1047-1051. https://doi.org/10.1212/01.WNL.0000092498.75010.57
10. Anadani M, Arthur AS, Alawieh A, et al. Blood pressure reduction and outcome after endovascular therapy with successful reperfusion: a multicenter study. J Neurointerv Surg. 2019;12(10):932-936. https://doi.org/10.1136/neurintsurg-2019-015561
11. Anadani M, de Havenon A, Yaghi S, et al. Blood pressure reduction and outcome after endovascular therapy: a secondary analysis of the BEST study. J Neurointerv Surg. 2020;https://doi.org/10.1136/neurintsurg-2020-016494
12. Cole DJ, Schell RM, Drummond JC, Patel PM, Marcontonio S. Focal cerebral ischemia in rats: effect of phenylephrine-induced hypertension during reperfusion. J Neurosur Anesthesiol. 1992;4(2):78-84. https://doi.org/10.1097/00008506-199204000-00002
13. Cole DJ, Matsumura JS, Drummond JC, Schell RM. Focal cerebral ischemia in rats: effects of induced hypertension, during reperfusion, on CBF. J Cereb Blood Flow Metab. 1992;12(1):64-69. https://doi.org/10.1038/jcbfm.1992.8
14. Cole DJ, Drummond JC, Ruta TS, Peckham NH. Hemodilution and hypertension effects on cerebral hemorrhage in cerebral ischemia in rats. Stroke. 1990;21(9):1333-1339. https://doi.org/10.1161/01.str.21.9.1333
15. Wahlgren N, Ahmed N, Davalos A, et al. Thrombolysis with altepase for acute ischaemic stroke in the Safe Implementation of Thrombolysis in Stroke-Monitoring Study (SITS-MOST): an observational study. Lancet. 2007;369(9558):275-282. https://doi.org/10.1016/s0140-6736(07)60149-4
16. Ahmed NW, Wahlgren N, Brainin M et al. Relationship of blood pressure, antihypertensive therapy, and outcome in ischemic stroke treated with intravenous thrombolysis: retrospective analysis from Safe Implementation of Thrombolysis in Stroke-International Stroke Thrombolysis Register (SITS-ISTR). Stroke. 2009;40(7):2442-2449. https://doi.org/10.1161/STROKEAHA.109.548602
17. Bath PM, Krishnan K. Interventions for deliberately altering blood pressure in acute stroke. Cochrane Database Syst Rev. 2014;https://doi.org/10.1002/14651858.CD000039.pub3
18. Anderson CS, Huang Y, Lindley RI, et al. Intensive blood pressure reduction with intravenous thrombolysis therapy for acute ischaemic stroke (ENCHANTED): an international, randomised, open-label, blinded-endpoint, phase 3 trial. Lancet. 2019;393(10174):877-888. https://doi.org/10.1016/S0140-6736(19)30038-8

19. Powers WJ, Rabinstein AA, Ackerson T, et al. 2018 Guidelines for the early management of patients with acute ischemic stroke: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2018;49(3):e46-e110. https://doi.org/10.1161/STR.000000000000158

20. Anadani M, Arthur AS, Tsivgoulis G, et al. Blood pressure goals and clinical outcomes after successful endovascular therapy: a multicenter study. Ann Neurol. 2020;87(6):830–839. https://doi.org/10.1002/ana.25716

21. Mazighi M, Labreuche J, Richard S, et al. Blood pressure target in acute stroke to reduce hemorrhage after endovascular therapy: the randomized BP TARGET study protocol. Front Neurol. 2020;11:480. https://doi.org/10.3389/fneur.2020.00480

**SUPPORTING INFORMATION**

Additional supporting information may be found online in the Supporting Information section.

How to cite this article: Anadani M, Matusevicius M, Tsivgoulis G, et al. Magnitude of blood pressure change and clinical outcomes after thrombectomy in stroke caused by large artery occlusion. Eur J Neurol. 2021;28:1922–1930. https://doi.org/10.1111/ene.14807