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THÈSE

pour le

DIPLÔME D'ÉTAT DE DOCTEUR EN MÉDECINE

Qualification en RADIOLOGIE ET IMAGERIE MÉDICALE

Effect of Personalized Blood Pressure Management during mechanical Thrombectomy Under General Anesthesia: a Single-Center Study

Effet de la gestion personnalisée de la pression artérielle pendant la thrombectomie mécanique sous anesthésie générale : une étude monocentrique

PALKA Océane

Née le 05 Juillet 1994 à Saint-Brieuc (22)

Sous la direction du Dr L'ALLINEC Vincent

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Liste des abréviations

AG	Anesthésie Générale
AIS	Acute Ischemic Stroke
ASPECTS	Alberta Stroke Program Early CT Score
AUC	Areas Under the Curve
AVC	Accident Vasculaire Cérébral
BP	Blood Pressure
CNIL	Commission Nationale Informatique et Liberté
DBP	Diastolic Blood Pressure
ECASS II	European Cooperative Acute Stroke Study II
GA	General Anesthesia
ICH	Intracranial Hemorrhage
IRM	Imagerie par Résonance Magnétique
IVT	Intravenous Thrombolysis
LVO	Large Vessel Occlusion
MAP	Mean Arterial Pressure
MRI	Magnetic Resonance Imaging
mRS	Modified Rankin Scale
MT	Mechanical Thrombectomy
NAD	Noradrenaline
NECT	Non-contrast Enhanced Computed Tomography
NIHSS	National Institutes of Health Stroke Scale
OMS	Organisation Mondiale de la Santé
PAD	Pression Artérielle Diastolique
PAM	Pression Artérielle Moyenne
PAS	Pression Artérielle Systolique
rTICI	Revised Thrombolysis in Cerebral Infarction
SBP	Systolic Blood Pressure
TIV	Thrombolyse Intra Veineuse
TM	Thrombectomie Mécanique

Plan

RESUME

Introduction : La variabilité de la pression artérielle (PA), en particulier l'hypotension artérielle pendant la thrombectomie mécanique (TM) lors d'un accident vasculaire cérébral (AVC) ischémique, est associée à une évolution défavorable à 3 mois. Notre précédente étude a démontré qu'une diminution de seulement 5 % de la PA par rapport à la PA de base (avant l'induction) était un facteur prédictif indépendant de mauvais résultats. Notre étude vise à évaluer l'efficacité d'un protocole personnalisé de gestion de la PA pendant la TM sous anesthésie générale (AG) sur la réduction des hypotensions et son impact sur les résultats fonctionnels à 90 jours.

Méthodes : Nous avons mené une étude avant-après impliquant deux cohortes rétrospectives de patients ayant subi une TM pour un AVC ischémique sous AG, avant et après la mise en place du protocole. Le protocole visait à maintenir la pression artérielle moyenne (PAM) à plus ou moins 10 % de la PAM de base avant l'induction. Le critère de jugement principal était le modified Rankin Scale (mRS) à 90 jours.

Résultats : Notre analyse a porté sur 179 patients : 121 avant et 58 après l'introduction du protocole. On a observé une diminution des chutes de PAM dans le groupe « après », en particulier pour les hypotensions sévères (32,8 % contre 48,8 % en dessous de 30 % par rapport à la PAM de base, et 51,7 % contre 66,1 % en dessous de 20 %). Toutefois, ces différences ne sont pas statistiquement significatives. Les patients du groupe « après » ont eu de moins bons résultats neurologiques : 33 patients (56.9 %) ont eu un score mRS > 2 contre 56 patients (46.3 %) dans le groupe « avant ». Cette association est restée statistiquement non significative dans les analyses univariées et multivariées.

Conclusion : La prise en charge personnalisée de la PA pendant la TM a entraîné une diminution des chutes de tension (mais non significative). De plus, cette étude n'a pas montré d'amélioration des résultats fonctionnels à 90 jours.

INTRODUCTION GENERALE

1. Généralités

L'OMS définit les accidents vasculaires cérébraux (AVC) comme « le développement rapide de signes cliniques localisés ou globaux de dysfonction cérébrale avec des symptômes durant plus de 24 heures pouvant entrainer la mort, sans autre cause apparente qu'une origine vasculaire » (1)

Effectivement, les AVC sont un problème de santé publique puisqu'ils représentent la première cause de handicap physique acquis de l'adulte, la deuxième cause de démence et la deuxième cause de mortalité dans le monde (première cause chez la femme) (2).

L'incidence mondiale de l'AVC en 2019 est estimée à 12,2 millions (3) et en France, on dénombre environ 150 000 nouveaux cas d'AVC par an(4).

Plus de 80 % de l'ensemble des AVC sont d'origine ischémique et sont dus à l'occlusion d'une artère cérébrale par un thrombus. L'ischémie entraîne la survenue rapide d'une mort cellulaire au centre du territoire cérébral touché. Il sera responsable des séquelles neurologiques. Ce territoire est entouré d'une zone dite de « pénombre » dans laquelle les cellules sont en souffrance, sans avoir débuté un processus de mort cellulaire. La sauvegarde de cette zone de pénombre est le but des traitements de revascularisation.

2. Imagerie

L'imagerie joue un rôle central dans la phase aiguë de l'AVC car elle permet de confirmer le diagnostic, d'orienter l'étiologie et de guider les choix thérapeutiques du neurologue. D'après les recommandations de la HAS, les patients suspects d'AVC doivent être adressés vers des établissements disposant d'une unité neurovasculaire (UNV) et nécessitent un accès prioritaire 24 h/24 et 7 j/7 à l'imagerie cérébrale. (5)

L'imagerie par résonance magnétique (IRM) est la modalité d'imagerie à privilégier car elle est la plus performante pour montrer précocement des signes d'ischémie récente. En seconde intention, un scanner si possible avec séquence de perfusion couplé à un angioscanner des troncs supra-aortiques doit être réalisé. L'étude de la perfusion permet d'estimer la pénombre parenchymateuse à risque d'ischémie.

Le score ASPECT (Alberta Stroke Program Early CT Score) est un outil de quantification précoce de l'étendue de l'ischémie cérébrale, défini initialement sur les lésions ischémiques détectées au scanner sans injection (6). Le score est établi en divisant le territoire de l'artère cérébrale moyenne (ACM) en 10 régions, chacune valant un point. Un point est soustrait pour chaque région présentant une ischémie aiguë. Plus l'ischémie est diffuse, plus la valeur s'approche de 0.

Ce score a également prouvé sa faisabilité en IRM, en se basant sur la séquence de diffusion (ASPECTS-DWI) (7). Il existe également un score ASPECT pour la circulation postérieure (pc ASPECTS) (8)

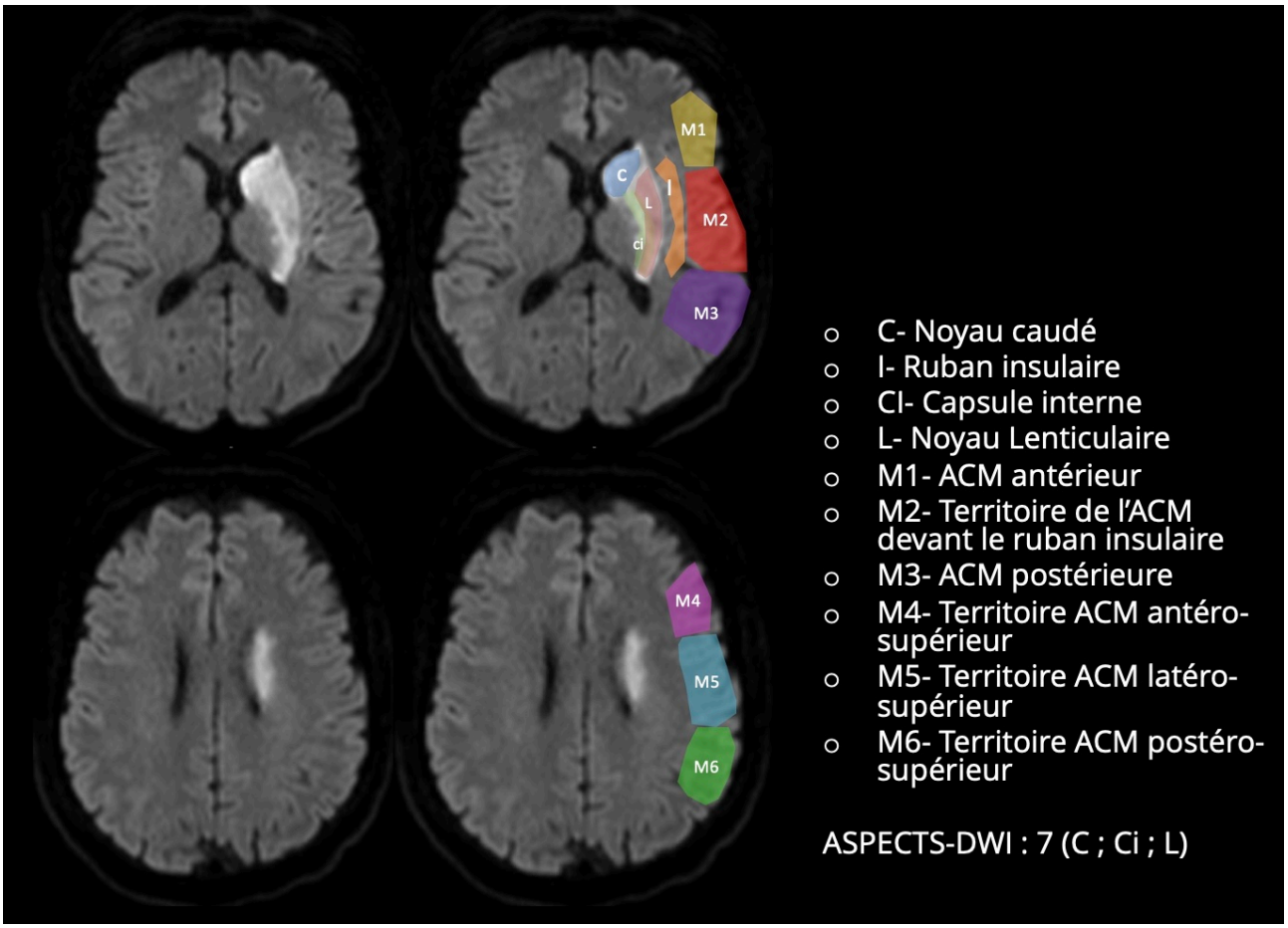

Figure 1 Schéma explicatif du score ASPECT. IRM cérébrale (séquence de diffusion) avec AVC ischémique du territoire sylvien profond gauche. Ici score ASPECT-DWI à 7.

Le score ASPECT est corrélé au pronostic fonctionnel à 3 mois de l'AVC ischémique aigu. Un score élevé (7 à 10) est associé à un meilleur pronostic, tandis qu'un score faible (0 à 6) est associé à un pronostic plus défavorable (9,10). Ce score constitue également une aide à la prise de décisions thérapeutiques. Par exemple, un score élevé peut indiquer que le patient est un bon candidat pour la thrombolyse intraveineuse (TIV) ou la thrombectomie mécanique (TM). Ainsi, il y aurait un avantage évident à la réalisation de la TM pour les patients ayant un score ASPECT > 5 (11). Un score bas serait un facteur prédictif de survenue d'hémorragie intra crânienne symptomatique après TIV (10). De nouvelles études suggèrent néanmoins un possible intérêt de la TM chez les patients avec un AVC étendu (9,10).

3. Les traitements de revascularisation

L'objectif thérapeutique dans la prise en charge d'un AVC ischémique est de restaurer la perfusion cérébrale dans la zone d'intérêt dite zone de « pénombre » par revascularisation afin de limiter les séquelles neurologiques. Ces traitements doivent être réalisés en urgence.

La thrombectomie mécanique (TM) est depuis 2015 recommandée à la phase aiguë dans le traitement de l'AVC chez les patients qui présentent une occlusion proximale des artères cérébrales (carotide, cérébrale moyenne, tronc basilaire), en complément de la TIV lorsqu'elle est indiquée ou d'emblée en cas de contre-indications à la TIV (11). Ces deux traitements de revascularisation sont synergiques et cette combinaison thérapeutique a montré son efficacité dans plusieurs essais randomisés. (12–14)

La TM est une technique de neuroradiologie interventionnelle permettant de recanaliser l'artère intra crânienne occluse par voie endovasculaire, soit par thromboaspiration, soit par utilisation d'un stent retriever ou les deux (technique combinée).

Le score angiographique rTICI (revised Thrombolysis in Cerebral Infarction Scale) permet d'évaluer la reperfusion cérébrale en fin de procédure (15). Un score rTICI supérieur ou égal à 2B témoigne d'une reperfusion significative.

Table I Score rTICI permettant d'évaluer la revascularisation lors de la thrombectomie mécanique

	Score TICI (Thrombolysis in Cerebral Infarction) révisé
0	Absence de perfusion ou flux antérograde au-delà du site de l'occlusion
1	Passage mais pas de perfusion. Le passage du produit de contraste existe au-delà de l'obstruction initiale, mais avec un remplissage minimal du territoire normal.
2	Perfusion incomplète : le produit de contraste passe l'occlusion et opacifie le lit artériel distal, mais la vitesse d'entrée ou de sortie du lit est plus lente ou incomplète par rapport aux territoires non impliqués.
2A	Perfusion avec un remplissage de la branche distale < 50% du territoire visualisé
2B	Perfusion avec remplissage de la branche distale > ou égal à 50 % du territoire visualisé
2C	Perfusion quasi complète, à l'exception d'un débit lent dans quelques vaisseaux corticaux distaux ou de la présence de petites emboles corticales distales
3	Perfusion complète avec remplissage normal de toutes les branches distales

La TM peut s'effectuer sous anesthésie générale (AG), ou sous anesthésie locale, associée ou non à une sédation consciente. Selon une récente méta-analyse, l'AG est associée à des taux de recanalisation plus élevés et à une meilleure récupération fonctionnelle à 3 mois par rapport aux techniques sans AG (16). Cela serait lié notamment à des conditions de procédure plus optimales grâce à l'immobilité du patient. Il s'agit de la technique privilégiée dans notre centre.

Malgré des taux de recanalisation élevés en fin de procédure, plus de 50 % des patients reperfusés connaissent encore un pronostic neurologique défavorable (17). Ces résultats seraient notamment expliqués par les fluctuations de pression artérielle (PA) pendant la TM, et en particulier les chutes tensionnelles. Plusieurs études ont en effet montré l'impact défavorable de l'hypotension pendant la TM sur l'évolution à 3 mois.(18–21)

Notre précédente étude, menée dans notre centre de Janvier 2018 à Juin 2021 est également en accord avec ces résultats. Dans cette étude observationnelle, rétrospective et monocentrique, nous avons évalué l'impact des hypotensions per-procédurales sur le pronostic neurologique des patients traités par TM sous AG pour un AVC ischémique. Nous avons constaté une corrélation positive entre la profondeur et la durée (« dose ») de l'hypotension et un mauvais pronostic neurologique à 3 mois. Il a notamment été démontré que même une hypotension de 5% par rapport à la PA initiale (avant induction) était un facteur indépendant de mauvaise évolution (mRS > 2). (**Annex 1**)

Aussi, depuis Février 2022, un protocole local de gestion de la PA a été mis en place afin d'optimiser la prise en charge hémodynamique des patients et également homogénéiser les pratiques entre les différents praticiens. (**Figure 2**)

Cette étude a pour objectif de connaître le bénéfice de ce protocole de gestion de la PA pendant la TM sous AG en ce qui concerne les hypotensions per procédurales et sur l'évolution fonctionnelle du patient à 3 mois, en comparant la population de l'étude antérieure avec celle de notre propre étude.

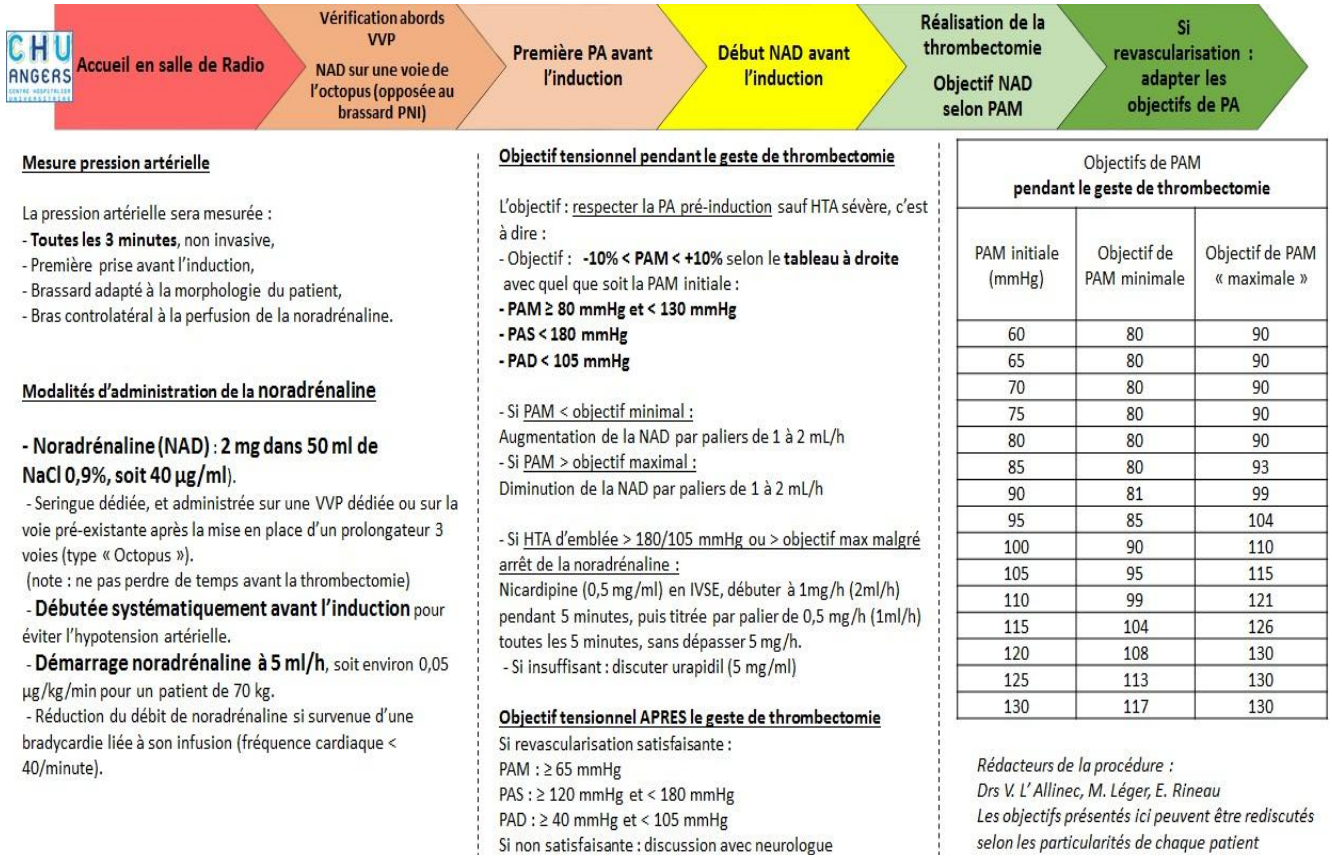

Figure 2 Protocole local de gestion de la pression artérielle pendant une TM sous AG au CHU d'Angers

ARTICLE

Effect of Personalized Blood Pressure Management during Mechanical Thrombectomy Under General Anesthesia: a Single-Center Study.

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1. Abstract

Introduction: Blood pressure (BP) variability, particularly arterial hypotension during mechanical thrombectomy (MT) for acute ischemic stroke (AIS), has been associated with unfavorable outcomes. Our prior research demonstrated that a mere 5% decrease in BP from baseline (preinduction) BP was an independent predictor of poor outcomes. This study seeks to assess the effectiveness of a personalized BP management protocol during MT under general anesthesia (GA) in mitigating hypotension and its impact on functional outcomes at 90 days.

Methods: We conducted a monocentric before-after study involving two retrospective cohorts of patients who underwent MT for AIS under GA, before and after implementing the protocol. The protocol aimed to maintain the mean arterial pressure (MAP) within 10% of the baseline MAP prior to induction. The main outcome measured was the modified Rankin Scale (mRS) at 90 days.

Results: Our analysis included 179 patients: 121 before and 58 after protocol implementation. The "after" group showed a reduced proportion of MAP drops, especially severe hypotension (32.8% vs. 48.8% below 30% from baseline, and 51.7% vs. 66.1% below 20%). However, these differences lacked statistical significance. Notably, patients in the "after" group had worse neurological outcomes: 33 patients (56.9%) had an mRS score > 2 vs. 56 patients (46.3%) in the "before" group. This association remained statistically insignificant in both univariate and multivariate analyses.

Conclusion: The personalized BP management during MT resulted in a decrease in BP drops (though not statistically significant). Furthermore, this study did not indicate any improvement in neurological outcomes at 90 days.

2. Introduction

Mechanical thrombectomy (MT), with or without intravenous thrombolysis (IVT), has become the established approach for treating acute ischemic stroke (AIS) caused by anterior large vessel occlusion (LVO). (22,23) Even with high recanalization rates, more than 50% of revascularized patients still face unfavorable outcomes at 90 days.(17)

Among the potential factors contributing to these outcomes, prior research has highlighted the significant influence of blood pressure (BP) during MT. Multiple studies have identified an association between arterial hypotension and BP variability during MT and poorer functional outcomes at 90 days, both under general anesthesia (GA) and conscious sedation.(18–21,24)

Our prior investigation, conducted at our center between January 2018 and June 2021, revealed that hypotension magnitude (measured by its depth and duration) was associated with unfavorable neurological outcomes at 3 months. Notably, even a 5% decrease from the baseline mean arterial pressure (MAP) emerged as an independent predictor of poor outcomes in patients undergoing MT under GA (**Annex 1**). These findings indicate the importance of taking precautions to minimize fluctuations in procedural BP.

The ideal BP thresholds to uphold during MT remain undefined. Presently, the 2019 AHA/ASA stroke guidelines solely advise keeping systolic blood pressure (SBP) under 180 and diastolic blood pressure (DBP) under 105 mmHg throughout the MT procedure, without addressing the potential negative impacts of BP variability.(22) Furthermore, the 2014 guidelines from the Society of Neurointerventional Surgery and the Neurocritical Care Society recommend maintaining SBP above 140 mmHg. (25) Despite various studies suggesting the significance of personalized BP monitoring, none has yet demonstrated the efficacy of this approach. (21,24,26)

Starting from February 2022, a BP management protocol was introduced at our university hospital center to enhance hemodynamic care for patients undergoing MT under GA.

The objective of this study was to evaluate the effectiveness of this individualized BP management protocol during MT under GA. We aimed to analyze its impact on procedural arterial hypotension and functional outcomes at 90 days. This was achieved by comparing the patient populations before and after the protocol's implementation.

3. Materials and Method

3.1. Study design and subjects

We conducted a before-after study involving two retrospective cohorts of patients who underwent MT for AIS under GA at Angers University Hospital. The "before" group was composed of all patients included in our earlier study from January 2018 to June 2021.(**Annex 1**, under review) The "after" group included all patients treated from February 2022, following the implementation of the BP protocol, until February 2023.

The inclusion criteria encompassed adult patients (≥ 18 years old) with AIS caused by LVO diagnosed through cerebral imaging (magnetic resonance imaging or angiographic sequences on computed tomography), and undergoing MT under GA. Exclusion criteria consisted of patients with unknown initial BP measurement, lacking automatic or computerized anesthetic monitoring, those receiving post-thrombolysis revascularization, individuals who experienced AIS subsequent to a cardiovascular procedure or recent GA (within 72 hours), patients intubated before revascularization, those with a pre-procedural modified Rankin Scale (mRS) score above 2 (27) or unavailable, if revascularization was unsuccessful (TICI 0 and 1), or if there was no available data on neurological outcomes at 3 months.

3.2. Recorded data

We used data from the Endovascular Treatment in Ischemic Stroke Registry (ETIS) and from patient records. Baseline clinical data encompassed various aspects, including demographics (age, sex), comorbid conditions, and risk factors (smoking status, diabetes mellitus, chronic arterial hypertension, dyslipidemia, atrial fibrillation, prior ischemic coronary arterial disease, and previous ischemic stroke). Additionally, information was collected on anti-hypertensive and anticoagulant treatments, baseline mRS score, baseline NIHSS (28), pretreatment with IVT.

The characteristics of the stroke were described, comprising the occlusion site (such as terminal internal carotid, middle cerebral artery localization, tandem, isolated cervical carotid artery, basilar artery), the severity assessed using the Alberta Stroke Program Early CT Score (ASPECTS) based on non-enhanced CT brain imaging (NECT) or magnetic resonance imaging (MRI) (6), as well as the time intervals from symptom onset to groin puncture and revascularization.

Parameters related to the MT procedure were gathered, including the Revised Thrombolysis in Cerebral Infarction (rTICI) score assessed at the conclusion of the procedure (15), the count of passes made, the successful MT strategy employed (stent retriever, direct aspiration, combined technique), and any associated complications.

Biological data obtained upon admission were gathered, including parameters like blood glucose levels, hemoglobin concentrations, platelet counts, prothrombin time, and international normalized ratio.

All patients underwent a 24-hour NECT to evaluate potential complications such as intracranial hemorrhage (ICH). We also examined the incidence of symptomatic intracranial hemorrhage (SICH), defined as hemorrhage apparent on CT or MRI that correlated with a rise in the NIHSS score of ≥ 4 (as per ECASS II) within 7 days. Additionally, the ASPECT and NIHSS scores at 24 hours were recorded.

We outlined the specific anesthetic agents employed for induction and the ones utilized for maintaining GA. Blood pressure data, including SBP, DBP and MAP, were measured prior to the induction of anesthesia, serving as the baseline BP. BP measurements were taken at intervals of every 5 minutes until 90 minutes following the commencement of the procedure. These values were automatically captured by the computerized anesthesia monitoring system. We documented the

administration of vasoactive therapies like nicardipine, urapidil, noradrenaline (NAD), neosynephrine, or ephedrine, along with their respective dosages.

3.3. Ethical considerations

The study protocol and consent form received approval from the Ethics Committee of Angers University Hospital (2023-026). In accordance with French Bioethics regulations, oral informed consent was obtained from patients if their level of consciousness permitted, or from their relatives otherwise. Data confidentiality was strictly maintained in accordance with the guidelines of the French commission for data protection (Commission Nationale Informatique et Liberté, CNIL), with registration number ar23-0021v0.

3.4. Blood pressure management

In the "before" group, BP management complied with current guidelines: maintaining BP below 180/105 mmHg (for SBP and DBP, respectively) during the MT procedure, following the 2019 AHA/ASA stroke guidelines (22) and maintaining SBP < 140 mmHg as outlined in the 2014 guidelines from the Society of Neurointerventional Surgery and the Neurocritical Care Society (25). If an episode of hypotension occurred during the procedure, it was subsequently managed by administering a vasopressor agent (with the specific molecule and dosage determined by the anesthetist's discretion).

In the "after" group, BP was managed in accordance with an individualized protocol (**Annex 2**). Developed through collaboration between neuroradiologist and anesthetist experts from Angers University Hospital, this protocol was inspired by the DETERMINE study protocol (29). Before MT, a BP cuff was positioned on the patient's arm, tailored to their morphology, on the opposite side of the diluted NAD infusion. Baseline BP was obtained in the interventional radiology room prior to anesthesia induction. Throughout the procedure, BP was continuously monitored non-invasively every 5 minutes.

To mitigate peri-procedural hypotension, diluted NAD (2 mg in 50 mL 0.9% NaCl solution, i.e. 40 µg/mL) was administered as a vasopressive support. NAD infusion commenced before induction at 0.2 mg/h using an electric syringe pump, and adjustments were made based on MAP changes.

During MT, the objective was to maintain MAP within 10% of baseline (i.e., -10% < MAP < 10%), with a minimal target MAP ≥ 80 mmHg. SBP and DBP were kept below 180/105 mmHg, and MAP was maintained below 130 mmHg.

In situations where MAP fell below the minimum target, NAD dosage was escalated incrementally by 0.04 to 0.08 mg/h. Conversely, if MAP exceeded the maximum target, NAD was reduced in increments of 0.04 to 0.08 mg/h. If initial arterial hypertension occurred (i.e., > 180/105 mmHg) or if hypertension persisted beyond the maximum target despite NAD discontinuation, intravenous nicardipine (0.5 mg/ml) was initiated using an electric syringe. It began at 1 mg/h for 5 minutes and was titrated by 0.5 mg/h every 5 minutes, without surpassing 5 mg/h. If this proved insufficient, urapidil (5 mg/ml) could be considered. Post-procedure, for cases of successful revascularization, the following BP targets were established: MAP ≥ 65 mmHg, SBP ≥ 120 mmHg and < 180 mmHg, DBP ≥ 40 mmHg and < 105 mmHg. In instances of unsuccessful revascularization, BP objectives would be determined through individual consultation with the neurologist.

3.5. Outcomes

Neurological functional status at 90 days, determined using the mRS, was evaluated by either certified vascular neurologists during routine clinical visits or by a qualified study nurse via a standardized telephone interview. A favorable outcome was characterized by an mRS score ≤ 2, whereas a poor outcome was indicated by an mRS score > 2.

3.6. Statistical analyses

We employed Chi-square tests to compare patient characteristics between groups for categorical variables. For continuous variables, Student's t-tests were employed, or the Mann-Whitney test was used for those that did not follow a normal distribution. To establish various thresholds for each patient corresponding to a MAP drop of 5%, 10%, 15%, 20%, and 30% from the baseline, we calculated the corresponding areas under the curve (AUC) using the trapezoidal rule, capturing the interplay of time and depth of arterial hypotension (Figure 3). AUC calculation was confined to revascularization time or up to 90 minutes of the procedure. To discern the relative impacts of time in arterial hypotension and the depth of hypotension, AUC values were indexed to both the lowest MAP value during the procedure and the total time spent in arterial hypotension based on the specified thresholds. Correlations between AUC and mRS were assessed through Kendall's correlation coefficient (k) supplemented with 95% confidence intervals (95% CI). We dichotomized mRS as favorable (mRS ≤ 2) and unfavorable (mRS > 2), and subsequently, we examined the link between AUC and the dichotomized mRS through multivariate logistic regression, adjusting for selected confounding factors. Initial BP values, lowest BP values, and procedure duration were omitted from these multivariate models due to collinearity with AUC values. To compare the "before" and "after" phases, we used a logistic regression model adjusting for the following empirically selected confounding factors (age, NIHSS score, ASPECTS, pre-induction MAP, revascularization duration, anticoagulant treatment, IVT, and occlusion localization). We then estimated odds ratios with their confidence intervals. All statistical analyses were conducted using the R software (R Core Team, 2022, version 4.1.3).

4. Results

4.1. Patients' characteristics

4.1.1. Group before and after

A total of 179 patients were included in the final analysis, with 121 in the "before" group and 58 in the "after" group following protocol implementation. A total of 74 patients were excluded (53 from the "before" group and 21 from the "after" group), as depicted in **Figure 3.**

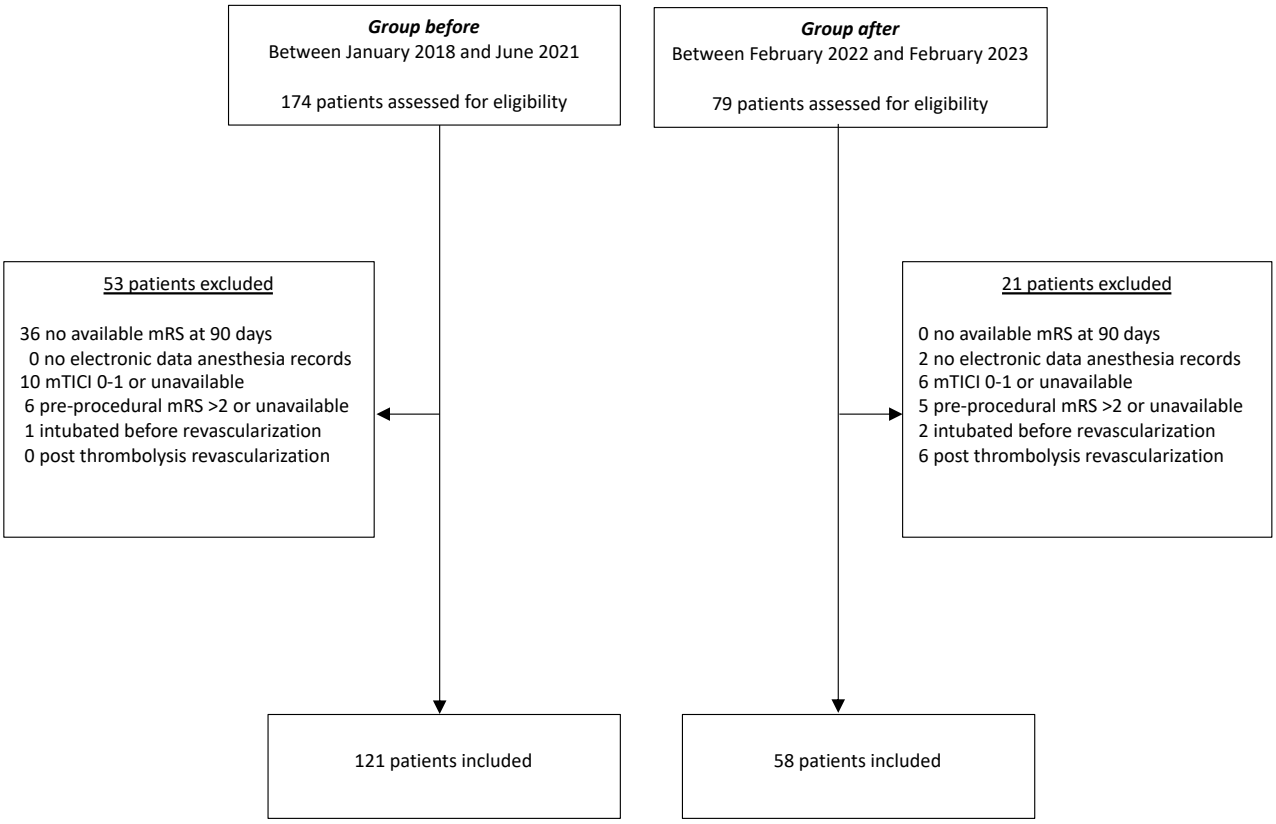

Figure 3 Flowchart of the study

The mean age of the cohort was 69.9 ± 14.8 years, with 89 patients (49.7%) being female. No significant differences emerged between the two groups in terms of baseline demographic and clinical characteristics. There were no noteworthy distinctions in baseline therapies, except for the use of CEI/A2R blockers: patients in the "after" group were more frequently treated with these blockers (45.6%) compared to the "before" group (28.1%) (P = 0.033). At baseline, no significant between-group differences were observed for mean NIHSS (16 ± 6 in the "before" group and 14 ± 7 in the

"after" group) or mean ASPECTS (7 ± 2 and 6 ± 2 for the respective groups). A summary of patient characteristics is presented in **Table II**. Comparison between included and excluded patients is resumed in **Annex 3**.

The two groups did not show any significant differences in occlusion location, mean time from symptom onset to groin puncture, mean time from symptom onset to recanalization, or mean procedure duration. In terms of the MT technique, there was a higher thromboaspiration rate in the "after" group (22.4%) compared to the "before" group (2.5%) (P < 0.001). Among the entire cohort, 166 patients (92.8%) achieved successful reperfusion (TICI score ≥ 2b), with 113 patients (93.4%) in the "before" group and 53 patients (91.3%) in the "after" group. No notable disparities were found in revascularization outcomes (P = 0.214).

Table II Population characteristics

		***Overall population* n = 179**	***Before group* n = 121 (68)**	***After group* n = 58 (32)**	***P***
Age (years)		69.9 ± 14.8	69.3 ± 14.8	71.1 ± 14.9	0.427
Women		89 (49.7)	59 (48.8)	30 (51.7)	0.833
Wake up stroke		60 (33.5)	46 (38.0)	14 (24.1)	0.095
Hypertension		96 (53.6)	59 (48.8)	37 (63.8)	0.084
Dyslipidemia		66 (36.9)	45 (37.2)	21 (36.2)	1.000
Diabetes mellitus		21 (11.8)	12 (10.0)	9 (15.5)	0.287
Active smoking status		29 (16.9)	19 (16.5)	10 (17.5)	0.185
Acute ischemic stroke		14 (7.8)	10 (8.3)	4 (6.9)	0.983
Coronary heart disease		26 (14.5)	18 (14.9)	8 (13.8)	1.000
Atrial Fibrillation		28 (15.6)	18 (14.9)	10 (17.2)	0.851
CEI/A2R blockers		60 (33.7)	34 (28.1)	26 (45.6)	**0.033**
Beta blockers		63 (35.4)	41 (33.9)	22 (38.6)	0.656
Calcium channel blockers		22 (12.4)	17 (14.0)	5 (8.8)	0.451
Aspirin		37 (20.7)	25 (20.7)	12 (20.7)	1.000
Clopidogrel		9 (5.0)	5 (4.1)	4 (6.9)	0.670
Anticoagulation		23 (13)	16 (13.3)	7 (12.3)	0.715
Pre-TM mRS					0.304
	0	155 (86.6)	108 (89.3)	47 (81.0)	
	1	19 (10.6)	10 (8.3)	9 (15.5)	
	2	5 (2.8)	3 (2.5)	2 (3.4)	
Baseline NIHSS		16 ± 7	16 ± 6	14 ± 7	0.057
NIHSS after 24h		12 ± 8	12 ± 9	13 ± 7	0.608
Thrombolysis		87 (48.6)	64 (52.9)	23 (39.7)	0.134
Initial imagery					1.000
	MRI	153 (85.5)	103 (85.1)	50 (86.2)	
	CT	26 (14.5)	18 (14.9)	8 (13.8)	
Occlusion localization					0.294
	Carotid terminus	13 (7.3)	6 (5.0)	7 (12.1)	
	MCA (M1 segment)	102 (57.0)	73 (60.3)	29 (50.0)	
	MCA (M2 segment)	33 (18.4)	24 (19.8)	9 (15.5)	
	Tandem	21 (11.7)	13 (10.7)	8 (13.8)	
	Cervical carotid	3 (1.7)	2 (1.7)	1 (1.7)	
	Basilar trunk	7 (3.9)	3 (2.5)	4 (6.9)	
MT procedure					**<0.001**

	Stent retriever	24 (13.4)	24 (19.8)	0 (0.0)	
	Thromboaspiration	16 (8.9)	3 (2.5)	13 (22.4)	
	Combined technique	139 (77.7)	94 (77.7)	45 (77.6)	
Final TICI					0.214
	2a	13 (7.3)	8 (6.6)	5 (8.6)	
	2b	32 (17.9)	21 (17.4)	11 (18.9)	
	2c	53 (29.6)	31 (25.6)	22 (37.9)	
	3	81 (45.3)	61 (50.4)	20 (34.5)	
Glycemia (g/L)		1.35 ± 0.47	1.33 ± 0.51	1.39 ± 0.40	0.532
Hemoglobin (g/dL)		13.1 ± 2.3	13.1 ± 2.6	13.2 ± 1.8	0.905
Blood platelets (G/L)		234 ± 95	226 ± 93	245 ± 98	0.275
Thrombin time (%)		92 ± 21	92 ± 22	94 ± 20	0.610
Baseline ASPECTS		7 ± 2	7 ± 2	6 ± 2	0.121
ASPECTS after 24 hours		6 ± 2	6 ± 2	6 ± 2	0.513
Onset to imagery time (min)		126 [95-163]	134 [105-171]	106 [86 -147]	0.005
Onset to anesthesia time (min)		275 [210-330]	275 [214-331]	275 [208-347]	0.907
Onset to revascularization time (min)		322 [259-384]	318 [266-381]	337 [233-387]	0.524
Duration of procedure (min)		86 [60-120]	79 [59-114]	89 [71-122]	0.257
Duration of revascularization (min)		38 [25-60]	37 [24-61]	45 [27-59]	0.133
Periprocedural complications		13 (7.3)	8 (6.6)	5 (8.6)	0.859
Craniectomy		7 (4.0)	7 (5.9)	0 (0.0)	0.141
Hemorrhagic transformation		52 (29.4)	36 (30.0)	16 (28.1)	0.931
Symptomatic hemorrhagic transformation		12 (6.7)	8 (6.6)	4 (6.9)	0.943
mRS					0.242
	> 2	89 (49.7)	56 (46.3)	33 (56.9)	
	≤ 2	90 (50.3)	65 (53.7)	25 (43.1)	

Count (%); mean ± standard deviation; median [interquartile range]
A2R, Angiotensin II Receptor; ASPECTS, Alberta Stroke Program Early CT Score; CEI, Conversing Enzyme Inhibitor; CT, Computed Tomography; MAP, Mean Arterial Pressure; mRS, modified Rankin Scale; MT, Mechanical Thrombectomy; TICI, Treatment in Cerebral Ischemia; MCA, Middle Cerebral Artery; MRI, Magnetic Resonance Imaging; NIHSS, National Institutes of Health Stroke Scale.

4.1.2. Outcomes

Among the 179 patients, 90 individuals (50.3%) achieved a favorable outcome at 90 days (mRS ≤ 2): 65 patients (53.7%) in the "before" group and 25 patients (43.1%) in the "after" group (P = 0.242). Patients with an unfavorable outcome were significantly older (P < 0.001), had higher baseline (P < 0.001) and 24-hour NIHSS scores (P < 0.001), lower ASPECTS at baseline (P < 0.001) and at 24 hours (P < 0.001), and received less IVT (P = 0.020). They also had lower final TICI scores (P = 0.045) and a higher incidence of hemorrhagic transformation (P = 0.003). Detailed comparisons can be found in **Table III**. Out of the total, 52 patients (29.4%) experienced ICH with 36 patients (30.0%) in the

"before" group and 16 patients (28.1%) in the "after" group (P = 0.931). SICH occurred in 8 patients (6.6%) and 4 patients (6.9%), respectively (P = 0.943).

Table III Comparison between patients with good and poor neurological outcomes according to the modified Rankin Scale

		Overall Population n = 179	Good outcome (mRS 0-2) n = 90	Poor Outcome (mRS 3-6) n = 89	*p-value*
	after	58 (32.4)	25 (27.8)	33 (37.1)	0.242
	before	121 (67.6)	65 (72.2)	56 (62.9)	
Age (years)		69.9 (14.8)	65.7 (16.1)	74.0 (12.2)	**<0.001**
Women		89 (49.7)	45 (50.0)	44 (49.4)	1.000
Wake up stroke		60 (33.5)	28 (31.1)	32 (36.0)	0.597
Hypertension		96 (53.6)	44 (48.9)	52 (58.4)	0.259
Dyslipidemia		66 (36.9)	31 (34.4)	35 (39.3)	0.602
Diabetes mellitus		21 (11.8)	8 (9.0)	13 (14.6)	0.415
Active smoking status		29 (16.9)	17 (19.5)	12 (14.1)	0.361
Acute ischemic stroke		14 (7.8)	5 (5.6)	9 (10.1)	0.392
Coronary heart disease		26 (14.5)	14 (15.6)	12 (13.5)	0.856
Atrial Fibrillation		28 (15.6)	11 (12.2)	17 (19.1)	0.289
CEI/ARA 2 blockers		60 (33.7)	32 (35.6)	28 (31.8)	0.712
Beta-blockers		63 (35.4)	29 (32.2)	34 (38.6)	0.461
Calcium channel blockers		22 (12.4)	9 (10.0)	13 (14.8)	0.460
Aspirin		37 (20.7)	17 (18.9)	20 (22.5)	0.684
Clopidogrel		9 (5.0)	6 (6.7)	3 (3.4)	0.505
Anticoagulation		23 (13)	5 (5.6)	18 (20.4)	**0.025**
Pre MT mRS					0.210
	0	155 (86.6)	77 (85.6)	78 (87.6)	
	1	19 (10.6)	12 (13.3)	7 (7.9)	
	2	5 (2.8)	1 (1.1)	4 (4.5)	
Intravenous thrombolysis		87 (48.6)	52 (57.8)	35 (39.3)	**0.020**
Occlusion localization					**0.037**
	Carotid terminus	13 (7.3)	4 (4.4)	9 (10.1)	
	MCA (M1 segment)	102 (57.0)	57 (63.3)	45 (50.6)	
	MCA (M2 segment)	33 (18.4)	20 (22.2)	13 (14.6)	
	Tandem	21 (11.7)	6 (6.7)	15 (16.9)	
	Cervical carotid	3 (1.7)	0 (0.0)	3 (3.4)	
	Basilar trunk	7 (3.9)	3 (3.3)	4 (4.5)	
MT technique					0.788
	Stent retriever	24 (13.4)	13 (14.4)	11 (12.4)	
	Thromboaspiration	16 (8.9)	9 (10.0)	7 (7.9)	

	Combined technique	139 (77.7)	68 (75.6)	71 (79.8)	
Final TICI					**0.045**
	2A	13 (7.3)	5 (5.6)	8 (9.0)	
	2B	32 (17.9)	12 (13.3)	20 (22.5)	
	2C	53 (29.6)	23 (25.6)	30 (33.7)	
	3	81 (45.3)	50 (55.6)	31 (34.8)	
Hemorrhagic Transformation		52 (29.4)	17 (18.9)	35 (40.2)	**0.003**
TOAST					0.322
	1	13 (9.8)	7 (9.5)	6 (10.3)	
	2	20 (15.2)	13 (17.6)	7 (12.1)	
	3	47 (35.6)	25 (33.8)	22 (37.9)	
	4	11 (8.3)	9 (12.2)	2 (3.4)	
	5	41 (31.1)	20 (27.0)	21 (36.2)	
NAD per induction		100 (56.2)	43 (48.3)	57 (64.0)	0.050
NAD per procedure		134 (75.3)	65 (73.0)	69 (77.5)	0.602
Thrombin time		92.49 (21.02)	96.90 (21.30)	87.73 (19.78)	**0.012**
Baseline NIHSS		16 ± 7	14 ± 6	18 ± 6	**<0.001**
Baseline ASPECT score		7 ± 2	7 ± 2	6 ± 2	**<0.001**
NIHSS at 24 hours		12 ± 8	8 ± 7	17 ± 8	**<0.001**
ASPECT score at 24 hours		6 ± 2	7 ± 2	5 ± 2	**<0.001**
Pre-induction SBP		153 ± 29	148 ± 29	158 ± 29	**0.021**
Pre-induction DBP		88 ± 25	86 ± 24	91 ± 26	0.138
Pre-induction PAM		106 ± 24	103 ± 23	110 ± 24	**0.044**
Onset to imagery time (min)		126 [95-163]	127 [99-170]	125 [95-161]	0.380
Onset to anesthesia time (min)		275 [210-335]	275 [206-320]	278 [215-338]	0.407
Onset to revascularization time (min)		322 [259-384]	318 [234-372]	340 [276-401]	0.065
Duration of procedure (min)		86 [60-120]	76 [52-104]	96 [69- 136]	**0.012**
Duration of revascularization (min)		40 [25-61]	32 [20-53]	47 [32-74]	**<0.001**

Count (%); mean ± standard deviation; median [interquartile range]
A2R, Angiotensin II Receptor; ASPECTS, Alberta Stroke Program Early CT Score; CEI, Conversing Enzyme Inhibitor; CT, Computed Tomography; MAP, Mean Arterial Pressure; MT, Mechanical Thrombectomy; TICI, Treatment in Cerebral Ischemia; MCA, Middle Cerebral Artery; mRS, modified Rankin Scale; MRI, Magnetic Resonance Imaging; NIHSS, National Institutes of Health Stroke Scale; TOAST, Trial of Org 10172 in Acute Stroke Treatment : 1) large-artery atherosclerosis, 2) small-vessel occlusion, 3) cardioembolism, 4) stroke of other determined etiology, 5) stroke of undetermined etiology.

4.2. BP and outcomes

4.2.1. BP in the two groups

No statistically significant differences were noted between the "before" and "after" groups in terms of baseline SBP (154 ± 30 vs. 150 ± 28, P = 0.397), baseline DBP (89 ± 27 vs. 87 ± 21, P = 0.709), and baseline MAP (106 ± 25 vs. 105 ± 21, P = 0.805). During the procedure, BP tended to be higher in the "after" group, with median MAP values exceeding 90 mmHg. The evolution of MAP over time in the two groups is visually depicted in **Figure 4**.

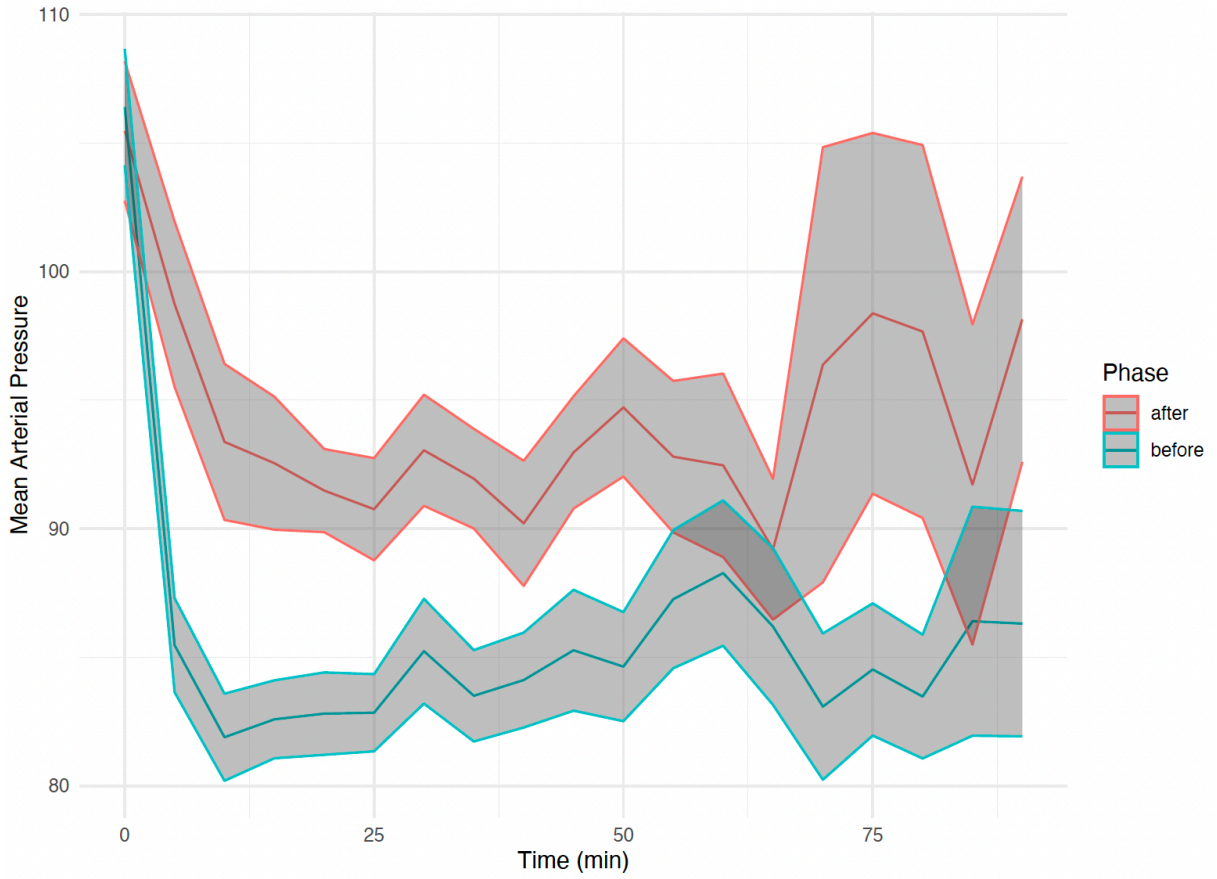

Figure 4 Evolution of procedural mean arterial blood pressure over time in the two groups

Detailed comparisons of blood pressures at different time points during the procedure can be found in **Annex 4** in the supplementary materials.

NAD usage was significantly more prevalent in the "after" group, with 65.8% in the "before" group and 94.8% in the "after" group (P < 0.001). The "before" group had a higher utilization of

ephedrine at 38.8% compared to 6.9% in the "after" group (P < 0.001). Similarly, the use of neosynephrine was higher in the "before" group at 11.6% versus 0.0% in the "after" group (P = 0.016). Details about intra-procedural anesthetic management are summarized in **Table IV**.

Table IV Intraprocedural anesthetic data

		Overall population n = 179	*Group before n* = 121	*Group after n* = 58	*P*-value
Maintenance anesthetic					0.051
	Propofol	148 (84.1)	96 (80.0)	52 (92.9)	
	Sevoflurane	28 (15.9)	24 (20.0)	4 (7.1)	
Pre-induction anti-hypertensive		5 (2.8)	4 (3.3)	1 (1.7)	0.907
Noradrenaline					
	Pre induction	30 (16.9)	19 (15.8)	11 (19.0)	0.757
	Per induction	100 (56.2)	53 (44.2)	47 (81.0)	**<0.001**
	Perprocedure	134 (75.3)	79 (65.8)	55 (94.8)	**<0.001**
Ephedrine per procedure		51 (28.5)	47 (38.8)	4 (6.9)	**<0.001**
Neosynephrine per procedure		14 (7.8)	14 (11.6)	0 (0.0)	**0.016**
Pre-induction SBP (mmHg)		153 ± 29	154 ± 30	150 ± 28	0.397
Pre-induction DBP (mmHg)		88 ± 25	89 ± 27	87 ± 21	0.709
Pre-induction MAP (mmHg)		106 ± 24	106 ± 25	105 ± 21	0.805
MAP drops					
	5 % from the baseline	142 (79.3)	97 (80.2)	45 (77.6)	0.840
	10 % from the baseline	133 (74.3)	90 (74.4)	43 (74.1)	1.000
	15 % from the baseline	124 (69.3)	85 (70.2)	39 (67.2)	0.814
	20 % from the baseline	110 (61.5)	80 (66.1)	30 (51.7)	0.092
	30 % from the baseline	78 (43.6)	59 (48.8)	19 (32.8)	0.063
Hypertension per procedure*		26 (14.5)	14 (11.6)	12 (20.7)	0.163

Count (%); mean ± standard deviation
MAP, Mean Arterial Pressure ; SBP, Systolic Blood Pressure ; DBP, Diastolic Blood Pressure
** at least one episode of SBP > 180 mmHg*

In the "before" group, 14 patients (11.6%) experienced at least one episode of hypertension (SBP > 180 mmHg) compared to 12 patients (20.7%) in the "after" group (P = 0.163). When examining both cohorts together, 142 patients (79.3%) encountered at least one MAP drop under 5%, 133 patients

(74.3%) under 10% from baseline, 124 patients (69.3%) under 15% from baseline, 110 patients (61.5%) under 20% from baseline, and 78 patients (43.6%) under 30% from baseline.

Upon comparison between the "before" and "after" groups, MAP drops were lower in the "after" group, though the differences were not statistically significant: 80.2% versus 77.6% under 5% from baseline MAP (P = 0.840), 74.4% versus 74.1% under 10% from baseline (P = 1), 70.2% versus 67.2% under 15% from baseline (P = 0.814), 66.1% versus 51.7% under 20% from baseline (P = 0.092), and 48.8% versus 32.8% under 30% from baseline (P = 0.063).

4.2.2. Relationship between MAP drops and neurological outcomes in the total population (before and after cohorts)

As shown in **Table V**, a positive correlation was observed within the overall patient cohort between MAP drops below different thresholds from baseline and poor neurological outcomes at 90 days. These correlations persisted after adjusting AUC values based on the total duration of arterial hypotension, reflecting the impact of the severity of hypotension, and the depth of arterial hypotension, indicating the impact of duration.

Table V Univariate analysis between AUC of MAP drops and poor outcomes (mRS > 2) at 90 days.

	k	95% CI	*p-value*
AUC of arterial hypotension			
MAP drop of 5 % from the baseline	0.19	0.09 - 0.28	**0.001**
MAP drop of 10 % from the baseline	0.19	0.09 - 0.28	**0.001**
MAP drop of 15 % from the baseline	0.18	0.07 - 0.28	**0.002**
MAP drop of 20 % from the baseline	0.17	0.07 - 0.27	**0.003**
MAP drop of 30 % from the baseline	0.16	0.05 - 0.27	**0.006**
AUC of arterial hypotension indexed on duration			
MAP drop of 5 % from the baseline	0.18	0.08 - 0.27	**0.002**
MAP drop of 10 % from the baseline	0.18	0.07 - 0.28	**0.001**
MAP drop of 15 % from the baseline	0.17	0.06 - 0.27	**0.002**
MAP drop of 20 % from the baseline	0.16	0.05 - 0.26	**0.005**
MAP drop of 30 % from the baseline	0.16	0.05 - 0.26	**0.007**
AUC of arterial hypotension indexed on depth			
MAP drop of 5 % from the baseline	0.17	0.06 - 0.27	**0.003**
MAP drop of 10 % from the baseline	0.15	0.04 - 0.25	**0.013**
MAP drop of 15 % from the baseline	0.15	0.03 - 0.25	**0.018**
MAP drop of 20 % from the baseline	0.15	0.03 - 0.26	**0.022**
MAP drop of 30 % from the baseline	0.07	-0.08 - 0.21	0.393

AUC, Area under the curve; MAP, Mean Arterial Pressure ; mRS, modified Rankin Scale ; k, Kendall correlation coefficient

Furthermore, positive correlations persisted in the multivariate analyses following adjustments for age, baseline NIHSS, and baseline ASPECTS. This pattern was consistent for almost all thresholds of arterial hypotension: under 5% (P = 0.002), under 10% (P = 0.003), under 15% (P = 0.006), and under 20% from baseline (P = 0.016). No statistically significant association was found for the threshold under 30% from baseline (P = 0.098). This detailed information is provided in **Table VI**.

Table VI Multivariate analysis* between AUC of MAP drops and poor outcomes (mRS > 2) at 90 days

	***P*-value**
MAP drop of 5 % from the baseline	0.002
MAP drop of 10 % from the baseline	0.003
MAP drop of 15 % from the baseline	0.006
MAP drop of 20 % from the baseline	0.016
MAP drop of 30 % from the baseline	0.098

*MAP, Mean Arterial Pressure; AUC, Area Under Curve; mRS, modified Rankin Scale; * adjusted for age, baseline NIHSS and baseline ASPECTS.*

4.2.3. Comparing neurological outcome before and after BP management protocol

In the univariate analysis, patients in the "after" group exhibited poorer neurological outcomes: 56 patients (46.3%) had a poor outcome in the "before" group, compared to 33 patients (56.9%) in the "after" group (P = 0.242). **Table II**

The results remained non-significant when controlling for age, NIHSS score, ASPECTS, pre-induction MAP, and revascularization duration (OR 1.59; 95% CI 0.72-3.60; P = 0.121). The association remained statistically non-significant after both reducing the list of confounding factors (namely, age, NIHSS score, and ASPECTS) and expanding it (including age, NIHSS score, ASPECTS, pre-induction MAP, revascularization duration, anticoagulant treatment, IVT, and occlusion localization). The results comparing neurological outcomes before and after the BP management protocol are outlined in **Table VII**.

Table VII Multivariate analysis comparing poor outcome (mRS > 2) at 90 days between before and after group.

	OR	95 % CI	*P-value*
Model 1	1.86	0.87-4.11	0.115
Model 2	1.59	0.72-3.60	0.121
Model 3	1.13	0.45-2.83	0.786

Model 1: adjusted for age, NIHSS score and ASPECTS.
Model 2: adjusted for age, NIHSS score, ASPECTS, pre-induction MAP, and revascularization duration.
Model 3: adjusted for age, NIHSS score, ASPECTS, pre-induction MAP, revascularization duration, anticoagulant treatment, IVT, and occlusion localization.

5. Discussion

In this study, our objective was to assess the influence of an individualized BP management protocol on arterial hypotension and its impact on functional neurological outcomes at 3 months for patients undergoing MT under GA for AIS. After implementing the protocol, we observed a decrease in the occurrence of arterial hypotension and an increase in MAP during the procedure, indicating protocol effectiveness despite the absence of statistical significance. However, we did not find a significant association with favorable neurological outcomes at 3 months for the group subjected to the individualized protocol. In fact, there was even a tendency towards worse neurological outcomes at 90 days, although this association did not reach statistical significance in the multivariate analyses.

Other ongoing trials are also exploring the effectiveness of individualized BP management during MT procedures, although their results have not been published yet. One such trial is the DETERMINE trial, which is a randomized, controlled, multicenter, prospective study. This trial's purpose is to evaluate the clinical significance of an individualized BP management approach during MT, comparing it with monitoring based on international recommendations under GA or conscious sedation. The DETERMINE trial's protocol is similar to ours, with the goal of maintaining MAP within 10% of the initial MAP measured just before the procedure. Similarly to our study, NAD is administered systematically before the procedure to prevent hypotension (29).

Another trial, the INDIVIDUATE trial, is a single-center randomized controlled trial with parallel groups, featuring an open-label design and blinded endpoint evaluation. This trial focuses on evaluating an individualized BP strategy, but instead of MAP, it concentrates on SBP. The goal is to maintain the intraprocedural SBP at the level observed during presentation, with a margin of approximately 10 mmHg (30).

Indeed, there are multiple interconnected hypotheses that might account for our findings. One potential explanation for these results is that efforts to minimize hypotensive incidents could have inadvertently led to elevated BP levels during the procedure, potentially producing an unintended counterproductive effect. This hypothesis was not confirmed in our study.

The observations from the "after" group indicate that MAP values during the procedure consistently remained elevated, surpassing 90 mmHg. A previous retrospective cohort study conducted by Rasmussen et al., which included 365 AIS patients, demonstrated an association between MAP levels exceeding 90 mmHg for over 45 minutes during MT and less favorable neurological outcomes at 3 months (31). The consistently higher BP levels during the procedure could potentially have adverse effects, suggesting the possibility of a dose-response relationship of BP that follows a U-shaped curve.

It is noteworthy that patients in the "after" group had a lower utilization of IVT, with only 39.7% receiving IVT compared to 52.9% in the "before" group. The presence of contraindications to IVT often identifies a subset of patients with higher rates of comorbidities, potentially including concurrent medical conditions, medications, or recent surgical history. This difference could contribute to the observed poorer neurological outcomes at 3 months. Existing research highlights the synergistic benefit of combining IVT and MT compared to MT alone. A recent meta-analysis of 30 clinical studies indicated that the bridging approach (IVT + MT) yields improved functional outcomes and reduced 90-day mortality without increasing the risk of early hemorrhagic complications.(32) This might be attributed to IVT's potential for accelerating early reperfusion in the ischemic region and resolving residual distal thrombi. Such findings align with current recommendations (22) advocating for IVT before TM when it is clinically indicated.

Regarding the complications associated with MT, we did not specifically account for emboli occurring in the same area or in new territories. However, research has demonstrated that such embolic events resulting in new ischemic lesions are predictive factors for unfavorable functional outcomes and are among the most common complications following MT (33). Recent studies utilizing diffusion-weighted imaging after MT have revealed that embolic events can manifest in approximately one-third of patients (34). As a result, only a minority of these embolic complications can be detected angiographically, and their clinical significance appears to be linked to the size of the resulting ischemic lesion.

In relation to the techniques used in MT, there was a notably higher utilization of contact aspiration alone in the "after" group. However, it is worth mentioning the ASTER trial (The Contact Aspiration vs Stent Retriever for Successful Revascularization), a multicenter randomized clinical trial that directly compared contact aspiration and the standard stent retriever technique for TM in AIS patients. This trial discovered no significant difference between the two techniques in terms of revascularization efficacy or neurological outcomes at 3 months (35). Similarly, the multicenter randomized COMPASS trial also demonstrated that direct aspiration is non-inferior to stent retriever first-line thrombectomy in terms of neurological outcomes at 90 days (36). These findings provide substantial support for considering direct aspiration as a viable alternative to stent retrievers for MT in AIS. In addition, the VECTOR trial (Adaptative Endovascular strategy to the Clot MRI in large intracranial vessel Occlusion), a recent multicenter, prospective, randomized study whose results have yet to be published, is comparing the combined technique (stent + contact aspiration) with contact aspiration alone in patients with AIS due to LVO. The outcomes of this study are currently pending.(37)

An important parameter that was not studied in our analysis is end-tidal CO2 (EtCO2), which has a significant impact on cerebral autoregulation in AIS (38). At our center, in line with the French Society of Anesthesia and Intensive Care (SFAR) guidelines (39), we strive to maintain EtCO2 levels between 35 and 40 mmHg for each patient undergoing MT under GA, aiming to prevent any negative effects on the neurological prognosis at 3 months.

Another factor not accounted for in our study is the collateral status of patients. Numerous studies have demonstrated that better collateral circulation is linked to slower stroke progression and improved functional outcomes. It is conceivable that patients selected for the "after" group might have had poorer collateral status, potentially influencing their neurological outcomes (40,41). However, incorporating collateral status assessment into research is complicated due to challenges in ensuring consistent reproducibility (42). These factors underline the complexity of stroke management and the need to consider multiple variables to comprehensively assess patient outcomes.

A before-after study presents certain inherent limitations. Throughout the analyzed period, various factors before, during, or after the procedure may have undergone alterations. Despite the extensive evaluation of numerous factors, it remains challenging to definitively attribute the obtained results solely to the implementation of the protocol. Our study is conducted at a single center and involves a limited number of patients, potentially leading to reduced statistical power. The retrospective nature of data collection introduces the possibility of data loss and the potential for unaccounted confounding variables affecting the analysis. The BP data collection was carried out automatically and via computerized means; however, the data points were recorded at intervals of every 5 minutes, which might diminish the accuracy in capturing rapid BP variations. Moreover, a majority of BP measurements were acquired non-invasively through the use of cuffs, which tends to be less precise compared to invasive BP measurements.

Given the study's design and the limited patient population, extrapolating the findings to a broader context can be difficult. Therefore, it is advisable to await the outcomes of randomized trials investigating the effects of individualized BP monitoring during MT. These trials would provide more robust evidence and insights into the potential benefits of such an approach.

6. Conclusion

Our study indicated that the implementation of individualized BP management resulted in decreased drops in MAP compared to baseline, particularly for cases of severe hypotension. However, our findings did not reveal any favorable impact of the BP management protocol on neurological outcomes at 3 months.

CONCLUSION GENERALE

Dans cette étude rétrospective, monocentrique, avant-après, notre objectif était d'évaluer les effets d'un protocole personnalisé de gestion de la PA chez les patients traités par TM sous AG sur les épisodes d'hypotension durant la TM et sur les résultats neurologiques à 90 jours. Le protocole a permis une réduction de l'incidence des hypotensions, avec une tendance générale à des niveaux de PA plus élevés pendant la procédure. Bien que ces résultats suggèrent l'efficacité du protocole, les différences observées n'ont pas atteint un seuil de signification statistique. Nous n'avons pas réussi à démontrer une association positive entre l'approche personnalisée de la PA et les résultats neurologiques à 3 mois. Il pourrait même y avoir des conséquences négatives associées à des niveaux plus élevés de PA pendant la procédure. Cependant, il est important de noter que de nombreux autres facteurs pourraient contribuer à ces résultats et nous ne pouvons pas conclure de manière définitive que les effets observés sont uniquement attribuables au protocole lui-même. Il est donc recommandé d'attendre les résultats d'essais randomisés portant sur les effets d'un monitorage individualisé de la PA pendant la TM. Ces essais fourniront des preuves plus solides et des indications sur les avantages potentiels d'une telle approche.

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LISTE DES FIGURES

LISTE DES TABLEAUX

TABLE DES MATIERES

ANNEXES

Annex 1 Our previous study assessing the impact of arterial hypotension "magnitude" on patients' neurological outcomes following MT under GA during AIS

Arterial hypotension "magnitude" during mechanical thrombectomy under general anesthesia and neurological outcome

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Despite recent advances in Acute Ischemic Stroke (AIS) treatment through mechanical thrombectomy (MT), over 50% of patients still confront unfavorable neurological outcomes[1]. MT, whether under general anesthesia (GA), local anesthesia, or sedation, provides a promising therapeutic avenue, with a recent randomized controlled trial showing superior neurological outcomes for those managed under GA[2]. Despite this, no current recommendation exists regarding optimal blood pressure management during MT.

It has been established that arterial hypotension during MT is associated with subsequent functional outcomes[3,4], but the depth and duration of hypotension have typically been evaluated separately. We herein report on the impact of the combined "magnitude" of arterial hypotension—integrating both the depth and duration of hypotensive episodes—on patients' neurological outcomes following MT under GA during AIS.

Ethical approval for the study (registration number 2021-125) was provided by the Ethical Committee of the Angers University Hospital, Angers, France (chairperson Doctor A.Armand) on 6 July 2021. Patient's consent for this study was waived according to the French law on bioethics[5]. All patients or their relatives were informed of the data collection. Data confidentiality was ensured by following the recommendations of the French Commission for Data Protection (Commission Nationale Informatique et Liberté, CNIL registration number ar21-0110v0).

From January 2018 to June 2021, we retrospectively enrolled all patients at the Angers University Hospital who underwent MT for AIS under GA, and were aged 18 years or older, diagnosed with Large Vessel Occlusion (LVO) on cerebral imaging. Exclusions were applied if initial blood pressure measurements were missing, if anesthetic monitoring was non-automatic, non-computerized, or in case of any recent events or procedures that could influence results. We excluded patients with post-thrombolysis revascularization, AIS following a cardiovascular procedure or recent GA (within 72 h), revascularization failure (TICI categories 0 and 1), or missing 90-day neurological outcome data.

Out of the 173 patients fitting the inclusion criteria, 53 were excluded, yielding a final analysis sample of 120 patients. The population was balanced by gender, had a mean age of 69.3 ± 14.8 years, a mean baseline NIHSS score of 16 ± 6, and a mean baseline ASPECT score of 7 ± 2. Blood pressure was non-invasively monitored for 119 patients (Table S1 in the supplementary materials). The flowchart of the study is resumed in the supplementary materials (Figure S1).

Sixty-four of the 120 patients (53.3%) had a favorable neurological outcome (i.e., a modified Rankin score (mRS) of 0, 1 or 2) at 90 days. Patients with poorer outcomes were generally older, had higher

baseline Mean Arterial blood Pressure (MAP), higher NIHSS before and at 24h after MT, lower ASPECT score at baseline and 24h after MT, and a longer procedure duration (Table S2).

We determined the different personalized thresholds for each patient corresponding to a drop in MAP of 5%, 10%, 15%, 20% and 30% from the baseline value. For these thresholds, we calculated the corresponding areas under the curve (AUC) using the trapezoidal rule, representing the combination of time and depth of arterial hypotension (Figure S2). Ninety-six patients (80.0%) experienced at least one drop below 5% from their baseline MAP value during the procedure. Examining the association between arterial hypotension magnitude and 90-day poor neurological outcomes revealed positive correlations between AUC and the mRS at 90 days for each PAM thresholds (i.e., higher AUC was associated with poorer neurological outcomes) (Table 1). The associations with the mRS at 90 days remained consistent when the AUC was normalized to the total duration of the procedure (i.e., primarily reflecting the impact of the depth of arterial hypotension) and when the AUC was normalized to the lowest per-procedural MAP value (i.e., primarily assessing the effect of the duration spent in arterial hypotension).

After adjusting for age, baseline NIHSS score, and baseline ASPECT score, the association between arterial hypotension AUC and unfavorable neurological outcomes remained across all PAM thresholds (Table S3 in the supplementary materials).

Our retrospective cohort study highlighted the per-procedural arterial hypotension "magnitude" impact on neurological outcomes in AIS patients treated with MT under GA. Not only the depth of MAP drops but also the duration of arterial hypotension below predefined thresholds contributed to the poor functional outcomes.

Past retrospective studies indicate that arterial hypotension during GA can independently predict poor neurological outcomes in AIS patients, whether the BP drops are significant (>40%)[3], or more modest[4]. The prevailing theory suggests that in LVO patients, compromised cerebral autoregulation in the ischemic penumbra might exacerbate the injury, impairing outcomes[6]. Our research suggests that even a minor 5% MAP reduction can significantly impact outcomes, underscoring the potential sensitivity of the ischemic penumbra to systemic BP fluctuations.

Our study has its limitations. Its monocentric nature and limited patient numbers may restrict its generalizability and statistical power. While BP data was automatically collected, we could only obtain a value every 5 minutes, omitting finer BP fluctuations. Our analyses specifically focus on per-

procedural hypotension and don't account for post-thrombectomy BP effects. Additionally, our study lacks data on end-tidal CO2, a key influencer of cerebrovascular dynamics in AIS[7].

Nonetheless, our study underscores the profound influence of the "magnitude" of arterial hypotension during MT under GA on the 90-day neurological outcomes of AIS patients. Our results call for meticulous blood pressure management during the MT procedure, especially for mild-to-severe hypotensive episodes.

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- Madjid Bouizegarene collected the data and wrote the first draft.
- Océane Palka collected the data and critically reviewed the manuscript.
- Mikael Mazighi, Sophie Godard, Emmanuel Rineau and Sigismond Lasocki critically reviewed the manuscript.
- Maxime Léger conceptualized the study, performed the statistical analyses, wrote and critically reviewed the manuscript.

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Table

Table 1. Univariate analyses of association between AUC of MAP drops and poor outcome (mRS >2) at 90 days

	k	**95% CI**	*p-value*
AUC of arterial hypotension			
MAP drop of 5 % from the baseline	0.19	0.07-0.32	0.003
MAP drop of 10 % from the baseline	0.19	0.07-0.32	0.004
MAP drop of 15 % from the baseline	0.18	0.05-0.31	0.005
MAP drop of 20 % from the baseline	0.19	0.06-0.32	0.005
MAP drop of 30 % from the baseline	0.21	0.07-0.33	0.003
AUC indexed on arterial hypotension duration			
MAP drop of 5 % from the baseline	0.20	0.08-0.32	0.002
MAP drop of 10 % from the baseline	0.20	0.08-0.32	0.002
MAP drop of 15 % from the baseline	0.19	0.06-0.31	0.004
MAP drop of 20 % from the baseline	0.19	0.06-0.31	0.005
MAP drop of 30 % from the baseline	0.21	0.08-0.34	0.002
AUC indexed on maximum arterial hypotension depth			
MAP drop of 5 % from the baseline	0.16	0.03-0.29	0.016
MAP drop of 10 % from the baseline	0.15	0.02-0.29	0.030
MAP drop of 15 % from the baseline	0.18	0.04-0.31	0.012
MAP drop of 20 % from the baseline	0.18	0.05-0.32	0.014
MAP drop of 30 % from the baseline	0.15	- 0.02-0.31	0.092

AUC, Area Under Curve; MAP, Mean Arterial Pressure; mRS, modified Rankin Scale; k, Kendall correlation coefficient

Annex 2 Local procedure for blood pressure management during thrombectomy under general anesthesia at the university hospital of Angers.

Local Procedure for Blood Pressure Management during Thrombectomy under General Anesthesia at the University Hospital of Angers

Blood Pressure Measurement

The blood pressure will be measured:
•Every 5 minutes, non-invasively,
•First measurement before induction,
•Using a cuff adapted to the patient's morphology,
•On the arm opposite to the noradrenaline infusion.

Administration of Noradrenaline

•Noradrenaline (NAD): 2 mg in 50 ml of 0.9% NaCl, resulting in 40 µg/ml concentration.
•Use a dedicated syringe and administer it through a dedicated peripheral venous line (VVP) or an existing line after attaching a three-way extension set (such as "Octopus"). (Note: Do not delay the thrombectomy procedure.)
•Start the infusion systematically before induction to prevent arterial hypotension.
•Initiate noradrenaline at a rate of 5 ml/h, approximately 0.05 µg/kg/min for a 70 kg patient.
•Reduce the noradrenaline infusion rate if bradycardia occurs (heart rate < 40/minute) due to its administration.

Blood Pressure Target During Thrombectomy Procedure

The goal is to maintain the pre-induction blood pressure, except in cases of severe hypertension, which means:
•Target: -10% < MAP < +10% as indicated in the table on the right.
Regardless of the initial MAP values, the following criteria should be met:
•MAP ≥ 80 mmHg and < 130 mmHg
•SBP< 180 mmHg
•DBP < 105 mmHg

If MAP is below the minimal target:
•increase Noradrenaline (NAD) infusion by 1 to 2 mL/h increments.
If MAP exceeds the maximal target:
decrease Noradrenaline (NAD) infusion by 1 to 2 mL/h increments.

If initial hypertension is > 180/105 mmHg or > the maximal target despite stopping Noradrenaline (NAD) infusion:
Nicardipine (0.5 mg/ml) via intravenous continuous infusion, starting at 1 mg/h (2 ml/h) for 5 minutes, then titrate by 0.5 mg/h (1 ml/h) increments every 5 minutes, not exceeding 5 mg/h.
•If the response is inadequate, consider using urapidil (5 mg/ml).

Blood Pressure Target AFTER the Thrombectomy Procedure If satisfactory revascularization is achieved:
•MAP: ≥ 65 mmHg
•SBP: ≥ 120 mmHg and < 180 mmHg
•DBP: ≥ 40 mmHg and < 105 mmHg
If revascularization is not satisfactory, consult with a neurologist for further management.

Objectives of MAP during the thrombectomy procedure.

Initial MAP (mmHg)	Minimum Target for MAP	Maximum Target for MAP
60	80	90
65	80	90
70	80	90
75	80	90
80	80	90
85	80	93
90	81	99
95	85	104
100	90	110
105	95	115
110	99	121
115	104	126
120	108	130
125	113	130
130	117	130

Authors of the procedure: Drs. V. L'Allinec, M. Léger, E. Rineau The objectives presented here can be reconsidered based on the specificities of each patient.

Annex 3 Comparison between included and excluded patients in clinical, biological and radiological characteristics

		Study cohort n = 179	Excluded patients n = 74	P value
Phase	before	121 (67.6)	53 (71.6)	0.632
	after	58 (32.4)	21 (28.4)	
Clinical features				
Age		69.9 ± 14.8	74.5 ± 13.1	0.021
Women		89 (49.7)	39 (52.7)	0.769
Wake up stroke		60 (33.5)	21 (31.3)	0.864
Hypertension		96 (53.6)	51 (69.9)	0.026
Dyslipidemia		66 (36.9)	26 (35.6)	0.965
Diabete Mellitus		21 (11.8)	8 (11.0)	0.522
Smoking		29 (16.9)	3 (4.3)	0.029
Acute ischemic stroke		14 (7.8)	8 (11.0)	0.579
Coronary heart disease		26 (14.5)	9 (12.3)	0.798
Atrial fibrillation		28 (15.6)	18 (24.7)	0.133
CEI/A2R blockers		60 (33.7)	30 (46.2)	0.103
Beta-blockers		63 (35.4)	34 (52.3)	0.025
Calcium channel blockers		22 (12.4)	8 (12.3)	1.000
Aspirin		37 (20.7)	8 (12.5)	0.209
Clopidogrel		9 (5.0)	4 (6.2)	0.961
Anticoagulation		25 (13)	26 (27.3)	0.077
Biological features				
Glycaemia (g/L)		1.35 ± 0.47	1.29 ± 0.29	0.385
Hemoglobin (g/dL)		13.2 ± 2.3	12.7 ± 3.4	0.367
Blood platelets (G/L)		234 ± 95	228 ± 92	0.722
Thrombin time (%)		92 ± 21	85 ± 23	0.057
Baseline MAP (mmHg)		104 ± 18	97 ± 22	0.015
Pre-MT mRS	0	155 (86.6)	56 (81.2)	<0.001
	1	19 (10.6)	3 (4.3)	
	2	5 (2.8)	1 (1.4)	
	3	0 (0.0)	8 (11.6)	
	4	0 (0.0)	1 (1.4)	
Intavenous thrombolysis		87 (48.6)	33 (45.8)	0.797
Baseline NIHSS		16 ± 7	14 ± 7	0.168
NIHSS at 24 hours		12 ± 8	13 ± 9	0.555
Radiological features				
Initial imagery	MRI	153 (85.5)	61 (82.4)	0.676
	CT	26 (14.5)	13 (17.6)	
Occlusion localization	Carotid terminus	13 (7.3)	5 (6.8)	0.115
	MCA (M1 segment)	102 (57.0)	42 (56.8)	
	MCA (M2 segment)	33 (18.4)	10 (13.5)	
	Tandem	21 (11.7)	5 (6.8)	

	Cervical carotid	3 (1.7)	4 (5.4)	
	Basilar trunk	7 (3.9)	8 (10.8)	
Baseline ASPECTS	0	0 (0.0)	1 (1.4)	0.674
	1	2 (1.1)	1 (1.4)	
	2	4 (2.3)	3 (4.3)	
	3	10 (5.6)	2 (2.9)	
	4	10 (5.6)	4 (5.8)	
	5	20 (11.3)	5 (7.2)	
	6	25 (14.1)	7 (10.1)	
	7	41 (23.2)	14 (20.3)	
	8	34 (19.2)	15 (21.7)	
	9	19 (10.7)	9 (13.0)	
	10	12 (6.8)	8 (11.6)	
ASPECTS after 24 hours	0	5 (2.1)	3 (1.7)	0.042
	1	8 (3.3)	5 (2.8)	
	2	11 (4.6)	11 (6.2)	
	3	23 (9.6)	12 (6.8)	
	4	21 (8.8)	20 (11.3)	
	5	22 (9.2)	19 (10.7)	
	6	34 (14.2)	25 (14.1)	
	7	45 (18.8)	34 (19.2)	
	8	40 (16.7)	28 (15.8)	
	9	20 (8.4)	14 (7.9)	
	10	10 (4.2)	6 (3.4)	
Final TICI	0	0 (0.0)	11 (17.2)	<0.001
	1	0 (0.0)	4 (6.2)	
	2a	13 (7.3)	2 (3.1)	
	2b	32 (17.9)	6 (9.3)	
	2c	53 (29.6)	14 (21.8)	
	3	81 (45.3)	27 (42.2)	
Perprocedural complications		13 (7.3)	7 (10.6)	0.559
Craniectomy		7 (4.0)	3 (4.5)	1.000
Hemorrhagic transformation		52 (29.4)	21 (30.9)	0.941

Count (%) ; mean ± standard deviation ; median [interquartile range]
A2R, Angiotensin II Receptor; ASPECTS, Alberta Stroke Program Early CT Score; CEI, Conversing Enzyme Inhibitor; CT, Computed Tomography; MAP, Mean Arterial Pressure; MT, Mechanical Thrombectomy; TICI, Treatment in Cerebral Ischemia; MCA, Middle Cerebral Artery; MRI, Magnetic Resonance Imaging; NIHSS, National Institutes of Health Stroke Scale

Annex 4 Blood pressure comparisons between before and after groups at different times of the procedure

BP over the time	Before	After	*P-value*
SBP 5 min	121 ± 30	138 ± 33	**0.002**
DBP 5 min	72 ± 18	83 ± 23	**0.001**
MAP 5 min	85 ± 20	99 ± 24	**<0.001**
SBP 10 min	116 ± 29	130 ± 29	0.005
DBP 10 min	68.39 ± 15.99	78 ± 23	**0.002**
MAP 10 min	81.89 ± 18.25	93 ± 23	**<0.001**
SBP 15 min	119 ± 28	129 ± 21	**0.018**
DBP 15 min	68 ± 14	78 ± 21	**0.001**
MAP 15 min	83 ± 16	93 ± 19	**0.001**
SBP 20 min	121 ± 28	129 ± 23	0.083
DBP 20 min	68 ± 14	75 ± 13	**0.002**
MAP 20 min	83 ± 16	91 ± 12	**0.001**
SBP 25 min	122 ± 24	134 ± 26	**0.006**
DBP 25 min	68 ± 14	73 ± 12	**0.039**
MAP 25 min	83 ± 14	91 ± 13	**0.002**
SBP 30 min	124 ± 27	138 ± 20	**0.004**
DBP 30 min	70 ± 18	75 ± 15	0.096
MAP 30 min	85 ± 18	93 ± 14	**0.016**
SBP 35 min	124 ± 27	135 ± 17	**0.021**
DBP 35 min	68 ± 13	75 ± 13	**0.010**
MAP 35 min	84 ± 14	92 ± 11	**0.002**
SBP 40 min	125 ± 24	135 ± 19	**0.033**
DBP 40 min	69 ± 12	75 ± 16	**0.047**
MAP 40 min	84 ± 14	91 ± 14	**0.023**
SBP 45 min	126 ± 26	137 ± 17	**0.041**
DBP 45 min	69 ± 15	75 ± 13	0.080
MAP 45 min	85 ± 16	93 ± 11	**0.019**
SBP 50 min	125 ± 25	137 ± 19	0.059
DBP 50 min	69 ± 12	77 ± 12	**0.013**
MAP 50 min	85 ± 14	95 ± 12	**0.004**
SBP 55 min	125 ± 28	137 ± 21	0.121
DBP 55 min	72 ± 15	77 ± 13	0.229
MAP 55 min	87 ± 16	93 ± 11	0.168
SBP 60 min	126 ± 25	135 ± 24	0.232
DBP 60 min	73 ± 16	74 ± 12	0.757
MAP 60 min	88 ± 16	92 ± 13	0.484
SBP 65 min	127 ± 24	132 ± 23	0.572
DBP 65 min	72 ± 14	71 ± 9	0.919

MAP 65 min	86 ± 16	89 ± 8	0.577
SBP 70 min	125 ± 25	142 ± 33	0.112
DBP 70 min	69 ± 13	77 ± 21	0.201
MAP 70 min	83 ± 14	95 ± 23	0.071
SBP 75 min	126 ± 26	143 ± 26	0.111
DBP 75 min	69 ± 10	77 ± 22	0.175
MAP 75 min	85 ± 12	97 ± 19	**0.045**
SBP 80 min	122 ± 18	151 ± 31	**0.012**
DBP 80 min	69 ± 9	77 ± 18	0.167
MAP 80 min	83 ± 10	98 ± 18	**0.024**
SBP 85 min	125 ± 23	145 ± 31	0.104
DBP 85 min	71 ± 18	71 ± 14	0.999
MAP 85 min	86 ± 17	92 ± 16	0.503
SBP 90 min	123 ± 21	149 ± 29	**0.031**
DBP 90 min	72 ± 16	80 ± 11	0.260
MAP 90 min	86 ± 16	98 ± 15	0.119

mean ± standard deviation
BP, Blood pressures; SBP, Systolic Blood Pressure; DBP, Diastolic Blood Pressure; MAP, Mean Arterial Pressure

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Effet de la gestion personnalisée de la pression artérielle pendant la thrombectomie mécanique sous anesthésie générale : une étude monocentrique

RÉSUMÉ

Introduction : La variabilité de la pression artérielle (PA), en particulier l'hypotension artérielle pendant la thrombectomie mécanique (TM) lors d'un accident vasculaire cérébral (AVC) ischémique, est associée à une évolution défavorable à 3 mois. Notre précédente étude a démontré qu'une diminution de seulement 5 % de la PA par rapport à la PA de base (avant l'induction) était un facteur prédictif indépendant de mauvais résultats. Notre étude vise à évaluer l'efficacité d'un protocole personnalisé de gestion de la PA pendant la TM sous anesthésie générale (AG) sur la réduction des hypotensions et son impact sur les résultats fonctionnels à 90 jours.

Méthodes : Nous avons mené une étude avant-après impliquant deux cohortes rétrospectives de patients ayant subi une TM pour un AVC ischémique sous AG, avant et après la mise en place du protocole. Le protocole visait à maintenir la pression artérielle moyenne (PAM) à plus ou moins 10 % de la PAM de base avant l'induction. Le critère de jugement principal était le modified Rankin Scale (mRS) à 90 jours.

Résultats : Notre analyse a porté sur 179 patients : 121 avant et 58 après l'introduction du protocole. On a observé une diminution des chutes de PAM dans le groupe « après », en particulier pour les hypotensions sévères (32,8 % contre 48,8 % en dessous de 30 % par rapport à la PAM de base, et 51,7 % contre 66,1 % en dessous de 20 %). Toutefois, ces différences ne sont pas statistiquement significatives. Les patients du groupe « après » ont eu de moins bons résultats neurologiques : 33 patients (56.9 %) ont eu un score mRS > 2 contre 56 patients (46.3 %) dans le groupe « avant ». Cette association est restée statistiquement non significative dans les analyses univariées et multivariées.

Conclusion : La prise en charge personnalisée de la PA pendant la TM a entraîné une diminution des chutes de tension (mais non significative). De plus, cette étude n'a pas montré d'amélioration des résultats fonctionnels à 90 jours.

Mots-clés : Accident vasculaire cérébral ischémique, thrombectomie mécanique, anesthésie générale, pression artérielle moyenne, pronostic neurologique

Effect of Personalized Blood Pressure Management during mechanical Thrombectomy Under General Anesthesia: a Single-Center Study

ABSTRACT

Introduction: Blood pressure (BP) variability, particularly arterial hypotension during mechanical thrombectomy (MT) for acute ischemic stroke (AIS), has been associated with unfavorable outcomes. Our prior research demonstrated that a mere 5% decrease in BP from baseline (preinduction) BP was an independent predictor of poor outcomes. This study seeks to assess the effectiveness of a personalized BP management protocol during MT under general anesthesia (GA) in mitigating hypotension and its impact on functional outcomes at 90 days.

Methods: We conducted a monocentric before-after study involving two retrospective cohorts of patients who underwent MT for AIS under GA, before and after implementing the protocol. The protocol aimed to maintain the mean arterial pressure (MAP) within 10% of the baseline MAP prior to induction. The main outcome measured was the modified Rankin Scale (mRS) at 90 days.

Results: Our analysis included 179 patients: 121 before and 58 after protocol implementation. The "after" group showed a reduced proportion of MAP drops, especially severe hypotension (32.8% vs. 48.8% below 30% from baseline, and 51.7% vs. 66.1% below 20%). However, these differences lacked statistical significance. Notably, patients in the "after" group had worse neurological outcomes: 33 patients (56.9%) had an mRS score > 2 vs. 56 patients (46.3%) in the "before" group. This association remained statistically insignificant in both univariate and multivariate analyses.

Conclusion: The personalized BP management during MT resulted in a decrease in BP drops (though not statistically significant). Furthermore, this study did not indicate any improvement in neurological outcomes at 90 days.

Keywords : Acute ischemic stroke, mechanical thrombectomy, general anesthesia, mean arterial blood pressure, neurological outcome, modified Rankin Scale

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