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Contact Aspiration Alone or Combined With Stent Retriever Thrombectomy for Middle Cerebral Artery Large Vessel Occlusion

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ABSTRACT

Background and Purpose: The effectiveness of a large-bore aspiration catheter for contact aspiration (CA) thrombectomy is compared to the combined use of an aspiration catheter and a stent retriever (CA+SR) for large vessel occlusion (LVO). We assessed the efficacy and safety of CA alone versus CA+SR as first-line treatment for middle cerebral artery (MCA) LVO in daily practice.

Methods: We retrospectively analyzed data from the SARA-3 registry of patients with MCA occlusion (M1 and M2 segments), dividing them into two groups: first-line CA alone and combined CA+SR. Demographic, clinical, angiographic, and clinical outcomes (National Institute of Health Stroke Scale score at 24 h and modified Rankin Scale [mRS] score at 3 months) were compared.

Results: Of 551 patients, 348 (63.8%) received CA alone and 203 (36.8%) received CA+SR. The groin-to-reperfusion time was significantly shorter in the CA-alone group than in the combined CA+SR group (median, 26 vs. 40 min, $p < 0.001$). The CA group demonstrated higher first-pass modified Thrombolysis In Cerebral Infarction (mTICI) 3 recanalization rates (47% vs. 37%; adjusted odds ratio [OR] 1.5 [confidence interval 1–2.1], $p = 0.042$), a higher final mTICI 3 rate (65% vs. 56%; OR 1.5 [1–2.2], $p = 0.037$), and fewer new territory embolisms (0.9% vs. 3.9%; OR 0.2 [0–0.8], $p = 0.028$) compared to the CA+SR group. The CA-alone group had better functional outcomes at 3 months (mRS $\leq$ 2, 77% vs. 63%; OR 1.9 [1.3–3], $p = 0.003$).

Conclusions: CA alone outperformed CA+SR as a first-line treatment for MCA LVO, yielding higher first-pass and final recanalization rates, lower new territory embolism risk, shorter procedure times, and better functional outcomes at 3 months.

1 | Introduction

Endovascular treatment of acute ischemic stroke (AIS) caused by large vessel occlusion (LVO) involves direct contact aspiration (CA) with a large-bore aspiration catheter, stent retrievers (SRs), and a combined approach (CA+SR) [1]. SR is a well-established and safe technique with high recanalization success [2]. Evidence demonstrated similar technical and clinical outcomes between SR and CA thrombectomy [3, 4], with shorter procedure times [5–7]. Constant technological improvement with the development of flexible, larger, softer aspiration catheters and cheaper [4, 8, 9] techniques might explain the increased interest in CA as a first-line strategy [10].

The combined approach was introduced with the idea that the synergistic effect of these two effective techniques might yield higher recanalization rates and favorable functional outcomes [11]. The higher procedural complexity of the combined approach may increase procedural time. The relevance of the first-line strategy for mechanical thrombectomy (MT) has been recently emphasized by the emergence of the first-pass effect (FPE) concept, showing improved outcomes for recanalization achieved with only one thrombectomy pass [12]. While some evidence suggests combining CA+SR improves FPE compared to SR alone [13–15], others show no difference [16–19]. Similarly, data comparing the safety and effectiveness of CA alone and a CA+SR first-line approach are limited and inconclusive. Some studies demonstrate that CA alone is not inferior to CA+SR for recanalization of LVO strokes [8, 20–22], while others have found that first-line CA was associated with significantly improved recanalization outcomes, faster procedure times [5], higher odds of favorable functional outcomes, and lower odds of symptomatic intracerebral hemorrhage (sICH) and mortality compared with CA+SR alone [21]. It has also been proposed that CA+SR thrombectomy improves first-pass recanalization rates compared with CA alone [23]. In summary, these studies tend to highlight the importance of achieving an effective, faster, and least harmful technique.

This study aimed to compare the efficacy and safety profiles of CA alone and combined CA+SR first-line thrombectomy on recanalization rates and clinical outcomes in patients with AIS due to middle cerebral artery (MCA) LVO in daily practice.

2 | Methods

2.1 | Study Design

We used data from the SARA-3 registry, which is an investigator-initiated prospective, multicenter, observational registry that included 23 comprehensive stroke centers, pooling individual data of adult patients for whom MT was indicated for AIS between January 2024 and December 2024. Written informed consent was obtained from all patients or their legal representatives. This study was approved by the ethical committee (ID HULP PI-6542). The indication for intervention for AIS was discerned based on the guidelines of the Standards of the European Stroke Organisation–European Society for Minimally Invasive Neurological Therapy Guidelines [24]. Endovascular therapy was performed by experienced neurointerventionalists at each comprehensive stroke center.

For this study, we included adult patients (>18 years old) with an anterior LVO treated by MT between January 2024 and December 2024. We limited our analysis to segments M1 and M2 of the MCA. We excluded patients with posterior circulation stroke, anterior cerebral artery occlusion, M3 or M4 occlusion, carotid artery occlusion, and tandem occlusion.

2.2 | MT Procedure

MT procedures were performed by senior interventional neuroradiologists, in a dedicated neuroangiography suite, under conscious sedation or general anesthesia in accordance with local practice. The decision regarding the thrombectomy technique for each case was at the discretion of the operator. If effective reperfusion was not achieved after the first pass procedure, the same or other techniques were employed for rescue maneuvers. The CA+SR treatment option involved using both systems simultaneously and aspirating through the aspiration catheter while simultaneously removing the impacted SR with the thrombus at the tip of the aspiration catheter.

2.3 | Clinical and Radiological Assessment

Functional outcome was assessed at 90 days by board-certified vascular neurologists during a routinely scheduled clinical visit or by a study nurse certified in evaluating the modified Rankin Scale (mRS) score during a standardized telephone interview if the patient was unable to attend. Radiological data, including baseline Alberta Stroke Program Early CT Score (ASPECTS) and modified Thrombolysis In Cerebral Infarction (mTICI) score, were prospectively collected and evaluated by experienced senior neuroradiologists.

2.4 | Outcomes

The primary outcome was the rate of complete recanalization (defined as mTICI 3) achieved after the first attempt. The secondary outcomes included the rate of complete recanalization at the end of the procedure (mTICI 3), time from groin to recanalization, complications, 24-h National Institutes of Health Stroke Scale (NIHSS) score, favorable clinical outcomes (defined as an mRS $\leq$2 at 3 months), and all-cause mortality at 3 months. Complications included sICH, defined as an increase of 4 points or more of the NIHSS score within 24 h attributable to the ICH, distal embolisms to a new territory, and procedural-related complications (vasospasm, dissection, or arterial rupture).

2.5 | Statistical Analysis

Quantitative variables are expressed as the median interquartile range (IQR), and categorical variables are expressed as numbers (percentages). Patients were divided into two groups based on the technique used on the first attempt at thrombus removal: the CA-alone group and the combined CA+SR group. Baseline data and procedural characteristics of the two groups were compared using the χ^2 test for categorical data and Student's *t*-test or Wilcoxon signed-rank test for continuous data. We applied linear regression models to assess the association between the thrombectomy technique and the recanalization rate, with adjustment for confounding factors. Odds ratios (ORs) and their corresponding 95% confidence intervals (CIs) were calculated, and a *p*-value <0.05 was considered statistically significant. All statistical analyses were performed using R (version 3.6.1, R Foundation for Statistical Computing, Vienna, Austria, https://www.R-project.org).

3 | Results

Of the 960 patients registered during the study period, 409 patients were excluded for the following reasons: posterior circulation stroke (96 patients), anterior cerebral artery occlusion (33 patients), M3 or M4 occlusion (32 patients), and carotid artery occlusion (248 patients). Of the remaining 551 patients included in the analysis, 348 (63.2%) were treated with a first-line CA alone (54% female; median [IQR] 74 [64–82]) and 203 (36.8%) with first-line CA+SR (56% female; median [IQR] 78 [66–83]). Table 1 summarizes the baseline characteristics of the cohort. The two groups were well balanced for baseline characteristics, except for general anesthesia. Patients treated with CA alone received more general anesthesia than those treated with the combined CA+SR technique (78% vs. 65%, $p < 0.001$).

In terms of procedural outcomes, the groin-to-reperfusion time was significantly shorter in the CA-alone group than in the combined CA+SR group (median [IQR], 26 min [15–42 min] vs. 40 min [23–58] min, $p < 0.001$). CA alone achieved a significantly higher rate of successful recanalization of mTICI 3 on the first pass (47% vs. 37%, $p = 0.032$) and a higher rate of successful recanalization of mTICI 3 at the end of the procedure (65% vs. 56%, $p = 0.053$) than the CA+SR group. After adjusting for general anesthesia, the rate of successful recanalization of mTICI 3 at the end of the procedure was significantly higher in the CA-alone group (Table 2).

The details and safety of the procedures and clinical outcomes are summarized in Table 2. The CA-alone group demonstrated a lower likelihood of new territory embolism than the CA+SR group (OR 0.2, 95% CI 0–0.8, $p = 0.028$). There were no significant between-group differences in procedural complications or NIHSS scores at 24 hours. The clinical outcomes at 90 days after MT were available for 419 of the 551 patients (76%). The CA-alone group had a higher rate of mRS $\leq$2 at 3 months than the CA+SR group (77% vs. 63%; OR 1.9, 95% CI 1.3–3, $p = 0.003$). Mortality at 90 days was comparable between the groups.

4 | Discussion

Several questions about the optimal recanalization strategy remain unanswered, as most studies establishing MT superiority used SR techniques. New strategies have emerged, such as CA and combined CA and SR use [10]. The Contact Aspiration vs Stent Retriever for Successful Revascularization Trial did not show the superiority of first-line CA alone versus an SR in terms of angiographic outcomes for anterior LVO [3]. The COMPASS study proved the noninferiority of first-line CA alone versus an SR in terms of clinical outcome [4]. Although clinical trials have provided level 1 evidence on the use of both SR and CA techniques to perform MT for LVO, which is reflected in recent guidelines [25], whether CA alone or the combined technique is safer or more effective is yet to be determined.

Neurointerventional teams have embraced CA as a first-line approach due to its ease of use, fast learning curve, effectiveness in achieving recanalization, and proven safety [26]. Technological improvements with flexible, larger, and softer large-bore aspiration catheters may explain the increased interest and use of this technique as a first-line strategy. One of the points that makes our study interesting is the comparison of techniques to analyze the parameters of efficacy and safety through daily clinical practice data. We reported the results from a national multicenter registry of 551 patients treated with CA alone or CA+SR first-line treatment over a recruitment period of 12 months. Our comparative analysis revealed three key advantages of using CA alone over combined CA+SR first-line thrombectomy for M1 and M2 occlusions. The benefits of CA alone included faster median procedure time, improved rates of successful recanalization (both on the first attempt and at the end of the procedure), decreased risk of embolism in new territories, and better functional outcome at 3 months. Demographic

TABLE 1 | Baseline characteristics of the two endovascular techniques.

	Contact aspiration alone first-line group $n = 348$ (63.2%)	Contact aspiration + stent retriever first-line group $n = 203$ (36.8%)	*p*-value
Age, years, median (IQR)	74 (64, 82)	78 (66, 83)	0.053
Female gender, *n* (%)	189 (54%)	113 (56%)	0.8
Previous modified Rankin Scale score, *n* (%)			0.5
0	259 (74%)	144 (71%)	
1	49 (14%)	29 (14%)	
2	35 (10%)	24 (12%)	
3	5 (1.4%)	6 (3.0%)	
Admission National Institute of Health Stroke Scale, median (IQR)	15 (10, 20)	16 (9, 19)	0.5
Admission Alberta Stroke Program Early CT Score, median (IQR)	8 (9–10)	8 (9–10)	>0.9
Pretreatment with intravenous thrombolysis, *n* (%)	103 (30%)	66 (33%)	0.5
Left site occlusion, *n* (%)	185 (53%)	96 (47%)	0.2
Occlusion site, *n* (%)			
Segment M1	244 (70%)	149 (73%)	0.4
Dominant segment M2	90 (26%)	44 (22%)	0.3
Nondominant segment M2	14 (4.0%)	10 (4.9%)	0.6
General anesthesia	273 (78%)	131 (65%)	<0.001*

Abbreviations: IQR, interquartile range; *n*, number of participants.
*Statistically significant contrast.

variables, clinical stroke severity, ASPECTS score, use of alteplase, and occluded vessels did not differ between the groups.

Other studies have also reported faster procedure times achieved using the direct aspiration technique. Recently, Fredrickson et al. [5] demonstrated a trend toward faster procedure time using aspiration alone (21 min) versus aspiration-assisted SR (27 min), and after adjusting for tandem occlusion, first-pass aspiration was found to be significantly associated with a procedure time of 25 min or less. In the COMPASS study, a multicenter randomized trial of 270 patients, shorter procedure times were achieved in the CA group [4]. Stapleton et al. [27] reported faster procedural times with CA but no difference in the overall mTICI outcome. To date, there are two randomized clinical trials comparing the combined approach with first-line CA. Nogueira et al. [22] found the noninferiority of the combined approach compared with CA, where the combined technique had successful recanalization in 81.9% of cases compared with 69.8% in the CA group. Recently, the results of the VECTOR trial [20] did not show the superiority of the combined CA+SR technique over CA alone in patients with positive susceptibility vessel sign occlusion with respect to achieving mTICI 2c–3 within three passes. Lapergue et al. [28] found similar procedural times but better mTICI outcomes using direct CA compared with the SR (Solitaire).

In contrast to the above studies, Colby and colleagues [23] reviewed 353 patients undergoing MT and found that CA+SR thrombectomy provided improved rates of first-pass recanalization compared with CA alone. In a recent study, Maïer et al. [21] demonstrated that CA+SR was associated with higher odds of successful recanalization for M1 occlusion compared with the use of SR, but not compared with CA. For intracranial ICA occlusion, the CA+SR approach was also not associated with higher rates of successful recanalization compared with first-line CA. Indeed, both techniques resulted in high recanalization rates and FPE (mTICI 3; 7.9% vs. 18.2% vs. 23.8% for SR, CA, and CA+SR, respectively). The final rate of successful recanalization was lower in the SR group than CA and CA+SR (77% vs. 87.6% vs. 88.2%, respectively). CA alone was found to be the fastest technique from puncture to recanalization (median, 35 min). CA+SR was associated with lower odds of favorable and excellent functional outcomes at 3 months and higher mortality compared with SR or CA alone, as well as a higher sICH rate (10.6% vs. 7.7% vs. 6.6% for SR, CA, and CA+SR, respectively).

A meta-analysis of 89 studies encompassing 9127 patients found higher rates of mTICI 2b/3 outcomes with CA compared with those treated with SRs (89% vs. 80%) [29]. Clinical outcomes were similar between the groups, with functional independence obtained in 52% of CA-treated patients and 48% of SR-treated patients. In many of these studies, SRs were used without direct local aspiration of the thrombus. A more restrictive meta-analysis of 10 studies with 1270 patients reported similar rates of recanalization, good clinical outcomes, and complications between CA alone and SRs [11]. These analyses are somewhat limited because of the heterogeneity of the studies with respect

TABLE 2 | Procedural and clinical outcomes of the two endovascular techniques.

	Contact aspiration alone first-line group $n = 348$ (63.2%)	Contact aspiration + stent retriever first-line group $n = 203$ (36.8%)	p-value	Adjusted model incidence rate ratio/odds ratio (95% confidence interval)[a]	p-value
Groin to recanalization time, min, median (IQR)	26 (15, 42)	40 (23, 58)	<0.001	−12.8 (−19.1, −6.6)	<0.001*
Recanalization after first-pass, n (%)					
mTICI 0	59 (18%)	45 (23%)	0.13	0.8 (0.5, 1.3)	0.4
mTICI 1	12 (3.6%)	12 (6.2%)	0.2	0.5 (0.2, 1.2)	0.14
mTICI 2a	29 (8.7%)	20 (10%)	0.5	0.8 (0.4, 1.4)	0.4
mTICI 2b	44 (13%)	14 (7.2%)	0.033	1.9 (1.0, 3.7)	0.049*
mTICI 2c	33 (9.9%)	32 (16%)	0.028	0.5 (0.3, 0.9)	0.017*
mTICI 3	155 (47%)	72 (37%)	0.032	1.5 (1.0, 2.1)	0.042*
mTICI 2c–3	188 (57%)	104 (54%)	0.5	1.1 (0.8, 1.6)	0.7
mTICI 2b–3	232 (70%)	118 (61%)	0.034	1.4 (1.0, 2.1)	0.075
Final number of passes, median (IQR)	1 (1, 3)	2 (1, 3)	0.4	1.0 (0.9, 1.2)	>0.9
Final recanalization, n (%)					
mTICI 0	9 (2.6%)	9 (4.8%)	0.2	0.6 (0.2, 1.6)	0.3
mTICI 1	1 (0.3%)	2 (1.1%)	0.3	0.3 (0.0, 3.0)	0.3
mTICI 2a	5 (1.5%)	6 (3.2%)	0.2	0.4 (0.1, 1.5)	0.2
mTICI 2b	36 (11%)	16 (8.5%)	0.5	1.3 (0.7, 2.5)	0.4
mTICI 2c	69 (20%)	50 (27%)	0.09	0.6 (0.4, 1.0)	0.042*
mTICI 3	222 (65%)	106 (56%)	0.053	1.5 (1.0, 2.2)	0.037*
mTICI 2c–3	291 (85%)	156 (83%)	0.5	1.1 (0.7, 1.8)	0.6
mTICI 2b–3	327 (96%)	172 (91%)	0.053	1.9 (0.9, 4.1)	0.084
Embolism to new territory, n (%)	3 (0.9%)	8 (3.9%)	0.022	0.2 (0.0, 0.8)	0.028*
Procedure-related complications, n (%)					
Vasospasm	5 (1.4%)	3 (1.5%)	>0.9	0.8 (0.2, 3.9)	0.8
Dissection	8 (2.3%)	6 (3.0%)	0.6	0.7 (0.3, 2.3)	0.6
Arterial rupture	4 (1.1%)	5 (2.5%)	0.3	0.5 (0.1, 1.8)	0.3
Other	4 (1.1%)	6 (3.0%)	0.2	0.3 (0.1, 1.2)	0.093
NIHSS score at 24 h, median (IQR)	4 (1, 10)	5 (2, 11)	0.11	−0.6 (−1.9, 0.6)	0.3
Differential NIHSS score 24 h to baseline, median (IQR)	−8 (−14, −4)	−7 (−12, −3)	0.068	−1.2 (−2.4, 0.1)	0.072
Parenchymal hemorrhage type 1, n (%)	13 (3.8%)	6 (3.0%)	0.6	1.2 (0.5, 3.6)	0.7
Parenchymal hemorrhage type 2, n (%)	15 (4.4%)	7 (3.5%)	0.6	1.5 (0.6, 4.0)	0.4

(Continues)

	Contact aspiration alone first-line group n = 348 (63.2%)	Contact aspiration + stent retriever first-line group n = 203 (36.8%)	p-value	Adjusted model incidence rate ratio/odds ratio (95% confidence interval)[a]	p-value
Symptomatic intracerebral hemorrhage, n (%)	13 (3.8%)	8 (4.0%)	>0.9	1.0 (0.4, 2.7)	>0.9
Modified Rankin Scale score 0–2 at 3 months, n (%)[b]	197 (77%)	103 (63%)	0.002	1.9 (1.3, 3)	0.003*
Mortality at 3 months, n (%)[c]	50 (16%)	27 (14%)	0.5	1.2 (0.7, 2.1)	0.4

Abbreviations: IQR, interquartile range; mTICI, modified Thrombolysis In Cerebral Infarction; n, number of participants; NIHSS, National Institute of Health Stroke Scale.

[a]Model was adjusted by general anesthesia.

[b]Unknown values for 92 patients treated with contact aspiration alone first-line and for 40 patients treated with contact aspiration + stent retriever first-line.

[c]Unknown values for 42 patients treated with contact aspiration alone first-line and for 13 patients treated with contact aspiration + stent retriever first-line.

*Statistically significant contrast.

to the treatment paradigms. Growing evidence has emphasized the cost profile of direct aspiration as a first-line strategy [4, 8, 9].

Recent technological advances show promising results in endovascular treatment of distal medium vessel occlusions (DMVOs). This entity causes 25%–40% of AISs and may result in substantial disability. Although intravenous thrombolysis (IVT) is more effective for distal than proximal LVO, IVT efficacy remains limited in DMVOs, with less than 50% achieving reperfusion and 25%–30% failing to achieve functional independence [30]. Current guidelines state that MT with SRs in M2 segments may be reasonable for selected patients [24, 25] and also recommend this for M3 segment occlusions [25]. However, a recent trial showed IVT superiority in these occlusions, where clinical severity was low (median NIHSS score 6) and various thrombectomy techniques were used [31]. Initial studies of smaller SRs and thromboaspiration devices suggest that MT is effective and safe for primary and secondary DMVOs [31–36]. Some studies indicate potential benefits in terms of recanalization [33, 34, 36] and outcomes [33, 36] with SR use compared to aspiration alone, while others report similar outcomes with first-pass aspiration [35]. Endovascular techniques failed to recanalize these occlusions in over 20% of cases [31]. The smaller, tortuous vessels in DMVO are associated with higher procedural risks, while lower benefits might be expected given the smaller tissue territory.

This study has several strengths and limitations. The prospective, multicenter design of this registry evaluates the two most commonly performed MT techniques, allowing for a reliable examination of the first-line strategy in clinical practice. Recruitment in 2024 ensures the use of the latest MT devices. However, the nonrandomized nature of the registry and the lack of independent adjudication of clinical outcomes and angiographic results may bias treatment choices. Our study included endovascular procedures by multiple operators. The results reflect the routine clinical practice of each neurointerventionalist and their usual first-line technique. We believe that the substantial number of cases gathered enhances this sample and suggests that additional factors may impact this decision. While multicenter studies establish generalizability, differences in techniques and resources complicate comparisons. The use of various SRs and aspiration catheters introduces potential bias. Additionally, imbalances in general anesthesia use were introduced in the adjusted models. Patients in both groups received anesthesia per hospital standard practice. Our sample showed a significant difference, with higher general anesthesia incidence among direct aspiration patients. However, anesthesia type has not been demonstrated to affect outcomes or prognosis in MT patients [37]. Without a randomized controlled design, the combined approach might have been used for patients with arterial tortuosity and difficulty navigating the aspiration catheter. We assessed only the first-line strategy, allowing interventionalists to switch techniques after the first pass in cases of failure. Patients where a second technique was attempted were included in the group according to the first-line strategy. Factors other than MT influence the mRS score, including the time from symptom onset to recanalization, the degree of collateral damage, patient comorbidities, and rehabilitation. Reducing recanalization times with early symptom detection, rapid and effective hospital transfer, reduced hospital stays, and improved access to early rehabilitation are key factors to address to improve these mRS scores at 3 months.

In conclusion, this multicenter study from a national registry showed that CA alone improved first-pass and final recanalization rates, procedure times, and functional outcomes at 3 months compared to CA+SR as first-line treatment for M1 and M2 occlusions. Further prospective studies and randomized clinical trials are needed to confirm these findings.

Conflicts of Interest

The authors declare no conflicts of interest.

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