Mechanical Thrombectomy of Distal Occlusions Using a Direct Aspiration First Pass Technique Compared with New Generation of Mini-0.017 Microcatheter Compatible–Stent Retrievers: A Meta-Analysis

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Key words
- ADAPT
- Meta-analysis
- Stent retrievers
- Stroke
- Thrombectomy

Abbreviations and Acronyms
AC: Anterior circulation
ADAPT: A direct aspiration first pass technique
CI: Confidence interval
GOS: Glasgow Outcome Scale
mRS: Modified Rankin scale
MT: Mechanical thrombectomy
PC: Posterior circulation
SR: Stent retriever
TICI: Thrombolysis in cerebral infarction

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BACKGROUND: **There are no current evidence-based recommendations on mechanical thrombectomy (MT) in M2 or other distal occlusions. The objective of this paper was to investigate clinical and radiologic outcomes of MT in distal locations using the new generation of mini-0.017 microcatheter compatible—stent retrievers (SRs) compared with a direct aspiration first pass technique (ADAPT) MT.**

METHODS: **A systematic search was performed for studies published from January 2016 to March 2019. According to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines, we included studies that reported clinical and radiologic outcomes of patients undergoing MT using new generation of SRs or ADAPT in distal locations. The cumulative prevalence was estimated for each outcome. Heterogeneity of the data was assessed by the Higgins index (I^2), and a random-effects model was applied.**

RESULTS: **Fifteen studies and 494 patients were included; 7 studies reported on patients treated with a new SR and 8 studies analyzed patients treated with ADAPT. The rate of thrombolysis in cerebral infarction score 2b–3 after MT for distal occlusions was 80.6% (383 of 494; 95% confidence interval [CI], 74.8%–86.3%; $I^2 = 64.4\%$). Successful recanalization was comparable after SR use with low-profile devices and ADAPT (176 of 226; 82%; 95% CI, 72.6%–1.5%; $I^2 = 70.5\%$ vs. 207 of 268; 79.4%; 95% CI, 71.8%–86.9%; $I^2 = 60.8\%$, respectively; $P = 0.4$). The rate of the modified Rankin scale score of 0–2 at 3 months was higher in the ADAPT group (160 of 251; 68.9%; 95% CI, 51.8%–85.9%; $I^2 = 92.2\%$) than the SR group (92 of 177; 58.7%; 95% CI, 37.3%–80%; $I^2 = 58.7\%$; $P = 0.01$). The mortality rate was lower among the ADAPT group (20 of 251; 5.4%; 95% CI, 1.4%–9%; $I^2 = 63\%$) than the SR group (16 of 108; 13%; 95% CI, 6%–19%; $I^2 = 13\%$; $P = 0.008$).**

CONCLUSIONS: **MT in distal locations using the new generation of SR yields comparable results compared with ADAPT in terms of recanalization; however, the use of SR is associated with lower functional independence and higher mortality rate.**

INTRODUCTION

Although many trials have established the benefit of mechanical thrombectomy (MT) in patients with acute ischemic stroke from proximal large vessel occlusion of the anterior circulation (AC) and posterior circulation (PC),[1] the benefit of MT performed in distal vessels remains a matter of debate.

The European Guidelines on Mechanical Thrombectomy in Acute Ischaemic Stroke[2] have stated that available data cannot provide specific evidence-based recommendations for or against MT plus best medical management in patients with M2 occlusions. The American Heart Association/American Stroke Association 2018 Guidelines for the Early Management of Patients with Acute Ischemic Stroke[3] also provide a weak recommendation (2b) for M2 or M3 thrombectomy, suggesting that it may be reasonable in certain cases, but no strong evidence is available.

Recently, a few studies[4,5] have proven that MT using new-generation thrombectomy devices for distal occlusions can be safely performed with high functional independence and recanalization rates, but it may be associated with an increased risk of complications. There is no strong evidence available regarding the risks and benefits of MT for distal occlusions (M2, M3, A2, and A3 for AC, and P1 and P2 for PC) using the new generation of mini stent retrievers (SRs) compared with a direct aspiration first pass technique (ADAPT).

We performed a meta-analysis to investigate clinical and radiologic

Table 1. Summary of Studies Included in the Meta-Analysis

Study Name	Design	Number of Patients with Distal Occlusions	Mean Age (years)	Number of Patients Treated with IV Thrombolysis	Initial NIHSS Score	Type of Device	mRS Score 0–2 at 3 Months*	TICI Score 2b–3*
Hofmeister, et al., 2018[8]	R	41	66	38	12	Catch Mini	28/34	32/41
Muller-Eschner, et al., 2019[9]	R	22	61	11	9	Aperio 3.5/28	12/22	18/22
Kurre, et al., 2017[10]	R	88	71	NA	14	Preset Lite	24/74	63/88
Dobrocky, et al., 2018[11]	R	38	79	19	7	Midframe Capture L	18/33	28/38
Kühn, et al., 2017[12]	R	26	66	10	18	Baby Trevo	10/14	25/26
Cerejo, et al., 2016[13]	R	6	62	6	13	Midframe Capture L	NA	5/6
Haussen, et al., 2016[14]	R	5	51	3	19	Baby Trevo	NA	5/5
Gory, et al., 2018[15]	P	48	69	31	13	3MAX/4MAX	20/48	31/48
Grieb, et al., 2019[16]	R	52	76	30	12	SOFIA5F/CATALIST5F	29/52	45/52
Premat, et al., 2018[17]	R	38	67	18	14	3MAX	10/22	29/38
Park and Kwak, 2016[18]	R	32	70	28	11	4MAX	25/32	27/32
Kim, et al., 2017[19]	R	25	71	13	15	4MAX	21/25	18/25
Altenbernd, et al., 2018[20]	R	31	69	29	15	3MAX	30/31	28/31
Mokin, et al., 2017[21]	R	36	60	8	NA	NA	20/36	23/36
Navia, et al., 2016[22]	R	6	60	3	12	3MAX	5/5	6/6

IV, intravenous; NIHSS = National Institutes of Health Stroke Scale; mRS, modified Rankin scale; TICI, thrombolysis in cerebral infarction; R, retrospective study; NA, not available; P, prospective study.
*Values are number of patients/total number of patients.

outcomes of MT in distal anterior and posterior vessel occlusion using a new generation of mini SRs and compared these outcomes relatively to ADAPT thrombectomy.

MATERIALS AND METHODS

Literature Search

This review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.[6] A systematic search was conducted using the MEDLINE, Scopus, Embase, and Cochrane databases from January 2016 to March 2019. "Thrombectomy," "ADAPT," "stent retriever," "stent-triever," "distal occlusion," "M2," "M3," "A2," "A3," "P1," and "P2" were used as search terms. Duplicates were removed from records identified in the database search. Studies were included if they 1) reported cases of MT of distal occlusions (M2, M3, A2, A3, P1, and P2) using ADAPT or new generation of 017 microcatheter compatible SRs (Catch Mini [Balt, Montmorency, France]; MindFrame Capture LP [Medtronic, Minneapolis, Minnesota, USA]; Trevo XP "Baby Trevo" [Stryker, Kalamazoo, Michigan, USA]; pRESET LITE [Phenox, Bochum, Germany]; and APERIO [Acandis GmbH, Pforzheim, Germany]); 2) reported details regarding the endovascular procedure and the devices used; 3) were written in English language; 4) measured outcome with the modified Rankin scale (mRS) (scores 0–6) or the Glasgow Outcome Scale (GOS) (secondary outcome); 5) provided the thrombolysis in cerebral infarction (TICI) score; and 6) were published between 2016 and 2019. Studies were excluded if they 1) were studies conducted on animal models, 2) reported both aspiration and stent thrombectomy procedures in a single patient without specification of the first strategy used, and 3) were lacking clinical details. Articles were then screened based on title and abstract; potentially relevant articles were selected for full-text evaluation, which was performed independently by 2 investigators. Discrepancies were resolved by the senior author. The study quality was evaluated using the modified Newcastle-Ottawa Scale.[7]

Data Extraction

Extracted data included study characteristics (publication year, sample size, study design, and type of device), intervention characteristics, efficacy results (TICI score), and safety outcome (mRS and GOS, and assessment time of mRS or GOS). Data extraction was conducted independently by 2 investigators. Discrepancies were resolved by the senior author. Good outcome was defined as a mRS score of 0–2 at 3-month follow-up, or a GOS score of 4–5. Successful recanalization was defined as TICI score 2b–3.

Outcomes

The primary objectives of this study were to define the rate of functional independency at 3 months, and to define the rate of TICI score 2b–3 among the ADAPT and SR groups.

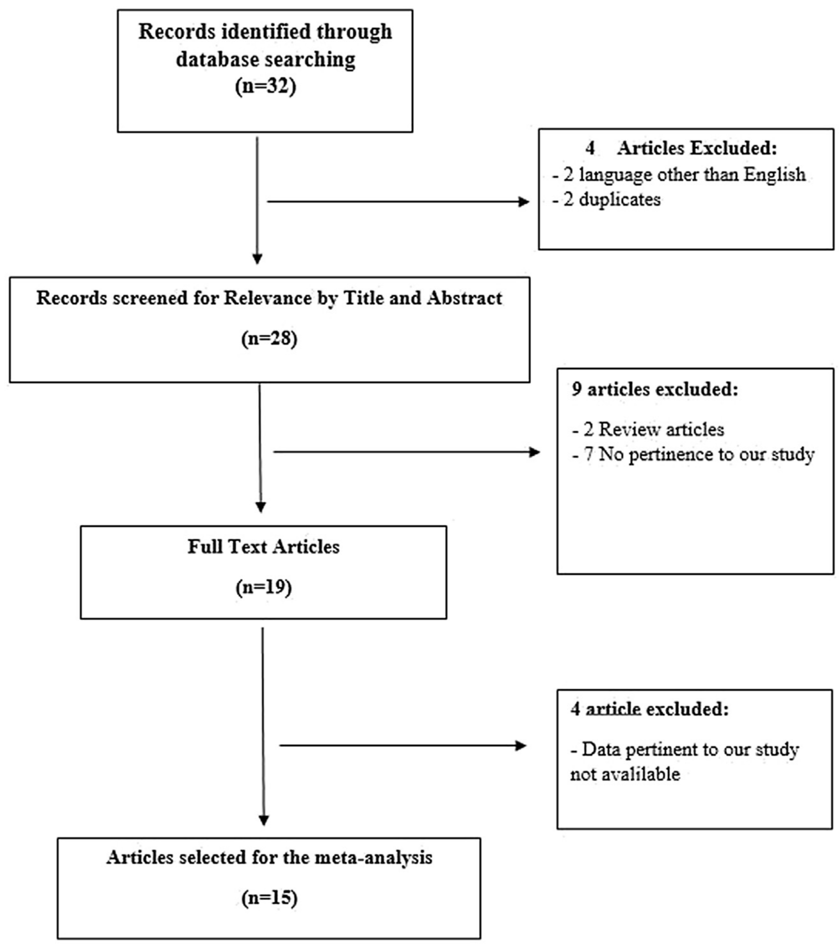

Figure 1. Flow diagram: Preferred Reporting Items for Systematic Reviews and Meta-Analyses diagram detailing the specifics of the systematic literature review and meta-analysis.

The secondary objectives were to define the mortality rate, intracranial hemorrhage rate, and outcome analysis among subgroups based on different site of thrombectomy.

Statistical Analysis

We estimated, from each cohort, the cumulative prevalence (%) and 95% confidence interval (CI) for each outcome. Heterogeneity of the data was assessed by the Higgins index (I^2), and subsequently, the DerSimonian and Laird random-effects models were applied. An I^2 value of >50% suggests substantial heterogeneity. The graphical representation was performed by forest plot. To evaluate the heterogeneity, the meta-regression and the subgroups analysis were performed. To verify the consistency of outcome meta-analysis results, the influence of each individual study on the summary effect estimate was assessed by the sensitivity analysis (leave-one-out approach). To compare the percentages of each group and to calculate the P values, the z test was used when appropriate. Statistical significance was set at $P < 0.05$. Meta-analysis was performed with ProMeta-2 (Internovi, Cesena, Italy) and OpenMeta[Analyst] (Brown University, Providence, Rhode Island, USA).

RESULTS

Literature Review

Studies included in this meta-analysis are summarized in Table 1.

The search flow diagram is shown in Figure 1. A total of 15 studies and 494 patients with acute ischemic stroke related to distal arterial occlusions were included in our review[17-31]. Seven studies reported patients treated with low-profile SR, whereas 8 studies analyzed patients treated with ADAPT.

Quality of Studies

Fourteen studies were retrospective series, whereas 1 study was a post hoc analysis of a randomized controlled trial. Details of the ratings of the included studies are reported in Table 2.

Clinical and Angiographic Outcomes

The investigated outcomes were analyzed with the random-effect meta-analysis because this model incorporates heterogeneity among studies (Figure 2). Overall, the rate of TICI score 2b–3 after MT for distal occlusions was 80.6% (383 of 494; 95% CI, 74.8%–86.3%; $I^2 = 64.4\%$). Successful recanalization was comparable after SR use with low-profile devices and ADAPT (176 of 226; 82%; 95% CI, 72.6%–91.5%, $I^2 = 70.5\%$ vs. 207 of 268; 79.4%; 95% CI, 71.8%–86.9%; $I^2 = 60.8\%$, respectively; $P = 0.4$). The rate of mRS score 0–2 at 3 months was higher in the ADAPT group (160 of 251; 68.9%; 95% CI, 51.8%–85.9%; $I^2 = 92.2\%$) than the SR group (92 of 177; 58.7%; 95% CI, 37.3%–80%; $I^2 = 58.7\%$; $P = 0.01$). The mortality rate was lower among the ADAPT group (20 of 251; 5.4%; 95% CI, 1.4%–9%; $I^2 = 63\%$) compared with the SR group (16 of 108; 13%; 95% CI, 6%–19%; $I^2 = 13\%$; $P = 0.008$).

Meta-regression showed a nonsignificant variation of the effect size ($P > 0.05$) over the investigated period, and the sensitivity analysis showed that no individual study significantly influenced the investigated primary outcomes (Figure 3).

Subgroups of Outcomes

Overall, the rate of TICI score 2b–3 at the first attempt was 57.7% (72 of 125; 95% CI, 50%–66%; $I^2 = 0\%$). The contact aspiration strategy presented a slightly higher rate of successful recanalization at the first attempt (54 of 90; 60%; 95% CI, 50%–70%; $I^2 = 0\%$) compared with the SR technique (18 of 35; 51%; 95% CI, 35%–68%; $I^2 = 0\%$); however, the difference was not significant ($P = 0.3$) (Table 3).

The rate of intracranial hemorrhage after MT was 7% (37 of 339; 95% CI, 4.5%–

Table 2. Quality Measure of Included Studies by the Newcastle-Ottawa Scale

Study Name	Selection 1	Selection 2	Selection 3	Selection 4	Comparability a	Comparability b	Exposure 1	Exposure 2	Exposure 3	Total
Retrospective design (score 0–9; high-quality = studies with ≥6 stars)										
Hofmeister, et al., 2018[8]	*	*					*		*	4
Muller-Eschner, et al., 2019[9]	*	*				*	*		*	5
Kurre, 2017[10]	*	*					*		*	4
Dobrocky, et al., 2018[11]	*	*				*	*		*	5
Kühn, et al., 2017[12]	*	*				*	*		*	5
Cerejo, et al., 2016[13]	*	*					*		*	4
Haussen, et al., 2016[14]	*	*					*			3
Grieb, et al., 2019[16]	*	*				*	*		*	5
Premat, et al., 2018[17]	*	*					*		*	4
Park and Kwak, 2016[18]	*	*					*		*	4
Kim, et al., 2017[19]	*	*				*	*		*	5
Altenbernd, et al., 2018[20]	*	*				*	*		*	5
Mokin, et al., 2017[21]	*	*				*	*		*	5
Prospective design/cohort (score 0–9; high-quality = studies with ≥6 stars)										
Gory, et al., 2018[15]	*	*	*	*			*	*	*	7

For comparability, a was not tested because the included studies did not report the control group, and b was tested analyzing the secondary outcomes (modified Rankin scale score 0–2 and thrombolysis in cerebral infarction 2b–3) among subgroups of the analyses.

*Indicates 1 point of the scale.

10%; I^2 = 14%), with a slightly higher prevalence among the SR group (26 of 221; 9.5%; 95% CI, 4.4%–14%; I^2 = 40%) compared with the ADAPT group (37 of 178; 5.5%; 95% CI, 2.1%–8.8%; I^2 = 0%; P = 0.1). Symptomatic hemorrhage occurred in 1.5% (6 of 399; 95% CI, 0.5%–2.3%; I^2 = 0%) of patients after MT, with no difference between the 2 techniques. The rate of vasospasm after thrombectomy was significantly higher among the SR group (23 of 156; 33%; 95% CI, 18%–60%; I^2 = 91%) compared with the ADAPT technique (2 of 93; 3%; 95% CI, 0.3%–5%; I^2 = 0%; P = 0.001). Vessel perforation and subarachnoid bleeding occurred in 1.7% (4 of 288; 95% CI, 0.2%–3%; I^2 = 0%) of patient after MT, without difference related to the technique.

Successful recanalization among distal AC vessels (M2, M3, A2, and A3 occlusions) was 82% (257 of 328; 95% CI, 74%–88%; I^2 = 65%), whereas among the PC (P1 and P2 occlusions) it was 89% (11 of 13; 95% CI, 75%–95%; I^2 = 0%). There were no differences related to type of technique used among the AC, whereas distal PC occlusions were treated with only SR strategy (**Table 3**). Among the AC occlusions, the rate of good functional outcome was higher for patients treated with ADAPT (125 of 197; 70%; 95% CI, 50%–90%; I^2 = 90%) than with SR (37 of 76; 48%; 95% CI, 37%–59%; I^2 = 0%; P = 0.002). Finally, the mRS score 0–2 was 40% (5 of 12; 95% CI, 14%–66%; I^2 = 0%) after SR for distal PC occlusions.

The rates of successful recanalization among subgroups of low-profile SR, and subgroups of different aspiration catheters are reported in **Figure 4**.

Study Heterogeneity

Substantial heterogeneity (>50%) was noted for the following outcomes: rate of TICI score 2b–3, mRS score 0–2, overall mortality rate, and rate of vasospasm. Heterogeneity was also noted for the subgroup of outcomes related to the location of the occlusion. Heterogeneity was likely related to the different locations of the occlusion, different devices adopted during the MT, and different patient inclusion criteria among the analyzed studies.

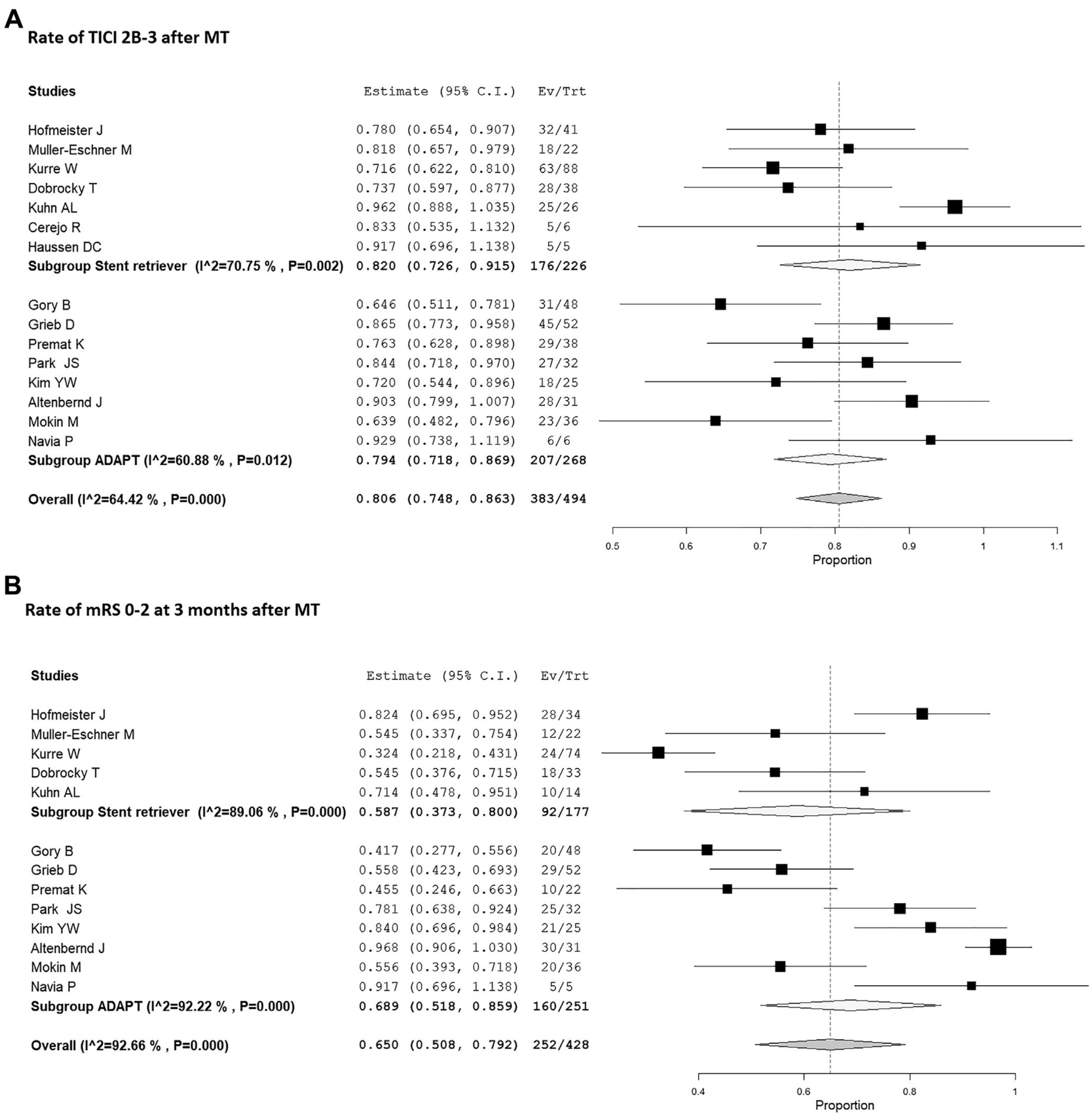

Figure 2. Forest plot with random-effects model demonstrating the overall proportion of thrombolysis in cerebral infarction score 2b–3 (**A**), and the overall proportion of modified Rankin scale score 0–2 at 3 months (**B**) after a direct aspiration first pass technique and stent retriever with low-profile devices. C.I., confidence interval; mRS, modified Rankin scale; MT, mechanical thrombectomy; TICI, thrombolysis in cerebral infarction; Ev/Trt, endovascular/treatment.

DISCUSSION

To date, there has been no direct comparison of new mini SRs and aspiration thrombectomy using a large-bore catheter (ADAPT) in patients with distal occlusions.

In this meta-analysis of nearly 500 patients who underwent MT for acute distal occlusions, we found that the overall rate of TICI score 2b–3 was 80.6%. Successful recanalization was comparable between low-profile SRs and ADAPT (176 of 226; 82% vs. 207 of 268; 79.4%, respectively). These results are quite similar to what has been already published on distal aspiration and SRs in proximal large vessel occlusion.[4]

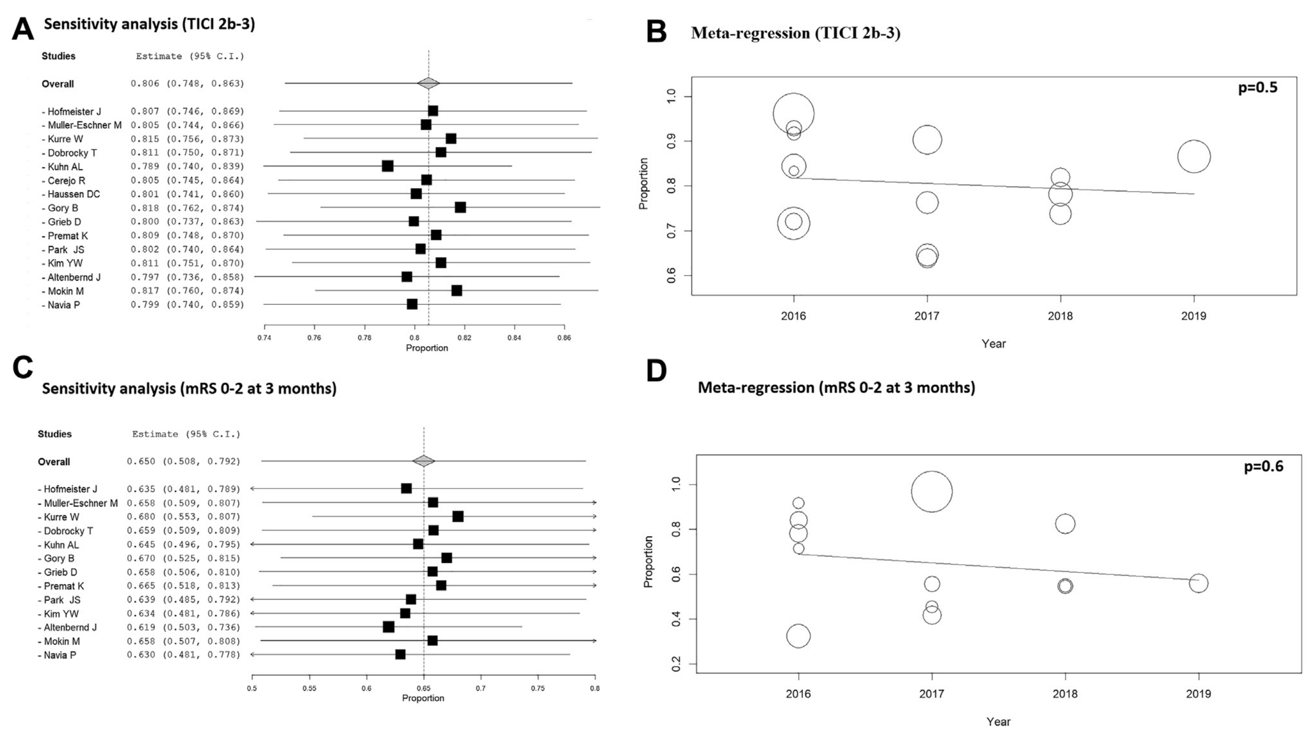

Figure 3. Rate of thrombolysis in cerebral infarction score 2b–3: sensitivity analysis showing that no individual study significantly influenced the reported outcome (**A**) and meta-regression showing an insignificant variation of the effect size over the analyzed period (**B**). Rate of modified Rankin scale score 0–2 at 3 months: sensitivity analysis showing that no individual study significantly influenced the rate of functional outcome (**C**) and meta-regression showing an insignificant variation of the effect size over the analyzed period (**D**). C.I., confidence interval; mRS, modified Rankin scale; TICI, thrombolysis in cerebral infarction.

In our analysis, the main differences were found analyzing the rate of mRS score 0–2 at 3 months, which was higher in the ADAPT group (160 of 251; 68.9%) than the SR group (92 of 177; 58.7%; P = 0.01), and mortality, which was lower among the ADAPT group (20 of 251; 5.4%) than the SR group (16 of 108; 13%; P = 0.008). In a recent meta-analysis,[4] functional independence at 90 days after stroke was seen in 57.6% of patients treated with a traditional SR and 48.6% of patients with local aspiration. The overall mortality rate was 16% compared with 7.7% of our analysis.

In our study, differences in the functional independence rate among the 2 groups can be partially related to the better outcomes found in some subgroups analysis after the ADAPT. For example, contact aspiration strategy yielded a slightly higher rate of successful recanalization at the first attempt (54 of 90; 60%) compared with the SR technique (18 of 35; 51%). Multiple passes are a known factor for increased rate of complications.[23] In addition, the rate of intracranial hemorrhage and vasospasm was (slightly) higher in the SR group than the ADAPT group; however, only the latter was significantly more prevalent (Table 3). However, there was no statistically significant difference in symptomatic hemorrhage, vessel perforation, and subarachnoid hemorrhage related to the used technique.

The lower mortality rate among the ADAPT group should be interpreted with caution because it cannot be ascribed to differences in periprocedural complications. First, possible confounding factors, that cannot be evaluated with classic methodology of the meta-analysis, should be considered. In addition, the small number of studies, the relatively low number of patients, and the heterogeneity of the available data may introduce a potential risk of bias.

In this regard, there is a need of randomized controlled trials that directly compare ADAPT and SR in distal circulation, specifically powered to assess differences in neurologic outcomes and mortality.

Investigating the current literature, it appears that the use of the new generation of mini SRs does not add a significant advantage compared with the ADAPT technique for distal occlusions.

Treatment-related outcomes reported in a recent meta-analysis[4] and series of thrombectomy in the M2 location with previous generation of SRs[24-28] were quite comparable with the results of the new generation devices found in our analysis, suggesting no added advantage of these newer devices for the M2 location. Specifically, the functional independence at 3 months (mRS score 0–2) ranged from 55% to 64%, which is comparable with our data (58.7% in the SR subgroup). Similarly, the rate of successful recanalization found in previously reported papers (range of TICI score ≥2b, 77%–93%) was in agreement with our report (range of TICI score ≥2b, 72%–96%). The mortality rate is

Table 3. Angiographic and Clinical Outcomes After Mechanical Thrombectomy for Distal Occlusions with a Direct Aspiration First Pass Technique or New Generation Low-Profile Stents Retriever

Variable	Overall Number (SR + ADAPT)	SR	Number of Articles	ADAPT	Number of Articles	*P* Value
Main outcomes						
Rate of TICI score 2b–3	383/494 = 80.6% (95% CI, 74.8–86.3) I^2 = 64.4%	176/226 = 82% (95% CI, 72.6–91.5) I^2 = 70.5%	7	207/268 = 79.4% (95% CI, 71.8–86.9) I^2 = 60.8%	8	0.4
Rate of mRS score 0–2 at 3 months	252/428 = 65% (95% CI, 50.8–79.2) I^2 = 92.6%	92/177 = 58.7% (95% CI, 37.3–80) I^2 = 58.7%	5	160/251 = 68.9% (95% CI, 51.8–85.9) I^2 = 92.2%	8	0.01
Mortality rate	36/359 = 7.7% (95% CI, 4–11.7) I^2 = 65%	16/108 = 13% (95% CI, 6–19) I^2 = 13%	4	20/251 = 5.4% (95% CI, 1.4–9)I^2 = 63%	8	0.008
Subgroups of outcomes						
Rate of TICI score 2b–3 at the first attempt	72/125 = 57.7% (95% CI, 50–66)I^2 = 0%	18/35 = 51% (95% CI, 35–68)I^2 = 0%	3	54/90 = 60% (95% CI, 50–70)I^2 = 0%	3	0.3
Overall rate of ICH	37/339 = 7% (95% CI, 4.5–10)I^2 = 14%	26/221 = 9.5% (95% CI, 4.4–14)I^2 = 40%	6	37/178 = 5.5% (95% CI, 2.1–8.8)I^2 = 0%	5	0.1
Symptomatic ICH	6/399 = 1.5% (95% CI, 0.5–2.3)I^2 = 0%	2/221= 1% (95% CI, 0.2–2.5)I^2 = 0%	6	4/178=1.7% (95% CI, 0.2–3)I^2 = 0%	5	0.8
Rate of vasospasm after MT	25/249 = 17% (95% CI, 7–28)I^2 = 90%	23/156 = 33% (95% CI, 18–60I^2 = 91%)	4	2/93 = 3% (95% CI, 0.3–5)I^2 = 0%	3	0.001
Vessel perforation/ SAH	4/288 = 1.7% (95% CI, 0.2–3)I^2 = 0%	3/126 = 2.4% (95% CI, 0.6–5)I^2 = 0%	3	1/162 = 1.4% (95% CI, 0.4–3)I^2 = 0%	5	0.6
Subgroups of locations						
TICI score 2b–C (distal AC)	257/328 = 82% (95% CI, 74–88)I^2 = 65%	74/92 = 84% (95% CI, 74–93)I^2 = 37%	5	183/236 = 80% (95% CI, 70–89)I^2 = 76%	7	0.5
mRS score 0–2 (distal AC)	162/273 = 62% (95% CI, 45–79)I^2 = 91%	37/76 = 48% (95% CI, 37–59)I^2 = 0%)	4	125/197 = 70% (95% CI, 50–90)I^2 = 90%	6	0.002
TICI score 2b–C (distal PC)	NA	11/13 = 89% (95% CI, 75–95)I^2 = 0%	4	NA	NA	NA
mRS score 0–2 (distal PC)	NA	5/12 = 40% (95% CI, 14–66)I^2 = 20%	4	NA	NA	NA

SR, stent retriever with low-profile stents; ADAPT, a direct aspiration first pass technique; TICI, thrombolysis in cerebral infarction; CI, confidence interval; mRS, modified Rankin scale; ICH, intracranial hemorrhage; MT, mechanical thrombectomy; SAH, subarachnoid hemorrhage; AC, anterior circulation; PC, posterior circulation; NA, not available.

also comparable, with a range of 12%–14% in the previous reports that matches the figures found in our meta-analysis (13% in the SR subgroup). Apparently, the only difference in outcome is related to the rate of symptomatic intracranial hemorrhage, which occurred in 1% of patients (2 of 221) in the SR subgroup of our analysis compared with an average rate of 6.4% in the aforementioned studies. It is possible indeed that a significant advantage for the lower profile SRs would be demonstrated for M3, A2, and A3, but this has to be demonstrated and is not the topic of the current study.

It would be interesting to study if these new low-profile stents can reduce the endothelium damage as shown in recent animal studies[29,30] and confirmed by a published case report.[31]

Limitations

Our study has several limitations. Most of the series were retrospective and low-quality studies with a relatively low number of patients. The heterogeneity was quite high for most of the reported outcomes, reflecting the different types of devices adopted and the different locations. Patients included in the 2 groups (ADAPT vs. SR) were heterogeneous, and

Type of stent retriever

Studies	Estimate (95% C.I.)	Ev/Trt
Hofmeister J	0.780 (0.654, 0.907)	32/41
Subgroup Catch Mini (I^2=NA , P=NA)	**0.780 (0.654, 0.907)**	**32/41**
Muller-Eschner M	0.818 (0.657, 0.979)	18/22
Subgroup Aperio 3.5/28 (I^2=NA , P=NA)	**0.818 (0.657, 0.979)**	**18/22**
Kurre W	0.716 (0.622, 0.810)	63/88
Subgroup Preset Lite (I^2=NA , P=NA)	**0.716 (0.622, 0.810)**	**63/88**
Dobrocky T	0.737 (0.597, 0.877)	28/38
Cerejo R	0.833 (0.535, 1.132)	5/6
Subgroup Mindframe Capture L (I^2=0 % , P=0.566)	**0.754 (0.628, 0.881)**	**33/44**
Kuhn AL	0.962 (0.888, 1.035)	25/26
Haussen DC	0.917 (0.696, 1.138)	5/5
Subgroup Baby Trevo (I^2=0 % , P=0.706)	**0.957 (0.887, 1.027)**	**30/31**
Type of aspiration catheter		
Grieb D	0.865 (0.773, 0.958)	45/52
Subgroup SOFIA 5F or CATALIST 5F (I^2=NA , P=NA)	**0.865 (0.773, 0.958)**	**45/52**
Premat K	0.763 (0.628, 0.898)	29/38
Mokin M	0.639 (0.482, 0.796)	23/36
Navia P	0.929 (0.738, 1.119)	6/6
Subgroup 3MAX (I^2=62.19 % , P=0.071)	**0.769 (0.619, 0.918)**	**58/80**
Park JS	0.844 (0.718, 0.970)	27/32
Kim YW	0.720 (0.544, 0.896)	18/25
Altenbernd J	0.903 (0.799, 1.007)	28/31
Subgroup 4MAX (I^2=35.65 % , P=0.211)	**0.843 (0.748, 0.937)**	**73/88**
Overall (I^2=59.74 % , P=0.002)	**0.818 (0.762, 0.874)**	**352/446**

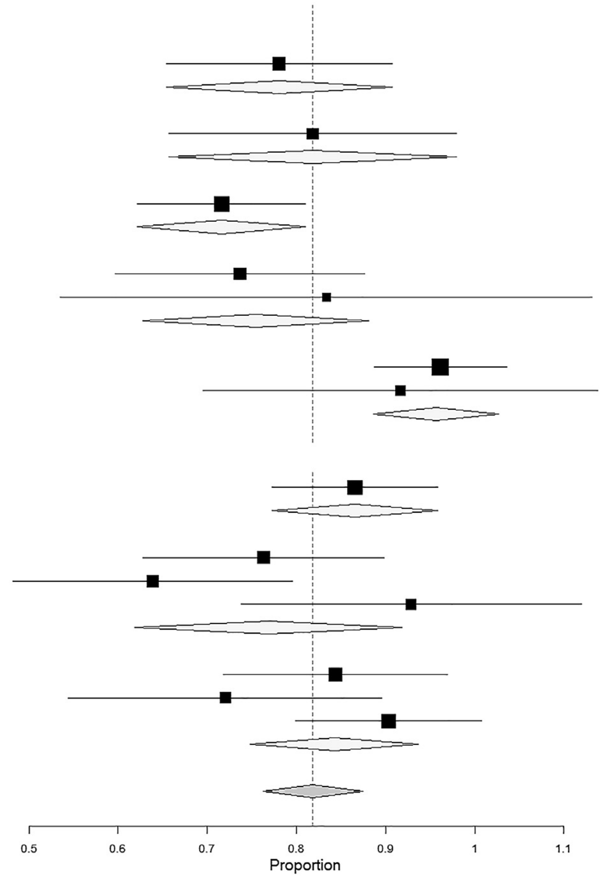

Figure 4. Subgroups analysis showing the rate of successful recanalization among the subgroups of low-profile stent retrievers and aspiration catheters used in the studies. C.I., confidence interval; Ev/Trt, endovascular/treatment; NA, not applicable.

potentially confounding factors affecting the studied outcomes were not tested. In addition, it was not possible to assess the overall proportion of patients treated with ADAPT and bailout SR if needed. Finally, the small number of cases may not provide enough power to demonstrate a statistically significant difference in some subgroup analyses.

CONCLUSIONS

In this meta-analysis, MT using the new generation of SR in distal AC and PC was associated with a similar successful revascularization rate compared with MT using ADAPT. However, functional independence at 3 months was higher in the ADAPT group and mortality was higher in the SR group.

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