Single-Center Experience Using the 3MAX Reperfusion Catheter for the Treatment of Acute Ischemic Stroke with Distal Arterial Occlusions

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Single-Center Experience Using the 3MAX Reperfusion Catheter for the Treatment of Acute Ischemic Stroke with Distal Arterial Occlusions

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6 Acronyms and Abbreviations:

- 7 AcomA: Anterior Communicating Artery
- 8 ACA: Anterior Cerebral Artery
- 9 ADAPT: A Direct Aspiration first-Pass Thrombectomy
- 10 AIS: Acute Ischemic Stroke
- 11 DSA: Digital Subtraction Angiography
- 12 ENT: Embolus to New Territory
- 13 IVT: Intravenous Thrombolysis
- 14 LVO: Large Vessel Occlusion
- 15 MCA: Middle Cerebral Artery
- 16 mRS: modified Rankin Scale
- 17 MRI: Magnetic Resonance Imaging
- 18 MT: Mechanical Thrombectomy
- 19 NIHSS: National Institute of Health Stroke Score
- 20 PCA: Posterior Cerebral Artery
- 21 r-TPA: recombinant tissue plasminogen activator
- 22 SCA: Superior Cerebellar Artery
- 23 SICH: Symptomatic IntraCranial Haemorrhage
- 24 TICI: Thrombolysis In Cerebral Infarction

INTRODUCTION

The management of acute ischemic stroke (AIS) in patients with large vessel occlusion (LVO) has been drastically modified by the positive results of 5 randomized clinical trials testing mechanical thrombectomy (MT) compared to the standard guideline-based therapy.[1–5] These studies led the American Stroke Association and American Heart Association to edict guidelines in June 2015 recommending that patients with AIS caused by LVO should be referred to MT by preferentially using stent retriever devices.[6]. The Direct Aspiration first-Pass Thrombectomy technique (ADAPT) using supple reperfusion catheters has shown convincing results in terms of reperfusion rates and procedure time reduction for LVO.[7,8] However, only scant data are available for smaller catheters like the 3MAX in distal occlusions.[9,10]

The primary endpoint of the study was the successful (i.e. Thrombolysis In Cerebral Infarction [TICI] score 2b/3) reperfusion rate using ADAPT with the 3MAX. Secondary evaluation criteria were 3MAX-related complications and good clinical outcome (defined as mRS ≤ 2) at 3 months.

MATERIAL AND METHODS

To evaluate the navigability, the safety and the ability to successfully reperfuse distal occlusions, we conducted a retrospective analysis of all consecutive patients with AIS for whom the 3MAX was used at least once in distal MT. Distal occlusions were defined as follows: ACA occlusions (from A2), MCA occlusions (from M2), PCA occlusions (from P1), Cerebellar arteries' occlusions. The M2 (a.k.a insular) segment was defined as the part of the MCA from the genu to the circular insular sulcus.

From August 2015 to December 2016, 32 consecutive patients (16 females [50%] and 16 males [50%]; mean age=67.4±18.7y, [range: 22-91]) for 38 distal occlusions underwent MT using the 3MAX. Five patients were treated for multiple occlusions. Four out of the 32 patients included in this study (12.5%) underwent MT subsequently to iatrogenic thromboembolic events, 3 among them occurred during neurointerventional procedures: the first patient had left acute M2 occlusion during the endovascular treatment of a vasospasm at day 10 after embolization of a ruptured anterior communicating artery (AcomA) aneurysm, the second patient had acute right M3 occlusion during the coiling of a ruptured AcomA aneurysm and the third patient presented multiple M3 occlusions in the aftermath of a periprocedural rupture of an AcomA aneurysm. The last patient had acute left M2 occlusion during a diagnostic coronarography. Of the 32 patients, 5 (15.6%) had tandem occlusions (two vertebrobasilar tandem occlusions and three internal carotid artery/middle cerebral artery tandem occlusions).

Device:

The Penumbra 3MAX is the smallest reperfusion catheter designed to perform the most distal thrombectomies. The distal outer and inner diameters are respectively 3.8F (1.27mm, 0.050 inches) and 2.7F (0.89 mm, 0.035 inches) with a proximal outer diameter of 4.7F (1.57mm, 0.062 inches) and a 153cm working length. It is designed to be mounted over a compatible 5-6F intermediate catheter to provide better support to the system. Thromboaspiration can be performed manually by linking a 20-60mL syringe to the 3MAX or by connecting an electric aspiration pump.

Preoperative care:

Preoperative evaluation included a medical examination with neurological assessment performed by a stroke neurologist using the National Institute of Health Stroke Score (NIHSS) swiftly followed by a brain Magnetic Resonance Imaging (MRI) to confirm the diagnosis, evaluate the ischemic lesion burden, assess the arterial occlusion and plan the procedure. According to our local guidelines, MRI is preferred to CT scan in patients with suspicion of AIS eligible for intravenous thrombolysis (IVT) and/or MT. Eighteen out of the 32 (56.3%) patients had IVT (r-TPA) before the endovascular procedure in a bridging fashion. All patients underwent this preoperative standardized management except for those whose thromboembolic event was depicted during neurointerventional procedures. In these latter cases the NIHSS could not be evaluated.

MT Procedure:

All MT were performed under general anaesthesia (n= 19 [59.4%]) or conscious sedation (n=13 [40.6%]). According to the ADAPT technique, an intermediate aspiration catheter (5MAX/ACE/ACE64 [Penumbra] or SOFIA/SOFIA PLUS [MicroVention Inc. Tustin CA, USA]) was mounted over the 3MAX and a 0.014'' microguide wire. The 3MAX was then positioned just upstream from the clot. The microguide wire was removed and the 3MAX was connected to the aspiration system to engage the clot. The 3MAX was then pulled back in the intermediate catheter under constant aspiration, and a control DSA was performed after each aspiration (*Figure 1*). A median of 2 ± 1.1 (IQR: 1-5) aspiration attempts was performed. If recanalization could not be achieved with ADAPT, the so-called "Solumbra" technique was attempted at the operator's discretion by deploying a stent retriever (Solitaire Flow Restoration device [ev3-Covidien, Irvine, CA, USA] and/or pREset [Phenox GmbH, Bochum, Germany]) through a Velocity 2.6F delivery microcatheter (Penumbra).

Evaluation criteria:

In each case, the feasibility of using the 3MAX (i.e.: ability to reach the occlusion site in the target vessel) was assessed. Efficacy of thromboaspiration through the 3MAX was evaluated using the TICI score.[11] Intracerebral hemorrhages were graded according to the SITS-MOST classification.[12] Major procedure-related

complications (procedure-related death, vessel perforation, emboli in a new territory [ENT]) including 3MAX-related complications as well as minor complications (vasospasm after thrombo-aspiration on the target vessel, minor puncture site complication) were also recorded. For each patient, delays from symptoms' onset to arterial puncture, symptoms' onset to successful reperfusion, reperfusion time (i.e. time from arterial puncture to recanalization) and procedure lasting were also evaluated.

Imaging and clinical follow-up:

All patients had post-MT dual-energy CT scan to depict early hemorrhagic complications and differentiate them from post-procedural contrast media extravasation [13]. All living patients had a control brain MRI within the 48h after MT to evaluate the extent of the ischemic lesions, depict potential complications and rule out reocclusion of the target vessel. Patients under general anaesthesia were extubated immediately after procedure if their clinical status allowed it. Neurological impairment was assessed using the NIHSS at admission, at day 1 and at discharge after exclusion of the deceased patients. Disability was evaluated with the modified Rankin Scale (mRS) performed at discharge and at 3 months, when available. A good functional outcome was defined as a mRS score ≤ 2 . All additional radiological exams, biology and medical consultations were also reviewed.

Statistical analysis:

Data analysis was performed using EPI Info 7.1.5.2 software (Centers for Disease Control and Prevention [CDC] Atlanta, Georgia, USA). Results are presented as means $\pm$ standard deviations and ranges or medians with their interquartile range (IQR). Comparison of means was performed using a Student-t test or Wilcoxon test, depending on the data distribution. Results were considered statistically significant when P-values < 0.05 .

Ethical Statement:

Neither approval of the institutional review board nor patient informed consent are required by the ethics committee of our institution for retrospective analyses of patients' records and imaging data.

RESULTS

Patients' demographics and results are summarized in *Table 1*.

Overall results

In one case (2.6%) of a 1.3 mm superior cerebellar artery (SCA) occlusion, the 3MAX could not be navigated. ADAPT alone with the 3MAX allowed successful (TICI 2b/3) reperfusion in 59.5% of the cases. In 10 cases (26.3%), the complementary "Solumbra" technique was used which allowed successful recanalization in 7 cases, thus achieving an overall reperfusion rate of 76.3%.

Median NIHSS score improved from 14 (IQR: 9-19) at admission to 9 (IQR: 5-18) at 24 hours to 6 (IQR:3-12) at discharge. mRS score was available for 23 patients (71.9%) at discharge and for 22 patients at 3 months (68.8%). A good functional outcome ($mRS \leq 2$) was obtained in 19% of the patients at discharge and 45.5% at 3 months.

Average delay between symptoms' onset and arterial puncture was 235.5 (± 113.8) minutes, average reperfusion time was 67.7 (± 33.4) minutes and procedures lasted a mean of 85.5 (± 38.0) minutes.

Five patients (15.6%) died during the follow-up: one at day 17 and one at day 67 from unrelated causes, two from remote (contralateral) parenchymal haemorrhages (PHrp2) subsequently to the therapeutical management (MT and IVT for both patients), and one from a multi-visceral failure. Six (18.8%) major procedure-related complications occurred including three (9.4%) 3MAX-related (2 ENTs and one vascular perforation). It is noteworthy that the ENTs were easily removed using ADAPT, and were not responsible for any clinical sequelae. The other major procedure-related complications were: two vascular perforations (one microguide wire-induced lenticulostriate perforation without any clinical consequences and one after stent retrieval) and one ipsilateral central retinal artery occlusion. In six patients, intracerebral haemorrhages were depicted: 3 (9.4%) SICH (2 PHrp2 and 1 PH2), 2 HI1, 1 PH1. Three of them also had asymptomatic subarachnoid haemorrhages. Significant spasm (defined as $>50\%$ of the target vessel's lumen) was seen in 7/38 (18.4%) arteries after ADAPT with the 3MAX. Three of them spontaneously regressed before the end of the procedure.

Anterior versus posterior circulation occlusions

Seven out of the 37 occlusions (18.9%) affected the posterior circulation. The median baseline NIHSS was lower in posterior distal occlusions (7 [IQR: 5-28] vs 15 [IQR: 12-24]; $p=0.47$). The rate of successful reperfusion was non significantly higher in the posterior occlusion group (85.7% vs 53.3%; $p>0.5$) and also after rescue stent retriever thrombectomy (100% vs 75%; $p>0.5$). Posterior occlusions were associated with a significantly better clinical outcome at 3 months (100% vs 44.4%; $p=0.029$) even though no statistical difference in NIHSS at discharge was found (5 [IQR: 4-11] vs 3 [IQR: 0-4] in the posterior group; $p>0.5$).

MT for iatrogenic thromboembolic events

Four iatrogenic thromboembolic events were included in the analysis. Successful reperfusion by 3MAX ADAPT alone was obtained in 3 of the 4 cases (80%) and for the last patient, additional stent retriever passages did not achieve successful reperfusion. Good clinical outcome at 3 months was achieved in 50% of cases. No embolic or hemorrhagic complication was recorded.

After exclusion of these patients from the main analysis, median NIHSS was 16 (IQR: 10-20). Successful reperfusion was achieved in 56.3% of cases with the 3MAX alone and in 75% of cases after complementary stent retriever thrombectomy. A good functional outcome could be obtained in 44% of cases. The results were not significantly different from the main analysis.

DISCUSSION

In the presented series, 59.5% of patients had successful TIC1 2b/3 reperfusion after ADAPT alone with the 3MAX and complementary stent retrieving techniques allowed to achieve an overall recanalization rate of 76.3% but three (9.4%) 3MAX-related major complications were recorded. Hence, a good functional outcome was obtained in only 45.5% of patients at 3 months.

ADAPT has gained acceptance as a safe and effective alternative to stent retrievers in LVO.[14,15] The THERAPY trial [16] supposed to compare thromboaspiration to IVT alone was halted due to emergent proof of the added value of MT over IVT alone, and did not achieve its primary endpoint. Thus there is a lack of solid evidence for ADAPT even though complementary data suggested that ADAPT is not inferior to primary stent retriever thrombectomy.[17]

Distal intracranial occlusions

For distal occlusions of the MCA, Saqur et al.[18] reported a 44.2% rate of complete reperfusion after IVT alone. Dorn et al.[19] compared stentriever-based MT in M2 vs M1 occlusions and reported a higher reperfusion rate (93.3% versus 76.0%; $p = 0.186$) with fewer periprocedural complications (None vs 3) in M2 occlusions.

Literature provides only retrospective series focused on distal occlusions (*Table 2*) mainly treated with stent retrievers and displays heterogeneous reperfusion rates (from 70 to 100%) but low complication rates[9,10,19–24]. Navia et al.[9] provided a 6 cases series of distal occlusions treated with ADAPT and found a 100% TIC1 2b/3 reperfusion rate with a 83% rate of good clinical outcome, no complication and no need to use stent retrievers. Due to the very low number of patients included, direct comparison is delicate. Also in this publication, the strokes' etiologies were not precised and maybe clots from different nature or different underlying condition may explain discrepancies with our results.

The choice between ADAPT and stent retriever thrombectomy as the frontline technique is not yet elucidated and the answer is probably not univocal. This study shows that the 3MAX can navigate efficiently in most situations and reach very distal occlusions, up to A3, M3 or P3 segments (*Figure 2*). Arguably, as a faster, safer and more cost-effective method[8], ADAPT with the 3MAX is acceptable as the frontline technique for distal occlusions. Kim et al.[23] compared forced arterial suction (n=25 patients) to stent retriever thrombectomy

(n=16) as the frontline technique in M2 occlusions and found a tendency toward a better reperfusion rate (64% vs 81.2%; $p=0.305$) with stent retrievers. No statistically significant differences in complication and good functional outcome rates were depicted. Authors also identified that an M2 occlusion located immediately after a severe angulation was associated with an increased rate of failure with ADAPT. In our series a perforation occurred in this exact location, supporting the fact that adequate assessment of the target vessel is crucial when choosing between ADAPT and stent retriever. Vargas et al. [10] proposed a series of 35 patients treated with ADAPT for distal occlusion which was very similar to our study. They reported a TICI 2b/3 rate of 77.1% after ADAPT alone with a conversion rate of 20% to achieve an overall reperfusion rate of 97.1% and reached good clinical outcome in 59.4% of patients at 3 months. Due to the limited number of patients in both our studies, direct comparison is hazardous however additional devices permitted to rescue a substantial amount of remaining occlusions. The 3MAX seemed more efficient in very distal occlusions due to the increase of aspiration force as the vessel's diameter gets closer to the 3MAX'. As reported in subgroup analysis, the 3MAX might be helpful in iatrogenic distal occlusions or in ENT to achieve successful reperfusion with a good level of safety, which remains essential in this context. Very acute clots may be more able to pass into small diameter catheters, making them easier to remove by aspiration. Hence, avoiding to deploy a stent that may seem more invasive in small vessels. Nevertheless, the self-reported reperfusion results showed that ADAPT alone with the 3MAX was able to recanalize most of distal occlusions even in the posterior circulation but was insufficient as the sole reperfusion device. Stent retrievers were still needed and rescued 7 of the 15 (46.7%) remaining occlusions. Moreover, in one case of a proximal SCA (*Fig 1.*) occlusion, the target SCA could not be catheterized due to vessel's angulation and small diameter. In the latter case, a Velocity microcatheter could reach the target occlusion, allowing successful reperfusion of the artery by deploying a Solitaire. For very challenging intracranial catheterization, stent retrievers might be preferred, not for their superiority to perfuse but simply because the tractability of the delivery microcatheter is more suitable.

Complications

MT for distal occlusions is controversial as it is known to be technically challenging and associated with a higher complication rate which is confirmed by the presented results. We experienced a perprocedural 3MAX-related rupture at the M1-M2 angulation point point which was managed by glue occlusion. Ultimately, the patient presented a multivisceral failure at day 9 (mRS 6). Contrast media extravasation and pseudoaneurysm formation

after aspiration thrombectomy have already been described with distal aspiration catheters such as the 4MAX [26]. One must always consider that these catheters can be harmful even on large intracranial arteries especially at junction points or in tortuous segments. In comparison, Vargas et al.'s [10] series comprised 80% isolated M2 occlusions, one M3 and one A3 occlusion; they reported two major procedure-related complications. In our series, we aimed to reperfuse even very distal occlusions up to A3 (one case), M3 (six cases) and P3 (two cases) which inevitably exposes to a greater risk of complications.

ENT may be encountered with all types of MT devices. However, in the literature, the ENT rate seems lower with aspiration devices (from 0% to 6%) [27,28] than with the stentriever (from 0% to 13.3%). [29,30] ENTs were observed in two cases in our series, which could be easily recanalized with the 3MAX without any clinical consequence.

Even though average NIHSS score was similar to other series, a low rate of good functional outcome at 3 months was obtained. This can be explained by a higher rate of major complications and the inclusion of patients in poor general condition (ruptured intracranial aneurysms, advanced cardiovascular diseases or recovered cardiac arrest before MT).

Procedure times

Average reperfusion time was 67.7 (± 33.4) minutes in this series and was rather long in comparison to the study of Vargas et al. [10] who obtained a mean time to recanalization of 35.5 (± 26.4 minutes) with distal ADAPT. It is a direct consequence of an inferior reperfusion rate after ADAPT alone and a superior rate of perprocedural complications. Moreover five patients had multiple occlusions and five had tandem occlusions which considerably increased the time of procedures.

Limitations

The value of this study is limited by the retrospective and monocentric fashion of data collection and analysis as well as the small volume of patients included. We also purposely included patients with iatrogenic thromboembolic events to display a more representative population who may benefit from distal recanalization. However, the nature of the clots encountered in thromboembolic events occurring during embolization is

243 probably different from the one observed in patients with non-iatrogenic acute ischemic stroke. The lack of
244 control group and the fact that mRS at 3 months was available for only 62.5% of the patients does not allow an
245 optimal assessment of clinical outcome. Furthermore, mRS is probably an inaccurate tool to evaluate the
246 outcome of patients with distal occlusions, especially in the ACA's and vertebrobasilar territories where the
247 clinical consequences (behavioral disorders, anopsia, dyspraxia...) are not adequately assessed by this scale.

248

249

250 **CONCLUSION**

251 The 3MAX reperfusion catheter is a well-navigable catheter, making it acceptable as a frontline technique in
252 distal MT, especially in case of periprocedural thromboembolic event but in general, the reperfusion rate appears
253 insufficient with ADAPT alone thus preventing operators from relying on it as the sole revascularization device.
254 One must also be aware of the risk of vascular injury, especially in tortuous and angulated segments.
255 Randomized trials are needed to efficiently compare ADAPT to stent retrievers.

256

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340

341

Figures

Figure 1.

Sixty-seven-year-old male patient with sudden onset of coma (NIHSS 28). **A.** Axial susceptibility-weighted MR images showing signal void inside the distal basilar artery assessing the presence of the clot which was confirmed by the MR angiography and during per-procedural selective left vertebral artery DSA (**B.** Black arrow) **C.** DSA through the ACE64 (Black arrow head): clot fragmentation caused by the initial road map injection for catheter navigation is demonstrated: bilateral PCA occlusions (P3, black asterisks) and bilateral SCA occlusions (First segment on the left side and second segment on the right side [Dotted arrows]) are seen.

D. Road map in AP projection. After two failed thromboaspiration attempts with the 3MAX, recanalization of the left PCA was obtained with a stent retriever (4/20 mm Solitaire FR; black star) (TICI 3 recanalization). **E.** Road map in AP projection: direct thromboaspiration through the 3MAX is successfully performed on the right PCA occlusion (white asterisk). **F.** Selective DSA through a Velocity 2.6F delivery microcatheter (Large arrow) (Penumbra) placed into the left SCA after a failed 3MAX navigation attempt, showing occlusion of the left SCA (black arrowhead). TICI 3 was obtained after the second stent retrieving attempt with a Solitaire FR. **G.** Control DSA in AP projection: TICI 3 recanalization of both PCAs and left SCA. Partial spontaneous recanalization of the right SCA during the procedure is also seen (arrow). **H.** Axial diffusion weighted images at day 1 after MT: multiple punctuate infarcts as well as an infarct in the right SCA territory are seen (lateral branches; white arrowhead).

Figure 2.

Fifty-year-old patient with acute onset aphasia and partial motor deficit (NIHSS = 6) due to a left M2 occlusion who underwent IVT+MT at 3 hours from symptoms' onset. **A.** Diffusion Weighted Imaging (DWI); axial slice showing small insular and opercular acute ischemic stroke (white arrows). **B.** Arterial Spin Labelling (ASL) perfusion MRI sequence displaying a large hypoperfusion (white asterisk) in the occluded territory assessing the DWI-Perfusion mismatch. Note the linear hyperperfusion corresponding to a transit arterial artefact, related to slowdown in a cortical branch (white arrow). **C:** Left internal carotid artery selective DSA in left anterior oblique (LAO) projection: inferior division M2 branch occlusion (black arrow) with arterial defect in the corresponding territory (white dotted arrow) are seen. **D:** Control DSA after two thromboaspiration attempts: TICI 2b recanalization after 26 minutes of recanalization time. Note the significant spasm at the occlusion's level (arrowhead). **E:** Control MRI 24h after MT, DWI; axial slice: no extension of ischemia is seen. **F.** ASL perfusion sequence at day 1 showing complete reperfusion of the posterior MCA territory defect. Note the faint hyperperfusion of the previously hypoperfused territory, also known as "luxury perfusion".

379 Tables

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381 **Table 1. Population characteristics, technical parameters and results**

Characteristics	Value
Sex	
-Male	16 (50%)
Mean age: years ($\pm$ S.D)	67.4 ($\pm$ 18.7)
Strokes' etiologies	
-Atherosclerosis	6 (18.8%)
-Cardioembolic	17 (53.1%)
-Embolic, iatrogenic	4 (12.5%)
-Unknown	5 (15.6%)
Median NIHSS score (IQR)	
-At admission	14 (9-19)
-At 24 hours	9 (5-18)
-At day 7	6 (3-12)
Occlusion's location	
-M2:	23 (60.5%)
-M3:	6 (15.8%)
-P1:	3 (7.9%)
-P2:	2 (5.3%)
-P3:	2 (5.3%)
-A3:	1 (2.6%)
-SCA:	1 (2.6%)
Anesthetic modality	
-General anaesthesia	19 (59.4%)
-Conscious sedation	13 (40.6%)
IVT	18 (56.3%)

Average delays: minutes ($\pm$ S.D)		
-Symptoms' onset to arterial puncture	235.5 ($\pm$ 113.8)	
-Arterial puncture to successful recanalization	67.7 ($\pm$ 33.4)	
-Procedure lasting	85.5 ($\pm$ 38)	
Median aspiration attempts: (IQR)	2 (1-5)	
TICI score:	After ADAPT alone	Final
-0: No perfusion	1 (2.7%)	1 (2.6%)
-1: Antegrade flow past the initial obstruction with minimal perfusion	5 (13.5%)	1 (2.6%)
-2a: Partial reperfusion (<50% of the occluded territory)	9 (24.4%)	7 (18.5%)
-2b: Partial reperfusion (>50% of the occluded territory)	6 (16.2%)	9 (23.7%)
-3: Full reperfusion	16 (43.2%)	20 (52.6%)
Complications		
-Mortality at one month:	4 (12.5%)	
-SICH:	3 (9.4%)	
-3MAX-related:	3 (9.4%):	
	<ul style="list-style-type: none"> • 2 ENTs • 1 vascular perforation 	

S.D: Standard Deviation; IVT: Intravenous Thrombolysis; IQR: Interquartile Range; TICI: Thrombolysis In Cerebral Infarction; Symptomatic Intracranial Hemorrhages; A3: Callosal segment of the anterior cerebral artery; M2: Insular segment of middle cerebral artery (MCA); M3: Opercular segment of the MCA; P1: Precommunicating segment of the posterior cerebral artery (PCA); P2: Ambient segment of the PCA; P3: Tectal segment of the PCA; SCA: superior cerebellar artery; ENT: Embolus to New Territory.

389 **Table 2. Literature review: Mechanical Thrombectomy for distal intracranial arterial occlusions**

Series	Population	Pre-treatment NIHSS	Device/Technique	TICI 2b/3 reperfusion rate	Embolization to new territory	Procedure-related death	0-2 mRS at follow-up
Pfaff J. et al. (2015) [21]	30 occlusions of the distal ACA	18	Stent retriever	88%	0%	0%	36.2% at 90 days
Dorn et al. (2015) [20]	15 M2 occlusions	13.73	Stent retriever	93.3%	0%	0%	60% at 3 months
Kurre W. et al. (2016) [22]	76 patients for 90 occlusions	14	Stent retriever (pREset LITE)	70.0%	13.3%	0%	~34% at 90 days.
Coutinho JM. et al. (2016) [23]	50 M2 occlusions	13	MERCI, Stent retriever	85%	NA	NA	60% at 90 days
Kim DW. et al. (2016) [24]	41 M2 occlusions	13	FAST*, Stent retriever	78%	0%	NA	80.5% at 3 months
Park JS. et al. (2016) [25]	32 M2 occlusions	10.9	Manual aspiration (4MAX)	84%	0%	0%	78% at 3 months
Vargas J. et al. (2016) [10]	35 patients	14	ADAPT (5/4/3MAX)	77.1%	NA	0%	59.4% at 90 days
Presented study	32 patients for 37 occlusions	14	ADAPT (3MAX)	3MAX alone: 59.5% Overall: 76.3%	6.3%	3.1%	45.5% at 3 months

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391 ACA : Anterior Cerebral Artery; ADAPT: A Direct Aspiration first-Pass Thrombectomy; TICI: Thrombolysis In Cerebral Infarction; NA: Not Available

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