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Original Article

Mechanical Thrombectomy Making Practical Use of an Aspiration Catheter While Selecting the Retrieval Technique during the Procedure

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Objective: To report the outcomes of thrombectomy for arterial occlusion involving the major arteries of the cerebral anterior circulation when an aspiration catheter (AC) was used in all cases, with the retrieval technique chosen during the procedure.

Methods: Of the 126 patients who underwent endovascular thrombectomy during the 2-year period of 2018–2019, the study subjects were 102 patients with arterial occlusion involving the major arteries of the cerebral anterior circulation. Patients were divided into two groups depending on when the procedure was performed. In the earlier group (January 2018–March 2019), treatment was performed using only a stent retriever (SR), whereas an AC was used for all cases in the later group (April–December 2019). Outcomes between groups were retrospectively compared. In the later group, the treatment strategy was to use the SR in combination with the AC (combined technique) for retrieval if the microcatheter reached the distal side of the occlusion site without difficulty. If the microcatheter did not easily reach the distal side, we did not stick to penetrating the occlusion site, and contact aspiration was performed.

Results: Thrombolysis in cerebral infarction (TICI) grade 2b–3 was achieved in 85% of patients in the earlier group and 95% in the later group. TICI grade 3 was achieved in 52% of the earlier group and 54% of the later group, showing no significant difference. TICI grade 2b–3 was achieved at first pass in 46% of patients in the earlier group, significantly lower than the 71% in the later group (P = 0.013). The mean number of passes decreased significantly from 1.84 in the earlier group to 1.32 in the later group (P = 0.002).

Conclusion: Using an AC from the start, and using a combined technique when the microcatheter reached the distal side of the occlusion site, the frequency of first-pass TICI grade 2b-3 increased, and the mean number of passes decreased in comparison with the SR-alone group.

Keywords mechanical thrombectomy, aspiration catheter, stent retriever

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Introduction

Endovascular thrombectomy is already standard treatment for acute stroke caused by occlusion of arteries of the proximal anterior circulation. Various effective procedures have been reported, but no consensus has been reached regarding which procedure should be selected.

We report the outcomes of thrombectomy for arterial occlusion involving the major arteries of the cerebral anterior circulation when an aspiration catheter (AC) was used in all cases, but the retrieval technique was selected during the procedure.

Table 1 Characteristics of patients and procedures

	Earlier group (n = 61)	Later group (n = 41)	P Value
Age, years, median (IQR)	81 (70–86)	82 (75–85)	0.410
Gender (M:F)	31:30	22:19	0.778
NIHSS on arrival, median (IQR)	18 (11–23)	18 (14–26)	0.244
DWI-ASPECTS, median (IQR)	8 (6–9)	7 (6–9)	0.806
Use of intravenous rt-PA (%)	34	44	0.334
Occlusion site (%)			
ICA	30	20	0.256
M1 middle cerebral artery segment	42	70	0.005
M2 middle cerebral artery segment	28	10	0.027
Process time, min, median (IQR)			
Onset to door	116 (48–230)	92 (45–144)	0.178
Door to puncture	59 (50–70)	54 (45–65)	0.035
Puncture to reperfusion	47 (30–71)	38 (33–62)	0.514
Door to reperfusion	111 (92–130)	97 (78–117)	0.069

ASPECTS: Alberta Stroke Program Early CT Score; DWI: diffusion-weighted image; ICA: internal carotid artery; IQR: interquartile range; NIHSS: National Institutes of Health Stroke Scale; rt-PA: recombinant tissue plasminogen activator

Materials and Methods

Of the 126 patients who underwent endovascular thrombectomy in our hospital during the 2-year period of 2018–2019, subjects comprised 102 patients with arterial occlusion involving the major arteries of the cerebral anterior circulation, after excluding patients with occlusion of the basilar artery or cervical carotid artery, and patients for whom MRI was contraindicated. These 102 patients were divided into two groups depending on when the procedure was performed. For those in the earlier group (January 2018–March 2019), treatment was carried out using a stent retriever (SR) alone, whereas all patients in the later group (April–December 2019) were treated using an AC. Outcomes in these two groups were compared retrospectively.

In the later group, an AC and a microcatheter were used for all patients. We used the ACE 68 catheter (Penumbra, Alameda, CA, USA), the React 68 catheter (Medtronic, Dublin, Ireland), the React 71 catheter (Medtronic), or the SODIAFLOW Plus (MicroVention Terumo, Tustin, CA, USA). Inner diameters of these ACs were 0.068, 0.070, or 0.071 inches. Selection of the specific device to use was left to the discretion of the operators. The treatment strategy was to use the SR in combination with the AC (combined technique) if the microcatheter reached the distal side of the occlusion site without difficulty. If the microcatheter did not reach the distal side easily, we did not stick to penetrating the occlusion site, and contact aspiration was performed for retrieval.

Statistical analyses were performed using SPSS software (version 24.0; IBM, Armonk, NY, USA). Differences between groups were assessed using the Mann–Whitney U-test, chi-square test or t-test. Values of $P < .05$ were considered to indicate statistical significance.

Results

The earlier group included 61 patients and the later group comprised 41 patients. No significant differences between the earlier and later groups were seen in age, National Institutes of Health Stroke Scale (NIHSS) score, diffusion-weighted imaging-Alberta Stroke Program Early CT Score (ASPECTS), onset-to-door time, or rate of intravenous recombinant tissue plasminogen activator (rt-PA) use. Door-to-puncture (D2P) time was significantly shorter in the later group, but no significant differences were seen in either puncture-to-reperfusion (P2R) time or door-to-reperfusion (D2R) time (**Table 1**).

The breakdown of techniques used for the later 41 patients, for whom an AC was used in all cases and the retrieval method was chosen intraoperatively, was as follows.

In 20 cases, the microcatheter was easily passed through the occlusion site and the AC also reached the occlusion site easily, and the SR and AC were used together for retrieval. In five cases, the AC was initially unable to reach the occlusion site, but reached the site easily after SR deployment, and the AC and SR were used together for retrieval. In five cases, the AC was used as a distal access catheter (DAC) due to difficulty with guiding access, and

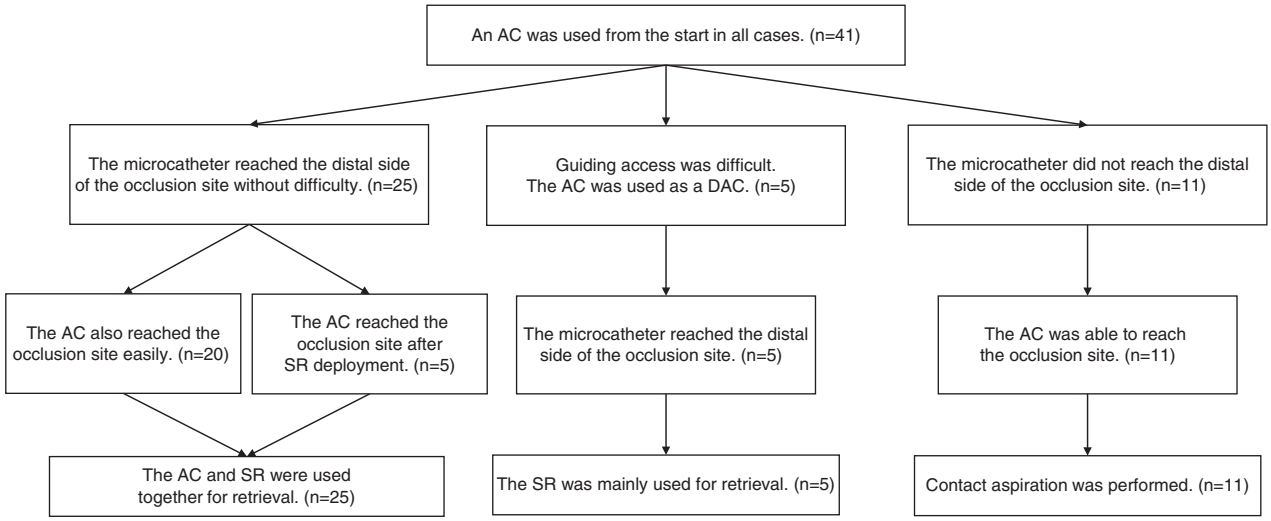

Fig. 1 Flowchart of techniques used for the group of patients that underwent endovascular thrombectomy between April and December 2019 when an AC was used in all cases (later group). AC: aspiration catheter; DAC: distal access catheter; SR: stent retriever

Table 2 Clinical outcomes

	Earlier group (n = 61)	Later group (n = 41)	P Value
TICI 2b-3 (n,[%])	52 (85)	39 (95)	0.115
TICI 2c-3 (n, [%])	36 (59)	24 (59)	0.961
TICI 3 (n,[%])	32 (52)	22 (54)	0.905
First pass TICI 2b-3 (n,[%])	28 (46)	29 (71)	0.013
First pass TICI 2c-3 (n,[%])	24 (39)	20 (49)	0.345
First pass TICI 3 (n,[%])	22 (36)	18 (44)	0.427
Pass-number, median (IQR)	1 (1–2)	1 (1–2)	0.009
Pass-number, mean	1.84 ± 1.03	1.32 ± 0.56	0.002
Any ICH (n,[%])	16 (26)	6 (15)	0.163
Symptomatic* ICH (n,[%])	0 (0)	0 (0)	
mRS at 7 days, median (IQR)	2 (1–4)	2 (0–4)	0.578
mRS at 90 days, median (IQR)	2 (1–4)	2 (0–4)	0.587
mRS 0–2 at 90 days (n,[%])	36 (59)	21 (51)	0.437

* NIHSS 4 or more worsening. ICH: intracranial hemorrhage; IQR: interquartile range; mRS: modified Rankin Scale; TICI: thrombolysis in cerebral infarction

the SR was mainly used for retrieval. In 11 cases, penetration of the occlusion site was unsuccessful, but the AC was able to reach the occlusion site, so contact aspiration was performed (**Fig. 1**).

Thrombolysis in cerebral infarction (TICI) grade 2b–3 was achieved in 85% of patients in the earlier group and 95% of patients in the later group, while TICI 2c–3 was achieved in 59% of those in the earlier group and 59% of those in the later group, and TICI grade 3 was achieved in 52% of patients in the earlier group and 54% of patients in the later group, these differences were not significant. TICI grade 2b–3 was achieved at first pass (first-pass TICI 2b–3) in 46% of patients in the earlier group, significantly lower than the 71% in the later group (P = 0.013). First-pass TICI 2c–3 was achieved in 39% of patients in the earlier group and 49% of patients in the later group, and first-pass TICI 3 was achieved in 36% of patients in the earlier group and 44% of patients in the later group, but this difference was not significant. Median number of passes was one in both groups. The mean number of passes decreased significantly from 1.84 in the earlier group to 1.32 in the later group (P = 0.002). No significant differences were seen in overall rate of any intracranial hemorrhage (ICH), rate of symptomatic ICH, or modified Rankin Scale scores after 7 and 90 days (**Table 2**).

Discussion

A direct aspiration first pass technique (ADAPT) reported in 2014 has been recognized as an effective procedure for

acute stroke thrombectomy.[1,2] On the other hand, after the 2015 publication of five randomized trials, the SR has become accepted as a standard device in patients with occlusions of the proximal anterior circulation.[3–8] Since that, several techniques using the combination of AC and SR have been reported.[9–11] However, no consensus has been reached regarding which procedure should be selected. With the continuous aspiration prior to intracranial vascular embolectomy (CAPTIVE) and stent retriever-assisted vacuum-locked extraction (SAVE) techniques, the SR and AC are drawn into the guiding catheter as a unit.[9,10] On the other hand, with a stent-retrieving into an AC with proximal balloon (ASAP) technique, the SR is drawn into the AC, and completely removed from the system.[11] In the CAPTIVE technique, after SR deployment, the AC is advanced under continuous aspiration, but a balloon guide catheter is not used. In the SAVE technique, aspiration is switched to the guiding catheter when drawing the SR and AC as a unit. In the ASAP technique, the AC is drawn under continuous aspiration and proximal flow arrest, with aspiration performed from the balloon guide catheter using a syringe. We incorporate the positive attributes of these techniques: a balloon guide catheter is used, the AC is advanced under continuous aspiration after SR deployment, then the SR and AC are drawn into the guiding catheter as a unit under proximal flow arrest. After the AC and SR are removed from the system, aspiration by a syringe from the balloon guide catheter is performed under flow arrest to avoid embolization of residual thrombus to new territory. We consider that the sequence of this procedure is not cumbersome.

When an SR is used alone, it is essential that the microcatheter reaches the distal side of the thrombus. Depending on the nature of the thrombus and the course of the distal vessel, the distal side of the occlusion site may be difficult to reach, which may lead to forcible maneuvers and time being wasted.

Issues with the use of an AC alone include difficulty reaching the occlusion site because of severe flexion, stenosis, or the ledge effect.

Of the procedures used for the 41 patients in the later group, an SR and AC were used together for retrieval in 20 cases in which the microcatheter passed easily through the occlusion site and the AC was easily reached, and five cases in which the AC was only able to reach the occlusion site after SR deployment.

The five cases in which the AC was used as a DAC due to difficulty with guiding access, and the 11 cases in which contact aspiration was used, may have been successful partly because an AC was used from the start.

The strategy of using an AC from the start in all cases has two advantages. The first is that if penetration of the occlusion site proves unsuccessful, there is no need to switch devices when changing to contact aspiration. The second is that if access is difficult or the occlusion site is not easily penetrated, the AC can be effectively used as a DAC. We consider this strategy has no disadvantages in terms of either safety or effectiveness.

The ASTER and COMPASS trials demonstrated the equivalent efficacy of ACs and SRs.[12,13] The retrieval method need not be decided in advance, but may be chosen flexibly during the procedure. Choosing whichever procedure is easier rather than sticking dogmatically to a particular type of retrieval may contribute to achieving safe reperfusion. The use of an AC expands the scope of procedures that can be used, providing a flexible choice of maneuvers, and is effective in overcoming the issues faced by single devices.

In this study, no significant differences in functional outcomes were identified between the earlier and later groups. Even though the frequency of first-pass TICI grade 2b–3 was increased, and the mean number of passes was decreased in the later group, P2R time was not shortened significantly. The P2R time may be reduced as clinicians become accustomed to AC and the combined technique, so further mastery of the procedure was considered indispensable.

Conclusion

Using an AC from the start, and using a combined technique when the microcatheter reaches the distal side of the occlusion site, the frequency of first-pass TICI grade 2b–3 was significantly increased. In addition, the mean number of passes decreased significantly in comparison with the SR-alone group.

Disclosure Statement

The authors declare no conflict of interest.

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