혈관내 혈전제거술에서 원위 접근 카테터의 역할

김 용 원
경북대학교 의과대학 신경과학교실

Role of distal access catheter in endovascular thrombectomy

Yong-Won Kim, MD
Department of Neurology, Kyungpook National University, School of Medicine, Daegu, Korea

Advancement of endovascular treatment devices lead to achieve higher reperfusion rates than the past. We review a role of distal access catheter (DAC) in endovascular thrombectomy of acute ischemic stroke with intracranial arterial occlusion. Distal part of DAC has characteristics including flexible and soft. Therefore, DAC can advance to the MCA and perform the aspiration thrombectomy. For the stent retriever, DAC can reduce thrombus fragmentation, distal embolization and vessel trauma during stent retrieval due to shorten length for stent retrieval. And, direct aspiration through DAC may be effective. The use of DAC seems valuable to perform mechanical thrombectomy in application of aspiration, stent retriever, or combined strategy.

Key Words: Acute ischemic stroke, Endovascular treatment, Distal access catheter

Introduction

Since release of Merci retriever (Concentric Medical, Mountain View, California, USA), thrombectomy devices related to endovascular thrombectomy (EVT) have developed rapidly. In MERCI (Mechanical Embolus Removal in Cerebral Ischemia) trial, the recanalization rate was significantly higher than in the historical control group (46% versus 18%, P〈0.0001).[1] The Penumbra pivotal stroke trial revealed 81.6% of revascularization rate (TIMI grade 2 or 3).[2] The SWIFT (Solitaire With the Intention For Thrombectomy) trial used Solitaire stent (Medtronic Neurovascular, CA, USA), and achieved 60.7% of recanalization rate (TIMI 2 or 3) and 58.2% of favorable clinical outcome at 3 months.[3] Advancement of endovascular treatment strategy lead to achieve higher reperfusion rates than the past.

Recent EVT trials including MR CLEAN, EXTEND-IA, ESCAPE, SWIFT PRIME, and REVASCAT have shown efficacy and safety of EVT in acute ischemic stroke with proximal anterior circulation occlusion.[4-8] And, stent retriever was most frequently used. Based on results from these trials, updated guidelines recommend EVT using stent retriever for patients with occlusion of a proximal intracranial artery.[9]

The distal access catheter (DAC) was designed to allow easy manipulation of endovascular devices by supporting microcatheter. Therefore, DAC was commonly used endovascular procedures including coil embolization, intracranial angioplasty, and embolization. We review a role of distal access catheter in EVT of acute ischemic stroke with intracranial arterial occlusion.

Yong-Won Kim
Department of Neurology, Kyungpook National University Hospital, Daegu, Korea
School of Medicine, Kyungpook National University, Daegu, Korea
130, Dongduk-ro, Jung-gu, 42119, Daegu, Korea
Tel: +82-53-420-5758 Fax: +82-53-422-4265
E-mail: yw.kim23@gmail.com

Application of Distal Access Catheter in mechanical thrombectomy

1. Aspiration thrombectomy

The penumbra system consisted of reperfusion catheter, separator, aspiration pump, and thrombus removal ring. The penumbra system designed to remove a clot by disruption using a separator and aspiration using reperfusion catheter. To achieve better outcome, advanced strategies including forced arterial suction thrombectomy and a direct aspiration first pass technique, were introduced.[10,11] These techniques are simple and straightforward. The Penumbra reperfusion catheter coaxially with .014-inch microguidewire and .021-inch microcatheter were advanced to the proximal end of the occlusion and wedged to the clot under manual aspiration using a 50-mL syringe. After then, penumbra reperfusion catheter was gently withdrawn continuing to maintain aspiration force.

To maximize aspiration force, new generation devices had more larger inner diameter than old generation devices and have been shown higher recanlization.[11] Regarding this advantage, DAC also has a similar advantage for aspiration thrombectomy although DAC did not designed for aspiration originally. Currently there have been several DACs that have launched, which include the Ace 064 (Penumbra, Alameda, CA, USA), Arc (Medtronic Neurovascular, CA, USA), Navien (Medtronic Neurovascular, CA, USA), Catalyst (Stryker, Fremont, CA, USA), Revive IC (Codman, Raynham, MA, USA), and Sofia (Microvention, CA, USA). Distal part of DAC has characteristics including flexible and soft. Therefore, DAC can advanced to the distal ICA/MCA and easily perform the aspiration thrombectomy.(Figure1) In addition, the most of DAC had a little smaller outer diameter than middle cerebral artery and basilar artery. So, closed space can be built by advancement of DAC. It may be associated with effective aspiration.

2. Intermediate guide catheter for stent retriever

In the general use of the stent retriever, the target occluded segment was accessed with a .014-inch microguidewire, and a .021-inch microcatheter was advanced beyond the occlusion. After positioning a microcatheter, proximal and distal ends of the occlusion were then confirmed by microinjection and the stent retriever was deployed for several minutes. After the balloon of the balloon guide catheter was inflated with remote aspiration through the guide catheter, the microcatheter and stent retriever were withdrawn into the guide catheter.

In cases of the DAC, after deploy of stent retriever, confirming the access of the DAC into the corresponding artery segment adjacent to the occluded segment, stent retriever was retrieved into the DAC under maintaining manual aspiration through side port. This strategy is combined form of thrombectomy using aspiration and stent retriever. The first advantage is reduced length for stent retrieval. This can reduce thrombus fragmentation, distal emboliza-

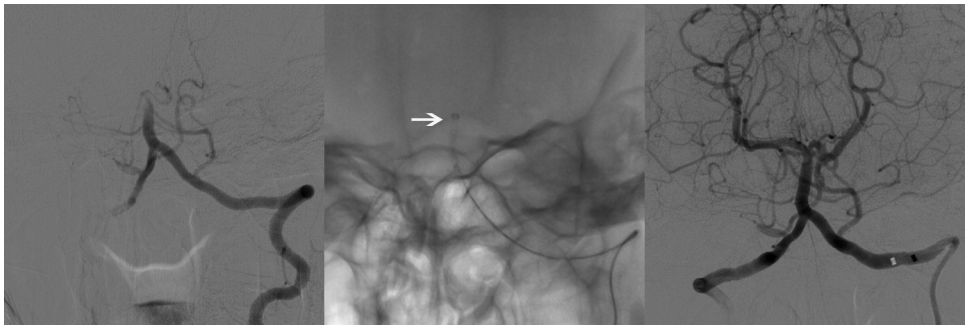

Figure 1. Aspiration thrombectomy using distal access catheter. A. Endovascular thrombectomy using NAVIEN 58 distal access catheter in case of basilar artery occlusion. B. Endovascular thrombectomy using Sofia plus catheter in case of middle cerebral artery occlusion.

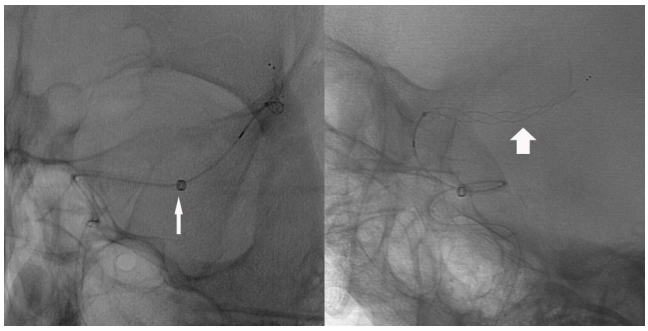

Figure 2. The use of distal access catheter during stent retriever thrombectomy. Catalyst 6 distal access catheter was placed in the MCA M1 segment and Trevo was deployed MCA M2 segment.

tion and vessel trauma during stent retrieval. Second advantage is to apply aspiration at the nearby occluded segment, not remote aspiration. This may be associated with effective aspiration, due to lack of backflow originated from anterior cerebral artery. Therefore, the effect of aspiration can improve.(Figure 2)

Conclusion

Each mechanical thrombectomy strategy has their own advantages. For example, aspiration strategy may be effective and safe in cases of basilar artery occlusion regarding hemorrhagic complication during microwire navigation, but stent retriever may be better for distal intracranial arterial occlusion regarding navigation of small sized artery.[12,13] The use of DAC seems valuable to perform mechanical thrombectomy in application of aspiration, stent retriever, or combined strategy.

References

1. Smith WS, Sung G, Starkman S, Saver JL, Kidwell CS, Gobin YP, et al. Safety and efficacy of mechanical embolectomy in acute ischemic stroke: results of the MERCI trial. *Stroke* 2005;36(7):1432-1438.
2. Penumbra Pivotal Stroke Trial Investigators. The penumbra pivotal stroke trial: safety and effectiveness of a new generation of mechanical devices for clot removal in intracranial large vessel occlusive disease. *Stroke* 2009;40(8): 2761-2768.
3. Saver JL, Jahan R, Levy EI, Jovin TG, Baxter B, Nogueira RG, et al. Solitaire flow restoration device versus the Merci Retriever in patients with acute ischaemic stroke (SWIFT): a randomised, parallel-group, non-inferiority trial. *Lancet* 2012;380(9849):1241-1249.
4. Berkhemer OA, Fransen PSS, Beumer D, Berg LA, Lingsma HF, Yoo AJ, et al. A randomized trial of intraarterial treatment for acute ischemic stroke. *N Engl J Med* 2015;372(1): 11-20.
5. Goyal M, Demchuk AM, Menon BK, Eesa M, Rempel JL, Thornton J, et al. Randomized assessment of rapid endovascular treatment of ischemic stroke. *N Engl J Med* 2015;372(11):1019-1030.
6. Campbell BCV, Mitchell PJ, Kleinig TJ, Dewey HM, Churilov L, Yassi N, et al. Endovascular therapy for ischemic stroke with perfusion-imaging selection. *N Engl J Med* 2015; 372(11):1009-1018.
7. Jovin TG, Chamorro A, Cobo E, Miquel MA, Molina CA, Rovira A, et al. Thrombectomy within 8 hours after symptom onset in ischemic stroke. *N Engl J Med* 2015;372(24): 2296-2306.
8. Saver JL, Goyal M, Bonafé A, Diener H, Levy EI, Pereira V, et al. Stent-retriever thrombectomy after intravenous t-PA vs. t-PA alone in stroke. *N Engl J Med* 2015;372(24):2285-2295.
9. Powers WJ, Derdeyn CP, Biller J, Coffey CS, Hoh BL, Jauch EC, et al. 2015 American Heart Association/American Stroke Association Focused Update of the 2013 Guidelines for the Early Management of Patients With Acute Ischemic Stroke Regarding Endovascular Treatment. *Stroke* 2015;46(10):3020-3035.
10. Kang DH, Hwang YH, Kim YS, Park J, Kwon O, Jung C. Direct thrombus retrieval using the reperfusion catheter of the penumbra system: forced-suction thrombectomy in acute ischemic stroke. *AJNR Am J Neuroradiol* 2011;32(2): 283-287.
11. Turk AS, Frei D, Fiorella D, Mocco J, Baxter B, Siddiqui A, et al. ADAPT FAST study: a direct aspiration first pass technique for acute stroke thrombectomy. *Journal of Neuro-*

Interventional Surgery 2014;6(4):260-264.
12. Kim YW, Son S, Kang DH, Hwang YH, Kim YS. Endovascular thrombectomy for M2 occlusions: comparison between forced arterial suction thrombectomy and stent retriever thrombectomy. *Journal of NeuroInterventional Surgery* July 2016. doi:10.1136/neurintsurg-2016-012466.
13. Eom YI, Hwang YH, Hong JM, Choi JW, Lim YC, Kang DH, et al. Forced arterial suction thrombectomy with the penumbra reperfusion catheter in acute basilar artery occlusion: a retrospective comparison study in 2 Korean university hospitals. *AJNR Am J Neuroradiol* 2014;35(12):2354-2359.