Original Paper

Seeing Is Believing: Headway27 as a Highly Visible and Versatile Microcatheter with Ideal Dimensions for Stroke Thrombectomy

William J. Ares^{a, b} Benjamin M. Zussman^{a, b} Cynthia L. Kenmuir^{a, c}
Gregory M. Weiner^{a, b} Habibullah Ziayee^{a, c} Devin Burke^{a, c}
Ashutosh P. Jadhav^{a, c} Tudor G. Jovin^{a, c} Brian T. Jankowitz^{a, b}
Bradley A. Gross^{a, b}

^aStroke Institute, University of Pittsburgh Medical Center, Pittsburgh, PA, USA;

^bDepartment of Neurological Surgery, University of Pittsburgh Medical Center,

Pittsburgh, PA, USA; ^cDepartment of Neurology, University of Pittsburgh Medical Center, Pittsburgh, PA, USA

Keywords

Stroke · Thrombectomy · Technique · Catheter

Abstract

Introduction: Microcatheter selection is an infrequent focus of stroke thrombectomy technique evaluation. The Headway27 microcatheter strikes an excellent balance of microcatheter dimensions (156 cm length, 2.6 Fr distal OD, ID 0.027 inches) and visibility, making it ideal for stroke thrombectomy. **Methods:** We evaluated a prospectively maintained acute stroke thrombectomy database containing 50 consecutive cases using the Headway27 microcatheter. From the database, patient demographics, clinical and angiographic information as well as procedural technical details and complications were extracted. **Results:** Manual aspiration thrombectomy (MAT) was performed alone in 72% of cases, stentriever-assisted MAT was performed in 6% of cases, and a combination was used in 22% of cases. Median groin puncture to final recanalization time was 27 min and mTICI 2B/3 recanalization was achieved in 94% of cases. There were 2 intra-procedural complications, neither related to the microcatheter. In all cases, the Headway27 reached the intended target vessel: M1 ($n = 4$), M2 ($n = 26$), M3 ($n = 13$), P2 ($n = 3$), P3 ($n = 1$), and basilar artery ($n = 3$). There were no cases requiring usage of an additional or alternative microcatheter. In 45/47 cases of MAT, the reperfusion catheter tracked over the Headway to the clot/intended target; in two cases, the microcatheter was used to deploy a stentriever that then allowed the reperfusion catheter to track to the clot. **Conclusion:** The Headway27 microcatheter reliably facilitated rapid clot access in anterior and posterior circulation acute large vessel occlusions with no microcatheter-associated complications.

© 2018 S. Karger AG, Basel

Dr. Bradley A. Gross
Department of Neurological Surgery, University of Pittsburgh
Suite B-400, UPMC Presbyterian
200 Lothrop St., Pittsburgh, PA 15213 (USA)
E-Mail grossb2@upmc.edu

Introduction

Continued technological advancements in guide catheters, reperfusion catheters, and microcatheters have steadily made acute stroke interventions faster, safer, and more efficacious. Many of the recent technological developments have been focused on the two former components of the triaxial system without focus on the microcatheter [1–3]. The Headway27 (MicroVention, Inc., Aliso Viejo, CA, USA) is a 0.027-inch microcatheter originally designed for the delivery of flow diverters; however, its use has not been described as a component of a stroke intervention system. Here we describe our experience with the Headway27 microcatheter in 50 consecutive ischemic stroke interventions with particular focus on its ability to reach a vascular target, deliver an aspiration catheter to an occlusive clot, and to deliver a stentriever.

Methods

Patient Selection and Data Collection

We retrospectively reviewed a prospectively collected acute stroke thrombectomy database to identify 50 consecutive cases from April to July 2017 utilizing the Headway27 microcatheter as a component of a tri- or quadaxial thrombectomy access system. Data were collected with respect to patient demographics and clinical considerations, procedural equipment, and technical details.

Endovascular Procedure

In this series, access for acute stroke thrombectomies was achieved with one of two 8-Fr non-balloon guide catheters with or without the assistance of an 8-Fr 65-cm arrow sheath. A VTK catheter was used to select and advance the guide catheter into the appropriate cervical parent vessel. Via the guide catheter a reperfusion catheter was advanced over the Headway27 microcatheter to engage the clot. As described previously, manual aspiration thrombectomy (MAT) utilizing a syringe was performed [4, 5]. Our protocol involved two attempts of syringe-mediated MAT. In cases where MAT proved ineffective or where the primary neurointerventionalist felt that the efficacy of MAT would be limited by anatomic considerations, a stentriever was deployed via the Headway27 microcatheter and the reperfusion catheter was advanced over the stentriever and aspiration was applied (stent-assisted manual aspiration thrombectomy [SMAT]) [6].

Results

Background and Demographics

Over a 3-month period, we performed 50 consecutive acute thrombectomies using the Headway27 as our primary microcatheter. Average patient age in the series was 70 (SD 14) and 54% were female. Mean NIHSS at the time of treatment was 16 (SD 7) and 32% of patients received tPA prior to thrombectomy. Initial location of the occlusion was most commonly the M1 (27, 54%). Other locations included the ICA terminus (9, 18%), M2 (7, 14%), basilar (6, 12%), and P1 (1, 2%). A coexistent ipsilateral extracranial carotid occlusion was found in 10 cases (20%).

Thrombectomy Technique and Results

MAT technique was used primarily in 47 patients (94%) and required conversion to SMAT in 11 patients (23%). In the 36 patients treated exclusively with MAT, the median number of passes was 2, and 30% had successful recanalization after the first pass. SMAT technique was used primarily in 3 patients (6%). The median groin puncture to clot access time was 16 min and the median groin puncture to final recanalization time was 27 min. The rate of TICI 2b/3 recanalization was 94%. In comparing MAT alone and MAT with rescue

SMAT, there was no significant difference in mean total procedural time (34 vs. 35 min) or rate of TICI2b/3 recanalization (97 vs. 93%). While two complications occurred in the series, neither was associated with the microcatheter. In one instance, a microwire perforated a distal M3 branch while attempting to aspirate distal emboli after clearance of a more proximal occlusion. Additionally, there was one episode of reperfusion catheter fracture necessitating snare recovery. Mean change in NIHSS score at 24 h was -6.7 (SD 7.6, median -6.5) and in patients with 3-month follow-up data available ($n = 29$), 48% had an mRS of 0–2.

Microcatheter Performance

In all 50 cases, the Headway27 reached the intended target vessel: M1 ($n = 4$), M2 ($n = 26$), M3 ($n = 13$), P2 ($n = 3$), P3 ($n = 1$), and basilar artery ($n = 3$). The microcatheter was used to deliver 8 different reperfusion catheters (0.044–0.072 inches ID range). In 45/47 MAT cases (96%), the reperfusion catheter tracked over the Headway27 to the clot/intended target; in two cases, the Headway was used to deploy a stentriever that then allowed the reperfusion catheter to track to the clot. Both cases were in the context of needing to bring the reperfusion catheter around the carotid siphon into the ophthalmic segment.

There were no cases requiring usage of an additional Headway or alternative microcatheter for thrombectomy. Both the Solitaire ($n = 9$) and Trevo ($n = 5$) stentriever were used without difficulty in deployment of either 4 or 6 mm sizes. There were no complications such as dissection or perforation related to the usage of the Headway microcatheter.

Discussion

With definitive randomized controlled trials demonstrating that acute stroke thrombectomy improves outcomes in patients with large vessel occlusions up to 24 h from onset of symptoms, much of the current lines of inquiry revolve around how we can perform the procedure faster, safer, and more effectively [7–10]. While current debates include reperfusion catheter selection, utility of stentriever versus direct aspiration, and utility of aspiration pumps, there has been very little investigation in regard to the optimal microcatheter system to use to deploy stentriever or deliver reperfusion catheters [4, 11–14]. We would posit that the optimal microcatheter for acute ischemic stroke intervention would have the following characteristics: length sufficient to reach the distal vasculature without sacrifice of catheter flexibility, intrinsic trackability to negotiate distal cerebral vasculature but with enough stiffness to deliver a bulky reperfusion catheter, sufficient visibility for safe travel through the distal cerebral vasculature (particularly in the context of procedures performed under MAC), and ability to deploy a stentriever safely and efficiently.

While the Headway27 microcatheter (MicroVention Inc, Aliso Viejo, CA, USA) was originally designed for delivery of flow diverters, it has many of the characteristics that also make it a promising acute stroke intervention microcatheter. Distal purchase with guidewires and microcatheters is a previously described technique used to negotiate tortuous vasculature [15]. To this end, the Headway27, with its hybrid braid/coil construction and a distal large ID and relatively small OD (0.027 inches and 2.6 Fr, respectively), tracks easily into the distal cerebral vasculature and delivers various sized reperfusion catheters without difficulty. In this series, the Headway27 was used to deliver 8 different reperfusion catheters that ranged in ID from 0.044 to 0.072 inches and only twice required supplementation with a stentriever due to inability to deliver the reperfusion catheter past the ophthalmic origin to the vascular target. While previous descriptions of avoidance of the ophthalmic “legde effect” have utilized larger profile microcatheters, the Headway27 is capable of performing the same task with a smaller outer diameter making it safer in the distal vasculature [16]. Additionally, a 3.1-Fr

Fig. 1. Visibility of microcatheters. The distal 5 cm of each catheter is visualized via fluoroscopic image. From top to bottom: Headway27 (MicroVention), Marksman (Medtronic), Velocity (Penumbra), and 3MAX (Penumbra).

Table 1. Comparison of microcatheter characteristics

Microcatheter	Proximal OD, Fr	Distal OD, Fr	Distal ID, in	Length, cm
Headway27	3.1	2.6	0.027	156
Marksman	3.2	2.8	0.027	150, 160
Velocity	2.9	2.6	0.025	160
3MAX	4.7	3.8	0.035	153
Excelsior XT-27	2.9	2.7	0.027	150
Phenom 27	3.0	2.7	0.027	150

proximal OD and semi-rigid proximal section provides sufficient support for 1:1 pushability even in tortuous distal anatomy. We found that the Headway27 was easily advanced as distal as the M3 without complication or need to exchange to another microcatheter to deploy a stentriever. Additionally, dual distal markers and a radiodense segment that extends nearly to the distal tip of the catheter make it exceptionally visible and improve the safety profile of a procedure that may be optimally done under mild i.v. conscious sedation (Fig. 1) [17].

In comparison to commonly used microcatheters, the Headway27 compares very favorably due to a number of factors (Table 1; Fig. 1). When compared to Velocity (Penumbra, Inc., Alameda, CA, USA), it is significantly more visible and has a larger ID for better angiographic runs and easier stent delivery. Headway27 also has a lower profile than the 3MAX (Penumbra, Inc., Alameda, CA, USA) catheter, making it more trackable with the added ability to deploy a stentriever. It has a smaller distal OD than Marksman (Medtronic, Minneapolis, MN, USA) without sacrificing distal ID, making it more flexible and more easily trackable with the same ability to perform angiographic runs. In comparison to the Excelsior XT-27 (Stryker, Fremont, CA, USA) and Phenom 27 (Medtronic, Minneapolis, MN, USA), Headway27 is longer and has a smaller distal OD, making it more suitable for safe delivery to more distal microvas-

culature, an important characteristic when trying to advance an aspiration catheter around the carotid siphon to the clot target. Moreover, unlike the other commonly used stroke microcatheters, Headway is officially approved for usage of either NBCA or Onyx in cases of wire perforation of the distal vasculature.

While flexibility and visibility are relatively subjective measures that we feel favor the usage of the Headway27 microcatheter for stroke thrombectomy, our clinical results and the fact that it was used to deliver a variety of aspiration catheters speaks to its safety and efficacy as a stroke microcatheter. As reinforced in the table, the dimensions of the catheter objectively compare quite favorably to alternative, comparable microcatheters, specifically in terms of microcatheter length and distal OD. As a more objective measure of utility, we feel that our 96% rate of successful delivery of the reperfusion catheter over the Headway to the intended target will serve as a useful benchmark for potential comparison to other microcatheters.

Conclusion

The Headway27 microcatheter can be used safely as a component of a triaxial acute stroke intervention system. Its dimensions and visibility compare very favorably to alternative microcatheters. In this series, it reliably and efficiently delivered reperfusion catheters and stentriever to the distal cerebral vasculature without complication.

Disclosure Statement

No authors have any financial or consulting interests with MicroVention. B.T.J. is a consultant for Medtronic. T.G.J. is a consultant for Neuravi, Codman Neurovascular, Stryker (PI DAWN; unpaid), Fundacio Ictus (PI REVASCAT; unpaid), and holds stock in Anaconda, Silk Road, Blockade. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Author Contributions

Drafting of the Article: W.J.A., B.A.G. Acquisition of data/data analysis: W.J.A., B.M.Z., C.L.K., G.M.W., H.Z., D.B. Reviewed and revised article prior to submission: all authors. Study supervision: B.A.G. Data sharing: N/A.

References

- 1 Mohlenbruch MA, Kabbasch C, Kowoll A, et al: Multicenter experience with the new SOFIA plus catheter as a primary local aspiration catheter for acute stroke thrombectomy. *J Neurointerv Surg* 2017;9:1223–1227.
- 2 Turk AS, Frei D, Fiorella D, et al: ADAPT FAST study: a direct aspiration first pass technique for acute stroke thrombectomy. *J Neurointerv Surg* 2014;6:260–264.
- 3 John S, Hussain MS, Toth G, et al: Initial experience using the 5MAX ACE reperfusion catheter in intra-arterial therapy for acute ischemic stroke. *J Cerebrovasc Endovasc Neurosurg* 2014;16:350–357.
- 4 Gross BA, Jadhav AP, Jovin TG, et al: Dump the pump: manual aspiration thrombectomy (MAT) with a syringe is technically effective, expeditious, and cost-efficient. *J Neurointerv Surg* 2018;10:354–357.
- 5 Jankowitz B, Grandhi R, Horev A, et al: Primary manual aspiration thrombectomy (MAT) for acute ischemic stroke: safety, feasibility and outcomes in 112 consecutive patients. *J Neurointerv Surg* 2015;7:27–31.
- 6 Jadhav AP, Aghaebrahim A, Horev A, et al: Stent retriever-mediated manual aspiration thrombectomy for acute ischemic stroke. *Interv Neurol* 2017;6:16–24.
- 7 Nogueira RG, Jadhav AP, Haussen DC, et al: Thrombectomy 6 to 24 Hours after Stroke with a Mismatch between Deficit and Infarct. *N Engl J Med* 2018;378:11–21.

- 8 Goyal M, Menon BK, van Zwam WH, et al: Endovascular thrombectomy after large-vessel ischaemic stroke: a meta-analysis of individual patient data from 5 randomised trials. *Lancet* 2016;387:1723–1731.
- 9 Jovin TG, Chamorro A, Cobo E, et al: Thrombectomy within 8 hours after symptom onset in ischemic stroke. *N Engl J Med* 2015;372:2296–2306.
- 10 Jovin TG, Albers GW, Liebeskind DS: Stroke treatment academic industry roundtable: the next generation of endovascular trials. *Stroke* 2016;47:2656–2665.
- 11 Lapergue B, Blanc R, Gory B, et al: Effect of Endovascular Contact Aspiration vs Stent Retriever on Revascularization in Patients with Acute Ischemic Stroke and Large Vessel Occlusion: The ASTER Randomized Clinical Trial. *JAMA* 2017;318:443–452.
- 12 Turk AS, Turner R, Spiotta A, et al: Comparison of endovascular treatment approaches for acute ischemic stroke: cost effectiveness, technical success, and clinical outcomes. *J Neurointerv Surg* 2015;7:666–670.
- 13 Phan K, Dmytriw AA, Teng I, et al: A Direct Aspiration First Pass Technique vs Standard Endovascular Therapy for Acute Stroke: A Systematic Review and Meta-Analysis. *Neurosurgery* 2017, DOI: 10.1093/neuros/nyx386.
- 14 Lapergue B, Blanc R, Gory B, et al: Effect of endovascular contact aspiration vs stent retriever on revascularization in patients with acute ischemic stroke and large vessel occlusion. *JAMA* 2017;318:443–452.
- 15 Lee TH, Choi CH, Park KP, Sung SM, Lee SW, Lee BH, Kim DH, Kim HJ, Kim CW, Kim S: Techniques for intracranial stent navigation in patients with tortuous vessels. *Am J Neuroradiol* 2005;26:1375–1380.
- 16 Yoo AJ, Frei D, Tateshima S, et al: The Penumbra Stroke System: a technical review. *J Neurointerv Surg* 2012;4:199–205.
- 17 Brinjikji W, Pasternak J, Murad MH, et al: Anesthesia-Related Outcomes for Endovascular Stroke Revascularization: A Systematic Review and Meta-Analysis. *Stroke* 2017;48:2784–2791.