


ORIGINAL RESEARCH

Basilar Artery Occlusion Thrombectomy Technique: An International Survey of Practice Patterns[†]

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BACKGROUND: Two recent trials demonstrated a benefit for endovascular therapy (EVT) in the treatment of basilar artery occlusion (BAO). In light of the expected increase in the use of EVT for BAO, we sought to understand the technique preferences of neurointerventionalists performing EVT for BAO.

METHODS: We conducted an international online survey of physician opinions on the use of EVT in BAO between January and March 2022. The survey was distributed through stroke and neurointerventional organizations. Survey questions examined selection of patients for the procedure and the techniques currently used for EVT in BAO. Responses from neurointerventionalists were analyzed.

RESULTS: More than 3000 participants were invited yielding 1245 respondents, of whom 543 were classified as neurointerventionalists across 52 countries and included in this analysis. Most neurointerventionalists would proceed to EVT for occlusions of the V4 segment, the basilar artery, or the posterior cerebral artery, without regard for prior intravenous thrombolysis. For BAO of embolic etiology, aspiration only thrombectomy was the preferred method of 50.3% of neurointerventionalists. For BAO of intracranial atherosclerotic disease etiology, combined stent retriever and aspiration thrombectomy was the preferred method of 40.5% of neurointerventionalists. The majority of neurointerventionalists (88.0%) would proceed to stenting after 3 or fewer

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failed passes for patients with BAO of intracranial atherosclerotic disease etiology. In patients undergoing stenting, aspirin and clopidogrel was the most common antiplatelet regime (52.4%).

CONCLUSIONS: Among the surveyed neurointerventionalists, the most common techniques for EVT of patients with BAO were contact aspiration or combined stent retriever with aspiration thrombectomy. For patients with BAO due to intracranial atherosclerotic disease, the majority of neurointerventionalists were willing to stent and do so most often after 3 or fewer failed passes and with the use of dual antiplatelet medications. Further study is needed to determine the optimal technique for EVT of BAO with or without intracranial atherosclerotic disease.

Key Words:

Key Words: basilar artery ■ contact aspiration ■ intracranial angioplasty ■ intracranial stenting ■ ischemic stroke ■ stent retriever ■ thrombectomy

Endovascular therapy (EVT) has been described as a treatment for patients with basilar artery occlusion (BAO) for over 30 years,¹ though the indications and technique have evolved over time. Despite representing up to 10% of large vessel occlusion strokes² and having a higher mortality rate than occlusions of the anterior circulation, BAO has been comparatively understudied.³ Registry data suggesting positive outcomes with EVT in BAO⁴⁻⁸ led to the widespread use of the procedure, despite the inconclusive results of the BEST (Basilar Artery Occlusion Endovascular Intervention versus Standard Medical Treatment) and BASICS (Basilar Artery International Cooperation Study) trials.⁹⁻¹²

Four main techniques for EVT are used in BAO: contact aspiration only thrombectomy, stent retriever thrombectomy,¹³ combined stent retriever and aspiration thrombectomy (combined thrombectomy), and angioplasty¹⁴ with or without stenting.¹⁵ The first 3 techniques are typically used as first-line during EVT while angioplasty with or without stenting is more likely used for large-vessel occlusion (LVO) related to intracranial atherosclerosis or after failure of another technique.^{16,17} In the event that stenting is pursued, antiplatelet therapy is used both acutely and during follow-up.¹⁸

In contrast to the BEST and BASICS trials, the preliminary results of the ATTENTION (Endovascular Treatment for Acute Basilar Artery Occlusion) and BAO-CHE (Basilar Artery Occlusion Chinese Endovascular) randomized controlled trials support the effectiveness of EVT for BAO.^{19,20} In anticipation of the full results of these trials, and in light of the multiple technical approaches to BAO thrombectomy, we conducted an international survey of clinicians who perform EVT on patients with BAO. The primary objective of this study was to understand the technique preferences of neurointerventionalists performing EVT for BAO, stratified by the underlying pathophysiological mechanisms.

The secondary objective of this study was to evaluate whether the technical preferences of neurointerventionalists differed by strata of country income (high- versus middle-income countries). We hypothesized that considerations of cost would lead to differences in technical preferences between strata, with greater use of stent-retriever technology in high-income countries and greater use of contact aspiration in middle-income countries.

METHODS

The ABBA (After the BEST of BASICS) survey was a large international survey of clinician opinions toward the use of EVT for BAO.^{11,12} Institutional review board approval was obtained from the co-lead site. Deidentified data are available upon request to the corresponding author.

Design

Details of the survey design have been previously published.¹¹ Briefly, 23 questions covering 6 BAO topics were created after review of the existing literature, with subsequent feedback by coauthors. An electronic version of the survey was created using the Research Electronic Data Capture system (Version 12.0.5). The estimated completion time was less than 10 minutes. Questions were designed to determine the respondent's current views and practices with regard to the use of EVT for BAO. Standard medical management was defined as any combination of antithrombotics, intravenous thrombolysis, antihypertensive, or statin medications. Advanced imaging was defined as any intracranial imaging other than a noncontrast computed tomography head and computed tomography angiography. Neurointerventionalists included interventional neurologists, interventional neuroradiologists, and endovascular

neurosurgeons. Noninterventionists included stroke neurologists at either primary or thrombectomy-capable centers or neuroradiologists. Questions regarding techniques used for EVT were presented to neurointerventionalists only through the use of branching logic. The survey was developed in English and additionally translated into Chinese by a native-speaking Chinese physician (Y.C.). Translations were verified by another bilingual physician (X.H.). Complete survey questions are presented in Supplement 1.

Distribution

The ABBA survey was conducted between January 18, 2022 and March 31, 2022. A web-based link was distributed through international stroke and neurointerventional organizations: the Dutch Neurovascular Society, the British and Irish Association of Stroke Physicians, Stroke Clinical Trials Network in Ireland, International stroke trial network of a coauthor (U.F.), the Brazil Stroke Society, the Colombia Association of Neurology, German Stroke Trial Network, the Italian Stroke Association, the Japanese Society for Neuroendovascular Therapy, the Madrid Association of Neurology, the Norway Stroke Organization, the European Stroke Organization blog, Indonesian Neurointerventionists, the Society of Vascular and Interventional Neurology (SVIN), and the Global SVIN COVID-19 stroke registry. The survey was also shared through electronic messaging app distribution to 5 organizations: 2 neurointerventional groups, the WeChat Stroke Network in China, MT2020, and Women in Neurointervention. Participants were additionally invited directly by the authors.

Statistical Analysis

Statistical analysis was performed using JMP 15 software (SAS Institute, Cary, NC). Descriptive statistics are provided where appropriate. Group differences were evaluated using the chi-square test or Fisher's exact test. Statistical significance was set at $\alpha=0.05$.

RESULTS

There were a total of 1245 responses collected across 73 countries. More than half of respondents were classified as noninterventionists (702, 56.4%). Three quarters of respondents and more than 85% of neurointerventionalist respondents were male. Most respondents were in practice for 10 years or fewer. The overall demographic characteristics of respondents are shown in Table 1. Differences in specialist (neurologist, stroke, neuroradiologist, and neurointerventionist) approaches to BAO selection and treatment are examined in a separate publication.²¹ For this analysis, only the responses

Nonstandard Abbreviations and Acronyms

ATTENTION	Endovascular Treatment for Acute Basilar Artery Occlusion
BAO	basilar artery occlusion
BAOCHE	Basilar Artery Occlusion Chinese Endovascular
EVT	endovascular therapy
LVO	large-vessel occlusion
mRS	modified Rankin scale
NIHSS	National Institutes of Health Stroke Scale

Table 1. Demographics

Characteristic	Number (column %)	
	All respondents	Interventionists
Years of practice (y)		
0–5	337 (27.09)	157 (28.91)
>5–10	334 (26.86)	170 (31.31)
>10–15	260 (20.90)	111 (20.44)
>15	313 (25.16)	105 (19.34)
Gender		
Male	934 (75.02)	469 (86.37)
Female	311 (24.98)	74 (13.63)
Specialty		
Stroke neurologist		
At thrombectomy center	557 (44.74)	–
At primary center	125 (10.04)	–
Neuroradiologist	20 (1.61)	–
Neurointerventionist		
Interventional neurologist	301 (24.18)	301 (55.43)
Interventional neuroradiologist	174 (13.98)	174 (32.04)
Endovascular neurosurgeon	68 (5.46)	68 (12.52)
Specialty category		
Interventionist	543 (43.61)	543 (100.00)
Noninterventionist	702 (56.39)	–
National income level		
High income	799 (64.18)	279 (51.38)
Middle income	446 (35.82)	264 (48.62)

from 543 neurointerventionalists across 52 countries were analyzed. Among the neurointerventionalists, 279 (51.4%) were from high-income countries and 264 (48.6%) were from middle-income countries.

Patient Selection

Nearly all neurointerventional respondents (535, 98.5%) believed that in certain circumstances EVT is superior to medical management for patients with BAO. More

than half of respondents (270, 52.4%) would perform thrombectomy on patients with an occlusive lesion at the V4 segment of the vertebral artery, and 69.1% were in favor of EVT in cases of isolated posterior cerebral artery first section (P1) occlusions. For BAO patients with a prestroke modified Rankin scale (mRS) score of ≤ 3 , 45.4% (235) of respondents would offer thrombectomy. For patients with a pre-morbid mRS score of ≤ 2 , 48.3% (250) of respondents would offer thrombectomy (Table 2). Neurointerventional respondents from high-income countries were more likely to offer EVT for BAO patients with higher degree of prestroke disability compared with those from middle-income countries (prestroke mRS ≤ 3 : 50.9% versus 39.2%, prestroke mRS ≤ 2 : 40.7% versus 56.7%; $P=0.002$).

Regardless of presenting National Institutes of Health Stroke Scale (NIHSS), 40.5% (210) of neurointerventional respondents would offer BAO thrombectomy, whereas 33.8% (175) would offer thrombectomy to patients with a NIHSS score of ≥ 6 and 16.0% (83) respondents would offer thrombectomy to patients with a NIHSS score of ≥ 10 . For 96.1% (490) of respondents, the use of intravenous thrombolysis would not affect the decision to proceed to thrombectomy (Table 2).

First-Line BAO Technique by Etiology

More than half of neurointerventional respondents (256, 50.3%) would use contact aspiration only as their first-line technique in the treatment of patients with presumed embolic etiology of BAO and 27.1% (138) would use combined aspiration and stent retriever thrombectomy. An additional 18.5% (94) of respondents would determine their first-line technique based on patient specific factors and 3.1% (16) of respondents would use stent-retriever-only thrombectomy (Table 2). Respondents from high-income countries were more likely to select aspiration-only thrombectomy (62.2% versus 36.8%) and less likely to select combined thrombectomy (21.1% versus 33.9%) than respondents from middle-income countries ($P<0.0001$, Table 3, Figure 1).

The most common first-line technique for BAO caused by intracranial atherosclerotic disease (ICAD) selected by neurointerventional respondents was combination aspiration and stent retriever thrombectomy (207, 40.5%), whereas 23.7% (121) would use aspiration-only thrombectomy. Angioplasty was selected by 16.4% (84) of respondents and 14.5% (74) of respondents selected stent-retriever-only thrombectomy. Only 2.2% (11) of respondents would select stenting as their first-line technique (Table 2). Respondents from high-income countries were more likely to select aspiration-only thrombectomy (40.1% versus 5.0%) and less likely to select combined thrombectomy

Table 2. Techniques and Selection

Question	n (column %)
I believe that, in certain predefined situations, additional endovascular therapy is superior to standard medical treatment for patients with basilar artery occlusion	
Agree or strongly agree	535 (98.53)
Neither agree nor disagree	5 (0.92)
Disagree or strongly disagree	3 (0.55)
For basilar artery occlusion with presumed embolic etiology, I would proceed with this technique first-line	
Aspiration only	256 (50.30)
Combined aspiration and stent retriever	138 (27.11)
Stent retriever only	16 (3.14)
I would decide based upon site of occlusion	53 (10.41)
I would decide based on thrombus surface	41 (8.06)
Other	5 (0.98)
For basilar artery occlusion with presumed ICAD, I would proceed with this technique first line	
Aspiration only	121 (23.68)
Combined aspiration and stent retriever	207 (40.51)
Stent retriever only	74 (14.48)
Angioplasty	84 (16.44)
Stent	11 (2.15)
Other	14 (2.74)
For basilar artery occlusion secondary to ICAD, in the event of failed reperfusion, I would proceed to intracranial stent with or without angioplasty after this number of failed passes	
1 Pass	75 (14.71)
2 Passes	128 (25.10)
3 Passes	246 (48.24)
4 Passes	33 (6.47)
Other	28 (5.49)
In cases where patients are undergoing stenting for basilar artery occlusions, which antiplatelet medication combination would you use*	
Aspirin and clopidogrel	267 (52.35)
Aspirin and ticagrelor	122 (23.92)
Aspirin and prasugrel	38 (7.45)
Aspirin and glycoprotein IIb/IIIa inhibitor	198 (38.82)
Single antiplatelet agent	16 (3.14)
Other	36 (7.06)
For an isolated P1 occlusion, I would consider proceeding to thrombectomy within my accepted time frame	
Strongly agree	152 (29.52)
Agree	204 (39.61)
Neither agree nor disagree	117 (22.72)
Disagree	37 (7.18)
Strongly disagree	5 (0.97)
In my opinion, with regards to stenting or angioplasty in patients with basilar artery occlusions patients who are noted to have an underlying atheromatous lesion felt to be significant	
I would consider stenting or angioplasty	465 (91.00)
Stenting or angioplasty should not be considered	34 (6.65)
Thrombectomy should not be routinely performed on patients outside of a clinical trial	8 (1.57)
Other	4 (0.78)

(Continued)

Table 2. Continued

With regard to patients who have received IV thrombolysis with known basilar artery occlusion	
IVT would not influence my decision	490 (96.08)
Thrombectomy should not be routinely performed on patients who have received IVT outside of a clinical trial	7 (1.37)
Thrombectomy should not be routinely performed on patients outside of a clinical trial	7 (1.37)
Other	6 (1.18)
In my opinion, with regards to the site of posterior circulation occlusion and EVT, thrombectomy should be performed on occlusions at	
Middle or distal basilar artery	33 (6.41)
Proximal, middle, or distal basilar artery	185 (35.92)
V4 segment of vertebral artery, proximal, middle, or distal basilar artery, or posterior cerebral artery	270 (52.43)
Thrombectomy should not be routinely performed on patients outside of a clinical trial	14 (2.72)
Other	13 (2.52)
Thrombectomy should be offered to patients with the following premorbid mRS score, within my accepted time frame, imaging requirements, and stroke severity	
≤2	250 (48.26)
≤3	235 (45.37)
Thrombectomy should not be routinely performed on patients outside of a clinical trial	17 (3.28)
Other	16 (3.09)
Thrombectomy should be offered to patients with the following NIHSS, within my accepted time frame, imaging requirements, and premorbid disability:	
≥6	175 (33.78)
≥10	83 (16.02)
<6	7 (1.35)
Regardless of NIHSS scale	210 (40.54)
Thrombectomy should not be routinely performed on patients outside of a clinical trial	9 (1.74)
Other	34 (6.56)

EVT indicates endovascular therapy; ICAD, intracranial atherosclerotic disease; IVT, intravenous thrombolysis; mRS, modified Rankin scale; and NIHSS, National Institutes of Health Stroke Scale.

*Multiple answers permitted.

(36.8% versus 44.8%) than respondents from middle-income countries ($P<0.0001$, Table 3, Figure 1).

Angioplasty or Stenting

In the setting of a significant intracranial atherosclerotic lesion in patients with BAO, most neurointerventionalists (465, 91.0%) would consider endovascular stenting or angioplasty. Given an ICAD etiology for BAO, 14.7%, 25.1%, and 48.2% of respondents would proceed to stenting or angioplasty after 1, 2, or 3 passes, respectively, without successful reperfusion (Table 2). Compared with neurointerventional respondents from middle-income countries, respondents from high-income countries were less likely to proceed to

Table 3. Income Stratified Techniques

Question	n (column %)		P value
	Middle income	High income	
For basilar artery occlusion with presumed embolic etiology, I would proceed with this technique first line			
Aspiration only	88 (36.82)	168 (62.22)	<0.0001
Combined aspiration and stent retriever	81 (33.89)	57 (21.11)	
Stent retriever only	8 (3.35)	8 (2.96)	
I would decide based upon site of occlusion	27 (11.30)	26 (9.63)	
I would decide based on thrombus surface	35 (14.64)	6 (2.22)	
Other	0 (0.00)	5 (1.85)	
For basilar artery occlusion with presumed intracranial atherosclerotic disease (ICAD), I would proceed with this technique first-line			
Aspiration only	12 (5.02)	109 (40.07)	<0.0001
Combined aspiration and stent retriever	107 (44.77)	100 (36.76)	
Stent retriever only	41 (17.15)	33 (12.13)	
Angioplasty	67 (28.03)	17 (6.25)	
Stent	5 (2.09)	6 (2.21)	
Other	7 (2.93)	7 (2.57)	
For basilar artery occlusion secondary to ICAD, in the event of failed reperfusion, I would proceed to intracranial stent with or without angioplasty after this number of failed passes			
1 Pass	30 (12.61)	45 (16.54)	<0.0001
2 Passes	70 (29.41)	58 (21.32)	
3 Passes	128 (53.78)	118 (43.38)	
4 Passes	9 (3.78)	24 (8.82)	
Other	1 (0.42)	27 (9.93)	
In cases where patients are undergoing stenting for basilar artery occlusions, which antiplatelet medication combination would you use*			
Aspirin and clopidogrel	169 (49.42)	98 (29.25)	<0.0001
Aspirin and ticagrelor	60 (17.54)	62 (18.51)	
Aspirin and prasugrel	9 (2.63)	29 (8.66)	
Aspirin and glycoprotein IIb/IIIa inhibitor	92 (26.90)	106 (31.64)	
Single antiplatelet agent	6 (1.75)	10 (2.99)	
Other	6 (1.75)	30 (8.96)	

*Multiple answers permitted.

stenting or angioplasty after 3 or fewer passes (81.2% versus 95.8%; $P<0.0001$, Table 3).

Antiplatelet Agents*

In cases where stenting is required in patients with BAO occlusion, respondents were most likely to use dual antiplatelet therapy with aspirin and clopidogrel (267, 52.4%), followed by aspirin and a glycoprotein IIb/IIIa inhibitor (198, 38.8%), and aspirin with ticagrelor (122, 23.9%). A small proportion of respondents would select combination aspirin and prasugrel (38, 7.5%) or single antiplatelet therapy (16, 3.1%, Table 2).

*A combination of selections was allowed.

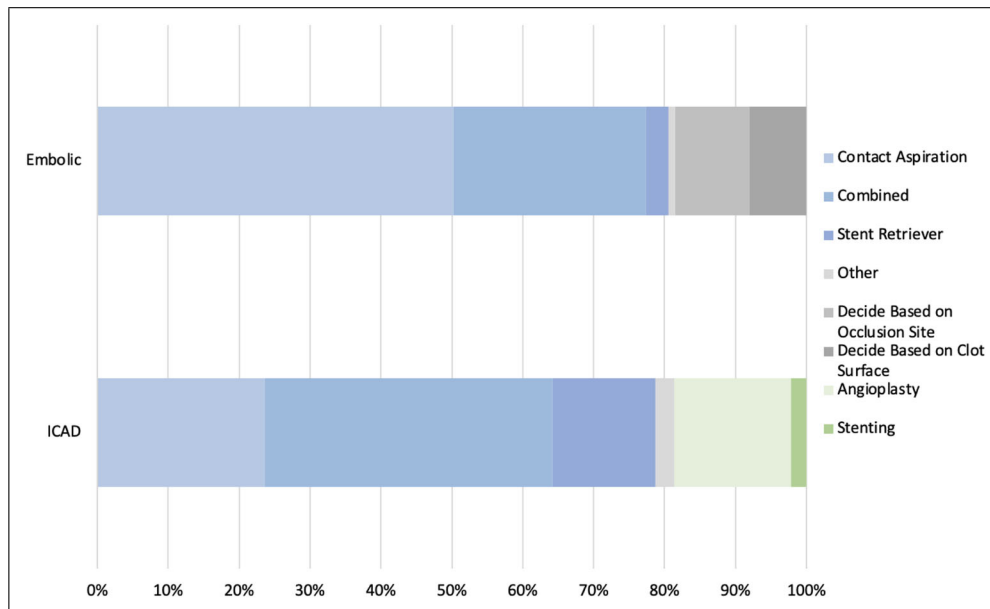


Figure 1. Choice of endovascular therapy technique by occlusion etiology.

Respondents from high-income countries were more likely to select aspirin and glycoprotein IIb/IIIa inhibitor (31.6% versus 26.9%; $P < 0.0001$) for periprocedural management of acute stenting compared with middle-income countries. Middle-income country respondents were more likely to select aspirin and clopidogrel (71.0% versus 36.0%; $P < 0.0001$, Table 3) compared with high-income countries respondents. Aspirin and ticagrelor were similarly next favored by middle-income and high-income country respondents (25.2% versus 22.8%) for stent management (Figure 2).

DISCUSSION

In this large international survey, most neurointerventionalists were supportive of the statement that EVT is superior to medical management for BAO, would perform EVT for occlusions between the V4 segment of the vertebral artery and the P1 segment of posterior cerebral artery, and would perform EVT without regard to prior intravenous thrombolysis therapy. In the case of embolic lesions, neurointerventionalists were more likely to use contact aspiration-only thrombectomy as their first-line technique, whereas in the case of intracranial atherosclerotic lesions, neurointerventionalists were most likely to use combined stent retriever and aspiration thrombectomy as their first-line technique. Neurointerventionalists would readily proceed to angioplasty or stenting with dual antiplatelet therapy in the setting of persistent occlusion by an atherosclerotic lesion.

Before May 2022, no randomized controlled trial had demonstrated the benefit of EVT in the treatment of

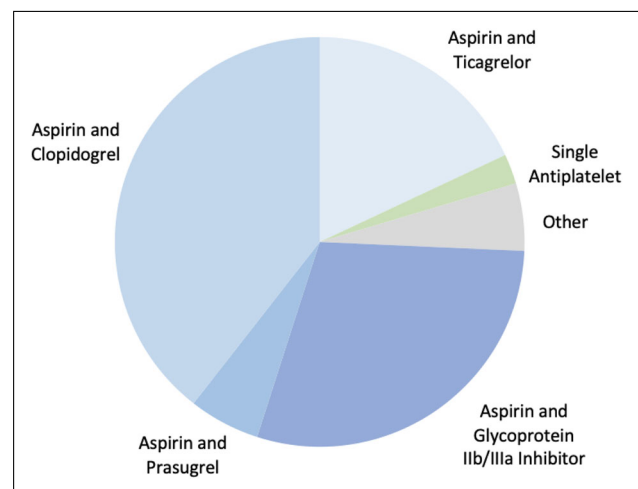


Figure 2. Choice of antiplatelet regimen during acute stenting for basilar occlusion.

BAO, though registry data supported its use. The preliminary results of 2 trials presented at the European Stroke Organization Conference 2022, ATTENTION and BAOICHE, indicate that EVT is superior to medical management for selected BAO.^{19,20} The ATTENTION trial included patients with confirmed occlusion of the basilar artery, a baseline NIHSS score ≥ 10 , and a premorbid mRS ≤ 2 within 12 hours of symptom onset. The BAOICHE trial included patients with confirmed occlusion of the basilar artery or bilateral vertebral arteries, a baseline NIHSS score ≥ 6 , and a premorbid mRS ≤ 1 within 6–24 hours from symptom onset. The ATTENTION trial permitted the use of any EVT technique at the discretion of the treating physician.

The BAOCHE trial required the use of the Solitaire FR device for the first pass as part of stent-retriever-only or combined thrombectomy and permitted angioplasty or stenting after one pass with persistent occlusion due to ICAD.^{19,20}

In this survey, conducted before the release of results from the ATTENTION and BAOCHE trials, a majority (98.5%) of neurointerventionalists surveyed believed that EVT was superior to medical management for BAO in certain circumstances. There was consensus for patient selection factors among respondents. In a patient with a premonitory mRS \leq 2, 93.6% of neurointerventionalists would proceed to EVT. There were 90.3% of neurointerventionalists who would proceed to EVT in a patient with NIHSS score \geq 10 and 40.5% would proceed regardless of NIHSS score. Responses from 88.4% of neurointerventionalists indicated that they would proceed to EVT in a patient with an occlusion of any segment of the basilar artery, and 52.4% would additionally proceed to EVT with an occlusion of the V4 segment of the vertebral artery or of the P1 segment of the posterior cerebral artery.^{22,23} The opinions of neurointerventionalists in this survey align closely with the inclusion criteria of the ATTENTION trial, suggesting the results of this trial may align with current clinical practice. Neurointerventionalists in this survey were permissive of treating patients with increased premonitory status.

The ASTER (Contact Aspiration versus Stent Retriever for Successful Revascularization), ASTER2 (Contact Aspiration versus Stent Retriever for Successful Revascularization), and COMPASS (Cardiovascular Outcomes for People Using Anticoagulation Strategies) randomized clinical trials demonstrated no difference in the rate of recanalization between first-line technique with stent-retriever-only compared to either contact aspiration-only²⁴ or combined thrombectomy in the treatment of anterior circulation LVO.^{25,26} Prior registry-based studies of LVO of the posterior circulation suggested that combined thrombectomy was superior to both aspiration-only thrombectomy and stent-retriever-only thrombectomy. Furthermore, they found that aspiration-only thrombectomy was superior to stent-retriever-only thrombectomy.^{27,28} In accordance with these findings, surveyed neurointerventionalists more often reported using combined thrombectomy or aspiration-only thrombectomy rather than stent-retriever-only thrombectomy as their first-line technique. As most of the anterior circulation LVO trials, the BEST and BAOCHE trials used stent retriever as first-line technique,^{10,17,20} it is intriguing that other techniques are now commonplace in EVT for BAO.

The ability to distinguish BAO related to embolic as compared to ICAD etiology can be challenging. Asian or African American demographic, smoking his-

tory, prior images indicating intracranial stenosis, presence of vessel calcification on computed tomography, midbasilar occlusion, and higher clot perviousness²⁹ would be suggestive of ICAD whereas history of atrial fibrillation and distal BAO may preferentially suggest an embolic mechanism.³⁰ In the setting of BAO with presumed embolic etiology, more than half (50.3%) of neurointerventionalists surveyed would select aspiration-only thrombectomy as their first-line technique with the next most frequent technique being combined stent-retriever and aspiration thrombectomy (27.1%).

In the setting of BAO believed to be due to ICAD, there was greater preference for the use of combined stent-retriever and aspiration thrombectomy (40.5% of respondents) with the next most frequent technique being aspiration-only thrombectomy (23.7%). This differential is in line with several studies reporting that stent retriever as first-line approach to debulk thrombus for ICAD-related LVO may lead to higher rates of successful reperfusion, lower rates of rescue treatment, and iatrogenic dissection as compared with contact aspiration.^{31,32} Moreover, removal of the thrombus within ICAD-related LVO may be challenging because of lack of contact between the catheter tip and thrombus with contact aspiration.³³ In patients undergoing percutaneous intervention for ST-segment-elevation myocardial infarction, aspiration thrombectomy has not been demonstrated to improve clinical outcomes in a meta-analysis of 3 randomized trials,³⁴ and the benefit of primary aspiration for ICAD-related LVO remains to be validated.³¹

Differences in respondent preferences by country income were observed for all techniques. Respondents from middle-income countries, with most originating from China in these strata, were more likely to use combined thrombectomy and less likely to use aspiration-only thrombectomy compared with respondents from high-income countries, regardless of the etiology of the BAO. This differential may be reflective of the higher rates of ICAD-related LVO in the Asian population³⁵ and the potential for higher reperfusion with first-line stent-retriever technique compared with contact aspiration in patients with underlying ICAD-related occlusion.³² It is also possible that the significantly higher cost of stent-retriever technology in high-income countries such as the United States compared with middle-income countries may affect preferential decision making toward greater use of contact aspiration.³⁶

Treatment failure is a significant concern for all EVT methods with failure to achieve recanalization observed in approximately 10%–15% of BAO patients.^{16,37} Similar to anterior LVO stroke, the first-pass effect^{38,39} is observed in BAO occlusion⁴⁰ with the odds of failed recanalization and subsequent poor neurological outcome increasing for every additional pass. The

benefits of EVT in BAO may be attenuated when more than 3 passes are required for recanalization.³⁷ Angioplasty with or without stenting has been demonstrated to prevent unsuccessful EVT in patients after the failure of another technique.^{41,42} In 1 retrospective study of patients who underwent EVT for BAO, angioplasty prevented treatment failure in 65 of 188 successfully reperfused patients.¹⁶ Most neurointerventionalists (91.0%) surveyed were willing to proceed to angioplasty or stenting in the case of persistent occlusion due to ICAD. Furthermore, most (88.1%) were willing to do so after 3 or fewer passes.

When performing stenting in the setting of persistent occlusion due to ICAD, most neurointerventionalists (92.3%) chose to use dual antiplatelet therapy. The most common dual antiplatelet therapy choices were aspirin and clopidogrel or aspirin and a glycoprotein IIb/IIIa inhibitor, but no combination had the support of more than 40% of those surveyed. Only 5.6% of interventionalists would select aspirin and prasugrel therapy, perhaps reflecting concern over bleeding risk with prasugrel. The heterogeneity of practice seen in this survey is in keeping with prior surveys of antithrombotic use in acute intracranial stenting and a lack of widely accepted evidence-based guidelines to inform practice.^{18,43} Cost may also play a role in the selection of an antiplatelet regimen given the large differences in medication cost between agents.

Although this survey captured the opinions of a large number of neurointerventionalists from many countries across the globe, the results should be interpreted with caution. As with all surveys, the results of this study reflect only current clinical practice and cannot be used to determine the optimal clinical treatment or endovascular technique for patients with BAO. Additionally, there is the potential risk of reporting bias as the responses were self-reported. It is possible that a respondent who indicated a given technique or medication as their first-line option uses a different technique or medication in the majority of treated patients. Survey recruitment was primarily conducted through national and international organizations; as a result, the participants may not reflect all neurointerventionalists but rather only those who are actively involved in such organizations. Although half of the neurointerventionalists in the survey were from middle-income countries, there were no participants from low-income countries. This may reflect both the lack of endovascular resources in these countries^{44,45} and a sampling bias.

CONCLUSIONS

In this large international survey of current practices about EVT for BAO, the majority of surveyed neuroint-

erventionalists supported the belief that EVT was superior to medical management, were willing to proceed to EVT for occlusions of any segment of the basilar, proximal posterior cerebral, and distal vertebral artery, and preferred to use aspiration-only thrombectomy or combined thrombectomy as first-line technique. For patients with BAO due to ICAD, neurointerventionalists were willing to proceed to stenting and to do so most often after ≤ 3 failed passes. There was no consensus on the choice of antiplatelet therapy following stenting. Further study is needed to understand the optimal technique for EVT of BAO with or without underlying ICAD, the optimal antiplatelet regimen in the setting of acute stenting, the motivations of neurointerventionalists for selecting a specific technique, and to determine if practice patterns change as the use of EVT becomes more widespread in the future.

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