Stroke: Vascular and Interventional Neurology

ORIGINAL RESEARCH

Current Opinions on Optimal Management of Basilar Artery Occlusion: After the BEST of BASICS Survey

Brian Drumm, MD*,†; Soma Banerjee, MD*,†; Muhammad M. Qureshi, MBBS, MPH; Wouter J. Schonewille, MD, PhD; Piers Klein, MA; Xiaochuan Huo, MD; Yimin Chen, MD; Daniel Strbian, MD, PhD, MSc; Urs Fischer, MD, MSc; Volker Puetz, MD; Wei Hu, MD, PhD; Xunming Ji, MD, PhD; Chuanhui Li, MD; Fana Alemseged, MD, PhD; Hiroshi Yamagami, MD, PhD; Simona Sacco, MD; Gustavo Saposnik, MD, MPH, PhD; Patrik Michel, MD; Espen Saxhaug Kristoffersen, MD, PhD; Petra Sedova, MD; Robert Mikulik, MD, PhD; James E. Siegler, MD; Thomas R. Meinel, MD; Diana Aguiar de Sousa, MD PhD; Kyriakos Lobotesis, MD; Dylan Roi, MD; Jelle Demeestere, MD; Kaiz S. Asif, MD; Sheila O. Martins, MD, PhD; Mohamad Abdalkader, MD; Mayank Goyal, MD; Thang Huy Nguyen, MD; Mai Duy Ton, MD; Yuyou Zhu, MD; Xinfeng Liu, MD, PhD; Zhongming Qiu, MD, PhD; Zhongrong Miao, MD; Jildaz Caroff, MD, PhD; Michele Romoli, MD, PhD; Francesco Diana, MD; Götz Thomalla, MD; Simon Nagel, MD; Else C. Sandset, MD, PhD; Bruce C.V. Campbell, MBBS, PhD; Tudor G. Jovin, MD; Raul G. Nogueira, MD; Jean Raymond, MD; Thanh N. Nguyen, MD

BACKGROUND: The best management of basilar artery occlusion (BAO) remains uncertain. The BASICS (Basilar Artery International Cooperation Study) and the BEST (Basilar Artery Occlusion Endovascular Intervention Versus Standard Medical Treatment) trials reported neutral results. We sought to understand physicians' approaches to BAOs and whether further BAO randomized controlled trials were warranted.

METHODS: We conducted an online international survey from January to March 2022 to stroke neurologists and neurointerventionalists. Survey questions were designed to examine clinical and imaging parameters under which clinicians would offer (or rescind) a patient with BAO to endovascular therapy (EVT) or best medical management versus enrollment into a randomized clinical trial.

RESULTS: Of >3002 invited participants, 1245 responded (41.4% response rate) from 73 countries, including 54.7% stroke neurologists and 43.6% neurointerventionalists. More than 95% of respondents would offer EVT to patients with BAO, albeit in various clinical circumstances. There were 70.0% of respondents who indicated that the BASICS and BEST trials did not change their practice. Only 22.1% of respondents would perform EVT according to anterior circulation occlusion criteria. The selection of patients for BAO EVT by clinical severity, timing, and imaging modality differed according to geography, specialty, and country income level. Over 80% of respondents agreed that further randomized clinical trials for BAO were warranted. Moreover, 45.6% of respondents indicated they would find it acceptable to enroll all trial-eligible patients into the medical arm of a BAO trial, whereas 26.3% would not enroll.

CONCLUSION: Most stroke physicians continue to believe in the efficacy of EVT in selected patients with BAO in spite of BEST and BASICS. There is no consensus on which selection criteria to use, and few clinicians would use anterior circulation occlusion criteria for BAOs. Further randomized clinical trials for BAO are warranted.

Key Words: basilar artery occlusion ■ endovascular therapy ■ intravenous thrombolysis ■ mechanical thrombectomy

Basilar artery occlusion (BAO) comprises up to 10% of strokes caused by large-vessel occlusion (LVO). They are associated with a higher morbidity and mortality than anterior circulation strokes, with a mortality rate of ≥40%.[1] Of the initial randomized clinical trials (RCTs) testing the effectiveness of endovascular therapy (EVT) for LVO, all but 2, the THRACE (Trial and Cost Effectiveness Evaluation of Intra-arterial Thrombectomy in Acute Ischemic Stroke) trial and EASI (Endovascular Acute Stroke Intervention) trial, excluded patients with posterior circulation LVOs.[2–6] Only 4 of 408 patients in THRACE had BAO (1%),[3] while 10 of 77 patients in the EASI study had BAO (13%; 9 of whom died).[6] Subsequently published RCTs of posterior circulation LVOs (BEST [Basilar Artery Occlusion Endovascular Intervention Versus Standard Medical Treatment] and BASICS [Basilar Artery International Cooperation Study]) have not shown a benefit of EVT over standard medical care.[7,8] These studies were hampered by a slow recruitment and a high crossover rate.[9] Preliminary results of the ATTENTION (Endovascular Treatment for Acute Basilar Artery Occlusion) trial and BAOCHE (Basilar Artery Occlusion Chinese Endovascular) trials conducted in China demonstrated superiority of EVT compared with medical management, but these trials included predominantly higher severity of BAO stroke.[10,11]

Several studies attempted to identify subsets of BAO patients more likely to benefit from endovascular reperfusion in acute BAO. Imaging studies highlighted the use of computed tomography (CT) angiography source images,[12,13] magnetic resonance imaging diffusion-weighted imaging posterior circulation Alberta Stroke Program Early CT Score scoring to determine infarct core,[14,15] and the Basilar Artery on Computed Tomography Angiography score combining clot burden and collaterals to identify patients more likely to have favorable outcomes.[16] Thrombolysis studies have highlighted improved reperfusion rates in patients treated with tenecteplase over alteplase in patients with BAO.[17,18]

In the wake of the inconclusive BEST and BASICS trial results, the primary objective of this international survey was to determine physicians' opinions on the use of EVT in patients with acute BAO, according to severity of clinical presentation, time from symptom onset, and imaging criteria. Questions were created to examine clinical and imaging parameters under which clinicians would offer (or rescind) patient enrollment into a future BAO RCT.

Surveys of clinicians' practices and opinions cannot provide evidence regarding what optimal care should be. Nevertheless, surveys can estimate the impact of past studies on clinical practice and inform the design, conduct, and feasibility of future trials. This survey was conducted after the publication of the BASICS and BEST trials, and before the public release of the ATTENTION and BAOCHE trial results.

Nonstandard Abbreviationsand Acronyms

ATTENTION	Endovascular Treatment for Acute Basilar Artery Occlusion
BAO	basilar artery occlusion
BAOCHE	Basilar Artery Occlusion Chinese Endovascular
BASICS	Basilar Artery International Cooperation Study
BEST	Basilar Artery Occlusion Endovascular Intervention Versus Standard Medical Treatment
EASI	Endovascular Acute Stroke Intervention
EVT	endovascular therapy
IVT	intravenous thrombolysis
LVO	large-vessel occlusion
mRS	modified Rankin scale
NIHSS	National Institute of Health Stroke Scale

METHODS

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Design

We conducted a literature review to create the survey questions, with the final questions determined by

Correspondence to: Thanh N. Nguyen, MD, FSVIN, FAHA, Boston Medical Center, 1 Boston Medical Center, Boston, MA 02118.
E-mail: Thanh.Nguyen@bmc.org

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†B. Drumm and S. Banerjee contributed equally.

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CLINICAL PERSPECTIVE

- This international survey aimed to investigate physician practices and opinions for patients with basilar artery occlusion who may be eligible for endovascular therapy in the wake of the neutral results of the BASICS (Basilar Artery International Cooperation Study) and BEST (Basilar Artery Occlusion Endovascular Intervention Versus Standard Medical Treatment) randomized trials.
- Most physicians would continue to offer endovascular therapy in selected patients with basilar artery occlusion even after the BEST and BASICS randomized trials. There was strong consensus that further randomized clinical trials for basilar artery occlusion are warranted; however, this may be a moving target in light of the recent results of the ATTENTION (Endovascular Treatment for Acute Basilar Artery Occlusion)and BAOCHE (Basilar Artery Occlusion Chinese Endovascular) trials.s

a modified Delphi consensus among the investigators. The introduction of the survey provided the rationale of the survey and that its completion was voluntary. Participants were informed that email addresses were sought to avoid duplicate answers and would not be shared. Questions were generated to ascertain a respondents' current views on BAO medical management versus EVT as well as their views on the need for further RCTs. Standard medical management was defined as any combination of antithrombotics, intravenous thrombolysis (IVT), antihypertensive, or statin medications, as appropriate. For questions on timing, this was defined as the time of onset of acute symptoms leading to the clinical diagnosis of BAO, or, if unknown, the last time the patient's condition was observed to be normal before the onset of stroke symptoms. This definition was chosen to align with the definitions set forth by BASICS and BEST. Advanced imaging was defined as any intracranial imaging other than a noncontrast CT head and CT angiography. A list of the survey questions is included (Table S1).

The survey was then designed using the secure web-based Research Electronic Data Capture application (Version 12.0.5) developed by Vanderbilt University. A pilot phase was conducted whereby co-authors conducted a test run of the online survey and provided feedback before final release. The online survey consisted of 23 questions on 7 distinct web pages, with estimated time completion of 6 to 10 minutes. The survey was divided into 6 sections: participant background, timing, stroke severity, location of occlusion, imaging, and individual preferences.

The English survey version was later translated into Chinese by a native Chinese speaker (Y.C.) and verified by another bilingual physician (X.H.) to ensure consensus in the translated version. The survey was tested several times (by Y.C.) to ensure identical branching logic in the translated Chinese version.

Distribution

The survey launched from January 18, 2022, to March 31, 2022. Physicians involved in stroke care (stroke consultants/neurologists, neuroradiologists, interventional neuroradiologists, interventional neurologists, and endovascular neurosurgeons) from around the world were invited to participate via a web-based link.

To identify the largest pool of potential respondents, national and international stroke organizations were approached to distribute the survey link among their members, including the Dutch Neurovascular Society, the British and Irish Association of Stroke Physicians, Stroke Clinical Trials Network in Ireland, international stroke trial network of a co-author (U.F.), the Brazil Stroke Society, German Stroke Trial Network, the Italian Stroke Association, the European Stroke Organization blog, the Madrid Association of Neurology, the Colombia Association of Neurology, the Norway Stroke Organization, Indonesian Neurointerventionalists, the Society of Vascular and Interventional Neurology Membership, and the Global Society of Vascular and Interventional Neurology COVID-19 stroke registry. The survey was also distributed via the Whatsapp or Telegram group for 3 stroke or neurointerventional groups: the WeChat Stroke Network in China, MT2020, and Women in Neurointervention.

If the survey was not completed in 1 session, reentry codes were provided and required to complete the survey using the email address provided. For the subset of participants identified through lists of contacts curated by authors, individual invitations were emailed, with reminders at 2 to 4 weeks. Those invited were encouraged to distribute the survey link among their network, and with requested feedback to lead authors on the number of persons the survey had been forwarded to for tracking. For those provided a link via their national stroke organizations, reminder emails were conducted at the discretion of the organization. As the survey was distributed by a variety of methods, a comprehensive list of those to whom the survey was sent could not be kept in line with data protection laws of societal organizations.

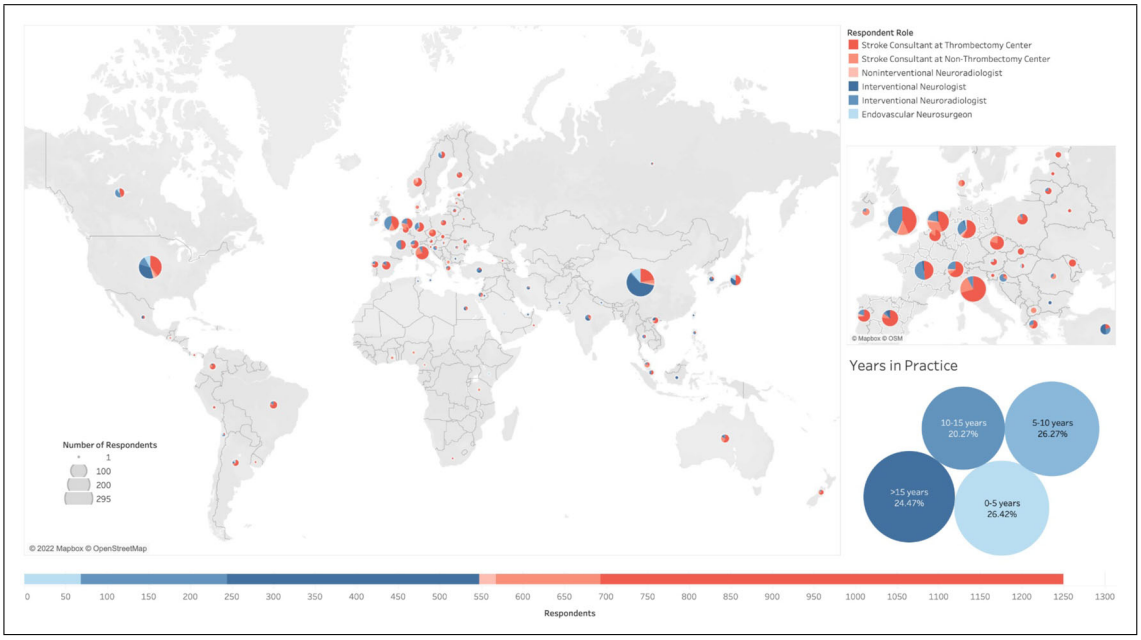

Figure 1. World map demonstrating responses from each country by physician specialty.

Bias

For the survey content, questions were reviewed to ensure neutral wording to avoid anchoring bias.[19] Numeric questions were provided with a slider tool to reduce imprecision bias.[19] Likert scale answers were used for questions pertaining to agreement with a statement.[20] We incorporated branching logic for neurointerventional-related questions only to be presented to neurointerventionalists.

To mitigate sampling and selection bias, participants from multiple organizations, including stroke and neurointerventional societies across a diverse geography, were invited. To reduce nonresponse bias, participants were contacted by the co-author who was most known to the participant (by their network within the same country or countries, by prior or ongoing collaboration). To decrease duplicate response bias, we programmed the survey to not allow repeat responses with the same email address.

Ethics

Approval by the local research ethics board was obtained via the Boston Medical Center Institutional Review Board (IRB H-42381). The study was classified as exempt.

Statistical Analysis

Statistical analysis was performed using SAS 9.4 software (SAS Institute, Cary, NC). The results were summarized using descriptive statistics (ie, frequencies, percentage). Differences between the groups (age, sex, experience, specialty, continent, and country income) were assessed by the chi-square test or Fisher's exact test (when appropriate). A P value of <0.05 was considered statistically significant for all tests. Figures were created with Tableau.

RESULTS

Demographic Distribution

There were >3002 surveys distributed electronically across 73 countries. There were 1245 respondents, of which 1166 had a complete response (41.4% response rate, 93.7% completion rate). Baseline characteristics of respondents are presented in Figure 1 and Table 1. Of respondents, 931 (75%) were men. There was a higher proportion of male respondents among neurointerventionalists compared with nonneurointerventionalists, (86.4% versus 66.2%; $P<0.0001$) and in Asia compared with other continents (85.5% versus 69.7%; $P<0.0001$).

Stroke physicians comprised 54.7% of respondents (44.7% at EVT centers; 10.0% referring to EVT centers); 43.6% were neurointerventionalists. There were 54.0% of respondents with <10 years' experience. This was more pronounced in middle-income countries (65.1%), whereas in Europe most respondents (57%) had >10 years' experience ($P<0.0001$) (Figure 1, Table 1).

Table 1. Descriptive Table of Respondents, n=1245

Characteristic	Number (%)
Sex	
Male	934 (75.02)
Female	311 (24.98)
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)
Interventional neuroradiologist	174 (13.98)
Endovascular neurosurgeon	68 (5.46)
Years of practice	
0–5	337 (27.07)
>5–10	335 (26.91)
>10–15	260 (20.88)
>15	313 (25.14)
≤10	672 (53.98)
>10	573 (46.02)
Specialty category	
Interventionist	543 (43.61)
Noninterventionist	702 (56.39)
Continent	
Asia	417 (33.49)
Africa	16 (1.29)
Europe	491 (39.44)
North America	234 (18.80)
South America	54 (4.34)
Oceania	33 (2.65)
Country income	
High	800 (64.26)
Low or middle	445 (35.74)

Decision to Offer EVT in BAO in Clinical Practice

There was 96.6% agreement that, in specific circumstances, EVT is more effective than standard medical treatment for patients with BAO, while 3.6% of respondents indicated EVT should be performed in BAO exclusively in an RCT setting. Regarding current practice, 50.4% indicated they felt EVT should be performed on patients with BAO on a case-by-case basis, followed by 22% with the opinion it should be performed with similar criteria to anterior circulation LVO (Q8). With regard to IVT, the majority (92.3%) responded that IVT in a patient with BAO would not influence their decision on whether to proceed with EVT (Q21) (Table 3).

Need for Another RCT After BEST and BASICS

While most respondents (70.0%) reported the results of the BASICS and BEST trials had not changed their preference to offer EVT to patients with BAO, there was consensus across all groups that further RCTs were warranted on EVT in patients with BAO (80.3% overall agreement) (Figure 2). There was higher agreement in Asia compared with other parts of the world (90.8% versus 75.1%; $P<0.0001$) (Table 2).

In a separate question, only 43.0% would enroll all eligible patients into the medical arm of a BAO RCT (Q22). This viewpoint was more common among respondents from middle-income compared with high-income countries (58.8% versus 38.5%; $P<0.0001$). Moreover, 26.3% of respondents would not enroll a patient into the medical arm of a BAO RCT (34.7% in high-income countries versus 15.0% in middle-income countries; $P<0.0001$). In the same question, 10.1% of respondents would only enroll patients with National Institute of Health Stroke Scale (NIHSS) score <10, while 10.2% would only enroll patients with NIHSS score ≥10. The remainder had a varying combination of timing or severity cutoffs under which they would consider enrolling patients in an RCT (Table 3, Figure 2).

We asked a question regarding the minimal important clinical difference, with a modified Rankin Scale (mRS) score of 0 to 3 as a favorable outcome, that would be pertinent to show EVT would be superior to medical management (Q23). The mean response was 12.9% (±4.87%) difference, with a median of 10% (interquartile range, 10%–17%).

Secondary Outcomes

Timing

Physicians were asked how they define the time of onset for a BAO stroke when considering a patient candidate for EVT. Overall, 59.1% selected the time of deterioration as the estimated time of onset of BAO, compared with 40.9% who selected the time from first symptom of stroke, regardless of severity.

In patients presenting with a BAO within 6 hours of symptom onset (as defined by the estimated time of BAO, and for subsequent timing questions), 73.7% would proceed to EVT without advanced imaging compared with 15.4% who would select for EVT with advanced imaging.

In those presenting with a BAO in the windows 6 to 12, 12 to 24, and 24 to 48 hours, the response was to use advanced imaging to select patients for EVT, in 56.3%, 69.4%, and 59.8%, respectively, followed by no advanced imaging, in 29.8%, 12.8%, and 3.9%, respectively. In these windows, 7.5%, 11.6%,

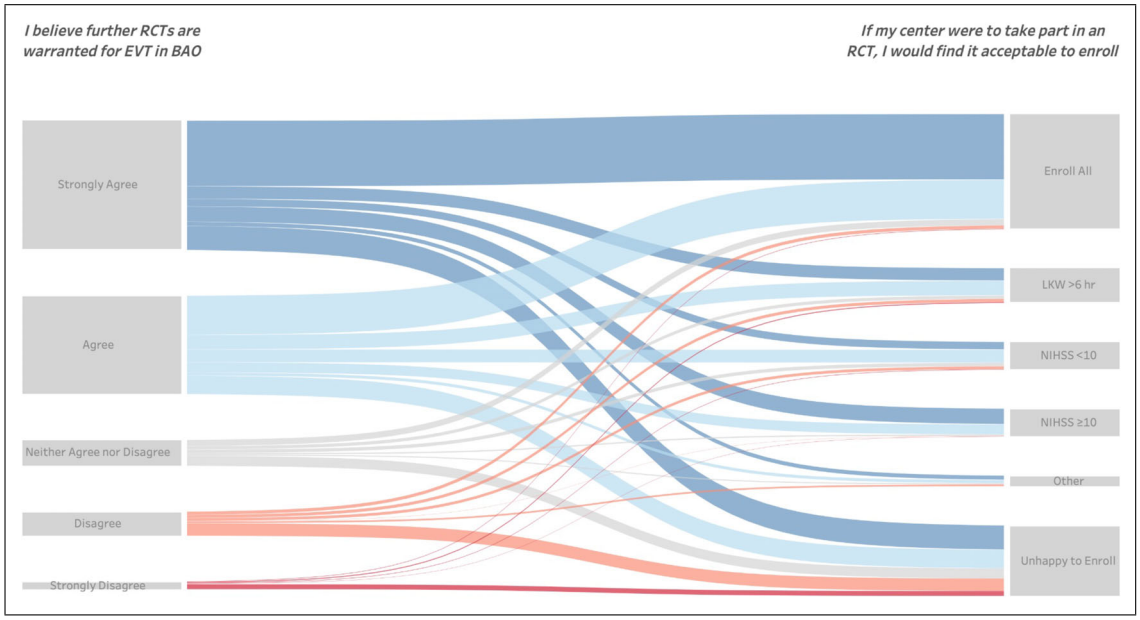

Figure 2. Sankey flow diagram showing respondent flow between whether a BAO RCT is warranted (left) to whether they would randomize patients into the medical arm of a BAO RCT (right). The width of the stream is proportional to the flow of the same respondents who selected from left to right. The left column represents responses to whether BAO RCTs are warranted: overall agree, 80.3%; neutral, 9.1%; and overall disagree, 10.5%. The right column represents responses whether a provider would randomize a patient into the medical arm of a BAO RCT: (1) all patients meeting trial criteria, 45.6%; (2) only patients with NIHSS score <10, 10.7%; (3) only patients NIHSS score ≥10, 10.8%; (4) only patients >6 hours from symptom onset, 13.5%; and (5) not happy to enroll, 26.3%. Respondents were allowed to select more than 1 option. BAO indicates basilar artery occlusion; EVT, endovascular therapy; LKW, last known well; NIHSS, National Institute of Health Stroke Scale; and RCT, randomized clinical trial.

and 29.8%, respectively, chose that patients should undergo thrombectomy only if enrolled as part of an RCT (Table 4).

Severity

Regarding stroke severity, the majority (42.7% overall) believed there should be no NIHSS threshold to stratify patients with BAO stroke for selection to EVT. This was consistent across demographics apart from North America, where the option of NIHSS score ≥6 was the more frequent choice (42.0%; P=0.0001). An NIHSS score of ≥6 was the next most common threshold overall, with 31.3% of respondents choosing this level, followed by an NIHSS threshold of ≥10 (14.2%).

With regard to the premorbid mRS threshold a physician would use to aid patient selection for EVT in BAO stroke, overall, 46.4% would select patients with premorbid mRS ≤3, and 46.2% would select premorbid mRS score ≤2.

Imaging Selection

Respondents were asked their opinion on posterior circulation Alberta Stroke Program Early CT Score CT angiography source images for patient selection to BAO EVT. Overall, 33.3% would use posterior circulation Alberta Stroke Program Early CT Score for EVT patient selection, whereas 41.2% would not, and 17.7% would use more advanced imaging. Of the 405 physicians who would use posterior circulation Alberta Stroke Program Early CT Score for EVT, the following thresholds were selected: >8, 11.4%; >7, 23.7%; >6, 40.9%; and >5, 23.9% (Table 3).

The question was raised if one believed advanced imaging was required to select patients with BAO for EVT and to then select the preferred modality. Advanced imaging was defined as any intracranial imaging other than a noncontrast CT head and CT angiography. Half of respondents selected magnetic resonance imaging with diffusion-weighted imaging, which was consistent across subgroups, except respondents from Africa who most commonly selected no additional advanced imaging required (33.3%). The next most common choices across all demographics were CT perfusion (15.6%), no advanced imaging required (15.4%), multiphase CT angiography (8.2%), and magnetic resonance perfusion (6.7%) (Table 3).

Clot Location

Regarding clot location (Q18), 45.3% of respondents would select for EVT patients with BAO with occlusions from the proximal to distal basilar, followed by 40.3% of respondents who would select from the fourth segment

Table 2. Equipoise of Basilar Artery Thrombectomy

Characteristic	N	Agree, n (%)	Neither, n (%)	Disagree, n (%)	*P* value
EVT is superior to Standard Medical Treatment in certain situations					
Overall	1244	1202 (96.62)	35 (2.81)	7 (0.56)	……
Years of practice					
≤10	672	653 (97.17)	13 (1.93)	6 (0.89)	0.03
>10	572	549 (95.98)	22 (3.85)	1 (0.17)	
Sex					
Male	933	906 (97.11)	20 (2.13)	7 (0.75)	0.02
Female	311	296 (95.18)	15 (4.82)	0 (0.00)	
Specialty category					
Interventionist	543	535 (98.53)	5 (0.92)	3 (0.55)	0.0006
Noninterventionist	701	667 (95.15)	30 (4.28)	4 (0.57)	
Continent					
Asia	416	398 (95.67)	14 (3.37)	4 (0.96)	0.08
Africa	16	13 (87.50)	1 (6.25)	1 (6.25)	
Europe	491	479 (97.56)	12 (2.44)	0 (0.00)	
North America	234	226 (96.58)	6 (2.56)	2 (0.85)	
South America	54	52 (96.30)	2 (3.70)	0 (0.00)	
Oceania	33	33 (100.0)	0 (0.00)	0 (0.00)	
Country income					
High	799	782 (97.87)	15 (1.88)	2 (0.25)	0.004
Low or middle	445	420 (94.38)	20 (4.49)	5 (1.12)	
I believe further RCTs are warranted for EVT in BAO					
Overall	1241	997 (80.34)	113 (9.11)	131 (10.56)	……
Years of practice					
≤10	671	560 (83.46)	54 (8.05)	57 (8.49)	0.009
>10	570	437 (76.67)	59 (10.35)	74 (12.98)	
Sex					
Male	931	749 (80.45)	81 (8.70)	101 (10.85)	0.61
Female	310	248 (80.00)	32 (10.32)	30 (9.68)	
Specialty category					
Interventionist	541	429 (79.30)	49 (9.06)	63 (11.65)	0.54
Noninterventionist	700	568 (81.14)	64 (9.14)		
Continent					
Asia	415	377 (90.84)	27 (6.51)	11 (2.65)	<0.0001
Africa	15	15 (100.00)	0 (0.00)	0 (0.00)	
Europe	491	371 (75.56)	48 (9.78)	72 (14.66)	
North America	233	166 (71.24)	31 (13.30)	35 (15.45)	
South America	54	45 (83.33)	4 (7.41)	5 (9.26)	
Oceania	33	23 (69.70)	3 (9.09)	7 (21.21)	
Country income					
High	798	591 (74.06)	90 (11.28)	117 (14.66)	<0.0001
Low or middle	443	406 (91.65)	23 (5.19)	14 (3.16)	
Do the results of the BASICS or BEST trials make you more or less likely to offer EVT?					
Characteristic	N	Less, n (%)	Unchanged, n (%)	More, n (%)	*P*
Overall	1241	185 (14.91)	869 (70.02)	187 (15.07)	……
Years of practice					
≤10	671	113 (16.84)	460 (68.55)	98 (14.61)	0.11
>10	570	72 (12.63)	409 (71.75)	89 (15.61)	
Sex					
Male	931	137 (14.82)	656 (70.46)	138 (14.72)	0.81
Female	310	47 (15.16)	213 (68.71)	50 (16.13)	

(*Continued*)

Table 2. (Continued)

Characteristic	N	Agree, n (%)	Neither, n (%)	Disagree, n (%)	*P* value
Specialty category					
Interventionist	541	55 (10.17)	407 (75.23)	79 (14.60)	0.0001
Noninterventionist	700	130 (18.57)	462 (66.00)	108 (15.43)	
Continent					
Asia	415	56 (13.49)	283 (68.19)	76 (18.31)	<0.0001
Africa	15	3 (20.00)	7 (46.67)	5 (33.33)	
Europe	491	83 (16.90)	340 (69.25)	68 (13.85)	
North America	233	20 (8.58)	189 (81.12)	24 (10.30)	
South America	54	19 (35.19)	22 (40.74)	13 (24.07)	
Oceania	33	4 (12.12)	28 (84.85)	1 (3.03)	
Country income					
High	798	112 (14.04)	593 (74.31)	93 (11.65)	<0.0001
Low or middle	443	73 (16.48)	276 (62.30)	94 (21.22)	

BAO indicates basilar artery occlusion; BASICS, Basilar Artery International Cooperation Study; BEST, Basilar Artery Occlusion Endovascular Intervention Versus Standard Medical Treatment; EVT, endovascular therapy; and RCT, randomized clinical trial.

of the vertebral artery to distal basilar. Neurointerventionalists were more likely to select the fourth segment of the vertebral artery to distal basilar compared with noninterventionists (52.4% versus 31.70%; $P<0.0001$).

Most respondents (64.0%) agreed that EVT should be offered to patients with isolated posterior cerebral artery first segment occlusions. This was consistent across all demographics, but agreement was lower in middle-income than high-income countries (53.7% versus 69.7%; $P<0.0001$) (Table 3).

Stenting or Angioplasty

Overall, 84.7% of respondents agreed that stenting or angioplasty for BAO in patients with underlying atheromatous disease, at the discretion of the interventionist, was appropriate, versus 10.1% who did not believe that stenting should be part of EVT in patients with BAO.

DISCUSSION

In this international survey conducted after the BEST and BASICS trial results,[7,8] most physicians continue to offer EVT in patients with BAO in clinical practice. The high proportion of respondents, across all demographic strata, who perceived that EVT is superior to medical management in selected cases and the high proportion of respondents reporting that the results of the 2 recent RCTs had not changed their opinions regarding EVT for BAO suggests that BEST and BASICS were not considered to have provided definitive evidence regarding the use of thrombectomy for BAOs. These perspectives are noted in the context of a contemporary BAO meta-analysis describing a higher risk of symptomatic intracerebral hemorrhage in EVT versus medically managed patients and nonsignificant trends of functional outcome improvement with EVT.[21]

There remained equally strong consensus that further RCT for BAO is warranted. Despite agreement by >80% of respondents about the need for further RCTs, only 46.3% reported willingness to enroll all patients with a BAO in an RCT, and 26.3% would not enroll patients into the medical management arm of an RCT. Respondents from Asia and middle-income countries exhibited greater willingness to enroll all eligible patients in an RCT compared with high-income countries, as exemplified by their successes with several recent and ongoing thrombectomy trials.[4,10,11] Enrollment only as part of an RCT as an option increased with later time windows but was not the majority response, even in the 24- to 48-hour window. These varying responses highlight the potential challenges a future trial may have in enrolling patients and avoiding crossover.

With regard to whether IVT would influence decision to EVT, there was a high response that it would have no impact, which we concede may be related, in part, to how generally the question was worded (Table S1). While there may be anchoring of opinions from recent data of the anterior circulation bridging thrombolysis trials,[22–26] it is important to highlight how well medical management performed in the BASICS prospective registry[1] and the 2 BAO RCTs compared with EVT.[7,8] In China, intravenous alteplase is currently reimbursed for patients with acute ischemic stroke within 3 hours of symptom onset (versus 4.5 hours in other countries), and in some provinces, alteplase is reimbursed only after the patient is hospitalized, partially explaining the lower use of IVT in the trials conducted in China.

The different treatment effect size between the anterior compared with the posterior circulation LVO EVT trials may, in part, be related to the higher proportion

Table 3. Summary of Responses by Clinical and Imaging Parameters

Question	Number (%)
Equipoise: BAO thrombectomy	1241
Should not be performed outside an RCT	44 (3.55)
Should be performed with similar criteria to anterior circulation	274 (22.08)
Should be performed only with advanced imaging	144 (11.60)
Should be performed on a case-by-case basis	626 (50.44)
Should be performed with NIHSS score ≥10	77 (6.20)
Should be performed as rescue after IVT judged unsuccessful	45 (3.63)
Other	31 (2.50)
Preference: if my center were to take part in a BAO RCT, I would find it acceptable to enroll in the medical arm	1245
All patients who meet trial criteria	535 (42.97)
Only patients with NIHSS score <10	126 (10.12)
Only patients with NIHSS score ≥10	127 (10.20)
Only patients >6 h from symptom onset	159 (12.77)
I would not be happy to enroll in the medical arm	327 (26.27)
Other	46(3.69)
Preference: in patients with BAO who received IVT	1173
EVT should not be performed outside an RCT	65 (5.54)
IVT would not influence my decision to proceed to EVT	1083 (92.33)
Other	25 (2.13)
Timing: time of onset is considered	1199
From time patient last known well	490 (40.87)
From the time acute symptoms were believed to be caused by BAO, even if preceded by strokelike symptoms not consistent with BAO	709 (59.13)
Severity: regarding NIHSS in patients with BAO, EVT should be offered (if acceptable timing and imaging)	1191
Only in RCT	34 (2.85)
Regardless of NIHSS	508 (42.65)
NIHSS score ≥10	169 (14.19)
NIHSS score ≥6	373 (31.32)
NIHSS score <6	15 (1.26)
Other	92 (7.72)
Severity: regarding premorbid mRS, BAO EVT should be offered	1191
Only in an RCT	44 (3.69)
Premorbid mRS score ≤2	550 (46.18)
Premorbid mRS score ≤3	553 (46.43)
Other	44 (3.69)
Clot location: regarding clot location in BAO patients, EVT should be offered	1185
Only in an RCT	46 (3.88)
Middle or distal basilar occlusion	83 (7.00)
Proximal, middle, or distal basilar occlusion	537 (45.32)
V4, proximal, middle, or distal basilar occlusion and posterior cerebral artery	478 (40.34)
Other	41 (3.46)
Clot location: for isolated P1 occlusion, I would proceed to EVT (within an acceptable time frame)	1185
Strongly agree	293 (24.73)
Agree	466 (39.32)
Neither agree nor disagree	273 (23.04)
Disagree	140 (11.81)
Strongly disagree	13 (1.10)
Imaging: regarding PC-ASPECTS on CTA source imaging and threshold for EVT selection in BAO patients, PC-ASPECTS	1218
Should not be used to select patients	502 (41.22)
>8	46 (3.78)
>7	96 (7.88)
>6	166 (13.63)
>5	97 (7.96)
More advanced imaging should be required in all patients before EVT	215 (17.65)
Other	67 (5.50)
Imaging: If advanced imaging† is believed to be required for BAO selection to EVT (because of time window versus other considerations), which imaging modality should be used	1217
Multiphase CTA collateral score	100 (8.22)
CT perfusion	190 (15.61)
MRI (DWI)	614 (50.45)
MRI perfusion	81 (6.66)
I do not believe advanced imaging is required	187 (15.37)
EVT should not be performed unless in RCT	20 (1.64)

BAO indicates basilar artery occlusion; CT computed tomography; CTA, computed tomography angiography; DWI, diffusion-weighted imaging; EVT, endovascular thrombectomy; MRI, magnetic resonance imaging; mRS, modified Rankin Scale; NIHSS, National Institute of Health Stroke Scale; PC-ASPECTS, posterior circulation Alberta Stroke Program Early CT Score; and RCT, randomized clinical trial.

of intracranial atherosclerotic disease (BASICS, 33%; BEST, 52%) and the higher probability of recanalization even with longer clot length with IVT.[9,27,28] The role of medical management in BAO will continue to be a dynamic target with evolving data demonstrating the relatively better performance of intravenous tenecteplase compared with alteplase in the posterior circulation[17] and in other patients with LVO.[29–33] We acknowledge the lack of a survey question related to physician preference regarding use of tenecteplase versus alteplase is a limitation in our study.

In a departure from the anterior circulation trials, many respondents did not perceive that NIHSS should be used to stratify patient selection in cases of BAO, possibly related to expansion of EVT criteria in considering patients for EVT with low NIHSS.[34] The utility of a dedicated posterior circulation NIHSS score merits further study and validation.[35] Intriguingly, a higher mRS threshold of 3 was favored by more respondents for patient selection than the traditional threshold of 2. This may reflect clinician receptiveness to expanding the indications for posterior circulation EVT in patients

Table 4. Time Preferences

	Advanced imaging should be required in the selection of patients for EVT, n (%)	EVT should occur without the need for advanced imaging, n (%)	EVT should be considered only as part of an RCT, n (%)	Other, n (%)	*P* value
<6 h from onset (N=1198)					
Overall	185 (15.44)	883 (73.71)	67 (5.59)	63 (5.26)	…
Years of practice					
≤10	101 (15.76)	472 (73.63)	34 (5.30)	34 (5.30)	0.96
>10	84 (15.08)	411 (73.79)	33 (5.92)	29 (5.21)	
Sex					
Male	136 (15.11)	676 (75.11)	51 (5.67)	37 (4.11)	0.016
Female	49 (16.44)	207 (69.46)	16 (5.37)	26 (8.72)	
Specialty category					
Interventionist	84 (16.09)	389 (74.52)	27 (5.17)	22 (4.21)	0.47
Noninterventionist	101 (14.94)	494 (73.08)	40 (5.92)	41 (6.07)	
Continent					
Asia	82 (20.60)	273 (68.59)	35 (8.79)	8 (2.01)	<0.0001
Africa	4 (26.67)	10 (66.67)	1 (6.67)	0 (0.00)	
Europe	66 (13.89)	348 (73.26)	21 (4.42)	40 (8.42)	
North America	21 (9.29)	185 (81.86)	9 (3.98)	11 (4.87)	
South America	10 (19.23)	40 (76.92)	1 (1.92)	1 (1.92)	
Oceania	2 (6.25)	27 (84.38)	0 (0.00)	3 (9.38)	
Country income					
High	90 (11.58)	603 (77.61)	28 (3.60)	56 (7.21)	<0.0001
Low or middle	95 (22.57)	280 (66.51)	39 (9.26)	7 (1.66)	
6–12 h of onset (N=1198)					
Overall	674 (56.26)	357 (29.80)	90 (7.51)	77 (6.43)	…
Years of practice					
≤10	387 (60.37)	176 (27.46)	43 (6.71)	35 (5.46)	0.0196
>10	287 (51.53)	181 (32.50)	47 (8.44)	42 (7.54)	
Sex					
Male	504 (56.00)	277 (30.78)	65 (7.22)	54 (6.00)	0.45
Female	170 (57.05)	80 (26.85)	25 (8.39)	23 (7.72)	
Specialty category					
Interventionist	297 (56.90)	174 (33.33)	24 (4.60)	27 (5.17)	0.0008
Noninterventionist	377 (55.77)	183 (27.07)	66 (9.76)	50 (7.40)	
Continent					
Asia	269 (67.59)	102 (25.63)	22 (5.53)	5 (1.26)	<0.0001
Africa	8 (53.33)	5 (33.33)	1 (6.67)	1 (6.67)	
Europe	254 (53.47)	128 (26.95)	49 (10.32)	44 (9.26)	
North America	97 (42.92)	97 (42.92)	14 (6.19)	18 (7.96)	
South America	34 (65.38)	15 (28.85)	3 (5.77)	0 (0.00)	
Oceania	12 (37.50)	10 (31.25)	1 (3.13)	9 (28.13)	
Country income					
High	392 (50.45)	250 (32.18)	63 (8.11)	72 (9.27)	<0.0001
Low or middle	282 (66.98)	107 (25.42)	27 (6.41)	5 (1.19)	
12–24 h of onset (N=1195)					
Overall	829 (69.37)	153 (12.80)	139 (11.63)	74 (6.19)	…
Years of practice					
≤10	452 (70.51)	83 (12.95)	65 (10.14)	41 (6.40)	0.39
>10	377 (68.05)	70 (12.64)	74 (13.36)	33 (5.96)	

(*Continued*)

Table 4. (Continued)

	Advanced imaging should be required in the selection of patients for EVT, n (%)	EVT should occur without the need for advanced imaging, n (%)	EVT should be considered only as part of an RCT, n (%)	Other, n (%)	*P* value
Sex					
Male	616 (68.67)	123 (13.71)	103 (11.48)	55 (6.13)	0.45
Female	213 (71.48)	30 (10.07)	36 (12.08)	19 (6.38)	
Specialty category					
Interventionist	376 (72.17)	84 (16.12)	34 (6.53)	27 (5.18)	<0.0001
Noninterventionist	453 (67.21)	69 (10.24)	105 (15.58)	47 (6.97)	
Continent					
Asia	310 (77.89)	48 (12.06)	31 (7.79)	9 (2.26)	<0.0001
Africa	11 (78.57)	0 (0.00)	2 (14.29)	1 (7.14)	
Europe	315 (66.60)	43 (9.09)	80 (16.91)	35 (7.40)	
North America	136 (60.18)	49 (21.68)	17 (7.52)	24 (10.62)	
South America	36 (69.23)	9 (17.31)	7 (13.46)	0 (0.00)	
Oceania	21 (65.63)	4 (12.50)	2 (6.25)	5 (15.63)	
Country income					
High	498 (64.26)	111 (14.32)	98 (12.65)	68 (8.77)	<0.0001
Low or middle	331 (78.81)	42 (10.00)	41 (9.76)	6 (1.43)	
24–48 h of onset (N=1198)					
Overall	716 (59.77)	47 (3.92)	357 (29.80)	78 (6.51)	–
Years of practice					
≤10	381 (59.44)	23 (3.59)	198 (30.89)	39 (6.08)	0.72
>10	335 (60.14)	24 (4.31)	159 (28.55)	39 (7.00)	
Sex					
Male	545 (60.56)	42 (4.67)	260 (28.89)	53 (5.89)	0.03
Female	171 (57.38)	5 (1.68)	97 (32.55)	25 (8.39)	
Specialty category					
Interventionist	356 (68.20)	25 (4.79)	110 (21.07)	31 (5.94)	<0.0001
Noninterventionist	360 (53.25)	22 (3.25)	247 (36.54)	47 (6.95)	
Continent					
Asia	271 (68.09)	12 (3.02)	100 (25.13)	15 (3.77)	<0.0001
Africa	7 (46.67)	1 (6.67)	6 (40.00)	1 (6.67)	
Europe	255 (53.68)	11 (2.32)	172 (36.21)	37 (7.79)	
North America	139 (61.50)	20 (8.85)	48 (21.24)	19 (8.41)	
South America	28 (53.85)	2 (3.85)	19 (36.54)	3 (5.77)	
Oceania	16 (50.00)	1 (3.13)	12 (37.50)	3 (9.38)	
Country income					
High	438 (56.37)	36 (4.63)	243 (31.27)	60 (7.72)	0.003
Low or middle	278 (66.03)	11 (2.61)	114 (27.08)	18 (4.28)	

EVT indicates endovascular thrombectomy; and RCT, randomized clinical trial.

with prestroke disability as in patients with anterior circulation EVT[36,37] or a reflection of clinicians considering BAO a more grave disease.

The majority of respondents supported EVT in BAO without advanced imaging within 6 hours, a parallel to the current guidelines of imaging selection in anterior circulation LVO.[38] Beyond 6 hours, and up to 48 hours, advanced imaging more commonly was the preferred modality for EVT selection, and if desired, then magnetic resonance imaging diffusion-weighted imaging was the most common modality, in parallel with the utility of this modality in discriminating potentially early salvageable infarct in patients with unknown or extended time of onset stroke.[39,40] Noncontrast head CT remained an important consideration among respondents for BAO EVT patient selection even in the 6- to 12-hour window, as with late anterior circulation EVT selection,[41,42] with a declining gradient in respondents considering its utility with progressive later windows.

The differential approach of providing EVT for BAO in middle-income countries where resources are likely to be less available could be observed with a lower

preference for magnetic resonance imaging diffusion weighted imaging as primary modality of advanced imaging and a larger proportion of respondents in this stratum favoring higher NIHSS thresholds for EVT. There was a lower proportion of respondents from middle-income countries (half of respondents) who would offer EVT in patients with isolated posterior cerebral artery first segment occlusions, underscoring the uncertainty of the benefit of EVT in patients with posterior circulation medium-vessel occlusion.[43–46] There was a greater likelihood of willingness to randomize eligible patients into an RCT among respondents in middle-income compared with high-income countries, suggesting this demographic stratum as a potentially favorable geography in the planning of future EVT BAO trials.

The high number of respondents for a stroke treatment survey, along with the completion rate, indicates a strong engagement among stroke and neurointerventional physicians in the hyperacute management of BAO. The disproportionately high number of male neurointerventionalist respondents is likely an indirect reflection of the sex distribution across this specialty.

Limitations

We highlight that the most frequent response for any of the survey questions does not translate to the correct response in practice. Simulated case scenarios may not reflect real-world practice. These responses may be a reflection of sampling bias as well as a reflection of the range in knowledge, experiences, and resources available to a physician as of Q1 2022.

Another limitation is that the After the BEST of BASICS survey was conducted before the release of the ATTENTION and BAOCHE BAO RCTs from China, the results of which were presented at the 2022 European Stroke Organization Congress and confirmed the benefit of EVT in patients with BAO and moderate to severe stroke. Despite the positive results of these trials, both study populations were confined to a Chinese population, known to have a higher prevalence of intracranial atherosclerotic disease[47–49] and may not apply to a population outside of China. In the recent history of stroke trials, it is not uncommon that public release of trial results completed earliest in Asia (ie, Clopidogrel in high-risk patients with acute nondisabling cerebrovascular events, Direct intraarterial thrombectomy in order to revascularize acute ischemic stroke patients with large vessel occlusion efficiently in chinese tertiary hospitals: a multicenter randomized clinical trial, Direct endovascular thrombectomy vs combined IVT and endovascular thrombectomy for patients with acute large vessel occlusion in the anterior circulation trial, Direct mechanical thrombectomy in acute LVO stroke, Japan Rescue), did not translate to adoption in other countries, as exemplified by continued enrollment in their counterpart trials (i.e., Platelet-Oriented inhibition in new TIA and minor ischemic stroke, all bridging IVT/EVT trials, all ongoing large-core EVT trials).[25,50]

With regard to the question on minimally important clinical difference, it was noted that 38.1% of respondents chose the option of a 10% increase in good outcome rate, the midpoint on which the slider started, reflecting that suggestion bias and midpoint bias may have played a role in respondents' answers.

CONCLUSIONS

In conclusion, most physicians would continue to offer EVT in selected patients with BAO, even after the BEST and BASICS RCTs were inconclusive. Few clinicians would use the same treatment criteria for BAO as in anterior circulation occlusion, and there is no consensus on which selection criteria to use. Further RCTs for BAO appear to be warranted, particularly patients with low NIHSS scores, who were not included in most of the trials conducted in China. The willingness to enroll all eligible patients in the medical arm of a BAO RCT was highest in Asia and middle- and low-income countries. The selection of patients for BAO EVT by clinical severity and imaging modality exhibited differences by respondent geography, physician specialty, and country income level.

ARTICLE INFORMATION

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Affiliations

Stroke Medicine, Imperial College Healthcare NHS Trust, Charing Cross Hospital, London, UK (B.D., S.B.); Stroke Medicine, Chelsea and Westminster NHS Foundation Trust, London, United Kingdom (B.D.); Department of Radiology, Neurology, Boston Medical Center, Boston University School of Medicine, Boston, MA, United States (M.M.Q., P.K., M.A., T.N.N.); Department of Neurology, St. Antonius Hospital, Nieuwegein, The Netherlands (W.J.S.); Interventional Neuroradiology, Beijing Tiantan Hospital, Beijing, China (X.H., Z.M.); Department of Neurology, Foshan Sanshui District People's Hospital, Foshan, Guangdong Province, China (Y.C.); Department of Neurology, Helsinki University Hospital, Helsinki, Finland (D.S.); Department of Neurology, Stroke Research Center Bern, Bern University Hospital, University of Bern, Bern, Switzerland (U.F., T.R.M.); Department of Neurology, Basel University Hospital, University of Basel, Basel, Switzerland (U.F.); Department of Neurology, University Hospital Carl Gustav Carus, Technische Universität Dresden, Dresden, Germany (V.P.); Dresden Neurovascular Center, University Hospital Carl Gustav Carus, Technische Universität Dresden, Dresden, Germany (V.P.); The First Affiliated Hospital of USTC, Division of Life Sciences and Medicine, China (W.H., Y.Z.); Xuanwu Hospital, Beijing, China (X.J., C.L.); Medicine and Neurology, Melbourne Brain Centre at the Royal Melbourne Hospital, University of Melbourne, Parkville, Victoria, Australia (F.A., B.C.C.); Stroke Neurology, National Hospital Organization, Osaka National Hospital, Osaka, Japan (H.Y.); Neuroscience Section, Department of Biotechnological and Applied Clinical Sciences, University of L'Aquila, L'Aquila AQ, Italy (S.S.); Stroke Outcomes and Decision Neuroscience Research Unit, Division of Neurology, University of Toronto, Toronto, Canada (G.S.); Neurology Service, Clinical Neurosciences, Lausanne University Hospital and University of Lausanne, Lausanne, Switzerland (P.M.); Department of

Neurology, Akershus University Hospital, Lørenskog, and Department of General Practice, University of Oslo, Oslo, Norway (E.S.K.); Department of Neurology, International Clinical Research Center, St. Anne's University Hospital and Faculty of Medicine, Masaryk University, Brno, Czech Republic (P.S., R.M.); Department of Internal Medicine and Cardiology, University Hospital Brno, Brno, Czech Republic (P.S.); Cooper Neurological Institute, Cooper University Hospital, Camden, NJ, United States (J.E.S., T.G.J.); Stroke Center, Centro Hospitalar Universitário Lisboa Central – CHULC, Portugal, CEEM and Institute of Anatomy, Faculdade de Medicina, Universidade de Lisboa, Lisbon, Portugal (D.A.d.S.); Radiology Imperial College Healthcare NHS Trust, Charing Cross Hospital, London, UK (K.L., D.R.); Department of Neurology, Leuven University Hospital, Leuven, Belgium (J.D.); Amita Health and University of Illinois-Chicago, Chicago, IL, United States (K.S.A.); Neurology, Federal University of Rio Grande do Sul, Porto Alegre, Hospital de Clínicas de Porto Alegre, Porto Alegre, Brazil (S.O.M.); Department of Radiology, University of Calgary, Alberta, Canada (M.G.); Cerebrovascular Disease, 115 People Hospital, Ho Chi Minh City, Vietnam (T.H.N.); Stroke Center, Bach Mai Hospital, Hanoi Medical University, Vietnam National University, Hanoi, Vietnam (M.D.T.); Stroke Center, Neurology, The First Affiliated Hospital of USTC, Division of Life Sciences and Medicine, University of Science and Technology of China, Hefei, China (X.L.); Xinqiao Hospital and The Second Affiliated Hospital, Army Medical University, Chongqing, China (Z.Q.); Department of Interventional Neuroradiology, NEURI Brain Vascular Center, Bicêtre Hospital, Assistance Publique Hôpitaux de Paris, Le Kremlin-Bicêtre, France (J.C.); Neurology and Stroke Unit, Department of Neuroscience, Bufalini Hospital, Cesena, Italy (M.R.); Department of Neuroradiology, University Hospital 'San Giovanni di Dio e Ruggi d'Aragona', Campania, Italy (F.D.); Universitätsklinikum Hamburg-Eppendorf, Klinik und Poliklinik für Neurologie, Hamburg, Germany (G.T.); Department of Neurology, Heidelberg University Hospital, Heidelberg, Germany (S.N.); Department of Neurology, Klinikum Ludwigshafen, Ludwigshafen, Germany (S.N.); Department of Neurology, Oslo University Hospital, Oslo, Norway (E.C.S.); The Norwegian Air Ambulance Foundation, Oslo, Norway (E.C.S.); Department of Neurology, University of Pittsburgh Medical Center, PA (R.G.N.); Neuroradiologie Interventionelle, Centre Hospitalier de l'Universite de Montreal, Montreal, Canada (J.R.)

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Supplemental Materials

Supporting Information.

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