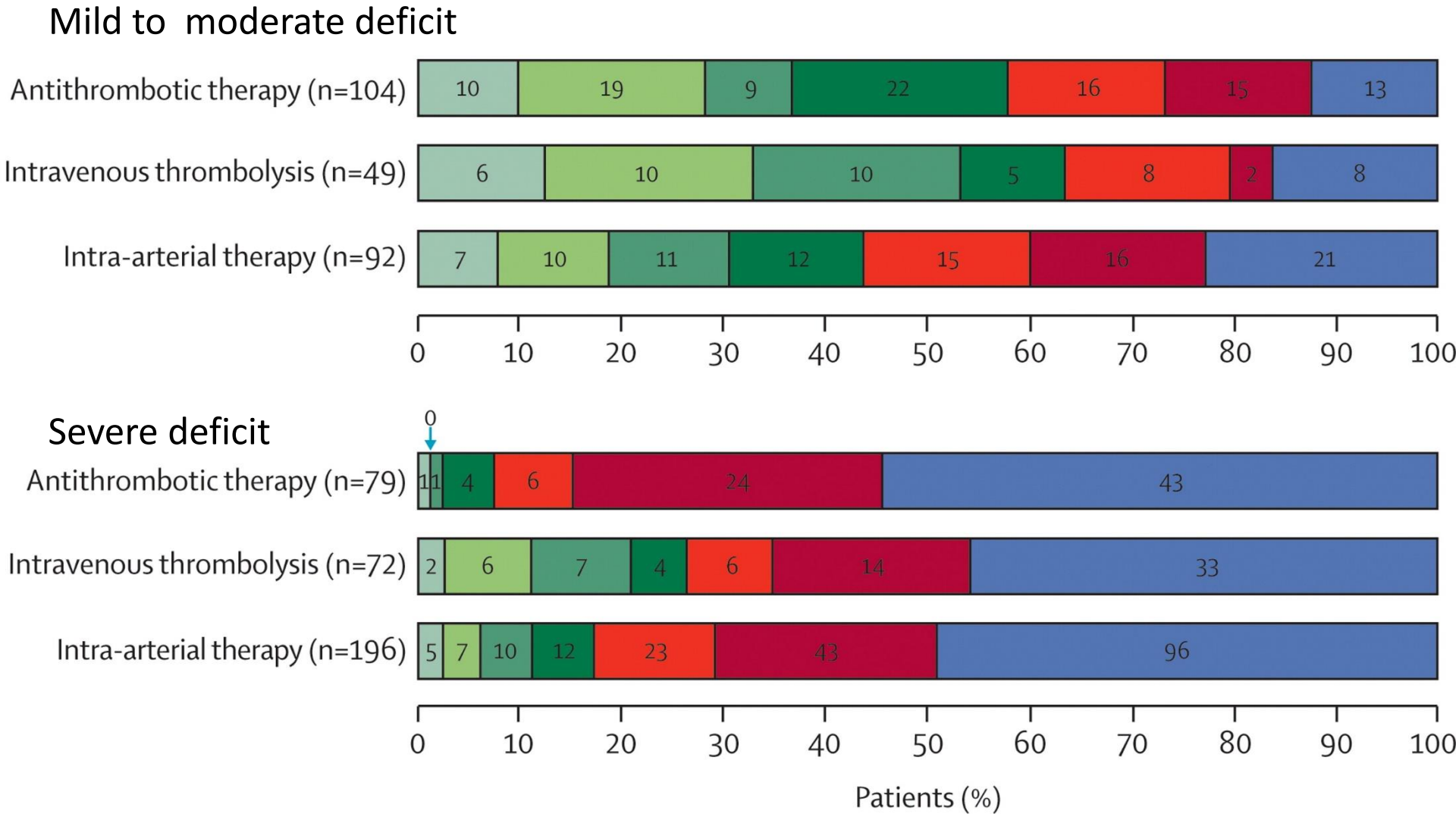
Epidemiology

- Ischemic stroke involving posterior circulation accounts for up to ~20% of all ischemic strokes
- About 14% of posterior circulation strokes are due to Basilar artery occlusion
- Basilar artery occlusion accounts for ~1% of all strokes
- Estimated incidence at 1-3 patients per 100,000 per year.

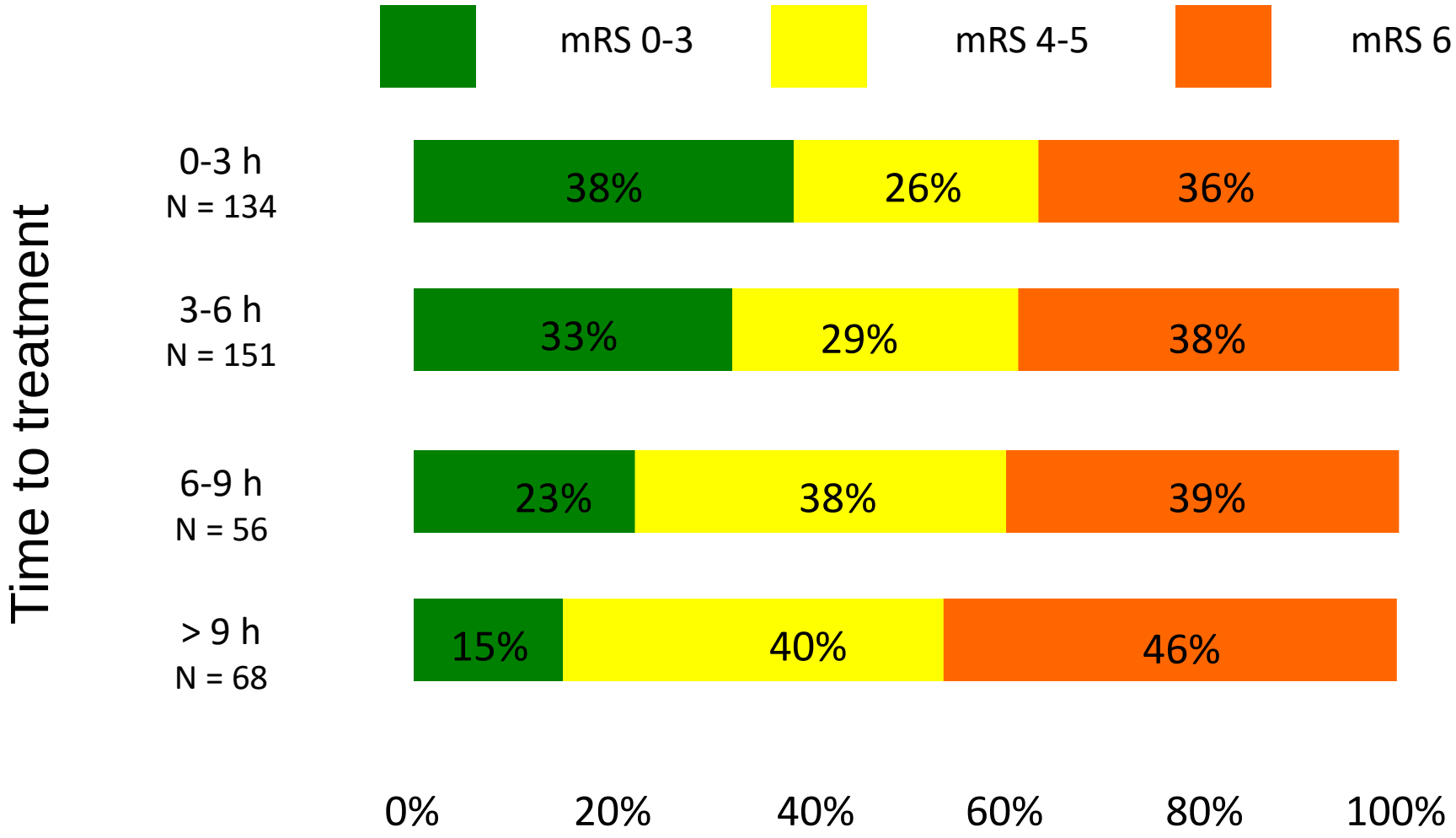
Treatment and outcomes of acute basilar artery occlusion in the Basilar Artery International Cooperation Study (BASICS): a prospective registry study

Schonewille WJ et al. Lancet Neurol 2009; 8: 724-30



Time saved brain(stem) in BASICS

Vergowen MD et al, Stroke 2012; 43: 3003-6



MEDICAL HYPOTHESIS

Time window for recanalization in basilar artery occlusion

Speculative synthesis

Perttu J. Lindsberg, MD
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ABSTRACT

Basilar artery occlusion (BAO) is one of the most devastating forms of stroke and few patien have good outcomes without recanalization. Most centers apply recanalization therapies f BAO up to 12–24 hours after symptom onset, which is a substantially longer time window tha the 4.5 hours used in anterior circulation stroke. In this speculative synthesis, we discuss rece advances in BAO treatment in order to understand why and under which circumstances long symptom duration might not necrotize the brainstem and turn therapeutic attempts futile. W raise the possibility that distinct features of the posterior circulation, e.g., highly develope persistent collateral arterial network, reverse filling of the distal basilar artery, and delica plasma flow siding the clot, might sustain brittle patency of brainstem perforators in the fa of stepwise growth of the thrombus. Meanwhile, the tissue clock characterizing the rapid necros of a typical anterior circulation penumbra will not start. During this perilous time period, reca alization at any point would salvage the brainstem from eventual necrosis caused by immine reinforcement and further building up of the clot. *Neurology*® 2015;85:1806–1815

Extent of Hypoattenuation on CT Angiography Source Images Predicts Functional Outcome in Patients With Basilar Artery Occlusion

Volker Puetz, MD; P.N. Sylaja, MD; Shelagh B. Coutts, MD; Michael D. Hill, MD, MSc; Imanuel Dzialowski, MD; Pia Mueller, MD; Ulf Becker, MD; Gabriele Urban; Christine O'Reilly, BSc; Philip A. Barber, MD; Pranshu Sharma, MD; Mayank Goyal, MD; Georg Gahn, MD; Ruediger von Kummer, MD; Andrew M. Demchuk, MD

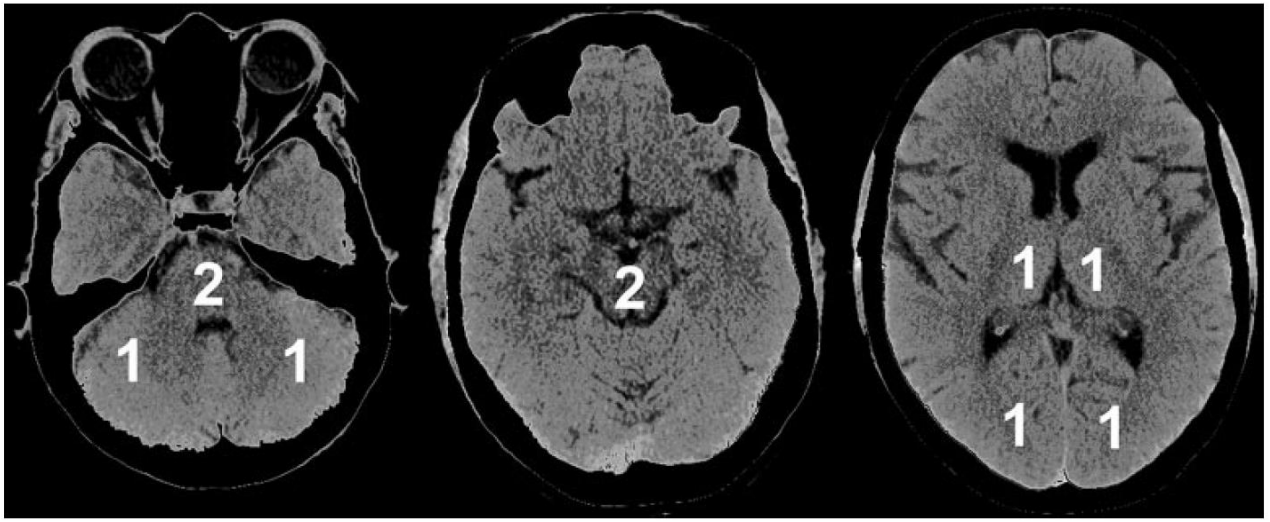


Figure 1. The posterior circulation Acute Stroke Prognosis Early CT score (pc-ASPECTS). From 10 points, 1 or 2 points each (as indicated) are subtracted for early ischemic changes (NCCT) or hypoattenuation (CTASI) in: left or right thalamus, cerebellum or PCA-territory, respectively (1 point); any part of midbrain or pons (2 points). Pc-ASPECTS=10 indicates a normal scan, pc-ASPECTS=0 indicates early ischemic changes (NCCT) or hypoattenuation (CTASI) in all above territories.

Predictors of outcomes

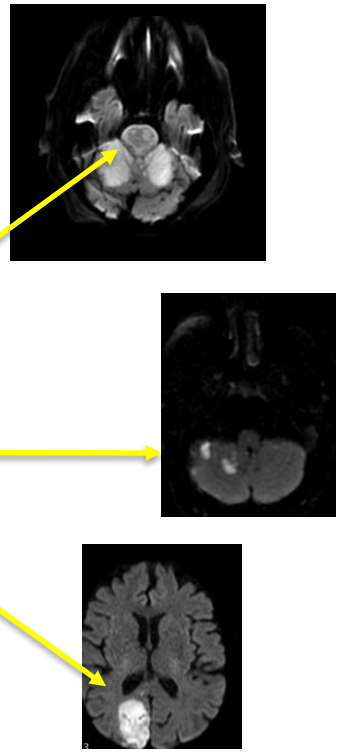
Baseline characteristics in derivation cohort:

- **Mean age 64 (+/- 13)**
- **Female: 33.33%**
- **HTN: 58.3%**
- **DM: 21.67%**
- **NIHSS (baseline): Median 18 (IQR 8-30)**
- **IV tPA: 11.7%**

Variables	B	S.E.	Sig	OR
Age	-0.130	0.05	0.009	0.878 (0.796-0.969)
Infarct volume, Brainstem	-1.154	0.368	0.002	0.315 (0.153-0.649)
Infarct volume, Thalamus	-0.218	0.356	0.540	0.804 (0.400-1.615)
Infarct volume, Cerebellum	-0.022	0.021	0.290	0.978 (0.939-1.019)
Infarct volume, Cortex	0.030	0.025	0.233	1.03 (0.981-1.083)

Of all posterior circulation regions, **only brainstem infarct volume (as measured on post treatment DWI-MRI) was predictive of good outcome.**

Age was also independently predictive of good outcome.



POST-VB score = age + (10× brainstem infarct volume).

Jadhav et al (EJN 2021)

International Journal of Stroke
2017, Vol. 12(7) 779–785

DOI: 10.1177/1747493017701153
journals.sagepub.com/home/wso
SAGE

Acute basilar artery occlusion: Endovascular Interventions versus Standard Medical Treatment (BEST) Trial—Design and protocol for a randomized, controlled, multicenter study

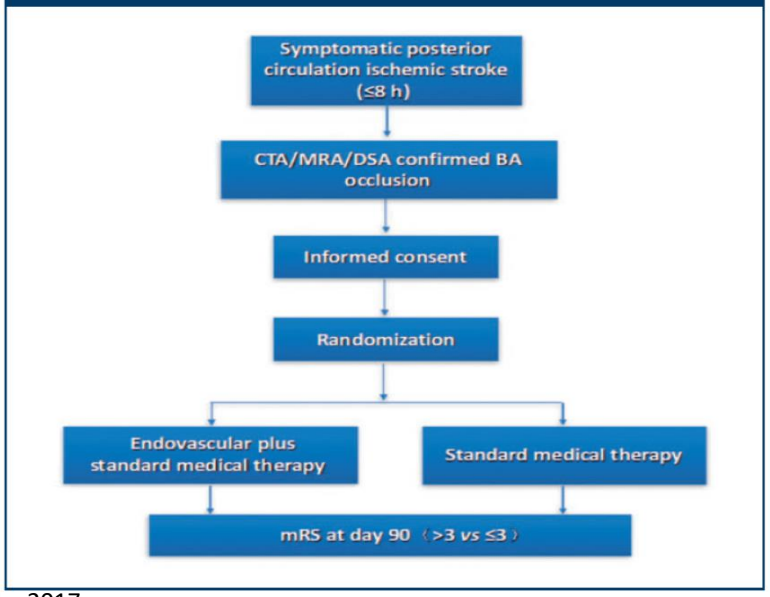
Xinfeng Liu[1], Gelin Xu[1], Yuxiu Liu[2], Wusheng Zhu[1], Minmin Ma[1], Yunyun Xiong[1], Wenjie Zi[1], Qiliang Dai[1], Thomas Leung[3], Bernard Yan[4], Stephen Davis[4], David S Liebeskind[5], Vítor M Pereira[6] and Raul G Nogueira[7]; on behalf of the BEST Trial Investigators

Table 1. Inclusion and exclusion criteria

Inclusion criteria
1. Age ≥ 18 years;
2. Acute ischemic stroke consistent with infarction in the basilar artery territory;
3. Basilar artery occlusion confirmed by CTA/MRA/DSA, within 8 h of estimated occlusion time;
4. Written informed consent from patient or surrogate, if unable to provide consent.
Exclusion criteria
1. Computed tomography (CT) or magnetic resonance imaging (MRI) evidence of cerebral hemorrhage on presentation;
2. Premorbid mRS ≥ 3 points;
3. Currently in pregnant or lactating;
4. Known serious sensitivity to radiographic contrast agents and nitinol metal;
5. Current participation in another investigation drug or device study;
6. Uncontrolled hypertension defined as systolic blood pressure > 185 mm Hg or diastolic blood pressure > 110 mm Hg that cannot be controlled except with continuous parenteral antihypertensive medication;
7. Known hereditary or acquired hemorrhagic diathesis, coagulation factor deficiency; or oral anticoagulant therapy with INR > 1.7 or institutionally equivalent prothrombin time;
8. Baseline lab values: glucose < 50 mg/dL or > 400 mg/dL, platelets < 100 × 10^9/L, or Hct < 25%;
9. Arterial tortuosity that would prevent the device from reaching the target vessel;
10. Life expectancy less than one year;
11. History of major hemorrhage in the past six months;
12. Imaging evidence of significant cerebellar mass effect or acute hydrocephalus.
13. Imaging evidence of bilateral extended brainstem ischemia.

CTA: computed tomography angiography; DSA: digital subtraction angiography; Hct: hematocrit; INR: international normalized ratio; mRS: modified Rankin Scale; MRA: magnetic resonance angiography.

Figure 1. Flow chart of BEST clinical trial. CTA: computed tomography angiography; MRA: magnetic resonance angiography; DSA: digital subtraction angiography; BA: basilar artery; mRS: modified Rankin Scale.



Liu et al., International Journal of Stroke 2017

Endovascular treatment versus standard medical treatment for vertebrobasilar artery occlusion (BEST): an open-label, randomised controlled trial

Xinfeng Liu, Qiliang Dai, Ruidong Ye, Wenjie Zi, Yuxiu Liu, Huaiming Wang, Wusheng Zhu, Minmin Ma, Qin Yin, Min Li, Xinying Fan, Wen Sun, Yunfei Han, Qiushi Lv, Rui Liu, Dong Yang, Zhonghua Shi, Dequan Zheng, Xiaorong Deng, Yue Wan, Zhen Wang, Yu Geng, Xingyu Chen, Zhiming Zhou, Geng Liao, Ping Jin, Yumin Liu, Xintong Liu, Meng Zhang, Feng Zhou, Hongchao Shi, Yunfeng Zhang, Fuqiang Guo, Congguo Yin, Guozhong Niu, Mei Zhang, Xueli Cai, Qiyi Zhu, Zhonglun Chen, Yingchun Liang, Bing Li, Min Lin, Wei Wang, Haowen Xu, Xinmin Fu, Wenhua Liu, Xiguang Tian, Zili Gong, Haicun Shi, Chuanming Wang, Penghua Lv, Zhonghai Tao, Liangfu Zhu, Shiquan Yang, Wei Hu, Pingzhou Jiang, David S Liebeskind, Vitor M Pereira, Thomas Leung, Bernard Yan, Stephen Davis, Gelin Xu, Raul G Nogueira*, on behalf of the BEST Trial Investigators†*

	Intervention (n=66)	Control (n=65)	Adjusted OR* (95% CI)	Unadjusted OR (95% CI)	p value
Primary outcome					
mRS 0–3 at 90 days	28 (42%)	21 (32%)	1·74 (0·81–3·74)	1·54 (0·76–3·15)	0·23
Secondary outcome					
mRS 0–2 at 90 days	22 (33%)	18 (28%)	1·40 (0·64–3·10)	1·31 (0·62–2·75)	0·48
mRS score at 90 days (ordinal)	4·5 (2–6)	4 (1·5–6)	1·36 (0·72–2·55)	1·13 (0·62–2·09)	0·69
mTICI	..	..	NA	1·40 (0·41–4·72)	0·60
0–2a	18 (29%; n=63)	5 (36%; n=14)†	NA	NA	NA
2b–3	45 (71%; n=63)	9 (64%; n=14)†	NA	NA	NA
NIHSS score after 24 h	26 (11–38; n=62)	20 (9–38; n=62)	NA	NA	0·41
NIHSS score at 5–7 days	18 (8–27; n=51)	13 (4–31; n=53)	NA	NA	0·48
GCS score after 24 h	7 (5–11; n=62)	8 (5–13; n=62)	NA	NA	0·51
GCS score at 5–7 days	9 (7–14; n=51)	13 (6–15; n=53)	NA	NA	0·52
pcASPECTS score at 24 h	6 (4–7; n=60)	6 (4–8; n=47)	NA	NA	0·41

	Intervention	Control	Unadjusted OR (95% CI)	Adjusted OR* (95% CI)
mRS score of 0–3 at 90 days				
Per-protocol	28 (44%; n=63)	13 (25%; n=51)	2·34 (1·05–5·22)	2·90 (1·20–7·03)
As-treated	36 (47%; n=77)	13 (24%; n=54)	2·77 (1·28–5·97)	3·02 (1·31–7·00)
mRS score of 0–2 at 90 days				
Per-protocol	22 (35%; n=63)	10 (20%; n=51)	2·20 (0·93–5·22)	2·57 (1·02–6·51)
As-treated	30 (39%; n=77)	10 (19%; n=54)	2·81 (1·23–6·41)	2·90 (1·20–7·04)

Liu et al., Lancet Neurology 2020

BASICS

van der Hoeven *et al. Trials* 2013, **14**:200
http://www.trialsjournal.com/content/14/1/200

TRIALS

STUDY PROTOCOL **Open Access**

The Basilar Artery International Cooperation Study (BASICS): study protocol for a randomised controlled trial

Erik JRJ van der Hoeven[1], Wouter J Schonewille[2*], Jan Albert Vos[1], Ale Algra[3,4], Heinrich J Audebert[5], Eivind Berge[6], Alfonso Ciccone[7], Mikael Mazighi[8], Patrik Michel[9], Keith W Muir[10], Víctor Obach[11], Volker Puetz[12], Cristanne AC Wijman[13^], Andrea Zini[14], Jaap L Kappelle[3] and On behalf of the BASICS study group

Abstract

Background: Despite recent advances in acute stroke treatment, basilar artery occlusion (BAO) is associated with a death or disability rate of close to 70%. Randomised trials have shown the safety and efficacy of intravenous thrombolysis (IVT) given within 4.5 h and have shown promising results of intra-arterial thrombolysis given within 6 h of symptom onset of acute ischaemic stroke, but these results do not directly apply to patients with an acute BAO because only few, if any, of these patients were included in randomised acute stroke trials.
Recently the results of the Basilar Artery International Cooperation Study (BASICS), a prospective registry of patients with acute symptomatic BAO challenged the often-held assumption that intra-arterial treatment (IAT) is superior to IVT. Our observations in the BASICS registry underscore that we continue to lack a proven treatment modality for patients with an acute BAO and that current clinical practice varies widely.

Design: BASICS is a randomised controlled, multicentre, open label, phase III intervention trial with blinded outcome assessment, investigating the efficacy and safety of additional IAT after IVT in patients with BAO. The trial targets to include 750 patients, aged 18 to 85 years, with CT angiography or MR angiography confirmed BAO treated with IVT. Patients will be randomised between additional IAT followed by optimal medical care versus optimal medical care alone. IVT has to be initiated within 4.5 h from estimated time of BAO and IAT within 6 h. The primary outcome parameter will be favourable outcome at day 90 defined as a modified Rankin Scale score of 0–3.

Discussion: The BASICS registry was observational and has all the limitations of a non-randomised study. As the IAT approach becomes increasingly available and frequently utilised an adequately powered randomised controlled phase III trial investigating the ad
(clinicaltrials.gov: NCT01717755).

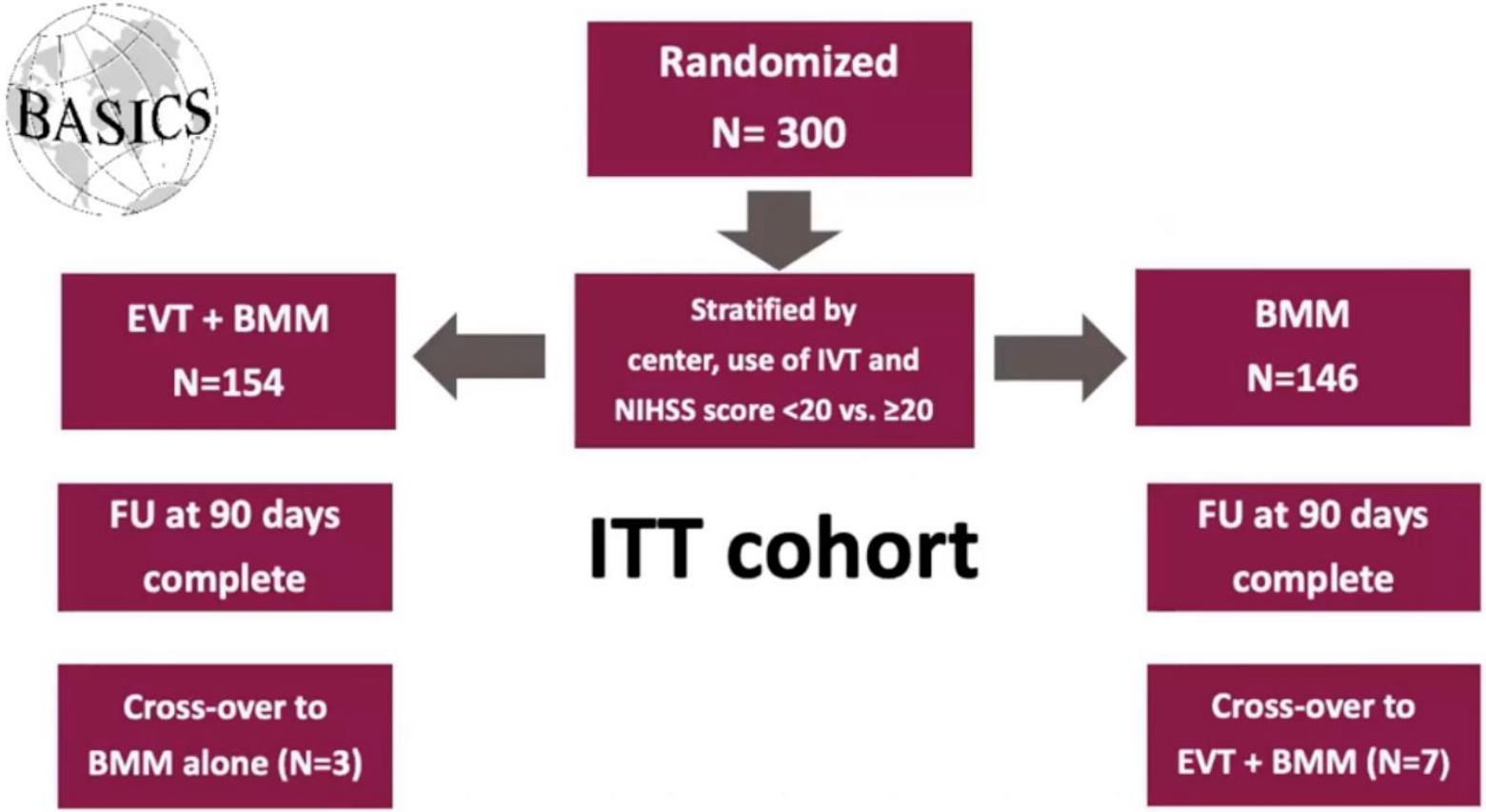
Keywords: Basilar artery occlusic
Stroke

Enrollment criteria

Patients can be enrolled in the study if the following criteria have been met:

1. symptoms and signs compatible with ischaemia in the basilar artery territory and an National Institutes of Health Stroke Scale (NIHSS) ≥10 at time of randomisation;
2. BAO confirmed by CTA or MRA;
3. aged 18 to 85 years;
4. initiation of IV rt-PA within 4.5 h of estimated time of BAO. Estimated time of BAO is defined as time of onset of acute symptoms consistent with the clinical diagnosis of basilar artery occlusion or if not known last time patient was seen normal prior to onset of these symptoms, hence time from symptom onset can be considerably longer than 4.5 h;
5. initiation of IA therapy should be feasible within 6 h of estimated time of BAO;
6. informed consent.

Van der Heuven et al., Trials 2013



Schoenwille, ESOC 2021

BASICS

Safety outcomes

	BMM + EVT (n=154)	BMM (n=146)	Risk Ratio (95% CI)*
sICH ≤3days	6 (3.9%)	1 (0.7%)	5.6 (0.7 – 45)
Mortality at 90 days	59 (38.3%)	63 (43.2%)	0.9 (0.7 – 1.1)

* Adjusted for stratification and atrial fibrillation

Schoenwille, ESOC 2021

The NEW ENGLAND JOURNAL of MEDICINE

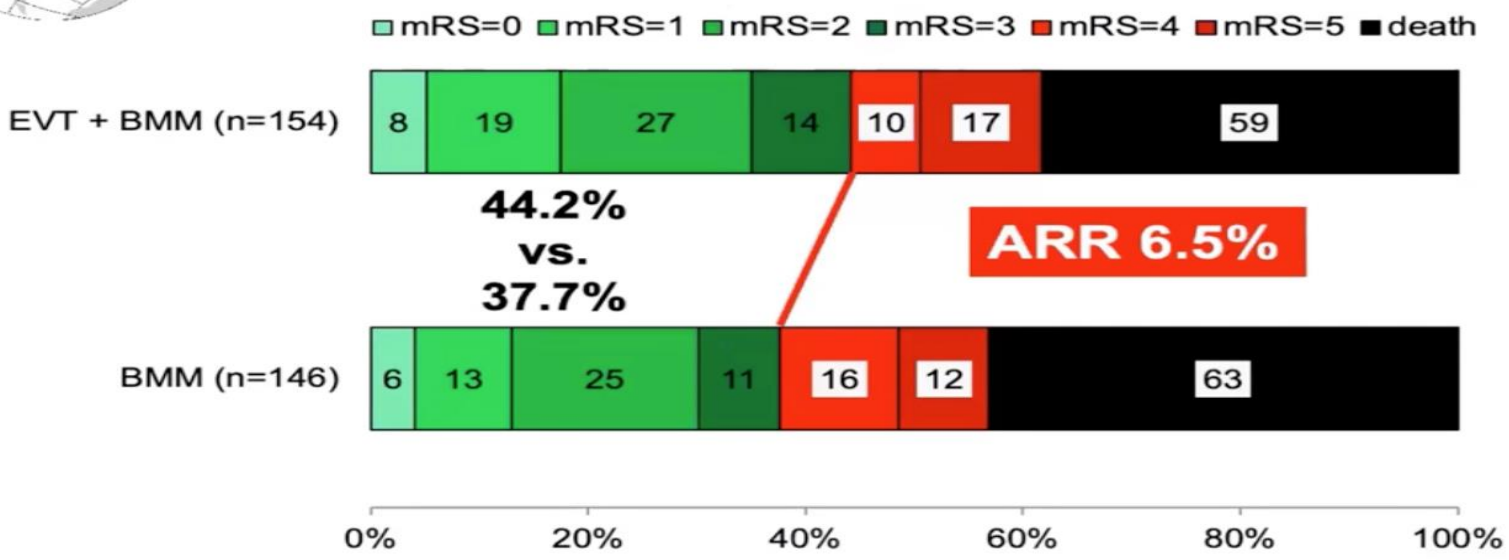
ORIGINAL ARTICLE

Endovascular Therapy for Stroke Due to Basilar-Artery Occlusion

L.C.M. Langezaal, E.J.R.J. van der Hoeven, F.J.A. Mont'Alverne, J.J.F. de Carvalho, F.O. Lima, D.W.J. Dippel, A. van der Lugt, R.T.H. Lo, J. Boiten, G.J. Lycklama à Nijeholt, J. Staals, W.H. van Zwam, P.J. Nederkoorn, C.B.L.M. Majoie, J.C. Gerber, M. Mazighi, M. Piotin, A. Zini, S. Vallone, J. Hofmeijer, S.O. Martins, C.H. Nolte, K. Szabo, F.A. Dias, D.G. Abud, M.J.H. Wermer, M.J.M. Remmers, H. Schneider, C.M. Rueckert, K.F. de Laat, A.J. Yoo, P.-J. van Doormaal, A.C.G.M. van Es, B.J. Emmer, P. Michel, V. Puetz, H.J. Audebert, O.M. Pontes-Neto, J.-A. Vos, L.J. Kappelle, A. Algra, and W.J. Schonewille, for the BASICS Study Group*

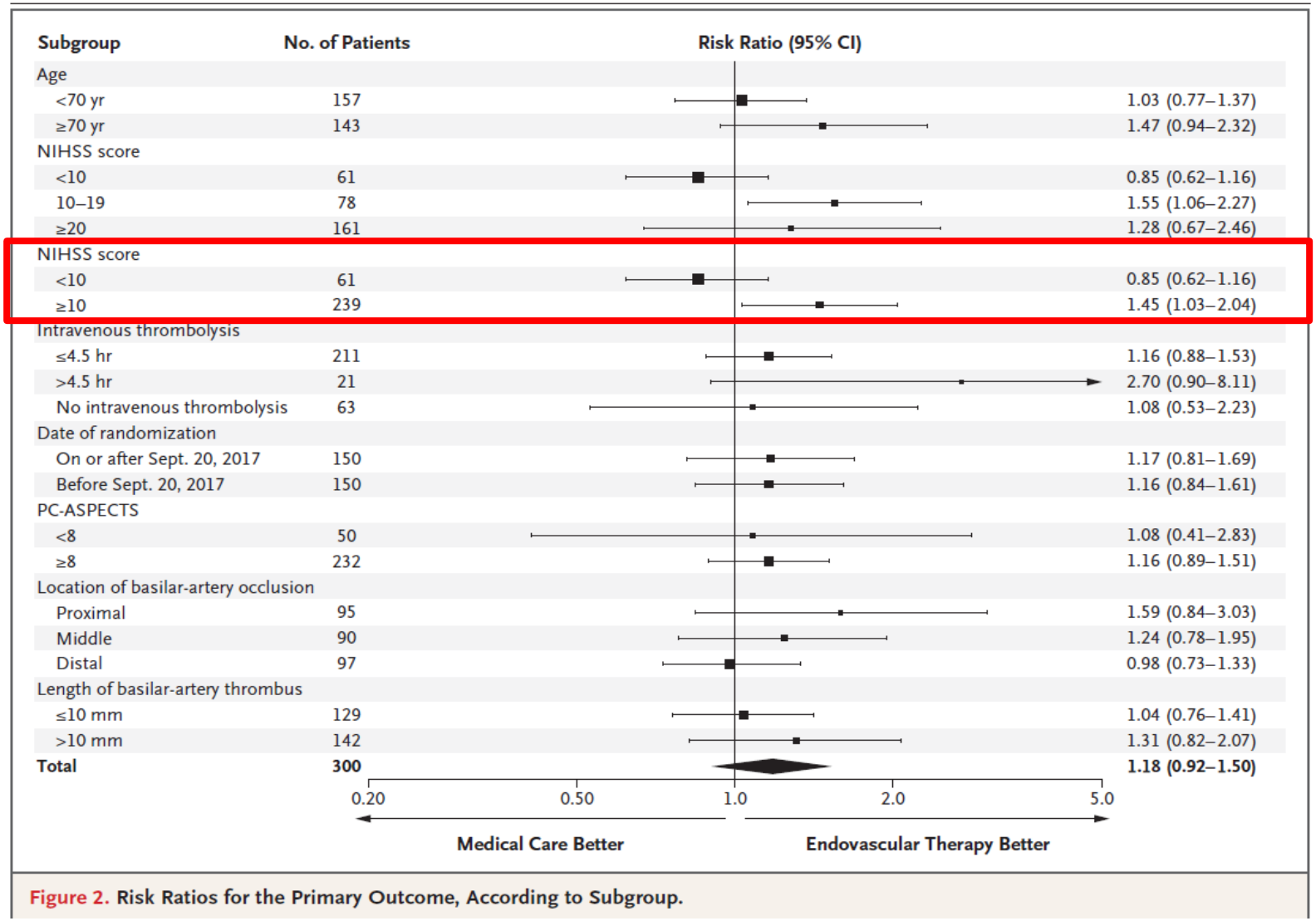
BASICS

Primary outcome



Schoenwille, ESOC 2021

BASICS SUBGROUP ANALYSES



Subgroup	No. of Patients	Risk Ratio (95% CI)
Age		
<70 yr	157	1.03 (0.77–1.37)
≥70 yr	143	1.47 (0.94–2.32)
NIHSS score		
<10	61	0.85 (0.62–1.16)
10–19	78	1.55 (1.06–2.27)
≥20	161	1.28 (0.67–2.46)
NIHSS score		
<10	61	0.85 (0.62–1.16)
≥10	239	1.45 (1.03–2.04)
Intravenous thrombolysis		
≤4.5 hr	211	1.16 (0.88–1.53)
>4.5 hr	21	2.70 (0.90–8.11)
No intravenous thrombolysis	63	1.08 (0.53–2.23)
Date of randomization		
On or after Sept. 20, 2017	150	1.17 (0.81–1.69)
Before Sept. 20, 2017	150	1.16 (0.84–1.61)
PC-ASPECTS		
<8	50	1.08 (0.41–2.83)
≥8	232	1.16 (0.89–1.51)
Location of basilar-artery occlusion		
Proximal	95	1.59 (0.84–3.03)
Middle	90	1.24 (0.78–1.95)
Distal	97	0.98 (0.73–1.33)
Length of basilar-artery thrombus		
≤10 mm	129	1.04 (0.76–1.41)
>10 mm	142	1.31 (0.82–2.07)
Total	**300**	**1.18 (0.92–1.50)**

Figure 2. Risk Ratios for the Primary Outcome, According to Subgroup.

Langezaal et al, NEJM 2021

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Trial of Thrombectomy 6 to 24 Hours after Stroke Due to Basilar-Artery Occlusion

T.G. Jovin, C. Li, L. Wu, C. Wu, Jian Chen, C. Jiang, Z. Shi, Z. Gao, C. Song, W. Chen, Y. Peng, C. Yao, M. Wei, T. Li, L. Wei, G. Xiao, H. Yang, M. Ren, J. Duan, X. Liu, Qingwu Yang, Y. Liu, Qingfeng Zhu, W. Shi, Qiyi Zhu, X. Li, Z. Guo, Qi Yang, C. Hou, W. Zhao, Q. Ma, Y. Zhang, L. Jiao, H. Zhang, D.S. Liebeskind, H. Liang, A.P. Jadhav, C. Wen, S. Brown, L. Zhu, H. Ye, M. Ribo, M. Chang, H. Song, Jun Chen, and X. Ji, for the BAOCHE Investigators*

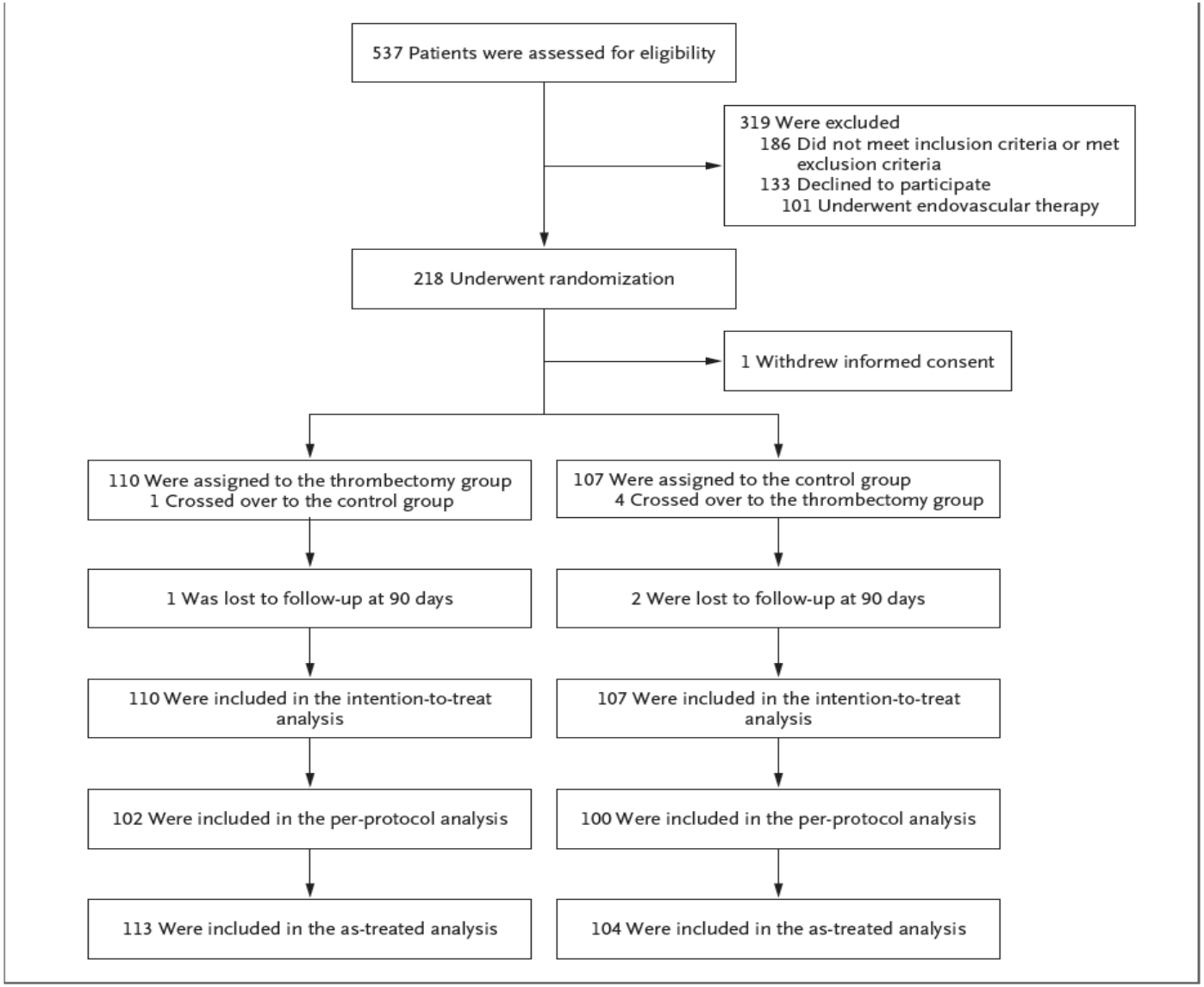
Basilar Artery Occlusion CHinese Endovascular trial

BAOCHE

Tudor G. Jovin MD & Xunming Ji MD
on behalf of the BAOCHE investigators

ClinicalTrials.gov, NCT02737189
Sponsored by Chinese National Ministry of Science and Technology

BAOCHE CONSORT DIAGRAM



Jovin TG et al., NEJM 2022

BAOCHE Inclusion/exclusion criteria

Inclusion Criteria	
	1. Posterior circulation acute ischemic stroke within 6-24 hours from symptom onset/last seen well (except for isolated vertigo), where patient is ineligible fo IV thrombolytic treatment or the treatment is contraindicated (e.g., subjec presents beyond recommended time from symptom onset), or where patien has received IV thrombolytic therapy without recanalization.
	2. Occlusion (TIMI 0-1) of the basilar artery or intracranial segments of bot vertebral arteries (V4) as evidenced by CTA/MRA/DSA.
	3. Age ≥18 and ≤ 80.
	4. Baseline NIHSS score obtained prior to randomization must be equal or highe than 6 points.
	5. No significant pre-stroke functional disability (mRS ≤ 1).
	6. Patient treatable within 24 hours of symptom onset. Symptoms onset is define as point in time the patient was last seen well (at baseline) if patients are unabl to provide a reliable history or the point in time when symptoms have starte if patients can provide a reliable history. Isolated vertigo (not accompanied b dysarthria, motor weakness, sensory symptoms, double vision, depressed leve of consciousness) is not considered onset of symptoms. Treatment start i defined as groin puncture.
	7. Informed consent obtained from patient or acceptable patient surrogate.

Neuroimaging exclusion criteria

17. Hypodensity amounting to a posterior circulation Acute Stroke Prognosis Early CT score (pc-ASPECTS) < 6 and Pons-midbrain-index of ≥ 3 on CT angiography source images or MR with diffusion-weighted imaging or non-contrast CT.
18. CT or MR evidence of hemorrhage (the presence of microbleeds on MRI is allowed).
19. Complete cerebellar infarct on CT or MRI with significant mass effect and compression of the fourth ventricle.
20. Complete unilateral or bilateral thalamic infarction on CT or MRI.
21. Evidence of vertebral occlusion, high grade stenosis or arterial dissection in the extracranial or intracranial segment that cannot be treated or will prevent access to the intracranial clot or excessive tortuosity of cervical vessels precluding device delivery/deployment.
22. Subjects with occlusions in both anterior and posterior circulation.
23. Evidence of intracranial tumor (except small meningioma).

Jovin TG et al., NEJM 2022

Extent of Hypoattenuation on CT Angiography Source Images Predicts Functional Outcome in Patients With Basilar Artery Occlusion

Volker Puetz, MD; P.N. Sylaja, MD; Shelagh B. Coutts, MD; Michael D. Hill, MD, MSc; Imanuel Dzialowski, MD; Pia Mueller, MD; Ulf Becker, MD; Gabriele Urban; Christine O'Reilly, BSc; Philip A. Barber, MD; Pranshu Sharma, MD; Mayank Goyal, MD; Georg Gahn, MD; Ruediger von Kummer, MD; Andrew M. Demchuk, MD

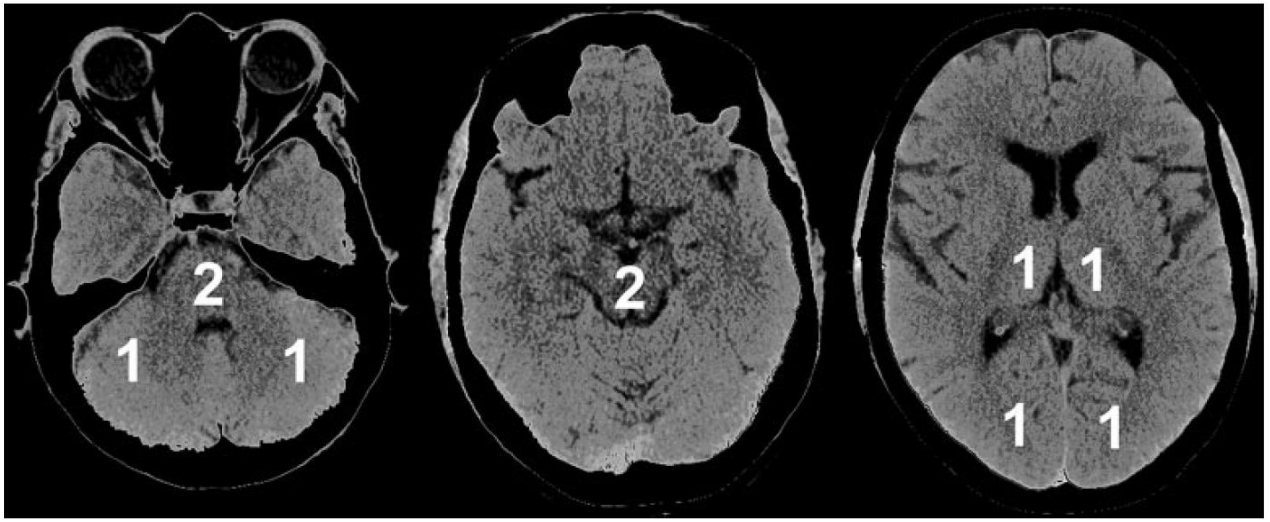


Figure 1. The posterior circulation Acute Stroke Prognosis Early CT score (pc-ASPECTS). From 10 points, 1 or 2 points each (as indicated) are subtracted for early ischemic changes (NCCT) or hypoattenuation (CTASI) in: left or right thalamus, cerebellum or PCA-territory, respectively (1 point); any part of midbrain or pons (2 points). Pc-ASPECTS=10 indicates a normal scan, pc-ASPECTS=0 indicates early ischemic changes (NCCT) or hypoattenuation (CTASI) in all above territories.

BAOCHE Baseline Characteristics

Table 1. Characteristics of the Patients at Baseline.*

Characteristic	Thrombectomy (N = 110)	Control (N = 107)
Age — yr	64.2±9.6	63.7±9.8
Male sex — no. (%)	80 (73)	79 (74)
Medical history		
Atrial fibrillation — no. (%)	14 (13)	13 (12)
Diabetes mellitus — no. (%)	30 (27)	29 (27)
Hypertension — no./total no. (%)	90/110 (82)	79/106 (75)
Modified Rankin scale score of 0 before stroke — no. (%)	85 (77)	89 (83)
NIHSS score†		
Median (IQR)	20 (15–29)	19 (12–30)
Distribution — no. (%)		
6–20	66 (60)	61 (57)
>20	44 (40)	46 (43)
Median systolic blood pressure at hospital arrival (IQR) — mm Hg‡	157 (138–175)	152 (138–166)
Median glucose level at hospital arrival (IQR) — mmol/liter§	8.0 (6.4–9.9)	7.6 (6.0–10.2)
Intravenous thrombolysis — no. (%)	15 (14)	23 (21)
Imaging characteristics		
Median PC-ASPECTS (IQR)¶	8 (7–10)	8 (7–10)
Median Pons-Midbrain Index (IQR)‖	1 (0–2)	1 (0–2)
Basilar-artery occlusion site — no./total no. (%)**		
Proximal basilar artery	53/107 (50)	45/105 (43)
Middle basilar artery	40/107 (37)	37/105 (35)
Distal basilar artery	13/107 (12)	23/105 (22)
Workflow times		
Distribution — no. (%)		
6–12 hr	64 (58)	71 (66)
>12 hr	46 (42)	36 (34)
Median duration (IQR) — min		
From stroke onset to randomization	664 (512–861)	662 (492–838)
From stroke onset to revascularization††	790 (626–1000)	NA
From hospital admission to groin puncture‡‡	153 (99–235)	NA
From groin puncture to revascularization§§	85 (59–129)	NA

Jovin TG et al., NEJM 2022

BAOCHE SAFETY RESULTS

Safety outcomes				
Death within 90 days	34 (31)	45 (42)	Risk ratio	0.75 (0.54 to 1.04)
Symptomatic intracranial hemorrhage¶¶				
According to SITS-MOST criteria	6/102 (6)	1/88 (1)	Risk ratio	5.18 (0.64 to 42.18)
According to ECASS II criteria	9/102 (9)	2/88 (2)	Risk ratio	3.88 (0.86 to 17.49)
Asymptomatic intracranial hemorrhage	8/102 (8)	3/88 (3)	Risk ratio	2.30 (0.63 to 8.41)
Procedure-related complication	12 (11)	NA		—
Vessel dissection	4 (4)	NA		—
Vessel perforation	3 (3)	NA		—
Distal embolization	5 (5)	NA		—
Other serious adverse events				
Pneumonia	51 (46)	50 (47)		—
Malignant brain edema	14 (13)	11 (10)		—
Gastrointestinal hemorrhage	15 (14)	10 (9)		—
Acute renal insufficiency	3 (3)	5 (5)		—
Cardiac ischemia	0	4 (4)		—
Acute heart failure	16 (15)	22 (21)		—
Acute respiratory failure	21 (19)	26 (24)		—

Jovin TG et al., NEJM 2022

BAOCHE EFFICACY RESULTS

Table 2. Trial Outcomes.*

Outcome	Thrombectomy (N=110)	Control (N=107)	Measure of Effect	Adjusted Value (95% CI)†
Primary outcome				
Modified Rankin scale score of 0–3 at 90 days — no. (%)	51 (46)	26 (24)	Rate ratio	1.81 (1.26 to 2.60)‡
Secondary outcomes				
Modified Rankin scale score at 90 days§	NA	NA	Common odds ratio	2.64 (1.54 to 4.50)
Modified Rankin scale score of 0 to 2 at 90 days — no. (%)	43 (39)	15 (14)	Rate ratio	2.75 (1.65 to 4.56)
Modified Rankin scale score of 0 to 4 at 90 days — no. (%)¶	61 (55)	46 (43)	Rate ratio	1.21 (0.95 to 1.54)
Dramatic neurologic improvement at 24 hr — no./total no. (%)‖	25/101 (25)	9/94 (10)	Rate ratio	2.50 (1.23 to 5.07)
Barthel Index score of 95 to 100 at 90 days — no./total no. (%)**	26/73 (36)	10/56 (18)	Rate ratio	2.20 (1.16 to 4.17)
Basilar-artery patency at 24 hr — no./total no. (%)††	76/83 (92)	15/77 (19)	Rate ratio	4.53 (2.81 to 7.30)
Median EQ-5D-3L score at 90 days (IQR)‡‡	0.78 (0.36–1.00)	0.46 (0.11–0.73)	Mean difference	0.24 (0.10 to 0.39)
Reperfusion on digital subtraction angiography — no./total no. (%)§§	89/101 (88)	NA		

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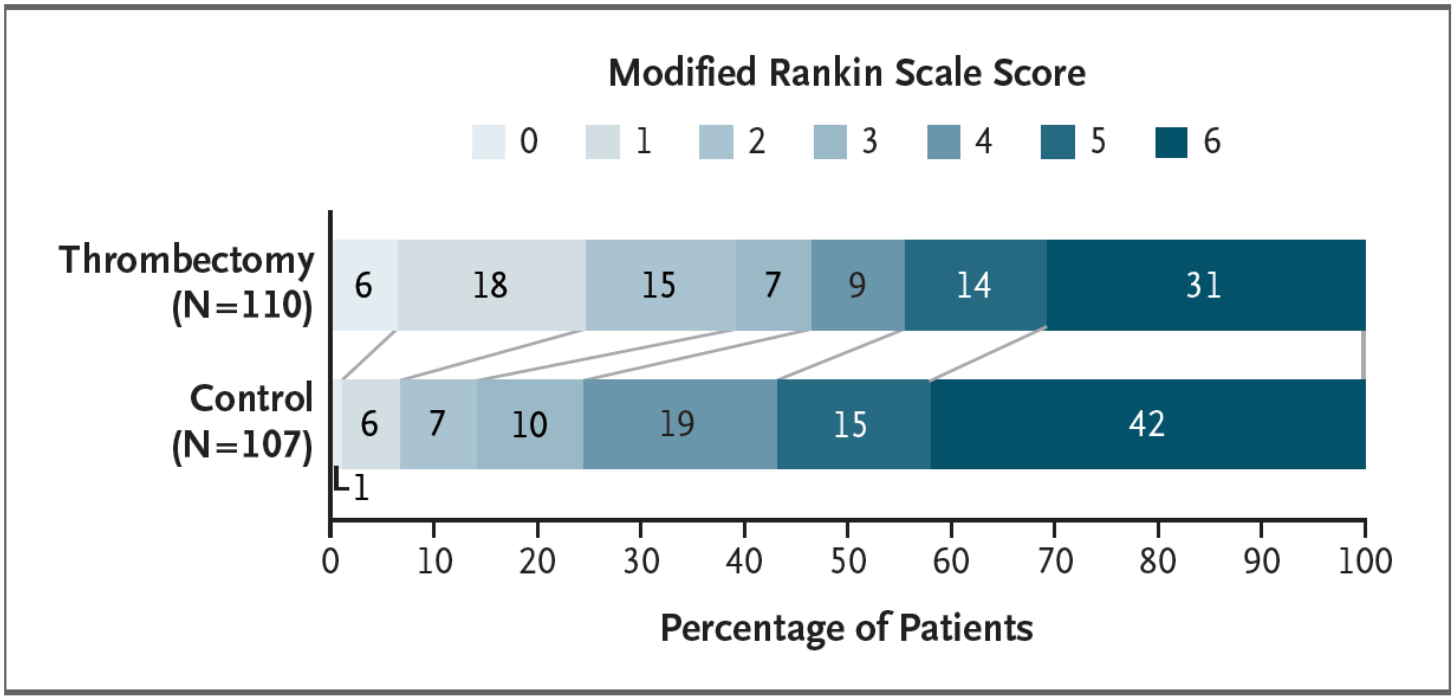
BAOCHE EFFICACY RESULTS

Common odds ratio 2.64 (1.54 to 4.50)



NNT=4.5

Figure 2. Distribution of Functional Scores at 90 Days (Intention-to-Treat Population).

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BAOCHE INTRACRANIAL STENTING

	Thrombectomy arm# N=110	mRS 0-3 at 90 days	sICH (SITS MOST)	sICH (ECASS III)
Intracranial stenting (total)	41/110 (37%)	17/41(41.5%)	2/38 (5.3%)	4/38 (10.5%)
Solitaire detached	28/41 (68%)			
Other stents	13/41 (32%)			

Jovin TG et al., NEJM 2022

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Trial of Endovascular Treatment of Acute Basilar-Artery Occlusion

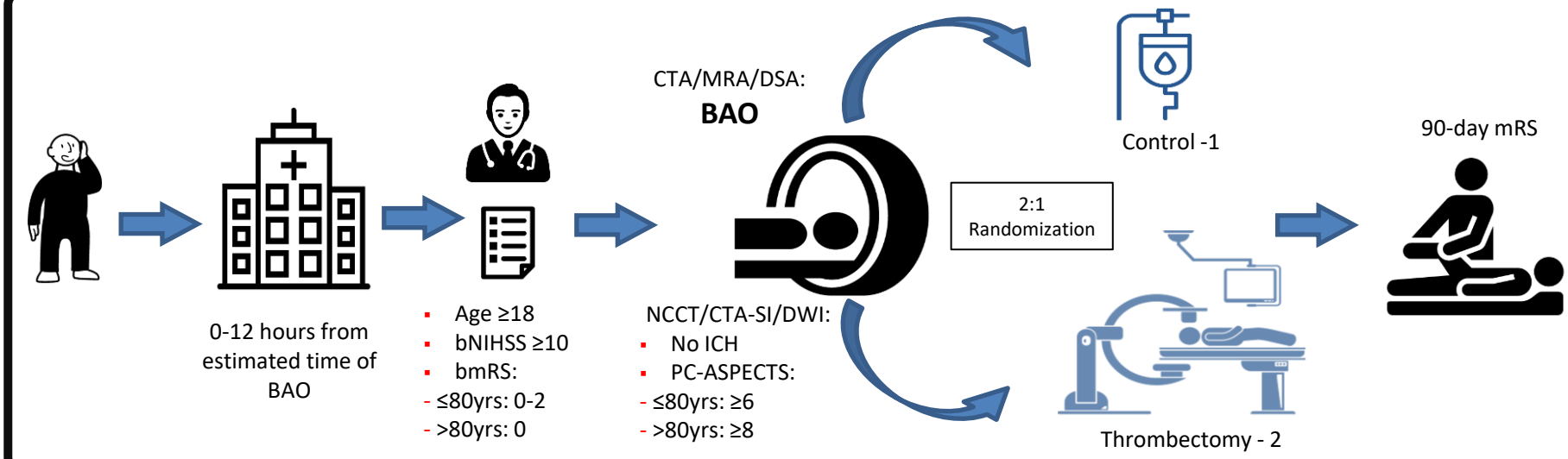
C. Tao, R.G. Nogueira, Y. Zhu, J. Sun, H. Han, G. Yuan, C. Wen, P. Zhou, W. Chen, G. Zeng, Y. Li, Z. Ma, C. Yu, J. Su, Z. Zhou, Z. Chen, G. Liao, Y. Sun, Y. Ren, H. Zhang, J. Chen, X. Yue, G. Xiao, Li Wang, R. Liu, W. Liu, Y. Liu, Li Wang, C. Zhang, T. Liu, J. Song, R. Li, P. Xu, Y. Yin, G. Wang, B. Baxter, A.I. Qureshi, X. Liu, and W. Hu, for the ATTENTION Investigators*

Tao et al., NEJM 2022

Study Objective

- To evaluate the hypothesis that Endovascular Therapy (EVT) is superior to Best Medical Management (BMM) alone in achieving more favorable outcomes (mRS ≤3) at 90 days in subjects presenting with Acute Basilar Artery Occlusion Stroke within ≦ 12 hours from the estimated time of BAO.

Study Methods



Tao et al., NEJM 2022

February 20, 2021 to January 3, 2022

Tao et al., NEJM 2022

Endovascular Treatment

Characteristic	EVT (N = 226)
Stent retriever only	11 (4.9%)
Aspiration only	77 (34.1%)
Combined technique	110 (48.7%)
Intracranial angioplasty/stenting	88 (38.9%)
Extracranial angioplasty/stenting	18 (8.0%)
Intra-arterial thrombolysis	12 (5.3%)
Final mTICI. 2b or 3-no./total no. (%)	208/223 (93.3%)

Tao et al., NEJM 2022

Primary Outcome: mRS 0-3 at 90 days

46.0 %
(n=104/226)

22.8%
(n= 26/114)

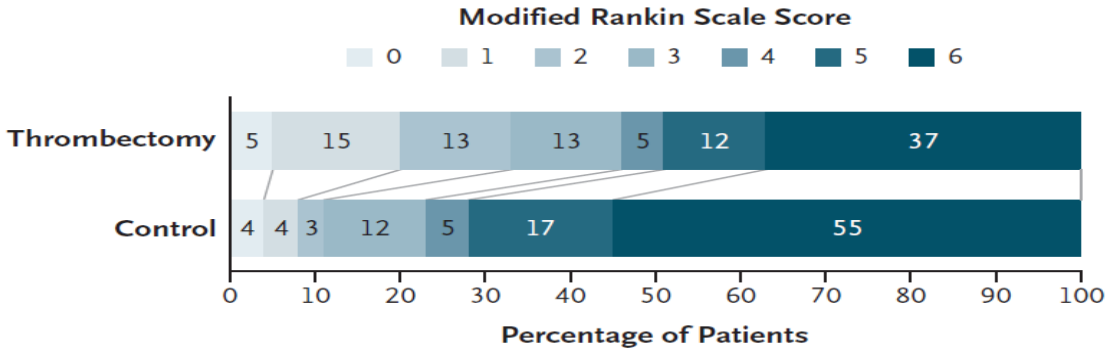


Figure 2. Distribution of Functional Outcomes at 90 Days in the Intention-to-Treat Population.

Shown are scores on the modified Rankin scale for the patients in the two treatment groups. The intention-to-treat population included all the patients who provided informed consent and underwent randomization. No patients were lost to follow-up. Scores range from 0 to 6, with 0 indicating no symptoms, 1 no clinically significant disability, 2 slight disability (patients are able to look after their own affairs without assistance but are unable to carry out all previous activities), 3 moderate disability (patients require some help but are able to walk unassisted), 4 moderately severe disability (patients are unable to attend to bodily needs without assistance and are unable to walk unassisted), 5 severe disability (patients require constant nursing care and attention), and 6 death. The adjusted common odds ratio for the modified Rankin scale score toward a better outcome with endovascular thrombectomy at 90 days was 2.87 (95% CI, 1.84 to 4.47).

NNT=4

Tao et al.,
NEJM 2022

Secondary Outcomes:

Outcome	EVT (N = 226)	BMM (N = 114)	Measure of effect	Adjusted Value (95% CI)	P value
Imaging Outcomes					
Patency at 24-72 hr on CTA/MRA — no./total no. (%)	148/162 (91.4)	26/69 (37.7)	Risk ratio	2.5 (1.9, 3.5)	<0.001
Asymptomatic Intracranial hemorrhage at 24-72h-no. (%)	19 (8.4)	2 (1.8)	Risk ratio	4.5 (1.0, 19.3)	0.054
Safety outcomes					
Death — no. (%)	83 (36.7)	63 (55.3)	Risk ratio	0.7 (0.5, 0.8)	<0.001
Symptomatic ICH (SIT-MOST criteria) at 24-72 h, No. (%)	12 (5.3)	0	Risk difference	5.3% (2.3%, 8.2%)	0.001

ATTENTION

Adjusted for age, baseline NIHSS, pre-morbid mRS, time from onset to randomization.
The 95% CI not adjusted for multiple comparisons.

Tao et al., NEJM 2022

Vertebrobasilar Occlusion Randomization to Endovascular Reperfusion versus Intravenous Thrombolysis or Medical Treatment Alone Systematic Evaluation (VERITAS) Collaboration

Raul G Nogueira, Tudor G Jovin, Xunming Ji, Lucianne C Langezaal, Qiliang Dai, Chunrong Tao, Timothy P Moran, Mohamed Doheim, Xinfeng Liu, Weiu Hu, Wouter J Schonewille **for the ATTENTION, BAOCHE, BASICS and BEST Investigators**

Nogueira et al., ISC 2023

Background:

Endovascular treatment versus standard medical treatment for vertebrobasilar artery occlusion (BEST): an open-label, randomised controlled trial

Xinfeng Liu, Qiliang Dai, Ruidong Ye, Wenjie Zi, Yuxiu Liu, Huaiming Wang, Wusheng Zhu, Minmin Ma, Qin Yin, Min Li, Xinying Fan, Wen Sun, Yunfei Han, Qiushi Lv, Rui Liu, Dong Yang, Zhonghua Shi, Dequan Zheng, Xiaorong Deng, Yue Wan, Zhen Wang, Yu Geng, Xingyu Chen, Zhiming Zhou, Geng Liao, Ping Jin, Yumin Liu, Xintong Liu, Meng Zhang, Feng Zhou, Hongchao Shi, Yunfeng Zhang, Fuqiang Guo, Congguo Yin, Guozhong Niu, Mei Zhang, Xueli Cai, Qiyi Zhu, Zhonglun Chen, Yingchun Liang, Bing Li, Min Lin, Wei Wang, Haowen Xu, Xinmin Fu, Wenhua Liu, Xiguang Tian, Zili Gong, Haicun Shi, Chuanming Wang, Penghua Lv, Zhonghai Tao, Liangfu Zhu, Shiquan Yang, Wei Hu, Pingzhou Jiang, David S Liebeskind, Vitor M Pereira, Thomas Leung, Bernard Yan, Stephen Davis, Gelin Xu, Raul G Nogueira*, on behalf of the BEST Trial Investigators†*

Lancet Neurol. 2020 Feb;19(2):115-122.

ORIGINAL ARTICLE

Trial of Endovascular Treatment of Acute Basilar-Artery Occlusion

C. Tao, R.G. Nogueira, Y. Zhu, J. Sun, H. Han, G. Yuan, C. Wen, P. Zhou, W. Chen, G. Zeng, Y. Li, Z. Ma, C. Yu, J. Su, Z. Zhou, Z. Chen, G. Liao, Y. Sun, Y. Ren, H. Zhang, J. Chen, X. Yue, G. Xiao, Li Wang, R. Liu, W. Liu, Y. Liu, Li Wang, C. Zhang, T. Liu, J. Song, R. Li, P. Xu, Y. Yin, G. Wang, B. Baxter, A.I. Qureshi, X. Liu, and W. Hu, for the ATTENTION Investigators*

N Engl J Med 2022;387:1361-72.

ORIGINAL ARTICLE

Endovascular Therapy for Stroke Due to Basilar-Artery Occlusion

L.C.M. Langezaal, E.J.R.J. van der Hoeven, F.J.A. Mont'Alverne, J.J.F. de Carvalho, F.O. Lima, D.W.J. Dippel, A. van der Lugt, R.T.H. Lo, J. Boiten, G.J. Lycklama à Nijeholt, J. Staals, W.H. van Zwam, P.J. Nederkoorn, C.B.L.M. Majoie, J.C. Gerber, M. Mazighi, M. Piotin, A. Zini, S. Vallone, J. Hofmeijer, S.O. Martins, C.H. Nolte, K. Szabo, F.A. Dias, D.G. Abud, M.J.H. Wermer, M.J.M. Remmers, H. Schneider, C.M. Rueckert, K.F. de Laat, A.J. Yoo, P.-J. van Doormaal, A.C.G.M. van Es, B.J. Emmer, P. Michel, V. Puetz, H.J. Audebert, O.M. Pontes-Neto, J.-A. Vos, L.J. Kappelle, A. Algra, and W.J. Schonewille, for the BASICS Study Group*

N Engl J Med 2021;384:1910-20.

ORIGINAL ARTICLE

Trial of Thrombectomy 6 to 24 Hours after Stroke Due to Basilar-Artery Occlusion

T.G. Jovin, C. Li, L. Wu, C. Wu, Jian Chen, C. Jiang, Z. Shi, Z. Gao, C. Song, W. Chen, Y. Peng, C. Yao, M. Wei, T. Li, L. Wei, G. Xiao, H. Yang, M. Ren, J. Duan, X. Liu, Qingwu Yang, Y. Liu, Qingfeng Zhu, W. Shi, Qiyi Zhu, X. Li, Z. Guo, Qi Yang, C. Hou, W. Zhao, Q. Ma, Y. Zhang, L. Jiao, H. Zhang, D.S. Liebeskind, H. Liang, A.P. Jadhav, C. Wen, S. Brown, L. Zhu, H. Ye, M. Ribo, M. Chang, H. Song, Jun Chen, and X. Ji, for the BAOCHE Investigators*

N Engl J Med 2022;387:1373-84.

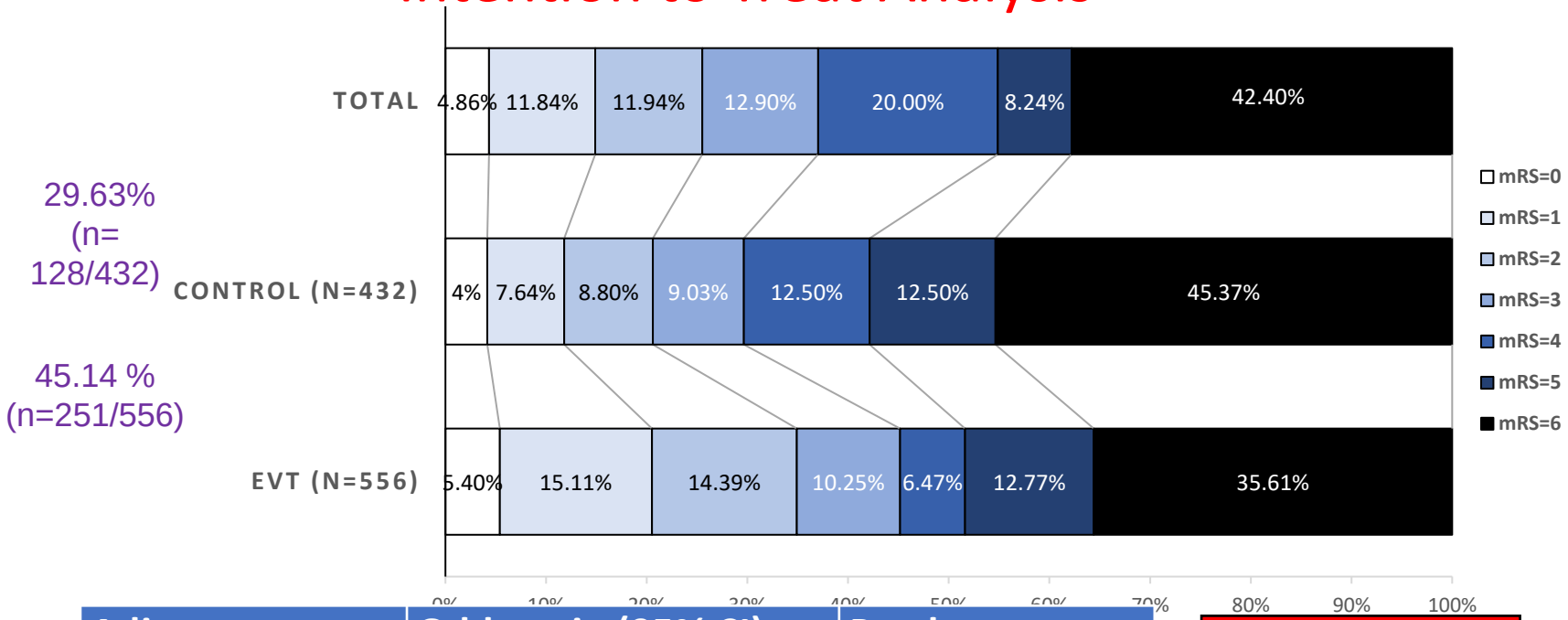
VERITAS

N= 988

Nogueira et al., ISC 2023

Primary Outcome: mRS 0-3 at 90 days

Intention to Treat Analysis



Adjustment	Odds ratio (95% CI)	P-value
Unadjusted	1.95 (1.5 to 2.5)	<0.0001
Adjusted*	2.48 (1.82 to 3.38)	<0.0001

ARR 15.51%

*Adjusted for age, sex, baseline NIHSS, baseline PC-ASPECTS, pre-morbid mRS, AF, time from onset to imaging, IVT

VERITAS

Nogueira et al., ISC 2023

Outcomes:

Per Protocol Analysis

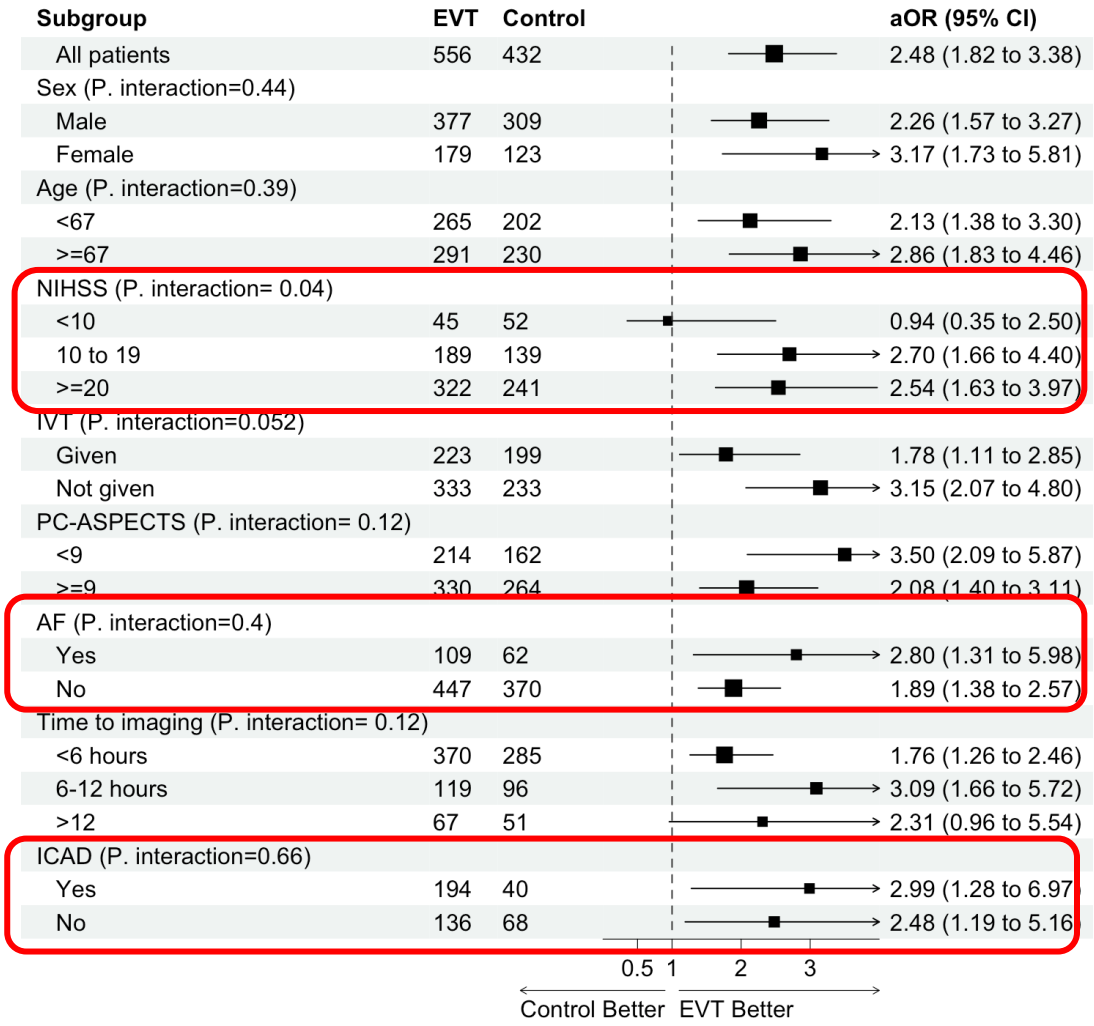
Outcome	EVT N= 546	Control N=404	Measure of effect	Adjusted value * (95% CI)	P-value
90-day mRS (0-3), N (%)	249 (45.6%)	116 (28.71 %)	Adjusted odds ratio	2.66 (1.92 to 3.67)	<0.0001
90-day mRS (0-2), N (%)	192 (35.16%)	77 (19.06%)	Adjusted odds ratio	2.87 (2.02 to 4.08)	<0.0001
90-day mRS, Md (IQR)	4 (2, 6)	5 (3, 6)	Adjusted common odds ratio	2.27 (1.75 to 2.93)	<0.0001
Symptomatic ICH, N (%)	30 (5.83%)	2 (0.53%)	Adjusted odds ratio	9.47 (2.21 to 40.63)	0.02
90-day mortality, N (%)	192 (35.16 %)	189 (46.78 %)	Adjusted odds ratio	0.52 (0.38 to 0.70)	<0.0001

***Adjusted for age, sex, baseline NIHSS, baseline PC-ASPECTS, pre-morbid mRS, AF, time from onset to imaging, IVT**

VERITAS

Nogueira et al., ISC 2023

90-Day mRS 0-3:



VERITAS

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UNRESOLVED QUESTIONS

- NIHSS 0-9
- iv vs ia vs iv/ia
- Adjunctive neuroprotectants
- Adjunctive ia (CHOICE)
- Anesthesia vs awake
- Stenting/angioplasty

Questions ?????