Early Intubation in Endovascular Therapy for Basilar Artery Occlusion

Stroke

CLINICAL TRIALS

Early Intubation in Endovascular Therapy for Basilar Artery Occlusion: A Post Hoc Analysis of the BASICS Trial

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BACKGROUND: The optimal anesthetic management for endovascular therapy (EVT) in patients with posterior circulation stroke remains unclear. Our objective was to investigate the impact of early intubation in patients enrolled in the BASICS trial (Basilar Artery International Cooperation Study).

METHODS: BASICS was a multicenter, randomized, controlled trial that compared the efficacy of EVT compared with the best medical care alone in patients with basilar artery occlusion. In this post hoc analysis, early intubation within the first 24 hours of the estimated time of basilar artery occlusion was examined as an additional covariate using regression modeling. We estimated the adjusted relative risks (RRs) for favorable outcomes, defined as modified Rankin Scale scores of 0 to 3 at 90 days. An adjusted common odds ratio was estimated for a shift in the distribution of modified Rankin Scale scores at 90 days.

RESULTS: Of 300 patients in BASICS, 289 patients were eligible for analysis (151 in the EVT group and 138 in the best medical care group). compared with medical care alone, EVT was related to a higher risk of early intubation (RR, 1.29 [95% CI, 1.09–1.53]; $P<0.01$), and early intubation was negatively associated with favorable outcome (RR, 0.61 [95% CI, 0.45–0.84]; $P=0.002$). Whereas there was no overall treatment effect of EVT on favorable outcome (RR, 1.22 [95% CI, 0.95–1.55]; $P=0.121$), EVT was associated with favorable outcome (RR, 1.34 [95% CI, 1.05–1.71]; $P=0.018$) and a shift toward lower modified Rankin Scale scores (adjusted common odds ratio, 1.63 [95% CI, 1.04–2.57]; $P=0.033$) if adjusted for early intubation.

CONCLUSIONS: In this post hoc analysis of the neutral BASICS trial, early intubation was linked to unfavorable outcomes, which might mitigate a potential benefit from EVT by indirect effects due to an increased risk of early intubation. This relationship may be considered when assessing the efficacy of EVT in patients with basilar artery occlusion in future trials.

GRAPHIC ABSTRACT: A graphic abstract is available for this article.

Key Words: anesthetics ■ basilar artery ischemia ■ intubation ■ ischemic stroke ■ treatment effectiveness

Stroke is a leading cause of acquired disability and death worldwide.[1] Several landmark trials have shown that endovascular therapy (EVT) improves functional outcomes of patients with acute ischemic stroke due to anterior circulation large vessel occlusion (acLVO).[2] Posterior circulation ischemic stroke accounts for about 10% of patients with ischemic stroke who have an intracranial large vessel occlusion and represents a different population with less-specific symptoms and overall worse prognosis.[3–6] Whereas initial randomized

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Nonstandard Abbreviations and Acronyms

acLVO	anterior circulation large vessel occlusion
BAO	basilar artery occlusion
BASICS	Basilar Artery International Cooperation Study
CS	conscious sedation
EVT	endovascular therapy
GA	general anesthesia
ICH	intracranial hemorrhage
mRS	modified Rankin Scale
NIHSS	National Institutes of Health Stroke Scale
RR	relative risk

controlled trials did not prove benefit from EVT in patients with basilar artery occlusion (BAO), recent trials have demonstrated improved functional outcomes in selected patients with BAO who are treated with EVT in addition to the best medical care.[7–10]

The optimal periprocedural anesthetic management of patients with ischemic stroke receiving EVT is not conclusively defined.[11] For acLVO, retrospective analyses of case series have shown an adverse effect of general anesthesia (GA) compared with conscious sedation (CS) on functional outcome.[12,13] In contrast, monocentric randomized controlled trials have indicated equal or improved outcomes of patients with acLVO who receive EVT under GA.[14–18]

For patients with posterior circulation stroke who may be more prone to require GA due to a reduced level of consciousness or impaired brainstem function, few studies have shown the feasibility of EVT with CS in these patients but have reported inconclusive results with regard to clinical outcome.[19–25] A recent meta-analysis based on 8 studies (1 randomized controlled trial with high risk of bias, 1 case-control study, 6 retrospective cohort studies) pointed to GA being associated with lower odds of functional independence compared with EVT under non-GA conditions but was limited by substantial inhomogeneity.[26] An exploratory randomized controlled trial including 87 patients with posterior circulation stroke who underwent EVT indicated that periprocedural CS was no better than GA in achieving favorable functional outcomes but was associated with lower reperfusion rates.[27] However, the results of this study were limited by low numbers, bicentric design, and high conversion rate (29.5%) from CS to GA. Data on the association of the anesthesia mode with the effect of EVT on functional outcomes from randomized BAO trials have not been published.

The aim of our study was to assess the association between early intubation and functional outcome of patients in the BASICS trial (Basilar Artery International Cooperation Study). While the BASICS trial was neutral regarding functional outcomes between BAO stroke patients treated with EVT and those receiving the best medical care alone, we specifically wanted to explore whether early intubation could have an adverse effect on functional outcomes.

METHODS

Patient Population

We performed a post hoc secondary analysis of observational cohort data derived from the BASICS trial. BASICS was a multicenter, randomized, controlled trial that investigated the efficacy of EVT in patients with acute symptomatic BAO and was conducted between October 2011 through December 2019. Details of the methodology and main trial results have been published.[7,28] In brief, eligible patients were individuals aged 18 years or older with acute symptomatic BAO as confirmed by computed tomography angiography or magnetic resonance angiography, who could undergo EVT within 6 hours of estimated time of BAO. Initially, only patients <85 years old and with a National Institutes of Health Scale Score (NIHSS) ≥10 points were included. After 4 years, inclusion criteria were expanded to allow recruitment of patients ≥85 years old and with an NIHSS <10 points. Best medical care could include treatment with intravenous thrombolysis within 4.5 hours since the estimated time of BAO. Imaging exclusion criteria were intracranial hemorrhage, bilateral extensive brainstem infarction, cerebellar mass effect, or acute hydrocephalus.

The study complied with The Strengthening the Reporting of Observational Studies in Epidemiology statement.[29] The trial protocol and amendments were approved by the national regulatory authority in each participating country and by the institutional review board at each participating center. All eligible patients or their legally authorized representatives provided written informed consent before enrollment.

Procedures

In the BASICS trial, patients were randomly assigned in a 1:1 ratio to receive either the best medical care or the best medical care plus EVT. The randomization was stratified by center, use of intravenous thrombolysis, and NIHSS score (<20 versus ≥20). The site investigators determined the best medical care, which was based on national guidelines and local protocols. The periprocedural anesthetic management, interventional methods, and devices for EVT were determined by local stroke neurologists, anesthetists, and interventionalists. Any intubation during the first 24 hours from the estimated time of BAO was prospectively recorded in the case report form and considered the primary exposure in this post hoc analysis. The primary reason for early intubation was classified as either routine practice (ie, routine practice to intubate and use GA before endovascular procedure and planned of a mechanical device) or medically indicated (ie, concern of ability to protect airway/aspiration risk, cardiopulmonary deterioration, signs of herniation/increased intracranial pressure, inadequate pain control or agitation, or other).[28]

Clinical Outcomes

To evaluate the efficacy of EVT and associations of early intubation with clinical outcomes, we used the modified

Rankin Scale (mRS) score 3 months after randomization. Favorable functional outcome was determined by an mRS score of 0 to 3, while an excellent functional outcome was defined by an mRS score of 0 to 2. We also assessed the safety of EVT by using data on symptomatic intracranial hemorrhage (ICH) within 3 days from randomization and mortality after 3 months. Symptomatic ICH was defined as any intracranial bleeding according to the Heidelberg Bleeding Classification, along with a neurological deterioration of ≥4 points in the NIHSS score or an increase of ≥2 points in 1 of the 11 NIHSS subcategories.[30] Basilar artery patency was assessed by using the modified arterial occlusive lesion scale at 24-hour computed tompgraphy-angiography, and partial or complete recanalization was defined as an modified arterial occlusive lesion score of 2 or 3.[31]

Statistical Analysis

Continuous variables were summarized using mean and SD or median and interquartile range, and categorical variables were presented as absolute and relative frequencies. Differences in the distribution of variables between groups and subgroups were assessed using appropriate statistical tests, including Wilcoxon rank-sum test, Student *t* test, χ^2 test, or Fisher Exact test. In line with the study protocol, robust Poisson regression was used to estimate the associations between treatment allocation and binary outcomes (favorable and excellent functional outcomes and death at 3 months) and relationships between treatment allocation and early intubation, adjusting for covariates such as intravenous thrombolysis, baseline NIHSS score, and atrial fibrillation as in the BASICS main article, and for early intubation.[7,28] Robust Poisson regression facilitates consistent estimation of relative risks (RRs), irrespective of the distribution of the outcome.[32] Models including a multiplicative interaction term between treatment status and intubation were estimated to explore interaction effects. Estimates were expressed as adjusted RRs with 95% Cis and *P* values. Subgroup analysis was conducted by stratifying estimates by intubation status. Ordered logistic regression was added as a sensitivity analysis to model mRS values on the original scale ranging from 0 to 6. This analysis was adjusted for the abovementioned covariates and adjusted common odds ratios were derived. The Brant test was used to test the assumption of proportional odds. To account for missing data on intubation status, a sensitivity analysis was conducted using bootstrapping-based multiple imputation (m=10 datasets). Rubin rule was used to combine multiple imputation estimates with df correction.[33] The significance level was set to 0.05 for all analyses. The statistical software used for analyses were Stata (version 16.1) and R (version 4.1.1).

RESULTS

Patient Population

Out of 300 patients included in the intention-to-treat population of the BASICS trial, 11 (3.7%) patients were excluded from this post hoc analysis because of missing data on intubation status (Figure 1). Among the remaining 289 patients (mean age was 66.9±12.7 years, 34.6% were women, median NIHSS score was 22 [interquartile range, 11–35] points), 151 (52.2%) received EVT and 138 (47.8%) received the best medical care. More patients in the EVT group were intubated within 24 hours from the estimated time of BAO compared with the medical care group (63.6% versus

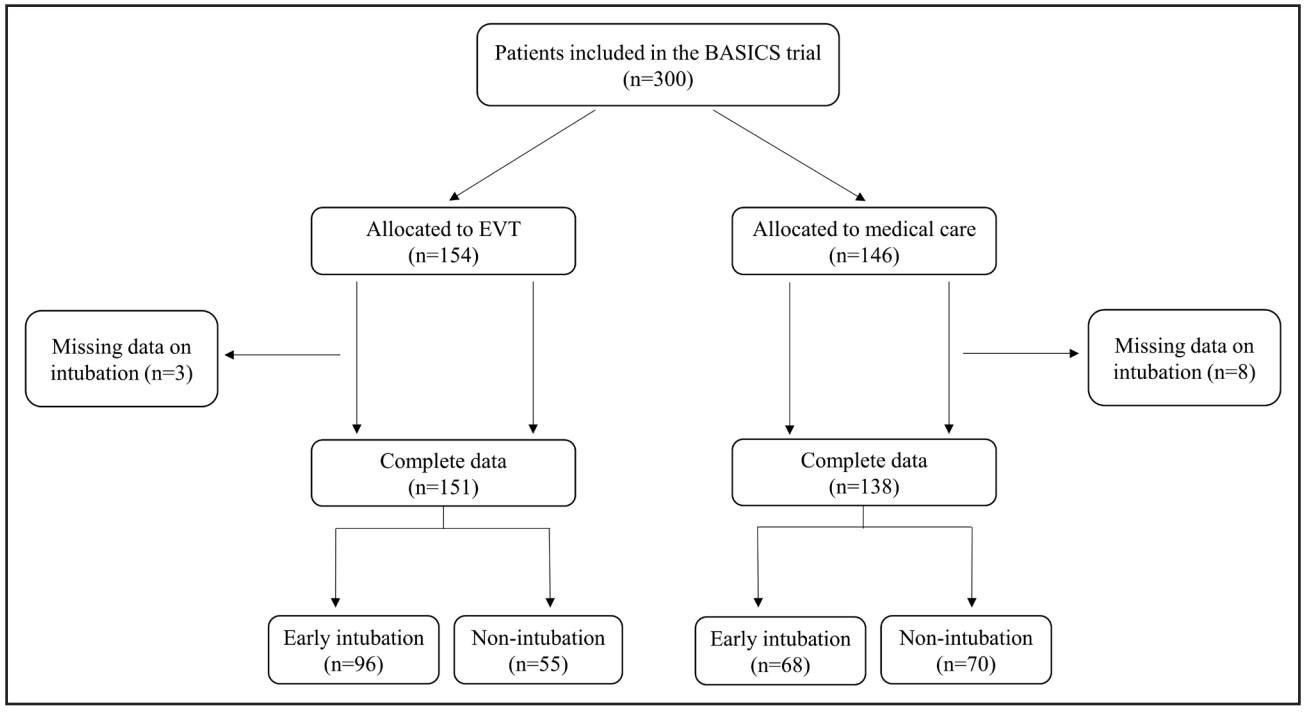

Figure 1. Flow diagram of the study population.
BASICS indicates Basilar Artery International Cooperation Study; and EVT, endovascular therapy

49.3%; *P*=0.014). Among the patients who underwent early intubation, reasons for intubation were more frequently related to routine practice in the EVT group than in the medical care group (15.8% versus 2.9%; *P*=0.009). The remaining patients were intubated for medical reasons. Atrial fibrillation was more frequent in the EVT group (29.1% versus 15.2%; *P*=0.005), but both groups were balanced in terms of demographics, medical history, stroke severity, and treatment specifics (Table 1).

The risk of intubation within the first 24 hours from estimated time of BAO was higher among patients who underwent EVT, and these patients had higher baseline NIHSS scores, were younger, and more often of male patients (*P*<0.05 for all relative risk estimates; Table 2).

Association of Early Intubation With Functional Outcome

As in the original analysis of the BASICS trial, there was no statistically significant overall treatment effect of EVT on favorable functional outcome when adjusted for atrial fibrillation, baseline stroke severity, and intravenous thrombolysis in this post hoc population (RR, 1.22 [95% CI, 0.95–1.55]; *P*=0.121; Table 3). When additionally considered in the regression model, early intubation was adversely associated with favorable functional outcomes at 3 months (RR, 0.61 [95% CI, 0.45–0.84]; *P*=0.002), whereas EVT was associated with an increased likelihood of favorable functional outcome (mRS scores 0–3) at 3 months compared with

Table 1. Baseline Characteristics of the Post Hoc Population According to Treatment Allocation and Intubation Status

Variable	All medical care (n=138)	All endovascular therapy (n=151)	*P* value	Medical care			Endovascular therapy		
				Intubation (n=68)	No intubation (n=70)	*P* value	Intubation (n=96)	No intubation (n=55)	*P* value
Age, mean±SD	67.1±12.2	66.9±13.2	0.89	65.6±12.4	68.5±11.8	0.15	66.7±12.6	67.2±14.3	0.83
Woman, n (%)	47 (34.1)	53 (35.1)	0.85	23 (33.8)	24 (34.3)	0.95	25 (26)	28 (50.9)	0.002
Medical history, n (%)									
Arterial hypertension	80 (58.4)	93 (61.6)	0.58	43 (63.2)	37 (53.6)	0.25	61 (63.5)	32 (58.2)	0.52
Diabetes	29 (21)	32 (21.3)	0.95	15 (22.1)	14 (20)	0.77	21 (21.2)	11 (20.4)	0.83
Atrial fibrillation	21 (15.2)	44 (29.1)	0.005	13 (19.1)	8 (11.4)	0.21	25 (26)	19 (34.6)	0.27
Coronary heart disease	18 (13.1)	20 (13.3)	0.98	5 (7.5)	13 (18.6)	0.05	13 (13.5)	7 (12.7)	0.89
Peripheral artery disease	7 (5.1)	10 (6.7)	0.57	2 (3)	5 (7.1)	0.44	7 (7.4)	3 (5.6)	0.75
Obesity (BMI>30)	11 (8.3)	13 (8.9)	0.85	7 (10.5)	4 (6.1)	0.53	10 (10.9)	3 (5.6)	0.37
Ischemic stroke	24 (17.4)	25 (16.6)	0.85	16 (23.5)	8 (11.4)	0.06	17 (17.7)	8 (14.6)	0.68
Posterior stroke	6 (4.4)	10 (6.6)	0.39	5 (7.4)	1 (1.4)	0.11	7 (7.3)	3 (5.5)	0.75
NIHSS, median (IQR)	22 (11–36)	21 (11–34)	0.99	35.5 (24.5–38)	11 (6–19)	<0.001	30 (18–37.5)	12 (8–17)	<0.001
pc-ASPECTS, median (IQR)*	10 (10–10)	10 (10–10)	0.67	10 (10–10)	10 (9–10)	0.60	10 (10–10)	10 (10–10)	0.57
Prestroke mRS, n (%)			0.73			0.10			0.01
0	105 (76.1)	121 (80.7)		46 (67.7)	59 (84.3)		74 (77.9)	47 (85.5)	
1	15 (10.9)	12 (8)		10 (14.7)	5 (7.1)		12 (12.6)	0	
2	16 (11.6)	14 (9.3)		11 (16.2)	5 (7.1)		7 (7.4)	7 (12.7)	
3	2 (1.5)	3 (2)		1 (1.5)	1 (1.4)		2 (2.1)	1 (1.8)	
IV thrombolysis, n (%)	109 (79)	118 (78.2)	0.86	53 (77.9)	56 (80)	0.77	75 (78.1)	43 (78.2)	0.99
Intubation within 24 h	68 (49.3)	96 (63.6)	0.01						
Reason intubation, n (%)†			0.009						
Routine practice	2 (2.9)	15 (15.8)		…	…		…	…	
Medically indicated	66 (97.1)	80 (84.2)		…	…		…	…	
Onset-to-randomization, h‡	2.1 (1.5–3.2)	1.8 (1.2–3.0)	0.07	2.2 (1.5–3.4)	2.0 (1.4–2.9)	0.34	1.8 (1.2–3.0)	2.0 (1.3–3.1)	0.44
Onset-to-needle time, h§	2.3 (1.5–3.5)	2.0 (1.4–3.3)	0.26	2.2 (1.7–3.2)	2.5 (1.5–3.5)	0.93	2.0 (1.5–3.3)	2.1 (1.4–3.5)	0.88
Onset-to-groin time, h‖	…	3.4 (2.5–4.5)		…	…		3.3 (2.4–4.4)	3.6 (2.8–4.8)	0.20

BMI indicates body mass index; EVT, endovascular therapy; IQR, interquartile range; NIHSS, National Institutes of Health Stroke Scale; and pc-ASPECTS, posterior circulation Acute Stroke Prognosis Early Computed Tomography Score.

*Data on pc-ASPECTS were available for 143 EVT patients and 132 medical care patients.

†Frequency data pertain to patients who underwent intubation within 24 h; data on intubation reasons were available for 95 EVT patients and all medical care patients.

‡Data on onset-to-randomization were available for 140 EVT patients and 131 medical care patients.

§Data on onset-to-needle time were available for 113 EVT patients and 107 medical care patients.

‖Data on onset-to-groin time were available for 140 EVT patients.

Table 2. Relative Risk Estimates for Intubation Within the First 24 Hours From Stroke Onset

Variable	Comparison	RR	95% CI	*P* value
Endovascular therapy	Yes vs no	1.29	1.09–1.53	<0.001
NIHSS	Per 1 point increase	1.04	1.03–1.05	<0.001
Male patient	Yes vs no	1.30	1.07–1.59	0.009
Age	Per 1 y increase	0.99	0.99–1.0	0.041

NIHSS indicates National Institutes of Health Stroke Scale; further included covariates (not shown in the table) were intravenous thrombolysis and atrial fibrillation; and RR, relative risk.

best medical care alone (RR, 1.34 [95% CI, 1.05–1.71]; *P*=0.018; Figure 2). This association remained largely unchanged after excluding patients whose early intubation was related to routine practice (RR, 1.29 [95% CI, 1.01–1.64]; *P*=0.045).

Considering the ordinal distribution of the mRS score, adjusting for atrial fibrillation, baseline stroke severity, intravenous thrombolysis, and early intubation, EVT was associated with a shift toward lower mRS scores at 3 months (odds ratio, 1.63 [95% CI, 1.04–2.57]; *P*=0.033; Figure 3A). The Brant test did not reject the assumption of proportional odds (Table S1). Consistently, EVT compared with medical care alone tended to be associated with excellent functional outcome (mRS score, 0–2; RR, 1.33 [95% CI, 0.99–1.80]; *P*=0.058). Relative risk estimates including further clinical outcomes are provided in Table 3.

The estimation of the interaction model did not provide evidence for an interaction between EVT and intubation status regarding favorable or excellent functional outcomes (*P*=0.97 and *P*=0.99, respectively; Table 3).

Subgroup Analysis by Intubation Status

In the EVT group, 28 of 96 (29.2%) patients with early intubation achieved a favorable functional outcome at 3 months as compared with 39 of 55 (70.9%) nonintubated patients. A similar difference in favorable functional outcome was observed among intubated and nonintubated patients in the medical care group (12/68 [17.7%] versus 40/70 [57.1%]; Figure S1). Ordinal mRS shift analysis was suggestive of a benefit from EVT in nonintubated but not in intubated patients (Figure 3B).

Safety and Secondary Outcomes

Fifty-seven of 151 (37.8%) patients in the EVT group compared with 58 of 138 (42%) patients in the medical care group had died at 3 months (Figure 2A). In adjusted analyses, EVT was not associated with mortality at 3 months, irrespective of considering early intubation as an additional covariate in the model (Table 3). Seven out of 151 (4.6%) patients in the EVT group had symptomatic ICH, while none of the patients in the medical care group had this complication. All 7 cases of symptomatic ICH in the EVT group occurred in patients with early intubation.

The patency of the basilar artery at 24 hours in patients who underwent EVT was 79.1% for intubated patients and 89.5% for nonintubated patients. In comparison, in the medical care group, the patency rate was 43.9% for intubated patients and 64% for nonintubated patients.

Sensitivity Analysis

Additional adjustment for location of BAO did not change the main results qualitatively (Table S2). Among patients

Table 3. Relative Risk Estimates for Clinical Outcomes

	Model 1: basic model			Model 2: adjusted for intubation			Model 3: interaction model		
	RR	95% CI	*P* value	RR	95% CI	*P* value	RR	95% CI	*P* value
Favorable outcome									
Endovascular therapy	1.22	0.95–1.55	0.12	1.34	1.05–1.71	0.02	1.34	1.06–1.68	0.01
Intubation				0.61	0.45–0.84	0.002	0.61	0.34–1.07	0.09
Interaction							1.01	0.53–1.93	0.97
Excellent outcome									
Endovascular therapy	1.19	0.88–1.61	0.25	1.33	0.99–1.79	0.058	1.34	0.99–1.81	0.06
Intubation				0.57	0.39–0.83	0.003	0.57	0.29–1.12	0.10
Interaction							0.99	0.46–2.18	0.99
Mortality									
Endovascular therapy	0.88	0.68–1.13	0.32	0.86	0.67–1.10	0.24	0.63	0.33–1.19	0.16
Intubation				1.34	0.87–2.07	0.19	1.11	0.66–1.87	0.69
Interaction							1.50	0.75–3.01	0.25

Favorable outcome was defined as mRS score of 0 to 3 and excellent outcome as mRS score of 0 to 2 at 3 mo; all estimates were adjusted for intravenous thrombolysis, baseline NIHSS scores and atrial fibrillation (N=289). mRS indicates modified Rankin Scale; NIHSS, National Institutes of Health Stroke Scale; and RR, relative risk.

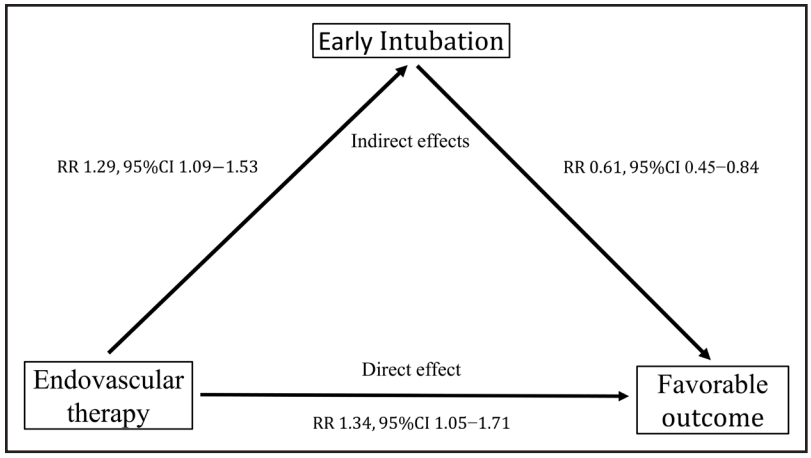

Figure 2. Directed acyclic graph representing direct and indirect effects of endovascular therapy (EVT) on favorable functional outcome and EVT.

in the EVT group alone, early intubation was consistently related to a lower probability of favorable functional outcome (RR, 0.59 [95% CI, 0.41–0.84]; $P<0.01$). Repeated analyses across the imputed data sets for the primary and secondary outcomes yielded results similar to those of the complete-case analysis (Table S3).

DISCUSSION

Our post hoc analysis of BAO patients in the BASICS trial showed that early intubation within 24 hours of the estimated time of BAO was associated with unfavorable functional outcome. Moreover, when adjusting for early intubation as an additional covariate, EVT was associated with improved functional outcomes. These findings suggest that a potential beneficial effect of EVT in the neutral BASICS trial might have been mitigated by indirect effects secondary to an increased risk of early intubation in BAO patients treated with EVT.

Whereas BASICS failed to show the superiority of EVT over best medical care alone, 2 recent randomized controlled trials have demonstrated the clinical efficacy of EVT in patients with BAO.[9,10] The preferential inclusion of patients with an NIHSS score ≥10 and without extensive early ischemic changes as indicated by pc-ASPECTS (posterior circulation Acute Stroke Prognosis Early Computed Tomography Score) ≥6 may have contributed to the positive results in these trials.[11,34] In the EVT groups of the ATTENTION (Endovascular Treatment for Acute Basilar-Artery Occlusion) and BAOCHE (Basilar Artery Occlusion Chinese Endovascular) trials, GA rates were 56% (124/223) and 65% (72/110), respectively, while the GA and intubation rates for the medical care groups were not reported.[9,10] It is therefore speculative whether adjusting for early intubation as a covariate would have resulted in a more pronounced treatment effect of EVT on functional outcomes in these trials, as well as in a recent meta-analysis that additionally included data from the BASICS and BEST (Endovascular Treatment Versus Standard Medical Treatment for Vertebrobasilar Artery Occlusion) trials.[9,10,35]

While it seems obvious that patients with BAO frequently require GA during EVT due to reduced consciousness or impaired brainstem function, it is important to note that EVT can be performed without GA in this patient population. The use of periprocedural GA in clinical trials and observational studies of patients undergoing EVT for posterior circulation stroke showed a wide variation, with rates ranging from 38% to 78%.[7–10,26] In contrast, patients with acLVO who underwent EVT had notably lower rates of periprocedural GA, with 29.6% in the HERMES population and <10% in the ESCAPE (Endovascular Treatment for Small Core and Anterior Circulation Proximal Occlusion With Emphasis on Minimizing CT to Recanalization Times) and REVASCAT (Randomized Trial of Revascularization With Solitaire FR Device Versus Best Medical Therapy in the Treatment of Acute Stroke due to Anterior Circulation Large Vessel Occlusion Presenting Within Eight Hours of Symptom Onset) trials. This suggests that a larger proportion of these patients were considered eligible for CS before the procedure.[11,36,37]

The recent exploratory randomized CANVAS II trial (Choice of Anesthesia for Endovascular Treatment of Acute Ischemic Stroke II), along with a meta-analysis of predominantly observational studies, were not adequately powered to provide conclusive evidence on whether periprocedural GA or CS was associated with improved functional outcomes in patients with posterior circulation stroke undergoing EVT.[26,27] While GA may have potential advantages over CS, such as higher reperfusion rates (as observed in the CANVAS II trial, where rates were 95.3% for GA and 77.3% for CS), our analysis showed that patency of the basilar artery at 24 hours was somewhat lower in intubated EVT patients compared with nonintubated patients (79.1% versus 89.5%). Additionally, all 7 ICH cases in the EVT group occurred in patients with early intubation. In contrast to acLVO trials, where almost no patients in the medical care groups received GA and early intubation for medical reasons,[12,38] nearly half (49.3%) of the patients in the medical care group of BASICS underwent early

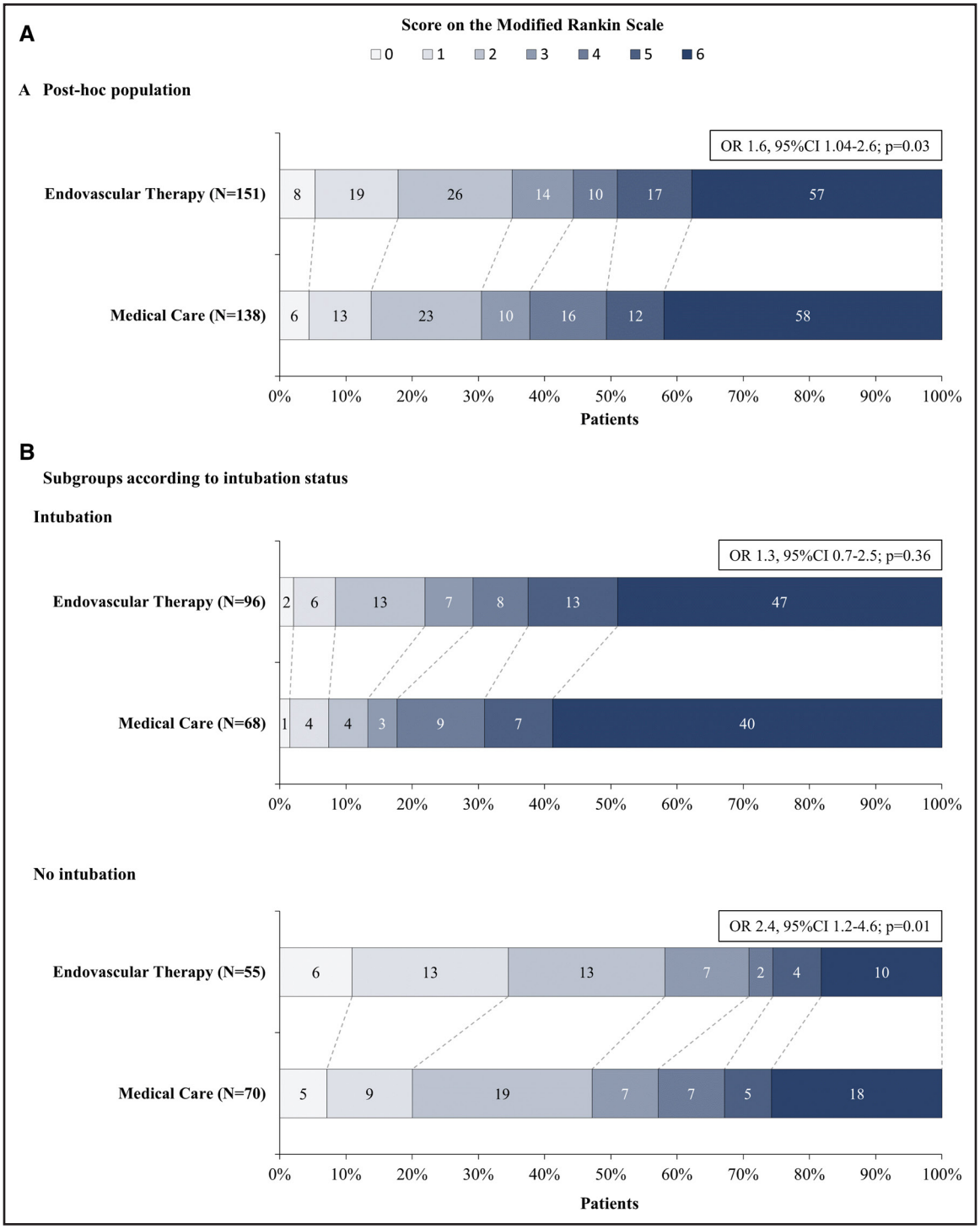

Figure 3. Distribution of the modified Rankin Scale (mRS) scores at 3 mo.
Ordered logistic regression with mRS score at 3 mo as outcome. All estimates were adjusted for intravenous thrombolysis, National Institutes of Health Stroke score, atrial fibrillation, and early intubation (if not used for stratification). Odds ratios (ORs) reflect associations with the probability of lower mRS scores.

intubation. Thus, clinical trials investigating the optimal periprocedural management during EVT for patients with BAO need to confine inclusion to patients who do not require GA and intubation for medical reasons, thereby limiting trial eligibility. Moreover, the conversion rate from CS to GA may be high in this population, as indicated by the CANVAS II trial, with a conversion rate of 29.5% from periprocedural CS to GA.[27]

BASICS did not collect data on specific periprocedural anesthetic management including end-tidal carbon dioxide and blood pressure monitoring to prevent hypotension and hypocapnia, the latter potentially causing cerebral

vasoconstriction, which may influence collateral circulation and functional outcome following EVT.[39,40] Although a specific protocol was applied, GA was associated with a higher rate of periprocedural hypotension compared with CS (53.5% versus 15.9%) in the CANVAS II trial.[27,41] A recent analysis suggests that the duration of periprocedural GA and intubation may be more important than the use of GA or CS per se during EVT.[42] In this analysis of patients with acLVO who received EVT, each additional 15 minutes of anesthetic exposure decreased the likelihood of achieving an independent functional outcome at 90 days by 1.5%. The duration of GA and intubation was not consistently collected in the BASICS trial; hence, we cannot comment on its influence on functional outcome in our analysis. However, given the high rate of early intubation for medical reasons, patients with BAO may have a lower likelihood of immediate postprocedural extubation, which could negatively impact functional outcomes.

The limitations of our findings include the lack of randomization of periprocedural anesthetic management in the BASICS trial. A large proportion of patients in both the EVT and medical care groups were early intubated for medical reasons, which poses a substantial risk of confounding by indication and residual confounding. Due to the small sample size (n=17) of patients who were intubated due to routine practice, we were unable to perform further statistical modeling in this subgroup. However, while the stroke severity as measured by the baseline NIHSS score was associated with the risk of early intubation, intubation status was not confounded by the NIHSS score in our analysis, as both were independently associated with functional outcome. Due to potential limitations of the NIHSS score for posterior circulation stroke, novel scores may better delineate the clinical severity in patients with BAO.[43] Our analysis only accounts for early intubation within 24 hours of estimated time of BAO but cannot provide information on the timing (eg, pre- versus post-EVT or randomization) and duration of early intubation or specific anesthetic management. Additionally, some patients may have been intubated before hospital arrival or for medical reasons after EVT, which limits our conclusions on the association of intubation status with benefit from EVT. Finally, as no standardized protocols for GA or CS were used, periprocedural treatment was based on local preference and standards and may vary significantly between centers, although BASICS was conducted at experienced stroke centers with high EVT expertise.

CONCLUSIONS

This post hoc analysis of the neutral BASICS trial revealed that early intubation was negatively associated with overall functional outcome and occurred more frequently in the EVT group compared with the medical care group. When accounting for this adverse indirect effect by adjusting for early intubation in regression analysis, we found an association of EVT with favorable functional outcome. These findings suggest that early intubation should be considered as a covariate or risk stratifier in future trials and emphasize the importance of thorough data collection on its indication.

ARTICLE INFORMATION

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Supplemental Material

Tables S1–S3
Figure S1
BASICS Study Group

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