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Type of intracranial hemorrhage after endovascular stroke treatment: association with functional outcome

Wouter van der Steen ,[1,2] Nadinda A M van der Ende,[1,2] Sven P R Luijten ,[2] Leon A Rinkel ,[3] Katinka R van Kranendonk,[4] Henk van Voorst ,[4,5] Stefan D Roosendaal,[4] Ludo F M Beenen,[4] Jonathan M Coutinho ,[3] Bart J Emmer,[4] Robert J van Oostenbrugge,[6] Charles B L.M Majoie ,[4] Hester F Lingsma,[7] Aad van der Lugt,[2] Diederik W J Dippel ,[1] Bob Roozenbeek,[1] on behalf of the MR CLEAN-NO IV, MR CLEAN-MED, and CONTRAST investigators

► Additional supplemental material is published online only. To view, please visit the journal online (http://dx.doi.org/10.1136/jnis-2022-019474).

For numbered affiliations see end of article.

Correspondence to
Dr Wouter van der Steen, Department of Neurology, Erasmus Medical Center, Rotterdam, The Netherlands; w.vandersteen@erasmusmc.nl

Received 1 August 2022
Accepted 3 October 2022
Published Online First 19 October 2022

ABSTRACT

Background Intracranial hemorrhage (ICH) is a frequent complication after endovascular stroke treatment.

Objective To assess the association of the occurrence and type of ICH after endovascular treatment (EVT) with functional outcome.

Methods We analyzed data from the MR CLEAN-NO IV and MR CLEAN-MED trials. Both trials included adult patients with ischemic stroke with a large vessel occlusion in the anterior circulation, who were eligible for EVT. ICH was classified (1) as asymptomatic or symptomatic (concomitant neurological deterioration of ≥4 points on the NIHSS, or ≥2 points on 1 NIHSS item), and (2) according to the Heidelberg Bleeding Classification. We used multivariable ordinal logistic regression analyses to assess the association of the occurrence and type of ICH with the modified Rankin Scale score at 90 days.

Results Of 1017 included patients, 331 (33%) had an asymptomatic ICH, and 90 (9%) had a symptomatic ICH. Compared with no ICH, both asymptomatic (adjusted common OR (acOR)=0.76; 95% CI 0.58 to 0.98) and symptomatic (acOR=0.07; 95% CI 0.04 to 0.14) ICH were associated with worse functional outcome. In particular, isolated parenchymal hematoma type 2 (acOR=0.37; 95% CI 0.14 to 0.95), combined parenchymal hematoma with hemorrhage outside infarcted brain tissue (acOR=0.17; 95% CI 0.10 to 0.30), and combined hemorrhages outside infarcted brain tissue (acOR=0.14; 95% CI 0.03 to 0.74) were associated with worse functional outcome than no ICH. Strength of the association of ICH with functional outcome depends on the type of ICH. Although the association is stronger for symptomatic ICH, asymptomatic ICH after EVT is also associated with worse functional outcome.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Symptomatic intracranial hemorrhage after endovascular stroke treatment is strongly associated with poor outcome. However, the association of asymptomatic intracranial hemorrhage with functional outcome is not established. In addition, the association with functional outcome of subtypes of intracranial hemorrhage based on their anatomic description is incompletely understood.

WHAT THIS STUDY ADDS

⇒ This study provides a better understanding of the associations of the occurrence and subtypes of intracranial hemorrhage after endovascular stroke treatment with functional outcome. Moreover, we have now established that asymptomatic intracranial hemorrhage is also associated with worse functional outcome.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The results of this study can be used to better assess the clinical significance of each intracranial hemorrhage occurring after endovascular stroke treatment. In addition, our study supports the notion that the distinction between symptomatic and asymptomatic intracranial hemorrhage should be refined.

INTRODUCTION

Intracranial hemorrhage (ICH) is a frequent complication after endovascular treatment (EVT) for acute ischemic stroke.[1] According to the Heidelberg Bleeding Classification, an ICH is classified as symptomatic when it is associated with concomitant neurological deterioration (ie, an increase of ≥4 points on the National Institutes of Health Stroke Scale (NIHSS) or ≥2 points on a specific NIHSS item).[2] In addition, the Heidelberg Bleeding Classification can be used to classify ICH based on imaging characteristics and anatomic description: hemorrhagic transformation of infarcted brain tissue is classified as hemorrhagic infarction type 1, hemorrhagic infarction type 2, or parenchymal hematoma type 1; hemorrhage within and beyond infarcted brain tissue is classified as parenchymal hematoma type 2; and hemorrhages outside

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To cite: van der Steen W, van der Ende NAM, Luijten SPR, *et al*. *J NeuroIntervent Surg* 2023;**15**:971–976.

infarcted brain tissue are classified as subarachnoid hemorrhage, subdural hematoma, intraventricular hemorrhage, or remote parenchymal hematoma.

Symptomatic ICH after reperfusion therapy is strongly associated with poor outcome.[3 4] However, the association of asymptomatic ICH with functional outcome is not established.[5–7] Moreover, the association with functional outcome for subtypes of ICH based on anatomic description is not always clear. A better understanding of these potential associations would provide more insight into the clinical significance of each type of ICH occurring after EVT.

The aim of this study was to assess the association of the occurrence, symptomatic status, and type of ICH after EVT with functional outcome.

METHODS

Study design and patients

This is a post hoc observational study with data from the Multicenter Randomized CLinical trial of Endovascular treatment for Acute ischemic stroke in the Netherlands (MR CLEAN)-NOIV and MR CLEAN-MED.[8 9] Both studies were phase III multicenter clinical trials with randomized group assignment, open label treatment, and blinded outcome evaluation. In MR CLEAN-NO IV, EVT plus intravenous thrombolytics was compared with EVT alone. In MR CLEAN-MED, EVT with routine periprocedural use of intravenous antithrombotics (ie, aspirin or unfractionated heparin) was compared with EVT without routine periprocedural use of antithrombotics. Both studies started inclusion in January 2018, and included adult patients with a large vessel occlusion in the anterior circulation eligible for EVT. MR CLEAN-NO IV included patients who presented directly to a hospital that was capable of providing EVT, and who were eligible for intravenous thrombolytics ≤4.5 hours after stroke onset or last seen well. Inclusion was completed in October 2020. MR CLEAN-MED included patients who were eligible for EVT ≤6 hours after stroke onset or last seen well. In January 2021, inclusion in MR CLEAN-MED was stopped owing to safety concerns about the study treatments. The studies ran in parallel to each other in intervention centers in the Netherlands, and MR CLEAN-NO IV also included patients in Belgium and France. Both studies used a deferred consent procedure in accordance with national legislation.[10] For the current analysis, we selected patients with deferred consent for 3-month clinical follow-up, who were treated with EVT (defined as entry into the angiography suite and receiving arterial puncture), and had available follow-up imaging of sufficient quality to assess the occurrence of ICH.

Protocols and results of both MR CLEAN-NO IV and MR CLEAN-MED have been published previously.[8 9 11 12] Both protocols were approved by a central medical ethics committee. De-identified data collected for the studies will be made available to others on reasonable request. Data can be requested with a proposal at the website of the CONTRAST consortium (www.contrast-consortium.nl), or by sending an e-mail to the corresponding author.

Outcomes

In both MR CLEAN-NO IV and MR CLEAN-MED, all patients were followed up until final assessment at 90 days. Clinical outcome data at 90 days were collected centrally through standardized telephone interviews by trained research nurses. A blinded outcome committee adjudicated the primary outcome (modified Rankin Scale (mRS) score) data based on the interview reports. In both trials, standard follow-up imaging (CT or MRI) was performed at 24 hours after EVT and at 5–7 days after EVT (or earlier at discharge). In addition, the treating physician could decide to perform imaging based on local protocols (eg, in cases of neurological deterioration). An imaging core committee consisting of neuroradiologists and interventionalists, masked to all clinical data except to the side of stroke, assessed the images. Among others, they assessed ICH occurrence and classified each ICH according to the Heidelberg Bleeding Classification. A blinded serious adverse event committee assessed whether an ICH was asymptomatic or symptomatic, also based on the Heidelberg Bleeding Classification (ie, concomitant increase of ≥4 points on the NIHSS or ≥2 points on a specific NIHSS item).

Statistical analysis

We formatted descriptive tables stratified for no ICH occurrence, asymptomatic ICH occurrence, or symptomatic ICH occurrence. We performed univariable and multivariable proportional odds regression analyses to assess the effect of the occurrence and type of ICH on the mRS score at 90 days. We analyzed the association of any ICH compared with no ICH (model 1); the association of ICH, classified as asymptomatic and symptomatic, compared with no ICH (model 2); and the association of each type of ICH classified according to the Heidelberg Bleeding Classification compared with no ICH (model 3). In model 3, patients with an isolated subdural hematoma, isolated intraventricular hemorrhage, or isolated remote parenchymal hematoma were merged into one subgroup, because of the small number of patients in these categories. In addition, patients with a combination of two or more hemorrhage types were analyzed in separate groups (ie, combined hemorrhagic infarction with hemorrhage outside infarcted brain tissue, combined parenchymal hematoma with hemorrhage outside infarcted brain tissue, or combined hemorrhages outside infarcted brain tissue). The effect estimates of all multivariable models were adjusted for age, sex, pre-stroke mRS score, baseline systolic blood pressure, history of diabetes mellitus, history of myocardial infarction, prior use of antithrombotics, baseline NIHSS score, stroke onset to groin puncture time, treatment with intravenous thrombolytics, post-EVT extended treatment in cerebral infarction score, final infarct volume, periprocedural treatment with aspirin, and periprocedural treatment with unfractionated heparin.

All statistical analyses were performed using R version 4.1.1. (www.cran.r-project.org) with the packages Hmisc, rms, and tableone. For univariable and multivariable regression analyses, we replaced missing independent variables with multiple imputation using the aregImpute function. We generated five multiple imputation sets, in which we used three knots for continuous variables.

RESULTS

Patients

Of 547 patients randomized in MR CLEAN-NO IV, eight patients had not given consent for 3-month clinical follow-up, and of 663 patients randomized in MR CLEAN-MED, 35 patients had not given consent for 3-month clinical follow-up (online supplemental figure I). Of the remaining patients, we excluded 69 patients of MR CLEAN-NO IV and 81 patients of MR CLEAN-MED who had not been treated with EVT (n=36), or had no follow-up imaging with sufficient quality to assess ICH occurrence (n=114). In total, 1017 patients were available for the analysis.

Table 1 Baseline characteristics of the study population, stratified by ICH occurrence and concomitant neurological deterioration

Characteristics	No ICH (n=596)	Asymptomatic ICH (n=331)	Symptomatic ICH (n=90)	Missing
Age, years; median (IQR)	71 (62–79)	72 (63–80)	75 (66–83)	0
Men, n (%)	325 (55)	193 (58)	44 (49)	0
Trial, n (%)				0
MR CLEAN-NO IV	300 (50)	145 (44)	25 (28)	
MR CLEAN-MED	296 (50)	186 (56)	65 (72)	
Pre-stroke mRS score, n (%)				2
0	419 (70)	230 (70)	51 (57)	
1	107 (18)	56 (17)	22 (24)	
2	54 (9.1)	33 (10)	10 (11)	
≥3	15 (3.0)	11 (3.3)	7 (7.8)	
Medical history				
Atrial fibrillation, n (%)	101 (17)	63 (19)	21 (23)	0
Diabetes mellitus, n (%)	80 (13)	59 (18)	19 (21)	0
Myocardial infarction, n (%)	72 (12)	29 (8.8)	13 (14)	0
Prior antithrombotic drug use				
Antiplatelet, n (%)	184 (31)	109 (33)	41 (46)	0
Coumarine, n (%)"	40 (6.7)	23 (6.9)	10 (11)	0
Direct oral anticoagulant, n (%)	36 (6.0)	21 (6.3)	6 (6.7)	0
Heparin, n (%)	4 (0.7)	1 (0.3)	1 (1.1)	0
SBP at baseline, mm Hg; mean (SD)	150 (25)	151 (25)	156 (24)	7
NIHSS score at baseline; median (IQR)	15 (8–19)	16 (11–20)	17 (10–21)	18
ASPECTS at baseline NCCT; median (IQR)	9 (8–10)	9 (7–10)	9 (8–10)	3
Level of occlusion on CTA, n (%)				3
ICA or ICA-T	148 (25)	84 (25)	20 (22)	
M1	331 (56)	183 (55)	43 (48)	
M2	112 (19)	63 (19)	26 (29)	
None	2 (0.3)	1 (0.3)	1 (1.1)	
Treatment with intravenous thrombolytics, n (%)	374 (63)	204 (62)	64 (71)	0
Onset to groin puncture time, median (IQR)	150 (115–195)	161 (130–218)	194 (145–254)	20
Periprocedural treatment with aspirin, n (%)	128 (21)	91 (27)	46 (51)	1
Periprocedural treatment with heparin, n (%)	193 (32)	126 (38)	47 (52)	2
Post-EVT eTICI score, n (%)				56
0	46 (8.3)	26 (8.2)	6 (6.7)	
1	11 (2.0)	5 (1.6)	0 (0.0)	
2a	43 (7.8)	32 (10)	9 (10)	
2b	107 (19)	85 (27)	22 (24)	
2c	71 (13)	39 (12)	11 (12)	
3	275 (50)	132 (41)	41 (46)	

Continuous variables are presented as median and IQR or mean and SD. Categorical variables are presented as frequencies (n) and percentages (%).
ASPECTS, Alberta Stroke Program Early CT Score; CTA, CT angiography; eTICI, extended thrombolysis in cerebral infarction; EVT, endovascular treatment; ICA(-T), internal carotid artery (terminus); ICH, intracranial hemorrhage; mRS, modified Rankin Scale; mRS, modified Rankin Scale; NCCT, non-contrast CT; NIHSS, National Institutes of Health Stroke Scale; SBP, systolic blood pressure.

Patient characteristics

Median age of included patients was 72 (IQR 63–80) years, 562 (55%) were men, and median baseline NIHSS score was 16 (IQR 9–20) (table 1). Most patients had an M1 occlusion (557 (55%)), followed by an internal carotid artery occlusion (252 (25%)), and an M2 occlusion (201 (20%)). In four (0.4%) patients the imaging core committee found no occlusion on baseline imaging. In total, 642 (63%) patients received intravenous thrombolytics, 265 (26%) periprocedural intravenous aspirin, and 366 (36%) periprocedural intravenous unfractionated heparin. Of the included patients, 620 (61%) only had CT as follow-up imaging, 327 (32%) only MRI, and 70 (6.9%) both CT and MRI. In total, 182/14 238 (1.3%) data points of independent variables used for the regression analyses were missing and imputed.

Outcomes

Of 1017 included patients, 331 (33%) had an asymptomatic ICH, and 90 (9%) had a symptomatic ICH (online supplemental table I). Asymptomatic ICHs mainly included isolated hemorrhagic infarction type 1 (99 (30%)), isolated hemorrhagic infarction type 2 (74 (22%)), and isolated subarachnoid hemorrhage (41 (12%)). Symptomatic ICHs mainly included combined parenchymal hematoma with hemorrhage outside infarcted

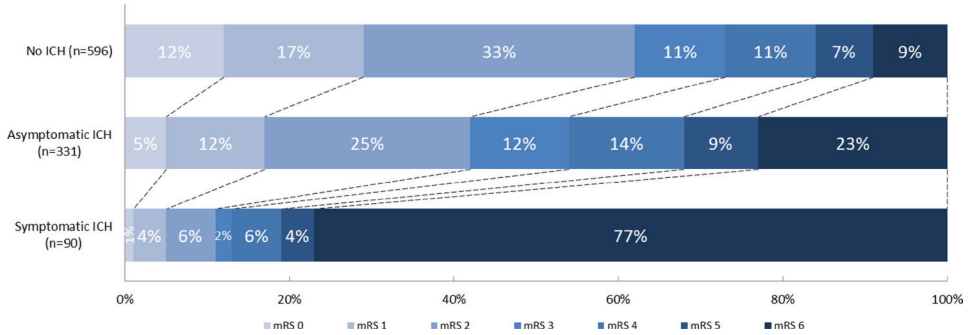

Figure 1 Distribution of modified Rankin Scale (mRS) scores at 90 days for patients with no intracranial hemorrhage (ICH), asymptomatic ICH, and symptomatic ICH. There was a significant shift towards worse functional outcomes for both patients with asymptomatic ICH versus patients with no ICH (adjusted common odds ratio (acOR)=0.76; 95% CI 0.58 to 0.98), and for patients with symptomatic ICH versus patients with no ICH (acOR=0.07; 95% CI 0.04 to 0.14).

brain tissue (59 (66%)), and isolated parenchymal hematoma type 2 (11 (12%)). None of the isolated hemorrhagic infarctions type 1 or 2 were classified as symptomatic ICH. Number of hemorrhages per subclassification of hemorrhages classified as 'Other' and of combined hemorrhages are given in the supplements (online supplemental tables II–V). Patients with any ICH more often had poor functional outcome than patients with no ICH (online supplemental figure II). Distribution of mRS scores at 90 days for patients with no ICH, asymptomatic ICH, and symptomatic ICH are given in figure 1. Distribution of mRS scores at 90 days for patients with ICH, stratified for type of ICH are given in figure 2.

Compared with no ICH, the occurrence of any ICH was associated with worse functional outcome in both univariable (common OR (cOR)=0.31; 95% CI 0.25 to 0.39) and multivariable (adjusted cOR=0.59; 95% CI 0.46 to 0.76) regression analyses (table 2). Subdivided by concomitant neurologic deterioration, both asymptomatic (acOR=0.76; 95% CI 0.58 to 0.98) and symptomatic ICH (acOR=0.07; 95% CI 0.04 to 0.14) were associated with worse functional outcome than no ICH. Classified by type of ICH, all estimates pointed towards worse functional outcome, but only isolated parenchymal hematoma type 2 (acOR=0.37; 95% CI 0.14 to 0.95), combined parenchymal hematoma with hemorrhage outside infarcted brain tissue (acOR=0.17; 95% CI 0.10 to 0.30), and combined hemorrhages outside infarcted brain tissue (acOR=0.14; 95% CI 0.03 to 0.74) were significantly associated with a worse functional outcome than no ICH occurrence.

DISCUSSION

In this post hoc study with combined data of two randomized controlled trials, we found that in patients with a stroke treated with EVT both asymptomatic and symptomatic ICH were associated with worse functional outcome. Strength of the association was stronger for symptomatic ICH and was dependent on the type of ICH, based on imaging characteristics and anatomic description.

Any ICH has been associated with worse functional outcome before, but not all studies found a significant association.[4 6 13] However, studies that did not find a significant association, did show a strong trend towards worse functional outcome. The results of our study indicate that the occurrence of any ICH indeed has a negative impact on functional outcome. Both

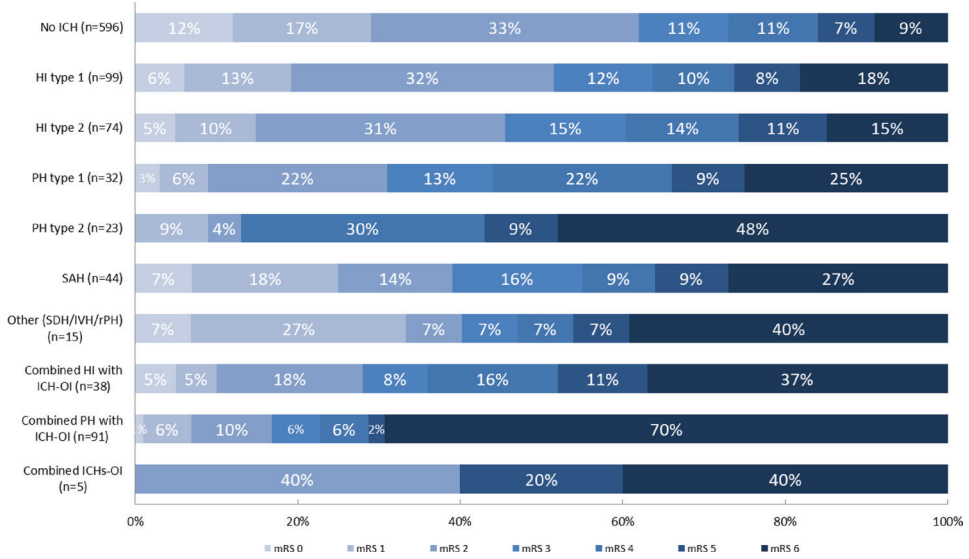

Figure 2 Distribution of modified Rankin Scale (mRS) scores at 90 days for patients with ICH stratified for imaging characteristics and anatomic description. HI, hemorrhagic Infarction; ICH, intracranial hemorrhage; ICH-OI, intracranial hemorrhage outside infarcted brain tissue; IVH, intraventricular hemorrhage; PH, parenchymal hematoma; SAH, subarachnoid hemorrhage; SDH, subdural hematoma; rPH, remote parenchymal hematoma.

Table 2 Regression analyses of the association of any intracranial hemorrhage (model 1), intracranial hemorrhage classified according to symptoms (model 2), and intracranial hemorrhage classified according to the Heidelberg Bleeding Classification (model 3) with the modified Rankin Scale score at 90 days

	Common OR (95% CI)	Adjusted common odds ratio (95% CI)*
Model 1		
Any intracranial hemorrhage	0.31 (0.25 to 0.39)	0.59 (0.46 to 0.76)
Model 2		
Asymptomatic intracranial hemorrhage	0.44 (0.35 to 0.57)	0.76 (0.58 to 0.98)
Symptomatic intracranial hemorrhage	0.04 (0.02 to 0.07)	0.07 (0.04 to 0.14)
Model 3		
Isolated hemorrhagic infarction type 1	0.61 (0.42 to 0.89)	0.76 (0.51 to 1.13)
Isolated hemorrhagic infarction type 2	0.54 (0.36 to 0.82)	1.00 (0.64 to 1.56)
Isolated parenchymal hematoma type 1	0.32 (0.17 to 0.59)	0.67 (0.35 to 1.30)
Isolated parenchymal hematoma type 2	0.12 (0.06 to 0.27)	0.37 (0.14 to 0.95)
Isolated subarachnoid hemorrhage	0.44 (0.25 to 0.77)	0.55 (0.30 to 1.03)
Other isolated hemorrhage (SDH/IVH/rPH)	0.35 (0.12 to 1.01)	0.50 (0.17 to 1.49)
Combined hemorrhagic infarction with hemorrhage outside infarcted brain tissue	0.23 (0.13 to 0.42)	0.52 (0.27 to 1.03)
Combined parenchymal hematoma with hemorrhage outside infarcted brain tissue	0.06 (0.04 to 0.10)	0.17 (0.10 to 0.30)
Combined hemorrhages outside infarcted brain tissue	0.20 (0.04 to 1.02)	0.14 (0.03 to 0.74)

Effect estimates are presented as common odds ratios (OR) and adjusted common odds ratios (aOR) with 95% confidence intervals (CI). The reference for all models was 'no intracranial hemorrhage'.
*Adjusted for age, sex, pre-stroke mRS score, history of hypertension, history of diabetes mellitus, history of myocardial infarction, prior use of antithrombotics, baseline NIHSS score, door intervention center to groin puncture time, intravenous thrombolytics, post-EVT eTICI score, final infarct volume, periprocedural treatment with aspirin, and periprocedural treatment with unfractionated heparin.
eTICI, extended thrombolysis in cerebral infarction; EVT, endovascular treatment; IVH, intraventricular hemorrhage; mRS, modified Rankin Scale; NIHSS, National Institutes of Health Stroke Scale; rPH, remote parenchymal hematoma; SDH, subdural hematoma.

asymptomatic and symptomatic ICH were associated with worse functional outcome in our study. For symptomatic ICH this is not surprising, as several other studies previously showed a strong association with worse functional outcome.[4 6 13 14] However, for asymptomatic ICH, earlier results have been less clear. Although asymptomatic ICH has previously been associated with higher mortality and longer stay on the intensive care unit, earlier studies only showed a non-significant trend towards worse functional outcome.[6 15] As the direction and effect of the different studies are consistent, we consider it likely that the significant association found in our study is correct. Apparently, an asymptomatic ICH is not asymptomatic after all.

As reaffirmed in our study, the strength of the association of an ICH depends on its type, based on imaging characteristics and anatomic description.[5 6] When combing results of earlier studies and our study, mainly parenchymal hematomas, and combined hemorrhages seem to be associated with a worse functional outcome.[5 6 16 17] This while isolated hemorrhagic infarctions appear to have no association with functional outcome. The impact of isolated hemorrhages outside infarcted brain tissue on outcome remains less clear. We did not find a significant association, but this might be caused by a lack of power due to the relatively small groups, even after combining isolated subdural hematomas, isolated intraventricular hemorrhages, and isolated remote parenchymal hematomas. Previous studies on the association of isolated hemorrhages outside infarcted brain tissue with functional outcome also had relatively small sample sizes.[4 6 18 19] Further meta-analysis with individual patient data may be required to gain more clarity on this issue.

Interestingly, none of the hemorrhagic infarctions in our study was classified as symptomatic. In addition, the majority of isolated parenchymal hematoma type 1, isolated subarachnoid hemorrhage, and combined hemorrhagic infarction with hemorrhage outside infarcted brain tissue was asymptomatic, whereas the majority of combined parenchymal hematoma with hemorrhage outside infarcted brain tissue was symptomatic. The distribution of hemorrhage types in our analyses is comparable to earlier studies on this topic.[5 6 16] However, we found slightly higher overall risks of intracranial hemorrhage and symptomatic intracranial hemorrhage than most other studies. This is probably caused by the increased risk of hemorrhage in the subgroup of patients allocated to periprocedural unfractionated heparin or aspirin in the MR CLEAN-MED trial.[20]

In the Heidelberg Bleeding Classification, an ICH is considered symptomatic when an increase of ≥4 points on the NIHSS or ≥2 points on a specific NIHSS item occurs.[2] This limit was set because this was the limit at which a change in neurological status was considered to be potentially associated with a worsened long-term prognosis. However, as our study found that by using this definition asymptomatic ICHs are also associated with worse functional outcome, this definition might need refinement.

Several studies have investigated the determinants of both asymptomatic and symptomatic ICH after endovascular stroke treatment; however, robust evidence is limited.[21] Now that the impact of these hemorrhages on functional outcome becomes more clear, it seems wise to put even more effort into trying to predict and, more importantly, prevent these hemorrhages. With this, it should be evaluated whether determinants differ according to location and anatomic description.[22 23] First, because we have reaffirmed that their prognostic value differs, and second because their underlying mechanisms differ.[24]

Lastly, our results suggest that standard follow-up imaging even in patients without neurological deterioration may be of

added value. The implementation of standard follow-up imaging may help clinicians in estimating the prognosis of the patient. In addition, it can play a key role in guiding care-related decisions like the antithrombotic treatment regimen.[25 26] Whether it is best to use MRI or CT for this indication should be evaluated in other studies. On the one hand, CT could be preferred as it is faster, cheaper, and more widely available. On the other hand, MRI could be preferred as its sensitivity and inter-rater agreement is better.[27]

Limitations

First, we used the data of two randomized controlled trials, potentially limiting the generalizability of the results. However, inclusion and exclusion criteria in the trials were lenient, and in the analyses we adjusted for the evaluated study treatments (ie, treatment with intravenous thrombolytics, periprocedural aspirin, or periprocedural unfractionated heparin). In addition, the study population is representative of clinical practice. Second, some patients in the MR CLEAN-NO IV and MR CLEAN-MED trial were excluded because they did not provide deferred consent for primary outcome assessment, potentially introducing a selection bias. However, in the main papers of the trials, sensitivity analyses on primary safety outcomes (ie, symptomatic ICH and death from any cause) including data of these patients showed comparable results to those in the main analyses. This indicates that there was no selective withdrawal of patients, limiting the risk of a bias. Third, follow-up CT scans were not always accompanied by a dual-energy scan to differentiate contrast staining from ICH. However, dual-energy scans change the radiological diagnosis of post-treatment ICH to 'contrast staining only' in only a small proportion of patients.[28] Last, we used different follow-up imaging modalities (ie, non-contrast CT and MRI). MRI depicts more hemorrhages and has higher intraobserver and interobserver agreement than CT.[27] This might have affected point estimates of the investigated associations. It would have been interesting to assess whether there was an interaction between follow-up imaging modality and effect of ICH on functional outcome. However, because patients with a poor neurological status more frequently underwent CT than MRI, these results would be confounded by indication.

CONCLUSION

The strength of the association of ICH with functional outcome depends on the type of ICH determined by concomitant neurological deterioration or anatomic description. Although the association is stronger for symptomatic ICH, we have now established that asymptomatic ICH after EVT is also associated with worse functional outcome.

Author affiliations
[1]Department of Neurology, Erasmus Medical Center, Rotterdam, The Netherlands
[2]Department of Radiology and Nuclear Medicine, Erasmus Medical Center, Rotterdam, The Netherlands
[3]Department of Neurology, Amsterdam UMC Locatie AMC, Amsterdam, The Netherlands
[4]Department of Radiology and Nuclear Medicine, Amsterdam UMC Locatie AMC, Amsterdam, The Netherlands
[5]Department of Biomedical Engineering and Physics, Amsterdam UMC Locatie AMC, Amsterdam, The Netherlands
[6]Department of Neurology, Maastricht University Medical Centre+, Maastricht, The Netherlands
[7]Department of Public Health, Erasmus Medical Center, Rotterdam, The Netherlands

Acknowledgements We thank the MR CLEAN-NO IV, MR CLEAN-MED, and CONTRAST investigators for their contribution. A list of all investigators is given in the supplements.

Contributors WvdS and BR designed the study with input from all authors. WvdS did the statistical analysis with input from NAMvdE, HL, and BR. WvdS wrote the first draft of the report with input from NAM, AL, DD, and BR. All authors have contributed to the collection of data and to writing of the manuscript, had full access to all the data in the study, and had final responsibility for the decision to submit for publication. BR is the guarantor of the study.

Funding The MR CLEAN-NO IV and MR CLEAN-MED trials were both funded through the Collaboration for New Treatments of Acute Stroke (CONTRAST) consortium, which acknowledges the support from the Netherlands Cardiovascular Research Initiative, an initiative of the Dutch Heart Foundation (CVON2015-01: CONTRAST); and from the Brain Foundation Netherlands (HA2015.01.06). The collaboration project is additionally financed by the Ministry of Economic Affairs by means of the PPP Allowance made available by Top Sector Life Sciences & Health to stimulate public–private partnerships (LSHM17016). This work was funded in part through unrestricted funding by Stryker, Medtronic, and Cerenovus.

Competing interests DWJD and AvdL report unrestricted grants from Stryker, Penumbra, Medtronic, Cerenovus, Thrombolytic Science, LLC, Dutch Heart Foundation, Brain Foundation Netherlands, The Netherlands Organization for Health Research and Development, Health Holland Top Sector Life Sciences & Health, and Thrombolytic Science, LLC for research, paid to the institution. BR reports funding from the Dutch Heart Foundation and the Netherlands Organisation of Health Research and Development, paid to the institution. BJE reports unrestricted grants from The Netherlands Organization for Health Research and Development, Health Holland Top Sector Life Sciences & Health, and Nicolab b.v. all paid to the institution. CM received funds from, CVON/Dutch Heart Foundation and Stryker, (related to this project, paid to institution) and from the European Commission, Healthcare Evaluation Netherlands TWIN Foundation (unrelated to this project; all paid to the institution) and is a shareholder of Nicolab.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and was approved by the central medical ethics committee at Erasmus University Medical CenterMR CLEAN-NO IV: MEC-2017-368MR CLEAN-MED: MEC-2017-366 Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. De-identified data collected for the studies will be made available to others upon reasonable request. Data can be requested with a proposal at the website of the CONTRAST consortium (www.contrast-consortium.nl), or by sending an email to the corresponding author.

ORCID iDs
Wouter van der Steen http://orcid.org/0000-0001-9428-1920
Sven P R Luijten http://orcid.org/0000-0002-6905-3296
Leon A Rinkel http://orcid.org/0000-0002-0291-8515
Henk van Voorst http://orcid.org/0000-0002-2647-3557
Jonathan M Coutinho http://orcid.org/0000-0002-8284-982X
Charles B L.M Majoie http://orcid.org/0000-0002-7600-9568
Diederik W J Dippel http://orcid.org/0000-0002-9234-3515

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SUPPLEMENTARY MATERIAL ON:

TYPE OF INTRACRANIAL HEMORRHAGE AFTER ENDOVASCULAR STROKE TREATMENT: ASSOCIATION WITH FUNCTIONAL OUTCOME

Wouter van der Steen, MD[1,2]; Nadinda van der Ende, MD[1,2]; Sven Luijten, MD[2]; Leon A. Rinkel, MD[3]; Katinka R. van Kranendonk, MD[4]; Henk van Voorst, MD[4,5]; Stefan D. Roosendaal, MD, PhD[4]; Ludo F.M. Beenen, MD, PhD[4]; Jonathan M. Coutinho, MD, PhD[3]; Bart J. Emmer, MD, PhD[4]; Robert J. van Oostenbrugge, MD, PhD[6]; Charles B.L.M. Majoie, MD, PhD[4]; Hester F. Lingsma, PhD[7]; Aad van der Lugt, MD, PhD[2]; Diederik W.J. Dippel, MD, PhD[1]; Bob Roozenbeek, MD, PhD[1,2]; on behalf of the MR CLEAN-NOIV and MR CLEAN-MED investigators

Affiliations:

1. Department of Neurology, Erasmus MC University Medical Center, Rotterdam, The Netherlands
2. Department of Radiology & Nuclear Medicine, Erasmus MC University Medical Center, Rotterdam, The Netherlands
3. Department of Neurology, Amsterdam University Medical Centers, location AMC, Amsterdam, The Netherlands
4. Department of Radiology & Nuclear Medicine, Amsterdam University Medical Center, University of Amsterdam, Amsterdam, The Netherlands
5. Department of Biomedical Engineering & Physics, Amsterdam University Medical Center, University of Amsterdam, Amsterdam, The Netherlands
6. Department of Neurology, Maastricht University Medical Center, Cardiovascular Research Institute Maastricht (CARIM), Maastricht, The Netherlands
7. Department of Public Health, Erasmus MC University Medical Center, Rotterdam, The Netherlands

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Supplementary Figure

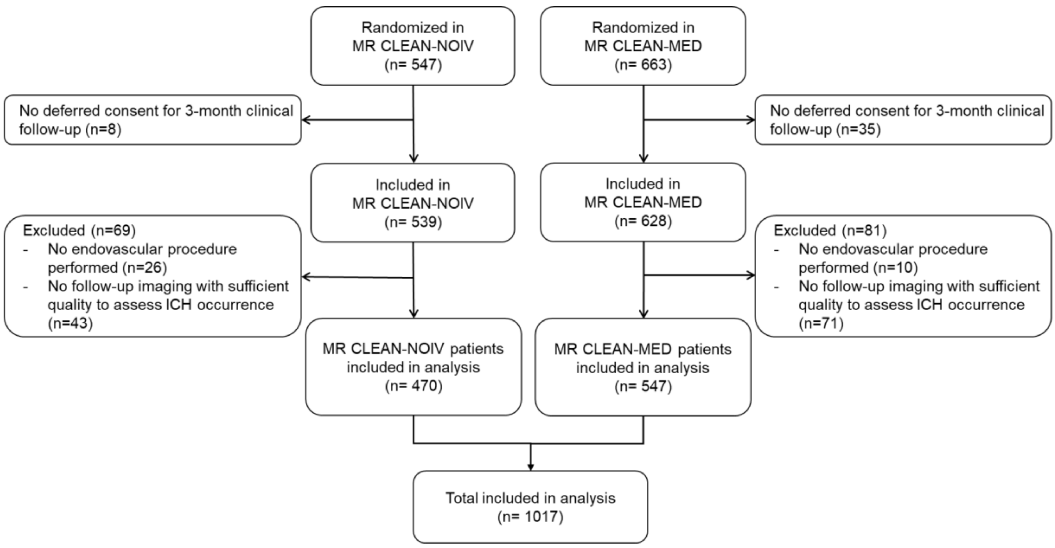

Figure I. Flowchart of included patients

ICH indicates intracranial hemorrhage

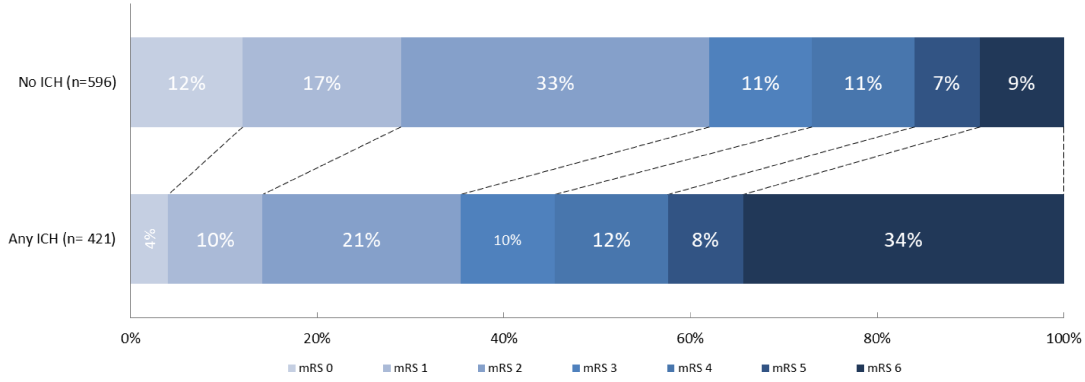

Figure II. Distribution of modified Rankin Scale (mRS) scores at 90 days for patients with no intracranial hemorrhage (ICH), and any ICH.

There was a significant shift towards worse functional outcomes for patients with any ICH versus patients with no ICH (adjusted common odds ratio (acOR), 0.59; 95% CI 0.46 to 0.76).

Supplementary Tables

Table I. Classification of intracranial hemorrhages (ICH) based on the Heidelberg Bleeding Classification, stratified for asymptomatic ICH vs. symptomatic ICH

	Asymptomatic ICH (n= 331)	Symptomatic ICH (n= 90)
Isolated hemorrhagic infarction type 1	99 (30%)	0 (0.0%)
Isolated hemorrhagic infarction type 2	74 (22%)	0 (0.0%)
Isolated parenchymal hematoma type 1	29 (8.8%)	3 (3.3%)
Isolated parenchymal hematoma type 2	12 (3.6%)	11 (12%)
Isolated subarachnoid hemorrhage	41 (12%)	3 (3.3%)
Other isolated hemorrhage (SDH/IVH/rPH)	10 (3.0%)	5 (5.6%)
Combined hemorrhagic infarction with hemorrhage outside infarcted brain tissue	32 (9.7%)	6 (6.7%)
Combined parenchymal hematoma with hemorrhage outside infarcted brain tissue	32 (9.7%)	59 (66%)
Combined hemorrhages outside infarcted brain tissue	2 (0.6%)	3 (3.3%)

Data are presented as n (%).

SDH indicates subdural hematoma; IVH, intraventricular hemorrhage; and rPH, remote parenchymal hematoma.

Table II. Subclassification of hemorrhages classified as 'Other isolated hemorrhage (SDH/IVH/rPH)'

	Subdural hematoma	Intraventricular hemorrhage	Remote parenchymal hemorrhage
Other isolated hemorrhage (SDH/IVH/rPH)	2	3	10

Number of hemorrhages per subclassification are presented as N.

Table III. Subclassification of hemorrhages classified as 'Combined hemorrhagic infarction with hemorrhage outside infarcted brain tissue'

	Subarachnoid hemorrhage	Subdural hematoma	Intraventricular hemorrhage	Remote parenchymal hemorrhage	Combined hemorrhages outside infarcted brain tissue
Hemorrhagic infarction type 1	9	2	0	4	3
Hemorrhagic infarction type 2	11	5	1	1	2

Number of hemorrhages per combined subclassification are presented as N.

Table IV. Subclassification of hemorrhages classified as 'Combined parenchymal hematoma with hemorrhage outside infarcted brain tissue'

	Subarachnoid hemorrhage	Subdural hematoma	Intraventricular hemorrhage	Remote parenchymal hemorrhage	Combined hemorrhages outside infarcted brain tissue
Parenchymal hematoma type 1	13	0	4	1	6
Parenchymal hematoma type 2	19	2	14	4	28

Number of hemorrhages per combined subclassification are presented as N.

Table V. Subclassification of hemorrhages classified as 'Combined hemorrhages outside infarcted brain tissue'

	Subdural hematoma	Intraventricular hemorrhage	Remote parenchymal hemorrhage
Subarachnoid hemorrhage	0	2	2
Subdural hematoma	X	0	0
Intraventricular hemorrhage	X	X	1

Number of hemorrhages per combined subclassification are presented as N. Combinations are only presented once. Cells with a combination that is already given in another cell are presented as 'X'.

Supplementary Investigator List

Investigators

MR CLEAN-NO IV Investigators

Principal investigators
Yvo Roos (MD, PhD),[1] Charles Majoie (MD, PhD)[1]

Study coordinators
Kilian Treurniet (MD),[1] Jonathan Coutinho (MD, PhD),[1] Bart Emmer (MD, PhD),[1] Natalie LeCouffe (MD),[1] Manon Kappelhof (MD),[1] Leon Rinkel (MD),[1] Agnetha Bruggeman (MD),[1]

Local principal investigators
Bob Roozenbeek (MD, PhD),[2] Adriaan van Es (MD, PhD),[2,26] Inger de Ridder (MD, PhD),[4] Wim van Zwam (MD, PhD),[4] Bart van der Worp (MD, PhD),[5] Rob Lo (MD, PhD),[5] Koos Keizer (MD, PhD),[6] Rob Gons (MD, PhD),[6] Lonneke Yo (MD, PhD),[6] Jelis Boiten (MD, PhD),[7] Ido van den Wijngaard (MD, PhD),[7] Geert Lycklama à Nijeholt (MD, PhD),[7] Jeannette Hofmeijer (MD, PhD),[8] Jasper Martens (MD),[8] Wouter Schonewille (MD, PhD),[9] Jan Albert Vos, (MD, PhD),[9] Anil Tuladhar (MD, PhD),[10] Floris Schreuder (MD, PhD),[10] Jeroen Boogaarts (MD, PhD),[10] Sjoerd Jenniskens (MD),[10] Karlijn de Laat (MD, PhD),[11] Lukas van Dijk (MD, PhD),[11] Heleen den Hertog (MD, PhD),[12] Boudewijn van Hasselt (MD),[12] Paul Brouwers (MD, PhD),[13] Emiel Sturm (MD),[13] Tomas Bulut (MD),[13] Michel Remmers (MD),[14] Anouk van Norden (MD),[14] Thijs de Jong (MD),[14] Anouk Rozeman (MD),[15] Otto Elgersma (MD, PhD),[15] Maarten Uyttenboogaart (MD, PhD),[16] Reinoud Bokkers (MD, PhD),[16] Julia van Tuijl (MD, PhD),[17] Issam Boukrab (MD),[17] Hans Kortman (MD),[17] Vincent Costalat (MD, PhD),[18] Caroline Arquizan (MD),[18] Robin Lemmens (MD, PhD),[19] Jelle Demeestere (MD),[20] Philippe Desfontaines (MD),[20] Denis Brisbois (MD),[20] Frédéric Clarençon (MD, PhD),[21] Yves Samson (MD)[21]

Executive and writing committee
Yvo Roos (MD, PhD),[1] Charles Majoie (MD, PhD),[1] Adriaan van Es (MD, PhD),[2,26] Diederik Dippel (MD, PhD),[2] Aad van der Lugt (MD, PhD),[2] Wim van Zwam (MD, PhD),[4] Jelis Boiten (MD, PhD),[7] Geert Lycklama à Nijeholt (MD, PhD),[7] Lonneke Yo (MD, PhD),[6] Koos Keizer (MD, PhD),[6] Jonathan Coutinho (MD, PhD),[1] Bart Emmer (MD, PhD),[1] Kilian Treurniet (MD),[1] Natalie LeCouffe (MD),[1] Manon Kappelhof (MD),[1]

Local MR CLEAN-NO IV collaborators

Data Safety Monitoring Board
Martin Brown (MD) – Chair,[22] Phil White (MD, PhD),[23] John Gregson (MD, PhD)[24]

Independent trial statistician
Daan Nieboer (MSc)[2]

MR CLEAN-MED investigators

Principal investigators
Diederik Dippel (MD, PhD),[2] Aad van der Lugt (MD, PhD)[2]

Study coordinators
Wouter van der Steen (MD),[2] Rob van de Graaf (MD, PhD),[2] Bob Roozenbeek (MD, PhD)[2]

Local principal investigators
Bob Roozenbeek (MD, PhD),[2] Adriaan van Es (MD, PhD),[2,26] Pieter Jan van Doormaal (MD),[2] Jonathan M. Coutinho (MD, PhD),[1] Bart Emmer (MD, PhD),[1] Inger de Ridder (MD, PhD),[4] Wim van Zwam (MD, PhD),[4] Bart van der Worp (MD, PhD),[5] Irene van der Schaaf (MD, PhD),[5] Rob Gons (MD, PhD),[6] Lonneke Yo (MD),[6] Jelis Boiten (MD, PhD),[7] Ido van den Wijngaard (MD, PhD),[7,26] Jeanette Hofmeijer (MD, PhD),[8] Jasper Martens (MD),[8] Wouter Schonewille (MD, PhD),[9] Jan Albert Vos, (MD, PhD),[9] Anil Man Tuladhar (MD, PhD),[10] Sjoerd Jenniskens (MD),[10] Karlijn de Laat (MD, PhD),[11] Lukas van Dijk (MD, PhD),[11] Heleen den Hertog (MD, PhD),[12] Boudewijn van Hasselt (MD),[12] Michel Remmers (MD),[14] Douwe Vos,[14] Anouk Rozeman (MD, PhD),[15] Otto Elgersma (MD,

PhD),[15] Maarten Uyttenboogaart (MD, PhD),[16] Reinoud Bokkers (MD, PhD),[16] Julia van Tuijl (MD, PhD),[17] Issam Boukrab (MD),[17] Benjamin Gory (MD, PhD),[27] Arturo Consoli (MD),[28] Mikaël Mazighi (MD, PhD),[29] Frederic Clarencon (MD, PhD),[30] Gaultier Marnat (MD),[21]

Executive and writing committee
Diederik Dippel (MD, PhD),[2] Aad van der Lugt (MD, PhD),[2] Rob van de Graaf (MD, PhD),[2] Wouter van der Steen (MD),[2] Bob Roozenbeek (MD, PhD),[2] Adriaan van Es (MD, PhD),[2] Yvo Roos (MD, PhD),[1] Charles Majoie (MD, PhD),[1] Robert van Oostenbrugge (MD, PhD),[4] Wim van Zwam (MD, PhD),[4] Julie Staals (MD, PhD),[4] Sjoerd Jenniskens (MD),[10] Lukas van Dijk (MD, PhD),[11] Heleen den Hertog (MD, PhD),[12]

Local MR CLEAN-MED collaborators

Data Safety Monitoring Board
Peter Rothwell (MD, PhD) – *Chair,*[31] Andrew Molyneux (MD, PhD),[31] Joanna Moschandreas (MD, PhD)[31]

Independent trial statistician
Daan Nieboer (MSc)[2]

Advisory Board
Gregory del Zoppo (MD, PhD)[32]

CONTRAST clinical trial collaborators

Research leaders
Diederik Dippel (MD, PhD),[2] Charles Majoie (MD, PhD)[1]

Consortium coordinator:
Rick van Nuland, (PhD)[3]

Imaging assessment committee
Charles Majoie (MD, PhD) – *Chair*,[1] Aad van der Lugt (MD, PhD) – *Chair*,[2] Adriaan van Es, (MD, PhD),[2,26] Pieter-Jan van Doormaal (MD),[2] René van den Berg, (MD, PhD),[1] Ludo Beenen (MD, PhD),[1] Bart Emmer (MD, PhD),[1] Stefan Roosendaal (MD, PhD),[1] Wim van Zwam (MD, PhD),[4] Alida Annechien Postma (MD, PhD),[33] Lonneke Yo (MD, PhD),[6] Menno Krietemeijer (MD),[6] Geert Lycklama (MD, PhD),[7] Jasper Martens (MD),[8] Sebastiaan Hammer (MD, PhD),[10] Anton Meijer (MD, PhD),[10] Reinoud Bokkers (MD, PhD),[16] Anouk van der Hoorn (MD, PhD),[16] Ido van den Wijngaard (MD, PhD),[7,26] Albert Yoo (MD, PhD),[25] Dick Gerrits (MD)[13]

Adverse event committee
Robert van Oostenbrugge (MD, PhD) – *Chair*,[4] Bart Emmer (MD, PhD),[1] Jonathan M. Coutinho (MD, PhD),[1] Martine Truijman (MD, PhD),[4] Julie Staals (MD, PHD),[4] Bart van der Worp (MD, PhD),[5] J. Boogaarts (MD, PhD),[10] Ben Jansen (MD, PhD),[17] Sanne Zinkstok (MD, PhD)[34]

Outcome assessment committee
Yvo Roos (MD, PhD) – *Chair*,[1] Peter Koudstaal (MD, PhD),[2] Diederik Dippel (MD, PhD),[2] Jonathan M. Coutinho (MD, PhD),[1] Koos Keizer (MD, PhD),[5] Sanne Manschot (MD, PhD),[7] Jelis Boiten (MD, PhD),[7] Henk Kerkhoff (MD, PhD),[15] Ido van den Wijngaard (MD, PhD)[7,26]

Data management group
Hester Lingsma (PhD),[2] Diederik Dippel (MD, PhD),[2] Vicky Chalos (MD),[2] Olvert Berkhemer (MD, PhD)[1,2]

Imaging data management
Aad van der Lugt (MD, PhD),[2] Charles Majoie (MD, PhD),[1] Adriaan Versteeg,[2] Lennard Wolff (MD),[2] Matthijs van der Sluijs (MD),[2] Henk van Voorst (MD),[1] Manon Tolhuisen (MSc),[1]

Biomaterials and translational group
Hugo ten Cate (MD, PhD),[4] Moniek de Maat (PhD),[2] Samantha Donse-Donkel (MD),[2] Heleen van Beusekom (PhD),[2] Aladdin Taha (MD),[2] Aarazo Barakzie (MD)[2]

Local collaborators
Vicky Chalos (MD, PhD),[2] Rob van de Graaf (MD, PhD),[2] Wouter van der Steen (MD),[2] Aladdin Taha (MD),[2] Samantha Donse-Donkel (MD),[2] Lennard Wolff (MD),[2] Kilian Treurniet (MD),[1] Sophie van den Berg (MD),[1] Natalie LeCouffe (MD),[1] Manon Kappelhof (MD),[1] Rik Reinink (MD),[1] Manon Tolhuisen (MD),[1] Leon Rinkel (MD),[1] Josje Brouwer (MD),[1] Agnetha Bruggeman (MD),[1] Henk van Voorst (MD),[1] Robert-Jan Goldhoorn (MD),[4] Wouter Hinsenveld (MD),[4] Anne Pirson (MD),[4] Susan Olthuis (MD),[4] Simone Uniken Venema (MD),[5] Sjan Teeselink (MD),[10] Lotte Sondag (MD),[10] Sabine Collette (MD)[16]

Research nurses
Martin Sterrenberg,[2] Naziha El Ghannouti,[2] Laurine van der Steen,[1] Sabrina Verheesen,[4] Jeannique Vranken,[4] Ayla van Ahee,[5] Hester Bongenaar,[6] Maylee Smallegange,[6] Lida Tilet,[6] Joke de Meris,[7] Michelle Simons,[8] Wilma Pellikaan,[9] Wilma van Wijngaarden,[9] Kitty Blauwendraat,[9] Yvonne Drabbe,[11] Michelle Sandiman-Lefeber,[11] Anke Katthöfer,[11] Eva Ponjee,[12] Rieke Eilander,[12] Anja van Loon,[14] Karin Kraus,[14] Suze Kooij,[15] Annemarie Slotboom,[15] Marieke de Jong,[16] Friedus van der Minne,[16] Esther Santegoets[17]

Study monitors
Leontien Heiligers[2], Yvonne Martens,[2] Naziha El Ghannouti[2]

Affiliations

[1] Amsterdam UMC, University of Amsterdam, Amsterdam, the Netherlands;
[2] Erasmus MC University Medical Center, Rotterdam, the Netherlands;
[3] Lygature, Utrecht, the Netherlands;
[4] Cardiovascular Research Institute Maastricht (CARIM), Maastricht University Medical Center, Maastricht, The Netherlands;
[5] University Medical Center Utrecht, Brain Center, Utrecht, the Netherlands;
[6] Catharina Hospital, Eindhoven, the Netherlands;
[7] Haaglanden Medical Center, the Hague, the Netherlands;
[8] Rijnstate Hospital, Arnhem, the Netherlands;
[9] St. Antonius Hospital, Nieuwegein, the Netherlands;
[10] Radboud University Medical Center, Nijmegen, the Netherlands;
[11] HagaZiekenhuis, the Hague, the Netherlands;
[12] Isala Klinieken, Zwolle, the Netherlands;
[13] Medisch Spectrum Twente, Enschede, the Netherlands;
[14] Amphia Hospital, Breda, the Netherlands;
[15] Albert Schweitzer Hospital, Dordrecht, the Netherlands;
[16] University Medical Center Groningen, the Netherlands;
[17] Elisabeth-TweeSteden Hospital, Tilburg, the Netherlands;
[18] Centre Hospitalier Universitaire de Montpellier, Montpellier, France;
[19] University Hospitals Leuven, Leuven, Belgium;
[20] Centre Hospitalier Chrétien, Liège, Belgium;
[21] Pitié-Salpêtrière hospital APHP-Sorbonne Université Paris France, Paris, France;
[22] National Hospital for Neurology and Neurosurgery, London, United Kingdom;
[23] Institute of Neuroscience and Newcastle University Institute for Ageing, Newcastle University, Newcastle, UK;
[24] London School of Hygiene & Tropical Medicine, London, United Kingdom;
[25] Texas Stroke Institute, Plano, Texas, United States of America
[26] Leiden Universitair Medisch Centrum, Leiden, the Netherlands
[27] University Hospital of Nancy, Nancy, France
[28] Foch Hospital, Suresnes, France
[29] Fondation Rothschild Hospital, Paris, France
[30] University Hospital of Bordeaux, Bordeaux, France
[31] John Radcliffe Hospital, Oxford, United Kingdom
[32] University of Washington, Seattle, Washington, United States
[33] School for Mental Health and Sciences (Mhens), Maastricht University Medical Center, Maastricht, The Netherlands
[34] TerGooi, Hilversum, The Netherlands

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7	Support for attending meetings and/or travel	☒ **None**	
8	Patents planned, issued or pending	☒ **None**	
9	Participation on a Data Safety Monitoring Board or Advisory Board	☐ **None**	
		DSMB ESCAPE MEVO	unpaid
10	Leadership or fiduciary role in other board, society, committee or advocacy group, paid or unpaid	☐ **None**	
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Manuscript Title: Type of intracranial hemorrhage after endovascular stroke treatment: association with functional outcome

Manuscript Number (if known): jnis-2022-019474.R1

In the interest of transparency, we ask you to disclose all relationships/activities/interests listed below that are related to the content of your manuscript. "Related" means any relation with for-profit or not-for-profit third parties whose interests may be affected by the content of the manuscript. Disclosure represents a commitment to transparency and does not necessarily indicate a bias. If you are in doubt about whether to list a relationship/activity/interest, it is preferable that you do so.

The author's relationships/activities/interests should be defined broadly. For example, if your manuscript pertains to the epidemiology of hypertension, you should declare all relationships with manufacturers of antihypertensive medication, even if that medication is not mentioned in the manuscript.

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		Name all entities with whom you have this relationship or indicate none (add rows as needed)	**Specifications/Comments (e.g., if payments were made to you or to your institution)**
Time frame: Since the initial planning of the work			
1	All support for the present manuscript (e.g., funding, provision of study materials, medical writing, article processing charges, etc.) **No time limit for this item.**	☒ **None**	
			Click the tab key to add additional rows.
Time frame: past 36 months			
2	Grants or contracts from any entity (if not indicated in item #1 above).	☐ **None**	
		The Netherlands Organization for Health Research and Development	paid to institution
		Health Holland Top Sector Life Sciences & Health	paid to institution
		Nicolab b.v	paid to institution
3	Royalties or licenses	☒ **None**	

		Name all entities with whom you have this relationship or indicate none (add rows as needed)	Specifications/Comments (e.g., if payments were made to you or to your institution)
4	Consulting fees	☒ **None**	
5	Payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing or educational events	☒ **None**	
6	Payment for expert testimony	☒ **None**	
7	Support for attending meetings and/or travel	☒ **None**	
8	Patents planned, issued or pending	☒ **None**	
9	Participation on a Data Safety Monitoring Board or Advisory Board	☒ **None**	
10	Leadership or fiduciary role in other board, society, committee or advocacy group, paid or unpaid	☐ **None**	
		Board Member UEMS Neuroradiology for the Netherlands	Unpaid
		Board Member Dutch Section Neuroradiology	Unpaid

		Name all entities with whom you have this relationship or indicate none (add rows as needed)	Specifications/Comments (e.g., if payments were made to you or to your institution)
11	Stock or stock options	☒ **None**	
12	Receipt of equipment, materials, drugs, medical writing, gifts or other services	☒ **None**	
13	Other financial or non-financial interests	☒ **None**	

Please place an "X" next to the following statement to indicate your agreement:

☒ I certify that I have answered every question and have not altered the wording of any of the questions on this form.

ICMJE DISCLOSURE FORM

Date: 9/21/2021

Your Name: Bob Roozenbeek

Manuscript Title: Type of intracranial hemorrhage after endovascular stroke treatment: association with functional outcome

Manuscript Number (if known): jnis-2022-019474.R1

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			Click the tab key to add additional rows.
Time frame: past 36 months			
2	Grants or contracts from any entity (if not indicated in item #1 above).	☐ **None**	
		Dutch Heart Foundation	Research grant paid to institution
		Netherlands Organisation of Health Research and Development	Research grants paid to institution
3	Royalties or licenses	☒ **None**	

		Name all entities with whom you have this relationship or indicate none (add rows as needed)	Specifications/Comments (e.g., if payments were made to you or to your institution)
4	Consulting fees	☒ **None**	
5	Payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing or educational events	☒ **None**	
6	Payment for expert testimony	☒ **None**	
7	Support for attending meetings and/or travel	☒ **None**	
8	Patents planned, issued or pending	☒ **None**	
9	Participation on a Data Safety Monitoring Board or Advisory Board	☒ **None**	
10	Leadership or fiduciary role in other board, society, committee or advocacy group, paid or unpaid	☒ **None**	

		Name all entities with whom you have this relationship or indicate none (add rows as needed)	Specifications/Comments (e.g., if payments were made to you or to your institution)
11	Stock or stock options	☒ **None**	
12	Receipt of equipment, materials, drugs, medical writing, gifts or other services	☒ **None**	
13	Other financial or non-financial interests	☒ **None**	

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ICMJE DISCLOSURE FORM

Date: 9/26/2022

Your Name: Charles Majoie

Manuscript Title: Type of intracranial hemorrhage after endovascular stroke treatment: association with functional outcome

Manuscript Number (if known): jnis-2022-019474.R1

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Time frame: Since the initial planning of the work			
1	All support for the present manuscript (e.g., funding, provision of study materials, medical writing, article processing charges, etc.) **No time limit for this item.**	☐ **None**	
		CVON/Dutch Heart Foundation	Paid to institution
		Stryker	Paid to institution
			Click the tab key to add additional rows.
Time frame: past 36 months			
2	Grants or contracts from any entity (if not indicated in item #1 above).	☐ **None**	
		European Commission	Paid to institution
		Healthcare Evaluation Netherlands	Paid to institution
		TWIN Foundation	Paid to institution
3	Royalties or licenses	☒ **None**	

		Name all entities with whom you have this relationship or indicate none (add rows as needed)	Specifications/Comments (e.g., if payments were made to you or to your institution)
4	Consulting fees	☒ **None**	
5	Payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing or educational events	☒ **None**	
6	Payment for expert testimony	☒ **None**	
7	Support for attending meetings and/or travel	☒ **None**	
8	Patents planned, issued or pending	☒ **None**	
9	Participation on a Data Safety Monitoring Board or Advisory Board	☒ **None**	
10	Leadership or fiduciary role in other board, society, committee or advocacy group, paid or unpaid	☒ **None**	

		Name all entities with whom you have this relationship or indicate none (add rows as needed)	Specifications/Comments (e.g., if payments were made to you or to your institution)
11	Stock or stock options	☐ **None**	
		Nicolab	Shareholder (minority interest)
12	Receipt of equipment, materials, drugs, medical writing, gifts or other services	☒ **None**	
13	Other financial or non-financial interests	☒ **None**	

Please place an "X" next to the following statement to indicate your agreement:

☒ I certify that I have answered every question and have not altered the wording of any of the questions on this form.

ICMJE DISCLOSURE FORM

Date: 9/21/2021

Your Name: Diederik Dippel

Manuscript Title: Type of intracranial hemorrhage after endovascular stroke treatment: association with functional outcome

Manuscript Number (if known): jnis-2022-019474.R1

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Time frame: Since the initial planning of the work			
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			Click the tab key to add additional rows.
Time frame: past 36 months			
2	Grants or contracts from any entity (if not indicated in item #1 above).	☐ **None**	
		Stryker	Funding for research paid to institution
		Penumbra	Funding for research paid to institution
		Medtronic	Funding for research paid to institution
		Cerenovus	Funding for research paid to institution
		Thrombolytic Science LLC	Funding for research paid to institution
		Dutch Heart Foundation	Funding for research paid to institution
		Brain Foundation Netherlands	Funding for research paid to institution
		The Netherlands Organization for Health Research and Development, Health Holland Top Sector Life Sciences & Health,	Funding for research paid to institution
		The Netherlands Organization for Health Research and Development,	Funding for research paid to institution
			Funding for research paid to institution

		Name all entities with whom you have this relationship or indicate none (add rows as needed)	Specifications/Comments (e.g., if payments were made to you or to your institution)
3	Royalties or licenses	☒ **None**	
4	Consulting fees	☒ **None**	
5	Payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing or educational events	☒ **None**	
6	Payment for expert testimony	☒ **None**	

		Name all entities with whom you have this relationship or indicate none (add rows as needed)	Specifications/Comments (e.g., if payments were made to you or to your institution)
7	Support for attending meetings and/or travel	☒ **None**	
8	Patents planned, issued or pending	☒ **None**	
9	Participation on a Data Safety Monitoring Board or Advisory Board	☐ **None**	
		Enchanted 3	unpaid
		TESLA	unpaid
10	Leadership or fiduciary role in other board, society, committee or advocacy group, paid or unpaid	☐ **None**	
		Chair of ESO Stroke Unit Committee	unpaid
		Research leader of CONTRAST consortium	unpaid
11	Stock or stock options	☒ **None**	
12	Receipt of equipment, materials, drugs, medical writing, gifts or other services	☒ **None**	
13	Other financial or non-financial interests	☒ **None**	

Please place an "X" next to the following statement to indicate your agreement:

☒ I certify that I have answered every question and have not altered the wording of any of the questions on this form.

ICMJE DISCLOSURE FORM

Date: 9/26/2022

Your Name: Hester Lingsma

Manuscript Title: Type of intracranial hemorrhage after endovascular stroke treatment: association with functional outcome

Manuscript Number (if known): jnis-2022-019474.R1

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			Click the tab key to add additional rows.
Time frame: past 36 months			
2	Grants or contracts from any entity (if not indicated in item #1 above).	☒ **None**	
3	Royalties or licenses	☒ **None**	

		Name all entities with whom you have this relationship or indicate none (add rows as needed)	Specifications/Comments (e.g., if payments were made to you or to your institution)
4	Consulting fees	☒ **None**	
5	Payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing or educational events	☒ **None**	
6	Payment for expert testimony	☒ **None**	
7	Support for attending meetings and/or travel	☒ **None**	
8	Patents planned, issued or pending	☒ **None**	
9	Participation on a Data Safety Monitoring Board or Advisory Board	☒ **None**	
10	Leadership or fiduciary role in other board, society, committee or advocacy group, paid or unpaid	☒ **None**	

		Name all entities with whom you have this relationship or indicate none (add rows as needed)	Specifications/Comments (e.g., if payments were made to you or to your institution)
11	Stock or stock options	☒ **None**	
12	Receipt of equipment, materials, drugs, medical writing, gifts or other services	☒ **None**	
13	Other financial or non-financial interests	☒ **None**	

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ICMJE DISCLOSURE FORM

Date: 9/26/2022

Your Name: Henk van Voorst

Manuscript Title: Type of intracranial hemorrhage after endovascular stroke treatment: association with functional outcome

Manuscript Number (if known): jnis-2022-019474.R1

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			Click the tab key to add additional rows.
Time frame: past 36 months			
2	Grants or contracts from any entity (if not indicated in item #1 above).	☒ **None**	
3	Royalties or licenses	☒ **None**	

		Name all entities with whom you have this relationship or indicate none (add rows as needed)	Specifications/Comments (e.g., if payments were made to you or to your institution)
4	Consulting fees	☒ **None**	
5	Payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing or educational events	☒ **None**	
6	Payment for expert testimony	☒ **None**	
7	Support for attending meetings and/or travel	☒ **None**	
8	Patents planned, issued or pending	☒ **None**	
9	Participation on a Data Safety Monitoring Board or Advisory Board	☒ **None**	
10	Leadership or fiduciary role in other board, society, committee or advocacy group, paid or unpaid	☒ **None**	

		Name all entities with whom you have this relationship or indicate none (add rows as needed)	Specifications/Comments (e.g., if payments were made to you or to your institution)
11	Stock or stock options	☒ **None**	
12	Receipt of equipment, materials, drugs, medical writing, gifts or other services	☒ **None**	
13	Other financial or non-financial interests	☒ **None**	

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ICMJE DISCLOSURE FORM

Date: 9/21/2022

Your Name: Jonathan Coutinho

Manuscript Title: Type of intracranial hemorrhage after endovascular stroke treatment: association with functional outcome

Manuscript Number (if known): 1T

In the interest of transparency, we ask you to disclose all relationships/activities/interests listed below that are related to the content of your manuscript. "Related" means any relation with for-profit or not-for-profit third parties whose interests may be affected by the content of the manuscript. Disclosure represents a commitment to transparency and does not necessarily indicate a bias. If you are in doubt about whether to list a relationship/activity/interest, it is preferable that you do so.

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		Name all entities with whom you have this relationship or indicate none (add rows as needed)	Specifications/Comments (e.g., if payments were made to you or to your institution)
Time frame: Since the initial planning of the work			
1	All support for the present manuscript (e.g., funding, provision of study materials, medical writing, article processing charges, etc.) **No time limit for this item.**	☒ None	
Time frame: past 36 months			
2	Grants or contracts from any entity (if not indicated in item #1 above).	☐ **None**	
		Boehringer	Honoraria for membership steering committee. All fees paid to my institution
		Bayer	Honoraria for membership steering committee. All fees paid to my institution
		Portola	Honoraria for membership steering committee. All fees paid to my institution
		The Netherlands Organisation for Health Research and Development (ZonMw, grant number 10430072110005)	Non-profit organization. All fees paid to my institute
		Dr. C.J. Vaillant Foundation	Non-profit organization. All fees paid to my institute
		Dutch thrombosis foundation	Non-profit organization. All fees paid to my institute

		Name all entities with whom you have this relationship or indicate none (add rows as needed)	Specifications/Comments (e.g., if payments were made to you or to your institution)
3	Royalties or licenses	☒ **None**	
4	Consulting fees	☒ **None**	
5	Payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing or educational events	☒ **None**	
6	Payment for expert testimony	☒ **None**	
7	Support for attending meetings and/or travel	☒ **None**	
8	Patents planned, issued or pending	☒ **None**	
9	Participation on a Data Safety Monitoring Board or Advisory Board	☒ **None**	
10	Leadership or fiduciary role in other board,	☒ **None**	

		Name all entities with whom you have this relationship or indicate none (add rows as needed)	Specifications/Comments (e.g., if payments were made to you or to your institution)
	society, committee or advocacy group, paid or unpaid		
11	Stock or stock options	☐ **None**	
		Trianect	Dr Coutinho is a shareholder of Trianect BV
12	Receipt of equipment, materials, drugs, medical writing, gifts or other services	☒ **None**	
13	Other financial or non-financial interests	☒ **None**	

Please place an "X" next to the following statement to indicate your agreement:

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ICMJE DISCLOSURE FORM

Date: 9/26/2022

Your Name: K.R. van Kranendonk

Manuscript Title: Type of intracranial hemorrhage after endovascular stroke treatment: association with functional outcome

Manuscript Number (if known): jnis-2022-019474.R1

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Time frame: past 36 months			
2	Grants or contracts from any entity (if not indicated in item #1 above).	☒ **None**	
3	Royalties or licenses	☒ **None**	

		Name all entities with whom you have this relationship or indicate none (add rows as needed)	Specifications/Comments (e.g., if payments were made to you or to your institution)
4	Consulting fees	☒ **None**	
5	Payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing or educational events	☒ **None**	
6	Payment for expert testimony	☒ **None**	
7	Support for attending meetings and/or travel	☒ **None**	
8	Patents planned, issued or pending	☒ **None**	
9	Participation on a Data Safety Monitoring Board or Advisory Board	☒ **None**	
10	Leadership or fiduciary role in other board, society, committee or advocacy group, paid or unpaid	☒ **None**	

		Name all entities with whom you have this relationship or indicate none (add rows as needed)	Specifications/Comments (e.g., if payments were made to you or to your institution)
11	Stock or stock options	☒ **None**	
12	Receipt of equipment, materials, drugs, medical writing, gifts or other services	☒ **None**	
13	Other financial or non-financial interests	☒ **None**	

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ICMJE DISCLOSURE FORM

Date: 9/21/2021

Your Name: Leon A. Rinkel

Manuscript Title: Type of intracranial hemorrhage after endovascular stroke treatment: association with functional outcome

Manuscript Number (if known): jnis-2022-019474.R1

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Time frame: past 36 months			
2	Grants or contracts from any entity (if not indicated in item #1 above).	☒ **None**	
3	Royalties or licenses	☒ **None**	

		Name all entities with whom you have this relationship or indicate none (add rows as needed)	Specifications/Comments (e.g., if payments were made to you or to your institution)
4	Consulting fees	☒ **None**	
5	Payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing or educational events	☒ **None**	
6	Payment for expert testimony	☒ **None**	
7	Support for attending meetings and/or travel	☒ **None**	
8	Patents planned, issued or pending	☒ **None**	
9	Participation on a Data Safety Monitoring Board or Advisory Board	☒ **None**	
10	Leadership or fiduciary role in other board, society, committee or advocacy group, paid or unpaid	☒ **None**	

		Name all entities with whom you have this relationship or indicate none (add rows as needed)	Specifications/Comments (e.g., if payments were made to you or to your institution)
11	Stock or stock options	☒ **None**	
12	Receipt of equipment, materials, drugs, medical writing, gifts or other services	☒ **None**	
13	Other financial or non-financial interests	☒ **None**	

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☒ I certify that I have answered every question and have not altered the wording of any of the questions on this form.

ICMJE DISCLOSURE FORM

Date: 9/27/2022

Your Name: Ludo F. Beenen

Manuscript Title: Type of intracranial hemorrhage after endovascular stroke treatment: association with functional outcome

Manuscript Number (if known): jnis-2022-019474.R1

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Time frame: Since the initial planning of the work			
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			Click the tab key to add additional rows.
Time frame: past 36 months			
2	Grants or contracts from any entity (if not indicated in item #1 above).	☒ **None**	
3	Royalties or licenses	☒ **None**	

		Name all entities with whom you have this relationship or indicate none (add rows as needed)	Specifications/Comments (e.g., if payments were made to you or to your institution)
4	Consulting fees	☒ **None**	
5	Payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing or educational events	☒ **None**	
6	Payment for expert testimony	☒ **None**	
7	Support for attending meetings and/or travel	☒ **None**	
8	Patents planned, issued or pending	☒ **None**	
9	Participation on a Data Safety Monitoring Board or Advisory Board	☒ **None**	
10	Leadership or fiduciary role in other board, society, committee or advocacy group, paid or unpaid	☒ **None**	

		Name all entities with whom you have this relationship or indicate none (add rows as needed)	Specifications/Comments (e.g., if payments were made to you or to your institution)
11	Stock or stock options	☒ **None**	
12	Receipt of equipment, materials, drugs, medical writing, gifts or other services	☒ **None**	
13	Other financial or non-financial interests	☒ **None**	

Please place an "X" next to the following statement to indicate your agreement:

☒ I certify that I have answered every question and have not altered the wording of any of the questions on this form.

ICMJE DISCLOSURE FORM

Date: 9/23/2022

Your Name: Nadinda van der Ende

Manuscript Title: Type of intracranial hemorrhage after endovascular stroke treatment: association with functional outcome

Manuscript Number (if known): jnis-2022-019474.R1

In the interest of transparency, we ask you to disclose all relationships/activities/interests listed below that are related to the content of your manuscript. "Related" means any relation with for-profit or not-for-profit third parties whose interests may be affected by the content of the manuscript. Disclosure represents a commitment to transparency and does not necessarily indicate a bias. If you are in doubt about whether to list a relationship/activity/interest, it is preferable that you do so.

The author's relationships/activities/interests should be defined broadly. For example, if your manuscript pertains to the epidemiology of hypertension, you should declare all relationships with manufacturers of antihypertensive medication, even if that medication is not mentioned in the manuscript.

In item #1 below, report all support for the work reported in this manuscript without time limit. For all other items, the time frame for disclosure is the past 36 months.

		Name all entities with whom you have this relationship or indicate none (add rows as needed)	**Specifications/Comments (e.g., if payments were made to you or to your institution)**
Time frame: Since the initial planning of the work			
1	All support for the present manuscript (e.g., funding, provision of study materials, medical writing, article processing charges, etc.) **No time limit for this item.**	☒ **None**	
			Click the tab key to add additional rows.
Time frame: past 36 months			
2	Grants or contracts from any entity (if not indicated in item #1 above).	☒ **None**	
3	Royalties or licenses	☒ **None**	

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4	Consulting fees	☒ **None**	
5	Payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing or educational events	☒ **None**	
6	Payment for expert testimony	☒ **None**	
7	Support for attending meetings and/or travel	☒ **None**	
8	Patents planned, issued or pending	☒ **None**	
9	Participation on a Data Safety Monitoring Board or Advisory Board	☒ **None**	
10	Leadership or fiduciary role in other board, society, committee or advocacy group, paid or unpaid	☒ **None**	

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12	Receipt of equipment, materials, drugs, medical writing, gifts or other services	☒ **None**	
13	Other financial or non-financial interests	☒ **None**	

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ICMJE DISCLOSURE FORM

Date: 9/27/2022

Your Name: Robert J. van Oostenbrugge

Manuscript Title: Type of intracranial hemorrhage after endovascular stroke treatment: association with functional outcome

Manuscript Number (if known): jnis-2022-019474.R1

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6	Payment for expert testimony	☒ **None**	
7	Support for attending meetings and/or travel	☒ **None**	
8	Patents planned, issued or pending	☒ **None**	
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ICMJE DISCLOSURE FORM

Date: 9/25/2022

Your Name: Stefan Roosendaal

Manuscript Title: Type of intracranial hemorrhage after endovascular stroke treatment: association with functional outcome

Manuscript Number (if known): jnis-2022-019474.R1

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6	Payment for expert testimony	☒ **None**	
7	Support for attending meetings and/or travel	☒ **None**	
8	Patents planned, issued or pending	☒ **None**	
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ICMJE DISCLOSURE FORM

Date: 8/26/2021

Your Name: Sven P.R. Luijten

Manuscript Title: Type of intracranial hemorrhage after endovascular stroke treatment: association with functional outcome

Manuscript Number (if known): jnis-2022-019474.R1

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ICMJE DISCLOSURE FORM

Date: 9/21/2022

Your Name: Wouter van der Steen

Manuscript Title: Type of intracranial hemorrhage after endovascular stroke treatment: association with functional outcome

Manuscript Number (if known): jnis-2022-019474.R1

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