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Accuracy of the ABC/2 score for intracerebral hemorrhage: Systematic review and analysis of MISTIE, CLEAR-IVH, CLEAR III

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Abstract

Background and Purpose—The ABC/2 score estimates intracerebral hemorrhage (ICH) volume, yet validations have been limited by small samples and inappropriate outcome measures. We determined accuracy of the ABC/2 score calculated at a specialized Reading Center (RC-ABC) or local site (site-ABC) versus the reference-standard CT-based planimetry (CTP).

Methods—In MISTIE-II, CLEAR-IVH and CLEAR-III trials, ICH volume was prospectively calculated by CTP, RC-ABC and site-ABC. Agreement between CTP and ABC/2 was defined as an absolute difference up to 5ml and relative difference within 20%. Determinants of ABC/2 accuracy were assessed by logistic regression.

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Conflict of interest

Johns Hopkins University holds a use patent for intraventricular tPA. Prof Hanley has acted as an expert witness.

Results—In 4369 scans from 507 patients, CTP was more strongly correlated with RC-ABC (r^2=0.93) than site-ABC (r^2=0.87). Although RC-ABC overestimated CTP-based volume on average (RC-ABC=15.2cm^3, CTP=12.7cm^3), agreement was reasonable when categorised into mild, moderate and severe ICH (kappa 0.75, p<0.001). This was consistent with overestimation of ICH volume in 6/8 previous studies. Agreement with CTP was greater for RC-ABC (84% within 5ml; 48% of scans within 20%) than for site-ABC (81% within 5ml; 41% within 20%). RC-ABC had moderate accuracy for detecting ≥ 5ml change in CTP volume between consecutive scans (sensitivity 0.76, specificity 0.86) and was more accurate with smaller ICH, thalamic haemorrhage and homogeneous clots.

Conclusions—ABC/2 scores at local or central sites are sufficiently accurate to categorise ICH volume and assess eligibility for the CLEAR III and MISTIE III studies, and moderately accurate for change in ICH volume. However, accuracy decreases with large, irregular or lobar clots.

Clinical Trial Registration—MISTIE-II NCT00224770; CLEAR-III NCT00784134; www.clinicaltrials.gov

Keywords

'volumetry'; 'Systematic Review'; 'stroke; hemorrhagic'; 'Randomized controlled trials'

Introduction

Spontaneous intracerebral haemorrhage (ICH) is associated with >40%[1] one-month mortality and >60% dependency[1] but remains the only major stroke subtype without specific treatment, except potentially acute blood pressure lowering.[2] Morbidity and mortality are associated with age, intraventricular extension and presenting level of consciousness.[3] However, reference-standard measurement of ICH by sophisticated techniques such as CT-based planimetry (CTP) is not widely available and requires substantial analysis time,[4] limiting its use in clinical practice and large studies.[5–6]

The ABC/2 score is a simple assessment of ICH size.[7] It has been used in the Surgical Trials in ICH (STICH I+II)[6] to define patients most likely to benefit from craniotomy for ICH, and is currently being used as one element in determining eligibility for randomisation in the ongoing Clot Lysis Evaluation of Accelerated Resolution of Intraventricular Hemorrhage III (CLEAR-III)[8] and minimally-invasive surgery plus rtPA for intracerebral hemorrhage evacuation (MISTIE) III trials.[9] However, ABC/2 has primarily been validated in small research cohorts by trained researchers.[7] The ABC/2 score is also commonly used in clinical practice for prognostication and treatment decisions, potentially with increased use with the advent of effective treatments. Therefore, in CLEAR-III, CLEAR-IVH and MISTIE-II and published studies, we addressed the following hypotheses:

1. The ABC/2 score accurately determines ICH volume compared to reference-standard CT-based planimetry, by experienced scorers (trial reading center) and after limited training (local trial sites).
2. The ABC/2 score is a valid tool for determining eligibility and clot resolution within randomised controlled trials of interventions for ICH.

Methods

Clinical Protocol

Participants were recruited from MISTIE-II,[10] CLEAR-IVH[11] and CLEAR-III,[7] the details of which have been reported previously. MISTIE-II (R01NS046309) was a prospective RCT testing image-guided catheter-based removal of ICH at 27 sites. Eighty one patients were assigned to minimally invasive surgery and 42 patients to standard medical care. In CLEAR-IVH, patients with intraventricular hemorrhage were randomized to placebo, 0.3mg, 1mg or 3mg of intraventricular recombinant tissue plasminogen activator (rtPA) twice daily or to 1mg rtPA at different time intervals.[11] CLEAR-III is a phase III, placebo-controlled trial randomizing 500 patients to either 1mg rtPA or placebo 8 hourly via an extraventricular drain in patients with complete obstruction of the third and/or fourth ventricle(s), small ICH (<30 ml) at time of enrolment, IVH and ICH clot stability at time of enrolment, and acquisition of the first CT scan within 24 hours of symptom onset. Patients undergo daily CT scans until 72 hours after study treatment has finished, with a follow-up scan at approximately 30 days. Scans included in this analysis had either an RC-ABC/2 or site-ABC/2 prospectively recorded during the trial.

CT analysis

The ABC/2 score was prospectively performed by the local site to determine eligibility for enrolment. In CLEAR-III and MISTIE-II, local sites were trained in the ABC/2 score as part of the 'Radiology Training Course,' whilst in CLEAR-IVH no specific training was provided. Subsequently, all scans were reviewed by the centralised CT Reading Center by trained observers, calculating ABC/2 including all slices with any ICH, and estimating ICH volume by CTP.[4,12]

Clot location and the presence and size of IVH by CTP were recorded. In the MISTIE study, the morphology of the ICH was determined by 2 (JK, NU) observers, semi-quantitatively scoring ICH from 1–5 for regularity and heterogeneity of the clot.[13]

Statistical Analysis

Differences in patient characteristics between trials were assessed by ANOVA and chi-squared tests for absolute (numerical difference between ABC/2 score and CTP) or relative differences (percentage). Agreement between each two of the three measures (CTP, RC-ABC/2, site-ABC/2) was assessed by correlation coefficient (r^2) and Bland-Altman plot for each study individually and for a pooled data set. The accuracy of the RC-ABC/2 and site-ABC/2 scores were determined by the proportion of scores within 5%, 10% or 20% or within 5ml (the threshold for stability in MISTIE-III and CLEAR-III), 12.5ml or 25ml of the CTP volume. Scans with no blood on any score were excluded from primary analyses. The null hypothesis of equal accuracy for RC-ABC/2 and site-ABC/2, compared to the reference-standard CTP, was tested with a modified McNemar's test, adjusted for clustered data.[14] For each of the above accuracy thresholds, agreement between ABC/2 measures and CTP was determined by kappa statistics with confidence intervals computed by nonparametric bootstrapping at the individual level. The relevant data set of n individuals was replicated 10000 times, where each replicated data set is constructed by resampling

(with replacement) n individuals and including the corresponding scans and kappa calculated. Confidence intervals were derived as the 2.5 and 97.5 percentiles of the resulting distribution.

Accuracy was also determined for categorising ICH volume into mild (<15ml), moderate (15–30ml) or severe clots (>30ml), for detecting ≥ 5ml change in ICH volume in consecutive scans, and for categorising sequential change in ICH volume in bands of 5ml. Because hematoma margins are less distinct with time, analyses were performed for all scans, and for each patient's first eligible scan.

Determinants of accuracy of the ABC/2 score were explored using logistic regression, adjusted for repeated measures, for 5ml or 20% agreement between CTP and the best-available ABC/2 score (preferentially RC-ABC/2). Models were derived including scan-specific factors (clot size, location and presence of IVH) with further models including age and gender. The impact of clot regularity and heterogeneity on the initial scan were determined in the MISTIE study.

Systematic Review

To assess consistency between our results and previously published studies, we searched Medline and EMBASE between inception and July 1st 2013 with the terms "(Hemorrhage OR Haemorrhage) AND (ABC OR ABC/2)," excluding non-english language papers. Reference lists of identified reviews and corresponding supplemental data was searched. After review of potential abstracts, all papers reporting a relationship between ABC/2 score versus a computer-based volumetric method were reviewed in full. Studies were assessed for quality according to the specificity of their population, size of study, method of assessment of ABC/2 score and ICH volume and relevance of reported outcomes.

Results

There were 4369 scans in 507 patients with ICH on CTP and an ABC/2 score (MISTIE 1029 scans, 117 patients; CLEAR-IVH 568 scans, 83 patients; CLEAR-III 2772 scans, 307 patients), with 3422 scans in 390 patients with both RC-ABC/2 and site-ABC/2 scores (table 1).

There was good agreement (figure 1) between RC-ABC/2 score and CTP, and a strong correlation between these measures on first eligible scans across all three trials (r^2=0.93, figure I, http://stroke.ahajournals.org), as well as for all scans from each trial (figures II–VII, supplemental tables I–IV, http://stroke.ahajournals.org). The correlation between site ABC/2 score and CTP on first eligible scans across all three trials was only slightly weaker (r^2=0.87). Despite the stronger correlation, RC-ABC/2 over-estimated mean ICH size for all three trials combined (CTP 12.7ml, SD-13.3; RC-ABC/2 15.2ml, SD 16.6; Site-ABC/2 13.1ml, SD 14.4), particularly in MISTIE which had larger ICH volumes (supplemental figure IV, CTP33.1ml, SD 18.6; RC-ABC/2 40.2ml, SD 24.6; Site-ABC/2 35.4ml, SD 20.9). Furthermore, there was greater variance in RC-ABC/2 vs. CTP (variance ratio 1.67, 95% CI: 1.57–1.77). Although the RC-ABC/2 score over-estimated ICH size on average, there were a

small number of scans with particularly large differences between RC-ABC/2 scores and CTP with larger CTP volumes (figure 1).

The RC-ABC/2 score was accurate for estimating absolute CTP ICH volume with approximately 50% of RC-ABC/2 scores within 20% of CTP, >80% of RC-ABC/2 scores within 5ml of CTP (table 2) and over 95% of RC-ABC/2 scores within 12.5ml of CTP. In particular, there was good agreement between RC-ABC/2 and CTP in defining ICH volume as mild, moderate or severe (kappa: all scans 0.74 $p<0.001$, 1st scans 0.74 $p<0.001$). Although site ABC/2 was less accurate than RC-ABC/2, there was no statistically significant association between the number of scans previously performed at a centre and the accuracy of the ABC/2 score (as the absolute difference between CTP and ABC/2 score); providing no evidence of a time-dependent learning effect in the accuracy of site-ABC/2. Fewer site-ABC/2 scores were within 20% or 5ml of CTP volume than RC-ABC/2 scores (table 2). However, over 95% of site-ABC/2 scans were within 12.5ml of the CTP and virtually all scans were within 25ml of the CTP (supplemental figure I–III, http://stroke.ahajournals.org). Both site-ABC/2 and RC-ABC/2 scores were accurate in defining eligibility for inclusion in the CLEAR-III study (<30ml ICH), including all scans from all studies (RC-ABC/2 $\kappa=0.79$, 95% CI: 0.72–0.85. $p<0.001$; Site $\kappa=0.85$, 0.79–0.90, $p<0.001$), first scans from all studies (RC-ABC/2 $\kappa=0.89$, 0.82–0.95, $p<0.001$; Site $\kappa=0.83$, 0.74 – 0.90, $p<0.001$) or in MISTIE alone (RC-ABC/2 $\kappa=0.79$, 0.71 – 0.86, $p<0.001$; Site $\kappa=0.79$, 0.71 – 0.86, $p<0.001$). For the first scan in each study, 2.1% of site-ABC/2 scores incorrectly classified ICH volume <30ml, compared to only 0.5% of RC-ABC/2 scores. The maximum error was 24ml for site-ABC/2 scores, and 33ml for RC-ABC/2 scores.

A change in RC-ABC/2 score ≥ 5ml between consecutive scans was moderately accurate for detecting ≥ 5ml change in CTP (sensitivity 0.76, specificity 0.86, table 3), with a positive correlation between greater absolute error and increasing CTP volume ($r^2=0.16$, $p<0.001$). There was a moderately strong association between change in ICH volume measured between consecutive scans on CTP and ABC/2 ($r^2=0.56$, $p<0.0001$), with stronger associations for smaller CTP volumes (mild $r^2=0.70$; moderate $r^2=0.58$; severe $r^2=0.38$). There was moderate agreement in categorising ICH into 5ml categories (kappa 0.38, $p<0.001$) but reasonable agreement when categorizing as small or large changes.

The accuracy of the ABC/2 score varied with CTP clot volume, with reduced accuracy for absolute clot volume but increased accuracy for relative clot volume (table 4). Lobar haemorrhages were less accurately estimated than thalamic haemorrhages, with no effect of IVH. These factors were similar for all three studies except clot location was less predictive in the CLEAR-III study. In MISTIE, the initial irregularity and homogeneity of the clot reduced accuracy of the ABC/2 score across all scans, but there were too few patients to demonstrate this on initial scans alone (supplemental table V).

Systematic Review

Ten studies[9,15–23] from 201 abstracts reported valid comparisons between the ABC/2 score and CT-based, computer-assisted volumetric assessments. Two of these studies were in children,[15–16] whilst three studies only included patients on oral anticoagulants.[17–19] The studies varied from 8[17] to 244[20] patients and the majority of studies only reported summary

estimates of association, or mean agreement (supplemental table VI), with only one study reporting percentage agreement within clinically applicable limits.[23] 6/8 studies demonstrated that ABC/2 score overestimated ICH size with greater errors at larger ICH sizes in 2 studies and greater errors with clot irregularity in 2 studies. However analysis methods varied considerably such that a quantitative synthesis was not possible.

Discussion

RC-ABC/2 was strongly correlated with CTP, with good accuracy within 5ml or 20% of CTP volume and when categorising ICH volume as mild, moderate or severe. However, the RC-ABC/2 score was only moderately accurate at detecting change in CTP volume. RC-ABC/2 scores were more accurate than site-ABC/2 scores for individual scans. Errors in estimating CTP volume increased with larger ICHs, lobar location, clot irregularity and clot heterogeneity.

This is the largest study validating the ABC/2 score in a clinical trial setting. Previous validations have provided unreliable assessments due to small sample sizes, and limited applicability due to reporting solely of measures of association or mean error rather than frequency of agreement. Our study confirms that ABC/2 overestimates larger ICHs, either through inflation of errors with non-spheroidal haemorrhages or differences in methods of calculating ABC/2,[20] although there was good agreement for ICH <60ml, and ICH irregularity and heterogeneity also reduced accuracy.[19] The strength of this study is the large number of patients and measures of agreement within clinically applicable limits.

ABC/2 score at local sites was also reasonably accurate, justifying its use for randomisation in clinical trials and probably in clinical practice. This is contrast to the ATACH study[23] but this report included only 56 scans from one trial. This discrepancy may also reflect the greater experience of local sites in our studies. Nonetheless, with lesser experience in routine clinical practice or new centers in trials, the accuracy of the ABC/2 score may be reduced, especially with larger, irregular clots. Furthermore, the ABC/2 score was accurate for small or large changes in CTP volume and differences between change in ICH estimated by CTP and ABC/2 were usually less than the absolute change in ICH volume.

This study suggests that the ABC/2 score is sufficiently accurate to be used as a rapid tool for randomisation in trials. In particular, the high accuracy with CTP volumes below 30ml supports its use in the CLEAR-III study, with the lack of interaction with IVH volume implying that clinicians could accurately distinguish IVH and ICH, and also supports its use for inclusion in MISTIE-III which requires an ICH volume greater than 30ml. However, potential inaccuracies in determining change in ICH volume at moderate ICH volumes need to be assessed in future studies.

There were differences between MISTIE-II, CLEAR-IVH and CLEAR-III. This is expected given differences in the inclusion criteria for these trials, with smaller ICH volumes, fewer lobar haemorrhages and more IVH in CLEAR-IVH and CLEAR-III compared to MISTIE-III. Despite these differences, the ABC/2 score was accurate within each study, and the same predictors of accuracy were present across the three studies.

This analysis was limited by significant heterogeneity between studies. However, this reflected inclusion of a broad range of patients, and the analysis was particularly appropriate to CLEAR-III and MISTIE-III. Secondly, the effect of ICH irregularity and heterogeneity was only prospectively assessed in the MISTIE study, but the results were in agreement with previous studies.[17–19] Thirdly, the experience of local sites in trials is likely to be greater than in routine clinical practice. This analysis is therefore most applicable to randomised trials where repeat assessments are perhaps more common. However, this suggests that with relatively brief training, the ABC/2 score is sufficiently accurate to guide treatment decisions. Fourthly, heterogeneity in the systematic review was too great to allow for a quantitative synthesis of studies. However, our study was the largest and consistent with most other reported trials, supporting the overall conclusions.

Conclusions

ABC/2 scores at local or central sites can be performed rapidly in a variety of settings. They are sufficiently accurate to categorise ICH volume and assess eligibility for the CLEAR III and MISTIE III studies, and moderately accurate for change in ICH volume. However, accuracy decreases with large, irregular or lobar clots. Attempts to improve the accuracy of volume measurements could provide additional clinical value.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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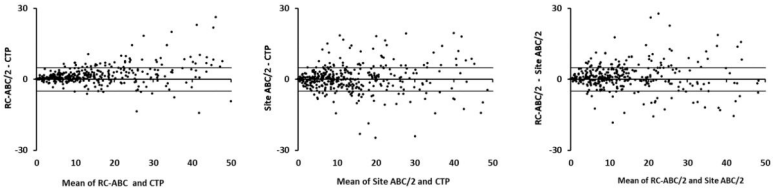

Figure 1. Bland-Altman plots comparing ICH volume measured by CT-based volumetrics (CTP) with ABC/2 score at the reading center (RC-ABC/2) or local site

Data includes the first eligible scan for each patient in the MISTIE, CLEAR-IVH and CLEAR III trials. Error lines indicating 5ml difference between ABC/2 score and ICH volume are also presented.

Table 1

Characteristics of included patients

Data are mean (SD), median (IQR) or frequency (%). p values from ANOVA or chi-squared tests comparing the three studies.

Characteristic	MISTIE	CLEAR IVH	CLEAR III	Combined	p-value
Age (SD)	61.4 (12)	55.0 (10)	58.6 (11)	58.7 (11.4)	<0.001
Male (SD)	77 (66)	48 (58)	171 (56)	296 (58)	0.17
Ethnicity (%)					
White	66 (56)	18 (22)	147 (48)	231 (46)	<0.001
Black	35 (30)	44 (53)	104 (34)	183 (36)	
Hispanic	4 (3)	8 (9.6)	4 (1)	16 (3)	
Asian	12 (10)	8 (9.6)	47 (15)	67 (13)	
Other/Unknown	0 (0)	5 (6)	5 (2)	10 (2)	
Hypertension (%)	102 (87)	43 (78)	283 (92)	428 (89)	0.006
Diabetes (%)	28 (24)	6 (7.5)	36 (12)	70 (14)	0.001
Antiplatelet Use (%)	15 (13)	7 (16)	63 (21)	85 (18)	0.18
Baseline GCS (IQR)	12 (8 – 14)	8 (5 – 13)	10 (7 – 14)	10 (7 – 14)	0.001
Clot Volume ml (SD)	39.0 (20)	10.9 (10)	10.6 (7.9)	17.2	<0.001
Clot Location (%)					
Basal Ganglia	75 (64.7)	48 (58.5)	77 (25.7)	200 (40.2)	<0.001
Thalamus	5 (4.3)	27 (33)	188 (62.6)	220 (44.2)	
Lobar	36 (31)	7 (8.5)	35 (11.7)	78 (15.6)	
Presence of IVH(%)	76 (65)	83 (100)	307 (100)	466 (92)	<0.001

Table 2

Agreement between CT-based volumetrics with ABC/2 score measured at the reading center or the local site

Percentage of ABC/2 scores calculated within 5ml or 12.5ml of the volume measured on CT-based volumetrics are reported. Kappa statistics assess agreement between site and RC-ABC/2 being within each threshold of the CTP volume; p-values are given for the null hypothesis of equal accuracy of RC-ABC/2 and site-ABC/2, based on McNemar's test among scans with all three measures.

		Percent Within 5ml of CTP				Percent Within 12.5ml of CTP			
Study	**N**	**Centre**	**Site**	**Kappa**	**Diff. p**	**Centre**	**Site**	**Kappa**	**Diff p**
MISTIE									
– First scans	**83**	**49.4**	**39.8**	**0.23** (0.02 – 0.43)	**0.15**	**80.7**	**78.3**	**0.48** (0.23 – 0.70)	**0.59**
– All scan	**535**	**47.9**	**44.9**	**0.19** (0.10 – 0.29)	**0.41**	**81.3**	**85.4**	**0.28** (0.18 – 0.40)	**0.23**
CLEAR-IVH									
– First scans	**32**	**93.8**	**87.5**	**0.22** (−0.10 – 0.78)	**0.32**	**96.9**	**90.6**	**0.48** (0.00 – 1.00)	**0.15**
– All scans	**175**	**97.7**	**84.6**	**0.10** (−0.03 – 0.35)	**0.003***	**99.4**	**96.6**	**0.28** (0.00 – 0.66)	**0.049***
CLEAR III									
– First scans	**275**	**89.0**	**82.9**	**0.23** (0.09 – 0.38)	**0.01***	**99.3**	**98.9**	†	**0.66**
– All scans	**2712**	**87.8**	**84.4**	**0.23** (0.16 – 0.31)	**0.03***	**98.6**	**98.8**	**−0.01** (0.10 – 0.24)	**0.71**
Combined									
– First scans	**390**	**81.0**	**74.1**	**0.36** (0.25 – 0.46)	**0.003***	**95.1**	**93.8**	**0.48** (0.27 – 0.66)	**0.28**
– All scans	**3422**	**82.1**	**78.3**	**0.32** (0.26 – 0.39)	**0.005***	**96.0**	**96.6**	**0.29** (0.20 – 0.38)	**0.34**

† Kappa not computable as only 2/275 RC-ABC/2 scans exceeded 12.5ml of the CTP volume

* $p < 0.05$.

Table 3

Agreement in change in best available ABC/2 score between consecutive scans with a change in CTP-based ICH volume

Results are given as the percentage of scans within each absolute volume band on CTP-based ICH volume that were found to be in each band of ICH volume on ABC/2 score.

		ICH volume category by CT-based planimetry (%)				
		<5 ml (n = 3277)	**5–10 (n = 304)**	**10 – 15 (n = 135)**	**15 – 20 (n = 57)**	**>20 (n = 80)**
ABC/2 category	<5 ml	86.6	38.2	15.6	11.1	1.7
	5 – 10	10.2	36.1	14.4	8.9	1.7
	10 – 15	2.1	16.6	32.2	13.3	10
	15 – 20	0.5	6.6	23.3	17.8	5
	> 20	0.5	2.5	14.4	48.9	81.7
	Total	100	100	100	100	100

Table 4

Associations with agreement between ABC/2 score and planimetric CT-based measures of ICH volume

Associations identified by logistic regression for within 20% or 5ml for measures across all scans (Study, Clot location, ICH volume and presence of IVH) and for each subject's initial scan (scan-specific measures + age, gender and admission GCS). Where available, RC-ABC/2 score used; otherwise, site-ABC was used. OR>1 indicates greater agreement.

	Predictors of 20% agreement				Predictors of 5ml agreement			
Model	**Predictor**	**OR**	**95% CI**	**p-val**	**Predictor**	**OR**	**95% CI**	**p-val**
All scans	**Study:**			0.18	**Study:**			0.08
	CLEAR III vs MISTIE	**1.03**	(0.70 – 1.49)	0.89	CLEAR III vs MISTIE	**1.13**	(0.66 – 1.95)	0.66
	CLEAR III vs CLEAR IVH	**1.39**	(0.98 – 1.99)	0.07	CLEAR III vs CLEAR IVH	**1.64**	(1.06 – 2.55)	0.027
	Clot Location:			<0.001	**Clot Location:**			0.08
	Thalamus vs lobar	**2.11**	(1.49 – 3.01)	<0.001	Thalamus vs lobar	**1.49**	(0.91 – 2.45)	0.12
	Basal Ganglia vs lobar	**1.19**	(0.86 – 1.66)	0.29	Basal Ganglia vs lobar	**0.97**	(0.63 – 1.50)	0.91
	ICH volume	**1.02**	(1.01 – 1.03)	0.001	**ICH volume**	**0.92**	(0.91 – 0.94)	<0.001
	IVH present	**1.03**	(0.70 – 1.52)	0.88	**IVH present**	**1.37**	(0.85 – 2.22)	0.20
First Scans	**Study:**			0.06	**Study:**			0.06
	CLEAR III vs MISTIE	**1.23**	(0.54 – 2.81)	0.63	CLEAR III vs MISTIE	**2.34**	(0.91 – 6.00)	0.08
	CLEAR III vs CLEAR IVH	**1.87**	(1.12 – 3.15)	0.018	CLEAR III vs CLEAR IVH	**1.92**	(1.03 – 3.60)	0.04
	Clot Location:			0.008	**Clot Location:**			0.88
	Thalamus vs lobar	**2.07**	(1.16 – 3.68)	0.014	Thalamus vs lobar	**1.16**	(0.55 – 2.47)	0.70
	Basal Ganglia vs lobar	**1.09**	(0.62 – 1.91)	0.76	Basal Ganglia vs lobar	**1.00**	(0.50 – 2.00)	0.99
	ICH volume	**1.02**	(1.00 – 1.04)	0.055	**ICH volume**	**0.95**	(0.93 – 0.97)	<0.001
	Age	**1.00**	(0.98 – 1.01)	0.70	**Age**	**1.01**	(0.99 – 1.03)	0.39
	Gender	**1.29**	(0.88 – 1.89)	0.18	**Gender**	**1.04**	(0.63 – 1.73)	0.85