

Standardization of CT Perfusion Parameters in Acute Ischemic Stroke: A Pilot Study

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Abstract

Computed tomography perfusion (CTP) imaging in acute ischemic stroke enables rapid and precise assessment of tissue perfusion status, supporting timely treatment decisions. We aimed to standardize optimal thresholds for infarct core, tissue at risk, and penumbra volumes across different CTP software packages using a digital perfusion phantom and to explore their relationship with stroke onset time to assess potential time-of-day variation. Digital phantom post-processing outputs from three Siemens Syngo.via packages and one GE Healthcare CT Perfusion 4D (CTP4D) software package were compared with those from iSchemiaView RAPID software. Equivalent relative cerebral blood flow (rCBF) and Time-to-Max (Tmax) thresholds corresponding to RAPID definitions were derived and retrospectively applied to multicenter clinical datasets. Phantom testing demonstrated inter-platform variability, with rCBF thresholds equivalent to RAPID $\leq 30\%$ ranging from 15.0% to 20.0%, and Tmax thresholds equivalent to > 6 seconds ranging from 5.5 to 6.2 seconds. Among 208 patients across four sites, calibration reduced median core volume estimates and modestly increased penumbra (mismatch) volumes. The median core reduction was 31.8 mL (95% CI: -35.8 to -23.8), while penumbra increased by 14.0 mL (95% CI: 8.9–18.3), although this effect varied across platforms. Consequently, the proportion of patients' eligibles for mechanical thrombectomy increased by 39.2 percentage points (95% CI: 32.2 to 46.2). A diurnal trend was observed, with smaller core volumes in the early morning. These findings highlight the need for cross-platform CTP calibration to enable reliable multicenter comparisons.

INTRODUCTION

Computed tomography perfusion (CTP) can quickly and effectively evaluate brain perfusion in acute ischemic stroke.¹ CTP provides measures of important imaging data required for clinical decision-making: the volumes of the potentially salvageable tissue (penumbra) and of the irreversibly damaged tissue (infarct core). It is known, however, that perfusion thresholds for penumbra and core infarct volume measurements can vary significantly between different software vendors.^{2–6}

There has been no standardization of CTP values obtained by the many different acquisition protocols and post-processing software (Siemens, GE, Philips, Canon, Toshiba, RAPID, Viz, etc.). These variations arise from differences in how the algorithms calculate critical parameters like cerebral blood flow (CBF), cerebral blood volume (CBV), and Time-to-Maximum (Tmax).^{7,8} Consequently, misclassification of ischemic core–penumbra mismatch can occur, with direct clinical consequences: exclusion of patients who would benefit from mechanical thrombectomy or futile treatment in those without salvageable tissue.^{9,10}

To improve the reliability of clinical decision-making and to achieve consistent results across different centers and databases, standardization is necessary. A digital calibration phantom has been developed⁷ that can standardize CTP parameters across different software platforms. This can result in greater consistency across databases and more uniform determination of perfusion parameters. Lessons from the North American Symptomatic Carotid Endarterectomy Trial (NASCET)¹¹ and European Carotid

Surgery Trial¹² have shown that standardization – in that instance of carotid stenosis measurement¹³ – is vital for producing meaningful results across multiple centers and databases.

In a retrospective multi-center pilot study, we aimed to create a best-practice model for consistent evaluation of existing imaging data, to identify challenges in standardizing CTP data collection across multiple sites, and to help establish more accurate analysis in future multi-center studies.

METHODS

Ethics Approval

This retrospective study analyzed anonymized, previously collected patient data. The requirement to obtain informed consent and ethic approval was waived by the Research Ethics Boards of all participating centers (see Supplementary File). The study was conducted in accordance with the relevant institutional guidelines or/declaration of Helsinki.

Calibration of CTP Software

A digital perfusion phantom was used to calibrate the five CTP software programs: three Siemens Syngo.via versions, CTP4D, and RAPID.⁷ Briefly, the phantom simulates brain tissue time-density curves to provide ground truth values for CBF, Tmax, and other required hemodynamic parameters typically seen in CTP studies. These phantom images were analyzed using the different CTP software programs, and the estimated CBF and Tmax values were compared with the ground truth values to assess any differences.⁷

Cerebral blood flow (CBF) and Tmax maps were generated for each software platform. Reference values for tissue state volumes infarct core and penumbra volumes on the digital perfusion were calculated using default thresholds, with the reference standard defined as core ($rCBF \leq 30\%$) and hypoperfused tissue-at-risk ($Tmax \geq 6$ s). Volumetric measurements of the reference digital phantom were performed using the three Siemens Syngo.via versions and CTP4D were quantitatively compared with those from RAPID. Thresholds were iteratively adjusted to generate calibrated volumes within each software platform to match RAPID volume values.

Patient CT perfusion datasets were processed at each site using each site's software platforms, with both default and calibrated thresholds applied. Subsequently, clinical datasets from the four centers were analyzed with the derived calibrated thresholds to evaluate the effects of cross-software harmonization.

Mechanical thrombectomy eligibility in multiple trials were based on RAPID-derived thresholds, using the DEFUSE 3 criteria to define ischemic core as regions with relative cerebral blood flow ($rCBF < 30\%$) and tissue at risk as regions with a time-to-maximum delay ($Tmax > 6$ seconds) with penumbra defined as

tissue at risk but not progressed to core¹². rCBF refers to the ratio of CBF in the affected brain region relative to the average CBF in the normal, contralateral hemisphere. Since these rCBF and Tmax thresholds, have been validated in phase III RCTs and are widely accepted in clinical practice, the other CTP software programs were calibrated against RAPID.⁸

Using previously established methodology,⁷ we compared the relationship between the pre- and post-calibrated CBF and Tmax values for each CTP software and those from RAPID. This process allowed us to determine the equivalent rCBF and Tmax thresholds for each software package, aligning them with the validated RAPID criteria.

Patient Data Collection

Data were collected retrospectively from four stroke centers: London Health Sciences Center (London, ON, Canada), John Radcliffe Hospital (Oxford, UK), University Hospital of Ludwig-Maximilians University (Munich, Germany) and West China Hospital (Chengdu China). The CTP software used at these sites were CT Perfusion 4D (GE Healthcare), and syngo.MR Neuro Perfusion Engine (Siemens) versions VB60, VB10A, VB20A.

Eligible patients were identified from the stroke databases at each center based on the following inclusion criteria: 1) aged 18 years or older, 2) diagnosed with acute ischemic stroke from large vessel occlusion in the anterior circulation, and 3) had admission CTP studies that could be retrieved. Large vessel occlusions were defined as occlusions in the intracranial internal carotid artery, the M1 segment of the middle cerebral artery, proximal M2 segments of the middle cerebral artery, the basilar artery, and other major intracranial arteries including the anterior cerebral and posterior cerebral arteries. For each patient, the penumbra-mismatch and core infarct volumes were measured both before and after calibrating the rCBF and Tmax thresholds. Without calibration, ischemic core and tissue at risk were defined by each software's program's original thresholds to demarcate $\text{rCBF} \leq 30\%$ and tissue at risk by $\text{Tmax} \geq 6$ seconds. Post-calibration, ischemic core and tissue at risk were defined by each software program's calibration-adjusted thresholds to demarcate $\text{rCBF} \leq 30\%$ and tissue at risk by $\text{Tmax} \geq 6$ seconds. Penumbra volume was defined as difference between Tissue-at-risk and ischemic core.

Statistical Analysis

Pre- and post-calibration ischemic core, tissue at risk, and penumbra volumes as well as their differences are compared descriptively using medians and interquartile ranges (IQR). For visual assessment of changes from pre- to post-calibration stratified by software, we used boxplots showing median differences and percentage changes along with 95% bootstrap confidence intervals (CI). To assess changes in the relationship between stroke onset time and estimated volumes pre- and post-calibration, we fitted a sinusoidal regression model using ordinary least squares, incorporating sine and cosine terms to model periodicity and interaction terms to evaluate differences in amplitude, phase, and

temporal patterns. Model predictions are plotted along with 95% CIs. All analyses were conducted in R (version 4.3.1)¹⁵, using R packages tidyverse (v. 2.0.0)¹⁶, ggeffects(v. 1.3.2)¹⁷, and boot (v.1.3.28.1)¹⁸.

RESULTS

We analyzed the imaging and clinical data in 208 acute ischemic stroke patients from all participating centers. Patient characteristics are shown in Table 1. Overall, 52.9% of patients were men and median age was 76.7 years (IQR: 64.0,83.0).

Table 1 Patient demographics by Center					
Age	London (n = 106)	Munich (n = 25)	Oxford (n = 27)	China (n = 50)	Total (n = 208)
Median (IQR)	76.8 (65.6, 81.6)	77.0 (64.0, 82.0)	78.0 (65.0, 87.0)	74.5 (60.0, 81.8)	76.7 (64.0, 83.0)
Sex					
Female	44 (41.5%)	12 (48.0%)	11 (40.7%)	31 (62.0%)	98 (47.1%)
Male	62 (58.5%)	13 (52.0%)	16 (59.3%)	19 (38.0%)	110 (52.9%)
NIHSS	6.0 (3.0,12.0)	7.0 (3.0, 10.0)	8.0 (6.0, 13.0)	14.5 (12.0,20.0)	9.0 (5.0, 15.0)

Calibration of CTP Software

The software/scanner packages showed pronounced differences when scanning the reference digital perfusion phantom (Table 2). To align with the RAPID 30% rCBF thresholds, the following adjusted thresholds were required: 16.8% for one Siemens center Syngo.via version VB60, 20.9% for Siemens version VB10A, 19.5% for Siemens version VB20A, and 15.0% for GE Healthcare CTP4D. To align with the RAPID Tmax 6 second threshold, adjusted thresholds ranged from 5.5 to 6.2 seconds.

Table 2

RAPID-equivalent Thresholds and CTP parameter-derived stroke volumes, stratified by Center

RAPID Equivalent Thresholds	GE CTP4D @London (n = 106)	Siemens Syngo.via (VB10A) @Munich (n = 25)	Siemens Syngo.via (VB60) @Oxford (n = 27)	Siemens Syngo.via (VB20A) @ China (n = 50)	Total (n = 208)
rCBF (%)	15.0	20.9	16.8	19.5	
Tmax (s)	6.0	6.2	6.1	5.5	
DEFUSE3_criteria_precalibration					
Eligible	7 (7.2%)	10 (40.0%)	21 (77.8%)	6 (12%)	44 (22.1%)
NOT eligible	90 (92.8%)	15 (60.0%)	6 (22.2%)	44 (88.0%)	155 (77.9%)
Missing	9	0	0	0	9
DEFUSE3_criteria_postcalibration					
Eligible	59 (59.0%)	17 (68.00%)	20 (74.1%)	29 (58.0%)	125 (61.9%)
NOT eligible	41 (41.0%)	8 (32.0%)	7 (25.9%)	21 (42.0%)	77 (38.1%)
Missing	6	0	0	0	6
CTP parameter-derived Stroke Volumes					
precalibration Core infarct (mL)^a					
Median (IQR)	47.8 (18.9, 91.6)	21.3 (8.7, 31.6)	6.6 (1.9, 18.2)	85.4 (57.7, 151.9)	44.9 (17.2, 91.7)
postcalibration Core infarct (mL) ^b					
Median (IQR)	5.7 (1.9, 22.0)	4.9 (1.8, 11.3)	0.0 (0.0, 1.8)	43.8 (25.2, 151.9)	6.8 (1.8, 22.0)
^a ... 9 missing values in Munich, ^b 6 missing in Munich					
The equivalent cerebral blood flow rCBF and Time- to-Max (Tmax) thresholds to those of RAPID for segmenting the infarct and penumbra. The calibrated rCBF and Tmax thresholds of different CT software relative to those of RAPID. result suggests differences in the infarct core volume across the three non-RAPID sites.					

RAPID Equivalent Thresholds	GE CTP4D @London (n = 106)	Siemens Syngo.via (VB10A) @Munich (n = 25)	Siemens Syngo.via (VB60) @Oxford (n = 27)	Siemens Syngo.via (VB20A) @ China (n = 50)	Total (n = 208)
				81.3)	33.4)
difference Core infarct (mL) ^a					
Median (IQR)	-38.4 (-69.0, -18.3)	-15.8 (-23.8, -8.7)	-5.3 (-17.1, -1.8)	-39.8 (-51.5, -30.5)	-31.8 (-53.5, -13.2)
precalibration Tmax >6s (mL) ^a					
Median (IQR)	79.9 (30.6, 153.5)	108.1 (41.4, 152.9)	54.8 (21.0, 101.9)	179.7 (140.8, 224.9)	108.9 (44.5, 179.7)
postcalibration Tmax >6s (mL) ^b					
Median (IQR)	51.4 (14.9, 134.9)	79.9 (30.7, 103.0)	41.6 (13.4, 94.4)	191.2 (147.2, 233.3)	91.1 (24.2, 172.7)
difference Tmax >6s (mL) ^a					
Median (IQR)	-19.6 (-34.2, -11.2)	-14.9 (-46.8, -6.9)	-6.0 (-10.8, -3.4)	2.4 (-4.2, 11.4)	-11.2 (-23.7, -3.3)??
precalibration Penumbra (Mismatch) (mL) ^a					
Median (IQR)	30.0 (6.8, 63.0)	69.9 (26.9, 95.6)	54.8 (17.7, 85.5)	78.4 (59.4, 112.2)	54.8 (17.4, 87.1)
postcalibration Penumbra (Mismatch) (mL) ^b					
Median (IQR)	44.9 (10.5, 112.0)	50.3 (22.0, 90.1)	41.6 (13.4, 92.7)	124.9 (100.1, 160.9)	73.1 (19.9, 122.1)
^a ... 9 missing values in Munich, ^b 6 missing in Munich					
The equivalent cerebral blood flow rCBF and Time- to-Max (Tmax) thresholds to those of RAPID for segmenting the infarct and penumbra. The calibrated rCBF and Tmax thresholds of different CT software relative to those of RAPID. result suggests differences in the infarct core volume across the three non-RAPID sites.					

RAPID Equivalent Thresholds	GE CTP4D @London (n = 106)	Siemens Syngo.via (VB10A) @Munich (n = 25)	Siemens Syngo.via (VB60) @Oxford (n = 27)	Siemens Syngo.via (VB20A) @ China (n = 50)	Total (n = 208)
difference Penumbra-Mismatch (mL) ^a					
Median (IQR)	11.5 (1.0, 31.9)	-3.6 (-14.3, 3.4)	0.7 (-2.0, 7.7)	46.6 (32.7, 54.5)	14.0 (0.6, 39.6)
Pre-Calibration Mechanical Thrombectomy	15 (14.2%)	8 (32.0%)	14 (82.4%)	29 (58.0%)	
^a ... 9 missing values in Munich, ^b 6 missing in Munich					
The equivalent cerebral blood flow rCBF and Time- to-Max (Tmax) thresholds to those of RAPID for segmenting the infarct and penumbra. The calibrated rCBF and Tmax thresholds of different CT software relative to those of RAPID. result suggests differences in the infarct core volume across the three non-RAPID sites.					

Changes in patient core infarct, tissue-at-risk and penumbra volumes

Measured median core infarct volumes were lower after calibration at all four sites. Among all 208 patients, median core infarct volume pre-calibration of 44.9 mL (IQR: 17.2,91.7) was lowered to 6.8 mL (IQR: 1.8,33.4) after calibration. The median reduction post calibration in core infarct volumes was – 31.8 ml (95% CI: -35.8, -23.8) (Table 2) across all centers, but with a larger reduction of about 38.4 mL using GE software and 39.8 mL using Siemens version VB20A (Fig. 1, Core infarct). Calibration substantially reduced both the estimated core infarct volume and its scatter (Fig. 2A).

Measured tissue-at-risk volumes (RAPID Tmax > 6s) were reduced after calibration at three sites and increased at one site. The largest reductions in volume were at sites using CTP4D and Siemens Version VB10A. Among all 208 patients, median tissue-at-risk declined from 108.9 mL (IQR: 44.5,179.7) pre-calibration to 91.1 mL (24.2, 172.7) post-calibration (Table 2).

Measured penumbra (mismatch) volumes were increased after calibration, at two sites and reduced at two sites. Across all 208 patients, penumbra volume was increased from 54.8 mL (IQR: 17.4, 87.1) pre-calibration to 73.1 mL (IQR: 19.9, 122.1) post-calibration (Table 2).

The median increase in penumbra (mismatch) volume was 14.0 (95% CI:8.9, 18.3)). After calibration, penumbra (mismatch) volumes increased for CTP4D (GE Healthcare) and Syngo.via VB20A (Siemens), whereas Syngo.via VB10A and VB60 (Siemens) showed minimal change between pre- and post-calibration values (Fig. 1, Penumbra).

Changes in mechanical thrombectomy eligibility before and after calibration

The DEFUSE 3 criteria¹²—based on ischemic core and mismatch volumes—are used clinically to select acute ischemic stroke patients for mechanical thrombectomy. Because calibration alters both volume measurements, the proportion of patients eligible for MT changed following calibration. Table 2 shows the proportions of eligibility for each individual center and for the overall patient group. The overall change was 39.2 percentage points (95% CI: 32.2, 46.2).

Relationship between pre- and post-calibration volumes and stroke onset time

Analysis of both uncalibrated and calibrated CTP data revealed a time-of-day trend in both pre- and post-calibration core infarct volumes, which decreased in the early morning and then increased during the afternoon and early evening, mildly attenuated in the calibrated data. Post-calibration tissue-at-risk (Tmax >6s) volumes were slightly lower for strokes occurring in the late morning and afternoon in the uncalibrated but not calibrated data (Fig. 2B). Both pre- and post-calibration penumbra (mismatch) volumes followed a time-of-day pattern of higher volumes in mid-late morning, mildly attenuated in the calibrated data. (Fig. 2C).

DISCUSSION

Using a digital perfusion phantom to calibrate CTP thresholds from different software platforms, we observed marked variability in rCBF thresholds for ischemic core and moderate variability in Tmax thresholds for tissue-at-risk. After calibration to the RAPID reference standard, patient measurements changed substantially for ischemic core volume, while tissue-at-risk and penumbra showed smaller changes. These shifts in volume estimates led to substantial changes in mechanical thrombectomy eligibility based on DEFUSE 3 criteria.

While prior work by Chung and colleagues⁷ demonstrated the feasibility of calibrating CTP thresholds between deconvolution algorithms using a digital phantom, the study focused primarily on algorithmic equivalence. In contrast, our study extends this approach by calibrating software platforms to a clinically validated reference standard (RAPID) and demonstrates the real-world impact of calibration across multicenter patient datasets. This pragmatic implementation enables harmonization of perfusion thresholds within routine clinical workflows and addresses a critical barrier to consistent treatment

selection across centers. Therefore, our study builds on previous research by providing clinically relevant multicenter calibration that supports real-world implementation.

Chen et al.⁸ conducted a single-center study, using clinical CTP images processed with RAPID and UGuard software to assess agreement in measuring ischemic core and penumbra. In contrast, our study employed a digital perfusion phantom to systematically calibrate CTP thresholds across multiple deconvolution algorithms, incorporating data from four independent centers. This design enabled a controlled evaluation of algorithmic variability. While Chen's work provided an internal validation within one healthcare system, our approach emphasizes external validation and establishes a standardized framework for cross-platform calibration. This facilitates reliable, multi-center comparisons and enhances the generalizability of perfusion imaging findings.

Our findings revealed differences between calibrated and non-calibrated CTP parameters, supporting the findings of Chung and colleagues which showed that calibrated thresholds can standardize ischemic core estimates across platforms, thereby decreasing variability in lesion volumes.⁷ A consistent reduction was observed in core infarct volumes across software platforms, highlighting the calibration's effectiveness and confirming the observation that commercial CTP software often overestimates infarct core.¹⁰ Ischemic core overestimation frequently arises in the context of ultra-early imaging, or when rapid reperfusion takes place shortly after imaging.^{16,17, 19,20} This has major implications for both clinical practice and research. We observed two key findings: a temporal effect, with a reduction in core volumes during afternoon and evening hours, and a software-specific effect, where CTP4D (GE Healthcare) estimates were substantially lower than RAPID (iSchemiaView), unlike Syngo.via (Siemens), which showed less difference.

Our calibration method was benchmarked against RAPID. Consequently, the accuracy of the resulting volume estimates is contingent upon the similarity of a given software's rCBF calculation method to that of RAPID. The < 30% rCBF threshold used by RAPID in clinical trials was chosen as a conservative threshold to avoid over-estimation of core volumes. In a study of 104 patients in whom MRI was obtained rapidly after CTP perfusion, the most accurate threshold for predicting the DWI core lesion volume was < 38%, however, in 4% of the cases this threshold overestimated the DWI lesion volume.²¹ A 30% threshold eliminated the overestimates but provided a modest underestimate of DWI volumes for most patients. These results are compatible with a study using a ground-truth CBF digital perfusion phantom that demonstrated a systematic underestimation of CBF with RAPID.⁷ This systematic underestimation may explain some of the observed discrepancy in infarct core estimates in the current study. It is also important to note that for patients imaged early after symptom onset, a stricter threshold (typically 20%) is needed to avoid core overcall.²²

These findings highlight the importance of calibration in harmonizing perfusion estimates, particularly when comparing data across different institutions or software. While core infarct volumes were influenced by calibration, penumbra-mismatch volumes remained relatively stable, showing smaller

differences across software packages. However, there was a slight increase in post-calibration penumbra-mismatch volumes with CTP4D.

Our study suggested moderate circadian variation in pre-calibration core infarct volumes, with a decline from late morning to early afternoon followed by an evening increase. This pattern aligns with emerging evidence that stroke severity and infarct progression are modulated by time of day.²³ Reidler et al.²⁴ demonstrated diurnal fluctuations in core infarct volumes and growth rate, while Mergenthaler et al.²³ reviewed that circadian clocks regulating metabolism and inflammation influence stroke susceptibility and recovery.

Calibration attenuated these temporal fluctuations, yielding more stable volume estimates. This finding is clinically relevant for time-sensitive stroke management, as uncalibrated software may overestimate evening infarct cores, potentially excluding patients from EVT. The evening reduction in core volume after calibration may thus expand the population eligible for mechanical thrombectomy.

Strengths and Limitations

The calibration used specific versions of widely used CTP platforms; consequently, the findings may not be generalizable to all software versions or reconstruction parameters. Furthermore, RAPID was the reference standard for threshold equivalence, consistent with current clinical practice; however, it does not constitute an absolute gold standard. The case selection process may have introduced selection bias, potentially affecting the robustness of the findings. The clinical validation used a retrospective design and although conducted at multiple centers, the sample size limits the robustness of the analysis in reliably detecting time-of-day variation.

Nevertheless, the study's strengths include the use of a unique validated digital perfusion phantom for objective reproducible calibration, facilitating comparison across multiple CTP software packages. Furthermore, the calibrated thresholds were subsequently applied to multicenter clinical datasets, facilitating evaluation of real-world impact across various scanners and institutional workflows. Integrating controlled digital phantom validation with external clinical application across multiple sites enhances internal validity, increases translational relevance, and strengthens the generalizability of findings.

CONCLUSIONS

Our study demonstrates that thresholds for identifying infarct and penumbra vary for different CTP software. To facilitate the comparison of results, it is necessary to calibrate rCBF and Tmax thresholds using a digital phantom across different CTP software.

Calibration using a digital perfusion phantom improves the consistency and accuracy of core infarct volume estimates across different CTP software platforms. For instance, pre-calibration volumes showed marked variability related to time of day and software type, whereas post-calibration volumes

were more stable. Penumbra (mismatch) volumes were largely unaffected by calibration, suggesting greater inherent robustness. Importantly, because calibration reduced ischemic core volumes, the proportion of patients eligible for mechanical thrombectomy according to DEFUSE 3 criteria increased substantially – a finding with direct clinical implications for patient selection.

These results emphasize the importance of standardized calibration protocols – such as by use of digital perfusion phantoms – to ensure reliable inter-center comparisons and support accurate, time-critical decision-making in acute stroke care. There is therefore a need for calibration protocols such as a digital perfusion phantom, particularly in multicenter or software-diverse imaging studies.

Larger, prospective studies are warranted to validate these findings and further explore the clinical impact of calibration in perfusion imaging. Furthermore, future research should develop automated cross-platform harmonization pipelines to support standardization initiatives.

Declarations

Author Contribution

JSB wrote the manuscript, AA did the statistical analysis and prepared the figures. AN, PLR, KJC, YW and XS processed CT perfusion datasets and performed threshold calibration at their respective study sites to derive standardised perfusion thresholds across software packages. ST, GWA, JLS, PM, DP, TYL, AMB critically revised the manuscript. All authors reviewed the manuscript.

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Data Availability

The data that support the findings of this study are not publicly available. Given the retrospective nature of the study, the participants did not give written consent for their data to be shared publicly, and ethical approval currently does not permit sharing of raw data. Approval will be sought by the corresponding

author upon reasonable request with scientific rationale and sound methodology. Requests for data sharing will be managed in accordance with data access and sharing policies of the originating centers.

Disclosures

A.M. Buchan is a cofounder of BRAINOMIX. G.W. Albers is a consultant for Genentech

and iSchemaView and has equity in iSchemaView. T-Y Lee licenses CT Perfusion software to GE Healthcare and NeuSoft (Shenyang, China).

The other authors report no conflicts.

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Figures

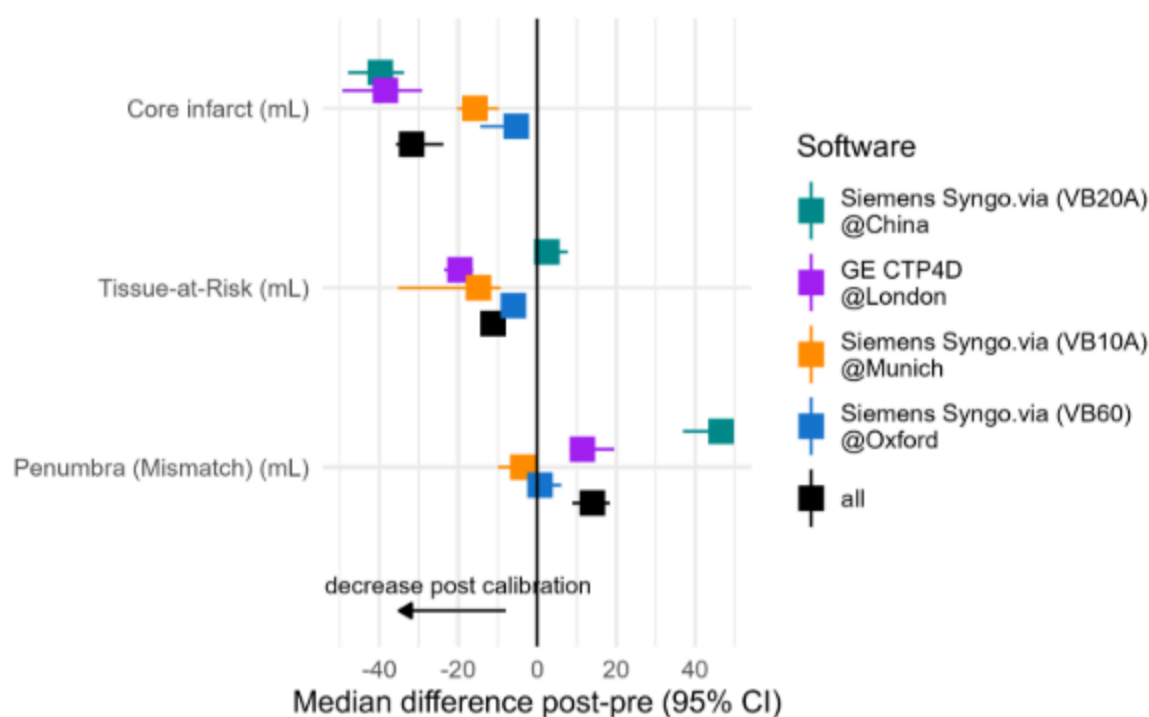


Figure 1

Median decrease in stroke volumes per Software and overall, after calibration. Decreased core infarct median volume post calibration across all software, but more marked decrease with GE Healthcare CTP4D and Siemens Syngo.via VB20A; CI, bootstrap confidence interval

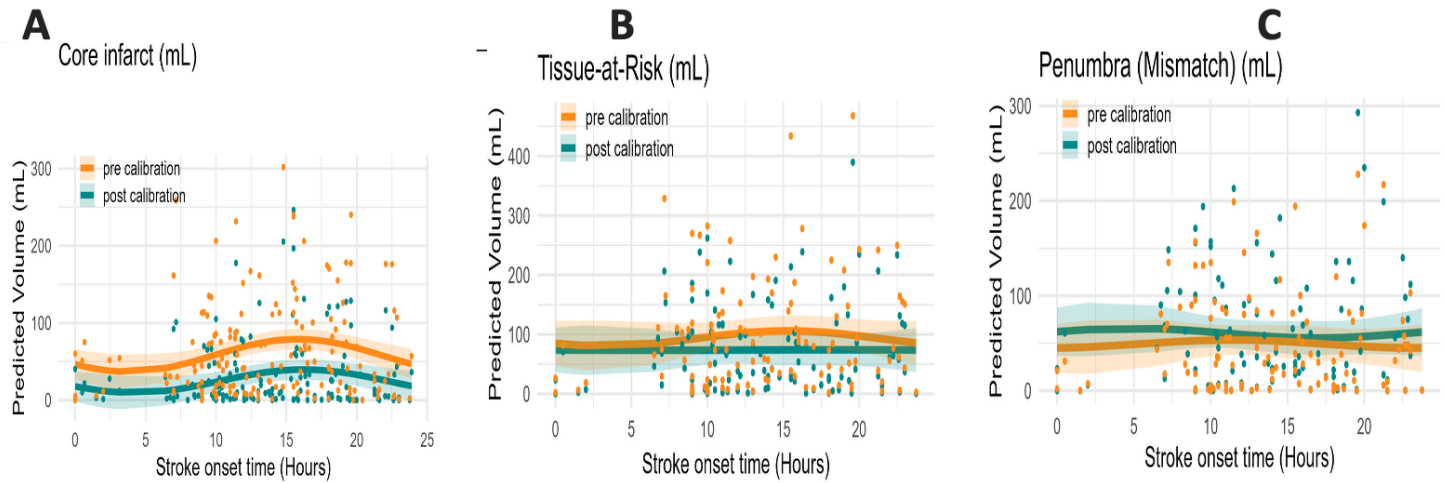


Figure 2

Pre- and post-calibration stroke volumes vs stroke onset time: (A) Core infarct,

volumes showed changes, (B) Tissue-at-risk ($T_{max} > 6s$), volumes did not differ, shows minimal change before and after calibration and (C) Mismatch (Penumbra) volumes showed smaller changes.

Supplementary Files

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