Research Square

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Early Diagnostic Performance and Clinical Utility of Neurologist-Performed Focused Cardiac Ultrasound in a Stroke Unit

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Abstract

Background:
Cardioembolic sources of embolism (CSOE) account for up to 30% of ischemic strokes, making echocardiography essential for etiologic evaluation. However, access to transthoracic echocardiography (TTE) may delay diagnosis. Focused cardiac ultrasound (FoCUS) has emerged as a rapid point-of-care alternative, but its role within a stroke-tailored cardiac assessment and its potential impact on clinical management and in-hospital workflow remain insufficiently explored. This study aimed to assess the clinical utility of neurologist-performed FoCUS in acute ischemic stroke, including its diagnostic agreement with TTE.

Methods:
We conducted a prospective, single-center study (January–October 2025) including consecutive patients with acute ischemic stroke admitted to the stroke unit who underwent both FoCUS and TTE during hospitalization. Certified neurologists performed FoCUS following national consensus guidelines. Primary outcome was overall CSOE concordance; secondary outcomes included agreement for high- and low-risk CSOE, agreement for each CSOE category, therapeutic impact, and workflow-related time intervals. Agreement with TTE was assessed using intraclass correlation coefficients and Cohen's kappa as appropriate.

Results:
Among 103 included patients (median age 76 years [IQR 62–85], 47% women), FoCUS showed substantial agreement with TTE for overall CSOE (k=0.74) and excellent concordance for high-risk CSOE (k=1.00; 100% sensitivity and specificity). FoCUS was performed significantly earlier than TTE (mean 1.9 vs. 6.0 days; p<0.001). FoCUS identified treatable high-risk CSOE in five previously undetermined strokes.

Conclusions:
FoCUS demonstrates high diagnostic reliability for clinically significant high-risk CSOE and offers timely cardiac evaluation in acute stroke care. Although not a substitute for TTE, FoCUS represents a valuable complementary tool in the etiologic workup and improves workflow efficiency.

INTRODUCTION

Up to 30% of all ischemic strokes are of cardioembolic origin, which makes echocardiography an essential diagnostic tool for identifying potential cardiac sources of embolism (CSOE) and guiding secondary prevention strategies[1]. For this reason, transthoracic echocardiography (TTE) is recommended in current clinical guidelines to identify not only atrial fibrillation (AF) predictors, such as left atrial enlargement, but also other CSOE including left ventricular (LV) dysfunction, valvular abnormalities, intracardiac thrombi, aortic atheroma (AA), and patent foramen ovale (PFO) [2,3].

Despite its diagnostic relevance, access to TTE often depends on its availability, which may delay the etiological workup and prolong hospital stay. Such delays are particularly critical when rapid decisions regarding secondary prevention strategies or additional diagnostic testing are required [4]. In addition, delayed cardiac imaging may reduce diagnostic yield, particularly for potentially transient cardioembolic findings that may no longer be detectable several days after the index event [5,6].

Focused Cardiac Ultrasound (FoCUS) is a specific application within the broader point-of-care ultrasound (POCUS) framework, designed as a simplified, goal-directed cardiac examination[7,8]. In the context of stroke care, neurologist-performed FoCUS, also referred to as echocardioscopy, has been proposed as an alternative model that enables earlier and more accessible cardiac imaging to accelerate the etiological workup in selected cases[9,10]. Recent consensus statements endorse the training and certification of neurologists in basic cardiac ultrasound protocols[11].

Previous studies have mainly focused on the diagnostic accuracy of neurologist-performed FoCUS for the identification of few selected high-risk CSOE [9,12,13]. However, the role of FoCUS as part of a stroke-tailored cardiac assessment in real-world stroke unit workflows, including the detection of both high- and low-risk CSOE and its potential impact on clinical management and in-hospital processes, remains insufficiently explored.

In this study, we aimed to assess the neurologist-performed FoCUS as part of a comprehensive cardiac evaluation in patients with acute ischemic stroke (AIS). We specifically assessed its ability to detect both high- and low-risk CSOE and explored its potential impact on etiologic classification, therapeutic decision-making, and in-hospital workflow metrics, while also examining its diagnostic agreement with standard cardiologist-evaluated TTE.

METHODS

Study design and participants

We conducted a prospective, single-center study at the Comprehensive Stroke Center Hospital de la Santa Creu i Sant Pau (Barcelona, Spain) a high-volume tertiary referral hospital serving an urban catchment population of approximately 500,000 inhabitants.

Between January 2025 and October 2025, we included consecutive patients admitted to the stroke unit with AIS or transient ischemic attack in whom TTE was clinically indicated as part of the routine etiologic workup, regardless of the initially suspected stroke mechanism.

Patients were included if they had undergone both a FoCUS performed by the neurology team and a standard TTE by the cardiology department during the same hospitalization.

All patients, or their legal representatives when appropriate, provided written informed consent prior to inclusion in the study.

Data collection

The following variables were recorded: sex, age, body mass index (BMI), vascular risk factors, prior antithrombotic treatments, and cardiac history including known structural cardiopathy, prior AF and new-onset AF detected after stroke. Stroke-related data included previous ischemic stroke and its etiology. Etiologic classification of the index event incorporated neurovascular imaging findings, brain imaging patterns on CT or MRI, and in-hospital cardiac rhythm monitoring results.

Echocardiographic data were collected from two independent assessments: neurologist-performed FoCUS and standard TTE performed in the cardiology echocardiography unit. The neurologic echocardiographic assessments were conducted twice a week in the stroke unit by four neurologists, all formally trained and certified in echocardioscopy, with accreditation endorsed by the Sociedad Española de Cardiología (SEC) and the Sociedad Española de Neurología (SEN) [11]. Cardiology department assessments were performed according to standard departmental availability and scheduling. Ultrasound examinations were conducted using a Philips CX50 (Philips Healthcare, Amsterdam, The Netherlands) system by the neurology team and a Philips Affiniti 70G (Philips Healthcare, Amsterdam, The Netherlands) system by the cardiology department.

Neurology team followed the recommendations outlined in the national consensus guidelines for echocardiography training and certification for non-cardiologists, endorsed by different societies including SEC and SEN [11]. Additionally, the procedures adhered to the consensus document on FoCUS developed by the Spanish Society of Neurosonology[8].

The FoCUS protocol included a structured bedside evaluation of acoustic window quality, global LV systolic function (LVSF) by visual estimation, cardiac chamber dimensions, aortic root and ascending aorta measurements, regional wall motion abnormalities, relevant mitral and aortic valve disease, and screening for large intracardiac masses or thrombi. AA was systematically assessed by neurologists as part of the FoCUS protocol. However, as cardiology evaluation of this structure was only performed in patients undergoing transesophageal echocardiography, this variable was excluded from predefined CSOE counts and agreement analyses, although it was considered in the assessment of the potential therapeutic impact of FoCUS. Interatrial septum (IS) anatomy was also explored to identify high-risk features such as atrial septal aneurysm. Detection of PFO was not performed using FoCUS due to its limited sensitivity compared with transcranial Doppler and the logistical requirement of a second operator for contrast studies [14]; consequently, PFO-related variables, such as PFO detected exclusively by bubble test studies, were not included in concordance analyses. Detailed variable definitions are provided in **Supplementary Table S1.**

The identified CSOE were classified as high- or low-risk sources of embolism (**Supplemental Table S2**). [15]

Key temporal metrics such as admission date and time, time to neurologist-performed FoCUS and cardiologist-performed TTE, and time to hospital discharge were also collected.

Outcomes

The primary outcome was the overall diagnostic concordance between neurologist-performed FoCUS and standard cardiologist-performed TTE for the identification of CSOE. Secondary outcomes included concordance for high- and low-risk CSOE, agreement across individual echocardiographic findings and CSOE categories, the proportion of patients in whom FoCUS findings led to etiologic reclassification, changes in secondary prevention strategy, and the timing of FoCUS during hospitalization, including exploratory analyses of diagnostic workflow intervals and length of stay.

Statistical analysis

Continuous variables were summarized as mean and standard deviation or median and interquartile range (IQR), as appropriate. Categorical variables were expressed as frequencies and percentages.

Normality of continuous variables was assessed using the Shapiro–Wilk test. For comparisons between groups, the unpaired Student's t-test was used for normally distributed variables, while the Mann–Whitney U test was applied for non-normally distributed data. Categorical variables were compared using the Pearson chi-squared test when appropriate, or Fisher's exact test otherwise. Statistical significance was set at $p \leq 0.05$.

Agreement between the neurological and cardiological echocardiographic assessments was evaluated according to the type of variable, with the cardiologist's TTE considered the gold standard. For continuous variables, the Intraclass Correlation Coefficient (ICC) was calculated using a two-way mixed-effects model for absolute agreement. For nominal categorical variables, Cohen's kappa coefficient was used to evaluate agreement between the two departments. For ordinal variables, inter-rater reliability was assessed using the weighted Cohen's kappa coefficient with squared weights, and agreement patterns were visualized using heatmaps. Concordance was interpreted according to established thresholds: for Cohen's kappa, values between 0.61 and 0.80 were considered substantial, and values above 0.80 as almost perfect agreement[16]. For ICC, values between 0.75 and 0.90 were considered substantial, and values above 0.90 as excellent agreement[17]. A detailed classification of agreement thresholds is presented in **Supplementary Table S3.**

Systematic differences between neurologist-performed FoCUS and standard TTE were evaluated to determine potential over- or under-detection. McNemar's test was applied for nominal variables, the Wilcoxon signed-rank test for ordinal variables, and paired t-tests for quantitative variables.

To explore the potential influence of operator experience, we assessed the relationship between the number of FoCUS examinations performed by each neurologist and their level of diagnostic agreement with TTE using Spearman's rho.

Statistical analysis was performed using R Statistical Software version 4.2.3 (R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

A total of 109 patients underwent FoCUS between January and October 2025. Of these, 103 also completed TTE and were included in the final analysis. Six patients were excluded due to death before TTE (n=3) or transfer to other centers (n=3).

Baseline characteristics of the participants are presented in Table 1. A history of ischemic cardiopathy was present in 17 cases (17%). Previous atrial fibrillation was documented in 15 patients (15%), and new-onset AF was detected during hospitalization in 9 cases (9%).

Acoustic window quality for FoCUS and TTE is shown in **Figure 1.** Agreement between modalities was poor (κ = 0.40; 95% confidence interval [CI] 0.22–0.58), with significantly lower ratings observed with FoCUS ($p < 0.001$).

Using TTE as the reference standard, a total of 46 CSOE were identified, including 34 low-risk and 12 high-risk sources. High-risk findings comprised 5 akinesia, 1 intracardiac thrombus, 1 rheumatic mitral valve disease and 5 severe LV systolic dysfunction. FoCUS identified 38 CSOE overall, including all 12 high-risk sources and 26 low-risk findings. Among the low-risk abnormalities detected by FoCUS, 3 were discordant with the reference standard (3 interatrial septal abnormalities reported by FoCUS were not confirmed by TTE). Conversely, eleven low-risk findings identified by TTE were not detected by FoCUS, including 7 IS abnormalities, 2 cases of mild-to-moderately reduced LVSF, and 2 cases of mitral annular calcification. The distribution of CSOE categorization between FoCUS and TTE is illustrated in the agreement heatmap (**Figure 2**).

Agreement between FoCUS and TTE was substantial for overall CSOE (k = 0.74; 95% CI 0.61–0.86) and for low-risk CSOE (k = 0.68; 95% CI 0.53–0.83). Agreement for high-risk CSOE was excellent (k = 1.00; 95% CI 1.00–1.00). For ordinal CSOE categories (no, low-risk, high-risk), agreement was excellent too (weighted k = 0.86; 95% CI 0.79–0.94). Sensitivity and specificity of FoCUS for identifying overall CSOE were 76% and 96%, respectively. For low-risk CSOE, sensitivity was 68% and specificity 96%; for high-risk CSOE, both sensitivity and specificity were 100%. *Detailed agreement metrics for the identification of high- and low-risk CSOE are provided in* ***Table 2.***

Overall, FoCUS demonstrated robust performance for the identification of clinically relevant cardiac abnormalities, particularly reduced left ventricular systolic function (k = 0.75; 95% CI 0.53–0.99), significant valvular disease (mitral: k = 0.93; 95% CI 0.85–1.00; aortic k = 0.79; 95% CI 0.60–0.99), and LAVI (k = 0.79; 95% CI 0.69–0.87). Agreement was moderate for findings requiring detailed structural characterization, including regional wall motion abnormalities (k = 0.56; 95% CI 0.30–0.79), IS abnormalities (k = 0.35) and aortic dimensions (aortic root k = 0.57; ascending aorta k = 0.50) . Detailed agreement results for individual echocardiographic variables are presented in **Table 3.**

Although this assessment was not compared with TTE, the aortic arch could be visualized in 97 patients (94.2%) whom a FoCUS was performed. Significant AA was identified in five cases (5.1%) with FoCUS, and one patient (1.0%) had a floating thrombus.

A strong positive correlation was observed between the number of examinations and the agreement with TTE for the identification of embolic sources (Spearman ρ = 0.95, p = 0.051). Agreement results stratified by neurologist are provided in the **Supplementary Figure S1.**

Echocardiographic evaluation contributed to etiologic reclassification in 5 patients who had been initially considered to have an indeterminate stroke mechanism before cardiac imaging. In 4 cases, both FoCUS and TTE identified a high-risk CSOE, leading to changes in secondary prevention. These findings included 1 case of severely reduced LVSF (28%), 1 rheumatic mitral valve disease, and 2 non-PFO interatrial communications in patients younger than 60 years. In an additional patient, FoCUS identified a floating thrombus in the aortic arch, which was considered a major embolic source in the clinical etiologic assessment and led to modification of secondary prevention strategy.

The median hospital stay was 9 days (IQR 6–14). The interval between admission and FoCUS was 1.9 days (IQR 0.89–3.55), shorter than between admission and TTE, which occurred after a median of 6.0 days (IQR 3.8–9.6) ($p < 0.001$). The time between FoCUS and TTE was 3.9 days (IQR 1.1–7.1). Following imaging, the median time to discharge was 7 days (IQR 3–12) after FoCUS and 2.1 days (IQR 0.1–6.0) after TTE ($p < 0.001$). Regarding disposition, 78 patients (77%) were discharged home, with 45 (44%) being discharged on the same day the TTE was completed.

DISCUSSION

In this prospective cohort study, neurologist-performed FoCUS was able to reliably identify clinically relevant CSOE, with particularly strong diagnostic performance for high-risk findings and potential implications for earlier etiologic classification and workflow efficiency.

FoCUS showed substantial agreement with TTE for the identification of CSOE, with excellent concordance for high-risk sources. These agreement estimates are comparable to those reported in previous validation studies [9,12,13]. However, prior studies were often conducted in smaller or selected populations, frequently focused on specific cardiac abnormalities, and did not always include consecutive patients. In contrast, our study reflects a prospective real-world cohort with comprehensive cardiac assessment, including both high- and low-risk sources, and neurologists formally trained in FoCUS, which may account for the robust diagnostic performance observed. Notably, early echocardiographic findings contributed to etiologic reclassification and modification of secondary prevention strategies in a small but clinically meaningful proportion of patients in our cohort.

Conversely, the lower concordance of FoCUS for low-risk CSOE was mainly driven by missed findings with limited impact on secondary prevention strategies. These included cases of mildly-to-moderately reduced LVSF and mitral annular calcification, abnormalities that rarely modify antithrombotic management. In addition, some IS abnormalities were not identified. However, such findings carry greater clinical relevance when associated with PFO in patients younger than 60 years [18], and notably all PFOs within this age group were detected by transcranial Doppler screening in our cohort. Agreement was also lower for regional wall motion assessment, which was exclusively explained by missed hypokinetic segments, findings that are not classified as CSOE. Importantly, all akinetic segments, considered high-risk CSOE, were correctly identified by FoCUS [15].

Suboptimal imaging quality also contributed to the discrepancies between FoCUS and TTE. Nearly half of FoCUS examinations were performed with less than optimal acoustic windows, probably reflecting the limited mobility and cooperation of acute stroke patients during the first days of hospitalization. Moreover, cardiology used a more advanced system, whereas neurology relied on a portable device, a difference that reflects real-world stroke unit practice.

The robust diagnostic performance of FoCUS shown in our study may be partly explained by the operators' structured training and their growing practical experience. All neurologists involved in the study had completed FoCUS certification endorsed by national societies, which likely contributed to the high overall agreement observed. As expected, a strong positive correlation was found between the number of examinations performed and the agreement with TTE for the identification of CSOE [19,20]. These observations underscore the importance of structured training and continued practical exposure to maintain high diagnostic reliability in FoCUS practice.

Beyond its diagnostic agreement, our study also provides clinically relevant insights into the temporal implications of implementing FoCUS within stroke unit workflows. In our cohort, FoCUS was performed a median of almost four days earlier than standard TTE, enabling earlier identification of high-risk CSOE and potentially facilitating more timely initiation of targeted secondary prevention strategies. This temporal advantage may be particularly important given that CSOE, such as intracardiac thrombi, can regress or become less detectable over time, reducing diagnostic yield when cardiac imaging is delayed, and because earlier etiologic clarification allows prompt initiation of specific secondary prevention strategies, which has been associated with a reduced risk of early recurrence during the highest-risk period following the index event [5,6,21]. Taken together, these findings suggest that the systematic use of FoCUS could contribute to preventing avoidable recurrent embolic events and optimizing hospital resource utilization. Future research should assess the cost-effectiveness of these approaches in different healthcare environments.

From a screening perspective, FoCUS showed high positive and negative predictive values for overall CSOE detection (92% and 85%, respectively). These findings suggest that a normal FoCUS examination may reliably identify patients with a very low probability of clinically relevant high-risk CSOE, thereby supporting its role as an early bedside triage tool in the etiologic work-up of acute ischemic stroke. In this context, FoCUS could help prioritize comprehensive cardiology evaluation for selected patients, while potentially avoiding unnecessary delays in those with reassuring initial findings,.

This study has several strengths. First, its prospective design with consecutive patient inclusion enhances the internal validity of the findings and reduces the risk of selection bias. Second, the study reflects real-world stroke unit practice, as FoCUS was implemented within routine clinical workflows and compared with TTE under usual care conditions. Importantly, unlike most previous validation studies focusing predominantly on selected high-risk CSOE, our protocol incorporated a comprehensive cardiac assessment that included both high- and low-risk CSOE as well as quantitative echocardiographic measurements. This

broad and structured data collection provides a more realistic appraisal of the diagnostic performance of neurologist-performed FoCUS across the spectrum of clinically relevant cardiac findings in acute stroke. Finally, the systematic recording of timing metrics and therapeutic implications allowed us to explore not only diagnostic agreement but also the potential clinical and organizational impact of early bedside cardiac imaging in stroke care pathways.

However, we acknowledge some limitations too. First, the sample size was moderate, which may limit the statistical power to detect differences in less prevalent findings or in subgroup analyses. Second, this was a single-center study conducted in a stroke unit with neurologists formally trained in FoCUS, which could limit the generalizability to centers with different expertise, workflows, or access to structured training programs. Third, although all neurologists performing FoCUS were trained and adhered to a standardized protocol, inter-operator variability was not evaluated. FoCUS images were automatically deleted shortly after acquisition due to device storage settings, preventing a formal blind re-reading and therefore limiting a more detailed assessment of interobserver reliability. Fourth, the two techniques were performed on different ultrasound systems, potentially influencing image quality, but this also mirrors real-world practice and enhances the external validity of the study. Fifth, FoCUS and TTE were not systematically performed at the same time points, which may have influenced the detection of dynamic cardiac findings.

CONCLUSIONS

Our findings support the feasibility and clinical utility of neurologist-performed FoCUS as an early bedside screening tool in the etiologic evaluation of acute ischemic stroke, with high diagnostic reliability for clinically relevant high-risk CSOE. However, its lower performance for low-risk findings and selected quantitative parameters reinforces that FoCUS should complement rather than replace comprehensive TTE. Operator-dependent variability observed in our cohort further highlights the need for structured training and reflects the evolving role of the neurologist as a neurocardiologist within integrated stroke care pathways.

DECLARATIONS

Compliance with Instructions for Authors

This manuscript complies with all Instructions for Authors of Neurocritical Care, including ethical standards, reporting guidelines, authorship criteria, and formatting requirements.

The study follows the STROBE guidelines, and the completed STROBE reporting checklist is included with the submission.

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Contributorship

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Data analysis and interpretation – JMFV, JMF, PCR

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Authorship Statement

All authors meet the criteria for authorship as defined by the International Committee of Medical Journal Editors (ICMJE), have made substantial contributions to the work, and have approved the final version of the manuscript.

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This manuscript has not been published previously and is not under consideration by another journal.

Declaration of conflicting interest

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Ethics Statement:

The study was approved by the Clinical Research Ethics Committee of the Hospital de la Santa Creu i Sant Pau (ethical permit number IIBSP-ECO-2011-109), and written informed consent was obtained from all patients.

Data Availability Statement:

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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TABLES

Table 1. Demographic and Clinical Variables

Variables	Overall (n = 109)
Female, n (%)	48 (47%)
Age, median_(IQR)	76 (62 – 85)
BMI, median_(IQR)	26.6 (23.5 - 28.7)
Hypertension, n (%)	65 (63%)
Diabetes mellitus, n (%)	17 (17%)
Dyslipidemia, n (%)	45 (44%)
History of Ischemic Cardiopathy, n (%)	17 (17%)
History of AF, n (%)	15 (15%)
New-onset AF during admission, n (%)	9 (9%)
Previous Stroke, n (%)	14 (14%)

Table 1: Baseline characteristics of the study population (n = 109). Continuous variables are presented as median and interquartile range, and categorical variables as counts and percentages. AF: atrial fibrillation. BMI: body mass index.

Table 2. Agreement for identification of CSOE

Variables		FoCUS (n, %)	TTE (n, %)	Agreement (k / weighted k)	p value	Systematic differences	Sensitivity	Specificity	PPV	NPV
CSOE (Yes/No)		38 (34%)	44 (40%)	k = 0.74 (0.61-0.86)	<0.001	0.061	76%	96%	92%	85%
Low-Risk CSOE (Yes/No)		26 (23%)	34 (30%)	k = 0.68 (0.53-0.83)	<0.001	0.061	68%	96%	89%	87%
High-Risk CSOE (Yes/No)		12 (11%)	12 (11%)	k = 1.00 (1.00-1.00)	<0.001	0.999	100%	100%	100%	100%
CSOE (ordinal categories)	No	75 (66%)	67 (59%)	weighted k = 0.86 (0.79-0.94)	<0.001	0.035	-	-	-	-
	Low-Risk	26 (23%)	34 (30%)							
	High-Risk	12 (11%)	12 (11%)							

Table 2. Agreement for identification of CSOE between neurologist-performed FoCUS and cardiologist-performed TTE. Patients presenting **two or more potential CSOE were counted separately for each identified category.** Agreement metrics were selected according to the type of variable: Cohen's kappa was used for nominal categorical variables and weighted Cohen's k with squared weights for ordinal variables. Systematic differences between FoCUS and TTE were assessed using McNemar's test for nominal variables and the Wilcoxon signed-rank test for ordinal variables. TTE was considered the reference standard. Abbreviations: CI (confidence interval), CSOE (Cardiac Sources of Embolism), FoCUS (focused cardiac ultrasound), k (Cohen's kappa), NPV (Negative Predictive Value), PPV (Positive Predictive Value), TTE (transthoracic echocardiography).

Table 3. Agreement between neurologist-performed FoCUS and cardiologist-performed TTE for the main echocardiographic findings.

Cardiac parameters			FoCUS (n, % / median (IQR))	TTE (n, % / median (IQR))	Agreement (k / weighted k / ICC, 95% CI)	p value	Systematic differences
Left ventricular systolic function	LVSF (normal vs reduced)		9 (9.1%)	10 (9.9%)	k = 0,75 (0.53-0.99)	<0.001	0.999
	LVSF (ordinal categories)	Normal	94 (91%)	93 (90%)	weighted k = 0.89 (0.77-1.00)	<0.001	0.765
		Mild-moderate	4 (3.9%)	5 (4,9%)			
		Severe	5 (4.9%)	5 (4,9%)			
Heart chamber dimensions	LAVI		31 (26 - 39)	31 (24 – 40)	ICC = 0.79 (0.69-0.87)	<0.001	0.849
	LAE		39 (38%)	39 (38%)	ICC = 0.54 (0.38-0.71)	<0.001	0.999
	LV size		41.0 (38.0 - 45.0)	44 (40 – 48)	ICC = 0.61 (0.39-0.74)	<0.001	<0.001
	Aortic root diameter		33.0 (30.0 - 36.0)	33.0 (30.0 - 35.0)	ICC = 0.57 (0.43-0.69)	<0.001	0.706
	Ascending aorta diameter		32.0 (30.0 - 35.0)	33.5 (30.0 - 36.0)	ICC = 0.50 (0.23-0.71)	<0.001	0.107
Regional wall motion abnormalities			11 (11%)	12 (12%)	k = 0.56 (0.30-0.79)	<0.001	0.999
Valvular abnormalities	Mitral valve		19 (19%)	19 (19%)	k = 0.93 (0.85-1.00)	<0.001	0.999
	Aortic valve		12 (12%)	10 (9.8%)	k = 0.79 (0.60-0.99)	<0.001	0.617
Large intracardiac masses			1 (1.0%)	1 (1.0%)	k = 1.00 (1.00-1.00)	<0.001	-
Intracardiac shunt	IS abnormalities		20 (20%)	21 (21%)	k = 0.35 (0.13-0.57)	<0.001	0.999

Table 3. Agreement between neurologist-performed FoCUS and cardiologist-performed TTE for the main echocardiographic findings. Agreement metrics were selected according to the type of variable: Cohen's Kappa was used for nominal categorical variables, weighted Cohen's Kappa with squared weights for ordinal variables, and the Intraclass Correlation Coefficient for continuous measurements. *Systematic differences* between FoCUS and TTE were assessed using McNemar's test for nominal

variables, the Wilcoxon signed-rank test for ordinal variables, and paired t-tests for continuous variables. TTE was considered the reference standard. Values for interatrial septum abnormalities exclude PFO detected exclusively by bubble test studies. Abbreviations: CI (confidence interval), FoCUS (focused cardiac ultrasound), IAS (interatrial septum), ICC (Intraclass Correlation Coefficient), IQR (interquartile range), k (Cohen's kappa), LA (left atrium), LAE (left atrial enlargement), LAVI (left atrial volume index), LV (left ventricle), LVSF (left ventricular systolic function), TTE (transthoracic echocardiography).

Figures

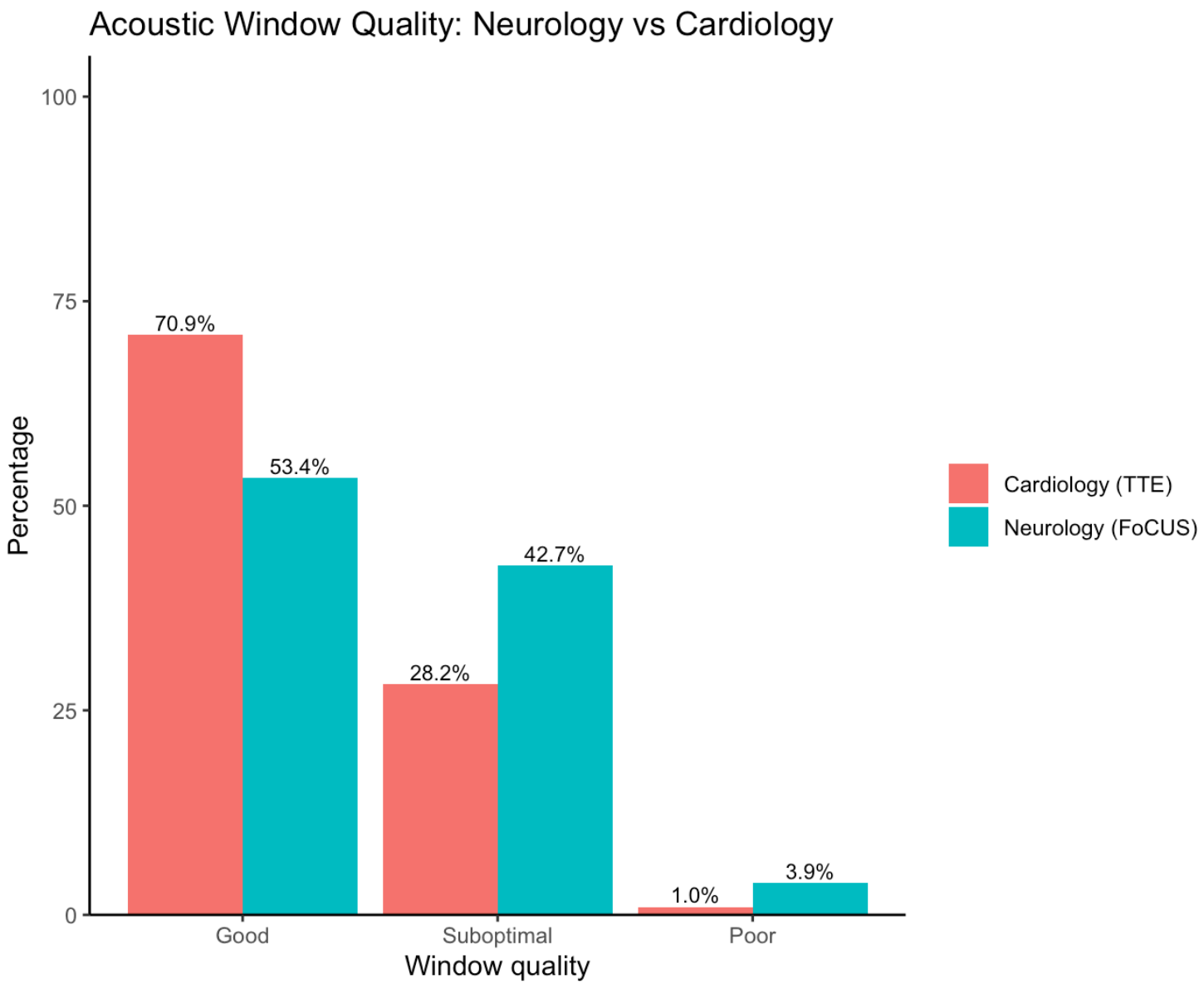


Figure 1

Window Quality. Acoustic Window Quality: FoCUS compared to TTE. FoCUS: Focused Cardiac Ultrasound. TTE: Transthoracic Echocardiography.

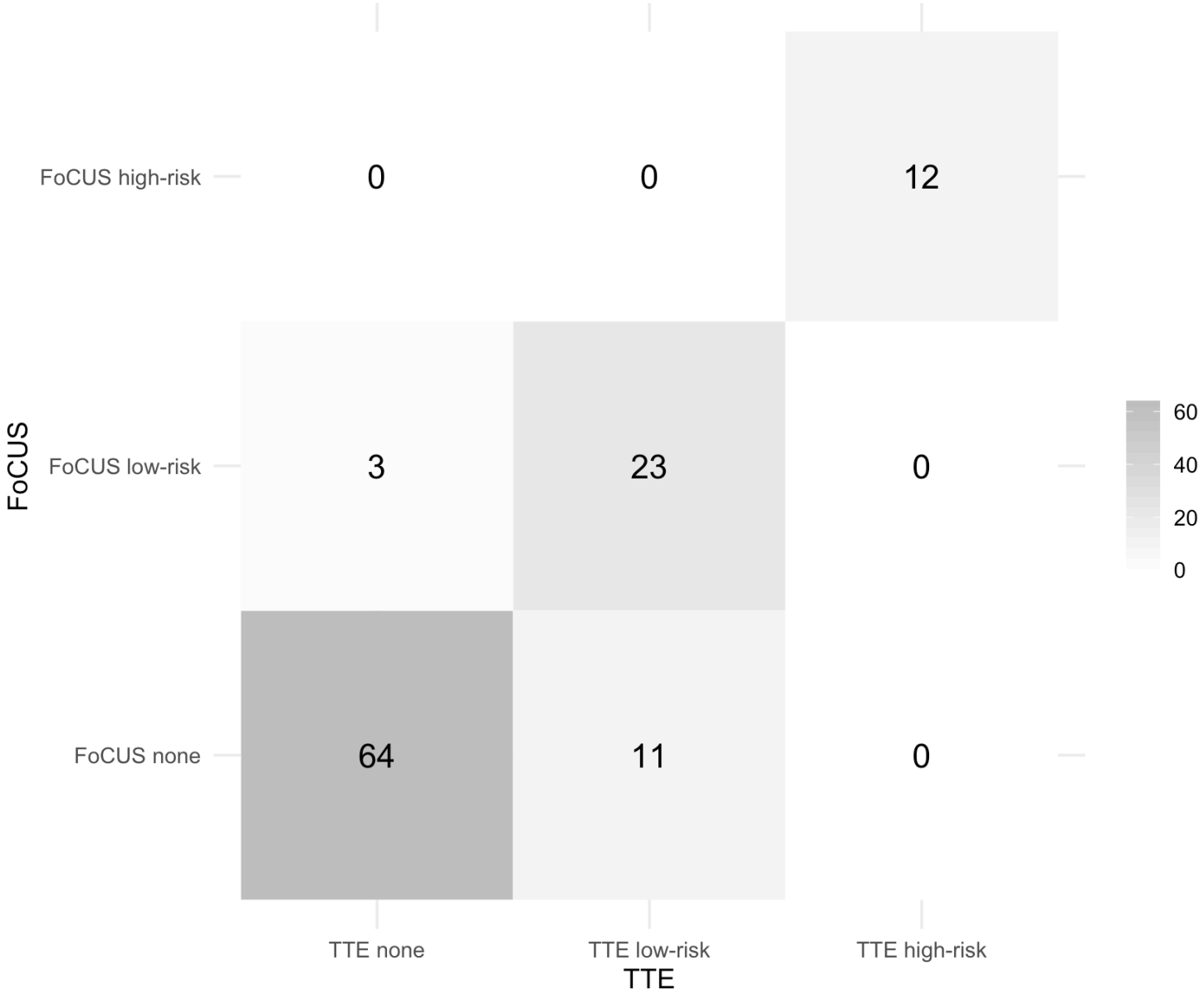


Figure 2

Agreement heatmap between FoCUS and TTE for the classification of cardioembolic sources of embolism. The heatmap illustrates the distribution of patients according to CSOE categorization by both modalities (no CSOE, low-risk CSOE, and high-risk CSOE). Patients presenting two or more potential CSOE were counted separately for each identified category. CSOE: Cardiac Sources of Embolism. FoCUS: Focused Cardiac Ultrasound. TTE: Transthoracic Echocardiography.

Supplementary Files

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