Research Article

CHA$_2$DS$_2$-VASc Score as a Predictor for Left Atrial Thrombus or Spontaneous Echo Contrast in Patients with Nonvalvular Atrial Fibrillation: A Meta-Analysis

Ping Sun, Zhi Hao Guo, and Hong Bin Zhang

Vasculocardiology Department, Cangzhou Central Hospital, No. 16 Xinhua Road, Yunhe Qu, Cangzhou 061000, China

Correspondence should be addressed to Ping Sun; sunping20020901@hotmail.com

Received 4 April 2020; Revised 8 June 2020; Accepted 22 June 2020; Published 11 July 2020

Academic Editor: Andrea I. Guaricci

Copyright © 2020 Ping Sun et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Objective. This meta-analysis aimed at exploring the predictive value of CHA$_2$DS$_2$-VASc score for the left atrial thrombus (LAT) or left atrial spontaneous echo contrast (LASEC) in patients with nonvalvular atrial fibrillation (NVAF).

Methods. PubMed, Embase, Web of Science, ScienceDirect, Cochrane Library, and Chinese core journals of the CNKI and Wanfang databases were searched to identify all the relevant papers that were published up to January 2020. The data were extracted for pooled odds ratios (ORs) with 95% confidence intervals (CIs), heterogeneity, subgroup, publication bias, and sensitivity analysis.

Results. Overall, 15 studies containing 6223 patients with NVAF were enrolled. All studies were evaluated for LAT, and 12 studies were evaluated for LASEC. The pooled analysis using a random-effects model showed that a high CHA$_2$DS$_2$-VASc score was related with LAT/LASEC (pooled OR = 1.59, 95% CI: 1.35–1.88, $P < 0.001$) with high heterogeneity ($I^2 = 76.9\%$, $P < 0.001$) and LAT (pooled OR = 1.83, 95% CI: 1.44–2.33, $P < 0.001$) with high heterogeneity ($I^2 = 79.4\%$, $P < 0.001$). The subgroup analysis demonstrated that the sample size may be the main source of heterogeneity. Although the Begg’s funnel plot based on 15 studies for LAT/LASEC ($P = 0.029$) and 12 studies for LAT ($P = 0.046$) indicated the presence of publication bias among the included studies, the trim-and-fill method verified the stability of the pooled outcomes. In addition, sensitivity analysis indicated that all effects were stable. Conclusion. The results of this meta-analysis showed that the CHA$_2$DS$_2$-VASc score is related with LAT and LASEC in patients with NVAF. However, more studies are warranted to address this issue.

1. Introduction

Atrial fibrillation (AF) is a fairly common arrhythmia worldwide, and 33 million people are estimated to be suffering from this condition [1]. Worryingly, the left atrial thrombus (LAT) and left atrial spontaneous echo contrast (LASEC) formation, which are among the most frequent complications that develop in patients with AF, are related to high rates of stroke and mortality [2–4]. The transesophageal echocardiography (TEE) is considered the global standard for detecting LAT with 97% sensitivity and 100% specificity [5, 6]. However, TEE facilities are limited in developing countries and depend greatly on the operator’s skill and experience. Thus, the clinical methods for LAT/LASEC prediction and risk assessment in a timely manner are particularly important.

CHA$_2$DS$_2$-VASc is a simple, clinical risk factor-based approach to thromboprophylaxis. Although the CHA2DS$_2$-VASc score has been widely used to evaluate the risk recurrence of AF [7] and ischemic stroke in patients with AF [8], there has been limited evidence of LAT/LASEC prediction according to CHA2DS2-VASc scores. In 2015, a letter to an editor [9] reported that a high CHA$_2$DS$_2$-VASc score can predict LAT/LASEC in patients with NVAF. However, more studies are warranted to address this issue.
2. Materials and Methods

This meta-analysis was based on the preferred reporting items for the systematic review and meta-analysis (PRISMA) project [26]. All data were collected from published trials. Hence, an additional ethical approval was not necessary.

2.1. Search Strategy. PubMed, Web of Science, ScienceDirect, Cochrane Library, and the Chinese core journals of the CNKI and Wanfang database were systematically searched to identify relevant studies from inception to January 2020 by using the following search terms: “CHA2DS2-VASc,” “thrombus,” and “fibrillation.” The reference lists of some major articles and reviews were manually checked to avoid missing relevant studies.

2.2. Inclusion and Exclusion Criteria. Studies were included if they satisfied the following criteria: original clinical trial, studies that reported the relation between CHA2DS2-VASc score and LAT/LASEC in patients with AF, and sufficient information to evaluate odds ratios (ORs) with 95% confidence intervals (CIs). Case reports, reviews, conference papers, editorials, and animal studies were excluded. The most informative study was included for the repeated studies carried out among identical research populations. Studies were identified using the above search strategy by two independent reviewers. A third reviewer was consulted when faced with uncertainty regarding eligibility.

2.3. Data Collection. Two reviewers extracted data concerning patient characteristics and clinical outcomes by using a standard data collection form. The first author’s name, year of publication, study design, region, paroxysmal AF percentage, age, ample size, number of LAT and LASEC, and CHA2DS2-VASc score were collected from each study that met the inclusion criteria.

2.4. Quality Assessment of the Selected Articles. The quality of the included studies was separately assessed by two reviewers by using the Quality Assessment of Diagnostic Accuracy Studies-2 (QUADAS-2) tool [27]. All eligible studies were evaluated on the basis of four domains: patient selection, index test, reference standard, and flow and timing. The ratings were cross-checked, and the difference was solved by a third reviewer.

3. Results

3.1. Search Strategy. Figure 1 displays the literature identification and selection process. The electronic searches yielded 701 potentially relevant studies. Among these studies, 676 were excluded due to duplication or irrelevance to the topic. The remaining 25 studies underwent a full-text review, and 15 studies [10–25] were finally included. The other 10 studies were excluded because 5 repeated studies were carried out among identical research populations; 3 studies were unable to extract related data; and the other 2 were reviews.

Figure 1: Flow diagram of the study screening and selection process.
| First author (year) | Design | Region | Paroxysmal AF (%) | Age | Male (%) | Warfarin (%) | N | LAT, n (%) | LAT, Present | LAT, Absent | LAT/LASEC, n (%) | LAT/LASEC Present | LAT/LASEC Absent |
|---------------------|--------|--------|-------------------|-----|----------|--------------|---|-------------|--------------|-------------|------------------|-------------------|-----------------|
| Chen 2017           | P      | China  | 59.3%             | 59.4 ± 11.8 | 61.9% | 42.9%        | 189 | 13 (6.87)  | 2.31 ± 1.32  | 1.29 ± 1.28  | NA               | NA                | NA              |
| Deftereos 2011      | R      | Greece | NA                | 62.2 ± 1.2  | 65.1% | NA           | 86  | 15 (17.44) | 3.8 ± 0.3    | 1.3 ± 0.1    | NA               | NA                | NA              |
| Jia 2019            | P      | China  | 82%               | 59 ± 13     | 66.2% | NA           | 397 | 38 (9.57)  | NA           | NA          | NA               | NA                | NA              |
| Kaplon-Cieslicka 2019| R      | Poland | 61%               | 60 (53-66)  | 66%   | NA           | 1033 | 59 (5.71)  | 3 (2-4)      | 2 (1-3)     | NA               | NA                | NA              |
| Kizawa 2018         | R      | Japan  | 62%               | 66 ± 10     | 69%   | 22%          | 581 | NA         | NA          | NA          | 147 (25.30)     | 3.1 ± 1.5         | 2.0 ± 1.4        |
| Kowalczyk 2015      | R      | Poland | NA                | 64 ± 8.8    | 64%   | NA           | 64  | 30 (46.85) | 3.2 ± 1.6    | 2.80 ± 1.8   | NA               | NA                | NA              |
| Liu 2014            | R      | China  | 83%               | 60.8 ± 11.2 | 64.2% | NA           | 525 | NA         | NA          | NA          | 57               | 2.77 ± 1.12       | 2.33 ± 1.17      |
| Ma 2015             | R      | China  | 88.0%             | 61.12       | 57.3% | NA           | 164 | 32 (19.51) | 3.4 ± 1.8    | 1.9 ± 1.4    | NA               | NA                | NA              |
| Pant 2016           | P      | USA    | 26%               | 65 ± 12     | 70%   | 48%          | 261 | 17 (6.51)  | 4.4 ± 1.6    | 3.0 ± 1.8    | 85               | (31.42)          | NA              |
| Sugiura 2012        | P      | Japan  | 66.2%             | 62 ± 11     | 77%   | 100%         | 225 | 23 (10.22) | 3 ± 2        | 2 ± 1        | NA               | NA                | NA              |
| Tang 2014           | R      | China  | 66.6%             | 58.1 ± 11.2 | 71.0% | 12.7%        | 1359| 61 (4.49)  | NA           | NA          | NA               | NA                | NA              |
| Uz 2014             | R      | Turkey | NA                | 70.1 ± 9.8  | 49%   | 32%          | 309 | 32 (10.36) | NA           | NA          | 70               | (22.65)          | NA              |
| Wang 2018           | R      | China  | 28.6%             | 66.1 ± 10.8 | 57.4% | 39.6%        | 472 | NA         | NA          | NA          | 80               | (16.95)          | 3.79 ± 1.75      |
| Whiteside 2019      | R      | USA    | 24.1%             | 65.8 ± 11.9 | 61.5% | 0%           | 226 | 7 (3.10)   | 3.43 ± 1.40  | 2.81 ± 1.62  | NA               | NA                | NA              |
| Zhang 2017          | R      | China  | 12.9%             | 67.62 ± 6.96| 57.3% | NA           | 332 | 116 (50)   | 2.88 ± 1.51  | 1.50 ± 1.22  | NA               | NA                | NA              |

Continuous variables are presented as mean, mean ± standard deviation, or median (interquartile range), and categorical variable is presented as no. (%).
3.2. Characteristics and Quality of Included Studies. The baseline characteristics of fifteen eligible studies in the meta-analysis are summarized in Table 1. The mean age of the participants was 59–70 years. The sample size of studies ranged from 64 to 1359 with a mean sample size of 415. Among the 15 studies [10–25] included in the final meta-analysis, 7 were from the China [10, 13, 16, 17, 21, 23, 25], 2 were from Poland [18, 20], 2 were from USA [22, 25], 2 were from Japan [12, 19], 1 was from Greece [11], and 1 was from Turkey [14]. The percentage of paroxysmal AF ranged from 64 to 1359 with a mean sample size of 415.

Sample size may account for the source of heterogeneity. Therefore, the random-effects model was used for data analysis. The pooled analysis showed that a high CHA2DS2-VASc score was related with LAT/LASEC (pooled OR = 1.59, 95% CI: 1.35–1.88, P < 0.001; I² = 76.9%, P < 0.001; Figure 3(a)) based on the 15 included studies [10–25] and related with LAT (pooled OR = 1.83, 95% CI: 1.44–2.33, P < 0.001; I² = 79.4%, P < 0.001; Figure 3(b)) based on the 12 included studies [11–14, 16–18, 20–22, 24, 25].

3.4. Subgroup Analysis. Subgroup analysis was conducted to investigate the source of heterogeneity (Table 2). The subgroup analysis for LAT/LASEC with 15 studies [10–25] was performed on the basis of sample size (≥415 vs. <415), publication year (before 2015 vs. after 2015), region (Asia vs. non-Asia), and proportion of male (≥65.3% vs. <65.3%). Sample size may account for the source of heterogeneity.

The subgroup analysis for LAT with 12 studies [11–14, 16–18, 20–22, 24, 25] was performed on the basis of sample size (≥379 vs. <379), publication year (before 2015 vs. after 2015), region (Asia vs. non-Asia), and proportion of male (≥66.0% vs. <66.0%). However, these factors did not account for the source of heterogeneity (Table 2).

3.5. Publication Bias Assessment. The publication bias for LAT/LASEC in 15 studies [10–25] was detected using the Begg’s test (P = 0.029) (Figure 4(a)). The trim-and-fill results show that three necessary studies have been missed. The adjusted fixed-effects pooled OR of 1.48 (95% CI: 1.24–2.13, P < 0.001) calculated using the trim-and-fill method was consistent with the original analysis (OR = 1.59, 95% CI: 1.35–1.88, P < 0.001; Figure 4(b)).

The publication bias for LAT in 12 studies [11–14, 16–18, 20–22, 24, 25] was detected using Begg’s test (P = 0.064) (Figure 4(c)). The trim-and-fill results show that two necessary studies have been missed. The adjusted fixed-effects pooled OR of 1.66 (95% CI: 1.30–2.13, P < 0.001) calculated using the trim-and-fill method was consistent with the original analysis (OR = 1.83, 95% CI: 1.44–2.33, P < 0.001; Figure 3(d)).

3.6. Sensitivity Analysis. Sensitivity analysis showed no noticeable change in the statistical significance of all outcomes by removing the single studies. This finding indicated that all effects were stable (15 LAT/LASEC-based studies, Figure 5(a); 12 LAT-based studies, Figure 5(b)).

4. Discussion

This meta-analysis and systematic review provided further viewpoint on the relationship between the CHA2DS2-VASc score and LAT/LASEC in patients with AF, and the results showed that patients with high CHA2DS2-VASc score had 1.59- and 1.83-fold higher risks of LAT/LASEC and LAT, respectively. This result was consistent with that of a previous study.

A previous study reported that the pooled analysis in the random-effects model demonstrated a statistically significant 70% increase in the detection of LAT/LASEC (OR = 1.70; 95% CI: 1.16–2.48) and 122% increased risk for detecting LAT (OR = 2.22; 95% CI: 1.11–4.44) from higher CHA2DS2-VASc score to lower CHA2DS2-VASc score based on the four studies [9]. This finding was consistent with our result. The strength of our results came by removing the single studies. This finding indicated that all effects were stable (15 LAT/LASEC-based studies, Figure 5(a); 12 LAT-based studies, Figure 5(b)).

Namely, predicting the LAT/LASEC in AF with CHA2DS2-VASc score remains challenging. Some studies have indicated that patients who are categorized as low risk by the CHA2DS2-VASc score (i.e., score 0 in males or 1 in females) also have a risk of LAT/LASEC [13, 28–30]. In other
words, the CHA\textsubscript{2}DS\textsubscript{2}-VASc score needs to be improved and perfected. Van Chien et al. has increased the predictive ability ($\chi^2$) from 3.53 to 33.48 by adding the left atrial volume index and the left atrial negative strain rate in the two-chamber view to the CHA\textsubscript{2}DS\textsubscript{2}-VASc score \cite{31}. Similarly, predictive ability has increased by 13% when the left atrial emptying fraction is added to the CHA2DS2-VASc score, as shown in Kim et al.’s study \cite{32}. In addition, the areas under the curve have increased from 0.70 to 0.81 by adding the renal dysfunction and the AF type to the CHA\textsubscript{2}DS\textsubscript{2}-VASc score, as shown in Kapłon-Cieślicka et al.’s study \cite{18}. New studies may be necessary to test if the addition of items, such as left atrial volume index, left atrial negative strain rate in two-chamber view, renal dysfunction, and AF type, to the CHA2DS2-VASc can increase the diagnostic efficiency of the score on LAT/LASEC.

This review has several important limitations that need to be acknowledged. First, the eligible articles included in our

![Figure 3: Forest plot of the association between CHA\textsubscript{2}DS\textsubscript{2}-VASc score and LAT/LASEC. (a) LAT/LASEC. (b) LAT. LAT: left atrial thrombus; LASEC: left atrial spontaneous echo contrast.](image)
Table 2: Subgroup analysis of potential sources of heterogeneity.

| Heterogeneity factors | No. of studies | OR (95% CI)          | P value  | I² (P value) |
|-----------------------|----------------|----------------------|----------|--------------|
|                       | For LAT/LASEC with 15 studies |                    |          |              |
| Sample size           | ≥415            | 1.33 (1.17–1.52)     | <0.001   | 47.9% (0.104) |
|                       | <415            | 2.02 (1.48–2.75)     | <0.001   | 82.4% (<0.001) |
|                       | Before 2015     | 1.83 (1.26–2.66)     | 0.002    | 84.5% (<0.001) |
|                       | After 2015      | 1.49 (1.26–1.77)     | <0.001   | 66.7% (0.003) |
| Publication year      | Asia            | 1.81 (1.39–2.35)     | <0.001   | 81.8% (<0.001) |
|                       | Non-Asia        | 1.36 (1.12–1.66)     | 0.002    | 66.4% (0.018) |
| Region                | ≥65.3%          | 1.42 (1.20–1.67)     | <0.001   | 70.4% (0.001) |
|                       | <65.3%          | 1.93 (1.28–2.91)     | 0.001    | 81.6% (0.001) |
|                       | Before 2015     | 2.03 (1.24–3.32)     | 0.005    | 87.1% (<0.001) |
|                       | After 2015      | 1.73 (1.37–2.19)     | <0.001   | 57.6% (0.038) |
|                       | Asia            | 2.37 (1.54–3.64)     | <0.001   | 80.7% (<0.001) |
|                       | Non-Asia        | 1.39 (1.11–1.76)     | 0.005    | 66.8% (0.017) |
| Proportion of male    | ≥66.0%          | 1.51 (1.17–1.96)     | 0.002    | 78.0% (<0.001) |
|                       | <66.0%          | 2.28 (1.54–3.38)     | <0.001   | 65.5% (0.013) |

CI: confidence intervals; SE: standard error.

Figure 4: Funnel plot to test for publication bias. (a) Begg’s test and (b) trim-and-fill method for LAT/LASEC; (c) Begg’s test and (d) trim-and-fill method for LAT.
meta-analysis were restricted to studies published in English and Chinese and likely caused selection bias. Second, complete information regarding some variables, such as renal dysfunction, AF type, and TEE, were lacking in the included article. Third, heterogeneity among studies existed and our analysis should be interpreted with caution.

In conclusion, our meta-analysis suggested that CHA2DS2-VASc score is a valuable predictor for LAT/LASEC in patients with AF. However, further well-designed studies included within the article. Third, heterogeneity among studies existed and our analysis should be interpreted with caution.

Conflicts of Interest
The authors declare that they have no conflicts of interest.

Supplementary Materials
Supplementary figure S1: risk of bias of the included studies. (Supplementary Materials)

References
[1] S. S. Chugh, R. Havmoeller, K. Narayanan et al., "Worldwide epidemiology of atrial fibrillation: a Global Burden of Disease 2010 Study," Circulation, vol. 129, no. 8, pp. 837–847, 2014.

[2] A. J. Camm, P. Kirchhof, G. Y. Lip et al., “Guidelines for the management of atrial fibrillation: the Task Force for the Management of Atrial Fibrillation of the European Society of Cardiology (ESC),” Europace, vol. 12, no. 10, pp. 1360–1420, 2010.

[3] C. T. January, L. S. Wann, J. S. Alpert et al., “2014 AHA/ACC/HRS guideline for the management of patients with atrial fibrillation: a report of the American College of Cardiology/American Heart Association Task Force on practice guidelines and the Heart Rhythm Society,” Circulation, vol. 130, no. 23, pp. e199–e267, 2014.

[4] A. Gažová, J. J. Leddy, M. Rexová, P. Hlívák, R. Hatala, and J. Kyselovič, "Predictive value of CHA2DS2-VASc scores regarding the risk of stroke and all-cause mortality in patients with atrial fibrillation (CONSORT compliant)," Medicine, vol. 98, no. 31, article e16560, 2019.

[5] J. W. McCready, L. Nunn, P. D. Lambiase et al., “Incidence of left atrial thrombus prior to atrial fibrillation ablation: is procedural transoesophageal echocardiography mandatory?,” Europace, vol. 12, no. 7, pp. 927–932, 2010.

[6] V. Koca, T. Bozat, V. Akkaya et al., “Left atrial thrombus detection with multiplane transesophageal echocardiography: an echocardiographic study with surgical verification,” The Journal of Heart Valve Disease, vol. 8, no. 1, pp. 63–66, 1999.

[7] F. Vitali, M. Serenelli, J. Airaksinen et al., “CHA2DS2-VASc score predicts atrial fibrillation recurrence after cardioversion: systematic review and individual patient pooled meta-analysis,” Clinical Cardiology, vol. 42, no. 3, pp. 358–364, 2019.

[8] S. van Doorn, T. P. A. Debray, F. Kaasenbrood et al., “Predictive performance of the CHA2DS2-VASc rule in atrial fibrillation: a systematic review and meta-analysis,” Journal of Thrombosis and Haemostasis, vol. 15, no. 6, pp. 1065–1077, 2017.

[9] E. Zhang, T. Liu, Z. Li, J. Zhao, and G. Li, “High CHA2DS2-VASc score predicts left atrial thrombus or spontaneous echo contrast detected by transesophageal echocardiography,” International Journal of Cardiology, vol. 184, pp. 540–542, 2015.

[10] F. Liu, W. Wei, Y. Xue, X. Zhan, X. Fang, and H. Liao, “Predictive value of serum uric acid level for left atrial thrombus or spontaneous echo contrast in patients with atrial fibrillation,” JACC, vol. 64, no. 16, p. C235, 2014.
[11] S. Deftereos, G. Giannopoulos, C. Kossyvakis et al., "Estimation of atrial fibrillation recency of onset and safety of cardioversion using NTproBNP levels in patients with unknown time of onset," *Heart*, vol. 97, no. 11, pp. 914–917, 2011.

[12] S. Sugiyama, E. Fujii, M. Senga, E. Sugiyama, M. Nakamura, and M. Ito, "Clinical features of patients with left atrial thrombus undergoing anticoagulant therapy," *Journal of Interventional Cardiac Electrophysiology*, vol. 34, no. 1, pp. 59–63, 2012.

[13] R.-B. Tang, J.-Z. Dong, X.-L. Yan et al., "Serum uric acid and risk of left atrial thrombus in patients with nonvalvular atrial fibrillation," *The Canadian Journal of Cardiology*, vol. 30, no. 11, pp. 1415–1421, 2014.

[14] O. Uz, M. Atalay, M. Dogan et al., "The CHA$_{2}$DS$_{2}$-VASc score as a predictor of left atrial thrombus in patients with nonvalvular atrial fibrillation," *Medical Principles and Practice*, vol. 23, no. 3, pp. 234–238, 2014.

[15] J. Zhao, T. Liu, P. Korantzopoulos et al., "Red blood cell distribution width and left atrial thrombus or spontaneous echo contrast in patients with non-valvular atrial fibrillation," *International Journal of Cardiology*, vol. 180, pp. 63–65, 2015.

[16] Z. X. Chen, W. J. Bai, H. Tang, W. Cheng, and L. Rao, "Assessment of left atrial appendage size and morphology by enhanced cardiac computed tomography in patients with non-valvular atrial fibrillation," *Sichuan Da Xue Xue Bao. Yi Xue Ban*, vol. 48, no. 6, pp. 911–916, 2017.

[17] F. Jia, Y. Tian, S. Lei, Y. Yang, S. Luo, and Q. He, "Incidence and predictors of left atrial thrombus in patients with atrial fibrillation prior to ablation in the real world of China," *Indian Pacing and Electrophysiology Journal*, vol. 19, no. 4, pp. 134–139, 2019.

[18] A. Kaplon-Cieslicka, M. Budnik, M. Gawalko et al., "Atrial fibrillation type and renal dysfunction as important predictors of left atrial thrombus," *Heart*, vol. 105, no. 17, pp. 1310–1315, 2019.

[19] S. Kizawa, T. Ito, K. Akamatsu et al., "Chronic kidney disease as a possible predictor of left atrial thrombogenic milieu among patients with nonvalvular atrial fibrillation," *The American Journal of Cardiology*, vol. 122, no. 12, pp. 2062–2067, 2018.

[20] E. Kowalczyk, J. D. Kasprzak, and P. Lipiec, "Heart failure as an independent predictor of thrombus persistence in nonvalvular atrial fibrillation: a transesophageal echocardiography-based study," *Polskie Archiwum Medycyny Wewnętrznej*, vol. 125, no. 5, pp. 358–362, 2015.

[21] J. W. Ma, X. H. Ma, L. J. Cui, and Z. Li, "The predictive value of CHADS$_{2}$ and CHA$_{2}$DS$_{2}$-VASc score in left atrial or left atrial appendage thrombus in patients with non-valvular atrial fibrillation," *Tianjin Medical Journal*, vol. 43, no. 3, pp. 304–307, 2015.

[22] R. Pant, M. Patel, E. Garcia-Sayan et al., "Impact of B-type natriuretic peptide level on the risk of left atrial appendage thrombus in patients with nonvalvular atrial fibrillation: a prospective study," *Cardiovascular Ultrasound*, vol. 14, 2015.

[23] F. Wang, M. Zhu, X. Wang et al., "Predictive value of left atrial appendage lobes on left atrial thrombus or spontaneous echo contrast in patients with non-valvular atrial fibrillation," *BMC Cardiovascular Disorders*, vol. 18, no. 1, p. 153, 2018.

[24] H. L. Whiteside, A. Nagabandi, K. Brown, D. N. Ayyala, and G. K. Sharma, "Prevalence and clinical characteristics associated with left atrial thrombus detection: Apixaban," *World Journal of Cardiology*, vol. 11, no. 2, pp. 84–93, 2019.