The Egyptian Journal of Hospital Medicine (April 2023) Vol. 91, Page 4052-4057

# CHA2DS2-VASc Score as A Risk Stratification in Patients with Heart Failure with Preserved Ejection Fraction: Review article

**Ragab Abdelsalam Mahfouz, Radwa Muhammad Abdullah, Muhammad Elsayed Sideq Elsayed, Ahmed Mohamed Hassan Salem**
Department of Cardiology, Faculty of Medicine, Zagazig University, Egypt
***Corresponding author:** Muhammad Elsayed Sideq Elsayed, **Mobile:** (+20) 01554663454, **E-mail:** Bassam_alsideq@yahoo.com

## ABSTRACT

**Background:** Age, heart failure, and hypertension are a few clinical characteristics that are separately linked to structural and electrical remodeling of the left atrium and make up the CHA2DS2-VASc index. In patients without atrial fibrillation (AF), remodeling and dysfunction are those of the left atrium (LA). The likelihood of stroke risk factors including atrial fibrillation.

**Objective:** This review's objective was to assess the prognosis and thromboembolic risk that patients with HFpEF are predicted by the CHA2DS2-VASc score.

**Methods:** We looked for data on Heart Failure, Hypertension, Atrial Fibrillation and Left Atrium in medical journals and databases like PubMed, Google Scholar, and Science Direct. However, only the most recent or extensive study was taken into account between February 2004 and September 2022. References from related works were also evaluated by the writers. There are not enough resources to translate documents into languages other than English, hence those documents have been ignored. It was generally agreed that documents such as unpublished manuscripts, oral presentations, conference abstracts, and dissertations did not qualify as legitimate scientific study.

**Conclusion:** CHA2DS2-VASc scores are simple to calculate, easy to remember, and reductionist. Utilizing the score in people with sinus rhythm can speed up clinical evaluation and help identify people who are particularly at risk of stroke.

**Keywords:** Heart failure, Hypertension, Atrial fibrillation, Left atrium.

## INTRODUCTION

The CHADS2 score has been supplemented with the "stroke risk modifier" risk variables to create score on the CHA2DS2-VASc [(1)]. The CHA2DS2-VASc score has taken the place of the CHADS2 score in clinical settings. Enabling the classification of low-risk patients with greater accuracy. In a number of patient populations, including AF patients undergoing outpatient elective electrical cardioversion, CHA2DS2-VASc has exceeded CHADS2 in terms of score [(2)].

**Table (1):** CHADS2 Score: Evaluation of stroke risk in atrial fibrillation [(3)]

| | Condition | Points |
|---|---|---|
| C | Congestive heart failure (or left ventricular systolic dysfunction) | 1 |
| H | Hypertension: blood pressure consistently above 140/90 mmHg (or treated hypertension on medication) | 1 |
| $A_2$ | Age ≥75 years | 2 |
| D | Diabetes Mellitus | 1 |
| $S_2$ | Prior Stroke or TIA or thromboembolism | 2 |
| V | Vascular disease (e.g. peripheral artery disease, myocardial infarction, aortic plaque) | 1 |
| A | Age 65–74 years | 1 |
| Sc | Sex category (i.e., female sex) | 1 |

The CHA2DS2-VASc score augments the CHADS2 score by three additional usual stroke risk factors: age 65-74, gender, and vascular disease. The score for the CHA2DS2-VASc in those over 75 assigns an additional 2 points of weight [(1)]. CHADS2's maximum score is 6, while CHA2DS2-VASc's highest score is 9. The maximum age score is 2, not 10, as would be projected if the columns were added together [(4, 5)].

**Table (2):** Annual stroke risk [(3)].

| CHADS2 Score | Adjusted Stroke Risk (%) |
|---|---|
| 0 | 1.9 |
| 1 | 2.8 |
| 2 | 4 |
| 3 | 5.9 |
| 4 | 8.5 |
| 5 | 12.5 |
| 6 | 18.2 |

**Table (3):** Matching yearly stroke risk and CHADS2 score [(3)].

| $CHA_2DS_2$-VASc Score | Stroke Risk % |
|---|---|
| 0 | 0 |
| 1 | 1.3 |
| 2 | 2.2 |
| 3 | 3.2 |
| 4 | 4.0 |
| 5 | 6.7 |
| 6 | 9.8 |
| 7 | 9.6 |
| 8 | 12.5 |
| 9 | 15.2 |

Based on data for hospitalised patients with AF, **Gage *et al.*** [(3)] originally published the adjusted stroke rates described above in 2001. In recent non-hospitalized



Received: 29/10/2022
Accepted: 01/01/2022

cohorts, actual stroke rates may differ from these estimates, as stroke rates are declining. Despite its simplicity, The CHADS2 score's shortcomings are highlighted by the fact that it does not cover a significant number of common stroke risk indicators. The annual stroke rate for even people classified by CHADS2 as low risk in its initial validation study is 1.9%, which is close to the national average 20% cardiovascular event rate over ten years threshold for main preventive treatments (i.e., statin therapy) [(6)]. Age 65 to 74, female gender, and vascular illness (particularly coronary artery disease) are risk factors (for dementia, peripheral artery disease, and aortic atherosclerosis) that were included to CHADS2 in order to account for these three additional independent risk variables [(7)]. An innovative and inclusive scoring system is CHA2DS2-VASc rating [(8)]. In 2016 and according to the recommendations of the European Society of Cardiology (ESC), patients with AF should start using oral anticoagulants (OACs) if their CHA2DS2-VASc score for males is at least 1, while it is at least 2 for females. This is done to determine how likely they are to have a stroke [(9)]. In 2014, The American Heart Association/American College of Cardiology/Heart Rhythm Society (AHA/ACC/HRS) guidelines for calculating the risk of stroke in people with non-valvular atrial fibrillation included the CHA2DS2-VASc score as an additional metric (non-valvular AF). For people with scores of 1 or above, as well as those who have already had a stroke or transient ischemic attack, OAC prophylaxis is recommended. Also, those with values of 2 or higher are highly encouraged to take OAC [(10)].

**CHADS2 components and its role in prediction of ischemic patient outcomes**

**Heart failure:**

One of the symptoms of heart failure CHA2DS2-VASc schema's most controversial risk variables. The controversy around the scoring system's heart failure criterion contributes to the uncertainty. The majority of significant research categorised heart failure as newly established MRI results or symptoms that point to varying degrees of left ventricular dysfunction. Studies have shown that moderate to severe left ventricular systolic dysfunction is a substantial risk factor for stroke in persons with atrial fibrillation (AF), beginning with the Atrial Fibrillation Investigator (AFI) program. Yet it hasn't been firmly confirmed that these standards represent distinct risk factors [(11)]. Another significant concern is that AF in a patient having heart failure with preserved ejection fraction (HFpEF) or heart failure with falling ejection fraction (HFrEF) can affect their risk of stroke. Cohort studies by **Sandhu *et al.* [(12)]** evaluated the risk of embolic events in 1103 HFrEF patients and 969 HFpEF patients with atrial fibrillation and found no association between reduced ejection fraction or the degree of left ventricular dysfunction fibrillation. Another research shows that stroke risk increased whether the patient presented recently with acute decompensation or with HFrEF or with HFpEF [(13)].

**Hypertension:**

Large cohort studies found that hypertension, between fifty and sixty percent of AF patients exhibited one of the most well-known stroke risk factors. It has been established that there are two independent risk factors for ischemic stroke in AF: a history of hypertension and a systolic blood pressure of 160 mm Hg. Certain antihypertensive medications have been demonstrated to lower the incidence of stroke in the general population by guaranteeing sufficient blood pressure control. However, it is still unknown how the duration of the disease, diastolic blood pressure, or the use of particular antihypertensive drugs may affect the outcome and may affect CHA2DS2-VASc in the AF group [(11)].

The creation of CHA2DS2-VASc, which gives patients over the age of 65 and those over the age of 75 an additional point, is evidence that the risk of stroke increases steadily as people become older. Stroke risk rises sharply for both sexes starting at one's sixtieth year of life and peaks at 22.3% for men and 23% for women eighteenth century. In a meta-analysis of six trials, patient age was linked to a 1.5-per-decade increase in risk. In the Birmingham Atrial Fibrillation Treatment of the Elderly (BAFTA) study, a randomized controlled trial with 973 participants, the oral anticoagulant warfarin performed better than aspirin in avoiding strokes in adults 75 years of age or older [(14)]. Despite research indicating that people with AF should take anticoagulants older than 65, this advice is usually disregarded in clinical settings due to worries about an increased risk of bleeding. Such worries may be brought on by a number of factors, such as the patient's overall health, additional medical issues, medication compliance, social settings, and individual preferences. Therefore, the decision to begin anticoagulant treatment of the aged should be patient-specific and take each of these considerations into account. However, because these drugs have been shown to have a positive therapeutic effect on elderly patients, anticoagulant therapy should not be limited based on age alone [(11)].

Diabetes is thought to impact fibrinolysis, platelet aggregation, and coagulation, which raises the risk of thromboembolism. Endothelial dysfunction is brought on by ongoing inflammation and oxidative stress, which combined create a vascular state that is prothrombotic. The diagnosis of diabetes was the only risk factor employed in early research on CHADS2 and CHA2DS2-VASc risk factor identification and validation. At the time, it was unknown whether variables like sickness length, severity, or management might affect the results.

The ATRIA cohort was recently studied, and it was found that longer diabetes duration, defined as N compared to shorter durations, a 3 year period was linked to an increased risk of stroke. The research also revealed that measurements of glycemic control based on HbA1c had no effect on stroke risk [15].

A study of 5717 participants from the PREFER registry found that patients with insulin-dependent diabetes had a significantly greater risk of stroke and systemic embolic events than those without the condition. Noninsulin-dependent diabetics and those with diabetes for a shorter period of time did not have a higher risk of ischemic stroke compared to those without diabetes. The outcomes of these studies in the setting of atrial fibrillation (AF) studies imply that certain diabetes disease characteristics enhance the risk of stroke, however additional research is necessary [16].

**Vascular disease**

It has been established that people with AF who have an increased risk of stroke that is associated with a history of vascular disease, which is characterized by suffering from a myocardial infarction, peripheral artery disease, or complicated aortic plaque. The increased risk of stroke does not, however, appear to be reliably predicted by coronary artery disease.

The effectiveness of diagnostic measures, such as coronary calcium scoring, ankle-brachial index, and carotid intimal medial assessments, has not been thoroughly studied, despite the fact that they have been demonstrated to be useful predictors of stroke risk in the general population. Significant vascular disease in the coronary and peripheral arteries predicts the development of atherosclerotic disease in the brain vascular system.

An increased risk of strokes brought on by the rupture of atherosclerotic plaque or microvascular disease is indicated by a history of vascular illness. AF patients may be more vulnerable to an elevated risk of atherothrombotic events even though the development of substantial plaque burden suggests the presence of an endovascular pro-inflammatory environment that encourages thrombus formation and enhances the risk of cardioembolic events as well stroke. It is essential to comprehend the diverse cerebrovascular event mechanisms in AF patients with vascular illness because they influence the efficacy of anticoagulant therapy in preventing strokes [11].

**Category: sex**

As there are more and more risk factors, it appears that the danger associated with being a woman is becoming more substantial. The risk of stroke increases considerably for older women (N=75) compared to older men as persons age. The AHA/ACC and ESC recommendations take into account the CHA2DS2-VASc score, which grants 1 point feminine gender. The misperception brought on by the implementation of the new schema is that, regardless of whether they have extra stroke risk factors, all women start out with a score of 1. The ability to treat more low-risk female patients the proportion of female patients treated has increased with anticoagulant medicine despite the fact that the available data may not always justify such a course of treatment, this fact has important therapeutic ramifications [17].

**Directions for Therapy**

The CHA2DS2-VASc score is suggested by the 2012 European Society of Cardiology atrial fibrillation treatment guidelines [9, 18]. The CHA2DS2-VASc score is recommended by both the Heart Rhythm Society and the American College of Cardiology/American Heart Association Task Committee on Practice Guidelines for 2014 [10].

The National Institute for Health and Care Excellence (NICE) and the European Society of Cardiology (ESC) guidelines prescribe oral anticoagulation therapy (OAT) with a vitamin K antagonist (such as warfarin with a target INR of 2-3) or one of the non-VKA oral anticoagulant medicines (NOACs, such as dabigatran, rivaroxaban, edoxaban, or apixaban) [9].

No anticoagulant therapy is required if the patient has a "low risk, no bleeding" CHA2DS2-VASc score, which is 0 for males and 1 for women [18]. Individual values and preferences should be addressed when prescribing antithrombotic medication given OAC to guys with a single stroke risk factor (a CHA2DS2-VASc score of 1) one) [19]. Oral anticoagulation shows a net therapeutic advantage over aspirin or no treatment even when there is only one risk factor for stroke [20]. Different guideline treatment levels and scientific methodologies lead to varied rates of thromboembolic events [21].

**Anticoagulation**

**Table (4):** Recommendations for therapy based on the CHA2DS2-VASc score [18, 22]

| Score | Risk | Anticoagulation Therapy | Considerations |
|---|---|---|---|
| 0 (male) or 1 (female) | Low | No anticoagulant therapy | No anticoagulant therapy |
| 1(male) | Moderate | Oral anticoagulant should be considered | Oral anticoagulant, with well controlled Vitamin K Antagonist (VKA, e.g. warfarin with time in therapeutic range >70%), or a Non-VKA Oral Anticoagulant (NOAC, e.g. dabigatran, rivaroxaban, edoxaban or apixaban) |
| 2 or greater | High | Oral anticoagulant is recommended | Oral anticoagulant, with well controlled Vitamin K Antagonist (VKA, e.g. warfarin with time in therapeutic range >70%), or a Non-VKA Oral Anticoagulant (NOAC, e.g. dabigatran, rivaroxaban, edoxaban or apixaban) |

Oral anticoagulation is advised or preferable for atrial fibrillation patients who have one or more stroke risk factors, such as a CHA2DS2-VASc score of less than one in males or two in females [23]. This is in line with a recent decision analysis model that shows how the accessibility of "safer" NOAC medications has changed the "tipping point" for anticoagulation, with the need for providing stroke prophylaxis (i.e., oral anticoagulation) being a stroke rate of about 1% per year. [9, 24].

For patients who have been advised to take oral anticoagulants for the prevention of strokes, the SAMe-TT2R2 score can be used to evaluate drug options. In order to choose the most appropriate oral anticoagulant, researchers must weigh vitamin K antagonists and non-vitamin K antagonist oral coagulants (NOAC) [25, 26].

**Bleeding danger**

When calculating the risk of stroke, always consider the possibility of bleeding. It is feasible to use tested bleeding risk scores for this purpose, such as the HEMORR2HAGES or HAS-BLED ratings. Guidelines advise using the HAS-BLED score to identify high-risk patients for ongoing assessment and monitoring and to address reversible risk factors for bleeding (such as uncontrolled hypertension, labile INRS, excessive alcohol consumption, or concurrent aspirin/NSAID use) [25]. The "labile INR" requirement of the HAS-BLED receives a score of 0 if the patient is not taking warfarin, otherwise it requires INR control competence. Results from the high HAS-BLED test do not suggest ceasing anticoagulant therapy. Other bleeding risk scores that did not account for "labile INR" had significantly lower bleeding prediction accuracy. Several people who sustained bleeding while on warfarin were routinely mislabeled as being at "low risk" based on comparisons to HAS-BLED [27].

**In patients with sinus rhythm, HFpEF and stroke**

Cardioembolic stroke is mostly caused by (in the United States) atrial fibrillation (AF) is followed by cardiac failure (HF), which affects more than 5 million people [28]. This is because HF patients have a lower stroke rate than AF patients. Cardioembolic stroke is mostly caused by atrial fibrillation (AF) [29]. During one month of HF diagnosis and while hospitalised, the risk of stroke is elevated. In addition, current research indicates that the total stroke rate among HFpEF patients without AF (1.0% per year) is close to the rate among HFrEF patients without AF (1.2% per year) [30].

**Table (5):** Yearly stroke risk (percent/year) stratified by type of heart failure, presence of atrial fibrillation, and usage of anticoagulants (if AF is present) [31].

| | Without AF (%/yr) | With AF (%/yr) | | |
|---|---|---|---|---|
| | | Overall | Warfarin (+) | Warfarin (-) |
| HFrEF | 1.2 | 1.6 | 1.2 | 2.2 |
| HFmEF | 1.0 | 1.8 | 1.5 | 2.2 |

---


- **Sources of funding:** This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.
- **Conflicts of interest:** There are no conflicts of interest, according to the authors.


## REFERENCES


1. **Lip Y, Nieuwlaat R, Pisters R *et al.* (2010):** Refining clinical risk stratification for predicting stroke and thromboembolism in atrial fibrillation using a novel risk factor-based approach: the euro heart survey on atrial fibrillation. Chest, 137 (2): 263–272.
2. **Yarmohammadi H, Varr C, Puwanant S *et al.* (2012):** Role of CHADS2 score in evaluation of thromboembolic risk and mortality in patients with atrial fibrillation undergoing direct current cardioversion (from the ACUTE Trial Substudy). The American journal of cardiology, 110 (2): 222-226.
3. **Gage F, Waterman D, Shannon W *et al.* (2001):** Validation of clinical classification schemes for predicting stroke: results from the National Registry of Atrial Fibrillation. JAMA., 285 (22): 2864-2870.
4. **Teodorovich N, Swissa S, Kogan Y *et al.* (2017):** Atrial fibrillation and CHADS2 score as mortality predictors in young versus elderly patients undergoing coronary angiography. Journal of Geriatric Cardiology (JGC), 14 (9): 582-588.
5. **Lip Y, Tse F, Lane A (2012):** Atrial fibrillation, Lancet, 379 (9816): 648-661.
6. **You J, Singer E, Howard A *et al.* (2012):** Antithrombotic therapy for atrial fibrillation: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. Chest, 141 (2): 31-39.
7. **Olesen B, Lip Y, Lane A *et al.* (2012):** Vascular disease and stroke risk in atrial fibrillation: a nationwide cohort study. Am J Med., 8 (2): 13-23.
8. **Olesen B, Torp-Pedersen C, Hansen L *et al.* (2012):** The value of the CHA2DS2-VASc score for refining stroke risk stratification in patients with atrial fibrillation with a CHADS2 score 0-1: a nationwide cohort study. Thromb Haemost., 107 (6): 1172-1179.
9. **Kirchhof P, Benussi S, Kotecha D *et al.* (2016):** ESC Guidelines for the management of atrial fibrillation developed in collaboration with EACTS. Europace, (11): 1609-1678.
10. **January T, Wann S, Alpert S *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, 23: 199-267.
11. **Jia X, Levine N, Birnbaum Y (2018):** The CHA2DS2-VASc score: Not as simple as it seems. International Journal of Cardiology, 257: 92-96.
12. **Sandhu K, Hohnloser H, Pfeffer A *et al.* (2015):** Relationship between degree of left ventricular dysfunction, symptom status, and risk of embolic events in patients with atrial fibrillation and heart failure. Stroke, 46 (3): 667-672.
13. **Agarwal M, Apostolakis S, Lane A *et al.* (2014):** The impact of heart failure and left ventricular dysfunction in predicting stroke, thromboembolism, and mortality in atrial fibrillation patients: a systematic review. Clinical therapeutics, 36 (9): 1135-1144.
14. **Chao F, Wang L, Liu J *et al.* (2015):** Age threshold for increased stroke risk among patients with atrial fibrillation: a nationwide cohort study from Taiwan. Journal of the American College of Cardiology, 66 (12): 1339-1347.
15. **Ashburner M, Go S, Chang Y *et al.* (2016):** Effect of diabetes and glycemic control on ischemic stroke risk in AF patients: ATRIA study. Journal of the American College of Cardiology, 67 (3): 239-247.
16. **Patti G, Lucerna M, Cavallari I *et al.* (2017):** Insulin-requiring versus noninsulin-requiring diabetes and thromboembolic risk in patients with atrial fibrillation: PREFER in AF. Journal of the American College of Cardiology, 69 (4): 409-419.
17. **Shroff R, Solid A. Herzog A (2014):** Atrial fibrillation, stroke, and anticoagulation in Medicare beneficiaries: trends by age, sex, and race, 1992–2010. Journal of the American Heart Association, 3 (3): 15-18.
18. **Camm J, Lip Y, De Caterina R *et al.* (2012):** focused update of the ESC Guidelines for the management of atrial fibrillation: an update of the 2010 ESC Guidelines for the management of atrial fibrillation. Developed with the special contribution of the European Heart Rhythm Association. Eur Heart J., 33 (21): 2719-2747.
19. **Joundi A, Cipriano E, Sposato A *et al.* (2016):** Ischemic stroke risk in patients with atrial fibrillation and

CHA2DS2-VASc score of 1: systematic review and meta-analysis. Stroke, 47 (5): 1364-1367.

20. **Fauchier L, Lecoq C, Clementy N *et al.* (2016):** Oral anticoagulation and the risk of stroke or death in patients with atrial fibrillation and one additional stroke risk factor: the Loire Valley Atrial Fibrillation Project. Chest, 149 (4): 960-968.
21. **Nielsen B, Larsen B, Skjøth F *et al.* (2016):** Stroke and thromboembolic event rates in atrial fibrillation according to different guideline treatment thresholds: a nationwide cohort study. Scientific reports, 6 (1): 1-7.
22. **National Clinical Guideline Centre (2014):** Atrial fibrillation: the management of atrial fibrillation. Atrial Fibrillation: The Management of Atrial Fibrillation - PubMed (nih.gov)
23. **Lip Y, Lane DA (2015):** Stroke prevention in atrial fibrillation: a systematic review. Jama., 313 (19): 1950-1962.
24. **Eckman H, Singer E, Rosand J *et al.* (2011):** Moving the tipping point: the decision to anticoagulate patients with atrial fibrillation. Circulation: Cardiovascular Quality and Outcomes, 4 (1): 14-21.
25. **Apostolakis S, Sullivan M, Olshansky B *et al.* (2013):** Factors affecting quality of anticoagulation control among patients with atrial fibrillation on warfarin: the SAMe-TT2R2 score. Chest, 144 (5): 1555-1563.
26. **Proietti M, Lip Y (2015):** Simple decision-making between a vitamin K antagonist and a non-vitamin K antagonist oral anticoagulant: using the SAMe-TT2R2 score. European Heart Journal-Cardiovascular Pharmacotherapy, 1 (3): 150-152.
27. **Proietti M, Senoo K, Lane A *et al.* (2016):** Major bleeding in patients with non-valvular atrial fibrillation: impact of time in therapeutic range on contemporary bleeding risk scores. Scientific reports, 6 (1): 22-24.
28. **Pullicino P, Thompson P, Mohr P *et al.* (2008):** Oral anticoagulation in patients with cardiomyopathy or heart failure in sinus rhythm. Cerebrovascular Diseases, 26 (3): 322-327.
29. **Abdul-Rahim H, Perez C, Fulton *et al.* (2015):** Risk of stroke in chronic heart failure patients without atrial fibrillation: analysis of the Controlled Rosuvastatin in Multinational Trial Heart Failure (CORONA) and the Gruppo Italiano per lo Studio della Sopravvivenza nell'Insufficienza Cardiaca-Heart Failure (GISSI-HF) Trials. Circulation, 131 (17): 1486-1494.
30. **Abdul-Rahim H, Perez C, MacIsaac L *et al.* (2017):** Risk of stroke in chronic heart failure patients with preserved ejection fraction, but without atrial fibrillation: analysis of the CHARM-Preserved and I-Preserve trials. European heart journal, 38 (10): 742-750.
31. **Kim W, Kim J (2018):** Heart failure as a risk factor for stroke. Journal of stroke, 20 (1): 33-37.