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Impact of the CHA_2DS_2-VASc Score on Anticoagulation Recommendations for Atrial Fibrillation

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Abstract

BACKGROUND—The Congestive heart failure, Hypertension, Age ≥ 75 years, Diabetes mellitus, Stroke ($CHADS_2$) score is used to predict the need for oral anticoagulation for stroke prophylaxis in patients with atrial fibrillation. The Congestive heart failure, Hypertension, Age ≥ 75 years, Diabetes mellitus, Stroke, Vascular disease, Age 65–74 years, Sex category (CHA_2DS_2-VASc) schema has been proposed as an improvement. Our objective is to determine how adoption of the CHA_2DS_2-VASc score alters anticoagulation recommendations.

METHODS—Between 2004 and 2008, 1664 patients were seen at the University of Virginia Atrial Fibrillation Center. We calculated the $CHADS_2$ and CHA_2DS_2-VASc scores for each patient. The 2006 American College of Cardiology/American Heart Association/Heart Rhythm Society guidelines for atrial fibrillation management were used to determine anticoagulation recommendations based on the $CHADS_2$ score, and the 2010 European Society of Cardiology guidelines were used to determine anticoagulation recommendations based on the CHA_2DS_2-VASc score.

RESULTS—The average age was 62 ± 13 years, and 34% were women. Average $CHADS_2$ and CHA_2DS_2-VASc scores were 1.1 ± 1.1 and 1.8 ± 1.5, respectively ($P < .0001$). The $CHADS_2$ score classified 33% as requiring oral anticoagulation. The CHA_2DS_2-VASc score classified 53% as requiring oral anticoagulation. For women, 31% had a $CHADS_2$ score ≥ 2, but 81% had a CHA_2DS_2-VASc score ≥ 2 ($P = .0001$). Also, 32% of women with a $CHADS_2$ score of zero had a CHA_2DS_2-VASc score ≥ 2. For men, 25% had a $CHADS_2$ score ≥ 2, but 39% had a CHA_2DS_2-VASc score ≥ 2 ($P < .0001$).

CONCLUSION—Compared with the $CHADS_2$ score, the CHA_2DS_2-VASc score more clearly defines anticoagulation recommendations. Many patients, particularly older women, are redistributed from the low- to high-risk categories.

Keywords

Anticoagulation; Atrial Fibrillation; Stroke; Warfarin

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Stroke is one of the most devastating complications of atrial fibrillation causing significant morbidity and mortality.[1,2] Anticoagulant medications, particularly aspirin and warfarin, have been shown to decrease the risk of stroke in patients with atrial fibrillation.[3,4] Warfarin is superior to aspirin for stroke prevention; however, it has an increased risk of bleeding.[5,6] Recently, dabigatran has been released as a possible alternative to warfarin therapy for nonvalvular atrial fibrillation. Available data suggest that both the stroke prevention benefit and bleeding complications are similar to those of warfarin.[7] Risk stratification is important to determine which patients have a stroke risk that is significant enough to justify the bleeding risk associated with these oral anticoagulants.

Multiple risk stratification schemes to predict stroke in patients with atrial fibrillation have been proposed over the last several decades.[8] In 2001, Gage et al[9] validated the Atrial Fibrillation Investigators score and the Stroke Prevention and Atrial Fibrillation score, as well as a new score, the Congestive heart failure, Hypertension, Age ≥ 75 years, Diabetes mellitus, Stroke ($CHADS_2$) (Table 1).[9] The $CHADS_2$ schema most accurately predicted the risk of stroke and has become the standard as described in the 2006 American College of Cardiology/American Heart Association/Heart Rhythm Society guidelines for the management of atrial fibrillation.[10] Despite its common use, several concerns have remained. First, more recent studies do not show that the $CHADS_2$ score has good predictive value. An evaluation of the Anticoagulation and Risk Factors in Atrial Fibrillation Cohort demonstrated a poor correlation between $CHADS_2$ score and thromboembolic events.[11] Second, there are several known risk factors for stroke in atrial fibrillation, particularly very old age, female gender, and vascular disease, which are not accounted for in the $CHADS_2$ score.[12,13] The 2006 guidelines discuss these risk factors but do not specify how these should be used in risk stratification. [10] Third, the risk of bleeding and the risk of stroke are similar for a $CHADS_2$ score = 1. Thus, aspirin is recommended for a score = 0 and oral anticoagulation is recommended for a score of ≥ 2, but either aspirin or oral anticoagulation is considered appropriate for intermediate-risk patients with a score = 1. Cohorts have shown that 30% to 50% of atrial fibrillation patients have a $CHADS_2$ score = 1, implying that a large segment of atrial fibrillation patients have no clear recommendation for anticoagulation based on these criteria.[9,14]

CLINICAL SIGNIFICANCE

- The $CHADS_2$ score is commonly used for stroke risk stratification for atrial fibrillation, but it does not have great predictive value.
- The CHA_2DS_2-VASc schema has been validated and seems to have improved value.
- Adoption of the CHA_2DS_2-VASc schema may as much as double the number of patients recommended for oral anticoagulation.
- This change will be seen mostly in older women.

A new schema, the Congestive heart failure, Hypertension, Age ≥ 75 years, Diabetes mellitus, Stroke, Vascular disease, Age 65–74 years, Sex category (CHA_2DS_2-VASc) score

or Birmingham Schema, has been proposed recently and seems to have better predictive value (Table 2).[15] The score relies on "definitive risk factors" (age ≥ 75 and prior stroke/transient ischemic attack) and "combination risk factors" (congestive heart failure, hypertension, age 65–74 years, diabetes, vascular disease, and female gender). This score has been incorporated into the European Society of Cardiology (ESC) guidelines and is becoming used in the United States.[16,17] The ESC guidelines recommend oral anticoagulation for a score ≥ 2 and aspirin or oral anticoagulation for a score = 1, with oral anticoagulation "preferred." In addition to providing more clarity with regard to anticoagulation recommendations for intermediaterisk patients, evaluation of this schema demonstrated that fewer patients fall into the intermediate risk group.[15] The annual adjusted stroke rates for both of these scoring systems are shown in Table 3.

We analyzed the $CHADS_2$ and CHA_2DS_2-VASc scores for our Atrial Fibrillation Center population. We hypothesized that shifting our patients from the $CHADS_2$ to CHA_2DS_2-VASc schema would significantly alter the number and distribution of patients recommended for oral anticoagulation. This has significant implications for both cost and bleeding complication risk.

MATERIALS AND METHODS

There were 1664 consecutive initial visits seen at the University of Virginia Atrial Fibrillation Center from October 2004 to April 2008 for nonvalvular atrial fibrillation. Thirtyseven percent of the patients were referred by primary care physicians, and 61% of patients were referred by cardiologists. Referrals from within the University of Virginia Health system account for 19% of patients, 40% come from our primary referral area, and 91% come from within the state of Virginia.

For each initial visit, a detailed database, designed according to American College of Cardiology/American Heart Association guidelines, was created using available medical records and patient history.[18] The data collected included demographic information, date of initial diagnosis of atrial fibrillation, types of symptoms, dates of symptomatic recurrences, and all previous cardiac studies and therapies. Information regarding comorbidities also was collected, including prior stroke, diabetes, coronary artery disease, peripheral vascular disease, congestive heart failure, hypertension, and bleeding events. Major bleeding was defined as any event that required transfusion or hospitalization. Vascular disease was defined as coronary artery disease or peripheral vascular disease.

By using the Atrial Fibrillation Center initial visit database, the $CHADS_2$ and CHA_2DS_2VASc scores were calculated retrospectively for each patient. The institutional review board of the University of Virginia approved this study.

Statistical Analysis

Continuous variables are expressed as mean ± standard deviation, and the significance of differences was tested using the unpaired, 2-sided *t* test. Categoric variables are expressed as numbers and percentages, and the *Z* test was used to compare the corresponding proportions of men and women with these variables. Multivariable logistic regression analysis was

performed. Covariates in the multivariable model included age and sex and significant univariate predictors ($P < .10$). P values < .05 were considered statistically significant.

RESULTS

Of the 1664 patients, 1094 (66%) were men and 570 (34%) were women. The mean ages for women at diagnosis and referral were 62.7 ± 13.6 and 68.0 ± 11.9 years, respectively, and the mean ages for men at diagnosis and referral were 57.3 ± 14.0 and 62.4 ± 13.0 years, respectively ($P < .0001$ for each). When controlling for the older age of the women with multivariable logistic regression analysis, there were no substantial differences between men and women. Women were more likely to have paroxysmal atrial fibrillation (68% vs 58%; $P < .0001$) and described more symptoms, particularly palpitations (80% vs 73%; $P = .008$). Patient comorbidities are demonstrated in Table 4. There were no differences between men and women in comorbidities, with the exception of coronary artery disease and heart failure. Women were less likely to have coronary artery disease (13% vs 16%; $P < .0001$) but slightly more likely to have heart failure (11% vs 9%; $P = .031$). At the time of the initial visit, the majority of men and women were being treated with antithrombotic medications. Aspirin was used in 27% of women and 31% of men ($P = .014$). Warfarin was used in 59% of women and 58% of men ($P = .014$). However, 20% of patients were taking neither aspirin nor oral anticoagulation. Major bleeding was seen in 1% of patients before being seen in the Atrial Fibrillation Center. Antiarrhythmic medications were being used in 34% of patients.

The average $CHADS_2$ and CHA_2DS_2-VASc scores were 1.1 ± 1.1 and 1.8 ± 1.5, respectively ($P < .0001$). The $CHADS_2$ score classified 34% as low risk (score = 0), 33% as intermediate risk (score = 1), and 33% as high risk (score ≥ 2). The CHA_2DS_2-VASc score classified 27% as low risk (score = 0), 20% as intermediate risk (score = 1) and 53% as high risk (score ≥ 2). The mean $CHADS_2$ and CHA_2DS_2-VASc scores in women were 1.2 ± 1.0 and 2.7 ± 1.3, respectively ($P < .0001$). The mean $CHADS_2$ and CHA_2DS_2-VASc scores in men were 1.0 ± 1.1 and 1.4 ± 1.4, respectively ($P < .0001$). The distribution of scores in both men and women is demonstrated in Figure 1.

Applying the recommendations for anticoagulation based on the CHA_2DS_2-VASc score and 2010 ESC guidelines rather than the $CHADS_2$ score and 2006 American College of Cardiology/American Heart Association/Heart Rhythm Society guidelines dramatically alters the numbers and distribution of patients definitively recommended for oral anticoagulation therapy (Figure 2). For women, 31% had a $CHADS_2$ score ≥ 2 but 81% had a CHA_2DS_2-VASc score ≥ 2 ($P < .0001$). In men, 25% had a $CHADS_2$ score ≥ 2 but 39% had a CHA_2DS_2-VASc score ≥ 2 ($P < .0001$). Also, 32% of women with a $CHADS_2$ score = 0 had a CHA_2DS_2-VASc score = 2. This change was driven almost entirely by a combination of female gender and age ≥ 75 years. A $CHADS_2$ score = 0 increased to a CHA_2DS_2-VASc score = 2 in only 3 women, according to a combination of female gender and vascular disease. In this population, no men with a $CHADS_2$ score = 0 had a CHA_2DS_2-VASc score = 2. All of the women who were in the intermediate-risk group with a $CHADS_2$ score = 1 had a CHA_2DS_2-VASc score ≥ 2, and thus would be definitively recommended for oral anticoagulation therapy. In contrast, 62% of men with an intermediate $CHADS_2$ score = 1 continued to have an intermediate CHA_2DS_2-VASc score = 1.

DISCUSSION

There is a marked shift in anticoagulation recommendations for patients with atrial fibrillation when the CHA_2DS_2-VASc stroke risk stratification schema as outlined in the ESC 2010 guidelines is used compared with the $CHADS_2$ score. The most obvious difference is the elimination of the large intermediate-risk group without clear recommendations for anticoagulation. In this study, this accounted for one third of patients. By applying the CHA_2DS_2-VASc schema, the number of intermediate risk patients with a score = 1 decreased to 20%. Further, the CHA_2DS_2-VASc schema provides clarity by recommending oral anticoagulation over aspirin for these intermediate-risk patients, although aspirin is considered an acceptable alternative.[16]

Because female gender is part of the CHA_2DS_2-VASc score, it is predictable that women would be more likely to shift to the high-risk group compared with men. However, the CHA_2DS_2-VASc schema also gives much greater weight to advancing age, and women with atrial fibrillation tend to be older than men with atrial fibrillation, as was the case in this study.[13] This combines to make the gender difference dramatic for anticoagulation recommendations when shifting from the $CHADS_2$ score to the CHA_2DS_2-VASc schema. All intermediate-risk women shifted to the high-risk group. However, approximately two thirds of men with an intermediate $CHADS_2$ score = 1 continued to have a CHA_2DS_2-VASc score = 1. In addition, one third of low-risk women by $CHADS_2$ score moved into the high-risk group with the CHA_2DS_2-VASc score, whereas all men with a $CHADS_2$ score = 0 continued to have a CHA_2DS_2-VASc score ≤ 1. Thus, adoption of the CHA_2DS_2-VASc score among physicians who adhere to guidelines has the potential to dramatically increase the number of women receiving oral anticoagulation while making little change in the number of men receiving oral anticoagulation.

It is important to recognize that the CHA_2DS_2-VASc score represents an entirely new schema and not merely an improvement of the $CHADS_2$ score. The annualized adjusted risk of stroke is different with each scoring system as demonstrated in Table 3. Although the $CHADS_2$ score was developed to identify patients with atrial fibrillation at high risk for stroke, the goal of the CHA_2DS_2-VASc score is to identify the truly low-risk patients who do not require oral anticoagulation therapy. Thus, this study is only evaluating changes in anticoagulation recommendations and does not address the patients' actual risk of stroke. In addition, this study in no way addresses the bleeding risk associated with anticoagulant medications. This is a significant issue because older women can be at increased risk of bleeding.

It is not clear how adoption of the CHA_2DS_2-VASc score would change actual clinical practice. Multiple studies have demonstrated that physicians do not adhere well to the current anticoagulation guidelines, with many low-risk patients receiving oral anticoagulation and many high-risk patients receiving neither oral anticoagulation nor aspirin. [19,20] There were signs of this in our own population. Approximately two thirds of both men and women were receiving oral anticoagulation, implying an aggressive use of oral anticoagulation because by $CHADS_2$ score, only one third of patients were truly high risk. Further complicating matters is the recent release of dabigatran, which seems to have

similar stroke prevention effect and bleeding risk to warfarin based on the Randomized Evaluation of Long-Term Anticoagulation Therapy (RE-LY) trial, but it is not yet widely used.[7]

The major advantage of the $CHADS_2$ score has been its simplicity. It is a straightforward algorithm consisting of a small number of variables. The disadvantages are that a significant number of patients are left without clear anticoagulation recommendations and its predictive value is not great. The CHA_2DS_2-VASc score retains this simplicity and clarifies recommendations for intermediate-risk patients as outlined in the 2010 ESC guidelines. Further, studies have shown improved predictive value.

This study is limited as a retrospective review. It also is a single-center study, and although our referral area is large, it is still geographically limited. As a tertiary population, the population characteristics are somewhat different from the known population with atrial fibrillation in the United States. However, in this study a large number of patients, particularly older women, were redistributed from the lowto high-risk categories.

CONCLUSIONS

Adoption of the CHA_2DS_2-VASc score anticoagulation recommendations has the potential to dramatically increase the number of patients recommended for oral anticoagulation therapy. The full impact of this risk stratification scheme on strokes, bleeding complications, and cost remains to be seen.

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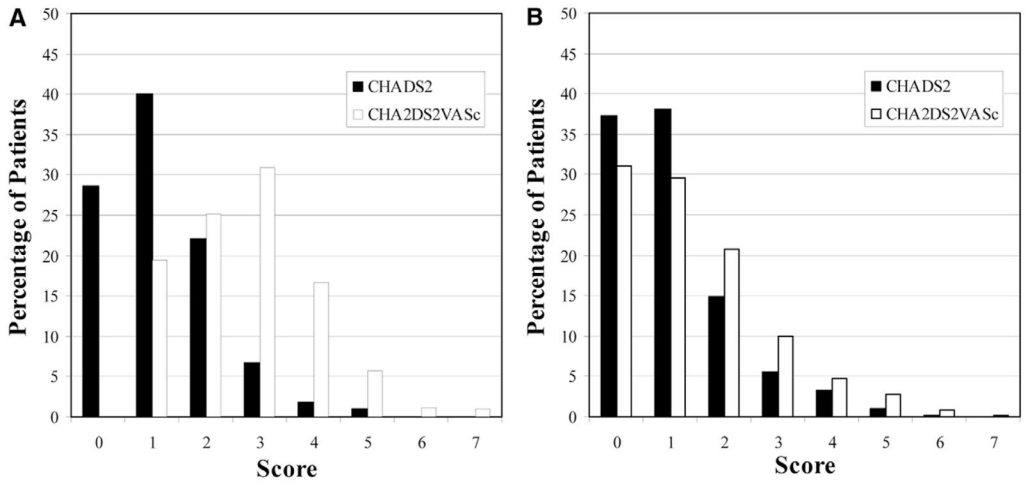

Figure 1.

Distribution of the $CHADS_2$ and CHA_2DS_2-VASc scores among women **(A)** and men **(B)**.

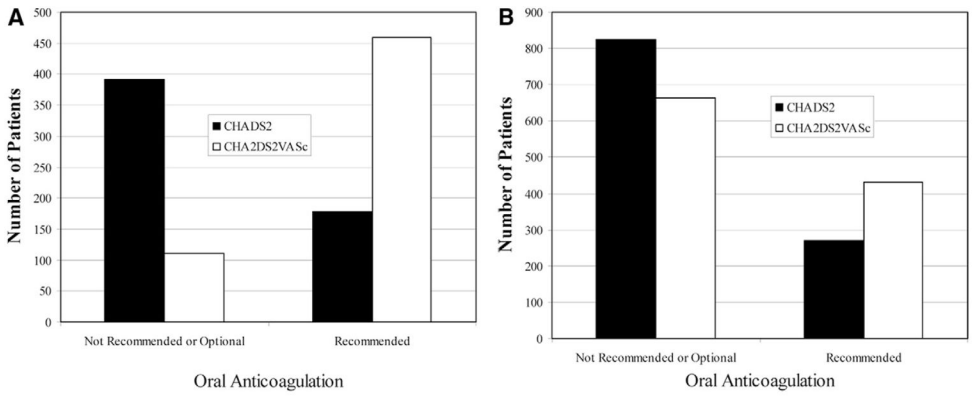

Figure 2.

Anticoagulation recommendations by $CHADS_2$ and CHA_2DS_2-VASc scores in women **(A)** and men **(B)**.

Table 1

$CHADS_2$ Score[9,10]

C	Congestive Heart Failure	1 point
H	Hypertension	1 point
A	Age ≥ 75 y	1 point
D	Diabetes	1 point
S_2	Stroke	2 points

Maximum total score = 6 points.

American College of Cardiology/American Heart Association/Heart Rhythm Society 2006 Anticoagulation Recommendations: Score = 0 aspirin. Score = 1 aspirin or oral anticoagulation. Score ≥ 2 oral anticoagulation.

Table 2

CHA_2DS_2-VASc Score[15,16]

C	Congestive Heart Failure	1 point
H	Hypertension	1 point
A_2	Age ≥ 75 y	2 points
D	Diabetes	1 point
S_2	Stroke	2 points
V	Vascular disease	1 point
A	Age ≥ 65 y	1 point
Sc	Sex category, female	1 point

Maximum total score = 9 points.

ESC 2010 Anticoagulation Recommendations: Score = 0 no therapy or aspirin (no therapy preferred). Score = 1 aspirin or oral anticoagulation (oral anticoagulation preferred). Score ≥ 2 oral anticoagulation.

Table 3

Adjusted Risk of Stroke for $CHADS_2$ and CHA_2DS_2-VASc Scores[9,15]

Score	$CHADS_2$ (%/y)	CHA_2DS_2-VASc (%/y)
0	1.9	0
1	2.8	1.3
2	4	2.2
3	5.9	3.2
4	8.5	4.0
5	12.5	6.7
6	18.2	9.8
7		9.6
8		6.7
9		15.2

Table 4

Comorbidities

	All Patients (1664) n (%)	Female (570) n (%)	Male (1094) n (%)
Heart failure*	156 (9)	62 (11)	94 (9)
Hypertension	931 (56)	334 (59)	597 (55)
Diabetes mellitus	217 (13)	79 (14)	138 (13)
Stroke or transient ischemic attack	114 (7)	35 (6.1)	79 (7)
Cardiovascular disease*†	258 (16)	77 (14)	181 (17)

*Comparisons were significant with a $P < .05$.

†Cardiovascular disease represents coronary artery disease or peripheral vascular disease.