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Comparison of $CHADS_2$ and CHA_2DS_2-VAS_C anticoagulation recommendations: evaluation in a cohort of atrial fibrillation ablation patients

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Aims Atrial fibrillation (AF) is associated with a high incidence of strokes/thromboembolism. The $CHADS_2$ score assigns points for several clinical variables to identify stroke risk. The CHA_2DS_2-VAS_C score uses the same variables but also incorporates age 65 to 74, female gender, and vascular disease in an effort to provide a more refined risk of stroke/thromboembolism. We aimed to examine oral anticoagulation (OAC) recommendations for a cohort of patients undergoing AF ablation depending upon whether thrombo-embolic risk was determined by the $CHADS_2$ or CHA_2DS_2-VAS_C score.

Methods and results For 1411 patients we compared OAC recommendations for each of these risk stratification schemes to one of the three OAC strategies: (i) NO-OAC, (ii) CONSIDER-OAC, and (iii) DEFINITE-OAC. Compared with the $CHADS_2$ score, the CHA_2DS_2-VAS_C score reduced NO-OAC from 40.3 to 21.8% and CONSIDER-OAC from 36.6 to 27.9% while increasing DEFINITE-OAC from 23.0 to 50.2% of patients. Age 65 to 74 and female gender accounted for 95.2% and vascular disease for only 4.8% of recommendations for more aggressive OAC using CHA_2DS_2-VAS_C. Most vascular disease occurred in patients with higher $CHADS_2$ scores already recommended for DEFINITE-OAC ($P < 0.0001$). Reclassifying 30 females of age <65 with a CHA_2DS_2-VAS_C score of 1 to the NO-OAC group had minimal effect on the overall recommendations.

Conclusion Compared with the $CHADS_2$ score, in our AF ablation population, the CHA_2DS_2-VAS_C score markedly increases the number of AF patients for whom OAC is recommended. It will be important to determine by randomized trials if this major paradigm shift to greater use of OAC using the CHA_2DS_2-VAS_C scoring improves patient outcomes.

Keywords Atrial fibrillation • Anticoagulation • CHA_2DS_2-VAS_C score • $CHADS_2$ score

Atrial fibrillation (AF) is frequently associated with morbidity and mortality from cerebrovascular accident (CVA)/transient ischaemic attack (TIA).[1] Randomized studies have evaluated the effects of anticoagulation with aspirin,[2–9] antiplatelet agents,[10] and oral anticoagulation (OAC) drugs such as warfarin[3–9] or newer agents[11–13] on the rate of thromboembolism. Risk stratification schemes[14–18] attempt to predict thrombo-embolic risk to identify patients who might benefit from OAC. These schemes generally divide patients into three subgroups: (i) Patients requiring no OAC (NO-OAC); (ii) Patients for whom OAC should be considered (CONSIDER-OAC); (iii) Patients who need definite OAC (DEFINITE-OAC). The most widely utilized scheme has been the $CHADS_2$ score,[15,16] which incorporates one point each for congestive heart failure (CHF)/left ventricular (LV) dysfunction, hypertension, age $\geq$75, and diabetes and two points for prior CVA/TIA. Under the $CHADS_2$ schema, the recommendation is aspirin for a score of 0, aspirin or OAC for a score of 1, and OAC for a score of $\geq$2. The $CHADS_2$ scoring system has been criticized[17] because it does not provide enough granularity for patients in the lower risk group with $CHADS_2 = 1$, leaving too many patients in the ambiguous group of aspirin vs. OAC and may not predict a very low-risk group who need no treatment or aspirin. $CHADS_2$ does not incorporate female gender,

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What's new?

- In patients undergoing atrial fibrillation (AF) ablation the CHA_2DS_2-VAS_C score markedly increased the number for whom oral anticoagulation (OAC) would be recommended.
- Recommendations for more aggressive OAC using the CHA_2DS_2-VAS_C score are largely driven by female gender and age 65 to <74.
- Most patients with vascular disease are already recommended for OAC based on their $CHADS_2$ score.
- The literature review reveals little randomized trial data to support OAC for patients with moderately low or intermediate risk for thrombo-embolic events.
- We need randomized trial data to justify the adopting recommendations for widespread use of OAC in moderately low and intermediate risk AF patients.

vascular disease, and age 65–74.[18] These perceived shortcomings resulted in the CHA_2DS_2-VAS_C score, first endorsed by the 2010 European AF guidelines.[19] The 2012 European update[20] excludes females of age <65 if that is the only risk factor. The recent Canadian guidelines[21] comment on the lack of value of female gender in the score and states that patients achieving a CHA_2DS_2-VAS_C score of 1 because of gender or vascular disease are low risk and should receive aspirin. Although there have been population-based statistical justifications of the improved ability of the CHA_2DS_2-VAS_C score to predict stroke,[22–26] *neither the CHA_2DS_2-VAS_C nor the $CHADS_2$ have been evaluated in a prospective randomized trial to select anticoagulant strategies*. While the benefits of OAC are obvious, increasing use of OAC is associated with an increased incidence of intracerebral haemorrhage[27] and, for warfarin, anticoagulation intensity correlates with the risk of death from intracerebral haemorrhage.[28] Furthermore, including vascular disease in a stroke-risk prediction model might improve prediction of all-cause ischaemic strokes but not necessarily thrombo-embolic strokes. Recommending OAC on the basis of vascular disease might not reduce strokes due to vascular disease.

In the present study, we apply the CHA_2DS_2-VAS_C score to a cohort of patients undergoing AF ablation to determine the changes in recommended anticoagulation strategy compared with the $CHADS_2$ score.

Methods

Patient population

The subjects were consecutive patients undergoing AF ablation at Sequoia Hospital, Redwood City, California, USA, from 10 October 2003 to 31 December 2011. All the patients signed written informed consent for their ablation procedure. Data collection was prospective and approved by the hospital IRB. Atrial fibrillation type was categorized as paroxysmal (lasting <1 week), persistent (AF lasting >1 week and <1 year or requiring pharmacological/electrical cardioversion in <1 week), and long-standing persistent (AF lasting >1 year).

Data collection and analysis

For each patient we recorded age, gender, AF duration and type, prior CVA/TIAs, left atrial (LA) size, and comorbidities including hypertension, diabetes, prior myocardial infarction (MI), peripheral vascular disease, and CHF/LV dysfunction. We calculated the $CHADS_2$ score for each patient: 1 point each CHF/LV dysfunction, hypertension, age ≥75, and diabetes and 2 points for prior stroke/TIA. We also calculated the CHA_2DS_2-VAS_C score for each patient: 1 point each for CHF/LV dysfunction, hypertension, age 65–74, diabetes, female gender, and vascular disease (defined as prior MI, vascular disease, or aortic atherosclerosis) and 2 points for age ≥75, and for prior stroke/TIA.

Recommendations for OAC were defined as NO-OAC for a $CHADS_2$ or CHA_2DS_2-VAS_C score of 0, CONSIDER-OAC for $CHADS_2$ or CHA_2DS_2-VAS_C scores of 1, and DEFINITE-OAC for $CHADS_2$ or CHA_2DS_2-VAS_C scores ≥2. We also examined the special categories of a CHA_2DS_2-VAS_C score of 1 due solely to female gender (age <65) and due to female gender of any age or vascular disease. For data analysis those patients with $CHADS_2$ or CHA_2DS_2-VAS_C scores ≥2 were combined into a single group.

We examined the number of patients the $CHADS_2$ score placed into each of the three anticoagulation strategies. We examined each $CHADS_2$ score to determine how many patients the CHA_2DS_2-VAS_C score reclassified into a different (i.e. more aggressive) anticoagulation strategy. For $CHADS_2$ score 0, we determined the number of patients remaining on CHA_2DS_2-VAS_C score 0 and the number advancing to CHA_2DS_2-VAS_C score 1 or CHA_2DS_2-VAS_C score ≥2. For $CHADS_2$ score 1, we determined the number of patients remaining on CHA_2DS_2-VAS_C score 1 and the number advancing to CHA_2DS_2-VAS_C score ≥2.

Statistical analysis

Statistical analysis was performed using XLSTAT 2011 (Paris, France). Continuous data were described as mean ± standard deviation and categorical data as counts and percentages. Cochran–Armitage trend analysis evaluated the incidence of vascular disease across $CHADS_2$ scores. Using analysis of variance or Cochran–Armitage trend test, we evaluated the trends for LA size, duration of AF in years, and incidence of paroxysmal, persistent, or long-standing persistent AF by $CHADS_2$ and CHA_2DS_2-VAS_C scores. We did not evaluate the trend for hypertension, diabetes, CHF/LV dysfunction, and prior stroke/TIA as these comprise a fundamental part of the $CHADS_2$ and CHA_2DS_2-VAS_C scoring system. We evaluated the trend for female gender and incidence of vascular disease across the $CHADS_2$ groups as these were not involved in the $CHADS_2$ scoring system. All the tests were two-sided and $P < 0.05$ was considered statistically significant.

Results

Patient population

Table 1 summarizes the clinical characteristics of the entire cohort of 1411 patients. The average LA size was 4.23 ± 0.84 cm, the average age was 62.9 ± 10 years, and 404 (28.6%) of the patients were female. Paroxysmal AF was present in 30.8%. The incidence of hypertension was 49.1%, diabetes 9.4%, CHF/LV dysfunction 7.9%, prior CVA/TIA 7.9%, and vascular disease 4.2%.

Table 1 also summarizes the trends in clinical variables as a function of the increasing $CHADS_2$ score. For $CHADS_2$ ($P < 0.0005$) but not CHA_2DS_2-VAS_C ($P = 0.579$), there was an increase in LA size with increasing scores. There was no significant difference in the duration of AF in years for either scoring system. For both scoring methods, there was generally more paroxysmal AF and less persistent or long-standing persistent AF at lower scores, compared with higher scores. For the $CHADS_2$ scoring system, there was a greater percentage of

Table 1 Clinical characteristics of patients for the entire cohort and by each $CHADS_2$ and CHA_2DS_2-VAS_C score

Score	Entire cohort	$CHADS_2$				CHA_2DS_2-VAS_C			*P* value
		0	1	2–6	*P* value	0	1	2–9	
Number of patients	1411	569 (40.3%)	517 (36.6%)	325 (23.0%)		308 (21.8%)	394 (27.9%)	709 (50.2%)	
Left atrial size (cm)	4.23 ± 0.84	4.12 ± 0.83	4.25 ± 0.80	4.42 ± 0.88	<0.0005	4.19 ± 0.75	4.23 ± 0.84	4.25 ± 0.88	=0.579
Age (years)	62.9 ± 10.0	59.0 ± 9.9	64.0 ± 8.6	67.7 ± 9.7	NA	53.8 ± 7.9	60.3 ± 8.7	68.2 ± 7.2	NA
Females	404 (28.6%)	132 (23.2%)	152 (29.4)%	120 (36.9%)	<0.0001	0 (0.0%)	74 (18.8%)	330 (46.5%)	NA
AF duration (years)	6.5 ± 7.3	6.7 ± 7.0	6.2 ± 7.4	6.8 ± 7.8	=0.409	6.2 ± 5.8	6.7 ± 7.8	6.6 ± 7.7	=0.641
Paroxysmal AF	435 (30.8%)	215 (37.8%)	152 (29.4%)	68 (20.9%)	<0.0001	109 (35.4%)	125 (31.7%)	201 (28.3%)	=0.023
Persistent AF	761 (53.9%)	279 (49.0%)	284 (54.9%)	198 (60.9%)	<0.001	152 (49.3%)	213 (54.1%)	396 (55.9%)	=0.064
Long-standing AF	215 (15.2%)	75 (13.2%)	81 (15.7%)	59 (18.1%)	=0.043	47 (15.3%)	56 (14.2%)	112 (15.8%)	<0.0001
Hypertension	693 (49.1%)	0 (0.0%)	426 (82.4%)	267 (82.1%)	NA	0 (0.0%)	177 (44.9%)	516 (72.8%)	NA
Diabetes	133 (9.4%)	0 (0.0%)	17 (3.3%)	116 (35.7%)	NA	0 (0.0%)	7 (1.8%)	126 (17.8%)	NA
CHF/LV dysfunction	112 (7.9%)	0 (0.0%)	27 (5.2%)	85 (26.2%)	NA	0 (0.0%)	11 (2.8%)	101 (14.2%)	NA
Prior stroke/TIA	112 (7.9%)	0 (0.0%)	0 (0.0%)	112 (34.5%)	NA	0 (0.0%)	0 (0.0%)	112 (15.8%)	NA
Vascular disease[a]	59 (4.2%)	11 (1.9%)	17 (3.3%)	31 (9.5%)	<0.0001	0 (0.0%)	7 (1.8%)	52 (7.3%)	NA

AF, atrial fibrillation; CHF, congestive heart failure; TIA, transient ischaemic attack.
[a]Defined as prior MI, peripheral vascular disease, or aortic atherosclerosis.
NA = not able to evaluate as characteristic used in score calculation.

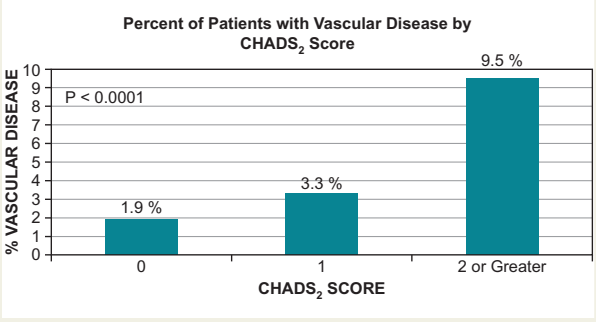

Figure 1 The percent of patients in each $CHADS_2$ score range with vascular disease. Most vascular disease occurs in patients with a $CHADS_2$ score of ≥2 and therefore rarely changes the anticoagulant recommendation when patients are evaluated using the $CHA_2DS_2VAS_C$ scoring system.

females with increasing scores ($P < 0.0001$) and also more vascular disease with increasing scores ($P < 0.0001$) as shown in *Figure 1*.

Total cohort using CHA_2DS_2-VAS_C compared with $CHADS_2$ score

Table 2 shows the number of patients in each $CHADS_2$ score group and the changes from each $CHADS_2$ score to each CHA_2DS_2-VAS_C score. Using the CHA_2DS_2-VAS_C score vs. the $CHADS_2$ score, 583 (41.3% of the entire cohort of 1411 patients) were reclassified into one or more higher grades of thrombo-embolic risk, for which more aggressive anticoagulation strategies are recommended. These 583 patients represented 53.7% of the 1086 patients with $CHADS_2$ score of 0 or 1. Of these 583 reclassified patients, 555 (95.2%) were changed because of female gender and/or age >65, while 28 (4.8%) were reclassified due to vascular disease. The number of patients in the DEFINITE-OAC group increased from 325 (23.0%) based on the $CHADS_2$ score to 709 (50.2%) based on the CHA_2DS_2-VAS_C score.

Changes in oral anticoagulation strategies for patients with a $CHADS_2$ score = 0

The $CHADS_2$ scoring system assigned 569 patients (40.3%) a score of 0 indicating a recommendation of NO-OAC. For the CHA_2DS_2-VAS_C scoring system this fell to 308 (21.8%) patients with a score of 0 and a recommendation of NO-OAC. For the 569 $CHADS_2$ score 0 patients, 199 (35.0%) were changed to a score of 1 using CHA_2DS_2-VAS_C. Of these 199 patients, 74 (37.2%) were reclassified on the basis of female gender, 118 (59.3%) males were changed on the basis of age >65; while only 7 (3.5%) were changed on the basis of vascular disease (7 males, 6 with prior MI and 1 with carotid disease). Of the 569 $CHADS_2$ score 0 patients, 62 changed to a CHA_2DS_2-VAS_C score of 2 indicating a recommendation of DEFINITE-OAC. Of these 62 patients, 58 (93.5%) were upgraded to a higher score and recommendation of more aggressive anticoagulation based on the combination of female gender and age >65. Only four (6.5%) males changed to a score of 2 based on vascular disease (three with prior MIs, one with carotid disease).

Of the 569 patients with a $CHADS_2$ score of 0, only 11 (1.93%) changed to CHA_2DS_2-VAS_C score 1 or 2 based on vascular disease. The reason why so few patients with a $CHADS_2$ score of 0 changed to higher categories based upon vascular disease is demonstrated in *Figure 1*. Only 1.9% of patients with a $CHADS_2$ score of 0 and 3.3% of those with a $CHADS_2$ score of 1 had vascular disease. In contrast, 9.5% of those with a $CHADS_2$ score ≥2 had vascular disease. This trend of increasing vascular disease with increasing

Table 2 The number of patients with each $CHADS_2$ score and the number of patients changed to each new score when evaluated by the CHA_2DS_2-VAS_C scoring system

$CHADS_2$	N	CHA_2DS_2-VAS_C	N
0	569	0	308
		1	199
		2	62
1	517	1	195
		2	224
		3	97
		4	1
2	221	2	70
		3	82
		4	67
		5	2
3	73	3	16
		4	30
		5	25
		6	2
4	22	4	4
		5	10
		6	8
5	8	6	4
		7	3
		8	1
6	1	7	1
Total	1411		1411

$CHADS_2$ score was statistically significant ($P = 0.0001$), suggesting that vascular disease occurs primarily in those patients whose $CHADS_2$ score already qualifies them for DEFINITE-OAC. The majority of changes to a higher risk status occurred because female gender and age >65 were incorporated into the CHA_2DS_2-VAS_C score.

CHA_2DS_2-VAS_C score = 1 due to female gender or vascular disease alone

Of the 199 patients with a CHA_2DS_2-VAS_C score of 1, 74 were due to female gender (30 of whom were age <65) and 7 were males with vascular disease. Eliminating *females* <65 only reduced the number of patients for whom a higher level of OAC was recommended from 41.2 to 39.2% and increased the number for whom NO-OAC is recommended from 21.8 to 23.9%. Eliminating *all females and males with vascular disease* would have only reduced the number of patients for whom a higher level of OAC was recommended to 35.6% and increased the number for whom NO-OAC is recommended to 27.6%.

Changes in oral anticoagulation strategies for patients with a $CHADS_2$ score = 1

There were 517 patients with a $CHADS_2$ score of 1 (CONSIDER-OAC). Using the CHA_2DS_2-VAS_C scores, this fell from 517 of 1411 (36.6%) to 195 of 1411 (13.8%) as 322 of 517 (62.3%) were changed to CHA_2DS_2-VAS_C score ≥2 (DEFINITE-OAC). Of these 322 patients, 64 (19.9%) were upgraded to a higher score because of female gender, 87 (27.0%) because of both female gender and age ≥65, and 154 (47.8%) males because of age ≥65. Only 17 (5.3%) patients were upgraded because of vascular disease (6 males <65, 5 with MIs, 1 with an abdominal aneurysm; 10 males >65, 8 with an MI, 2 with an abdominal aneurysm; 1 female >65 with a prior MI). Thus, of the 517 patients with a $CHADS_2$ score of 1, only 17 (3.29%) moved to a DEFINITE-OAC recommendation because of vascular disease.

Discussion

Our study makes two important observations. First, when compared with the $CHADS_2$ scoring system, the CHA_2DS_2-VAS_C scoring system results in fewer patients in the low and intermediate thrombo-embolic risk groups and increases the number of patients in the DEFINITE-OAC group. Secondly, in our patient population, incorporating vascular disease into the CHA_2DS_2-VAS_C score contributes little to the reclassification of patients' stroke risk. The incorporation of 1 point for female gender, 1 point for age 65–75, and 2 points for age ≥75 accounts for nearly all changes in the aggressiveness of anticoagulant strategy. It is not surprising that vascular disease had little effect on *changing* OAC recommendations, since most of the factors (diabetes, hypertension, or age ≥75) found in the $CHADS_2$ scoring system are associated with atherosclerotic vascular disease. Therefore, most vascular disease patients are already in the $CHADS_2$ score ≥2 group for whom OAC is already recommended.

Vascular disease in atrial fibrillation patients

The true incidence of vascular disease is probably grossly underestimated in AF populations when only clinically apparent disease is included in the score. This could diminish the predictive value of vascular disease as there may be many patients with silent vascular disease as severe as those with clinically diagnosed disease. Vascular disease was an independent predictor of subsequent stoke risk in a large Danish National Registry of hospitalized patients with non-valvular AF who were not on OAC.[22] However, another study evaluating the CHA_2DS_2-VAS_C score in AF patients taking part in several clinical trials found that vascular disease did not predict subsequent strokes.[29] The incidence of vascular disease in our study is lower than that reported in several other studies examining the CHA_2DS_2-VAS_C score[29,30] in hospital cohorts, which may reflect the fact that we examined a group of outpatients who were healthy enough to be considered for catheter ablation of AF. It is unknown if subsequent strokes in patients with generalized vascular disease are due to thrombo-embolic events preventable by OAC, or due to atherosclerotic/ischaemic events, not preventable by OAC.

Goals of the CHA_2DS_2-VAS_C score

The CHA_2DS_2-VAS_C system includes stroke-risk factors not included in the $CHADS_2$ score in the attempt to provide a less ambiguous decision tree for physicians deciding which AF patients require OAC. The CHA_2DS_2-VAS_C score successfully identifies a very low-risk group, for whom no OAC is needed. Several national cohort studies evaluated large numbers of patients with AF and

document the ability of the CHA_2DS_2-VAS_C score to predict CVA/TIA.[22–26] What remains uncertain is whether the large number of patients who move to higher risk classifications also benefit from OAC. A study from a large Danish National Registry showed a benefit of warfarin over aspirin in patients with a $CHADS_2$ score ≥ 0 and a CHA_2DS_2-VAS_C score ≥ 1.[24] However, this study has the shortcomings of being registry-driven data obtained from patients discharged from the hospital. These findings are not equivalent to a randomized trial and may not be representative of outpatients with AF.

Evidence from randomized trials that oral anticoagulation benefits lower risk atrial fibrillation patients

There have been relatively few randomized trials directly comparing OAC and aspirin, especially in lower risk patients. Randomized trials of *high-risk* patients generally show that OAC is superior to aspirin. However, what is the evidence from randomized trials that lower risk patients, such as those upgraded to CONSIDER- or DEFINITE-OAC by CHA_2DS_2-VAS_C benefit from OAC? The randomized studies of OAC in high-risk patients include the EAFT trial,[3] which randomized 669 patients with non-rheumatic AF and a recent TIA or minor ischaemic stroke and found warfarin superior to both aspirin and placebo. The AFASAK study[6] randomized 1007 patients with chronic non-valvular AF to warfarin, aspirin, or placebo. Although this study demonstrated a benefit of warfarin over both aspirin and placebo, *it did not risk-stratify patients into high- and low-risk groups*. The BAFTA study[4] randomized 973 AF patients age >75 to warfarin or aspirin and demonstrated that for the entire cohort warfarin was superior for preventing thrombo-embolic events. Several other randomized studies have been unable to show a benefit of OAC for warfarin compared with aspirin. Although the SPAF trial showed the superiority of both aspirin and warfarin compared with placebo for preventing strokes in non-valvular AF,[4] *it was unable to show a superiority of warfarin over aspirin, especially in those patients <75 years of age*. In the SPAF trial,[9] when aspirin was compared with warfarin, there were 4.6% patients having a stroke *with residual* on warfarin and only 4.3% having a stroke *with residual* on aspirin, probably due to 1.8% of patients on warfarin having an intracranial bleed vs. 0.8% on aspirin. The PTAF trial[5] randomized 729 ambulatory outpatients with non-valvular AF, an average age of 75, and no prior evidence for a thrombo-embolic event to aspirin or warfarin and *showed no advantage of warfarin over aspirin*. A meta-analysis[31] of 4052 patients with non-valvular AF randomized to receive OAC or aspirin showed a benefit for warfarin *only for the high stroke-risk subset*. High-risk patients were classified as those with hypertension, diabetes, or prior CVA/TIA. *Patients without these risk factors did not benefit from taking warfarin*. The AVERROES trial[13] randomized patients unsuitable for warfarin to apixiban or aspirin. Apixaban was superior for the group as a whole but *there was no statistically significant advantage over aspirin in the 65–75 year age group or in those with a $CHADS_2$ score of 0 or 1*.

Thus, it is not absolutely certain that low- to intermediate-risk patients will benefit from OAC and we should be cautious about recommending OAC for a large number of lower risk patients by using CHA_2DS_2-VAS_C scores without data from randomized trials to document its benefit. *Table 3* summarizes these randomized trials of OAC vs. aspirin. Of the trials that did not stratify for stroke risk,[5,6,9] only one of three showed OAC to be superior to aspirin. Of the trials that did stratify for stroke risk,[4,13,31] two of three showed a benefit of OAC *only in high-risk patients*, and the trial enrolling only high-risk patients[3] showed a benefit of OAC. It remains to be proven by a randomized clinical trial if the newer OAC drugs are enough safer than warfarin to provide a better outcome than placebo or aspirin in lower risk patients. Even if newer OAC drugs are safer, it does not mean patients will receive them rather than warfarin when OAC is recommended by CHA_2DS_2-VAS_C. In our clinical experience, penetration of the newer drugs is significantly reduced by

Table 3 Summary of randomized trials of OAC vs. aspirin in patients with non-valvular AF with outcomes evaluated by stroke risk (not specified, low risk or high risk)

Study	Number of patients	Patient population	Stroke risk		
			Not specified	Low risk	High risk
AFASAK[6]	1007	Ambulatory, no CVA within 1 month	Warfarin superior		
SPAF[9]	1100	Age >60, no CVA within 2 years	Warfarin = Aspirin		
PATAF[5]	729	Ambulatory patients, average age = 75	Warfarin = Aspirin		
BFTA[4]	973	Ambulatory, age >75		Warfarin superior[a]	Warfarin = aspirin[b]
Meta-analysis[29]	4052	Six randomized trials warfarin vs. aspirin		Warfarin = aspirin[c]	Warfarin superior[d]
AVERROES[13]	5599	High risk for CVA and unsuitable for warfarin		Apixaban = aspirin[e]	Apixaban superior[f]
EAFT[3]	455	All patients with recent CVA/TIA			Warfarin superior[g]

[a]$CHADS_2$ scores 1 and 2.
[b]$CHADS_2$ scores 3–6 (small number of patients).
[c]No hypertension, diabetes, or prior CVA/TIA.
[d]Hypertension, diabetes, or prior CVA/TIA.
[e]$CHADS_2 = 0$ or 1.
[f]$CHADS_2 \geq 2$.
[g]Prior CVA/TIA.

cost concerns and patients' fears about lack of a readily available reversal agent. Using the CHA_2DS_2-VAS_C scoring system in a population that includes a large number of patients with a lower risk of thromboembolism by the $CHADS_2$ score may force many patients with a low risk–benefit ratio to start OAC.

The large cohort of 7329 patients used to justify the CHA_2DS_2-VAS_C score in the 2010 European Guidelines[19] were all in the SPORTIF-V trials[32,33] and had *'moderate- to high-risk of thromboembolism'*. No conclusions can be drawn about the value of OAC compared with aspirin or no OAC in lower risk patients as *all patients* were taking OAC with either warfarin or ximelagatran and none were considered lower risk patients.

Should age 65- to <75, gender, and vascular disease be considered?

The most recent Canadian AF guidelines[21] *question the value of female gender in risk analysis*, pointing out that in multivariate analysis, female gender is not an independent risk factor for stroke among patients with a CHA_2DS_2-VAS_C score of 1.[23] The 2012 European Guidelines *recommend ignoring female gender if age <65 and if gender is the only factor resulting in a CHA_2DS_2-VAS_C score of 1*.[20] Another study which examined the value of the three new components of the CHA_2DS_2-VAS_C score for predicting thrombo-embolic events, found that age 65 to <75 was a strong predictor, female gender was a borderline predictor, and vascular disease was not a predictor.[29] These observations would seem to raise questions about the value of gender and vascular disease as a component of the CHA_2DS_2-VAS_C score. Even if the CHA_2DS_2-VAS_C score is a better predictor of total strokes, it does not necessarily follow that OAC will prevent strokes better than aspirin in the lower- to intermediate-risk patients.

Randomized trials are needed in lower risk atrial fibrillation patients

Eckman *et al.*[34] suggests that the stroke rate in AF patients has declined recently for all $CHADS_2$ scores, possibly due to the use of antihypertensive drugs and cholesterol-lowering agents. They suggest recent lower estimates of stroke risk shift the 'tipping point' such that anticoagulation with warfarin is preferred only at a *higher* $CHADS_2$ score than currently used. It would seem ethical to perform a large randomized trial of aspirin vs. any of the OAC medications in patients whose recommended OAC strategy would be different using CHA_2DS_2-VAS_C vs. $CHADS_2$ scoring systems. In our AF ablation cohort, up to 41.3% of patients would have been candidates for such a study. The outcome of such a study would determine whether the marked increase in the number of patients for whom OAC is recommended by CHA_2DS_2-VAS_C translates into fewer thrombo-embolic events or instead results in more bleeding complications and/or haemorrhagic strokes.

Limitations

Our study examines the hypothetical effect of the CHA_2DS_2-VAS_C system on anticoagulation recommendations for a real-world cohort of patients undergoing AF ablation. Although they may not be representative of all AF patients, they may be more representative of ambulatory AF patients than some of the large registry studies of hospitalized AF patients. We examined our patients at only one point in time and patient's risk scores may change over time. We cannot make a determination as to which scoring system is best since all our patients underwent an AF ablation, many had AF eliminated, and those on OAC were not randomized. Current guidelines recommend that post-ablation patients remain on OAC according to their risk scores.

Conclusions

Compared with the $CHADS_2$ score, the CHA_2DS_2-VAS_C score markedly increases the number of AF patients for whom DEFINITE-OAC is recommended. In our patient population, this is driven almost exclusively by incorporation of age >65 and female gender into the CHA_2DS_2-VAS_C score. Vascular disease played only a minor role in changing OAC recommendations, as most vascular disease occurred in patients for whom the $CHADS_2$ scoring system already recommended DEFINITE-OAC. Even when using the CHA_2DS_2-VAS_C modifications for anticoagulation recommendations by the 2012 European Guidelines[20] and the recent Canadian Guidelines,[21] our data suggest that CHA_2DS_2-VAS_C markedly increases the number of patients for whom OAC is recommended. Since the CHA_2DS_2-VAS_C scoring system results in many more patients recommended for OAC, it will be important to determine by a randomized trial whether the CHA_2DS_2-VAS_C scoring system's classification scheme results in improved outcomes, without increased morbidity/mortality due to bleeding complications compared with the $CHADS_2$ score.

Conflict of interest: none declared.

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