Internal Medicine Journal. 2016; 46(5): 583-589

Do physicians correctly calculate thromboembolic risk scores? A comparison of concordance between manual and computer-based calculation of $CHADS_2$ and CHA_2DS_2-VASc scores

M. A. Esteve-Pastor,[1] F. Marín,[1] V. Bertomeu-Martinez,[2] I. Roldán-Rabadán,[3] Á. Cequier-Fillat,[4] L. Badimon,[5] J. Muñiz-García,[6] M. Valdés,[1] M. Anguita-Sánchez,[7] and FANTASIIA Study Investigators

[1] Department of Cardiology, Hospital Clínico Universitario Virgen de la Arrixaca, Murcia, [2] Department of Cardiology, Hospital Universitario San Juan, Alicante, [3] Department of Cardiology, Hospital La Paz, Madrid, [4] Department of Cardiology, Hospital de Bellvitge, [5] Cardiovascular Research Center, CSIC-ICCC, Hospital de la Santa Creu i Sant Pau, IIB-Sant Pau, Barcelona, [6] Department of Cardiology, Hospital Universitario A Coruña, La Coruña and [7] Department of Cardiology, Hospital Universitario Reina Sofía, Córdoba, Spain

Abstract

Background. Clinical risk scores, $CHADS_2$ and CHA_2DS_2-VASc scores, are the established tools for assessing stroke risk in patients with atrial fibrillation (AF).

Aim. The aim of this study is to assess concordance between manual and computer-based calculation of $CHADS_2$ and CHA_2DS_2-VASc scores, as well as to analyse the patient categories using $CHADS_2$ and the potential improvement on stroke risk stratification with CHA_2DS_2-VASc score.

Methods. We linked data from Atrial Fibrillation Spanish registry FANTASIIA. Between June 2013 and March 2014, 1318 consecutive outpatients were recruited. We explore the concordance between manual scoring and computer-based calculation. We compare the distribution of embolic risk of patients using both $CHADS_2$ and CHA_2DS_2-VASc scores

Results. The mean age was 73.8 ± 9.4 years, and 758 (57.5%) were male. For $CHADS_2$ score, concordance between manual scoring and computer-based calculation was 92.5%, whereas for CHA_2DS_2-VASc score was 96.4%. In $CHADS_2$ score, 6.37% of patients with AF changed indication on antithrombotic therapy (3.49% of patients with no treatment changed to need antithrombotic treatment and 2.88% of patients otherwise). Using CHA_2DS_2-VASc score, only 0.45% of patients with AF needed to change in the recommendation of antithrombotic therapy.

Conclusion. We have found a strong concordance between manual and computer-based score calculation of both $CHADS_2$ and CHA_2DS_2-VASc risk scores with minimal changes in anticoagulation recommendations. The use of CHA_2DS_2-VASc score significantly improves classification of AF patients at low and intermediate risk of stroke into higher grade of thromboembolic score. Moreover, CHA_2DS_2-VASc score could identify 'truly low risk' patients compared with $CHADS_2$ score.

Key words

Atrial fibrillation, stroke risk score, oral anticoagulation, antithrombotic treatment, CHA_2DS_2-VASc score

Introduction

Atrial fibrillation (AF) is the most common cardiac rhythm disorder in general population which is associated with high risk of mortality and morbidity from stroke events.[1] Patients who survive a non-fatal stroke are more likely to suffer recurrences.[2] Stroke risk in AF is not homogeneous and is closely correlated with bleeding risk.[3, 4] In this context, risk stratification schemes try to help in clinical decision making.[5]

The $CHADS_2$ score (Table 1) was developed to identify AF patients with high risk for stroke.[5] Despite stroke risk in AF being a continuum, the most risk stratification schemes have been used to 'artificially' categorise patients into low risk ($CHADS_2 = 0$), moderate risk ($CHADS_2 = 1$) and high risk ($CHADS_2 \geq 2$) stroke strata.[2, 6] The $CHADS_2$ schema is widely used due to its simplicity and ease, but different analysis showed that the classical $CHADS_2$ score generates a large intermediate risk group (>60%), and a $CHADS_2 = 0$ does not reliably identify AF patients who are at low risk.[1, 6] In 2009 new Birmingham schema – CHA_2DS_2-VASc (Table 1) was proposed, being more inclusive of common stroke risk factors in AF. CHA_2DS_2-VASc significantly improves the predictive value of the $CHADS_2$, and this score has been used as the basis of treatment recommendations.[1, 6] CHA_2DS_2-VASc score consistently performs better accuracy in the identification of truly low-risk patients (CHA_2DS_2-VASc = 0) with AF who do not need any antithrombotic therapy[3, 7;] and this score performs at least as good as $CHADS_2$ in identifying high-risk patients (CHA_2DS_2-VASc ≥ 2) who need antithrombotic therapy (Class I recommendation).[8] Also the CHA_2DS_2-VASc score classifies only a small proportion (<15.0%) as moderate risk (CHA_2DS_2-VASc = 1) when oral anticoagulation should be considered (Class IIa recommendation).[1, 7, 9] CHA_2DS_2-VASc scheme successfully predicts cardiovascular events and mortality, but not major bleeds.[10] Indeed, HAS-BLED score is better for predicting major bleeding than $CHADS_2$ or CHA_2DS_2-VASc. So it is important the knowledge and use of both thrombotic and bleeding risk schemes.[4]

Table 1. Assessment of risk score with $CHADS_2$ and CHA_2DS_2-VASc score[1, 17]

$CHADS_2$	Score	CHA_2DS_2-VASc	Score
Congestive heart failure	1	Congestive heart failure	1
Hypertension	1	Hypertension	1
Age ≥75 years	1	Age ≥75 years	2
Diabetes mellitus	1	Diabetes mellitus	1
Stroke/TIA	2	Stroke/TIA	2
		Vascular disease	1
		Aged 65–74 years	1
		Sex category (female)	1
Maximum score	6	Maximum score	9

Despite the evidence in favour of antithrombotic therapy for stroke prevention, there are still many patients with AF underdiagnosed or undertreated.[11] Euro Heart Survey in AF[12] provided a detailed description of antithrombotic drugs related to stroke risk stratification schemes in real life cardiology practice. This survey showed how antithrombotic therapy prescription was quite high throughout all risk categories, irrespective of the stroke risk stratification scheme used. This suboptimal use may, among several reasons, be related to unawareness among clinicians to guidelines and risk stratification schemes. In the last focused update of the European Society of Cardiology guidelines for the management of AF strongly recommend a practice shift towards greater focus on the identification of patients without thromboembolic risk factors who do not benefit from antithrombotic therapy instead to trying to focus on

identifying high-risk patients.[13, 14] At present, CHA_2DS_2-VASc risk score has largely been validated in several cohorts of patients with AF around the world to correctly reclassified thromboembolic risk in patients with intermediate risk with $CHADS_2$ because despite the modest degree of the risk discrimination improvement, the clinical consequence of reclassification could be substantial.[15, 16]

The aim of this study was to analyse the quality and applicability assessment of stroke risk scores in clinical practice and its influence on antithrombotic therapy in a wide cohort through FANTASIIA (Fibrilación Auricular: influencia del Nivel y Tipo de Anticoagulación Sobre la incidencia de Ictus y Accidentes hemorrágicos) national registry. Our objective was to assess concordance between manual and computer-based calculation of $CHADS_2$ and CHA_2DS_2-VASc scores. In addition, this study aims to analyse that patients categorised as low and intermediate risk of stroke using $CHADS_2$ should improve stroke risk stratification with CHA_2DS_2-VASc score.

Methods

Registry data sources

For this study, we linked data from Atrial Fibrillation Spanish registry FANTASIIA. FANTASIIA registry holds information on current situation of AF non-valvular in Spanish population. This study assesses incidence of thrombotic and bleeding events at 3 years follow up in non-valvular AF, type of antithrombotic drugs (vitamin K antagonists (VKA) or new oral anticoagulants) and appropriate recommendation of antithrombotic therapy. Patients with rheumatic mitral valve disease or patients with prosthetic heart valves were excluded.

Study population

We recruited 1318 consecutive outpatients diagnosed as non-valvular AF from June 2013 to March 2014. This prospective national multicenter observational study included all consecutive patients older than 18 years with non-valvular AF who were treated with oral anticoagulation (VKA or new oral anticoagulants) at least 6 months before a patient's enrolment. Patient management was according to usual local practice without further intervention. The $CHADS_2$ and CHA_2DS_2-VASc scores were calculated for each patient with the relevant variables collected at baseline. These scores were calculated both manually and automatically with computer application.

The FANTASIIA registry complied with the Declaration of Helsinki and the study protocols were approved by San Juan Hospital institutional ethics boards and the Ethic Committee of every participant centre. All participants provided written informed consent.

Statistical analysis

Continuous variables were tested for normality by the Kolmogorov–Smirnov test. Continuous variables are presented as a mean ± SD or median (interquartile range, as appropriate, and categorical variables as a percentage). Kolmogorov–Smirnov test was used to check for normal distribution of continuous data. Unpaired *t*-test or chi-square test was used to compare differences between the two groups. A P value <0.05 was accepted as statistically significant. Statistical analyses were performed using spss version (Chicago, IL, USA).

Results

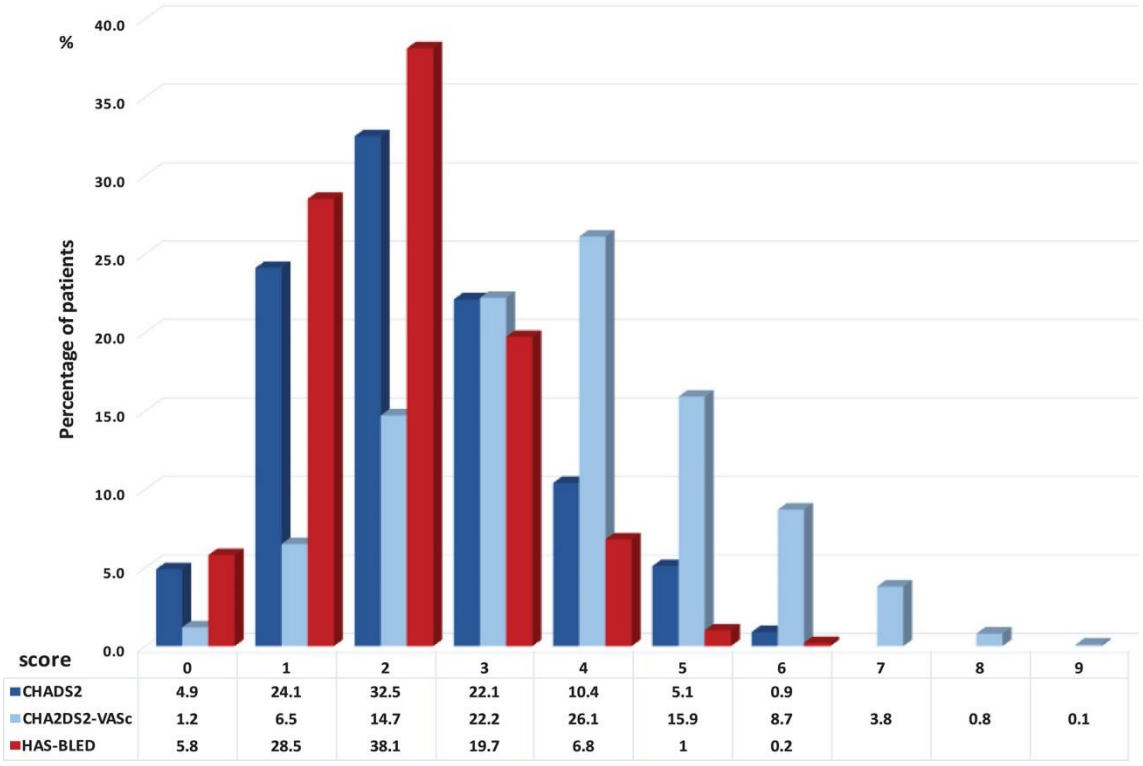
Baseline clinical characteristics of the patients are shown in Table 2. A total of 1318 patients were included by 85 Spanish investigators (80.9% cardiologists, 10.9% primary care physicians and 8.3% internal medicine specialists). The mean age was 73.8 ± 9.4 years, and 758 (57.5%) were male. Hypertension was the most prevalent stroke risk factor (81.0%) followed by hypercholesterolaemia (54.0%) and diabetes (29.0%). Other remarkable comorbidities were ischaemic stroke (15.9%) and major bleeding (3.3%). At the time of the initial visit, the majority of patients (77.1%) were treated with VKA: 927 (71.9%) with acenocoumarol (the most widely oral anticoagulant used in Spain) and 67 patients (5.2%) with warfarin. New oral anticoagulants were used in 22.9% of patients with AF.

Table 2. Baseline clinical characteristics of studied population[†]

Patients	*n* = 1318
Female sex	560 (42.5)
Age, years	73.8 ± 9.4
Age ≥ 75 years	689 (52.3)
Cardiovascular risk factors	no. (%)
Hypertension	1068 (81.0)
Hypercholesterolaemia	711 (54.0)
Diabetes mellitus	386 (29.3)
Current smoker	60 (4.6)
Concomitant disease	no. (%)
Renal impairment	251 (19.0)
Hepatic impairment	13 (1.0)
Vascular disease	92 (7.0)
Previous stroke	210 (15.9)
Thyroid diseases	173 (13.1)
Current alcoholic/drugs consumption	210 (15.9)
Major bleeding events	44 (3.3)
Previous heart disease	629 (47.7)
Heart failure	376 (28.5)
Coronary heart disease	245 (18.6)
$CHADS_2$ score	no. (%)
$CHADS_2 = 0$	64 (4.9)
$CHADS_2 = 1$	318 (24.1)
$CHAD_S \geq 2$	936 (71.0)
CHA_2DS_2-VASc score	no.(%)
CHA_2DS_2-VASc = 0	16 (1.2)
CHA_2DS_2-VASc = 1	86 (6.5)
CHA_2DS_2-VASc ≥ 2	1216 (92.3)
HAS-BLED score	no. (%)
HAS-BLED ≥ 3	363 (27.7)
Concomitant treatment[‡]	no. (%)
Diuretics	766 (59.4)
ACE (angiotensin-converting enzyme) inhibitors	402 (31.2)
Angiotensin receptor blockers	529 (41.0)
Statins	726 (56.3)
Antiplatelet therapy	128 (9.9)
Antithrombotic treatments[‡]	no. (%)
Vitamin K antagonists	994 (77.1)
Acenocoumarol	927 (71.9)
Warfarin	67 (5.2)
New oral anticoagulants	296 (22.9)

† Data are presented as observed number (no. (%)) or mean ± standard deviation (SD).
‡ Available for 1290 patients.
CHADS, congestive heart failure, hypertension, age ≥ 75 years, diabetes mellitus, stroke; HAS-BLED, hypertension, abnormal renal/liver function, stroke, bleeding history or predisposition, labile international normalised ratio, elderly, drugs/alcohol concomitantly; VASc, vascular disease, aged 65–74 years, sex category.

The $CHADS_2$ score classified 4.9% as low risk (score = 0), 24.1% classified as intermediate risk (score = 1) and 71.0% classified as high risk (score ≥2). The CHA_2DS_2-VASc score classified 1.2% as low risk (score = 0), 6.5% classified as intermediate risk (score = 1) and 92.3% classified as high risk (score ≥ 2). In this registry, 27.7% of patients showed high bleeding risk, assessed by HAS-BLED score (score ≥ 3) (Fig. 1).



score	0	1	2	3	4	5	6	7	8	9
CHADS2	4.9	24.1	32.5	22.1	10.4	5.1	0.9			
CHA2DS2-VASc	1.2	6.5	14.7	22.2	26.1	15.9	8.7	3.8	0.8	0.1
HAS-BLED	5.8	28.5	38.1	19.7	6.8	1	0.2			

Figure 1. Distribution of stroke risk categories according to $CHADS_2$ (■), CHA_2DS_2-VASc (■) and HAS-BLED (■) scores in all study patients. The number (%) is shown in each bar.

Concordance between manual and computer-based calculation of risk scores

For $CHADS_2$ score, overall concordance between manual scoring and computer-based calculation was 92.5%; whereas for CHA_2DS_2-VASc score, the concordance between manual and computer-based scoring was 96.4% (Table 3). We found a strong concordance between the manual and the computer-based score calculation. These results lead to a change in recommendation of oral anticoagulation. In $CHADS_2$ score, 6.37% of patients with AF changed indication on antithrombotic therapy (3.49% of patients with no treatment changed to need antithrombotic treatment and 2.88% of patients otherwise). Using CHA_2DS_2-VASc score, only 0.45% of patients with AF needed to change in the recommendation of antithrombotic therapy.

Table 3. Concordance between manual and computer-based calculation of risk scores

	$CHADS_2$ manual				CHA_2DS_2-VASc manual			
$CHADS_2$ app.		0	1	≥2	CHA_2-VASc app.		0	1	≥2
	0	50	5	0		0	10	2	0
	1	10	269	38		1	5	61	13
	≥2	2	44	895		≥2	1	21	1200

CHADS, congestive heart failure, hypertension, age ≥ 75 years, diabetes mellitus, stroke; VASc, vascular disease, aged 65–74 years, sex category.

Comparison between $CHADS_2$ and CHA_2DS_2-VASc risk scores

The distribution of both $CHADS_2$ and CHA_2DS_2-VASc scores is demonstrated in Table 4. Of the 64 patients classified as low risk with $CHADS_2$ schema (score = 0), only 16 patients were classified at low risk with CHA_2DS_2-VASc schema (score = 0), while 30 patients could be estimated at intermediate risk based on CHA_2DS_2-VASc score = 1 (9 women <65 years, 20 men between 65 and 74 years and 1 man with vascular disease). Finally, 18 patients were reclassified into high embolic risk with a CHA_2DS_2-VASc = 2 (15 women between 65 and 74 years and 3 men with vascular disease).

Table 4. The number of patients with each $CHADS_2$ score and the number of patients changed to each new score when evaluated by CHA_2DS_2-VASc score

Risk scores	Number of patients
$CHADS_2$ = 0	64
CHA_2DS_2-VASc = 0	16
CHA_2DS_2-VASc = 1	30
CHA_2DS_2-VASc = 2	18
$CHADS_2$ = 1	318
CHA_2DS_2-VASc = 0	0
CHA_2DS_2-VASc = 1	56
CHA_2DS_2-VASc = 2	137
CHA_2DS_2-VASc = 3	123
CHA_2DS_2-VASc = 4	2

CHADS, congestive heart failure, hypertension, age ≥ 75 years, diabetes mellitus, stroke; VASc, vascular disease, aged 65–74 years, sex category.

Regarding 318 patients classified as intermediate risk with $CHADS_2$ schema (score = 1), only 56 patients were classified as intermediate risk with the new risk scale, CHA_2DS_2-VASc = 1, whereas 137 patients were reclassified as high risk, CHA_2DS_2-VASc score = 2 (12 women <65 years, 88 men between 65 and 74 years, 27 men >75 years and 10 men <65 years with vascular disease). A total of 123 patients were reclassified into higher grade of thromboembolic risk CHA_2DS_2-VASc = 3 (73 women between 65 and 74 years, 32 women >75 years, 13 men between 65 and 74 years with vascular disease and 5 men >75 years with vascular disease). Finally, two patients with $CHADS_2$ score = 1 were reclassified into CHA_2DS_2-VASc = 4 (two women between 65 and 74 years with vascular disease).

Of our cohort, 81.1% of patients with $CHADS_2$ score = 0–1, and 23.0% of all patients were reclassified into higher grade of thromboembolic risk with CHA_2DS_2-VASc score.

After reclassification, patients with CHA_2DS_2-VASc ≥ 2 required antithrombotic therapy and patients with CHA_2DS_2-VASc = 1 were considered to start anticoagulation treatment. Nevertheless, latest European guidelines[6] recommend female patients with CHA_2DS_2-VASc = 1 due to gender alone as a single risk factor (nine women in our study) would not need anticoagulation if they clearly fulfil only the criteria of 'age < 65 years'. These women younger than 65 years have a low risk for stroke (0.7% per year) and do not need anticoagulation treatment.[17]

Discussion

The findings of this study confirm that Spanish physicians correctly calculate thromboembolic risk scores. Manual $CHADS_2$ and CHA_2DS_2-VASc risk scores showed excellent concordance with both computer-based risk scores.

The major advantage to use $CHADS_2$ score has always been its simplicity, because this score is a straightforward algorithm consisting of a small number of variables. Most clinicians who manage patients with AF become familiar with $CHADS_2$ score as a guide to stroke risk due to its simplicity. Nevertheless, this score does not discriminate particularly well between very low-risk patients and intermediate risk patients with AF. Therefore, CHA_2DS_2-VASc has been included in guidelines to be more inclusive of common stroke risk factors with three new variables. However, CHA_2DS_2-VASc score calculation is more complex and may involve errors.[18]

In this study, we analysed the comparison between manual and computer-based calculation of both $CHADS_2$ and CHA_2DS_2-VASc scores. We have seen that there is a high correlation between scores obtained by computer-based and manual calculation.

For $CHADS_2$ score, there is a 92% of concordance, while for CHA_2DS_2-VASc score there is a 96.4% of concordance between both systems. Despite $CHADS_2$ score is simpler to calculate, in our study it has been observed greater concordance in the calculation of CHA_2DS_2-VASc score. Maybe these results showed the knowledge and adherence of Spanish physicians to the last guidelines and clinical practices for the treatment of AF.

These results lead to a change in antithrombotic therapy in 3.49% of patients whose stroke risk was calculated with $CHADS_2$ score and only 0.45% of patients with CHA_2DS_2-VASc score. These findings show minimal changes in anticoagulation recommendations according to the manual or computer-based scoring system used with CHA_2DS_2-VASc score, but for $CHADS_2$ score this change in anticoagulation recommendation is higher, being close to 5%.

In addition, we reported that CHA_2DS_2-VASc score can further refine stroke risk stratification better than $CHADS_2$ score, and this scoring system may be an useful tool to predict with more precision thromboembolic events in patients with AF. In our study, using $CHADS_2$ score we identified 24.1% of patients with intermediate risk ($CHADS_2$ score = 1) and 71.0% of patients with AF were identified with high-thromboembolic risk ($CHADS_2 \geq 2$). When CHA_2DS_2-VASc score was used to stratify stroke risk, the intermediate risk (CHA_2DS_2-VASc = 1) decreased to 6.5 and 92.3% of all patients of AF were

classified as high risk with CHA_2DS_2-VASc score (score ≥2). This study has shown that when we reclassified patients with $CHADS_2$ score into CHA_2DS_2-VASc score, more than 20% of all patients were reclassified to a high-risk stratum by CHA_2DS_2-VASc score. In the controversial low/intermediate group of $CHADS_2$ 0–1 score, 81.1% of patients in this group were reclassified into higher grade of thromboembolic risk with CHA_2DS_2-VASc score. Importantly, we estimated 4.9% patients at low risk by $CHADS_2$ score ($CHADS_2$ = 0), whereas only 1.2% of all patients with AF were classified into low risk with CHA_2DS_2-VASc. These findings are consistent with the increasing literature from multiple different cohorts that CHA_2DS_2-VASc score is better than $CHADS_2$ specially in identification of truly low-risk patients (CHA_2DS_2-VASc = 0) who may not need any thrombotic therapy and CHA_2DS_2-VASc is better in reducing patients classified in intermediate risk score.[1, 15] Our results are consistent with American[8] and European[6] clinical guidelines for the management of patients with AF. Both guidelines now recommend the use of CHA_2DS_2-VASc score for risk stratification because CHA_2DS_2-VASc score identified those patients who are truly at low risk. As a consequence, fewer patients were assigned to the low-risk category with CHA_2DS_2-VASc score than when using $CHADS_2$ score. Our clinical data showed that 382 (28.9%) patients were classified as $CHADS_2$ 0–1, whereas only 102 (7.7%) were classified as CHA_2DS_2-VASc 0–1 score. Moreover, the nationwide Danish registry showed, similar to FANTASIIA registry, that event in patients categorised as 'low risk' using a $CHADS_2$ score = 0, the CHA_2DS_2-VASc score significantly improved the predictive value of the $CHADS_2$ score alone.[7]

Indeed, there is a change of perspective. The goal of the CHA_2DS_2-VASc score is to identify the truly low-risk patients who do not require oral anticoagulation therapy.[13] Multiple studies have demonstrated that physicians do not adhere well to the current anticoagulation guidelines.[19] In the study of validation of CHA_2DS_2-VASc, a Danish cohort, including 47 576 AF patients with $CHADS_2$ score 0–1 without warfarin treatment, thromboembolic events occurred at 3.49%/year compared with 0.84%/year and 1.79%/year in the patient groups reclassified as having CHA_2DS_2-VASc scores of 0 and 1 respectively.[10] These results confirm that patients with $CHADS_2$ score of 0 were not all at low risk and anticoagulation decision based simply on $CHADS_2$ score may underestimated the real risk in patients with AF, and the use of CHA_2DS_2-VASc score significantly improves reclassification of AF patients. The clinical consequence of this reclassification is substantial to start anticoagulation treatment. In our study, according to the latest European guidelines on AF,[6] using $CHADS_2$ score 71.0% of patients with AF would have the recommendation to start oral anticoagulation, whereas using CHA_2DS_2-VASc score, 92.3% of patients with AF (CHA_2DS_2-VASc ≥ 2) would have definite indication of start oral anticoagulation and 6.5% of patients with AF (CHA_2DS_2-VASc = 1) would have consider indication of start oral anticoagulation therapy.[6]

As mentioned above, $CHADS_2$ score does not classify patients with low or intermediate thromboembolic risk correctly so any small change between scores obtained by computer-based and manual calculation could involve a substantial change in indication of anticoagulation and, if calculated wrongly, may increase the thromboembolic risk in patients with AF.

As a result of these findings, physicians correctly calculate risk scores, specifically CHA_2DS_2-VASc score which is more complex because it includes more items, so the lack of adherence of clinical guidelines is due to other problems that need to be analysed in detail.

Study limitations

This article only reports the baseline data of the FANTASIIA registry and follow up is ongoing. A more comprehensive assessment of the data on the management and treatment of AF in population would be obtained from FANTASIIA long-term registry which is scheduled in 2016. Most of our patients were under acenocoumarol. Acenocoumarol is the most common VKA used in Spain and shows a shorter half-life than warfarin (10 vs 36 h), but without differences on the time on therapeutic range.

Conclusions

We have found a strong concordance between manual and computer-based score calculation of both $CHADS_2$ and CHA_2DS_2-VASc risk scores. These findings show minimal changes in anticoagulation recommendations according to the manual or computer-based scoring system used above with CHA_2DS_2-VASc risk score. In addition, the use of CHA_2DS_2-VASc score significantly improves the classification of AF patients at low and intermediate risk of stroke into higher grade of thromboembolic score, which would have indication of oral anticoagulation therapy, and could identify 'truly low risk' patients compared with the commonly used $CHADS_2$ score, being consistent with the finding in several cohorts.

Acknowledgements

This project has been developed under the agreement of *Agencia de Investigación de la Sociedad Española de Cardiología*. We thank all investigators who have collaborated in the FANTASIIA registry.

References

1. Lip GYH , Nieuwlaat R , Pisters R , Lane DA , Crijns HJGM . 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* 2010; 137: 263–72.
2. The Task Force for the Management of Atrial Fibrillation of the European Society of Cardiology (ESC). Guidelines for the management of atrial fibrillation. *Eur Heart J* 2010; 31: 2369–429.
3. Lip GYH . Stroke and bleeding risk assessment in atrial fibrillation: when, how, and why? *Eur Heart J* 2013; 34: 1041–9.
4. Roldán V , Marín F , Manzano-Fernández S , Gallego P , Vílchez JA , Valdés M *et al.* The HAS-BLED score has better prediction accuracy for major bleeding than CHADS2 or CHA2DS2-VASc scores in anticoagulated patients with atrial fibrillation. *J Am Coll Cardiol* 2013; 62: 2199–204.
5. Mason PK , Lake DE , DiMarco JP , Ferguson JD , Mangrum JM , Bilchick K *et al.* Impact of the CHA_2DS_2-VASc score on anticoagulation recommendations for atrial fibrillation. *Am J Med* 2012; 125: 603.e1–6.
6. Camm AJ , Lip GYH , De Caterina R , Savelieva I , Atar D , Hohnloser SH *et al.* 2012 focused update of the ESC Guidelines for the management of atrial fibrillation. *Eur Heart J* 2012; 33: 2719–47.
7. Olesen JB , Torp-Pedersen C , Hansen ML , Lip GYH . 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* 2012; 107: 1172–9.
8. Anderson JL , Halperin JL , Albert NM , Bozkurt B , Brindis RG , Curtis LH *et al.* Management of patients with atrial fibrillation (Compilation of 2006 ACCF/AHA/ESC and 2011 ACCF/AHA/HRS recommendations): a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines
9. Coppens M , Eikelboom JW , Hart RG , Yusuf S , Lip GYH , Dorian P *et al.* The CHA2DS2-VASc score identifies those patients with atrial fibrillation and a CHADS2 score of 1 who are unlikely to benefit from oral anticoagulant therapy. *Eur Heart J* 2013; 34: 170–6.
10. Jover E , Roldán V , Gallego P , Hernández-Romero D , Valdés M , Vicente V *et al.* Predictive value of the CHA2DS2-VASc score in atrial fibrillation patients at high risk for stroke despite oral anticoagulation. *Rev Esp Cardiol (Engl Ed)* 2012; 65: 627–33.
11. Nattel S , Guasch E , Savelieva I , Cosio FG , Valverde I , Halperin JL *et al.* Early management of atrial fibrillation to prevent cardiovascular complications. *Eur Heart J* 2014; 35: 1448–56.
12. Lip GYH , Laroche C , Dan G-A , Santini M , Kalarus Z , Rasmussen LH *et al.* A prospective survey in European Society of Cardiology member countries of atrial fibrillation management: baseline results of EURObservational Research Programme Atrial Fibrillation (EORP-AF) pilot general registry. *Europace* 2014; 16: 308–19.
13. Anderson JL , Halperin JL , Albert NM , Bozkurt B , Brindis RG , Curtis LH *et al.* Management of patients with atrial fibrillation (compilation of 2006 ACCF/AHA/ESC and 2011 ACCF/AHA/HRS recommendations): a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol* 2013; 61: 1935–44.

14. Lane DA , Lip GYH . Use of the CHA(2)DS(2)-VASc and HAS-BLED scores to aid decision making for thromboprophylaxis in nonvalvular atrial fibrillation. *Circulation* 2012; 126: 860–5.
15. Lip GYH , Frison L , Halperin JL , Lane DA . Identifying patients at high risk for stroke despite anticoagulation: a comparison of contemporary stroke risk stratification schemes in an anticoagulated atrial fibrillation cohort. *Stroke* 2010; 41: 2731–8.
16. Okumura K , Inoue H , Atarashi H , Yamashita T , Tomita H , Origasa H *et al.* Validation of CHA_2DS_2-VASc and HAS-BLED scores in Japanese patients with nonvalvular atrial fibrillation: an analysis of the J-RHYTHM Registry. *Circ J* 2014; 78: 1593–9.
17. Friberg L , Benson L , Rosenqvist M , Lip GYH . Assessment of female sex as a risk factor in atrial fibrillation in Sweden: nationwide retrospective cohort study. *BMJ* 2012; 344: e3522.
18. Fuster V , Rydén LE , Cannom DS , Crijns HJ , Curtis AB , Ellenbogen KA *et al.* ACC/AHA/ESC 2006 guidelines for the management of patients with atrial fibrillation—executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and the European Society of Cardiology Committee for Practice Guidelines (Writing Committee to Revise the 2001 Guidelines for the Management of Patients with Atrial Fibrillation). *Eur Heart J* 2006; 27: 1979–2030.
19. Winkle RA , Mead RH , Engel G , Kong MH , Patrawala RA . Comparison of CHADS2 and CHA2DS2-VASC anticoagulation recommendations: evaluation in a cohort of atrial fibrillation ablation patients. *Europace* 2014; 16: 195–201.