The HAS-BLED score predicts long-term major bleeding and death in anticoagulated non-valvular atrial fibrillation patients undergoing electrical cardioversion

García-fernández, Amaya; Marín, Francisco; Roldán, Vanessa; Galcerá-jornet, Emilio; Martínez-martínez, Juan Gabriel; Valdés, Mariano; Sogorb, Francisco; Lip, Gregory Y.h.

DOI:
10.1016/j.ijcard.2016.04.167

Document Version
Peer reviewed version

Citation for published version (Harvard):
García-fernández, A, Marín, F, Roldán, V, Galcerá-jornet, E, Martínez-martínez, JG, Valdés, M, Sogorb, F & Lip, GYH 2016, 'The HAS-BLED score predicts long-term major bleeding and death in anticoagulated non-valvular atrial fibrillation patients undergoing electrical cardioversion', *International Journal of Cardiology*, vol. 217, pp. 42-48. https://doi.org/10.1016/j.ijcard.2016.04.167

International Journal of Cardiology 217 (2016) 42–48

Contents lists available at ScienceDirect

International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard

The HAS-BLED score predicts long-term major bleeding and death in anticoagulated non-valvular atrial fibrillation patients undergoing electrical cardioversion☆,☆☆

Amaya García-Fernández [a,1], Francisco Marín [b,*,1], Vanessa Roldán [c,1], Emilio Galcerá-Jornet [a,1], Juan Gabriel Martínez-Martínez [a,1], Mariano Valdés [b,1], Francisco Sogorb [a,1], Gregory Y.H. Lip [d,1]

[a] Arrhythmia Unit, Cardiology Department, General University Hospital of Alicante, Spain
[b] Department of Cardiology, Virgen de la Arrixaca University Hospital, University of Murcia, Spain
[c] Hematology and Medical Oncology Unit, Morales Meseguer University Hospital, University of Murcia, Spain
[d] University of Birmingham Institute of Cardiovascular Sciences, City Hospital, Birmingham, United Kingdom

ARTICLE INFO

Article history:
Received 18 March 2016
Received in revised form 19 April 2016
Accepted 30 April 2016
Available online 3 May 2016

Keywords:
Atrial fibrillation
Electrical cardioversion
Haemorrhage
Mortality
Risk factors
HAS-BLED

ABSTRACT

Background: Atrial fibrillation (AF) patients eligible for cardioversion tend to be younger and are at lower risk than 'general' AF clinic populations. We evaluated the incidence of major bleeding and death, as well as the predictive value of the HAS-BLED score in non-valvular AF patients who underwent electrical cardioversion (ECV).
Methods: Consecutive non-valvular AF patients who underwent ECV were recruited. Major bleeding episodes and mortality were recorded. Factors associated with both endpoints and the predictive value of the HAS-BLED score were analysed.
Results: 406 patients (281 males; age 66.9 ± 10.9 years) undergoing 571 ECV were included. After a follow-up of nearly 3 years, 20 patients presented with major bleeding (1.9%/year;) and 26 patients died (2.4%/year). The HAS-BLED score predicted both major bleeding [c-statistics: 0.77; 95%CI: 0.71–0.83; $p < 0.001$] and mortality [c-statistics: 0.83; 95%CI: 0.79–0.87; $p < 0.001$]. Variables associated with bleeding were: renal impairment (HR: 4.35; 95%CI: 1.22–15.52; $p = 0.02$), poor quality anticoagulation (HR: 3.21; 95%CI: 1.11–9.32; $p = 0.03$), previous bleeding-predisposition (HR: 5.43; 95%CI: 1.76–16.75; $p = 0.003$) and the HAS-BLED score (HR: 1.88; 95%CI: 1.34–2.64; $p < 0.001$). Factors associated with mortality were: age (HR: 1.08; 95%CI: 1.03–1.14; $p = 0.004$), poor quality anticoagulation (HR: 3.11; 95%CI: 1.15–8.36; $p = 0.02$), previous bleeding-predisposition (HR: 5.90; 95%CI: 1.41–24.65; $p = 0.01$), liver impairment (HR: 9.27; 95%CI:1.64–52.34; $p = 0.01$), the CHA_2DS_2-VASc score (HR: 1.63; 95%CI: 1.18–2.26; $p = 0.003$) and the HAS-BLED score (HR: 2.74; 95%CI: 1.86–4.04); $p < 0.001$).
Conclusions: In AF patients undergoing ECV, major bleeding episodes and mortality were independently associated with poor quality anticoagulation control and previous bleeding-predisposition. The HAS-BLED score successfully predicted major bleeding and mortality.

1. Introduction

Thromboprophylaxis with oral anticoagulation (OAC) in atrial fibrillation (AF) is highly effective in preventing ischaemic stroke and mortality, however it increases the risk of bleeding complications, the most serious of which is intracranial haemorrhage [1].

Among AF patients, those who undergo a rhythm control strategy tend to be younger and have less comorbidities [2–5] Electrical cardioversion (ECV) is commonly used to restore sinus rhythm in AF; however, nearly half of the individuals have arrhythmia recurrence in the first few months after the procedure [6]. International guidelines recommend long-term anticoagulation regardless of procedural success based on thromboembolic risk [7,8].

☆ Funding sources: The authors are supported by RD12/0042/0049 (RETICS) from ISCIII and PI13/00,513/FEDER from ISCIII.
☆☆ Disclosures: GYHL: Consultant for Bayer/Janssen, Astellas, Merck, Sanofi, BMS/Pfizer, Biotronik, Medtronic, Portola, Boehringer Ingelheim, Microlife and Daiichi-Sankyo. Speaker for Bayer, BMS/Pfizer, Medtronic, Boehringer Ingelheim, Microlife, Roche and Daiichi-Sankyo. Others: none declared
* Corresponding author at: Department of Cardiology, Hospital Universitario Virgen de la Arrixaca, Ctra Madrid-Cartagena s/n, 30120, Murcia, Spain.
E-mail address: fcomarino@hotmail.com (F. Marín).
[1] This author takes responsibility for all aspects of the reliability and freedom from bias of the data presented and their discussed interpretation.

http://dx.doi.org/10.1016/j.ijcard.2016.04.167
0167-5273/

Specific risk stratification scores have been developed to assess bleeding risk in AF patients taking OAC [9,10]. Among these, the HAS-BLED score [11] performs better than other schemes for predicting serious bleeding in cohorts of AF patients taking vitamin K antagonists (VKA) and non-VKA. Importantly, the HAS-BLED is the only score able to predict intracranial haemorrhage in AF [11]. Guidelines recommend the use of the HAS-BLED score to assess the risk of major bleeding in AF patients, and draw attention to revisable bleeding risk factors [7,8]. However the HAS-BLED score has not been explored in AF patients who undergo ECV.

The aims of the present study are as follows: 1) to analyse the incidence of short and long-term major haemorrhagic complications and mortality in AF patients who undergo ECV; 2) to study factors associated with these adverse events; and 3) to assess the predictive value of the HAS-BLED score for long-term bleeding and mortality in anticoagulated AF patients undergoing ECV.

2. Methods

2.1. Study patients and data collection

We recruited all consecutive patients with persistent, non-valvular AF who had undergone one or more elective ECV procedures between January 2008 and July 2012 in a University Hospital in South-eastern Spain. Patients with valvular-AF (rheumatic valve disease, severe valve disease, prosthetic valve or mitral valve repair surgery) were excluded.

Data on baseline clinical characteristics, risk factors for bleeding and antithrombotic drug treatment were obtained from the hospital medical records. The CHA_2DS_2-VASc (congestive heart failure, hypertension, age ≥ 75, diabetes mellitus, prior stroke or transient ischemic attack, vascular disease, age 65–74, female sex) and the HAS-BLED (hypertension, abnormal renal/liver function, previous stroke, previous bleeding/predisposition, labile INR, age ≥ 65, concomitant drugs or alcohol abuse) scores were calculated for every patient using established definitions of the different risk factors, as previously described [11,12].

We considered *lone AF* as the absence of heart disease, hypertension, diabetes, pulmonary, renal or thyroid disease and those situations which could precipitate the arrhythmia, such as surgery or alcohol consumption. *Hypercholesterolemia* was defined *as* low-density lipoprotein cholesterol >130 mg/dl or actual lipid-lowering therapy. Patients with asthma, chronic obstructive pulmonary disease or obstructive sleep apnea were classified as having *pulmonary disease. Thyroid disease* was defined as hypo or hyperthyroidism or treatment for either pathology.

Following international recommendations, anticoagulant therapy was maintained for at least 4 weeks after ECV in most of the patients, but the decision about the continuation of anticoagulation after the procedure was at the discretion of the responsible physician. Patients with different types of anticoagulant treatment were included. Acenocoumarol is the most widely used VKA in Spain and most of the individuals received this therapy. As non-VKA oral anticoagulants (NOAC) were first approved in Spain in 2011, only a small number of individuals received these drugs when this study was conducted.

In patients who received VKAs, data about quality of anticoagulation control after ECV were collected. The *time in therapeutic range* (TTR) was calculated as the percentage of tests in range (*international normalized ratio* (INR): 2.0–3.0) over total number of tests (over a maintenance period of at least six consecutive months). An average TTR <60% was considered as poor quality anticoagulation control (*labile INR*).

In our region, all citizens have a personal identification number that enables healthcare professionals to consult data about all hospital admissions, visits to the out-patient clinics, deaths, as well as data about medical prescriptions and other clinical information related to the patients. We recorded major bleeding episodes and deaths occurred after every ECV. Data on stroke and other thromboembolic events (TE) in this population were also registered and have been published elsewhere [13].

Success of ECV and recurrence rates (symptomatic or asymptomatic AF, confirmed by a physician) were also registered. Follow-up started the day of the inclusion (day when the ECV was performed) and ended on July 2013.

Major bleeding was defined following the 2005 International Society of Thrombosis and Haemostasis criteria [14]. All deaths had to be confirmed by the medical records. Mortality was classified as being of *vascular* (cardiac, stroke, pulmonary embolism etc.) or *non-vascular* (neoplasm, trauma, respiratory disease etc.) origin.

2.2. Statistical analysis

Categorical variables were expressed as percentages. The Kolmogorov–Smirnov test was used to analyse the normal distribution of continuous variables. Quantitative variables are expressed as mean ± standard deviation or as median (interquartile range (IQR)), depending on its distribution being normal or not. In order to assess the association between the different individual risk factors and the incidence of an adverse event, univariate Cox-regression models and multivariate models were fitted. All factors identified from the univariate analyses with a p value <0.10 were used in the multivariate analysis. We also evaluated the impact of the CHA_2DS_2-VASc and the HAS-BLED scores with a Cox-regression model. For the multivariate analysis, the scores were evaluated separately, using the score as a dependent variable and keeping in the model only other variables with a p value <0.01 in the univariate analysis that are not included in the score. The ability of HAS-BLED score to predict major bleeding and mortality was calculated with the *area under receiver operating characteristic* (*ROC*) *curve* and the *c-statistic*. Data analysis was performed using SPSS, version 20.0 for Windows (SPSS Inc., Chicago, IL). A *p value* < 0.05 was considered as significant.

2.3. Ethics

This study was approved by the Ethical Committee of Alicante University Hospital (approval number: PI_2013/09) and was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. Patients gave their informed consent prior to their inclusion in the study.

3. Results

3.1. Baseline characteristics and anticoagulation after cardioversion

We included 406 patients, who underwent 571 ECV. Baseline characteristics of the patients are shown in Table 1. Table 2 shows success of ECV, AF recurrence rates and use of OAC after cardioversion. After 4 procedures (0.7%), the responsible physician did not prescribe OAC as the arrhythmia duration was <48 h and the patients had no risk factors for embolism. NOAC (dabigatran or rivaroxaban) were used at some time during follow-up after 86 procedures (15.1%), although the rate of overall use around the time of ECV was low (6.2%), as shown in Table 2.

Over the follow-up period, anticoagulant therapy was stopped after 63 ECV (11.1%). Of these, the main reason for cessation of OAC was cited as a return to sinus rhythm (39 patients; 62.0%). Median time to anticoagulation withdrawal was 368 (202–367) days.

Among patients on VKAs, data on INR control during follow-up for at least 6 consecutive months were not available after 29 procedures (5.4%). For the remainder of ECV patients, mean TTR was 58.91 ± 14.91%, with TTR <60% in 215 (39.7%).

Table 1
Baseline characteristics of 406 patients with non-valvular atrial fibrillation undergoing electrical cardioversion.

Patients	Mean ± SD median (IQR) n (%)
Age (years)	66.9 ± 10.9
Male sex	281 (69.2)
Isolated AF	37 (9.1)
Hypertension	324 (80.0)
Heart failure	110 (27.2)
Diabetes mellitus	117 (28.9)
Previous embolism	23 (5.7)
Vascular disease	90 (22.2)
Actual or previous tobacco use	186 (51.0)
Hypercholesterolemia	273 (68.3)
Pulmonary disease	118 (29.1)
Thyroid disease	41 (10.1)
Previous bleeding/bleeding predisposition (anaemia)	79 (19.4)
Renal impairment	20 (4.9)
Liver impairment	3 (0.7)
Concomitant drugs*	67 (16.5)
Alcohol abuse	28 (6.9)
CHA_2DS_2-VASc score**:	3 (2–4)
Low risk	35 (8.6)
Moderate/intermediate risk	60 (14.8)
High risk	311 (76.6)
HAS-BLED score***:	2 (1–3)
Low risk	110 (28.7)
Moderate/intermediate risk	104 (27.1)
High risk	170 (44.2)

Abbreviations: AF: atrial fibrillation.
*Antiplatelet agents, non-steroidal anti-inflammatory drugs.
CHA_2DS_2-VASc: congestive heart failure (1 point), hypertension (1 point), age ≥ 75 (2 points), diabetes mellitus (1 point), prior stroke or transient ischemic attack (2 points), vascular disease (1 point), age 65–74 (1 point), female (1 point).
**_Low risk_: _males with 0 points_, _females with1 point_; _moderate/intermediate risk_: _males with 1 point_; _high risk_: _≥2 points._
HAS-BLED: hypertension (1 point), abnormal renal/liver function (1 point each), previous stroke (1 point), previous bleeding/predisposition (1 point), labile INR (1 point), age ≥ 65 (1 point), concomitant drugs or alcohol abuse (1 point each).
***_Low risk_: 0–1 points; _moderate/intermediate risk_: 2 points; _high risk_: ≥3 points.

3.2. Adverse events during follow-up

Median follow-up was approximately 3 years [1005 (619–1489) days], during which 30 patients (7.3%) were lost to follow-up.

Table 3 summarises the observed adverse events. Two patients presented with more than one bleeding event, with 23 the total number of episodes. Bleeding sites were as follows: 12 gastrointestinal (52.3%), 5 neurological (21.7%), 4 urinary tract (17.4%) and 2 had other origins (8.6%). The annual incidence of intracranial haemorrhage was 0.4%. Of the bleeding events, 4 (17.4%) were the cause of death (3 intracranial and 1 gastrointestinal). Mortality of intracranial bleeding was 60%. All patients were receiving anticoagulant therapy at point of the bleeding event: 22 (95.7%) with acenocoumarol and 1 (4.3%) with dabigatran. Concomitant antiplatelet therapy was prescribed in 7 (30.4%). After the bleeding episode, anticoagulant therapy was stopped in 3 patients (13.0%) and antiplatelet therapy in another 3 (13.0%). As shown in Table 3, median time to major bleeding was almost 2 years. Only 2 episodes occurred in the first 30 days after ECV, both patients were on acenocoumarol.

Table 2
Cardioversion success, atrial fibrillation recurrence rates and anticoagulant therapy after 571 electrical cardioversion procedures.

	n (%)
ECV success	495 (87)
AF recurrence	399 (80.6)
Anticoagulant therapy after ECV:	567 (99.3)
Acenocoumarol	519 (91.6)
Non-vitamin K antagonists	35 (6.2)
Warfarin	13 (2.2)

Abbreviations: ECV: electrical cardioversion; AF: atrial fibrillation.

Table 3
Major bleeding events, mortality and thromboembolic events during follow-up.

	Major bleeding	Death	Thromboembolism
Number of patients	21	26	20
Annual incidence (%)	1.9	2.4	1.9
Total number of events	23	26	28
Time to first event (days)*	672 (207–963)	664 (354–1252)	746 (149–1180)
Age (years)**	70.1 ± 9.5	74.6 ± 7.6	73.7 ± 13.0
Male sex***	17 (85.0)	22 (84.6)	12 (60.0)
CHA_2DS_2-VASc score*	4 (2–5)	4 (2–6)	4 (3–6)
HAS-BLED score*	4 (2–6)	4(3–6)	4 (3–5)

*Median (interquartile range).
**Mean ± SD.
***N (%).

Causes of death were as follows: (i) vascular: 14 (54.0%): i.e. heart failure: 4; haemorrhagic stroke: 3; sudden death: 3; ischaemic stroke: 2; gastrointestinal bleeding: 1; aortic aneurism rupture: 1; (ii) non-vascular: 10 (38.0%): i.e. neoplasm: 8; infection: 2; and (iii) unknown: 2 (8.0%). Twenty-three (88.5%) patients who died were receiving anticoagulants: 21 acenocoumarol, 1 warfarin and 1 dabigatran. Median time to death was approximately 2 years and no patient died in the first month after ECV.

During follow-up, 20 patients experienced 28 TE, being most of them (n = 25; 96.1%) strokes or transient ischaemic attacks. Only one TE was considered to be related to the procedure, occurring 48 h after ECV in a female patient on acenocoumarol. All patients (n = 20, 100.0%) who sustained TE had received acenocoumarol after the ECV. As previously mentioned, details about stroke and thromboembolism in this population have been published elsewhere [13].

3.3. Predictors of major bleeding and death

ROC-curves analysis showed that the HAS-BLED score was associated with major bleeding [c-statistic: 0.77; 95%CI: 0.71–0.83; p < 0.001] and mortality [c-statistic: 0.83; 95%CI: 0.79–0.87; p < 0.001] (Fig. 1). Fig. 2 shows the annual incidence of major bleeding and mortality, based on HAS-BLED score.

Table 4 summarises determinants of major bleeding in the Cox regression model. On multivariate analysis, factors independently associated with bleeding were: renal impairment (HR: 4.35; 95%CI: 1.22–15.52; p = 0.02), poor quality anticoagulation control (HR: 3.21; 95%CI: 1.11–9.32; p = 0.03), previous bleeding or predisposition (HR: 5.43; 95%CI: 1.76–16.75; p = 0.003) and the HAS-BLED score (HR: 1.88; 95%CI: 1.34–2.64; p < 0.001).

Independent predictors of mortality on Cox-regression analysis were: age (HR: 1.08; 95%CI: 1.03–1.14; p = 0.004), poor quality anticoagulation (HR: 3.11; 95%CI: 1.15–8.36; p = 0.02), previous bleeding or predisposition (HR: 5.90; 95%CI: 1.41–24.65; p = 0.01), liver impairment (HR: 9.27; 95%CI:1.64–52.34; p = 0.01), the CHA_2DS_2-VASc score (HR: 1.63; 95%CI: 1.18–2.26; p = 0.003) and the HAS-BLED score (HR: 2.74; 95%CI: 1.86–4.04); p < 0.001) [Table 5].

4. Discussion

In this study, in a contemporary cohort of patients with non-valvular AF who underwent ECV, we show for the first time that long-term major bleeding and mortality were independently related to the HAS-BLED score. The annual incidence of major haemorrhage was 1.9% and annual mortality was 2.4%. Second, quality of anticoagulation control in those who continued on VKA after cardioversion was suboptimal (mean TTR was 58.9%). Third, we show that independent predictors of *major bleeding* in these patients were: severe renal disease, poor quality

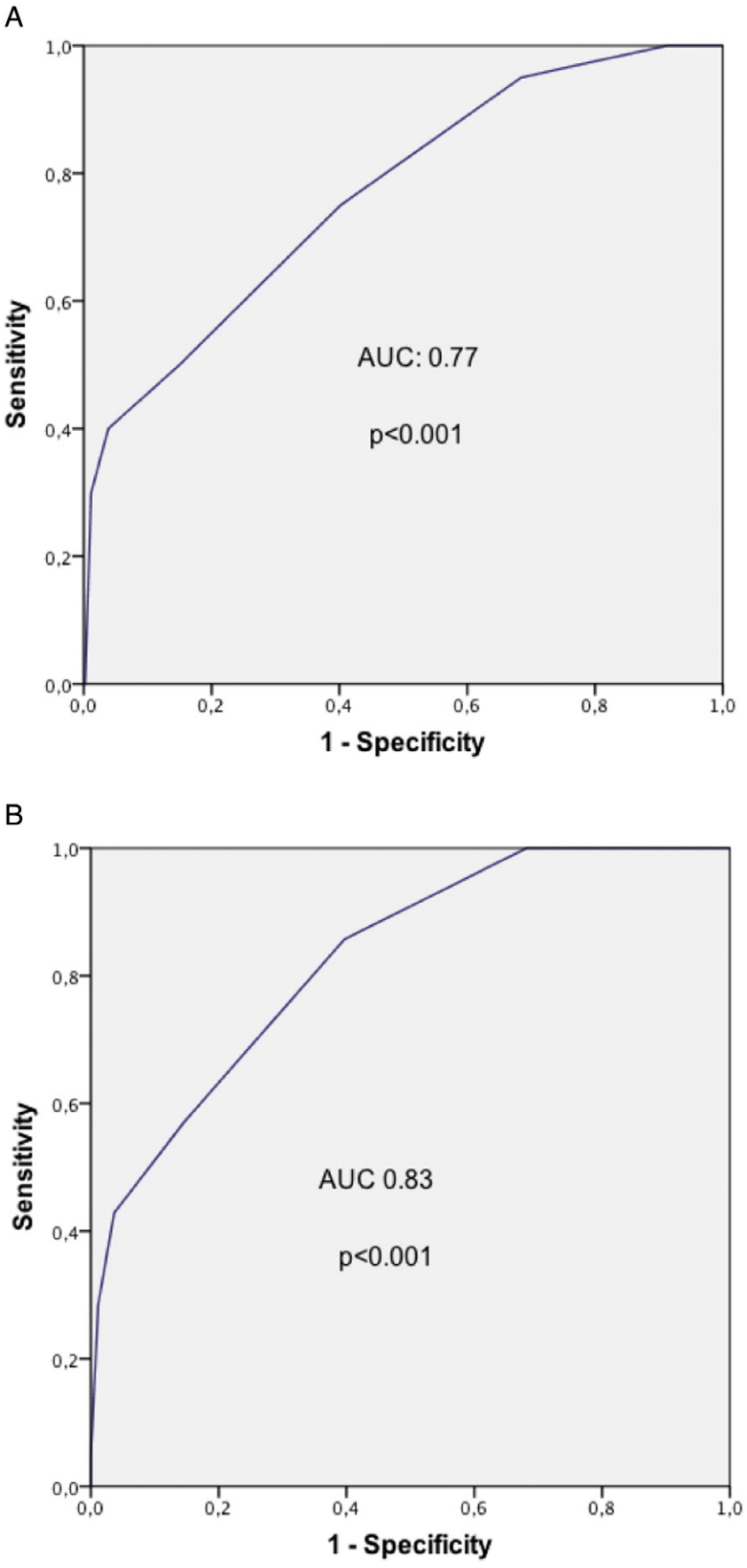

Fig. 1. ROC curves for the HAS-BLED score as a predictor of A) major bleeding and B) mortality.

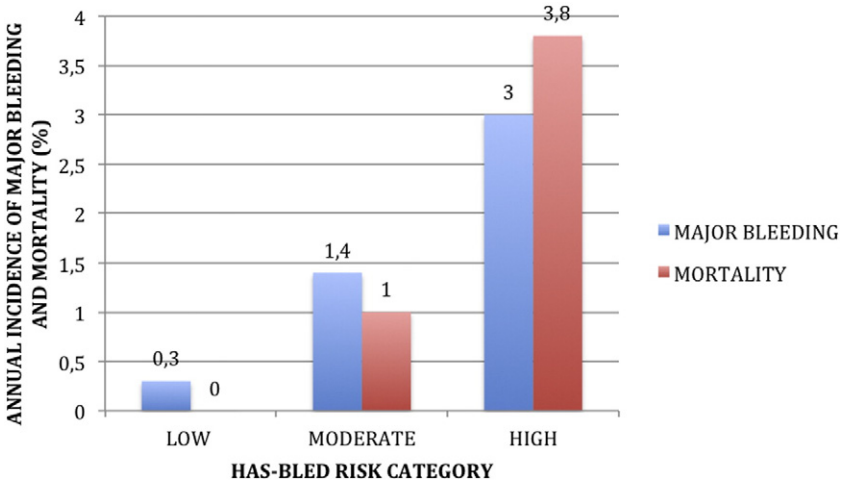

Fig. 2. Annual incidence of major bleeding and mortality depending on HAS-BLED category*. **Low risk*: 0–1 points; *moderate/intermediate risk*: 2 points; *high risk*: ≥3 points.

anticoagulation control and previous bleeding or predisposition, whilst independent predictors of *mortality* were: advanced age, liver impairment, suboptimal anticoagulation control and previous bleeding or anaemia.

Observational data about bleeding complications and death in the group of AF patients in which ECV is performed are scarce and, to the best of our knowledge, the use of major bleeding risk scores has not been previously validated in this setting. Our group has recently described the incidence and predictors of ischaemic stroke and other thromboembolic complications in this particular group of AF patients [13]. A recent paper from the FibStroke study analysed postcardioversion strokes (ischaemic strokes and intracranial bleeding), however risk scores were not examined [15]. In our opinion, AF individuals who undergo ECV differ from the "general" AF clinic populations, as, for example, our patients are younger and have lower thromboembolic risk than those patients with long-standing-persistent or permanent AF included in the EORP-AF registry, study that describes contemporary AF management by European cardiologists [4,5].

As previously shown [16], the incidence of adverse events pericardioversion under the use of anticoagulant therapy — either with VKAs or NOACs — is small. In the group analysed, only two major bleeding episodes and one embolic stroke took place in the first month after ECV. All these patients were receiving acenocoumarol as anticoagulant treatment. At long-term follow-up, most of the adverse events occurred in patients under VKAs, and only two patients on NOACs (dabigatran) experienced bleeding or death. No TE occurred in individuals on NOACs. Recently, Coquard and colleagues [17] published their experience on 50 patients who underwent ECV under anticoagulation with dabigatran and rivaroxaban. They found that the use of NOACs for ECV is safe, with only one major bleeding in a patient on rivaroxaban and no evidence of stroke. Our data support the safety of the use of NOACs for cardioversion, nevertheless we need to highlight that the rate of use of this anticoagulation therapy for ECV in our study was low.

The incidences of major bleeding and intracranial haemorrhage in the patients studied (1.9% per year and 0.4% per year, respectively-most received acenocoumarol as anticoagulant therapy) were broadly similar to that reported with warfarin [18]. In concordance with other studies [19], the mortality associated with bleeding episodes was high (nearly 20%), particularly that of intracranial haemorrhage. Overall annual mortality rate was 2.4%, with most of the deaths being of vascular origin, and a significant proportion of deaths related to intracranial or gastrointestinal bleeds. In a substudy of the RELY (Randomized Evaluation of Long-Term Anticoagulation Therapy) [20], which investigated causes and predictors of mortality in AF patients taking oral anticoagulation with dabigatran or warfarin, the annual death rate was 3.8%. As expected, most deaths were of cardiovascular origin, whilst more than one third were non-cardiovascular.

Table 4
Risk factors associated with major bleeding using Cox regression model.

Risk factor	Univariate analysis HR (95%CI); p value	Multivariate analysis HR (95%CI); p value
Age	1.03 (0.98–1.07); 0.22	
Male sex	2.74 (0.80–9.32); 0.11	
Hypertension	0.74 (0.27–2.00); 0.55	
Heart failure	2.29 (0.97–5.39); 0.058	0.73 (0.24–2.25); 0.59
Diabetes	2.81 (1.19–6.61); 0.018	2.88 (1.01–8.18); 0.05
Previous embolism	0.04 (0.00–233.41); 0.48	
Vascular disease	3.23 (1.37–7.60); 0.007	0.79 (0.23–2.69); 0.71
Actual or previous tobacco use	2.72 (1.05–7.00); 0.03	2.64 (0.91–7.70); 0.08
Previous bleeding or predisposition	9.21 (3.72–22.83); <0001	5.43 (1.76–16.75); 0.003
Renal impairment	15.09 (6.35–35.87); <0.001	4.35 (1.22–15.52); 0.02
Liver impairment	6.87 (0.91–5.59); 0.06	3.08 (0.29–32.29); 0.35
INR lability	4.17 (1.52–11.48); 0.006	3.21 (1.11–9.32); 0.03
Concomitant drugs*	2.91 (1.21–7.04); 0.01	0.81 (0.22–3.02); 0.75
Alcohol abuse	4.42 (1.62–12.07); 0.004	2.57 (0.82–8.19); 0.11
CHA_2DS_2-VASc score	1.20 (0.53–1.95); 0.15	
HAS-BLED score	2.03 (1.53–2.68); <0.001	1.88 (1.34–2.64); <0.001**

Abbreviations: INR: international normalized ratio.
*Antiplatelet agents, nonsteroidal antiinflamatory drugs.
** On multivariate analysis, the impact of the HAS-BLED score was analysed separately, using the score as a dependent variable, and excluding those factors with a p value <0.1 in the univariate model that are already included in the score (previous bleeding or predisposition, renal impairment, liver impairment, INR lability, concomitant drugs and alcohol abuse).

Table 5
Risk factors associated with mortality in the Cox regression model.

Risk factor	Univariate analysis HR (CI95%); p value	Multivariate analysis HR (CI95%); p value
Age	1.09 (1.05–1.41); <0.001	1.08 (1.03–1.14); 0.004
Male sex	2.58 (0.89–7.50); 0.08	0.39 (0.12–1.22); 0.11
Hypertension	5.93 (0.80–43.81); 0.08	2.18 (0.27–17.73); 0.47
Heart failure	2.10 (0.97–4.55); 0.06	1.04 (0.44–2.48); 0.93
Diabetes	1.88 (0.87–4.11); 0.11	
Previous embolism	3.55 (1.21–10.41); 0.02	2.93 (0.86–10.03); 0.09
Vascular disease	3.06 (1.42–6.62); 0.004	0.98 (0.37–2.58); 0.96
Actual or previous tobacco use	1.83 (0.83–4.03); 0.14	
Previous bleeding or predisposition	5.85 (2.70–12.68); <0.001	5.90 (1.41–24.65); 0.01
Renal impairment	6.62 (2.66–16.52); <0001	1.25 (0.37–4.24); 0.71
Liver impairment	26.07 (3.70–69.90); <0.001	9.27 (1.64–52.34); 0.01
INR lability	2.99 (1.20–7.39); 0,01	3.11 (1.15–8.36); 0.02
Concomitant drugs*	1.91 (0.83–.40); 0.13	
Alcohol abuse	2.56 (0.88–7.45); 0.08	1.85 (0.50–6.90); 0.35
CHA_2DS_2-VASc score**	1.58 (1.25–2.00); <0.001	1.63 (1.18–2.26); 0.003
HAS-BLED score**	2.37 (1.79–3.13); <0.001	2.74 (1.86–4.04); <0.001

Abbreviations: INR: international normalized ratio.
*Antiplatelet agents, non-steroidal anti-inflammatory drugs.
**On multivariate analysis, the impact of the CHA_2DS_2-VASc and HAS-BLED scores was analysed separately, using the score as a dependent variable, and excluding those factors with a p value <0.1 in the univariate model that are already included in the score (age, sex, hypertension, heart failure, previous embolism and vascular disease for CHA_2DS_2-VASc and age, hypertension, previous embolism, previous bleeding or predisposition, renal impairment, liver impairment, INR lability and alcohol abuse for HAS-BLED).

Most of our patients took uninterrupted OAC long-term after the procedure, however, an important finding of this study is that the quality of anticoagulation control in these real-world AF patients was suboptimal. Acenocoumarol is the vitamin-K antagonist most commonly used in Spain and, even if the studies comparing its efficacy with that of warfarin are scarce, acenocoumarol has a higher risk of supratherapeuthic INR, potentially leading to a poorer TTR [21]. A recent European Society of Cardiology position document [22] recommended that AF patients with risk factors for thromboembolism should receive effective anticoagulant therapy by achieving a TTR > 70% when VKAs are used. Nonetheless, nearly 40% of our patients had TTR < 60%, and mean TTR was 59%. Indeed, Van Walraven et al. [23] found that patients taking warfarin generally spend more than a third of their time outside of the therapeutic range and a recent Spanish multicentre observational study [24] showed that AF patients on VKAs spend less than half of the time within therapeutic range. Of note, the TTR, as an estimate the quality of anticoagulation control, is a consistent bleeding risk marker [25]. In our study labile INR tripled the risk of having serious bleeding complications and death.

To predict which AF patients are likely to do well on VKA (good average TTR), Apostolakis et al. [26] recently proposed and validated the SAMe-TT_2R_2 score, which includes factors such as female sex, young age, some medical conditions, rhythm control strategy, tobacco use and race as predictors of poor anticoagulation control. The SAMe-TT_2R_2 score has also been validated in different Spanish cohorts of patients on acenocoumarol, showing that a high SAMe-TT_2R_2 score (≥2) translates into poorer quality of anticoagulation, with higher incidence of cardiovascular events, bleeding and mortality [27]. The present study is consistent with these data, given that poor anticoagulation control carries a substantially higher risk of bleeding and death. In a retrospective study by Morgan and co-workers [28], which analysed stroke incidence and mortality related to INR control in more than 2000 AF patients taking warfarin, mortality rates were significantly related to TTR. Indeed, greater efforts should be made on improving anticoagulation control, and a well-organized management of anticoagulant therapy (for example in anticoagulation clinics) results in a higher proportion of individuals with adequate anticoagulation levels [23]. We also presume that patients on VKA with inadequate TTR (despite good compliance and clinical management) and those who are likely to have poor anticoagulation control on VKA should be considered for treatment with a NOAC.

Severe renal disease was another risk factor associated with major bleeding, consistent with several studies. Our group has previously shown that renal insufficiency doubles bleeding risk in anticoagulated AF patients [29]. In a *post-hoc* analysis of the AMADEUS study, moderate to severe renal impairment increased bleeding risk in 60% and doubled the risk of ischemic stroke [30]. However, the prevalence of AF in advanced stages of renal disease is high, affecting more than 25% of haemodialysis patients [31]. Special care should be taken when deciding about anticoagulant therapy in these patients, delicately balancing embolic versus haemorrhagic risk.

In our study, previous bleeding and conditions that increased bleeding risk (mainly anaemia) conferred a five-fold risk of having a major bleeding event and increased mortality by 6-fold. Both prior bleeding history or predisposition have been previously associated with bleeding and death in AF patients [32].

The bleeding risk factors discussed above are components of the HAS-BLED score, a simple, user-friendly, score, which was designed to predict the risk of major bleeding in AF patients [11]. Our group has demonstrated that the HAS-BLED risk score is associated to major bleeding, cardiovascular events and mortality in AF patients taking oral anticoagulation with acenocoumarol [29]. We now extend our previous study by showing that in AF patients undergoing ECV, most of which continue with oral anticoagulation after the procedure, the HAS-BLED score successfully predicted both long-term major bleeding and mortality. Of note, an increase in one point with the HAS-BLED score doubled the risk of major bleeding and tripled the risk of death, with most of the bleeding episodes and nearly all deaths occurring in patients with a high HAS-BLED score (≥3 points). Moreover, the HAS-BLED score has a good predictive accuracy for both adverse events (c-statistics >0.75). We previously reported that the HAS-BLED score had a *c-statistic* for bleeding of 0.70 and of 0.62 for all-cause mortality in AF patients taking acenocoumarol [29]. In the present study, we confirm that the HAS-BLED score is also a good predictor of mortality in non-valvular AF patients. To our knowledge, this is the first time that the score is validated for major bleeding and mortality in the particular population of non-valvular AF patients eligible for ECV.

4.1. Limitations

Our study is limited by its single-centre cohort and observational design. Nonetheless it reflects a 'real world' situation. For these reasons, and even if our study reports extensive and reliable data, some of the information may have been missed. Even if the number of events is relatively low, it is in accordance with that of previous studies, and

practically all the major bleeding complications and deaths could be registered.

Anticoagulation therapy for cardioversion and during follow-up was not the same for all the patients, most of them received VKAs and a smaller proportion took NOACs (dabigatran or rivaroxaban), for this reason, a comparison between both anticoagulant therapies cannot be made. The majority of the patients received acenocoumarol, a VKA which is the one most commonly used in Mediterranean countries. Although no studies have compared acenocoumarol and warfarin, the former is believed to lead to less stable anticoagulation. TTR was calculated as the proportion of tests in range. Although some would confine TTR to the Rosendaal method, measurement of the percentage of tests in therapeutic range is a validated method, accepted in current guidelines to estimate quality of anticoagulation for patients on VKAs [7,33].

Another limitation of this study is that the HAS-BLED score could not be calculated for every patient (because incomplete data about INR were available); nevertheless the proportion of missing TTR data was small.

5. Conclusion

In AF patients undergoing ECV long-term major bleeding episodes and mortality were independently associated with poor quality anticoagulation control and previous bleeding or predisposition. The HAS-BLED score was significantly associated with major bleeding and mortality in these patients.

Conflict of interest

The authors report no relationships that could be construed as a conflict of interest.

References

[1] R.G. Hart, L.A. Pearce, M.I. Aguilar, Meta-analysis: antithrombotic therapy to prevent stroke in patients who have nonvalvular atrial fibrillation, Ann. Intern. Med. 146 (2007) 857–867.
[2] M.T. Caloto, P. Piñera, J. Povar, I. Ayala, A. Marín, C. Del Arco, Características y presentación clínica de los pacientes con episodios de fibrilación auricular elegibles Para restauración del ritmo sinusal: implicaciones Para el manejo en urgencias (estudio RHYTHM-AF-España), Emergencias 23 (2011) 246–260.
[3] M.J. Alegret, X. Viñolas, C. Romero-Menor, et al., Trends in the use of electrical cardioversion for atrial fibrillation: influence of major trials and guidelines on clinical practice, BMC Cardiovasc. Disord. 12 (2012) 42–48.
[4] G.Y. Lip, C. Laroche, G.A. Dan, 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 16 (2014) 308–319.
[5] G.Y.H. Lip, C. Laroche, P.M. Ioachim, et al., Prognosis and treatment of atrial fibrillation patients by European cardiologists: one year follow-up of the EURObservational Research Programme-Atrial Fibrillation general registry pilot phase (EORP-AF pilot registry), Eur. Heart J. 35 (2014) 3365–3376.
[6] I.C. Van Gelder, H.K. Crijns, W.H. Van Gilst, Prediction of uneventful cardioversion and manteinance of sinus rhythm form direct current electrical cardioversion of chronic atrial fibrillation and flutter, Am. J. Cardiol. 68 (1991) 41–46.
[7] A.J. Camm, G.Y. Lip, R. De Caterina, et al., ESC Committee for Practice Guidelines. 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, Europace 14 (2012) 1385–1415.
[8] C.T. January, L.S. Wann, J.S. Alpert, et al., American College of Cardiology/American Heart Association Task Force on Practice Guidelines. AHA/ACC/HRS Guidelines for the Management of Patients With Atrial Fibrillation, J. Am. Coll. Cardiol. 64 (2014), e1–76, http://dx.doi.org/10.1016/j.jacc.2014.03.022 (Accessed september 5, 2015).
[9] G.Y. Lip, F. Andreotti, L. Fauchier, et al., Bleeding risk assessment and management in atrial fibrillation patients: a position document from the European heart rhythm association, endorsed by the European Society of Cardiology Working group on thrombosis, Europace 13 (2011) 723–746.
[10] S. Apostolakis, D.A. Lane, Y. Guo, H. Buller, G.Y. Lip, Performance of the HEMORR2AGES, ATRIA and HAS-BLED bleeding risk-prediction scores in patients with atrial fibrillation undergoing anticoagulation, J. Am. Coll. Cardiol. 60 (2012) 861–867.
[11] R. Pisters, D.A. Lane, R. Nieuwlaat, C.B. de Vos, H.J. Crijns, G.Y. Lip, A novel user-friendly score (HAS-BLED) to assess one-year risk of major bleeding in atrial fibrillation patients: the EuroHeart Survey, Chest 138 (2010) 1093–1100.
[12] G.Y.H. Lip, R. Nieuwlaat, R. Pisters, D.A. Lane, H.J. Crijns, 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 (2010) 263–272.
[13] A. García-Fernández, F. Marín, V. Roldán, et al., Long-term predictors of thromboembolic events in non-valvular atrial fibrillation patients undergoing electrical cardioversion, Circ. J. 80 (2016) 605–612.
[14] S. Schulman, C. Kearon, Subcomittee on control of anticoagulation of the scientific and standardization Committee of the International Society on thrombosis and Haemostasis. Definition of major bleeding in clinical investigations of antihemostatic medicinal products in non-surgical patients, J. Thromb. Haemost. 3 (2005) 692–694.
[15] A. Palomäki, P. Mustonen, J.E. Hartikainen, et al., Strokes after cardioversion of atrial fibrillation. The FibStroke study, Int. J. Cardiol. 203 (2016) 269–273.
[16] R. Cappato, M.D. Ezekowitz, A.L. Klein, et al., on behalf of the X-VeRT Investigators, Rivaroxaban vs vitamin K antagonists for cardioversion in atrial fibrillation, Eur. Heart J. 35 (2014) 3346–3355.
[17] C. Coquard, G. Moubarak, M. Baudet, D. Logeart, J.G. Dilinger, A. Cohen-Solal, Clinical experience of dabigatran and rivaroxaban in electrical cardioversion of atrial fibrillation, Int. Cardiovasc. Forum J. 4 (2015) 71–72.
[18] N.S. Roskell, M. Samuel, H. Noack, B.U. Monz, Major bleeding in patients with atrial fibrillation receiving vitamin-K antagonists: a systematic review of randomized and observational studies, Europace 15 (2013) 787–797.
[19] K.K. Andersen, T.S. Olsen, C. Dehlendorf, L.P. Kammersgaard, Hemorrhagic and ischemic strokes compared: stroke severity, mortality and risk factors, Stroke 40 (2009) 2068–2072.
[20] E. Marijon, J.Y. Le Heuzey, S. Conolly, et al., R.E.-L.Y. Investigators, Causes of death and influencing factors in patients with atrial fibrillation: a competing-risk analysis from the randomized evaluation of long-term anticoagulant therapy study, Circulation 128 (2013) 2192–2201.
[21] C. Pattacini, C. Manotti, R. Quintavalla, A.G. Dettori, A comparative study on the quality of oral anticoagulant therapy (warfarin versus acenocoumarol), Thromb. Haemost. 71 (1994) 188–191.
[22] R. De Caterina, S. Husted, L. Wallentin, et al., C. Committee, New oral anticoagulants in atrial fibrillation and acute coronary syndromes: ESC working group on thrombosis-task force on anticoagulants in heart disease position paper, J. Am. Coll. Cardiol. 59 (2012) 1413–1425.
[23] C. Van Walraven, A. Jennings, N. Oake, D. Fergusson, A.J. Foster, Effect of study setting on anticoagulation control: a systematic review and metaregression, Chest 129 (2006) 1155–1166.
[24] V. Bertomeu-González, M. Anguita, J. Moreno-Arribas, et al., FANTASIIA Study Investigators, Quality of anticoagulation with vitamin K antagonists, Clin. Cardiol. 38 (2015) 357–364.
[25] H.D. White, M. Gruber, J. Feyzi, et al., Comparison of outcomes among patients randomized to warfarin therapy according to anticoagulant control: results from the SPORTIF III and V, Arch. Intern. Med. 167 (2007) 239–245.
[26] S. Apostolakis, R.M. Sullivan, B. Olshansky, G.Y. Lip, Factors affecting quality of anticoagulation control among patients with atrial fibrillation on warfarin: the SAMe-TT2R2 score, Chest 144 (2013) 1555–1563.
[27] P. Gallego, V. Roldán, F. Marín, et al., SAMe-TT2R2 score, time in therapeutic range and outcomes in anticoagulated patients in atrial fibrillation, Am. J. Med. 127 (2014) 1083–1088.
[28] C.L. Morgan, P. McEwan, A. Tukiendorf, P.A. Robinson, A. Clemens, J.M. Plumb, Warfarin treatment in patients with atrial fibrillation: observing outcomes associated with varying levels of INR control, Thromb. Res. 124 (2009) 37–41.
[29] P. Gallego, V. Roldán, J.M. Torregrosa, et al., Relation of the HAS-BLED risk score to predict major bleeding, cardiovascular events and mortality in anticoagulated patients with atrial fibrillation, Circ. Arrhythm Electrophysiol. 5 (2012) 312–318.
[30] S. Apostolakis, Y. Guo, D.A. Lane, H. Buller, G.Y.H. Lip, Renal function and outcomes in anticoagulated patients with non-valvular atrial fibrillation: the AMADEUS trial, Eur. Heart J. 34 (2013) 3572–3579.
[31] R. Marinigh, D.A. Lane, G.Y. Lip, Several renal impairment and stroke prevention in atrial fibrillation: implications for thromboprofilaxis and bleeding risk, J. Am. Coll. Cardiol. 57 (2011) 1339–1348.
[32] M. Hughes, G.Y.H. Lip, Risk factors for anticoagulation-related bleeding complications in patients with atrial fibrillation: a systematic review, Q J. Med. 100 (2007) 599–607.
[33] National Institute for Health and Care Excellence. Atrial Fibrillation: The Management of Atrial Fibrillation. NICE Clinical Guideline 180 2014. (Available at): http://www.nice.org.uk/guidance/cg180/resources/guidance-atrial-fibrillation-the-manangement-of-atrial-fibrillation.pdf. (Accessed December 8th, 2015).