Submitted: 17 December, 2021 Accepted: 12 January, 2022 Published: 08 March, 2023 DOI:10.22514/sv.2022.020

Open Access
Signa Vitae

ORIGINAL RESEARCH

Factors related to the success or failure of cardioversion in atrial fibrillation and emergency department revisit according to restoration of sinus rhythm: analysis of the URGFAICS cohort

Irene Cabello[1], Javier Jacob[1,*], Oriol Yuguero[2], María Arranz[3], Jorge-Alexis Guzmán[4], Anna Moreno[2], Paloma Francés[4], Julia Santos[3], Anna Esquerrà[5], Álvaro Zarauza[1], Josep-María Mòdol[5], on behalf of URGFAICS Research Group

[1]Emergency Department, Hospital Universitari de Bellvitge, 08907 Barcelona, Spain
[2]Emergency Department, Hospital Arnau de Vilanova, 25007 Lleida, Spain
[3]Emergency Department, Hospital de Viladecans, 08840 Barcelona, Spain
[4]Emergency Department, Hospital Universitari Joan XXIII de Tarragona, 43001 Tarragona, Spain
[5]Emergency Department, Hospital Universitari Germans Trias i Pujol de Badalona, 08916 Barcelona, Spain

***Correspondence**
jjacob@bellvitgehospital.cat
(Javier Jacob)

Abstract

Rhythm control in atrial fibrillation (AF) improves haemodynamic status and symptoms. However, there are few data related to revisit of patients who have undergone cardioversion in the Emergency Department (ED). The aim of the study was to compare ED revisit within 30 days according to the effectiveness of cardioversion and analyse the variables related to effective cardioversion. We undertook a multicentre, observational, cohort study with a 30-day follow-up. Older adults with AF presenting to 5 EDs in Spain and undergoing cardioversion were included. The primary endpoint was revisit to the ED within 30 days, and univariate and multivariate analyses were carried out according to the effectiveness of cardioversion. We enrolled 336 patients who underwent cardioversion in the ED. Following the index visit, 7.4% revisited the ED within 30 days, with no differences with respect to the effectiveness of cardioversion (hazard ratio: 0.87; 95% confidence interval (CI) 0.31–2.43). In the multivariate study, AF lasting <48 hours was related to more effective cardioversion (adjusted odds ratio (aOR): 2.14; 95% CI 1.16–3.59) while the use of amiodarone (aOR: 0.52; 95% CI 0.27–0.99) and digoxin in ED (aOR: 0.28; 95% CI 0.13–0.66) was related to less effective cardioversion. In patients with AF undergoing a rhythm control strategy in the ED, the absence of restoration of sinus rhythm was not associated with a greater frequency of 30-day ED revisit.

Keywords

Atrial fibrillation; Emergency department; Revisit; Sinus rhythm restoration; URGFAICS

1. Introduction

Atrial fibrillation (AF) is the most common sustained cardiac arrhythmia in adults worldwide [1]. The incidence and prevalence of AF are increasing, with significant associated morbidity, mortality, and costs, including a 2-fold increase in mortality and a 6-fold increase in the risk of stroke [2–4]. The progression of recent-onset AF (AF of less than 1 year duration) can be modified by an early rhythm control strategy, which provides better control of haemodynamic status and symptom management, reducing hospital stay and also allowing immediate return to normal activities [5, 6]. However, this strategy does not provide an advantage in survival over a rate-control strategy or in the prevention of stroke [7].

Acute presentation of AF is frequently managed in the emergency department (ED). In recent years, the high prevalence of AF in the ED has led to emergency physicians playing an increasingly more relevant role in the management of AF. The management of AF in the ED includes rapid assessment of the need for thromboembolic prophylaxis, the need to control the heart rate when elevated or symptomatic, and the possibility of achieving rhythm control in recent-onset AF or permanent AF in previously correctly anticoagulated patients. Reestablishment of sinus rhythm (SR) can be performed by direct current cardioversion (DCC) or by the administration of antiarrhythmic drugs. DCC has shown to be more effective than pharmacological cardioversion (PhC) [8, 9]. However, long-term maintenance of SR remains a challenge. Some studies have reported that recurrence of AF is lower when cardioversion is performed early [10, 11] but there are few data on ED revisit related to the restoration of SR. In a previous study, ED revisit after discharge for another episode of AF was not high but was related to a worse perceived quality of life [12, 13]. ED revisit is mainly due to the reappearance of symptoms that previously led to consultation, especially the reappearance of palpitations [13].

We hypothesised that the absence of restoration of SR may

This is an open access article under the CC BY 4.0 license (https://creativecommons.org/licenses/by/4.0/).

be associated with greater ED revisit related to the previous AF episode. Therefore, the aim of this study was to compare ED revisit within 30 days after discharge according to the effectiveness of cardioversion in patients consulting for AF. We also analysed the variables related to effective cardioversion.

2. Methods

2.1 Study design and setting

This was a secondary analysis of the URGFAICS (Atrial Fibrillation in the Emergency Department Institut Català Salut) registry, which is a multipurpose, analytic, non-interventionist, multicentre Spanish registry with a prospective 30-day follow-up [13]. We included all consecutive patients diagnosed with AF in the EDs of five public hospitals of the Catalan health institute: hospital universitari Joan XXIII de Tarragona, hospital universitari Arnau de Vilanova de Lleida, hospital universitari de Bellvitge de l'Hospitalet de Llobregat, hospital universitari Germans Trias I Pujol de Badalona and hospital de Viladecans. Patients were consecutively included from September 2016 to February 2017. Eligible patients were all men and women 18 years of age or older who consulted to the ED with symptoms related to AF or the casual finding of AF on electrocardiogram (ECG) performed 12 hours prior to consultation. The diagnosis of AF was performed by a 12-lead ECG recorded at admission following to the diagnostic criteria of the last European cardiology society guidelines, with the presence of irregular RR intervals and non-discernible, distinct P waves [9]. Exclusion criteria were age younger than 18 years, an electrical rhythm other than AF and patients who did not provide informed consent. To achieve consecutive inclusion, the research team consisted of emergency physicians responsible for the conduct of the study who performed the initial recruitment and requested informed consent from the patients in each participating centre. Patients were consecutively included by emergency physicians responsible for carrying out the study after having obtained informed consent from the patients in the participating centres. Although each site had more than one investigator, all cases were confirmed by the principal investigator of each centre to ensure that the patients met the diagnostic criteria of AF, fulfilled all the inclusion and none of exclusion criteria. Investigators were not blinded to the objective of the study. To perform this analysis, only patients in whom DCC or PhC was performed were selected independently of its effectiveness. The decision to perform cardioversion depended on the attending physician, following the recommendations established at the time of the study [9].

Forty-eight variables were retrospectively extracted from medical records including age, male sex, comorbidities, long-term treatments at home, duration of the episode from the onset of symptoms to ED visit, clinical data, thrombotic risk, vital signs, ED pharmacologic treatment, type of cardioversion and treatment at discharge. Symptoms related to AF were those described in the modified European Heart Rhythm Association (EHRA) scale and the Canadian Cardiovascular Society Severity of Atrial Fibrillation (CCS-SAF) scale [12, 14].

The main outcome was 30-day revisit ED after the index episode, and the main predictor of interest was the success of cardioversion. The reason for the ED revisit had to be related to the AF of the index episode. The principal investigator of each centre performed the 30-day follow-up by consulting the hospital clinical history or by telephone call to the patient. For the analysis of ED revisit, only patients directly discharged from the ED were included.

2.2 Data analysis

Categorical variables are expressed as absolute and relative frequencies, and continuous data are presented as means with standard deviation (SD) or, if not normally distributed, as median, and interquartile range. For comparisons, the Chi-square test was used for the qualitative variables (or the Fisher exact test in 2×2 tables when the expected values were less than 5), and the student's t test for independent measures was used for the quantitative variables, if the distribution did not affect the principle of normality (analysed using Kolmogorov-Smirnov test), or using the nonparametric Mann-Whitney test if affected.

To study the variables associated with the cardioversion success, the variables with significant differences between groups in the bivariate analysis were introduced into logistic regression (without interaction terms) with checks for nonlinearity and forward stepwise variable selection, with an entry criterion of a p value < 0.20. The resulting variables were expressed as odds ratio (OR) with the 95% confidence interval (CI).

The primary outcome was 30-day revisit to the ED depending on the success of cardioversion. Survival curves were constructed using the Kaplan-Meier model. Global differences between the different survival curves were determined using log-rank statistics. The group achieving cardioversion success was used as the reference group. The effect of successful cardioversion on 30-day revisit was expressed as crude hazard ratios (HRs), with 95% CI, and then the HR was adjusted for all potential confounding factors ($p < 0.20$), using direct Cox regression analysis. Differences were considered statistically significant with a p value < 0.05 or when the 95% CI of the OR or the HR excluded the value of 1. Secondary outcomes were the analysis of the variables related to effective cardioversion. The IBM SPSS Statistics Version 24.0 (IBM, Chicago, Il, USA) was used for the statistical analyses.

3. Results

A total of 1199 patients with AF who consulted to the ED were enrolled in the URGFAICS study. Of these, 372 (31%) patients underwent cardioversion, constituting the study group. We subsequently excluded patients who required hospitalisation (n = 36), and therefore, 336 patients who were discharged home were finally included in the main objective sub-study group (Fig. 1). Cardioversion, either electrical or pharmacological, was effective in 254 patients (68.3%). A total of 258 patients (69.4%) underwent pharmacological cardioversion, 59 received DCC (15.9%) and 57 (15.3%) underwent both. Table 1 shows the demographic data and characteristics of the study group and the univariate analysis according to whether cardioversion was effective or not, while Table 2

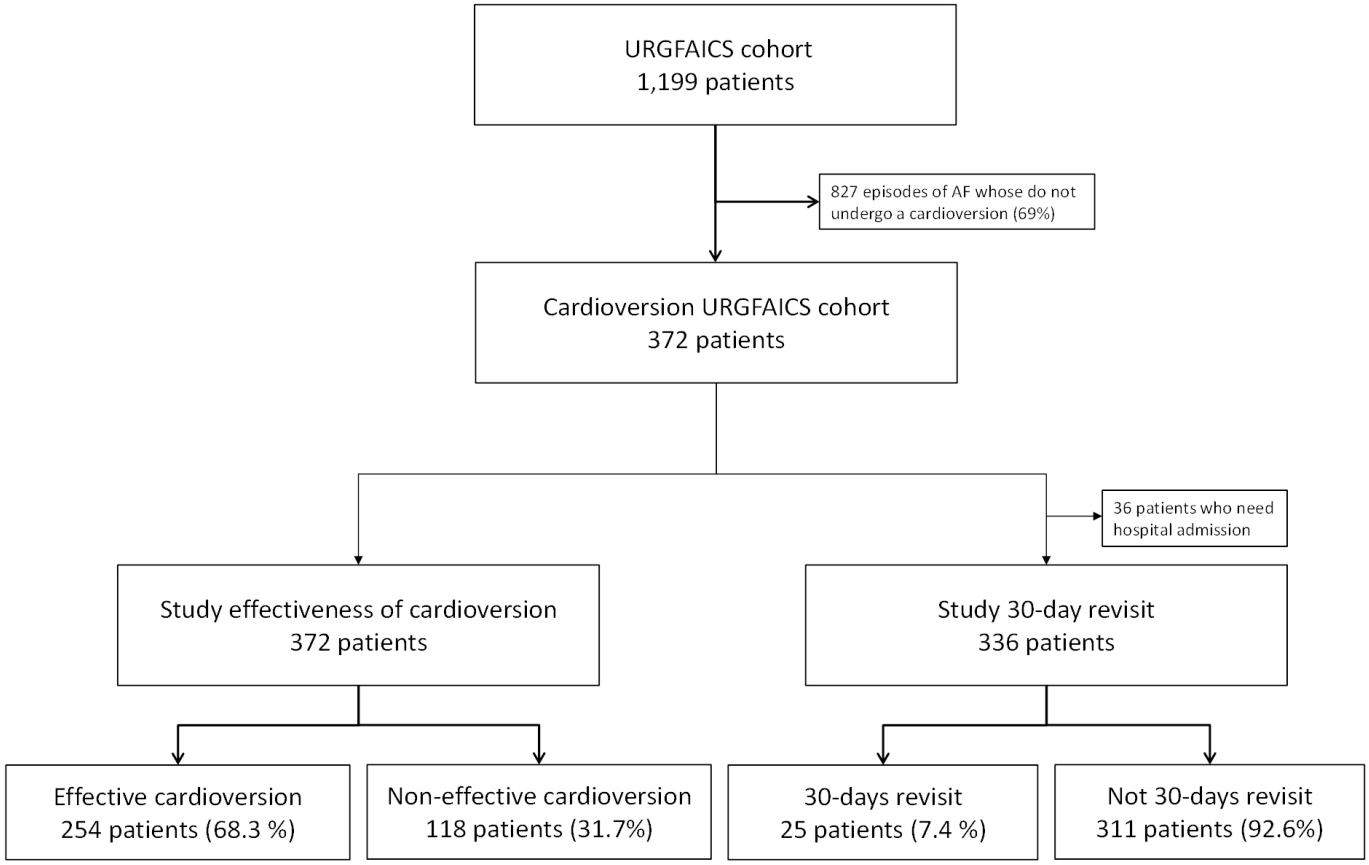

FIGURE 1. Patient inclusion flow chart.

shows the clinical data and ED treatment. When comparing the effectiveness of cardioversion, univariate analysis showed failure to achieve cardioversion to be significantly related to the presence of a greater number of comorbidities. Patients undergoing cardioversion with AF of less than 48 hours more readily converted to SR ($p < 0.001$). Cardioversion was more effective in patients attended for palpitations and less effective in those attended for shortness of breath. The factors independently associated with successful or unsuccessful cardioversion after multivariate adjustment are presented in Table 3. AF lasting less than 48 hours was related to successful cardioversion (adjusted OR 2.14 (1.16–3.59); $p = 0.015$), while the use of amiodarone (adjusted OR: 0.52; 95% CI 0.27–0.99) and digoxin in ED (adjusted OR: 0.28; 95% CI 0.13–0.66) was related to unsuccessful cardioversion. Twenty-five patients (7.4%) presenting AF in the ECG revisited the ED revisit within 30 days. There were no differences when compared with the effectiveness of cardioversion. These results are shown in Fig. 2 with the means of survival curves for ED revisit within 30 days based on the effectiveness of cardioversion in Fig. 2A (unadjusted HR 1.18 (95% CI 0.51–2.74); $p = 0.694$) and Fig. 2B (adjusted HR 1.17 (95% CI 0.40–3.40); $p = 0.777$).

4. Discussion

The purpose of our study was to determine whether SR restoration was associated with early 30-day ED revisit in patients with AF. To do this, we compared a group of patients in whom cardioversion was effective with another group in whom cardioversion was ineffective, not considering the indication of cardioversion but rather the result of the procedure. The population in our study is representative of the majority of patients with AF described in other registries [15–19], with older patients (65 years of age or older) being the most prevalent. The usefulness of cardioversion in haemodynamically stable patients with AF has been studied by many groups. Several studies have demonstrated the safety and effectiveness of ED cardioversion, especially with DCC, reporting infrequent, transient adverse events irrespective of the method used [3, 8, 19–21]. Surprisingly, we observed no differences in ED revisit between the two groups according to the effectiveness of cardioversion. In our study, the overall percentage of revisit at 30 days was low (7.4%) compared with the 10.3% to 15.4% reported in previous studies [18, 19, 22]. Considering the few data available in relation to early ED revisit, it is difficult to establish whether our data are limited by the low-revisit rate. Several studies have compared a rhythm-control strategy versus a rate-control strategy, cardioversion by DCC versus PhC, or different class Ic antiarrhythmic drugs versus amiodarone [7, 19, 23–25]. However, to our knowledge no previous study has specifically compared discharge rhythm and 30-day ED revisit.

According to our results, SR restoration was not associated with early 30-day ED revisit in patients with AF. The Atrial Fibrillation Follow-up Investigation of Rhythm Management (AFFIRM) study, which included a total of 4060 patients, concluded that management of AF with a rhythm-control strategy offers no survival advantage compared with rate-control [7].

TABLE 1. Demographic data and characteristics of the patients included in the study. Univariate analysis according to the effectiveness of cardioversion.

	Total	Missing values	Effective CV	Non-effective CV	*p*-value
	(N = 372)	n (%)	(N = 254)	(N = 118)	
	n (%)		n (%)	n (%)	
Demographic data					
Age (years), Mean (SD)	68.2 (14.1)	0 (0.0)	66.2 (13.5)	72.4 (14.3)	<0.001
Age ≥75 years	136 (36.6)	0 (0.0)	75 (29.5)	61 (51.7)	<0.001
Male sex	177 (47.6)	0 (0.0)	131 (51.6)	46 (39.0)	0.024
Comorbidities					
Hypertension	245 (65.9)	0 (0.0)	162 (63.8)	83 (70.3)	0.214
Diabetes	74 (19.9)	0 (0.0)	53 (20.9)	21 (17.8)	0.490
Heart valve disease	82 (22.0)	0 (0.0)	47 (18.5)	35 (29.7)	0.016
Previous heart failure	66 (17.7)	0 (0.0)	36 (14.2)	30 (25.4)	0.008
Coronary artery disease	54 (14.6)	3 (0.8)	30 (12.0)	24 (20.3)	0.034
Chronic renal failure	57 (15.3)	0 (0.0)	31 (12.2)	26 (22.0)	0.014
Chronic obstructive pulmonary disease	40 (10.8)	0 (0.0)	29 (11.4)	11 (9.3)	0.544
History of stroke	27 (7.3)	0 (0.0)	13 (5.1)	14 (11.9)	0.020
Peripheral vascular disease	25 (6.7)	0 (0.0)	11 (4.3)	14 (11.9)	0.007
History of thromboembolism	9 (2.4)	0 (0.0)	5 (2.0)	4 (3.4)	0.473
Previous AF	144 (38.7)	0 (0.0)	94 (37.0)	50 (42.4)	0.323
Home medications					
Beta-blocker	169 (45.4)	0 (0.0)	118 (46.5)	51 (43.2)	0.560
Calcium channel blockers	63 (16.9)	0 (0.0)	34 (13.4)	29 (24.6)	0.007
Amiodarone	36 (9.7)	0 (0.0)	21 (8.3)	15 (12.7)	0.177
Digoxin	6 (1.6)	0 (0.0)	4 (1.6)	2 (1.7)	1.000
Antiarrhythmic Class Ic	55 (14.8)	0 (0.0)	43 (16.9)	12 (10.2)	0.087
Dronedarone	2 (0.5)	0 (0.0)	2 (0.8)	0 (0.0)	1.000
Oral anticoagulant	168 (45.2)	0 (0.0)	110 (43.3)	58 (49.2)	0.292
Thrombotic risk					
CHA_2DS_2-VASc ≥2 points	275 (73.9)	0 (0.0)	179 (70.5)	96 (81.4)	0.026

CV—cardioversion; AF—atrial fibrillation; SD—standard deviation.

Neither did they find differences in the secondary endpoints, such as stroke or cardiac arrest. A recently published study also concluded that in patients presenting to the ED with recent-onset AF, a wait-and-see approach was not inferior to early cardioversion in achieving SR at 4 weeks [26]. These studies support our findings, concluding that early restoration of SR is not necessarily mandatory. These data do not invalidate the fact that successful cardioversion is feasible and safe in the ED. It has also been related to the occurrence of fewer adverse events, better haemodynamic status, and better symptom management [3, 7]. The latest guidelines support the use of rhythm control and based on the results of previous studies, DCC is probably the best option for achieving SR restoration [3, 9]. However, when SR restoration is not achieved for any reason, our data suggest that emergency physicians can safely discharge patients home provided that they are stable, rate control is achieved, and thromboprophylaxis is optimised.

A secondary aim of our study was to determine the variables associated with increased efficiency of cardioversion. Our data reflect an association between AF duration ≤48 hours and successful cardioversion. It is well known that patients with recent-onset AF respond much better to cardioversion [17]. In a recent analysis of the Hospital EmeRgency department Management Strategies of Atrial Fibrillation (HERMES-AF) cohort, the global effectiveness of a rhythm control strategy for achieving SR in patients with AF of short duration was 84%. Moreover, this strategy was associated with better control of AF symptoms and a lower need for hospitalisation [16].

The use of amiodarone and digoxin in the ED during the AF episode, which was related to non-effective cardioversion in our study, is indicated in patients with previous heart disease or in acute heart failure and may act as a confounding factor. Both drugs were still associated with non-effective cardioversion after the adjusted analysis with variables such

TABLE 2. Clinical characteristics and treatment of the patients. Univariate analysis according to the effectiveness of cardioversion.

	Total	Missing values	Effective CV	Non-effective CV	*p*-value
	(N = 372)	n (%)	(N = 254)	(N = 118)	
	n (%)		n (%)	n (%)	
Acute episode data					
AF lasting ≤48 hours	230 (61.8)	0 (0.0)	174 (68.5)	56 (47.5)	<0.001
Clinical data					
Palpitations	223 (59.9)	0 (0.0)	164 (64.6)	59 (50.0)	0.008
Shortness of breath	41 (11.0)	0 (0.0)	18 (7.1)	23 (19.5)	<0.001
Thoracic discomfort	65 (17.5)	0 (0.0)	42 (16.5)	23 (19.5)	0.485
Dizziness or similar[1]	30 (8.1)	0 (0.0)	16 (6.3)	14 (11.9)	0.067
Casual find	18 (4.8)	0 (0.0)	11 (4.3)	7 (5.9)	0.503
Other symptoms[2]	20 (5.4)	0 (0.0)	12 (4.7)	8 (6.8)	0.413
Vital signs					
SBP (mmHg), Mean (SD)	128.3 (24.9)	13 (3.5)	128.4 (25.6)	128.2 (23.6)	0.934
DBP (mmHg), Mean (SD)	79.3 (15.5)	16(4.3)	78.5 (15.6)	80.9 (15.3)	0.169
Heart rate (bpm), Mean (SD)	124.4 (29.0)	0 (0.0)	123.9 (29.1)	125.5 (28.7)	0.613
Oxygen saturation (%), Mean (SD)	97.4 (2.3)	21 (5.6)	97.5 (2.1)	97.2 (2.6)	0.294
HR >110 bpm	262 (70.4)	0 (0.0)	177 (69.7)	85 (72.0)	0.644
SBP <90 mmHg	18 (5.0)	13 (3.5)	15 (6.1)	3 (2.7)	0.165
ED treatment					
Digoxin	60 (16.2)	1 (0.3)	22 (8.7)	38 (32.2)	<0.001
Amiodarone	225 (60.5)	0 (0.0)	135 (53.1)	90 (76.3)	<0.001
Beta-blockers[3]	54 (14.5)	0 (0.0)	35 (13.8)	19 (16.1)	0.554
Antiarrhythmic Class Ic	87 (23.4)	0 (0.0)	63 (24.8)	24 (20.3)	0.344
Calcium channel blockers	3 (0.8)	0 (0.0)	3 (1.2)	0 (0.0)	0.555
Vernakalant	3 (0.8)	0 (0.0)	3 (1.2)	0 (0.0)	0.555
Type of cardioversion					
Pharmacological	258 (69.4)	0 (0.0)	149 (58.7)	109 (92.4)	<0.001
DCC	59 (15.9)	0 (0.0)	55 (21.7)	4 (3.4)	<0.001
Pharmacological and DCC	57 (15.3)	0 (0.0)	52 (20.5)	5 (4.2)	<0.001
Discharge treatment					
Anticoagulant begin[4]	93 (45.1)	0 (0.0)	67 (45.9)	26 (43.3)	0.738
Antivitamin K agonist	58 (28.2)	0 (0.0)	43 (29.5)	15 (25.0)	
Direct oral anticoagulant	32 (15.5)	0 (0.0)	23 (15.8)	9 (15.0)	
Heparin	3 (1.5)	0 (0.0)	1 (0.7)	2 (3.3)	
Digoxin	10 (2.7)	4 (1.1)	1 (0.4)	9 (7.8)	<0.001
Amiodarone	97 (26.4)	5 (1.3)	67 (26.7)	30 (25.9)	0.867
Beta-blockers	77 (20.9)	4 (1.1)	45 (17.9)	32 (27.6)	0.033
Antiarrhythmic Class Ic	37 (10.1)	4 (1.1)	29 (11.5)	8 (6.9)	0.172
Calcium channel blockers	6 (1.6)	5 (1.3)	4 (1.6)	2 (1.7)	1
Follow-up data					
30-day revisit	25 (7.4)	0 (0.0)	17 (7.1)	8 (8.2)	0.72

TABLE 2. Continued.

	Total	Missing values	Effective CV	Non-effective CV	*p*-value
	(N = 372)	n (%)	(N = 254)	(N = 118)	
	n (%)		n (%)	n (%)	
Symptoms of revisit[5]					
Palpitations	17 (68.0)	0 (0.0)	11 (64.7)	6 (75.0)	1
Thoracic discomfort	8 (32.0)	0 (0.0)	6 (35.3)	2 (25.0)	1
Shortness of breath	2 (8.0)	0 (0.0)	2 (11.8)	0 (0.0)	1
ECG in AF of 30-days revisit	25 (7.4)	0 (0.0)	17 (7.1)	8 (8.2)	0.72

CV—cardioversion; AF—atrial fibrillation; SD—standard deviation; ASA—acetyl-salicylic acid; SBP—systolic blood pressure; DBP—diastolic blood pressure; HR—heart rate; bpm—beats per minute; ED—emergency department; DCC—direct current cardioversion.

[1]Dizziness or similar: dizziness, pre-syncope, syncope, sensation of instability. [2]Other symptoms: abdominal pain, sickness. [3]IV beta-blockers: propranolol, esmolol. [4]Calculation performed only for patients who did not receive previous anticoagulant treatment (n = 206).[5]Analysis performed in patients who presented revisit at 30 days. The sum is greater than 100% because the same patient may present more than one symptom as a reason for reconsultation (n = 25).

TABLE 3. Analysis of the unadjusted and adjusted odds ratio for the variable effectiveness of cardioversion.

	Unadjusted OR (95% CI)	*p*-value	Adjusted OR (95% CI)	*p*-value
Demographic data				
Age ≥75 years	0.35 (0.22–0.57)	<0.001	0.57 (0.29–1.12)	0.102
Male	1.67 (1.07–2.60)	0.024	1.69 (0.95–3.00)	0.075
Comorbidity				
Heart valve disease	0.54 (0.33–0.89)	0.016	0.78 (0.39–1.57)	0.486
History of heart failure	0.48 (0.28–0.84)	0.008	0.74 (0.32–1.72)	0.487
Coronary artery disease	0.53 (0.30–0.96)	0.034	0.52 (0.22–1.24)	0.142
Chronic renal failure	0.49 (0.28–0.87)	0.014	1.10 (0.48–2.52)	0.815
Stroke	0.40 (0.18–0.88)	0.02	0.75 (0.21–2.72)	0.666
Peripheral vascular disease	0.34 (0.15–0.77)	0.007	0.34 (0.11–1.03)	0.057
Home treatment				
Calcium channel blockers	0.47 (0.27–0.83)	0.007	0.57 (0.27–1.22)	0.145
Acute episode data				
AF lasting ≤48 hours	2.41 (1.54–3.77)	<0.001	2.14 (1.16–3.59)	0.015
Clinical data				
Palpitations	1.82 (1.17–2.84)	0.008	0.63 (0.31–1.28)	0.199
Shortness of breath	0.32 (0.16–0.61)	<0.001	0.92 (0.31–2.71)	0.879
ED treatment				
Digoxin	0.20 (0.11–0.36)	<0.001	0.28 (0.13–0.60)	0.001
Amiodarone	0.35 (0.22–0.58)	<0.001	0.52 (0.27–0.99)	0.050

AF—atrial fibrillation; SD—standard deviation; CV—cardioversion; OR: odds ratio; CI—confidence interval; ED—emergency department.

Adjusted model: age ≥75 years, male, heart valve disease, history of heart failure, coronary artery disease, chronic renal failure, stroke, peripheral vascular disease, home treatment with calcium channel blockers, antiarrhythmic class Ic or amiodarone; systolic blood pressure <90 mmHg in ED, AF lasting ≤48 hours, palpitations, shortness of breath, dizziness or similar (pre-syncope, syncope, sensation of instability), digoxin or amiodarone in ED.

as heart failure, coronary artery disease or heart valve disease. Calcium channel blockers and digoxin are drugs used for heart rate control and have no effect on rhythm control [27]. While amiodarone is frequently used in the ED, especially in patients in whom class Ic drugs are contraindicated, its effect is slow [28]. The AVRO clinical assay, which compared vernakalant

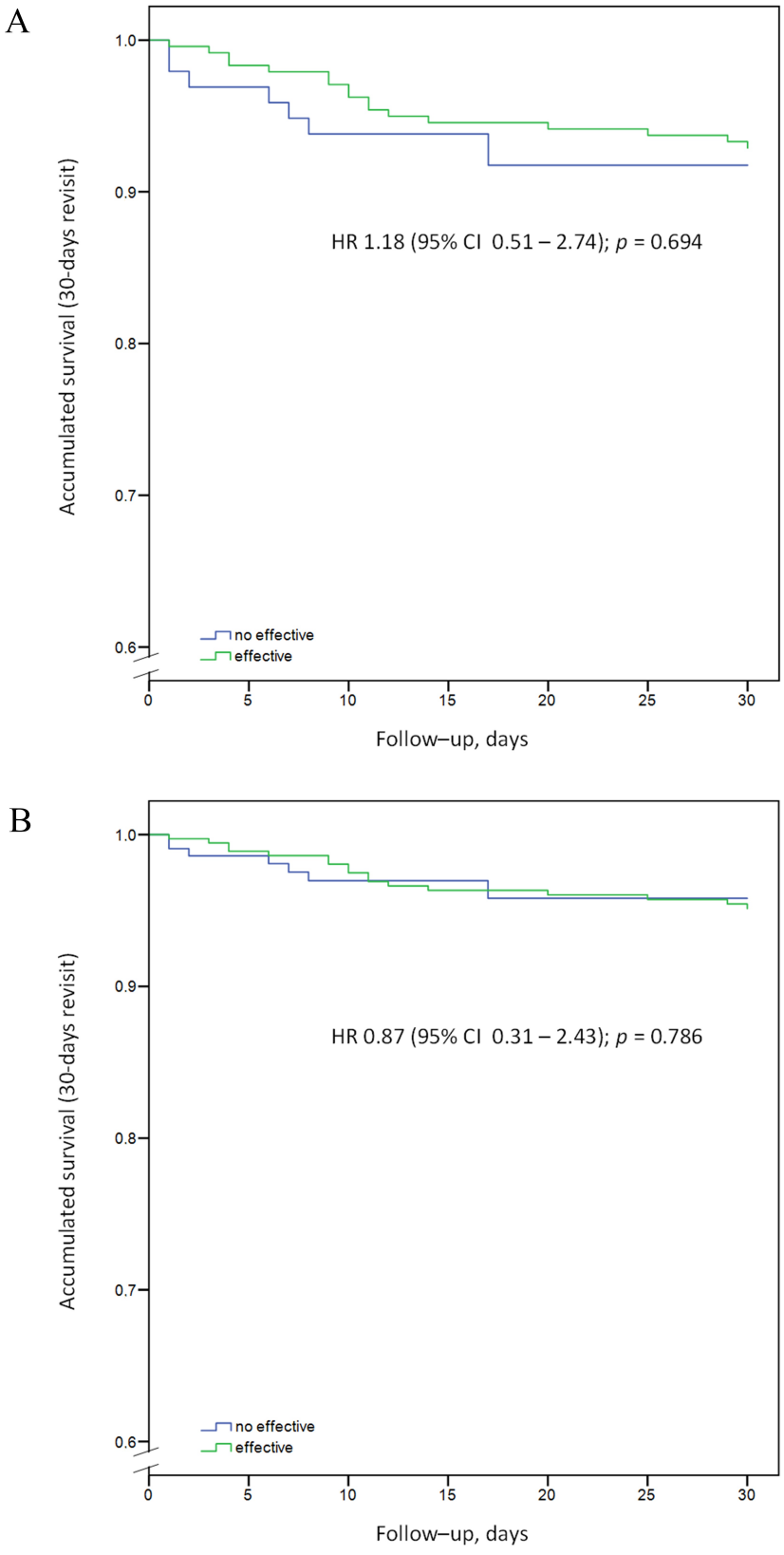

FIGURE 2. Survival curves for ED revisit at 30 days for a new episode of AF according to the effectiveness of cardioversion (n = 336). (A) unadjusted HR; (B) adjusted HR. Adjustment made based on the following variables: age ≥75 years, gender, history of heart valve disease, previous heart failure, ischaemic heart disease, chronic renal failure, stroke, peripheral vascular disease; use of calcium blockers, amiodarone; duration of AF <48 hours, presence of palpitations, shortness of breath or dizziness; CHA_2DS_2-VASc ≥2 points, use of digoxin or amiodarone in the emergency department, use of digoxin or beta-blockers at discharge from the emergency department.

with amiodarone. Its use in ED is safe and effective revealed that while amiodarone only achieved restoration of SR in 22.6% of patients after 4 hours of treatment, its use in the ED is safe and effective [29, 30]. In another study comparing flecainide, propafenone and amiodarone, amiodarone achieved SR restoration in 30% of patients after 6 hours of infusion [25]. Although amiodarone is a class I (level of evidence A) indication for patients with recent-onset AF and structural heart disease, we believe it is over-used in the ED and is scarcely effective.

This observational cohort study had several limitations, including the small number of patients undergoing cardioversion in the initial study group (31%). Nonetheless, in several previous registries, such as the Canadian registry or the GEFAUR-1 study, only 42% of all the eligible patients received rhythm control therapy [17–19]. Another limitation is that we reported patients who revisited the ED for a new episode of AF or symptoms related to AF, but we did not monitor the remaining patients with ECG, and therefore, the true incidence of recurrent asymptomatic AF at 30-days was likely underestimated. Additionally, the instructions given to patients in the index visit in regard to when to revisit the ED were not standardised among the emergency physicians from the different centres participating in the study, and thus, there may have been a hospital-dependent bias in revisit. On the other hand, another limitation was that we have no follow-up data related to ablation, which is a technique that should be evaluated in patients with AF. In our setting, the guidelines of the European Society of Cardiology are followed, and ED physicians evaluate the need for referral to an arrhythmia unit for a complete study and ablation, if indicated, in all AF cases [9]. We believe that the lack of data on ablation in our study did not affect the results since, in our country, this technique is not usually carried out before 30 days.

5. Conclusion

In summary, the variable associated with the success of cardioversion was mainly the short duration of AF (acute AF) and with the failure the use of digoxin and amiodarone. No association was found between the absence of restoration of SR and a higher 30-day ED revisit related to AF. In patients with AF, emergency physicians should determine whether patients are good candidates for ablation regardless of cardioversion outcomes. Therefore, each case must be independently evaluated and referred to an arrhythmia unit if necessary.

AVAILABILITY OF DATA AND MATERIALS

The data presented in this study are available on reasonable request from the corresponding author.

AUTHOR CONTRIBUTIONS

IC—conceived the study, participated in its design and coordination and helped to draft the manuscript; JJ—participated in the design of the study and performed the statistical analysis; OY, MA, JAG, AM, PF, JS, AE, AZ, JMM—participated in data collection and revision of the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The present study was conducted according to the Declaration of Helsinki on Ethical Principles for Medical Research Involving Human Subjects, and patients provided informed consent to participate and to be contacted for follow-up. Patient data were anonymized for the purposes of this registry and patient confidentiality was maintained according to national standards. The study was approved by the Clinical Research Ethics Committee of Bellvitge University Hospital, Barcelona, Spain (reference number PR354/16).

ACKNOWLEDGMENT

We thank CERCA Programme/Generalitat de Catalunya for institutional support.

Members of the investigative team of the URGFAICS study: Oriol Yuguero, Xavier Ichart Tomas, Anna Moreno Pena (Hospital Arnau de Vilanova); Jorge-Alexis Guzman, Paloma Francés, Jesús Galvez Mora (Hospital Universitari Joan XXIII); Josep-Maria Mòdol, Anna Esquerrà, Adrià Steinherr, Neus Robert (Hospital Universitari Germans Trias i Pujol de Badalona); Javier Jacob, Irene Cabello, Alvaro Zarauza, Genis Camprubí (Hospital Universitari de Bellvitge); María Arranz, Julia Santos, Loreto Espuis Albas, Javier Del Castillo Nos, Àngel Sierra Moreno, Cristina Herranz Martínez (Hospital de Viladecans).

FUNDING

This research received no external funding.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

[1] Staerk L, Wang B, Preis SR, Larson MG, Lubitz SA, Ellinor PT, *et al*. Lifetime risk of atrial fibrillation according to optimal, borderline, or elevated levels of risk factors: cohort study based on longitudinal data from the Framingham heart study. The BMJ. 2018; 361: k1453.

[2] Benjamin EJ, Muntner P, Alonso A, Bittencourt MS, Callaway CW, Carson AP, *et al*. Heart disease and stroke statistics-2019 update: a report from the American Heart Association. Circulation. 2019; 139: e56–e528.

[3] Coll-Vinent B, Fuenzalida C, Garcia A, Martin A, Miró O. Management of acute atrial fibrillation in the emergency department: a systematic review of recent studies. European Journal of Emergency Medicine. 2013; 20: 151–159.

[4] Cohen M, Naccarelli GV. Pathophysiology and disease progression of atrial fibrillation: importance of achieving and maintaining sinus rhythm. Journal of Cardiovascular Electrophysiology. 2008; 19: 885–890.

[5] Kirchhof P, Camm AJ, Goette A, Brandes A, Eckardt L, Elvan A, *et al*. Early rhythm-control therapy in patients with atrial fibrillation. New England Journal of Medicine. 2020; 383: 1305–1316.

[6] Willems S, Meyer C, de Bono J, Brandes A, Eckardt L, Elvan A, *et al*.

Cabins, castles, and constant hearts: rhythm control therapy in patients with atrial fibrillation. European Heart Journal. 2019; 40: 3793–3799c.

[7] Wyse DG, Waldo AL, Dimarco JP, Domanski MJ, Rosenberg Y, Schron EB, *et al*. A comparison of rate control and rhythm control in patients with atrial fibrillation. The New England Journal of Medicine. 2002; 347: 1825–1833.

[8] Cohn BG, Keim SM, Yealy DM. Is emergency department cardioversion of recent-onset atrial fibrillation safe and effective? The Journal of Emergency Medicine. 2013; 45: 117–127.

[9] Hindricks G, Potpara T, Dagres N, Arbelo E., Bax JJ, Blomström-Lundqvist C, *et al*. 2020 ESC Guidelines for the diagnosis and management of atrial fibrillation developed in collaboration with the European Association for Cardio-Thoracic Surgery (EACTS). European Heart Journal. 2021; 42: 373–498.

[10] Osmanagic A, Möller S, Osmanagic A, Sheta HM, Vinther KH, Egstrup K. Effect of early direct current cardioversion on the recurrence of atrial fibrillation in patients with persisten atrial fibrillation. The American journal of cardiology. 2015; 116: 225–229.

[11] Klein AL, Grimm RA, Jasper SE, Murray RD, Apperson-Hansen C, Lieber EA, *et al*. Efficacy of transesophageal echocardiography-guided cardioversion of patients with atrial fibrillation at 6 months: a randomized controlled trial. American Heart Journal. 2006; 151: 380–389.

[12] Dorian P, Cvitkovic SS, Kerr CR, Crystal E, Gillis AM, Guerra PG, *et al*. A novel, simple scale for assessing the symptom severity of atrial fibrillation at the bedside: the CCS-SAF scale. Canadian Journal of Cardiology. 2006; 22: 383–386.

[13] Jacob J, Cabello I, Yuguero O, Alexis Guzmán J, Arranz Betegón M, Abadías MJ, *et al*. Emergency Atrial Fibrillation Registry of the Catalan Institute of Health (URGFAICS): analysis by type of atrial fibrillation and revisits within 30 days. Emergencias. 2019; 31: 99–106.

[14] Wynn GJ, Todd DM, Webber M, Bonnett L, McShane J, Kirchhof P, *et al*. The european heart rhythm association symptom classification for atrial fibrillation: validation and improvement through a simple modification. Europace. 2014; 16: 965–972.

[15] Coll-Vinent B, Martín A, Sánchez J, Tamargo J, Suero C, Malagón F, *et al*. Benefits of Emergency Departments' Contribution to Stroke Prophylaxis in Atrial Fibrillation: The EMERG-AF Study (Emergency Department Stroke Prophylaxis and Guidelines Implementation in Atrial Fibrillation). Stroke. 2017; 48: 1344–1352.

[16] Martín A, Coll-Vinent B, Suero C, Fernández-Simón A, Sánchez J, Varona M, *et al*. Benefits of rhythm control and rate control in recent-onset atrial fibrillation. the HERMES-AF study. Academic Emergency Medicine. 2019; 26: 1034–1043.

[17] del Arco C, Martín A, Laguna P, Gargantilla P. Analysis of current management of atrial fibrillation in the acute setting: gefaur-1 study. Annals of Emergency Medicine. 2005; 46: 424–430.

[18] Rosychuk RJ, Graham MM, Holroyd BR, Rowe BH. Emergency department presentations for atrial fibrillation and flutter in Alberta: a large population-based study. BMC Emergency Medicine. 2017; 17: 2.

[19] Stiell IG, Sivilotti MLA, Taljaard M, Birnie D, Vadeboncoeur A, Hohl CM, *et al*. Electrical versus pharmacological cardioversion for emergency department patients with acute atrial fibrillation (RAFF2): a partial factorial randomised trial. The Lancet. 2020; 395: 339–349.

[20] Carbajosa-Dalmau J, Martín A, Paredes-Arquiola L, Jacob J, Coll-Vinent B, Llorens P. Safety of emergency-department electric cardioversion for recent-onset atrial fibrillation. emergencias. 2019; 31: 335–340.

[21] Schmidt AS, Lauridsen KG, Møller DS, Christensen PD, Dodt KK, Rickers H, *et al*. Anterior–lateral versus anterior–posterior electrode position for cardioverting atrial fibrillation. Circulation. 2021; 144: 1995–2003.

[22] Stiell IG, Clement CM, Rowe BH, Brison RJ, Wyse DG, Birnie D, *et al*. Outcomes for emergency department patients with recent-onset atrial fibrillation and flutter treated in canadian hospitals. Annals of Emergency Medicine. 2017; 69: 562–571.e2.

[23] Fernández A, Coll-Vinent B, Martín A, Suero C, Sánchez J, Varona M, *et al*. Cardioversion in recent onset atrial fibrillation. Emergencias. 2019; 31: 227–233.

[24] Crijns HJ, Weijs B, Fairley AM, Lewalter T, Maggioni AP, Martín A, *et al*. Contemporary real life cardioversion of atrial fibrillation: Results from the multinational RHYTHM-AF study. International Journal of Cardiology. 2014; 172: 588–594.

[25] Conti A, Del Taglia B, Mariannini Y, Pepe G, Vanni S, Grifoni S, *et al*. Management of patients with acute atrial fibrillation in the ED. The American Journal of Emergency Medicine. 2010; 28: 903–910.

[26] Pluymaekers NAHA, Dudink EAMP, Luermans JGLM, Meeder JG, Lenderink T, Widdershoven J, *et al*. Early or delayed cardioversion in recent-onset atrial fibrillation. New England Journal of Medicine. 2019; 380: 1499–1508.

[27] McGrath P, Kersten B, Chilbert MR, Rusch C, Nadler M. Evaluation of metoprolol versus diltiazem for rate control of atrial fibrillation in the emergency department. The American Journal of Emergency Medicine. 2021; 46: 585–590.

[28] Cabello I, Jacob J, Arranz M, Yuguero O, Guzman J, Moreno-Pena A, *et al*. Impact of emergency department management of atrial fibrillation with amiodarone on length of stay. A propensity score analysis based on the URGFAICS registry. European Journal of Emergency Medicine. 2020; 27: 429–435.

[29] Camm AJ, Capucci A, Hohnloser SH, Torp-Pedersen C, Van Gelder IC, Mangal B, *et al*. A randomized active-controlled study comparing the efficacy and safety of vernakalant to amiodarone in recent-onset atrial fibrillation. Journal of the American College of Cardiology. 2011; 57: 313–321.

[30] Carbajosa Dalmau J, Cosín-Sales J, Pérez-Durá MJ, Urtubia-Palacios A, Hernández-Sori N, Peiró-Gómez A, *et al*. Vernakalant in hospital emergency practice: safety and effectiveness. Emergencias. 2017; 29: 397–402. (In Spanish)

How to cite this article: Irene Cabello, Javier Jacob, Oriol Yuguero, María Arranz, Jorge-Alexis Guzmán, Anna Moreno, *et al*. Factors related to the success or failure of cardioversion in atrial fibrillation and emergency department revisit according to restoration of sinus rhythm: analysis of the URGFAICS cohort. Signa Vitae. 2023; 19(2): 39-47. doi: 10.22514/sv.2022.020.