Open Access

Original Article

Predictors of Short and Long-Term Success of Electrical Cardioversion in Persistent Atrial Fibrillation

Hira Ahmad, Muhammad Shabbir, Huma Mushtaq*, Shahid Mukarram*, Tehreem Fahd*, Syed Sajidain Syed*

Department of Cardiac Electrophysiology, Armed Forces Institute of Cardiology & National Institute of Heart Diseases/National University of Medical Sciences (NUMS), Rawalpindi Pakistan, *Department of Cardiology, Armed Forces Institute of Cardiology & National Institute of Heart Diseases/ National University of Medical Sciences (NUMS), Rawalpindi Pakistan

ABSTRACT

Objective: To determine the predictors of short-term and long-term success of electrical cardioversion in persistent atrial fibrillation.

Study Design: Prospective longitudinal study.

Place and Duration of Study: Department of Cardiology, Electrophysiology Division, Armed Forces Institute of Cardiology & National Institute of Heart Diseases (AFIC-NIHD), Rawalpindi Pakistan, from Sep 2024 to Apr 2025.

Methodology: A total of 119 male and female patients aged 20 to 90 years diagnosed with persistent atrial fibrillation. Patients with valvular heart disease, prior history of electrical cardioversion, paroxysmal atrial fibrillation, and left atrial clot were excluded. Electrical cardioversion was performed, and short-term (sinus rhythm restoration after a week) and long-term (sinus rhythm restoration after three months) success was noted. Data analysis was carried out using Statistical Package for the Social Sciences (SPSS) version 26.

Results: The mean age of the participants was 55.95±11.46 years, and the mean Atrial Fibrillation (AF) duration was 12.63±3.72 days. Patients aged more than 50 years were 77(64.7%), and 72(60.5%) patients were male. Successful cardioversion was recorded in 104 patients (87.4%). Short-term and long-term success was recorded in 92(77.3%) and 80(67.2%) patients, respectively. Acute successful cardioversion was more frequent when performed by a consultant with more than 12 years of experience (91.0% versus 76.7%, *p*-value 0.041).

Conclusion: Electrical cardioversion was shown to be an effective and successful therapy for persistent atrial fibrillation. Although success rates inevitably declined over time, the promising early outcomes demonstrate that electrical cardioversion is a dependable first-line technique for restoring sinus rhythm.

Keywords: Atrial Fibrillation, Electrocardiography, Electrical Cardioversion, Sinus Rhythm, Treatment Outcome.

How to Cite This Article: *Ahmad H, Shabbir M, Mushtaq H, Mukarram S, Fahd T, Syed SS. Predictors of Short and Long-Term Success of Electrical Cardioversion in Persistent Atrial Fibrillation. Pak Armed Forces Med J 2025; 76(Suppl-1): S229-S233.*
DOI: https://doi.org/10.51253/pafmj.v76iSUPPL-1.13818

INTRODUCTION

Atrial fibrillation (AF) affects approximately 2.3 million individuals in the United States alone, and its occurence increases with age,[1] leading to catastrophic complications, including thromboembolic phenomena and death.[2] Current treatment options available include rate-limiting agents and anticoagulants, and electrical or pharmacological cardioversion,[3] however, treatment goal is restoration of normal sinus rhythm as it not only decreases thromboembolic phenomena and complications of anticoagulation therapy but also improves cardiac function.[4] Electrical cardioversion (EC) is the preferred treatment due to its rapid restoration of a normal sinus rhythm (NSR), higher success rate, and fewer adverse effects.[5] Multiple studies have explored factors affecting the outcomes of EC, aiming to identify factors associated with increased efficacy of electrical cardioversion with increasing age, increased body mass index (BMI), long duration of AF comorbid conditions, Left Ventricle (LV) dysfunction, deranged Thyroid Function Tests (TFTs), and enlargement of the left Atrium (LA), to be the factors determining recurrence of AF, whereas others showed contradictory results.[6,7] In the AFFIRM (Atrial Fibrillation Follow-up Investigation of Rhythm Management) study, LA diameter was shown to be a strong predictor of AF recurrence, within 6 months of successful cardioversion, particularly when the diameter exceeded 5.0 cm, while P-wave duration of >135 milliseconds was noted as another risk factor.[8] Furthermore, young age and short duration of AF <3 months and concomitant antiarrhythmic therapy have been associated with favorable outcomes of EC with increased likelihood of long-term maintenance of NSR.[9,10] Few studies in Pakistan explored factors associated with the success rate and recurrence of

Correspondence: Dr Hira Ahmad, Department of Cardiac Electrophysiology, AFIC & NIHD, Rawalpindi Pakistan
Received: 06 Sep 2025; revision received: 20 Nov 2025; accepted: 21 Nov 2025

atrial fibrillation after electrical cardioversion in patients with persistent atrial fibrillation. This study aims to generate local evidence on this important problem and provide a platform for future research on this topic and to determine the predictors of short-term and long-term success of electrical cardioversion in persistent atrial fibrillation.

METHODOLOGY

This study was conducted at the Department of Cardiology, Electrophysiology Division, AFIC-NIHD, Rawalpindi Pakistan, from September 2024 to April 2025, after obtaining ethics approval from the Ethics Committee of AFIC/NIHD on 12th September 2024 (Approval No: 9/2/R&D/2024/328).

Persistent atrial fibrillation was defined as atrial fibrillation episodes lasting >7 days or requiring termination by electrical or medical cardioversion.[11,12] Restoration of sinus rhythm after electrical cardioversion, confirmed on ECG, was labelled successful cardioversion, persistence of sinus rhythm at seven-day follow-up was called short-term success, and sinus rhythm at 3 months was called long-term success. The sample size was 119 was calculated using the World Health Organisation (WHO) sample size calculator, with an anticipated occurrence of persistent AF of 8.4%, a 5% margin of error, and a 95% confidence level.[13] Participants were enrolled using a non-probability consecutive sampling technique.

Inclusion Criteria: Male and female patients, aged 20 to 90 years, diagnosed with persistent atrial fibrillation were included.

Exclusion Criteria: Patients with valvular heart disease, right atrial enlargement of more than 50mm, prior history of electrical cardioversion, paroxysmal atrial fibrillation, and left atrial clot were excluded.

Informed written consent was taken from all enrolled participants. Baseline information and demographics, including age (years), gender (male/female), Body mass index (BMI, weight in kg/height in m²), duration of AF (days), and comorbidities such as diabetes (HbA1c >6.5%) and hypertension (Blood Pressure > 140/80 mmHg), were recorded. History was taken and physical examinations were performed by co-researcher under the supervision of a consultant electrophysiologist. Echocardiography was performed to assess Left Ventricular Ejection Fraction (LVEF), Left Atrium (LA) size, and valve function. Patients continued to receive anticoagulation and other medicines. Direct Current Cardioversion (DCCV) was performed under conscious sedation. Two pairs of electrode patches were placed on the anterior chest wall, and a biphasic 200J shock was delivered using the electrode pair.[9] In the event of failure, a second shock was administered in the same manner. If the second shock failed, the third shock was administered at 200J, with electrodes placed in an anteroposterior position on the left side of the chest. A post-DCCV ECG was obtained to confirm successful cardioversion, as noted according to operational definitions. Upon stabilization, patients were discharged with home medications and scheduled for follow-up in the outpatient department at one week and then at three months. ECG was performed at each follow-up visit to assess both short-term and long-term success. Figure shows patient flow diagram of the study.

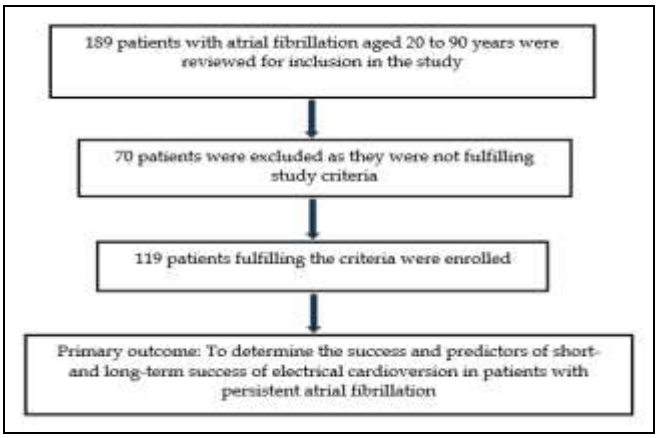

Figure: Patient Flow Diagram (n=119)

Data analysis was carried out using Statistical Package for the Social Sciences (SPSS) version 26. Means±SD were recorded for quantitative data, such as age, BMI, AF duration, and consultant experience, after checking the normality of the data with the Shapiro-Wilk test, while frequencies and percentages were recorded for qualitative data like gender, smoking history, comorbidities, successful cardioversion, short-term, and long-term success. Successful cardioversion, both in the short term and long term, was stratified by age, gender, BMI, duration of AF, smoking history, and comorbidities to control for effect modifiers. Chi-square test was applied where a p-value ≤0.05 was considered as statistically significant.

RESULTS

A total of 119 patients were enrolled with mean age of the participants being 55.95±11.46 years, mean BMI being 24.46±1.60 kg/m², mean AF duration being 12.63±3.72 days and mean consultant experience being

10.93±3.23 years. Participants aged 50 years or older were 77(64.7%), and 72(60.5%) were male while patients with a BMI of more than 24.0kg/m^2 were 75(63.0%) and 37(31.1%) patients had a history of smoking, as shown in Table-I.

Table-I: Baseline Parameters of Study Participants (n=119)

Parameters		n(%)
Age (years)	50 or below	42(35.3)
	More than 50	77(64.7)
Gender	Male	72(60.5)
	Female	47(39.5)
BMI (kg/m2)	24.0 or below	44(37.0)
	More than 24.0	75(63.0)
AF Duration (days)	10 or below	48(40.3)
	More than 10	71(59.7)
Smoking	Yes	37(31.1)
	No	82(68.9)
Comorbidities	Yes	34(28.6)
	No	85(71.4)
Consultant experience (years)	Above 12	89(74.8)
	Below 12	30(25.2)

BMI: Body mass index, AF: Atrial fibrillation

Successful cardioversion was recorded in 104(87.4%) patients with short-term success observed in 92(77.3%) patients, while long-term success was recorded in 80(67.2%) patients. Out of the total 89 patients, 81(91.0%) underwent successful cardioversion performed by a consultant with more than 12 years of experience, compared to 23(25.8%) patients who underwent cardioversion performed by a consultant with less than 12 years of experience, which was statistically significant (p-value =0.041) but no other significant association was recorded, as shown in Table-II.

Table-II: Association of Successful Cardioversion with Baseline Parameters (n=119)

		Successful CV n(%)		Total n(%)	p-value
		Yes	No		
Age (years)	50 or below	36(85.7)	6(14.3)	42(100.0)	0.683
	More than 50	68(88.3)	9(11.7)	77(100.0)	
Gender	Male	60(83.3)	12(16.7)	72(100.0)	0.098
	Female	44(93.6)	3(6.4)	47(100.0)	
BMI (kg/m2)	24.0 or below	41(93.2)	3(6.8)	44(100.0)	0.145
	More than 24.0	63(84.0)	12(16.0)	75(100.0)	
AF Duration (days)	10 or below	40(83.3)	8(16.7)	48(100.0)	0.272
	More than 10	64(90.1)	7(9.9)	71(100.0)	
Smoking	Yes	31(83.8)	6(16.2)	37(100.0)	0.425
	No	73(89.0)	9(11.0)	82(100.0)	
Comorbidities	Yes	28(82.4)	6(17.6)	34(100.0)	0.295
	No	76(89.4)	9(10.6)	85(100.0)	
Consultant Experience (years)	Above 12	81(91.0)	8(9.0)	89(100.0)	0.041
	Below 12	23(76.7)	7(23.3)	30(100.0)	

BMI: Body mass index, AF: Atrial fibrillation, CV: Cardioversion

Short-term success did not vary significantly across age, gender, BMI, AF duration, smoking status, or comorbidity groups. Consultant experience was the only factor independently associated with short-term success, with operators having more than 12 years of experience demonstrating higher success rates (p=0.009) as shown in Table-III.

Table-III: Association of Short-Term Success with Baseline Parameters (n=119)

		Short term success n(%)		Total n(%)	p-value
		Yes	No		
Age (years)	50 or below	33(78.6)	9(21.4)	42(100.0)	0.808
	More than 50	59(76.6)	18(23.4)	77(100.0)	
Gender	Male	54(75.0)	18(25.0)	72(100.0)	0.456
	Female	38(80.9)	9(19.1)	47(100.0)	
BMI (kg/m2)	24.0 or below	38(86.4)	6(13.6)	44(100.0)	0.071
	More than 24.0	54(72.0)	21(28.0)	75(100.0)	
AF Duration (days)	10 or below	33(68.8)	15(31.3)	48(100.0)	0.067
	More than 10	59(83.1)	12(16.9)	71(100.0)	
Smoking	Yes	32(86.5)	5(13.5)	37(100.0)	0.108
	No	60(73.2)	22(26.8)	82(100.0)	
Comorbidities	Yes	30(88.2)	4(11.8)	34(100.0)	0.078
	No	62(72.9)	23(27.1)	85(100.0)	
Consultant Experience (years)	Above 12	74(83.1)	15(16.9)	89(100.0)	0.009
	Below 12	18(60.0)	12(40.0)	30(100.0)	

BMI: Body mass index, AF: Atrial fibrillation

Long-term success did not differ significantly across age, gender, BMI, AF duration, or consultant experience but smoking status and the presence of comorbidities were significantly associated with long-term outcomes as patients with no history of smoking had lower success rates (p=0.010), and patients with comorbidities demonstrated higher long-term success (p=0.026). These findings suggest that long-term success is influenced more by patient-related clinical factors than by operator experience, as shown in Table-IV.

Table-IV: Association of Long-Term Success with Baseline Parameters (n=119)

		Long term success n(%)		Total n(%)	p-value
		Yes	No		
Age (years)	50 or below	30(71.4)	12(28.6)	42(100.0)	0.471
	More than 50	50(64.9)	27(35.1)	77(100.0)	
Gender	Male	46(63.9)	26(36.1)	72(100.0)	0.337
	Female	34(72.3)	13(27.7)	47(100.0)	
BMI (kg/m2)	24.0 or below	32(72.7)	12(27.3)	44(100.0)	0.328
	More than 24.0	48(64.0)	27(36.0)	75(100.0)	
AF Duration (days)	10 or below	30(62.5)	18(37.5)	48(100.0)	0.366
	More than 10	50(70.4)	21(29.6)	71(100.0)	
Smoking	Yes	31(83.8)	6(16.2)	37(100.0)	0.010
	No	49(59.8)	33(40.2)	82(100.0)	
Comorbidities	Yes	28(82.4)	6(17.6)	34(100.0)	0.026
	No	52(61.2)	33(38.8)	85(100.0)	
Consultant Experience (years)	Above 12	62(69.7)	27(30.3)	89(100.0)	0.329
	Below 12	18(60.0)	12(40.0)	30(100.0)	

BMI: Body mass index, AF: Atrial fibrillation

DISCUSSION

In our study, successful cardioversion with restoration of sinus rhythm was recorded in

104(87.4%) patients, short-term success was observed in 92(77.3%) patients while long-term success was recorded in 80(67.2%) patients. Our study results were significantly higher than literature, where reported success rate of 67% and long-term success rate of 72.0% was found.[10,14] However, another author reported acute successful cardioversion was observed in 94.5% patients, which was slightly higher than our findings while at long-term follow-up, a sinus rhythm was recorded in 61.0% of patients.[15] Better success rates were reported in another study which grouped patients according to the duration of AF, where acute success rate among patients with AF duration of less than 2 months was 98.5%, compared to 97.1% with AF duration of 2 to 4 months, and 96.5% with AF duration of more than 6 months.[16] We noted a successful cardioversion rate among patients aged more than 50 years at 88.3% versus 85.7% where females (93.6%) were more likely to have a successful cardioversion compared to males (83.3%), however, this difference was not statistically significant with similar observations recorded in relation to BMI and AF duration, supported by recent evidence.[17] While low BMI was frequently found in successful cardioversion, the success rate was statistically not different with those identified as having AF despite being underweight or of normal weight had a poorer prognosis than their obese counterparts.[18,19] Although no significant association between gender was noted, female patients had more frequent successful cardioversions, in contrast to another study where female patients had poor cardioversion outcomes.[20] There is evidence linking the length of AF to the transition from coarse to fine AF, but there is an indication that coarse AF patients have a better chance of entering and staying in sinus rhythm; however, this was unrelated to the length of AF.[21] A trial remodeling appears to be linked to the duration of AF, although rate-induced cellular calcium excess has also been demonstrated to promote atrial remodeling regardless of time, suggesting that atrial remodeling may also occur rapidly.[22]

LIMITATIONS OF STUDY

This study has several limitations. It was a single-center study with a relatively small sample size, which limits the generalizability of the findings. Additionally, the follow-up duration was relatively short, and atrial fibrillation recurrence was assessed using only a 12-lead ECG during follow-up visits; continuous monitoring with Holter or other ambulatory devices was not performed, which may have led to under-detection of asymptomatic or intermittent arrhythmias. Future multicenter studies with larger cohorts, longer follow-up, and comprehensive rhythm monitoring are warranted.

CONCLUSION

Electrical cardioversion was shown to be an effective and successful therapy for persistent atrial fibrillation with a significant relationship between acute procedure success and the experience of the attending physician, which highlights the importance of procedural expertise in enhancing effectiveness.

Conflict of Interest: None.

Funding Source: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

HA & MS: Data acquisition, data analysis, critical review, approval of the final version to be published.

HM & SM: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

TF & SSS: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. Shima N, Miyamoto K, Kato S, Yoshida T, Uchino S. Primary success of electrical cardioversion for new-onset atrial fibrillation and its association with clinical course in non-cardiac critically ill patients: sub-analysis of a multicenter observational study. J Intensive Care 2021; 9(1): 46. https://doi.org/10.1186/s40560-021-00562-8
2. Yoshida T, Uchino S, Sasabuchi Y, Hagiwara Y. Prognostic impact of sustained new-onset atrial fibrillation in critically ill patients. Intensive Care Med 2020; 46(1): 27-35. https://doi.org/10.1007/s00134-019-05822-8
3. Yoshida T, Uchino S, Sasabuchi Y. Clinical course after identification of new-onset atrial fibrillation in critically ill patients: The AFTER-ICU study. J Crit Care 2020; 59: 136-142. https://doi.org/10.1016/j.jcrc.2020.06.014
4. Arrigo M, Jaeger N, Seifert B, Spahn DR, Bettex D, Rudiger A. Disappointing success of electrical cardioversion for new-onset atrial fibrillation in cardiosurgical ICU patients. Crit Care Med 2015; 43(11): 2354-2359. https://doi.org/10.1097/CCM.0000000000001257
5. 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). Eur Heart J 2021; 42(5): 373-498. https://doi.org/10.1093/eurheartj/ehaa612
6. Klein Klouwenberg PM, Frencken JF, Kuipers S, Ong DS, Peelen LM, van Vught LA, et al. Incidence, predictors, and outcomes of new-onset atrial fibrillation in critically ill patients with sepsis: a cohort study. Am J Respir Crit Care Med 2017; 195(2): 205-211. https://doi.org/10.1164/rccm.201603-0618OC

7. Brandes A, Crijns H, Rienstra M, Kirchhof P, Grove EL, Pedersen KB, et al. Cardioversion of atrial fibrillation and atrial flutter revisited: current evidence and practical guidance for a common procedure. Europace 2020; 22(8): 1149-1161. https://doi.org/10.1093/europace/euaa057
8. Nguyen ST, Belley-Côté EP, Ibrahim O, Um KJ, Lengyel A, Adli T, et al. Techniques improving electrical cardioversion success for patients with atrial fibrillation: a systematic review and meta-analysis. Europace 2023; 25(2): 318-330. https://doi.org/10.1093/europace/euac199
9. Vinter N, Holst-Hansen MZB, Johnsen SP, Lip GYH, Frost L, Trinquart L. Electrical energy by electrode placement for cardioversion of atrial fibrillation: a systematic review and meta-analysis. Open Heart 2023; 10(2): e002456. https://doi.org/10.1136/openhrt-2023-002456
10. Kuppahally SS, Foster E, Shoor S, Steimle AE. Short-term and long-term success of electrical cardioversion in atrial fibrillation in managed care system. Int Arch Med 2009; 2: 39. https://doi.org/10.1186/1755-7682-2-39
11. Huo Y, Gaspar T, Schönbauer R, Wójcik M, Fiedler L, Roithinger FX, et al. Low-voltage myocardium-guided ablation trial of persistent atrial fibrillation. NEJM Evid 2022; 1(11): EVIDoa2200141. https://doi.org/10.1056/EVIDoa2200141
12. Blum S, Aeschbacher S, Meyre P, Zwimpfer L, Reichlin T, Beer JH, et al. Incidence and predictors of atrial fibrillation progression. J Am Heart Assoc 2019; 8(20): e012554. https://doi.org/10.1161/JAHA.119.012554
13. Nguyen BO, Weberndorfer V, Crijns HJ, Geelhoed B, Ten Cate H, Spronk H, et al. Prevalence and determinants of atrial fibrillation progression in paroxysmal atrial fibrillation. Heart 2022; 109(3): 186-194. https://doi.org/10.1136/heartjnl-2022-321027
14. Frick M, Frykman V, Jensen-Urstad M, Ostergren J, Rosenqvist M. Factors predicting success rate and recurrence of atrial fibrillation after first electrical cardioversion in patients with persistent atrial fibrillation. Clin Cardiol 2001; 24(3): 238-244. https://doi.org/10.1002/clc.4960240313
15. Blich M, Edoute Y. Electrical cardioversion for persistent or chronic atrial fibrillation: outcome and clinical factors predicting short and long term success rate. Int J Cardiol 2006; 107(3): 389-394. https://doi.org/10.1016/j.ijcard.2005.03.057
16. Toso E, Blandino A, Sardi D, Battaglia A, Garberoglio L, Miceli S, et al. Electrical cardioversion of persistent atrial fibrillation: acute and long-term results stratified according to arrhythmia duration. Pacing Clin Electrophysiol 2012; 35(9): 1126-1134. https://doi.org/10.1111/j.1540-8159.2012.03453.x
17. Ebert M, Stegmann C, Kosiuk J, Dinov B, Richter S, Arya A, et al. Predictors, management, and outcome of cardioversion failure early after atrial fibrillation ablation. Europace 2018; 20(9): 1428-1434. https://doi.org/10.1093/europace/eux327
18. Kang SH, Choi EK, Han KD, Lee SR, Lim WH, Cha MJ, et al. Underweight is a risk factor for atrial fibrillation: a nationwide population-based study. Int J Cardiol 2016; 215: 449-456. https://doi.org/10.1016/j.ijcard.2016.04.036
19. Wang J, Yang YM, Zhu J, Zhang H, Shao XH, Tian L, et al. Overweight is associated with improved survival and outcomes in patients with atrial fibrillation. Clin Res Cardiol 2014; 103(7): 533-542. https://doi.org/10.1007/s00392-014-0681-7
20. Hellman T, Kiviniemi T, Vasankari T, Nuotio I, Biancari F, Bah A, et al. Prediction of ineffective elective cardioversion of atrial fibrillation: a retrospective multi-center patient cohort study. BMC Cardiovasc Disord 2017; 17(1): 33. https://doi.org/10.1186/s12872-017-0470-0
21. Zhao TX, Martin CA, Cooper JP, Gajendragadkar PR. Coarse fibrillatory waves in atrial fibrillation predict success of electrical cardioversion. Ann Noninvasive Electrocardiol 2018; 23(4): e12528. https://doi.org/10.1111/anec.12528
22. Goette A, Honeycutt C, Langberg JJ. Electrical remodeling in atrial fibrillation. Time course and mechanisms. Circulation 1996; 94(11): 2968-2974. https://doi.org/10.1161/01.CIR.94.11.2968