Journal of BMANA

DOI: https://doi.org/XXXXXXX-XXXXXXX

Review Article

Controversies and updates in management of atrial fibrillation

Azizul Hoque, MD, PhD, FACC.

[1] Division of Cardiology, Emory University School of Medicine, Atlanta, USA

Abstract

Atrial fibrillation (AF) is the most common arrhythmia leading to multiple comorbidities and cardiovascular (CV) mortality. Several controversies and questions always existed in the management of AF: the clinical significance of earlier detection of AF, importance of the duration and burden of AF, optimal rate control, rate and rhythm control controversies, stroke prevention strategies, cardioversion in AF less than 48 hours without prior anticoagulation, inadequate stroke risk assessment with current AF stroke risk calculators, dilemma of using class 1C antiarrhythmic drugs (AADs) in patients with AF with coronary artery disease (CAD), and when and how to perform catheter based AF ablation, etc. Recent knowledge from multiple observational, prospective and randomized control trials (RCTs) have helped us reshape our understanding in those areas to better treat those patients with tailored approaches taking into consideration of individual stroke and bleeding risk assessments.

Key Words: Atrial fibrillation, controversies, rate and rhythm control, antiarrhythmic drugs, catheter ablation.

Among arrhythmias, atrial fibrillation (AF) is the most common sustained form leading to multiple comorbidities, such as stroke, heart failure (HF) and dementia.[1] Prevalence of AF has been increasing with better detection, aging of the population, and longer survival of patients with AF.[1,2] Over the last decades, AF management has evolved from rate control to a more proactive rhythm control strategy to achieve and maintain in sinus rhythm. Several controversies persisted over the last decades about understanding of the mechanisms, detection and management of AF, which included rate control vs rhythm control strategies, choice of antiarrhythmic therapies, stroke prevention strategies, cardioversion and ablation therapies. With accumulation of enormous data from registries, prospective and RCTs, we have better understanding in certain areas, but some controversies still persist. The purpose of this review is to highlight some of the clinical controversies and progress in these areas.

Detection and burden of AF

AF is a global epidemic associated with comorbidity and mortality. Early detection of AF is essential to initiate a comprehensive approach to management, slow the progression of the disease, prevent complications like stroke and HF, and most importantly improve survival.[3]

AF is commonly diagnosed when the patient presents with symptomatic arrhythmia to a healthcare facility. In an asymptomatic patient, it could be detected on a routine clinical examination, by cardiac monitoring, implantable loop recorder (ILR), pacemaker interrogation, and recently, by smart wearable devices. The 12 lead ECG, once considered as the gold standard to confirm the diagnosis of AF, is only relevant in persistent AF, not in paroxysmal AF. Since 30% of strokes are cryptogenic, potentially from unrecognized AF, continuous monitoring with an ILR has shown increased detection of subclinical AF.[4,5] Initial data with ILR devices reported that even short episodes of AF were associated with increased risk of stroke.[6] Interestingly, in the randomized LOOP trial occult AF detection rate was nearly 30% in the ILR arm of this trial, but the reductions in stroke or systemic embolism risk were lower to usual care despite being on appropriate oral anticoagulation, which suggests that shorter duration subclinical AF might have less clinical importance compared to longer duration and/or clinically significant AF.[7] Upon further analysis the LOOP study also revealed that the subjects who had elevated levels of NT-proBNP were at higher risk of thromboembolic events or HF compared with those with lower levels,[8] suggesting the importance of finding those subsets of patients with AF who not only are at higher risk of stroke but also at risk of progression of HF.

However, the question remains what duration and burden of AF are clinically important to prevent stroke or systemic embolism, HF, or other adverse cardiovascular outcomes? AF burden is defined as the percentage of monitored time the person remains in AF.[9] Results from multiple studies have shown that the greater the burden of AF, the higher the risk of stroke and HF.[10-13] However, the episode duration related to increased stroke risk is variable.[6,10,11,14]

In the ASSERT study, subclinical AF episodes lasting at least 6 min were associated with an increased risk of stroke.[6] However, results from TRENDS,[12] the Combined Use of BIOTRONIK Home Monitoring and Predefined Anticoagulation to Reduce Stroke Risk (IMPACT)[15] study, and a time-dependent analysis for ASSERT[6] did not show clear temporal relationship between episodes of subclinical AF and stroke.[15,16] This further complicates our understanding of a connection between atrial stasis, thrombus formation, and stroke and raises the possibility that stroke mechanisms could be independent of episodes of subclinical AF.[16]

The recently published Apixaban for Stroke Prevention in Subclinical Atrial Fibrillation (ATRESIA) trial showed that for patients with subclinical AF lasting 6 min to 24 hours, anticoagulation with apixaban resulted in a lower risk of stroke or systemic embolism than aspirin, but a higher risk of major bleeding.[17] Similarly, the NOAH-AFNET 6 trial demonstrated no reduction in CV death, stroke, or systemic embolism with edoxaban compared with placebo in a population at increased risk of stroke and with incidentally detected atrial high-rate episodes (AHRE) but without known AF, independent of AHRE duration.[18] This study results suggest that the diagnosis of AF itself carries an increased stroke risk, compared to those exhibiting only AHRE. AHRE is still clinically relevant since about 1 in 5 patients was ultimately diagnosed with AF in this study. Unfortunately, the stroke risk calculators, such as CHA_2DS^2 -VASc, (Table 1), ATRIA [19-21]

GRAFIELD-AF[22,23] were not developed taking into consideration of the burden of AF. Rather, they merely incorporated the presence or absence of AF. such as CHA_2DS_2-VASc, (Table 1), ATRIA19-21 and GRAFIELD-AF[22,23] were not developed taking into consideration of the burden of AF. Rather, they merely incorporated the presence or absence of AF.

While the debate continues, based on the current strength of evidence, recently published ACC/AHA/ACCP/HRS guideline for AF recommends that for patients who have device-detected AF with high-rate episodes lasting greater than 24 hrs and CHA_2DS_2-VASc score <2, it is reasonable to initiate oral anticoagulation after discussion with the patient.[24] For patients who have device-detected AF from 5 min to 24 hrs with CHA_2DS_2-VASc score <3, with shared decision-making, it is reasonable to start oral anticoagulation for stroke prevention.[24] In patients with device-detected AF episodes lasting less than 5 min without another indication for anticoagulation, oral anticoagulation should be avoided.[24]

Stroke prevention strategy

Stroke prevention is the most important aspect of AF management to improve survival and reduce comorbidities. Benefits of anticoagulation have been validated in all forms of AF including paroxysmal, persistent, long-standing persistent, and permanent forms of AF.[25-27] Anticoagulation strategy is guided by the patient's individual risk score, risk of bleeding with anticoagulation, and patient's preference. Absolute annual stroke risk score should be calculated by available AF stroke risk scores, which is considered low (≤1%), intermediate (1-2%) and high (>2%) (Table 1.).

Table 1. CHA_2DS_2-VASc Score and annual stroke risk. Adapted from Lip et al.,[10] and Gazova et al.,[28]

Clinical condition		Points		CHA_2DS_2-VASc Score	Annual Stroke Risk (%)
Congestive heart failure	C	1		0	0
				1	1.3
Hypertension	H	1		2	2.2
Age ≥75 years	A_2	2		3	3.2
Diabetes mellitus	D	1		4	4.0
Prior stroke or TIA or Thromboembolism	S_2	2		5	6.7
				6	9.8
Vascular disease	V	1		7	9.6
Age 65 – 74 years	A	1		8	12.5
Sex category	Sc	1		9	15.2
CHA_2DS_2-VASc score = congestive heart failure, hypertension, age, diabetes mellitus, prior stroke or TIA or thromboembolism, vascular disease, age, sex category					

Based on the evidence current ACC[24] and ESC[29] AF guidelines recommend that AF patients with CHA2DS2-VASc score ≥2% in men and ≥3 in women should receive anticoagulation for stroke prevention.[19,22,30-34] Direct oral anticoagulants are better choice than warfarin, but should be avoided in patients with moderate to severe rheumatic mitral stenosis and mechanic valves.[19,22,30-34]

The net clinical benefit for patients with intermediate risk (non-sex CHA_2DS_2-VASc score of 1) is not as clear. Current ACC/AHA/ACCP/HRS AF guideline put anticoagulation of intermediate risk group with non-sex CHA_2DS_2-VASc score of 1 in class 2A indication.[24] A recently published population-based study focused on intermediate stroke risk group with non-sex CHA_2DS_2-VASc score of 1, the AFNOR (AF in Norway) trial showed that a combined outcome of ischemic stroke, major bleeding, and mortality was lower among AF patients who were on anticoagulation compared to those who were not.[35] These data may help guiding the shared decision making process while starting anticoagulation in this intermediate risk group.

Contrary to prior practice habits, recent studies have shown that aspirin either alone or in combination with clopidogrel is not recommended as an alternative to anticoagulation in patients with AF who are eligible for anticoagulation.[36] In addition, for patients with AF without risk factors for stroke, aspirin therapy has no benefit for prevention of stroke or peripheral thromboembolism.[37,38]

Despite commonly used, CHA_2DS_2-VASc score was found to be suboptimal in certain group of patients, like those with renal disease. When stroke risk is borderline or unclear with traditional CHA_2DS_2-VASc score, ATRIA[39-41] or GARFIELD-AF[42,43] scores could be helpful where additional risk factors, like smoking status, chronic kidney disease and dementia are included.[24] Individual risk assessment should be implemented to further define intervention strategies to reduce bleeding, such as stopping antiplatelet therapy or nonsteroidal anti-inflammatory drugs or consideration of left atrial appendage occlusion devices.[44] Recent interest in proBNP level as well as left atrium and left atrial appendage size and function could help better define stroke risk. However, these factors are not well validated and not yet incorporated into clinical decision making.[45]

If there is no absolute contraindication to anticoagulation, several studies have shown that stroke prevention benefits outweigh the risks of bleeding with anticoagulation, even in patients thought to be at elevated risk of bleeding.[46,47] It is important to note that the issue of anticoagulation should be periodically reassessed, maybe every 6 months, since a patient's risk profile may change over time, with the addition of new risk factors.[24]

Controversy about cardioversion of AF less than 48 hours without prior anticoagulation

Not only can the duration and burden of AF be underestimated in asymptomatic AF patients, but also recent data suggest that stroke risk in patients with <48 hours of AF are not uniformly low. Multiple studies have shown that for patients with AF <48 hours, stroke risk with cardioversion increases with increase in CH_2ADS_2-VASc score,[48,49] particularly, when the score is $\geq$2 without prior anticoagulation. Patients with CH_2ADS_2-VASc score of 0 to 1 and AF duration of <12 hours represent the lowest risk of stroke post-cardioversion in the absence of prior anticoagulation.[48]

Rate Control vs. Rhythm Control

What is the ideal rate control?

In the RACE II study (Rate Control Efficacy in Permanent Atrial Fibrillation: A Comparison Between Lenient Versus Strict Rate Control II) where 614 patients with permanent AF were randomized to either lenient rate control (resting heart rate <110 bpm) or strict rate control (resting heart rate <80 bpm), no significant difference was seen in primary composite outcome of death from cardiovascular causes, hospitalization for HF, stroke, systemic embolism, bleeding, and life-threatening arrhythmic events.[50] However, specific populations that may benefit from a low heart rate target include those with rate-related cardiomyopathy,[51] those with implantable cardiodefibrillators,[52] those who received cardiac resynchronization therapy,[53] and those with tachy-brady episodes with AF.[54]

Rhythm Control

Several studies have shown that a rhythm control strategy improves quality of life [55-59] and left ventricular (LV) function[60-64] in patients with AF. The benefit of rhythm control is likely the greatest in those with earliest restoration of sinus rhythm.[65-68] In the EAST-AFNET 4 randomized trial, rhythm control arm achieved a 25% reduction in the combined endpoint of mortality rate, stroke, and hospitalizations due to HF or acute coronary syndrome.[69] Two other observational studies, where rhythm control strategies were adopted early within the first year of onset of AF, showed a 15%[70] and 19%[71] reduction of combined endpoint of CV death, ischemic stroke, or hospitalization for ischemia or HF.

Class 1C drug dilemma in AF management

As recommended by 2023 ACC/AHA/ACCP/HRS[24] and 2020 ESC[29] AF guidelines, Class 1C drugs flecainide[72-74] and propafenone[74-80] are preferred AADs for maintenance of sinus rhythm in patients with AF without any structural heart disease or prior history of myocardial infarction (MI).[81,82] Since the CAST (Cardiac Arrhythmia Suppression Trial)[81] published in 1991, class 1C drugs were not recommended in patients with CAD with or without MI. A large-scale data analysis recently published by Kiani et al.,[83] in 2023 further shed some light about the safety and feasibility of the treatment of AF in patients with varying degree of CAD with class 1C agents. The study included 3,445 patients with AF treated with class 1C AADs compared to 2,216 patients with AF who were treated with class III AADs, and concluded that in patients with stable and nonobstructive CAD, class 1C AAD use was independently associated with better event-free survival than with class III AAD use.[83] This study clearly established a negative interaction of class 1C drug with poorer survival in patients with obstructive CAD, suggesting the possibility of using class 1C AADs in patients with AF and nonobstructive CAD without prior history of MI.

Caution with class III AADs

Dronedarone can be used for maintenance of sinus rhythm but should be avoided in patients with recent decompensated HF or severe LV systolic dysfunction.[74,84-86] In RCTs, amiodarone[87] and dofetilide[88] have been shown to be effective in maintaining sinus rhythm in patients with AF and HF and these two AADs are better options in HF with reduced ejection fraction (HFrEF) where other AADs are contraindicated. It is important to note that low dose amiodarone is more effective in maintaining sinus rhythm compared to sotalol and class 1C drugs. However, amiodarone should not be the first choice and is reserved for patients for whom other AADs are not effective or contraindicated because of its potential serious side effects and drug interactions.[24] Unfortunately, regardless of ACC and ESC recommendations, class 1C drugs are still underused and amiodarone is still overused despite its potential long-term side effects.[89]

New debate about catheter-based AF ablation (AF-ablation) strategy

Over the last decade, with accumulation of data from multiple recent trials, AF-ablation has become the major focus of AF management.[90-97] The new debate is when and how to perform AF-ablation. The EAST-AFNET 4[69] trial was the first RCT to reshape our long-held view from the AFFIRM[98] trial that there was no clinical benefit in rhythm control vs. rate control strategy in the management of AF. This trial clearly demonstrated the benefit of early rhythm control strategy to rate control.[69] It is important to note that 20% of patients in the early rhythm control strategy had AF-ablation compared to 7% in the rate control group. Trials exploring additional ablation targets apart from pulmonary vein isolation (PVI), such as VENUS (PVI with ethanol infusion of the Vein of Marshall),[99] ERASE-AF (PVI with posterior, inferior, septal, lateral and anterior left atrial wall segments)[100] and CONVERGE (PVI with LA roof line isolation or PVI with endocardial and epicardial posterior wall isolation)[101] trials, showed greater freedom from atrial arrhythmias compared to PVI only and no significant difference in adverse events between the treatment and control groups. Since traditional thermal ablation procedures have the potential for serious complications, such as pulmonary vein stenosis, phrenic nerve injury or esophageal injury,[102] the recently published PULSED AF Pivotal[103] trial using the newer generation pulsed field ablation technology demonstrated low procedure-related adverse events with no pulmonary vein stenosis, phrenic nerve injury or esophageal injury, but was equally effective as thermal ablation.[103] AF-ablation has been shown to be more effective than AADs for both persistent and paroxysmal AF and that earlier approach of rhythm control strategies improve AF-ablation success rates.[104-109] It is important to note that about 30% to 40% of patients will have recurrence of AF after first ablation,[104,110] and about 11% of patients will have a repeat ablation in 1 year.[111] Though most patients have better quality of life post AF-ablation, recurrence of AF with symptoms or LV dysfunction will necessitate further treatment. Catheter ablation of typical atrial flutter has a high success rate of 90% and should be given consideration as a first-line therapy for treatment of typical atrial flutter, if not indicated for other reasons.[24]

Current approach of AF with heart failure (HF) management

The relationship of AF and HF appears to be complex both pathophysiologically and clinically, and both disease entities frequently coexist.[61,112,113] Approximately one-third of patients with HFrEF will have AF at some point,[114] and the prevalence of AF is even higher in HF with preserved ejection fraction, approaching up to one-half of patients.[115,116] Regardless of reasonable rate control, allowing AF to persist longer, eventually will worsen LV function. Over the years, the focus has shifted in the treatment of AF with HF patients from rate control to rhythm control strategy with earlier intervention, preferably by catheter ablation. Multiple RCTs in patient with AF and HF have shown significant improvement of LV function and clinical symptoms after AF-ablation.[67,114,117-120] Romeo et al, 2022 recently published a large meta-analysis of eight RCTs showing a 35% relative risk reduction and 4.7% absolute risk reduction in all-cause mortality in AF-ablation arm compared to medical therapy in patents with AF and HF.[121] An early and aggressive approach to rhythm control by AF-ablation can reduce AF burden, resulting in favorable ventricular remodeling and halting of any occult tachycardia-induced cardiomyopathy.

Conclusion

Apart from traditional risk calculators, new stroke risk markers should be further studied, incorporated, and validated for calculating individual risk assessment for AF-related thromboembolism to better understand the controversies that still exist. Despite significant advances in catheter-based ablation therapy, AADs will remain a cornerstone of rhythm control strategy for millions of AF patients worldwide. Unfortunately, more than two-thirds of AF recurrence happens in the first year of single or repeated ablations.[105,122] With recent advances in newer comprehensive ablation techniques, the AF recurrence rate is expected to improve. Ideal patient selection for AF ablation is still evolving. Though, AF-ablation is helpful to improve symptoms and halt progression of HF, a substantial number of patients will still require AADs to maintain their rhythm despite

being ablated. Recent advancement in molecular biology of AF have helped us better understand the mechanisms underlying different forms of AF and identify newer approaches to develop mechanism-based AADs, including AF-specific ion-channel blockers, targeting the abnormal Ca2+-handling such as Ca2+-calmodulin protein kinase II, ryanodine receptor type-2, and modulation of upstream signal pathways.[123]

References

1. Schnabel RB, Yin X, Gona P, et al. 50 year trends in atrial fibrillation prevalence, incidence, risk factors, and mortality in the Framingham Heart Study: a cohort study. Lancet. Jul 11 2015;386(9989):154-62. doi:10.1016/S0140-6736(14)61774-8

2. Tsao CW, Aday AW, Almarzooq ZI, et al. Heart Disease and Stroke Statistics-2023 Update: A Report From the American Heart Association. Circulation. Feb 21 2023;147(8):e93-e621. doi:10.1161/CIR.0000000000001123

3. Hendriks JM, Gallagher C, Middeldorp ME, Sanders P. New approaches to detection of atrial fibrillation. Heart. Dec 2018;104(23):1898-1899. doi:10.1136/heartjnl-2018-313423

4. Li L, Yiin GS, Geraghty OC, et al. Incidence, outcome, risk factors, and long-term prognosis of cryptogenic transient ischaemic attack and ischaemic stroke: a population-based study. Lancet Neurol. Sep 2015;14(9):903-913. doi:10.1016/S1474-4422(15)00132-5

5. Sanna T, Diener HC, Passman RS, et al. Cryptogenic stroke and underlying atrial fibrillation. N Engl J Med. Jun 26 2014;370(26):2478-86. doi:10.1056/NEJMoa1313600

6. Healey JS, Connolly SJ, Gold MR, et al. Subclinical atrial fibrillation and the risk of stroke. N Engl J Med. Jan 12 2012;366(2):120-9. doi:10.1056/NEJMoa1105575

7. Svendsen JH, Diederichsen SZ, Hojberg S, et al. Implantable loop recorder detection of atrial fibrillation to prevent stroke (The LOOP Study): a randomised controlled trial. Lancet. Oct 23 2021;398(10310):1507-1516. doi:10.1016/S0140-6736(21)01698-6

8. Xing LY, Diederichsen SZ, Hojberg S, et al. Effects of Atrial Fibrillation Screening According to N-Terminal Pro-B-Type Natriuretic Peptide: A Secondary Analysis of the Randomized LOOP Study. Circulation. Jun 13 2023;147(24):1788-1797. doi:10.1161/CIRCULATIONAHA.123.064361

9. Chen LY, Chung MK, Allen LA, et al. Atrial Fibrillation Burden: Moving Beyond Atrial Fibrillation as a Binary Entity: A Scientific Statement From the American Heart Association. Circulation. May 15 2018;137(20):e623-e644. doi:10.1161/CIR.0000000000000568

10. Lip GY, Nieuwlaat R, Pisters R, Lane DA, Crijns HJ. 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. Feb 2010;137(2):263-72. doi:10.1378/chest.09-1584

11. Capucci A, Santini M, Padeletti L, et al. Monitored atrial fibrillation duration predicts arterial embolic events in patients suffering from bradycardia and atrial fibrillation implanted with antitachycardia pacemakers. J Am Coll Cardiol. Nov 15 2005;46(10):1913-20. doi:10.1016/j.jacc.2005.07.044

12. Glotzer TV, Daoud EG, Wyse DG, et al. The relationship between daily atrial tachyarrhythmia burden from implantable device diagnostics and stroke risk: the TRENDS study. Circ Arrhythm Electrophysiol. Oct 2009;2(5):474-80. doi:10.1161/CIRCEP.109.849638

13. Passman RS, Weinberg KM, Freher M, et al. Accuracy of mode switch algorithms for detection of atrial tachyarrhythmias. J Cardiovasc Electrophysiol. Jul 2004;15(7):773-7. doi:10.1046/j.1540-8167.2004.03537.x

14. Van Gelder IC, Healey JS, Crijns H, et al. Duration of device-detected subclinical atrial fibrillation and occurrence of stroke in ASSERT. Eur Heart J. May 1 2017;38(17):1339-1344. doi:10.1093/eurheartj/ehx042

15. Martin DT, Bersohn MM, Waldo AL, et al. Randomized trial of atrial arrhythmia monitoring to guide anticoagulation in patients with implanted defibrillator and cardiac resynchronization devices. Eur Heart J. Jul 7 2015;36(26):1660-8. doi:10.1093/eurheartj/ehv115

16. Lopes RD, Alings M, Connolly SJ, et al. Rationale and design of the Apixaban for the Reduction of Thrombo-Embolism in Patients With Device-Detected Sub-Clinical Atrial Fibrillation (ARTESiA) trial. Am Heart J. Jul 2017;189:137-145. doi:10.1016/j.ahj.2017.04.008

17. Healey JS, Lopes RD, Granger CB, et al. Apixaban for Stroke Prevention in Subclinical Atrial Fibrillation. N Engl J Med. Nov 12 2023;doi:10.1056/NEJMoa2310234

18. Kirchhof P, Toennis T, Goette A, et al. Anticoagulation with Edoxaban in Patients with Atrial High-Rate Episodes. N Engl J Med. Sep 28 2023;389(13):1167-1179. doi:10.1056/NEJMoa2303062

19. Connolly SJ, Ezekowitz MD, Yusuf S, et al. Dabigatran versus warfarin in patients with atrial fibrillation. N Engl J Med. Sep 17 2009;361(12):1139-51. doi:10.1056/NEJMoa0905561

20. Eckman MH, Singer DE, Rosand J, Greenberg SM. Moving the tipping point: the decision to anticoagulate patients with atrial fibrillation. Circ Cardiovasc Qual Outcomes. Jan 1 2011;4(1):14-21. doi:10.1161/CIRCOUTCOMES.110.958108

21. Ommen SR, Mital S, Burke MA, et al. 2020 AHA/ACC Guideline for the Diagnosis and Treatment of Patients With Hypertrophic Cardiomyopathy: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. J Am Coll Cardiol. Dec 22 2020;76(25):e159-e240. doi:10.1016/j.jacc.2020.08.045

22. Granger CB, Alexander JH, McMurray JJ, et al. Apixaban versus warfarin in patients with atrial fibrillation. N Engl J Med. Sep 15 2011;365(11):981-92. doi:10.1056/NEJMoa1107039

23. Brokmeier H, Kido K. Off-label Use for Direct Oral Anticoagulants: Valvular Atrial Fibrillation, Heart Failure, Left Ventricular Thrombus, Superficial Vein Thrombosis, Pulmonary Hypertension-a Systematic Review. Ann Pharmacother. Aug 2021;55(8):995-1009. doi:10.1177/1060028020970618

24. Joglar JA, Chung MK, Armbruster AL, et al. 2023 ACC/AHA/ACCP/HRS Guideline for the Diagnosis and Management of Atrial Fibrillation: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. Circulation. Jan 2 2024;149(1):e1-e156. doi:10.1161/CIR.0000000000001193

25. Al-Khatib SM, Thomas L, Wallentin L, et al. Outcomes of apixaban vs. warfarin by type and duration of atrial fibrillation: results from the ARISTOTLE trial. Eur Heart J. Aug 2013;34(31):2464-71. doi:10.1093/eurheartj/eht135

26. Link MS, Giugliano RP, Ruff CT, et al. Stroke and Mortality Risk in Patients With Various Patterns of Atrial Fibrillation: Results From the ENGAGE AF-TIMI 48 Trial (Effective Anticoagulation With Factor Xa Next Generation in Atrial Fibrillation-Thrombolysis in Myocardial Infarction 48). Circ Arrhythm Electrophysiol. Jan 2017;10(1)doi:10.1161/CIRCEP.116.004267

27. Steinberg BA, Hellkamp AS, Lokhnygina Y, et al. Higher risk of death and stroke in patients with persistent vs. paroxysmal atrial fibrillation: results from the ROCKET-AF Trial. Eur Heart J. Feb 1 2015;36(5):288-96. doi:10.1093/eurheartj/ehu359

28. Gazova A, Leddy JJ, Rexova M, Hlivak P, Hatala R, Kyselovic J. Predictive value of CHA2DS2-VASc scores regarding the risk of stroke and all-cause mortality in patients with atrial fibrillation (CONSORT compliant). Medicine (Baltimore). Aug 2019;98(31):e16560. doi:10.1097/MD.0000000000016560

29. Hindricks G, Potpara T, Dagres N, 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): The Task Force for the diagnosis and management of atrial fibrillation of the European Society of Cardiology (ESC) Developed with the special contribution of the European Heart Rhythm Association (EHRA) of the ESC. Eur Heart J. Feb 1 2021;42(5):373-498. doi:10.1093/eurheartj/ehaa612

30. Patel MR, Mahaffey KW, Garg J, et al. Rivaroxaban versus warfarin in nonvalvular atrial fibrillation. N Engl J Med. Sep 8 2011;365(10):883-91. doi:10.1056/NEJMoa1009638

31. Giugliano RP, Ruff CT, Braunwald E, et al. Edoxaban versus warfarin in patients with atrial fibrillation. N Engl J Med. Nov 28 2013;369(22):2093-104. doi:10.1056/NEJMoa1310907

32. Lopez-Lopez JA, Sterne JAC, Thom HHZ, et al. Oral anticoagulants for prevention of stroke in atrial fibrillation: systematic review, network meta-analysis, and cost effectiveness analysis. BMJ. Nov 28 2017;359:j5058. doi:10.1136/bmj.j5058

33. Ruff CT, Giugliano RP, Braunwald E, et al. Comparison of the efficacy and safety of new oral anticoagulants with warfarin in patients with atrial fibrillation: a meta-analysis of randomised trials. Lancet. Mar 15 2014;383(9921):955-62. doi:10.1016/S0140-6736(13)62343-0

34. Carnicelli AP, Hong H, Connolly SJ, et al. Direct Oral Anticoagulants Versus Warfarin in Patients With Atrial Fibrillation: Patient-Level Network Meta-Analyses of Randomized Clinical Trials With Interaction Testing by Age and Sex. Circulation. Jan 25 2022;145(4):242-255. doi:10.1161/CIRCULATIONAHA.121.056355

35. Anjum M, Ariansen I, Hjellvik V, et al. Stroke and bleeding risk in atrial fibrillation with CHA2DS2-VASC risk score of one: the Norwegian AFNOR study. Eur Heart J. Nov 23 2023;doi:10.1093/eurheartj/ehad659

36. Investigators AWGotA, Connolly S, Pogue J, et al. Clopidogrel plus aspirin versus oral anticoagulation for atrial fibrillation in the Atrial fibrillation Clopidogrel Trial with Irbesartan for prevention of Vascular Events (ACTIVE W): a randomised controlled trial. Lancet. Jun 10 2006;367(9526):1903-12. doi:10.1016/S0140-6736(06)68845-4

37. Sato H, Ishikawa K, Kitabatake A, et al. Low-dose aspirin for prevention of stroke in low-risk patients with atrial fibrillation: Japan Atrial Fibrillation Stroke Trial. Stroke. Feb 2006;37(2):447-51. doi:10.1161/01.STR.0000198839.61112.ee

38. Hart RG, Pearce LA, Aguilar MI. Meta-analysis: antithrombotic therapy to prevent stroke in patients who have nonvalvular atrial fibrillation. Ann Intern Med. Jun 19 2007;146(12):857-67. doi:10.7326/0003-4819-146-12-200706190-00007

39. Singer DE, Chang Y, Borowsky LH, et al. A new risk scheme to predict ischemic stroke and other thromboembolism in atrial fibrillation: the ATRIA study stroke risk score. J Am Heart Assoc. Jun 21 2013;2(3):e000250. doi:10.1161/JAHA.113.000250

40. Zhu W, Fu L, Ding Y, et al. Meta-analysis of ATRIA versus CHA(2)DS(2)-VASc for predicting stroke and thromboembolism in patients with atrial fibrillation. Int J Cardiol. Jan 15 2017;227:436-442. doi:10.1016/j.ijcard.2016.11.015

41. van den Ham HA, Klungel OH, Singer DE, Leufkens HG, van Staa TP. Comparative Performance of ATRIA, CHADS2, and CHA2DS2-VASc Risk Scores Predicting Stroke in Patients With Atrial Fibrillation: Results From a National Primary Care Database. J Am Coll Cardiol. Oct 27 2015;66(17):1851-9. doi:10.1016/j.jacc.2015.08.033

42. Fox KAA, Lucas JE, Pieper KS, et al. Improved risk stratification of patients with atrial fibrillation: an integrated GARFIELD-AF tool for the prediction of mortality, stroke and bleed in patients with and without anticoagulation. BMJ Open. Dec 21 2017;7(12):e017157. doi:10.1136/bmjopen-2017-017157

43. Dalgaard F, Pieper K, Verheugt F, et al. GARFIELD-AF model for prediction of stroke and major bleeding in atrial fibrillation: a Danish nationwide validation study. BMJ Open. Nov 11 2019;9(11):e033283. doi:10.1136/bmjopen-2019-033283

44. Chao TF, Lip GYH, Lin YJ, et al. Incident Risk Factors and Major Bleeding in Patients with Atrial Fibrillation Treated with Oral Anticoagulants: A Comparison of Baseline, Follow-up and Delta HAS-BLED Scores with an Approach Focused on Modifiable Bleeding Risk Factors. Thromb Haemost. Apr 2018;118(4):768-777. doi:10.1055/s-0038-1636534

45. Alkhouli M, Friedman PA. Ischemic Stroke Risk in Patients With Nonvalvular Atrial Fibrillation: JACC Review Topic of the Week. J Am Coll Cardiol. Dec 17 2019;74(24):3050-3065. doi:10.1016/j.jacc.2019.10.040

46. Friberg L, Rosenqvist M, Lip GY. Net clinical benefit of warfarin in patients with atrial fibrillation: a report from the Swedish atrial fibrillation cohort study. Circulation. May 15 2012;125(19):2298-307. doi:10.1161/CIRCULATIONAHA.111.055079

47. Steinberg BA, Ballew NG, Greiner MA, et al. Ischemic and Bleeding Outcomes in Patients With Atrial Fibrillation and Contraindications to Oral Anticoagulation. JACC Clin Electrophysiol. Dec 2019;5(12):1384-1392. doi:10.1016/j.jacep.2019.07.011

48. Gronberg T, Hartikainen JE, Nuotio I, Biancari F, Ylitalo A, Airaksinen KE. Anticoagulation, CHA2DS2VASc Score, and Thromboembolic Risk of Cardioversion of Acute Atrial Fibrillation (from the FinCV Study). Am J Cardiol. Apr 15 2016;117(8):1294-8. doi:10.1016/j.amjcard.2016.01.024

49. Wong BM, Perry JJ, Cheng W, et al. Thromboembolic events following cardioversion of acute atrial fibrillation and flutter: a systematic review and meta-analysis. CJEM. Jul 2021;23(4):500-511. doi:10.1007/s43678-021-00103-0

50. Van Gelder IC, Groenveld HF, Crijns HJ, et al. Lenient versus strict rate control in patients with atrial fibrillation. N Engl J Med. Apr 15 2010;362(15):1363-73. doi:10.1056/NEJMoa1001337

51. Nerheim P, Birger-Botkin S, Piracha L, Olshansky B. Heart failure and sudden death in patients with tachycardia-induced cardiomyopathy and recurrent tachycardia. Circulation. Jul 20 2004;110(3):247-52. doi:10.1161/01.CIR.0000135472.28234.CC

52. van Gelder IC, Phan HM, Wilkoff BL, et al. Prognostic significance of atrial arrhythmias in a primary prevention ICD population. Pacing Clin Electrophysiol. Sep 2011;34(9):1070-9. doi:10.1111/j.1540-8159.2011.03124.x

53. Boriani G, Gasparini M, Landolina M, et al. Incidence and clinical relevance of uncontrolled ventricular rate during atrial fibrillation in heart failure patients treated with cardiac resynchronization therapy. Eur J Heart Fail. Aug 2011;13(8):868-76. doi:10.1093/eurjhf/hfr046

54. Boriani G, Padeletti L, Santini M, et al. Rate control in patients with pacemaker affected by brady-tachy form of sick sinus syndrome. Am Heart J. Jul 2007;154(1):193-200. doi:10.1016/j.ahj.2007.04.001

55. Cooper HA, Bloomfield DA, Bush DE, et al. Relation between achieved heart rate and outcomes in patients with atrial fibrillation (from the Atrial Fibrillation Follow-up Investigation of Rhythm Management [AFFIRM] Study). Am J Cardiol. May 15 2004;93(10):1247-53. doi:10.1016/j.amjcard.2004.01.069

56. Miura K, Ikemura N, Kimura T, et al. Treatment strategies and subsequent changes in the patient-reported quality-of-life among elderly patients with atrial fibrillation. Am Heart J. Apr 2020;222:83-92. doi:10.1016/j.ahj.2020.01.011

57. Kosior DA, Szulc M, Rosiak M, Rabczenko D, Opolski G, For The Investigators Of The Hot Cafe Polish S. Functional status with rhythm- versus rate-control strategy for persistent atrial fibrillation. Pol Arch Intern Med. Nov 30 2018;128(11):658-666. doi:10.20452/pamw.4316

58. Hagens VE, Ranchor AV, Van Sonderen E, et al. Effect of rate or rhythm control on quality of life in persistent atrial fibrillation. Results from the Rate Control Versus Electrical Cardioversion (RACE) Study. J Am Coll Cardiol. Jan 21 2004;43(2):241-7. doi:10.1016/j.jacc.2003.08.037

59. Ha AC, Breithardt G, Camm AJ, et al. Health-related quality of life in patients with atrial fibrillation treated with rhythm control versus rate control: insights from a prospective international registry (Registry on Cardiac Rhythm Disorders Assessing the Control of Atrial Fibrillation: RECORD-AF). Circ Cardiovasc Qual Outcomes. Nov 2014;7(6):896-904. doi:10.1161/HCQ.0000000000000011

60. Hsu LF, Jais P, Sanders P, et al. Catheter ablation for atrial fibrillation in congestive heart failure. N Engl J Med. Dec 2 2004;351(23):2373-83. doi:10.1056/NEJMoa041018

61. Prabhu S, Kistler PM. Atrial Fibrillation, an Under-Appreciated Reversible Cause of Cardiomyopathy: Implications for Clinical Practice From the CAMERA-MRI Study. Heart Lung Circ. Jun 2018;27(6):652-655. doi:10.1016/S1443-9506(18)30152-5

62. Stronati G, Guerra F, Urbinati A, Ciliberti G, Cipolletta L, Capucci A. Tachycardiomyopathy in Patients without Underlying Structural Heart Disease. J Clin Med. Sep 8 2019;8(9)doi:10.3390/jcm8091411

63. Jeong YH, Choi KJ, Song JM, et al. Diagnostic approach and treatment strategy in tachycardia-induced cardiomyopathy. Clin Cardiol. Apr 2008;31(4):172-8. doi:10.1002/clc.20161

64. Marcusohn E, Postnikov M, Kobo O, et al. Factors Associated with Left Ventricular Function Recovery in Patients with Atrial Fibrillation Related Cardiomyopathy. Isr Med Assoc J. Feb 2022;24(2):101-106.

65. Roy D, Talajic M, Nattel S, et al. Rhythm control versus rate control for atrial fibrillation and heart failure. N Engl J Med. Jun 19 2008;358(25):2667-77. doi:10.1056/NEJMoa0708789

66. Rillig A, Magnussen C, Ozga AK, et al. Early Rhythm Control Therapy in Patients With Atrial Fibrillation and Heart Failure. Circulation. Sep 14 2021;144(11):845-858. doi:10.1161/CIRCULATIONAHA.121.056323

67. Marrouche NF, Brachmann J, Andresen D, et al. Catheter Ablation for Atrial Fibrillation with Heart Failure. N Engl J Med. Feb 1 2018;378(5):417-427. doi:10.1056/NEJMoa1707855

68. Di Biase L, Mohanty P, Mohanty S, et al. Ablation Versus Amiodarone for Treatment of Persistent Atrial Fibrillation in Patients With Congestive Heart Failure and an Implanted Device: Results From the AATAC Multicenter Randomized Trial. Circulation. Apr 26 2016;133(17):1637-44. doi:10.1161/CIRCULATIONAHA.115.019406

69. Kirchhof P, Camm AJ, Goette A, et al. Early Rhythm-Control Therapy in Patients with Atrial Fibrillation. N Engl J Med. Oct 1 2020;383(14):1305-1316. doi:10.1056/NEJMoa2019422

70. Kim D, Yang PS, You SC, et al. Treatment timing and the effects of rhythm control strategy in patients with atrial fibrillation: nationwide cohort study. BMJ. May 11 2021;373:n991. doi:10.1136/bmj.n991

71. Dickow J, Kirchhof P, Van Houten HK, et al. Generalizability of the EAST-AFNET 4 Trial: Assessing Outcomes of Early Rhythm-Control Therapy in Patients With Atrial Fibrillation. J Am Heart Assoc. Jun 7 2022;11(11):e024214. doi:10.1161/JAHA.121.024214

72. Anderson JL, Gilbert EM, Alpert BL, et al. Prevention of symptomatic recurrences of paroxysmal atrial fibrillation in patients initially tolerating antiarrhythmic therapy. A multicenter, double-blind, crossover study of flecainide and placebo with transtelephonic monitoring. Flecainide Supraventricular Tachycardia Study Group. Circulation. Dec 1989;80(6):1557-70. doi:10.1161/01.cir.80.6.1557

73. Kirchhof P, Andresen D, Bosch R, et al. Short-term versus long-term antiarrhythmic drug treatment after cardioversion of atrial fibrillation (Flec-SL): a prospective, randomised, open-label, blinded endpoint assessment trial. Lancet. Jul 21 2012;380(9838):238-46. doi:10.1016/S0140-6736(12)60570-4

74. Valembois L, Audureau E, Takeda A, Jarzebowski W, Belmin J, Lafuente-Lafuente C. Antiarrhythmics for maintaining sinus rhythm after cardioversion of atrial fibrillation. Cochrane Database Syst Rev. Sep 4 2019;9(9):CD005049. doi:10.1002/14651858.CD005049.pub5

75. Reimold SC, Cantillon CO, Friedman PL, Antman EM. Propafenone versus sotalol for suppression of recurrent symptomatic atrial fibrillation. Am J Cardiol. Mar 1 1993;71(7):558-63. doi:10.1016/0002-9149(93)90511-a

76. Bellandi F, Simonetti I, Leoncini M, et al. Long-term efficacy and safety of propafenone and sotalol for the maintenance of sinus rhythm after conversion of recurrent symptomatic atrial fibrillation. Am J Cardiol. Sep 15 2001;88(6):640-5. doi:10.1016/s0002-9149(01)01806-9

77. Pritchett EL, Page RL, Carlson M, Undesser K, Fava G, Rythmol Atrial Fibrillation Trial I. Efficacy and safety of sustained-release propafenone (propafenone SR) for patients with atrial fibrillation. Am J Cardiol. Oct 15 2003;92(8):941-6. doi:10.1016/s0002-9149(03)00974-3

78. Dogan A, Ergene O, Nazli C, et al. Efficacy of propafenone for maintaining sinus rhythm in patients with recent onset or persistent atrial fibrillation after conversion: a randomized, placebo-controlled study. Acta Cardiol. Jun 2004;59(3):255-61. doi:10.2143/AC.59.3.2005179

79. Kochiadakis GE, Igoumenidis NE, Hamilos ME, et al. Sotalol versus propafenone for long-term maintenance of normal sinus rhythm in patients with recurrent symptomatic atrial fibrillation. Am J Cardiol. Dec 15 2004;94(12):1563-6. doi:10.1016/j.amjcard.2004.08.041

80. Meinertz T, Lip GY, Lombardi F, et al. Efficacy and safety of propafenone sustained release in the prophylaxis of symptomatic paroxysmal atrial fibrillation (The European Rythmol/Rytmonorm Atrial Fibrillation Trial [ERAFT] Study). Am J Cardiol. Dec 15 2002;90(12):1300-6. doi:10.1016/s0002-9149(02)02867-9

81. Echt DS, Liebson PR, Mitchell LB, et al. Mortality and morbidity in patients receiving encainide, flecainide, or placebo. The Cardiac Arrhythmia Suppression Trial. N Engl J Med. Mar 21 1991;324(12):781-8. doi:10.1056/NEJM199103213241201

82. Kober L, Torp-Pedersen C, McMurray JJ, et al. Increased mortality after dronedarone therapy for severe heart failure. N Engl J Med. Jun 19 2008;358(25):2678-87. doi:10.1056/NEJMoa0800456

83. Kiani S, Sayegh MN, Ibrahim R, et al. The Feasibility and Safety of Flecainide Use Among Patients With Varying Degrees of Coronary Disease. JACC Clin Electrophysiol. Jul 2023;9(7 Pt 2):1172-1180. doi:10.1016/j.jacep.2022.12.021

84. Touboul P, Brugada J, Capucci A, Crijns HJ, Edvardsson N, Hohnloser SH. Dronedarone for prevention of atrial fibrillation: a dose-ranging study. Eur Heart J. Aug 2003;24(16):1481-7. doi:10.1016/s0195-668x(03)00321-x

85. Singh BN, Connolly SJ, Crijns HJ, et al. Dronedarone for maintenance of sinus rhythm in atrial fibrillation or flutter. N Engl J Med. Sep 6 2007;357(10):987-99. doi:10.1056/NEJMoa054686

86. Hohnloser SH, Crijns HJ, van Eickels M, et al. Effect of dronedarone on cardiovascular events in atrial fibrillation. N Engl J Med. Feb 12 2009;360(7):668-78. doi:10.1056/NEJMoa0803778

87. Deedwania PC, Singh BN, Ellenbogen K, Fisher S, Fletcher R, Singh SN. Spontaneous conversion and maintenance of

sinus rhythm by amiodarone in patients with heart failure and atrial fibrillation: observations from the veterans affairs congestive heart failure survival trial of antiarrhythmic therapy (CHF-STAT). The Department of Veterans Affairs CHF-STAT Investigators. Circulation. Dec 8 1998;98(23):2574-9. doi:10.1161/01.cir.98.23.2574

88. Pedersen OD, Bagger H, Keller N, Marchant B, Kober L, Torp-Pedersen C. Efficacy of dofetilide in the treatment of atrial fibrillation-flutter in patients with reduced left ventricular function: a Danish investigations of arrhythmia and mortality on dofetilide (diamond) substudy. Circulation. Jul 17 2001;104(3):292-6. doi:10.1161/01.cir.104.3.292

89. Barra S, Primo J, Goncalves H, Boveda S, Providencia R, Grace A. Is amiodarone still a reasonable therapeutic option for rhythm control in atrial fibrillation? Rev Port Cardiol. Sep 2022;41(9):783-789. doi:10.1016/j.repc.2021.03.019

90. Atienza F, Almendral J, Ormaetxe JM, et al. Comparison of radiofrequency catheter ablation of drivers and circumferential pulmonary vein isolation in atrial fibrillation: a noninferiority randomized multicenter RADAR-AF trial. J Am Coll Cardiol. Dec 16 2014;64(23):2455-67. doi:10.1016/j.jacc.2014.09.053

91. Chen M, Yang B, Chen H, et al. Randomized comparison between pulmonary vein antral isolation versus complex fractionated electrogram ablation for paroxysmal atrial fibrillation. J Cardiovasc Electrophysiol. Sep 2011;22(9):973-81. doi:10.1111/j.1540-8167.2011.02051.x

92. Di Biase L, Elayi CS, Fahmy TS, et al. Atrial fibrillation ablation strategies for paroxysmal patients: randomized comparison between different techniques. Circ Arrhythm Electrophysiol. Apr 2009;2(2):113-9. doi:10.1161/CIRCEP.108.798447

93. Katritsis DG, Pokushalov E, Romanov A, et al. Autonomic denervation added to pulmonary vein isolation for paroxysmal atrial fibrillation: a randomized clinical trial. J AmColl Cardiol. Dec 17 2013;62(24):2318-25. doi:10.1016/j.jacc.2013.06.053

94. Mamchur SE, Mamchur IN, Khomenko EA, Bokhan NS, Scherbinina DA. 'Electrical exclusion' of a critical myocardial mass by extended pulmonary vein antrum isolation for persistent atrial fibrillation treatment. Interv Med Appl Sci. Mar 2014;6(1):31-9. doi:10.1556/IMAS.6.2014.1.5

95. Verma A, Mantovan R, Macle L, et al. Substrate and Trigger Ablation for Reduction of Atrial Fibrillation (STAR AF): a randomized, multicentre, international trial. Eur Heart J. Jun 2010;31(11):1344-56. doi:10.1093/eurheartj/ehq041

96. Sau A, Howard JP, Al-Aidarous S, et al. Meta-Analysis of Randomized Controlled Trials of Atrial Fibrillation Ablation With Pulmonary Vein Isolation Versus Without. JACC Clin Electrophysiol. Aug 2019;5(8):968-976. doi:10.1016/j.jacep.2019.05.012

97. Calkins H, Hindricks G, Cappato R, et al. 2017 HRS/EHRA/ECAS/APHRS/SOLAECE expert consensus statement on catheter and surgical ablation of atrial fibrillation: Executive summary. Heart Rhythm. Oct 2017;14(10):e445-e494. doi:10.1016/j.hrthm.2017.07.009

98. Wyse DG, Waldo AL, DiMarco JP, et al. A comparison of rate control and rhythm control in patients with atrial fibrillation. N Engl J Med. Dec 5 2002;347(23):1825-33. doi:10.1056/NEJMoa021328

99. Valderrabano M, Peterson LE, Swarup V, et al. Effect of Catheter Ablation With Vein of Marshall Ethanol Infusion vs Catheter Ablation Alone on Persistent Atrial Fibrillation: The VENUS Randomized Clinical Trial. JAMA. Oct 27 2020;324(16):1620-1628. doi:10.1001/jama.2020.16195

100. Huo YG, T; Schönbauer, R, et al. Low-Voltage Myocardium-Guided Ablation Trial of Persistent Atrial Fibrillation. NEJM Evidence. 2022;1(11)

101. DeLurgio DB, Crossen KJ, Gill J, et al. Hybrid Convergent Procedure for the Treatment of Persistent and Long-Standing Persistent Atrial Fibrillation: Results of CONVERGE Clinical Trial. Circ Arrhythm Electrophysiol. Dec 2020;13(12):e009288. doi:10.1161/CIRCEP.120.009288

102. Cappato R, Calkins H, Chen SA, et al. Updated worldwide survey on the methods, efficacy, and safety of catheter ablation for human atrial fibrillation. Circ Arrhythm Electrophysiol. Feb 2010;3(1):32-8. doi:10.1161/CIRCEP.109.859116

103. Verma A, Haines DE, Boersma LV, et al. Pulsed Field Ablation for the Treatment of Atrial Fibrillation: PULSED AF Pivotal Trial. Circulation. May 9 2023;147(19):1422-1432. doi:10.1161/CIRCULATIONAHA.123.063988

104. Packer DL, Mark DB, Robb RA, et al. Effect of Catheter Ablation vs Antiarrhythmic Drug Therapy on Mortality, Stroke, Bleeding, and Cardiac Arrest Among Patients With

Atrial Fibrillation: The CABANA Randomized Clinical Trial. JAMA. Apr 2 2019;321(13):1261-1274. doi:10.1001/jama.2019.0693

105. You L, Zhang X, Yang J, Wang L, Zhang Y, Xie R. The Long-Term Results of Three Catheter Ablation Methods in Patients With Paroxysmal Atrial Fibrillation: A 4-Year Follow-Up Study. Front Cardiovasc Med. 2021;8:719452. doi:10.3389/fcvm.2021.719452

106. Kuck KH, Lebedev DS, Mikhaylov EN, et al. Catheter ablation or medical therapy to delay progression of atrial fibrillation: the randomized controlled atrial fibrillation progression trial (ATTEST). Europace. Mar 8 2021;23(3):362-369. doi:10.1093/europace/euaa298

107. Monahan KH, Bunch TJ, Mark DB, et al. Influence of atrial fibrillation type on outcomes of ablation vs. drug therapy: results from CABANA. Europace. Oct 13 2022;24(9):1430-1440. doi:10.1093/europace/euac055

108. Nyong J, Amit G, Adler AJ, et al. Efficacy and safety of ablation for people with non-paroxysmal atrial fibrillation. Cochrane Database Syst Rev. Nov 22 2016;11(11):CD012088. doi:10.1002/14651858.CD012088.pub2

109. Friedman DJ, Field ME, Rahman M, et al. Catheter ablation and healthcare utilization and cost among patients with paroxysmal versus persistent atrial fibrillation. Heart Rhythm O2. Feb 2021;2(1):28-36. doi:10.1016/j.hroo.2020.12.017

110. Kuck KH, Furnkranz A, Chun KR, et al. Cryoballoon or radiofrequency ablation for symptomatic paroxysmal atrial fibrillation: reintervention, rehospitalization, and quality-of-life outcomes in the FIRE AND ICE trial. Eur Heart J. Oct 7 2016;37(38):2858-2865. doi:10.1093/eurheartj/ehw285.

111. Piccini JP, Sinner MF, Greiner MA, et al. Outcomes of Medicare beneficiaries undergoing catheter ablation for atrial fibrillation. Circulation. Oct 30 2012;126(18):2200-7. doi:10.1161/CIRCULATIONAHA.112.109330

112. Anter E, Jessup M, Callans DJ. Atrial fibrillation and heart failure: treatment considerations for a dual epidemic. Circulation. May 12 2009;119(18):2516-25. doi:10.1161/CIRCULATIONAHA.108.821306

113. Verma A, Kalman JM, Callans DJ. Treatment of Patients With Atrial Fibrillation and Heart Failure With Reduced Ejection Fraction. Circulation. Apr 18 2017;135(16):1547-1563. doi:10.1161/CIRCULATIONAHA.116.026054

114. Packer DL, Piccini JP, Monahan KH, et al. Ablation Versus Drug Therapy for Atrial Fibrillation in Heart Failure: Results From the CABANA Trial. Circulation. Apr 6 2021;143(14):1377-1390. doi:10.1161/CIRCULATIONAHA.120.050991

115. Kotecha D, Lam CS, Van Veldhuisen DJ, Van Gelder IC, Voors AA, Rienstra M. Heart Failure With Preserved Ejection Fraction and Atrial Fibrillation: Vicious Twins. J Am Coll Cardiol. Nov 15 2016;68(20):2217-2228. doi:10.1016/j.jacc.2016.08.048

116. artipy U, Dahlstrom U, Fu M, Lund LH. Atrial Fibrillation in Heart Failure With Preserved, Mid-Range, and Reduced Ejection Fraction. JACC Heart Fail. Aug 2017;5(8):565-574. doi:10.1016/j.jchf.2017.05.001

117. Khan MN, Jais P, Cummings J, et al. Pulmonary-vein isolation for atrial fibrillation in patients with heart failure. N Engl J Med. Oct 23 2008;359(17):1778-85. doi:10.1056/NEJMoa0708234

118. MacDonald MR, Connelly DT, Hawkins NM, et al. Radiofrequency ablation for persistent atrial fibrillation in patients with advanced heart failure and severe left ventricular systolic dysfunction: a randomised controlled trial. Heart. May 2011;97(9):740-7. doi:10.1136/hrt.2010.207340

119. Jones DG, Haldar SK, Hussain W, et al. A randomized trial to assess catheter ablation versus rate control in the management of persistent atrial fibrillation in heart failure. J Am Coll Cardiol. May 7 2013;61(18):1894-903. doi:10.1016/j.jacc.2013.01.069

120. Hunter RJ, Berriman TJ, Diab I, et al. A randomized controlled trial of catheter ablation versus medical treatment of atrial fibrillation in heart failure (the CAMTAF trial). Circ Arrhythm Electrophysiol. Feb 2014;7(1):31-8. doi:10.1161/CIRCEP.113.000806

121. Romero J, Gabr M, Alviz I, et al. Improved survival in patients with atrial fibrillation and heart failure undergoing catheter ablation compared to medical treatment: A systematic review and meta-analysis of randomized controlled trials. J Cardiovasc Electrophysiol. Nov 2022;33(11):2356-2366. doi:10.1111/jce.15622

122. Wang Y, Xu Y, Ling Z, et al. Radiofrequency catheter ablation for paroxysmal atrial fibrillation: outcomes during a 3-year follow-up period. J Int Med Res. Apr 2019;47(4):1636-1648. doi:10.1177/0300060519828522

123. Saljic A, Heijman J, Dobrev D. Emerging Antiarrhythmic Drugs for Atrial Fibrillation. Int J Mol Sci. Apr 7 2022;23(8)doi:10.3390/ijms2308409

Declarations

Conflict of interest: The author declares no conflict of interest.

Human and Animal Rights and Informed Consent

This article does not contain any studies with human or animal subjects performed by the author.

Correspondence

Azizul Hoque, MD, PhD, FACC. Emory Heart & Vascular Center, 2356 Lenora Church Road, Snellville, GA, 30078
E-Mail: azizul.hoque@emoryhealthcare.org.