










# Rhythm monitoring, success definition, recurrence, and anticoagulation after atrial fibrillation ablation: results from an EHRA survey

Ana Carolina Schwab <sup>1\*</sup>, Ante Anic <sup>2</sup>, Michal M. Farkowski <sup>3</sup>, Jose Guerra <sup>4</sup>, Konstantinos E. Iliodromitis <sup>5</sup>, Kristine Jubele <sup>6,7</sup>, Rui Providencia <sup>8,9</sup>, Julian K.R. Chun <sup>10</sup>, and Serge Boveda <sup>11,12,13</sup>

<sup>1</sup>Department of Cardiology, Helios Frankenklinik Kronach, Kronach, Germany; <sup>2</sup>Department for Cardiovascular Diseases, University Hospital Center Split, Split, Croatia; <sup>3</sup>II Department of Heart Arrhythmia, National Institute of Cardiology, Alpejska 42, 04-628 Warsaw, Poland; <sup>4</sup>Department of Cardiology, Hospital de la Santa Creu i Sant Pau, IIB SANT PAU, CIBERCV, Universitat Autònoma de Barcelona, Barcelona, Spain; <sup>5</sup>Evangelical Hospital Hagen-Haspe, Clinic for Cardiology and Electrophysiology, Hagen, Germany; <sup>6</sup>Arrhythmia Department, P. Stradins Clinical University Hospital, Riga, Latvia; <sup>7</sup>Arrhythmia Department, Riga Stradins University Riga, Latvia; <sup>8</sup>St Bartholomew's Hospital, Barts Heart Centre, Barts Health NHS Trust, London, UK; <sup>9</sup>Institute of Health Informatics, University College of London, London, UK; <sup>10</sup>CCB, Cardiology, Med. Klinik III, Markuskrankenhaus Frankfurt, Germany; <sup>11</sup>Heart Rhythm Department, Clinique Pasteur, 31076 Toulouse, France; <sup>12</sup>Universitair Ziekenhuis Brussel - VUB, Heart Rhythm Management Centre, Brussels, Belgium; and <sup>13</sup>Paris Cardiovascular Research Center, INSERM U970, 75908 Paris Cedex 15, France

Received 23 September 2022; accepted after revision 5 October 2022

## Abstract

Atrial fibrillation (AF) is a major challenge for the healthcare field. Pulmonary vein isolation is the most effective treatment for the maintenance of sinus rhythm. However, clinical endpoints for the procedure vary significantly among studies. There is no consensus on the definition of recurrence and no clear roadmap on how to deal with recurrences after a failed ablation. The purpose of this study was to perform a survey in order to show how clinicians currently approach this knowledge gap. An online survey, supported by the European Heart Rhythm Association (EHRA) Scientific Initiatives Committee, was conducted between 1 April 2022 and 8 May 2022. An anonymous questionnaire was disseminated via social media and EHRA newsletters, for clinicians to complete. This consisted of 18 multiple-choice questions regarding rhythm monitoring, definitions of a successful ablation, clinical practices after a failed AF ablation, and the continuance of anticoagulation. A total of 107 replies were collected across Europe. Most respondents (82%) perform routine monitoring for AF recurrences after ablation, with 51% of them preferring a long-term monitoring strategy. Cost was reported to have an impact on the choice of monitoring strategy. Self-screening was recommended by most (71%) of the respondents. The combination of absence of symptoms and recorded AF was the definition of success for most (83%) of the respondents. Cessation of anticoagulation after ablation was an option mostly for patients with paroxysmal AF and a low CHA<sub>2</sub>DS<sub>2</sub>-VASc score. The majority of physicians perform routine monitoring after AF ablation. For most physicians, the combination of the absence of symptoms and electrocardiographic endpoints defines a successful result after AF ablation.

## Keywords

Catheter ablation • Rhythm monitoring • Anticoagulation • EHRA survey • Recurrence

\* Corresponding author. E-mail address: carolinaschwab@gmail.com

© The Author(s) 2022. Published by Oxford University Press on behalf of the European Society of Cardiology.

This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial License (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited. For commercial re-use, please contact [journals.permissions@oup.com](mailto:journals.permissions@oup.com)

## What's new?

- This is the first comprehensive, multi-national survey on real-world practices after AF ablation in regard to recurrences and monitoring.
- More than 80% of physicians perform routine monitoring after AF ablation.
- For most physicians, the combination of the absence of symptoms and electrocardiographic endpoints defines a successful result after AF ablation.

## Introduction

Atrial fibrillation (AF) is the most common arrhythmia in daily clinical practice. Its estimated prevalence was 59.7 million in 2019, which had almost doubled since 1990.<sup>1</sup> A recent publication suggests that the direct costs of AF to the UK National Health Service in 2030 will be between £2.3 billion and £5.6 billion, mainly driven by admissions.<sup>2</sup>

Pulmonary vein isolation (PVI) is the most effective treatment for maintenance of sinus rhythm.<sup>3</sup> However, success rates and clinical endpoints for PVI vary significantly among studies.<sup>4</sup> This is in part due to the diverse definitions of recurrence after PVI, as well as the different monitoring methods implemented to document asymptomatic recurrences.<sup>5,6</sup> Even the classic definition of an AF episode recommended by the European Society of Cardiology (ESC) AF 2020 guidelines (30 s)<sup>3</sup> has not enough data supporting it because a 30 s recording does not always predict clinically meaningful AF patterns.<sup>7</sup>

It is known that the success rate of catheter ablation varies significantly depending on the type and duration of AF,<sup>8</sup> electrical and structural remodelling of the left atrium and the expertise of a cardiac electrophysiologist (EP),<sup>9</sup> the diagnosis-to-ablation time,<sup>10</sup> as well as the screening tools and duration of the screening afterwards.<sup>11</sup> This may result in a success rate variation between 50 and 80%, over 1–2 years of follow up.<sup>12</sup>

The AF 2020 ESC guidelines point out that the optimal procedural outcome measure, the definition of success after ablation, and the threshold of AF burden that requires anticoagulation are important evidence gaps.<sup>3</sup> We have performed a survey to better understand how clinicians currently deal with these areas of uncertainty.

## Methods

### Study methodology

A questionnaire was developed by the European Heart Rhythm Association (EHRA) Scientific Initiatives Committee and distributed through the Survey Monkey Platform. The questionnaire was anonymous and complied with the European General Data Protection Regulation 2016/679. The questionnaire consisted of 18 multiple-choice questions regarding rhythm monitoring, success definition, clinical practice after failed ablation, and anticoagulation. The full questionnaire is provided in the [Supplementary material online, Appendix](#).

### Study duration and distribution

The survey was conducted online between 1 April 2022 and 8 May 2022, and was promoted via social media (Facebook, Twitter, and LinkedIn) and EHRA newsletters, as well as national working groups newsletters.

### Statistical analysis

Categorical variables are expressed as numbers and percentages. Pearson's  $\chi^2$  test is used to compare groups. Statistics are obtained using the IBM Statistical Product and Service Solutions Statistics for Windows, Version 25.0 (IBM Corp., Armonk, NY, USA) is used. A *P*-value that is <0.05 is considered statistically significant.

## Results

### Sociodemographic profile of respondents

A total of 107 respondents completed the survey; 23% of the respondents were aged 30–39, 32% aged 40–49, 29% aged 50–59, and 15% were >60 years. Participant physicians represented 21 members of the ESC, 5% were from countries represented by affiliated societies, and 82% were male. The respondents identified themselves as senior EPs (37%), heads of an EP laboratory/department (38%), EP fellows (9%), and junior EP (14%).

### Rhythm monitoring

Routine monitoring of recurrences after AF ablation is performed by 82% of the respondents. Approximately, half (51%) of the respondents think that short-term monitoring strategies (electrocardiogram, 24–48 h Holter monitoring) are not enough to monitor recurrences after AF ablation, and advocate for longer monitoring investigations. Smartphones/wearables are routinely used by 37% of the responders as a long-term monitoring strategy (*Figure 1*). External loop recorder or 7-day Holter was used routinely by 29% of the respondents. The greatest limitation of long-term monitoring strategies as shown in *Figures 1* and *2* are costs, which abrogated the adoption of smartphones/wearables and implantable loop recorders for 37 and 47% of the respondents, respectively.

As many as 71% of the respondents (57/80) routinely instruct the patients to perform frequent self-screening following the methods shown in *Figure 3*. Rhythm monitoring with a pulse oximeter was not recommended by any of the respondents.

### Success definition

A composite endpoint (both the absence of symptoms and of recorded AF) was reported as the success endpoint for 83% of the respondents. However, it was difficult to find a consensus about the minimal duration that should be considered for an AF recurrence. The absence of recorded AF was defined as 'no significant AF burden' for 31% of the group, while 24% defended the idea of no recurrence if not longer than 30 s, and 28% required no recorded AF at all, independently from burden or duration. The endpoint of a successful AF ablation, for 15% of the respondents, was rendering the patient asymptomatic. The absence of recorded AF, independent of symptoms, was stated as success definition by 1% of treating physicians.

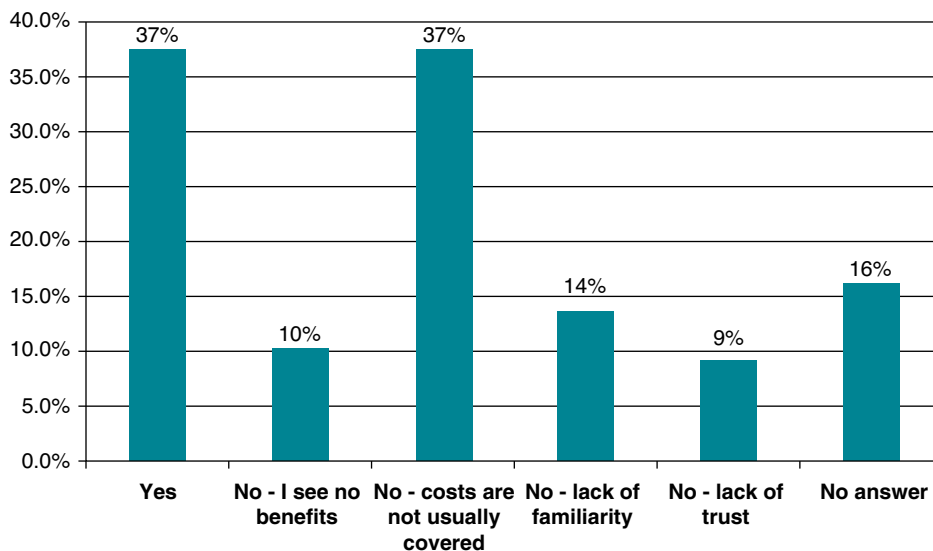
When treating the recurrence, patients with persistent AF should receive more intensive treatment compared with those patients with paroxysmal AF, in the opinion of the respondents. *Figure 4* shows the physician preference for AF management following failed AF ablation. Pulmonary vein isolation only was therapy of choice for paroxysmal AF recurrence ( $P = 0.01$ ). Substrate modification was therapy of choice for persistent AF recurrence ( $P = 0.03$ ).

Following failed AF ablation, 21% of physicians change their strategy to rate control if AF is persistent, and only 7% change to rate control if AF is paroxysmal ( $P = 0.02$ ).

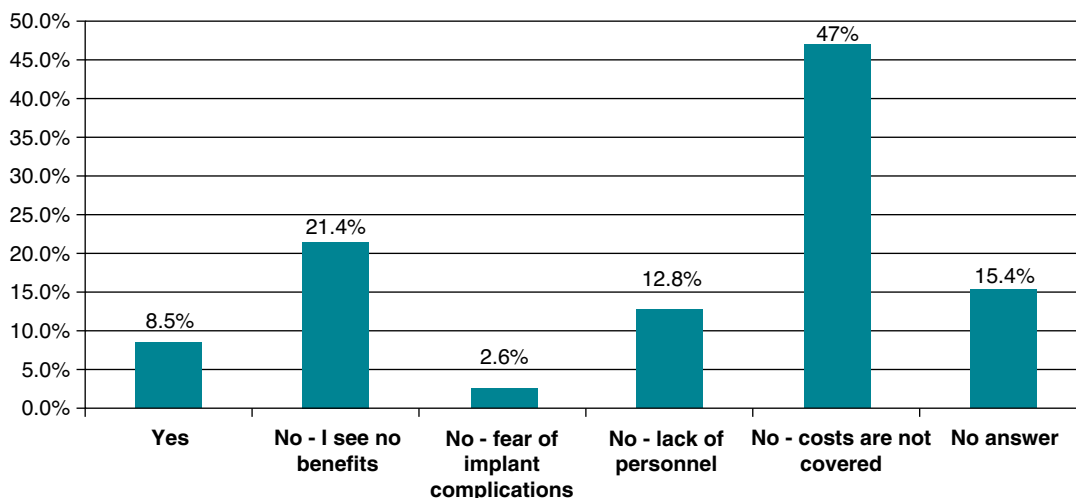
### Anticoagulation and left atrial appendage closure device

The respondents answered whether oral anticoagulants (OACs) should be interrupted after successful AF ablation and when, if so. The questionnaire proposed different scenarios depending on the AF type (paroxysmal or persistent), and the CHA<sub>2</sub>DS<sub>2</sub>-VASc score (0, 1, or >2 for men, or 1, 2, or >3 for women). The available options were:

- (1) Interruption of OAC 2 months after successful PVI,
- (2) Interruption of OAC as per local protocol,



**Figure 1** Use of smartphones/wearables for recurrence monitoring after AF ablation (with more than one negative answer allowed).



**Figure 2** Use of implantable loop recorders for recurrence monitoring after AF ablation (with more than one negative answer allowed).

- (3) Interruption of OAC based on the obtained cardiac implantable electronic device (CIED) interrogation,
- (4) Interruption of OAC based on information obtained from wearables or smartphones, and
- (5) No interruption of OAC.

The groups were divided according to whether there was persistent or paroxysmal AF, and according to the CHA<sub>2</sub>DS<sub>2</sub>-VASc score.

The interruption of OAC after AF ablation was declared more frequent in patients with paroxysmal AF and a low CHA<sub>2</sub>DS<sub>2</sub>-VASc score, as shown in *Table 1*.

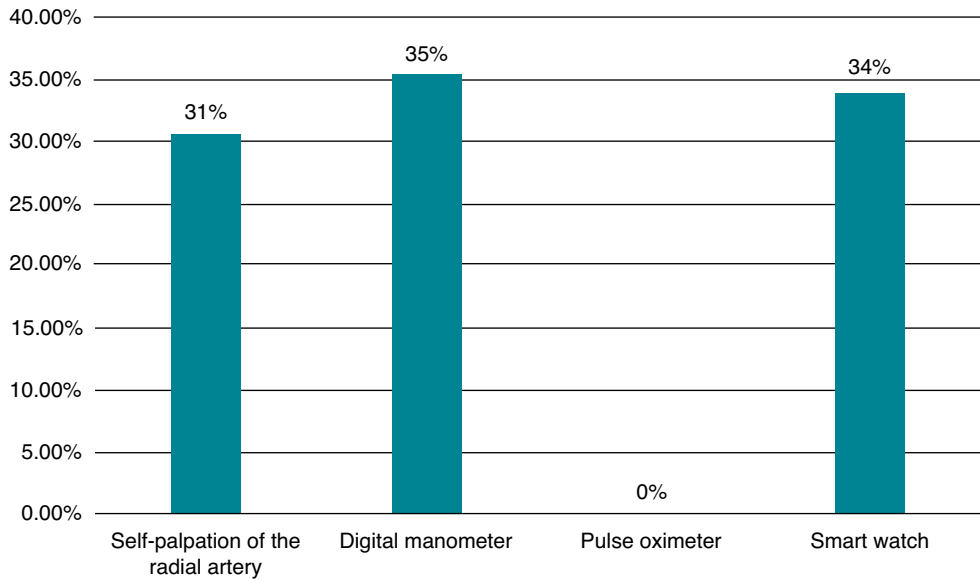
Regarding the subgroup of patients with previous left atrial appendage closure (LAAC), 14% of respondents do not perform AF ablation in this subset of patients. For the rest of physicians who perform AF ablation in patients with LAAC, 19% prescribe OAC regardless of the

CHA<sub>2</sub>DS<sub>2</sub>-VASc score, 47% prescribe OAC only for a period of 2 months, and 8% do not prescribe any OAC at all.

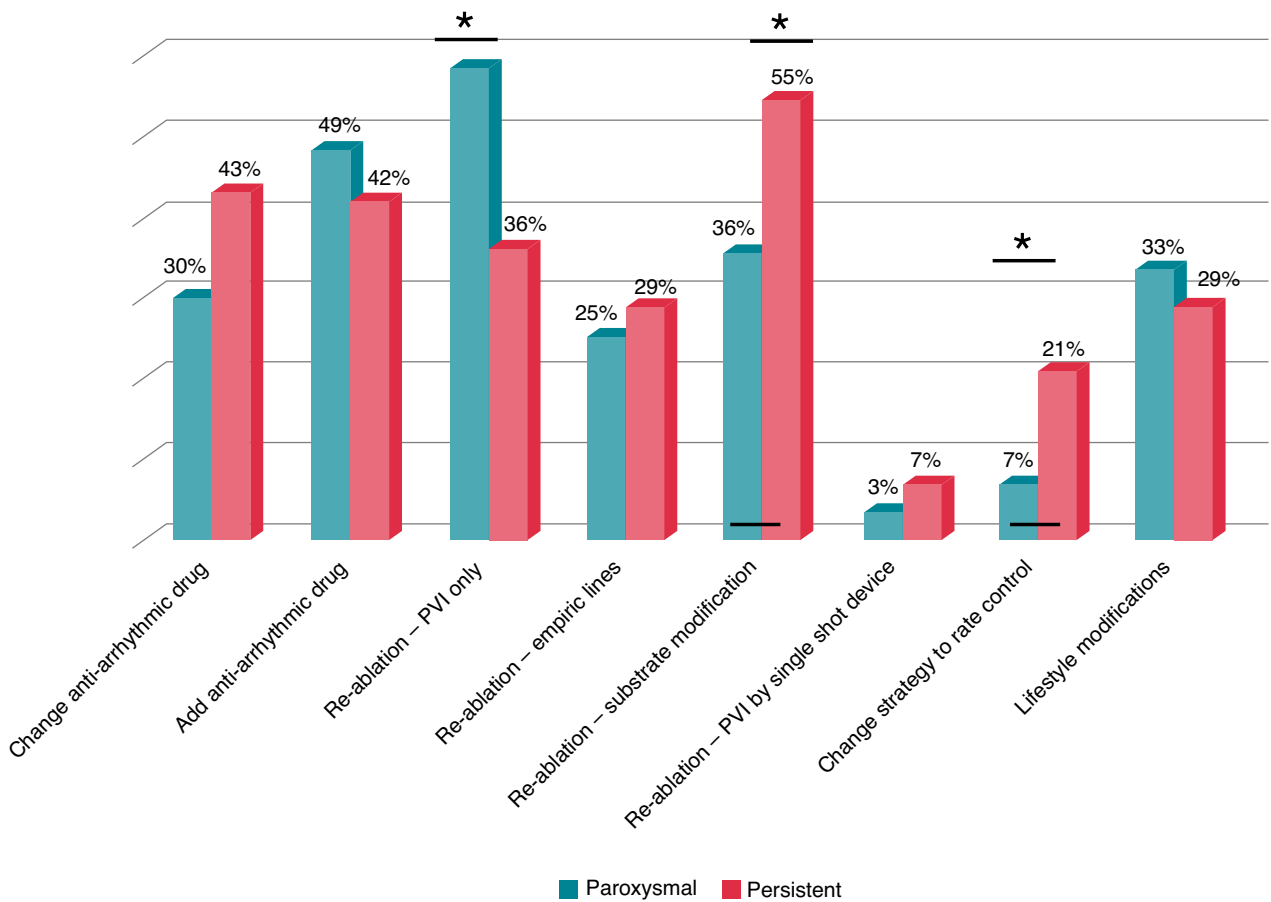
## Discussion

This survey allows a better understanding of the current clinical practice after AF ablation. The key findings are that:

- The majority of respondents perform routine monitoring after AF ablation, with more than half preferring a long-term monitoring strategy.
- The cost of long-term monitoring was the main reason for not using it.



**Figure 3** Self-screening instructions to assess heart rate of patients.



**Figure 4** Preferred therapy after a first failed AF ablation both in paroxysmal and persistent AF. \* $p < 0.05$ .

**Table 1** Termination of anticoagulation after AF ablation depending on paroxysmal or persistent AF, and the CHA<sub>2</sub>DS<sub>2</sub>-VASc score

	CHA <sub>2</sub> DS <sub>2</sub> -VASc, male (female)	After 2 months (%)	Local protocol (%)	Based on CIED (%)	Based on wearables/smartphones (%)	Do not stop (%)
Paroxysmal	0 (1)	72	14	7	2	4
Persistent	0 (1)	57	17	8	6	12
Paroxysmal	1 (2)	34	24	11	6	25
Persistent	1 (2)	22	23	16	8	31
Paroxysmal	>2 (3)	10	12	7	2	67
Persistent	>2 (3)	8	11	6	1	73

- Self-screening for AF is widely recommended by physicians.
- A combined endpoint (absence of symptoms and recorded AF) is the preferred definition for success after ablation.
- AF type (paroxysmal or persistent) affects the management plan after a failed ablation procedure.
- Cessation of anticoagulation after ablation is an option mostly for paroxysmal AF with a low CHA<sub>2</sub>DS<sub>2</sub>-VASc score.

## Rhythm monitoring

According to our survey, 82% of the respondents perform routine rhythm monitoring after AF ablation. There is evidence to show that silent AF might be as clinically relevant as non-silent AF.<sup>13</sup> It is shown that the incidence of asymptomatic AF increases after ablation from 5 to 37% and routine rhythm monitoring can identify those asymptomatic patients.<sup>14</sup>

From the respondents that monitor patients after ablation, almost half opt for long-term monitoring instead of short-term monitoring. The LINQ AF study found that long-term burden analysis was an accurate diagnosis pattern for AF recurrences, since long-term burden analysis does not over-reports failures.<sup>15</sup> The CASTLE AF study found that AF burden at 6 months was predictive of hard clinical outcomes in patients with AF and heart failure.<sup>16</sup>

Despite the proved efficacy of long-term monitoring in the detection of asymptomatic AF episodes,<sup>17</sup> costs still play a crucial role for its implementation into clinical practice.

The majority of our respondents recommend the budget-friendly alternative of self-screening, which has shown a sensitivity of 95% and a specificity of 86% and is being increasingly more adopted.<sup>18</sup> The Apple Watch study showed promising results with AF self-screening in more than 400 000 patients.<sup>19</sup>

## Success definition

Despite recent attempts to define and clarify the endpoints of AF ablation,<sup>8</sup> the definition of success remains a matter of debate.<sup>20</sup> The majority of our respondents (83%) opted for a composite endpoint based on the absence of symptoms and recorded AF, as the success definition criterion. This echoes a tendency in the literature to consider the combined endpoint<sup>21</sup> where both symptoms and actual rhythm play a role. The classic definition of AF diagnosis, according to the ESC guidelines, is at least 30 s of recorded AF,<sup>3</sup> but there is no consensus on the definition of AF recurrence after ablation. Therefore, the perceived treatment success may vary from 28.2 to 72%, depending on the required duration and the method used to detect an AF recurrence.<sup>10,22</sup> Our study confirms the heterogeneous definition of recurrence, that is currently used by the medical community.

Following an AF recurrence, the management step differs between cases of paroxysmal or persistent AF. In failed paroxysmal AF ablation,

the respondents mostly opted for re-ablation with PVI only, while persistent AF recurrence was mostly treated with substrate modification. This approach seems compatible with the rationale that non-pulmonary triggers may play a significant role in non-paroxysmal AF.<sup>18</sup> More conservative strategies after failed ablation, such as changing or adding antiarrhythmic drugs, were proposed for both paroxysmal and persistent AF recurrences. Only 30% of the respondents recommended lifestyle modifications after recurrences, despite that it had been proven that risk-factor management results in a reduction in symptom burden and severity of AF, as well as cardiac remodelling.<sup>23</sup>

## Anticoagulation and left atrial appendage closure device

An important question is whether OAC should be stopped after AF ablation. From observational retrospective studies, there is weak evidence to show that successful ablation may reduce the risk of cerebrovascular embolic events, thus allowing the cessation of OAC.<sup>24</sup> This risk reduction may be especially true for patients with a low CHA<sub>2</sub>DS<sub>2</sub>-VASc score, and access to continuous monitoring.<sup>25,26</sup> Accordingly, our respondents showed a tendency to terminate OAC in patients with paroxysmal AF and a low CHA<sub>2</sub>DS<sub>2</sub>-VASc score.

Left atrial appendage closure is an alternative therapy for patients for whom OAC is not suitable. There is evidence showing that the combination of LAAC and an AF ablation procedure is feasible and safe,<sup>27,28</sup> and can improve left atrial function.<sup>29</sup> Thus, 74% of our respondents are in favour of performing AF ablation in patients with LAAC.

## Conclusion

The majority of physicians perform routine monitoring after AF ablation. For most physicians, a combination of clinical and electrocardiographic endpoints defines a successful result after AF ablation. Our results highlight the gap between consensus recommendations and real-world clinical practice.

## Supplementary material

Supplementary material is available at *Europace* online.

## Acknowledgements

The production of this document is under the responsibility of the Scientific Initiatives Committee of the European Heart Rhythm Association: Serge Boveda (Chair), Giulio Conte (Co-Chair), Ante Anic, Sergio Barra, Julian K.R. Chun, Carlo de Asmundis, Nikolaos Dargès, Michal M. Farkowski, Jose Guerra, Konstantinos E. Iliodromitis, Kristine Jubele, Jędrzej Kosiuk, Eloi Marijon, Rui Providencia, and Frits Prinzen. The authors acknowledge

the EHRA Scientific Research Network centres participating in this survey. A list of these centres can be found on the EHRA website.

**Conflict of interest:** A.A. received consulting fees and speaking honoraria from Boston Scientific Inc., Farapulse Inc., Galaxy Medical Inc., and Biosense & Webster Contracted research from Boston Scientific Inc., Farapulse Inc., Galaxy Medical Inc., Biosense & Webster. M.M.F. received proctoring/speaker fees from BMS/Pfizer, Boehringer Ingelheim, Medtronic, Abbott, and Boston Scientific. S.B. is consultant for Medtronic, Boston Scientific, Microport, and Zoll. J.G. has served as consultant for Medtronic, Boston Scientific, Microport, and Abbott, received speaker fees from Medtronic, Boston Scientific, and Abbott, and received a research grant from Abbott.

## Funding

None declared.

## Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

## References

- Lippi G, Sanchis-Gomar F, Cervellin G. Global epidemiology of atrial fibrillation: an increasing epidemic and public health challenge. *Int J Stroke* 2021;**16**:217–21.
- Burdett P, Lip GYH. Atrial fibrillation in the UK: predicting costs of an emerging epidemic recognizing and forecasting the cost drivers of atrial fibrillation-related costs. *Eur Heart J Qual Care Clin Outcomes* 2022;**8**:187–94.
- 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): 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* 2021;**42**:373–498.
- Wazni OM, Marrassi NF, Martin DO, Verma A, Bhargava M, Saliba W et al. Radiofrequency ablation vs antiarrhythmic drugs as first-line treatment of symptomatic atrial fibrillation: a randomized trial. *JAMA* 2005;**293**:2634–40.
- Calkins H, Hindricks G, Cappato R, Kim YH, Saad EB, Aguinaga L et al. 2017 HRS/EHRA/ECAS/APHS/SOLAECE expert consensus statement on catheter and surgical ablation of atrial fibrillation. *Europace* 2018;**20**:e1–e160.
- Aguilar M, Macle L, Deyell MW, Yao R, Hawkins NM, Khairy P et al. Influence of monitoring strategy on assessment of ablation success and postablation atrial fibrillation burden assessment: implications for practice and clinical trial design. *Circulation* 2022;**145**: 21–30.
- Steinberg JS, O'Connell H, Li S, Ziegler PD. Thirty-second gold standard definition of atrial fibrillation and its relationship with subsequent arrhythmia patterns: analysis of a large prospective device database. *Circ Arrhythm Electrophysiol* 2018;**11**:e006274.
- Gaita F, Scaglione M, Battaglia A, Matta M, Gallo C, Galatà M et al. Very long-term outcome following transcatheter ablation of atrial fibrillation. Are results maintained after 10 years of follow up? *Europace* 2018;**20**:443–50.
- Perino AC, Leef GC, Cluckey A, Yunus FN, Askari M, Heidenreich PA et al. Secular trends in success rate of catheter ablation for atrial fibrillation: the SMASH-AF cohort. *Am Heart J* 2019;**208**:110–9.
- De Greef Y, Schwagten B, Chierchia CB, de Asmundis C, Stockman D, Buyschaert I. Diagnosis-to-ablation time as a predictor of success: early choice for pulmonary vein isolation and long-term outcome in atrial fibrillation: results from the Middelheim-PVI Registry. *Europace* 2018;**20**:589–95.
- Kimura T, Aizawa Y, Kurata N, Nakajima K, Kashimura S, Kunitomi A et al. Assessment of atrial fibrillation ablation outcomes with clinic ECG, monthly 24-h Holter ECG, and twice-daily telemonitoring ECG. *Heart Vessels* 2017;**32**:317–25.
- Mujović N, Marinković M, Lenarczyk R, Tiltz R, Potpara TS. Catheter ablation of atrial fibrillation: an overview for clinicians. *Adv Ther* 2017;**34**:1897–917.
- Boriani G, Pettoelli D. Atrial fibrillation burden and atrial fibrillation type: clinical significance and impact on the risk of stroke and decision making for long-term anticoagulation. *Vascul Pharmacol* 2016;**83**:26–35.
- Hindricks G, Piorkowski C, Tanner H, Kobza R, Gerdts-Li JH, Carubicchio C et al. Perception of atrial fibrillation before and after radiofrequency catheter ablation: relevance of asymptomatic arrhythmia recurrence. *Circulation* 2005;**112**: 307–13.
- Wechselberger S, Kronborg M, Huo Y, Piorkowski J, Neudeck S, Päßler E et al. Continuous monitoring after atrial fibrillation ablation: the LINQ AF study. *Europace* 2018;**20**:f312–20.
- Brachmann J, Sohns C, Andresen D, Siebels J, Sehner S, Boersma L et al. Atrial fibrillation burden and clinical outcomes in heart failure: the CASTLE-AF trial. *JACC Clin Electrophysiol* 2021;**7**:594–603.
- Manganiello S, Anselmino M, Amellone C, Pelissero E, Giuggia M, Trapani G et al. Symptomatic and asymptomatic long-term recurrences following transcatheter atrial fibrillation ablation. *Pacing Clin Electrophysiol* 2014;**37**:697–702.
- Yılmaz M, Candemir B. Approach to recurrence of atrial fibrillation after catheter ablation. *Minerva Cardiol Angiol* 2021;**69**:81–93.
- Perez MV, Mahaffey KW, Hedlin H, Rumsfeld JS, Garcia A, Ferris T et al.; for the Apple Study Investigators. Large-scale assessment of a smartwatch to identify atrial fibrillation. *N Engl J Med* 2019;**381**:1909–17.
- Hunter S. The definition of success in atrial fibrillation ablation surgery. *Ann Cardiothorac Surg* 2014;**3**:89–90.
- Andrade JG, Yao RRJ, Deyell MW, Hawkins NM, Rizkallah J, Jolly U et al.; CIRCA-DOSE Study Investigators. Clinical assessment of AF pattern is poorly correlated with AF burden and post ablation outcomes: a CIRCA-DOSE sub-study. *J Electrocardiol* 2020;**60**: 159–64.
- Lohrmann G, Kaplan R, Ziegler PD, Monteiro J, Passman R. Atrial fibrillation ablation success defined by duration of recurrence on cardiac implantable electronic devices. *J Cardiovasc Electrophysiol* 2020;**31**:3124–31.
- Abed HS, Wittert GA, Leong DP, Shirazi MG, Bahrami B, Middeldorp ME et al. Effect of weight reduction and cardiometabolic risk factor management on symptom burden and severity in patients with atrial fibrillation: a randomized clinical trial. *JAMA* 2013;**310**: 2050–60.
- Atti V, Turagam MK, Viles-Gonzalez JF, Lakkireddy D. Anticoagulation after catheter ablation of atrial fibrillation: is it time to discontinue in select patient population? *J Atr Fibrillation* 2018;**11**:2092.
- Pothineni NVK, Frankel DS. Discontinuing anticoagulation after catheter ablation of atrial fibrillation. *Card Electrophysiol Clin* 2020;**12**:259–64.
- van Vugt SPG, Westra SW, Volleberg RHJA, Hannink G, Nakamura R, de Asmundis C et al. Meta-analysis of controlled studies on minimally interrupted vs. Continuous use of non-vitamin K antagonist oral anticoagulants in catheter ablation for atrial fibrillation. *Europace* 2021;**23**:1961–9.
- Wintgens LIS, Klaver MN, Swaans MJ, Alipour A, Balt JC, van Dijk VF et al. Left atrial catheter ablation in patients with previously implanted left atrial appendage closure devices. *Europace* 2019;**21**:428–33.
- Romero J, Gabr M, Patel K, Briceno D, Diaz JC, Alvarez I et al. Efficacy and safety of left atrial appendage electrical isolation during catheter ablation of atrial fibrillation: an updated meta-analysis. *Europace* 2021;**23**:226–37.
- Wazni O, Boersma L, Healey JS, Mansour M, Tondo C, Phillips K et al. Comparison of anticoagulation with left atrial appendage closure after AF ablation: rationale and design of the OPTION randomized trial. *Am Heart J* 2022;**251**:35–42.