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PERSPECTIVE ARTICLE

Combined atrial fibrillation ablation and left atrial appendage closure: Indications and approaches

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Abstract

Atrial fibrillation (AF) is associated with an increased burden of cardiovascular complications. Early rhythm control has demonstrated promising benefits in this context. Oral anticoagulation has significantly improved overall survival in AF patients by reducing thromboembolic events. However, several comorbidities are linked to an elevated risk of hemorrhagic complications. Left atrial percutaneous appendage closure (LAPAC) is emerging as a promising therapeutic strategy in this subgroup of patients. Interventional cardiologists are increasingly exploring a combined approach involving simultaneous AF ablation and LAPAC to harness the benefits of both procedures and potentially reduce the length of in-hospital stay. According to current literature, the periprocedural safety of combined procedures appears comparable to that of each procedure performed separately, although it is associated with increased hospitalization costs. Notably, the appropriate anticoagulation/antiaggregant therapy regimen following combined procedures remains a subject of ongoing debate. A minimum of 8 weeks of oral anticoagulation is mandatory following AF ablation, irrespective of the patient's stroke risk or the energy modality used. Conversely, LAPAC should be offered only to patients with contraindications to long-term oral anticoagulation. In the early post-discharge period, no significant differences are observed between combined and isolated procedures. Over long-term follow-up, device thrombosis may occur, with its incidence seemingly unaffected by combined procedures. However, peri-device leaks tend to increase over time in patients undergoing combined procedures, with ridge edema related to radiofrequency delivery considered the primary cause of this phenomenon. New emerging energies (such as pulsed-field ablation) require further evaluation to determine long-term outcomes. According to published position papers, the combined strategy of AF ablation and LAPAC may be a reasonable therapeutic option in selected patients.

Keywords: Atrial fibrillation; Transcatheter ablation; Left atrial appendage closure; Stroke; Anticoagulation

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1. Introduction

Atrial fibrillation (AF) is the most common form of supraventricular arrhythmia. The progressive aging of the general population and the increasing survival rates of patients

with advanced cardiomyopathies, due to improvements in pharmacological treatments, will likely lead to an increase in AF prevalence in the coming years. AF is associated with various adverse outcomes. Patients affected by AF face a higher risk of cardiovascular complications, including hospitalization, stroke, and death, as well as a reduced quality of life.[1] Treatment objectives in AF patients are primarily focused on stroke prevention, which is typically achieved through oral anticoagulation therapy, provided that the patient is eligible. Second, managing AF symptoms is essential to mitigate adverse outcomes and enhance quality of life.

2. Rhythm control strategy and the role of percutaneous transcatheter ablation

Rhythm control strategies, which can be implemented using either antiarrhythmic medications or percutaneous ablation techniques, have shown promising benefits, particularly for patients with underlying structural heart disease. Early rhythm-control therapy has been linked to a reduced risk of adverse cardiovascular outcomes in patients with early-stage AF and associated cardiovascular conditions.[2]

Over time, AF percutaneous ablation has become an established and effective method for rhythm control. Technological advancements in electroanatomic mapping systems and energy sources have significantly improved procedural safety and long-term outcomes. However, AF recurrences are still a concern, particularly when triggers are located outside the conventional ablation targets, such as the pulmonary veins. This issue calls for future advancements in ablation techniques to address these recurrences more effectively.

Despite these recurrences, many patients who experience post-ablation arrhythmia show a reduced burden of arrhythmias, with less frequent and shorter episodes of AF. These patients have reported a better quality of life compared to the pre-ablation period. These benefits are expected to extend to other adverse conditions that commonly affect AF patients.[3] According to the most recent European Society of Cardiology (ESC) guidelines, catheter ablation is recommended as a first-line treatment for rhythm control in patients with paroxysmal AF, with a Class I indication. The same level of evidence supports its use in patients with persistent AF who do not respond to antiarrhythmic drug therapy.[4]

AF percutaneous ablation typically involves creating endocardial lesions, usually with radiofrequency energy, to isolate the pulmonary veins – recognized as common triggers of AF – from the left atrial wall. This procedure requires disruption of the endocardium and exposure of the subendothelial tissue. During the healing phase, a thrombotic process occurs at the site of the lesions. To prevent embolic complications, all patients who undergo AF ablation, regardless of the energy source or ablation strategy used, must be treated with therapeutic oral anticoagulation[4] for at least 8 weeks following the procedure, as specified by the latest ESC guidelines.

3. Thromboembolic risk profile and the role of oral anticoagulation

AF is well-known for its association with thromboembolic events, particularly stroke. In the early 1990s, it was demonstrated that administering oral anticoagulation to patients with AF led to prolonged survival. However, this benefit was counterbalanced by an increased risk of hemorrhagic events, which are often seen in patients undergoing oral anticoagulation therapy. Over the years, much debate has focused on the optimal approach to stratifying a patient's stroke risk. Several scoring systems have been proposed by various international medical societies, and different clinical parameters have been introduced and revised, often leading to confusion in interpreting these scores.

The key issue in this debate is the net clinical benefit of anticoagulation therapy, considering both a patient's intrinsic stroke risk and the added risk of bleeding complications. After over 20 years of clinical research, the congestive heart failure, hypertension, age, diabetes mellitus, stroke, vascular disease, and sex category (CHA_2DS-VASc) score was adopted in the 2024 ESC guidelines. At present, it is a standard practice for clinicians to calculate the CHA_2DS-VASc score for all AF patients and to initiate oral anticoagulation therapy (Class I indication) for patients with a score of two or higher.[5]

Historically, the burden of AF – specifically the distinction between self-terminating episodes lasting <7 days versus persistent, non-self-terminating episodes – was not considered a stroke risk factor. While AF burden has yet to be included in stroke risk scores, recent guidelines from the American Heart Association have recognized that arrhythmia burden may influence a patient's thromboembolic risk profile. Interestingly, catheter ablation for AF may have a protective effect, reducing the overall thromboembolic risk.[4]

4. Thromboembolic risk profile and the role of left atrial appendage (LAA)

The LAA is a crucial structure in the formation of cardiac thrombus, which can lead to transient ischemic attacks and strokes in patients with AF. The LAA's anatomy can vary significantly between patients, and its morphology – often

described as a long, tubular, and hooked structure with several lobes – plays an important role in thrombus formation. Imaging of the LAA is critical for identifying the presence of thrombi, especially in patients with non-valvular AF.

As mentioned earlier, oral anticoagulation may mitigate thromboembolic risk but increases the likelihood of hemorrhagic complications. In patients with contraindications to long-term oral anticoagulation, LAA closure (LAAC) has emerged as a viable therapeutic alternative. The procedure involves placing a device at the ostium of the LAA to seal off the appendage from the systemic circulation. Over time, the device becomes re-endothelialized, typically within 3 – 6 months after implantation. During this healing period, double antiplatelet therapy is usually required, as these patients are often unable to tolerate oral anticoagulants.

Recent studies have demonstrated that LAA closure is safe and effective in preventing thromboembolic events.[6,7]

According to the latest ESC guidelines, LAAC is recommended (Class IIa, Level B) for patients with moderate-to-high stroke risk who have long-term contraindications to oral anticoagulation. In addition, a lower level of evidence (Class IIb, Level B) suggests that LAAC may be an alternative strategy for patients at high risk of bleeding.[4]

In 2025, Wazni *et al.*[8] reported the findings from the OPTION trial, which enrolled patients with AF and an elevated CHA_2DS-VASc score (≥2 in men and ≥3 in women). All patients underwent catheter ablation and were randomly assigned in a 1:1 ratio to undergo LAA closure after ablation or receive oral anticoagulation. The primary safety endpoint, tested for superiority, was non-procedure-related major bleeding or clinically relevant non-major bleeding. The primary efficacy endpoint, tested for non-inferiority, was a composite of death from any cause, stroke, or systemic embolism at 36 months. A total of 803 patients were assigned to undergo LAA closure, and 797 to receive anticoagulant therapy. At 36 months, the primary safety endpoint event rate was 8.5% in the LAA closure group and 18.1% in the anticoagulation group (p<0.001 for superiority). A primary efficacy endpoint event had occurred in 41 (5.3%) and 44 patients (5.8%), respectively (p<0.001 for non-inferiority). Furthermore, complications related to the appendage closure device or procedure occurred in 23 patients.[8]

5. Combined percutaneous transcatheter ablation and LAA closure: Implications for anticoagulation management

As previously discussed, percutaneous ablation is a valid therapeutic approach for rhythm control in symptomatic AF patients. The benefits of ablation in reducing arrhythmic burden and improving long-term survival, particularly in patients with heart failure, have been well-documented. However, interventional procedures such as ablation carry inherent risks, including periprocedural complications, which are often minimized in high-volume centers.

While percutaneous ablation improves AF symptoms, it does not alter the patient's thromboembolic risk profile or eligibility for oral anticoagulation. Regardless of the success of rhythm control (whether through antiarrhythmic drugs or percutaneous ablation), the decision to administer oral anticoagulation is primarily based on the CHA_2DS_2-VASc score. Importantly, all patients undergoing AF ablation should receive oral anticoagulation therapy for 8 weeks following the procedure, regardless of their thromboembolic risk.

In contrast, LAAC is typically proposed for patients who have contraindications to oral anticoagulation therapy, and during the healing process, double antiplatelet therapy is necessary. When combining these two procedures, choosing the optimal antiplatelet therapy regimen remains a topic of ongoing research. Recent studies have shown that double antiplatelet therapy may carry a similar hemorrhagic risk to novel oral anticoagulants, raising further concerns about its use in the future.

6. Combined percutaneous transcatheter ablation and LAA closure: Concerns on procedural aspects

Interventional cardiologists should carefully consider procedural outcomes and safety when performing combined AF ablation and LAAC. Combined procedures are only justified if they offer clinical benefit without compromising periprocedural safety. Several procedural aspects merit close consideration.[9]

(i) Anesthetic choice: LAAC device deployment is generally guided by transesophageal echocardiography. General anesthesia may be preferable to increase patients' tolerance, notably for transesophageal echocardiography maneuvers. Considering the anesthetic professional shortage in most hospital centers, the need for anesthesia may add a limiting factor, making it difficult for patients to access the procedure. This is also considering that the majority of percutaneous AF ablations are normally performed under conscious sedation.

(ii) Imaging and transseptal access: Transesophageal echocardiography is typically used to guide a lower and more posterior transseptal puncture, which is recommended to optimize alignment of the device delivery to the appendage plane. This tool is normally

used in high-volume centers performing transseptal access without echo guidance.

(iii) Procedural sequencing: According to published data in the vast majority of centers performing combined procedures, pulmonary vein isolation is usually the first step of the procedure. This approach is primarily motivated by the need to freely maneuver ablation catheters without the risk of device entrapment or dislodgement.

(iv) Energy delivery and device sizing: Radiofrequency energy, the predominant modality for AF ablation, induces endothelial disruption and subsequent tissue edema. Closure device measurements are frequently conducted in real time using an appendage angiography from two different fluoroscopic views. Endoluminal area may be underestimated when endothelial edema caused by radiofrequency delivery involves the ridge area. By underestimating device measurements, we should expect an increased post-procedural device leak.

(v) Left atrial dwell time: Periprocedural catheter thrombosis, followed by thromboembolic complications, is typically associated with dwell time in the left atrium. Despite adequate periprocedural anticoagulation, with activated clotting time titrated to >250 s, such complications are rarely observed. Interventional cardiologists focus on faster, safer procedures to minimize left atrial dwell time. Notably, combined procedures tend to increase the dwell time, and how this increase impacts periprocedural outcomes remains a subject of ongoing debate.

7. Outcome, safety, costs, and hospitalization rates of combined procedures

From an interventional point of view, safety and efficacy remain key outcomes when addressing combined procedures. Recent observational studies showed that the length of hospital stay and major adverse cardiovascular events, such as mortality, stroke, and vascular injury, are comparable when AF ablation is combined with left atrial percutaneous appendage closure (LAPAC) on the same day.[10-14]

Moreover, a meta-analysis on the published observational studies by Junarta *et al.*[15] concluded that combined catheter ablation with LAA was associated with similar rates of arrhythmia-free survival, stroke, and major periprocedural complications compared to catheter ablation alone (Table 1).

Notably, a higher incidence of heart block has been observed in combined procedures, a complication not typically seen when these two procedures are performed separately, and no clear rationale has been identified. Not surprisingly, hospital costs are also higher with combined procedures.

Table 1. Observational studies on left atrial appendage closure and atrial fibrillation ablation

Study	Number of patients	Control group present	Ablation energy used	Follow-up (months)
Panikker *et al.*[10]	20	Yes	RF	12
Ismayl *et al.*[11]	919	Yes	Not specified	None
Mo *et al.*[12]	76	Yes	Not specified	24
Yang *et al.*[13]	65	Yes	RF	12
Ren *et al.*[14]	42	Yes	Cryoablation	12

Abbreviation: RF: Radiofrequency.

Hospital readmission within 30 days is a strong indicator of procedural appropriateness and safety. In the United States, the volume of combined procedures increased between 2016 and 2019, and, not surprisingly, the readmission rate decreased over the same period.[16] In particular, the 30-day readmission rates did not differ between combined procedures and when AF ablation or LAPAC were performed separately.

Longer-term follow-up data remain limited in the literature. A 2-year outcome trial from a multinational registry showed a 2.1% incidence of device-related thrombus.[17] At the end of follow-up, 8% of enrolled patients were still on oral anticoagulation. According to the latest guidelines, LAPAC is considered in patients with long-term contraindication to oral anticoagulation therapy.

Radiofrequency delivery for pulmonary vein isolation leads to tissue edema at least in the first phase of the lesion healing process. Edema in the ridge portion can lead to underestimation of appendage dimensions, increasing the long-term incidence of periprocedural leaks – a main concern in combined procedures.[18] This limitation may be overcome by performing appendage occlusion before radiofrequency delivery. Manipulating the ablation catheter near recently positioned devices carries the risk of device displacement. In the available literature, radiofrequency ablation is usually performed before LAPAC.

Recently, new horizons for pulmonary vein isolation based on pulsed field ablation have emerged. The atrial necrotic process of this new type of energy is non-thermal and not fibrosis-driven, which may result in reduced or absent periprocedural edema compared to thermal ablation.

A case report by Guggiotti *et al.*[19] described LAA closure following pulmonary vein isolation using pulsed field

ablation, noting swelling of the left atrial ridge. However, a 27 mm LAAC device was successfully implanted. Single-case series are gradually appearing in the literature, showing no compromise in terms of safety and outcomes.[9]

8. Combined procedures: Criteria for proceeding or deferring

Based on the data presented, several important considerations can be drawn. The decision-making process described by the authors appears strongly influenced by the experience level of the centers and operators involved. In particular, highly trained interventional specialists operating within high-volume, tertiary referral centers – often characterized by multidisciplinary teams and state-of-the-art facilities – are more inclined to opt for combined procedures. This preference is likely driven by their ability to manage complex cases, familiarity with advanced techniques, and availability of adequate infrastructure to ensure patient safety and procedural success. In contrast, operators working in lower-volume centers, where procedural experience is limited and resources may be inadequate or substandard for complex interventions, should exercise caution. In such settings, the decision to perform combined procedures may carry a significantly higher risk and may not be appropriate. These centers should consider referring patients to more experienced institutions or, alternatively, adopt a staged approach when clinically justified. Ultimately, the choice of procedural strategy should be guided by carefully assessing institutional capabilities, operator expertise, and patient-specific factors to ensure optimal outcomes.

Table 2. Recommendations and precautions

Recommendations and precautions	Descriptions
What is recommended?	- Concomitant LAA closure and AF ablation should be considered in a selected cohort of patients with contraindication to oral anticoagulation - Anticoagulation for 8 weeks after ablation, even after concomitant LAA closure
What should be done?	- LAA closure should be carried out after ablation - Careful examination of the LAA dimension before ablation should be accomplished - Consider PFA for PVI
What should be avoided?	- Routinely combine LAA closure and AF ablation

Abbreviations: AF: Atrial fibrillation; LAA: Left atrial appendage; PFA: Pulsed field ablation; PVI: Pulmonary vein isolation.

9. Conclusion

The combination of AF ablation and LAAC presents a promising strategy for managing patients with AF who are at high risk for both arrhythmias and thromboembolic events. While the safety and efficacy of these combined procedures continue to evolve, the growing body of evidence suggests that they offer significant benefits in stroke prevention and symptom control. Continued research is needed to refine these approaches and optimize patient outcomes in the future.[20] Recommendations based on the current evidence and clinical experience are summarized in Table 2.

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Conflict of interest

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Author contributions

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