

EXPERT CONSENSUS DOCUMENT

The Society of Thoracic Surgeons 2026 Clinical Practice Guidelines for the Prevention and Treatment of New-Onset Postoperative Atrial Fibrillation After Cardiac Surgery



Subhasis Chatterjee, MD,^{1,2} Michael C. Grant, MD, MSE,³ Dawn S. Hui, MD,⁴ Thomas A. Schwann, MD,⁵ John H. Alexander, MD, MHS,⁶ Mario F. L. Gaudino, MD, PhD,⁷ Charles A. Mack, MD,⁷ S. Chris Malaisrie, MD,⁸ HelenMari Merritt, DO,⁹ Pallavi Sood, PhD,¹⁰ Moritz Wyler von Ballmoos, MD, PhD,¹¹ and Stefano Schena, MD, PhD¹²

ABSTRACT

BACKGROUND Postoperative atrial fibrillation (POAF) is the most frequent complication after cardiac surgery and is associated with greater morbidity, mortality, length of stay, and cost. Multiple pharmacologic and procedural strategies exist for POAF prevention and treatment, yet practice variation persists. The Society of Thoracic Surgeons (STS) Workforce on Evidence-Based Surgery convened a multidisciplinary writing group to synthesize contemporary evidence and develop guideline recommendations for preventing and treating new-onset POAF after cardiac surgery.

METHODS In 2025, the group used the Population, Intervention, Comparison, Outcome framework to formulate clinical questions spanning preoperative, intraoperative, and postoperative domains. Following standardized STS methodology, evidence from randomized controlled trials and observational studies was reviewed, and recommendations were graded by Class of Recommendation and Level of Evidence.

RESULTS The group developed 15 recommendations: 8 addressing preventive strategies, 3 intraoperative techniques, and 4 postoperative treatments. Two Class I recommendations addressed perioperative oral amiodarone and rhythm cardioversion for hemodynamically unstable POAF. Two Class IIa recommendations supported posterior pericardiotomy and perioperative β -blockers. Eight Class IIb recommendations reflected areas of uncertainty and limited data. Three Class III recommendations addressed therapies without demonstrated benefit.

CONCLUSIONS Levels of Evidence vary across interventions, and high-quality data remain limited for POAF after cardiac surgery. Pharmacologic studies often lack granularity in dose and timing, and intraoperative maneuvers continue to evolve. Individualized risk assessment remains essential given therapy-related adverse effects. The 2026 STS guidelines provide the most comprehensive recommendations focused on POAF after cardiac surgery, offering a framework to standardize care and highlight future investigational priorities.

(Ann Thorac Surg 2026;122:255–78)

© 2026 by The Society of Thoracic Surgeons. Published by Elsevier Inc. All rights are reserved, including those for text and data mining, AI training, and similar technologies.

The Supplemental Tables and Supplemental Figure can be viewed in the online version of this article [<https://doi.org/10.1016/j.athoracsur.2026.04.002>] on <https://www.annalsthoracicsurgery.org>.

The Society of Thoracic Surgeons Executive Committee approved this document.

Presented at the Sixty-second Annual Meeting of The Society of Thoracic Surgeons, New Orleans, LA, Jan 29-Feb 1, 2026.

¹Division of Cardiothoracic Surgery, Michael E. DeBakey Department of Surgery, Baylor College of Medicine, Houston, Texas; ²The Texas Heart Institute at Baylor College of Medicine, Houston, Texas; ³Department of Anesthesiology and Critical Care Medicine, Johns Hopkins University School of Medicine, Baltimore, Maryland; ⁴Department of Cardiothoracic Surgery, Joe and Teresa R. Lozano Long School of Medicine, University of Texas Health San Antonio, San Antonio, Texas; ⁵Division of Cardiac Surgery, Department of Surgery, Corewell Health East, Royal Oak, Michigan; ⁶Division of Cardiology, Duke Clinical Research Institute, Duke Health, Durham, North Carolina; ⁷Department of Cardiothoracic Surgery, Weill Cornell Medicine, New York, New York; ⁸Division of Cardiac Surgery, Bluhm Cardiovascular Institute, Northwestern University, Chicago, Illinois; ⁹Cardiothoracic Surgery, Nebraska Methodist Hospital, Omaha, Nebraska; ¹⁰The Society of Thoracic Surgeons, Chicago, Illinois; ¹¹Department of Cardiovascular and Thoracic Surgery, Texas Health Fort Worth, Fort Worth, Texas; and ¹²Division of Cardiothoracic Surgery, Medical College of Wisconsin, Milwaukee, Wisconsin

Address correspondence to Dr Chatterjee, Division of Cardiothoracic Surgery, Michael E. DeBakey Department of Surgery, Baylor College of Medicine, One Baylor Plaza, MC-390, Houston, TX 77030; email: subhasis.chatterjee@bcm.edu.

Abbreviations and Acronyms

AATS = American Association for Thoracic Surgery
 ACSD = Adult Cardiac Surgery Database
 ACC = American College of Cardiology
 ACCP = American College of Clinical Pharmacy
 AF = atrial fibrillation
 AHA = American Heart Association
 CABG = coronary artery bypass grafting
 CHA₂DS₂-VASc = C: congestive heart failure (or left ventricular systolic dysfunction); H: hypertension; A₂: age ≥75 years; D: diabetes mellitus; S₂: prior stroke, transient ischemic attack, or thromboembolism; V: vascular disease; A: age 65-74 years; Sc: sex category (female sex)
 CCB = calcium channel blocker
 COPPS = Colchicine for the Prevention of Postpericardiotomy Syndrome
 COPPS-2 = Colchicine for Prevention of the Post-pericardiotomy Syndrome and Post-operative Atrial Fibrillation
 COR = Class of Recommendation
 DOAC = direct oral anticoagulant
 EACTS = European Association for Cardio-Thoracic Surgery
 ESC = European Society of Cardiology
 FDA = Food and Drug Administration
 HR = hazard ratio
 HRS = Heart Rhythm Society
 ICU = intensive care unit
 INR = international normalized ratio
 LAAO = left atrial appendage occlusion
 LOE = Level of Evidence
 LOS = length of stay
 NNT = number needed to treat
 OAC = oral anticoagulation
 OR = odds ratio
 PACES = Postoperative Atrial Fibrillation after Coronary Artery Bypass Grafting-Evaluation of Strategies
 POAF = postoperative atrial fibrillation
 PP = posterior pericardiotomy
 PVI = pulmonary vein isolation
 RCT = randomized controlled trial
 RR = relative risk
 SIRS = Steroids in Cardiac Surgery
 STS = Society of Thoracic Surgeons
 VKA = vitamin K antagonist

EXECUTIVE SUMMARY

New-onset postoperative atrial fibrillation (POAF), the most common complication after cardiac surgery, is associated with higher morbidity and mortality rates and longer hospitalization. This expert consensus outlines evidence-based perioperative, intraoperative, and postoperative strategies to prevent and treat POAF.

The Society of Thoracic Surgeons (STS) Clinical Practice Standards Committee convened a multidisciplinary expert panel comprising cardiac surgeons, cardiologists, anesthesiologists, and intensivists with recognized expertise in the prevention and treatment of POAF. A comprehensive literature review (2010-2025) was conducted with a medical librarian,

encompassing observational studies, randomized trials, meta-analyses, and contemporary guidelines. Panelists were organized into working groups based on PICO (Population, Intervention, Comparator, Outcome) domains covering preoperative, intraoperative, and postoperative phases of care. Panelists addressed 17 clinical questions using a structured, iterative process based on modified Delphi methodology to achieve consensus. Each proposed recommendation was evaluated for clinical relevance, strength of evidence, and feasibility in practice. Final recommendations were assigned a Class of Recommendation (COR) and Level of Evidence (LOE) according to the American Association for Thoracic Surgery (AATS)/European Association for Cardio-Thoracic Surgery (EACTS)/European Society of Thoracic Surgeons (ESTS)/STS framework.¹

Consensus was reached on 15 clinical recommendations addressing the prevention and treatment of POAF after cardiac surgery. Recommendations were generally organized into 3 primary domains: (1) perioperative interventions to reduce POAF, (2) intraoperative strategies to prevent POAF, and (3) postoperative treatment of POAF.

Perioperative recommendations addressed the use of β-blockers, amiodarone, calcium channel blockers (CCBs), colchicine, electrolyte repletion, and anti-inflammatory agents. Intraoperative strategies included posterior pericardiotomy (PP), biatrial pacing, and prophylactic injection of botulinum toxin into epicardial fat pads to prevent POAF or to reduce the risk of future thromboembolic events. Postoperative treatment covered rate vs rhythm control and cardioversion. Recognizing that POAF may be different from preexisting atrial fibrillation (AF), the utility of anticoagulation was evaluated. Finally, for patients selected for anticoagulation, the effectiveness of direct oral anticoagulants vs vitamin K antagonists (VKA) was compared.

BACKGROUND

POAF after cardiac surgery is the most common perioperative complication and a secondary form of AF.² It is associated with greater patient morbidity, longer intensive care unit (ICU) and overall hospital length of stay (LOS), higher health care costs, and greater long-term mortality.³

Although the incidence of POAF has remained relatively stable over time, its pathogenesis is multifactorial. Proposed mechanisms include atrial ischemia, postoperative inflammatory activation, electrolyte derangements, structural cardiac abnormalities, autonomic nervous system

TABLE 1 Interventions Evaluated for Postoperative Atrial Fibrillation After Cardiac Surgery in Major Guidelines: Scope of Coverage Comparison

Phase of Care	Treatment	SCA/EACTA ^a (2019)	Canadian CV Society/ Canadian HRS ^a (2020)	ACC/AHA/ ACCP/HRS ^a (2023)	ESC/EACTS ^a (2024)	STS (2026)
Preoperative	β-blockers	✓	✓	✓		✓
	Amiodarone	✓	✓	✓	✓	✓
	Calcium channel blockers	✓				✓
	Glucocorticoids					✓
	Magnesium		✓			✓
	Potassium					✓
	Colchicine	✓	✓			✓
	High-dose antioxidant/ metabolic supplements		✓			✓
Intraoperative	Posterior pericardiotomy		✓	✓	✓	✓
	Prophylactic left atrial appendage occlusion					a
	Botulinum toxin					✓
	Prophylactic surgical ablation/pulmonary vein isolation					a
	Biatrial pacing		✓			✓
Postoperative	Cardioversion (hemodynamic instability)	✓	✓	✓		✓
	Rate versus rhythm control	✓	✓	✓		✓
	Oral anticoagulation	✓	✓	✓		✓
	Direct oral anticoagulant vs vitamin K antagonist		✓			✓

^aInsufficient evidence determination. Check marks (✓) indicate that the guideline addresses the intervention; they do not signify endorsement. The STS (2026) column includes interventions receiving positive recommendations (Class I, IIA, IIB) and Class III (harm/no benefit) recommendations. ACC, American College of Cardiology; ACCP, American College of Chest Physicians; AHA, American Heart Association; CCS, Canadian Cardiovascular Society; CHRS, Canadian Heart Rhythm Society; EACTA, European Association of Cardiothoracic Anaesthetists; EACTS, European Association for Cardio-Thoracic Surgery; ESC, European Society of Cardiology; HRS, Heart Rhythm Society; SCA, Society of Cardiovascular Anesthesiologists; STS, The Society of Thoracic Surgeons.

dysregulation, and patient-specific genetic and physiologic susceptibilities.⁴

Progress in prevention and treatment is hindered by the absence of a universally accepted definition, heterogeneous clinical presentation, multifactorial etiology, and variability in diagnostic monitoring and reporting. Consequently, practice patterns remain diverse and continue to evolve, ranging from relatively weak evidence-based preventive strategies to ad hoc, episode-directed therapies.⁵

Based on expert panel deliberation and a comprehensive review of current evidence, this clinical practice guideline provides clinicians with evidence-based recommendations for the prevention and management of new-onset POAF after cardiac surgery. Whereas several existing AF guidelines address POAF only briefly, this document serves as a focused, current, and comprehensive resource specifically dedicated to guiding its prevention and treatment after cardiac surgery (Table 1).^{6–9}

EPIDEMIOLOGY

POAF develops in 20% to 50% of cardiac surgery patients, with substantial variation by

procedure type: ~20% to 30% after isolated coronary artery bypass grafting (CABG), 30% to 40% after isolated valve surgery, and 40% to 50% after combined CABG/valve procedures.² Differences in the definition of POAF based on its duration, variability in postoperative rhythm monitoring, and differences in reporting practices collectively contribute to the wide range observed.¹⁰ Additional heterogeneity arises from diverse patient risk profiles and perioperative factors influencing susceptibility across the continuum of care.

Preoperative factors associated with POAF include older age, left atrial enlargement, obesity, obstructive sleep apnea, left ventricular systolic/diastolic dysfunction, prior asymptomatic supraventricular arrhythmias, chronic obstructive pulmonary disease, diabetes, chronic kidney disease, and β-blocker withdrawal.^{11,12} Intraoperative factors, such as cardiopulmonary bypass, prolonged cross-clamp time, and greater surgical complexity, further increase risk, as do postoperative practices such as intravenous inotropic agent use and aggressive diuresis.^{12,13}

RISK AND CLINICAL CONSEQUENCES

POAF is not benign. A pooled analysis of data from 246,340 patients showed POAF was associated with elevated odds of perioperative mortality (odds ratio [OR], 1.92), stroke (OR, 2.17), myocardial infarction (OR, 1.28), and acute renal failure (OR, 2.74), as well as longer ICU and hospital LOS.¹⁴ Health-economic analyses estimate annual United States costs >\$2 billion.¹⁵ Beyond the index admission, compared with patients without POAF, patients with POAF have a higher late stroke rate (1.06 vs 0.88 per 100 patient-years) and a ~5- to 8-fold greater likelihood of recurrent AF at 5 to 10 years, along with greater risks of dementia, cardiomyopathy, heart failure, and premature death.^{2,12,14,16,17}

These sequelae highlight the importance of a multimodal approach to prevention, early rhythm management, and individualized anticoagulation approaches that carefully balance thromboembolic and bleeding risks.¹⁸ Whether interventions that reduce POAF also mitigate these downstream complications remains uncertain. Current evidence suggests POAF may function more as a marker of perioperative or patient vulnerability than as a direct causal mechanism for adverse outcomes—an area warranting further study.

NATURAL HISTORY AND PATHOPHYSIOLOGY

POAF most often develops 2 to 4 days after surgery; >70% of cases occur before day 4 and >90% by day 7.¹³ Episodes are typically paroxysmal, with rapid ventricular response and variable hemodynamic compromise.¹⁹ Most episodes terminate spontaneously or with short-term therapy, yet they often prompt additional testing and interventions that prolong hospitalization and extend into the postdischarge period.²⁰ Nevertheless, 20% to 30% of episodes persist or recur beyond discharge, and in-hospital recurrences are common.²¹ Interestingly, a study involving continuous rhythm monitoring for 1 year after CABG showed that most of these POAF episodes are brief (median duration, 4 minutes; median cumulative time, 50 minutes), which has potential implications for current management and anticoagulation practices.²²

Mechanistically, surgical trauma, cardiopulmonary bypass, and shed blood trigger inflammation and oxidative stress, producing conduction heterogeneity; the efficacy of anti-inflammatory strategies supports this pathway hypothesis. Autonomic imbalance increases sympathetic

activity and pulmonary vein firing, and atrial stretch and ischemia-reperfusion disrupt calcium handling and shorten refractoriness. Epicardial fat contributes proinflammatory mediators and modulates parasympathetic tone. These changes promote electrophysiologic remodeling, such as shortened action potentials, slowed conduction, and reentrant circuits. Although POAF is often transient, it can persist in patients with preexisting atrial fibrosis or cardiometabolic disease.

METHODS

PANEL AND SCOPE. The STS Workforce on Evidence-Based Surgery convened a multidisciplinary writing group of surgeons, cardiologists, anesthesiologists, and intensivists with expertise in adult cardiac surgery and the prevention and treatment of new-onset POAF (all subsequent references to POAF refer to new-onset AF after cardiac surgery). All members completed conflict of interest disclosures, and no significant conflicts were identified.

KEY QUESTIONS AND SEARCH STRATEGY. Research questions were formulated using the PICO (Population, Intervention, Comparison, Outcome) framework (Supplemental Table 1).²³ With a medical librarian, we developed comprehensive PubMed and Embase search strategies (Supplemental Table 2) to identify pharmacologic and procedural strategies for preventing and treating new-onset POAF in the preoperative, intraoperative, and postoperative periods. Searches were restricted to English-language human studies published between January 1, 2010, and December 31, 2024. Foundational studies published before 2010 were included if they provided essential context or established key concepts relevant to the topic. Reference lists of identified articles and major reviews were hand-searched to identify additional relevant studies. Selected publications appearing after the 2010-2024 search window were incorporated when they offered important updates or informed the discussion.

STUDY SELECTION. The review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework (Supplemental Figure). Records were managed in Covidence. After duplicate removal, 2596 records were screened in Covidence using a 2-step process (title/abstract screening, followed by full-text review). All members of the writing group screened studies to identify relevant literature. Titles/abstracts were screened by a single reviewer per study, whereas full-text articles were

independently reviewed by 2 reviewers per study. Conflicts were resolved by discussion. All members of the writing group were involved in both screening stages.

DATA SYNTHESIS AND EVIDENCE GRADING. A total of 301 studies met inclusion criteria. Data extraction and qualitative synthesis informed recommendations, which were graded using the joint AATS/European Association for Cardio-Thoracic Surgery (EACTS)/European Society of Thoracic Surgeons (ESTS)/STS definitions for COR and LOE (Figure).¹ Selected studies that informed the statements are outlined in evidence extraction tables (Supplemental Tables 3–8).

CONSENSUS DEVELOPMENT. Recommendations were finalized through a modified Delphi process requiring a 100% response rate and $\geq 75\%$ agreement for approval. Items were scored on a 5-point Likert scale (1 = strongly agree, 2 = agree, 3 = neutral, 4 = disagree, and 5 = strongly disagree), and 3 voting rounds were needed to reach consensus. The final list of recommendation statements and associated COR/LOE grading are presented in Table 2, and voting results are presented in Supplemental Table 8.

GOVERNANCE AND PUBLIC COMMENT. The manuscript was drafted by the writing group chairs (S.C., S.S.), with contributions from all members. It was subsequently reviewed and approved by the STS Workforce on Evidence-Based Surgery, the STS Council on Quality, Research & Patient Safety, and the STS Executive Committee, and then circulated for a 2-week public comment period.

COMMENT

PREVENTIVE STRATEGIES. Statement 1: In patients undergoing cardiac surgery, perioperative oral amiodarone administration is indicated to prevent new-onset POAF. (COR I, LOE B-R)

Amiodarone is a Class III antiarrhythmic medication whose additional physiologic effects include sodium and calcium channel inhibition and noncompetitive α - and β -receptor blockade. Although amiodarone prolongs the QT interval, there is no consensus threshold for its discontinuation. The oral bioavailability of amiodarone is 30% to 50%, with unpredictable pharmacokinetics. Its half-life is ~ 55 days, and it is metabolized principally in the liver. Its most frequent adverse effect is bradycardia.²⁴

The efficacy of perioperative amiodarone in preventing new-onset POAF was studied extensively in previous seminal randomized controlled

trials (RCTs). In the landmark 2005 Prevention of Arrhythmias that Begin Early After Revascularization, valve Replacement or Repair (PAPABEAR) trial²⁵ (601 patients, 1999–2003), compared with placebo, amiodarone reduced tachyarrhythmias (16.1% vs 29.5%; hazard ratio [HR], 0.52; 95% CI, 0.34–0.69; $P < .001$), with no differences in complications, mortality, or 1-year readmission. Daoud and colleagues²⁶ found that 7 days of preoperative amiodarone reduced the POAF rate from 53% to 25% ($P < .003$). In a third placebo-controlled RCT, the Atrial Fibrillation Suppression Trial (AFIST),²⁷ combination therapy with β -blockers plus amiodarone for 6 days preoperatively reduced POAF compared with β -blockers alone (22.5% vs 38%, $P < .01$). Finally, in a multicenter registry of 235 hospitals with 12,758 patients who underwent CABG, the 17% of patients who received perioperative amiodarone had less POAF and shorter hospital LOS.²⁸

Across the 4 cited studies,^{25–28} encompassing $>20,000$ patients, prophylactic amiodarone produced a small, consistent increase in mild bradycardia (typically 3%–6%, compared with 1%–3% in control groups), whereas rates of clinically significant heart block remained low ($<2\%$) in both arms. No trial showed a statistically significant rise in high-grade atrioventricular block requiring pacing, and higher-dose regimens accounted for most bradycardic events.

Taken together, the cumulative evidence shows that perioperative amiodarone lowers POAF risk substantially while incurring a low and clinically acceptable bradyarrhythmia risk. Moreover, a large meta-analysis evaluating the use of amiodarone in general demonstrated a very low incidence of serious adverse events with low-dose short-term amiodarone use.²⁹

More recent studies are smaller, are single-center, and often use submaximal dosing.²⁴ Despite these limitations, most associated amiodarone with lower POAF risk.^{30–35} In an effort to better characterize the dose-response relationship, Buckley and colleagues³⁶ performed a meta-analysis of 14 RCTs ($n = 2864$ patients, 1966–2005) comparing total administered amiodarone doses of <3000 mg, 3000 to 5000 mg, and >5000 mg. The results suggested that total amiodarone doses of ≥ 3000 mg may be more effective than lower doses in reducing POAF; moreover, preoperative administration did not confer an advantage over postoperative administration.

More recently, a benefit from even lower cumulative amiodarone dosing has been suggested:

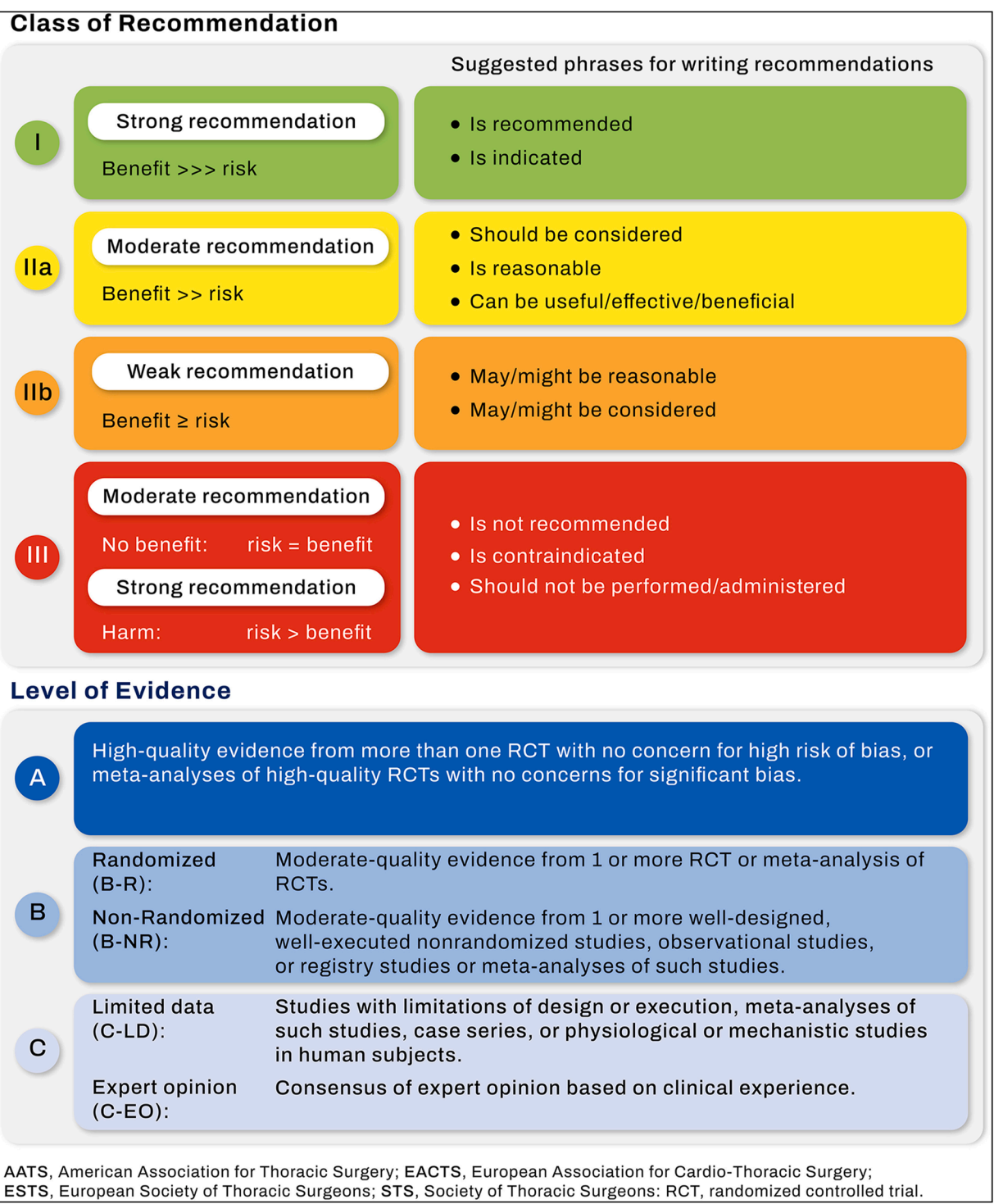


FIGURE Definitions of classes of recommendation and levels of evidence from the Society of Thoracic Surgeons/American Association for Thoracic Surgeons Harmonizing Guidelines. (From Milojevic M, Freemantle N, Hayanga JWA, et al. Harmonizing guidelines and other clinical practice documents: a joint comprehensive methodology manual by the American Association for Thoracic Surgery (AATS), European Association for Cardio-Thoracic Surgery (EACTS), European Society of Thoracic Surgeons (ESTS), and Society of Thoracic Surgeons (STS). *Ann Thorac Surg*. 2025;119(1):83-100. Reprinted with permission. ©2024 The American Association for Thoracic Surgery, The Society of Thoracic Surgeons and European Association for Cardio-Thoracic Surgery. Published by Elsevier Inc on behalf of The American Association for Thoracic Surgery and The Society of Thoracic Surgeons and by Oxford University Press on behalf of European Association for Cardio-Thoracic Surgery. All rights are reserved, including those for text and data mining, AI training, and similar technologies.)

TABLE 2 Recommendations and Associated Class of Recommendation (COR) and Level of Evidence (LOE)

No.	Statement	COR	LOE
Preventive Phase			
1	In patients undergoing cardiac surgery, perioperative oral amiodarone administration is indicated to prevent new-onset POAF.	I	B-R
2	In patients undergoing cardiac surgery, perioperative beta-blocker administration is reasonable to prevent new-onset POAF.	IIa	B-R
3	In patients undergoing cardiac surgery, perioperative use of nondihydropyridine calcium channel blockers may be reasonable to prevent new-onset POAF.	IIb	C-LD
4	In patients undergoing cardiac surgery, the use of perioperative glucocorticoids may be considered to prevent new-onset POAF.	IIb	B-R
5	In patients undergoing cardiac surgery, perioperative intravenous magnesium may be considered to prevent new-onset POAF.	IIb	B-R
6	In patients undergoing cardiac surgery, colchicine may be effective in preventing new-onset POAF.	IIb	B-R
7	In patients undergoing cardiac surgery, routine potassium repletion is not recommended to prevent new-onset POAF.	III-NB	B-R
8	In patients undergoing cardiac surgery, high-dose antioxidant vitamin or metabolic supplement regimens are not recommended for prevention of new-onset POAF.	III-NB	B-R
Intraoperative Adjuncts			
9	In patients undergoing cardiac surgery, creation of a left posterior pericardiotomy should be considered at the time of cardiac surgery to prevent new-onset POAF.	IIa	B-R
10	In patients undergoing cardiac surgery, biatrial pacing may be considered for prevention of new-onset POAF.	IIb	B-R
11	In patients undergoing cardiac surgery, injection of botulinum toxin into epicardial fat pads is not recommended to prevent new-onset POAF.	III-NB	C
Treatment of POAF			
12	Among patients who develop POAF with hemodynamic instability, electrical cardioversion is recommended.	I	C-EO
13	Among patients with hemodynamically stable POAF, a strategy of rate control versus rhythm conversion may be reasonable.	IIb	B-R
14	In patients without prior history of atrial fibrillation undergoing cardiac surgery who develop new-onset POAF, oral anticoagulation may be considered to prevent thromboembolic events while weighing the risk of bleeding.	IIb	B-NR
15	In patients without prior history of atrial fibrillation undergoing cardiac surgery who develop new-onset POAF and anticoagulation is initiated, direct oral anticoagulants may be considered to reduce the risk of bleeding compared with vitamin K antagonists.	IIb	B-NR

Class of Recommendation (COR): I = strong recommendation; IIa = moderate recommendation; IIb = weak recommendation; III = recommendation of no benefit or recommendation of harm. Level of Evidence (LOE): A = high-quality evidence; B = moderate-quality evidence from randomized (R) or nonrandomized (NR) studies; C-LD = limited data; C-EO = consensus of expert opinion. POAF, postoperative atrial fibrillation. From Milojevic M, Freemantle N, Hayanga JWA, et al. Harmonizing guidelines and other clinical practice documents: a joint comprehensive methodology manual by the American Association for Thoracic Surgery (AATS), European Association for Cardio-Thoracic Surgery (EACTS), European Society of Thoracic Surgeons (ESTS), and Society of Thoracic Surgeons (STS). *Ann Thorac Surg*. 2025;119(1):83-100. Reprinted with permission. ©2024 The American Association for Thoracic Surgery, The Society of Thoracic Surgeons and European Association for Cardio-Thoracic Surgery. Published by Elsevier Inc on behalf of The American Association for Thoracic Surgery and The Society of Thoracic Surgeons and by Oxford University Press on behalf of European Association for Cardio-Thoracic Surgery. All rights are reserved, including those for text and data mining, AI training, and similar technologies.

Chatterjee and colleagues,³⁷ in a meta-analysis of 23 published RCTs (3950 patients, 1990-2011), reported a significant POAF reduction with oral (relative risk [RR], 0.59; 95% CI, 0.49-0.70) and intravenous amiodarone therapy (RR, 0.57; 95% CI, 0.43-0.75). Moreover, both preoperative (RR, 0.55; 95% CI, 0.46-0.65) and postoperative (RR, 0.50; 95% CI, 0.33-0.75) administration of amiodarone significantly reduced POAF incidence. Sensitivity analyses demonstrated that when at least 300 mg intravenous amiodarone was loaded and a total dose of 1 g was given, recipients had a lower risk of POAF than the control patients. This

prophylaxis benefit was stronger in CABG patients than in valve surgery patients.

Finally, Mehaffey and colleagues³⁴ further noted a \$458 per-patient cost savings with a strategy of postoperative intravenous amiodarone (900 mg/24 h), followed by oral therapy (400 mg daily), suggesting cost-effectiveness.

Several reports have examined combination therapy with amiodarone and β -blockers. A meta-analysis of 11 RCTs (2199 patients)³⁸ showed that the combination reduced POAF risk more than β -blockers alone (RR, 0.63; 95% CI, 0.49-0.80), but no difference was seen between the single-agent

strategies (RR, 0.81; 95% CI, 0.63-1.06), indicating incremental benefit with combined prophylaxis. These findings support considering a multimodal approach for selected patients, although the optimal dosing and timing remain uncertain.

Recent cardiology guideline recommendations for POAF reflect this mixed evidence. The 2023 American College of Cardiology (ACC)/American Heart Association (AHA)/American College of Chest Physicians (ACCP)/Heart Rhythm Society (HRS) AF Guidelines⁷ assign perioperative amiodarone a COR 2a, LOE B-R for cardiac surgical patients at high-risk for POAF. The 2024 European Society of Cardiology (ESC) AF Guidelines⁹ provide a stronger (COR 1, LOE A) endorsement.

In summary, amiodarone is among the most extensively studied agents for POAF prophylaxis. While trial design, dosing variability, and comparator choice must be considered in the interpretation, the weight of evidence supports its efficacy in reducing POAF across cardiac surgical populations, with additional data suggesting cost-effectiveness. Although the optimal prophylaxis intensity may vary by procedure type, patient comorbidities, and individual tolerance for medication adverse effects such as bradycardia and hypotension, individualized risk-benefit assessment remains essential. The supportive evidence for perioperative amiodarone is more robust than that for β -blockers; thus, a stronger recommendation is issued.

Statement 2: In patients undergoing cardiac surgery, perioperative β -blocker administration is reasonable to prevent new-onset POAF. (COR IIa, LOE B-R)

Preoperative β -blocker use has been a National Quality Forum benchmark³⁹ since 2007; 65% to 86% of cardiac surgery patients in the STS Adult Cardiac Surgery Database (ACSD) received β -blockers.^{40,41} Despite extensive literature, the efficacy of β -blocker prophylaxis for POAF remains controversial. Many studies are underpowered, use heterogeneous control groups, and lack clarity on optimal dosing, duration, or physiologic titration. Also, most trials do not stratify outcomes by POAF risk, limiting the strength of meta-analyses derived from them.

A Cochrane review of 63 randomized and nonrandomized controlled studies (7768 patients) concluded, on the basis of low-certainty evidence, that β -blocker use reduced POAF risk (RR, 0.50; 95% CI, 0.42-0.59) without affecting mortality or myocardial infarction risk.⁴² A separate

meta-analysis of 5 RCTs similarly associated β -blockers with lower POAF risk (OR, 0.43; 95% CI, 0.30-0.61) but not with any difference in the risk of mortality, ischemic stroke, or myocardial infarction.⁴³ Other meta-analyses corroborated these protective effects.^{44,45}

In contradistinction, large registry studies found that β -blockers do little to reduce POAF risk. In fact, Brinkman and colleagues,⁴⁰ using the STS-ACSD (2008-2012) to analyze data from 506,110 CABG patients, reported that β -blocker use within 24 hours of low-risk cardiac surgery was associated with higher adjusted POAF risk (OR, 1.09; 95% CI, 1.06-1.12; $P < .001$) without affecting mortality or major morbidity. O'Neal and colleagues,⁴¹ using an institutional STS database, likewise found no benefit, and other investigators have reached similar conclusions.^{46,47}

Evidence on specific β -blockers is limited. Carvedilol, with combined α - and β -blockade, appears particularly effective in patients with hypertension or left ventricular dysfunction. It also exerts antioxidant and anti-inflammatory effects by myocardial superoxide dismutase and glutathione peroxidase upregulation.⁴⁸ Three meta-analyses have demonstrated carvedilol's superiority over metoprolol in reducing POAF.⁴⁸⁻⁵⁰

Landirolol, an ultra-short-acting intravenous β -blocker, showed promise in Asian studies, but was only approved by the United States Food and Drug Administration (FDA) in November 2024.⁵¹⁻⁵³ Landiolol's utility in the United States and other Western populations warrants further studies.

Other guideline recommendations reflect this mixed evidence (Table 1). The 2023 ACC/AHA/ACCP/HRS AF Guidelines issued preoperative β -blockade a COR 2a, LOE B-R for high-risk cardiac surgery patients.⁷ The 2024 European Society of Cardiology AF Guidelines⁹ make no recommendations regarding perioperative β -blocker use (Table 1). Indeed, the STS convened a 2022 "Preoperative Beta Blocker Working Group," which attempted to address the heterogeneity in clinical practice but reached no clear conclusions (Table 3).^{13,54-60} Ongoing analyses of STS ACSD data are evaluating the association of perioperative β -blocker exposure with POAF and clinical outcomes, with the goal of better informing future guideline development.

Prophylaxis decisions should account for procedural complexity, baseline POAF risk, and patient-specific factors, including existing β -blocker therapy, hemodynamic stability, and contraindications to rate-control agents. Of particular importance, patients already

TABLE 3 Guidelines and Recommendations Regarding Prophylactic β -Blockers in Cardiac Surgery

Organization	Specifications
2011 ACCF/AHA Guideline for Coronary Artery Bypass Graft Surgery ⁵⁵	Class I 1. β-Blockers should be administered for at least 24 hours before CABG to all patients without contraindications to reduce the incidence or clinical sequelae of postoperative AF. (Level of Evidence: B) 2. β-Blockers should be reinstituted as soon as possible after CABG in all patients without contraindications to reduce the incidence or clinical sequelae of AF. (Level of Evidence: B) 3. β-Blockers should be prescribed to all CABG patients without contraindications at the time of hospital discharge. (Level of Evidence: C) Class IIa 1. Preoperative use of β-blockers in patients without contraindications, particularly in those with an LVEF >0.30, can be effective in reducing the risk of in-hospital mortality. (Level of Evidence: B)
AHA Scientific Statement: Secondary Prevention after Coronary Artery Bypass Graft Surgery (2015) ⁵⁶	1. All CABG patients should be prescribed perioperative β-blocker therapy to prevent postoperative AF, ideally starting before surgery, unless contraindicated (ie, bradycardia, severe reactive airway disease) (Class I; Level of Evidence A); 2. CABG patients with a history of MI should be prescribed β-blocker therapy unless contraindicated (Class I; Level of Evidence A); 3. CABG patients with LV dysfunction should be prescribed β-blocker therapy (bisoprolol, sustained-release metoprolol succinate, or carvedilol), unless contraindicated (Class I; Level of Evidence B)
EACTS Guidelines on Perioperative Medication in Adult Cardiac Surgery (2017) ⁵⁷	1. It should be considered to continue β-blocker therapy prior to cardiac surgery (Class IIa; Level of Evidence B) 2. Perioperative low dose oral β-blocker therapy, starting 2–3 days before cardiac surgery, should be considered for the prevention of postoperative AF (Class IIa, Level of Evidence: B); 3. If β-blockers are initiated preoperatively, careful up-titration, according to blood pressure and heart rate, starting several days before surgery, is recommended. (Class I, Level of Evidence: C)
Society of Cardiovascular Anesthesiologists/European Association of Cardiothoracic Anaesthetists Practice Advisory for the Management of Perioperative Atrial Fibrillation in Patients Undergoing Cardiac Surgery (2019) ¹³	Continuation of β-blockers pre- and postoperatively for patients already taking them (Level of Evidence: A/B) Postoperative administration of β-blockers for all other patients without contraindications (Level of Evidence: A)
ACC/AHA/SCAI Guidelines for Coronary Artery Revascularization (2021) ⁵⁸	Class 2a, Level of Evidence: B–R: 1. In patients undergoing CABG who do not have a contraindication to β-blockers, the administration of β-blockers before surgery can be beneficial to reduce the incidence of postoperative atrial fibrillation. Class 2b, Level of Evidence: B–NR 1. In patients undergoing CABG who do not have a contraindication to β-blockers, preoperative use of β-blockers may be effective in reducing in-hospital and 30-day mortality rates. 2. In patients undergoing CABG, the role of preoperative β-blockers for the prevention of acute postoperative myocardial ischemia, stroke, AKI, or ventricular arrhythmia is uncertain.
ACC/AHA/ACCP/HRS Guideline for the Diagnosis and Management of Atrial Fibrillation (2023) ⁵⁹	Class 2a, Level of Evidence: B–R In patients undergoing cardiac surgery who are at high risk for postoperative AF, it is reasonable to administer short-term prophylactic β-blockers or amiodarone to reduce the incidence of postoperative AF.
Enhanced Recovery After Surgery Cardiac Society: Prevention and Management of Postoperative Atrial Fibrillation After Cardiac Surgery (2023) ⁶⁰	1. If currently on β-blocker, then continue the current regimen. Last dose given morning of surgery. 2. If β-blocker naive, administer oral metoprolol 12.5–25 mg preoperatively the morning of surgery (hold for HR <60 beats/min, SBP <100 mm Hg). 3. Oral metoprolol 12.5–25 mg twice daily starting on postoperative day 1 (hold for HR <60 beats/min, SBP <100 mm Hg) for patients not on vasoactive medications. 4. Amiodarone is listed as an alternative.

ACC, American College of Cardiology; ACCF, American College of Cardiology Foundation; ACCP, American College of Clinical Pharmacy; AF, atrial fibrillation; AHA, American Heart Association; AKI, acute kidney injury; B–NR, moderate-quality evidence from ≥ 1 well-designed, well-executed nonrandomized studies, observational studies, or registry studies; meta-analyses of such studies; CABG, coronary artery bypass grafting; EACTS, European Association for Cardio-Thoracic Surgery; HR, heart rate; HRS, Heart Rhythm Society; LV, left ventricle; LVEF, left ventricular ejection fraction; MI, myocardial infarction; NQF, National Quality Forum; SBP, systolic blood pressure; SCAI, Society for Cardiovascular Angiography and Interventions. From Shahian DM, Paone G, Habib RH, et al. The Society of Thoracic Surgeons Preoperative Beta Blocker Working Group interim report. *Ann Thorac Surg*. 2025;119(2):476–484. Reprinted with permission. ©2025 Published by Elsevier Inc. on behalf of the Society of Thoracic Surgeons.

receiving long-term β -blocker therapy should probably continue these medications through the perioperative period as tolerated, because withdrawal may increase POAF risk due to β -receptor upregulation and a hyperadrenergic state.⁶¹

Statement 3: In patients undergoing cardiac surgery, perioperative use of nondihydropyridine calcium channel blockers may be reasonable to prevent new-onset POAF. (COR IIB, LOE C-LD)

The evidence for using CCBs to prevent POAF after cardiac surgery is weak. Multiple small RCTs have evaluated perioperative CCBs with various agents, doses, and comparators; the outcomes are heterogeneous and show little clear benefit. Meta-analyses provide the most insight.

A 2003 meta-analysis⁶² of 41 RCTs (3327 patients) examined supraventricular arrhythmias in 15 of those RCTs (1756 patients) and found no overall reduction in POAF with CCBs (OR, 0.73; 95% CI, 0.48-1.12), although subgroup analyses suggested risk was reduced with nondihydropyridines (OR, 0.62; 95% CI, 0.41-0.93) and increased with dihydropyridines (OR, 2.69; 95% CI, 0.57-12.64). Individually, diltiazem (OR, 0.54; 95% CI, 0.28-1.04) and verapamil (OR, 0.69; 95% CI, 0.42-1.15) had comparable effects on supraventricular arrhythmias.

A 2018 network meta-analysis of 9 RCTs (940 patients) compared perioperative diltiazem with nitroglycerin or placebo.⁶³ Diltiazem prevented POAF more effectively than nitroglycerin (OR, 0.3; 95% CI, 0.18-0.85) and nonsignificantly more effectively than placebo (OR, 0.35; 95% CI, 0.08-1.55). No adequate head-to-head trials have compared CCBs with β -blockers or amiodarone.

Overall, CCBs appear less effective than β -blockers or amiodarone for preventing POAF, and their prophylactic use is limited by potential adverse effects: atrioventricular block, peripheral edema, hypotension, and low cardiac output. Consequently, other AF guidelines^{7,9} make no recommendations regarding the use of CCBs for preventing POAF after cardiac surgery.

Statement 4: In patients undergoing cardiac surgery, the use of perioperative glucocorticoids may be considered to prevent new-onset POAF. (COR IIB, LOE B-R)

The hypothesis that mitigating the systemic inflammatory response reduces POAF has prompted numerous investigations of glucocorticoids, although high-quality contemporary evidence remains limited. A meta-analysis of 7 RCTs

(1046 patients) found significant heterogeneity ($I^2 = 65\%$) due to variation in steroid dosing. When analysis was restricted to moderate-dose steroids, significant treatment effect without significant heterogeneity was noted (OR, 0.32; 95% CI, 0.21-0.50; $P < .00001$). However, only 2 studies reported on perioperative glucocorticoid use, and rhythm follow-up was only up to 72 hours.⁶⁴

A prospectively planned meta-analysis⁶⁵ of patient-level data from 2 RCTs, the Steroids in Cardiac Surgery (SIRS) Trial and the Dexamethasone in Cardiac Surgery (DECS) study, analyzed POAF as a secondary outcome. In 11,989 patients from 88 centers and 19 countries, steroids did not decrease POAF (OR, 0.94; 95% CI, 0.87-1.02; $P = .15$); however, definitions of POAF in these studies were not consistent with generally accepted definitions: The SIRS trial defined new-onset AF as AF requiring pharmacologic therapy or cardioversion, whereas the DECS study defined new-onset AF as “any marking on the ICU list reporting atrial fibrillation.” The 2019 EACTS/European Association of Cardiothoracic Anesthesiology/European Board of Cardiovascular Perfusion guidelines on cardiopulmonary bypass⁶⁶ note the association of steroids with myocardial injury (as seen in the SIRS trial).¹⁸

Statement 5: In patients undergoing cardiac surgery, perioperative intravenous magnesium may be considered to prevent new-onset POAF. (COR IIB, LOE B-R)

Multiple meta-analyses of RCTs published in the early 2000s concluded that intravenous magnesium reduces patients' risk of atrial arrhythmias.⁶⁷⁻⁶⁹ However, 2 more recent meta-analyses may both better reflect current practice and provide insight when taking into account the quality of the studies included in the analysis. One meta-analysis of RCTs demonstrated a beneficial effect of intravenous magnesium supplementation (20 studies, $n = 3696$) on supraventricular arrhythmia risk (OR, 0.69; 95% CI, 0.53-0.90) compared with saline (number needed to treat [NNT] = 14). However, this apparent benefit was weakened when low-quality studies were excluded (Jadad score < 3 ; OR, 0.85; 95% CI, 0.66-1.11).⁷⁰ Likewise, in another meta-analysis of RCTs, intravenous magnesium resulted in a lower incidence of POAF (OR, 0.58; 95% CI, 0.43-0.79). When the analysis was restricted to high-quality studies with POAF as the primary end point, intravenous magnesium supplementation did not result in a lower incidence of arrhythmias (OR, 0.94; 95% CI, 0.61-1.44; $I^2 = 0.40$).

The results of Egger and Begg tests indicated that the positive effects of smaller or lower-quality studies are probably influenced by publication bias.⁷¹ Given its potential efficacy, reasonable expense, favorable adverse effect profile, and wide therapeutic window, intravenous magnesium supplementation maybe considered for POAF prevention.

Statement 6: In patients undergoing cardiac surgery, colchicine may be effective in preventing new-onset POAF. (COR IIb, LOE B-R)

Multiple meta-analyses of RCTs have investigated the effect of postoperative use of colchicine on POAF, including a recent study of 8 RCTs ($n = 1895$) that concluded that colchicine reduces POAF risk (RR, 0.7; 95% CI, 0.59-0.82; $I^2 = 0\%$). However, colchicine use and significant adverse gastrointestinal events were consistently associated with POAF (RR, 2.2; 95% CI, 1.38-3.51), even though patients were no more likely to discontinue colchicine than placebo (RR, 1.33; 95% CI, 0.93-1.89).⁷² Several other meta-analyses of RCTs have consistently confirmed the reduction in POAF.⁷³⁻⁷⁷ These results are all based on pooled data from small trials with variable dosing strategies, durations of therapy, and definitions of POAF.

The original Colchicine for the Prevention of Postpericardiotomy Syndrome (COPPS) trial,⁷⁸ which showed that colchicine reduced the primary end point of postpericardiotomy syndrome, also explored the possibility that it also reduced POAF. The COPPS POAF substudy ($n = 336$) found that patients randomly assigned to the colchicine arm had a lower incidence of POAF (12% vs 22%, $P = .02$) than the standard care group, with similar overall adverse effects.⁷⁹ The colchicine dosing regimen began on postoperative day 3, with 1.0 mg twice daily for the first day, followed by a maintenance dose of 0.5 mg twice daily for 1 month in patients weighing >70 kg and halved doses for those weighing <70 kg or intolerant to the highest dose.

Wanting to focus on POAF, the investigators of the COLchicine for Prevention of the Post-pericardiotomy Syndrome and Post-operative Atrial Fibrillation (COPPS-2) trial ($n = 360$) changed the dosing regimen of colchicine to begin 48 to 72 hours preoperatively and to continue for 1 month postoperatively. Moreover, the dosage was halved, with patients >70 kg receiving 0.5 mg twice daily and patients <70 kg receiving 0.5 mg once daily. The results showed that colchicine use significantly reduced the

incidence of postpericardiotomy syndrome (the primary end point) but not the incidence of POAF (a secondary end point) (33.9% vs 41.7%; 95% CI, -2.2% to 17.6%).⁷⁹ Although COPPS-2 showed no POAF reduction in the intention-to-treat analysis, the prespecified on-treatment analysis showed a meaningful benefit: Among patients who completed colchicine therapy ($\sim 80\%$ adherence), the POAF rate was only 27%, compared with 41% for the control patients (absolute difference, 14%; NNT = 7).

In essence, COPPS and COPPS-2 differ in 4 material ways. First, study design and intent: COPPS was a single-center trial with POAF as a secondary end point, whereas COPPS-2 was a multicenter RCT powered for prevention of postpericardiotomy syndrome, again with POAF as a secondary end point.

Second, timing of colchicine initiation: COPPS started colchicine postoperatively, whereas COPPS-2 included a preoperative loading dose, possibly contributing to higher early gastrointestinal intolerance.

Third, dosing strategy and tolerability: COPPS used higher initial doses, whereas COPPS-2 reduced the total daily dose and adjusted for body weight, yet still observed greater gastrointestinal intolerance and discontinuation.

Fourth, POAF efficacy signals: COPPS showed a clear reduction in POAF with similar discontinuation rates, whereas COPPS-2 found no significant benefit in the intention-to-treat analysis but did show a clinically meaningful reduction in POAF in the prespecified on-treatment cohort.

In summary, data from these trials indicate that colchicine provides a clinically relevant reduction in POAF risk for patients who can tolerate the medication. Postoperative use of colchicine may be effective in preventing POAF, although optimal dosing strategies still need to be developed to limit its adverse effects.

Statement 7: In patients undergoing cardiac surgery, routine potassium repletion is not recommended to prevent new-onset POAF. (COR III-NB, LOE B-R)

Historically, repletion of potassium after cardiac surgery to prevent arrhythmia generally, and POAF specifically, is widely accepted despite limited evidence of its efficacy. Observational results are conflicting. A 2020 single-center observational cohort study ($n = 3064$) associated potassium levels <4.5 mEq/L with greater incidence of POAF.⁷¹ However, another single-center observational study (2016) of 2041 patients

revealed that prophylactic potassium supplementation did not reduce the incidence of POAF; paradoxically, higher levels of potassium were associated with greater incidence of POAF.⁸⁰

The recent (2024) Prevention of Dysrhythmias on the Cardiac Intensive Care Unit - Does Maintenance of High-normal Serum Potassium Levels Matter (TIGHT-K) prospective, multicenter RCT (n = 1690) of potassium repletion to 3.6 or 4.5 mEq/L in patients undergoing isolated CABG found no difference between groups in the primary outcome of ≥ 1 episodes of POAF (diagnosed by any means, including Holter monitor) in the first 120 hours after surgery or by hospital discharge. Likewise, this high-quality study found the incidence of other dysrhythmias, LOS, and mortality rate did not differ.⁸¹ Although these results do not support routine potassium repletion specifically to prevent POAF by targeting a threshold potassium level, the value of potassium repletion for other clinical goals—for example, ventricular arrhythmia prevention, acidosis correction, diuresis augmentation—is outside the scope of these guidelines.

Statement 8: In patients undergoing cardiac surgery, high-dose antioxidant vitamin or metabolic supplement regimens are not recommended for prevention of new-onset POAF. (COR III-NB, LOE B-R)

Several anti-inflammatory medications, including carnitine, naproxen, and statins, have been evaluated for POAF prevention. Although several small, single-center randomized trials have suggested possible benefit, these findings have not been reproduced in larger or higher-quality studies.⁸²⁻⁸⁵ In particular, the use of nonsteroidal anti-inflammatory-based approaches in cardiac surgical patients has raised concerns about renal dysfunction and gastrointestinal bleeding, particularly in light of the FDA's boxed warning against their use in patients who undergo coronary revascularization.^{82,86}

Similarly, high-dose antioxidant vitamin or metabolic supplement regimens, such as vitamin C-based protocols, *N*-acetylcysteine, polyunsaturated fatty acids, and related strategies, have been studied in multiple RCTs and synthesized in meta-analyses.⁸⁷ Although a few pooled analyses have shown reductions in POAF, the evidence is characterized by substantial heterogeneity in agent selection, dosing, therapeutic duration, study design, and definition of POAF. These inconsistencies limit comparability across trials and reduce confidence in the reliability and reproducibility of any observed effect.

Given the absence of consistent benefit across higher-quality evidence, combined with known safety concerns for certain agents, high-dose antioxidant vitamin or metabolic supplement regimens are not recommended for POAF prevention.

INTRAOPERATIVE ADJUNCTIVE PROCEDURES. Statement 9: In patients undergoing cardiac surgery, creation of a left posterior pericardiotomy should be considered at the time of cardiac surgery to prevent new-onset POAF. (COR IIa, LOE B-R)

PP is based on the idea that retained pericardial fluid can irritate the atria and trigger POAF and that continuous drainage into the left pleural space may reduce this irritation. By creating a controlled posterior opening, the procedure aims to prevent effusion-related atrial inflammation and arrhythmogenesis. A 4- to 5-cm vertical incision is created posterior to the phrenic nerve, extending from the level of the left inferior pulmonary vein toward the diaphragm. This incision is carried through the pericardium to allow communication with the left pleural cavity, after which unobstructed drainage and hemostasis are confirmed before the operation proceeds.

Randomized trials have compared left PP vs standard of care during cardiac surgery. A 2023 meta-analysis of 25 trials,⁸⁸ including 22 studies (4300 patients) with POAF as the primary outcome, associated PP with a ~50% risk reduction (11.7% vs 23.7%; OR, 0.49; 95% CI, 0.38-0.61). PP also lowered rates of supraventricular tachyarrhythmia, early and late pericardial effusions, and tamponade, without significantly affecting pulmonary complications, reexploration, mortality, or ICU stay. Most studies were single-center, and 73% of operations were isolated CABG. Evidence from broader surgical populations is supportive.

The Posterior Left Pericardiotomy for the Prevention of Postoperative Atrial Fibrillation After Cardiac Surgery (PALACS) trial⁸⁹ enrolled 420 patients undergoing CABG (45%), aortic valve replacement (53%), and/or aortic surgery (44%); mean CHA₂DS₂-VASC (C: congestive heart failure (or left ventricular systolic dysfunction); H: hypertension; A₂: age ≥ 75 years; D: diabetes mellitus; S₂: prior stroke, transient ischemic attack, or thromboembolism; V: vascular disease; A: age 65-74 years; Sc: sex category [female sex]) was 2, and 37% were >3 . PP significantly reduced POAF (OR, 0.44; 95% CI, 0.27-0.70; $P = .0005$) across all procedures. A post hoc analysis⁹⁰ identified posterolateral effusion ≥ 10 mm as an independent predictor of POAF; PP markedly

decreased these effusions (37% vs 67%, $P < .001$), supporting a mechanistic link. The signal that PP reduces posterolateral effusions, an independent predictor of POAF, provides a coherent explanation for the benefit observed across CABG and aortic surgery.

Enhanced posterior pericardial drainage may reduce atrial irritation and POAF. A recent propensity-matched observational study of >2500 patients who underwent concomitant CABG and aortic valve replacement showed that adding a posterior pericardial drain lowered POAF risk (33% vs 43%, $P = .002$; adjusted OR, 0.67; 95% CI, 0.52-0.88; $P = .003$).⁹¹ A meta-analysis of 19 RCTs ($n = 3425$) similarly found that posterior pericardial drainage, whether by pericardiotomy or a posterior chest tube, reduced the odds of POAF by 58% (OR, 0.42; 95% CI, 0.29-0.59; $P < .001$; $I^2 = 66\%$), with corresponding reductions in pericardial effusions and tamponade. These findings support the mechanistic rationale for PP and interest in drainage-based POAF prevention.

The recent Pericardiotomy and Amiodarone for Prophylaxis against Postoperative Atrial Fibrillation in Cardiac Surgery (PAPPA) trial showed that patients who underwent PP combined with a structured low-dose amiodarone regimen had significantly less POAF after CABG than matched historical controls (18% vs 32%, $P = .004$).⁹² Notably, this benefit persisted in the intention-to-treat analysis, which included patients who could not complete the full 3-g amiodarone load. The per-protocol analysis, limited to patients who received the regimen as intended (80%), showed an even greater reduction in POAF (19% vs 37%, $P = .001$). These parallel findings highlight both the real-world effectiveness and the enhanced efficacy of using complementary strategies, PP and prophylactic amiodarone, to reduce the overall risk of POAF.

In CABG and mixed surgical cohorts, PP consistently lowers the incidence of POAF, pericardial effusion, and tamponade. The maneuver is rapid, low-risk, and inexpensive, although outcomes may vary with surgical setting, effusion management, and institutional practice. Evidence remains more limited in isolated mitral valve surgery. The 2023 ACC/AHA⁷ and the 2024 ESC/EACTS guidelines⁹ both issued a Class IIa, Level B recommendation for PP; the ACC/AHA guideline does not extend the recommendation to mitral or tricuspid surgery, whereas the ESC/EACTS guideline provides an unqualified endorsement. Consistent with the ESC/EACTS

position, we recommend that PP be considered, given its favorable benefit-to-risk profile in patients without prior cardiac surgery.

Statement 10: In patients undergoing cardiac surgery, biatrial pacing may be considered for prevention of new-onset POAF. (COR IIb, LOE B-R)

Much of the available data regarding the potential for atrial pacing to prevent POAF was published before 2010. These studies' findings are summarized in a Cochrane review updated in 2013 that associated any form of atrial pacing with a significant reduction in POAF risk after cardiac surgery (OR, 0.47; 95% CI, 0.36-0.61) compared with no pacing.⁹³ Similarly, a 2019 meta-analysis of 14 RCTs ($n = 1727$) revealed that compared with no pacing, any form of atrial pacing was associated with lower incidence of POAF (OR, 0.49; 95% CI, 0.35-0.69). These findings were the result of pooling small studies and were associated with significant heterogeneity. Subgroup analysis suggested that biatrial pacing (used in 554 patients) was the most effective strategy, being associated with the largest POAF risk reduction (OR, 0.36; 95% CI, 0.20-0.64) compared with no pacing, although those findings were similarly associated with significant heterogeneity ($I^2 = 63\%$).⁹⁴ Among these studies, the duration of pacing varied, as did the definition and diagnosis of POAF. Placing temporary epicardial leads after cardiac surgery is not without risk because, theoretically, it incurs a higher risk of bleeding or tamponade after temporary wires are removed.

Statement 11: In patients undergoing cardiac surgery, injection of botulinum toxin into epicardial fat pads is not recommended to prevent new-onset POAF. (COR III-NB, LOE C)

Parasympathetic and sympathetic activation of cardiomyocytes has been shown in animal studies to initiate and sustain AF, and the extent of pericardial adiposity correlates with AF in humans.⁹⁵⁻⁹⁷ The anterior fat pad contains efferent parasympathetic fibers that, when stimulated, shorten action potential duration and the atrial effective refractory period, prolong atrial cycle length, and reduce atrioventricular conduction time—changes that favor AF. Intraoperative cholinergic blockade with botulinum toxin injection has therefore been proposed to reduce POAF. A meta-analysis of 3 RCTs (509 patients) found no reduction in POAF.⁹⁸ Studies of topical botulinum toxin show mixed results.⁹⁹⁻¹⁰¹ Two RCTs of

anterior fat pad excision during CABG^{102,103} also showed no effect on POAF rates.

EVIDENCE REVIEW WITHOUT RECOMMENDATION. The writing group elected to present prophylactic left atrial appendage occlusion (LAAO) and concomitant surgical ablation as evidence reviews rather than formal recommendations. In prior ACC/AHA guidelines, interventions for which usefulness or efficacy is less well established have been designated as Class IIb, explicitly acknowledging clinical uncertainty. The current Harmonizing STS/AATS methodology¹ does not include an equivalent designation, raising concern that a graded recommendation could overstate the strength or consistency of the available evidence. Functionally, the conclusion is similar: Both prophylactic LAAO and prophylactic pulmonary vein isolation (PVI) or surgical ablation may be performed in selected patients, but the supporting evidence remains uncertain. These procedures are already being performed in contemporary practice, both in clinical trials and off-label. As additional RCT data emerge, these topics will be revisited in future iterations of the guidelines.

Prophylactic Concomitant LAAO to Reduce the Risk of Late Stroke and Thromboembolic Events. The left atrial appendage has been implicated as a source of a large proportion of cardioembolic strokes in patients with AF.¹⁰⁴ In patients without prior AF, prophylactic concomitant LAAO during cardiac surgery has been proposed as a strategy to mitigate both the short-term thromboembolic risk associated with POAF and the lifetime risk of developing AF, particularly in patients for whom long-term anticoagulation may be limited by bleeding concerns.

Early observational studies and meta-analyses have yielded conflicting results. Several large registry-based analyses associated prophylactic LAAO with higher rates of POAF and higher hospital costs, without a corresponding reduction in perioperative stroke or mortality.¹⁰⁵⁻¹⁰⁹ The mechanisms underlying these findings remain uncertain but may relate to localized atrial inflammation, mechanical irritation at the appendage base, or greater procedural complexity. These observations underscore the importance of careful patient selection and standardized surgical technique when LAAO is performed prophylactically.

More recent data with extended follow-up suggest a potential long-term benefit. A meta-analysis of contemporary studies, including 2 randomized trials and 4 risk-adjusted cohort studies (n = 4130), demonstrated lower 5-year stroke rates with prophylactic LAAO compared

with no LAAO (6.8% vs 4.3%; HR, 0.65; 95% CI, 0.45-0.94). Techniques included clip-based exclusion, epicardial or endocardial suture ligation, and appendage amputation. In this analysis, LAAO was not associated with a higher risk of POAF (RR, 1.05; 95% CI, 0.86-1.28), although this estimate was derived from only 3 studies and showed moderate heterogeneity. Landmark analysis suggested better 4-year survival in patients who underwent LAAO.¹¹⁰ Interpretation is limited by the use of Kaplan-Meier-derived rather than individual patient data, variable stroke definitions, incomplete reporting of CHA₂DS₂-VASC scores, and inconsistent rhythm surveillance.

Additional real-world evidence comes from a large Medicare/Medicaid cohort of patients who underwent mitral valve surgery (n = 38,597; 1875 matched pairs; median CHA₂DS₂-VASC score 3). In this analysis, prophylactic LAAO was associated with higher rates of POAF (44.6% vs 38.4%) but lower rates of in-hospital stroke (1.0% vs 2.1%) and a lower 5-year risk of stroke or thromboembolism (6.4% vs 8.3%; HR, 0.74), with similar long-term survival.¹¹¹ The use of prophylactic LAAO increased from 11% to 24% during the study period. Notably, the NNT to prevent 1 late thromboembolic event (n = 53) was comparable to that observed in the randomized Left Atrial Appendage Occlusion Study (LAAOS III) trial among patients with established AF, despite differences in reported anticoagulant use.¹¹² This similarity is striking given that 77% of participants in LAAOS III received oral anticoagulation (OAC), whereas anticoagulant use in the prophylactic cohort was not reported.

Several randomized trials are ongoing to refine patient selection and clarify whether prophylactic LAAO has long-term benefit. The AtriClip Left Atrial Appendage Exclusion Concomitant to Structural Heart Procedures (ATLAS) trial¹¹³ randomly assigned patients with CHA₂DS₂-VASC ≥ 2 and HAS-BLED (Hypertension, Abnormal renal/liver function, Stroke, Bleeding history or predisposition, Labile international normalized ratio [INR], Elderly, Drugs/alcohol concomitantly) score ≥ 2 to LAAO or standard care. The results showed the feasibility of prophylactic LAAO, but the study was not powered to detect differences in POAF rates.

In addition, the Left Atrial Appendage Exclusion for Prophylactic Stroke Reduction Trial (LeAPPS; NCT 05478304) international trial has enrolled 6500 patients at risk for AF and stroke (by age, CHA₂DS₂-VASC, left atrial size, or brain

natriuretic peptide criteria) to AtriClip vs no LAAO.¹¹⁴ The ongoing Left Atrial Appendage Closure by Surgery-2 (LAACS-2; NCT 03724318) trial¹¹⁵ is assessing neurologic outcomes after cardiac surgery irrespective of preoperative AF; however, its cohort may include many patients with preexisting AF, as did the original LAACS trial.¹¹⁶ Other studies currently underway include the Left Atrial Appendage Closure by Surgery and the Incidence of Stroke in Patients Undergoing Open-heart Surgery (NCT06172738) and the Left Atrial Appendage CLOSURE for the Prevention of Thromboembolism in patients Undergoing Aortic Bioprosthesis Surgery (LAA_CLOSURE) (NCT02321137).

Overall, contemporary evidence suggests that prophylactic LAAO during cardiac surgery reduces late thromboembolic and stroke risk, potentially at the cost of a modest increase in early POAF. However, findings remain mixed, and limitations in study design, heterogeneity, and outcome ascertainment preclude issuance of a formal recommendation at this time.

Concomitant Surgical Ablation, Including PVI, to Prevent New-Onset POAF. Interest in prophylactic surgical ablation during cardiac surgery has increased as emerging data suggest that modifying the atrial substrate at the time of operation reduces vulnerability to POAF, even in patients without preexisting AF. A meta-analysis of 7 RCTs (n = 687)¹¹⁷ showed that prophylactic PVI lowers 30-day POAF rates (21% vs 37%; RR, 0.50; 95% CI, 0.3-0.8); $I^2 = 64\%$) and incident AF at longest follow-up (3% vs 10%; RR, 0.3; 95% CI, 0.2-0.7; $I^2 = 0\%$). Six trials enrolled isolated-CABG patients almost exclusively (>98.5%); 6 used radio-frequency PVI, and 1 targeted ganglionated autonomic plexi. PVI also decreased antiarrhythmic and anticoagulant use at discharge, without differences in stroke or bleeding. The overall certainty of evidence was low; 3 trials had high risk of bias, and 4 had some concerns with open-label designs increasing the potential for treatment bias.

Separately, a small FDA-approved feasibility study of prophylactic PVI combined with LAAO in patients aged ≥ 70 years (mean CHA₂DS₂-VASc 4), without prior AF, reported markedly lower POAF rate (7%) than the control group (55%). However, stroke, readmission, and postdischarge rhythm outcomes were not assessed.¹¹⁸ Additional prospective trials are needed to better assess the efficacy of prophylactic PVI in preventing POAF and downstream adverse outcomes.

Collectively, these data strengthen the argument that surgical ablation may reduce both early

and late atrial arrhythmias when performed in selected patients. However, existing trials remain small, heterogeneous, and subject to performance and detection bias. Most cohorts were limited to isolated CABG, rhythm monitoring was variable, and long-term outcomes, such as stroke, hospitalization for heart failure, and quality of life, were sparsely reported. Overall, significant uncertainty remains regarding the benefit of prophylactic surgical ablation. The strategy might be considered, particularly in centers with experience in surgical ablation, but the evidence is not definitive enough to support routine use.

TREATMENT OF POAF.

Statement 12: Among patients who develop POAF with hemodynamic instability, electrical cardioversion is recommended. (COR I, LOE C-EO)

Despite the lack of high-quality data to support the practice, it is generally accepted to perform immediate rhythm cardioversion for patients who develop POAF and concomitant hemodynamic instability to avoid organ injury associated with systemic malperfusion or vasoactive administration. This recommendation is consistent with other published guidance^{13,119} and the AHA Advanced Cardiovascular Life Support Tachycardia algorithm.¹²⁰

Statement 13: Among patients with hemodynamically stable POAF, a strategy of rate control versus rhythm conversion may be reasonable. (COR IIb, LOE B-R)

Hemodynamically stable POAF may be managed by either rate control or rhythm conversion, guided by patient-specific factors and institutional practice patterns. Each of these recommendations has a strong evidence-based endorsement as a management strategy. Yet, management varies widely across centers; an STS ACSD analysis found that the proportion of CABG patients with POAF discharged on amiodarone ranged from 8% to 92% across institutions.^{121,122}

Several studies have investigated whether a rate control approach or a rhythm conversion strategy is more effective in patients with hemodynamically stable POAF. A recent meta-analysis of 8 RCTs with 910 patients found that rhythm conversion offered no advantage over rate control regarding hospital LOS; AF recurrence at 1 week, 1 month, or 3 months; or other short-term outcomes.¹²³ These studies were largely small and of low quality, and approaches to cardioversion and follow-up varied, so the findings should be interpreted cautiously.

A larger, prospective RCT ($n = 523$) by the Cardiothoracic Surgical Trials Network similarly found that among patients who developed POAF, treatment with rate control vs rhythm conversion produced no significant differences in LOS, serious adverse event rates, or mortality. Freedom from AF from discharge to 60-day follow-up was similar between the rate control and rhythm conversion groups (84.2% vs 86.9%, $P = .4$).¹²⁴ Notably, approximately one-quarter of patients in each group required crossover, most often due to lack of efficacy in the rate-control arm or adverse effects of amiodarone in the rhythm-control arm, underscoring the pragmatic complexity of managing POAF in real-world surgical populations.

A post hoc analysis of data from patients with a history of heart failure or left ventricular ejection fraction <0.50 showed earlier restoration of sinus rhythm in the rhythm-control group but no difference in sinus rhythm maintenance at 60 days.¹²⁵ An observational study of elective electrical cardioversion also found no greater likelihood of sinus rhythm at discharge or 3 months.¹²⁶ Importantly, none of these studies specifically addressed the effect of earlier sinus rhythm restoration and its influence on anticoagulation decisions.

Collectively, these findings suggest that rate control and/or rhythm conversion are appropriate management strategies, but neither has demonstrated clear superiority over the other for treating hemodynamically stable POAF after cardiac surgery. As a result, the level of recommendation is Class IIb, indicating that in most patients, either approach could be used without major differences in outcomes.

Statement 14: In patients without prior history of atrial fibrillation undergoing cardiac surgery who develop new-onset POAF, oral anticoagulation may be considered to prevent thromboembolic events while weighing the risk of bleeding. (COR IIb, LOE B-NR)

The net benefit of anticoagulation for patients with POAF after cardiac surgery remains uncertain. Standard practice has been to treat anticoagulation for POAF in the same manner as anticoagulation for preexisting, nonsurgical AF; however, recent data challenge that assumption. In a Danish registry study, 2108 patients who developed POAF after isolated CABG had a lower thromboembolism rate than 8432 propensity-

matched patients with nonsurgical, nonvalvular AF (18.3 vs 29.7 events per 1000 person-years).

Although anticoagulation was associated with fewer thromboembolic events in the POAF and nonsurgical AF groups, overall thromboembolism rates were similar between patients with and without POAF after cardiac surgery, indicating a lower absolute risk threshold and an unclear net benefit of routine anticoagulation.¹²⁷ These findings suggest that POAF after cardiac surgery carries a lower thromboembolic risk than nonsurgical AF and that automatic application of nonsurgical AF anticoagulation strategies may not be appropriate in this population.

Another observational study of 3412 patients who developed POAF found that 27.3% received OAC, which was not associated with reduced stroke or systemic embolism at 30 days, 3 months, or 6 months but was associated with more bleeding at all intervals.¹²⁸ Similarly, data from the STS ACSD for 166,747 patients who developed POAF after CABG showed that 25.7% were discharged on anticoagulation. Anticoagulation for POAF was linked to no reduction in ischemic stroke (adjusted OR, 0.87; 95% CI, 0.65-1.16; $P = .35$) but was associated with a 4-fold higher rate of major bleeding (adjusted OR, 4.30; 95% CI, 3.69-5.03; $P < .001$) and higher 30-day mortality (adjusted OR, 1.20; 95% CI, 1.02-1.40; $P = .024$).^{121,122} These findings underscore the importance of careful selection and timing of initiation in the early postoperative period, when bleeding risk is highest.

Determining which patients with POAF are at highest risk for stroke and therefore most likely to benefit from anticoagulation remains challenging. Thromboembolic risk varies among subgroups depending on procedural factors, baseline comorbidities, and the clinical course and persistence of POAF. In patients who underwent isolated left-sided valve surgery, POAF was associated with thromboembolic rates comparable to those seen in nonsurgical AF, and anticoagulation appeared to reduce events in both groups.¹²⁹ In contrast, among CABG patients, those with lower CHA₂DS₂-VASc scores (<4) had minimal stroke risk, whereas potential benefit was observed primarily in those with higher scores (≥ 4).¹³⁰ However, the predictive utility of the CHA₂DS₂-VASc score in postoperative patients remains uncertain.

A recent STS ACSD analysis of data from 9861 propensity-matched pairs of CABG patients with POAF found ~25% were discharged on OAC.¹³⁰

OAC use was associated with higher mortality (HR, 1.16; 95% CI, 1.06-1.26) and bleeding rates (HR, 1.60; 95% CI, 1.38-1.85) but no difference in thromboembolic events, and no interaction was observed among CHA₂DS₂-VASc score, OAC use, and mortality, suggesting that traditional stroke-risk models alone are insufficient to guide anticoagulation decisions after cardiac surgery.

Interpretation of the data is hampered by substantial heterogeneity in clinical practice, including patient selection, timing of initiation, agent choice, treatment duration, and outcome definitions.¹³¹⁻¹³³ Early initiation during periods of active surgical bleeding risk represents a fundamentally different exposure than initiation after surgical hemostasis has stabilized and probably contributes to variability in observed bleeding outcomes.^{8,12,18} Current society guidelines reflect this uncertainty. The 2023 ACC/AHA atrial fibrillation guidelines⁷ (Class 2a, based on nonrandomized data) state that it is reasonable to administer OAC for ~60 days after POAF and then reassess the need for continued therapy. Similarly, the 2024 ESC/EACTS guidelines⁹ (Class 2a) recommend that long-term anticoagulation be considered in patients at elevated thromboembolic risk.

Ongoing trials aim to address these evidence gaps. The Postoperative Atrial Fibrillation after Coronary Artery Bypass Grafting-Evaluation of Strategies (PACES; NCT04045665) trial is a prospective, multicenter, open-label, randomized study evaluating optimal antithrombotic management in patients with new-onset POAF after CABG. Participants are randomly assigned 1:1 to an OAC-based regimen—using either a VKA (INR target 2-3) or a direct OAC (DOAC)—plus background antiplatelet therapy, or to an antiplatelet-only strategy with single-agent aspirin or a P2Y₁₂ inhibitor. Results from PACES are anticipated to clarify the comparative benefits and bleeding risks of OAC vs antiplatelet monotherapy in this population and to inform future guideline recommendations.

Our synthesis of available evidence suggests limited benefit from routine anticoagulation. Anticoagulation may be appropriate for selected high-risk patients (eg, those with left-sided valvular surgery or elevated neurologic risk), but routine use for all POAF patients is not supported. Decisions should be individualized, balancing thromboembolic and bleeding risks within the broader clinical context.

Statement 15: In patients without a prior history of atrial fibrillation undergoing cardiac surgery who develop new-onset POAF and anticoagulation is initiated, direct oral anticoagulants may be considered to reduce the risk of bleeding compared with vitamin K antagonists. (COR IIB, LOE B-NR)

When anticoagulation is chosen for POAF after cardiac surgery, options include VKAs (eg, warfarin) and DOACs (eg, the factor Xa inhibitors apixaban, rivaroxaban, edoxaban; and the factor IIA inhibitor dabigatran). North American registry data suggest that factor Xa DOACs have been prescribed more frequently than VKAs for POAF since ~2020.¹³⁴ Recent studies have compared safety, convenience, and cost. A meta-analysis of RCTs and observational studies (n = 16,902) showed that DOACs were associated with lower bleeding risk (RR, 0.74; 95% CI, 0.62-0.89) and major neurologic events compared with warfarin, without differences in mortality.¹³⁵ Other analyses consistently report similar or lower rates of major bleeding with DOACs or VKAs.¹³⁶⁻¹³⁸ A recent RCT found that although outcomes were similar for both types of drug, patients taking DOACs found them more convenient and had a better perception of the anticoagulation experience than patients receiving VKAs for POAF.¹³⁹

DOACs achieve therapeutic anticoagulation within hours of dosing (onset ≈ 2 hours; peak effect ≈ 4 hours), whereas VKAs require several days to reach a therapeutic INR. Accordingly, DOAC initiation should generally be deferred until surgical hemostasis is secure and chest tube output has stabilized, rather than being initiated at a fixed postoperative time point.^{140,141} When initiated safely, DOACs appear at least as effective as VKAs for thromboembolic prevention in POAF, offering comparable or lower bleeding risk and practical advantages such as shorter hospital LOS and less laboratory monitoring. Dose selection should follow labeled AF dosing with appropriate renal adjustment, recognizing that postoperative renal function can fluctuate. VKAs remain the anticoagulant of choice in patients with mechanical prosthetic valves or other established contraindications to DOAC therapy.

POSTDISCHARGE SURVEILLANCE AND MONITORING

Evidence is limited on optimal postdischarge rhythm monitoring, but several studies suggest that late or subclinical AF after cardiac surgery is either more common or far less burdensome than

previously recognized. A small implantable-recorder study ($n = 22$) with a median follow-up of 26 months found a 36% annualized incidence of new AF among patients with previous POAF and a CHA₂DS₂-VASc score ≥ 2 .¹⁴² In contrast, a larger multicenter study ($n = 198$) in which loop recorders were implanted in patients at the time of CABG and monitored for 1 year showed a median cumulative postdischarge AF burden of only 6 hours.²² These findings highlight that continuous monitoring can uncover silent POAF that routine care misses, yet the overall burden in some cohorts may remain low despite its detection. Similar results from extended monitoring in high-risk nonsurgical populations reveal that nearly one-third of patients develop previously unrecognized AF over 18 months.¹⁴³

Collectively, these data indicate that short-duration or symptom-driven surveillance probably underestimates true AF incidence. Ongoing studies, including the home-monitoring substudy of the PACES (NCT04045665) trial, will be important for identifying which patients benefit from extended monitoring and how detected AF should guide anticoagulation and long-term management.

LIMITATIONS, RESEARCH GAPS, AND FUTURE DIRECTIONS

Although progress has been made in better understanding the epidemiology and mechanisms of POAF, substantial evidence gaps remain that result in limitations in providing recommendations. A lack of consensus persists regarding the precise definition of POAF. Moreover, the widespread heterogeneity in the design of POAF trials can make interpreting their results challenging. The goals of effective prevention and ad hoc treatment remain elusive. Additional pathophysiologic insights into POAF's mechanisms are needed to guide targeted prevention strategies. Importantly, a deeper understanding of the relationship between POAF and adverse clinical outcomes will help determine whether this association is causal or merely correlative, thereby informing decisions regarding prevention, rhythm control, cardioversion, and requirements for anticoagulation.

Personalized risk prediction is also unreliable. Current scoring systems (CHA₂DS₂-VASc, HAS-BLED, and POAF-specific indices) offer only modest discrimination.¹⁴⁴ Integrating circulating or tissue biomarkers—reflecting inflammation, oxidative stress, atrial stretch, or adipose-derived

mediators—with operative complexity may improve risk stratification.^{2,15} Machine-learning models and registry-based data sets could further enable dynamic perioperative risk modeling; currently, however, their accuracy is modest and constrained by heterogeneous study designs as well as insufficient external validation.

Another unmet need is standardized quantification of AF burden. Most studies classify POAF dichotomously as present or absent, disregarding episode duration, frequency, and temporal clustering. Emerging tools, such as continuous telemetry, wearable monitors, and automated electronic health record algorithms, may allow more precise characterization of arrhythmia burden and its relationship to outcomes. Determining whether cumulative AF burden predicts stroke, heart failure, or progression to persistent AF will be critical to refining rhythm-control strategies and guiding anticoagulation management.

Finally, long-term outcomes remain underexplored. Trials are needed to define the optimal type, dose, and timing of perioperative β -blockade and amiodarone prophylaxis. For amiodarone specifically, comparative studies are needed of preoperative initiation time points (eg, 5 vs 7 vs 10 days), minimum effective duration, and equivalence of rapid loading vs extended oral regimens. Procedure-specific prophylaxis strategies represent another high-priority research area, as trials comparing intensive multimodal prophylaxis vs standard care in high-risk subgroups (eg, combined CABG/valve surgery, mitral valve procedures) could determine whether operation type should guide prophylaxis intensity. Risk-prediction models incorporating both patient factors and procedural complexity may enable more individualized prophylaxis approaches.

Additional trials should attempt to identify the optimal duration of rate-control therapy after discharge and the safest strategies for anticoagulation in patients with new-onset POAF. Developing standardized POAF prevention protocols and regular review of implementation practices can also help ensure that evidence-based recommendations are applied consistently across programs.^{18,60,144} Addressing these gaps will require harmonized definitions, standardized outcome measures, and collaboration across surgical and cardiovascular disciplines. As the evidence base strengthens through targeted investigation of these priority areas, future iterations of POAF guidelines can progress from the current

predominance of Class IIb recommendations toward stronger classes of recommendation supported by higher-quality evidence, ultimately improving clinical decision-making and patient outcomes.

SUMMARY AND KEY TAKE-HOME MESSAGES

New-onset POAF remains one of the most frequent and consequential complications after cardiac surgery. Its clinical phenotype is distinct from that of nonsurgical AF, with different mechanisms, natural history, and therapeutic implications. Areas of consensus have begun to emerge. Preoperative optimization, prophylaxis with amiodarone or β -blockers in appropriate patients, meticulous rhythm surveillance, and early rhythm or rate control are supported by consistent evidence and should be considered standard elements of perioperative management.

At the same time, several key questions remain unresolved. Determining which patients derive a net clinical benefit from anticoagulation in new-onset POAF requires further study. The value of arrhythmia burden in guiding anticoagulation decisions remains uncertain, and integrating this information into risk-adapted treatment algorithms is an important next step. Randomized trials comparing early vs delayed anticoagulation, stratified by arrhythmia burden and thromboembolic risk, are urgently needed.

POAF is perhaps best considered a marker of perioperative stress and a modifiable target for quality improvement. Advancing care will

depend on multidisciplinary collaboration, standardized data reporting, and pragmatic clinical trials that connect mechanistic understanding with patient-centered outcomes.

In conclusion, POAF is common and clinically consequential after cardiac surgery and is associated with perioperative morbidity as well as heightened risks of late AF, stroke, and heart failure hospitalization.^{2,14} Preventive strategies, meticulous rhythm surveillance, and individualized anticoagulation can mitigate these risks, but multidisciplinary collaboration and sustained evidence generation through registries and pragmatic trials will be necessary. Key priorities include clarifying modifiable variables, refining prediction tools, and measuring arrhythmia burden—efforts that will be pivotal to translating mechanistic insights into durable system-wide improvements in patient outcomes.

The authors thank medical librarian Yimin Geng for her expertise and invaluable assistance in developing the literature search strategy for this review. They also acknowledge the STS Evidence-Based Surgery team and staff members—Jane Han, Pallavi Sood, and Bansari Upadhyay—for their dedicated support during the preparation of this manuscript. They would like to extend their gratitude to Stephen N. Palmer, PhD, ELS, for his tremendous support in editing the manuscript. They are grateful to the members of the STS Workforce on Evidence-Based Surgery for their critical review and feedback, which helped shape the manuscript, and to the public reviewers for their thorough evaluation and constructive comments, which the authors carefully noted and incorporated.

FUNDING SOURCES

The authors have no funding sources to disclose.

DISCLOSURES

The authors have no conflicts of interest to disclose.

REFERENCES

- Milojevic M, Freemantle N, Hayanga JWA, et al. Harmonizing guidelines and other clinical practice documents: a joint comprehensive methodology manual by the American Association for Thoracic Surgery (AATS), European Association for Cardio-Thoracic Surgery (EACTS), European Society of Thoracic Surgeons (ESTS), and Society of Thoracic Surgeons (STS). *Ann Thorac Surg*. 2025;119:83–100.
- Gaudino M, Di Franco A, Rong LQ, Piccini J, Mack M. Postoperative atrial fibrillation: from mechanisms to treatment. *Eur Heart J*. 2023;44:1020–1039.
- Rezaei Y, Peighambari MM, Naghshbandi S, et al. Postoperative atrial fibrillation following cardiac surgery: from pathogenesis to potential therapies. *Am J Cardiovasc Drugs*. 2020;20:19–49.
- Maesen B, Nijs J, Maessen J, Allesie M, Schotten U. Post-operative atrial fibrillation: a maze of mechanisms. *Europace*. 2012;14:159–174.
- Dobrev D, Aguilar M, Heijman J, Guichard JB, Nattel S. Postoperative atrial fibrillation: mechanisms, manifestations and management. *Nat Rev Cardiol*. 2019;16:417–436.
- Andrade JG, Aguilar M, Atzema C, et al. The 2020 Canadian Cardiovascular Society/Canadian Heart Rhythm Society comprehensive guidelines for the management of atrial fibrillation. *Can J Cardiol*. 2020;36:1847–1948.
- 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. *J Am Coll Cardiol*. 2024;83:109–279.
- Muehlschlegel JD, Burrage PS, Ngai JY, et al. Society of Cardiovascular Anesthesiologists/European Association of Cardiothoracic Anesthetists practice advisory for the management of perioperative atrial fibrillation in patients undergoing cardiac surgery. *Anesth Analg*. 2019;128:33–42.
- Van Gelder IC, Rienstra M, Bunting KV, et al. 2024 ESC Guidelines for the management of atrial fibrillation developed in collaboration with the European Association for Cardio-Thoracic Surgery (EACTS). *Eur Heart J*. 2024;45:3314–3414.
- Andrews TC, Reimold SC, Berlin JA, Antman EM. Prevention of supraventricular arrhythmias after coronary artery bypass surgery. A meta-analysis of randomized control trials. *Circulation*. 1991;84:III236–III244.

11. Lee SH, Kang DR, Uhm JS, et al. New-onset atrial fibrillation predicts long-term newly developed atrial fibrillation after coronary artery bypass graft. *Am Heart J*. 2014;167:593–600.e1.
12. Suero OR, Ali AK, Barron LR, et al. Postoperative atrial fibrillation (POAF) after cardiac surgery: clinical practice review. *J Thorac Dis*. 2024;16:1503–1520.
13. O'Brien B, Burrage PS, Ngai JY, et al. Society of Cardiovascular Anesthesiologists/European Association of Cardiothoracic Anaesthetists practice advisory for the management of perioperative atrial fibrillation in patients undergoing cardiac surgery. *J Cardiothorac Vasc Anesth*. 2019;33:12–26.
14. Caldonazo T, Kirov H, Rahouma M, et al. Atrial fibrillation after cardiac surgery: a systematic review and meta-analysis. *J Thorac Cardiovasc Surg*. 2023;165:94–103.e24.
15. Waterford SD, Ad M. 7 Pillars of postoperative atrial fibrillation prevention. *Innovations (Phila)*. 2021;16:498–503.
16. Lubitz SA, Yin X, Rienstra M, et al. Long-term outcomes of secondary atrial fibrillation in the community: the Framingham Heart Study. *Circulation*. 2015;131:1648–1655.
17. Ahlsson A, Fengsrud E, Bodin L, Englund A. Postoperative atrial fibrillation in patients undergoing aortocoronary bypass surgery carries an eightfold risk of future atrial fibrillation and a doubled cardiovascular mortality. *Eur J Cardiothorac Surg*. 2010;37:1353–1359.
18. Grant MC, Crisafi C, Alvarez A, et al. Perioperative care in cardiac surgery: a joint consensus statement by the Enhanced Recovery After Surgery (ERAS) Cardiac Society, ERAS International Society, and The Society of Thoracic Surgeons (STS). *Ann Thorac Surg*. 2024;117:669–689.
19. Funk M, Richards SB, Desjardins J, Bebon C, Wilcox H. Incidence, timing, symptoms, and risk factors for atrial fibrillation after cardiac surgery. *Am J Crit Care*. 2003;12:424–433 [quiz: 434–435].
20. Izhar U, Ad N, Rudis E, et al. When should we discontinue antiarrhythmic therapy for atrial fibrillation after coronary artery bypass grafting? A prospective randomized study. *J Thorac Cardiovasc Surg*. 2005;129:401–406.
21. Lowres N, Mulcahy G, Jin K, et al. Incidence of postoperative atrial fibrillation recurrence in patients discharged in sinus rhythm after cardiac surgery: a systematic review and meta-analysis. *Interact Cardiovasc Thorac Surg*. 2018;26:504–511.
22. Herrmann FEM, Jeppsson A, Kirov H, et al. Long-term continuous monitoring of new-onset atrial fibrillation after coronary artery bypass grafting. *JAMA*. 2025;334:1827–1835.
23. Hosseini M-S, Jahanshahloo F, Akbarzadeh MA, Zarei M, Vaez-Gharamaleki Y. Formulating research questions for evidence-based studies. *J Med Surg Public Health*. 2024;2:100046.
24. Waterford SD, Prescher L, Ad M, Santore LA, Spellman Cordell, Ad N. Amiodarone and postoperative atrial fibrillation. *Vessel Plus*. 2022;6:28.
25. Mitchell LB, Exner DV, Wyse DG, et al. Prophylactic Oral Amiodarone for the Prevention of Arrhythmias that Begin Early After Revascularization, Valve Replacement, or Repair: PAPABEAR: a randomized controlled trial. *JAMA*. 2005;294:3093–3100.
26. Daoud EG, Strickberger SA, Man KC, et al. Preoperative amiodarone as prophylaxis against atrial fibrillation after heart surgery. *N Engl J Med*. 1997;337:1785–1791.
27. Giri S, White CM, Dunn AB, et al. Oral amiodarone for prevention of atrial fibrillation after open heart surgery, the Atrial Fibrillation Suppression Trial (AFIST): a randomised placebo-controlled trial. *Lancet*. 2001;357:830–836.
28. Atreya AR, Priya A, Pack QR, et al. Use and outcomes associated with perioperative amiodarone in cardiac surgery. *J Am Heart Assoc*. 2019;8:e009892.
29. Ruzieh M, Moroi MK, Aboujamous NM, et al. Meta-analysis comparing the relative risk of adverse events for amiodarone versus placebo. *Am J Cardiol*. 2019;124:1889–1893.
30. Ahmed MA, Ghoneim AE, Abdel Wahab AAE, Mahmoud AB. Does prophylactic low-dose amiodarone decrease the incidence of postoperative atrial fibrillation after coronary artery bypass graft surgery? A randomized controlled trial. *Cardiothorac Surg*. 2022;30:24.
31. Amr YM, Elmistekawy EM, Hammad AA. Intraoperative loading dose of amiodarone for prophylaxis against atrial fibrillation after valvular heart surgery. *Anesth Essays Res*. 2010;4:96–101.
32. Azemati S, Dehghanpisheh L, Vatankhah P, et al. Evaluation of the effect of small single intravenous dose of amiodarone on the prevention of arrhythmias in patients who underwent coronary artery bypass graft surgery: a randomized controlled trial. *J Arrhythm*. 2024;40:529–535.
33. Deng JH, Jia B, Yao YT. The efficacy and safety of intraoperative intravenous amiodarone in patients undergoing on-pump coronary artery bypass grafting surgery: a systemic review and PRISMA-compliant meta-analysis. *J Cardiothorac Surg*. 2024;19:274.
34. Mehaffey JH, Hawkins RB, Byler M, et al. Amiodarone protocol provides cost-effective reduction in postoperative atrial fibrillation. *Ann Thorac Surg*. 2018;105:1697–1702.
35. Shalen EF, Heitner SB, Al-Rashdan L, et al. Perioperative amiodarone to prevent atrial fibrillation after septal myectomy in obstructive hypertrophic cardiomyopathy. *ESC Heart Fail*. 2021;8:4791–4799.
36. Buckley MS, Nolan PE Jr, Slack MK, et al. Amiodarone prophylaxis for atrial fibrillation after cardiac surgery: meta-analysis of dose response and timing of initiation. *Pharmacotherapy*. 2007;27:360–368.
37. Chatterjee S, Sardar P, Mukherjee D, Lichstein E, Aikat S. Timing and route of amiodarone for prevention of postoperative atrial fibrillation after cardiac surgery: a network regression meta-analysis. *Pacing Clin Electrophysiol*. 2013;36:1017–1023.
38. Polintan ET, Monsalve R, Menghrajani RH, et al. Combination prophylactic amiodarone with beta-blockers versus beta-blockers in atrial fibrillation after cardiac surgery: a systematic-review and meta-analysis. *Heart Lung*. 2023;62:256–263.
39. Shahian DM, Edwards FH, Ferraris VA, et al. Quality measurement in adult cardiac surgery: part 1—conceptual framework and measure selection. *Ann Thorac Surg*. 2007;83:53–512.
40. Brinkman W, Herbert MA, O'Brien S, et al. Preoperative beta-blocker use in coronary artery bypass grafting surgery: national database analysis. *JAMA Intern Med*. 2014;174:1320–1327.
41. O'Neal JB, Billings FT 4th, Liu X, et al. Effect of preoperative beta-blocker use on outcomes following cardiac surgery. *Am J Cardiol*. 2017;120:1293–1297.
42. Blessberger H, Lewis SR, Pritchard MW, et al. Perioperative beta-blockers for preventing surgery-related mortality and morbidity in adults undergoing cardiac surgery. *Cochrane Database Syst Rev*. 2019;9:CD013435.
43. Thein PM, White K, Banker K, et al. Preoperative use of oral beta-adrenergic blocking agents and the incidence of new-onset atrial fibrillation after cardiac surgery. A systematic review and meta-analysis. *Heart Lung Circ*. 2018;27:310–321.
44. Ji T, Feng C, Sun L, et al. Are beta-blockers effective for preventing post-coronary artery bypass grafting atrial fibrillation? Direct and network meta-analyses. *Ir J Med Sci*. 2016;185:503–511.
45. Khan MF, Wendel CS, Movahed MR. Prevention of post-coronary artery bypass grafting (CABG) atrial fibrillation: efficacy of prophylactic beta-blockers in the modern era: a meta-analysis of latest randomized controlled trials. *Ann Noninvasive Electrocardiol*. 2013;18:58–68.
46. Filardo G, da Graca B, Sass DM, et al. Preoperative β -blockers as a coronary surgery quality metric: the lack of evidence of efficacy. *Ann Thorac Surg*. 2020;109:1150–1158.
47. Guinot PG, Fischer MO, Nguyen M, et al. Maintenance of beta-blockers and cardiac surgery-related outcomes: a prospective propensity-matched multicentre analysis. *Br J Anaesth*. 2024;133:288–295.
48. DiNicolantonio JJ, Beavers CJ, Menezes AR, et al. Meta-analysis comparing carvedilol versus metoprolol for the prevention of

postoperative atrial fibrillation following coronary artery bypass grafting. *Am J Cardiol*. 2014;113:565-569.

49. Norhayati MN, Shaiful Bahari I, Zaharah S, et al. Metoprolol for prophylaxis of postoperative atrial fibrillation in cardiac surgery patients: systematic review and meta-analysis. *BMJ Open*. 2020;10:e038364.

50. Wang HS, Wang ZW, Yin ZT. Carvedilol for prevention of atrial fibrillation after cardiac surgery: a meta-analysis. *PLoS One*. 2014;9:e94005.

51. Sezai A, Osaka S, Yaoita H, et al. Safety and efficacy of landiolol hydrochloride for prevention of atrial fibrillation after cardiac surgery in patients with left ventricular dysfunction: Prevention of Atrial Fibrillation After Cardiac Surgery With Landiolol Hydrochloride for Left Ventricular Dysfunction (PLATON) trial. *J Thorac Cardiovasc Surg*. 2015;150:957-964.

52. Sakamoto A, Hamasaki T, Kitakaze M. Perioperative landiolol administration reduces atrial fibrillation after cardiac surgery: a meta-analysis of randomized controlled trials. *Adv Ther*. 2014;31:440-450.

53. Osumi M, Tashiro T, Morita Y, et al. Preventive effect of intra-operative landiolol administration on atrial fibrillation after off-pump coronary artery bypass grafting. *Adv Ther*. 2014;31:1109-1117.

54. Shahian DM, Paone G, Habib RH, et al. The Society of Thoracic Surgeons Preoperative Beta Blocker Working Group interim report. *Ann Thorac Surg*. 2025;119:476-484.

55. Hillis LD, Smith PK, Anderson JL, et al. 2011 ACCF/AHA Guideline for Coronary Artery Bypass Graft Surgery: executive summary: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *Circulation*. 2011;124:2610-2642.

56. Kulik A, Ruel M, Jneid H, et al. Secondary prevention after coronary artery bypass graft surgery: a scientific statement from the American Heart Association. *Circulation*. 2015;131:927-964.

57. Sousa-Uva M, Head SJ, Milojevic M, et al. 2017 EACTS Guidelines on perioperative medication in adult cardiac surgery. *Eur J Cardiothorac Surg*. 2018;53:5-33.

58. Lawton JS, Tamis-Holland JE, Bangalore S, et al. 2021 ACC/AHA/SCAI guideline for coronary artery revascularization: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *J Am Coll Cardiol*. 2022;79:e21-e129.

59. 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*. 2024;149:e1-e156.

60. Chatterjee S, Cangut B, Rea A, et al. Enhanced Recovery After Surgery Cardiac Society turnkey order set for prevention and management of postoperative atrial fibrillation after cardiac surgery: proceedings from the American Association for Thoracic Surgery ERAS Conclave 2023. *J Thorac Cardiovasc Surg Open*. 2024;18:118-122.

61. Greenberg JW, Lancaster TS, Schuessler RB, Melby SJ. Postoperative atrial fibrillation following cardiac surgery: a persistent complication. *Eur J Cardiothorac Surg*. 2017;52:665-672.

62. Wijesundera DN, Beattie WS, Rao V, Karski J. Calcium antagonists reduce cardiovascular complications after cardiac surgery: a meta-analysis. *J Am Coll Cardiol*. 2003;41:1496-1505.

63. Hu Y, Yang X, Zhang L, et al. Perioperative diltiazem or nitroglycerin in on-pump coronary artery bypass: a systematic review and network meta-analysis. *PLoS One*. 2018;13:e0203315.

64. Marik PE, Fromm R. The efficacy and dosage effect of corticosteroids for the prevention of atrial fibrillation after cardiac surgery: a systematic review. *J Crit Care*. 2009;24:458-463.

65. Whitlock RP, Dieleman JM, Belley-Cote E, et al. The effect of steroids in patients undergoing cardiopulmonary bypass: an individual patient meta-analysis of two randomized trials. *J Cardiothorac Vasc Anesth*. 2020;34:99-105.

66. Wahba A, Milojevic M, Boer C, et al. 2019 EACTS/EACTA/EBSCP guidelines on cardiopulmonary bypass in adult cardiac surgery. *Eur J Cardiothorac Surg*. 2020;57:210-251.

67. Henyan NN, Gillespie EL, White CM, Kluger J, Coleman CI. Impact of intravenous magnesium on post-cardiothoracic surgery atrial fibrillation and length of hospital stay: a meta-analysis. *Ann Thorac Surg*. 2005;80:2402-2406.

68. Shiga T, Wajima Z, Inoue T, Ogawa R. Magnesium prophylaxis for arrhythmias after cardiac surgery: a meta-analysis of randomized controlled trials. *Am J Med*. 2004;117:325-333.

69. Alghamdi AA, Al-Radi OO, Latter DA. Intravenous magnesium for prevention of atrial fibrillation after coronary artery bypass surgery: a systematic review and meta-analysis. *J Card Surg*. 2005;20:293-299.

70. De Oliveira GS Jr, Knautz JS, Sherwani S, McCarthy RJ. Systemic magnesium to reduce postoperative arrhythmias after coronary artery bypass graft surgery: a meta-analysis of randomized controlled trials. *J Cardiothorac Vasc Anesth*. 2012;26:643-650.

71. Cook RC, Yamashita MH, Kearns M, et al. Prophylactic magnesium does not prevent atrial fibrillation after cardiac surgery: a meta-analysis. *Ann Thorac Surg*. 2013;95:533-541.

72. Agarwal S, Beard CW, Khosla J, et al. Safety and efficacy of colchicine for the prevention of post-operative atrial fibrillation in patients undergoing cardiac surgery: a meta-analysis of randomized controlled trials. *Europace*. 2023;25:eua169.

73. Ge P, Fu Y, Su Q, et al. Colchicine for prevention of post-operative atrial fibrillation: meta-analysis of randomized controlled trials. *Front Cardiovasc Med*. 2022;9:1032116.

74. Lee JZ, Singh N, Howe CL, et al. Colchicine for prevention of post-operative atrial fibrillation: a meta-analysis. *JACC Clin Electrophysiol*. 2016;2:78-85.

75. Kirov H, Caldonazo T, Runkel A, et al. Colchicine in patients with coronary disease who underwent coronary artery bypass surgery: a meta-analysis of randomized controlled trials. *Am J Cardiol*. 2024;231:48-54.

76. Zhao H, Chen Y, Mao M, Yang J, Chang J. A meta-analysis of colchicine in prevention of atrial fibrillation following cardiothoracic surgery or cardiac intervention. *J Cardiothorac Surg*. 2022;17:224.

77. Imazio M, Brucato A, Ferrazzi P, et al. Colchicine reduces post-operative atrial fibrillation: results of the Colchicine for the Prevention of the Postpericardiotomy Syndrome (COPPS) atrial fibrillation substudy. *Circulation*. 2011;124:2290-2295.

78. Imazio M, Trincheri R, Brucato A, et al. Colchicine for the Prevention of the Post-pericardiotomy Syndrome (COPPS): a multicentre, randomized, double-blind, placebo-controlled trial. *Eur Heart J*. 2010;31:2749-2754.

79. Imazio M, Brucato A, Ferrazzi P, et al. Colchicine for prevention of postpericardiotomy syndrome and postoperative atrial fibrillation: the COPPS-2 randomized clinical trial. *JAMA*. 2014;312:1016-1023.

80. Howitt SH, Grant SW, Campbell NG, Malagon I, McCollum C. Are serum potassium and magnesium levels associated with atrial fibrillation after cardiac surgery? *J Cardiothorac Vasc Anesth*. 2020;34:1152-1159.

81. O'Brien B, Campbell NG, Allen E, et al. Potassium supplementation and prevention of atrial fibrillation after cardiac surgery: the TIGHT R randomized clinical trial. *JAMA*. 2024;332:979-988.

82. Horbach SJ, Lopes RD, da C, Guaragna JC, et al. Naproxen as prophylaxis against atrial fibrillation after cardiac surgery: the NAFARM randomized trial. *Am J Med*. 2011;124:1036-1042.

83. Dastan F, Talasaz AH, Mojtahedzadeh M, et al. Randomized trial of carnitine for the prevention of perioperative atrial fibrillation. *Semin Thorac Cardiovasc Surg*. 2018;30:7-13.

84. Aydin U, Yilmaz M, Duzyol C, et al. Efficiency of postoperative statin treatment for preventing new-onset postoperative atrial fibrillation in patients undergoing isolated coronary artery bypass grafting: a prospective randomized study. *Anatol J Cardiol*. 2015;15:491-495.

85. Patti G, Bennett R, Seshasai SR, et al. Statin pretreatment and risk of in-hospital atrial fibrillation among patients undergoing cardiac surgery: a collaborative meta-analysis of 11 randomized controlled trials. *Euro-pace*. 2015;17:855-863.
86. U.S. Food and Drug Administration. Nonsteroidal Anti-inflammatory Drugs (NSAIDs). Accessed July 3, 2025. <https://www.fda.gov/drugs/postmarket-drug-safety-information-patients-and-providers/nonsteroidal-anti-inflammatory-drugs-nsaids>
87. Ali-Hassan-Sayegh S, Mirhosseini SJ, Rezaeisadrabadi M, et al. Antioxidant supplementations for prevention of atrial fibrillation after cardiac surgery: an updated comprehensive systematic review and meta-analysis of 23 randomized controlled trials. *Interact Cardiovasc Thorac Surg*. 2014;18:646-654.
88. Abdelaziz A, Hafez AH, Elaraby A, et al. Posterior pericardiotomy for the prevention of atrial fibrillation after cardiac surgery: a systematic review and meta-analysis of 25 randomised controlled trials. *Euro-Intervention*. 2023;19:e305-e317.
89. Gaudino M, Sanna T, Ballman KV, et al. Posterior left pericardiotomy for the prevention of atrial fibrillation after cardiac surgery: an adaptive, single-centre, single-blind, randomised, controlled trial. *Lancet*. 2021;398:2075-2083.
90. Rong LQ, Di Franco A, Rahouma M, et al. Postoperative pericardial effusion, pericardiotomy, and atrial fibrillation: an explanatory analysis of the PALACS trial. *Am Heart J*. 2023;260:113-123.
91. Rabelo LG, Zindovic I, Astrom DO, et al. A posterior pericardial chest tube is associated with reduced incidence of postoperative atrial fibrillation after cardiac surgery: a propensity score-matched study. *J Thorac Cardiovasc Surg Open*. 2024;22:244-254.
92. Makarem A, Paneitz D, Winship T, et al. Pericardiotomy and Amiodarone for Prophylaxis Against Postoperative Atrial Fibrillation in Cardiac Surgery (PAPPA). *Ann Thorac Surg*. 2025;120:461-468.
93. Arsenault KA, Yusuf AM, Crystal E, et al. Interventions for preventing post-operative atrial fibrillation in patients undergoing heart surgery. *Cochrane Database Syst Rev*. 2013;2013:CD003611.
94. Ruan Y, Robinson NB, Naik A, et al. Effect of atrial pacing on post-operative atrial fibrillation following coronary artery bypass grafting: pairwise and network meta-analyses. *Int J Cardiol*. 2020;302:103-107.
95. Al Chekatie MO, Welles CC, Metoyer R, et al. Pericardial fat is independently associated with human atrial fibrillation. *J Am Coll Cardiol*. 2010;56:784-788.
96. Batal O, Schoenhagen P, Shao M, et al. Left atrial epicardial adiposity and atrial fibrillation. *Circ Arrhythm Electrophysiol*. 2010;3:230-236.
97. Jing M, Liu Q, Xi H, et al. Relationship between left atrium, epicardial fat and severity of atrial fibrillation. *Int J Cardiovasc Imaging*. 2025;41:1185-1196.
98. Abuelazm M, Saleh O, Kambalapalli S, et al. The efficacy and safety of botulinum toxin epicardial fat injection to prevent postoperative atrial fibrillation in patients undergoing cardiac surgery: a meta-analysis of randomized controlled trials. *Proc (Bayl Univ Med Cent)*. 2024;37:279-286.
99. Wang W, Mei YQ, Yuan XH, Feng XD. Clinical efficacy of epicardial application of drug-releasing hydrogels to prevent postoperative atrial fibrillation. *J Thorac Cardiovasc Surg*. 2016;151:80-85.
100. Greenstein D, Beau J, Gottlieb G, Teller D, Kulik A. Topical amiodarone during cardiac surgery: Does epicardial application of amiodarone prevent postoperative atrial fibrillation? *J Thorac Cardiovasc Surg*. 2017;154:886-892.
101. Feng XD, Wang XN, Yuan XH, Wang W. Effectiveness of biatrial epicardial application of amiodarone-releasing adhesive hydrogel to prevent postoperative atrial fibrillation. *J Thorac Cardiovasc Surg*. 2014;148:939-943.
102. White CM, Sander S, Coleman CI, et al. Impact of epicardial anterior fat pad retention on postcardiothoracic surgery atrial fibrillation incidence: the AFIST-III Study. *J Am Coll Cardiol*. 2007;49:298-303.
103. Kazemi B, Ahmadzadeh A, Safaei N, et al. Influence of anterior periaortic fat pad excision on incidence of postoperative atrial fibrillation. *Eur J Cardiothorac Surg*. 2011;40:1191-1196.
104. Chatterjee S, Alexander JC, Pearson PJ, Feldman T. Left atrial appendage occlusion: lessons learned from surgical and transcatheter experiences. *Ann Thorac Surg*. 2011;92:2283-2292.
105. Yao X, Gersh BJ, Holmes DR Jr, et al. Association of surgical left atrial appendage occlusion with subsequent stroke and mortality among patients undergoing cardiac surgery. *JAMA*. 2018;319:2116-2126.
106. Shuhaiber JH, Abbas M, Morland T, Kirchner HL, El-Manzalawy Y. Atrial appendage closure is associated with increased risk for post-operative atrial fibrillation. *J Cardiothorac Surg*. 2024;19:619.
107. Ando M, Funamoto M, Cameron DE, Sundt TM 3rd. Concomitant surgical closure of left atrial appendage: a systematic review and meta-analysis. *J Thorac Cardiovasc Surg*. 2018;156:1071-1080.e2.
108. Melduni RM, Schaff HV, Lee HC, et al. Impact of left atrial appendage closure during cardiac surgery on the occurrence of early postoperative atrial fibrillation, stroke, and mortality: a propensity score-matched analysis of 10 633 patients. *Circulation*. 2017;135:366-378.
109. Hawkins RB, Clark SS, Mehaffey JH, et al. Concomitant left atrial appendage closure outcomes and cost: a multi-institutional cohort analysis. *J Surg Res*. 2020;248:137-143.
110. Baudo M, Sicouri S, Yamashita Y, et al. Stroke prevention with prophylactic left atrial appendage occlusion in cardiac surgery patients without atrial fibrillation: a meta-analysis of randomized and propensity-score studies. *Circ Cardiovasc Interv*. 2024;17:e014296.
111. Tam DY, Sallam A, Chen Q, et al. Mortality and stroke after routine left atrial appendage occlusion in patients undergoing isolated mitral repair without atrial fibrillation in the United States. *J Thorac Cardiovasc Surg*. 2025;170:1525-1533.
112. Whitlock RP, Belley-Cote EP, Paparella D, et al. Left atrial appendage occlusion during cardiac surgery to prevent stroke. *N Engl J Med*. 2021;384:2081-2091.
113. Gerdisch MW, Garrett HE Jr, Mumtaz MA, et al. Prophylactic left atrial appendage exclusion in cardiac surgery patients with elevated CHA₂DS₂-VASc score: results of the randomized ATLAS trial. *Innovations (Phila)*. 2022;17:463-470.
114. Whitlock RP, McCarthy PM, Gerdisch MW, et al. The left atrial appendage exclusion for prophylactic stroke reduction (LEAAPS) trial: rationale and design. *Am Heart J*. 2025;284:94-102.
115. Madsen CL, Park-Hansen J, Irmukhamedov A, et al. The Left Atrial Appendage Closure by Surgery-2 (LAACS-2) trial protocol rationale and design of a randomized multicenter trial investigating if left atrial appendage closure prevents stroke in patients undergoing open-heart surgery irrespective of preoperative atrial fibrillation status and stroke risk. *Am Heart J*. 2023;264:133-142.
116. Madsen CV, Park-Hansen J, Holme SJV, et al. Randomized trial of surgical left atrial appendage closure: protection against cerebrovascular events. *Semin Thorac Cardiovasc Surg*. 2023;35:664-672.
117. Visanji M, Belley-Cote EP, Pandey A, et al. Prophylactic ablation during cardiac surgery in patients without atrial fibrillation: a systematic review and meta-analysis of randomized trials. *Interdiscip Cardiovasc Thorac Surg*. 2024;39:ivae195.
118. Willekes CL, Fanning JS, Heiser JC, et al. Randomized feasibility trial of prophylactic radiofrequency ablation to prevent atrial fibrillation after cardiac surgery. *J Thorac Cardiovasc Surg*. 2024;167:2129-2135.e1.
119. Kirchhof P, Benussi S, Kotecha D, et al. 2016 ESC Guidelines for the management of atrial fibrillation developed in collaboration with EACTS. *Eur Heart J*. 2016;37:2893-2962.
120. American Heart Association. Adult Tachycardia With a Pulse Algorithm. CPR & First Aid: Emergency Cardiovascular Care. Accessed August 5, 2025. https://cpr.heart.org/-/media/CPR-Files/CPR-Guidelines-Files/Algorithms/AlgorithmACLS_Tachycardia_200612.pdf?sc_lang=en

121. Krahn KM, Koshman SL, Wang T, et al. Anticoagulant prescribing patterns in new-onset atrial fibrillation after cardiac surgery. *Ann Thorac Surg*. 2024;117:859–865.
122. Matos JD, McIlvaine S, Grau-Sepulveda M, et al. Anticoagulation and amiodarone for new atrial fibrillation after coronary artery bypass grafting: prescription patterns and 30-day outcomes in the United States and Canada. *J Thorac Cardiovasc Surg*. 2021;162:616–624.e3.
123. Ahmed M, Belley-Cote EP, Qiu Y, et al. Rhythm vs. rate control in patients with postoperative atrial fibrillation after cardiac surgery: a systematic review and meta-analysis. *J Clin Med*. 2023;12:4534.
124. Gillinov AM, Bagiella E, Moskowitz AJ, et al. Rate control versus rhythm control for atrial fibrillation after cardiac surgery. *N Engl J Med*. 2016;374:1911–1921.
125. Yang E, Spragg D, Schulman S, et al. Rate versus rhythm control in heart failure patients with post-operative atrial fibrillation after cardiac surgery. *J Card Fail*. 2021;27:915–919.
126. Kiviniemi T, Malmberg M, Biancari F, et al. Thromboembolisms related to post-operative electrical cardioversions for atrial fibrillation in patients with surgical aortic valve replacement. *Eur Heart J Qual Care Clin Outcomes*. 2018;4:120–125.
127. Butt JH, Xian Y, Peterson ED, et al. Long-term thromboembolic risk in patients with postoperative atrial fibrillation after coronary artery bypass graft surgery and patients with nonvalvular atrial fibrillation. *JAMA Cardiol*. 2018;3:417–424.
128. Taha A, Nielsen SJ, Franzen S, et al. Stroke risk stratification in patients with postoperative atrial fibrillation after coronary artery bypass grafting. *J Am Heart Assoc*. 2022;11:e024703.
129. Butt JH, Olesen JB, Gundlund A, et al. Long-term thromboembolic risk in patients with postoperative atrial fibrillation after left-sided heart valve surgery. *JAMA Cardiol*. 2019;4:1139–1147.
130. Riad FS, Grau-Sepulveda M, Jawitz OK, et al. Anticoagulation in new-onset postoperative atrial fibrillation: an analysis from the Society of Thoracic Surgeons Adult Cardiac Surgery Database. *Heart Rhythm O2*. 2022;3:325–332.
131. Yao RJR, Hawkins NM, Lavaie Y, et al. Anticoagulation management of postoperative atrial fibrillation after cardiac surgery: a systematic review. *J Card Surg*. 2021;36:2081–2094.
132. Chatterjee S, Ad N, Badhwar V, et al. Anticoagulation for atrial fibrillation after cardiac surgery: do guidelines reflect the evidence? *J Thorac Cardiovasc Surg*. 2024;167:694–700.
133. Taha A, Martinsson A, Nielsen SJ, et al. New-onset atrial fibrillation after coronary surgery and stroke risk: a nationwide cohort study. *Heart*. 2024;111:18–26.
134. Mazzeffi M, Beller J, Wisniewski A, et al. Systemic anticoagulation at discharge in cardiac surgical patients with postoperative atrial fibrillation: a statewide cohort study. *Ann Thorac Surg Short Rep*. 2025;3:791–796.
135. Koh KK, Ling RR, Tan SYS, et al. Direct oral anticoagulants in atrial fibrillation following cardiac surgery: a systematic review and meta-analysis with trial sequential analysis. *Br J Anaesth*. 2022;129:154–162.
136. Hage A, Dolan DP, Nasr VG, et al. Safety of direct oral anticoagulants compared to warfarin for atrial fibrillation after cardiac surgery: a systematic review and meta-analysis. *Semin Thorac Cardiovasc Surg*. 2022;34:947–957.
137. Moser N, Omar MA, Koshman SL, et al. Direct oral anticoagulants for atrial fibrillation in early postoperative valve repair or bioprosthetic replacement. *J Thorac Cardiovasc Surg*. 2024;168:523–532.e3.
138. Anderson E, Johnke K, Leedahl D, et al. Novel oral anticoagulants vs warfarin for the management of postoperative atrial fibrillation: clinical outcomes and cost analysis. *Am J Surg*. 2015;210:1095–1102 [discussion: 1102–1103].
139. Moonsamy P, Zhao Y, Makarem A, et al. Randomized controlled: trial of new oral anticoagulants versus warfarin for postcardiac surgery atrial fibrillation: the NEW-AF trial. *Ann Surg*. 2025;282:630–638.
140. Hashim SW, Collazo S, Greco A, Mather JF, McKay RG. Half-dose direct oral anticoagulation versus warfarin for atrial fibrillation following cardiac surgery. *J Cardiovasc Surg (Torino)*. 2024;65:169–176.
141. Pereira MP, Lima EG, Pitta FG, et al. Rivaroxaban versus warfarin in postoperative atrial fibrillation: cost-effectiveness analysis in a single-center, randomized, and prospective trial. *J Thorac Cardiovasc Surg Open*. 2023;15:199–210.
142. Sabbag A, Berkovich A, Raanani E, et al. Subclinical postoperative atrial fibrillation: a randomized trial. *Front Cardiovasc Med*. 2023;10:1153275.
143. Reiffel JA, Verma A, Kowey PR, et al. Incidence of previously undiagnosed atrial fibrillation using insertable cardiac monitors in a high-risk population: the REVEAL AF study. *JAMA Cardiol*. 2017;2:1120–1127.
144. Pandey A, Okaj I, Ichhpuniani S, et al. Risk scores for prediction of postoperative atrial fibrillation after cardiac surgery: a systematic review and meta-analysis. *Am J Cardiol*. 2023;209:232–240.

The Dog That Did Not Bark: What the 2026 STS Postoperative Atrial Fibrillation Guidelines Tell Us by What They Declined to Say



INVITED COMMENTARY:

“To the curious incident of the dog in the night-time.” “The dog did nothing in the night-time.”

“That was the curious incident,” remarked Sherlock Holmes.

— Arthur Conan Doyle, “Silver Blaze” (1892)¹

In Conan Doyle’s story, Holmes solved the mystery not by what the dog did, but by what it

did not do: it never barked. The Society of Thoracic Surgeons (STS) 2026 clinical practice guidelines on new-onset postoperative atrial fibrillation (POAF), published by Chatterjee and colleagues² in this issue of *The Annals of Thoracic Surgery*, deserve the same attention. The most consequential signal in the document is an absence. Despite entrenched practice patterns and long-standing perceptions of best practice derived from nonsurgical atrial fibrillation, the writing group declined to endorse routine anticoagulation with conviction, by assigning it a class IIB designation and stepping deliberately below the American College of Cardiology/