

The 2026 American Association for Thoracic Surgery Expert Consensus Document: Management of atrial functional mitral regurgitation

Makoto Mori, MD, PhD,^a Gorav Ailawadi, MD,^b Steven F. Bolling, MD,^b Rebecca T. Hahn, MD, FACC,^c Tsuyoshi Kaneko, MD,^d Ammar M. Killu, MBBA, FHRS,^e Anson M. Lee, MD,^f Patrick McCarthy, MD,^g Stephanie Mick, MD,^h Fabien Praz, MD,ⁱ Gilbert H. L. Tang, MSc, MBA, FRCSC, FACC,^j Marc Gillinov, MD,^k and Arnar Geirsson, MD^l

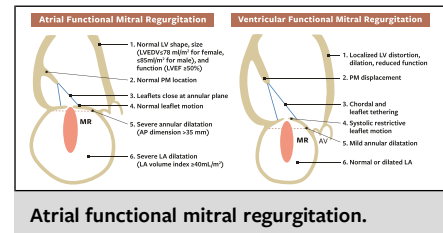
ABSTRACT

Objective: Atrial functional mitral regurgitation (AFMR) represents a distinct pathophysiologic entity characterized by MR secondary to left atrial dilation and annular remodeling, in the absence of significant left ventricular disease. With the increasing prevalence of atrial fibrillation and heart failure with preserved ejection fraction, AFMR has emerged as an important and potentially underrecognized etiology of MR. This expert consensus statement provides an evidence- and experience-based framework for the evaluation and management of AFMR, encompassing diagnosis, medical and rhythm therapy, surgical and transcatheter interventions, and postoperative management.

Methods: The American Association for Thoracic Surgery convened an international multidisciplinary panel of cardiac surgeons, cardiologists, and electrophysiologists with expertise in atrial and mitral valve disease. The panel conducted a systematic literature review and iterative Delphi consensus process to develop recommendations, graded according to class of recommendation and level of evidence.

Results: Consensus was achieved on 18 statements, organized into 5 sections: definition, pathophysiology, and diagnostic evaluation of AFMR; medical and rhythm management strategies; surgical treatment and concomitant procedures; transcatheter and hybrid interventions; and postoperative rhythm and anticoagulation management.

Conclusions: AFMR represents a distinct form of secondary MR driven by atrial remodeling. This document summarizes current expert consensus to guide diagnosis, timing, and choice of intervention, and highlights the need for multidisciplinary collaboration and prospective research to optimize outcomes. (J Thorac Cardiovasc Surg 2026; ■:1-17)



CENTRAL MESSAGE

Expert consensus recommendations for AFMR encompass diagnosis, rhythm and medical therapy, surgical and interventional strategies, and postoperative care, through a multidisciplinary heart team.

PERSPECTIVE

As atrial fibrillation and HFpEF become increasingly prevalent, AFMR will represent a growing indication for mitral valve intervention. This consensus document offers guidance to clinicians on evaluation, diagnostic differentiation from ventricular functional MR, rhythm and medical therapy, surgical and interventional therapy, and research priorities for this disease process.

See Commentary on page XXX.

See Discussion on page XXX.

From the ^aDivision of Cardiac Surgery, Yale School of Medicine, New Haven, Conn;

^bDepartment of Cardiac Surgery, University of Michigan, Ann Arbor, Mich; ^cDepartment of Medicine, Columbia University Irving Medical Center, New York, NY;

^dDivision of Cardiothoracic Surgery, Washington University in St Louis, St Louis, Mo;

^eDivision of Heart Rhythm Services, Department of Cardiovascular Medicine, Mayo Clinic, Rochester, Minn; ^fDepartment of Cardiothoracic Surgery, Stanford University, Stanford, Calif;

^gDivision of Cardiac Surgery, Northwestern University Feinberg School of Medicine and Northwestern Medicine Bluhm Cardiovascular Institute, Chicago, Ill;

^hDepartment of Cardiothoracic Surgery, Weill Cornell Medicine, New York, NY; ⁱDepartment of Cardiology, Bern University Hospital, Inselspital, University of Bern, Bern, Switzerland;

^jDepartment of Cardiovascular Surgery, Mount Sinai Health System, New York, NY; ^kDepartment of Thoracic and Cardiovascular Surgery, Cleveland Clinic, Cleveland, Ohio; and ^lDivision of

Cardiac Surgery, Department of Surgery, Columbia University Vagelos College of Physicians and Surgeons, New York, NY

Read at the 106th Annual Meeting of the American Association for Thoracic Surgery, Chicago, Illinois, May 2-6, 2026.

Received for publication Feb 2, 2026; revisions received March 25, 2026; accepted for publication March 26, 2026.

Address for reprints: Arnar Geirsson, MD, Department of Surgery, Columbia University Irving Medical Center, 177 Fort Washington Ave, New York, NY 10032 (E-mail: ag4877@cumc.columbia.edu).

0022-5223/\$36.00

Copyright © 2026 by The American Association for Thoracic Surgery

<https://doi.org/10.1016/j.jtcvs.2026.03.621>

Abbreviations and Acronyms

AATS	= American Association for Thoracic Surgery
AFMR	= atrial functional mitral regurgitation
CoR	= class of recommendation
GDMT	= guideline-directed medical therapy
HFpEF	= heart failure with preserved ejection fraction
LA	= left atrium
LAA	= left atrial appendage
LAAOS	= Left Atrial Appendage Occlusion Study
LoE	= level of evidence
LVEF	= left ventricular ejection fraction
NYHA	= New York Heart Association
PVI	= pulmonary vein isolation
SGLT2i	= sodium-glucose cotransporter-2 inhibitors
TEER	= transcatheter edge-to-edge repair
TR	= tricuspid regurgitation
VFMR	= ventricular functional mitral regurgitation



Scanning this QR code will take you to the table of contents to access supplementary information. To view the AATS Annual Meeting Webcast, see the URL next to the webcast thumbnail.

Atrial functional mitral regurgitation (AFMR) is an increasingly recognized clinical entity distinct from both degenerative and ventricular functional MR.^{1,2} Defined by mitral insufficiency resulting from left atrial enlargement and annular remodeling in the setting of preserved left ventricular systolic function and normal valvular anatomy, AFMR reflects the growing epidemiologic burden of atrial fibrillation and heart failure with preserved ejection fraction (HFpEF) in aging populations.

AFMR remains underdiagnosed, inconsistently characterized, and variably managed in contemporary practice.^{3,4} The mechanisms, clinical trajectory, and therapeutic responses of AFMR differ fundamentally from those of ventricular functional MR (VFMR), underscoring the need for a dedicated framework to guide diagnostic evaluation and treatment.⁵⁻⁷ Although AFMR and VFMR may coexist in some patients, MR driven primarily by annular enlargement in AFMR and by papillary displacement in VFMR each warrant different treatment considerations. Over the past decade, multimodality imaging, atrial fibrillation treatment, and expanding surgical and transcatheter options have transformed the therapeutic

approaches for functional MR. Most guideline recommendations and trials focus on ventricular functional MR and provide limited guidance, whereas recent 2025 European Society of Cardiology/European Association for Cardio-Thoracic Surgery Guidelines for the Management of Valvular Heart Disease provide more in-depth definitions and treatment recommendations for AFMR.^{8,9} Observational studies suggest substantial morbidity and mortality among symptomatic patients treated medically, whereas surgical series demonstrate excellent outcomes when annular geometry is restored and atrial fibrillation is addressed concomitantly.¹⁰ Emerging transcatheter approaches may provide alternatives for high-risk patients, and early data suggest an advantage over medical treatment alone; however, few patients have been included in randomized trials.^{11,12}

Recognizing these gaps, the American Association for Thoracic Surgery (AATS) convened an international multidisciplinary expert panel to develop a comprehensive consensus statement on AFMR evaluation and management. Through systematic literature review and structured Delphi methodology, the panel generated graded recommendations spanning disease definition, diagnostic imaging, medical and rhythm therapy, surgical strategies, transcatheter interventions, and postoperative management.

This document aims to provide clinicians with practical, mechanism-based guidance for treating AFMR, emphasize the importance of multidisciplinary heart team decision making, and identify research priorities needed to advance evidence-based care for this increasingly prevalent condition.

METHODS AND RESULTS

Following AATS/Society for Thoracic Surgeons methodology for expert consensus development, a 13-member, international multidisciplinary panel was formed. The panel developed consensus statements and rated each of them based on class of recommendation and level of evidence based on established methodology and standardized AATS conventions.¹³ Individual class of recommendation (CoR) is selected in accordance with the estimated benefit-risk ratio and signifies the strength of recommendation. Level of evidence (LoE) is based on the quality of evidence from clinical trials, cohort studies, meta-analyses, case series as well as clinical experience and expert opinion (Figure 1).

Literature search was conducted using PubMed with assistance from the scholarly librarian and included reviewing all publications since 2000 and clinical guideline sources. Recommendations were proposed, refined through serial Delphi rounds, and adopted when $\geq 75\%$ agreement was achieved with more than 80% participation from the panel. Expert consensus was obtained in 18 statements organized into 5 sections: definition, pathophysiology, and diagnostic evaluation of AFMR; medical and rhythm management strategies; surgical treatment and concomitant

Class of Recommendation

		Suggested phrases for writing recommendations
I	Strong recommendation Benefit >>> risk	• Is recommended • Is indicated
	Moderate recommendation Benefit >> risk	• Should be considered • Is reasonable • Can be useful/effective/beneficial
IIa	Weak recommendation Benefit ≥ risk	• May/might be reasonable • May/might be considered
	Moderate recommendation No benefit: risk = benefit Strong recommendation Harm: risk > benefit	• Is not recommended • Is contraindicated • Should not be performed/administered

Level of Evidence

A	High-quality evidence from more than one RCT with no concern for high risk of bias, or meta-analyses of high-quality RCTs with no concerns for significant bias.	
	Randomized (B-R):	Moderate-quality evidence from 1 or more RCT or meta-analysis of RCTs.
B	Non-Randomized (B-NR):	Moderate-quality evidence from 1 or more well-designed, well-executed nonrandomized studies, observational studies, or registry studies or meta-analyses of such studies.
	Limited data (C-LD):	Studies with limitations of design or execution, meta-analyses of such studies, case series, or physiological or mechanistic studies in human subjects.
C	Expert opinion (C-EO):	Consensus of expert opinion based on clinical experience.

AATS, American Association for Thoracic Surgery; EACTS, European Association for Cardio-Thoracic Surgery; ESTS, European Society of Thoracic Surgeons; STS, Society of Thoracic Surgeons; RCT, randomized controlled trial.

FIGURE 1. Class of recommendation and level of evidence definitions. Adopted definitions of classes of recommendation and level of evidence. Reprinted from reference.¹³ RCT, Randomized controlled trial.

procedures; transcatheter and hybrid interventions; and postoperative rhythm and anticoagulation management (Table 1).

Each member of the panel contributed to literature review, development of statements, Delphi voting and writing

of the document that was finalized by the chairs. The panel and the AATS Adult Cardiac Clinical Practice Standards Committee reviewed and approved the document before it was submitted for final approval to the AATS Board of Directors and submitted for publication.

TABLE 1. Summary of recommendations

Section	Recommendation	Class of recommendation	Level of evidence
1. Definition, pathophysiology, and diagnostic evaluation			
1.1	For patients presenting with moderate-severe or severe AFMR, evaluation by a multidisciplinary heart team is recommended.	I	C-LD
1.2	Imaging should be used as a core diagnostic modality to distinguish AFMR from VFMR because pathogenesis, therapy, and outcomes differ.	I	A
1.3	Symptomatic moderate-severe or severe AFMR should be considered for treatment, including GDMT, rhythm control, and/or valvular intervention (surgical or transcatheter).	IIa	B-NR
2. Medical and rhythm management			
2.1	In patients with AFMR and preserved ejection fraction, GDMT should be considered.	IIa	C-LD
2.2	Optimization of GDMT should be considered before any mitral valve intervention for AFMR.	IIa	C-LD
2.3	Rhythm control should be attempted in suitable patients before mitral valve intervention.	IIa	B-NR
3. Surgical treatment			
3.1	Surgical correction of MR should be considered in suitable-risk patients with symptomatic moderate-severe or severe AFMR.	IIa	B-NR
3.2	Mitral valve repair should be considered as the primary surgical strategy over mitral valve replacement for AFMR.	IIa	C-LD
3.3	Mitral valve repair should be considered as a concomitant procedure for moderate-severe or severe AFMR in patients undergoing cardiac surgery for other indications.	IIa	C-EO
Concomitant AF surgery and LAA management			
3.4	For patients undergoing surgical therapy for AFMR with atrial fibrillation, concomitant surgical AF ablation is recommended.	I	B-NR
3.5	For patients undergoing surgical ablation for AF during AFMR surgery, biatrial maze should be considered.	IIa	C-EO
3.6	In patients with AFMR and atrial fibrillation undergoing cardiac surgery, LAA exclusion is recommended.	I	B-NR
3.7	Surgical LAA management should use a reliable technique, and completeness should be verified intraoperatively.	I	A
Tricuspid valve considerations			
3.8	When repairing AFMR in patients with AF, concomitant tricuspid valve repair should be considered for moderate or greater TR.	IIa	C-EO
4. Transcatheter/hybrid interventions			
4.1	Mitral TEER may be considered in select patients with AFMR who are high-risk surgical candidates with suitable anatomy and after optimization of medical therapy and rhythm control.	IIb	B-NR
5. Postoperative rhythm and anticoagulation management			
5.1	After mitral operation and surgical AF ablation for AFMR, short-term (≈ 3 mo) prophylactic antiarrhythmic drugs are reasonable to prevent early AF recurrence.	IIa	B-NR
5.2	In patients undergoing mitral surgery and AF ablation for AFMR, continuation of anticoagulation for at least 3 mo should be considered.	IIa	B-NR
5.3	After surgical LAA exclusion, continuation of oral anticoagulation should be individualized by the heart team with shared decision making.	IIa	C-LD

AFMR, Atrial functional mitral regurgitation; C-LD, C-limited data; GDMT, guideline-directed medical therapy; VFMR, ventricular functional mitral regurgitation; B-NR, B-nonrandomized; C-EO, C-expert opinion; AF, atrial fibrillation; LAA, left atrial appendage; TR, tricuspid regurgitation.

Section 1: Definition, Pathophysiology, and Diagnostic Evaluation of AFMR

Statement 1.1: For patients presenting with moderate-severe or severe AFMR, evaluation by a multidisciplinary

heart team is recommended. (CoR I, LoE C-limited data). AFMR can be defined as secondary MR occurring in the setting of preserved left ventricular (LV) systolic function and geometry, characterized by preserved LV

ejection fraction (LVEF) ($\geq 50\%$) without regional wall motion abnormalities or leaflet tethering, absence of LV dilatation (LV end-diastolic volume ≤ 78 mL/m² for women, ≤ 85 mL/m² for men), mitral annular dilatation (systolic anteroposterior diameter >35 mm), and LA enlargement (LA volume index >40 mL/m²). The above definition (ie, *The Journal of the American College of Cardiology* definition) was proposed by the JACC: Cardiovascular Imaging Expert Panel and was found to have the highest association with survival outcome among various definitions currently used.^{14,15} Echocardiography typically demonstrates normal leaflet morphology and motion with planar coaptation and a central MR jet. In advanced stages, overlap with ventricular secondary MR may emerge due to late LV remodeling from chronic volume overload.⁹ Clinical context such as a history of atrial fibrillation and HFpEF supplements diagnosis, although not always present (Figure 2).

Multidisciplinary heart team evaluation is essential for patients with moderate-severe or severe AFMR because clinical decision making is complex, evidence is evolving, and outcomes depend heavily on timely, appropriate intervention. AFMR typically affects older patients with atrial fibrillation, HFpEF, and multiple comorbidities; mechanisms, prognosis, and therapeutic options differ from primary and ventricular functional MR requiring nuanced integration of imaging, rhythm management, and mechanical correction of MR. AFMR management should be individualized, using multimodality imaging to clarify mechanism and severity and to guide selection among guideline-directed medical therapy (GDMT), rhythm control, surgery, and transcatheter options in a dedicated heart team setting.^{14,16}

Evidence from broader populations of patients with MR shows that a formal heart-team process improves both care delivery and survival. In a single-center study of severe primary MR, implementation of a structured mitral heart team increased multidisciplinary evaluation from 29% to 89% and intervention from 24% to 75% and was associated with lower 2-year mortality after matching (19% vs 32%).¹⁷ Similarly, a cohort of 1365 patients with MR discussed by an expert valve team demonstrated that heart team-guided management facilitated appropriate selection among surgery, transcatheter therapies, and conservative treatment.¹⁸ Another single-center observational study comparing outcomes before and after the implementation of a dedicated heart team reported improved survival among patients with mitral valve pathology evaluated through the heart team model.¹⁹ These data, although not AFMR-specific, support the principle that systematic multidisciplinary evaluation reduces undertreatment and improves outcomes in patients with complex MR.

Observational studies also underscore the need for risk stratification and shared decision making. Medically treated AFMR carries substantial rates of cardiac death and heart-failure hospitalization, particularly in patients with severe MR, New York Heart Association (NYHA) functional class II or IV symptoms, or multiple comorbidities.¹⁰ Surgical and transcatheter options are expanding, but the optimal timing, choice of procedure, and integration with atrial fibrillation ablation remain uncertain and must be tailored to patient frailty, symptom burden, atrial/ventricular remodeling, and local expertise. The heart team approach is strongly endorsed in management of valvular heart disease.^{20,21} Extrapolating these principles to AFMR supports a Class I recommendation that moderate-severe or severe

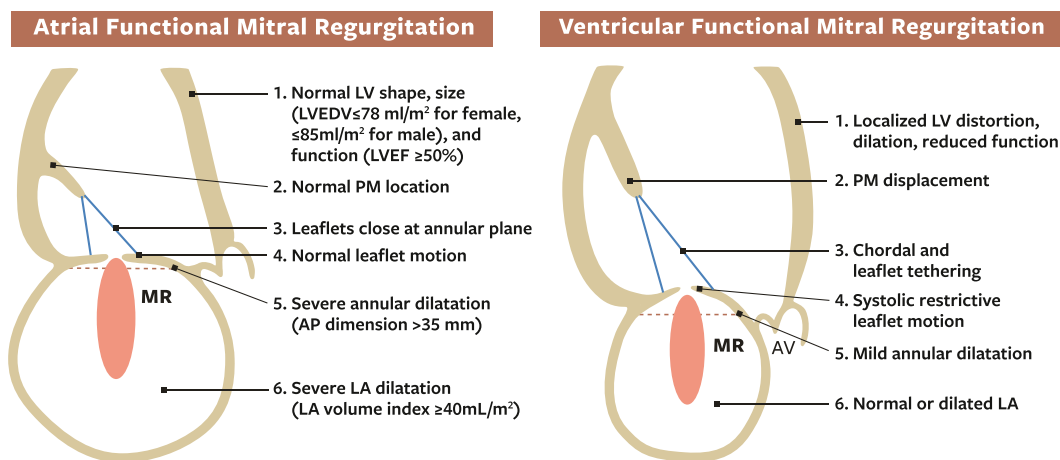


FIGURE 2. Characteristics of atrial functional mitral regurgitation (AFMR). The figure summarizes characteristics of AFMR. These include preserved left ventricular (LV) function (ejection fraction $\geq 50\%$) with no regional wall motion abnormalities or distortion, absence of leaflet tethering, normal leaflet motion and morphology, dilated mitral annulus, and marked dilatation of the left atrium (left atrial volume index [LAVI] >34 mL/m²). The resulting MR arises from the central coaptation gap. These patients frequently have atrial fibrillation and/or heart failure with preserved ejection fraction. AV, Aortic valve; PM, papillary muscle.

AFMR be evaluated by a multidisciplinary heart team, despite limited AFMR-specific data.

Statement 1.2: It is recommended to use imaging as a core diagnostic modality to clearly distinguish AFMR from VFMR, because pathogenesis, therapy, and outcomes are different. (CoR I, LoE A). Failure of mitral leaflet coaptation in secondary disease may occur in the setting of a remodeled and dysfunctional ventricle (ie, VFMR) or dilated annulus/left atrium (ie, AFMR). These 2 subtypes of functional MR have different pathophysiological and morphological characteristics, as well as contrasting prognostic and therapeutic implications.^{4,5,7,14,22-24} AFMR should be viewed as a dominant pathophysiologic phenotype rather than a strictly discrete entity. In clinical practice, overlap between AFMR, VFMR, and mild degenerative mechanisms is common, and management decisions should be guided by the predominant mechanism of regurgitation and the overall clinical context.

AFMR has seen increasing recognition as an etiology of MR in the setting of normal LV mechanics, with typically normal leaflet motion (Carpentier Type I) although a second subtype related to atrigenic leaflet tethering (Carpentier Type IIIB) has recently been described.²⁵ Studies suggest the underlying mechanism is related to insufficient leaflet remodeling in response to increased mechanical stress, LA dilation, and annular dilation with altered annular dynamics.^{26,27} AFMR is most often associated with atrial fibrillation and may coexist with HFpEF in a significant proportion of patients, although the exact prevalence is not exactly known but ranges from <10% to 36% in various registries and retrospective studies.^{14,28} In the prospective European Society of Cardiology Heart Failure Registry of patients with heart failure, the estimated prevalence of moderate-severe or more MR was 20%, whereas the Acute Decompensated Heart Failure Syndromes (ATTEND) Registry showed that 18% of patients with decompensated HFpEF have moderate or severe MR.^{29,30}

VFMR is associated with restricted systolic motion of the leaflets (Carpentier Type IIIB) with tethering resulting from LV remodeling/dysfunction. The hallmark of VFMR is apically tethered leaflets resulting from an imbalance between tethering and closure forces. Annular dilatation may also be present.³¹ The term *ischemic MR* is applied to functional MR when the underlying cause of the LV abnormalities is coronary artery disease. The morphologic changes associated with ischemic and nonischemic functional MR are distinct, but both are associated with ventricular enlargement with lateral displacement of the papillary muscles.^{32,33} Ventricular remodeling results in the point of leaflet coaptation being displaced below the mitral valve annulus, and this is termed leaflet tethering. The chordal apparatus appears stretched, and individual chords may be under significant tension.

Given the distinct morphologic characteristics that distinguish AFMR and VFMR, echocardiography is the imaging modality of choice for the initial assessment of MR etiology as well as quantitation. Cardiac magnetic resonance imaging may be integral to the determination of MR severity when echocardiographic imaging is nondiagnostic. It is also useful in assessing severity of LV remodeling and contractile dysfunction as well as the pattern of myocardial fibrosis that has been linked to prognosis after surgical correction of MR.^{16,34-37}

Statement 1.3: Symptomatic moderate-severe and severe AFMR should be considered for treatment, including GDMT, rhythm control, and/or valvular intervention (surgical or transcatheter). (CoR IIa, LoE B-nonrandomized). Treatment is recommended for most symptomatic patients with moderate-severe and severe MR, regardless of etiology. Although ideal treatment for AFMR is still being investigated, symptomatic patients with moderate-severe and severe AFMR should be strongly considered for treatment, including medical management, rhythm control, and valvular intervention.^{16,26,28,38,39}

AFMR results in a volume overloaded state with impaired atrial function and may result in ventricular dysfunction; therefore, in symptomatic patients, medical therapy for heart failure (usually HFpEF) should be pursued.^{3,16,40} Sodium-glucose cotransporter-2 inhibitors (SGLT2i) have been shown to reduce cardiovascular mortality and heart failure hospitalizations and improve quality of life in patients with HFpEF and should be considered in addition to any valvular intervention.⁴¹⁻⁴³

In the advanced setting of ventricular dysfunction, GDMT including beta-blockers, angiotensin-converting enzyme inhibitors or angiotensin receptor blockers, aldosterone antagonists, and volume optimization with diuresis improve heart failure symptoms and may prolong life expectancy. In addition, GDMT may reduce the degree of MR and lead to reverse left atrial remodeling.^{44,45}

AFMR and atrial fibrillation have a closely intertwined relationship, with 60% to 80% of AFMR being associated with atrial fibrillation.^{10,24,46,47} Successful conversion to sinus rhythm may result in lower MR grades and reduction of left atrial dilation.^{1,16,24,46} Catheter ablation, as opposed to medical therapy alone, may be more successful in maintaining sinus rhythm while the potential influence of atrial fibrillation recurrence on MR progression remains unknown. Therefore, close monitoring is warranted even after successful ablation with reduction in MR severity.^{45,48} In contrast to VFMR, surgical mitral valve repair for AFMR is durable with low rates of recurrent MR. Restoration of annular geometry with an annuloplasty ring is mandatory and concomitant procedures to manage atrial fibrillation, if indicated, may further improve long-term repair results.^{47,49,50}

Data are limited for transcatheter treatment of AFMR because most studies examining transcatheter devices focus only on VFMR or do not distinguish between AFMR and other forms of secondary MR. Although transcatheter devices improve leaflet coaptation and locally induce indirect annuloplasty, they may only partially fix the geometric changes of the annulus that result in AFMR. Transcatheter edge-to-edge repair (TEER) for patients with AFMR has a high success rate in reducing MR and may improve functional status up to 1-year postprocedure,⁵¹⁻⁵⁴ but requires further study to determine their efficacy.

Section 2: Medical and Rhythm Management of AFMR

Statement 2.1: In patients with AFMR and preserved EF, GDMT should be considered. (CoR IIa, LoE C-limited data). GDMT optimization has shown benefits in patients with heart failure symptoms and associated functional MR. Specific data on AFMR are sparse, but key principles may be extrapolated from the experience with VFMR. The use of SGLT2i has been shown to reduce functional MR in 1 small randomized controlled trial that included patients with LVEF 35% to 50% compared with standard heart failure treatment, in which the mechanism of MR was VFMR in 80.5% and isolated AFMR in 19.5% of patients.⁵⁵ The addition of ertugliflozin reduced AFMR by 1 grade or more in only 29% of the patients, which represents a rather modest effect on valve disease. In addition, 1 study found that efforts to maintain sinus rhythm, including medical therapy, can induce reverse LA remodeling and prevent or reduce the development of AFMR and tricuspid regurgitation (TR) in patients with atrial disease due to atrial fibrillation.⁵⁶ A substudy of the Catheter Ablation versus Antiarrhythmic Drug Therapy for Atrial Fibrillation randomized clinical trial as well as a recent meta-analysis of 17 studies showed that catheter ablation compared with pharmacological therapy may reduce MR severity over time.^{57,58}

In patients with a high likelihood of associated HFpEF (overweight, systemic hypertension, atrial fibrillation, pulmonary hypertension, elderly, and diastolic dysfunction), the use of SGLT2i has been shown to reduce cardiovascular mortality and should be therefore liberally implemented in at risk candidates although their efficacy in reducing AFMR has not been investigated yet.⁴³ Diuretics are useful to treat symptoms of congestion, including dyspnea and peripheral edema. In patients with hypertension, afterload reduction using renin-angiotensin blockade should be implemented, even if an influence on prognosis has not been demonstrated in patients with HFpEF. Similarly, beta-blockers and calcium antagonists have no proven benefit for HFpEF treatment and should not be prescribed for this sole indication.

In summary, SGLT2i, diuretics, and afterload reduction to treat associated systemic hypertension should be

implemented before considering any valve intervention. Maintenance of sinus rhythm represents an additional early treatment goal that can be achieved and/or supported by appropriate antiarrhythmic medication.

Statement 2.2: Optimization of GDMT should be considered before consideration of any mitral valve intervention for AFMR. (CoR IIa, LoE C-limited data).

The effect of GDMT for patients with HFpEF is less well defined, but the general framework is similar to that of heart failure with reduced ejection fraction.⁵⁹ SGLT2i reduce heart failure hospitalizations in patients with heart failure, extending to all ranges of LVEF, including preserved EF.^{60,61} Afterload reduction with mineralocorticoid antagonists, angiotensin receptor blockers, and angiotensin receptor-neprilysin inhibitors are mainstays of the treatment of heart failure with reduced ejection fraction but have been found to have variable effects on heart failure hospitalizations. Most of the benefits have tended to manifest in patients with LVEF in the lower range of normal.⁵⁹

The effect of GDMT specifically in patients with AFMR is not well studied. Patients with AFMR are vulnerable to cardiac mortality risk and heart failure hospitalization and have been shown to have higher risk for adverse outcomes in the presence of symptomatic heart failure and increased comorbidities suggesting that treating patients with AFMR could be beneficial.^{62,63} Limited data demonstrate benefits for patients with VFMR, and it is unknown whether this data can be extrapolated to AFMR patients. Ertugliflozin, an SGLT2i, was shown to decrease the severity of VFMR as measured by echocardiographic parameters, but the study was not designed or powered to show a difference in heart failure hospitalizations or mortality.⁵⁵ MR severity may also be reduced in patients given sacubitril/valsartan compared with valsartan alone.⁶⁴ In a separate in vitro study, sacubitrilat (the active metabolite of the angiotensin receptor-neprilysin inhibitor sacubitril) and valsartan reduced the arrhythmogenicity in isolated atrial biopsies from patients undergoing open heart surgery, suggesting a potential mechanism for improved clinical outcomes for patients treated with this afterload reducing drug combination.⁶⁵ Given the association of AFMR with adverse outcomes in the presence of heart failure, GDMT should be considered before interventional procedures or surgery. Because direct data specific to the AFMR population are lacking, this is an area of research priority.

Statement 2.3: It is reasonable to attempt rhythm control in suitable patients before mitral valve intervention. (CoR IIa, LoE B-nonrandomized).

Restoration of sinus rhythm is associated with meaningful improvements in AFMR, raising the possibility that effective rhythm control may obviate or delay the need for mitral valve intervention or surgery in selected patients. Although randomized evidence is not available, observational studies support this strategy. The broader benefits of early

rhythm control are supported by the early treatment of atrial fibrillation for stroke prevention (EAST-AFNET) 4 trial, in which early sinus rhythm restoration reduced cardiovascular death, stroke, acute coronary syndrome, and heart failure hospitalization.⁶⁶

Observational data involving 54 patients with moderate or greater AFMR demonstrated improvement in mitral valve function following restoration and maintenance of sinus rhythm with catheter ablation. When stratified by rhythm status at follow-up, 82% of patients with recurrent atrial fibrillation continued to exhibit significant MR, compared with only 24% of patients who remained in sinus rhythm, despite similar baseline MR severity.¹ A retrospective study of 117 patients hospitalized with atrial fibrillation and AFMR showed that restoration of sinus rhythm was associated with favorable reverse remodeling, including reductions in both MR and TR vena contracta dimensions at 12 months.⁵⁶ Additional analysis of 136 patients with persistent atrial fibrillation-related AFMR undergoing initial catheter ablation revealed that patients with postablation MR improvement experienced significantly lower rates of the composite end point of all-cause mortality and heart failure hospitalization over 2 years compared with those without MR improvement.⁶⁷ A more recent single-center study of 795 patients with new-onset atrial fibrillation and concomitant high-grade functional MR reported improvement in MR severity in 58.8% of patients following rhythm-control therapy. Predictors of persistent high-grade MR despite rhythm control included NYHA functional class IV symptoms and echocardiographic markers of more advanced severe MR, which the study defined as effective regurgitant orifice area $>0.4 \text{ cm}^2$, vena contracta width $>8 \text{ mm}$, and left atrial volume index $>48 \text{ mL/m}^2$.⁶⁸ Individuals with long-standing atrial fibrillation or substantially enlarged left atria and very severe MR had higher rates of arrhythmia recurrence and should undergo close surveillance if a rhythm-control strategy is pursued.⁶⁹ As 61% recurrence of atrial fibrillation within 1 year of catheter ablation was observed among patients with significant MR, and progression of the original MR,⁶⁹ close surveillance within several months of ablation may be reasonable. Taken together, successful rhythm control may reduce AFMR severity and improve clinical outcomes in a selected patient group. However, intervention should not be delayed in patients with persisting AFMR despite attempted rhythm control.

Section 3: Surgical Treatment of AFMR

Mitral Valve Repair and Replacement. *Statement 3.1: Surgical correction of MR should be considered in suitable-risk patients with moderate-severe or severe AFMR in the presence of symptoms. (CoR IIa, LoE B-non-randomized).* The efficacy of surgical correction of AFMR has been investigated in the REVEAL-AFMR multicenter

registry including more than 1000 patients with severe AFMR, of whom 113 patients who underwent surgery, showing improved midterm survival and heart failure rehospitalization compared with medical management.¹⁰ Despite possible confounders, only the surgical group showed a significant decrease in heart failure biomarkers and the primary outcomes of all-cause mortality and heart failure hospitalization.

Outcomes of mitral valve surgery for AFMR differ from that of VFMR. Studies comparing surgery in patients with moderate-severe AFMR to those with VFMR showed better survival and fewer reoperations in the AFMR group.^{10,70} Comparable results of AFMR and degenerative MR surgery have been reported.⁷¹ In contrast, the better surgical outcomes observed in AFMR compared with VFMR may be attributed to preserved ventricular function and dimensions as well as concomitant maze procedure to treat the underlying cause, atrial fibrillation. Therefore, surgery is able to address the 2 key pathophysiologic drivers of the MR in 1 operation. Considering the annular dilatation as a primary driver of MR in AFMR, mitral repair with annuloplasty is the preferred approach.

Statement 3.2: Mitral valve repair should be considered as the primary surgical correction strategy over mitral valve replacement for AFMR. (CoR IIa, LoE C-limited data).

Several observational studies in patients undergoing mitral valve repair with mitral annuloplasty only, have demonstrated excellent short-term surgical outcomes with low rates of residual MR, good long-term survival and acceptable long-term freedom from recurrent MR $\geq 3+$ ranging from 80% to 89% at 10 years.^{47,72-74} In respect to annuloplasty sizing, it is reasonable to size based on anterior leaflet surface area and downsizing the ring/band by 1 or 2 sizes, whereas the types of annuloplasty used for the repair, such as incomplete band or complete ring, do not appear to influence durability of repair.⁷² Smaller studies suggest that mitral valve repair may be associated with higher freedom from cardiac death rather than mitral valve replacement with no difference noted in the need for mitral valve reoperations.^{50,75} In real-world observational study for investigating the prevalence and therapeutic options for atrial functional mitral regurgitation, of 113 patients who underwent mitral valve operation, 40% underwent mitral valve replacement, suggesting the equipoise in repair or replacement approach for AFMR.¹⁰ Although the sample size was small, there was no statistically significant difference in the survival between those undergoing repair and replacement during the median follow-up of 434 days. In this registry, patients who underwent replacement had a larger atrial size, although the repair durability related to left atrial dimension in this patient group remains unknown.

Although pathologically distinct, results of mitral valve repair for AFMR appear as favorable as those of mitral repair for primary degenerative MR with atrial

fibrillation.^{71,76} Therefore, in the absence of VFMR phenotype, AFMR patients requiring surgical correction should be considered for mitral repair rather than replacement.

Statement 3.3: Mitral valve repair should be considered for moderate-severe or severe AFMR as a concomitant procedure in patients undergoing cardiac surgery for other indications. (CoR IIa, LoE C-expert opinion). For patients undergoing cardiac surgery for other indications, concomitant procedures should be considered when they offer benefits with acceptable added risk. As such, concomitant mitral repair should be considered for more than moderate AFMR in patients undergoing cardiac surgery for other indications regardless of symptoms.

Prior work has found that mitral valve repair for AFMR has significant benefit, with high rates of successful repair, low rates of recurrent MR, and may lead to improved survival.^{47,72,76,77} Even when performed with concomitant surgical ablation for atrial fibrillation and concomitant tricuspid repair, mitral repair for AFMR is low risk, with low rates of morbidity and mortality.^{76,78} Data on pacemaker rate in concomitant mitral-tricuspid repair for AFMR is limited, but experienced centers report pacemaker rates of approximately 2%.⁷¹ Studies encompassing broader practice settings report higher rates between 7% and 14%.⁷⁹⁻⁸² Overall, mitral repair for AFMR is safe with excellent outcomes, but a higher pacemaker rate in the concomitant mitral-tricuspid repair operation must be acknowledged.

Treatment is recommended for most patients with moderate-severe and severe MR, regardless of etiology of MR. There is scant data on concomitant mitral repair for AFMR at the time of other closed atrium cardiac operations (eg, aortic valve replacement or coronary artery bypass grafting). However, the natural history of moderate-severe or severe MR in AFMR portends poor outcomes, with frequent readmissions for heart failure and lower survival.¹⁰ Other works have found that concomitant mitral valve repair at the time of aortic valve surgery or coronary artery bypass grafting is safe, with acceptable risks of morbidity and mortality.⁸³⁻⁸⁶ Inferring from a broader functional MR data, concomitant mitral valve may lead to reduced heart failure symptom burden and improved survival compared with leaving moderate-severe or severe functional MR untreated.^{84,86}

Moderate-severe or severe MR is associated with poor long-term outcomes, and concomitant mitral valve repair at the time of other cardiac surgery is shown to be safe. Mitral repair for AFMR is effective and durable with excellent outcomes. Given the benefits and low risk, concomitant mitral repair for moderate-severe or severe AFMR should be considered for patients undergoing cardiac surgery for another indication.

Concomitant surgical ablation and left atrial appendage management. *Statement 3.4: For patients undergoing surgical therapy for AFMR with atrial fibrillation, it is recommended that they undergo correction of MR with concomitant surgical atrial fibrillation ablation. (CoR I, LoE B-nonrandomized).* In general, patients with mitral valve disease and atrial fibrillation have the best clinical outcomes if they undergo concomitant operative treatment for both conditions. Evidence from degenerative MR demonstrates that concomitant mitral valve repair and surgical atrial fibrillation ablation results in improved long-term rhythm control and survival compared with mitral valve surgery alone.^{87,88}

About 60% to 80% of patients with AFMR undergoing surgical treatment have coexisting atrial fibrillation.^{10,47} Although direct evidence evaluating surgical ablation specifically in AFMR remains limited, the strong association between atrial fibrillation burden and severity of MR supports a combined operative strategy. Restoration of sinus rhythm through catheter ablation has been shown to reduce MR severity, suggesting that successful surgical ablation might increase the durability of mitral valve repair in these patients.¹

When compared with surgical ablation in patients with degenerative mitral valve disease, surgical ablation in those with AFMR is less successful.⁷⁶ By 5 years postsurgery, 40% to 60% of patients will experience recurrence of atrial fibrillation.^{72,89} Therefore, long-term rhythm monitoring is essential. Further studies are necessary to determine whether AFMR patients with successful ablation derive clinical benefits, including greater freedoms from anticoagulation, thromboembolic events, and the need for anticoagulation.

Statement 3.5: For patients undergoing surgical ablation for atrial fibrillation in the setting of AFMR surgery, biatrial maze should be considered. (CoR IIa, LoE C-expert opinion). Surgical ablation options can be broadly categorized into pulmonary vein isolation (PVI), a left atrial maze, and biatrial maze (Cox-Maze III/IV). Isolated surgical PVI is not recommended for patients with persistent and long-standing persistent atrial fibrillation, regardless of the presence or absence of significant MR. In advanced stages of atrial fibrillation, biatrial Cox-Maze III/IV is the preferred surgical ablation approach allowing for more extensive lesion set potentially resulting in >90% sinus rhythm maintenance at 3 years.^{90,91}

Although no studies directly compare the relative effectiveness of PVI, left atrial maze, and biatrial maze specifically in the setting of AFMR, comparative data are available from cohorts undergoing concomitant surgical ablation for degenerative mitral valve disease. In randomized patients undergoing degenerative mitral valve repair, biatrial maze procedure was associated with a significantly

lower prevalence of postoperative atrial fibrillation compared with PVI.⁹² With respect to left atrial maze versus biatrial maze in degenerative mitral valve disease, multiple studies have demonstrated superior efficacy of biatrial ablation, particularly in patients with nonparoxysmal atrial fibrillation.^{93,94} Left atrial ablation only may closely approximate the efficacy of biatrial lesion sets in selected surgical cohorts, and left atrial only ablation is less effective in patients older than age 75 years, in those with a left atrial diameter >5 cm, and in individuals with atrial fibrillation duration exceeding 5 years.⁹⁵ In the real-world observational study for investigating the prevalence and therapeutic options for atrial functional mitral regurgitation cohort, the mean age of AFMR patients was 77 years, and the average left atrial diameter was 5.1 cm, findings that argue against a left-sided-only ablation strategy for most patients with AFMR.¹⁰ Furthermore, inclusion of right atrial lesion sets is recommended in the presence of right atrial dilation or TR, both of which are common findings in AFMR.⁹⁶

Although biatrial ablation is generally the most appropriate strategy in AFMR, it is associated with longer cardiopulmonary bypass time and an increased risk of conduction disturbances requiring permanent pacemaker implantation.⁹⁴ These potential downsides should also be considered when selecting the optimal surgical ablation approach for patients with AFMR.

Statement 3.6: In patients with AFMR and atrial fibrillation undergoing cardiac surgery, left atrial appendage exclusion is recommended. (CoR I, LoE B-nonrandomized). The left atrial appendage (LAA) is the origin of thrombus in more than 90% of AF-related strokes, making it a strategic target for embolic prevention in patients with atrial fibrillation.⁹⁷ Surgical left atrial appendage (LAA) exclusion or exclusion has long been performed, but recent evidence, including a randomized trial supports its routine use during concomitant cardiac surgery.⁹⁷ Although not specific to AFMR, these findings are likely applicable to patients with AFMR.

Meta-analysis of 22 studies, reported that surgical LAA exclusion was associated with a marked reduction in long-term stroke or thromboembolism (40%-50% relative reduction) and a statistically significant reduction in overall mortality over follow-up.⁹⁸ Another meta-analysis also reported significant reduction (hazard ratio, 0.64; 95% CI, 0.53-0.77) in stroke or embolic events in patients with a history of atrial fibrillation, and a significant reduction (hazard ratio, 0.72; 95% CI, 0.67-0.78) in mid- and late mortality in these patients.⁹⁹

Strongest evidence supporting exclusion of LAA in patients with atrial fibrillation comes from the Left Atrial Appendage Occlusion (LAAOS) III randomized trial that enrolled 4811 patients with atrial fibrillation and CHA₂DS₂-VASc ≥ 2 . At a median 3.8-year follow-up, stroke or systemic embolism occurred in 4.8% of patients with LAA exclusion with anticoagulation versus 7.0% in

patients receiving anticoagulation therapy only, yielding an absolute risk reduction of 2.2% and a 33% relative reduction (hazard ratio, 0.67; 95% CI, 0.53-0.85). Notably, 77% of participants remained on anticoagulation therapy, confirming an incremental protective effect beyond pharmacotherapy while the same protective effect was also observed in patients not taking long-term anticoagulation therapy. Rates of major bleeding, heart failure hospitalization, and perioperative complications were not significantly different between the groups.¹⁰⁰ Taken together, these recent studies, and the underlying database and single center reports, strongly support the recommendation of LAA exclusion in patients with atrial fibrillation undergoing cardiac surgery.¹⁰¹⁻¹⁰³

Statement 3.7: Surgical management of the LAA is recommended with a reliable technique and verified at the time of operation to be complete. (CoR I, LoE A). Exclusion of the LAA at the time of surgery for atrial fibrillation significantly reduces the long-term stroke risk.⁹⁷ Following the LAAOS III trial, current guidelines support Class I designation for exclusion of the LAA for patients with atrial fibrillation at the time of cardiac surgery.¹⁰¹ Notably, the LAAOS III trial required transesophageal echocardiogram confirmation of complete appendage exclusion for patients undergoing suture ligation of the appendage without excision when done through a minithoracotomy. Intraoperative transesophageal echocardiogram was recommended, but not mandated, to verify complete exclusion of the LAA. Most patients continued to receive ongoing antithrombotic therapy.

The technique of LAA exclusion is important. Historically, incomplete appendage closure was identified more frequently in patients undergoing suture exclusion or stapler ligation compared with surgical excision with suture closure in patients with follow-up transesophageal echocardiogram after cardiac surgery.¹⁰⁴ Incomplete exclusion was associated with a high rate of LAA thrombus, likely increasing the risk of thromboembolic events in this subgroup. In 2 small studies evaluating double-layer suture closure, thromboembolic events occurred in approximately 25% of patients with incomplete closure.^{105,106} Small residual necks were associated with higher rates of thromboembolic events, whereas no events were observed in the small number of patients with a partial residual stump without a reduced neck, underscoring the importance of complete closure of the appendage in patients with atrial fibrillation.

As a result of early reports of incomplete closure and associated thromboembolic events, device-based clip exclusion was developed to provide more consistent exclusion. In an early multicenter trial examining the effectiveness of the device at the time of median sternotomy, 98% of patients were found to have effective exclusion of the LAA on either follow-up computed tomography angiogram

or transesophageal echocardiogram 3 months after the procedure.¹⁰⁷ Subsequent evolution of the device led to a thoracoscopic application. Compared with surgical ligation (ie, suture closure or stapling), exclusion using clips results in a higher rate of complete exclusion (~95%-98%) by image-based verification after surgery.¹⁰⁸⁻¹¹⁰ Complete exclusion is verified with transesophageal echocardiogram demonstrating the lack of color Doppler flow into the LAA and collapsed LAA cavity.¹⁰¹ Incomplete exclusion found at the time of operation should be revised, likely with suture reinforcement of the site of incomplete exclusion because the removal and replacement of clip is often difficult and prone to causing LAA injury. Given the strong evidence of the benefit of LAA exclusion in patient with atrial fibrillation, and different rates of technical success based on approach to exclusion, a meticulous approach to LAA management is recommended, with complete exclusion verified with transesophageal echocardiogram in the intraoperative setting.

Tricuspid Valve Considerations. *Statement 3.8: When repairing AFMR in patients with atrial fibrillation, concomitant tricuspid valve repair should be considered for moderate or greater TR. (CoR IIa, LoE C-expert opinion).*

Atrial fibrillation is an important risk factor for the development of TR. In a large population-based cohort, nearly one-third of patients with atrial fibrillation developed moderate or greater TR over time, and the presence of TR was associated with significantly worse survival.¹¹¹ Similarly, after mitral valve repair for degenerative mitral valve disease, preoperative atrial fibrillation was independently associated with the development of late TR, even in patients with less-than-moderate TR at the time of surgery, despite concomitant surgical ablation.¹¹² After surgery for ischemic secondary MR, preoperative atrial fibrillation, even when treated with surgical atrial fibrillation ablation, was likewise strongly associated with late moderate or greater TR. Patients who developed significant late TR experienced worse clinical outcomes, including higher rates of major adverse cardiac events, worsening NYHA functional class, and more frequent heart failure hospitalizations.¹¹³

In the specific setting of AFMR, severe TR occurs in approximately 15% of patients.¹⁰ Moderate TR is similarly prevalent in AFMR, likely due to chronic atrial dilation and atrial fibrillation substrate. In a prospective cohort of 314 AFMR patients undergoing mitral valve repair and a Cox-Maze procedure, tricuspid repair was performed for moderate or greater TR and was required in 58.3% of patients. Using this strategy, the 5-year freedom from $\geq 3+$ TR was only about 50%. The development of $\geq 3+$ TR was significantly more frequent in patients with LVEF <50%, enlarged right atrial area, increased tricuspid annular diameter, and in those who did not undergo tricuspid repair at the

index operation.⁷⁴ A smaller single-center retrospective study of 40 AFMR patients who underwent surgical mitral repair (50% also undergoing a maze procedure and 78% undergoing tricuspid repair) demonstrated similar findings: 60% of patients who either did not undergo tricuspid repair or failed to restore sinus rhythm developed moderate or severe TR during mean follow-up of 42 ± 24 months.¹¹⁴

For the common clinical scenario involving mitral valve repair, tricuspid valve repair, and the biatrial maze procedure, the limited available literature suggests that the risk of permanent pacemaker implantation is approximately 11% to 15%.^{71,114} Collectively, the available data support consideration for proactive management of TR at the time of surgical treatment for AFMR in patients with atrial fibrillation, even when a concomitant surgical ablation procedure is performed.

Section 4: Transcatheter and Hybrid Interventions

Statement 4.1: Mitral TEER may be considered in select patients With AFMR deemed high-risk surgical candidates, with suitable anatomy for TEER, and after optimization of medical therapy and rhythm control, when appropriate. (CoR IIb, LoE B-nonrandomized).

Mitral TEER in AFMR is more complex than VFMR given the mechanism of MR is primarily due to annular dilatation with flat coaptation and sometimes limited mitral valve leaflet area. The Multicenter Randomized Controlled Study to Assess Mitral Valve Reconstruction for Advanced Insufficiency of Functional or Ischemic Origin (MATTERHORN) randomized trial showed noninferiority between mitral valve surgery and TEER in functional MR, including small proportion of atrial functional MR patients.¹² A recent propensity-based overlap weighting analysis involving 1081 patients (N = 441 vs 640) showed a prognostic advantage of mitral TEER over medical treatment alone with reduced all-cause death and heart failure hospitalization.¹¹ Attempts at TEER should be preceded by the institution of optimal medical therapy and attempted rhythm control. Optimal medical therapy includes the standard pillars of heart failure medications, including mainly diuretics and SGLT2i agents, when appropriate, whereas rhythm control can be medical or electrical. Several single-arm single and multicenter registries have found TEER in AFMR had similar short- and midterm outcomes in terms of mortality and MR reduction to $\leq 1+$ MR compared with VFMR.^{52,115-119} Two recent meta-analyses also confirmed the above findings, while also demonstrating favorable remodeling of the LA volume index and improvement in quality-of-life indices.^{120,121} However, in 1 study, atriogenic hamstringing (Carpentier IIb) patients had lower technical success and less sustained MR reduction, and poorer survival at 1 year compared with those with isolated

annular dilation (Carpentier Class I).¹²² Therefore, careful anatomic selection appeared important in achieving sustained success in TEER in AFMR.

Section 5: Postoperative Rhythm and Anticoagulation Management

Statement 5.1: In Patients undergoing mitral operation for AFMR and surgical ablation, it is reasonable to prescribe short-term (3-month) prophylactic antiarrhythmic drugs to prevent early recurrence of atrial fibrillation. (CoR IIa, LoE B-nonrandomized). Early postoperative atrial fibrillation is frequent after mitral surgery with concomitant surgical ablation for AFMR. These early recurrences often occur during the first 2 to 3 months, when atrial stunning, inflammation, volume shifts, and autonomic changes create a particularly arrhythmogenic milieu despite technically successful lesion sets. Short-term prophylactic antiarrhythmic drug therapy is intended to bridge this healing period, suppressing early atrial tachyarrhythmias that may otherwise promote adverse remodeling and longer-term atrial fibrillation persistence.

The strongest evidence in the surgical arena comes from randomized trial, including 90 patients undergoing surgical atrial fibrillation ablation, where a 3-month course of prophylactic amiodarone significantly reduced the composite of atrial arrhythmia recurrence, need for cardioversion or repeat ablation, or crossover to antiarrhythmic drug therapy (19% vs 52%; $P = .001$).¹²³ However, approximately 20% of trial participants underwent isolated maze procedures, and only half underwent concomitant mitral surgery. Patients with AFMR who undergo mitral valve intervention and ablation often have more extensive atrial disease, greater postoperative inflammatory burden, and abrupt changes in atrial loading after correction of MR. Thus, although informative, these data require cautious extrapolation to the AFMR population.

Additional support comes from the catheter ablation literature, which is biologically relevant to the postoperative blanking period after surgical ablation. A meta-analysis of 12 randomized trials including 3625 patients showed that short-term antiarrhythmic drug therapy (>2 months) after catheter ablation significantly reduced early atrial fibrillation recurrence compared with no antiarrhythmic drug, although it did not influence late recurrence beyond the blanking period.¹²⁴ These findings reinforce the concept that antiarrhythmic drug are most useful as temporary adjuncts to stabilize rhythm while ablation lesions mature, rather than as long-term disease-modifying therapy.

In patients with AFMR, atrial remodeling and dilation are often advanced, and the substrate for recurrent atrial fibrillation is particularly robust. Against this background, a short, protocolized 3-month course of prophylactic antiarrhythmic drug (most commonly amiodarone, with

alternatives selected based on comorbidities and QT interval) is a reasonable strategy to enhance early rhythm stability after mitral operation and surgical ablation. Careful monitoring for drug toxicity and intentional discontinuation in patients who remain in sinus rhythm are key elements of this approach.

Statement 5.2: In patients with AFMR and atrial fibrillation undergoing mitral operation and ablation, continuation of anticoagulation therapy for at least 3 months should be considered. (CoR IIa, LoE B-nonrandomized). In patients with AFMR and concomitant atrial fibrillation undergoing mitral valve surgery with surgical atrial fibrillation ablation, continuation of anticoagulation for at least 3 months is supported by both postablation perspective and mitral valve repair or replacement perspectives.

Atrial fibrillation remains a strongly prothrombotic condition, and restoration of sinus rhythm by ablation does not immediately eliminate stroke risk. The 2024 international consensus on atrial fibrillation ablation emphasizes the persistence of thromboembolic risk even after seemingly successful ablation, reflecting both early postprocedural atrial stunning and the high likelihood of transient arrhythmia recurrence during the blanking period. Thus, even after correction of the mitral lesion and concomitant atrial fibrillation ablation, a residual early risk of atrial thrombus formation exists. In respect to AFMR, data suggest that although combined mitral repair and atrial fibrillation ablation improves long-term rhythm outcomes, the early postoperative period remains vulnerable. Concomitant atrial fibrillation ablation during mitral surgery show freedom from atrial fibrillation of roughly 70% at 1 year with substantial early recurrences in some series.⁸⁷ This pattern supports maintaining systemic anticoagulation therapy through the period of atrial mechanical recovery and reverse remodeling, during which thromboembolic risk is greatest. Anticoagulation therapy in this setting is also justified by prosthesis- and repair-related considerations independent of atrial fibrillation. Consideration of at least 3 months of systemic anticoagulation after surgical mitral repair or after implantation of a mitral bioprosthesis is recommended, even in patients without another indication for oral anticoagulation, due to thrombotic risk associated with suture lines, prosthetic material, and incomplete endothelialization.^{21,125,126} These valve-related factors reinforce the need for postoperative anticoagulation in AFMR patients undergoing repair or bioprosthetic replacement.

Taken together, the persistence of early postablation thromboembolic risk, documented recurrence patterns in AFMR, and valve-related thrombotic risk all support that continuation of anticoagulation for at least 3 months should be considered after mitral surgery with atrial fibrillation ablation. Beyond this period, therapy should be individualized based on rhythm status, CHA₂DS₂-VASc score, left atrial characteristics, and

valve type. The optimal anticoagulation for higher risk patients post-catheter ablation for atrial fibrillation (OCEAN) and anticoagulation one year after ablation of atrial fibrillation in patients with atrial fibrillation (ALONE-AF) trials demonstrated the safety of aspirin monotherapy, without additional anticoagulation, in patients who were at least 1 year removed from successful catheter-based ablation.^{127,128} Although these were not surgical ablation trials, the emerging data provide useful guidance on when anticoagulation discontinuation may be considered after successful ablation.

Statement 5.3: For patients with atrial fibrillation undergoing concomitant surgical LAA exclusion, continuation of oral anticoagulation therapy should be at the discretion of the heart team with shared decision making. (CoR IIa, LoE C-limited data). The LAAOS III trial demonstrated that surgical LAA exclusion performed at the time of cardiac surgery reduces ischemic stroke or systemic embolism when added to standard therapy. A substantial proportion of participants continued guideline-directed oral anticoagulation, and the trial was neither designed nor powered to determine whether surgical LAA exclusion alone permits routine discontinuation of anticoagulation therapy. A secondary analysis of the trial suggested that the stroke-reduction benefit of LAA exclusion was directionally consistent regardless of anticoagulation use.⁹⁷ Some retrospective studies suggest that surgical LAA exclusion is associated with lower ischemic stroke rates even in individuals without a history of atrial fibrillation, although a randomized study of patients with valvular heart disease failed to demonstrate benefit at 1 year.^{129,130}

The completeness of surgical LAA exclusion is highly variable in real-world settings. Multiple studies demonstrate that incomplete exclusion, which could be frequent depending on approach, is associated with persistent LAA flow or residual stump and has been linked to higher rates of thromboembolic events.¹⁰⁴⁻¹⁰⁶ Thus, any consideration of anticoagulation cessation must incorporate confirmation of successful exclusion, typically with postprocedural imaging. Given that the net clinical benefit of discontinuing anticoagulation hinges on technical success of LAA exclusion, overall cardioembolic risk, bleeding risk, institutional and operator expertise, and patient values, a heart team-driven, individualized approach with shared decision making is warranted. At present, contemporary expert consensus statements continue to recommend the maintenance of anticoagulation in at-risk patients following surgical or percutaneous LAA exclusion, reflecting ongoing uncertainty regarding the safety of withholding systemic anticoagulation after LAA exclusion.¹³¹ Ongoing trials (eg, anticoagulation and left atrial appendage closure and left atrial appendage exclusion for prophylactic stroke reduction) are anticipated to clarify the safety and efficacy of anticoagulation therapy withdrawal after surgical LAA exclusion.^{132,133}

Section 6: Future Directions and Research Priorities

This expert consensus document acknowledges the increasing presence of AFMR in clinical practice. With increasing prevalence of atrial fibrillation and HFpEF, more patients with AFMR will undergo evaluation for treatment and intervention. A heart team approach is recommended for diagnostic and therapeutic planning with GDMT optimization before surgical or interventional therapies to treat significant symptomatic MR. Concomitant treatment of atrial fibrillation with ablation techniques and LAA exclusion is emphasized as well as for significant TR. How to manage patients with severe atrial functional TR and atrial fibrillation without significant MR is not addressed in this Consensus Statement document. These patients are infrequently referred for surgical treatment in the current era of transcatheter tricuspid valve therapies, and more data are required to form specific recommendations for this subgroup.

Advancing the treatment of AFMR requires a more standardized and prospective approach to disease characterization and management. Priority areas include the development of a unified AFMR classification that integrates atrial and annular geometry, mixed or advanced disease associated with reduced LV function, establishment of prospective registries that pair detailed imaging phenotypes with rhythm outcomes, as well as studying if adjunctive surgical repair techniques beyond annuloplasty is beneficial to longer term outcomes. Such efforts would improve patient stratification and help define predictors of durable repair and recurrent MR following rhythm-control interventions. Randomized trials comparing surgical and transcatheter strategies specifically in AFMR are needed, with end points including repair durability, rhythm control durability, and structural remodeling. Longitudinal assessment of atrial reverse remodeling after rhythm and valve intervention remains a key knowledge gap and may clarify optimal timing and modality of intervention.

Conflict of Interest Statement

See [Table E1](#). Dr Ailawadi reports consulting and speaking for Abbott, Edwards, Medtronic, Arthrex (paid to individual) and consulting to individual from Cultiv8, Anteris, Philips, and Capstan. Dr Geirsson receives consulting fees from Edwards Lifescience, Medtronic, enableCV, and Intuitive Surgical. Dr Gillinov receives consulting fees from Edwards Lifesciences, Medtronic, Abbott, ClearFlow, Artivion, AtriCure, Johnson and Johnson, Baxter, and Corcym. Dr Hahn reports speaker fees from Edwards Lifesciences, and Philips Healthcare; she has institutional consulting contracts for which she receives no direct compensation with Abbott Structural, Anteris, Boston Scientific, Edwards Lifesciences, Medtronic, Novartis and

Rob'E; she has equity with Trajectory Medical Inc. Dr Taneko is on the advisory board for Edwards, Abbott, 4C Medical, and is a speaker for Medtronic and Artivion. Dr Killu receives consulting fees from Abbott Research, Atricure, and Biosense Webster, and receives consulting fees from and serves on the advisory board of Boston Scientific and receives research support from Medtronic and has intellectual property of APT. Dr Lee has grants and contracts from AtriCure and Transmedics. Dr McCarthy receives speaking fees and royalties from Edwards Lifesciences, Atricure, serves on the advisory board for Arthrex, and is surgical primary investigator REPAIR-MR Trial for Abbott. All other authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

References

- Gertz ZM, Raina A, Saghy L, et al. Evidence of atrial functional mitral regurgitation due to atrial fibrillation: reversal with arrhythmia control. *J Am Coll Cardiol*. 2011;58(14):1474-1481. <https://doi.org/10.1016/j.jacc.2011.06.032>
- Naser JA, Michelena HI, Pelikka PA, et al. Prevalence and incidence of atrial functional mitral regurgitation and its association with mortality. *JACC Cardiovasc Imaging*. 2024;17(3):333-335. <https://doi.org/10.1016/j.jcmg.2023.09.006>
- Amabile A, Fereydooni S, Mori M, et al. Variable definitions and treatment approaches for atrial functional mitral regurgitation: a scoping review of the literature. *J Card Surg*. 2022;37(5):1182-1191. <https://doi.org/10.1111/jocs.16312>
- Moonen A, Ng MKC, Playford D, Strange G, Scalia GM, Celermajer DS. Atrial functional mitral regurgitation: prevalence, characteristics and outcomes from the National Echo Database of Australia. *Open Heart*. 2023;10(1):e002180. <https://doi.org/10.1136/openhrt-2022-002180>
- Okamoto C, Okada A, Nishimura K, et al. Prognostic comparison of atrial and ventricular functional mitral regurgitation. *Open Heart*. 2021;8(1):e001574. <https://doi.org/10.1136/openhrt-2021-001574>
- Hirji SA, Cote CL, Javadikaskari H, Malaczyn A, McGurk S, Kaneko T. Atrial functional versus ventricular functional mitral regurgitation: prognostic implications. *J Thorac Cardiovasc Surg*. 2022;164(6):1808-1815.e4. <https://doi.org/10.1016/j.jtcvs.2020.12.098>
- Mori M, Zogg CK, Amabile A, et al. Impact of secondary mitral regurgitation on survival in atrial and ventricular dysfunction. *PLoS One*. 2022;17(12):e0277385. <https://doi.org/10.1371/journal.pone.0277385>
- Otto CM, Nishimura RA, Bonow RO, et al. 2020 ACC/AHA guideline for the Management of Patients with Valvular Heart Disease: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *J Thorac Cardiovasc Surg*. 2021;162(2):e183-e353. <https://doi.org/10.1016/j.jtcvs.2021.04.002>
- Praz F, Borger MA, Lanz J, et al. 2025 ESC/EACTS guidelines for the management of valvular heart disease. *Eur Heart J*. 2025;46(44):4635-4736. <https://doi.org/10.1093/eurheartj/ehaf194>
- Kagiyama N, Kaneko T, Amano M, et al. Clinical outcomes of mitral valve surgery in atrial functional mitral regurgitation in the REVEAL-AFMR registry. *JAMA Netw Open*. 2024;7(8):e2428032. <https://doi.org/10.1001/jamanetworkopen.2024.28032>
- Kaneko T, Kagiyama N, Okazaki S, et al. Transcatheter edge-to-edge repair vs medical therapy in atrial functional mitral regurgitation: a propensity score-based comparison from the OCEAN-Mitral and REVEAL-AFMR registries. *Eur Heart J*. 2026;47:1304-1314. <https://doi.org/10.1093/eurheartj/ehaf511>
- Rudolph F, Geyer M, Baldus S, et al. Transcatheter repair versus surgery for atrial versus ventricular functional mitral regurgitation: a post hoc analysis of the MATTERHORN trial. *Circulation*. 2025;151(6):418-420. <https://doi.org/10.1161/circulationaha.124.072648>
- 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). *J Thorac Cardiovasc Surg*. 2025;169(1):170-185. <https://doi.org/10.1016/j.jtcvs.2024.07.048>
- Zoghbi WA, Levine RA, Flachskampf F, et al. Atrial functional mitral regurgitation: a JACC: Cardiovascular Imaging Expert Panel viewpoint. *JACC Cardiovasc Imaging*. 2022;15(11):1870-1882. <https://doi.org/10.1016/j.jcmg.2022.08.016>
- Koschatko S, Heitzinger G, Jantsch C, et al. Atrial functional mitral regurgitation: effect of phenotype definition on classification, valve features, and prognosis. *J Am Coll Cardiol*. 2026. <https://doi.org/10.1016/j.jacc.2026.01.057>
- Farhan S, Silbiger JJ, Halperin JL, et al. Pathophysiology, echocardiographic diagnosis, and treatment of atrial functional mitral regurgitation: JACC state-of-the-art review. *J Am Coll Cardiol*. 2022;80(24):2314-2330. <https://doi.org/10.1016/j.jacc.2022.09.046>
- Waldron C, Mori M, Krane M, et al. Implementing formal mitral heart team improves multidisciplinary evaluation rate and survival of patients with severe primary mitral regurgitation. *J Am Heart Assoc*. 2024;13(9):e033324. <https://doi.org/10.1161/jaha.123.033324>
- Welman MJM, Streukens SAF, Mephtah A, et al. Outcomes of mitral valve regurgitation management after expert multidisciplinary valve team evaluation. *J Clin Med*. 2024;13(15):4487. <https://doi.org/10.3390/jcm13154487>
- Sardari Nia P, Olsthoorn JR, Heuts S, et al. Effect of a dedicated mitral heart team compared to a general heart team on survival: a retrospective, comparative, non-randomized interventional cohort study based on prospectively registered data. *Eur J Cardiothorac Surg*. 2021;60(2):263-273. <https://doi.org/10.1093/ejcts/ezab065>
- Otto CM, Nishimura RA, Bonow RO, et al. 2020 ACC/AHA guideline for the management of patients with valvular heart disease: executive summary: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *J Am Coll Cardiol*. 2021;77(4):450-500. <https://doi.org/10.1016/j.jacc.2020.11.035>
- Praz F, Borger MA, Lanz J, et al. 2025 ESC/EACTS guidelines for the management of valvular heart disease. *Eur J Cardiothorac Surg*. 2025;67(8):ezaf276. <https://doi.org/10.1093/ejcts/ezaf276>
- Dziadzko V, Dziadzko M, Medina-Inojosa JR, et al. Causes and mechanisms of isolated mitral regurgitation in the community: clinical context and outcome. *Eur Heart J*. 2019;40(27):2194-2202. <https://doi.org/10.1093/eurheartj/ehz314>
- Sarrazyn C, Fortuni F, Laenens D, et al. Clinical and echocardiographic parameters associated with outcomes in patients with moderate secondary mitral regurgitation. *Heart*. 2024;111(1):35-42. <https://doi.org/10.1136/heartjnl-2024-324526>
- Naser JA, Michelena HI, Lin G, et al. Incidence, risk factors, and outcomes of atrial functional mitral regurgitation in patients with atrial fibrillation or sinus rhythm. *Eur Heart J Cardiovasc Imaging*. 2023;24(11):1450-1457. <https://doi.org/10.1093/ehjci/ehad199>
- Kagiyama N, Mondillo S, Yoshida K, Mandoli GE, Cameli M. Subtypes of atrial functional mitral regurgitation: imaging insights into their mechanisms and therapeutic implications. *JACC Cardiovasc Imaging*. 2020;13(3):820-835. <https://doi.org/10.1016/j.jcmg.2019.01.040>
- Deferm S, Bertrand PB, Verbrugge FH, et al. Atrial functional mitral regurgitation: JACC review topic of the week. *J Am Coll Cardiol*. 2019;73(19):2465-2476. <https://doi.org/10.1016/j.jacc.2019.02.061>
- Machino-Ohtsuka T, Seo Y, Ishizu T, et al. Novel mechanistic insights into atrial functional mitral regurgitation—3-dimensional echocardiographic study. *Circ J*. 2016;80(10):2240-2248. <https://doi.org/10.1253/circj.CJ-16-0435>
- Riccardi M, Cikes M, Adamo M, et al. Functional mitral regurgitation and heart failure with preserved ejection fraction: clinical implications and management. *J Card Fail*. 2024;30(7):929-939. <https://doi.org/10.1016/j.cardfail.2024.02.024>
- Chioncel O, Lainscak M, Seferovic PM, et al. Epidemiology and one-year outcomes in patients with chronic heart failure and preserved, mid-range and reduced ejection fraction: an analysis of the ESC Heart Failure Long-Term Registry. *Eur J Heart Fail*. 2017;19(12):1574-1585. <https://doi.org/10.1002/ehf.813>
- Kajimoto K, Sato N, Takano T. Functional mitral regurgitation at discharge and outcomes in patients hospitalized for acute decompensated heart failure with a preserved or reduced ejection fraction. *Eur J Heart Fail*. 2016;18(8):1051-1059. <https://doi.org/10.1002/ehf.562>
- Nielsen SL, Nygaard H, Mandrup L, et al. Mechanism of incomplete mitral leaflet coaptation—interaction of chordal restraint and changes in mitral leaflet coaptation

- geometry. Insight from in vitro validation of the premise of force equilibrium. *J Biomech Eng.* 2002;124(5):596-608. <https://doi.org/10.1115/1.1500741>
32. El Sabbagh A, Reddy YNV, Nishimura RA. Mitral valve regurgitation in the contemporary era: insights into diagnosis, management, and future directions. *JACC Cardiovasc Imaging.* 2018;11(4):628-643. <https://doi.org/10.1016/j.jcmg.2018.01.009>
 33. Aruta P, Muraru D, Guta AC, et al. Comparison of mitral annulus geometry between patients with ischemic and non-ischemic functional mitral regurgitation: implications for transcatheter mitral valve implantation. *Cardiovasc Ultrasound.* 2018;16(1):27. <https://doi.org/10.1186/s12947-018-0145-8>
 34. Zoghbi WA, Adams D, Bonow RO, et al. Recommendations for noninvasive evaluation of native valvular regurgitation: a report from the American Society of Echocardiography developed in collaboration with the Society for Cardiovascular Magnetic Resonance. *J Am Soc Echocardiogr.* 2017;30(4):303-371. <https://doi.org/10.1016/j.echo.2017.01.007>
 35. Lancellotti P, Pibarot P, Chambers J, et al. Multi-modality imaging assessment of native valvular regurgitation: an EACVI and ESC council of valvular heart disease position paper. *Eur Heart J Cardiovasc Imaging.* 2022;23(5):e171-e232. <https://doi.org/10.1093/ehjci/jeab253>
 36. Chinitz JS, Chen D, Goyal P, et al. Mitral apparatus assessment by delayed enhancement CMR: relative impact of infarct distribution on mitral regurgitation. *JACC Cardiovasc Imaging.* 2013;6(2):220-234. <https://doi.org/10.1016/j.jcmg.2012.08.016>
 37. Lopes BBC, Kwon DH, Shah DJ, et al. Importance of myocardial fibrosis in functional mitral regurgitation: from outcomes to decision-making. *JACC Cardiovasc Imaging.* 2021;14(4):867-878. <https://doi.org/10.1016/j.jcmg.2020.10.027>
 38. Dhont S, Deferm S, Bertrand PB, Vandervoort PM. Atrial functional mitral regurgitation: definition, mechanisms, and treatment perspectives. *Curr Cardiol Rep.* 2025;27(1):16. <https://doi.org/10.1007/s11886-024-02188-2>
 39. Iliakis P, Dimitriadis K, Pырpyris N, et al. Atrial functional mitral regurgitation: from diagnosis to current interventional therapies. *J Clin Med.* 2024;13(17):5035. <https://doi.org/10.3390/jcm13175035>
 40. Carabello BA. The management of functional mitral regurgitation. *Curr Cardiol Rep.* 2007;9(2):112-117. <https://doi.org/10.1007/bf02938337>
 41. Anker SD, Butler J, Usman MS, et al. Efficacy of empagliflozin in heart failure with preserved versus mid-range ejection fraction: a pre-specified analysis of EMPEROR-preserved. *Nat Med.* 2022;28(12):2512-2520. <https://doi.org/10.1038/s41591-022-02041-5>
 42. Solomon SD, McMurray JJV, Claggett B, et al. Dapagliflozin in heart failure with mildly reduced or preserved ejection fraction. *N Engl J Med.* 2022;387(12):1089-1098. <https://doi.org/10.1056/NEJMoa2206286>
 43. Vaduganathan M, Docherty KF, Claggett BL, et al. SGLT-2 inhibitors in patients with heart failure: a comprehensive meta-analysis of five randomised controlled trials. *Lancet.* 2022;400(10354):757-767. [https://doi.org/10.1016/s0140-6736\(22\)01429-5](https://doi.org/10.1016/s0140-6736(22)01429-5)
 44. Vandervoort PM, Deferm S. The course of atrial functional mitral regurgitation: the atrium dictates the path. *J Am Coll Cardiol.* 2024;83(16):1508-1510. <https://doi.org/10.1016/j.jacc.2024.03.357>
 45. Hirose K, Nakanishi K, Daimon M, et al. Association of atrial fibrillation progression with left atrial functional reserve and its reversibility. *J Am Heart Assoc.* 2024;13(1):e032215. <https://doi.org/10.1161/jaha.123.032215>
 46. Mohsen Y, Rottländer D, Großmann N, Lewandowski N, Horlitz M, Stöckigt F. Unraveling the interplay: early-stage atrial functional mitral regurgitation and left atrial electrical substrate in atrial fibrillation patients. *Front Cardiovasc Med.* 2024;11:1382570. <https://doi.org/10.3389/fcvm.2024.1382570>
 47. Wagner CM, Brescia AA, Watt TMF, et al. Surgical strategy and outcomes for atrial functional mitral regurgitation: all functional mitral regurgitation is not the same. *J Thorac Cardiovasc Surg.* 2024;167(2):647-655. <https://doi.org/10.1016/j.jtcvs.2022.02.056>
 48. Ito K, Abe Y, Watanabe H, et al. Prognostic significance of residual functional mitral regurgitation in hospitalized heart failure patients with chronic atrial fibrillation and preserved ejection fraction after medical therapies. *J Echocardiogr.* 2019;17(4):197-205. <https://doi.org/10.1007/s12574-018-0412-6>
 49. Takahashi Y, Abe Y, Sasaki Y, et al. Mitral valve repair for atrial functional mitral regurgitation in patients with chronic atrial fibrillation. *Interact Cardiovasc Thorac Surg.* 2015;21(2):163-168. <https://doi.org/10.1093/icvts/ivv119>
 50. Sideris K, Burri M, Mayr A, et al. Functional mitral valve regurgitation: mitral valve repair or replacement? Our "Road Map" for the appropriate strategy. *J Clin Med.* 2024;13(11):3264. <https://doi.org/10.3390/jcm13113264>
 51. Tanaka T, Sugiura A, Öztürk C, et al. Transcatheter edge-to-edge repair for atrial secondary mitral regurgitation. *JACC Cardiovasc Interv.* 2022;15(17):1731-1740. <https://doi.org/10.1016/j.jcin.2022.06.005>
 52. Doldi P, Stolz L, Orban M, et al. Transcatheter mitral valve repair in patients with atrial functional mitral regurgitation. *JACC Cardiovasc Imaging.* 2022;15(11):1843-1851. <https://doi.org/10.1016/j.jcmg.2022.05.009>
 53. Benito-González T, Carrasco-Chinchilla F, Estévez-Loureiro R, et al. Clinical and echocardiographic outcomes of transcatheter mitral valve repair in atrial functional mitral regurgitation. *Int J Cardiol.* 2021;345:29-35. <https://doi.org/10.1016/j.ijcard.2021.09.056>
 54. von Stein P, Stolz L, Haurand JM, et al. Transcatheter edge-to-edge repair for atrial and ventricular secondary mitral regurgitation: insights from the REPAIR Study. *JACC Cardiovasc Interv.* 2025;18(16):2020-2032. <https://doi.org/10.1016/j.jcin.2025.05.031>
 55. Kang DH, Park SJ, Shin SH, et al. Ertugliflozin for functional mitral regurgitation associated with heart failure: EFFORT trial. *Circulation.* 2024;149(24):1865-1874. <https://doi.org/10.1161/circulationaha.124.069144>
 56. Soulat-Dufour L, Lang S, Addetia K, et al. Restoring sinus rhythm reverses cardiac remodeling and reduces valvular regurgitation in patients with atrial fibrillation. *J Am Coll Cardiol.* 2022;79(10):951-961. <https://doi.org/10.1016/j.jacc.2021.12.029>
 57. Okazaki RA, Flashner LC, Kinlay S, et al. Catheter ablation for atrial fibrillation in patients with significant mitral regurgitation: a systematic review and meta-analysis. *Heart Rhythm.* 2025;22(3):637-646. <https://doi.org/10.1016/j.hrthm.2024.07.110>
 58. Dhont S, Bertrand PB, Erzeel J, et al. The interaction between atrial fibrillation and mitral regurgitation: insights from the CABANA randomized clinical trial. *Eur J Heart Fail.* 2025;27(8):1500-1507. <https://doi.org/10.1002/ehj.3668>
 59. Heidenreich PA, Bozkurt B, Aguilar D, et al. 2022 AHA/ACC/HFSA guideline for the management of heart failure: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *J Am Coll Cardiol.* 2022;79(17):e263-e421. <https://doi.org/10.1016/j.jacc.2021.12.012>
 60. Anker SD, Butler J, Filippatos G, et al. Empagliflozin in heart failure with a preserved ejection fraction. *N Engl J Med.* 2021;385(16):1451-1461. <https://doi.org/10.1056/NEJMoa2107038>
 61. Packer M, Butler J, Zannad F, et al. Effect of empagliflozin on worsening heart failure events in patients with heart failure and preserved ejection fraction: EMPEROR-preserved trial. *Circulation.* 2021;144(16):1284-1294. <https://doi.org/10.1161/circulationaha.121.056824>
 62. Kim K, Kitai T, Kaji S, et al. Outcomes and predictors of cardiac events in medically treated patients with atrial functional mitral regurgitation. *Int J Cardiol.* 2020;316:195-202. <https://doi.org/10.1016/j.ijcard.2020.06.042>
 63. Kagami K, Kagiama N, Kaneko T, et al. Heart failure with preserved ejection fraction in atrial functional mitral regurgitation - insight from the REVEAL-AFMR. *Int J Cardiol.* 2025;422:132958. <https://doi.org/10.1016/j.ijcard.2025.132958>
 64. Kang DH, Park SJ, Shin SH, et al. Angiotensin receptor neprilysin inhibitor for functional mitral regurgitation. *Circulation.* 2019;139(11):1354-1365. <https://doi.org/10.1161/circulationaha.118.037077>
 65. Primessnig U, Deißler PM, Wakula P, et al. Effects of BNP and sacubitril/valsartan on atrial functional reserve and arrhythmogenesis in human myocardium. *Front Cardiovasc Med.* 2022;9:859014. <https://doi.org/10.3389/fcvm.2022.859014>
 66. Kirchhof P, Camm AJ, Goette A, et al. Early rhythm-control therapy in patients with atrial fibrillation. *N Engl J Med.* 2020;383(14):1305-1316. <https://doi.org/10.1056/NEJMoa2019422>
 67. Masuda M, Sekiya K, Asai M, et al. Influence of catheter ablation for atrial fibrillation on atrial and ventricular functional mitral regurgitation. *ESC Heart Fail.* 2022;9(3):1901-1913. <https://doi.org/10.1002/ehf2.13896>
 68. Ausbuettel F, Schuett H, Mueller HH, et al. Atrial fibrillation first? Investigating rhythm control in de novo high-grade functional mitral regurgitation and atrial fibrillation. *Clin Res Cardiol.* 2025. <https://doi.org/10.1007/s00392-025-02656-x>
 69. Gertz ZM, Raina A, Mountantonakis SE, et al. The impact of mitral regurgitation on patients undergoing catheter ablation of atrial fibrillation. *Europace.* 2011;13(8):1127-1132. <https://doi.org/10.1093/europace/eur098>
 70. Pyeate SR, Rahimi M, Braasch MC, et al. Outcomes of mitral valve surgery for atrial functional mitral regurgitation vs ventricular functional mitral regurgitation. *Eur J Cardiothorac Surg.* 2025;67(10):eaf319. <https://doi.org/10.1093/ejcts/ezaf319>
 71. Song K, Lee JH, Woo HT, et al. Surgical outcome of mitral valve surgery in atrial functional mitral regurgitation compared with degenerative etiology. *J*

- Thorac Cardiovasc Surg.* 2025;169(5):1471-1482.e4. <https://doi.org/10.1016/j.jtcvs.2024.06.002>
72. Bakir NH, Bernabei A, Burns DJP, et al. Durability of annuloplasty in patients with atrial functional mitral regurgitation associated with atrial fibrillation. *J Thorac Cardiovasc Surg.* 2025;170(1):177-186.e3. <https://doi.org/10.1016/j.jtcvs.2024.08.029>
 73. Shin JH, Lee SH, Joo HC, Youn YN, Kim JH, Lee S. Long-term outcomes of mitral valve repair for atrial functional mitral regurgitation. *Ann Thorac Surg.* 2025;120(1):71-78. <https://doi.org/10.1016/j.athoracsur.2024.09.001>
 74. Ye Q, Zhao Y, Bai C, et al. Outcome of mitral repair combined with Cox-maze procedure for atrial functional mitral regurgitation with heart failure with recovered ejection fraction. *Eur J Cardiothorac Surg.* 2023;64(2):ezad273. <https://doi.org/10.1093/ejcts/ezad273>
 75. Kawamoto N, Fukushima S, Kainuma S, et al. Mitral valve surgery for atrial functional mitral regurgitation: predicting recurrent mitral regurgitation and mid-term outcome. *Gen Thorac Cardiovasc Surg.* 2022;70(9):761-769. <https://doi.org/10.1007/s11748-022-01793-8>
 76. Song K, Jang WS, Kim YS, Yoo J. Outcomes of maze procedure and mitral valve surgery in atrial functional mitral regurgitation: a retrospective study. *J Cardiothorac Surg.* 2024;19(1):433. <https://doi.org/10.1186/s13019-024-02858-w>
 77. Sakaguchi T, Totsugawa T, Orihashi K, et al. Mitral annuloplasty for atrial functional mitral regurgitation in patients with chronic atrial fibrillation. *J Card Surg.* 2019;34(9):767-773. <https://doi.org/10.1111/jocs.14136>
 78. Fan X, Tang Y, Ma Y, et al. Mitral valve repair and concomitant maze procedure versus catheter ablation in the treatment of atrial functional mitral regurgitation. *BMC Cardiovasc Disord.* 2022;22(1):543. <https://doi.org/10.1186/s12872-022-02972-4>
 79. Gammie JS, Chu MWA, Falk V, et al. Concomitant tricuspid repair in patients with degenerative mitral regurgitation. *N Engl J Med.* 2022;386(4):327-339. <https://doi.org/10.1056/NEJMoa2115961>
 80. Ragnarsson S, Taha A, Nielsen SJ, et al. Pacemaker implantation following tricuspid valve annuloplasty. *JTCVS Open.* 2023;16:276-289. <https://doi.org/10.1016/j.xjon.2023.08.017>
 81. Iribarne A, Alabbadi SH, Moskowitz AJ, et al. Permanent pacemaker implantation and long-term outcomes of patients undergoing concomitant mitral and tricuspid valve surgery. *J Am Coll Cardiol.* 2024;83(17):1656-1668. <https://doi.org/10.1016/j.jacc.2024.02.042>
 82. Badhwar V, Chikwe J, Gillinov AM, et al. Risk of surgical mitral valve repair for primary mitral regurgitation. *J Am Coll Cardiol.* 2023;81(7):636-648. <https://doi.org/10.1016/j.jacc.2022.11.017>
 83. Gillinov AM, Blackstone EH, Cosgrove DM 3rd, et al. Mitral valve repair with aortic valve replacement is superior to double valve replacement. *J Thorac Cardiovasc Surg.* 2003;125(6):1372-1387. [https://doi.org/10.1016/s0022-5223\(02\)73225-x](https://doi.org/10.1016/s0022-5223(02)73225-x)
 84. Nombela-Franco L, Ribeiro HB, Urena M, et al. Significant mitral regurgitation left untreated at the time of aortic valve replacement: a comprehensive review of a frequent entity in the transcatheter aortic valve replacement era. *J Am Coll Cardiol.* 2014;63(24):2643-2658. <https://doi.org/10.1016/j.jacc.2014.02.573>
 85. Deja MA, Grayburn PA, Sun B, et al. Influence of mitral regurgitation repair on survival in the surgical treatment for ischemic heart failure trial. *Circulation.* 2012;125(21):2639-2648. <https://doi.org/10.1161/circulationaha.111.072256>
 86. Samad Z, Shaw LK, Phelan M, et al. Management and outcomes in patients with moderate or severe functional mitral regurgitation and severe left ventricular dysfunction. *Eur Heart J.* 2015;36(40):2733-2741. <https://doi.org/10.1093/eurheartj/ehv343>
 87. Gillinov AM, Gelijns AC, Parides MK, et al. Surgical ablation of atrial fibrillation during mitral-valve surgery. *N Engl J Med.* 2015;372(15):1399-1409. <https://doi.org/10.1056/NEJMoa1500528>
 88. Lee R, McCarthy PM, Wang EC, et al. Midterm survival in patients treated for atrial fibrillation: a propensity-matched comparison to patients without a history of atrial fibrillation; 2012. *J Thorac Cardiovasc Surg.* 2012;143(6):1341-1351; discussion 1350-1341. <https://doi.org/10.1016/j.jtcvs.2012.02.006>
 89. Kim K, Kim HJ, Jung SH, Lee J, Kim JB. Functional insufficiency of mitral and tricuspid valves associated with atrial fibrillation: impact of postoperative atrial fibrillation recurrence on surgical outcomes. *Korean Circ J.* 2023;53(8):550-562. <https://doi.org/10.4070/kcj.2022.0355>
 90. Ad N, Henry L, Friehling T, Wish M, Holmes SD. Minimally invasive stand-alone Cox-maze procedure for patients with nonparoxysmal atrial fibrillation; 2013. *Ann Thorac Surg.* 2013;96(3):792-798; discussion 798-799. <https://doi.org/10.1016/j.athoracsur.2013.05.007>
 91. 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(36):3314-3414. <https://doi.org/10.1093/eurheartj/ehae176>
 92. Blackstone EH, Chang HL, Rajeswaran J, et al. Biatlial maze procedure versus pulmonary vein isolation for atrial fibrillation during mitral valve surgery: new analytical approaches and end points. *J Thorac Cardiovasc Surg.* 2019;157(1):234-243.e9. <https://doi.org/10.1016/j.jtcvs.2018.06.093>
 93. Cappabianca G, Ferrarese S, Tutino C, et al. Safety and efficacy of biatrial vs left atrial surgical ablation during concomitant cardiac surgery: a meta-analysis of clinical studies with a focus on the causes of pacemaker implantation. *J Cardiovasc Electrophysiol.* 2019;30(10):2150-2163. <https://doi.org/10.1111/jce.14117>
 94. Churyla A, Idrissi A, Andrei AC, et al. Biatlial or left atrial lesion set for ablation during mitral surgery: risks and benefits. *Ann Thorac Surg.* 2017;103(6):1858-1865. <https://doi.org/10.1016/j.athoracsur.2016.10.017>
 95. Ad N, Holmes SD, Lamont D, Shuman DJ. Left-sided surgical ablation for patients with atrial fibrillation who are undergoing concomitant cardiac surgical procedures. *Ann Thorac Surg.* 2017;103(1):58-65. <https://doi.org/10.1016/j.athoracsur.2016.05.093>
 96. McCarthy PM. The maze IV operation is not always the best choice: matching the procedure to the patient. *JTCVS Tech.* 2023;17:79-83. <https://doi.org/10.1016/j.xjtc.2021.06.031>
 97. 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(22):2081-2091. <https://doi.org/10.1056/NEJMoa2101897>
 98. Friedman DJ, Piccini JP, Wang T, et al. Association between left atrial appendage occlusion and readmission for thromboembolism among patients with atrial fibrillation undergoing concomitant cardiac surgery. *JAMA.* 2018;319(4):365-374. <https://doi.org/10.1001/jama.2017.20125>
 99. Martín Gutiérrez E, Castaño M, Gualis J, et al. Beneficial effect of left atrial appendage closure during cardiac surgery: a meta-analysis of 280 585 patients. *Eur J Cardiothorac Surg.* 2020;57(2):252-262. <https://doi.org/10.1093/ejcts/ezz289>
 100. Connolly SJ, Healey JS, Belley-Cote EP, et al. Oral anticoagulation use and left atrial appendage occlusion in LAAOS III. *Circulation.* 2023;148(17):1298-1304. <https://doi.org/10.1161/circulationaha.122.060315>
 101. 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(1):e1-e156. <https://doi.org/10.1161/cir.0000000000001193>
 102. Tzeis S, Gerstenfeld EP, Kalman J, et al. 2024 European Heart Rhythm Association/Heart Rhythm Society/Asia Pacific Heart Rhythm Society/Latin American Heart Rhythm Society expert consensus statement on catheter and surgical ablation of atrial fibrillation. *Heart Rhythm.* 2024;21(9):e31-e149. <https://doi.org/10.1016/j.hrthm.2024.03.017>
 103. Wyler von Ballmoos MC, Hui DS, Mehaffey JH, et al. The Society of Thoracic Surgeons 2023 clinical practice guidelines for the surgical treatment of atrial fibrillation. *Ann Thorac Surg.* 2024;118(2):291-310. <https://doi.org/10.1016/j.athoracsur.2024.01.007>
 104. Kanderian AS, Gillinov AM, Pettersson GB, Blackstone E, Klein AL. Success of surgical left atrial appendage closure: assessment by transesophageal echocardiography. *J Am Coll Cardiol.* 2008;52(11):924-929. <https://doi.org/10.1016/j.jacc.2008.03.067>
 105. Aryana A, Singh SK, Singh SM, et al. Association between incomplete surgical ligation of left atrial appendage and stroke and systemic embolization. *Heart Rhythm.* 2015;12(7):1431-1437. <https://doi.org/10.1016/j.hrthm.2015.03.028>
 106. Güner A, Kalçık M, Gündüz S, et al. The relationship between incomplete surgical obliteration of the left atrial appendage and thromboembolic events after mitral valve surgery (from the ISOLATE Registry). *J Thromb Thrombolysis.* 2021;51(4):1078-1089. <https://doi.org/10.1007/s11239-020-02291-5>
 107. Ailawadi G, Gerdtsch MW, Harvey RL, et al. Exclusion of the left atrial appendage with a novel device: early results of a multicenter trial; 2011. *J Thorac Cardiovasc Surg.* 2011;142(5):1002-1009, 1009.e1. <https://doi.org/10.1016/j.jtcvs.2011.07.052>
 108. Petersen J, Böning H, Yildirim S, et al. Efficacy of four different left atrial appendage closure techniques during cardiac surgery-A transesophageal echocardiography follow-up study. *JTCVS Tech.* 2024;26:43-49. <https://doi.org/10.1016/j.xjtc.2024.05.007>

109. van Laar C, Verberkmoes NJ, van Es HW, et al. Thoracoscopic left atrial appendage clipping: a multicenter cohort analysis. *JACC Clin Electrophysiol.* 2018;4(7):893-901. <https://doi.org/10.1016/j.jacep.2018.03.009>
110. Lim SK, Kim CH, Choi KH, et al. A comparative study of thoracoscopic left atrial appendage clipping vs stapled resection. *Ann Thorac Surg.* 2024;117(6):1230-1236. <https://doi.org/10.1016/j.athoracsur.2023.09.010>
111. Patlolla SH, Schaff HV, Nishimura RA, et al. Incidence and burden of tricuspid regurgitation in patients with atrial fibrillation. *J Am Coll Cardiol.* 2022;80(24):2289-2298. <https://doi.org/10.1016/j.jacc.2022.09.045>
112. McCarthy PM, Szlapka M, Kruse J, et al. The relationship of atrial fibrillation after surgery for ischemic mitral regurgitation in patients with degenerative mitral repair. *J Thorac Cardiovasc Surg.* 2021;161(6):2030-2040.e3. <https://doi.org/10.1016/j.jtcvs.2019.11.098>
113. Bertrand PB, Overbey JR, Zeng X, et al. Progression of tricuspid regurgitation after surgery for ischemic mitral regurgitation. *J Am Coll Cardiol.* 2021;77(6):713-724. <https://doi.org/10.1016/j.jacc.2020.11.066>
114. Kaneyuki D, Nakajima H, Asakura T, et al. Midterm results of mitral valve repair for atrial functional mitral regurgitation: a retrospective study. *J Cardio-thorac Surg.* 2020;15(1):312. <https://doi.org/10.1186/s13019-020-01362-1>
115. Popolo Rubbio A, Testa L, Grasso C, et al. Transcatheter edge-to-edge mitral valve repair in atrial functional mitral regurgitation: insights from the multicenter MITRA-TUNE registry. *Int J Cardiol.* 2022;349:39-45. <https://doi.org/10.1016/j.ijcard.2021.11.027>
116. Masiero G, Montonati C, Rubbio AP, et al. Impact of transcatheter edge-to-edge mitral valve repair on atrial functional mitral regurgitation from the GIOTTO registry. *Am J Cardiol.* 2024;211:219-227. <https://doi.org/10.1016/j.amjcard.2023.11.007>
117. Rotländer D, Hausleiter J, Schmitz T, et al. Impact of residual mitral regurgitation after transcatheter edge-to-edge repair in atrial functional mitral regurgitation: results from MITRA-PRO registry. *Catheter Cardiovasc Interv.* 2024;104(5):1015-1026. <https://doi.org/10.1002/ccd.31242>
118. Sodhi N, Asch FM, Ruf T, et al. Clinical outcomes with transcatheter edge-to-edge repair in atrial functional MR from the EXPAND study. *JACC Cardiovasc Interv.* 2022;15(17):1723-1730. <https://doi.org/10.1016/j.jcin.2022.07.023>
119. Tanaka T, Sugiura A, Vogelhuber J, et al. Outcomes of transcatheter edge-to-edge repair for atrial functional mitral regurgitation. *EuroIntervention.* 2024;20(4):e250-e260. <https://doi.org/10.4244/eij-d-23-00819>
120. Moras E, Gandhi K, Koshy AN, et al. Mitral transcatheter edge-to-edge repair in patients with atrial functional mitral regurgitation. *J Am Coll Cardiol.* 2024;83(13):1253-1255. <https://doi.org/10.1016/j.jacc.2024.01.031>
121. Hatab T, Khan SU, Arshad HB, et al. Meta-analysis of transcatheter edge-to-edge repair for atrial functional mitral regurgitation. *J Soc Cardiovasc Angiogr Interv.* 2023;2(5):101050. <https://doi.org/10.1016/j.jscv.2023.101050>
122. von Stein P, von Stein J, Hohmann C, et al. Atrial functional mitral regurgitation subtypes undergoing transcatheter edge-to-edge repair: suboptimal outcomes in atrigenic hamstringing. *JACC Cardiovasc Imaging.* 2025;18(1):16-29. <https://doi.org/10.1016/j.jcmg.2024.06.019>
123. Ad N, Holmes SD, Shuman DJ, Pritchard G, Miller CE. Amiodarone after surgical ablation for atrial fibrillation: is it really necessary? A prospective randomized controlled trial. *J Thorac Cardiovasc Surg.* 2016;151(3):798-803. <https://doi.org/10.1016/j.jtcvs.2015.07.034>
124. Chen G, Li G, Zhang D, Wang X, Guo X. Blanking period antiarrhythmic drugs after catheter ablation for atrial fibrillation: a meta-analysis of randomized controlled trials. *Front Cardiovasc Med.* 2023;10:1071950. <https://doi.org/10.3389/fcvm.2023.1071950>
125. Russo A, Grigioni F, Avierinos JF, et al. Thromboembolic complications after surgical correction of mitral regurgitation incidence, predictors, and clinical implications. *J Am Coll Cardiol.* 2008;51(12):1203-1211. <https://doi.org/10.1016/j.jacc.2007.10.058>
126. Heras M, Chesebrough JH, Fuster V, et al. High risk of thromboemboli early after bioprosthetic cardiac valve replacement. *J Am Coll Cardiol.* 1995;25(5):1111-1119. [https://doi.org/10.1016/0735-1097\(94\)00563-6](https://doi.org/10.1016/0735-1097(94)00563-6)
127. Verma A, Birnie DH, Jiang C, et al. Antithrombotic therapy after successful catheter ablation for atrial fibrillation. *N Engl J Med.* 2026;394:323-332. <https://doi.org/10.1056/NEJMoa2509688>
128. Kim D, Shim J, Choi EK, et al. Long-term anticoagulation discontinuation after catheter ablation for atrial fibrillation: the ALONE-AF randomized clinical trial. *JAMA.* 2025;334(14):1246-1254. <https://doi.org/10.1001/jama.2025.14679>
129. McCarthy PM, Mehran R, Gerdisch M, et al. Left atrial appendage exclusion during open cardiac surgery in patients without atrial fibrillation reduces 4-year ischemic stroke and mortality. *JTCVS Struct Endovascular.* 2024;4. <https://doi.org/10.1016/j.xjse.2024.100032>
130. Yuan X, Ju F, Wu H, et al. Surgical left atrial appendage occlusion in valvular heart disease without atrial fibrillation: the OPINION trial. *Eur Heart J.* 2025. <https://doi.org/10.1093/eurheartj/ehaf674>
131. Saw J, Holmes DR, Cavalcante JL, et al. SCAI/HRS expert consensus statement on transcatheter left atrial appendage closure. *JACC Cardiovasc Interv.* 2023;16(11):1384-1400. <https://doi.org/10.1016/j.jcin.2023.01.011>
132. Gosvig K, Goller J, Hansson NH, et al. Rationale and design of the anticoagulant therapy after left atrial appendage closure (ATLAAC) trial. *Am Heart J.* 2025;287:86-93. <https://doi.org/10.1016/j.ahj.2025.04.015>
133. 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. <https://doi.org/10.1016/j.ahj.2024.10.006>

Key Words: atrial functional mitral regurgitation, mitral valve repair, transcatheter edge-to-edge repair, management

APPENDIX E1

TABLE E1. Author relationships with industry and other entities

Writing group member	Primary affiliation	Location	All entities with whom the author may have the indicated relationships, and if payments were made to the author or institution
Gorav Ailawadi, MD, MBA	University of Michigan, Department of Cardiac Surgery	Ann Arbor, Mich	Abbott, Edwards, Medtronic, Arthrex (consulting and speaking, paid to individual) Cultiv8, Anteris, Philips, Capstan (consulting to individual)
Steven F. Bolling	University of Michigan	Ann Arbor, Mich	
Arnar Geirsson	Columbia University Vagelos College of Physicians and Surgeons, Department of Surgery, Division of Cardiac Surgery	New York, NY	Edwards Lifescience, Medtronic, enableCV and Intuitive Surgical
Marc Gillinov	Department of Thoracic and Cardiovascular Surgery, Cleveland Clinic	Cleveland, Ohio	Edwards Lifesciences, Medtronic, Abbott, ClearFlow, Artivion, AtriCure, Johnson and Johnson, Baxter, Corcym
Rebecca T. Hahn, MD, FACC	Department of Medicine, Columbia University Irving Medical Center	New York, NY	Speaker fees from Edwards Lifesciences, and Philips Healthcare; institutional consulting contracts for which she receives no direct compensation with Abbott Structural, Anteris, Boston Scientific, Edwards Lifesciences, Medtronic, Novartis and Rob'E; equity with Trajectory Medical Inc.
Tsuyoshi Kaneko, MD	Division of Cardiothoracic Surgery, Washington University in St. Louis	St Louis, Mo	Edwards, Abbott, 4C Medical (advisory board), Medtronic, Artivion (speaker)
Ammar M. Killu, MBBS FHRS	Mayo Clinic, Department of Cardiovascular Medicine, Division of Heart Rhythm Services	Rochester, Minn	Abbott (research, consulting [money to myself and institution]) Atricure (speaker, consulting [money to institution]) Biosense Webster (consulting [money to institution]), Boston Scientific (speaker, consulting, advisory board [money to institution]), Medtronic (research [money to institution]), APT (intellectual property [no royalties/payments])
Anson M. Lee, MD	Department of Cardiothoracic Surgery, Stanford University	Stanford, Calif	AtriCure, Transmedics
Patrick M. McCarthy	Division of Cardiac Surgery, Northwestern University Feinberg School of Medicine and Northwestern Medicine Bluhm Cardiovascular Institute	Chicago, Ill	Edwards Lifesciences (speaking fees and royalties), Atricure (speaking fees), Arthrex (advisory board), Genesee (royalties), Abbott (surgical primary investigator REPAIR-MR Trial [unpaid], advisory board)
Stephanie L. Mick, MD	Weill Cornell Medicine	New York, NY	Johnson and Johnson, Medtronic, Artivion
Makoto Mori, MD PhD	Yale School of Medicine, Division of Cardiac Surgery	New Haven, Conn	None
Fabien Praz, MD	Department of Cardiology, Bern University Hospital, Inselspital, University of Bern	Bern, Switzerland	Fabien Praz has received a research grant to the institution from Abbott Vascular and has been compensated for travel expenses by Abbott Vascular, Edwards Lifesciences, Medira, Siemens Healthineers, and InQB8 Medical Technologies. He has received speaker fees to the institution from Abbott Vascular and Edwards Lifesciences

(Continued)

TABLE E1. Continued

Writing group member		Primary affiliation	Location	All entities with whom the author may have the indicated relationships, and if payments were made to the author or institution				
Gilbert Tang		Department of Cardiovascular Surgery, Mount Sinai Health System	New York, NY	Dr Tang has received speaker's honoraria and served as a physician proctor, consultant, advisory board member, TAVR publications committee member, RESTORE study steering and screening committee member, APOLLO trial screening committee member and IMPACT MR steering committee member for Medtronic, has received speaker's honoraria and served as a physician proctor, consultant, advisory board member, ENVISION trial screening committee member, and TRILUMINATE trial anatomic eligibility and publications committee member for Abbott Structural Heart, has served as an advisory board member for Boston Scientific, a consultant for Shockwave Medical, Anteris, Philips, Edwards Lifesciences, Peija Medical and Shenqi Medical Technology, and has received speaker's honoraria from Siemens Healthineers.				
Writing group member	Grants or contracts	Royalties or licenses	Consulting fees	Payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing or educational events	Payment for expert testimony	Support for attending meetings and/or travel	Participation on a data safety monitoring board or advisory board	Leadership or fiduciary role in other board, society, committee or advocacy group Paid or unpaid
Gorav Ailawadi, MD, MBA			x	x				
Steven F Bolling								
Arnar Geirsson			x					
Marc Gillinov			x					
Rebecca T. Hahn, MD, FACC			x	x				
Tsuyoshi Kaneko, MD				x				x
Ammar M. Killu, MBBS FHRS	x		x	x		x	x	x
Anson M. Lee, MD	x							
Patrick M. McCarthy		x		x			x	

(Continued)

TABLE E1. Continued

Writing group member	Grants or contracts	Royalties or licenses	Consulting fees	Payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing or educational events	Payment for expert testimony	Support for attending meetings and/or travel	Participation on a data safety monitoring board or advisory board	Leadership or fiduciary role in other board, society, committee or advocacy group Paid or unpaid
Stephanie L. Mick, MD			x					
Makoto Mori MD PhD								
Fabien Praz, MD	x			x		x	x	
Gilbert Tang			x	x				