PCR
MITRAL
Focus Group

Mitral Valve Regurgitation

From Assessment to Referral

#PCRMitralFocusGroup

For more information about the PCR Mitral Focus Group

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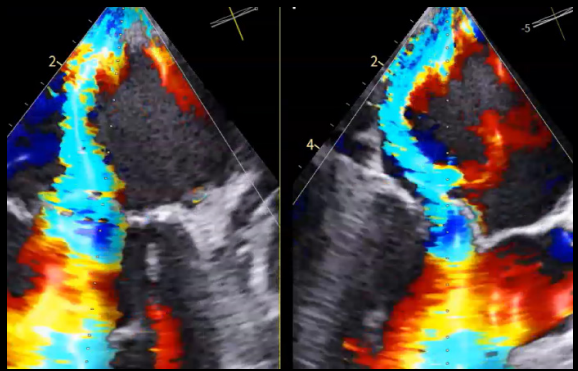
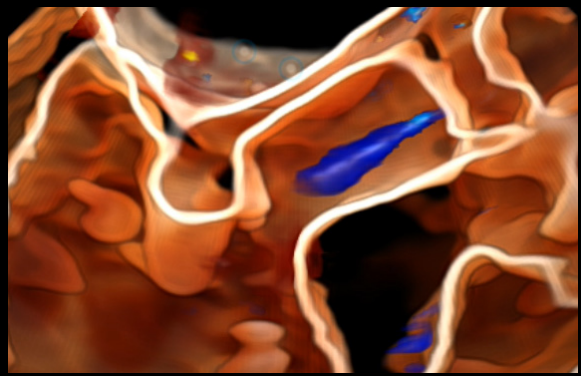




Introduction

Why MR matters: prevalence, prognosis, and treatment opportunities

Why MR Matters

- Common and progressive valve disease
- Often under-recognized
- Timing of referral determines outcome
- Long asymptomatic phase
- Irreversible remodeling if late
- Early referral improves prognosis

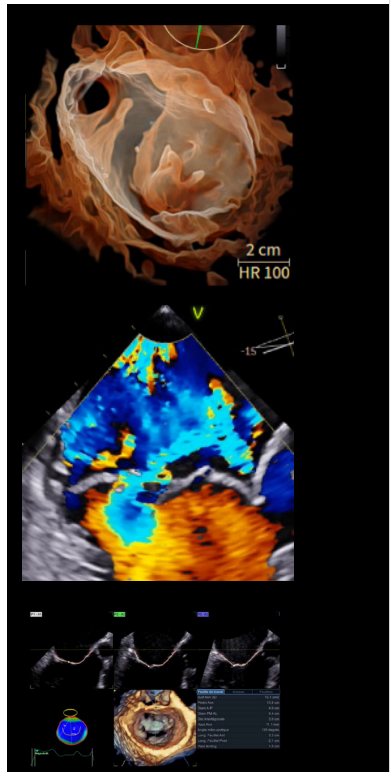
Role of Imaging

- Confirms severity
- Defines mechanism
- Assesses consequences
- Guides intervention timing

ESC Core Principles

- Multiparametric grading mandatory
- Mechanism-driven management

Heart-Team decision



Anatomic 4D zoom, precise color doppler assessement and quantitative tools are required

Mitral regurgitation severity is a powerful, graded predictor of survival. Even mild MR is associated with reduced long-term survival, with stepwise worsening from mild to severe MR for both all-cause and cardiovascular mortality. These data emphasize that MR is not benign and support early recognition, close follow-up, and timely intervention before advanced disease stages.

Key Messages

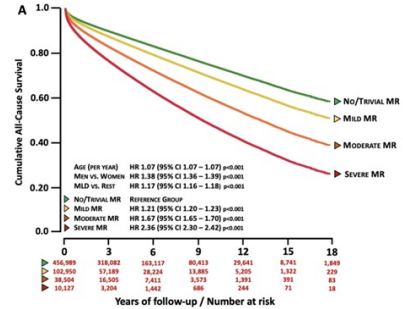
- MR progressive
- Timing critical

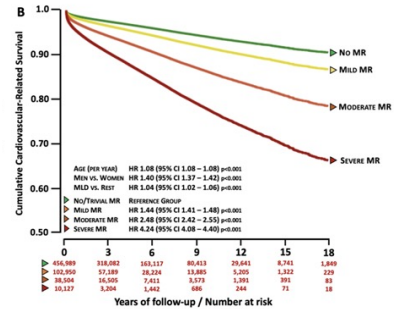
Take-Home

- Refer early
- Before LV damage

Final Message

- MR is treatable
- Early action improves survival



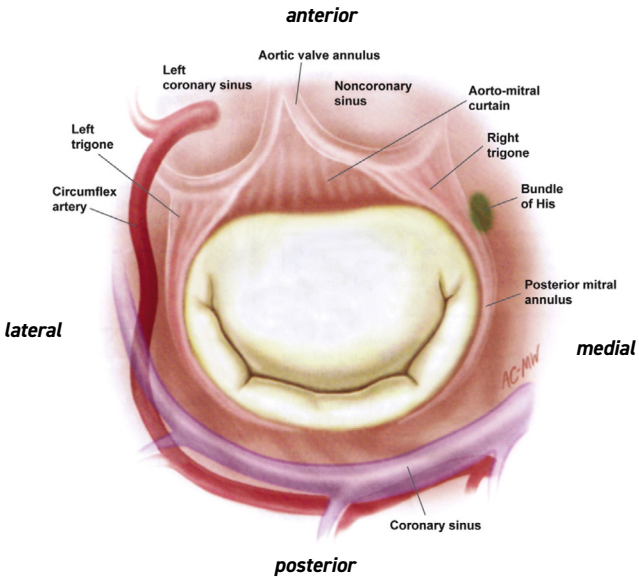


Playford D, et al. Heart 2024;0:1–8. doi:10.1136/heartjnl-2024-324790

Basics of Mitral Regurgitation

Anatomy of the mitral valve and apparatus

The echocardiographer must recognize the segmental anatomy of the mitral valve (A1–A3, P1–P3) and identify the exact scallop(s) involved in MR. Understanding the annulus (saddle shape, dimensions), leaflet length and mobility, chordal integrity, and commissures is essential to define mechanism and repair feasibility. Precise anatomical localization directly guides surgical or transcatheter strategy.



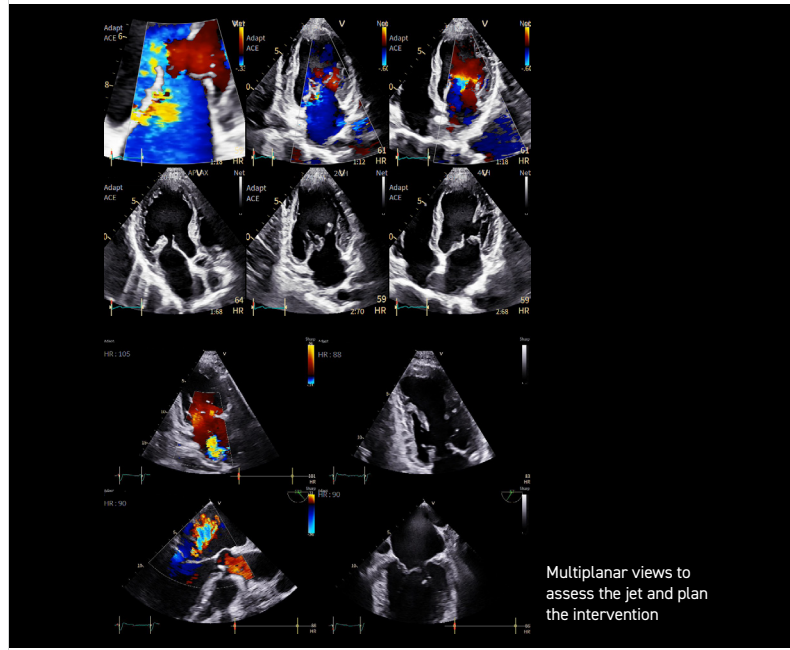
Carpentier's Reconstructive Valve Surgery. 2010

Etiologies of MR (primary vs secondary)

Mechanism First

- Primary MR
- Secondary MR
- Mixed MR (calcifications?)

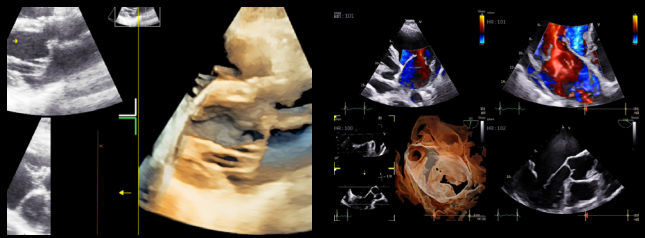
Mechanism determines therapy



Multiplanar views to assess the jet and plan the intervention

Primary MR

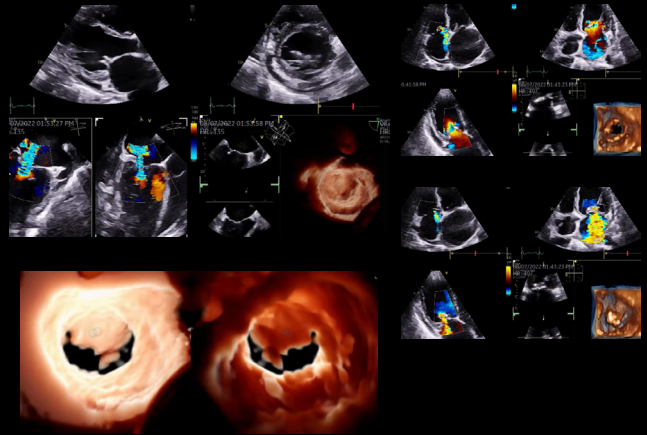
- Primary (degenerative) mitral regurgitation results from intrinsic leaflet or chordal pathology, most commonly fibro-elastic deficiency or myxomatous disease.
- The typical lesions are leaflet prolapse (≥2 mm systolic displacement into the left atrium) or flail leaflet due to chordal rupture, usually generating eccentric MR.
- In early stages, the left ventricle remains structurally normal, with preserved or supranormal LVEF because MR unloads the LV into the low-pressure atrium. Therefore, LVESD is the most sensitive marker of early LV involvement, while LVEF overestimates true contractility; GLS detects subclinical dysfunction.
- The combination of prolapse/flail with LVESD < 40 mm and LVEF > 60% defines isolated primary MR and identifies the optimal window for durable surgical repair before irreversible remodeling.



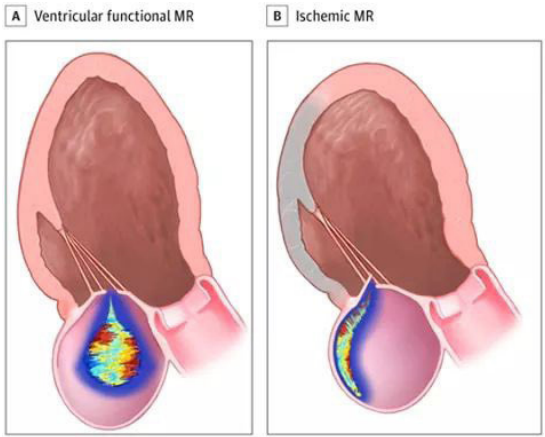
Combined 4D TTE and TEE assessment to confirm patient suitability for repair

Secondary MR

- Secondary (functional) mitral regurgitation occurs despite structurally normal mitral leaflets and chordae, resulting from left ventricular or left atrial disease that distorts the mitral apparatus.
- Ventricular remodeling with papillary muscle displacement and annular dilation leads to leaflet tethering and restricted systolic closure (ventricular SMR), whereas isolated annular enlargement related to atrial dilation and atrial fibrillation causes atrial SMR.
- MR severity therefore, reflects the underlying myocardial or atrial pathology rather than primary valve disease.
- The left ventricle is typically dilated and/or dysfunctional in ventricular SMR, while preserved in atrial SMR.
- Management targets the causal disease (HF therapy, rhythm control) first; persistent severe MR with suitable anatomy may then justify transcatheter repair.



Secondary MR

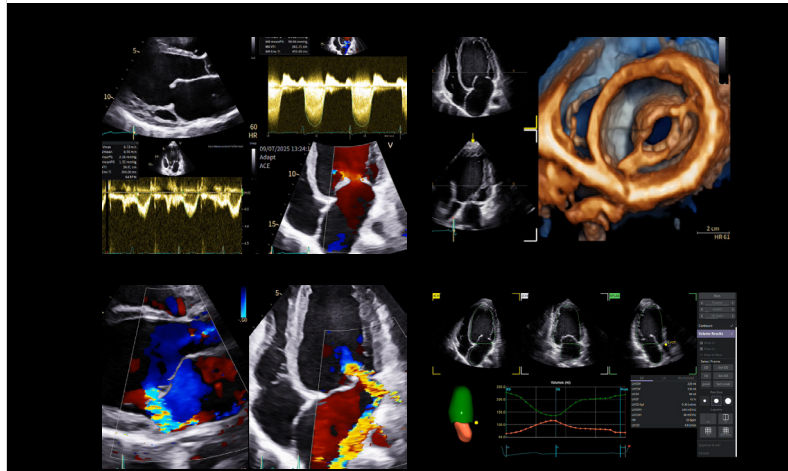


Reddy et al. JAMA Cardiol. 2020 Jul 1. doi:10/1001

Ventricular MR

- Due to LV dilation/dysfunction → leaflet tethering (Carpentier IIIb), reduced closing forces.
- Seen in ischemic/dilated cardiomyopathy; MR reflects ventricular disease.
- Dynamic severity (↑ with exercise/afterload).
- Treat LV first (GDMT ± CRT); TEER if severe MR persists and anatomy suitable.

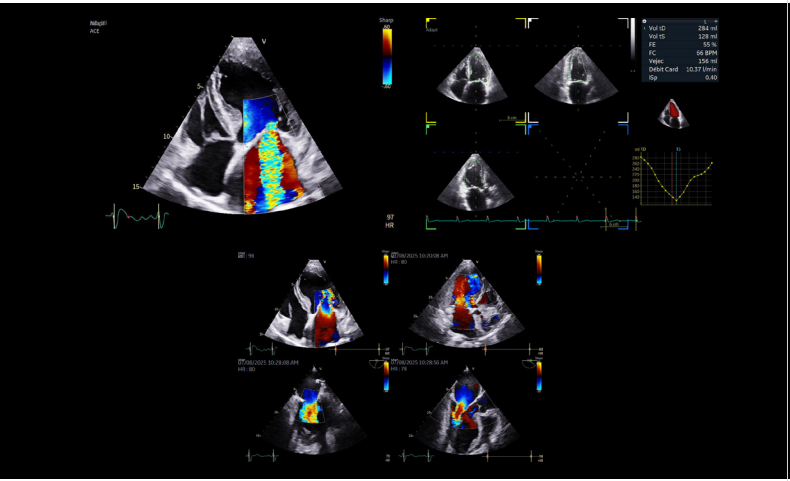
Interpret MR with LV size/function and tethering—this is a ventricular problem with a valvular leak.



Better reproducibility through automated Doppler, 2D, and 4D quantification

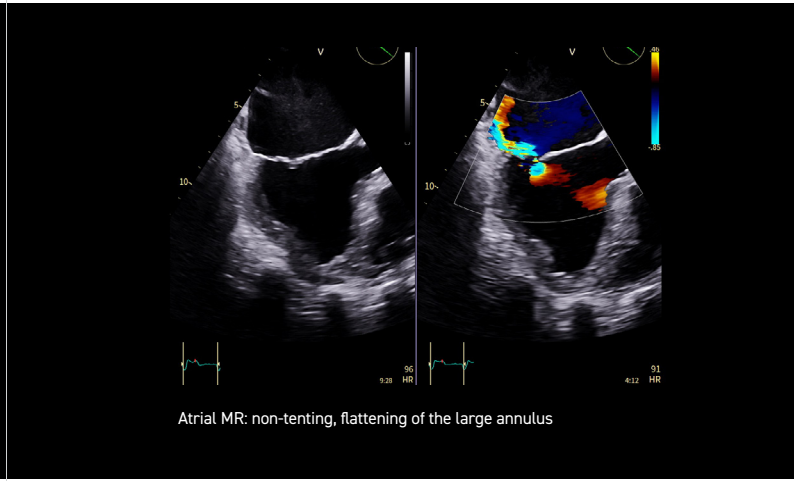
Atrial SMR

- Atrial secondary mitral regurgitation (atrial SMR) arises from left atrial and annular remodeling with structurally normal leaflets and preserved left ventricular function.
- Chronic atrial fibrillation or long-standing atrial dilation leads to mitral annular enlargement and loss of leaflet coaptation, without significant leaflet tethering.
- The left ventricle is typically normal in size and systolic function, distinguishing atrial SMR from ventricular SMR.
- MR severity therefore reflects the extent of atrial disease and annular dysfunction rather than ventricular remodeling.
- Management prioritizes rhythm control and treatment of atrial cardiomyopathy; in persistent severe MR with suitable anatomy, annuloplasty-based or transcatheter repair strategies may be considered.



Atrial MR Link

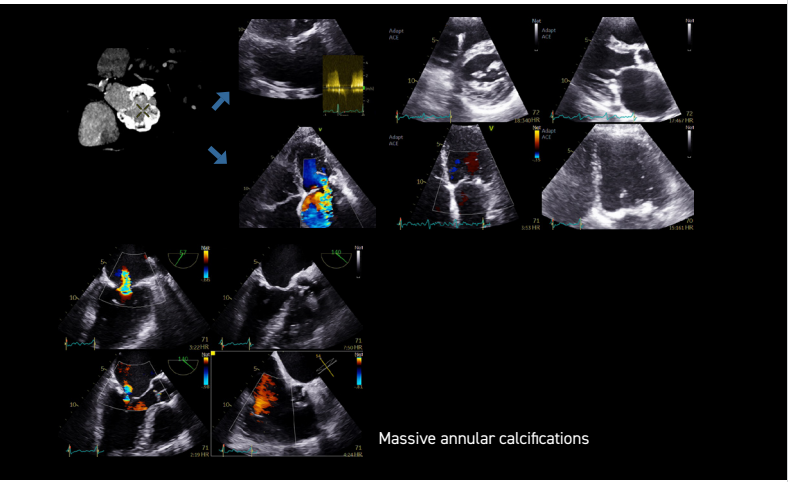
- Progressive left atrial enlargement is the primary driver of atrial secondary mitral regurgitation (atrial SMR).
- Annular dilation from atrial remodeling leads to loss of leaflet coaptation despite normal leaflets and preserved LV function.
- According to ESC guidance, severe LA dilation and/or atrial fibrillation with preserved LV should prompt recognition of atrial SMR rather than primary or ventricular MR.
- Clinically, increasing LA size and MR severity signal advancing atrial cardiomyopathy and support early rhythm control and consideration of mitral intervention in persistent severe cases.



Atrial MR: non-tenting, flattening of the large annulus

Mixed MR

- Mixed mitral regurgitation results from the coexistence of primary leaflet pathology and secondary ventricular or atrial remodeling, a frequent situation in elderly or calcific valve disease.
- Degenerative changes, annular dilation, ventricular tethering, and mitral annular or leaflet calcifications may all contribute to incomplete coaptation.
- Evaluation must therefore identify and describe the dominant mechanism driving MR severity.
- Precise imaging should localize calcifications, define their depth and extension toward the myocardium, and assess residual leaflet mobility and coaptation length.
- This integrated anatomical analysis determines repair feasibility and the remaining space for edge-to-edge clipping or annuloplasty strategies.

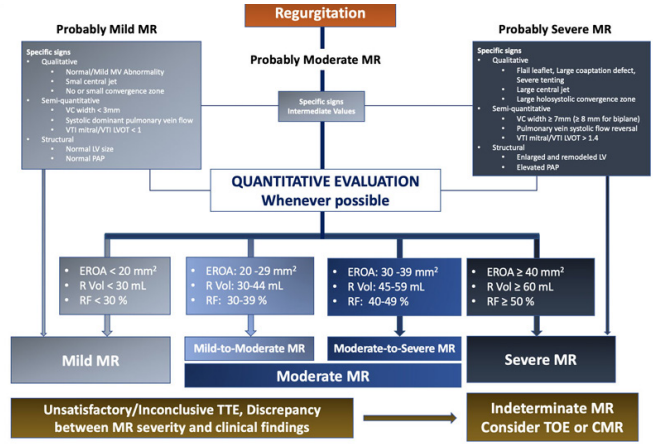


Massive annular calcifications

Echocardiographic Assessment of MR

Multiparametric framework for MR assessment

Severity Assessment



ESC/EACTS Guidelines. Eur Heart J 2021.

Integration

- Concordant parameters strengthen diagnosis
- Discordance → further imaging

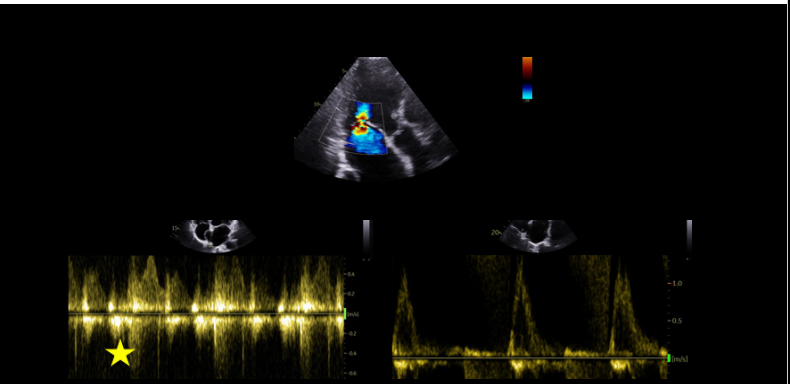
Common Pitfalls

- Eccentric jets underestimated
- Low flow MR underestimated

Core echocardiographic measurements and assessment tools (including TEE examples)

Qualitative Markers

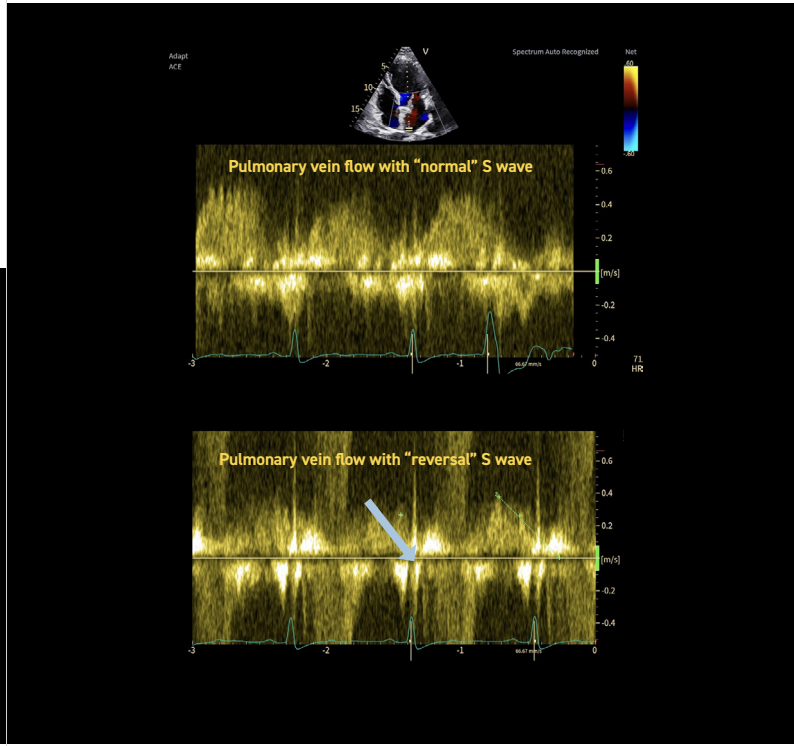
- Qualitative echocardiographic markers of severe mitral regurgitation rely on visual and Doppler features reflecting high regurgitant flow. A large color Doppler jet, particularly when occupying a substantial portion of the left atrium, suggests significant MR, although jet area is influenced by loading conditions and atrial size. An eccentric wall-hugging jet despite a small jet area can be severe. Be careful.
- A dense, triangular continuous-wave (CW) Doppler envelope reflects rapid pressure equalization between the LV and LA, another hallmark of severe regurgitation. These qualitative signs must always be integrated with quantitative parameters in a multiparametric grading approach.



Systolic flow reversal in the pulmonary vein

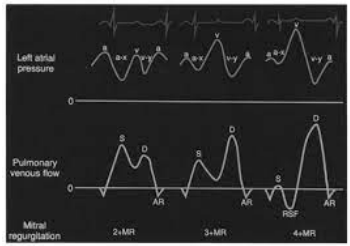
Pulmonary Vein Flow

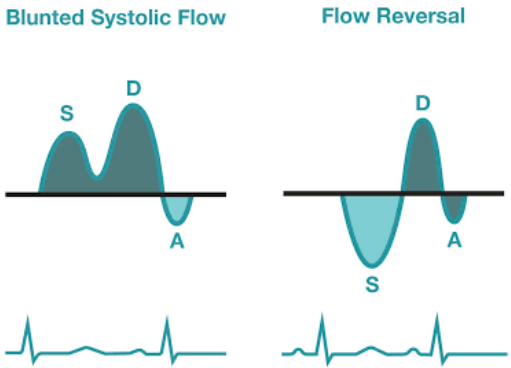
- Pulmonary vein systolic flow reversal on pulsed-wave Doppler reflects transmission of high left atrial pressure during systole and is a specific marker of severe mitral regurgitation. When present in ≥1 pulmonary vein (preferably the right upper), it strongly supports severe MR within a multiparametric assessment.



Pulmonary venous flow systolic reversal

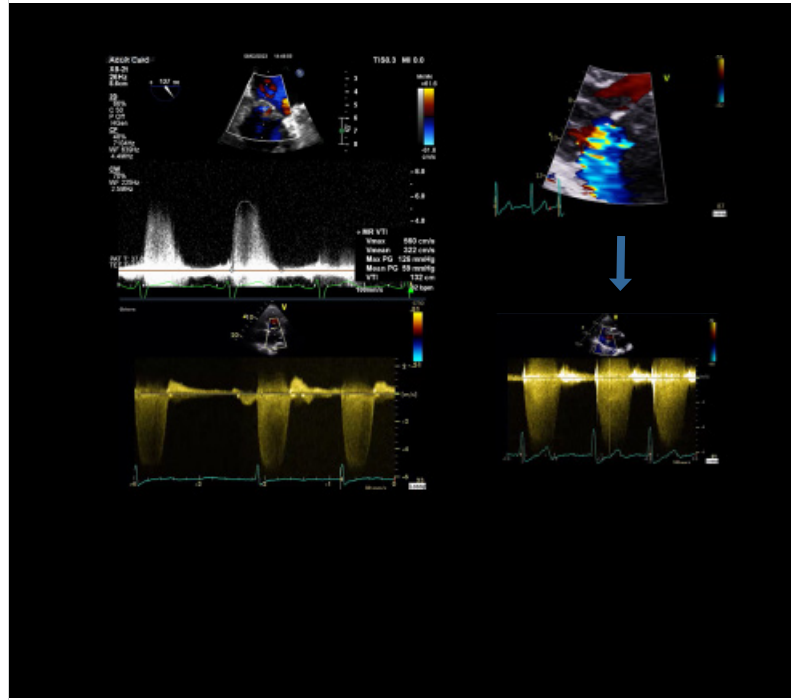
- Evaluation of right upper pulmonary flow on TTE.
- Best: TOE evaluation best performed with the PW sample placed about 1 cm deep into the pulmonary vein.





CW Doppler MR signal

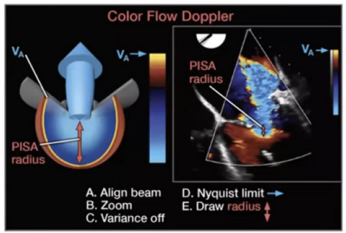
- Dense MR signal with a full envelope indicates more severe MR.
- CW Doppler envelope may be truncated (notched) with a triangular contour and an early peak velocity (blunt): elevated LA pressure or a prominent regurgitant pressure wave in the LA due to severe MR.
- In eccentric MR, it may be difficult to record the full CW envelope of the jet (example below).



Facts and trends about echocardiographic assessment of functional MR

- Direct assessment of vena contracta area (Kahlert P et al. JASE 2008).
- Quantification of EROA and Rvol of functional MR with 3D echocardiography (Marsan N et al. JACC 2009).
- Flow convergence is not always hemispheric but rather an ellipsoid shell.

Mitral Regurgitation: Flow Convergence Method (PISA)



r = Radial distance from orifice (cm)
V_A = Aliasing velocity at radial distance (r) (cm/s)
V_{Max} = Peak velocity of MR jet (cm/s)
VTI = VTI of MR jet (cm)
ERO = Effective regurgitant orifice (cm^2)
RVol = Regurgitant volume (mL/beat)
RF = Regurgitant fraction (%)

$$PISA = 2 \times \pi \times r^2$$

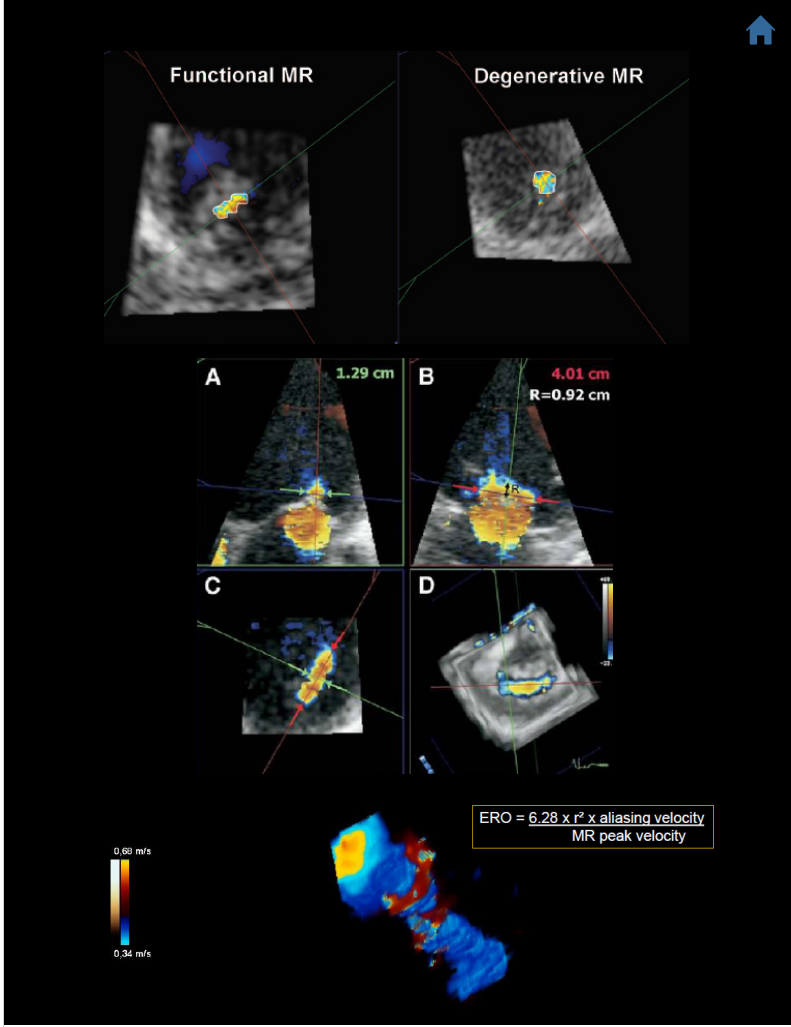
$$\text{Regurgitant flow} = 2 \times \pi \times r^2 \times V_A$$

$$ERO = \frac{\text{Reg. flow}}{V_{Max}} = \frac{2 \times \pi \times r^2 \times V_A}{V_{Max}}$$

$$RVol = ERO \times VTI \qquad RF = \frac{RVol}{\text{Stroke volume}^*}$$

* Calculated as forward stroke volume (either using transmitral inflow or the sum of LVOT flow and RVol)

	Mild	Moderate	Severe
EROA (cm^2)	< 0.20	0.20 - 0.39	≥ 0.40
RVol (mL)	< 30	30 - 59	≥ 60
RF (%)	< 30	30 - 49	≥ 50



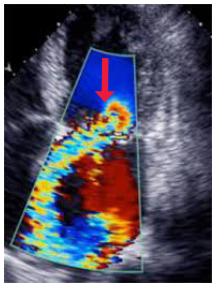
Imaging of the mitral valve: Semi-quantitative methods

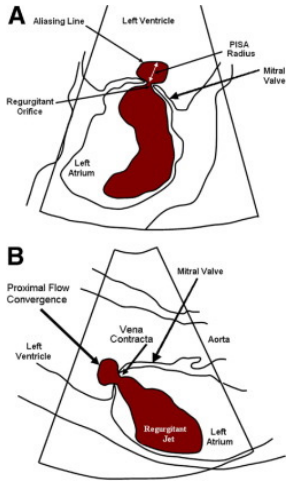
- Colour flow imaging should only be used for detecting MR.
- Due to the hemodynamic influence (↑ LA pressure: small area jet), colour flow area should be avoided for MR severity quantification.

Vena contracta width

1. **Orifice:** circular in primary MR; non circular in secondary MR (elongated along the mitral coaptation line).
2. **Multiple MR jets:** the respective widths of the multiple VC are not additive.
3. **≥ 8mm on 2D echo: severe.**
4. **3D VC cross-sectional area: severe MR ≥ 40 mm².**

Goebel B et al. EHJ CVI 2018
Lancellotti P et al. EHJ CVI 2022
Grayburn P et al. Circulation 2012





Biner S et al. JACC IMG 2010

Quantification is now consensual

2017

	Mitral regurgitation	
Qualitative		
Valve morphology	Flail leaflet/ruptured papillary muscle/ large coaptation defect	
Colour flow regurgitant jet	Very large central jet or eccentric jet adhering, swirling, and reaching the posterior wall of the LA	
CW signal of regurgitant jet	Dense/triangular	
Other	Large flow convergence zone[a]	
Semiquantitative		
Vena contracta width (mm)	≥7 (>8 for biplane)[b]	
Upstream vein flow[c]	Systolic pulmonary vein flow reversal	
Inflow	E-wave dominant ≥1.5 m/s[d]	
Other	TVI mitral/TVI aortic >1.4	
Quantitative	Primary	Secondary[b]
EROA (mm²)	≥40	≥20
Regurgitant volume (mL/beat)	≥60	≥30
+ enlargement of cardiac chambers/vessels	LV, LA	

2021

	Secondary mitral regurgitation
Qualitative	
Mitral valve morphology	Normal leaflets but with severe tenting, poor leaflet coaptation
Colour flow jet area	Large central jet (>50% of LA) or eccentric wall impinging jet of variable size
Flow convergence	Large throughout systole
Continuous wave Doppler jet	Holosystolic/dense/triangular
Semiquantitative	
Vena contracta width (mm)	≥7 (≥8 mm for biplane)
Pulmonary vein flow	Systolic flow reversal
Mitral inflow	E-wave dominant (>1.2 m/s)
TVI mitral/TVI aortic	>1.4
Quantitative	
EROA (2D PISA, mm²)	≥40 mm² (may be ≥30 mm² if elliptical regurgitant orifice area)
Regurgitant volume (mL/beat)	≥60 mL (may be ≥45 mL if low flow conditions)
Regurgitant fraction (%)	≥50%
Structural	
Left ventricle	Dilated
Left atrium	Dilated

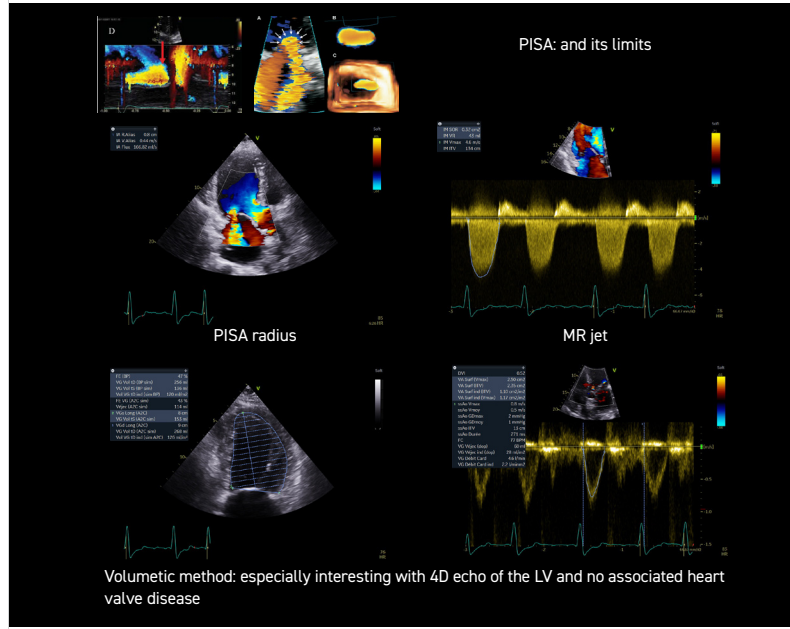
Quantification is now consensual (continued)

2020

Stage	Definition	Valve Anatomy	Valve Hemodynamics*
A	At risk of MR	■ Normal valve leaflets, chords, and annulus in a patient with CAD or cardiomyopathy	■ No MR jet or small central jet area <20% LA on Doppler ■ Small vena contracta <0.30 cm
B	Progressive MR	■ Regional wall motion abnormalities with mild tethering of mitral leaflet ■ Annular dilation with mild loss of central coaptation of the mitral leaflets	■ ERO <0.40 cm^2† ■ Regurgitant volume <60 mL ■ Regurgitant fraction <50%
C	Asymptomatic severe MR	■ Regional wall motion abnormalities and/or LV dilation with severe tethering of mitral leaflet ■ Annular dilation with severe loss of central coaptation of the mitral leaflets	■ ERO ≥0.40 cm^2† ■ Regurgitant volume ≥60 mL ‡ ■ Regurgitant fraction ≥50%
D	Symptomatic severe MR	■ Regional wall motion abnormalities and/or LV dilation with severe tethering of mitral leaflet ■ Annular dilation with severe loss of central coaptation of the mitral leaflets	■ ERO ≥0.40 cm^2† ■ Regurgitant volume ≥60 mL ‡ ■ Regurgitant fraction ≥50%

Quantitative Thresholds

- Quantitative echocardiographic thresholds of severe mitral regurgitation include an effective regurgitant orifice area (EROA) ≥0.40 cm^2, regurgitant volume ≥60 mL, and vena contracta width ≥7 mm. These parameters provide objective grading of MR severity when concordant. However, each has limitations: EROA and volume depend on geometric assumptions (PISA) and loading conditions; vena contracta may be inaccurate in non-circular or multiple jets.
- Thresholds are lower in secondary MR (EROA ≥0.30 cm^2). Therefore, quantitative data must always be integrated with qualitative signs and chamber remodeling in a multiparametric assessment.

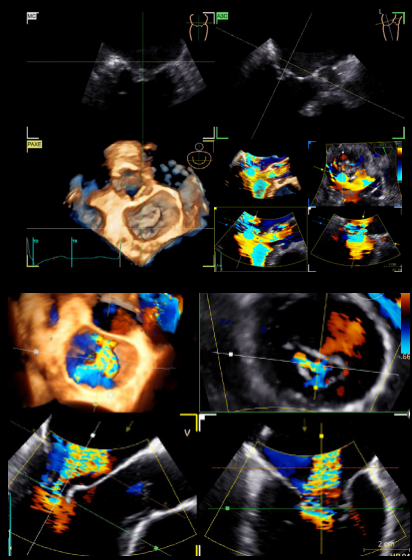


Volumetic method: especially interesting with 4D echo of the LV and no associated heart valve disease

Advanced Imaging Modalities

3D Echo Value

- Three-dimensional echocardiography overcomes the geometric assumptions of 2D imaging by measuring the true vena contracta area, enabling accurate quantification of irregular or multiple MR jets.
- It provides detailed leaflet anatomy and scallop localization and defines annular size, shape, and dynamics.
- 3D echo is therefore essential for precise MR mechanism analysis and procedural planning.



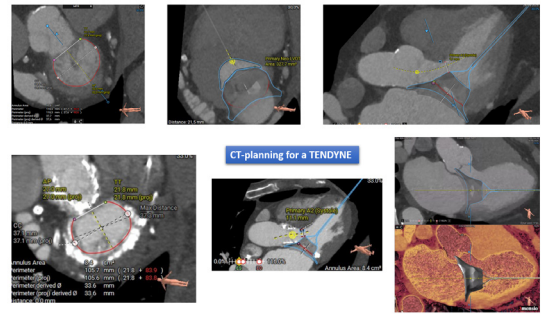
4D Color doppler and MPR for 3D vena contracta assessment

CMR Role

- Cardiac magnetic resonance (CMR) provides highly accurate and reproducible quantification of regurgitant volume and fraction independent of jet geometry or acoustic windows.
- It is particularly valuable when echocardiographic parameters are discordant or technically limited.
- CMR also delivers comprehensive assessment of ventricular volumes, function, and myocardial tissue (fibrosis/scar), refining the evaluation of MR consequences and prognosis.
- It is therefore the reference modality for volumetric validation and complementary decision-making in selected MR patients

CT Role

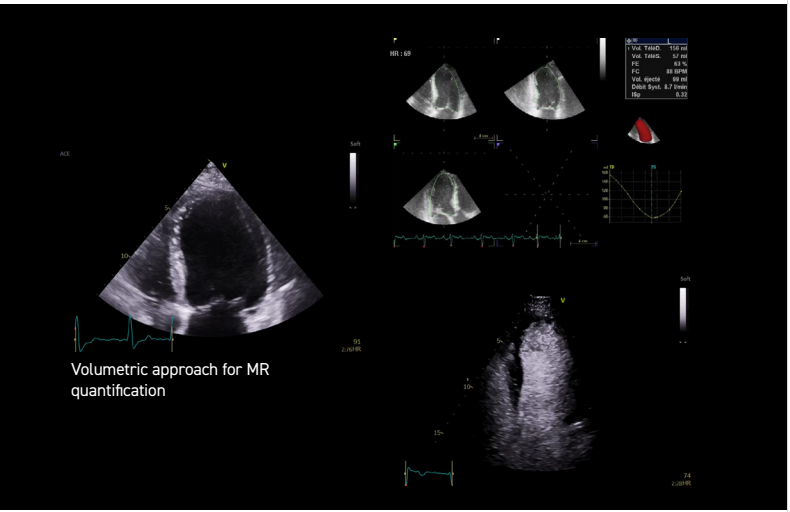
- Cardiac CT provides precise anatomical assessment of the mitral annulus and leaflet/annular calcifications, including their extent, depth, and relation to the myocardium and circumflex artery.
- It is essential for transcatheter mitral valve replacement (TMVR) planning, enabling annular sizing, prediction of LVOT obstruction, and device feasibility assessment.
- CT therefore complements echocardiography in complex or heavily calcified mitral anatomy.



Impact of MR on Cardiac Chambers

Cardiac Consequences

- Chronic mitral regurgitation induces progressive remodeling of all cardiac chambers and the pulmonary circulation. The left ventricle (LV) develops volume overload with dilation preceding EF decline; LVESD and LVEF define timing of intervention.
- The left atrium (LA) enlarges and loses function, predisposing to atrial fibrillation and reflecting MR chronicity. Sustained elevation of left atrial pressure leads to pulmonary hypertension, an adverse prognostic marker.
- In advanced stages, pressure overload affects the right ventricle (RV), whose dysfunction signals late disease and worse outcomes



Volumetric approach for MR quantification

LV Remodeling

- In chronic MR, the LV dilates before LVEF declines, reflecting compensated volume overload. Because part of stroke volume is ejected into the low-pressure left atrium, LVEF overestimates true myocardial contractility; therefore LVESD and GLS better detect early dysfunction.

LV Referral Triggers

- LVEF ≤60%
- LVESD ≥40 mm

Pulmonary Hypertension

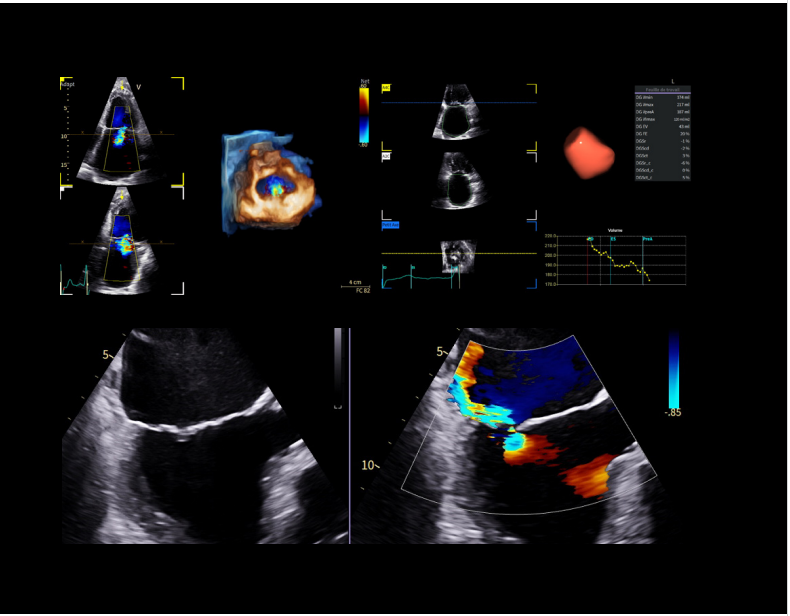
- sPAP >50 mmHg adverse

Pulmonary Hypertension

- Chronic MR leads to prove increasingly elevated left atrial pressure and pulmonary venous hypertension, which progressively involve the right heart. Pulmonary hypertension induces right ventricular (RV) pressure overload, followed by RV dilation and systolic dysfunction in advanced stages.
- According to ESC guidance, the presence of pulmonary hypertension and/or RV impairment identifies late disease and worse prognosis. Clinically, rising sPAP, RV enlargement or dysfunction, and tricuspid regurgitation should prompt timely referral, as right-heart involvement may become only partially reversible after mitral correction.

LA Remodeling

- Chronic MR causes progressive left atrial (LA) dilation and functional impairment from sustained volume overload. Increasing LA size reflects MR duration and severity and promotes atrial fibrillation, which often marks disease progression. In practice, LA volume index ≥60 mL/m² or new-onset AF in primary MR supports severe, long-standing disease and strengthens the indication for referral/intervention even if symptoms are mild.
- Serial LA assessment therefore helps track MR burden and timing of treatment.



Clinical Classification and Staging

ESC guidelines and role of symptoms vs imaging

Symptoms

- Symptoms in mitral regurgitation typically appear late, after significant cardiac remodeling has occurred.
- Dyspnea or reduced exercise capacity often reflects advanced LV, LA, or pulmonary involvement rather than early disease.
- Therefore, clinical decision-making should not rely on symptoms alone.
- According to ESC guidance, intervention timing in severe MR is primarily driven by objective imaging markers (LV size/function, LA dilation, pulmonary pressure, AF) even in apparently asymptomatic patients.

Imaging vs Symptoms

- Timing of intervention is determined primarily by imaging, not symptoms.
- ESC guidelines emphasize objective markers of cardiac impact—LVESD, LVEF, LA volume, pulmonary pressure, AF, and RV function—to identify the optimal window before irreversible remodeling.
- Because symptoms appear late and EF may remain preserved despite dysfunction, serial echocardiography drives referral and treatment decisions in both symptomatic and asymptomatic severe MR.

When and How to Refer

Referral Importance

- Early referral to a Heart Valve Center preserves the likelihood of durable mitral repair. ESC guidelines stress that intervention should occur before LV dilation/dysfunction, pulmonary hypertension, or atrial fibrillation develop, when valve anatomy is still favorable. Delayed referral increases the need for replacement and worsens outcomes. Therefore, severe MR or early remodeling markers should trigger prompt specialist evaluation, even in asymptomatic patients.

When to Refer

- Severe MR
- LV dysfunction
- AF
- PH

Uncertain MR

- Discordant echo
- Mechanism unclear

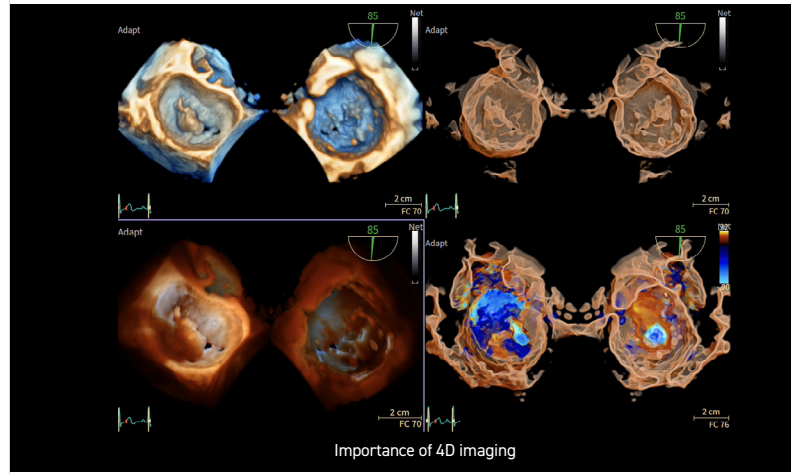
Heart Valve Center

- Comprehensive imaging
- Heart-Team evaluation

Management and Treatment Options

Primary MR Treatment

- In primary (degenerative) mitral regurgitation, surgical mitral repair is the preferred treatment when a durable result is achievable.
- ESC guidelines emphasize intervention in experienced centers with high repair rates to restore leaflet coaptation and preserve the native valve.
- Early surgery in suitable anatomy provides excellent long-term durability, while replacement is reserved for non-repairable valves.
- In patients unsuitable for surgery according to Heart Team assessment, transcatheter edge-to-edge repair (TEER) is recommended when anatomy is favorable.
- The goal is timely referral to achieve durable correction before ventricular or atrial remodeling occurs.

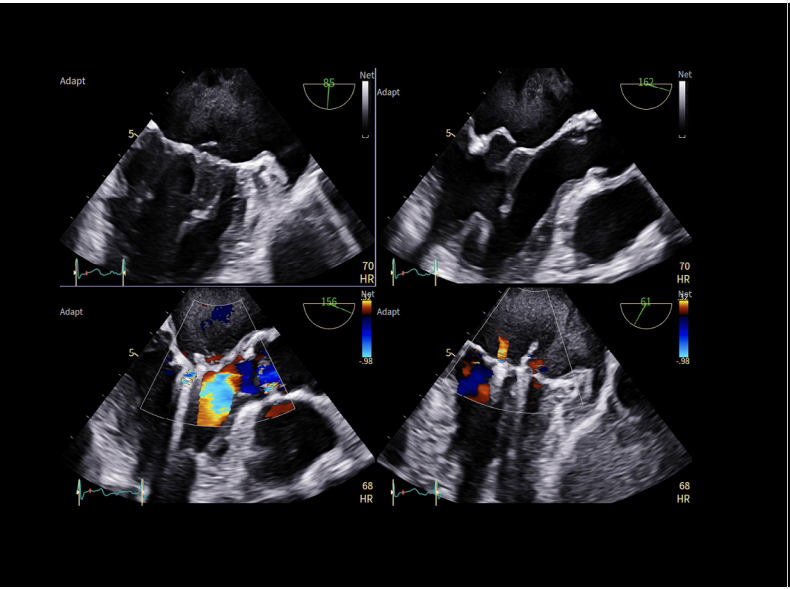


Importance of 4D imaging

Primary MR Asymptomatic

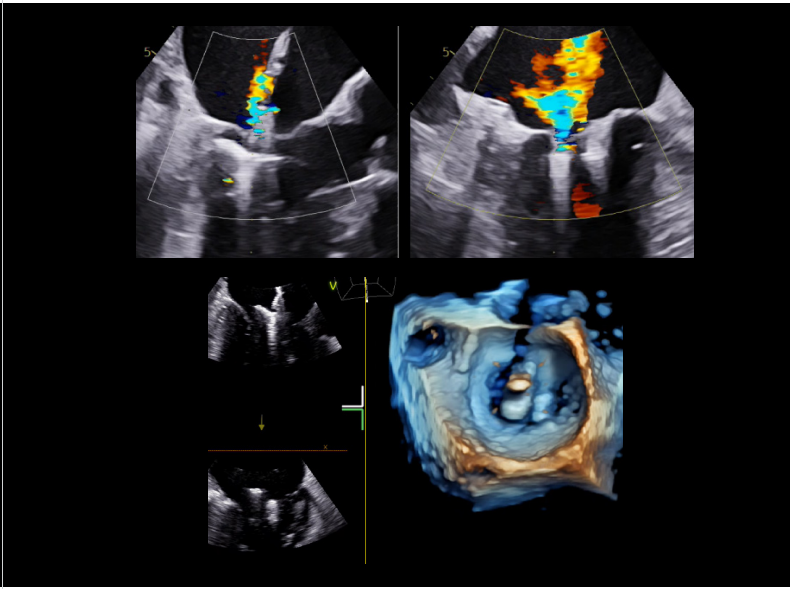
Operate if triggers present

- AF
- PH
- LA dilation



TEER in Primary MR

- In primary mitral regurgitation, transcatheter edge-to-edge repair (TEER) is indicated in symptomatic severe MR when surgical risk is prohibitive or high and valve anatomy is suitable.
- ESC guidelines position TEER as an alternative to surgery in inoperable or high-risk patients, aiming to reduce MR severity and improve symptoms (Class IIa, Level B).
- Optimal outcomes require favorable leaflet anatomy (adequate length, limited calcification, central jet) and Heart Team evaluation in an experienced valve center.



Secondary MR Treatment and Management

Secondary MR Strategy

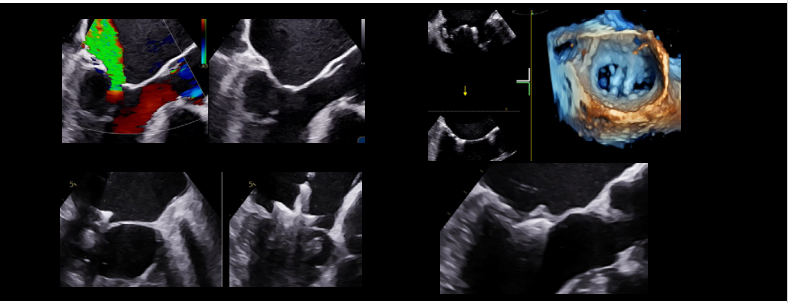
- Treat underlying disease first

HF Optimization

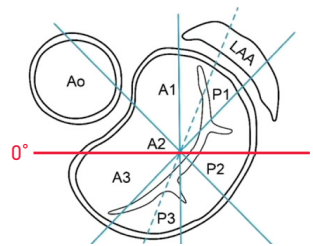
- GDMT
- CRT if indicated

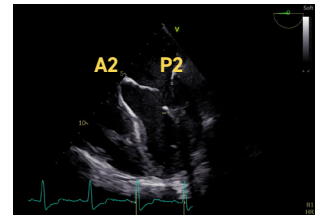
TEER in SMR

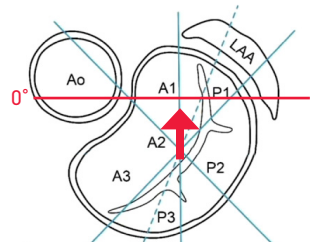
- In secondary (functional) mitral regurgitation, treatment is driven primarily by the underlying myocardial or atrial disease. ESC guidelines recommend optimized heart-failure therapy (GDMT) and CRT when indicated as first-line management.
- **In patients with persistent severe symptomatic MR despite optimal therapy, transcatheter edge-to-edge repair (TEER) is recommended when anatomy is suitable and LV dimensions/function remain within treatable range.**
- Surgical intervention is considered selectively, mainly when combined with other cardiac surgery (Class Ia, Level B). The goal is symptom relief and reduction of HF hospitalizations rather than cure of ventricular disease.

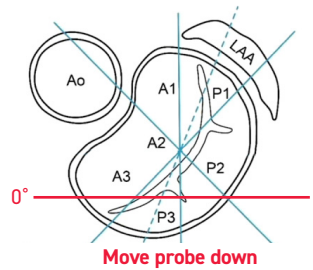


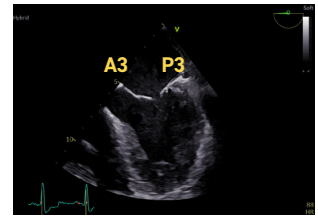
TEE for M-TEER → Confirm mechanism/Be systematic





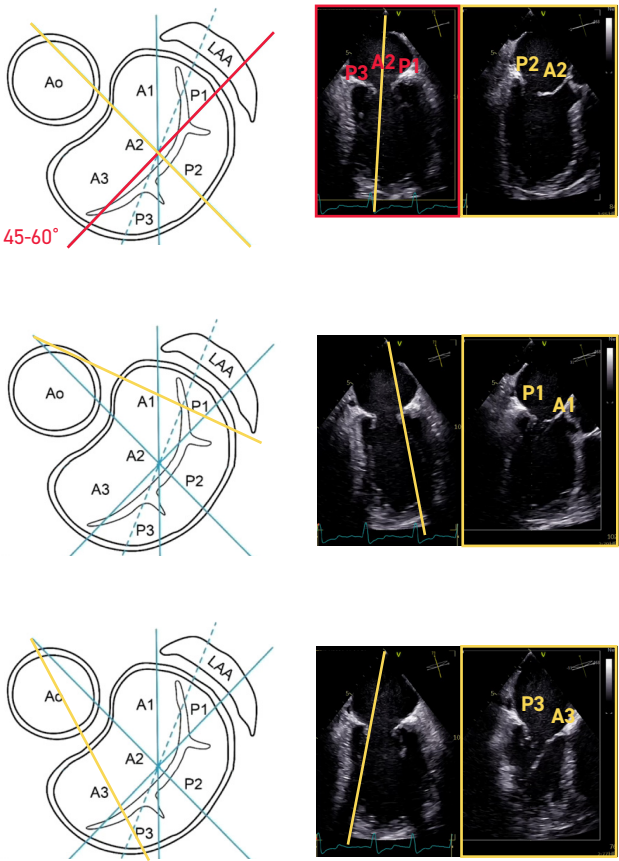




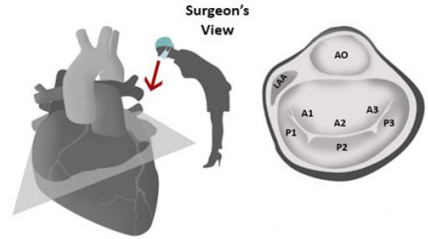


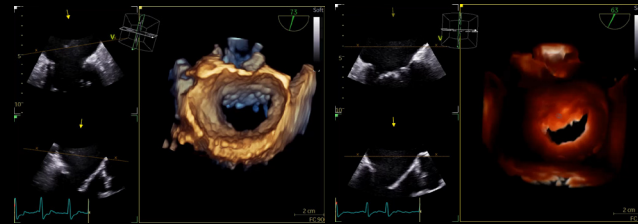
TEE for M-TEER ➔ Confirm mechanism/Be systematic

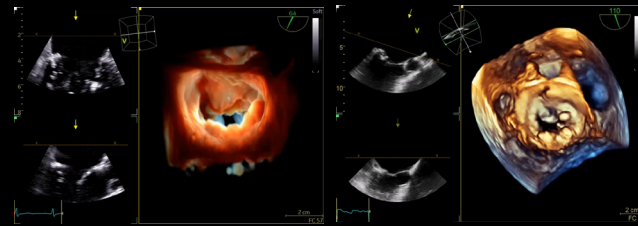
3D-TEE provides incremental value



TEE for M-TEER ➔ Confirm mechanism/Be systematic/ importance of 4D capabilities

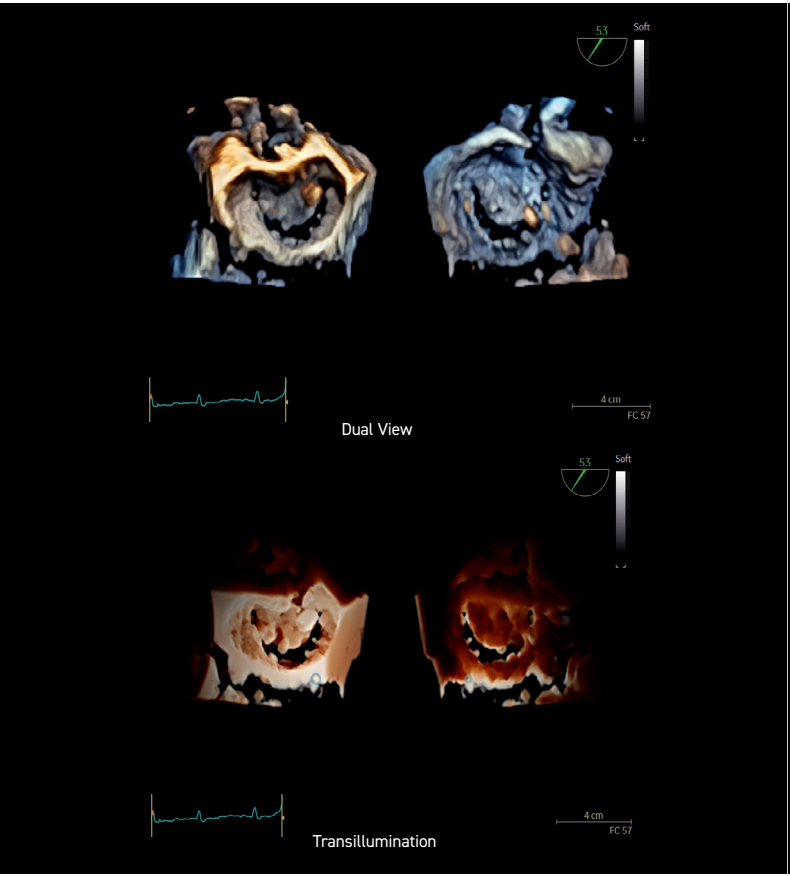



Ischemic MR

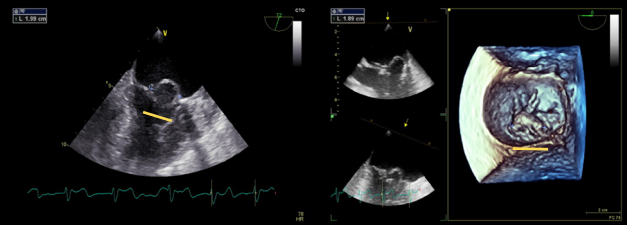

Prolapse MR

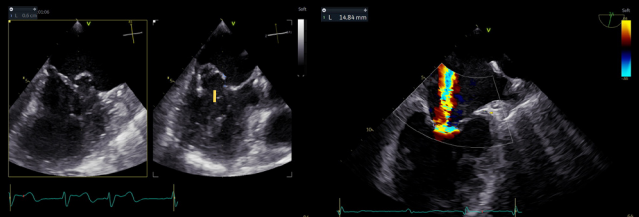
Mixed MR

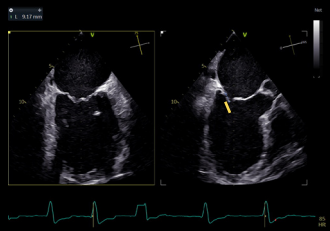
TEE for M-TEER → Confirm mechanism/Be systematic/ importance of 4D capabilities



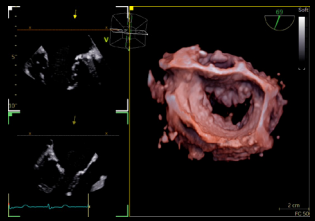
TEE – Confirm features of favorable anatomy


Flail width

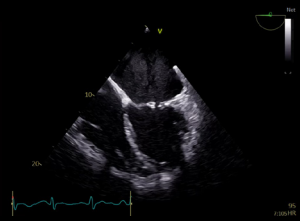

Flail gap


Post Leaflet Length

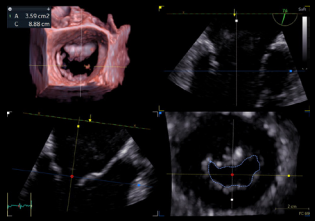
TEE – Confirm features of unfavorable anatomy



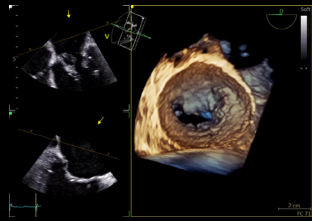
Cleft



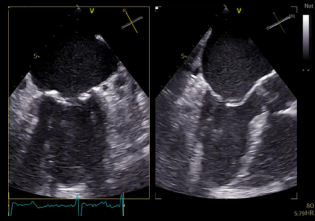
Grasp zone calcification



MVA



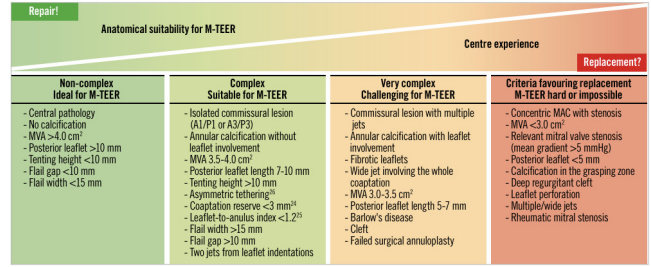
Perforation



Restriction

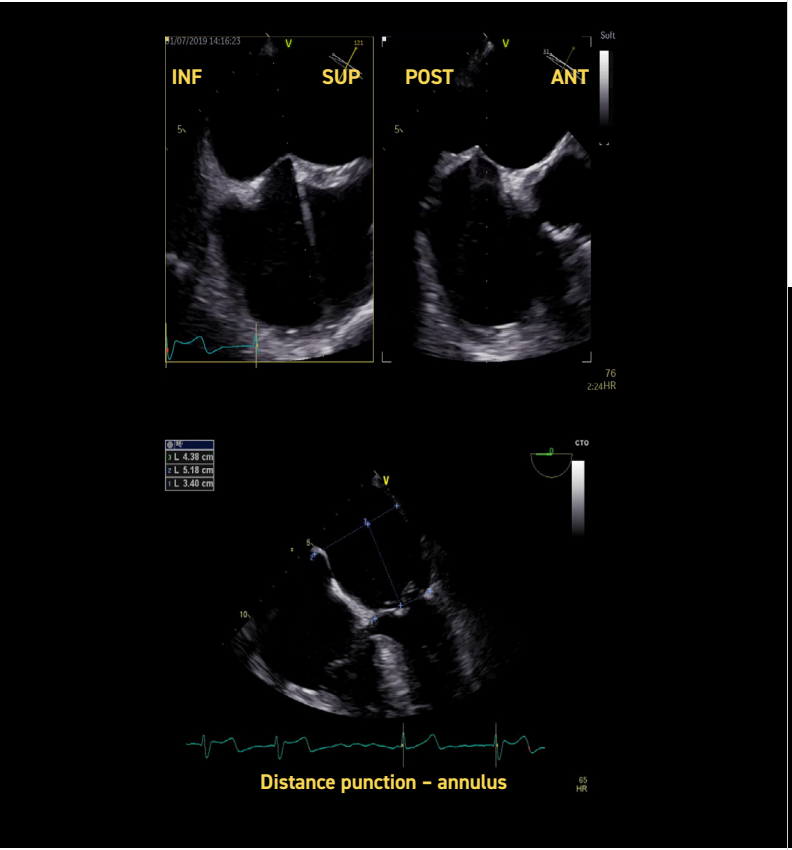
Repair Feasibility

- Leaflet anatomy (length – thickness)/Annulus/calcification



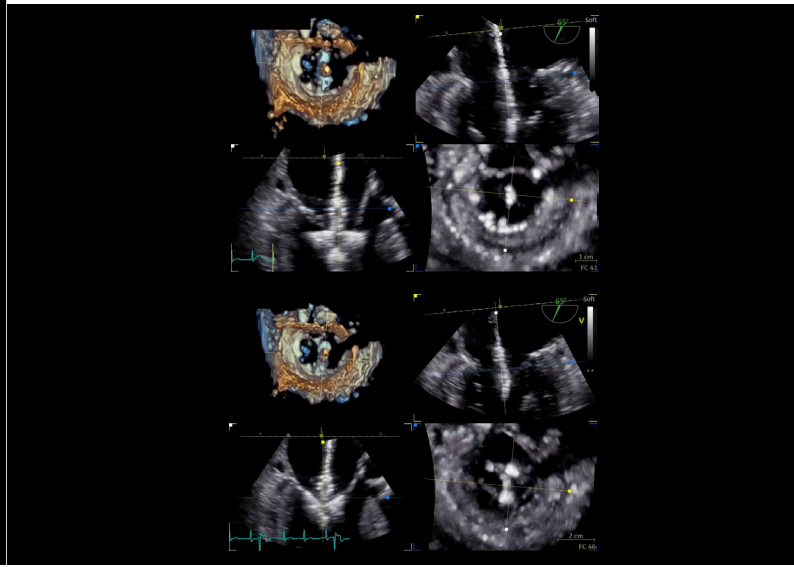
Hausleiter et al. Eurointervention 2018.

TEE – Look at the IAS and LAA



Atrial SMR Management

- Management targets the underlying atrial cardiomyopathy. ESC guidance emphasizes rhythm control of atrial fibrillation and optimization of volume status to reduce annular dilation and MR severity.
- In patients with persistent severe symptomatic atrial SMR despite optimal medical/rhythm therapy, mitral intervention (surgical annuloplasty or TEER) may be considered after Heart Team evaluation (Class IIb, Level B).
- The objective is restoration of leaflet coaptation by annular reduction, while LV function is typically preserved.



Follow-up and Longitudinal Assessment

Follow-Up

- Moderate MR: Yearly echo
- Severe MR Every 6 months

Earlier Review

- Symptoms
- AF onset

Integrative Echo

- Follow-up after mitral regurgitation intervention requires integrative echocardiography combining valve result and cardiac remodeling.
- Assessment should document residual MR severity, transmitral gradient, leaflet motion/device position, and exclude stenosis or detachment.
- Consequences must be tracked through LV size/function, LA volume, pulmonary pressure, and RV function, compared with baseline.
- Serial echo therefore determines procedural success, reverse remodeling, and need for re-intervention.

Echo Report

- The echocardiographic report in mitral regurgitation must clearly state the mechanism (primary, ventricular or atrial secondary, mixed) with precise lesion localization. Severity should be graded using a multiparametric approach integrating qualitative, quantitative, and Doppler signs. Cardiac remodeling must be documented with LVESD, LVEF, GLS, LA volume, and sPAP. ***This structured report directly supports guideline-based timing of referral and intervention***
- During follow-up, the echocardiographic report should document residual or recurrent MR severity, transmitral gradient, and device/repair integrity, compared with prior studies. It must also track evolution of LV size/function, LA volume, pulmonary pressure, and RV function to assess reverse remodeling and durability of correction.

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