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EACVI DOCUMENT

European Association of Cardiovascular Imaging survey on the evaluation of mitral regurgitation

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Aims To evaluate the diagnosis and imaging of patients with mitral regurgitation (MR) and the management in routine clinical practice across Europe, the European Association of Cardiovascular Imaging Scientific Initiatives Committee performed a survey across European centres. In particular, the routine use of echocardiography, advanced imaging modalities, heart valve clinics, and heart valve teams was explored.

Methods and results A total of 61 responders, mainly from tertiary centres or university hospitals, from 26 different countries responded to the survey, which consisted of 22 questions. For most questions related to echocardiography and advanced imaging, the answers were relatively homogeneous and demonstrated good adherence to current recommendations. In particular, the centres used a multi-parametric echocardiographic approach and selected the effective regurgitant orifice and vena contracta width as their preferred assessments. 2D measurements are still the most widely used parameters to assess left ventricular structure; however, the majority use 3D trans-oesophageal echocardiography (TOE) to evaluate valve morphology in severe MR. The majority of centres reported the onsite availability and clinical use of ergometric stress echocardiography, cardiac computed tomography (CCT), and cardiac magnetic resonance (CMR) imaging. Heart valve clinics and heart valve teams were also widely prevalent.

Conclusion Consistent with current guidelines, echocardiography (transthoracic echocardiography and TOE) remains the first-line and central imaging modality for the assessment of MR although the complementary use of 3D TOE, CCT, and CMR appears to be growing. Heart valve clinics and heart valve teams are now widely prevalent.

Keywords EACVI • mitral regurgitation • echocardiography • CMR • cardiac CT

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Introduction

Mitral regurgitation (MR) is the second-most prevalent valvular heart disease in Europe and is characterized by undertreatment and poor outcomes.[1,2] An accurate diagnostic workflow is essential to facilitate early detection and to optimize treatment in both acute and chronic MR. Transthoracic echocardiography (TTE) and trans-oesophageal echocardiography (TOE) are the key imaging techniques, with 3D echocardiography increasingly used to evaluate patients with severe MR being considered for intervention. In addition, other imaging modalities including cardiac computed tomography (CCT) and cardiac magnetic resonance (CMR) have also demonstrated their utility in providing complementary information during the diagnostic workup and in the planning of structural interventions.

The assessment and management of patients with MR have been updated in the last 'guidelines for the management of valvular heart disease', developed by the task force for the management of valvular heart disease of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery.[3] These guidelines have provided clear and straightforward recommendations, assisting healthcare providers in their clinical decision-making for patients with valvular heart diseases and with a clear focus upon the importance of heart valve clinics and the heart valve team.

The European Association of Cardiovascular Imaging (EACVI) Scientific Initiatives Committee conducts surveys to explore imaging-related clinical practice across the world.[4–7] This EACVI survey aimed to identify the most common imaging modalities and techniques used in the diagnostic workup and management of patients with MR in routine clinical practice. In addition, this survey investigated the current use of and access to advanced imaging modalities like 3D echocardiography, CCT, CMR, and heart valve clinics and heart valve teams in the evaluation of patients with MR.

Methods

The present survey was conducted by the EACVI Scientific Initiative Committee from 6 June 2022 to 9 November 2022 according to previously described criteria[4–6] (www.escardio.org/eacvi/surveys). Imagers were invited to complete an online survey comprising 22 questions, investigating the diagnostic workup and use of imaging in patients with MR and how these patients are managed in routine clinical practice. The survey was disseminated to established centres within the EACVI Scientific Initiative Committee network and via social media.

Results

In total, 61 centres from 26 different countries responded to the survey. Responding centres were located in Austria (2), Belgium (2), Croatia (1), Denmark (5), Egypt (1), Finland (1), France (2), Georgia (1), Germany (8), Greece (1), Ireland (1), Italy (6), Korea (Republic of) (1), Lebanon (1), the Netherlands (1), Nigeria (1), New Zealand (1), Norway (5), Portugal (4), Romania (2), Serbia (1), Spain (5), Sweden (4), Switzerland (2), United Arab Emirates (1), and the United Kingdom of Great Britain and Northern Ireland (3). Most centres were tertiary centres or university hospitals (70%) and provided a high-volume service (52% of centres performed >250 TTEs per week whilst only 3% of centres did <50 TTEs per week). Most centres (79%) reported having a heart valve clinic, a heart valve team, and facilities for percutaneous mitral valve interventions whilst two-thirds (64%) described on-site surgical facilities.

Echocardiography

TTE and TOE were available at almost all responding centres, and these modalities remain the first-line imaging assessments for patients with MR. Ergometric stress echocardiography, CCT, and CMR were present in 80%, 82%, and 84%, respectively.

Evaluation of MR severity

Figure 1 shows echocardiographic parameters routinely used to evaluate a patient with moderate to severe MR. More than four-fifths of responders regularly used pulsed wave Doppler of mitral inflow, continuous wave Doppler of MR, vena contracta width, effective regurgitant orifice area, left atrial (LA) dimension/volume, and left ventricular (LV) dimension/volume in their assessments. When the responders had to choose the most three useful parameters to evaluate moderate to severe MR, 74% selected effective regurgitant orifice area, 61% reported vena contracta width, and 34% chose LV dimensions/volume (*Figure 2*).

Almost all (>90%) participants routinely included the following parameters in their echocardiographic report: description of valve morphology, Doppler measurements, LA dimensions/volume, and LV dimensions/volume; however, only 33% included a description of colour flow area.

More than 80% of respondents used the flow convergence method (proximal isovelocity surface area [PISA]) to assess the regurgitant volume both in primary and secondary MR, and 30–40% reported the use of CMR in challenging cases. The majority (>90%) reported using LV dimensions and 2D biplane LV ejection fraction (LVEF) (Simpson) to evaluate and follow the LV in patients with a moderate to severe MR, whilst 36% used 3D LVEF and 61% used LV global longitudinal strain.

Echocardiography/CMR/CCT

A third of responders (34%) used 3D TTE routinely for all patients with a least moderate MR; 37% reported routine use of 3D TOE in the diagnostic workup of patients with at least moderate MR, with this figure rising to 40% in severe MR; 8% reported that 3D TOE was not available in their institution (*Figure 3*).

In uncomplicated asymptomatic patients with severe primary (prolapse of the posterior leaflet) MR not fulfilling the criteria for surgery, 40% of responders used 3D TOE for further assessment, whilst CMR and ergometric stress echocardiography were used in 20% and 38% of centres, respectively.

In patients with discordant grading of MR severity on TTE, the majority (>85%) used TOE for additional assessment using the multi-parametric approach recommended by current guidelines, whilst 3D vena contracta and CMR were used by 36% and 37%, respectively.

The two additional features most commonly included in echocardiographic reports for patients with 'malignant mitral valve prolapse' (mitral valve prolapse associated with increased risk of sudden cardiac death) were the presence of mitral annular disjunction (MAD) (>80%) and bileaflet mitral valve prolapse (65%).

CCT was most often (54%) used for assessing the coronary arteries in younger patients being considered for mitral valve surgery. CMR was mainly (57%) used to evaluate MR severity in patients with unclear grading on echocardiography, whilst just under half (47%) also used CMR to assess LV volumes and ejection fraction. A fifth only used CMR for research purposes. Myocardial fibrosis was evaluated by CMR to understand the mechanism of LV dysfunction in 50% of institutions, and 13% used CMR on a regular clinical basis (*Figure 4*).

Follow-up

47% of responders followed up patients after successful mitral valve repair annually with clinical evaluation and TTE in an outpatient cardiac clinic, whilst 17% followed up these patients annually at a heart valve clinic using TTE.

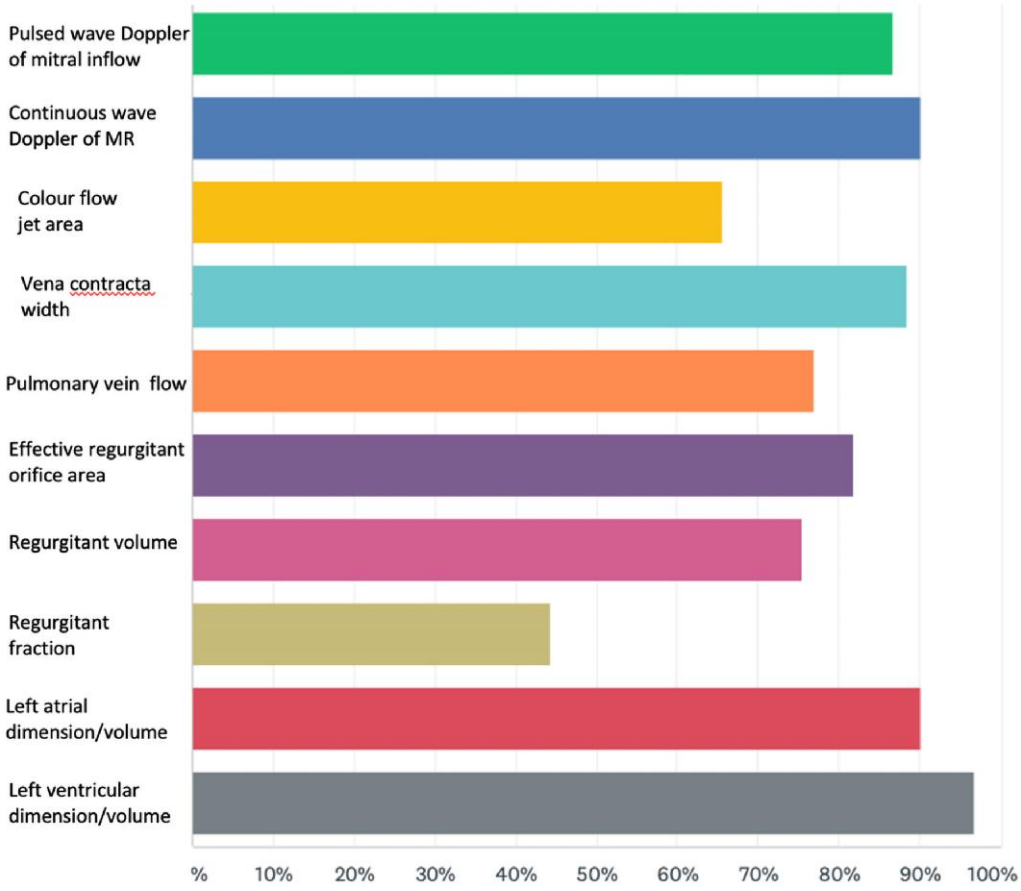

Figure 1 Bar chart showing the different echocardiographic parameters used for evaluation of MR in the different institutions (multiple choice).

Discussion

This EACVI survey on MR involved 61 centres, mostly tertiary care/university hospitals and high-volume centres, from 26 countries, and assessed the routine clinical practice and diagnostic workup of patients with MR. Almost all participants used TTE and TOE as their first-line imaging test, whilst the majority reported the onsite availability of ergometric stress echocardiography, CCT, and CMR. Three-quarters reported having a heart valve clinic and heart valve team, which is in line with current clinical guidelines that emphasize the importance of these structures in the management of patients with MR.

Evaluation of MR

Multiple methods are available to assess the severity of MR, which focus both upon the regurgitation itself and its impact on other cardiac structures in particular the LA, LV, and pulmonary artery pressure. Our survey indicates that echocardiography remains the front-line and most used imaging modality with the majority of respondents using pulsed wave Doppler assessments of mitral inflow, continuous wave Doppler of the MR jet, the vena contracta width, and the effective regurgitant orifice area as well as assessments of LA and LV dimensions/volumes to evaluate patients with moderate to severe MR. This aligns closely with current recommendations from both the ESC and American Society of Echocardiography, which emphasize the need for a multi-parametric assessment and not over-reliance on any single echocardiographic parameter, which on their own can be subject to wide variability related to multiple factors (anatomic, physiologic, and operator dependent).[3,8]

Interestingly, when the survey respondents were asked regarding their preferred echocardiographic parameters, the effective regurgitant orifice and vena contracta width emerged as the most popular parameters, selected by more than 60% of the responders. Only 30% favoured the use of systolic reversal of pulmonary vein flow that has high specificity for severe MR but can be challenging to image. The preference for the effective regurgitant orifice and vena contracta width is consistent with current guidelines. The flow convergence (PISA) method was the preferred approach to assess the regurgitant volume in both patients with primary and secondary MR. This may reflect the most recent ESC guidelines that no longer suggest different thresholds to define severe primary and severe secondary MR, recommending an effective regurgitation orifice area of $\geq$40 mm^2 and a regurgitant volume of $\geq$60 mL.[3,8]

A third of responders used CMR to assess the regurgitant volume in challenging cases. Again, this is in accordance with current guidelines that recommend CMR when echocardiographic assessments are inconclusive. CMR was also used to provide a more accurate estimation of chamber size and to evaluate for the presence of myocardial scarring, which is associated with adverse events in patients with mitral valve prolapse.[9] Current guidelines have limited recommendations on how to perform a comprehensive assessment of MR by CMR in a standardized way and on thresholds that should be used for decision-making.[3] The high reported use of CMR in clinical practice highlights the need for more research to standardize the assessment of MR by CMR and to establish clear thresholds to identify severe disease and the need for intervention.

Discordant grading of MR severity, when various TTE parameters used to grade MR are inconsistent, is a challenging clinical scenario, often encountered when the assessment of LV remodelling and function

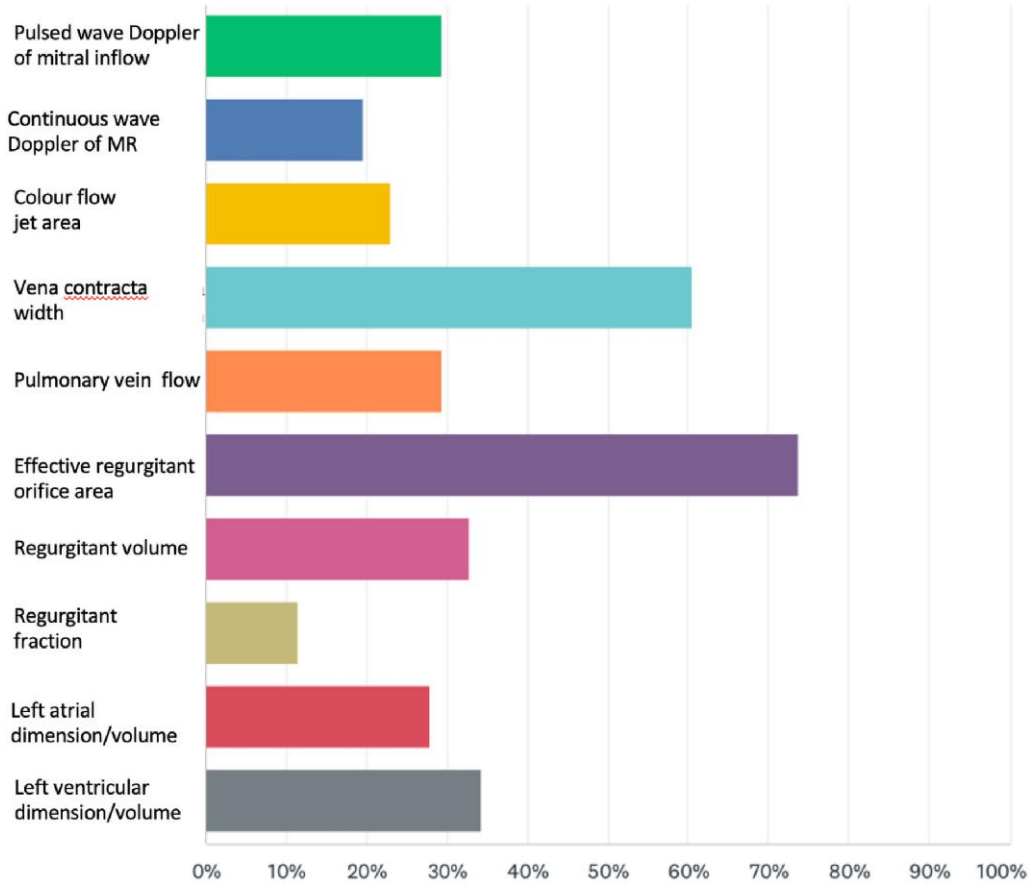

Figure 2 Bar chart showing the different echocardiographic parameters, the responders where asked to choose the three most useful parameters to evaluate a moderate to severe MR.

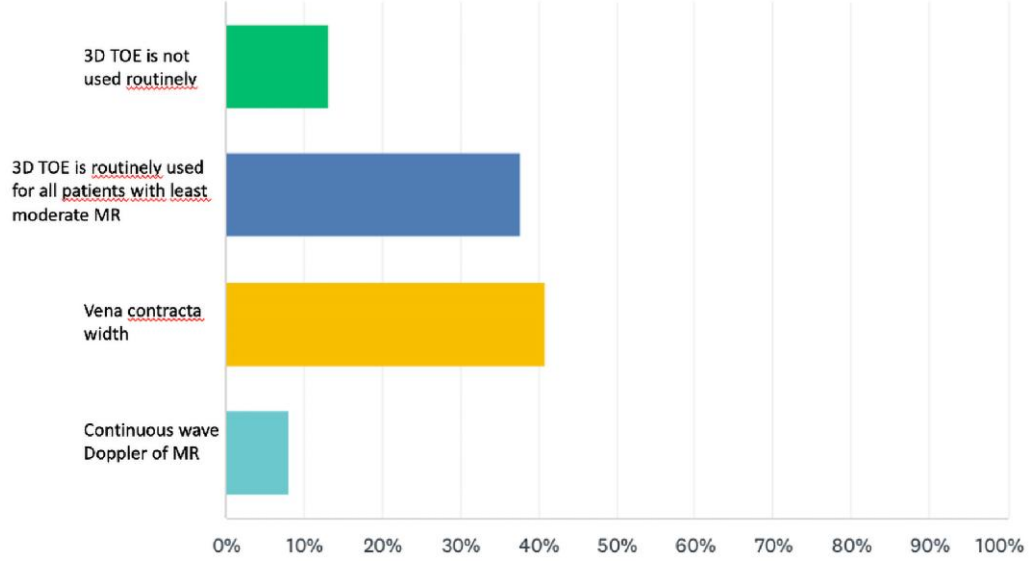

Figure 3 The use of 3D TOE in diagnostic workup of patients with a least moderate MR.

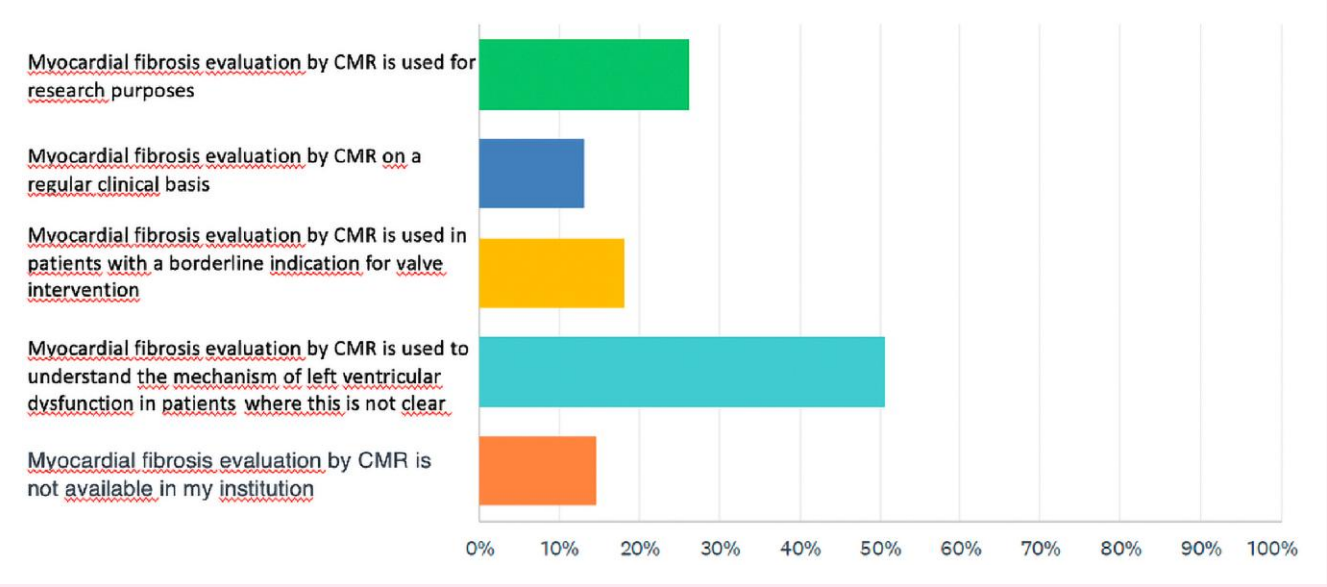

Figure 4 The use of CMR for evaluation of myocardial fibrosis for risk stratification and treatment decisions for patients with at least moderate MR.

do not agree with the severity of valve regurgitation. In these cases, the majority (>85%) of responders prefer TOE to help adjudicate disease severity consistent with current guidelines, although around a third of respondents would use the 3D vena contracta or CMR for additional quantification, despite the limited data on thresholds for clinical decision-making both for 3D vena contracta and CMR.[3]

There has been an increased attention over recent years on 'arrhythmic mitral valve prolapse'.[10,11] The two most reported echocardiographic features in an echocardiographic report in these patients were MAD (>80%) and the presence of bileaflet mitral valve prolapse.

Advanced imaging of MR/3D echocardiography/CMR/CCT

3D echocardiography is increasingly used in the evaluation of both MR severity and cardiac remodelling as well as providing key insights into mitral valve geometry and MR mechanism.[8] However, only 36% of responders used 3D LVEF (3D volume), greatly outnumbered by 2D-based evaluations of the LV, which was used by 94%. This may be surprising since most of the responders were located at tertiary care/university hospitals, where one would expect 3D echocardiography to be available. Similarly, only a third of responders used 3D TTE to assess valve severity, although almost 80% used this technique to assess valve morphology in those with severe MR. Furthermore, 3D TOE was used by 40% of patients with uncomplicated asymptomatic severe primary MR not meeting the criteria for surgery. This reflects the increased use of 3D TOE in the diagnostic work-up and management of patients with MR, consistent with recent guidelines and improvements in image acquisition and image quality.

CCT was mostly (54%) used to assess the coronary arteries in patients being considered for mitral valve surgery. CMR was mainly (57%) used for evaluation of MR severity in patients with unclear grading on echocardiography, for more detailed assessment of LVEF and volumes and to understand the mechanism of any underlying LV dysfunction (50%). One in eight centres used CMR regularly and routinely in their clinical practice consistent with the growing application of multi-modality imaging in patients with heart valve disease.

Limitations

The number of respondents was relatively small, and most respondents were from tertiary centres or university hospitals with a high volume of patients. The findings of this survey may therefore not be generalizable to other clinical environments.

Conclusions

In patients with MR, echocardiography (TTE and TOE) remains the first-line and central imaging modality although the complementary use of CCT and CMR appears to be growing. Centres use a multiparametric echocardiographic approach, but effective regurgitant orifice and vena contracta width are their preferred echocardiographic measures for MR quantification. 2D measurements of the LV are still the most widely used parameters, but the majority use 3D TOE to evaluate valve morphology in severe MR. Heart valve clinics and heart valve teams are now widely prevalent, and in general, the results of this survey demonstrate relatively homogenous adherence to current clinical guidelines and recommendations.

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Conflict of interest: None declared.

Data availability

The data underlying this article will be shared on reasonable request to the corresponding author.

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