

Educational needs and application of guidelines in the management of patients with mitral regurgitation. A European mixed-methods study

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Aims

To assess the knowledge and application of European Society of Cardiology (ESC) Guidelines in the management of mitral regurgitation (MR).

Methods and results

A mixed-methods educational needs assessment was performed. Following a qualitative phase (interviews), an online survey was undertaken using three case scenarios (asymptomatic severe primary MR, symptomatic severe primary MR in the elderly, and severe secondary MR) in 115 primary care physicians (PCPs), and 439 cardiologists or cardiac surgeons from seven European countries. Systematic cardiac auscultation was performed by only 54% of clinicians in asymptomatic patients. Cardiologists appropriately interpreted echocardiographic assessment of mechanism and quantification of primary MR ($\geq 75\%$), but only 44% recognized secondary MR as severe. In asymptomatic severe primary MR with an indication for surgery, 27% of PCPs did not refer the patient to a cardiologist and medical therapy was overused by 19% of cardiologists. In the elderly patient with severe symptomatic primary MR, 72% of cardiologists considered mitral intervention (transcatheter edge-to-edge valve repair in 72%). In severe symptomatic secondary MR, optimization of medical therapy was advised by only 51% of PCPs and 33% of cardiologists, and surgery considered in 30% of cases (transcatheter edge-to-edge repair in 64%).

Conclusion

Systematic auscultation is underused by PCPs for the early detection of MR. Medical therapy is overused in primary MR and underused in secondary MR. Indications for interventions are appropriate in most patients with primary MR, but are unexpectedly frequent for secondary MR. These gaps identify important targets for future educational programs.

Keywords

Educational needs assessment • Guidelines • Mitral regurgitation • Mitral valve surgery • Transcatheter mitral valve therapy

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Introduction

Mitral regurgitation (MR) is the most frequent valvular disease in the community and the second most frequent among patients referred to hospital.^{1–3} European and American guidelines provide recommendations for the diagnosis and management of primary and secondary MR, which are different entities due to major differences in pathophysiology, prognosis, and indications for intervention.^{4,5} However, evidence has demonstrated significant discrepancies between guidelines and practice.^{6–10} These studies did not include transcatheter techniques, which may impact on the awareness and management of MR.

The Education Committee of the European Society of Cardiology (ESC) felt that there was a need for a contemporary survey in a wide range of European practitioners to assess both their perceived needs in knowledge, skills and confidence, and their actual practice according to case scenarios. The in-depth analysis of perceived and objective gaps between guidelines and practices is the first step to identify educational needs in order to drive interventions to improve compliance to guidelines and patient care.

Methods

A mixed-methods approach was used to obtain a comprehensive understanding of the practice gaps experienced by primary care physicians (PCPs), general cardiologists, sub-speciality cardiologists (specialized in imaging, heart failure, electrophysiology, and percutaneous interventions), and cardiac surgeons in seven European countries (France, Germany, Italy, Poland, Spain, Sweden, and the United Kingdom). The mixed-methods approach allowed a combination of the depth of qualitative data and the power of quantitative data.¹¹ In order to obtain a variety of perspectives regarding the diagnosis and management of MR, and ensure the validity of findings, this study triangulated methodological approaches (qualitative and quantitative), data collection methods (literature review, interviews and surveys), and data sources (PCPs, cardiologists and surgeons).

Inclusion criteria

Inclusion and purposive sampling criteria were selected with the goal of obtaining a sample representing the population targeted by the future education. All participants had to be actively practicing (defined as 50% or more time spent for patient care), for at least 5 years. Purposive sampling was utilized based on country of practice, years of clinical experience, and practice setting.¹²

Ethics

Study protocol approval was obtained from an independent ethical review board, to ensure: participant anonymity and confidentiality, and consistency with international ethical guidelines. Each participant completed an informed consent form before participating in the study.

Recruitment

Cardiologists and cardiac surgeons were recruited between March and May 2016 using membership lists from the European Society of Cardiology. Primary care physicians were recruited through a panel of experts obtained from an international healthcare provider database

complying with the Ethical Standards for Market and Social Research code of conduct.¹³ E-mail invitations were sent with a link to a qualitative interview or respond to an online survey.

Interviews

Areas of investigation across the patient care pathway were proposed based on literature review (led by co-authors P.L. and S.M.) and consultation with a committee of experts. Semi-structured 45-min telephone interviews were then conducted with physicians, using open-ended questions, adapted according to the role of each physician group, designed to assess self-reported knowledge, skill and confidence. Interviews were conducted by trained interviewers in the language of the participant. Following the interview, the quality of the data collected was rated according to depth of the coverage of each area of investigation and a final list of seven areas of investigation was defined (*Table 1*). A sample of interviews was selected for transcription based on the interviewers' rating and the interviewee's characteristics (country, clinical experience, and setting) to ensure diversity of perspectives.

Survey

The quantitative survey was designed based on the findings of the qualitative study portion. The 15–20-min survey comprised questions of self-reported knowledge, skill and confidence using multiple ordered category responses. Participants were asked to respond to questions by indicating their current level of knowledge, skill and confidence (1=low; 5=optimal). Questions were adapted for the groups of physicians.

Three clinical cases were embedded in the survey in order to explore the diagnosis, treatment, and management of MR, including an asymptomatic patient with severe primary MR, a symptomatic elderly patient with severe primary MR, and a patient with ischaemic heart disease and severe secondary MR (see [Supplementary material online, Table S1](#)). Participants were asked to respond to multiple choice questions addressing the seven areas of investigation.

Analysis plan

Transcribed qualitative interviews were systematically coded using NVivo 7.0 software (QSR International, Cambridge, MA, USA), according to the areas of investigation. An interviewer debriefing session was then conducted to allow interviewers to discuss the emerging themes from the interviews, and to further refine the coding process. The qualitative analysis approach integrated the principles of thematic analysis¹⁴ and directed content analysis¹⁵ into a four step approach: (i) codes were identified based on the literature review and the interviewer's debriefing; (ii) transcripts were coded according to the developed coding structure; (iii) new codes were developed for data that did not fit the predefined codes; (iv) key emerging themes were identified from the data.

The analysis of the quantitative survey data employed frequencies, cross-tabulations, χ^2 , and analysis of variance, using SPSS 22.0 software (IBM Corporation, Armonk, NY, USA). To simplify analyses, the knowledge, skill and confidence (originally self-reported on 5-point scales from 1=low to 5=optimal) were dichotomised: 1–3 on each scale was grouped as low to moderate, while 4 and 5 on each scale was grouped as good to optimal, as performed in previous needs assessments.^{16,17} In addition, responses provided to the case scenarios were interpreted in light of the optimal answers in alignment with the 2012 ESC guidelines, since the study was conducted in 2016.⁴

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Table 1 Areas of investigation and main findings

Areas of investigation	PCPs	Cardiologists	Main findings
1 Early detection of MR	+	+	(A) Systematic auscultation is underused by PCPs for the detection of asymptomatic primary MR. There is a need for improvement of symptom interpretation
2 Distinction between primary and secondary MR	-	+	(B) Interpretation of echocardiography by cardiologists is good for primary MR, but less satisfying for secondary MR
3 Assessment of MR severity	-	+	(C) Appropriate quantification for primary MR, but not for secondary MR
4 Clinical decision-making process	+	+	(D) Medical therapy is overused in primary MR and underused in secondary MR (E) Indications for intervention in asymptomatic or symptomatic patients with severe primary MR are appropriate, but indications for intervention in secondary MR are unexpectedly high (F) MitraClip is frequently proposed in high-risk patients with primary or secondary MR
5 Long-term management and follow-up	+	+	(G) There is a need for improvement of knowledge and skills of PCPs in long-term patient management
6 Familiarity with the use of ESC Guidelines	-	+	(H) ESC Guidelines are widely used by European cardiologists
7 Communication and collaboration with the multidisciplinary team	+	+	(I) Referral to specialized centres is mentioned by most cardiologists

ESC, European Society of Cardiology; MR, mitral regurgitation; PCP, primary care physician.

Results

Sample

The overall study sample comprised 554 physicians, including 51 in the exploratory qualitative phase and 503 in the quantitative phase: 115 PCPs, 215 general cardiologists, and 224 sub-speciality cardiologists or surgeons, which were analysed together (see [Supplementary material online, Table S2 and S3](#)). A proportion of 11.9% of contacted potential participants followed the link included in the recruitment e-mail, but after application of inclusion and purposive sampling criteria and elimination of incompletes, the final response rates (completed/contacted) for this study were 2.3% for the qualitative phase and 3.0% for the quantitative phase. Fifty-six percent of the sample had a community practice and 44% an academic practice; 73% had more than 10 years of clinical practice experience.

Main findings

The study identified nine main findings, grouped into seven main themes ([Table 1](#)) and presented for each theme according to analysis of knowledge, skill and confidence, followed by analyses of answers to the three case scenarios.

As the aim was to identify needs and objective gaps between guidelines and practice, presentation of the results emphasizes the perceived need for improvement in knowledge, skill and confidence ([Tables 2 and 3](#)) and inappropriate practices identified from the three case scenarios ([Tables 4 and 5](#)). Areas in which care was appropriate are mentioned in the text and figures.

Early detection of MR (area of investigation 1)

The knowledge of symptoms related to MR was considered as needing improvement by 40–45% of PCPs ([Table 2](#)).

The analysis of the case scenarios of asymptomatic MR demonstrated 54% of PCPs performed systematic auscultation and 22% of them referred a patient with a markedly abnormal auscultation only if the murmur persisted ([Table 4](#)). In the case scenario of symptomatic primary MR, dyspnoea was mis-graded as non-severe by 33% of PCPs and by 71% cardiologists ([Tables 4 and 5](#)).

Interpretation of echocardiography (areas of investigation 2 and 3)

Understanding of echo reports was considered to need improvement by 53% of PCPs ([Table 2](#)). Approximately 20% of cardiologists declared a need for improvement in the interpretation of eccentric jets, MR quantification, and measurement of tricuspid annulus diameter ([Table 3](#)).

Case scenarios showed that the most cardiologists could interpret the mechanism and quantification of primary MR (87% and 86%, respectively in primary asymptomatic MR and 75% for mechanisms and quantification in primary symptomatic MR). Tricuspid annulus diameter was measured by 44% of cardiologists ([Table 5](#)).

Secondary MR was appropriately diagnosed by 93% of cardiologists, but attributed to left ventricular (LV) dilatation and dysfunction for 79% and to valve structure and movement in only 14%. Secondary MR was appropriately quantified by 44% of cardiologists, while 32% mis-graded MR as not severe ([Table 5](#)) and 25% requested other investigations to quantify MR.

Clinical decision-making (area of investigation 4)

A need for improvement was reported regarding the choice between immediate intervention and a 'wait and see' approach for 33% of general cardiologists and 22% of sub-speciality cardiologists ([Table 3](#)). The choice between valve replacement and repair was reported as

Table 2 Primary care physicians perceiving a need for improvement of their knowledge (K) or skill (S), according to main findings detailed in Table 1

Main findings	Item	n	% needing improvement
A	Symptoms of MR (K)	47	44
A	Detecting MR symptoms in patients with respiratory conditions (S)	47	44
A	Detecting MR symptoms in patients with other cardiac conditions (S)	43	41
A	Clinically investigating a patient with dyspnoea in order to refer him/her to the appropriate specialist (S)	28	26
B	Understanding echo reports (S)	56	53
G	Monitoring MR symptoms during long-term follow-up (K)	60	56
G	Managing MR symptoms during long-term follow-up (K)	50	46
G	Adequate frequency of follow-up with the patient after an intervention (K)	61	57*
G	Adjusting medication with the presence of other co-morbidities/conditions (S)	45	42
G	Monitoring MR symptoms after an intervention (S)	59	56
G	Managing MR symptoms after an intervention (S)	62	59
G	Frequency of the follow-up after an intervention (S)	58	55
H	Guidelines about long-term follow-up of MR patients (K)	60	56

Need for improvement was defined as 1-low to 3-moderate knowledge, skill, or confidence on a 5-point scale.

MR, mitral regurgitation.

* $P < 0.05$ between countries.

Table 3 General and sub-speciality cardiologists perceiving a need for improvement of their knowledge (K), skill (S), or confidence (C), according to main findings detailed in Table 1

Main findings	Item	General cardiologists		Sub-speciality cardiologists/surgeons	
		n	% needing improvement	n	% needing improvement
B	Reading/interpreting echo in presence of eccentric jet (S)	31	17*	34	21**
B	Quantitate MR severity (S)	29	18	32	20**
C	Measuring the tricuspid annulus diameter (S)	30	18*	40	24**
E	Providing recommendations/decide between immediate surgery and adopting a 'wait and see' approach (C)	66	33*	43	22
E	Providing recommendations/decide between valve replacement vs. repair (C)	73	37*	46	24**
G	Criteria for frequency of follow-up according to patient profile (K)	25	16	32	21
I	Inclusion criteria for the MitraClip clinical trial (K)	74	48*	59	36**
I	Existence and availability of clinical trials in the field of MR (other than MitraClip) (K)	90	60	66	45
I	Referring process to clinical trials (K)	82	57	69	43**
F/I	Referring process to specialised centre for percutaneous valve intervention (K)	39	24*	31	18**
F/I	Decision to refer a patient for a percutaneous valve intervention* (C)	96	48*	32	34**
I	Decision to refer a patient to a specialized centre or a/another sub-specialised cardiologist (C)	45	23	64	25

Need for improvement was defined as 1-low to 3-moderate knowledge, skill or confidence on a 5-point scale.

MR, mitral regurgitation.

* $P < 0.05$ between countries.

** $P < 0.05$ between sub-specialities.

needing improvement in 37% of general cardiologists and 24% of sub-speciality cardiologists (Table 3).

In the case scenario of asymptomatic primary MR, indication for surgery was appropriate for 57% of cardiologists but 19% chose

medical therapy first (Figure 1A and Table 5). When surgery was considered, 85% of cardiologists favoured valve repair.

In the case scenario of symptomatic primary MR at high-risk for surgery, 40% of PCPs and 16% of cardiologists introduced

Table 4 Main gaps identified from answers of primary care physicians for the three case scenarios, according to main findings detailed in Table 1

Main findings	Item	n	%
Asymptomatic severe primary MR			
A	Systematic auscultation in all patients	58	54
A	Consider referral to a cardiologist only if the murmur persists at a further examination	24	22
A	Severe MR is unexpected in an asymptomatic patient	22	20
G	During follow-up after mitral valve repair, you will refer the patient to the cardiologist only in case of symptoms	22	20
Symptomatic severe primary MR in the elderly			
A	The patient is not severely symptomatic	33	31
E	Introduce beta-blockers and ACE-inhibitors for a patient in NYHA class III with LVEF 65%	42	40
Symptomatic severe secondary MR			
F	Indicate mitral surgery in a patient in NYHA class III with suboptimal medical therapy	20	18
G	After stabilization in NYHA class II, refer to the cardiologist only if symptoms worsened	32	30

ACE, angiotensin converter enzyme; LVEF, left ventricular ejection fraction; MR, mitral regurgitation; NYHA, New York Heart Association.

Table 5 Main gaps identified from answers of general and sub-speciality cardiologists for the three case scenarios, according to main findings detailed in Table 1

Main findings	Item	General cardiologists		Sub-speciality cardiologists/surgeons		All cardiologists
		n	%	n	%	%
Asymptomatic severe primary MR						
C	Measurement of tricuspid annulus diameter on TTE before surgery	91	45	81	42	44*
E	Try medical therapy first	36	18	40	21	19*
H	ESC guidelines do not give a clear recommendation for decision-making in this particular patient	21	10	34	17	14*
Symptomatic severe primary MR in the elderly						
A	The patient is not severely symptomatic	136	68	145	74	71*
E	Introduce beta-blockers and ACE-inhibitors for a patient in NYHA class III with LVEF 65%	32	16	32	17	16
E/F	MitraClip is not an option because this is a primary (organic) regurgitation	47	23	31	16	20
Symptomatic severe secondary MR						
B	Diagnosis of secondary MR because of:					*
	the analysis of leaflet structure and movement	24	12	33	17	14
	left ventricular dilatation and dysfunction	164	81	149	77	79
B	MR is not severe according to quantitative indices	74	37	51	26	32
E	Indication for myocardial viability testing	103	51	104	54	52*
E/F	Indicate intervention in a patient in NYHA class III with suboptimal medical therapy and no myocardial viability:					*
	MitraClip	70	35	69	36	35
	Isolated mitral valve surgery	11	5	12	6	6
	Mitral + coronary surgery	46	23	39	20	22

ACE, angiotensin converter enzyme; ESC, European Society of Cardiology; LVEF, left ventricular ejection fraction; MR, mitral regurgitation; NYHA, New York Heart Association; TTE, transthoracic echocardiography.

* $P < 0.05$ between countries.

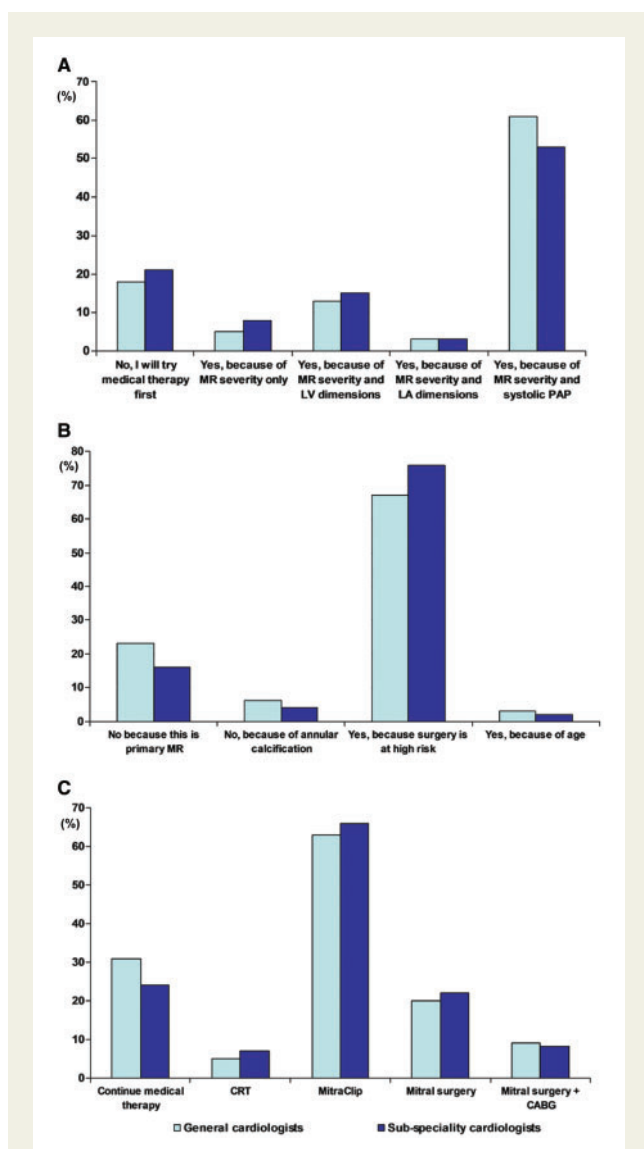


Figure 1 Answers of cardiologists to questions from case scenarios (see [Supplementary material online, Table S1](#)). (A) ‘Do you consider intervention on the mitral valve at this stage?’ (asymptomatic patient with severe primary mitral regurgitation). (B) ‘Is MitraClip an alternative to mitral surgery in this patient?’ (symptomatic elderly patient with severe primary mitral regurgitation). (C) ‘How would you treat this patient?’ (patient with ischaemic heart disease and severe secondary MR, symptomatic despite optimal medical therapy). MR, mitral regurgitation; LV, left ventricular; PAP, pulmonary artery pressure; CRT, cardiac resynchronization therapy; CABG, coronary artery bypass grafting.

beta-blockers and angiotensin-converting enzyme (ACE) inhibitors (Tables 4 and 5). Despite high-risk for surgery, 47% of PCPs and 76% of cardiologists considered that this should be weighed against the prognosis without intervention. Intervention was indicated on the mitral valve by 72% of cardiologists. Transcatheter edge-to-edge repair was considered as an alternative to surgery by 72% of cardiologists, but 20% stated this was not an option because MR was of primary origin (Figure 1B).

In the case scenario of secondary MR, transcatheter repair or surgery were frequently recommended in a symptomatic patient with suboptimal therapy instead of optimization of medical therapy (Table 5). When the patient was symptomatic under optimal medical therapy, transcatheter repair or surgery was recommended by the majority of cardiologists (Figure 1C).

Long-term management and follow-up (area of investigation 5)

Primary care physicians perceived a need for improving skills in monitoring and managing MR symptoms during long-term follow-up (56% and 46%, respectively) and for improving knowledge (50%) and skills (60%) for patient management after intervention (Table 2).

Case scenarios revealed just 20–30% of PCPs referred patients with severe MR and/or those after intervention to a cardiologist and only in the event of worsening of symptoms, and not systematically (Table 4).

Familiarity with ESC guidelines (area of investigation 6)

The use of different guidelines is shown in Figure 2.

In the case scenario of asymptomatic primary MR, 73% of cardiologists answered that ESC guidelines favour intervention, but 17% felt the ESC guidelines did not give a clear recommendation. For symptomatic secondary MR, a class IIb recommendation was appropriately mentioned by 47% of cardiologists for surgery and by 40% for transcatheter repair.

Multidisciplinary heart team (area of investigation 7)

Only a quarter of cardiologists reported a need for improvement in their level of confidence for the decision to refer a patient to a specialized centre or another sub-specialized cardiologist (Table 3).

In case scenarios, referral to a centre with specific expertise was mentioned by 88% of cardiologists for asymptomatic severe primary MR and 64% for symptomatic secondary MR.

Discussion

This contemporary mixed-methods study conducted on a large number and a wide range of PCPs, cardiologists, and surgeons combines qualitative and quantitative data, identifying important perceived gaps in knowledge and skills and objective deviations from guidelines as assessed by the three case scenarios covering diverse presentations of MR. The main findings are useful for defining objectives for future educational programs (Take home figure).

Detection of mitral regurgitation

Valvular heart disease is frequently not diagnosed in the community,^{1,3} contributing to late or no referral to surgery.² Despite limited sensitivity,^{10,18} auscultation is the only way to detect valvular disease in large populations. Echocardiographic screening is more reliable but raises organizational and economic concerns. Primary care physicians play a major role in the detection of murmurs, but only half of them performed systematic cardiac auscultation in this study. The under-use of systematic auscultation is consistent with a survey on European patients, in which their PCP used a stethoscope on every visit for 24% and never for 16%.¹⁹ The need for improving symptom

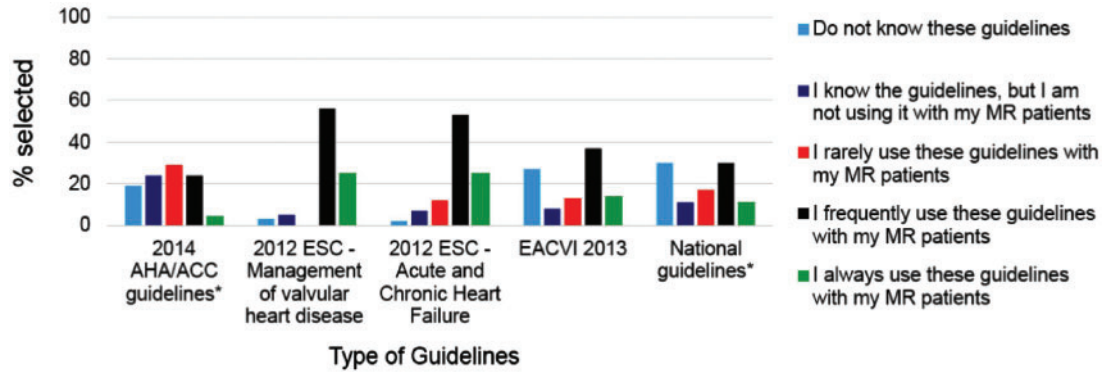
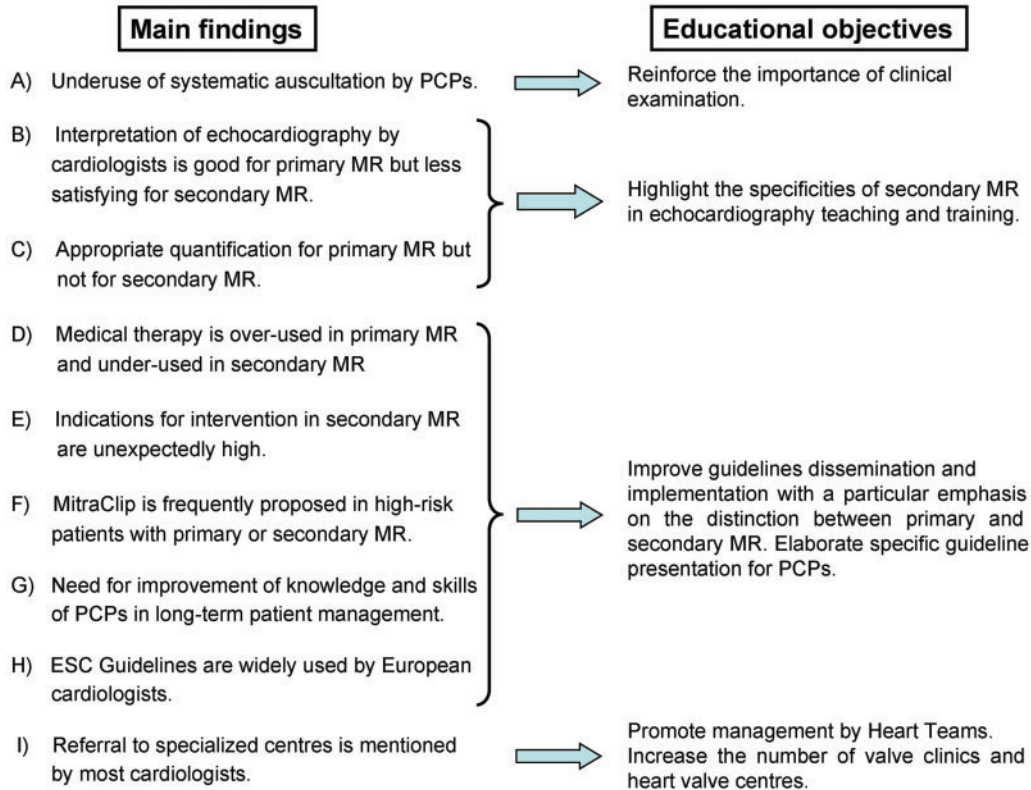


Figure 2 Use of guidelines among cardiologists for the management of patients with mitral regurgitation. MR, mitral regurgitation.



Take home figure Correspondence between main findings and educational objectives.

interpretation was reported and attested by misinterpretation of dyspnoea in the case scenario of symptomatic MR.

Interpretation of echocardiography

Interpretation of echocardiography was found to be superior than in an American survey.¹⁰ This may be partly attributed to the difference in who predominantly performs echocardiography in different countries—cardiologists in most European countries and sonographers in

the USA. There was no difference between countries with regards to the quantification of MR. A gap between guidelines and practice was the lack of measurement of the tricuspid annulus by almost half of cardiologists.

Interpretation of echocardiography was appropriate for primary MR in case scenarios. The perceived need for skill improvement for interpreting eccentric jets corresponds to particular situations, which were not presented in the case scenarios.

Interpretation of echocardiography was less satisfactory in secondary MR. Although the diagnosis of secondary MR was correct in the case scenario, it was more frequently attributed solely to demonstration of LV dysfunction rather than combined with analysis of valve anatomy and motion. This could lead to misdiagnosis in patients with primary MR and LV dysfunction. Quantification was more poorly performed for secondary than primary MR, suggesting a lack of knowledge regarding specific quantification criteria for secondary MR. This may, however, reflect the lower level of evidence supporting thresholds for secondary than for primary MR.^{4,5} These specific thresholds have not changed in the 2017 ESC guidelines, although it is mentioned that they still need to be validated in clinical trials.²⁰

Clinical decision-making

In the case scenario of asymptomatic primary MR, there was a class IIa recommendation for surgery because of pulmonary hypertension.^{4,5} As many as 19% of cardiologists used medical therapy first despite the lack of supporting evidence. This is consistent with the Euro Heart Survey in which 24% of asymptomatic patients with severe MR were not considered for surgery despite class I or IIa recommendations.²¹ Surveys in Canadian and American cardiologists also showed late referral of asymptomatic patients with severe MR.^{6,9} In symptomatic primary MR with preserved LV ejection fraction, the use of ACE-inhibitors and beta-blockers was not justified, highlighting the overuse of medical therapy in primary MR.

Intervention was considered by 72% of cardiologists in a symptomatic patient with severe primary MR, despite high-risk for surgery. This percentage is improved as compared with previous surveys. A frequent reason for denying surgery in these surveys was the presence of comorbidities.^{7,8} The more frequent consideration of intervention may be related to a better implementation of guidelines, but also to the availability of less invasive interventions, as attested by the fact that 72% of cardiologists considered transcatheter repair.

Decision-making is more difficult in secondary than primary MR due to the lack of evidence supporting the benefit of correction of MR.^{4,5} Cardiologists are less confident and less frequently indicate surgery than for primary MR.^{8,10} The only randomized trial in ischaemic MR did not find a benefit on LV remodelling when adding mitral valve surgery to coronary revascularization.²² In non-ischaemic secondary MR, observational data did not suggest a benefit from surgery.²³ These uncertainties are attested by a class IIb recommendation for intervention in American and European guidelines, provided medical therapy is optimal.^{4,5} Surprisingly, more than half of cardiologists recommended intervention in the case scenario of secondary MR despite suboptimal medical therapy. Transcatheter repair was more frequently recommended than surgery. Despite promising results from registries, the clinical benefit remains to be proven by ongoing randomized trials.²⁴

Recommendations for patient management corresponding to the three case scenarios have not changed in the 2017 ESC guidelines.²⁰

Long-term management and follow-up

The interpretation of symptoms was put forward by PCPs while referral to a cardiologist was considered only if symptoms occurred. These findings attest to a lack of knowledge on the need for echocardiographic follow-up in asymptomatic patients.^{4,5}

Familiarity with ESC guidelines

Overall, ESC guidelines were more frequently known and used by European cardiologists than American and National guidelines. However, this is somewhat discordant with the gaps observed between practice and guidelines. This highlights the need for evaluating not only self-reported knowledge of guidelines but their actual application, as in this survey including case scenarios and by dedicated registries.

Multidisciplinary heart team

Although the concepts of heart team and heart valve centres have been introduced recently in 2012 and further reinforced in the 2017 ESC guidelines,^{4,20} most cardiologists referred patients to specialized centres, in particular for primary MR, probably due to expertise in valve repair. Limited availability of valve repair was mentioned as a gap in an American survey.¹⁰ Only 64% of cardiologists referred the patient with secondary MR to a specialized centre, although different sub-speciality cardiologists should be involved in optimization of medical therapy, indications for stimulation/defibrillation and discussion of a surgical or transcatheter intervention.

Limitations

The response rates were low but consistent with other studies using the same methodology.¹⁰ Voluntary participation and self-reporting may account for potential selection and reporting biases. As the study was conducted in multiple countries, self-reporting of knowledge, skill or confidence could be influenced by cultural factors and local healthcare organization. It is not possible to extrapolate the results to other countries. Modalities of teaching information were not studied and could be the focus of future studies.

Conclusion

This European mixed-method study analysing perceived needs and actual practices from case scenarios provides an in-depth insight into insufficient guideline application in the management of MR. Dedicated registries should also assess guidelines application and complete this structured process led by the ESC aiming at identifying priority targets for needs-based educational programs with the final goal of improving patient care.

Supplementary material

Supplementary material is available at *European Heart Journal* online.

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