

European survey on valvular heart disease clinical experience from the European Society of Cardiology council on valvular heart disease

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Aims

The aim of this survey is to analyze how current recommendations on valvular heart disease (VHD) management have been adopted. Identifying potential discrepancies between recommendations and everyday clinical practice would enable us to better understand and address the remaining challenges in this controversial and complex field.

Methods and results

A total of 33 questions, distributed via email to all European Society of Cardiology (ESC) affiliated countries through the newsletter of the ESC council on VHD, were answered by 689 respondents, mainly from tertiary care settings. The results of this survey showed that VHD patients are mostly managed by tertiary care centres, where multi-disciplinary heart teams are frequently a reality. Cardiac computed tomography (CT) is often used in the preprocedural planning of transcatheter interventions, particularly for sizing and deliverability assessment. Echocardiography represents the most widely used imaging modality in the diagnostic, intra-operative and follow-up phase of VHD patients. Cardiac magnetic resonance (CMR) is still largely underused, also for conditions such as mitral annular disjunction, or for the assessment of left ventricle volumes where it is considered as the gold standard, despite 3D volumes by echocardiography having proved good comparability with CMR. As for endocarditis, despite still underused, transesophageal echocardiography (TEE) represents the approach of choice for the diagnosis of native and prosthesis valve endocarditis (up to 46% of the respondents use it). In this context, positron emission tomography-CT is largely underused.

Conclusion

There is widespread adoption of current recommendation on the evaluation of VHD and these are frequently used to guide patient management. Nonetheless, there are still many discrepancies across centres and countries which need to be addressed with the aim of improving patients' management and outcomes and ultimately positively impacting on healthcare resources.

Keywords

Valvular • Clinics • Survey

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Introduction

Valvular heart disease (VHD) remains a significant cause of morbidity and mortality globally and is linked to increased mortality especially with increasing age.^{1,2} Although rheumatic heart disease has declined in the developed world, with an increased older population, non-rheumatic heart disease is on the rise. Incidence of rheumatic disease remains prevalent in the developing world, causing up to 320 000 deaths worldwide each year.^{1,3,4} Congenital abnormalities account for roughly 6% of the cases; amongst these, bicuspid aortic valve disease, which is the most common congenital heart disease, can lead to early development of valve calcification and poor leaflet excursion.^{5,6}

Despite the great advances in the treatment of VHD, its management still varies significantly from tertiary centres, with high numbers of cases and availability of the entire spectrum of treatment options, to smaller centres where the numbers are significantly lower and some of the key elements of the heart valve centre may not be present. This, in turn, can lead to a discrepancy in the management of VHD case, depending on the experience of the team, the access to multi-disciplinary teams' members, and the availability of different and sophisticated imaging modalities. Many practitioners are now familiar with the concept of infectious endocarditis teams, consisting of cardiologists specializing in imaging and VHD, microbiologist consultant, and cardiothoracic surgeons.^{7,8} This concept can be and has been translated to all VHDs. Indeed, since 2010 the concept of heart team has rapidly entered the daily practice of many cardiologists and has found important application in the setting of VHD with the aim of determining the best treatment plan for each individual patient and by doing so, improving prognosis. This survey was conducted to analyze how current recommendations on VHD management have been adopted. Identifying similarities and discrepancies in the approach and management of VHD in multiple centres across Europe and non-European countries, as well as potential discrepancies between recommendations and everyday clinical practice would enable us to better understand and address the remaining challenges in this controversial and complex field.

Methods

Through a consensus meeting and based on the most recent European and American guidelines, the questions were decided by the European Society of Cardiology (ESC) council on VHD board, to cover all aspects of VHD. A survey monkey was then used as a survey tool to distribute these questionnaires to participants across European and non-European countries. Specifically, the survey was sent via email to all members of national societies with an affiliation with the ESC, through the newsletter of the ESC council on VHD (Table 1). The survey was sent to a total of 1000 interviewed members.

Results

Population

This survey encompasses 36 questions which were answered by 689 responders. The questionnaire was locked on March 12th, 2021. Of the 689 total respondents, 538 gave complete responses to all the survey questions. Of these, 55.8% came from Tertiary care centres, while 44.2% from secondary care settings. Most of the respondents (71.9%) practices in Europe, followed by Asia, Africa, United States/Canada, and Australia (14.8%, 7.1%, 4.9% and 1.2%, respectively). On a total of 538, 88.9% of the respondents were cardiologist, followed by residents/fellows, physicians in other disciplines, and others (6.1%, 2.2% and 2.6%, respectively). Respondent's age was fairly balanced across groups (age 20–30, 3.7%; 31–40, 27.9%; 41–50, 26.2%; 51–60, 24.5%; 61–70, 14.3%; >70, 3.4%) (Figure 1).

Table 1 Questions included in the survey

- (1) On an average month, how many patients do you personally treat in your hospital (including both in and out-patients)
- (2) What would be the best description for your practice/hospital?
- (3) Availability of cardiac surgery and/or with structural heart disease program in your practice/hospital?
- (4) What proportion of your time is spent on valvular heart disease?
- (5) Do you have a heart valve clinic in your institution?
- (6) Do you discuss every VHD case at multi-disciplinary meetings?
- (7) Do you have a multidisciplinary 'Heart Team' meeting for all valve patients requiring intervention/surgery?
- (8) If you have an 'Endocarditis Team', which of the following specialists are involved
- (9) Availability and use of diagnostic exams: which modalities are available in your hospital
- (10) Do you recommend antibiotic prophylaxis?
- (11) How often do you perform BNP or NT-pro brain natriuretic peptide (NT-proBNP) in VHD patients?
- (12) Do you refer a patient for surgery/interventional procedure when:
 - A patient is still asymptomatic, based on imaging parameters.
 - Only when the patient is symptomatic
- (13) Who follows up with the patient after surgery
- (14) When there is a discrepancy in the measurements for normal flow severe AS, which test would you use first for further assessment?
- (15) When do you use echocardiography during TAVR procedures (intraoperatively)?
- (16) Do you use one plane (PLAX) or multiplanar assessment of LVOT (including 3D) on routine AS assessment?
- (17) Which is your preferred imaging modality to assess myocardial impairment?
- (18) In left ventricular dilatation, which is the modality you use to follow up the patient prior to surgery?
- (19) How often do echocardiographers obtain ascending and descending flow reversal (even if AR is not severe)?
- (20) Are volumes by 3D echo and/or volumes by cardiac MRI added to routine assessment?
- (21) For the assessment of severe secondary MR, do you employ:
 - EROA
 - Regurgitant Volume
- (22) For the quantification of primary MR, to what extent do you agree with the following statements?
- (23) For eccentric mitral regurgitation (potentially severe), which would be your test of choice following transthoracic echocardiography?
- (24) Mitral annular disjunction: which is the modality of choice to diagnose mitral annular disjunction?
- (25) Which is your preferred imaging modality to assess myocardial impairment:
 - LVEF by Echocardiography
 - Myocardial Strain by Echocardiography
 - Detection and quantitation of myocardial fibrosis by CMR
- (26) In the case of disproportional symptoms of mitral stenosis (moderate MS but patient symptomatic), what modality would be your choice?
- (27) What is your preferred modality to assess mitral annular calcification?

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- (28) Prosthetic valve endocarditis: how often do you perform PET-CT in suspected prosthetic valve endocarditis?
- (29) Endocarditis: when an aortic abscess is suspected, which modality do you use to confirm this?
- (30) Which is your preferred modality to assess mitral annular calcification?
- (31) Which exam do you perform in cases of prosthetic valve dysfunction, for example paravalvular leak?
- (32) Do you employ 3D printing in peri procedural planning of TAVI valve-in-valve?
- (33) What is your age group?
- (34) What is your profession?
- (35) Where do you practice?

Concepts of heart team and heart valve centre

On the interviewed sample, over 2/3 had a structural heart disease program in their institution (461/677, 68.1%) and spend about 34% of their practice on VHD. Nonetheless, the presence of a Heart Valve Team was still not dominant, with a 51.8% reporting the absence of such structured clinic within their hospital/program.⁹ In instances where a Heart Valve Team was present, it was generally led by a Cardiologist. Interestingly, notwithstanding the presence or absence of a structured Heart Valve Team, most of the cases are discussed in a multidisciplinary environment, with a 21.7% being the cases requiring intervention and a 41.7% the complex cases. Only in the 20.9% of the sample, all valvular disease cases are discussed by the heart valve team, independently of the complexity or management of the case. In some instances (17.8%), the multi-disciplinary team is exclusively involved in the discussion of endocarditis cases. When present, the endocarditis team was often built of a cardiologist, cardiac surgeons, infection disease specialists, and microbiologists. Quite surprisingly, the survey showed that infectious disease specialists are only involved in roughly 32% of the cases.

Patient evaluation: diagnostic exams and indications to intervention

In relation to the imaging modalities available for the diagnosis of VHD, virtually all the interviewed sample referred the use of transthoracic echocardiography (TTE—96.9%), followed by transesophageal echocardiography (TEE—88.6%) and computed tomography (CT—80.7%). The use of dobutamine stress echocardiography, 3-dimensional (3D) echocardiography, exercise echocardiography and cardiac magnetic resonance (CMR), was also highly prevalent (75.8%, 68.4%, 64.8%, 61.5%, respectively) with a minority also using positron emission tomography (PET) (36.3%) in the diagnosis of VHD. Surprisingly, the application of biomarkers to the diagnosis of VHD was rare, with only 26% performing BNP or NT-pro-BNP routinely and a 38% only requiring it in cases where symptoms of heart failure were present. Interestingly, most of the interviewed sample relied on the results of the imaging studies to refer a patient to intervention, despite the presence/absence of symptoms (73.4%). After a valve procedure, most of the patients were followed by a community cardiologist (56%) or heart valve clinic in the context of a tertiary centre (43.6%).

Infective endocarditis

PET-CT was employed in cases where prosthetic valve endocarditis was suspected by over 35% of the interviewed sample, while 25.8% only resorted to this exam when an abscess was suspected, and over 25% never used it. In the suspect of aortic abscess, over 46% of the respondents would use a TEE to confirm the diagnosis, 11.3% an electrocardiogram (ECG)-gated CT while 39.5% would use both TEE and ECG-gated CT. Other than endocarditis, the occurrence of paravalvular leaks was generally investigated by means of TEE by over the 70% of the sample. Less frequently TTE or 3D echocardiography is used (15.4% and 10.1%, respectively).

Aortic Stenosis (AS) and transcatheter aortic valve replacement (TAVR)

The assessment of moderate AS (particularly in case of discrepancy in the measurements of normal flow AS) is still a challenging topic, with a range of used approaches and no clear winner. Despite a 53.5% declared to preferentially use stress echocardiography to rule out moderate vs. severe AS, a significant proportion did rely on CT calcium scoring (31.2%), with a minority using CMR in doubtful cases. Of interest, one of the parameters that usually is prone to error and thus can hamper the assessment of the severity of AS is the diameter of the left ventricular outflow tract (LVOT). In this context, the multi-planar approach was used in 42.4% of the cases, with a 35.9% relying on single plane assessment and reserving the multiplanar only to doubtful cases (21.7%). Ascending and descending flow reversal were obtained as part of the standard echo protocol in roughly 45% of the cases, while in a similar proportion, they were only used when hemodynamically significant aortic regurgitation was suspected. The use of intraoperative echocardiography to guide transcatheter aortic valve replacement (TAVR) was routinely based on TEE in 36.7% of the cases, with a 20.7% relying on TTE guidance and almost 20% of physicians not using echocardiography during TAVR procedures. In the pre-procedural planning of a TAVR valve-in-valve procedure, 11.9% used 3D printing.

Mitral regurgitation

Secondary or functional mitral regurgitation (MR) is a condition that poses several challenges for the clinicians, starting from the difficulties in its assessment and grading.¹⁰ Respondents to this survey employ effective regurgitant orifice area more frequently than Regurgitant Fraction to establish severity of functional MR (61.8% vs. 38.2%, respectively). For the quantification of primary MR, proximal isovelocity surface area (PISA) was employed by a total 66.2%; 51.6% trusted left ventricular (LV) dimensions in terms of remodelling, 49.6% employ exercise echocardiography or cardiopulmonary exercise testing (CPEx) in borderline degree of MR, 40.8% employ 3D colour Doppler and 57.2% use regurgitant fraction in clinical practice. In eccentric MR cases, after TTE, TEE was generally used to define the morphology of the valve and thus the aetiology of the regurgitation, with CMR being used only by the 11% of the respondents.

Mitral stenosis

In cases of disproportional symptoms of mitral stenosis (MS), with symptoms that are not justified by the severity of MS, most of the clinician would use exercise echocardiography to rule out the presence of a misdiagnosed severe MS (64.8%). Echocardiography represents the method of choice to assess Mitral annular calcification for the 51.4% of the interviewed sample, followed by CT (32.7%) and less frequently by 3D echocardiography (11.2%).

Mitral-annular disjunction

Mitral annular disjunction (MAD) consists of an altered spatial relation between the left atrial wall, the attachment of the mitral leaflets, and the

Q: What is your age group ?

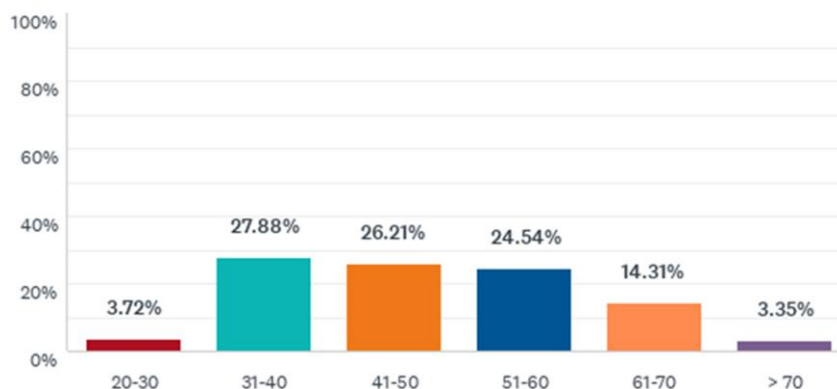


Figure 1 Age distribution of the people completing the survey.

upper part of the LV free wall, which is seen on echocardiography as a wide separation between the atrial wall-mitral valve junction and the top of the LV free wall. There has been increased attention to MAD in recent years due to its association with myxomatous mitral valve disease and mitral valve prolapse and importantly because of its potential association with ventricular arrhythmias and sudden cardiac death.¹¹ This survey reports that the modality of choice to assess MAD is echocardiography, being used by over 70% of the respondents, while CMR was used by 28.8% of the sample.

Left ventricular assessment

The evaluation of LV function in patients with VHD is of utmost importance to establish timing and indication for intervention as well as prognosis. The assessment of LV ejection fraction, despite its well-known limitations, still represents the most widely used approach (56%) for this purpose. Myocardial strain analysis is still underutilized, with only 29.2% applying this methodology to the study of LV function. Echocardiography was widely used to follow-up patients with LV dysfunction prior to a scheduled surgery/intervention for VHD (92.2%). In this context, the estimation of LV volumes was mostly done by 2D echocardiography (51.3%), while the use of 3D volumes and CMR were rarely employed (16.2% and 9.1%, respectively) (see [Supplementary material](#)).

Discussion

VHD is a leading cause of death in Europe and the Western Countries. In the early 2000s, the Euro Heart Survey on VHD depicted the prevalence and management at that time of valve disease in Europe. Since then, the management of VHD has evolved with new guidelines being published and importantly the 'outbreak' of transcatheter therapies.

This survey was designed to identify potential discrepancies between guidelines and current clinical practices with the scope of having a better understanding of the management of patients with native VHD or previous interventions. The results of this survey highlight both adherences and discrepancies between clinical practice and VHD guidelines. Briefly, few considerations can be made based on these results:

- (1) Tertiary Care centres, where multi-disciplinary Heart Teams are frequently a reality, are highly involved in the management of VHD patients.
- (2) Cardiac CT is often used in the preprocedural planning of transcatheter interventions, particularly for sizing and deliverability assessment.

- (3) Echocardiography represents the most widely used imaging modality in the diagnostic, intra-operative and follow-up phase of VHD patients.
- (4) CMR is still largely underused particularly for conditions such as MAD, for the assessment of LV volumes and for the purpose of viability or scarring assessment.
- (5) As for endocarditis, despite still underused (up to 46% of the respondents use it), TEE represents the approach of choice for the diagnosis of native and prosthesis valve endocarditis. PET-CT is largely underused in the diagnostic approach to valve endocarditis.

Based on these results, there is still a long way to go to improve VHD management and importantly, to achieve a level of standardization across countries. One example of the wide discrepancies was the echocardiographic guidance of TAVR procedures. This is, in fact, routinely based on TEE in 36.7% of the cases, with a 20.7% relying on TTE guidance and a vast portion (almost 20%) using none. It would be interesting to understand how and if this translates in any differences in outcomes, particularly the occurrence of more than moderate paravalvular regurgitation. Another interesting point is how rarely TEE is used in the diagnostic approach of endocarditis. TEE is, in fact, recommended by guidelines, but still according to this survey, only 46% of the respondents would request it in case where clinical suspicion is high but TTE was not conclusive.¹²

Optimizing outcomes for patients remains a priority for providers, and therefore the relationship between experience, clinical approach, and clinical outcomes, which has been apparent across procedurally based medical fields, is of great interest. However, the number of procedures performed does not simply explain this phenomenon. Rather, clinical judgment, decision making, and appropriate patient selection are all thought to have important roles. In this setting, two strategies could be potentially adopted to improve results and patient outcomes: (i) transfer cases to tertiary care centres, where numbers are higher and thus is experience and (ii) increase cases in smaller centres, to bring the learning curve up to an adequate level.

The explosion of structural interventions made very clear that heart valve clinics are a necessity¹³ and furthermore, the multimodality valvular assessment to be implemented in clinical practice.^{14,15} A heart valve specialist can be characterized¹⁵ by: (i) a record of training within a heart valve centre; (ii) valve-related programmed activity, e.g. valve clinics, inpatient care, involvement with Heart Team meetings, specialization in imaging of valve disease, research; (iii) continuous medical education in valve disease by attendance at scientific meetings of

professional societies (e.g. the ESC Working Group on VHD, ESC, European Association of Cardiovascular Imaging (EACVI) or European Association of percutaneous coronary interventions (EAPCI), European Association for Cardiothoracic Surgery or National Society Working Groups on Valve Disease).

How to achieve homogeneity?

Adherence to clinical guidelines in terms of the 'first line (1a) suggested tests' is important. But furthermore, the valve physician should prove competency through continuous education: conferences, online meetings and even certification/recertification. As we move towards sub-specialization, the term 'structural imager' raises the question of which clinicians need to complete a specific curriculum¹⁶ or supplement existing knowledge. The consensus on structural imager curriculum will help enhancing valve centres and bring homogeneous results throughout European centres. ESC council on VHD is aiming towards the education and knowledge development of physicians as well as the establishment of valve clinics but also to mitigate any gaps of knowledge in the community.

Limitations

This study has all the intrinsic limitations of a survey. In particular, as stated in the methods section, the survey was sent to members of cardiac societies that are affiliated to the ESC. This represents a bias in the sense that the results of this survey may not be generalized across countries. Additionally, the overall number of survey respondents is relatively low, and the majority worked in tertiary care centres with a high volume of patients. This is another reason why the findings of this survey may not be generalized across other clinical environments.

Conclusion

This European survey on clinical practices on VHD was conducted to identify discrepancies between guidelines and clinical practice. Despite the intrinsic limitations of a survey, the results of this survey highlighted differences in clinical practices across countries and centres as well as some gaps in knowledge. Through continuous education and ongoing support, it is our duty to mitigate results and provide greater homogeneity across centres and importantly across countries.

Lead author biography



Anna is a Fellow of the American Society of Echocardiography and a Nucleus Member of the Council on Valvular Heart Disease of the European Society of Cardiology. She is an active reviewer for the most important cardiology peer-reviewed international journals such as *Circulation*, *JACC*, *JASE*, *American Journal of Cardiology*, *European Heart Journal*. Anna serves as Editorial Board Member of the *Journal of the American Society of Echocardiography*. Her research is focused on valvular

heart disease, with a particular interest in the imaging approach to tricuspid and mitral regurgitation physiopathology. Anna is currently Medical Director of the Cardiac Imaging Core Lab of the Baylor Scott & White Research Institute, and in this role is actively involved in many device studies for the treatment of valve disease. In the meantime, Anna has also been pursuing her academic career and is now an Assistant Professor in the Department of Cardiology of the University Federico II of Naples, Italy.

Supplementary material

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

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