Current use of cardiac magnetic resonance in tertiary referral centres for the diagnosis of cardiomyopathy: the ESC EORP Cardiomyopathy/Myocarditis Registry

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Aims
Cardiac magnetic resonance (CMR) is recommended in the diagnosis of cardiomyopathies, but it is time-consuming, expensive, and limited in availability in some European regions. The aim of this study was to determine the use of CMR in cardiomyopathy patients enrolled into the European Society of Cardiology (ESC) cardiomyopathy registry [part of the EURObservational Research Programme (EORP)].

Methods and results
Three thousand, two hundred, and eight consecutive adult patients (34.6% female; median age: 53.0 ± 15 years) with cardiomyopathy were studied: 1260 with dilated (DCM), 1739 with hypertrophic (HCM), 66 with restrictive cardiomyopathy, and 36 with arrhythmogenic right ventricular cardiomyopathy (ARVC). CMR scans were performed at baseline in only 29.4% of patients. CMR utilization was variable according to cardiomyopathy subtypes: from 51.1% in ARVC to 36.4% in HCM, 33.8% in DCM, and 20.6% in DCM (P < 0.001). CMR use in tertiary referral centres located in different European countries varied from 1% to 63.2%. Patients undergoing CMR were younger, less symptomatic, less frequently had implantable cardioverter-defibrillator (ICD)/pacemaker implanted, had fewer cardiovascular risk factors and comorbidities (P < 0.001). In 28.6% of patients, CMR was used along with transthoracic echocardiography (TTE); 67.6% patients underwent TTE alone, and 0.9% only CMR.

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Introduction

Cardiomyopathies are a heterogeneous group of disorders defined by structural and functional abnormalities of the myocardium unexplained by loading conditions or coronary artery disease. Cardiac imaging is a prerequisite for the diagnosis and management of cardiomyopathy and international guidelines on the assessment of cardiomyopathies recommend a multimodality imaging approach to diagnosis, including transthoracic echocardiography (TTE) and cardiac magnetic resonance (CMR). Some limitations of TTE may be overcome using CMR. The great advantage of CMR imaging is not only the important role in patients with poor echo windows but also the crucial role in evaluating tissue characteristics and myocardial perfusion. However, CMR is a time-consuming and expensive method with limited availability in some European regions. It can be anticipated that the real-life choice of the appropriate technique is based on expert knowledge, cost–benefit ratio and, most importantly, its availability. However, no data are available regarding the current use of CMR in cardiomyopathies, especially at a European level.

The Cardiomyopathy/Myocarditis Registry is part of the EUObserVational Research Programme (EORP) and is designed to collect prospective clinical data on patients with a confirmed diagnosis of cardiomyopathy. The aim is to provide insights into the contemporary features, diagnostic process, and management of patients with cardiomyopathy across Europe.

In this study of adult patients with cardiomyopathy enrolled in the registry, we analysed the use of CMR and the potential CMR determinants according to cardiomyopathy subtypes and clinical profile of patients in different European tertiary cardiology centres.

Methods

General design

The design and protocol for the EORP Cardiomyopathy/Myocarditis Registry as well as the mandatory criteria for the participating centres have been reported previously. The study was approved by local ethics committees and all participants gave written informed consent to registry enrolment. The diagnostic work-up and therapy as documented by the registry reflected the local approach to management of cardiomyopathy patients. The data on patients’ demographics and clinical characteristics were gathered by means of structured electronic case report form accessible via a secure website. The study was coordinated and supervised by the EORP department of ESC.

Patients and cardiomyopathies subtypes

Three thousand, two hundred and eight consecutive adult patients (34.9% female; median age at enrolment 53.0 ± 15 years; mean age the first evaluation in the centre: 49 ± 15 years) with cardiomyopathy were enrolled in the registry. Less than one-third of patients enrolled in the registry underwent CMR and the use varied greatly between cardiomyopathy subtypes, clinical profiles of patients, and European tertiary referral centres. This gap with current guidelines needs to be considered carefully by scientific societies to promote wider availability and use of CMR in patients with cardiomyopathies.
study: 1260 had dilated cardiomyopathy (DCM); 1739 hypertrophic cardiomyopathy (HCM); 66 restrictive cardiomyopathy (RCM); and 143 arrhythmogenic right ventricular cardiomyopathy (ARVC). Patients were recruited in 68 centres located in 18 countries. Participating centres should have the expertise in management of cardiomyopathies and were selected using pre-specified criteria, that is, Cardiac Magnetic Resonance Imaging Lab with experience in diagnosis of typical and atypical cardiomyopathies. The number of enrolled patients was diverse from 27 up to 659 per country. The inclusion criteria comprised: age >18 years, consent to study participation and unequivocal diagnosis of cardiomyopathy consistent with diagnostic criteria for either probands or relatives. All the definitions applied for the study population were formerly specified in the core manuscript. For the purpose of the study, the whole cardiomyopathy population was divided into subjects with CMR (CMR population) and without CMR used in the diagnostic process (non-CMR population).

Diagnostic tests
Data on the following tests regarding cardiomyopathy diagnosis were noted in the CRF: electrocardiogram, transthoracic echocardiography (TTE) with Doppler assessment, CMR, 24 h ECG Holter monitoring, exercise test, and genetics. Data on all tests were recorded at two time points: at baseline and at 1-year follow-up. The analysis presented here was focused on CMR application in the cardiomyopathy diagnostic process; TTE was used as a comparator for CMR applicability.

Among detailed TTE and CMR parameters registered in the CRF protocol, the study presented information on whether CMR and TTE were performed and on conclusion of the CMR scanning (normal, abnormal, and inconclusive). According to the EORP Registry CRF, the following reasons for diagnosis were taken into account: incidental, symptoms, history of cardiac arrest, family screening, and so on.

Statistical analysis
Univariate analysis was applied to both continuous and categorical variables. Continuous variables were reported as mean ± standard deviation (SD) and/or as median and interquartile range (IQR) when appropriate. Among-group comparisons were made using the non-parametric test (Kruskal–Wallis test). Categorical variables were reported as percentages. Among-group comparisons were made using the χ² test or a Fisher’s exact test if any expected cell count was <5. A univariate logistic regression analysis was performed to identify variables associated with CMR use in study population. Odds ratio (OR) and 95% confidence intervals were obtained. All analyses were performed using SAS statistical software version 9.4 (SAS Institute Inc., Cary, NC, USA).

Results
Prevalence of CMR use in cardiomyopathy patients
Baseline CMR scans were performed in 944 (29.4%) patients. The prevalence of CMR use in different cardiomyopathies was as follows: 20.6% in DCM, 33.8% in HCM, 36.4% in RCM, and 51.1% in ARVC (P < 0.001) (Table 1 and Figure 1). Abnormal CMR results were present in 93.4% of patients, with the highest percentage in RCM (95.8%) and HCM (94.9%) followed by DCM (91.5%) and ARVC (87.7%) (P = 0.030); normal CMR results were registered in 5.6% of patients, and only 1.0% the CMR results were inconclusive for diagnosis (Table 1).

In 83 subjects without a baseline CMR imaging, the CMR evaluation was focused on CMR application in the cardiomyopathy diagnostic process. The total prevalence of CMR use at baseline and at 1-year follow-up raised to 32.0% with the highest prevalence in ARVC (53.9%) (Table 1).

The prevalence of CMR use (baseline+1-year follow-up data) in patients with cardiomyopathies varied from 1% to 63.2% in centres located in different European countries (Figure 2).

Demographic and clinical characteristics of CMR and non-CMR populations
Some demographic features differed in patients diagnosed using CMR compared to the non-CMR population. Age at enrolment (50.0 ± 15.7 vs. 54.8 ± 14.6 years, P < 0.001) and age at the first evaluation in the centre (46.8 ± 16.4 vs. 50.5 ± 15.5 years, P < 0.001) were lower in the CMR population. The CMR group had lower BMI (26.5 ± 4.6 vs. 27.3 ± 5.0 kg/m², P < 0.001), Inherited metabolic disorders were more frequently observed in CMR subjects (2.0 vs. 0.7%, P = 0.012). NYHA class was less advanced in the CMR population (NYHA I/II/III/IV: 37.0/43.0/16.5/3.4%) than in non-CMR subjects (NYHA I/II/III/IV: 23.5/47.9/24.3/4.4%, P < 0.001). History of arrhythmias, atrial fibrillation (20.3% vs. 36.2%, P < 0.001), sustained VT (8.2% vs. 12.8%, P < 0.001), and AV block (6.1% vs. 10.5%, P = 0.003) were less frequent in CMR than in non-CMR population.

The percentage of the patients with implanted ICD was lower in the CMR as compared with the non-CMR population (18.0% vs. 29.67%, P < 0.001). The ICDs were implanted in approximately 80% patients for primary and in 20% for secondary prophylaxis of sudden cardiac death (SCD) both in CMR and non-CMR subjects. Among patients implanted for the primary prophylaxis of SCD (n = 677): 148 (21.86%) subjects were examined by CMR. Among patients implanted for the secondary prophylaxis of SCD (n = 155): 37 (23.87%) underwent CMR.

The following comorbidities were less prevalent in CMR population: arterial hypertension (29.8% vs. 39.3%, P < 0.001), diabetes mellitus (9.8% vs. 13.9%, P = 0.001), hyperlipidaemia (28.8% vs. 39.3%, P < 0.001), and renal impairment (6.5% vs. 12.8%, P < 0.001).

Univariate logistic regression analysis of different demographic, clinical, and imaging variables associated with the CMR use in the whole population confirmed the above-mentioned results and quantified the magnitude of effects through odds ratio (Table 2).

CMR use and reason for cardiomyopathy diagnosis
In patients in whom the CMR imaging was performed at baseline and/or follow-up, incidental, history of cardiac arrest, family screening, and other reasons for diagnosis, were registered more frequently than in non-CMR population. On the other hand, in non-CMR subjects, the presence of symptoms dominated as a reason for diagnosis (71.7% vs. 57.3% in CMR population, P < 0.001) (Table 3). Similar observations were obtained in patients with DCM (P < 0.001) and HCM (P = 0.01) (Table 4).
Table 1 Prevalence of CMR use in a whole cardiomyopathy population and in different types of cardiomyopathies

| Variables                      | Type of cardiomyopathy | P value |
|-------------------------------|------------------------|---------|
|                               | All (N = 3208)         |         |
| CMR scan performed            |                        |         |
| CMR scan                       | Normal                 | 0.941   |
| CMR scan abnormal              |                        | 0.561   |
| CMR scan inconclusive          |                        | 0.094   |
| TTE                           |                        | 0.962   |
|                               | All (N = 1260)         |         |
| CMR scan performed            | Normal                 | 0.259   |
| CMR scan abnormal              |                        | 0.057   |
| CMR scan inconclusive          |                        | 0.116   |
| TTE                           |                        | 0.960   |
|                               | All (N = 1739)         |         |
| CMR scan performed            | Normal                 | 0.073   |
| CMR scan abnormal              |                        | 0.007   |
| CMR scan inconclusive          |                        | 0.014   |
| TTE                           |                        | 0.951   |
|                               | All (N = 66)           |         |
| CMR scan performed            | Normal                 | 0.006   |
| CMR scan abnormal              |                        | 0.008   |
| CMR scan inconclusive          |                        | 0.013   |
| TTE                           |                        | 0.951   |
|                               | All (N = 143)          |         |
| CMR scan performed            | Normal                 | 0.011   |
| CMR scan abnormal              |                        | 0.001   |
| CMR scan inconclusive          |                        | 0.001   |
| TTE                           |                        | 0.951   |

Discussion

This study shows that less than one-third of adult patients enrolled in the ESC EORP Cardiomyopathy Registry underwent CMR and that CMR characterization of myocardial tissue is fundamental in cases of suspected amyloidosis, sarcoidosis, and familial disease. In contemporary cardiology practice, TTE followed by CMR as complementary modality should be implemented. As a result of clear guidance on the importance of CMR in characterizing cardiomyopathy subtypes, ESC guidelines recommended the use of CMR in nearly all cardiomyopathy subtypes except DCM, as well as for further subtypes with a higher risk of late mortality.

At baseline, CMR was used as a single diagnostic method in only 0.0% of patients with HCM, in 7.6% of patients with DCM, in 18.2% of patients with ARVC, and in 45.6% of patients with ARVC (Table 2). This demonstrates that CMR imaging should be performed both for diagnosis, prognosis, and treatment strategy, and the prediction of myocardial tissue evaluation. TTE was the only diagnostic imaging method used in 67.6% of patients enrolled in the ESC EORP Cardiomyopathy Registry. The Registry provided data also on the conclusions of the CMR characterization of myocardial tissue. CMR imaging was used to assess and to diagnose cardiomyopathy subtypes, as well as for further subcategories, and for further subtypes with a higher risk of late mortality, as well as for further subcategories, and for further subtypes with a higher risk of late mortality.
however, CMR was used only in 36.4% of RCM subjects. Access to CMR assessment was even less in HCM (33.8%) and DCM (20.6%). These data contrast with current ESC guidelines for HCM, where CMR is a class I, level B recommendation in the evaluation of heart disease and Class I, Level C recommendation in patients with suspected HCM, who have inadequate
echocardiographic window in order to confirm the diagnosis. In the case of HCM and DCM, myocardial scar burden is also an important consideration when assessing prognosis and risk for sudden death risk.\textsuperscript{19,21}

**Table 2** Demographic and clinical characteristics of patients with cardiomyopathy associated with the use of CMR (based on baseline and follow-up data)—simple comparison and logistic regression analysis

| Variables                               | CMR \((N = 1027)\) | Non-CMR \((N = 2181)\) | \(P\)-value | OR (95\% CI) | OR \(P\)-value |
|-----------------------------------------|---------------------|------------------------|-------------|--------------|---------------|
| Age at enrolment (years), mean ± SD     | 50.0 (±15.7)        | 54.8 (±14.6)           | <0.001      | 0.979 (0.974–0.984) | <0.001        |
| Age at first evaluation in the centre, mean ± SD | 46.8 (±16.4)        | 50.5 (±15.5)           | <0.001      | 0.986 (0.981–0.990) | <0.001        |
| Gender: female                          | 355/1027 (34.57%)   | 764/2181 (35.03%)      | 0.797       | 0.980 (0.838–1.145) | 0.798         |
| Body mass index (kg/m\(^2\)), mean ± SD | 26.5 (±4.6)         | 27.3 (±5.0)            | <0.001      | 0.970 (0.955–0.986) | <0.001        |
| Inherited metabolic disorder           | 10/507 (1.97%)      | 11/1586 (0.69%)        | 0.012       | 2.879 (1.215–6.819) | 0.016         |
| NYHA class                              |                     |                        |             |              |               |
| NYHA I                                  | 314/848 (37.03%)    | 419/1784 (23.49%)      | <0.001      | /            | /             |
| NYHA II                                 | 365/848 (43.04%)    | 854/1784 (47.87%)      | 0.570       | 0.986 (0.838–1.145) | 0.001         |
| NYHA III                                | 140/848 (16.51%)    | 433/1784 (24.27%)      | 0.432       | 0.892 (0.591–1.347) | 0.001         |
| NYHA IV                                 | 29/848 (3.42%)      | 78/1784 (4.37%)        | 0.496       | 0.866 (0.633–1.183) | 0.365         |
| History of arrhythmias                  |                     |                        |             |              |               |
| History of atrial fibrillation          | 208/1027 (20.25%)   | 790/2181 (36.22%)      | <0.001      | 0.557 (0.410–0.773) | <0.001        |
| History of sustained VT                 | 84/1027 (8.18%)     | 278/2181 (12.75%)      | <0.001      | 0.610 (0.472–0.788) | <0.001        |
| History of resuscitated VF/cardiac arrest | 32/1027 (3.12%)   | 99/2181 (4.54%)        | 0.057       | 0.676 (0.451–1.015) | 0.059         |
| History of AV block                     | 31/507 (6.11%)      | 166/1586 (10.47%)      | 0.003       | 0.557 (0.374–0.829) | 0.004         |
| History of BBB                          | 83/507 (16.37%)     | 373/1586 (23.52%)      | <0.001      | 0.637 (0.490–0.828) | <0.001        |
| Family history of sudden death          | 170/983 (17.29%)    | 354/1986 (17.82%)      | 0.721       | 0.964 (0.788–1.179) | 0.722         |
| Cardioverter defibrillator implanted    | 185/1027 (18.01%)   | 647/2181 (29.67%)      | <0.001      | 0.521 (0.433–0.626) | <0.001        |
| Primary prophylaxis                     | 148/185 (80.00%)    | 529/647 (81.76%)       | 0.587       | 0.892 (0.591–1.347) | 0.587         |
| Secondary prophylaxis                   | 37/185 (20.00%)     | 118/647 (18.24%)       |            |              |               |
| Pacemaker implanted                     | 45/1027 (4.38%)     | 279/2181 (12.79%)      | <0.001      | 0.309 (0.224–0.428) | <0.001        |
| History of stroke: TIA or Stroke        | 59/1019 (5.79%)     | 144/2172 (6.63%)       | 0.365       | 0.866 (0.633–1.183) | 0.365         |
| Comorbidities                           |                      |                        |             |              |               |
| Arterial hypertension                   | 306/1027 (29.80%)   | 858/2181 (39.34%)      | <0.001      | 0.654 (0.558–0.767) | <0.001        |
| Diabetes mellitus I or II               | 101/1027 (9.97%)    | 302/181 (13.85%)       | 0.001       | 0.679 (0.535–0.862) | 0.001         |
| Hyperlipidaemia/dyslipidaemia           | 296/1027 (28.82%)   | 857/2181 (39.29%)      | <0.001      | 0.626 (0.533–0.734) | <0.001        |
| Renal impairment                        | 67/1027 (6.52%)     | 278/2181 (12.75%)      | <0.001      | 0.478 (0.362–0.631) | <0.001        |
| Chronic obstructive pulmonary disease   | 44/1027 (4.28%)     | 114/2181 (5.23%)       | 0.250       | 0.812 (0.538–1.159) | 0.250         |

AV, atrioventricular; BBB, bundle branch block; CI, confidence interval; CMR, cardiac magnetic resonance imaging; NYHA, New York Heart Association classification; OR, odds ratio; TIA, transient ischaemic attack; VF, ventricular fibrillation; VT, ventricular tachycardia.

**Table 3** CMR use depending on the reason for diagnosis of cardiomyopathies (based on baseline and follow-up data)

| Reason for diagnosis | CMR \((N = 1027)\) | Non-CMR \((N = 2181)\) | \(P\)-value |
|----------------------|--------------------|------------------------|-------------|
| Incidental           | 214/995 (21.51%)   | 285/2025 (14.07%)      | <0.001      |
| Symptoms             | 570/995 (57.29%)   | 1452/2025 (71.70%)     | <0.001      |
| History of cardiac arrest | 18/995 (1.81%) | 29/2025 (1.43%)        | <0.001      |
| Family screening     | 147/995 (14.77%)   | 201/2025 (9.93%)       | <0.001      |
| Other                | 46/995 (4.62%)     | 58/2025 (2.86%)        | <0.001      |
| ND                   | 32                 | 156                    |             |

CMR in different centres/countries

Our data show that CMR has variable and limited availability in some European centres. The differences between centres localized in different countries need to be interpreted cautiously as the ESC registry...
Cardiac magnetic resonance in patients with cardiomyopathy

**Table 4** CMR use depending on the reason for diagnosis of different cardiomyopathies (based on baseline and follow-up data)

| Reason for diagnosis | CMR (N = 280) | Non-CMR (N = 980) | P-value | CMR (N = 644) | Non-CMR (N = 1095) | P-value |
|----------------------|---------------|-------------------|---------|---------------|-------------------|---------|
| Incidental           | 36/273 (13.19%) | 80/925 (8.65%)    | <0.001  | 168/620 (27.10%) | 196/996 (19.68%) | 0.001   |
| Symptoms             | 194/273 (71.06%) | 776/925 (83.89%)  |         | 309/620 (49.84%) | 595/996 (59.74%) |         |
| History of cardiac arrest | 4/273 (1.47%)   | 16/925 (1.73%)    |         | 7/620 (1.13%)    | 11/996 (1.10%)   |         |
| Family screening     | 26/273 (9.52%)  | 31/925 (3.35%)    |         | 107/620 (17.26%) | 161/996 (16.16%) |         |
| Other                | 13/273 (4.76%)  | 22/925 (2.38%)    |         | 29/620 (4.68%)   | 33/996 (3.31%)   |         |
| ND                   | 7              | 55                |         | 24             | 99                |         |

**Reason for diagnosis**

| CMR (N = 26)               | Non-CMR (N = 40) | P-value |
|----------------------------|------------------|---------|
| Incidental                 | 3/26 (11.54%)    | 2/40 (5.00%) | 0.738  |
| Symptoms                   | 22/26 (84.62%)   | 36/40 (90.00%) |         |
| History of cardiac arrest  | 0/26 (0.00%)     | 0/40 (0.00%)   |         |
| Family screening           | 0/26 (0.00%)     | 1/40 (2.50%)   |         |
| Other                      | 12/26 (4.35%)    | 1/40 (2.50%)   |         |
| ND                         | 7                | 55              |         |

**Table 5** Application of different imaging modalities for the diagnosis of cardiomyopathies (based on baseline data)

| Variables | CMs (N = 3208) | DCM (N = 1260) | HCM (N = 1739) | RCM (N = 66) | ARVC (N = 143) |
|-----------|----------------|---------------|----------------|--------------|----------------|
| TTE (+)/CMR (-) | 2170/3208 (67.64%) | 968/1260 (76.83%) | 1098/1739 (63.14%) | 39/66 (59.09%) | 65/143 (45.45%) |
| TTE (+)/CMR (+)  | 916/3208 (28.55%)  | 253/1260 (20.08%)  | 568/1739 (32.66%)  | 24/66 (36.36%)  | 71/143 (49.65%)  |
| TTE (-)/CMR (+)  | 28/3208 (0.87%)   | 6/1260 (0.48%)    | 20/1739 (1.15%)   | 0/66 (0.00%)    | 2/143 (1.40%)    |

**ARVC**, arrhythmogenic right ventricular CM; CM, cardiomyopathy; CMR, cardiac magnetic resonance; DCM, dilated CM; HCM, hypertrophic CM; ND, no data; RCM, restrictive CM; TTE, transthoracic echocardiography.

is, by definition, limited to a small number of selected centres that may not be representative of local healthcare systems. Nevertheless, the frequency of CMR use varied substantially between centres localized in European countries with the highest percentage reaching 63.2% and the lowest 1%. Indications for CMR assessment are well-established, thus it may be assumed that the low frequency of CMR use relates to local restraints, for example, relatively high costs and incomplete reimbursement. Limited access to scanners with cardiac dedication and lack of skills to interpret CMR images may also partly explain our findings. Importantly, most patients in the registry were enrolled at tertiary reference centres and teaching hospitals, and thus the use of CMR in general cardiovascular practice is likely to be even lower.

**CMR and clinical profile of patients**

In addition to the variation between cardiomyopathies, we observed differences in the characteristics of patients that were scanned. The CMR population was younger, less symptomatic, with a lower prevalence of cardiovascular risk factors and associated cardiovascular diseases compared to the non-CMR population. This may be explained by the perceived need for CMR in patients with milder disease in whom the diagnosis was less secured or in whom risk assessment was more challenging. On the other hand, concomitant renal impairment as the limitation for contrast administration may explain less-frequent CMR use in this population. In support of this, the reason for diagnosis in patients undergoing CMR was more likely to be incidental or prompted by family screening rather than symptoms. Another explanation is that many patients with the most severe disease had ICDs implanted as thus were difficult to scan. It should be noted that electrotherapy could be a limitation for CMR use in cardiomyopathy patients. On the other hand, the decision of ICD implantation is still too rarely taken based on the reference imaging modality of CMR.

The indications (primary vs. secondary) for SCD prophylaxis did not determine the percentage of patients undergoing CMR imaging in the EORP Registry. The CMR use was similar in population with the urgent indications for ICD implantation (secondary prophylaxis of SCD) as well as in population with the elective ICD implantations (primary prophylaxis of SCD).
Study limitations

There are limitations intrinsic to all registries including selection bias and lack of adjudication. As most patients were enrolled in tertiary referral centres, our results may not be generally applicable, and CMR use could be even lower in less expert centres. In relation to the considerable disparities among centres located in different countries on prevalence of CMR use, it should be emphasised that our results pertain primarily to centres with high CMR utilization. Participating centres should have the expertise in management of cardiomyopathies, that is, CMR Imaging Lab with experience in diagnosis of typical and atypical cardiomyopathies. Therefore, the presented data may even overestimate the actual CMR use. The considerable disparities among the number of enrolled patients should also be noted. Especially low-number centres may mismatch analysis of the percentage of CMR use. Additionally <50% of the ESC affiliated counties have been enrolled into the Registry and it constitutes the next limitation of the study. It should be noted that some patients had ICD at baseline or underwent ICD implantation during the follow-up, thus limiting CMR use. Generally, a lot of therapeutic decisions, that is, ICD implantation for primary prevention of SCD, have been made without ‘gold-standard’ like CMR imaging.

The follow-up was as short as 12 months and a waiting time for CMR might have been longer in some countries due to reimbursement issues. The study presents only information on whether CMR was performed and on conclusion of the CMR, without details of the CMR imaging. The registry was not dedicated to study a temporal sequence of the use of CMR and TTE in cardiomyopathy diagnostic process and an impact of the CMR result on the management. This is an inherent limitation of all registries.

Conclusion

The EORP Cardiomyopathy/Myocarditis Registry provides real-life data on the use of CMR in patients with cardiomyopathies. Regardless of the potential value of CMR in this setting, the overall use of CMR in Europe is limited. Less than one-third of patients enrolled in the registry underwent CMR and the use varied greatly between cardiomyopathy subtypes, clinical profiles of patients, and European tertiary referral centres. This gap between society recommendations and clinical practice needs to be better understood and should be considered more deliberately in the drafting of practice guidelines. An improvement regarding access, training, and reimbursement is necessary to provide wider application of CMR in diagnosis of cardiomyopathies.

Supplementary data

Supplementary data are available at European Heart Journal - Cardiovascular Imaging online.

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