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REVIEW ARTICLE

A Method for the Assessment of Mitral Valve Regurgitation Grade and Severity

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Abstract:

Background:

Previous grading and severity scores of MR were based on a mix of objective echocardiographic data and subjective findings such as the presence or absence of symptoms. There is a need for a grade - and a severity -score for Mitral Valve Regurgitation (MR) that is based purely on objective findings and avoids the ambiguity of labelling the same degree of MR differently according to symptoms severity and/or the underlying etiology.

Methods:

We reviewed published reports regarding MR severity and grades and provided a method for the assessment of MR severity and grades based purely on objective data regardless of the symptom(s) and/or underlying cause(s) of MR. Objective Echocardiographic and/or Cardiac Magnetic Resonance (CMR) findings of Vena Contracta (VC) size in cm², Effective Regurgitant Orifice area (ERO) in cm², Effective Regurgitant Volume (ERV) in mls/beat, and Regurgitation Fraction (RF) as a percentage of the left ventricular stroke volume, were given a score value of A, B, C or D with increasing severity, thus ranging from the mildest degree "A" to most severe "D".

Results:

As summarized in Table 4, MR severity ranged between 4 "As" to 4 "Ds". Further elaboration regarding the parameter(s) most severely affected may be added to the score value, e.g., scoring MR with a VC = 0.60 cm² associated with EROA = 0.4cm², ERV = 60mls and RF = 45% will be 2D (EROA and ERV) MR, thereby avoiding overlap between various degrees of MR and/or further data manipulation to make other parameters fit one grade of MR or another.

Conclusion:

Applying this scoring/grading system to Echocardiographic and/or CMR studies of patients with mitral valve regurgitation will enhance our endeavors to use a clear and unified language regarding MR severity without compromising the quality of Echocardiographic or CMR findings and/or reporting.

Keywords: Mitral, Valve, Regurgitation, Severity, Grade, Score, Transcatheter, Repair, Replacement.

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1. INTRODUCTION

Significant mitral valve regurgitation (MR) is a growing public health problem with increasing incidence with age, reaching around 15% of all Septogenarians [1]. The severity of this "correctable" disease entity at the time of diagnosis and during follow-up is the most important predictor of subsequent complications, including heart failure, hospitalization and probability of death [2]. Accordingly, the finding of "Severe" MR has become the primary indication of referral for surgical

correction even in the absence of symptoms and/or signs of left ventricular dysfunction [3 - 6].

Echocardiography is the tool most commonly used to evaluate the mitral valve function. MR has previously been graded as mild, moderate, and severe mainly through quantitative estimation of three severity levels of four Echocardiographic parameters, namely; Vena Contracta (VC) in cm², Effective Regurgitant Orifice area (ERO) in cm², Effective Regurgitant Volume (ERV) in mls/beat, and Regurgitation Fraction (RF) as a percentage of the left ventricular stroke volume [4]. More recent grading of MR into A, B, C and D grades according to a mix of different levels of

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the above parameters, the presence or absence of symptoms, and other findings including the underlying cause of MR has been proposed (summarized in Tables 2 and 3) [5, 6]. However, considerable degrees of overlap between various levels of quantifications led to the attempted division of moderate MR into two subcategories; mild-to-moderate and moderate-to-severe MR, but even that was not widely accepted [4, 5]. Another significant challenge in quantifying MR is the lack of a protocol that accommodates discordant findings in one or more of the four objective parameters in MR, e.g., MR with Vena Contracta = 0.60 cm² associated with EROA = 0.4cm², ERV = 55 mls, and RF = 50 mls is -by definition-a mix of moderate and severe MR [4]as well as grade B, C and D primary and secondary MR [4, 5]. Moreover, neither of these methods of MR grade allow the inclusion of new parameters that may prove more valuable than the parameters listed above in the assessment of MR. Therefore, we proposed a new method for the assessment of grade and severity of mitral valve regurgitation.

Table 1. Reasons for proposing a new method for the assessment of MR grade and severity.

1. To avoid the use of subjective parameters to define MR severity
2. To avoid the use of overlapping degree(s) of MR severity (mild-to-moderate and moderate-to-severe)
3. To avoid ambiguous definitions for the same degree of MR severity based on the underlying etiology and/or the presence of symptoms
4. To avoid manipulating Echocardiographic and CMR findings to render them fit into a single degree of MR severity
5. To accommodate the inclusion of potentially more sensitive parameters in the assessment of MR by replacing one or more of the four parameters presented here

2. METHODS AND RESULTS

For reasons summarized in Table 1 and based upon the land-mark Zoghbi *et al.*'s report to the American Society of Echocardiography [4], we proposed a refined method for the assessment of mitral regurgitation severity and grade that minimize the potential of overlap between various reported grades of MR and respect variations in observed values of the four parameters VC, EROA, ERV and RF on Echocardiography or CMR. Each of the four parameters is given a score value ranging from "A" to "D" according to severity grade (Table 4). MR severity score may range from 4As "mildest" to 4Ds "the most severe" MR. A score of one "D" or more is graded as 1D, 2Ds, 3Ds, or 4Ds mitral regurgitation. A score of one "C" or more is graded as 1C, 2Cs, 3Cs or 4Cs MR *etc.*

Further elaboration regarding the parameter(s) most severely affected may be added to the score value, e.g., MR with Vena Contracta = 0.60 cm associated with EROA = 0.4 cm², ERV = 55 mls, and RF = 50% will be 2D (EROA and RF) primary, secondary or mixed pathology MR, thereby confining the definition of MR severity to the objective parameters most severely affected and avoiding further data manipulation to impose compliance with one grade or another. The underlying cause of MR may be highlighted following the grade, as shown in the example above.

Table 2. Echo. Findings of mitral valve currently used to stage primary MR [5, 6].

-	Stage / Quantification				
Parameter	Grade	A	B	C	D
	Vena Contracta (cm ²)	<0.30	<0.70	>0.70	>0.70
	EROA (cm ²)	-	<0.40	≥0.40	≥0.40
	ERV (ml/beat)	-	<60	≥60	≥60
	RF (%)	-	-	≥50	≥50

3. DISCUSSION

Applying this scoring/grading system to Echocardiographic and/or Cardiac Magnetic Resonance (CMR) studies of patients with mitral valve regurgitation will enhance our endeavors to use a clear and unified language regarding MR severity without compromising the quality of Echocardiographic or CMR findings and/or reporting. It will also lead to avoiding grading severe mitral valve regurgitation with ambiguity based on the presence or absence of symptoms and/or the underlying etiology [5, 6].

Table 3. Echo. Findings of mitral valve currently used to stage secondary MR [5, 6].

-	Stage / Quantification				
Parameter	Grade	A	B	C	D
	Vena Contracta (cm)	<0.30	-	-	-
	EROA (cm ²)	-	<0.40	≥0.40	≥0.40
	ERV (ml/beat)	-	<60	≥60	≥60
	RF (%)	-	<50	<50	≥50

Table 4. Proposed method for echo. or CMR assessment of MR grade and severity.

-	Grade / Quantification				
Parameter / Severity		A	B	C	D
	Vena Contracta (cm)	<0.30	0.30-0.49	0.50-0.69	≥0.70
	EROA (cm ²)	<0.20	0.20-0.29	0.30-0.39	≥0.40
	ERV (ml/beat)	<30.0	30-44	45-59	≥60
	RF (%)	<30.0	30-39	40-49	≥50
	Severity of MR	4As	4Bs	4Cs	4Ds

The current ACC/AHA guideline for the management of patients with valvular heart disease^{5,6} defines grades "C" and "D" primary MR according to these four Echocardiographic parameters – equally- as VC>0.70 cm, EROA>0.40 cm², ERV≥60 mls, and RF≥50% (Table 2). Grades "C" and "D" differ only in the presence of symptoms in the latter (grade D). Whereas, it abandoned VC in secondary MR and defines grades "C" and "D" secondary MR– equally - as EROA≥0.40 cm², ERV≥ 60 mls (Table 3). Grades "C" and "D" secondary MR differs only in the presence of symptoms and RF ≥ 50% in the latter (grade D).

Our grading system defines primary MR with VC = 0.70 cm², EROA = 0.40 cm², ERV = 60 mls, and RF = 50%" as 4Ds primary MR. It also defines secondary MR with EROA = 0.40 cm² and ERV = 60 mls and RF = 45%" as 2Ds (EROA and ERV) secondary MR. It also defines secondary MR with

EROA= 0.40 cm² and ERV = 60 mls and RF = 50%” as 3Ds (EROA, ERV and RF) secondary MR. All these are regardless of the presence or absence of the symptoms and/or the underlying cause of MR. The proposed MR grade and severity score are also applicable to patients with combined primary and secondary MR who are, otherwise, not amenable to grading according to a single underlying etiology as in all previous grading systems [4, 5].

CONCLUSION

The proposed MR grade and severity score allow a more concise and detailed comparison of Echocardiographic and CMR findings in mitral valve regurgitation studies during follow up and/or following surgical or percutaneous transcatheter interventions for mitral valve repair or replacement. The correlation between the proposed MR score/grade and the rate of MR complications including the impact of MR on patients’ exercise tolerance, hospitalization, need for surgery and/or transcatheter intervention as well as short - and long - term survival awaits repeat analysis of existing data and/or novel prospective studies.

CONSENT FOR PUBLICATION

Not applicable.

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CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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