Editorial

Insights from the EACVI document on multi-modality imaging assessment of native valvular regurgitation: what does it add to the ESC guidelines on the management of valvular heart disease?

European Association of Cardiovascular Imaging (EACVI) and European Society of Cardiology (ESC) council of valvular heart disease (VHD) have recently published a position paper on multi-modality imaging (MMI) assessment of native valvular regurgitation (1). The growing availability of devices and therapeutic techniques in recent years has enabled the treatment of increasingly complex valve disease. The opportunity to integrate data from different non-invasive imaging techniques allows a more precise morphologic and functional characterization of the disease and consequently the choice of the most appropriate therapeutic option. The purpose of this EACVI document is to complement the ESC 2021 guidelines on VHD by providing clinical guidance for the evaluation of native valve regurgitation by MMI (2).

General imaging consideration

Whether the role of two-dimensional (2D) and three-dimensional (3D) echocardiography in the evaluation of VHD is firmly established, the role of cardiac magnetic resonance (CMR) in this field has recently started expanding (3-5). Despite suffering from several limitations, including reduced spatial resolution that allows only suboptimal assessment of the valvular and subvalvular apparatus compared with echocardiography, CMR can provide important anatomical and functional data in patients with VHD, including quantitative assessment of valve regurgitation, especially in cases of poor echocardiographic window and/or uncertain diagnosis (6). Of note, CMR is the gold-standard imaging technique for the assessment of cardiac chambers size, thus enabling adequate assessment of adverse remodeling due to chronic severe valvular regurgitation, as well as reverse remodeling following appropriate therapy. In addition, as CMR provides myocardial tissue characterization, it may be useful to detect fibrosis and early myocardial damage in patients with long-standing VHD, as well as to better understand the myocardial pathology underlying functional valve lesions (7-9). Despite recent technical innovations, the role of cardiac computed tomography (CCT) in patients with valve regurgitation remains limited.

Aortic regurgitation

Several qualitative, semi-quantitative and quantitative parameters for the estimation of severe aortic regurgitation (AR) have been added to those described in the latest European guidelines on the management of VHD.(2) The visualization of a large region of color flow convergence and the presence of diastolic flow reversal in the abdominal aorta are additional qualitative indices of severe AR. However, as the latter is highly dependent on aortic compliance, its use should be limited in elderly patients. Along with vena contracta (VC) width and pressure half time (PHT), the ratio between jet width (measured immediately below the aortic annulus) and left ventricular outflow tract (LVOT) diameter ≥ 65% and the ratio between the cross-sectional area (CSA) of the jet and the CSA of the LVOT ≥ 60% are semiquantitative parameters for severe AR. Among quantitative parameters, the presence of a regurgitant fraction (RF) [(ratio between regurgitant volume (RV) and left ventricular (LV) stroke volume (SV)] ≥ 50% has been added as criterion suggestive of severe AR at either echocardiographic or CMR evaluation. The phase-contrast direct method is the most validated approach for quantitative assessment of AR using CMR with the advantage of not being affected by coexisting valvular regurgitation lesions.

Address for Correspondence: Giuseppe Iuliano, Cardio-Thoracic-Vascular Department, University Hospital "San Giovanni di Dio e Ruggi d'Aragona", Heart Tower – Room 807, Largo Città d'Ippocrate, 84131 Salerno, Italy
Phone: +39 3465335232 E-mail: gi.iuliano93@gmail.com
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MMI assessment of severe AR

Echocardiographic assessment of AR should include 2D and 3D data regarding LV size and function, LVOT, annulus, aortic valve, aortic root and Doppler measurements of regurgitation severity. CMR may provide useful additional information about the mechanism of AR, the presence of fibrosis and the size of the aorta and represents the second-line imaging modality of choice in case of inconclusive or unexhaustive echocardiographic study. CCT scan is rarely performed in clinical practice in this setting, but it may be useful in case of preprocedural intervention planning (aortic size, calcifications, coronary artery disease).

Mitral regurgitation

No additional parameters were added about the grading of mitral regurgitation (MR). Stress echocardiography may be useful in case of discordance between symptoms and grade of regurgitation, being able to assess changes in MR severity, LV filling pressure, and systolic pulmonary artery pressure (sPAP) during and at peak exercise. Additionally, it can play a role in the prognostic stratification of such patients. In degenerative MR, the increase in regurgitation severity ≥ 1 grade, dynamic pulmonary hypertension (sPAP ≥ 60mmHg), the absence of contractile reserve (< 5% increase in LV ejection fraction or < 2% increment in global longitudinal strain) and reduced right ventricular contractile recruitment (quantified by tricuspid annular plane systolic excursion <18 mm) are suggestive of poor prognosis. On the other hand, among patients with functional MR, the increasing MR severity [effective regurgitant orifice area (EROA) ≥ 13 mm^2] and the presence of dynamic sPAP ≥ 60 mmHg at stress echocardiography predicts worse prognosis.

CMR represents the second-line imaging technique for quantitative MR evaluation, although reference intervals for MR grading have not yet been established and the few existing comparative studies between CMR and echocardiography show only modest agreement in MR severity assessment (10). As for echocardiography, a RF ≥ 50% is considered suggestive of severe MR. Being the direct assessment of flow at the level of mitral valve less accurate due to excessive valve plane systolic excursion, the indirect approach that compares LV SV to aortic forward flow is the most reproducible method to assess RF with CMR.

MMI assessment of severe MR

Thorough 2D and 3D echocardiographic imaging of the mitral valvular apparatus, together with quantitative multiparametric Doppler assessment of regurgitation and evaluation of LV size and function are mandatory for correct grading of MR. When the results of the echocardiographic study, including transthoracic- (TTE) and transesophageal (TOE) exam, are inconclusive, CMR should be performed as a second-line imaging modality, being able to quantitatively assess MR and to provide careful information about MR mechanism, fibrosis and myocardial viability. CCT scan may be useful in specific settings (e.g. preprocedural intervention planning) as complementary imaging modality.

Tricuspid regurgitation

Compared to latest European guidelines on the management of VHD, more criteria suggestive of severe tricuspid regurgitation (TR) are described in the EACVI document on multi-modality imaging assessment of native valvular regurgitation. A large flow convergence zone throughout systole, as well as 3D VC area or quantitative Doppler EROA ≥ 75 mm2, represent additional parameters of severe TR. Similar to AR and MR, a RF ≥ 50% denotes severe TR at either echocardiographic or magnetic resonance imaging evaluation, despite the role of CMR in evaluating TR has not yet been firmly established and further studies are warranted to confirm this threshold. The indirect method assessing the RV from the difference between total right ventricular SV (using planimetry of short-axis cine images) and forward SV across the pulmonary valve (using phase-contrast velocity mapping) is the method of choice. In case of severe TR, the sub-grading in massive or torrential regurgitation is of clinical interest in patients undergoing transcatheter tricuspid valve intervention, as clinical studies highlighted the incremental prognostic value of this recently proposed novel TR grading scheme in terms of clinical outcome in patients with advanced disease (11-16). Massive TR is defined with VC width 14-20 mm, 3D VC area or quantitative Doppler EROA - 95-114 mm2, EROA by PISA 60-79 mm^2 and RV - 60-74 ml. Echocardiographic parameters of torrential TR are VC width ≥ 21 mm, 3D VC area or quantitative Doppler EROA ≥ 115 mm2, EROA by PISA ≥ 80 mm2 and RV ≥ 75 ml.

MMI assessment of severe TR

A careful echocardiographic evaluation of TR must include a comprehensive imaging of tricuspid valve, right heart chambers morphology and function and Doppler measurements of TR severity examined in multiple acoustic windows. CMR may be indicated in case of unexhaustive or inconclusive echocardiographic study and represents the imaging modality of choice to assess the right atrium and right ventricle due to its high accuracy and reproducibility. CCT scan can be helpful in preprocedural intervention planning.

Pulmonary regurgitation

Evaluation and management of pulmonary regurgitation (PR) are not discussed in the most recent ESC guidelines on VHD, whereas they are extensively addressed in the EACVI document.(1, 2) Grading of PR is less well validated compared to other native valvular regurgitation and PR severity should be assessed by integrating information from all different approaches available (especially echocardiography and CMR). The estimation of severe PR is based on several qualitative, semiquantitative and quantitative parameters. Despite VC width thresholds suggestive of severe PR have not yet been validated, a VC/pulmonary valve annulus ratio ≥ 50% is an indicator of greater than mild PR, while a ratio ≥ 0.7 indicates severe PR. A deceleration time < 260 ms, a PHT < 100 ms, a PR index (ratio of PR duration by CW Doppler to total diastolic time) < 0.77 and the ratio between the jet width (evaluated at the right ventricular outflow tract) and the annulus > 65% are all markers of severe PR. The only quantitative parameter for grading PR is RF, which if > 40% indicates severe PR. At CMR assessment, both direct (phase-contrast technique) and indirect methods of quantification may be used to calculate RF, despite the direct method (with a coaxial through plane phase-contrast sequence planned just above the pulmonary valve) is the preferred approach.

MMI assessment of severe PR

CMR is the imaging modality of choice for quantification of PR and for anatomical and functional characterization of the right ventricle. When available, it should be performed in most cases of suspected significant PR unless 2D and/or 3D echocardiographic study is conclusive. CCT may be helpful in case of preprocedural interventional planning.

Giuseppe Iuliano, Rodolfo Citro
Cardio-Thoracic-Vascular Department, University Hospital “San Giovanni di Dio e Ruggi d’Aragona”, Largo Città d’Ippocrate, 84131 Salerno, Italy
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