Editorial

Should mitral valve area assessment in patients with mitral stenosis be based on anatomical or on functional evaluation? A plea for 3D echocardiography as the new clinical standard

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This editorial refers to “Non-invasive assessment of mitral valve area during percutaneous balloon mitral valvuloplasty: role of real-time 3D echocardiography” by J. Zamorano et al. on page 2086

In the last decade, 3D echocardiography has evolved from a research tool to clinical utility in several cardiac applications. One of these is the accurate planimetry of native stenotic mitral1–7 and aortic8 valves and even mechanical prosthetic valves, both in the mitral and aortic position.9

Percutaneous mitral valvuloplasty (PMV) has become the procedure of choice for treatment of selected patients with mitral stenosis with favourable mitral valve anatomy, as mentioned by Zamorano et al. in this issue of the Journal.10 Although the Gorlin-derived mitral valve area (MVA) has been used before and after PMV, echocardiography is of paramount importance in assessing the indication before this procedure, as well as the success and possible complications afterwards.1,5 Until recently, MVA was assessed indirectly by the pressure half-time method,1–7 or by direct planimetry, by 2D transthoracic echocardiography,2–4,6,7 by 3D transthoracic echocardiography2,3,6,7 or by 3D transoesophageal echocardiography (TEE).1,3–5 All these methods have their advantages and limitations. Pressure half-time-derived MVA can be obtained easily, but may to a great extent, be influenced by haemodynamic factors like aortic or mitral regurgitation, left atrial and ventricular diastolic properties, heart rate, rhythm, and cardiac index.2,7 These haemodynamic factors change rapidly during the immediate post-PMV period, which may explain the large discrepancies observed in earlier studies between the pressure half-time derived MVAs and the Gorlin-derived MVA.10 The theoretical advantage of planimetry is that it provides a relatively haemodynamic-independent assessment of the anatomical MVA. The major limitation of 2D planimetry in mitral stenosis, in contrast to 3D planimetry, is that there is no controlled sectioning of the mitral funnel orifice. The smallest and most perpendicular view is often not measured, but rather a tangential cross-section. 3D TEE overcomes these problems, and in addition provides detailed anatomical (commissural splitting and leaflet tears), and functional information (mitral regurgitation). 3D TEE, however, is semi-invasive and, for prolonged PMV procedures in the catheterization laboratory anaesthesia is required.

In this issue of the Journal Zamorano et al. have studied 29 patients with rheumatic mitral stenosis in a multi-centre study before and after PMV with second generation transthoracic real-time 3D echocardiography with the Philips Sonos 7500 ultrasound machine. The feasibility of the method of transthoracic 3D MVA assessment has been described previously.2,3,6,7 Binder et al. used a first generation real-time 3D echocardiography machine (Vol- umetrics®), in which 3D planimetry proved to be a fast, easy, accurate, and reproducible technique in comparison to 2D planimetry and pressure half-time-derived MVA.2 In that study, however, it was not applied to the setting of PMV, in contrast to the present study by

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Zamorano et al., in which real-time 3D echocardiography was the most accurate ultrasound technique for measuring MVA, with a better pre- and post-procedural agreement with the invasively (Gorlin) derived MVA, compared to 2D planimetry and pressure half-time-derived MVA. The success rate for real-time 3D echocardiography in 29 consecutive mitral stenosis patients in two centres was 100% for all methods, making real-time 3D echocardiography a feasible technique, with an acceptable acquisition and analysis time of approximately 20 min. Post-PMV the agreement with the Gorlin-derived MVA was much better, in contrast to 2D planimetry and pressure half-time-derived MVA, which may be due to the haemodynamic and compliance changes affecting the latter, as was observed before.\(^1\)\(^1\)

Also, compared to conventional 2D planimetry, real-time 3D echocardiography was superior, especially post-PMV. In 2D planimetry, malpositioning errors in depth and angle of the ultrasound beam can easily lead to an overestimation of the MVA up to 88%, which is not an acceptable accuracy for patient management.\(^2\)\(^2\) Importantly, interobserver variability for real-time 3D echocardiography planimetry was in an earlier report by Zamorano et al. in a larger series of mitral stenosis patients\(^3\) better than for 2D planimetry. Furthermore, it was easier and faster to define the image plane with the smallest orifice area, when real-time 3D echocardiography planimetry was used, and reproducibility for the Wilkins score was better than for 2D echocardiography.

In conclusion, real-time 3D echocardiography offers visualization of the entire mitral valve apparatus, and allows en face views of the mitral funnel orifice, from which accurate measurements of the MVA can be made pre-PMV. It is also a very suitable technique for monitoring both the efficacy of the PMV procedure (commissural splitting, MVA before and after), as well as its complications (leaflet tearing and mitral regurgitation) with a better accuracy compared to 2D planimetry and pressure half-time-derived MVA. Therefore, in our opinion, 3D echocardiography should be the preferred modality for MVA assessment. It offers more information than the Gorlin MVA assessment, which has its well-known limitations. One of the limitations of transthoracic real-time 3D echocardiography may be image quality in hard to image patients, and rarely image artefacts. In these cases, 3D TEE may be a good alternative, also allowing 3D planimetry and morphology assessment.\(^1\)\(^,\)\(^5\)

Also, unconventional 3D echocardiography indices, like the geometry of the mitral stenosis and mitral valve volume (i.e. the volume of the leaflets) assessed by 3D TEE may be interesting for patient selection for PMV. In one study, the mitral valve volume before PMV was found to be inversely correlated to a successful PMV procedure.\(^5\)

This makes 3D echocardiography and especially real-time 3D echocardiography a new clinical standard, which offers more than the conventionally used ultrasound indices for assessment of the severity of mitral stenosis: a fast and reproducible technique with detailed anatomical information and orifice area assessment, relatively independent of confounding haemodynamic variables.

References