Live 3D in the optimal assessment of MV stenosis pre- and post-PBMV

Philips EPIQ 7 **ultrasound system**

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Mitral valve area (MVA) in patients with mitral stenosis can be calculated by various methods, for example, 2D planimetry, pressure half-time method (PHT), and continuity equation, each with advantages and disadvantages. This paper focuses on the incremental value of Live 3D assessment of MV stenosis.

Background

American Society of Echocardiography (ASE) guidelines recommend MVA by 2D planimetry as the reference method for MVA assessment as it is a true anatomic assessment of lesion severity.[1] More recently, ESE/ASE guidelines for 3D acquisition and display[2] promote 3D guided 2D MVA as superior to conventional 2D assessment. It provides the ability to precisely orient the imaging plane exactly orthogonally to the minimum mitral valve orifice and is not limited to the two planes provided by Live xPlane.

Case study

A 28-year-old male with a remote history of rheumatic fever was referred for cardiac consultation with class 2 NYHA dyspnea. He had also recently suffered a cerebrovascular accident (CVA) with residual left hemiparesis.

Transthoracic echocardiography (TTE) was performed using the Philips EPIQ 7 ultrasound system and the X5-1 xMATRIX transducer.

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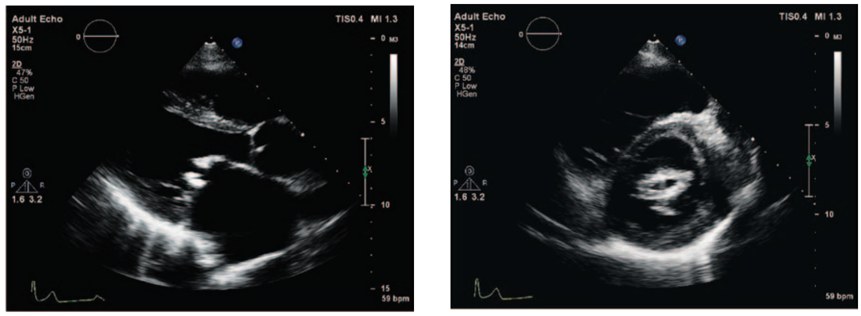
2D imaging confirmed the classic features of rheumatic mitral valve disease (Figures 1A and 1B). There were markedly restricted posterior leaflet mobility, classic 'hockey stick' deformity of the anterior leaflet, patchy leaflet calcification, and severe subvalvular disease which was particularly well seen by Live 3D imaging (Figure 2). The estimated Wilkins score was 9.



Figures 1A and 1B The parasternal long-axis and short-axis views, respectively, of the mitral valve. There are classic features of rheumatic disease with poor posterior leaflet mobility, classic 'hockey stick' deformity of the anterior leaflet, and commissural fusion.

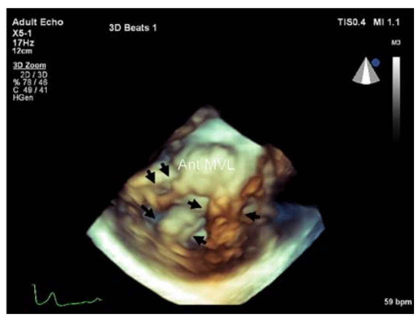
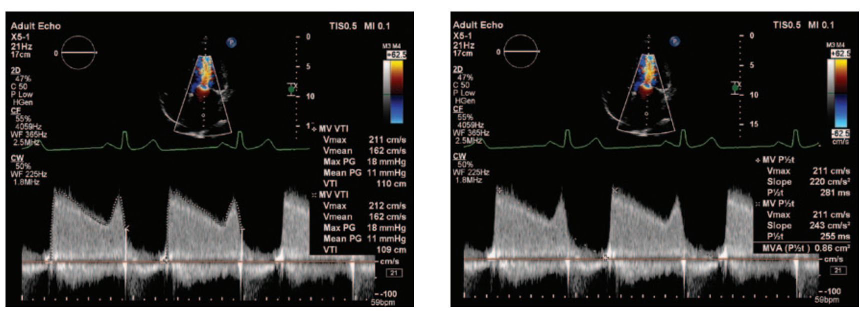


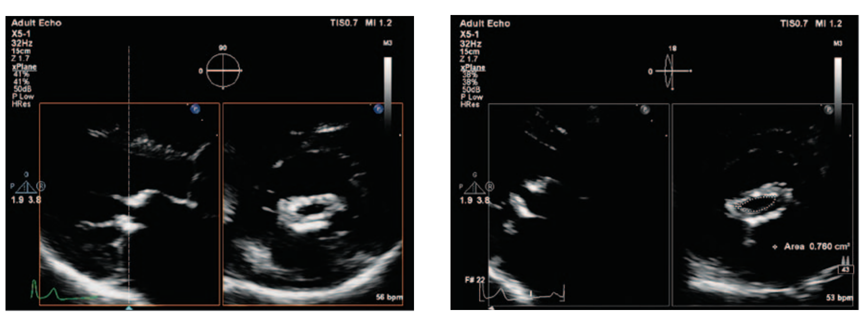
Figure 2 A 3D zoom view looking down on the mitral valve chordae, which are markedly shortened and thickened (black arrows).

Doppler examination revealed a diastolic mean gradient of 11 mmHg at a heart rate of 60 bpm while the MVA by 2D planimetry and PHT techniques both obtained valve areas < 1 cm^2 (Figs. 3A, 3B, and 3C).

2D planimetry was enhanced by the use of simultaneous biplane imaging (Live xPlane) to guide selection of the minimal MV orifice (Figures 3C and 3D). The measured right ventricular systolic pressure (RVSP) was 33 mmHg.



Figures 3A and 3B Demonstration of the mitral valve CW Doppler measuring mean gradient (A) and pressure half-time (B) from which MVA has been calculated (0.86 cm^2).

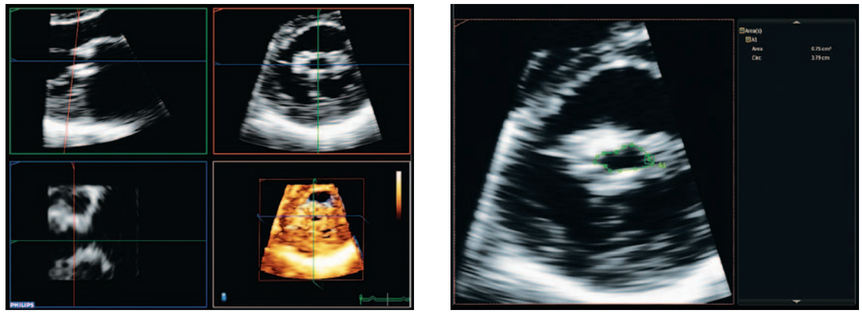


Figures 3C and 3D MVA calculation by 2D planimetry with Live xPlane assistance (0.76 cm^2).

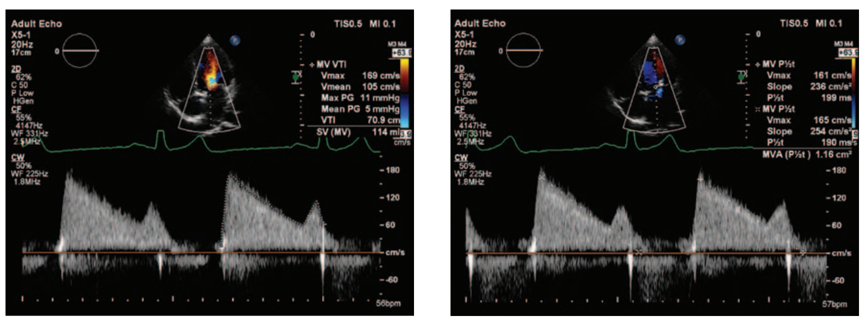
Live 3D-guided 2D MVA was easily performed in our case by obtaining a Live 3D zoom data set of the mitral valve and utilizing the on-cart Q-App 3DQ tools (Figures 4A and 4B). In this case, the calculated MVA was 0.75 cm², which was consistent with severe stenosis.

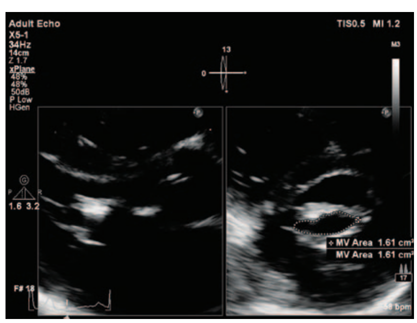
Transesophageal Echo (TEE) excluded LA thrombus and confirmed the TTE findings.

The patient proceeded to percutaneous balloon mitral valvuloplasty (PBMV). Five balloon dilatations were guided by 2D and Live 3D TTE. Post-PBMV, the mitral valve hemodynamics were significantly improved. The diastolic mean gradient was now 5 mmHg at a heart rate of 60 bpm while the MVA by both 2D and 3D was 1.6 cm². (Figures 5A, 5B, 5C, 6A, and 6B).

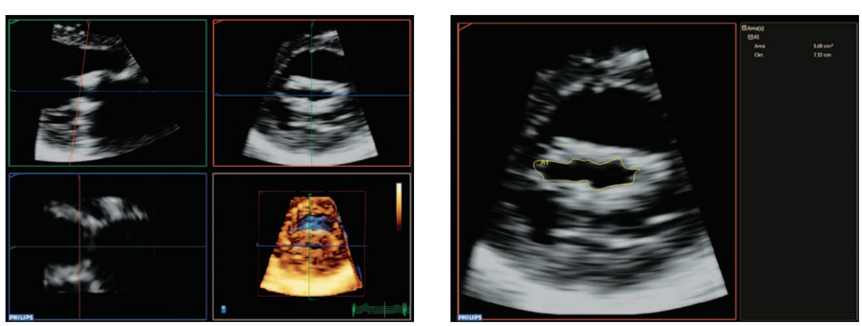


Figures 4A and 4B Method of calculation of MVA using 3D guided 2D planimetry. MVA was calculated at 0.75 cm2. This method allows optimal orientation of the imaging plane exactly orthogonal to the minimum mitral valve orifice.





Figures 5A, 5B (above) and 5C (left) Demonstration of the MV hemodynamics post-PBMV. Gradients have fallen and MVA has increased significantly. Note that the MVA by PHT is less improved and is generally regarded to be a less reliable method for MVA calculation early post-PBMV.



Figures 6A and 6B Demonstration of the 3D guided 2D planimetry MVA post PBMV. MVA has improved to 1.6 cm².

On both 2D and Live 3D imaging, there was evidence of significant commissural splitting, particularly at the posteromedial commissure (Figure 7).

The severity of mitral regurgitation did not increase (Figure 8).

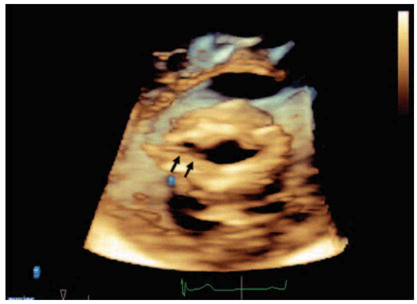


Figure 7
3D zoom of the mitral valve from the LV perspective, which demonstrates the splitting of the posteromedial commissure that has occurred with PBMV (dark arrows).

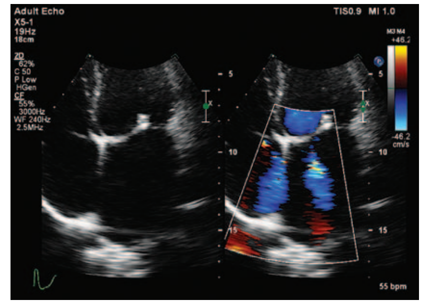


Figure 8
Apical 4-chamber view of the MV post-PBMV demonstrating only grade ¼ regurgitation from the posteromedial commissure.

Conclusion

The current case demonstrates the full range of echo parameters available for the optimal assessment of mitral valve stenosis. Live 3D imaging provides superior MVA assessment and its utility on the EPIQ 7 system is simplified by incorporating all imaging modalities in the X5-1 transducer together with simplified measurement tools on cart. This allows easy integration of these Live 3D techniques into routine lab workflow.

References

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2. Lang RM, Badano LP, Tsang W, et al. EAE/ASE recommendations for image acquisition and display using three-dimensional echocardiography. J Am Soc Echocardiogr. 2012;25:3-46.

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