

3D-Echocardiography in Mitral stenosis

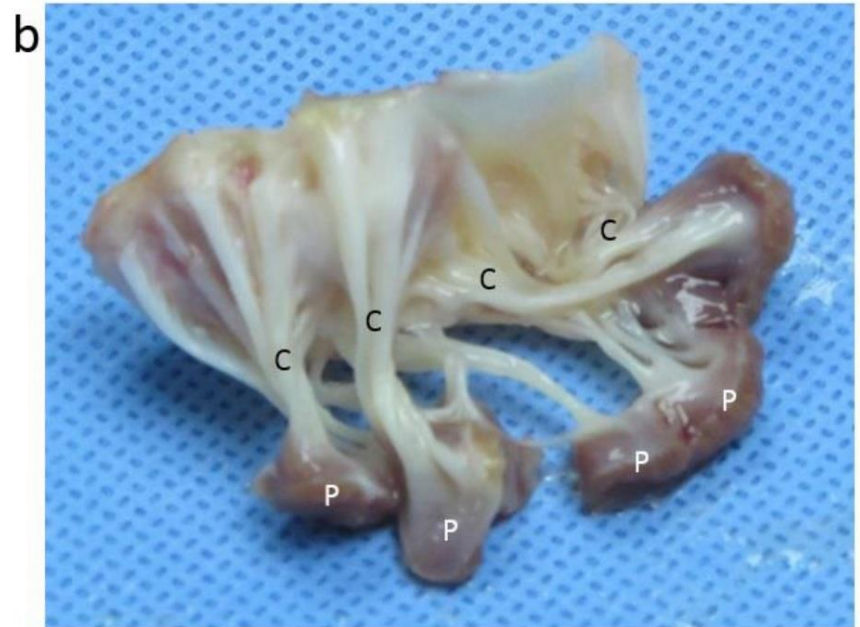
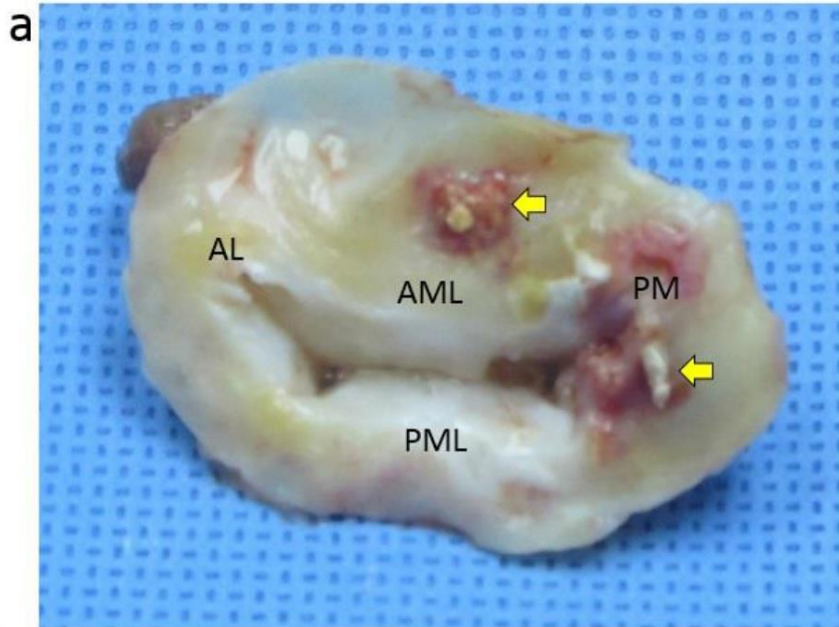
Dr. Hani Mahmoud-Elsayed

MBBCh, MSc, MD, FESC, FASE, FEACVI

*Consultant cardiologist, Director of Echocardiography Lab
Aswan Heart Centre, Magdi Yacoub Foundation, Egypt*

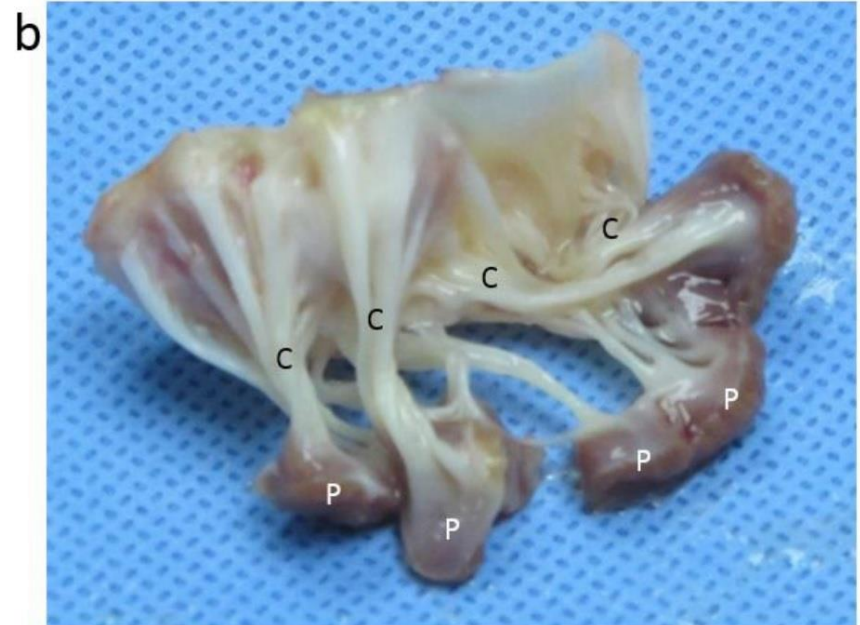
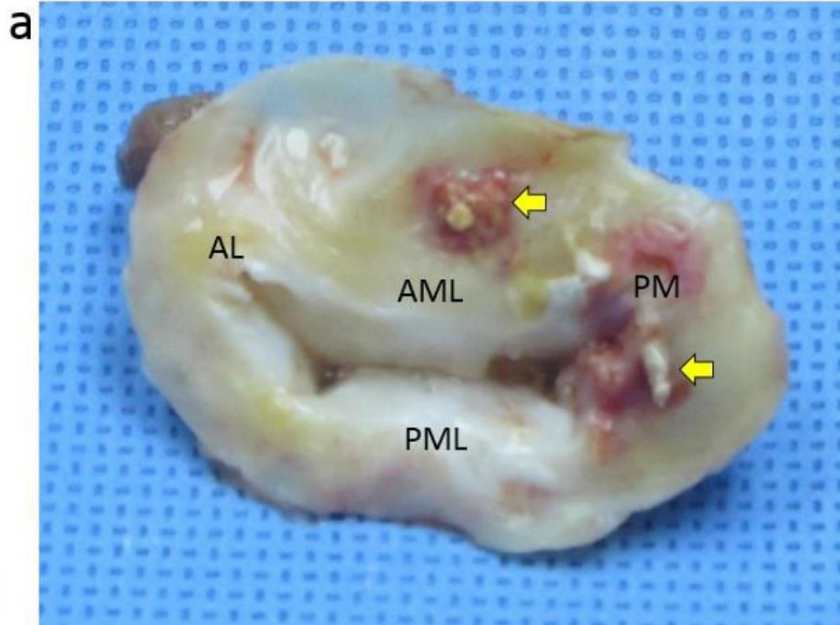


- **Rheumatic fever (RF)** remains the major cause of mitral valve stenosis, particularly in developing countries

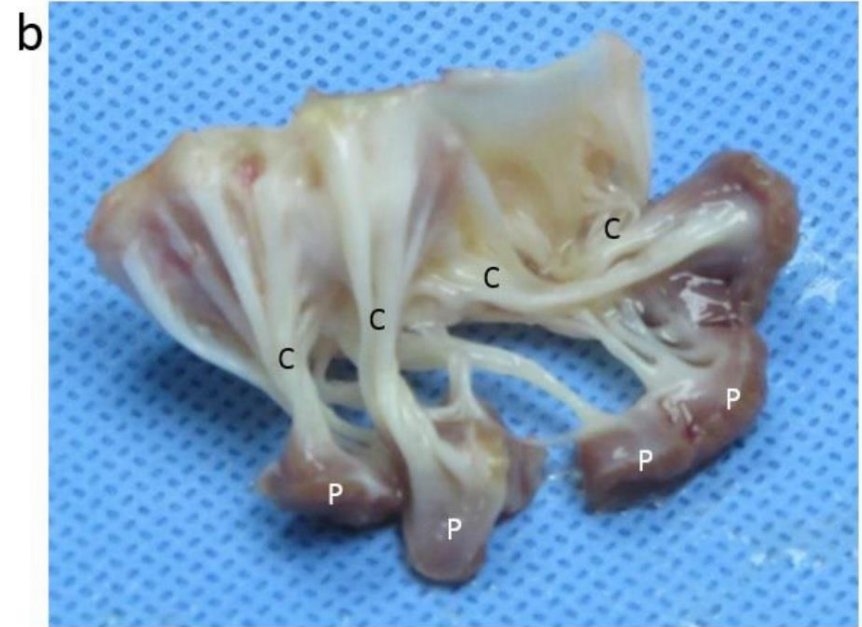
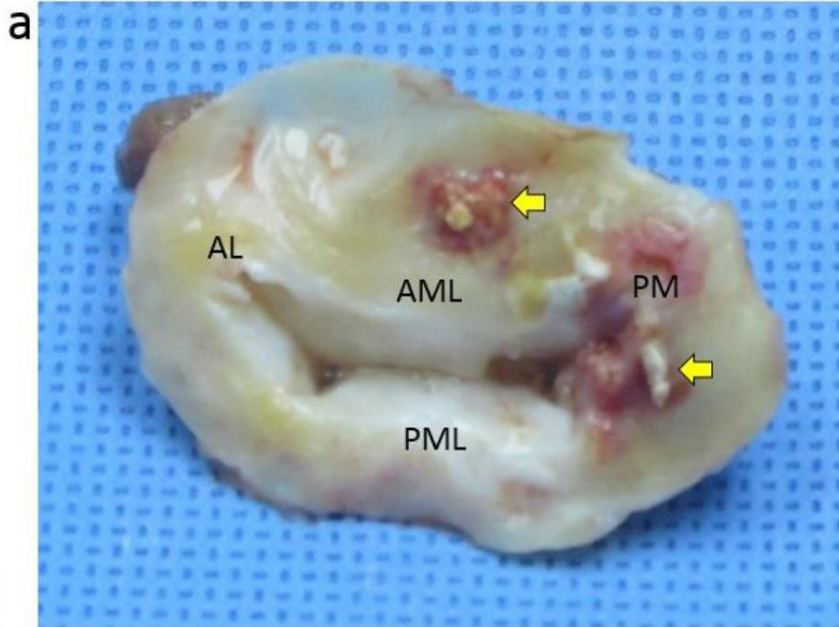


Rheumatic inflammation of the endocardium predisposes to multiple gross changes in the mitral valve including:

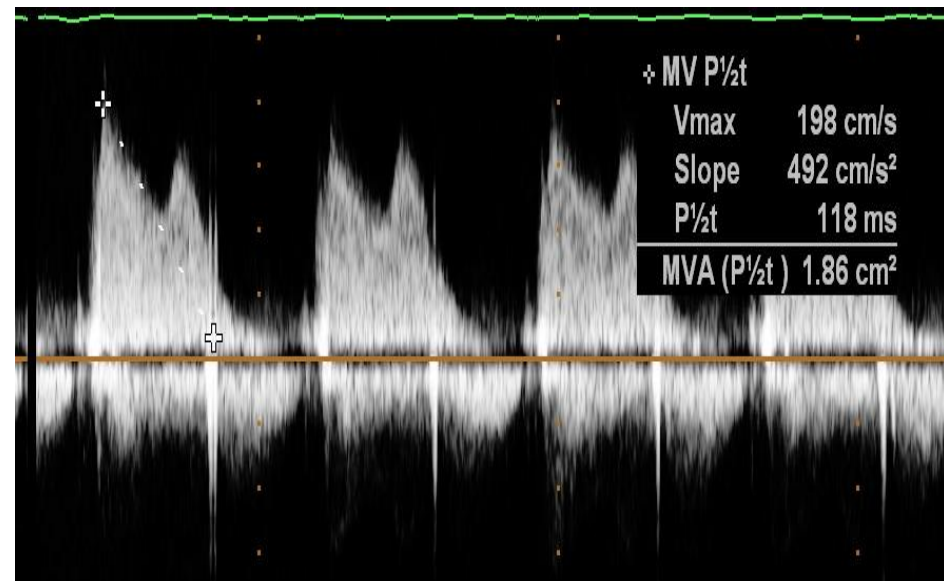
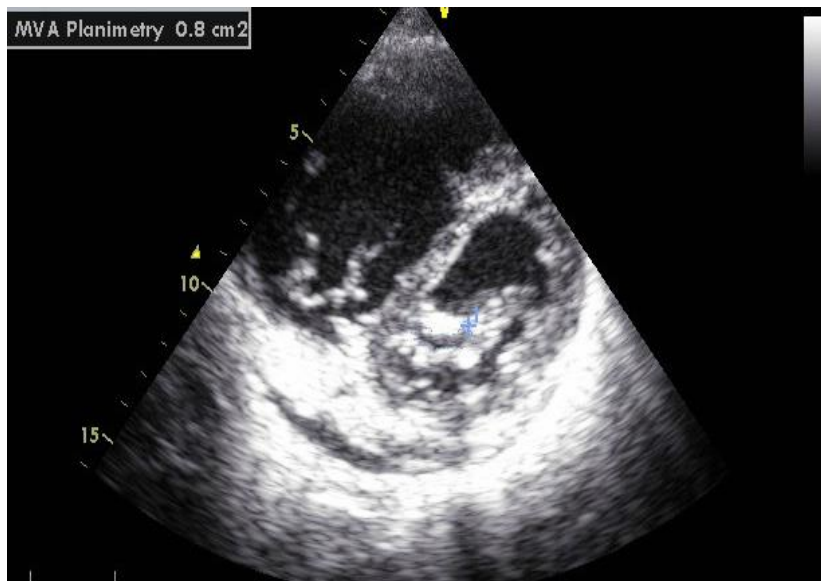
- **Leaflet thickening** that starts at the tips then progresses to the bases
- **Leaflet calcification**



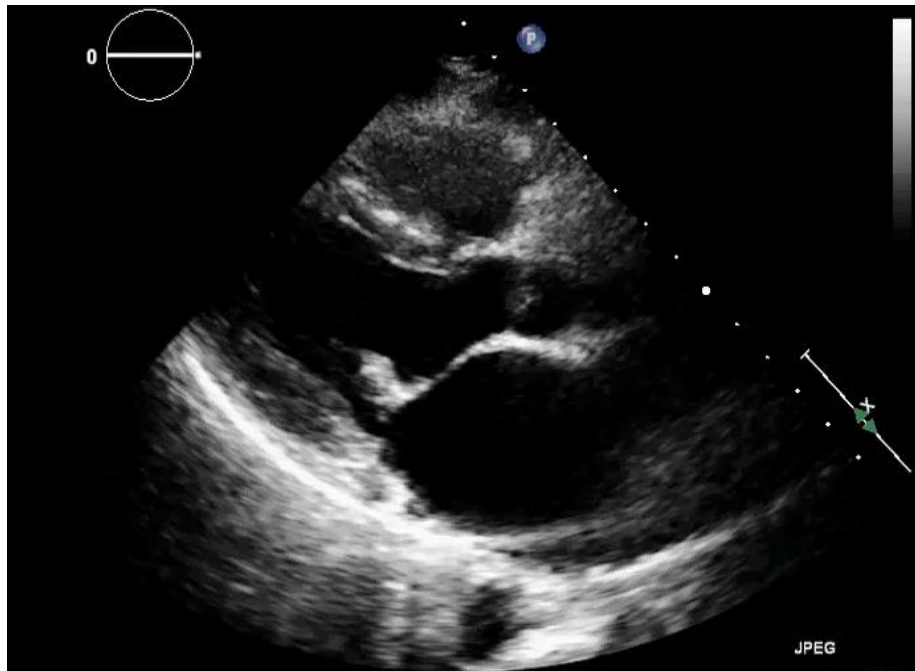
- **Chordal thickening**, fusion & shortening causing a funnel-shaped mitral valve apparatus.
- Sometimes one of the earliest gross changes of the mitral valve is the **disappearance of the indentations** of the posterior leaflet hiding the demarcation of the three scallops.



- Hemodynamic severity of mitral valve stenosis is best determined by mitral valve area measured by **planimetry** and the diastolic **PG** & **pressure half-time**.

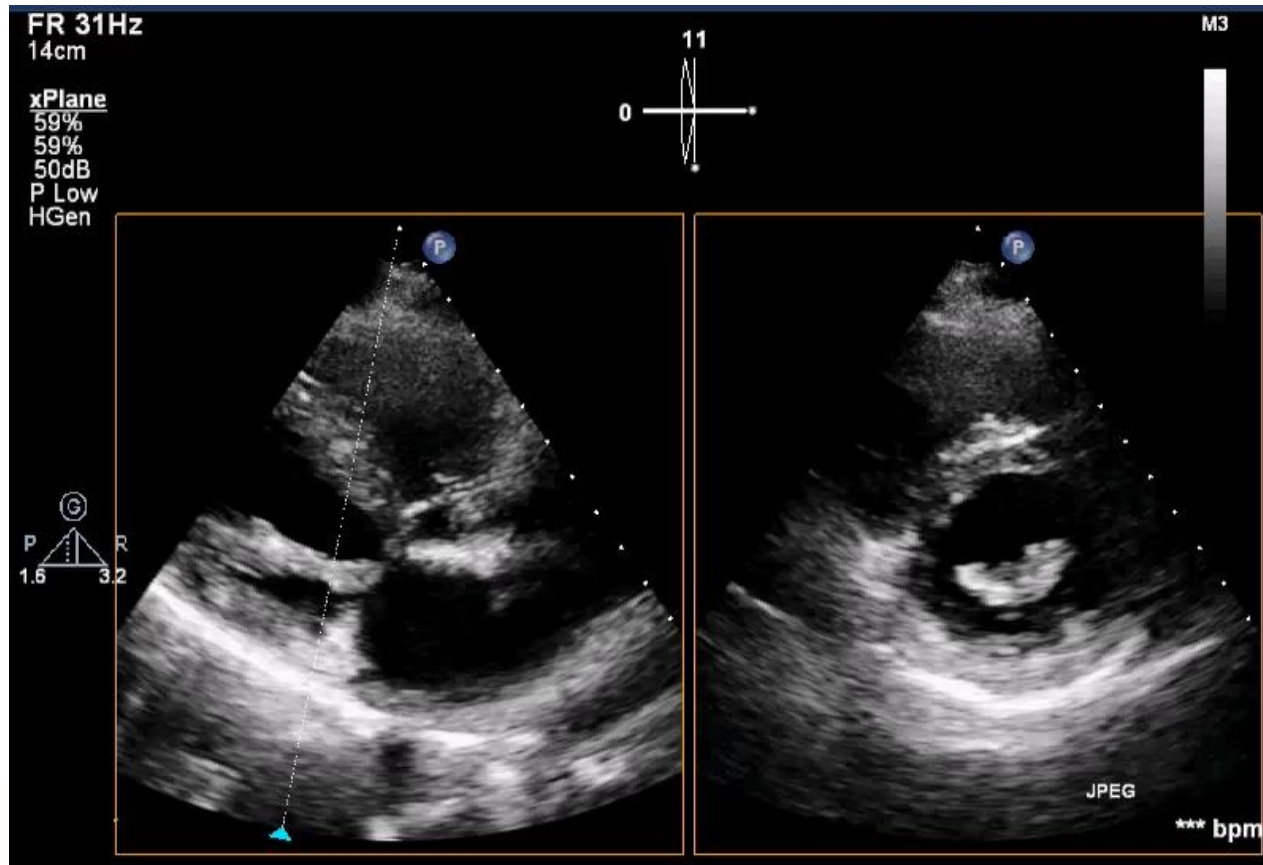


- 2D echocardiography had been always used for evaluation of mitral stenosis severity and mechanism

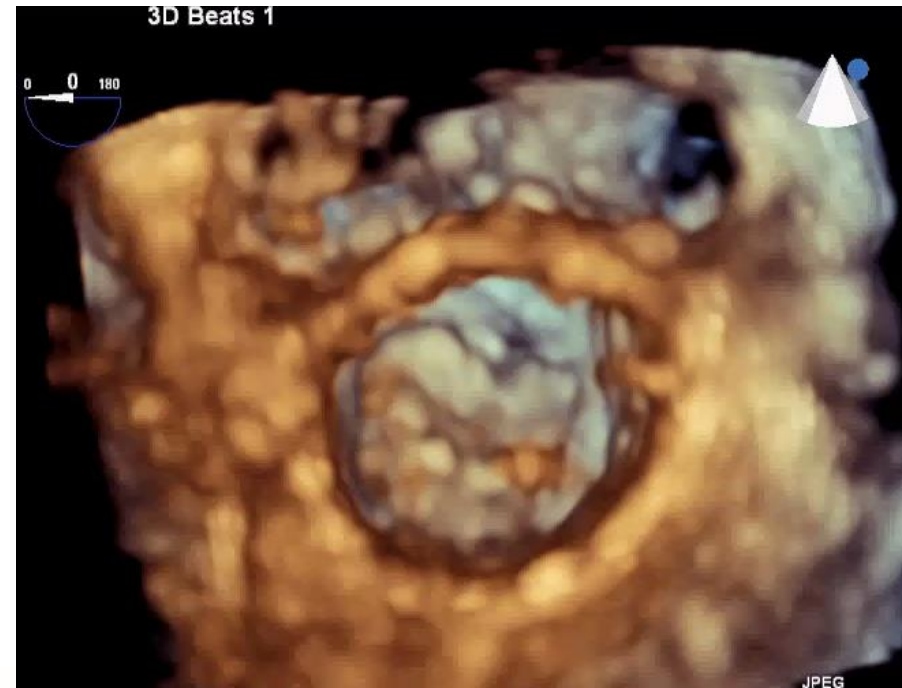
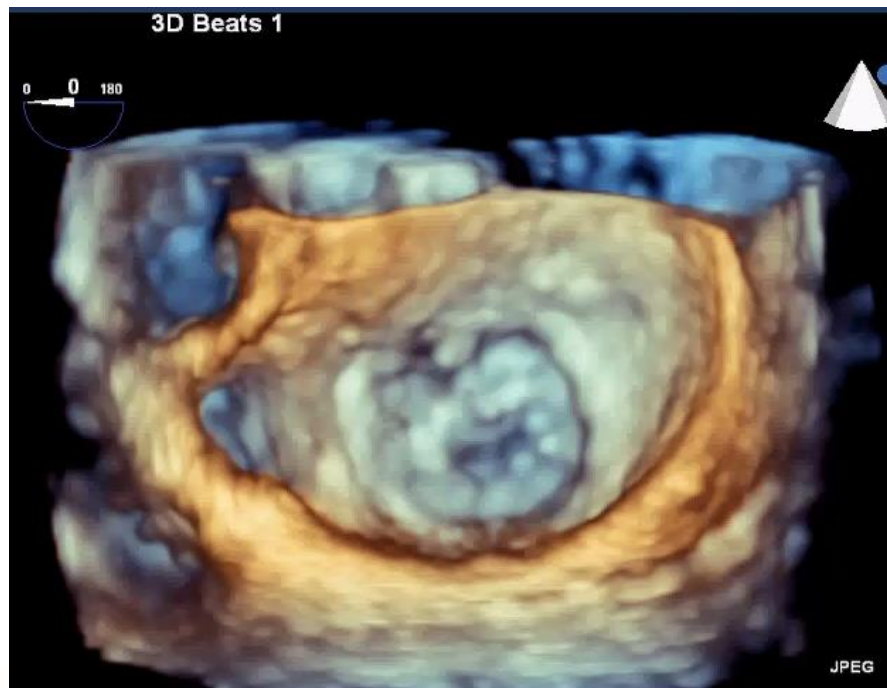


Limitations of 2D echocardiography

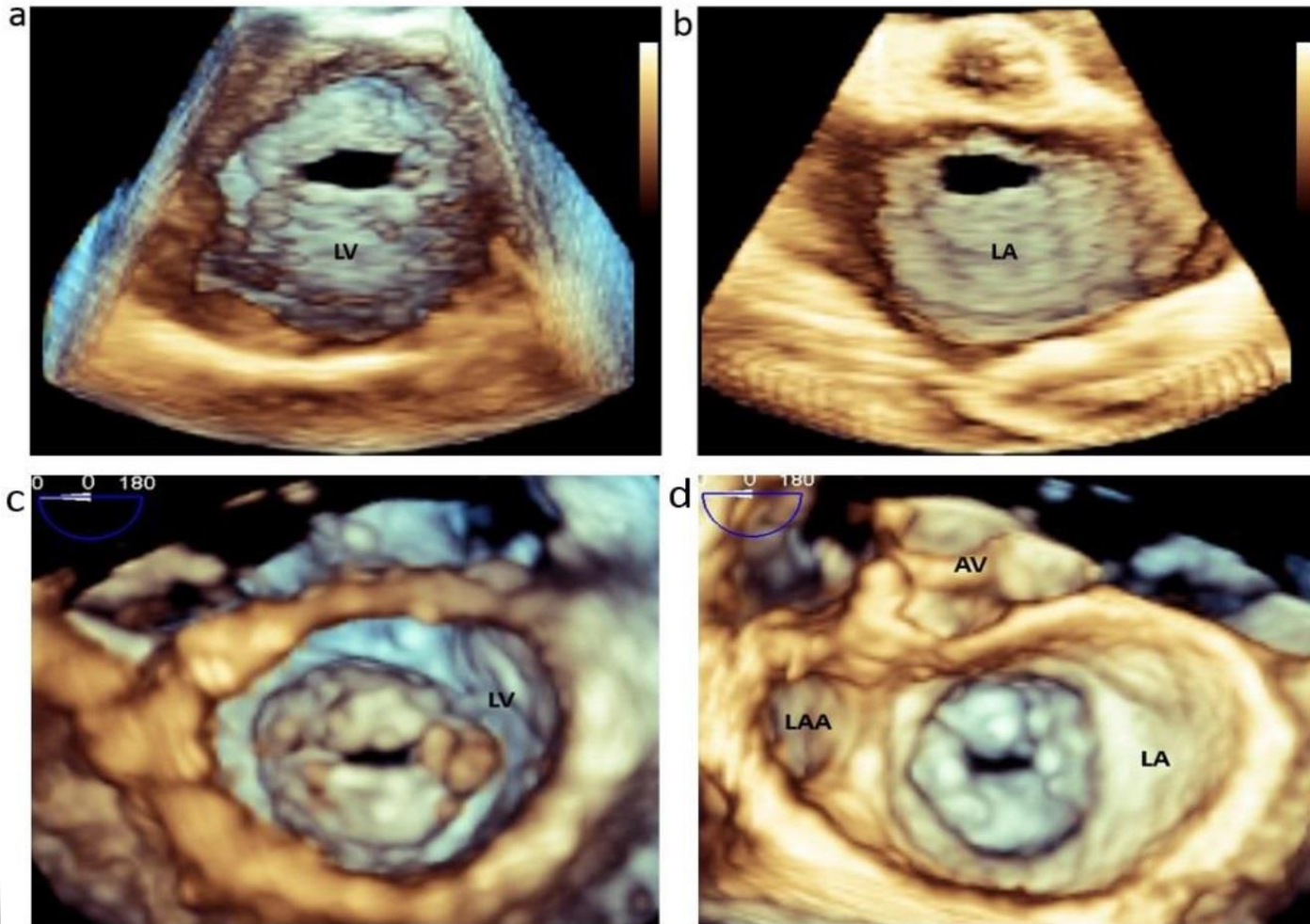
- Under or overestimation of MVA due to **inappropriate cuts**
- Inability to fully assess the **commissures** with accuracy



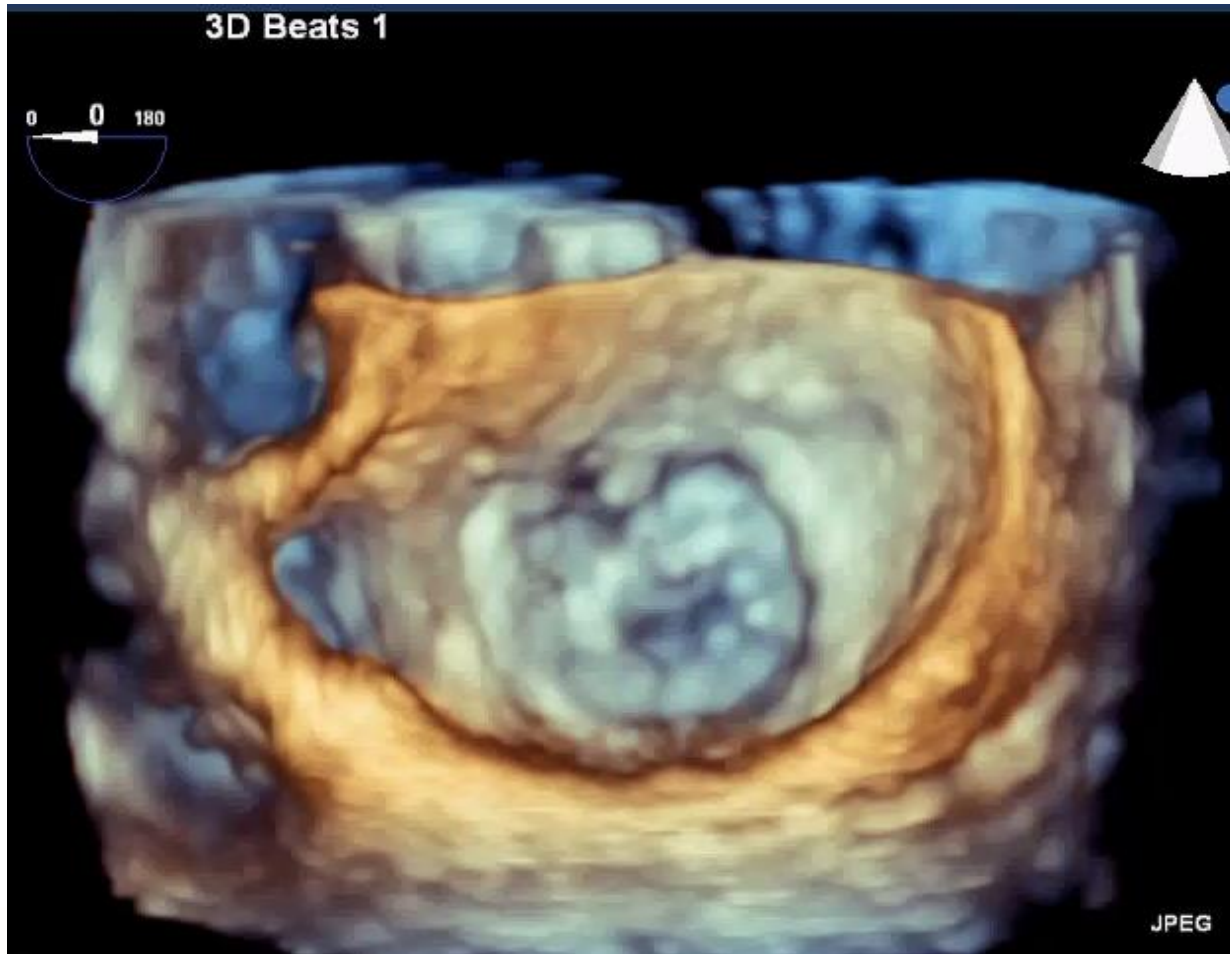
Three-dimensional (3D) echocardiographic Assessment of the MV should be incorporated into the routine trans-thoracic and/or trans-esophageal evaluation because it provides more physiological as well as morphological information.



Through providing a unique “**en face**” view for the mitral valve from both left atrial (LA) as well as left ventricular (LV) perspectives real-time three-dimensional echocardiography (RT3DE) allows accurate morphologic analysis of the entire mitral valve apparatus.



- The higher spatial and temporal resolution of **TEE** makes it more superior than TTE in all aspects of MV evaluation by RT3DE



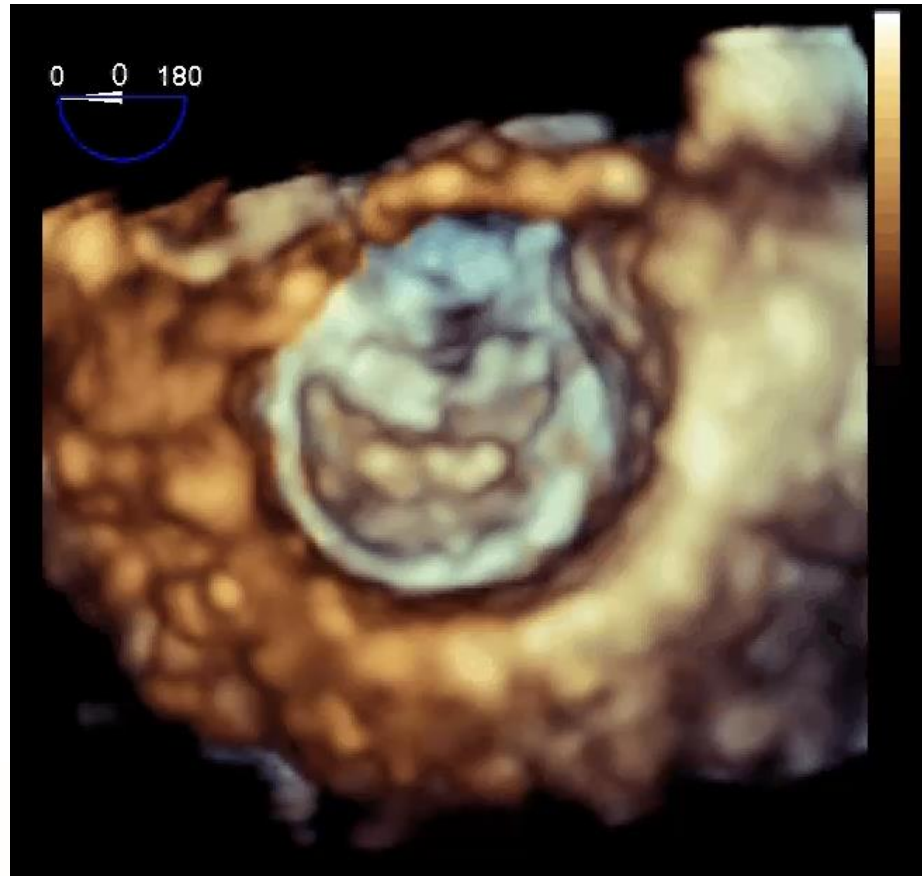
Qualitative assessment

Qualitative assessment

Feasible **rotation and orientation** of the 3D data set,

Better evaluation of the mitral **commissures** in terms of fusion and calcification.

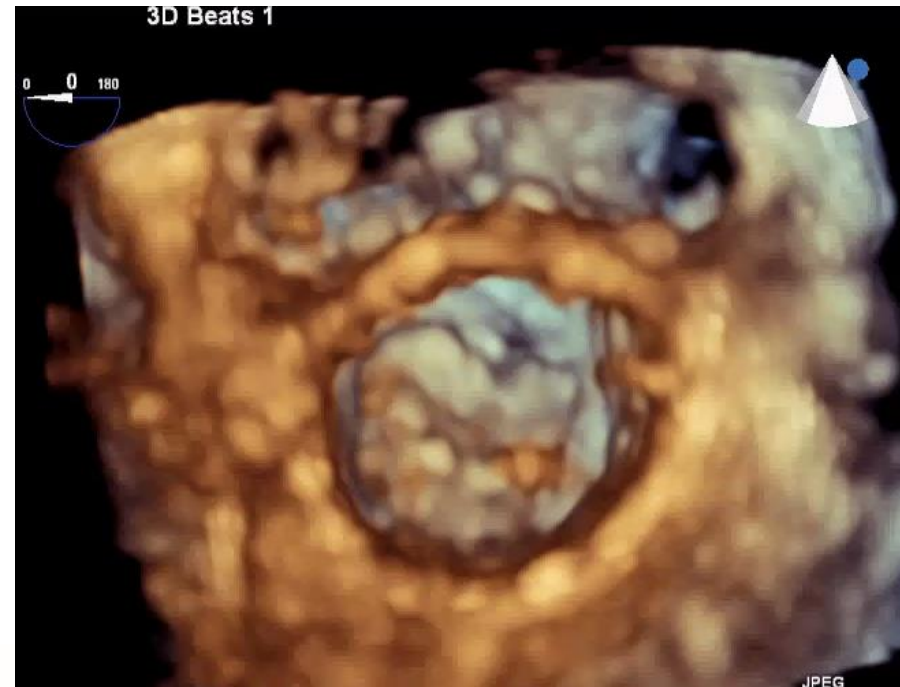
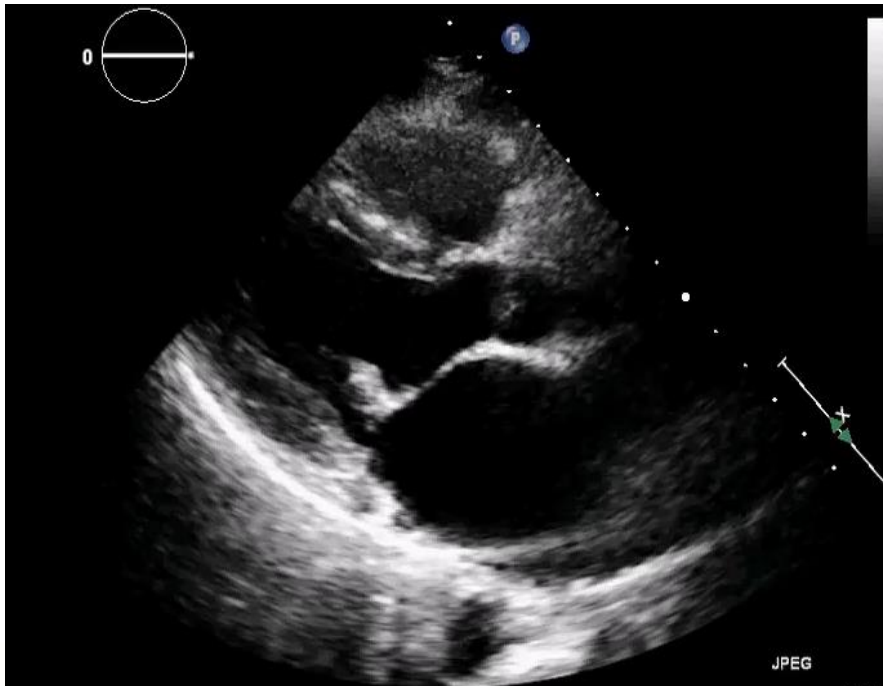
Assessment of the leaflet **mobility and pliability**.



Leaflet visualization

The whole mitral leaflet length is difficult to be evaluated through a single 2D echocardiographic image and different imaging planes are needed.

By RT3DE, visualization and evaluation of the whole leaflets length are feasible through one 3D data set.



Reduced diastolic opening (funnel shaped valve)

The RT3DE driven enface view for the mitral valve from the LV perspective creates a unique opportunity to qualitatively assess the shape of the real mitral valve orifice that is _in many occasions_ not symmetrically oval or circular.

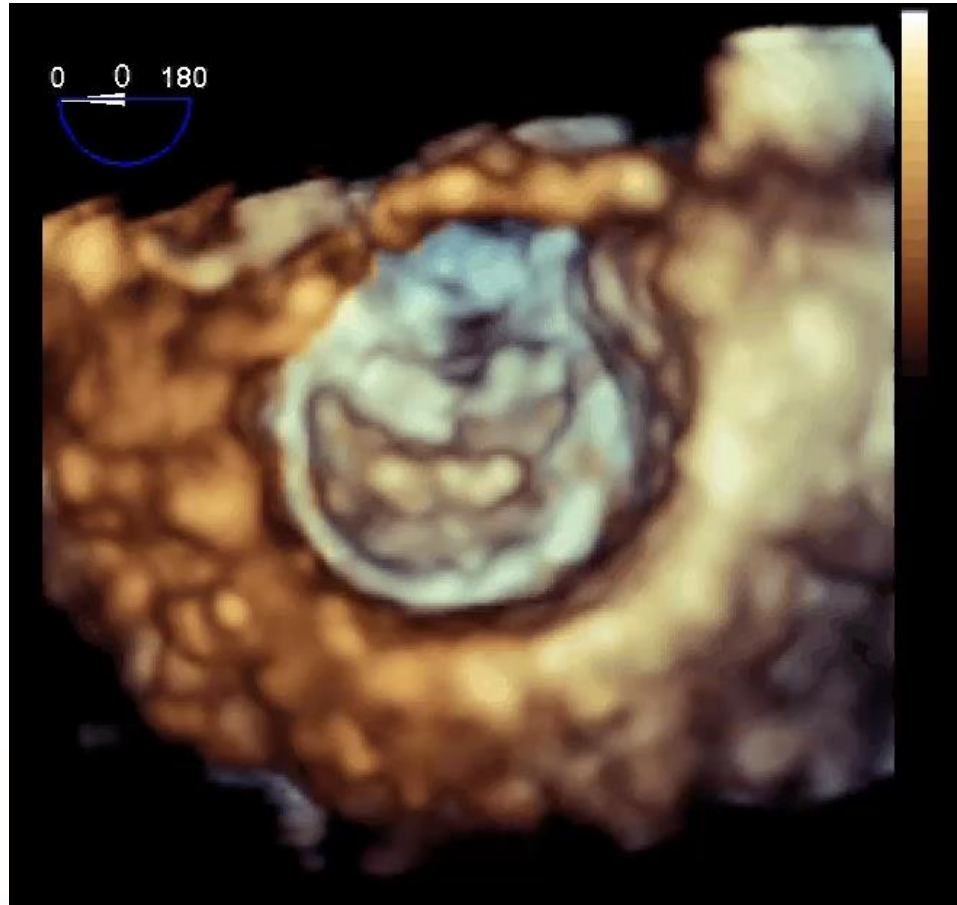
3D-TEE from the LV aspect

Dr. Hani Mahmoud

Commissural fusion

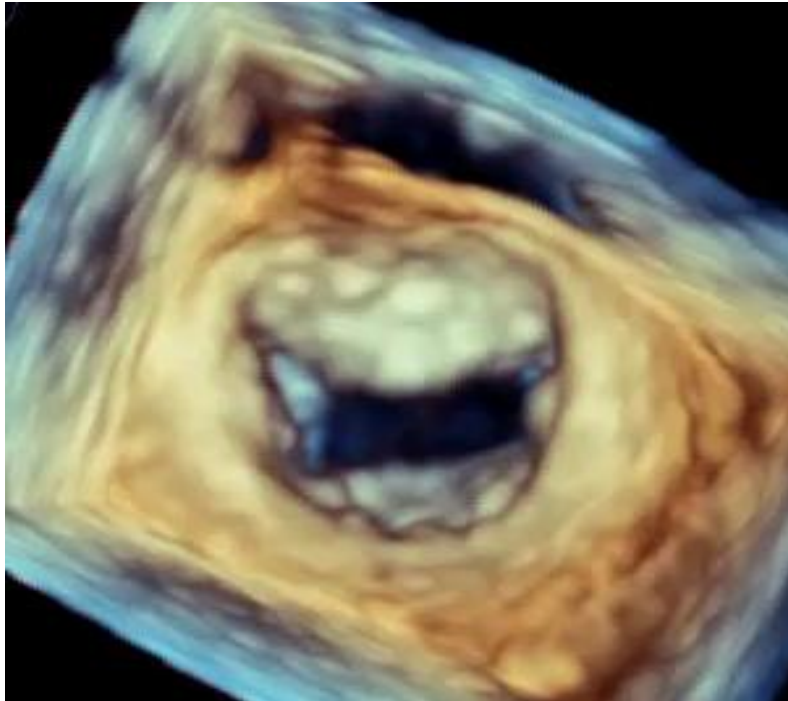
Commissural fusion can be assessed from the LV en-face view of the mitral valve using either 3DTTE or 3DTEE.

Right-to-left **tilting** of that volume can expose the antero-lateral commissure, while left-to-right tilting can expose the postero-medial commissure.



Commissural fusion

Normal

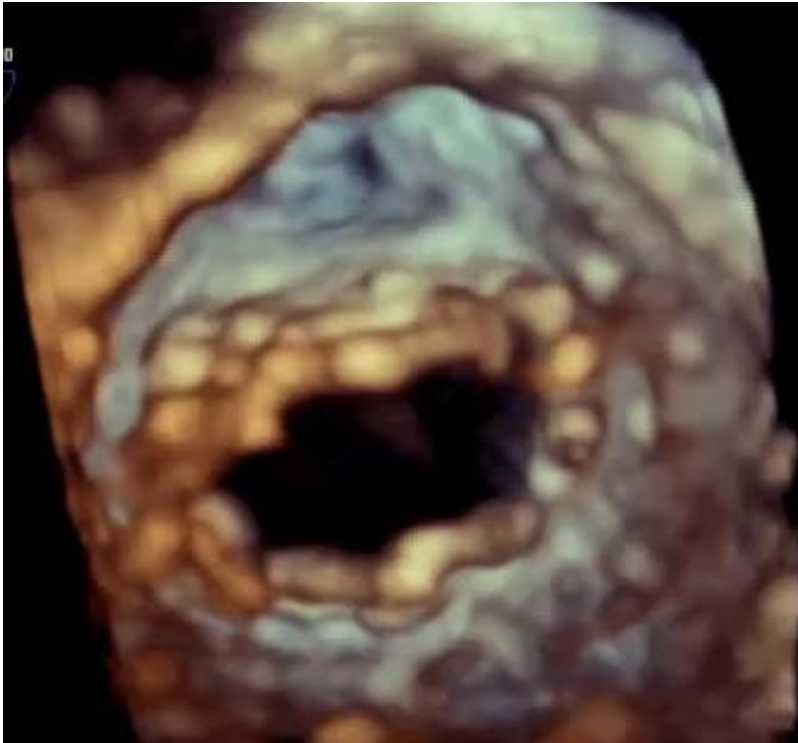


MS

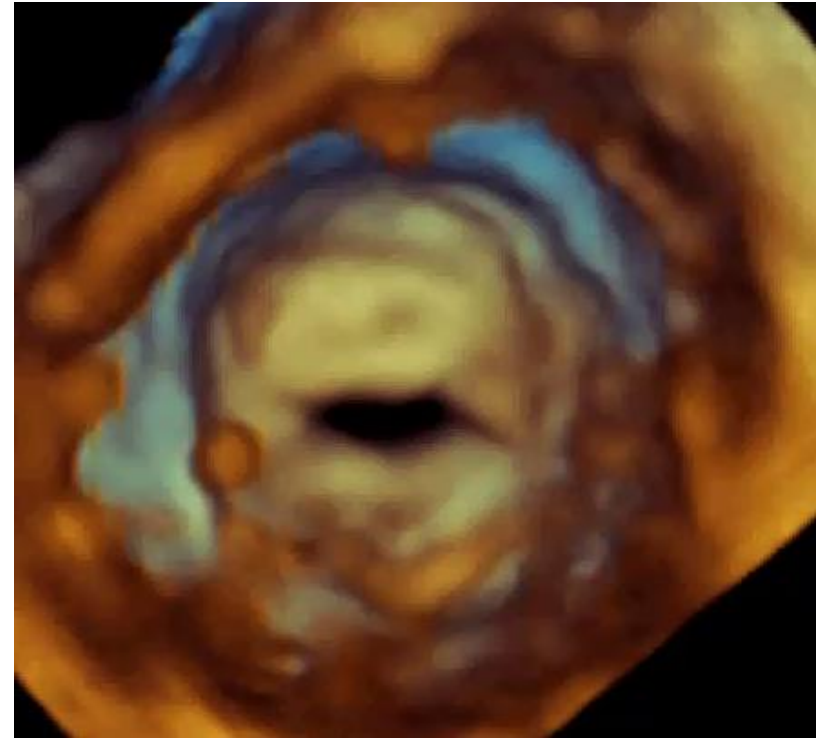


Commissural fusion

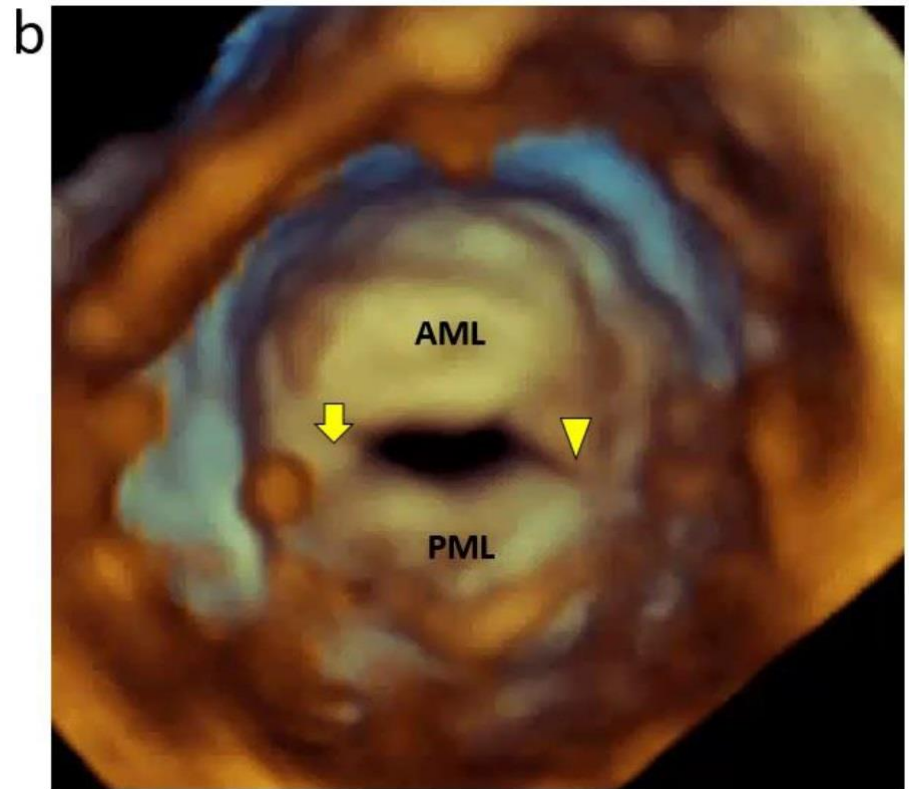
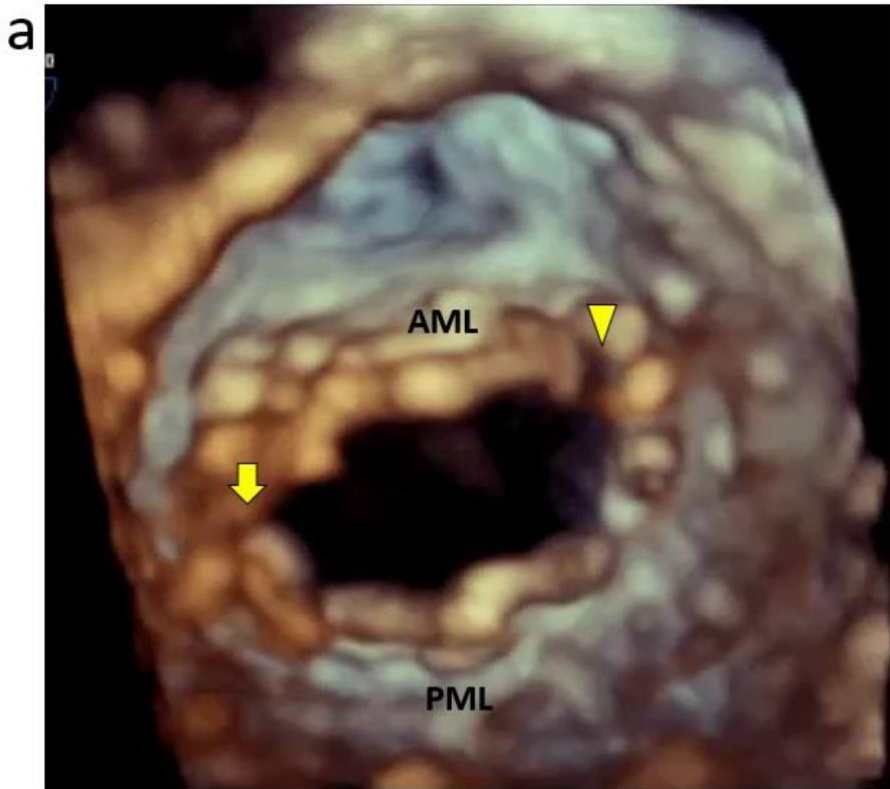
Normal



MS



Commissural fusion

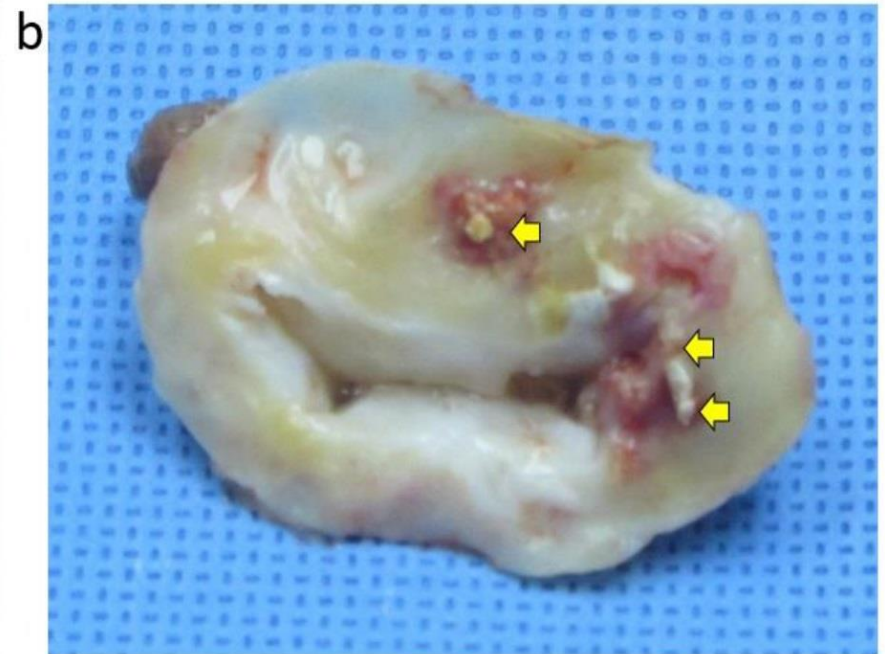
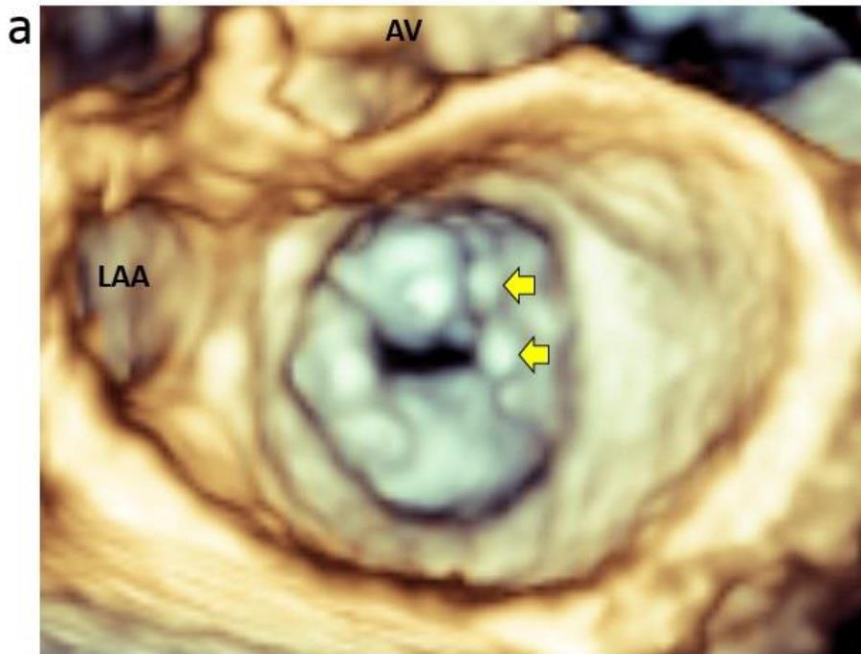


Commissural fusion



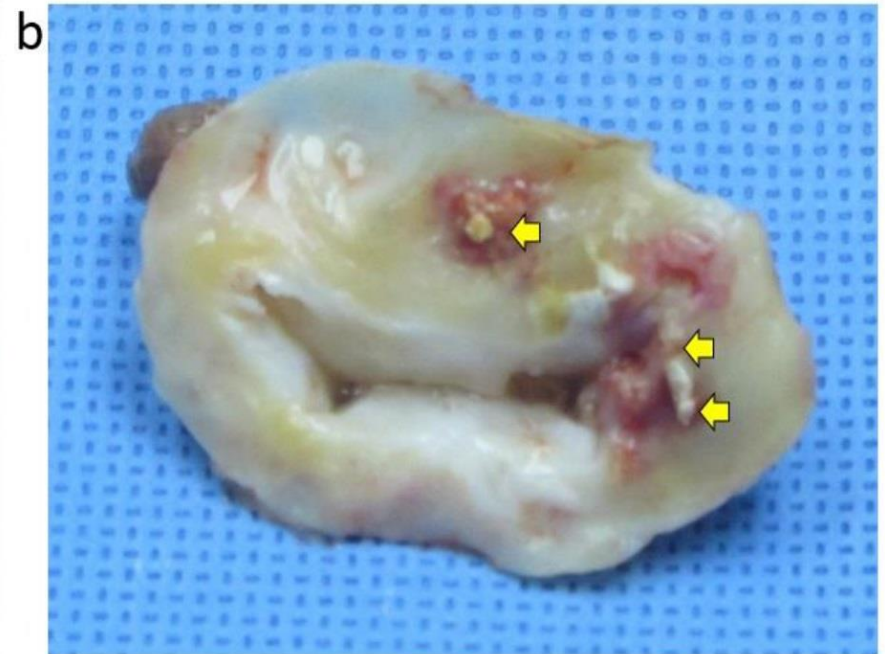
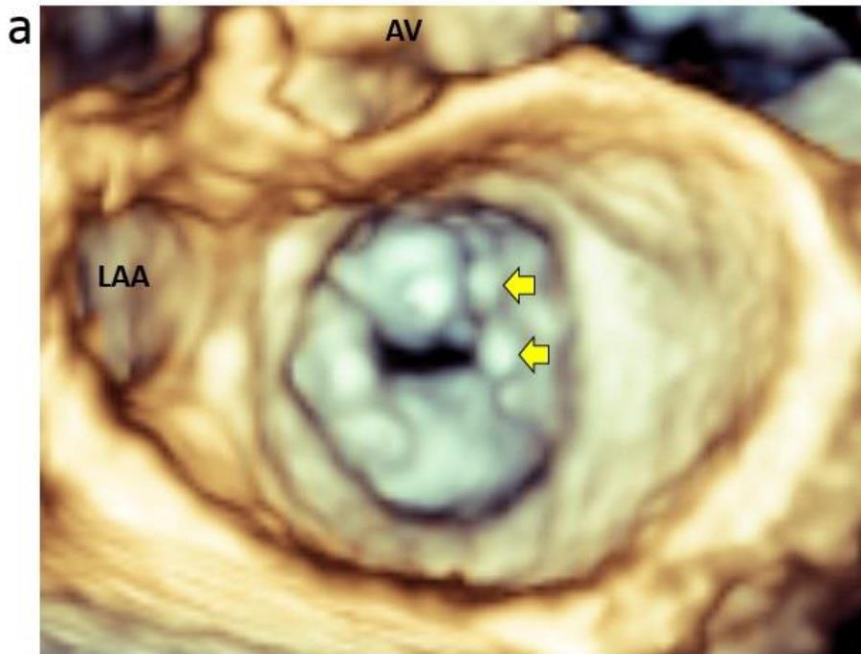
Commissural calcification

- The assessment of leaflet calcification as well as its distribution along the mitral valve orifice, particularly at the commissures is of great importance in predicting the suitability and outcome after **percutaneous mitral balloon valvuloplasty (PMBV)**.
- RT3DTE can predict the extent and distribution of calcification in each scallop utilizing a single 3D data set.



Commissural calcification

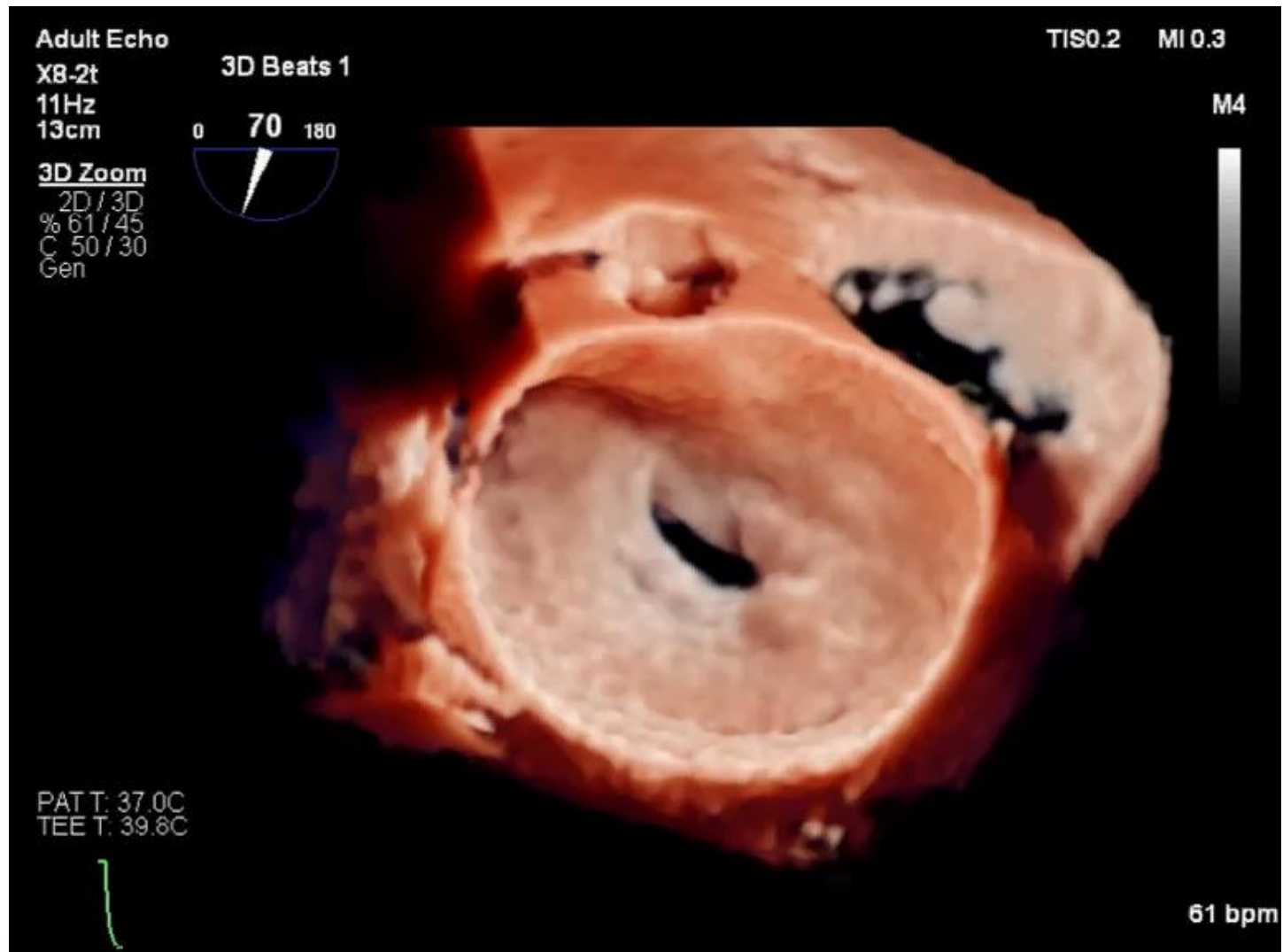
- One of the limitations of RT3DE is the inability to accurately differentiate between **calcium and normal tissue** if both are at the same distance
- However, because calcification usually protrudes into the LA cavity and relatively **less mobile** than normal tissue they can be identified and their **location and distribution** in relation to the commissures can be appreciated.



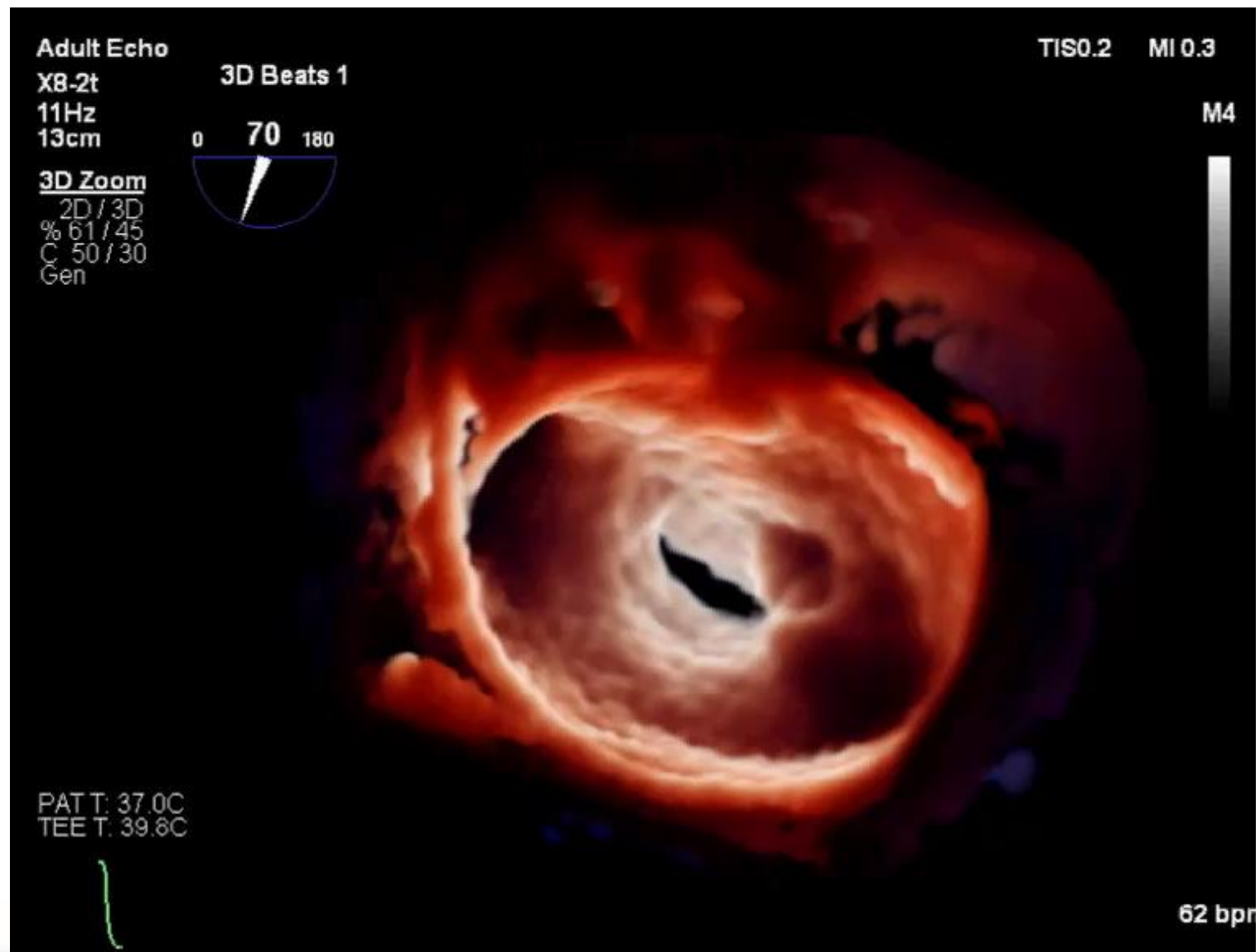
Commissural calcification



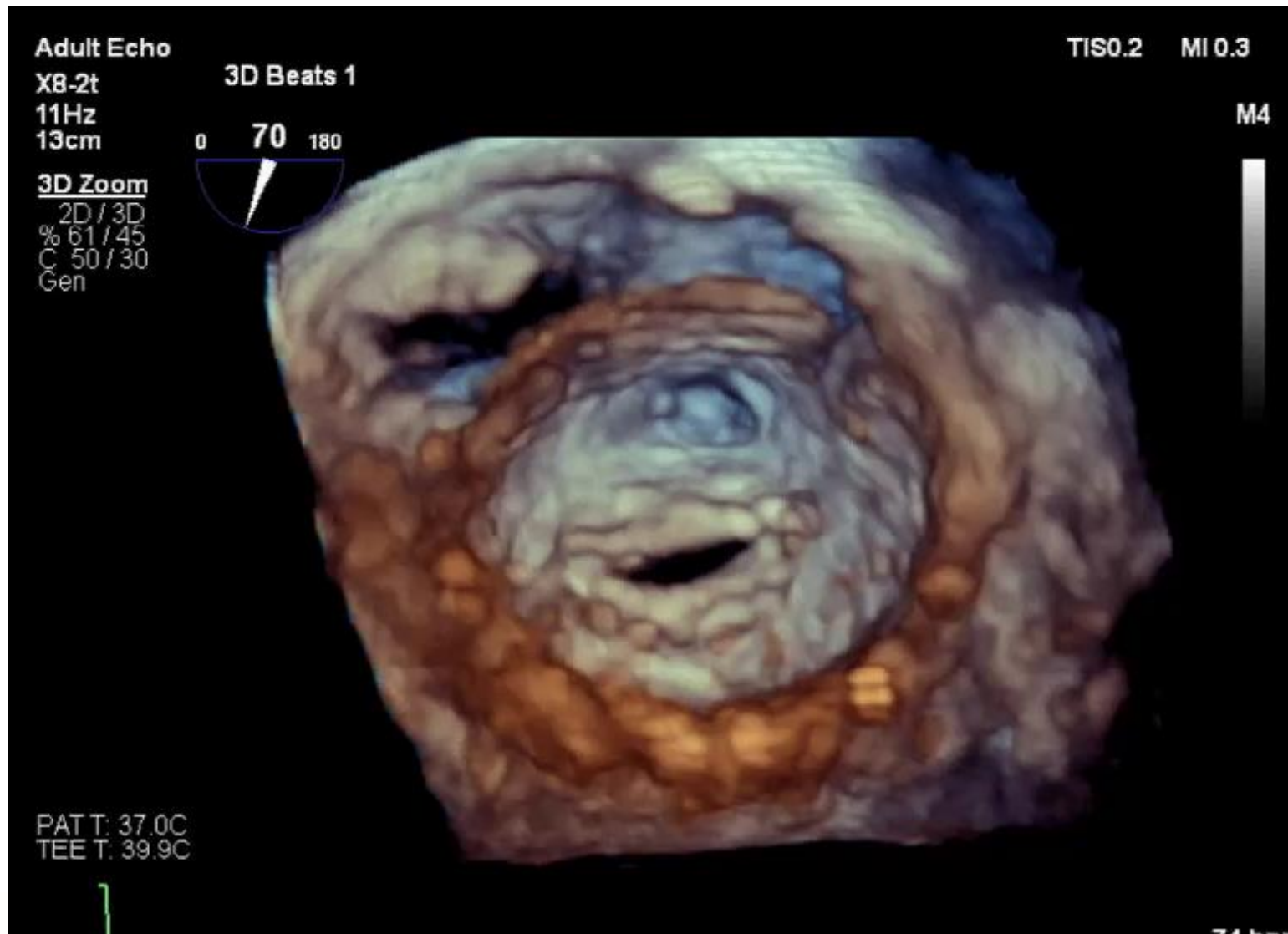
Commissural calcification



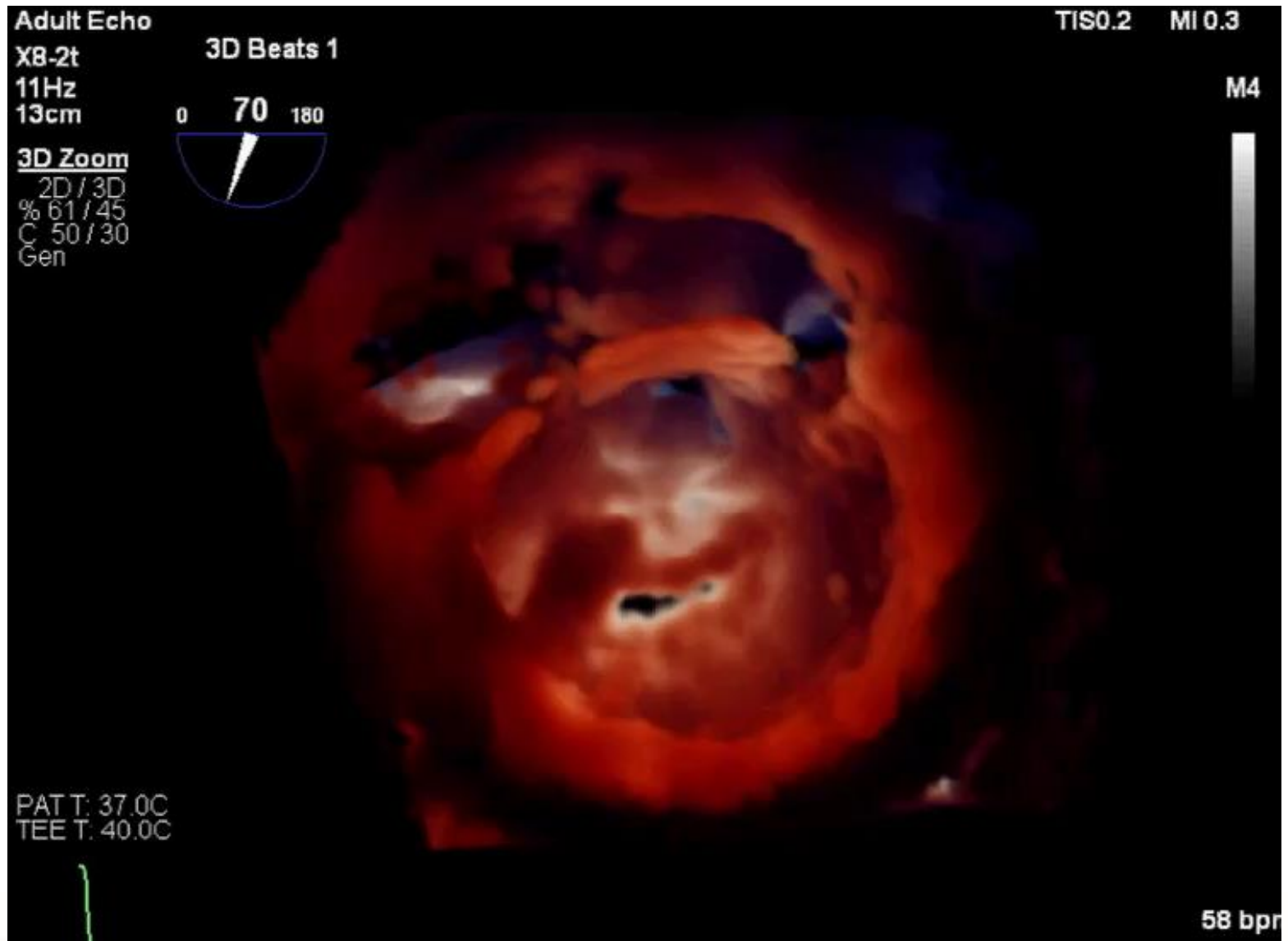
Commissural calcification



Commissural calcification

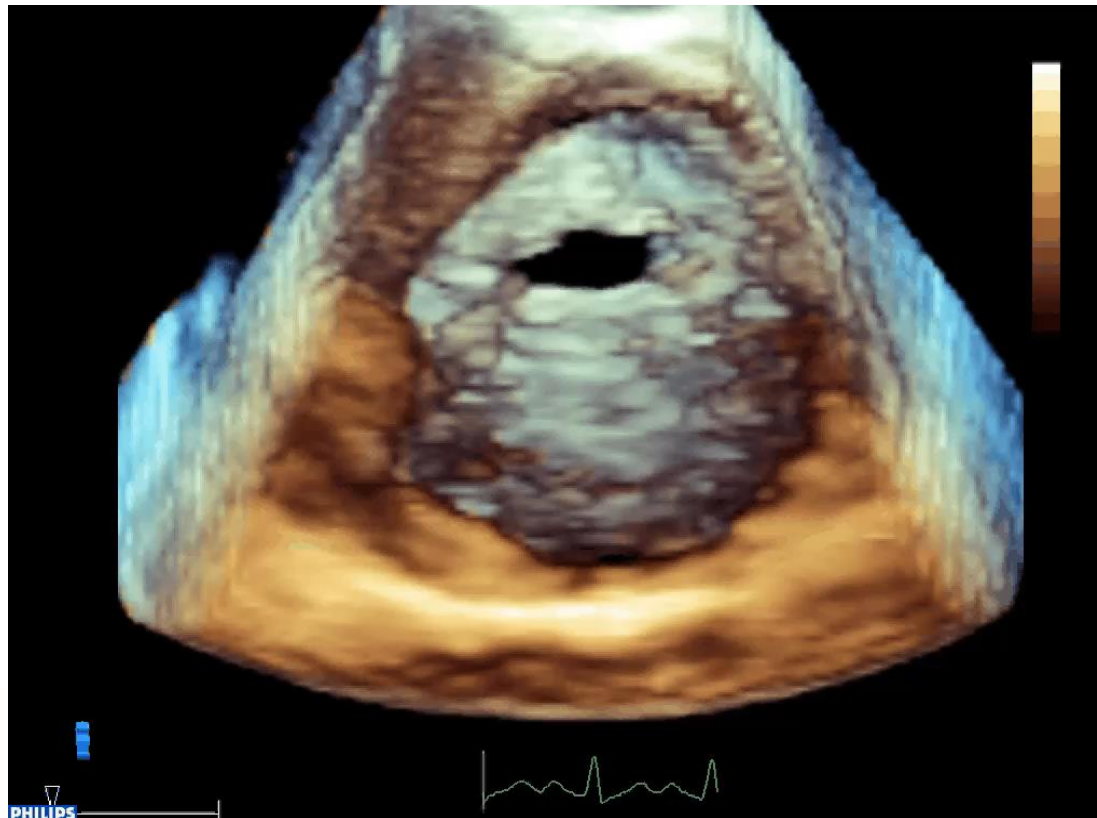


Commissural calcification

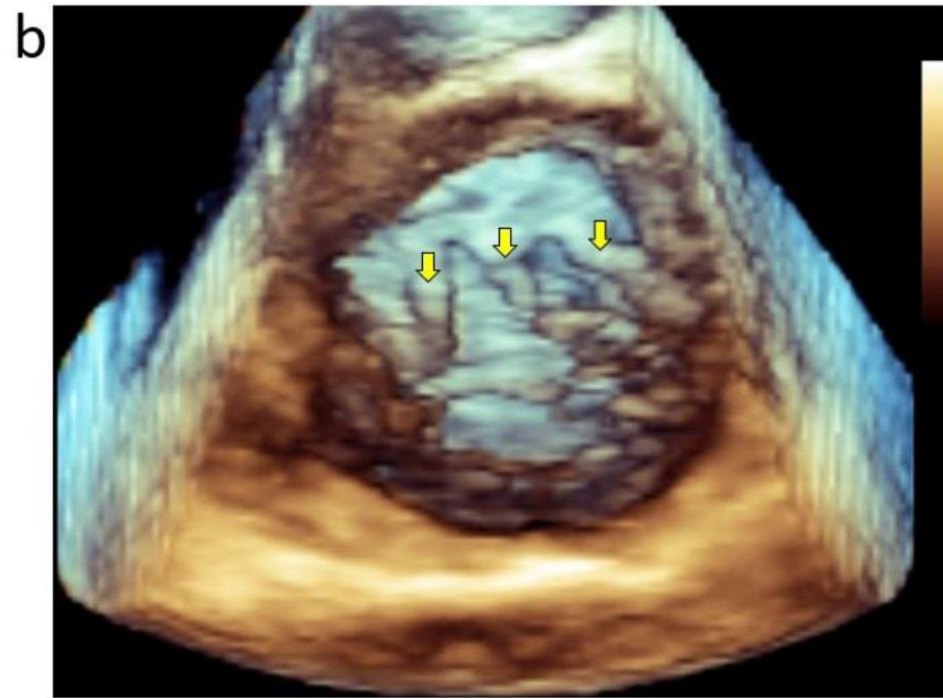
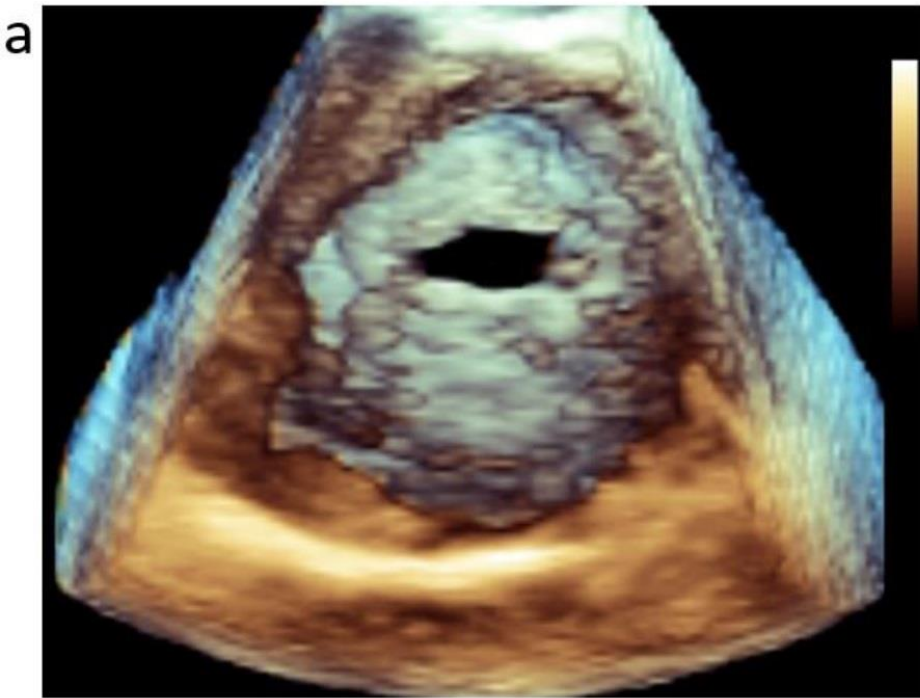


Sub-valvular apparatus

- 2D echocardiography was shown to **underestimate** the subvalvular affection.
- while RT3DE was used to assess and score the affection of the subvalvular apparatus with a good reproducibility.



Sub-valvular apparatus



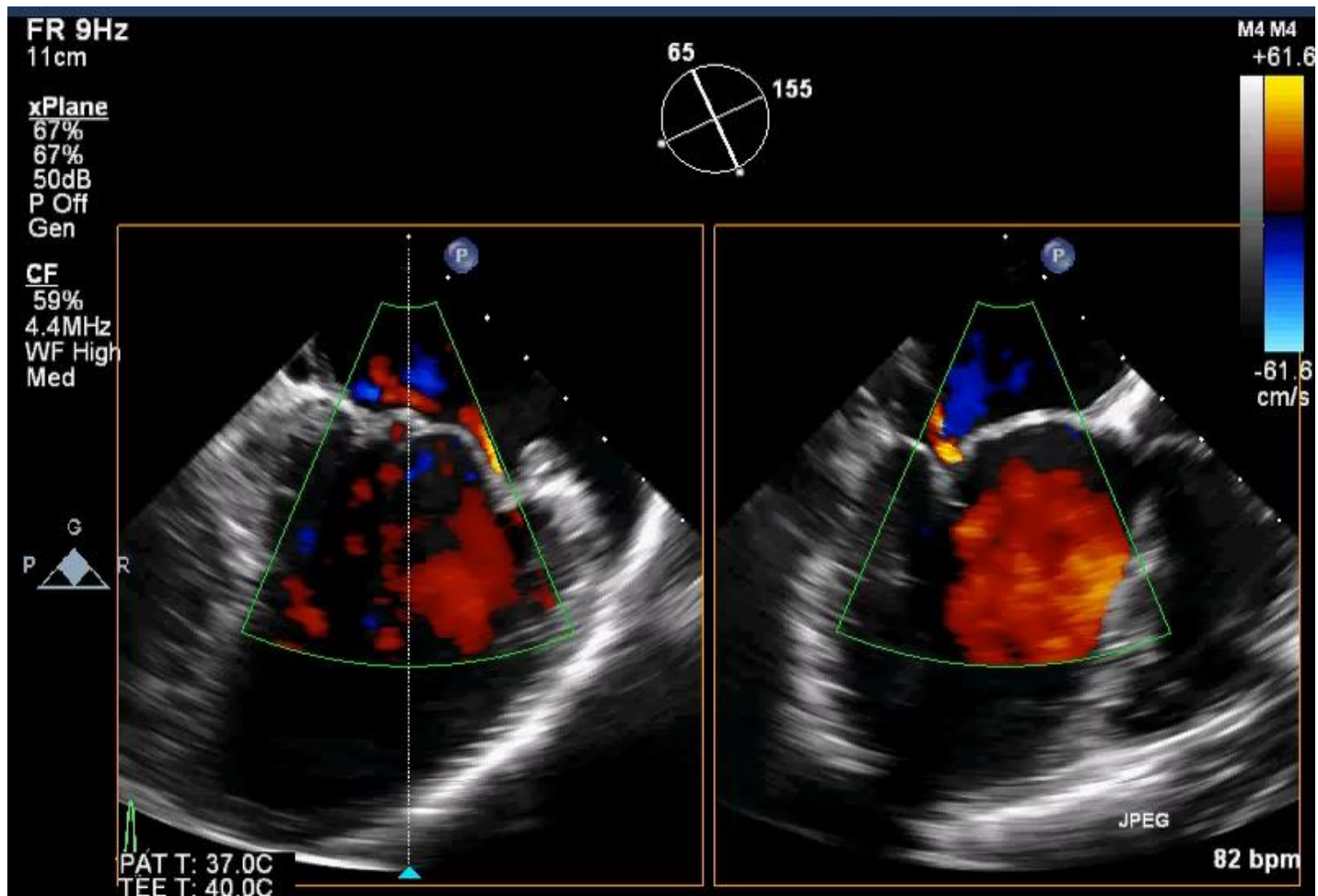
Sub-valvular apparatus



Sub-valvular apparatus



Sub-valvular apparatus



Sub-valvular apparatus

LA view



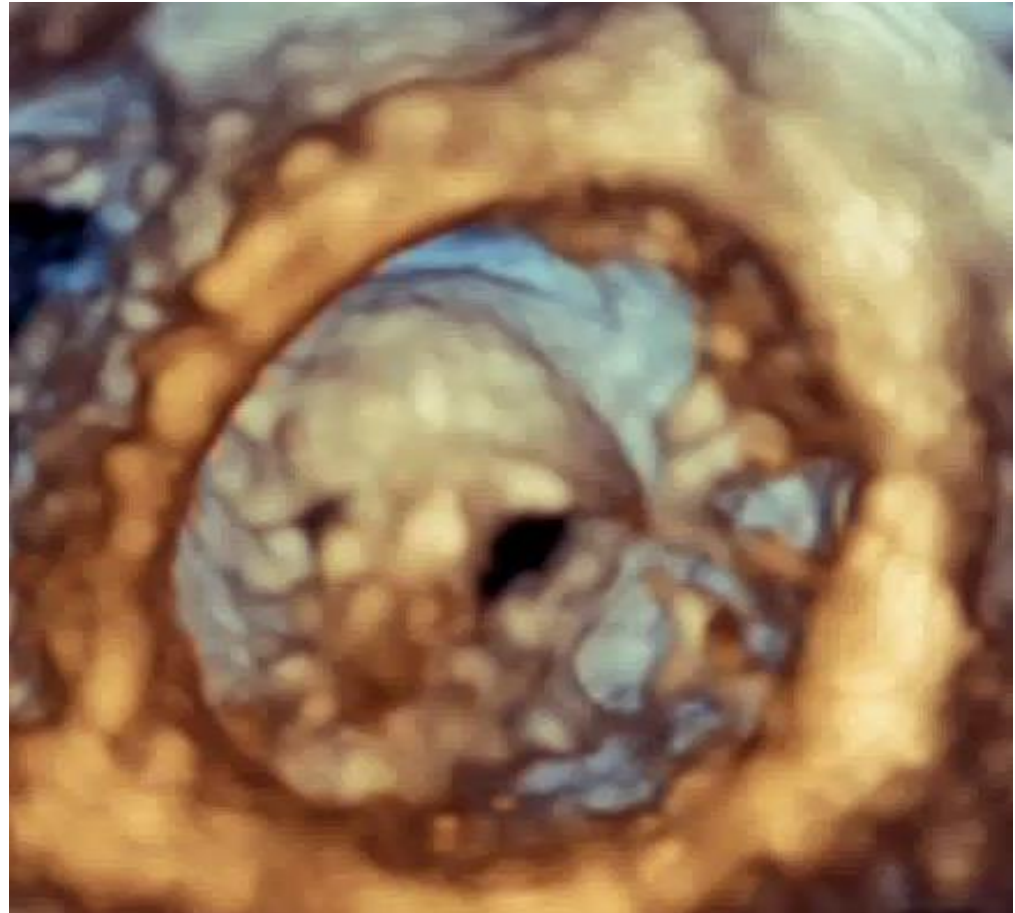
Sub-valvular apparatus

LA view



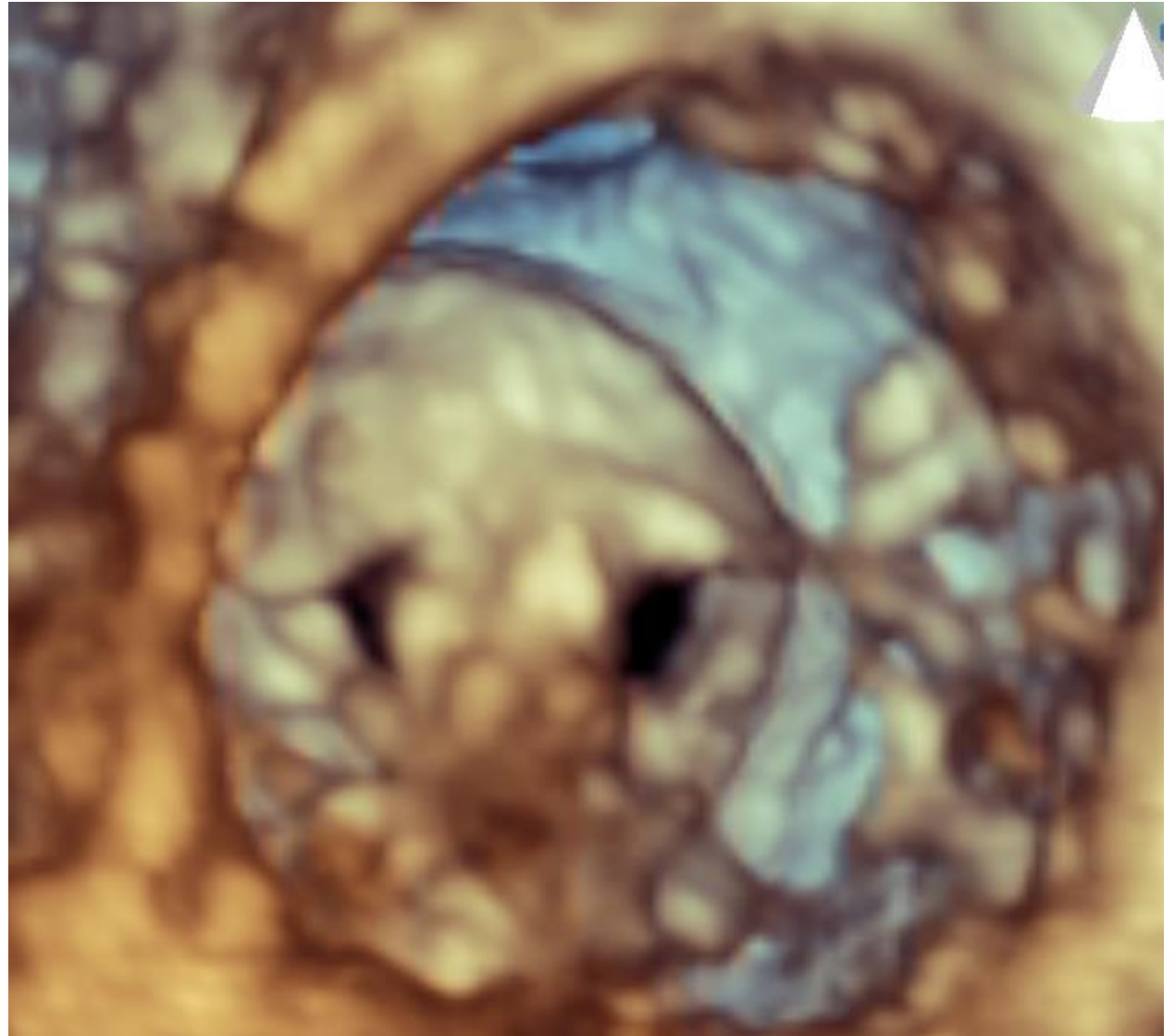
Sub-valvular apparatus

LV view



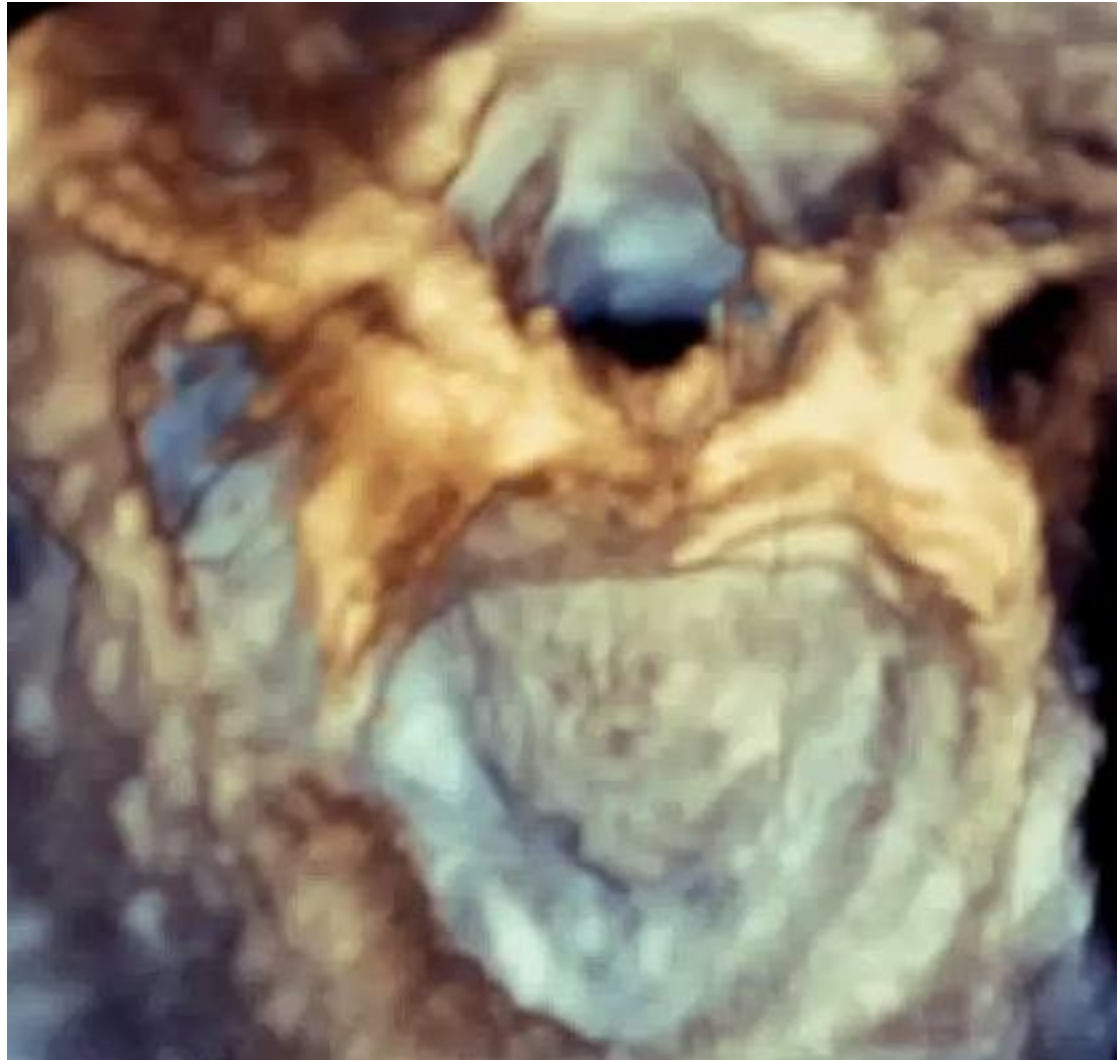
Sub-valvular apparatus

LV view



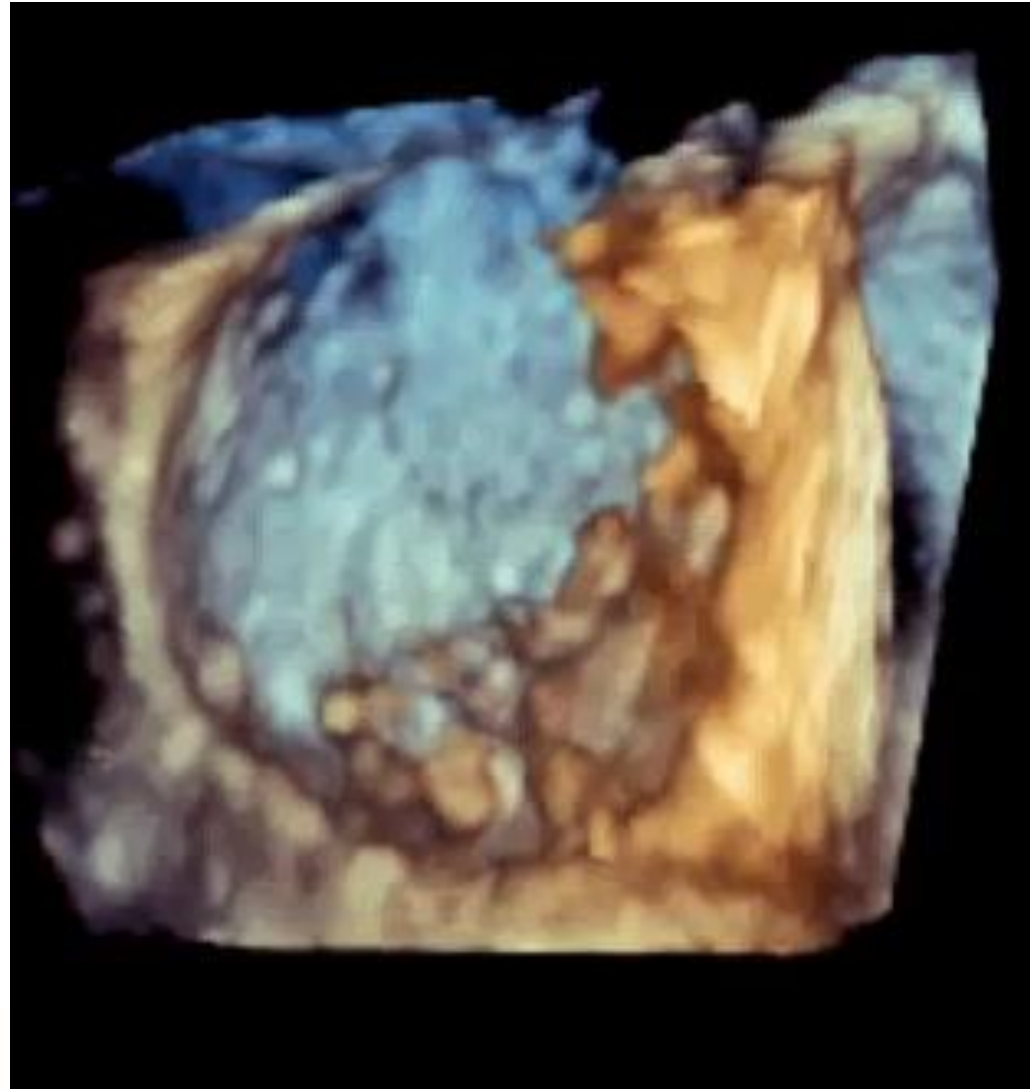
Sub-valvular apparatus

LA view



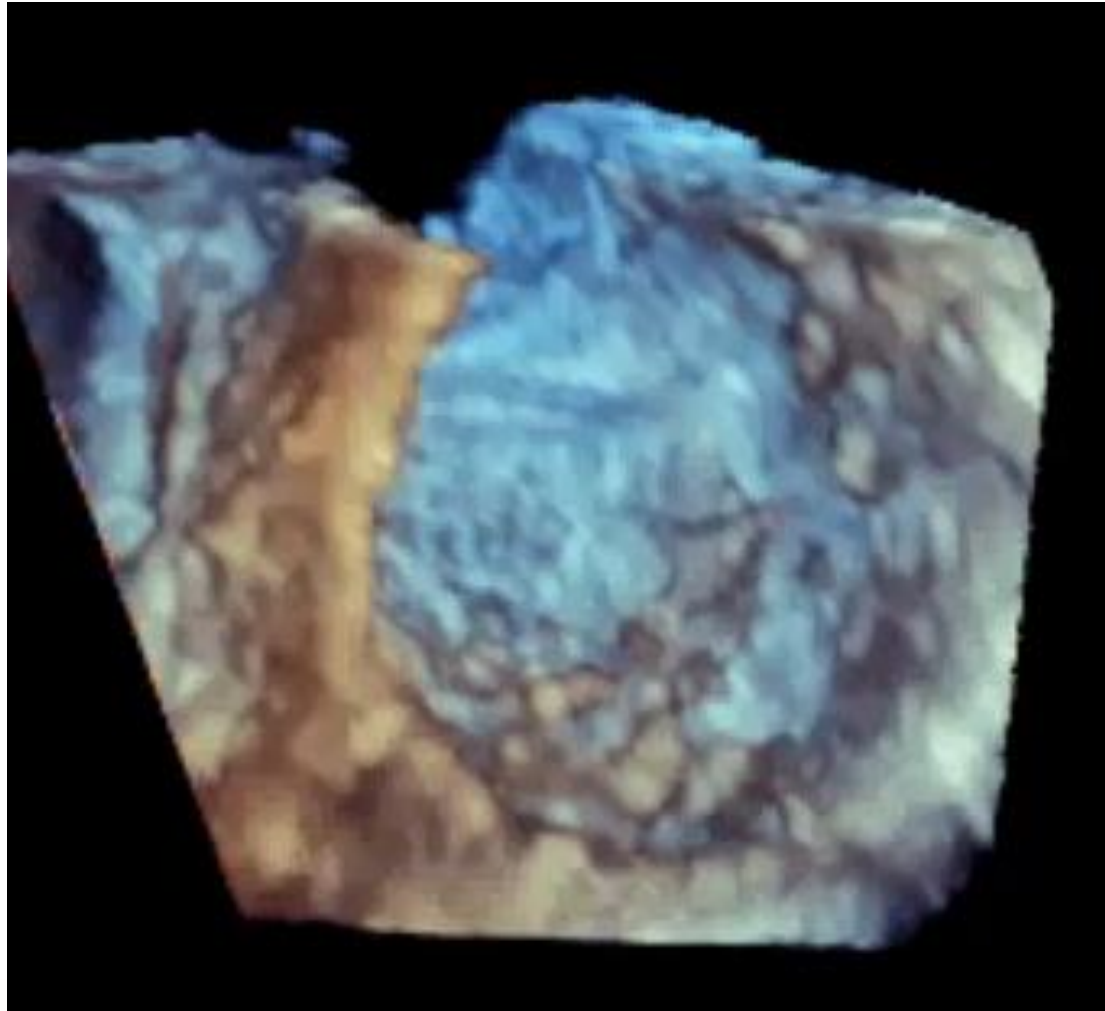
Sub-valvular apparatus

LV view



Sub-valvular apparatus

LV view





What was the PG after cropping the sub-valvular apparatus?

Dr. Ahmed Afifi

Quantitative assessment

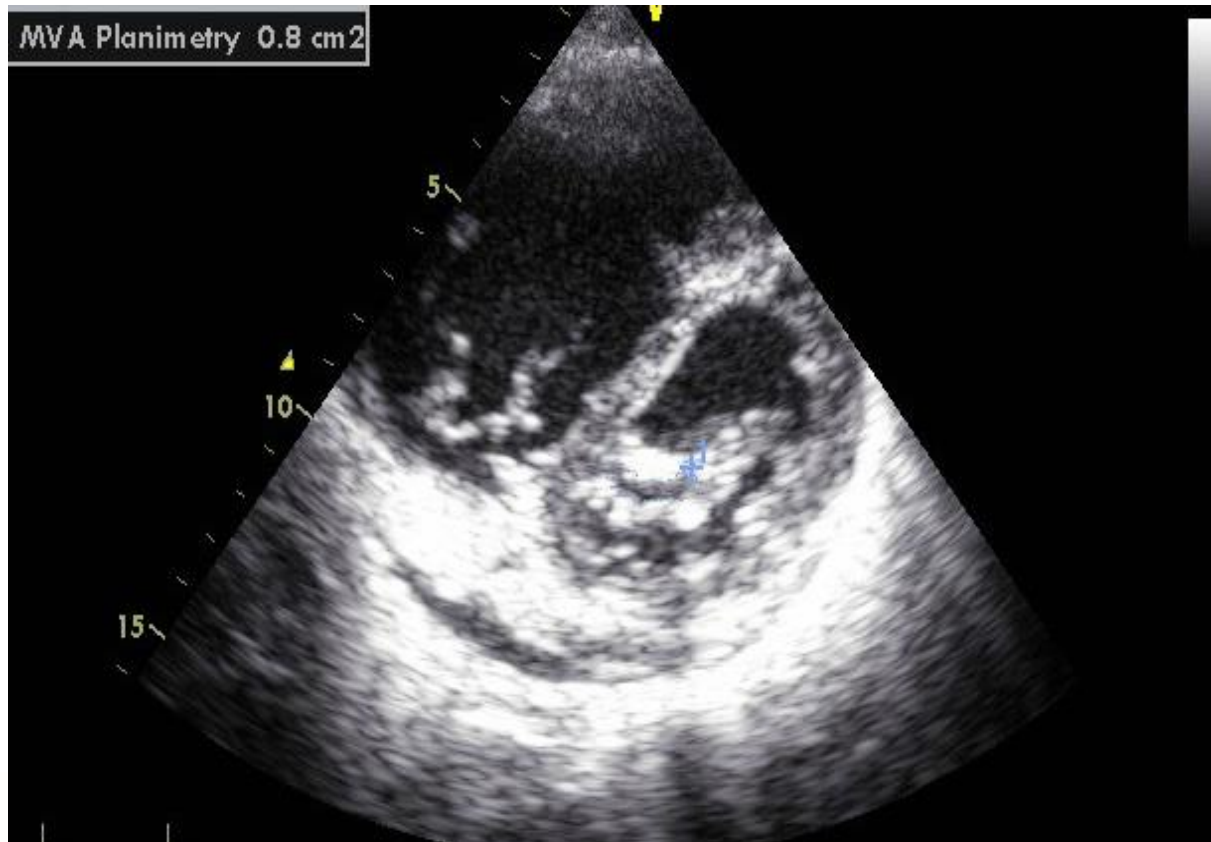
MVA calculation

MV area (MVA) can be calculated by plenty of methods:

- The invasive Gorlin formula
 - Pressure half time (PHT)
 - Continuity equation
 - Proximal isovelocity surface area (PISA) method
 - 2D Planimetry
 - 3D Planimetry
 - MVN method
- The invasively calculated **Gorlin formula** is considered the gold standard method for measuring (MVA).

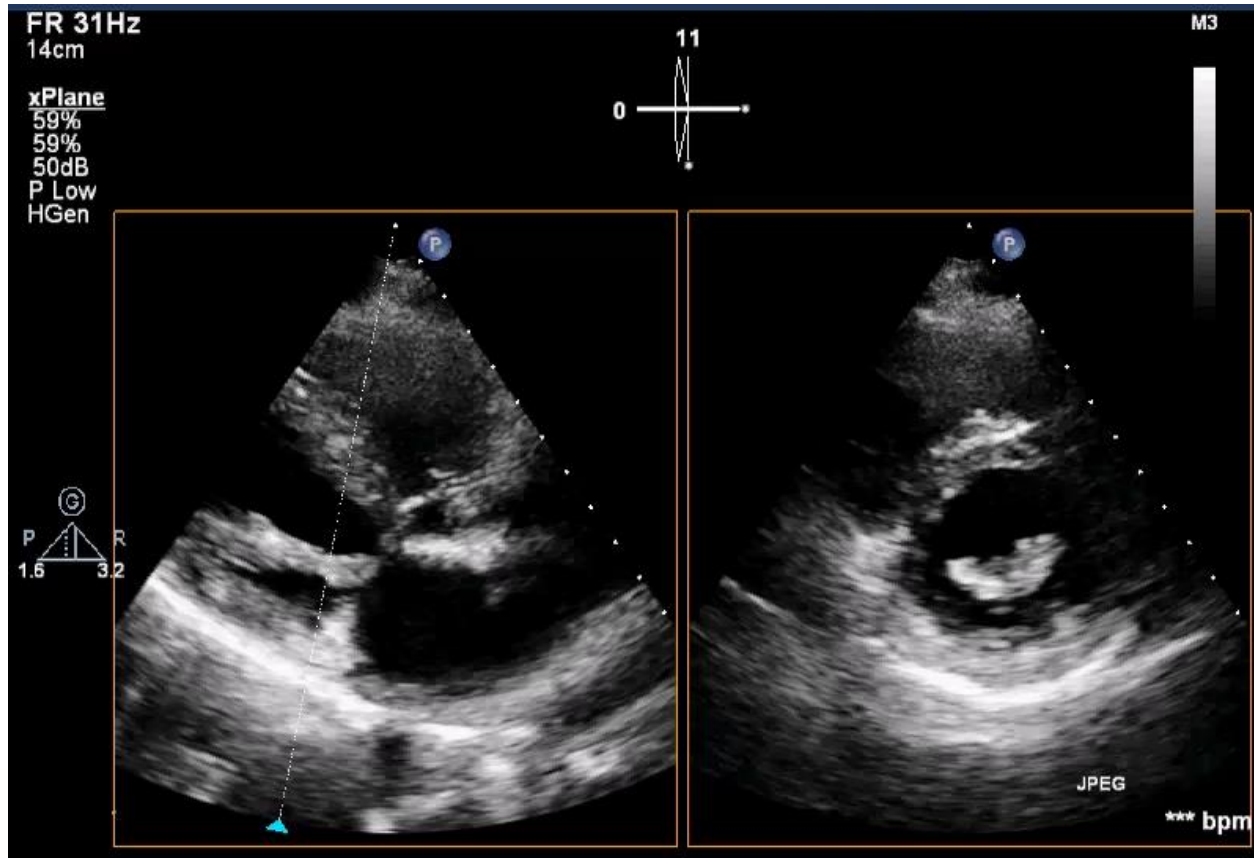
MVA calculation

- **Planimetry** of the MV orifice was shown to be one the best methods to calculate the MVA as it is not affected by the hemodynamics.

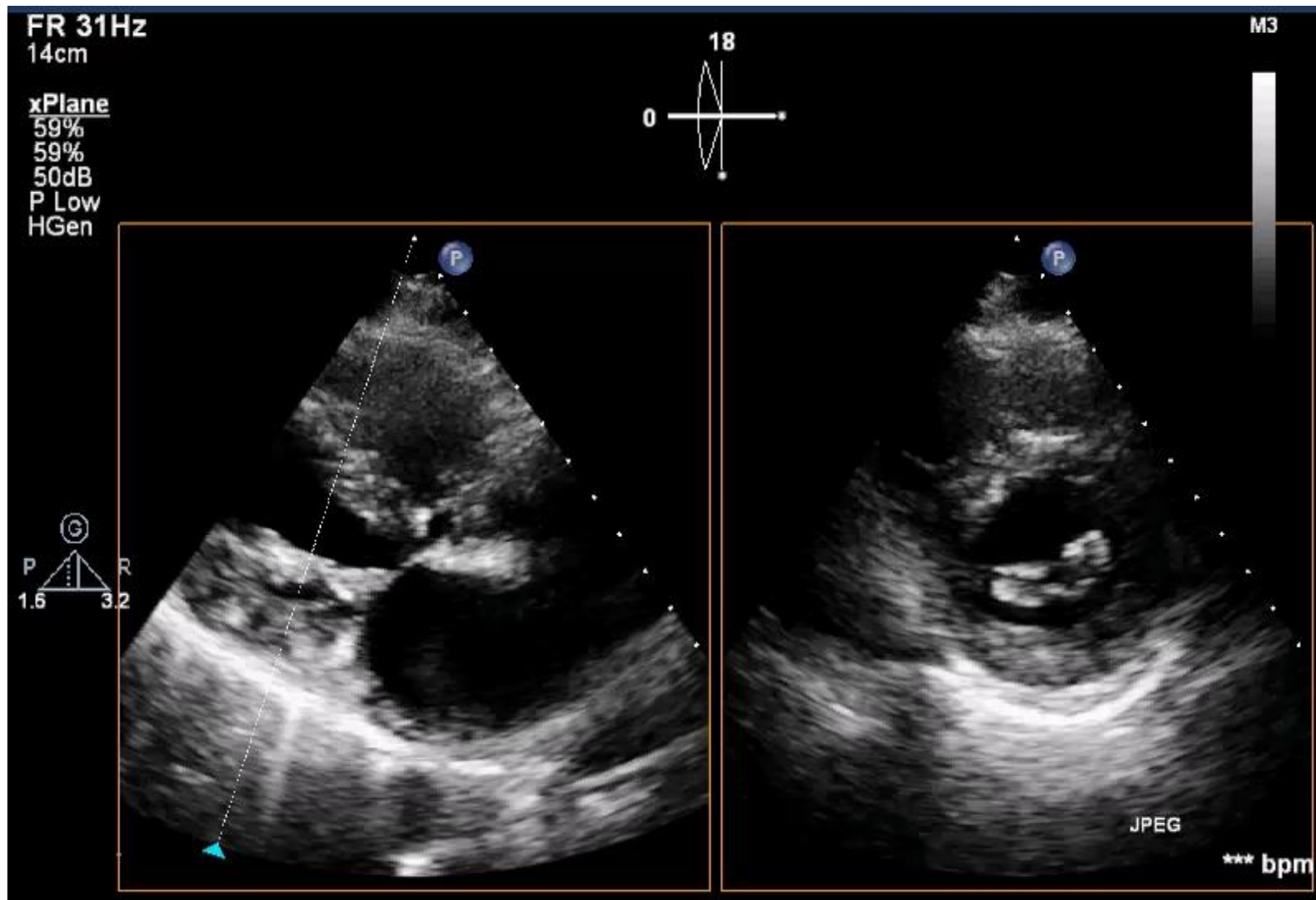


MVA calculation

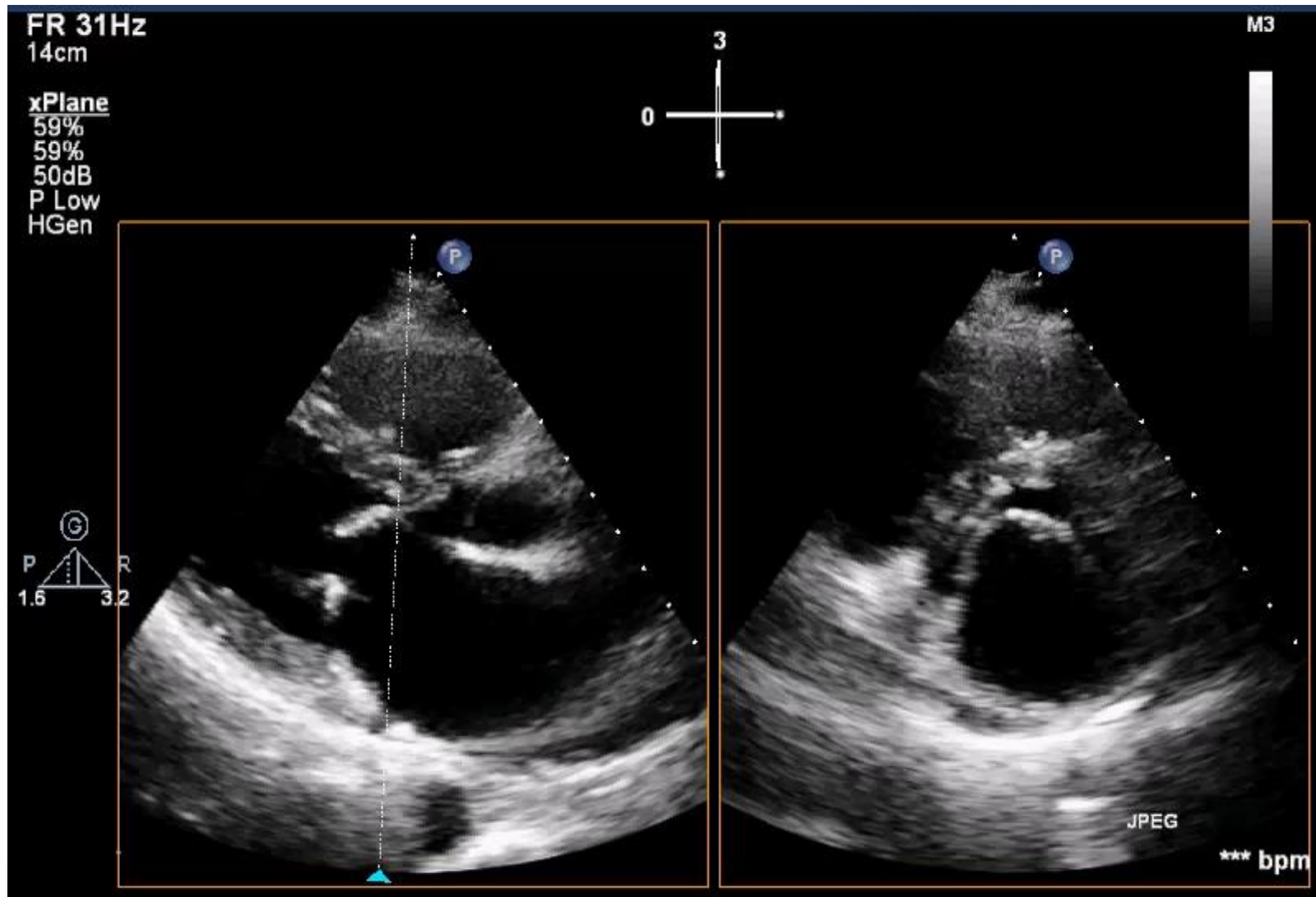
- However, 2D planimetry is limited to the **parasternal window** and is very much operator dependent that needs a skilled echocardiographer to make sure that the imaging plane is **cutting exactly** as the maximum true MV orifice in diastole otherwise under and/or overestimation of the MVA can result.



MVA calculation



MVA calculation



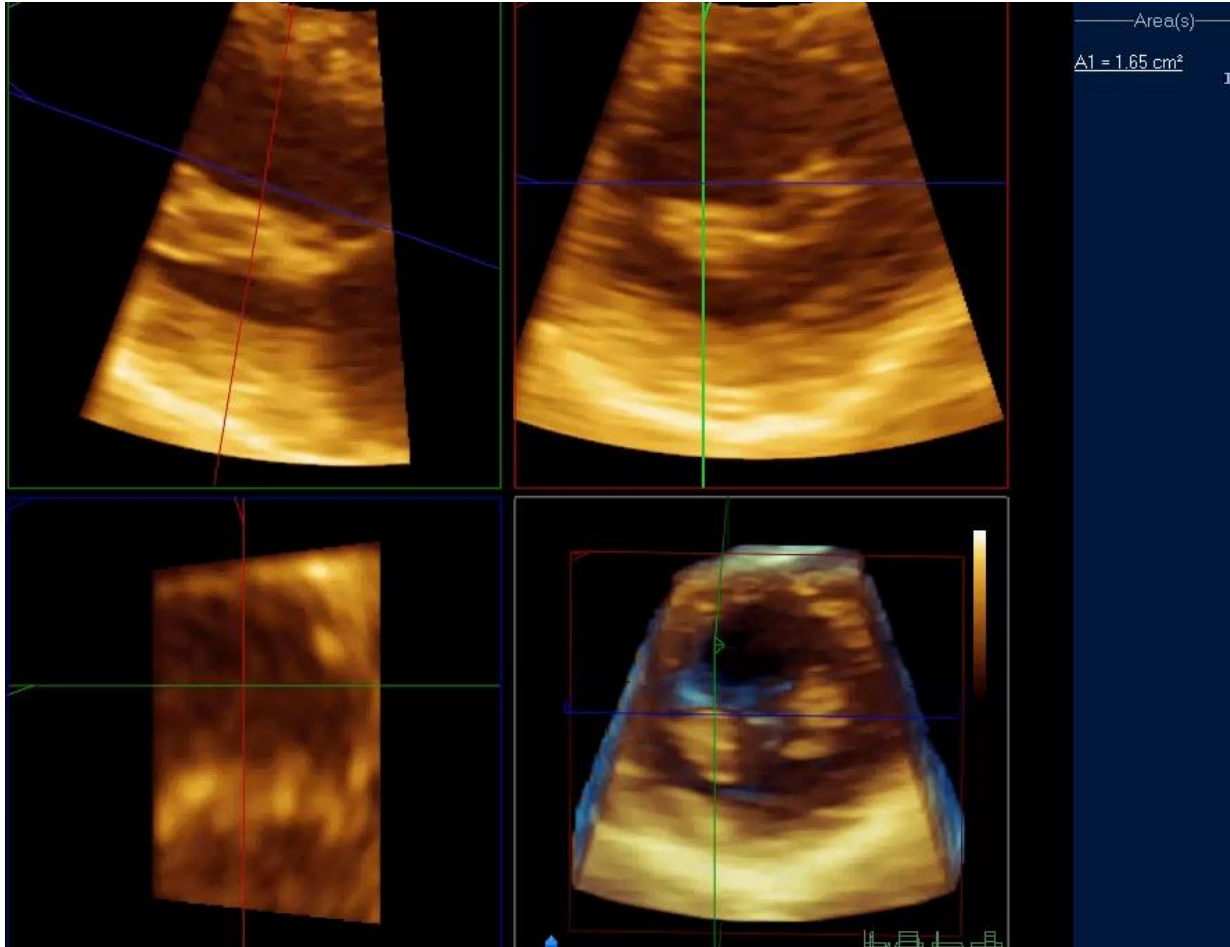
3D Planimetry

- it can utilize both parasternal as well as apical **windows**



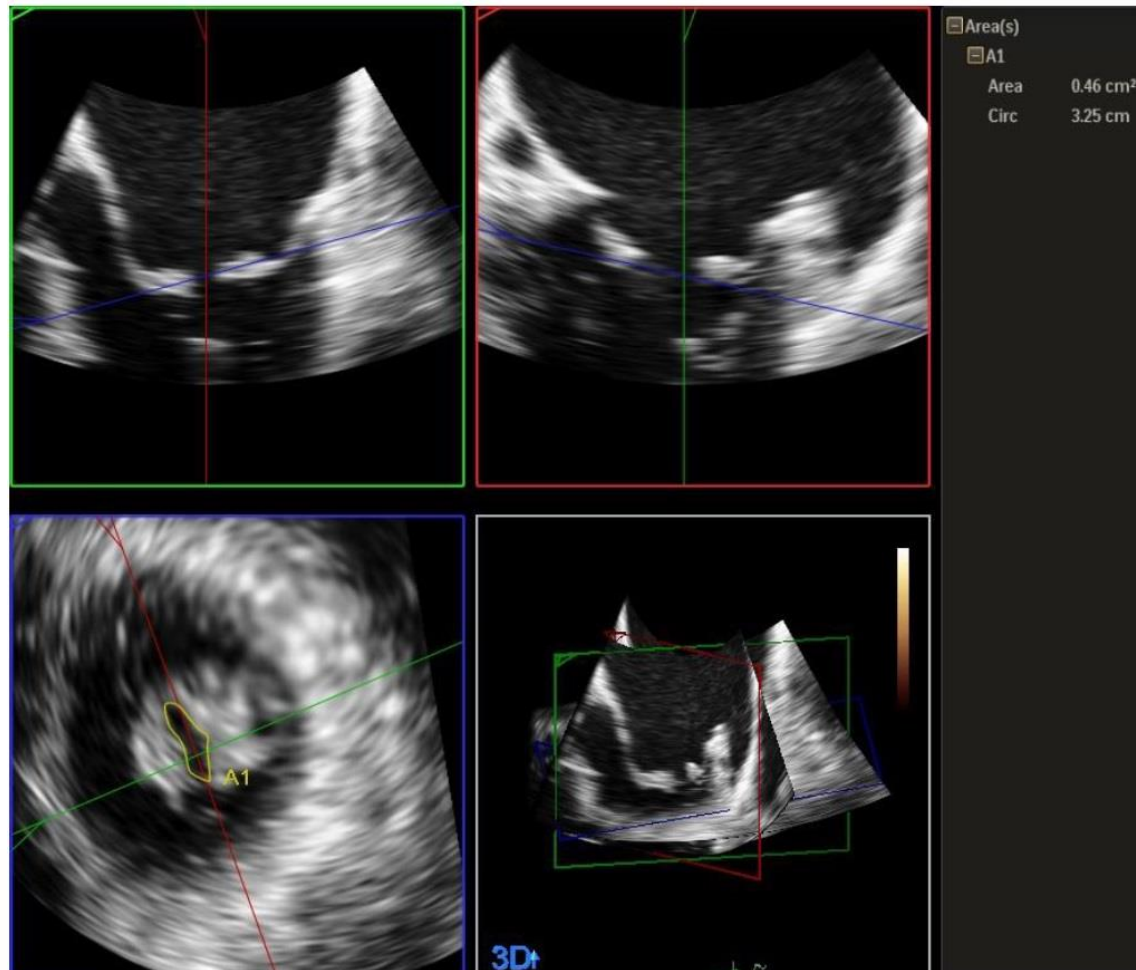
3D Planimetry

- it gives a unique opportunity to determine the true MV diastolic orifice and to choose the **correct plane** of measuring using the multi-planar reformation (**MPR**) software and/or by **direct planimetry** of the MV orifice on the 3D image.

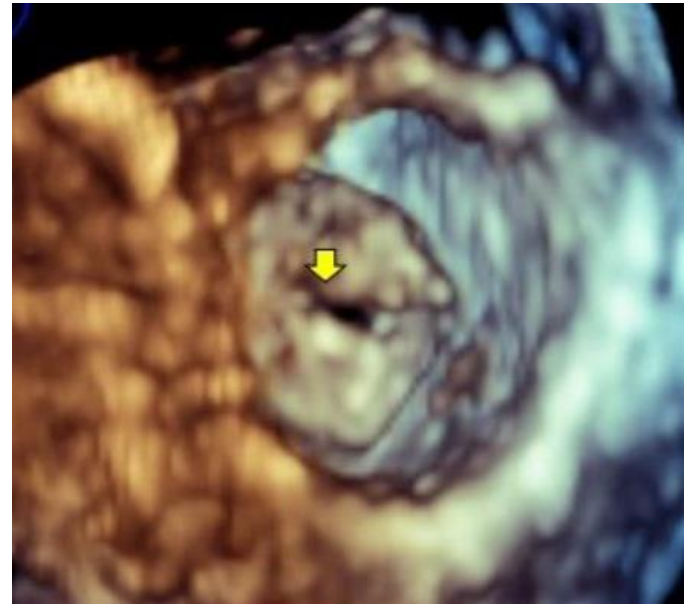
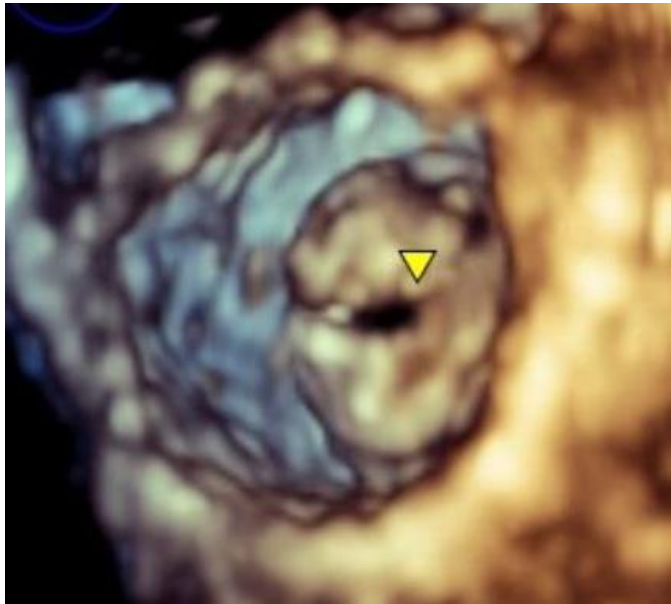


3D Planimetry

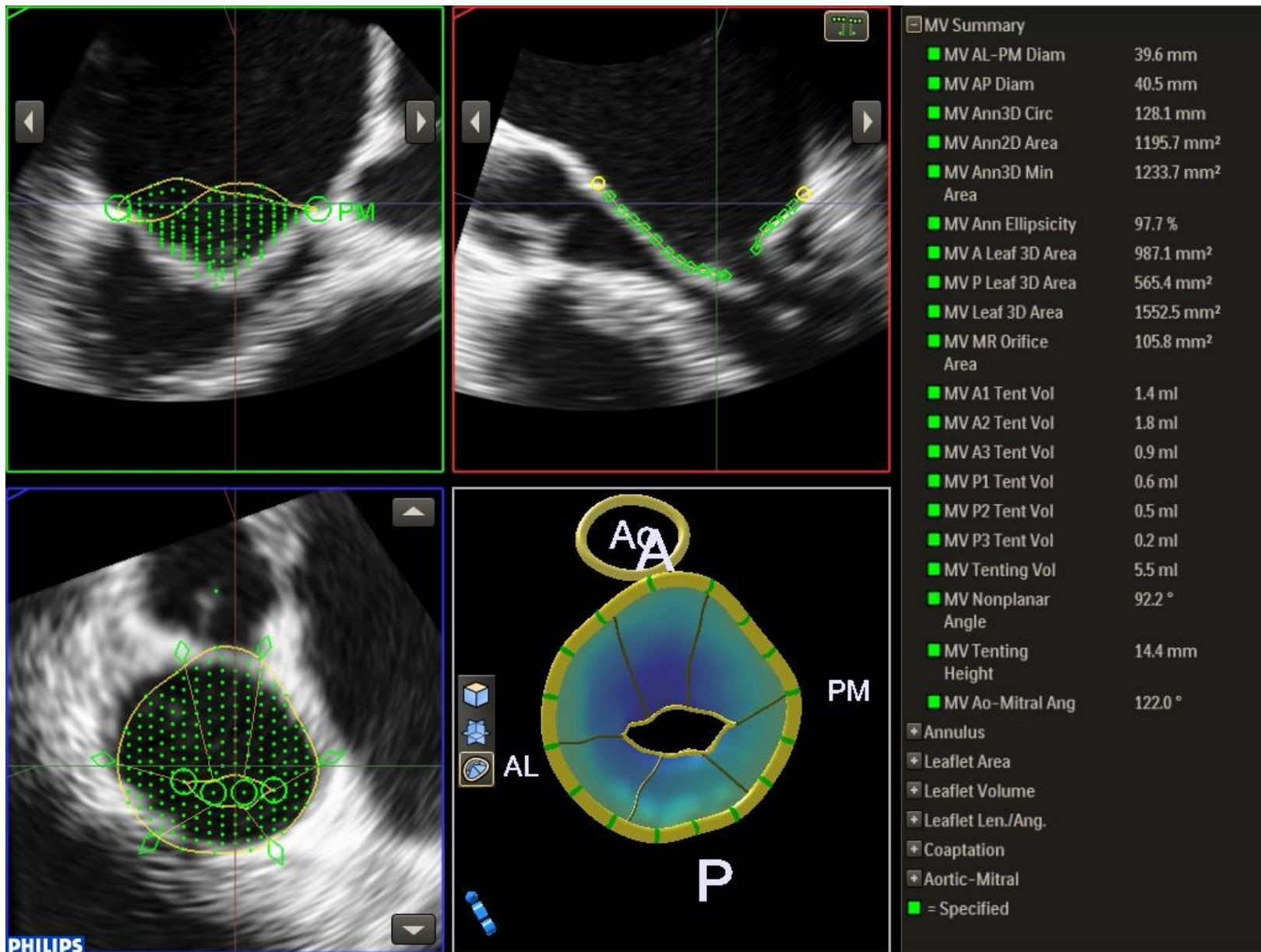
- It was shown to be well correlated with the directly measured **MVA at the operation**, and to be superior than MVA calculated using **2D planimetry** as well as **PHT**



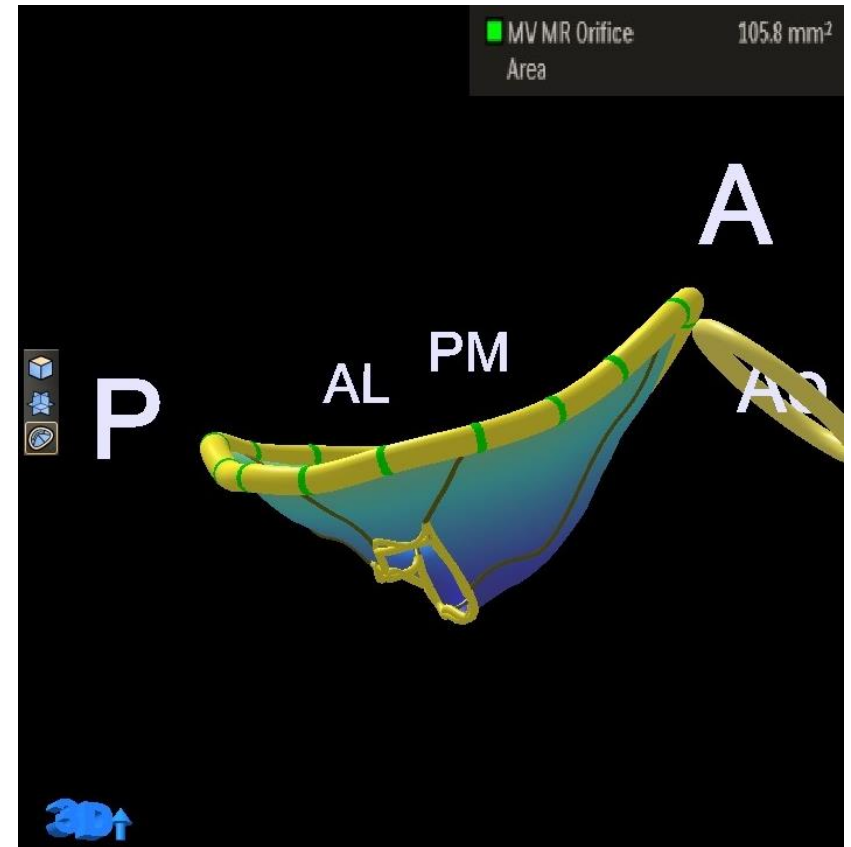
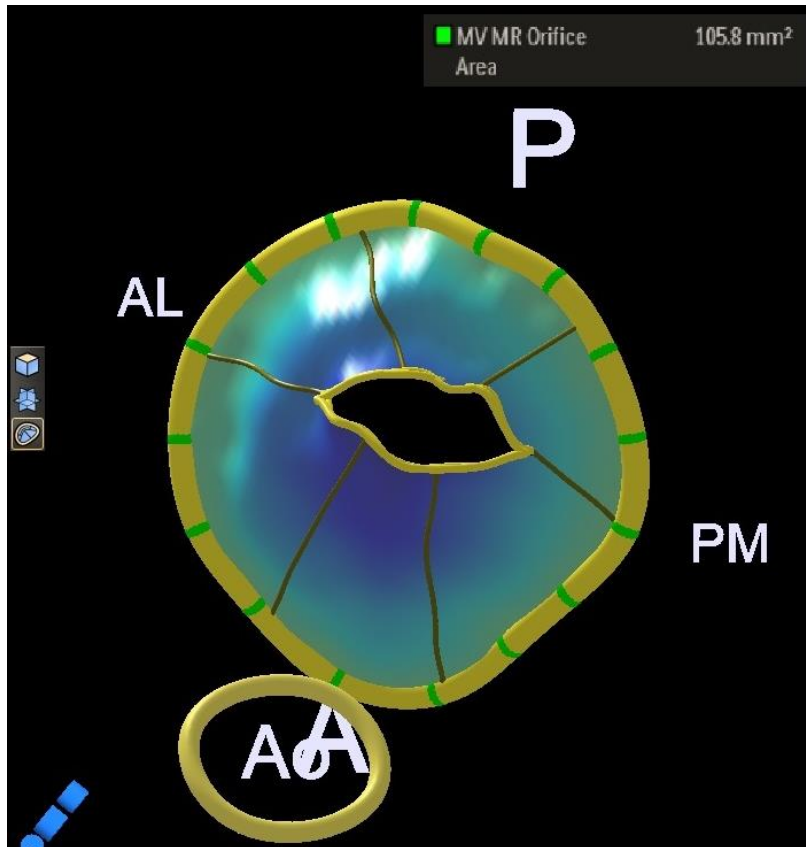
MVN method



MVN method



MVN method



Echocardiography

A Journal of Cardiovascular Ultrasound and Allied Techniques

ORIGINAL INVESTIGATION

A novel method to measure mitral valve area in patients with rheumatic mitral stenosis using three-dimensional transesophageal echocardiography: Feasibility and validation

Hani M. Mahmoud Elsayed MBBCh, MSc, FASE ,

Mohamed Hassan MD, FACC, Michael Nagy MBBCh, MSc,

Alaaeldin Amin MD, Ahmed Elguindy MD, MRCP, FACC,

Kerolos Wagdy MBBCh, MSc, Magdi Yacoub FRCS, FRS

First published: 22 December 2017

RT-TT3DE MV score

RT-TT3DE score

Journal of the
JASE
American Society of Echocardiography

Validation of a New Score for the Assessment of Mitral Stenosis Using Real-Time Three-Dimensional Echocardiography

Ashraf M. Anwar, MD, Wael M. Attia, MD, Youssef F.M. Nosir, MD, PhD, Osama I.I. Soliman, MD, PhD,
Mohammed A. Mosad, MSc, Munir Othman, MD, Marcel L. Geleijnse, MD, PhD, Ali M. El-Amin, MD, Folkert
J. Ten Cate, MD, PhD  

RT-TT3DE score

Anwar et al. introduced a score based on real-time 3-dimensional transthoracic echocardiography (**RT-TT3DE**) for the assessment of patients with MS **before PMBV**.

- This score includes the **evaluation and scoring** of:
 - ✓ Both mitral leaflets
 - ✓ Subvalvular apparatus
- ✓ RT-TT3DE score was shown to be feasible and highly reproducible with good interobserver and intraobserver agreement in the assessment of MV in patients with MS.
- **Leaflet mobility** and the involvement of the **subvalvular apparatus** were the best predictors of optimal PMBV results.
- **High RT-TT3DE calcification score** was associated with the incidence and severity of post-procedural MR.

RT-TT3DE score

-	Anterior mitral leaflet			Posterior mitral leaflet		
	A1	A2	A3	P1	P2	P3
Thickness (0-6) (0 = normal, 1 = thickened)*	0-1	0-1	0-1	0-1	0-1	0-1
Mobility (0-6) (0 = normal, 1 = limited)*	0-1	0-1	0-1	0-1	0-1	0-1
Calcification (0-10) (0 = no, 1-2 = calcified)**	0-2	0-1	0-2	0-2	0-1	0-2
Subvalvular apparatus						
	Proximal third		Middle third		Distal third	
Thickness (0-3) (0 = normal, 1 = thickened)	0-1		0-1		0-1	
Separation (0-6) (0 = normal, 1 = partial, 2 = no)	0, 1, 2		0, 1, 2		0, 1, 2	
*Normal = 0, mild = 1 to 2, moderate = 3 to 4, severe ≥ 5.						
**Normal = 0, mild = 1 to 2, moderate = 3 to 5, severe ≥ 6.						



Percutaneous Mitral Balloon Valvuloplasty (PMBV)

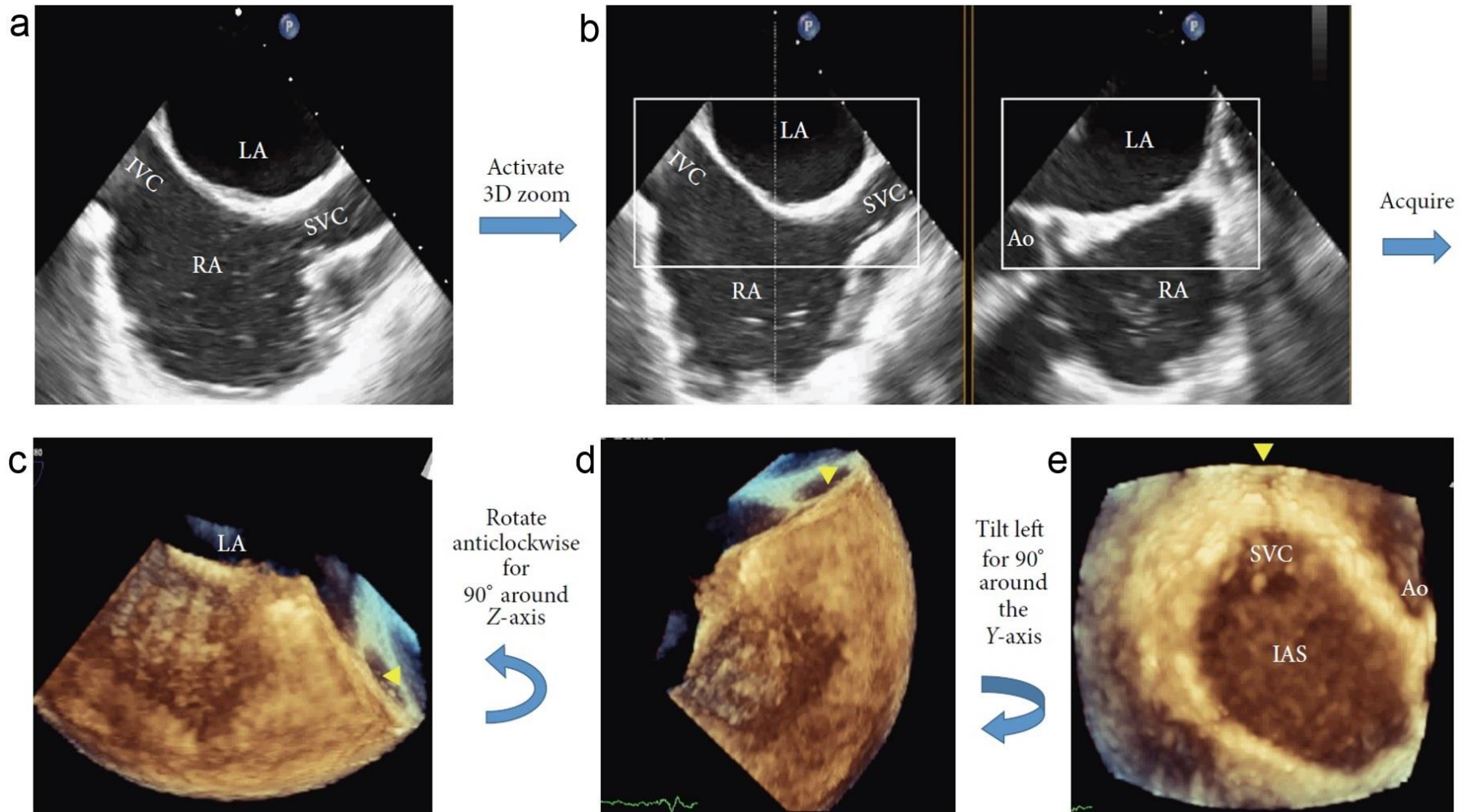
Percutaneous Mitral Balloon Valvuloplasty (PMBV)

Although many centers are used to have **fluoroscopy** as the sole guiding modality during PMBV, yet 2D/3D-TEE was shown to have an incremental value in different procedural steps;

- Trans-septal puncture (TSP)
- Balloon positioning
- Balloon inflation
- Assessment of the results & complications

Trans-septal puncture (TSP)

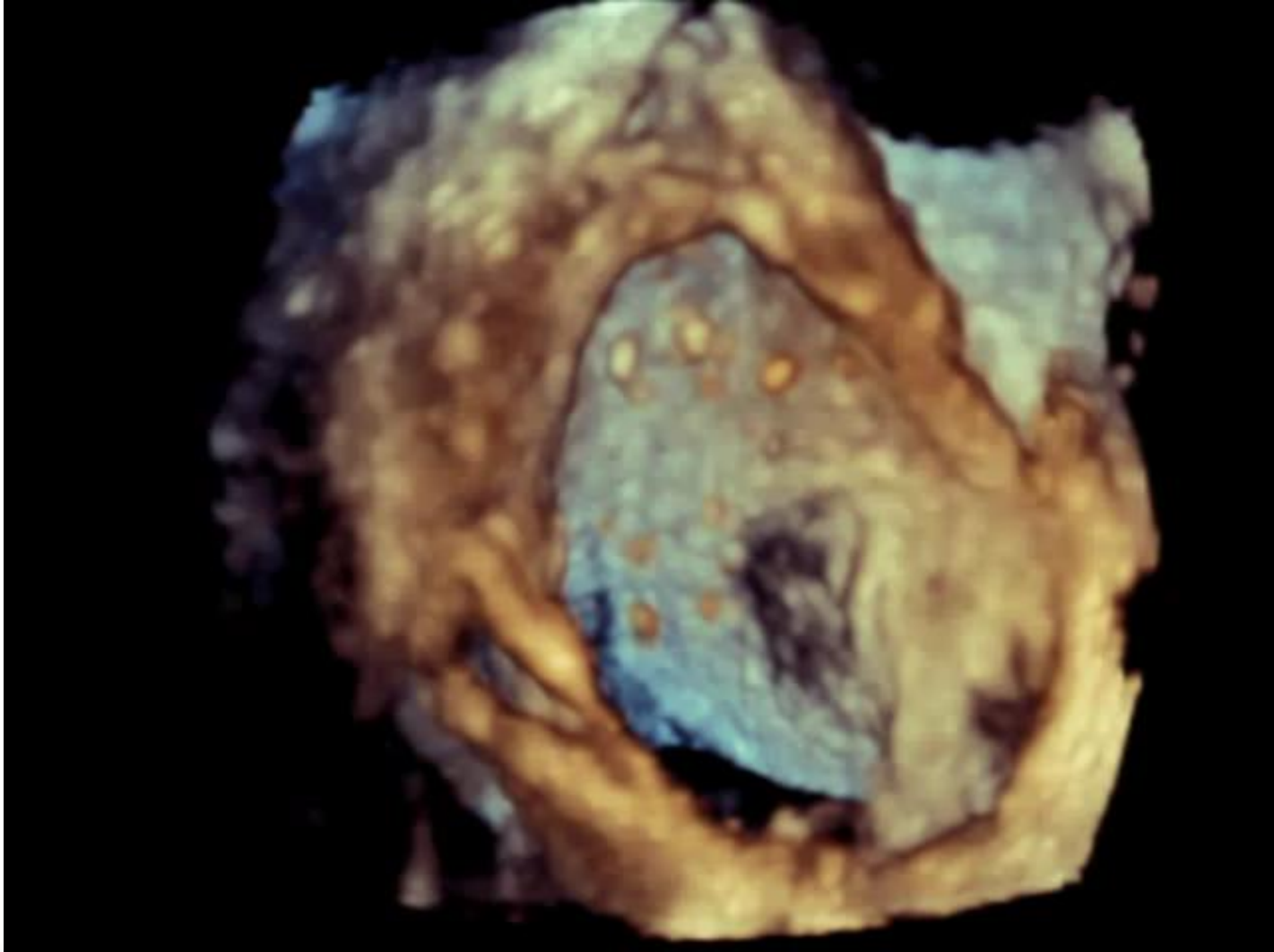
RATLE 90 maneuver



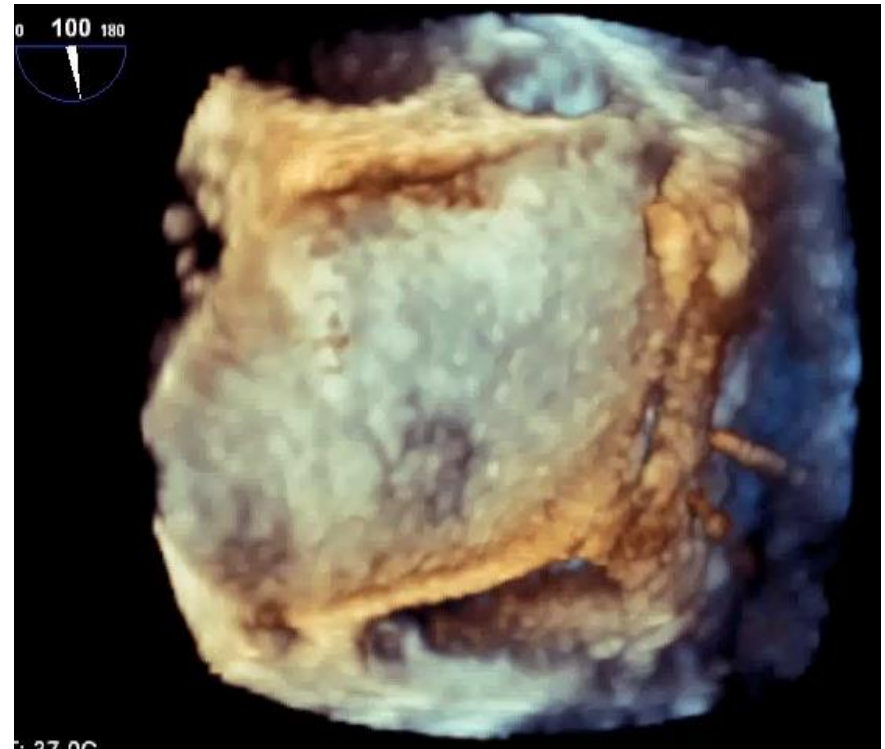
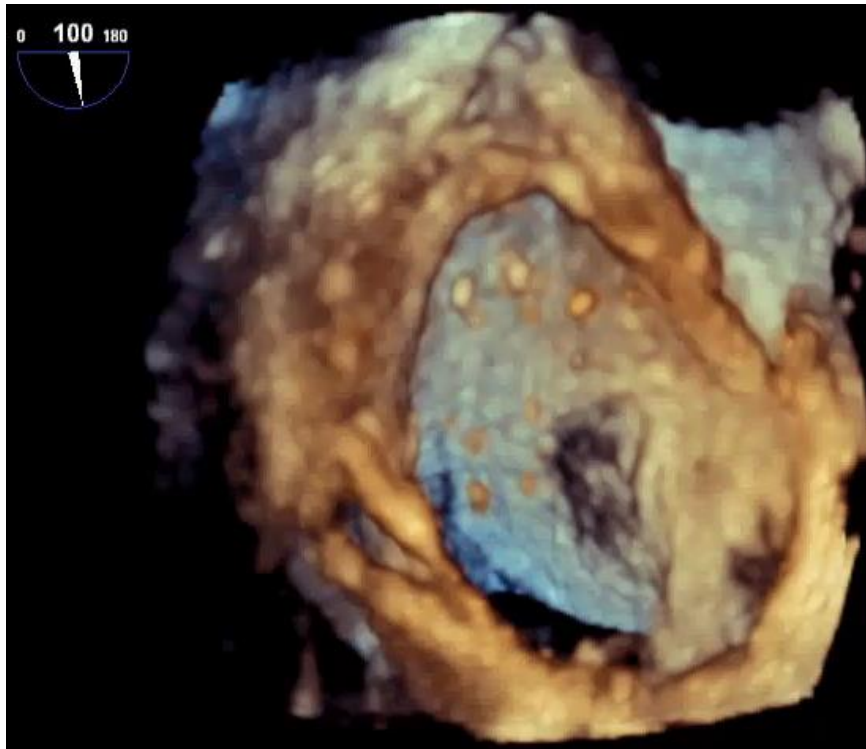
RATLE 90 maneuver



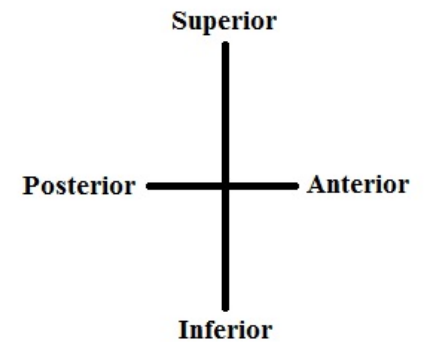
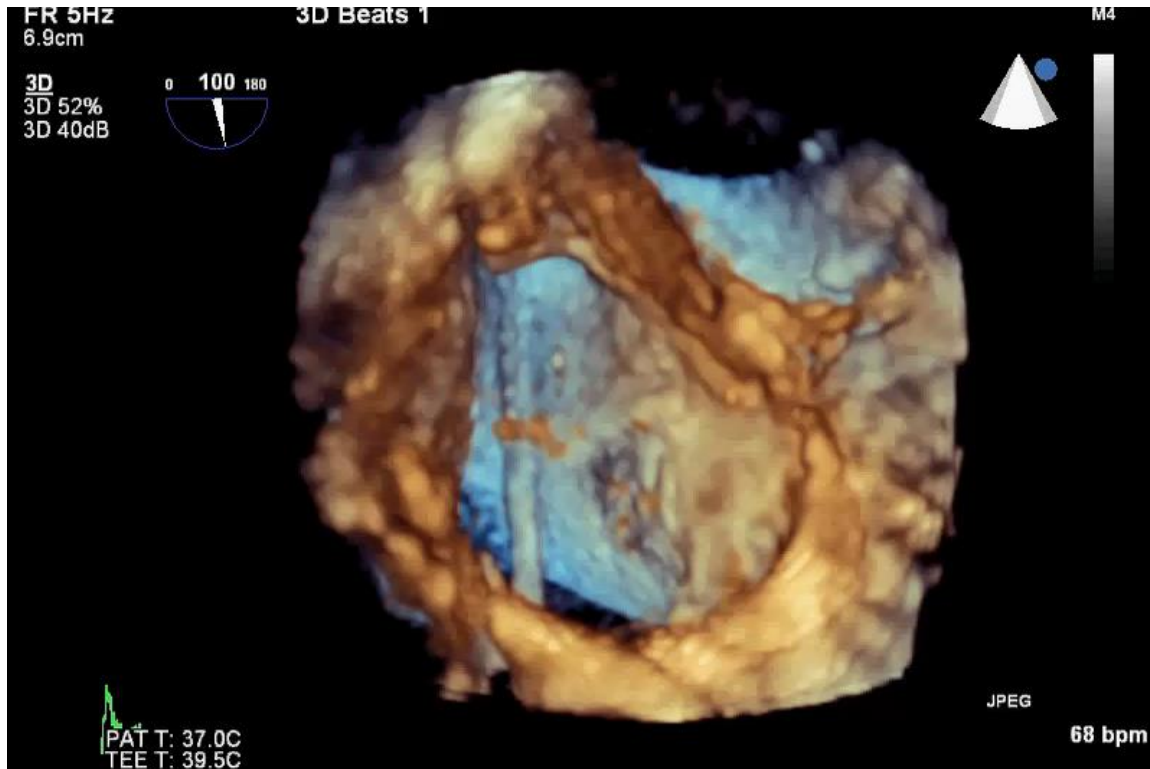
RATLE 90 maneuver

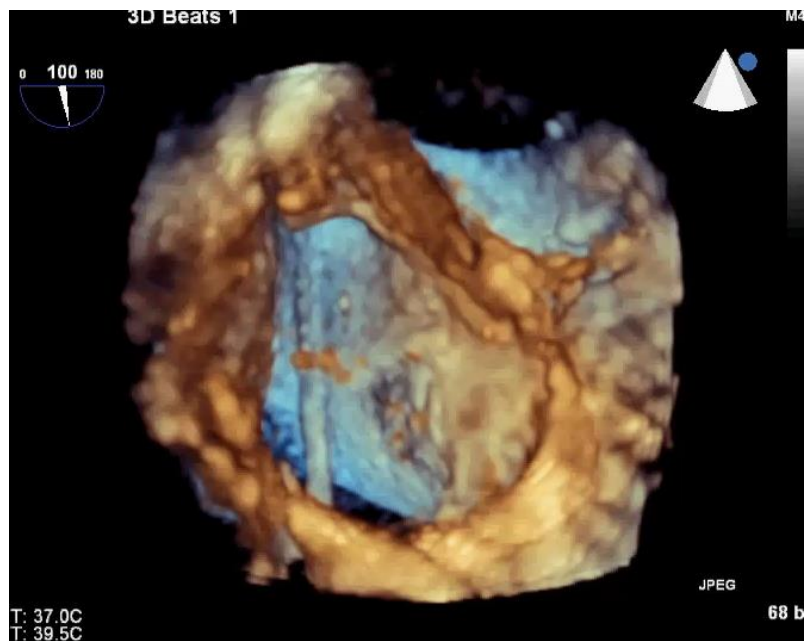


RATLE 90 maneuver

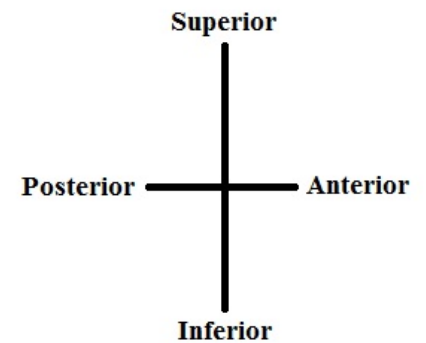
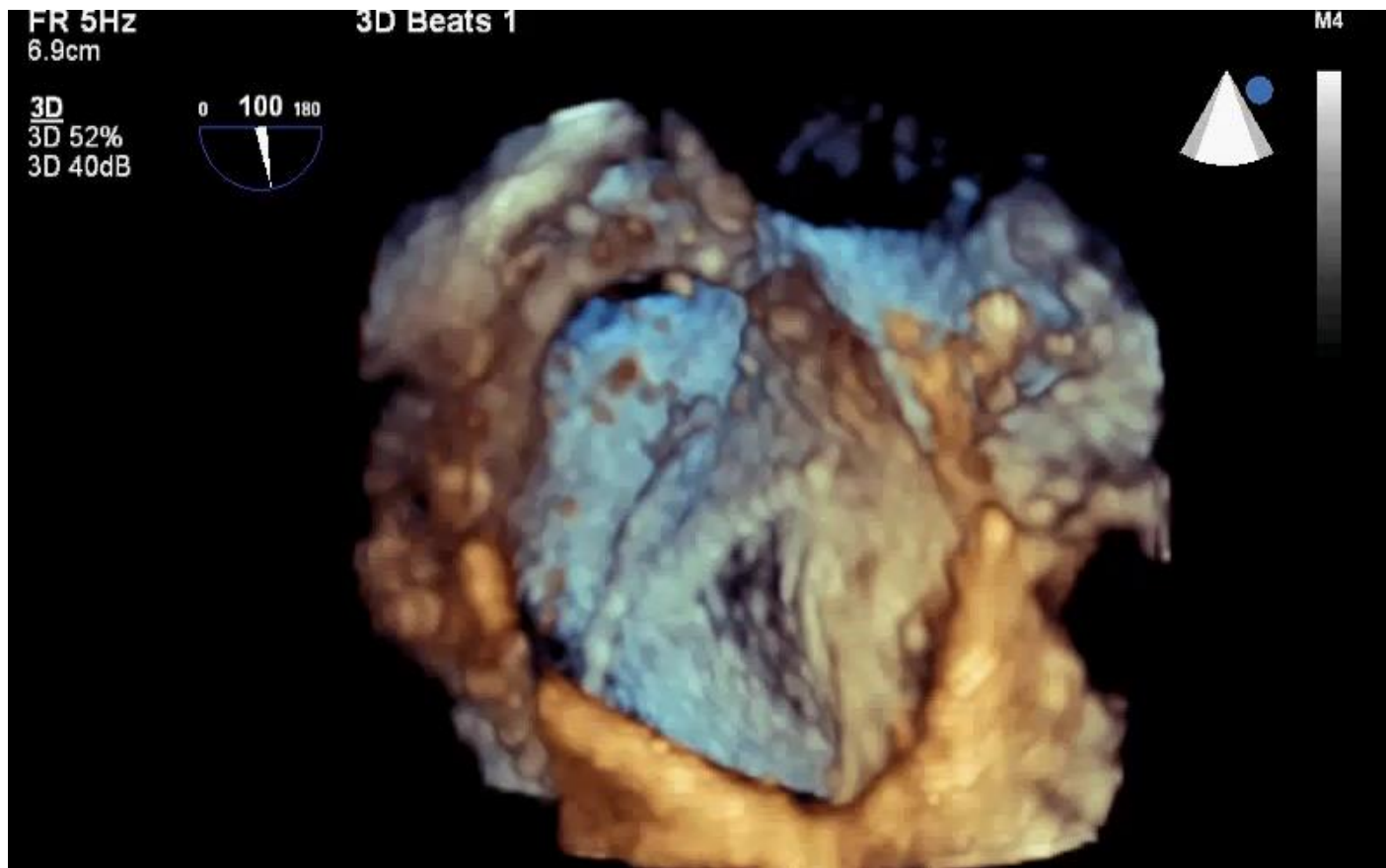


RATLE 90 maneuver

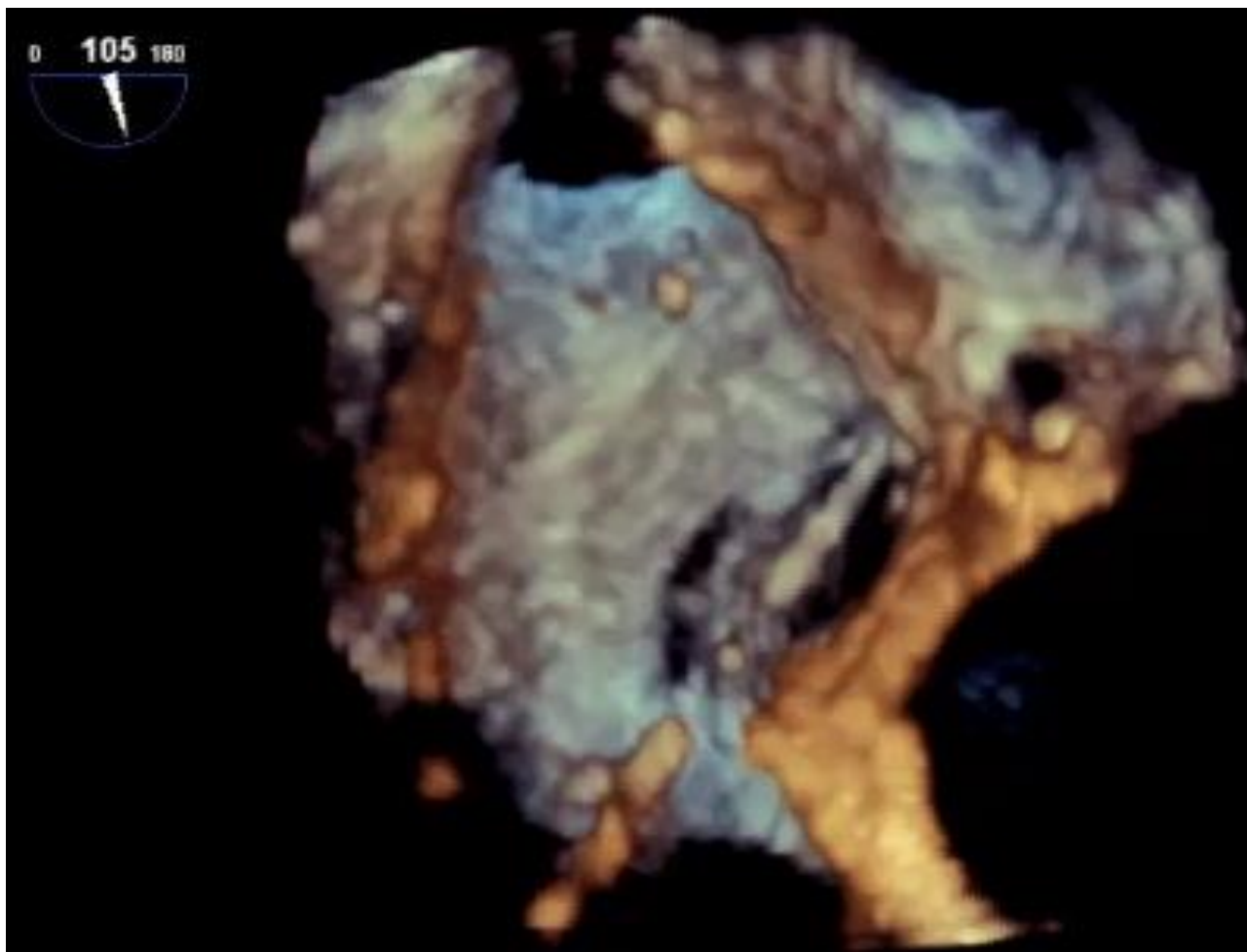


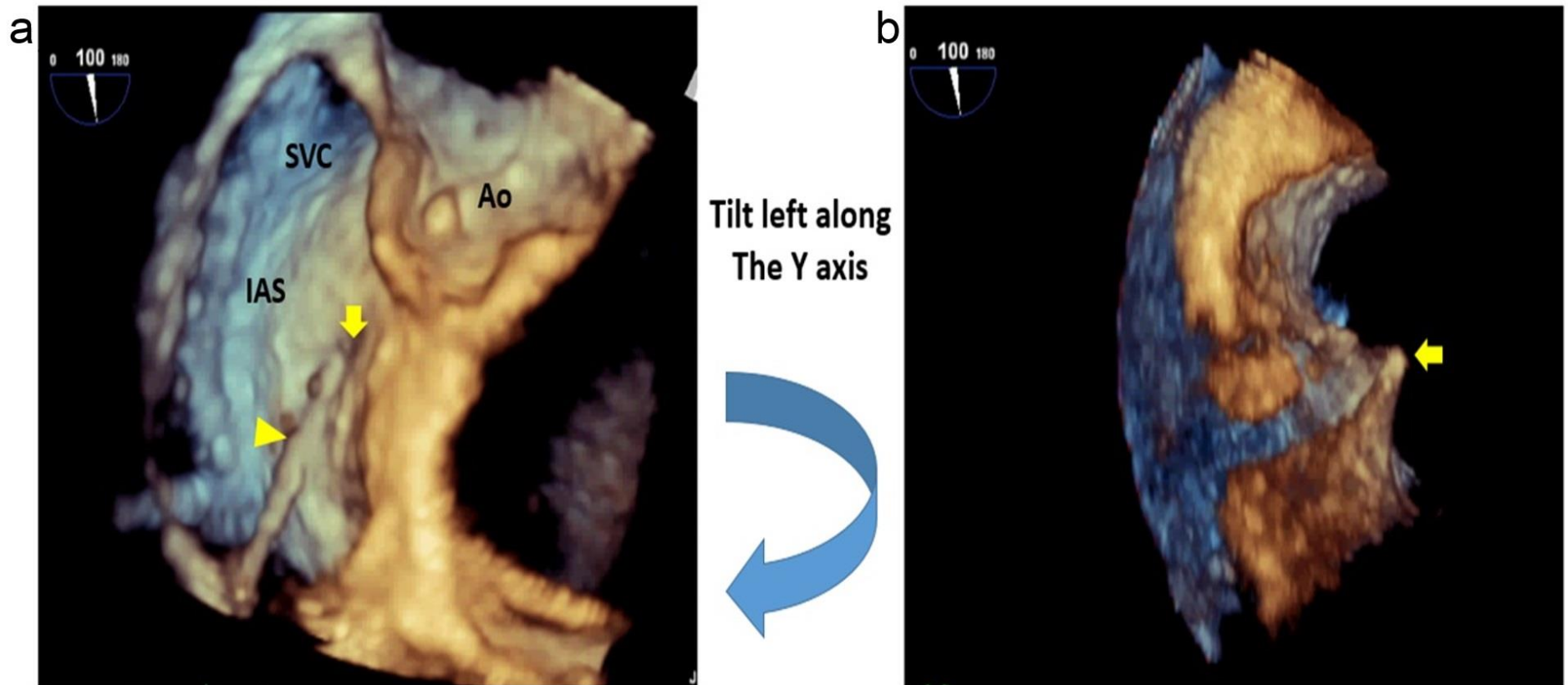


RATLE 90 maneuver

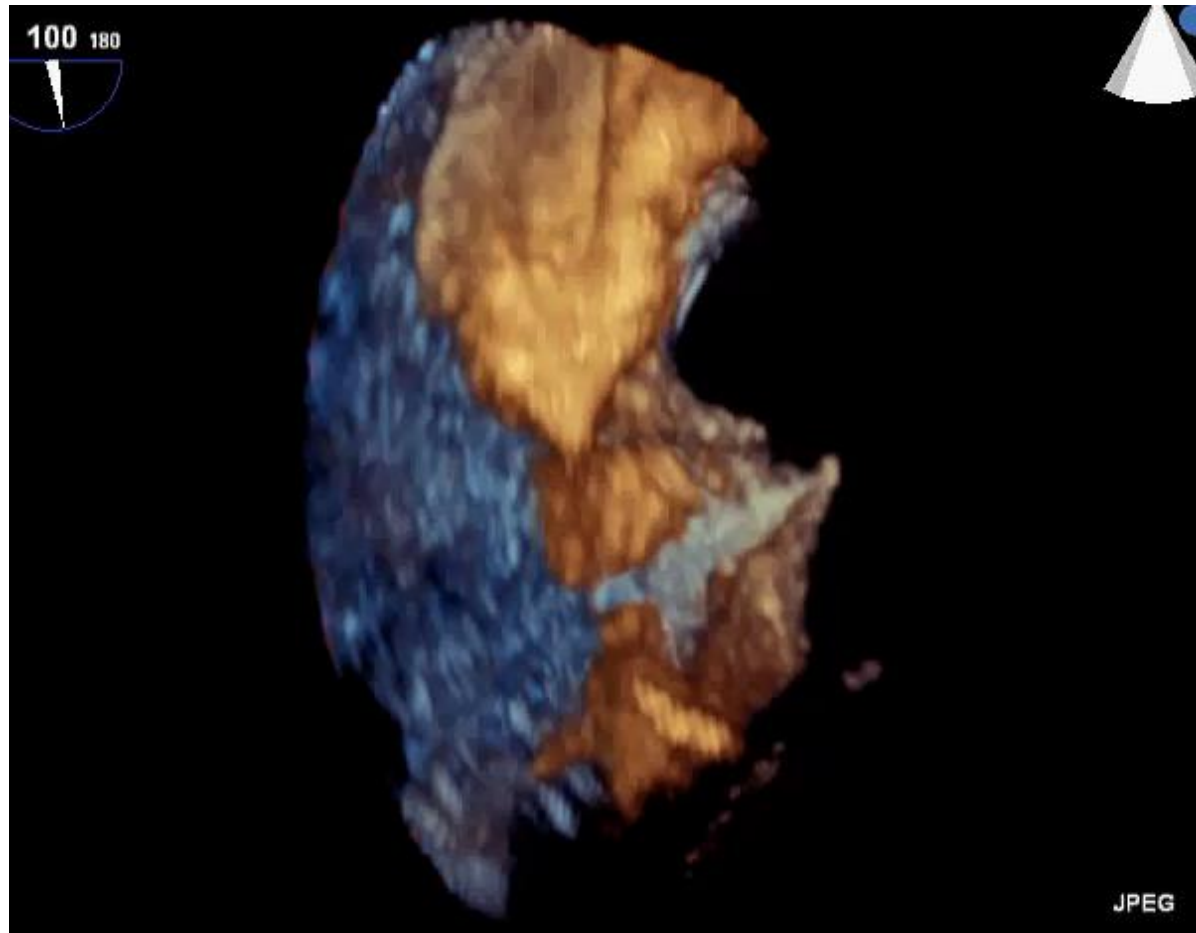


Septal Puncture

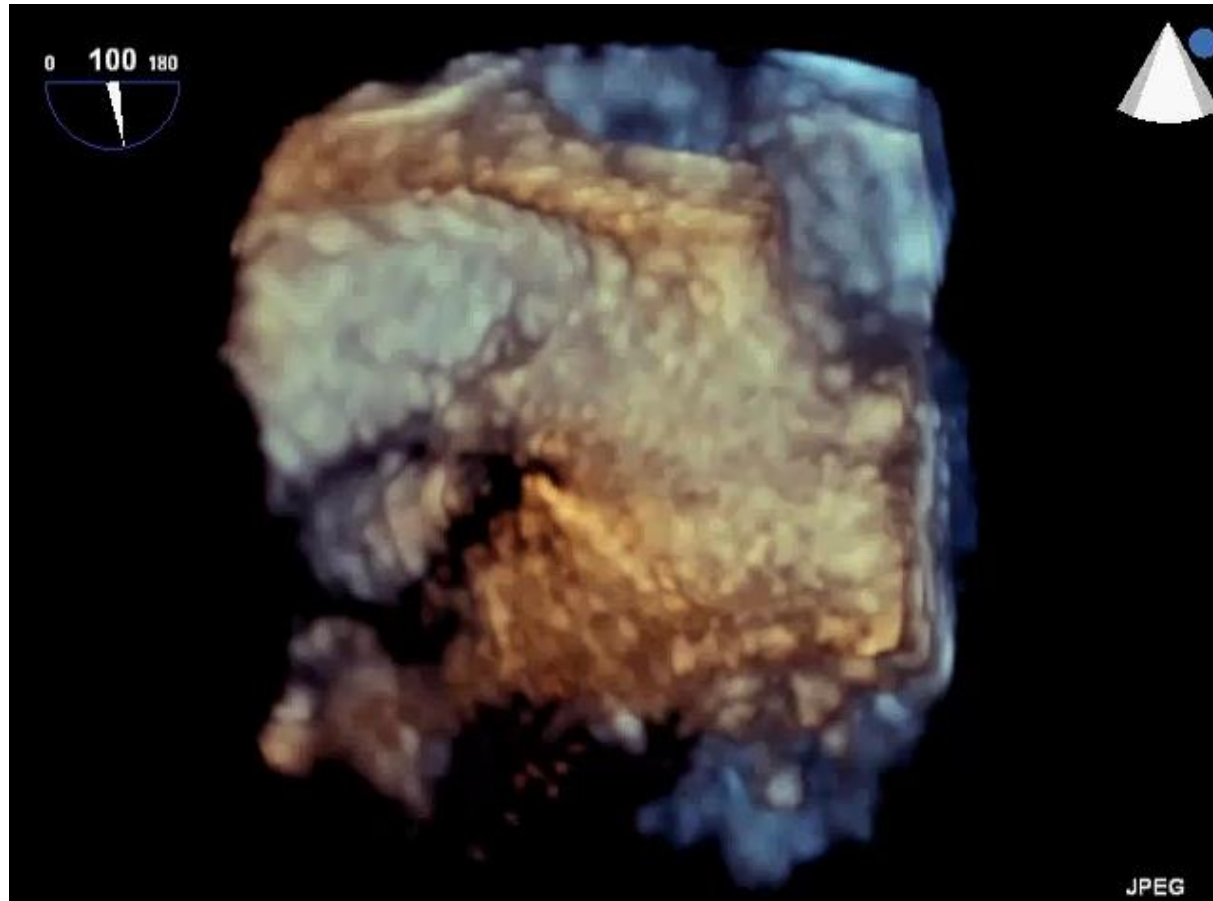




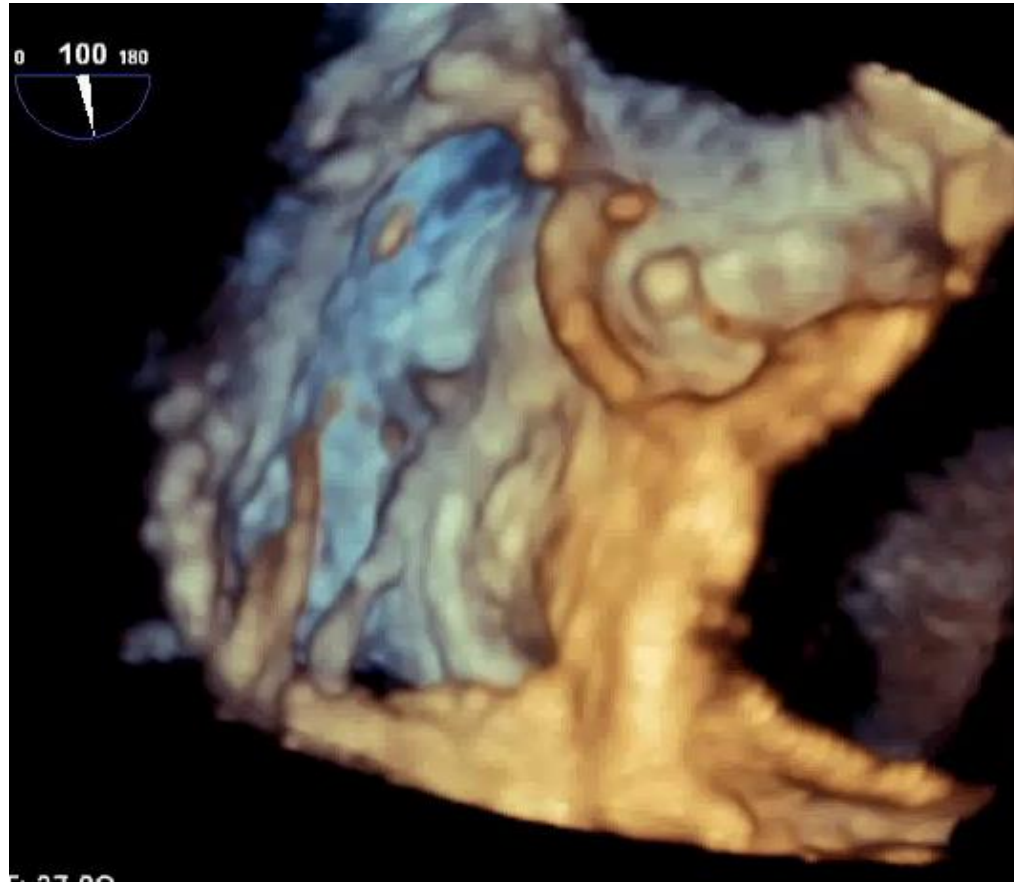
RATLE 90 maneuver



RATLE 90 maneuver



RATLE 90 maneuver



Cardiology Research and Practice

Cardiology Research and Practice
Volume 2015 (2015), Article ID 174051, 4 pages
<http://dx.doi.org/10.1155/2015/174051>

Research Article

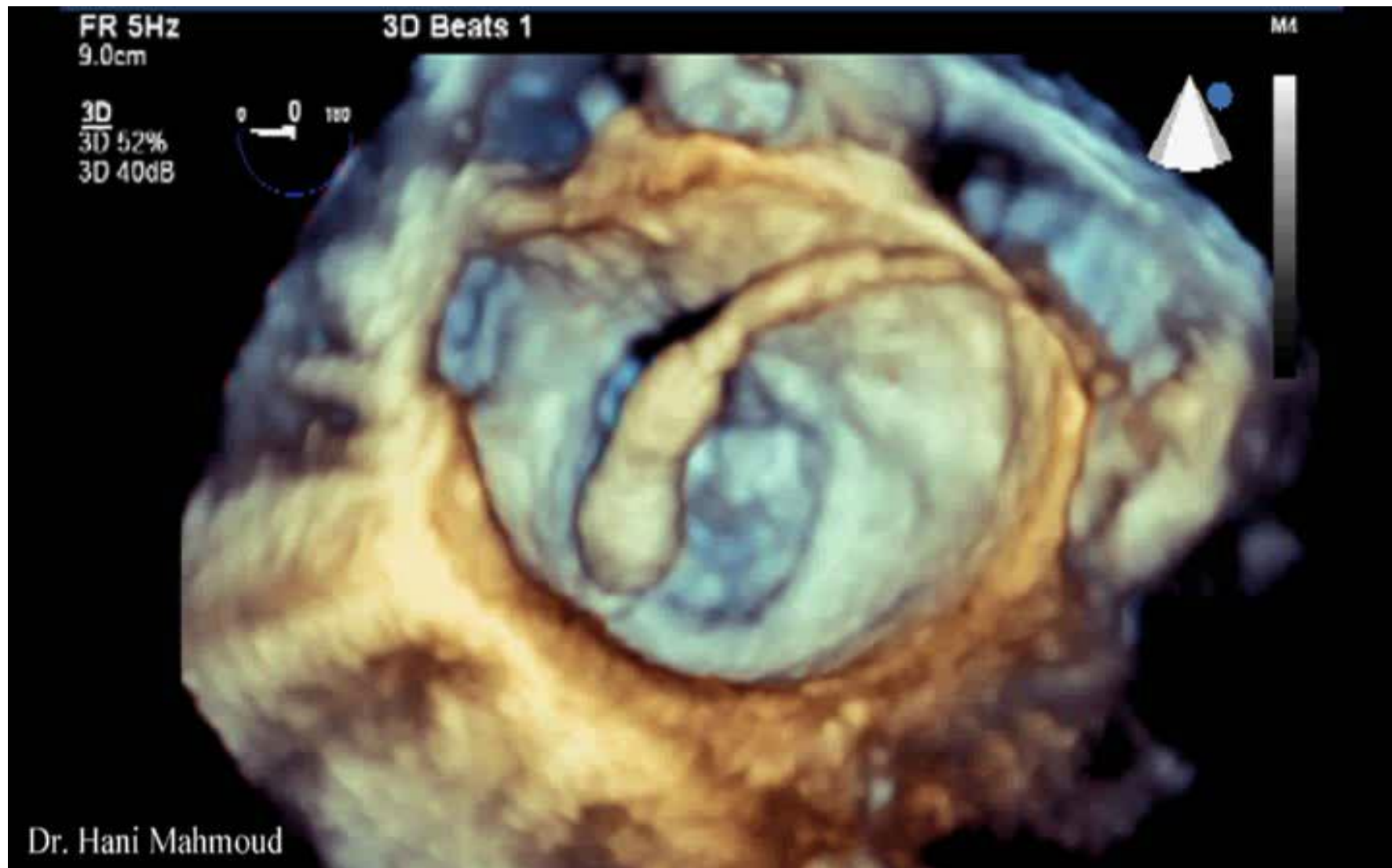
A Proposed Maneuver to Guide Transseptal Puncture Using Real-Time Three-Dimensional Transesophageal Echocardiography: Pilot Study

Hani M. Mahmoud,¹ Mohammed A. Al-Ghamdi,¹ Abdullah E. Ghabashi,¹ and Ashraf M. Anwar²

Received 20 April 2015; Revised 17 May 2015; Accepted 19 May 2015

Academic Editor: Terrence D. Ruddy

Balloon positioning & inflation



Assessment of the result

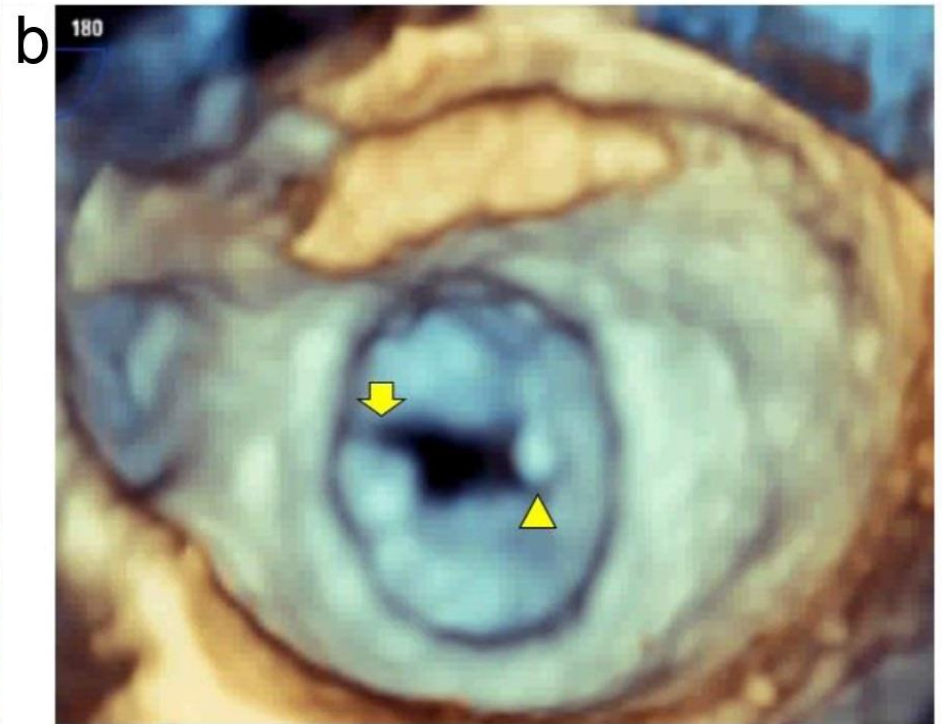
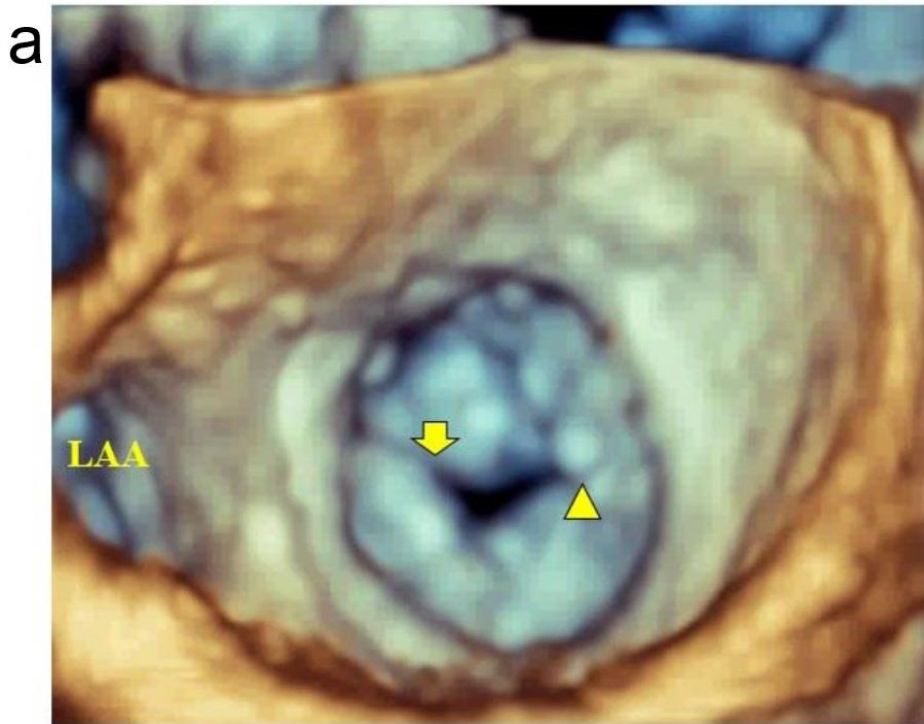
Assessment of the result



Assessment of the result



Assessment of the result



Luigi P. Badano
Roberto M. Lang
Denisa Muraru
Editors

Textbook of Three-Dimensional Echocardiography

Second Edition

 Springer

EXTRAS ONLINE



Mitral Valve Congenital Abnormalities and Stenosis

8

Hani Mahmoud-Elsayed

Abstract

Three-dimensional echocardiography (3DE) has tremendously improved our ability to diagnose and assess the severity of mitral valve congenital abnormalities such as congenital mitral cleft, congenital double orifice mitral valve and parachute mitral valve.

Rheumatic mitral valve stenosis is still a high-prevalent heart valve disease in many countries and degenerative, calcific, mitral stenosis is an emerging heart valve disease

Mitral Valve Congenital Malformations

Congenital abnormalities of the mitral valve (MV) represent a wide range of lesions that can be associated with other congenital heart abnormalities [1]. Congenital abnormalities of the MV have been detected in almost 0.5% of 13,400 patients [2].

Preoperative assessment of the anatomical problem is crucial for successful MV repair. As suboptimal repair was

Conclusion

Conclusion

- ✓ 3D Echocardiography should be incorporated in the routine echocardiographic examination of patients with mitral stenosis.
- ✓ It can utilize any echocardiographic window for image acquisition
- ✓ It is proven to be superior than 2D echocardiography in qualitative as well as quantitative assessment of the mitral stenosis
- ✓ It has a role in assessment of leaflet mobility, commissural fusion, commissural calcification
- ✓ 3D Echocardiography methods (3D-Planimetry & MVN method) is proven to be the most accurate non-invasive method for MVA calculation
- ✓ 3D Echocardiography have an additive value during PBMV in terms of guiding TSP, balloon positioning, inflation and assessment of the results.



مركز فحوصات القلب
CARDIAC INVESTIGATION CENTER

www.ciceg.net

