


The 44th Annual International Congress of the
**EGYPTIAN SOCIETY OF
CARDIOLOGY**
CardioEgyt2017



**3D/4D TEE in Congenital Mitral
Valve Lesions**

By
Dr. Fatma Aboalsoud Taha, MD
Lecturer of Cardiology, Tanta University
Consultant of Structural and Congenital Heart Diseases

Epidemiology

- **Congenital malformations of the MV represent about 0.5%.**
- **Congenital anomalies of the MV are often associated with other congenital heart anomalies.**

(Banerjee A et al. Echocardiographic evaluation of congenital mitral valve anomalies in children. Am J Cardiol 1995;76:1284-91).



Normal anatomy

- It is bicuspid and marks the left AV junction.

- It is a complex comprises:

- The annulus Saddle-s

- The leaflets.

- ❖ Anterior (aortic) and

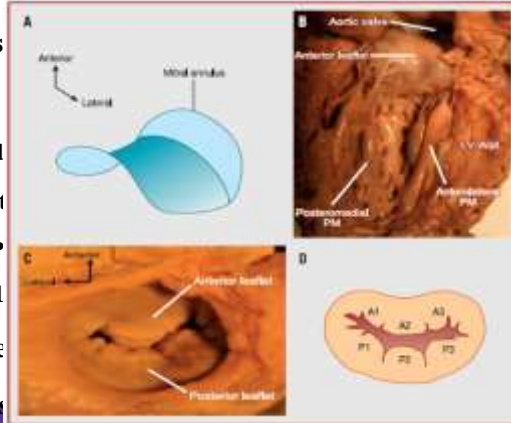
- ❖ Carpentier classification

- The posterior leaflet: P

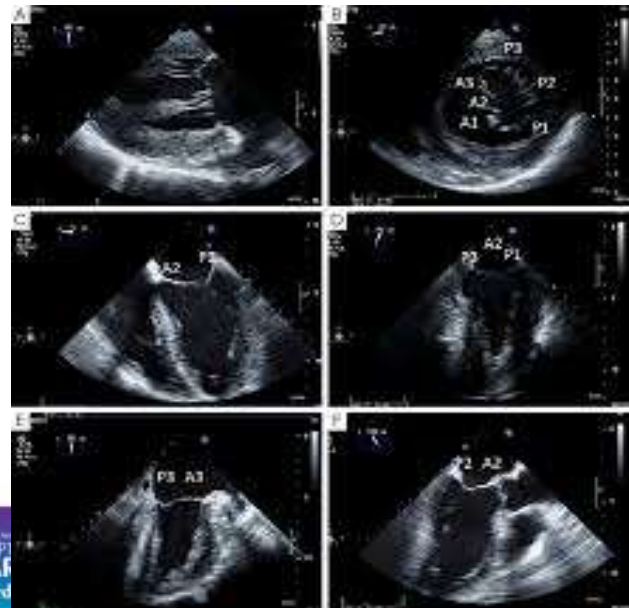
- The anterior leaflet: A

- The chordae tendinae

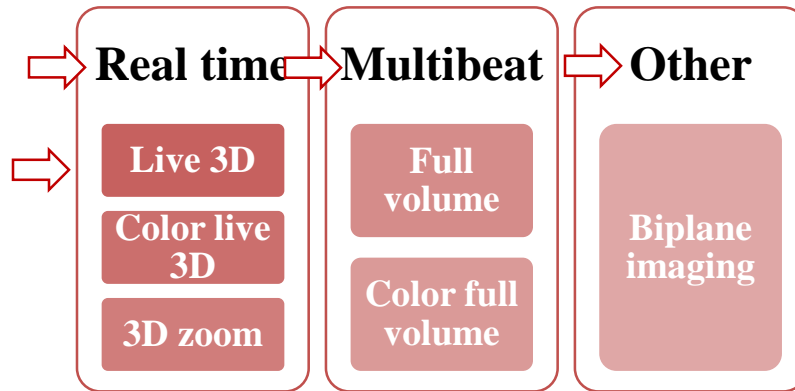
- The papillary muscles



TEE assessment of MV



3D TEE imaging modalities of MV



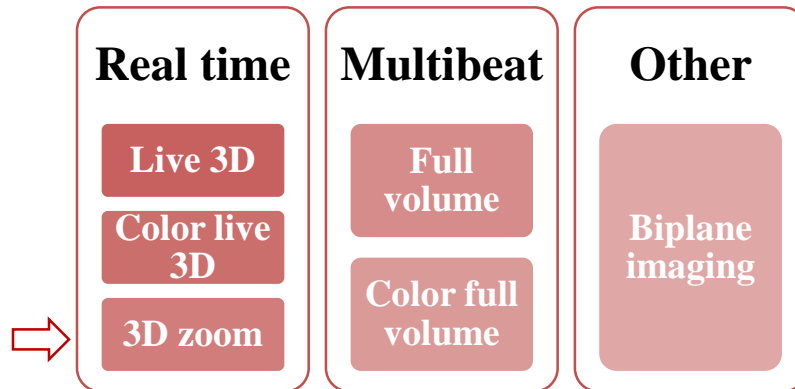
3D TEE imaging modalities of MV

Real time Live

- It reflects the MV leaflets on the display with a limited field of view (FR).
- It has a high frame rate (FR).



3D TEE imaging modalities of MV



3D TEE imaging modalities of MV

3D Zoom (Zoom in RT)

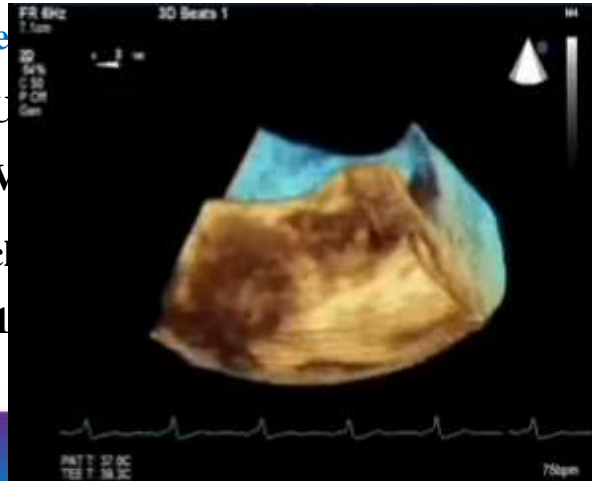
- A magnified subsection of 3D pyramidal volume that is centered to the MV.
- It is kept as small as is reasonable to improve the temporal resolution.



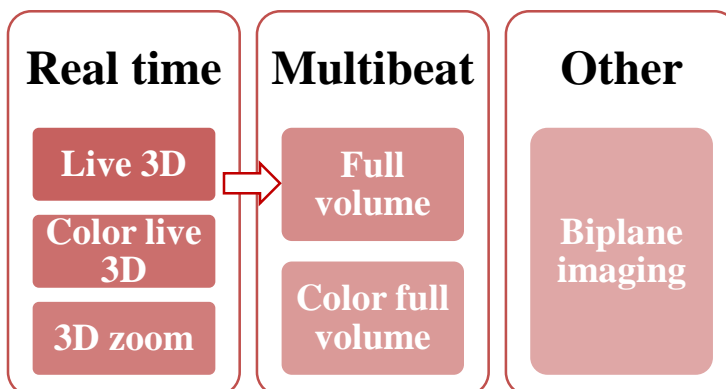
3D TEE imaging modalities of MV

3D Zoom (Zoom in RT)

- The surgical e
- 3D rotation (U
- view of the MV
- Rotate z (Cloc
- of the image (1
- o'clock).



3D TEE imaging modalities of MV



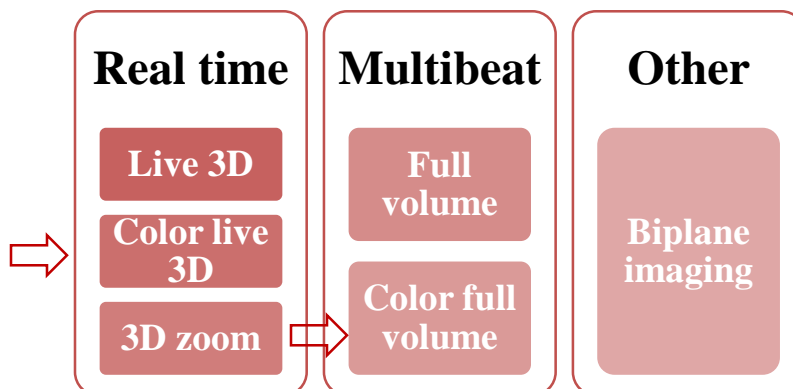
3D TEE imaging modes

Full volume (FV)

- An ECG-gated acquisition over consecutive same cardiac cycles
- Advantage:
 - It has high temporal resolution
 - Can be cropped
- Disadvantage:
 - The demarcation of the mitral valve is difficult
 - Avoided by e



3D TEE imaging modalities of MV



3D TEE imaging modes

Color Doppler 3D

- By application of color to real time 3D.
- Or a gated acquisition of a small 3D volume with superimposed 3D color Doppler flow.



Applications of 3D TEE in MV assessment

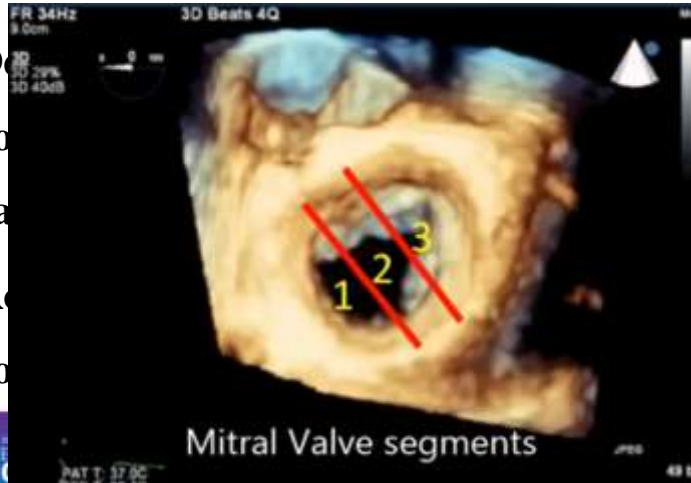
1. Examination of MV anatomy.
2. Quantification of MV anatomy.
3. Assessment of MR.
4. Assessment of MS.
5. Intraoperative assessment (immediate post-repair).
6. Cardiac surgeon's perspective.



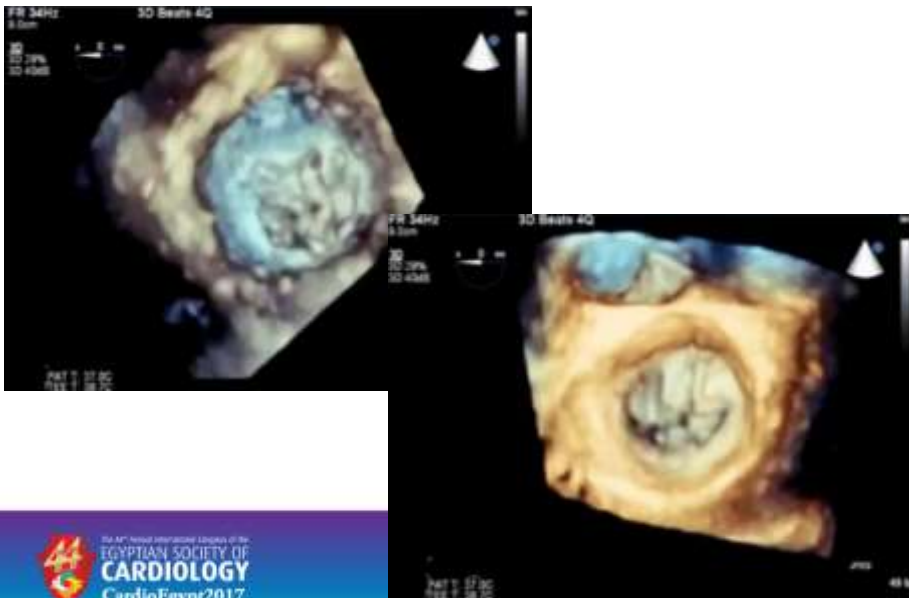
Applications of 3D TEE in MV assessment

Examination of MV anatomy

- D... flets,
- co... nents
- ca... fine
- R... fine
- co...



Applications of 3D TEE in MV assessment



Applications of 3D TEE in MV assessment

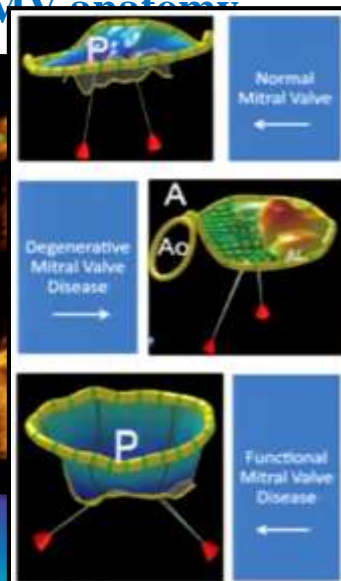
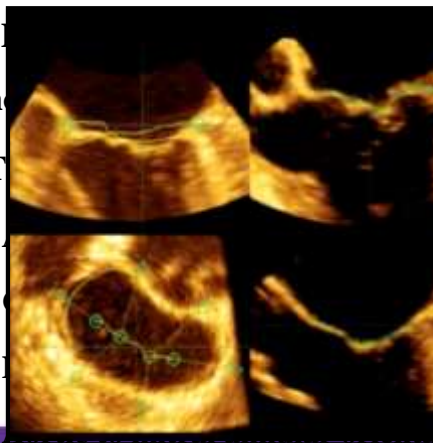
1. Examination of MV anatomy.
2. Quantification of MV anatomy.
3. Assessment of MR.
4. Assessment of MS.
5. Intraoperative assessment (immediate post-repair).
6. Cardiac surgeon's perspective.



Applications of 3D TEE in MV assessment

Quantification of MV anatomy

- 3D
- n
- T
- 1.
- 2.
- 3.
- 4.



Applications of 3D TEE in MV assessment

1. Examination of MV anatomy.
2. Quantification of MV anatomy.
3. Assessment of MR.
4. Assessment of MS.
5. Intraoperative assessment (immediate post-repair).
6. Cardiac surgeon's perspective.



Applications of 3D TEE in MV assessment

Assessment of MR

- 3D TEE allows direct measurement of:
 1. Asymmetrical ellipsoid EROA.
 2. Eccentric MR jets.
 3. Multiple jets.
- The 3D VC area represents the ERO of MR
- Rvol can be measured by multiplying VC area by the
- Anatomic ROA can also be measured offline.
- 3D-VC area has good correlation with angiographic MRI measurements (2).

$$ERO = 6.28 \times r^2 \times \text{aliasing velocity} \times \text{MR peak velocity}$$



- (1) Little SH et al. 3D color Doppler echocardiography for direct measurement of VC area in MR: in vitro validation and clinical experience. JACC Cardiovasc Imaging. 2008;1:695-704.
- (2) Kahlert P et al. Direct assessment of size and shape of noncircular VC area in functional versus organic MR using real-time 3D echocardiography. J Am Soc Echocardiogr. 2008;21:912-921.



Applications of 3D TEE in MV assessment

Assessment of MR

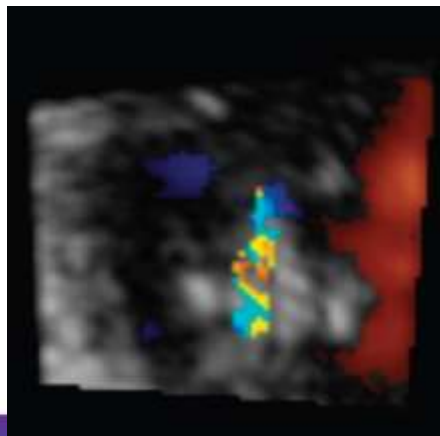
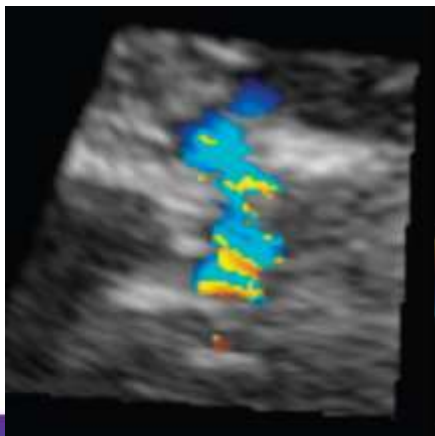
➤ 3D TEE assessment of VC area:

- 3D TEE zoom or FV can be used.
- Image is cropped to two long-axis views of the jet.
- Translation of the plane perpendicular to the regurgitant jet until the en face view of the VC area (Narrowest CSA).
- Finally, the 3D VC area is traced by manual planimetry.



Applications of 3D TEE in MV assessment

Assessment of MR



Applications of 3D TEE in MV assessment

1. Examination of MV anatomy.
2. Quantification of MV anatomy.
3. Assessment of MR.
4. Assessment of MS.
5. Intraoperative assessment (immediate post-repair).
6. Cardiac surgeon's perspective.



Applications of 3D TEE in MV assessment

Assessment of MS

- **3D TEE** seems of interest for evaluation of **MVA** as it combines the advantages of **TEE** (excellent visualization of **MV**) and of **3D** (acquisition of a **3D** volume of the entire **MV**).

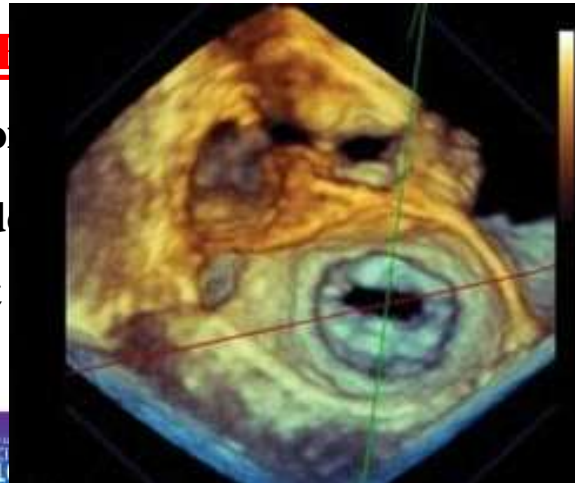


Applications of 3D TEE in MV assessment

Assessment of MS

➤ 3D TEE

- 3D zoom used.
- The identification of the smallest orifice



Applications of 3D TEE in MV assessment

1. Examination of MV anatomy.
2. Quantification of MV anatomy.
3. Assessment of MR.
4. Assessment of MS.
5. Intraoperative assessment (immediate post-repair).
6. Cardiac surgeon's perspective.

Applications of 3D TEE in MV assessment

Intraoperative assessment

- Aspects addressed immediately after **MV repair (Surgical, minimally invasive or transcatheter):**
 1. Residual MR.
 2. Adequacy of coaptation.
 3. SAM of the anterior mitral leaflet. It results from a mismatch of annular dimension and the residual leaflet height. (Sometimes volume loading minimizing SAM, or placement of a larger ring, leaflet shortening or even valve replacement is required).



Applications of 3D TEE in MV assessment

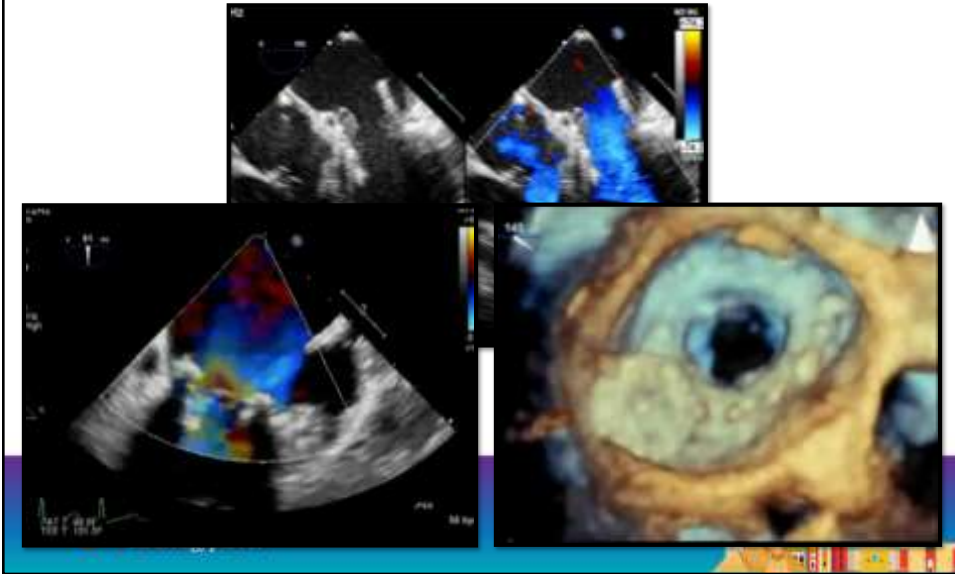
Intraoperative assessment

- **After MV replacement:**
 - Paravalvular leak is important to be assessed by 3D zoom and color 3D post replacement of prosthetic, bioprosthetic or Melody valve.



Applications of 3D TEE in MV assessment

Intraoperative assessment



Applications of 3D TEE in MV assessment

1. Examination of MV anatomy.
2. Quantification of MV anatomy.
3. Assessment of MR.
4. Assessment of MS.
5. Intraoperative assessment (immediate post-repair).
6. Cardiac surgeon's perspective.



Applications of 3D TEE in MV assessment

Cardiac surgeon's perspective

- Most prolapses can be repaired by experienced cardiac surgeons, while most complex valves can be repaired by MV specialized surgeons.
- 3D TEE allows identification:
 1. Lesion localization.
 2. Mechanism of MR.
 3. Severity of MR.
 4. Selection of best surgical approach.
 5. Choice of surgeon – Reference surgeon.
- Finally, most valves can be successfully repaired.



Anomalies of the mitral valve

- **Anomalies of the leaflets**
 - Mitral valve prolapse.
 - Isolated cleft.
 - Double orifice mitral valve.
 - Mitral ring.
 - Ebstein's malformation of the mitral valve.
- **Anomalies of the tensor apparatus**
 - Arcade or hammock valve.
 - Straddling mitral valve.
- **Anomalies of the papillary muscles**
 - Parachute mitral valve.



Anomalies of the leaflets

Mitral valve prolapse.

- **Definition:**

A single or bileaflet prolapse at least 2 mm beyond the long-axis annular plane during ventricular systole.

- **Types:**

1. A classic prolapse: Leaflet thickening > 5mm.
2. Non-classic prolapse: A lesser leaflet thickening.



Mitral valve prolapse.

- **Aetiology:**

1. Adolescence: Myxomatous degeneration (Posterior or both).
2. Childhood:
 - Connective tissue diseases such as Marfan syndrome and Ehler-Danlos syndrome.
 - Secondary to a distortion of LV geometry, as in unrepaired ASD.

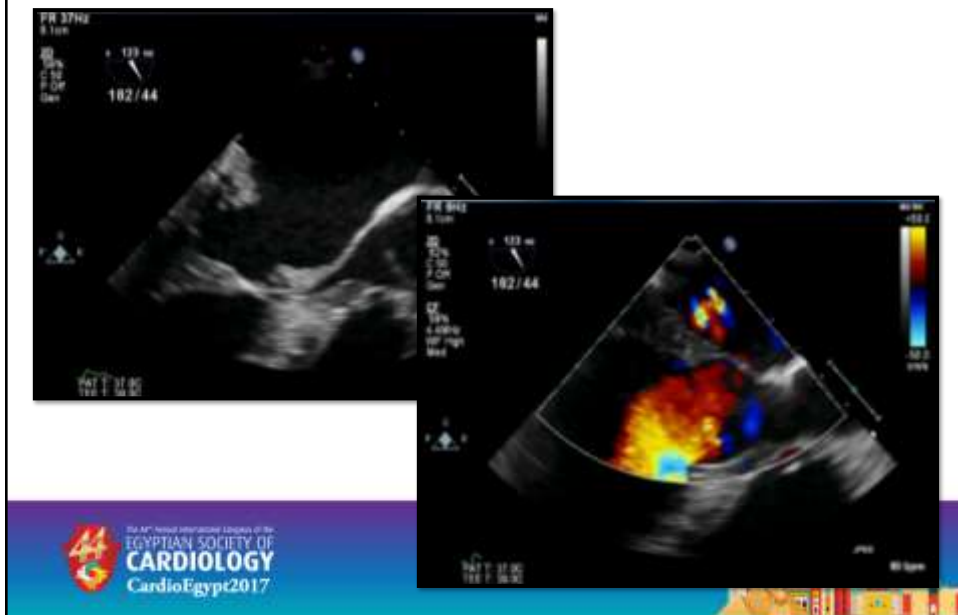


Mitral valve prolapse.



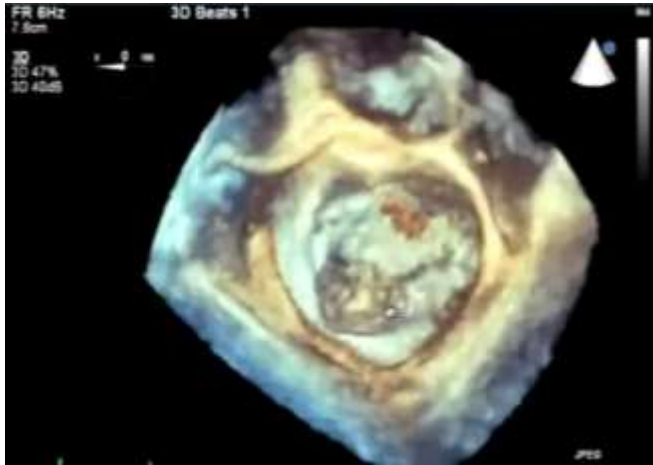
44
The 44th Annual International Congress of the
**EGYPTIAN SOCIETY OF
CARDIOLOGY**
CardioEgypt2017

Mitral valve prolapse.

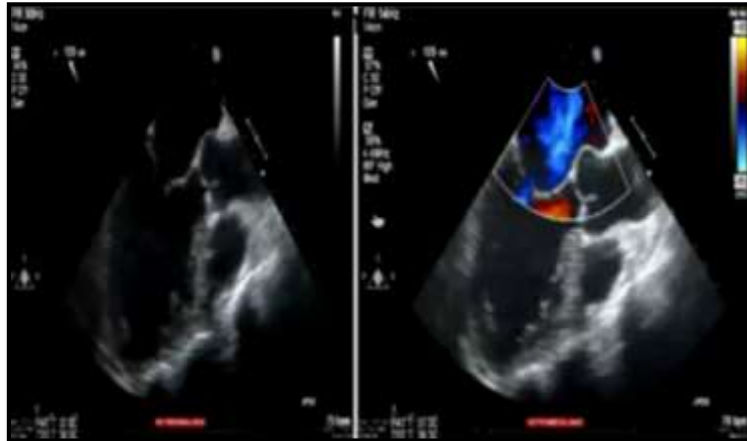


44
The 44th Annual International Congress of the
**EGYPTIAN SOCIETY OF
CARDIOLOGY**
CardioEgypt2017

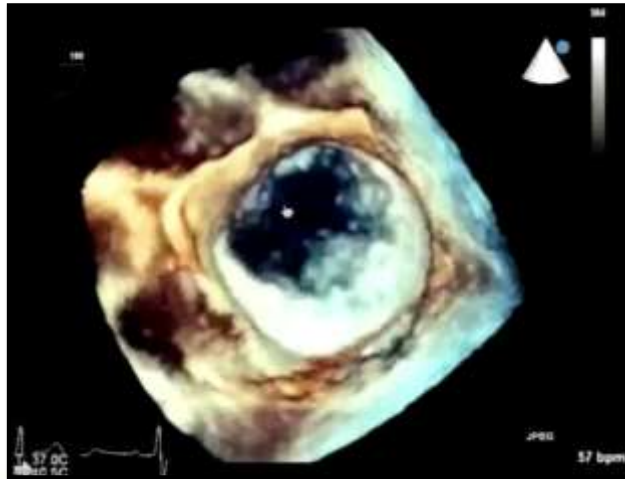
Mitral valve prolapse.



Mitral valve prolapse.



Mitral valve prolapse.



Cleft mitral valve

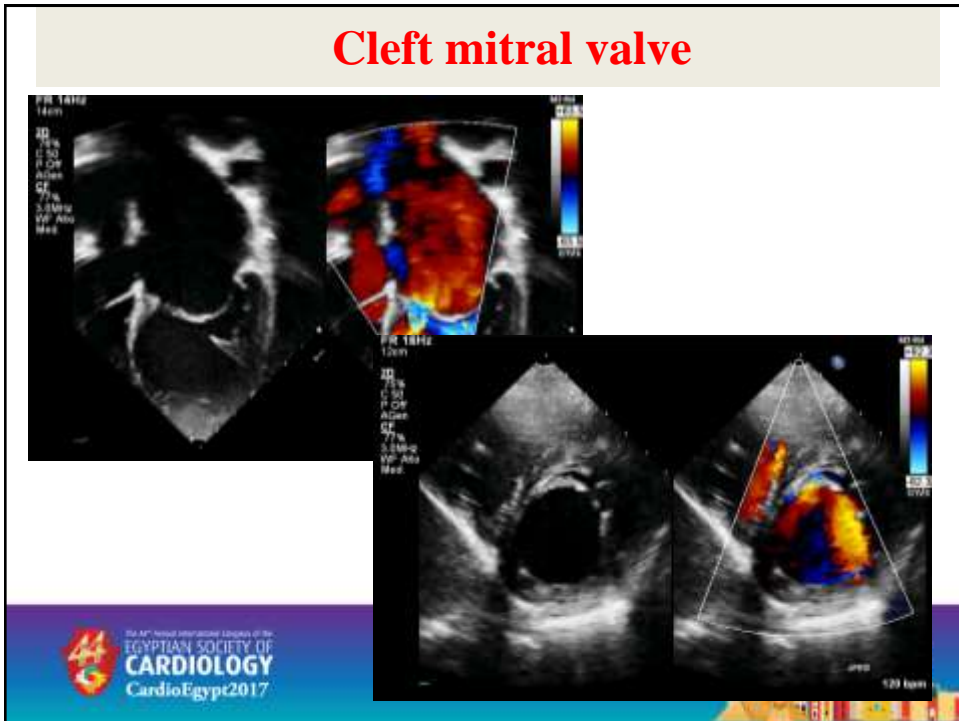
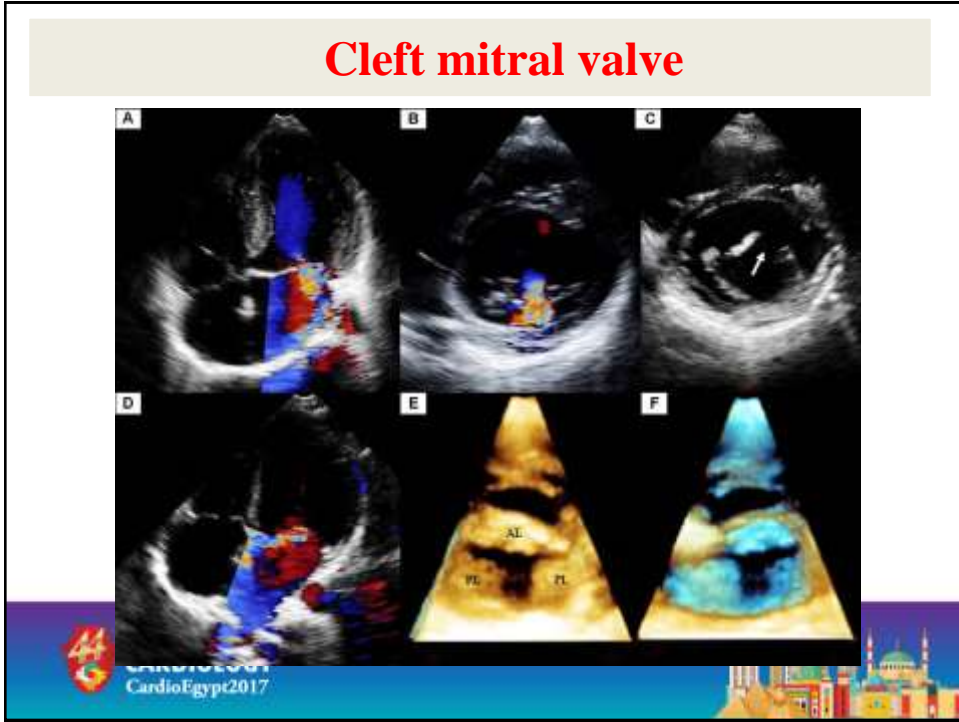
- **Definition:**

A division of one of the leaflets (usually the anterior leaflet) .

- **Types:**

Isolated MV cleft	Associated with AVSD
Two separate AV valves.	Five-leaflet common AV valve.
	• Partial or incomplete form:
Inlet and outlet lengths of the LV septal surface are equal.	
Normal position of PM.	
Cleft directed towards the aortic root.	





Cleft mitral valve



Double orifice mitral valve (DOMV)

- **Definition:**

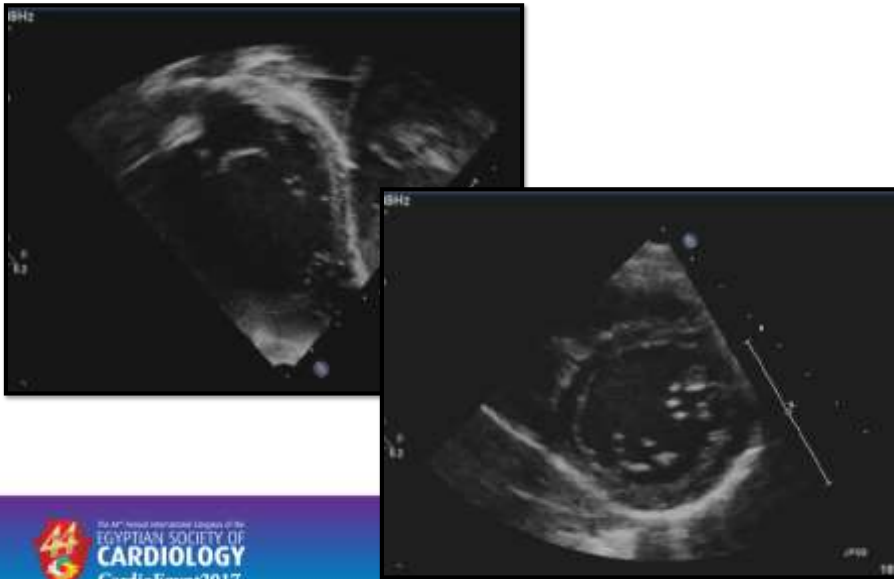
A single fibrous annulus with two orifices opening into the LV.

- **Classification:**

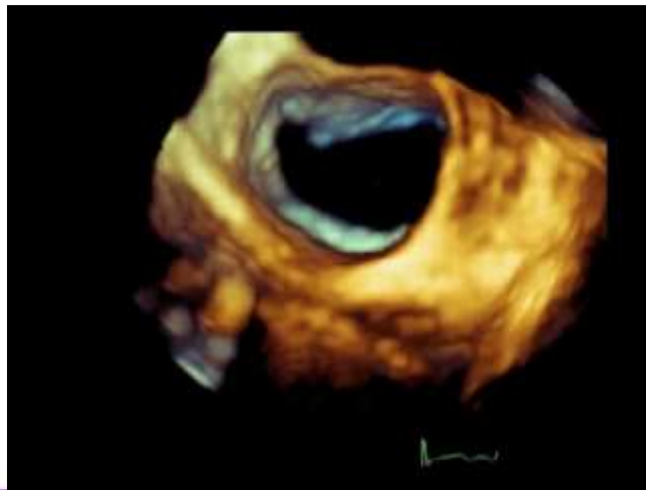
1. **The incomplete type:** At the leaflet edge level.
2. **The complete type:** From the leaflet edge all the way through the valve annulus.
3. **The hole type (eccentric):** Secondary orifice occurs in the lateral commissure of the mitral valve.



Double orifice mitral valve (DOMV)



Double orifice mitral valve (DOMV)



Mitral ring

- **Definition:**

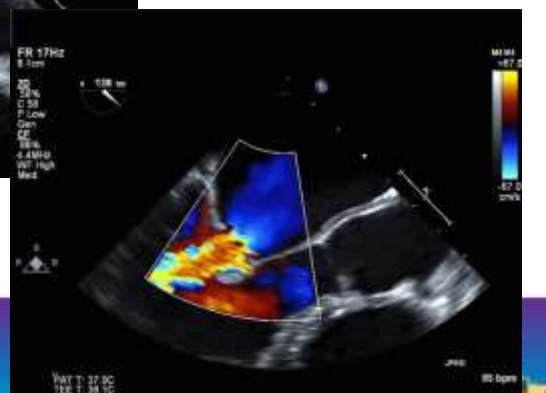
It is often associated with Shone's syndrome and exceptionally isolated.

- **Types:**

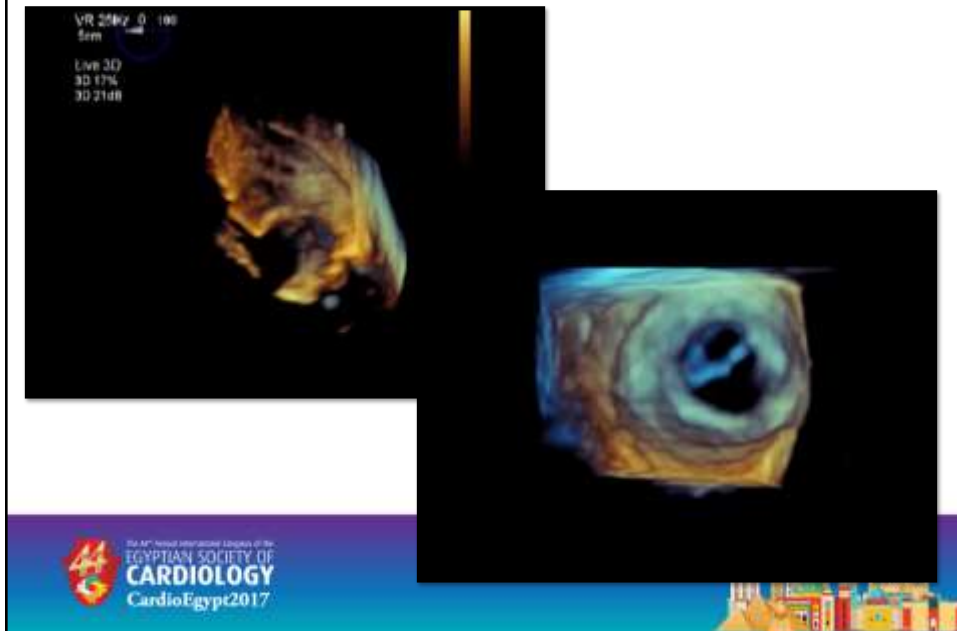
- **The supramitral ring:** A fibrous membrane just above the mitral annulus, beneath the LAA, not adhering to the leaflets and associated with a normal subvalvular apparatus.
- **The intramitral ring** is a thin membrane located within the funnel of the MV, closely adherent to the leaflets, always combined with abnormal subvalvular apparatus.
- **The ring can be either complete, circumferential or partial.**



Mitral ring



Mitral ring



Ebstein's malformation of the MV

- **Definition:**
 - **Downward displacement of the MV orifice into LV.**
 - **Unlike Ebstein's malformation of the tricuspid valve, the atrialized inlet portion is usually not thinned.**
 - **This exceedingly rare anatomical condition causes MI.**

Anomalies of the tensor apparatus

Arcade or hammock valve

- **Definition:**

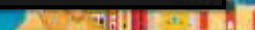
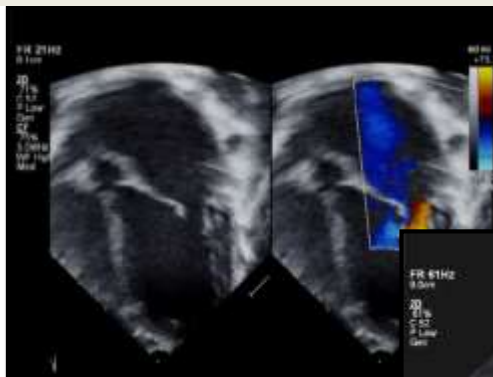
- Connection of the PMs to the mitral leaflets either directly or through short chordae.

- **Types:**

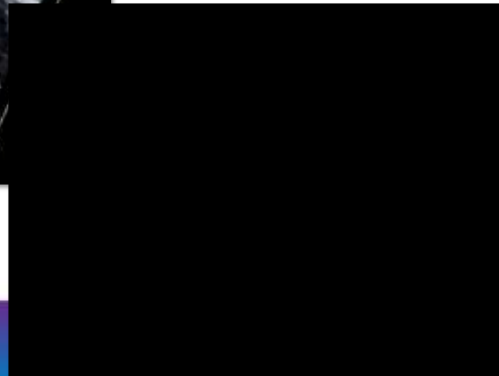
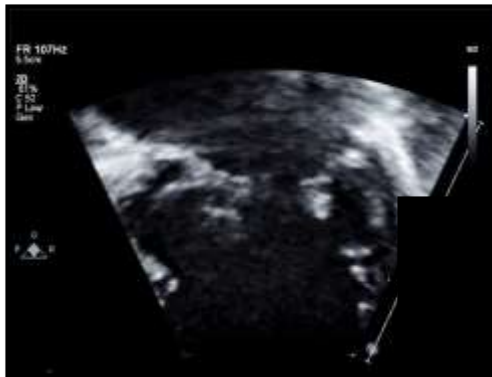
- **The most severe form:** With no chordae tendinae, the papillary muscles are directly fused with the free edge of the leaflet.
- **The less severe form:** The tendinous cords are thickened and extremely short, may cause both stenosis and insufficiency.



Arcade or hammock valve



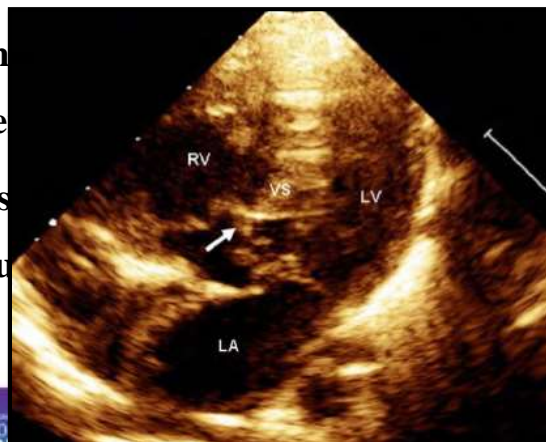
Arcade or hammock valve



Straddling of MV

• Definition:

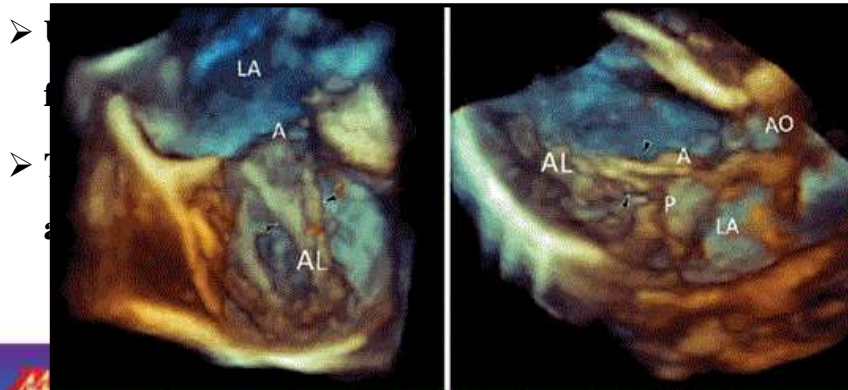
- An abnormal attachment of chordae to both ventricles
- SMV is associated with VSD and conotruncal anomalies



Anomalies of the papillary muscles

Parachute mitral valve

- Definition:



CARDIOLOGY
CardioEgypt2017



Thank You



44th Anniversary
EGYPTIAN SOCIETY OF
CARDIOLOGY
CardioEgypt2017

