A “PHYSIOLOGIST’S” VIEW OF THE MITRAL VALVE APPARATUS ANATOMY

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MITRAL VALVE APPARATUS

• Echocardiography is the primary diagnostic tool for evaluating patients with known or suspected mitral valve disease.

• Mitral valve apparatus consists of the annulus, the two leaflets, the chords, the papillary muscles (anterio-lateral, posteromedial) and the ventricle.

• Pathological changes in any component can cause mitral valve dysfunction.
• Mitral annulus is a complex 3D structure and along with the aortic and tricuspid annulus is part of the fibrous skeleton of the heart.

• It has a saddle-like shape with a mean surface area of 7 cm².

• In vitro testing and computer modeling this shape alleviates the stress exerted on the leaflets, during systole and diastole.
MITRAL ANNULUS

• The anterolateral portion share a common wall with the aortic annulus (aortomitral courtain) and is more stable as opposed to the posterior portion which has a greater circumference and is more pliable.

• When the annulus dilated, it does so posteriorly.

• The mitral annular area is dynamic throughout the cardiac cycle and is influenced by LA contraction and filling dynamics.
MITRAL LEAFLETS

• The broad anterior leaflet accounts for the majority of the closing surface.

• The anterior leaflet is in continuity with the left and non-coronary cusps.

• The posterior leaflet although of a smaller surface has a greater circumferential attachment to the annulus.

• Both leaflets consists of three scallops each.
THE CHORDS AND THE PAPILLARY MUSCLES

- The chords, 25 in number, consist of collagen and elastin and extend from the papillary muscles to the leaflet tips.
- They anchor the leaflets, so that they do not prolapse during systole while allowing symmetric coaptation.
- The two papillary muscles contract to facilitate closure of the leaflets.
- The anterolateral has dual perfusion, the obtuse marginal and the diagonal branches and gives chords to the lateral parts of the leaflets.
- The posteromedial is perfused from the PDA and gives chords to the medial parts of the leaflet.
MECHANISMS OF MITRAL REGURGITATION

• The primary disease affects leaflets and chords and is mainly due to degenerative disease and less frequently to thickening and calcification due to aging and comorbidities, such as CKD, DM and hypertension.

• In mitral valve prolapse coaptation is displaced at least 2 mm off the annular plane and can be accompanied by thickening and/or MR.

• Its prevalence is 2.4% and has an autosomal dominant inheritance with variable penetration.
MECHANISMS OF MITRAL REGURGITATION

- Two forms are observed, the **fibroelastic deficiency**, which presents later in life with new onset MR and isolated chordal rupture, usually of the mid segment of the posterior leaflet, and the **Barlow's disease**, which is characterized by accumulation of mucopolysacharides in the leaflets and chords and is accompanied by dilated annulus.
The secondary MR is due to papillary muscle dysfunction due to underlying myocardial infarct (ischemic MR) or due to lateral displacement of both papillary muscles in dilated cardiomyopathy.

Especially ischemic MR is associated with worse prognosis post-MI.
ISCHEMIC MR
CARPENTIER CLASSIFICATION

• 1. Mitral annular dilatation due to chronic AF

• 2. Prolapse or flail mitral valve

• 3a. Restriction of leaflets in both systole and diastole (rheumatic disease)

• 3b. Restriction of leaflets in systole (secondary mitral regurgitation)
QUANTIFICATION OF MR

• 1. Color jet area absolute or corrected for LA area, Vena Contracta (2D-3D).

• 2. Regurgitant volume based on PISA method with its limitations especially in flail and secondary MR with the eccentric jets and the isovelocity shells which are usually are not hemispherical.

• 3. Volumetric methods with its limitations with regards to the measurement of the mitral annulus.

• 4. Ancillary parameters such as LV dimensions, Doppler of the pulmonary veins, the density of the CW envelope, PA pressure, the duration of MR in systole, the early transmitral velocity.

• 5. In questionable cases MRI calculated regurgitant volumes can be of use.

• The decreased tolerability of the regurgitant volume of the hypocontractile ventricle, as well as the inaccuracy of PISA method for secondary MR has set lower values for the latter as opposed to the primary MR, as far as the severity of the MR, i.e. for primary ERO 0.4 cm² and 60 ml regurgitant volume and 0.2 cm² and 30 ml for the secondary.
Aliasing velocity

r = 0.7 cm

-30.8 cm/s

Peak MR velocity = 454 cm/s
THANK YOU VERY MUCH