MITRAL REGURGITATION

ETIOLOGIES

ACUTE	CHRONIC
Annulus disorder • Endocarditis (abscess) • Trauma (surgery) • Paravalvular leak by suture interruption (surgery)	**Inflammatory** • Rheumatic heart disease • Lupus • Scleroderma
Leaflet disorder • Endocarditis (perforation) • Trauma (BMV) • Tumor (atrial myxoma) • Myxomatous degeneration • LED – Libman-Sacks lesion	**Degenerative** • Myxomatous degeneration (Barlow, MVP) • Marfan • Ehlers-Danlos • Pseudoxanthoma elasticum • Calcification of mitral annulus
Rupture of chordae tendineae • Spontaneous • Myxomatous degeneration (prolapse, Marfan, Ehlers-Danlos) • Endocarditis • Acute rheumatic fever • Trauma	**Infective** • Endocarditis
Papillary muscle disorder • ACS • Acute LV dysfunction • Infiltrative disease (sarcoidosis, amyloidosis) • Trauma	**Structural** • Rupture chordae tendineae (spontaneous or secondary to ACS, trauma, MV prolapse, endocarditis) • Rupture or dysfunction of papillary muscle • Dilation of mitral valve annulus and LV cavity • Hypertrophic cardiomyopathy • Paravalvular prosthetic leak
Primary mitral valve prosthetic disorder • Cusp perforation (endocarditis) • Cusp degeneration • Mechanical failure • Immobilized disc or ball	**Congenital** • Mitral valve clefts or fenestrations • Parachute mitral valve with endocardial cushions defects, endocardial fibroelastosis, • Transposition of great arteries • Anomalous origin of left coronary artery

Carpentier's classification

- **Type I**: normal leaflet motion – jet is central
- **Type II**: increased leaflet motion (leaflet prolapse) – jet is directing towards **opposite** side
- **Type IIIa**: restricted leaflet motion during diastole and systole – jet is central or same side
- **Type IIIb**: restricted leaflet motion predominantly during systole (ischemic) – jet is same side

Primary MR: degenerative (Barlow, IE, connective disease)
Secondary MR: functional (LV dysfunction…)

Coronary artery disease
30% patients with CAD have some degree of MR
- Tethering of posterior leaflet because of regional LV dysfunction
- Worse MR because associated to LV remodeling and systolic dysfunction

- Also ischemic damage to papillary muscles, dilation of mitral valve ring and/or loss of systolic annular contraction contributing to MR
- Severe MR associated to poor prognosis
- 20% MR after ACS – more adverse outcomes

PATHOPHYSIOLOGY

- 50% regurgitant volume is ejected in LA before aortic valve opening
- Orifice size and pressure gradient are labile – gradient depends on SVR and mitral annulus
- Severe MR – **LV volume overload** (↑ preload and afterload)
- LV and LA compliance increases = low LV filling pressure - ↑ LVEDV = **chronic compensated stage of severe MR**
    - ↑mitral annulus + regurgitant orifice = ↓ contractility LV
    - Eccentric hypertrophy (↑ mass)
- LA can dilate and cause afib
- Eventually LV function deteriorates, EF falls, ESV and EDV ↑, LV compliance ↓, LV filling pressure ↑ → pulmonary congestion with mild effort and ↓ CO
- ↓ SV in late in chronic severe MR
    - ↓EF reflect impaired myocardial function (contractility) and patients do poorly after surgical correction of MR → EF < 35% = high risk patients without post-op benefits
    - **LVESV or diameter**: predictor of function and survival after surgery (**> 40mm**)

Acute MR

- Sudden onset severe reflux into normal sized LA
- Signs and symptoms depend on size and compliance of pre-existing LA

CLICINAL SYMPTOMS

- Fatigue (**low CO**), left heart failure symptoms, palpitations (AF), and pulmonary congestion
- Right heart failure present in acute MR

PHYSICAL EXAM

JVP, carotid, precordial motion directly related to severity of leak not cause

CAROTID

- Mild – normal
- Moderate-severe – brisk, often ↓pulse volume (if presence of heart failure)
    - b/c N or decrease forward SV ejected more rapidly than normal during early systole
- Severe – quick rising, poorly sustained, low amplitude

JVP

- Large V waves
- AF – loss a, V more prominent

PRECORDIAL

LV impulse

- Hyperdynamic
- Displaced
- Dilated
- +/- Palpable S3 – early diastole, pt hold breath end-exp (decubitus)

Parasternal impulse

- Pulm HTN – sustained RV lift, holosystolic
    - More common in combined MR/MS

    - Also loud P2, RV S4, TR/PR
- Systolic expansion of **enlarged LA** = late systolic thrust

S1
- ↓S1 amplitude (masked by murmur)
- Loud if holosystolic prolapse of MV

S2
- Severe – wide split and early A2 (shortening of LV ejection)
- P2 louder if pHTN P2>A2

S3
- **Common** – means large regurgitation volume
- Also present if LV dysfct with dilation

S4
- LV S4 never seen in rheumatic MR b/c LA dilated and can't generate force
- S4 common in **acute or papillary muscle dysfunction due to cardiomyopathy**
- RV S4 if PHTN (louder with insp, max intensity at LLSB)

MURMUR

SYSTOLIC
- Starts with S1 and extends to S2 – **beyond A2** (pressure gradient between LV-LA after Ao valve closure)
  ○ 50% of entire regurg vol reflux to LA before AV open
- **Holosystolic**
    - **Late systolic**: mild MR – PVM or papillary muscle dysfunction
    - **Early systolic**: Acute MR – diamond shaped decreasing in late systole (↑ pressure non compliant LA)
    - **Holosystolic**: Severe MR – long murmur + diastolic rumble
- High pitch
- Loudest at **apex**
- Radiate
    - Axilla or left scapula (murmur directed **posteriorly** – anterior leaflet involvement)
    - Towards sternum and base (murmur directed **anterior** – prolapse of posterior leaflet)
- Ruptured chordae – murmur usually harsh, loud (>gr 3)
- **Not amplified post PVC**
- Regurgitant murmur – fremitus
- ↓ upward position, Valsalva
- ↑ handgrip, squatting
- Little correlation between intensity of systolic murmur and severity of MR
- Silent MR: LV dilatation, ACS, paraprosthetic valvular regurgitation, emphysema, obesity, chest deformity, prosthetic valve

DIASTOLIC
- short mid-diastolic flow murmur, brief, low- to med-pitched apically best heard with bell when pt decubitus, light pressure - ↑ flow during filling in diastole

DIFFERENTIAL DIAGNOSIS

TR
- hard to separate if RV enlarged
- TR usually increase with **inspiration** (Carvallo), MR softer

VSD
- maximum location at LLSB

HOCM

- also has long SEM
- may not have typical radiation
- attn to change with posture, maneuver, drugs

ddx MR and **AS** – carotid, length of murmur, murmur post PVC (murmur increases with AS)

ECHOCARDIOGRAPHY

Primary MR

- Assess LV size and function, RV function, left atrial size, PA pressure, mechanism and severity of primary MR
- CMR is indicated in chronic primary MR to assess LV and RV volumes, function or MR severity

Secondary MR

- Assess the etiology of chronic secondary MR and extend and location of wall motion abnormalities and LV function, severity of MR and pulmonary hypertension.

★ **Suggested reference:** Zoghbi W. et al. Recommendations for the evaluation of the severity of native valvular regurgitation with two-dimensional and Doppler echocardiography. 2003 J Am Society Echocardiography;16:777-802.

Poor prognosis when ERO ≥ 20 mm^2

TEE

- Not recommended for routine evaluation and follow-up
- Performed when TTE images are **inadequate**
- Useful in **IE** – better visualization of underlying infected structures
- More precise quantification of regurgitation severity and better evaluation of likelihood of success of MV repair

Follow-up

- Severe primary MR (C1): annual or biannual
- Moderate MR: 1-2 years
- Mild MR: 1-2 years

★ **Suggested reference:** Nishimura R. A. et al. 2014 ACC/AHA guidelines for the management of patients with valvular heart disease. J Am Coll Cardiol 2014;63:e57-185 – **Tables 15-16**

CATHETERIZATION

- Ventriculography and hemodynamic measurements when noninvasive testing are inconclusive
  - Severity of MR
  - LV function
  - Need for surgery
- Discrepancy between noninvasive testing and clinical symptoms

★ **Suggested reference:** Nishimura R. A. et al. 2014 ACC/AHA guidelines for the management of patients with valvular heart disease. J Am Coll Cardiol 2014;63:e57-185.

EXERCISE TESTING

Can be used to establish the presence of symptoms in patients with chronic primary MR and exercise tolerance.

TREATMENT

★ **Suggested reference:** Nishimura R. A. et al. 2014 ACC/AHA guidelines for the management of patients with valvular heart disease. J Am Coll Cardiol 2014;63:e57-185 – **Table 17, 18, figure 4**

MEDICAL

Acute MR

- Vasodilators
- IABP
- Prompt mitral surgery

INTERVENTIONS

Primary MR

MV repair >> MV surgery if possible (especially when **posterior leaflet** involved)

- LVEF greater than 30% and symptoms
- LVEF between 30-60% and asymptomatic, with LVESD of 40 mm or more

Surgical repair

- Pliable valves
- Degenerative MR due to MVP
- Annular dilatation
- Papillary muscle dysfunction due to ischemia or rupture
- Chordal rupture
- Perforation of mitral leaflet cause by IE

Older valves with calcium, deformed, rigid, severe subvalvular chordal thickening and loss of leaflet substances = MVR necessary

↓EF 10% if valve apparatus not preserved!

Minimal invasive procedures vs. conventional sternotomy showed similar performance results when performed by experienced surgeons.

Annuloplasty and repair of posterior leaflet shows better outcomes than MVR – mortality < 1%, 95% freedom of reoperation, 80% with MR < ¾ at 15-20 years post-op.

Annuloplasty and repair is more complex with 2 leaflets but shows better outcomes than MVR – 80% freedom of reoperation, 60% with MR < ¾ at 15-20 years post-op. Durability of the procedure is uncertain.

MitraClip

- Clip is safe (Everest I) but less effective than surgical repair (Everest II)
- Residual MR by creating 2 regurgitant orifice – similar to Alfieri procedure
- Reduce symptoms by reducing MR, reverse LV remodeling
- For patients with chronic severe MR with symptoms NYHA 3-4 despite medical therapy for HF and are not candidate for surgery
    - Degenerative MR with malcoaptation A2-P2, functional MR
    - Coaptation depth < 11 mm
    - Coaptation length > 2 mm
- **Class IIb** indication in guidelines

★ **Suggested reference:** Mauri L. et al. 4-Year results of a randomized controlled trial of percutaneous repair versus surgery for mitral regurgitation. J Am Coll Cardiol 2013;62:317-328.

Secondary chronic MR

- Reasonable if severe secondary MR undergoing surgery for CABG
- If patient has persistent symptoms despite optimal medical therapy
- Recent data not conclusive….

★ **Suggested reference:** Asgar A. et al. Secondary mitral regurgitation in heart failure. J Am Coll Cardiol 2015;65:1231-48.

Content of this summary from these references:

- Otto C & Bonow R. Valvular Heart Disease. (2012) In Bonow R. *et al*. Braunwald's Heart Disease, 9th edition, pp. 1468-1539. Philadelphia, PA: Elsevier.
- Nishimura R. A. et al. 2014 ACC/AHA guidelines for the management of patients with valvular heart disease. J Am Coll Cardiol 2014;63:e57-185.
- Zoghbi W. et al. Recommendations for the evaluation of the severity of native valvular regurgitation with two-dimensional and Doppler echocardiography. 2003 J Am Society Echocardiography;16:777-802.