Primary vs. Secondary Mitral Regurgitation: What the Guidelines Say and Why

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No Disclosures
Valve Dysfunction

Functional Disturbance
Why? How bad?

Anatomic Change  Disease
Mitral Valve is More than Leaflets
Primary vs. Secondary MR

- Structural (leaflets and chords) = Primary MR
  - Degenerative (myxomatous/Barlow’s, fibroelastic deficiency)
  - Endocarditis
  - Rheumatic
- Functional (ventricle and annulus) = secondary MR
  - Cardiomyopathy
  - Coronary disease ("ischemic cardiomyopathy")

Emphasized the distinction between primary and secondary (functional) MR
As well as…..

– Indications for intervention
– Outcomes of intervention
– Echocardiographic grading of severity

Primary
Degenerative MR

Barlow’s
Fibroelastic Deficiency

Rheumatic
Functional (secondary) regurgitation

- Occurs in the presence of anatomically normal leaflets and chords when there is left ventricular dysfunction
  - Non-ischemic
  - Ischemic

Why is there regurgitation when the valve apparatus is structurally intact?
Apical Tethering is the Marker of Functional Mitral Regurgitation
Mechanisms of Ischemic Mitral Regurgitation

- Decreased closing force
- Increased tethering
- Bulging Papillary muscle traction
- Decreased closing force
- Annular dilatation

Papillary muscle function

- Papillary muscle dysfunction per se **does not** cause functional mitral regurgitation
- early studies: dogs (ligation, formaldehyde)
  - Mittal AK et al: Circulation 1971;44:174
When MR is caused by outward bulging of the inferior base, extending the ischemic zone to include the papillary muscle can paradoxically diminish MR by reducing tethering.

Take home message

The term papillary muscle dysfunction should be abandoned!
Pathophysiology

- LV Systolic Function
- Papillary muscle displacement
- Papillary muscle function
- Annular dimension

Impact of Loading Conditions

- LV Systolic Function
- Papillary muscle displacement
- Papillary muscle function
- Annular dimension

Loading Conditions
Impact of anesthesia

BP ↓ SVR

? Impact on LV Fxn,
Annular Dimensions.
Papillary M. Geometry

MR

Karanir et al AJC 2000:85;199-203, Gemayel et Circulation 2001

Effect of Systemic BP

BP = 123/82
Color Gain = 50

BP = 164/92
Color Gain = 50
Functional MR is Prognostically Important

Impact of mitral regurgitation on prognosis post MI

<table>
<thead>
<tr>
<th>Death</th>
<th>Technique</th>
<th>Adj RR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical trials</td>
<td></td>
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<td></td>
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<tr>
<td>Lehman, 1998 (TMR)</td>
<td>Ventriculography</td>
<td>6.68</td>
<td>2.2-19.7</td>
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<tr>
<td>Peltzow, 2004* (CABALL)</td>
<td>Ventriculography</td>
<td>2.02</td>
<td>1.34-3.02</td>
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<tr>
<td>Population-based cohort</td>
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<td></td>
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<tr>
<td>Buri, 2006*</td>
<td>Echocardiography, semi-quantitative</td>
<td>1.45</td>
<td>1.05-1.99</td>
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<tr>
<td>Consecutive hospital admission</td>
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<tr>
<td>Tscherg, 1992</td>
<td>Ventriculography</td>
<td>1.49</td>
<td>1.21-1.83</td>
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<tr>
<td>Fedders, 2007</td>
<td>Echocardiography, semi-quantitative</td>
<td>2.66</td>
<td>0.89-8.01</td>
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<tr>
<td>Gould, 2001</td>
<td>Echocardiography, semi-quantitative</td>
<td>2.38</td>
<td>1.31-4.28</td>
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<tr>
<td>Case-control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ormiston, 2001*</td>
<td>Echocardiography, quantitative</td>
<td>2.32</td>
<td>1.31-2.79</td>
</tr>
<tr>
<td>Cardiac death</td>
<td></td>
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<tr>
<td>Lehman, 1998 (TMR)</td>
<td>Ventriculography</td>
<td>12.2</td>
<td>3.5-42</td>
</tr>
<tr>
<td>Lehman, 1997* (SAHC)</td>
<td>Ventriculography</td>
<td>2.0</td>
<td>1.29-3.04</td>
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<tr>
<td>Case-control</td>
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<tr>
<td>Ormiston, 2001*</td>
<td>Echocardiography, quantitative</td>
<td>2.38</td>
<td>1.31-4.28</td>
</tr>
<tr>
<td>Heart failure</td>
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<td></td>
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<tr>
<td>Population-based cohort</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Buri, 2006*</td>
<td>Echocardiography, semi-quantitative</td>
<td>3.64</td>
<td>1.74-8.02</td>
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<tr>
<td>Case-control</td>
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<td></td>
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<tr>
<td>Ormiston, 2001*</td>
<td>Echocardiography, quantitative</td>
<td>4.48</td>
<td>2.4-8.3</td>
</tr>
</tbody>
</table>

Prognosis worsens with increasing MR severity

Survival (±SE) after diagnosis according to degree of MR as graded by RVol ≥30 mL/beat or <30 mL/beat.

Francesco Grigioni, Sarano, Zehr, Bailey and Tajik
Circulation. 2001;103:1759-1764

Copyright © American Heart Association, Inc. All rights reserved.
Survival (±SE) after diagnosis according to degree of MR as graded by ERO ≥20 mm² or <20 mm².

Since we know it carries a bad prognosis we should fix it!
Does MV Repair help?

Castleberry (Duke) Circulation 2014
CABG vs CABG + MVR
3-4+MR LVEF<45%

Mihaljevic et al JACC 2007: 49;2191 (Cleveland Clinic)

CTSurgical Network

- Moderate ischemic MR: Randomized trial CABG alone vs CABG plus ring repair
- n = 250
Conclusions

• Mitral-valve repair was associated with a reduced prevalence of moderate or severe mitral regurgitation but an increased number of untoward events (longer pump run, LOS, neurologic events).

• In patients with moderate ischemic mitral regurgitation, the addition of mitral-valve repair to CABG did not result in a higher degree of left ventricular reverse remodeling.
Conclusions

• Thus, at 1 year, this trial did not show a clinically meaningful advantage of adding mitral-valve repair to CABG (survival, CVA, QOL, readmissions, NYHA class)

• Longer-term follow-up may determine whether the lower prevalence of mitral regurgitation translates into a net clinical benefit.

Treatment

Primary MR

Medical vs Intervention
Secondary MR

Medical vs Intervention

2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease
A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines
Developed in Collaboration With the American Association for Thoracic Surgery, American Society of Echocardiography, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Anesthesiologists, and Society of Thoracic Surgeons

Guidelines on the management of valvular heart disease (version 2012)
The Joint Task Force on the Management of Valvular Heart Disease of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS)
### Table 17: Summary of Recommendations for Chronic Primary MR

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>COR</th>
<th>LOE</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>MV surgery is recommended for asymptomatic patients with chronic severe primary MR (stage D) and LV EF ≤25%</td>
<td>I</td>
<td>B</td>
<td>(565, 576)</td>
</tr>
<tr>
<td>MV surgery is recommended for symptomatic patients with chronic severe primary MR and LV dysfunction (LV EF 26%–60% and LV ESVF &lt;30 ml/m²)</td>
<td>I</td>
<td>B</td>
<td>(358, 362, 392, 324)</td>
</tr>
<tr>
<td>LV repair is recommended in preference to MVR when surgical treatment is indicated for patients with chronic severe primary MR limited to the posterior leaflet</td>
<td>I</td>
<td>B</td>
<td>(357, 364, 395, 400)</td>
</tr>
<tr>
<td>MV repair is recommended in preference to MVR when surgical treatment is indicated for patients with chronic severe primary MR involving the anterior leaflet or both leaflets when a successful and durable repair can be accomplished</td>
<td>I</td>
<td>B</td>
<td>(56, 457-463)</td>
</tr>
<tr>
<td>Concomitant MV repair or replacement is indicated in patients with chronic severe primary MR undergoing cardiac surgery for other indications</td>
<td>I</td>
<td>B</td>
<td>(410)</td>
</tr>
<tr>
<td>MV repair is recommended in symptomatic patients with chronic severe primary MR (stage C1) with preserved LV function (LVEF &gt;50% and LVESE &gt;15 mm) when the likelihood of a successful and durable repair without residual MR is &gt;95% with an expected mortality rate of &lt;1%, when performed at a Valve Center of Excellence</td>
<td>IIa</td>
<td>B</td>
<td>(597-599, 600, 601)</td>
</tr>
<tr>
<td>MV repair is recommended in asymptomatic patients with chronic severe primary MR (stage C1) and preserved LV function in whom there is a high likelihood of a successful and durable repair with 11-year outcomes of AF or TV pericardial hypertrophy in a study of asymptomatic patients with a mean age of &gt;70 years</td>
<td>IIIb</td>
<td>B</td>
<td>(410)</td>
</tr>
<tr>
<td>Concomitant MV repair is recommended in patients with chronic moderate primary MR (stage B) undergoing cardiac surgery for other indications</td>
<td>IIIb</td>
<td>C</td>
<td>N/A</td>
</tr>
<tr>
<td>MV surgery may be considered in symptomatic patients with chronic severe primary MR and LVEF &lt;50% (stage D)</td>
<td>IIIb</td>
<td>C</td>
<td>N/A</td>
</tr>
<tr>
<td>MV repair may be considered in patients with chronic mitral valve disease when surgical treatment is indicated if a durable and successful repair is likely or if the reliability of long-term anticoagulation management is questionable</td>
<td>IIIb</td>
<td>B</td>
<td>(64, 406, 413)</td>
</tr>
<tr>
<td>Non-sustained MR repair may be considered for severely symptomatic patients (NYHA class III/IV) with chronic severe primary MR (stage D) who have reasonable life expectancy but a prohibitive surgical risk because of severe comorbidities</td>
<td>IIIb</td>
<td>B</td>
<td>(426)</td>
</tr>
<tr>
<td>MV repair should be performed for treatment of isolated chronic primary MR limited to less than half of the posterior leaflet unless MV repair has been attempted and was unsuccessful</td>
<td>IIIb</td>
<td>C</td>
<td>(97, 407-409)</td>
</tr>
</tbody>
</table>

### Table 18: Summary of Recommendations for Chronic Severe Secondary MR

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>COR</th>
<th>LOE</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>MV surgery is reasonable for patients with chronic severe secondary MR (stages C and D) who are undergoing CABG or AVR</td>
<td>IIa</td>
<td>C</td>
<td>N/A</td>
</tr>
<tr>
<td>MV surgery may be considered for severely symptomatic patients (NYHA class III/IV) with chronic severe secondary MR (stage D)</td>
<td>IIb</td>
<td>B</td>
<td>(418, 448-449)</td>
</tr>
<tr>
<td>MV repair may be considered for patients with chronic moderate secondary MR (stage B) who are undergoing other cardiac surgery</td>
<td>IIIb</td>
<td>C</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Repair vs. replacement

Equipoise??

Original Article
Mitral-Valve Repair versus Replacement for Severe Ischemic Mitral Regurgitation


N Engl J Med
Volume 370(1):23-32
January 2, 2014
Grading Mitral Regurgitation

Direct Measures
Collateral Damage (LV, LA enlargement, PHTN)

How are the Criteria Different?
# Grading Mitral Regurgitation

<table>
<thead>
<tr>
<th>Structural parameters</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>LV size</td>
<td>Normal*</td>
<td>Normal or dilated</td>
<td>Usually dilated**</td>
</tr>
<tr>
<td>Mitral leaflets or support apparatus</td>
<td>Normal or abnormal</td>
<td>Normal or abnormal</td>
<td>Abnormal/ Flail leaflet/ Repeated papillary muscle</td>
</tr>
<tr>
<td>Doppler parameters</td>
<td>Color flow jet area*</td>
<td>Small, central jet (usually &lt; 4 cm² or &lt; 20% of LA area)</td>
<td>Variable</td>
</tr>
<tr>
<td>Mitral inflow – PW</td>
<td>A wave dominant‡</td>
<td>Variable</td>
<td>E wave dominant‡ (E usually 1.2 m/s)</td>
</tr>
<tr>
<td>Jet density – CW</td>
<td>Incomplete or faint</td>
<td>Dense</td>
<td>Dense</td>
</tr>
<tr>
<td>Jet contour – CW</td>
<td>Parabolic</td>
<td>Usually parabolic</td>
<td>Early peaking - triangular</td>
</tr>
<tr>
<td>Pulmonary vein flow</td>
<td>Systolic dominance‡</td>
<td>Systolic blunting§</td>
<td>Systolic flow reversal‡</td>
</tr>
<tr>
<td>Quantitative parameters*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vc width (cm)</td>
<td>&lt; 0.3</td>
<td>0.3 - 0.69</td>
<td>&gt; 0.7</td>
</tr>
<tr>
<td>RVol (mL/beat)</td>
<td>&lt; 30</td>
<td>30.44</td>
<td>46.59</td>
</tr>
<tr>
<td>EF (%)</td>
<td>&lt; 20</td>
<td>35.89</td>
<td>40.79</td>
</tr>
<tr>
<td>EROA (cm²)</td>
<td>&lt; 0.20</td>
<td>0.20 - 0.29</td>
<td>0.30 - 0.39</td>
</tr>
</tbody>
</table>

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**C** Asymptomatic severe MR.
- Severe mitral valve prolapse with loss of coaptation or flail leaflet.
- Rheumatic valve changes with leaflet restriction and loss of central coaptation.
- Prior IE.
- Thickening of leaflets with radiation heart disease.
- Central jet MR < 40% LA or holosystolic eccentric jet MR.
- Vena contracta < 0.7 cm.
- Regurgitant volume < 60 mL.
- Regurgitant fraction < 50%.
- ERO > 0.40 cm².
- Angiographic grade 3-4+

**D** Symptomatic severe MR.
- Severe mitral valve prolapse with loss of coaptation or flail leaflet.
- Rheumatic valve changes with leaflet restriction and loss of central coaptation.
- Prior IE.
- Thickening of leaflets with radiation heart disease.
- Central jet MR < 40% LA or holosystolic eccentric jet MR.
- Vena contracta < 0.7 cm.
- Regurgitant volume < 60 mL.
- Regurgitant fraction < 50%.
- ERO > 0.40 cm².
- Angiographic grade 3-4+.
Does “prognostically important” mean that the regurgitation is severe?
Should we be using 2D PISA to measure regurgitant volume and effective regurgitant orifice in patients with secondary MR?

Is effective regurgitant orifice the best way to identify severe mitral regurgitation?
Summary

• Primary and Secondary MR are fundamentally different diseases
  – Pathophysiology
  – Anatomy
  – Outcomes
  – Approaches to treatment

• Grading severity is challenging for secondary MR
  – Use integrated approach