Ischemic Mitral Regurgitation: indications for surgery

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Definition of IMR

- Valve leaflets and subvalvular apparatus are structurally normal
- Size, location, and transmurality of the MI determines:
  1. severity (mild, moderate, severe).
  2. clinical manifestation (acute-chronic)

IMR is a ventricular disease
Carpentier’s Functional Classification

Type IIIb

Restricted Leaflet Motion

Pathogenesis
Leaflet Tethering

Infarcted posterior LV wall bulges outward in systole and drags the posteromedial papillary muscle away with it:

1- asymmetric and restricted motion of the PML during systole.
2- AML pseudoprolapse..... Causing MR
Clinical types of ischemic MR

- **Acute Ischemic MR:**
  - Post-infarction
  - Ruptured papillary muscle or Papillary muscle necrosis.

- **Chronic Ischemic MR:**
  - MR caused by ischemic heart disease in the presence of a structurally normal valve.
Moderate MR

- Regurgitant volume 40-60 ml/beat
- Regurgitant fraction 30-50 %
- Effective regurgitant orifice 20-40 mm²
- Absence of secondary complications of MR
  - Pulmonary hypertension
  - Atrial fibrillation
  - LV dilatation
Surgical Options

- Revascularization alone.
- Revascularization and MV Repair with a restrictive annuloplasty ring
- Subvalvular additional techniques
- Revascularization and MV Replacement
Aims of surgery on IMR

- Improving or abolishing MR
- Improvement of functional class and quality of life.
- Promotion of LV remodeling.
- Survival benefit.
Survival (mean ± SE) after diagnosis according to degree of MR graded by effective regurgitant orifice (ERO) 20 mm² or < 20 mm².

**Multivariate analysis** :
mortality increased in case of regurgitation with ERO 20 mm² (adjusted relative risk 2.23, p < 0.003)
ERO < 20 mm² (adjusted relative risk 1.65, p < 0.049).

303 pts MR after MI
190 No MR after MI

*Grigioni F*, Mayo Clinic *Circulation* 2001;**103**:1759–64
Ischemic MR

Development of Heart Failure

p=0.001

ERO ≥20
68%

ERO 1-19
46%

ERO = 0
18%

Grigioni et al. Circulation 2001;103:1759-1764
Presence of IMR affects survival and functional class after MI

Bursi et al, Mayo clinic, Circulation, 2005

773 pts with MI
Population based
Moderate MR at discharge impacts the late development of CHF
Late outcomes in patients with uncorrected mild to moderate mitral regurgitation at the time of isolated coronary artery bypass grafting.

- Isolated CABG.
- 163 mild to moderate MR. vs (matched 1:2) 326 No MR, 99% followed for 6 y
- Actuarial survival at 6 years: 81.0% vs 84.7% (p=0.918).
- Event-free survival: 45.7% vs 64.7% (p=0.025).
- NYHA Class III/IV: 20.0% vs 8.1% (p=0.004).

Ischemic mitral regurgitation: revascularization alone versus revascularization and mitral repair

- 355 patients with Ischemic MR.
- CABG (n=168) vs CABG + MV Rep (n=187)

- Reduction in Ischemic MR by 2 or more grades: 11% vs 89% (p=0.001).
- Operative mortality with 3+ or 4+ MR: 4.7% vs 11.0% (p=0.11).
- 5-year survival with 3+ or 4+ MR: 41% vs 44% (p=0.53).

Survival After Coronary Revascularization, With and Without Mitral Valve Surgery, in Patients With Ischemic Mitral Regurgitation

<table>
<thead>
<tr>
<th>Group</th>
<th>Total</th>
<th>Medical</th>
<th>PCI</th>
<th>CABG</th>
<th>CABG+MV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2757</td>
<td>1305</td>
<td>537</td>
<td>687</td>
<td>226</td>
</tr>
</tbody>
</table>

No clear survival advantage of addition of MVR over revascularization

(Circulation. 2003;108[suppl II]:II-103-II-110.)
Is repair preferable to replacement for ischemic mitral regurgitation?

- 482 patients with ischemic MR.
- 397 MV Repair    85 MV Replacement.
- 5-year freedom from repair failure 91%.
- 5-year survival was better in MV repair group (58% vs 36%; p=0.08).
- In high risk subgroup survival was similar
- Benefits are lessened if
  - IMA not used
  - Lateral wall motion abnormality is present
  - MR jet is complex

Gillinov AM, J Thorac Cardiovasc Surg. 2001 Dec;122(6):1125-41
Repair is better than replacement, if repair is simple
Conclusion: In patients with chronic ischemic mitral regurgitation during CABG, mitral valve replacement is associated with lower recurrence of regurgitation. No differences were found regarding survival and reoperation rates.
Peri-operative Mortality
Mitral Repair v/s Replacement.

Late Mortality
Mitral Repair v/s Replacement.

Incidence of Re-operation Mitral Repair v/s Replacement.

Recurrence of MR
Mitral Repair v/s Replacement.

Objective: To investigate the efficacy of coronary artery bypass grafting (CABG) combined with or without MV Repair/replacement for the ischemic MVR.

Meta-analysis of 5 articles with a total of 3120 patients enrolled:
- CABG and MVRR group included 575 patients.
- CABG only group included 2545 patients.
Survival on CABG with or without MVS for IMR.
Zhang H. et al.

Results

• Long-term survival was higher in the CABG only group (hazard ratio [HR], 1.34; 95% confidence interval [CI] 1.15–1.58, \( P=0.003 \)).

• Hospital mortality was similar in both the groups (OR, 2.54; 95% CI, 0.65–9.95; \( P=0.18 \)).

• No differences were found in the degree of residual MVR, the mean of LVESV, LVEF, or NYHA class.
Short-term Survival after CABG with or without MVR in IMR.

**Figure 2.** Short-term survival forest plots. (CI – confidence interval; DF – degrees of freedom; M-H – Mantel-Haenszel).
Long-term Survival after CABG with or without MVR in IMR.  

**Figure 4.** Long-term survival forest plots. (CI – confidence interval; DF – degrees of freedom; SE – standard error; IV – inverse variance.)
Despite the substantial effort by the CTS Trials Network and other groups treatment of moderate IMR continues to be a matter of debate. Until the evidence becomes more persuasive it might be safe to practice a tailored approach to the treatment of moderate IMR.
Summary

• No difference at 1 year:
  • in the degree of reverse remodeling
  • in mortality
  • in MACCE, hospital readmission, or QOL

• CABG + MV repair associated with more:
  • neurologic events
  • increased cross clamp and cardiopulmonary bypass time
  • longer ICU and hospital LOS

• At 1 year, higher degree of moderate and severe MR in the CABG alone group
Conclusion

• The trial did not demonstrate a clinically meaningful advantage to the routine addition of MVr to CABG

• Longer-term follow-up is ongoing
  • Will the lower incidence of moderate or severe MR at one-year translate into a net clinical benefit for patients undergoing CABG + mitral repair?
Are adjunct subvalvular techniques more effective than isolated restrictive annuloplasty for treating ischemic mitral regurgitation?

- Meta-analysis of 10 articles to see whether subvalvular techniques are more effective than isolated restrictive annuloplasty in addressing ischemic mitral regurgitation.
- Two were propensity-matched studies, four retrospective and four prospective, non-randomized studies.
- In almost all studies, the recurrence of MR postoperatively was less when subvalvular techniques were used; with no difference in early or in-hospital mortality.

**Conclusion:** Subvalvular techniques in combination with annuloplasty are safe and may better address ischemic MR than the use of annuloplasty ring alone.

Papillary Muscle Approximation Versus Restrictive Annuloplasty Alone for Severe Ischemic Mitral Regurgitation.

- Ninety-six patients with severe ischemic MR were randomized to either undersizing restrictive mitral annuloplasty (RA) or papillary muscle approximation with undersizing restrictive mitral annuloplasty (PMA) associated with complete surgical myocardial revascularization.

- Primary endpoint: change in left ventricular end-diastolic diameter (LVEDD) after 5 years.
RESULTS:
• At 5 years, mean LVEDD was 56.5 ± 5.7 mm with PMA versus 60.6 ± 4.6 mm with RA (mean change from baseline -5.8 ± 4.1 mm and -0.2 ± 2.3 mm, respectively; p < 0.001).
• Ejection fraction was 44.1 ± 6% in the PMA group versus 39.9 ± 3.9% in the RA group (mean change from baseline 8.8 ± 5.9% and 2.5 ± 4.3%, respectively; p < 0.001).
• There was no statistically significant difference in mortality at 5 years.
• Freedom from MACCE favored PMA in the last year of follow-up.
• PMA significantly reduced tenting height, tenting area, and interpapillary distance soon after surgery and for the long-term, and significantly lowered moderate-to-severe MR recurrence.
• No differences were found in QOL measures.
## Indications for mitral valve surgery in secondary mitral regurgitation

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<thead>
<tr>
<th>Indication</th>
<th>Class</th>
<th>Level</th>
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<tbody>
<tr>
<td>Surgery is indicated in patients with severe MR undergoing CABG, and LVEF &gt; 30%.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Surgery should be considered in patients with moderate MR undergoing CABG.</td>
<td>IIa</td>
<td>C</td>
</tr>
<tr>
<td>Surgery should be considered in symptomatic patients with severe MR, LVEF &lt; 30%, option for revascularization, and evidence of viability.</td>
<td>IIa</td>
<td>C</td>
</tr>
<tr>
<td>Surgery may be considered in patients with severe MR, LVEF &gt; 30%, who remain symptomatic despite optimal medical management (including CRT if indicated) and have low comorbidity, when revascularization is not indicated.</td>
<td>IIb</td>
<td>C</td>
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2014 AHA/ACC guidelines

- **Class IIa**
  - Mitral valve surgery is reasonable for patients with chronic severe secondary MR (stages C and D) who are undergoing CABG or AVR. *(Level of Evidence: C)*

- **Class IIb**
  - Mitral valve repair or replacement may be considered for severely symptomatic patients (NYHA class III to IV) with chronic severe secondary MR (stage D) who have persistent symptoms despite optimal GDMT for HF. 224–235 *(Level of Evidence: B)*
  - Mitral valve repair may be considered for patients with chronic moderate secondary MR (stage B) who are undergoing other cardiac surgery. *(Level of Evidence: C)*
Ischemic Mitral Regurgitation

Presence of moderate IMR is detrimental to survival and functional class

Presence of moderate IMR is prognostic for poor survival and functional class after CABG

Restrictive mitral annuloplasty may not be enough in decreasing and maintaining mitral competence, the addition of subvalvular technique may be necessary

Repair is better than replacement if repair is simple in advance disease tissue valve should be inserted