Ischemic Cardiomyopathy & Mitral Regurge
Role of Surgery

Ibrahim Khadragi
Professor of Cardio-Thoracic Surgery
Alexandria University

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Pathology of ischemic MR (IMR)

- IMR has multiple subgroups, with the most common situation being functional MR, in which the valve leaflets are structurally normal, but LV remodeling with apical and posterior displacement of papillary muscles, leads to excess valvular tenting + Loss of systolic annular contraction → prevent leaflet coaptation.
Surgery for IMR

Correction of IMR through either repair or replacement provides a good 5-year survival rate, with more than 75% of the survivors in New York Heart Association classes I and II.


Surgical Treatment Options for IMR

**Isolated CABG**

**CABG + MV Surgery**
- Mitral Valve Replacement
- Mitral Valve Repair
- Undersized Mitral Annuloplasty

Alternative Surgical Procedures for IMR
- Second-Order Chordal Cutting
- Alfieri Edge-to-Edge Repair
- Infarct Plication
- Papillary Muscle Approximation
- Papillary Muscle Sling
- Surgical Relocation of the Posterior Papillary Muscle
- Posterior MV Restoration
1. Mitral valve replacement with mechanical or bioprosthetic valve

Excision of the anterior leaflet of mitral valve with division of chordae, the posterior leaflet with its chordal attachments should be preserved.

When To Repair or Replacement?

• The End-systolic distance between the coaptation point of mitral leaflets and the plane of mitral annulus could be used as a key factor to decide either repair (≤10 mm) or replacement (>10 mm).
2. Mitral Valve Repair

Mitral Valve Repair and stabilizing Annuloplasty
+ Coronary Revascularization in IMR
Results in Reverse Left Ventricular Remodeling

Jeroen J. Bax, Netherlands

3. Undersized Mitral Annuloplasty

Restrictive Mitral annuloplasty (down-sizing of the annulus by 2 sizes)

The GeoForm annuloplasty (3D)-shaped ring is effective in relieving FMR in most of the patients with dilated cardiomyopathy leading to reduction of LV dimension (REVERSE REMODELING).

Reverse remodeling is defined as a 10% reduction in left ventricular dimension

**How to predict reverse LV Remodeling?**

- In patients with a Preoperative LVED dimension exceeding 65mm, additional surgical procedures are necessary to obtain reverse remodeling.


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**4. Second-Order Chordal Cutting**

Allows ballooning of the leaflets and enhances coaptation.

- Secondary chordae tendinae attaching the posteromedial papillary muscle (white arrow) to the belly of anterior mitral valve leaflet (black arrow).
5. Alfieri edge-to-edge repair

The edge-to-edge approximation (Alfieri repair) consists of suturing the anterior and posterior leaflets together to create a “double orifice” mitral valve. Anchoring the prolapsing free edge to the facing edge of the posterior leaflet (“edge-to-edge” technique) enhances coaptation.

6. Infarct Plication

- An approach for ventricular remodeling to relieve IMR
- Restores papillary muscle position closer to the anterior mitral annulus and reduces tethering of the leaflets.
7. Papillary Muscle Approximation

A single coated, braided, polyester 2-0 U-shaped suture reinforced by two patches of autologous pericardium is passed through the bodies of the posterior and anterior papillary muscles.

Mitral plasty final aspect with repositioning of the papillary muscles to the mid-line and insertion of flexible mitral ring.

CABG + Papillary Muscle Approximation + ventriculoplasty (Dor)

Result in better left ventricle function and shape in patients with IMR, even at long-term follow-up.

Long-term effect of papillary muscle approximation combined with ventriculoplasty on left ventricle function in patients with ischemic cardiomyopathy and functional mitral regurgitation

8. Papillary muscle sling

**Intraventricular Remodeling**
A Gore-Tex tube encircles the trabecular base of the posterior and anterior papillary muscle. The tube is then tightened and secured with sutures, creating a complete sling that brings both papillary muscles in close contact and in a more normal "papillary muscle-to-mitral annulus" alignment.


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9. Surgical Relocation of the Posterior Papillary Muscle in chronic IMR (Traction Suture)

Ventricular remodeling surgery is an effective procedure for surgical indirect relocation of the posterior papillary muscle tip in the setting of a severely dilated LV.

Direct relocation of the posterior papillary muscle may be useful for patients with a minimally dilated LV or regional left ventricular geometric changes causing mitral regurgitation.
10. Posterior mitral valve restoration

Described by Fundaro and coworkers.


Severe MR

[Surgery Indicated]

When functional MR is severe, it may be corrected by placement of an annuloplasty ring that decreases the annular circumference, shortens the intertrigonal distance, reduces the septal-lateral (anterior-posterior) annular diameter, and restores the geometry of the annulus, thereby allowing the MV leaflets to coapt.

Papillary muscle rupture often produces severe MR and hemodynamic decompensation, which is an indication for emergency surgery.
Does Coronary Artery Bypass Grafting Alone Correct Moderate IMR?
CABG surgery alone for moderate IMR leaves many patients with significant residual MR.
Intraoperative TEE may significantly underestimate the severity of ischemic MR.
So, a preoperative diagnosis of moderate MR warrants concomitant mitral annuloplasty.

Mild MR
[Surgery Might be Indicated]
we learned conclusively in the multicenter SAVE (Survival and Ventricular Enlargement) trial that even a mild degree of MR portended a substantial excessive risk of cardiovascular mortality within 5 years after acute myocardial infarction.
The hemodynamic effects of drugs received during surgery often lessen the severity of the MR, and mild intraoperative MR may increase postoperatively.
Hence, it is reasonable to perform MV repair when there is moderate and, in many cases, of mild MR detected on intraoperative TEE.
Previously Undetected Mitral Regurgitation During CABG  
[Surgery Might be Indicated]

On occasion, intraoperative TEE may detect previously undiagnosed, significant MR in a patient undergoing CABG surgery. 
IMR due to LV remodeling and apical tenting of the leaflets can be very dynamic and may respond to acute hemodynamic management in the operating room by increasing or decreasing in severity according to changes in afterload and LV size. 
In this situation, the surgeon should explore the mitral valve and determine the mechanism of the MR. If there is a structural abnormality such as prolapse or flail, the valve should be repaired or replaced. 

Conclusion

• All types of repair offer very similar results for IMR. If perfect repair is not feasible, cardiac surgeons should not hesitate to replace the mitral valve as it is an excellent alternative therapy, though long-term outcome is mainly dependent on preoperative condition. 
• The benefit from repair lessened or was negated if an internal thoracic artery graft was not used, if a lateral wall motion abnormality was present, or if the mitral regurgitation jet pattern was complex.

• Although CABG + MV annuloplasty reduces postoperative MR and improves early symptoms compared with CABG alone, it does not improve long-term functional status or survival in patients with severe functional ischemic MR.

• The MV annuloplasty in this setting, without addressing fundamental ventricular pathology, is insufficient to improve long-term clinical outcomes.


THANK YOU
Thank You SO Much. This is an appealing Marcedes Benz. But can you drive it in the proper direction?

• To fix IMR without surgery is very appealing too.
• BUT we should remember that besides Revascularization (PCI)
• We have to fix each pathophysiological mechanism involved in the genesis of IMR: LV remodeling (regional left ventricular myocardial scarring, anterior-lateral and inferior-posterior regions), valve prolapse (Mitral tenting), annular dilatation, papillary rupture.
• **Percutaneous Restrictive Annuloplasty** (CARILLON Mitral Contour System is a fixed-length, double-anchor, nitinol device designed to be positioned within the CS/GCV to reduce FMR.)

• **Septolateral Annular Cinching** (Septolateral annular cinching suture spans the annular septolateral dimension and was externalized to an epicardial tourniquet.)

• **Percutaneous Alfieri Clip Repair**

Either separate or in combination address annular dilatation and mitral tenting, but have little impact on the effect of regional myocardial scarring.

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Papillary muscle repositioning for Reduction of Ischemic Mitral Regurgitation

**Myocor Coapsys**

**Dacron Patch-Inflatable Balloon Device.** An epicardial inflatable patch-balloon device is applied to the infarct and inflated under echo guidance to eliminate MR.
Percutaneous Mitral Valve Repair Using the Clip Device Edge-to-Edge Technique

• Remember the Major adverse events: partial clip detachment, post-procedure stroke, valve surgery (general anesthesia twice).

Results of the EVEREST (Endovascular Valve Edge-to-Edge REpair Study) Phase II Randomized Clinical Trial. 2010

THANK YOU

Endovascular Valve Edge-to-Edge REpair Study (EVEREST II)
Randomized Clinical Trial:
Primary Safety and Efficacy Endpoints

Ted Feldman, Laura Mauri, Elyse Foster, Don Glower on behalf of the EVEREST II Investigators

American College of Cardiology
March 14, 2010
Atlanta, GA
Catheter-Based Mitral Valve Repair
MitraClip® System

Investigational Device only in the US;
Not available for sale in the US

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**EVEREST II Randomized Clinical Trial**

**Key Inclusion/Exclusion Criteria**

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<th>Inclusion</th>
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<tr>
<td>- Candidate for MV Surgery</td>
<td>- AMI within 12 weeks</td>
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<tr>
<td>- Moderate to severe (3+) or severe (4+) MR</td>
<td>- Need for other cardiac surgery</td>
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<tr>
<td>- Symptomatic</td>
<td>- Renal insufficiency</td>
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<td>- &gt;25% EF &amp; LVESD ≤55mm</td>
<td>- Creatinine &gt;2.5mg/dl</td>
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<td>- Asymptomatic with one or more of the following</td>
<td>- Endocarditis</td>
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<td>- LVEF 25-60%</td>
<td>- Rheumatic heart disease</td>
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<td>- LVESD ≥40mm</td>
<td>- MV anatomical exclusions</td>
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<td>- New onset atrial fibrillation</td>
<td>- Mitral valve area &lt;4.0cm²</td>
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<td>- Pulmonary hypertension</td>
<td>- Leaflet flail width (≥15mm) and gap (≥10mm)</td>
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<td>- Leaflet tethering/coaptation depth (≥11mm) and length (≤2mm)</td>
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ACC/AHA Guidelines JACC 52:e1-e142, 2008

Investigational Device only in the US;
Not available for sale in the US
EVEREST II RCT: MR Reduction
Per Protocol Cohort

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<th>Device Group</th>
<th>Control Group</th>
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<tr>
<td>Baseline</td>
<td>3+/4+</td>
<td>3+/4+</td>
</tr>
<tr>
<td>12 Months</td>
<td>≤2+</td>
<td>≤2+</td>
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<td></td>
<td>81.5%</td>
<td>97.0%</td>
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Investigational Device only in the US; Not available for sale in the US

EVEREST II RCT: Summary

- Safety & effectiveness endpoints met
  - Safety: MAE rate at 30 days
    - MitraClip device patients: 9.6%
    - MV surgery patients: 57%
  - Effectiveness: Clinical Success Rate at 12 months
    - MitraClip device patients: 72%
    - MV surgery patients: 88%

- Clinical benefit demonstrated for MitraClip System and MV surgery patients through 12 months
  - Improved LV function
  - Improved NYHA Functional Class
  - Improved Quality of Life

- Surgery remains an option after the MitraClip procedure

Investigational Device only in the US; Not available for sale in the US
• Since the MitraClip procedure is still relatively new, continued investigation is required to further define patient populations that will benefit most.