

Mitral Valve Repair or Replacement. How long is this feud to last?

Michele Di Mauro¹, Marco Cargoni², Roberta Liberi³, Roberto Lorusso⁴, and Antonio Calafiore⁵

¹Maastricht UMC+

²Mazzini Hospital

³SS Annunziata Hospital

⁴Maastricht University Medical Centre

⁵Henry Dunant Hospital Center

March 21, 2022

Abstract

Choosing to perform mitral valve (MV) repair or replacement remains a hot and highly debated topic. The current guidelines seem to be conflicting in this specific field and the evidences at our disposal are scarce, only one small randomized trial and few larger retrospective studies. The meta-analysis by Gamal and coworkers tries to summarize the current evidences, concluding that MV replacement for the treatment of ischemic mitral regurgitation is at least as safe as repair and certainly offers a more stable result over time than the latter. Obviously, the implantation of a prosthesis, especially a mechanical one, brings with it a series of problems, such as anticoagulation and, above all, a possible lack of ventricular remodeling, especially if a chordal sparing replacement is not performed. It must be said, on the other hand, that isolated annuloplasty cannot act as a counterpart to replacement, because ischemic MR cannot be considered only an annular disease. Therefore, wanting to mimic the nature that, after an infarction, enacts a series of changes involving also the mitral leaflets and chordae, the surgeons are called to act also on these two entities and not only to downsize the annulus. In a nutshell, a procedure should not be opposed in a fundamentalist way to another one, but we must accept the concept of armamentarium where both procedures are present and tail on the single patient, and also on the surgeon's expertise, the technique guaranteeing the best possible result.

Mitral Valve Repair or Replacement. How long is this feud to last?

Michele Di Mauro, MD, PhD, MSC, FESC (1), Marco Cargoni, MD (2), Roberta Liberi, MD (3), Roberto Lorusso, MD, PhD (1)*, Antonio M Calafiore, MD (4)*

1. Cardio-Thoracic Surgery Dept. Heart & Vascular Centre. Maastricht University Medical Centre (MUMC). Cardiovascular Research Institute Maastricht (CARIM). Maastricht. The Netherlands.
2. Department of Cardiac Anaesthesia and Intensive Care, "Mazzini" Hospital, Teramo, Italy
3. Department of Heart Disease, "SS Annunziata" Hospital, Chieti, Italy
4. Division of Cardiac Surgery A, "Henry Dunant" Hospital, Athens, Greece

**same contribution*

Word Count: 920

Corresponding Author:

Michele Di Mauro, MD, PhD, MSC, FESC.

Cardio-Thoracic Surgery Unit,

Heart and Vascular Centre,

Maastricht University Medical Centre (MUMC),

P. Debyelaan 25, 6202 AZ

Maastricht, The Netherlands

Email: mdimauro1973@gmail.com

Abstract

Choosing to perform mitral valve (MV) repair or replacement remains a hot and highly debated topic. The current guidelines seem to be conflicting in this specific field and the evidences at our disposal are scarce, only one small randomized trial and few larger retrospective studies. The meta-analysis by Gamal and coworkers tries to summarize the current evidences, concluding that MV replacement for the treatment of ischemic mitral regurgitation is at least as safe as repair and certainly offers a more stable result over time than the latter. Obviously, the implantation of a prosthesis, especially a mechanical one, brings with it a series of problems, such as anticoagulation and, above all, a possible lack of ventricular remodeling, especially if a chordal sparing replacement is not performed.

It must be said, on the other hand, that isolated annuloplasty cannot act as a counterpart to replacement, because ischemic MR cannot be considered only an annular disease. Therefore, wanting to mimic the nature that, after an infarction, enacts a series of changes involving also the mitral leaflets and chordae, the surgeons are called to act also on these two entities and not only to downsize the annulus.

In a nutshell, a procedure should not be opposed in a fundamentalist way to another one, but we must accept the concept of armamentarium where both procedures are present and tail on the single patient, and also on the surgeon's expertise, the technique guaranteeing the best possible result.

Ennio Flaiano, an important Italian writer said "I have few ideas but confused" and we strongly believe that it is really appropriate to make this quote talking about the treatment of ischemic mitral regurgitation. Indeed, comparing the two most important guidelines on the management of heart valve disease, the European [1] and the North American [2] ones, it is possible to read two different recommendations. The former states that although the surgical approach has to be tailored to the individual case, in selected patients without advanced left ventricular (LV) remodeling, mitral valve repair with an undersized complete rigid ring restores valve competence, improves symptoms, and results in reverse LV remodeling. Conversely, even if valve replacement avoids recurrence of mitral regurgitation, this does not translate into better LV reverse [3] From this it is possible to infer that they lean toward a conservative procedure over MV replacement.

The AHA/ACC guidelines [2], on the other hand, unequivocally recommend mitral replacement with chordal sparing over annuloplasty, with a 2b class of evidence[3-5].

So apparently choosing or not choosing one procedure rather the other has become a geographical issue.

In this confusing scenario, the meta-analysis of Gamal and coworkers [6] tries to thin out at least somewhat the fog. Among 2987 records initially identified, the authors report pooled results of 14 studies including only one randomized trial [7]. Pooled analysis on mortality clearly confirms that MV replacement is as safe as MV repair [OR (95 % CI): 0.66 (0.41-1.07)], as already reported in both clinical trial and some large retrospective analyses, already cited by AHA/ACC guidelines [2-5,7].

Likewise, MV repair is confirmed to be a harbinger of a higher rate of late MR recurrence (pooled rate [200 (34.4 %) vs 22 (3.9 %); OR (16.8 (5.07-55.7, p=0.00001) although this is not matched by a significant increase in the rate of reinterventions [55 (7.0 %) and 40 (6.0 %); OR (95 % CI): 1.34 (0.87-2.06), p=0.19]. This difference can obviously be explained by the fact that MR recurrence includes by definition also moderate grade that is not indicated for surgery in the first instance, let alone as reintervention, and by the fact that patients who have undergone surgery often refuse to undergo a new procedure and choose the path of medical therapy.

Conversely, repair seems to result in improved left ventricular remodeling with consequent improvement in the patient's functional capacity.

However, the latter finding could be related to the fact that not everyone performs mitral replacement with sparing of the subvalvular apparatus as suggested by many surgeons[8] .

Indeed, in CTSNET trial [7], where 95.4% of those receiving valve replacement had also a chordal-sparing procedure, the mean change of left ventricular end systolic volume from baseline was -9.0 ml/m^2 and $-6.5 / \text{m}^2$, not statistically significant ($p=0.19$),

Similarly, in a large multicenter Italian study [5] in which almost all the patients had MV replacement with preservation of valvular-subvalvular continuity, LV remodeling in terms of ejection fraction was similar in both groups ($P =0.66$).

From what has just been said, it would seem that the best choice is to replace the mitral valve, in the presence of ischemic etiology, because at equal survival, repair results in a higher recurrence rate. Yet, as we have seen, the European guidelines continue to support the choice of repair as a priority without consistent scientific evidences (rather, the opposite).

To best address the issue of high MR recurrence rate, we must return for a moment to the definition of secondary (or ischemic, predominantly) mitral insufficiency and change the paradigm of surgical treatment of this disease. In a recent editorial [9], we have already pointed out that ischemic MR represents a unique situation in cardiac surgery. In fact, although MR has long been considered a ventricular problem, suggesting that the valve leaflets and chordal structures are merely innocent bystanders, this concept needs to be challenged.

In ischemic MR, a set of adaptive processes termed 'mitral plasticity' takes the field aimed to reduce the amount of regurgitation. Unfortunately, the mitral plasticity is not always able to achieve the goal of balancing higher tenting forces and papillary muscles displacement.

Mimicking what the nature does, surgery may adopt some surgical steps to go along with the annuloplasty, such as anterior leaflet augmentation and second order chordal cutting [10].

We believe it is time to end this feud between repair and replacement (figure 1). It is now obvious that they are both worthwhile surgical approaches, and this is also confirmed by the meta-analysis by Gamal et al [6].

Already at the beginning of the 2000s we proposed a simple echocardiographic parameter, the coaptation depth, to choose between the two techniques, reserving replacement for patients with worse LV remodeling, going against the dogma according to which MV repair should be the predominant choice to be adopted [11]. Today we know that isolated annuloplasty may not be enough to reach a long-term stability and competence of the valve and, in these cases, we can choose between a more complex MV repair procedure that includes also a valvular and subvalvular procedure, or valve replacement. In a nutshell, as often happens in surgery, a procedure should not be opposed in a fundamentalist way to another one, but we must accept the concept of armamentarium where both procedures are present and tail on the single patient, and also on the surgeon's expertise, the technique guaranteeing the best possible result. But the struggle to generate a single, long-lasting, and effective technique in ischemic mitral regurgitation will certainly continue...at least, in the guidelines recommendations.

References

1. Vahanian A, Beyersdorf F, Praz F, Milojevic M, Baldus S, Bauersachs J, Capodanno D, Conradi L, De Bonis M, De Paulis R, Delgado V, Freemantle N, Gilard M, Haugaa KH, Jeppsson A, Jüni P, Pierard L, Prendergast BD, Sádaba JR, Tribouilloy C, Wojakowski W; ESC/EACTS Scientific Document Group. 2021 ESC/EACTS Guidelines for the management of valvular heart disease. *Eur Heart J*. 2022 Feb 12;43(7):561-632
2. Otto CM, Nishimura RA, Bonow RO, Carabello BA, Erwin JP 3rd, Gentile F, Jneid H, Krieger EV, Mack M, McLeod C, O'Gara PT, Rigolin VH, Sundt TM 3rd, Thompson A, Toly C. 2020 ACC/AHA

- Guideline for the Management of Patients With Valvular Heart Disease: Executive Summary: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *Circulation*. 2021 Feb 2;143(5):e35-e71.
3. Acker MA, Parides MK, Perrault LP, Moskowitz AJ, Gelijns AC, Voisine P, Smith PK, Hung JW, Blackstone EH, Puskas JD, Argenziano M, Gammie JS, Mack M, Ascheim DD, Bagiella E, Moquete EG, Ferguson TB, Horvath KA, Geller NL, Miller MA, Woo YJ, D'Alessandro DA, Ailawadi G, Dagenais F, Gardner TJ, O'Gara PT, Michler RE, Kron IL, CTSN. Mitral-valve repair versus replacement for severe ischemic mitral regurgitation. *N Engl J Med* 2014;370:23-32.
 4. Magne J, Girerd N, S n chal M, et al. Mitral repair versus replacement for ischemic mitral regurgitation: comparison of short-term and long-term survival. *Circulation*. 2009;120:S104-11.
 5. Lorusso R, Gelsomino S, Vizzardi E, et al. Mitral valve repair or replacement for ischemic mitral regurgitation? The Italian Study on the Treatment of Ischemic Mitral Regurgitation (ISTIMIR). *J Thorac Cardiovasc Surg*. 2013;145:128-39.
 6. Gamal MA, El-Fiky MM, Gamea MM, Elrazek IA. Mitral Valve Repair versus Replacement in Severe Ischemic Mitral Regurgitation Systematic Review and Meta-Analysis. *J Card Surg* 2022 in press
 7. Goldstein D, Moskowitz AJ, Gelijns AC, et al. Two-Year Outcomes of Surgical Treatment of Severe Ischemic Mitral Regurgitation. *N Engl J Med*. 2016 Jan 28;374(4):344-53.
 8. Yun KL, Sintek CF, Miller DC, et al. Randomized trial comparing partial versus complete chordal-sparing mitral valve replacement: effects on left ventricular volume and function. *J Thorac Cardiovasc Surg* 2002;123:707-14
 9. Calafiore AM, Totaro A, Paparella D, Gaudino M, Prapas S, Mick SL, Di Mauro M. Mimicking natural mitral adaptation to ischaemic regurgitation: a proposed change in the surgical paradigm. *Eur J Cardiothorac Surg*. 2020 Jul 1;58(1):35-39
 10. Calafiore AM, Totaro A, Testa N, Sacra C, Castellano G, Guarracini S, Di Marco M, Prapas S, Gaudino M, Lorusso R, Paparella D, Di Mauro M. The secret life of the mitral valve. *J Card Surg*. 2021 Jan;36(1):247-259.
 11. Calafiore AM, Gallina S, Di Mauro M, Gaeta F, Iaco AL, D'Alessandro S, Mazzei V, Di Giammarco G. Mitral valve procedure in dilated cardiomyopathy: repair or replacement? *Ann Thorac Surg*. 2001 Apr;71(4):1146-52

Figure legend

Figure 1. The feud between mitral valve repair and replacement

