Determinants of functional capacity after mitral valve annuloplasty or replacement for ischemic mitral regurgitation

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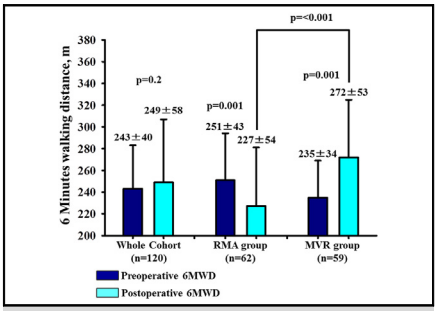
ABSTRACT

Objective: To identify the exercise echocardiographic determinants of long-term functional capacity, in patients with chronic ischemic mitral regurgitation, after restrictive mitral valve annuloplasty (RMA) or mitral valve replacement (MVR).

Methods: We retrospectively analyzed 121 patients with significant chronic ischemic mitral regurgitation, who underwent RMA (n = 62) or MVR (n = 59), between 2005 and 2011. Preoperatively, all patients underwent a resting echocardiographic examination, and a 6-minute walking test (6-MWT) to measure distance. Resting and exercise stress echocardiography, and the 6-MWT were repeated at 41 ± 16.5 months.

Results: After surgery, the 6-MWT distance significantly improved in the MVR group, and decreased in the RMA group (+37 ± 39 m vs −24 ± 49 m, respectively; $P < .0001$). Exercise indexed effective orifice area was significantly higher in the MVR, versus the RMA, group (MVR: change from 1.3 ± 0.2 cm^2/m^2 to 1.5 ± 0.3 cm^2/m^2; RMA: change from 1.1 ± 0.3 cm^2/m^2 to 1.2 ± 0.3 cm^2/m^2; $P = .001$). The mean mitral gradients significantly increased from rest to exercise, in both groups, but to a greater extent in the RMA group (change from 4.4 ± 1.4 to 11 ± 3.6 mm Hg; MVR: change from 4.3 ± 1.8 to 9 ± 3.5 mm Hg; $P = .006$). On multivariate analysis, MVR and exercise indexed effective orifice area were the main independent determinants of postoperative 6-MWT. In the RMA group, 25 patients experienced late mitral regurgitation recurrence, severe in 9 (14%) of them. The rate of postoperative cardiovascular events was significantly higher in the RMA group (21% vs MVR: 8%; $P = .03$). Follow-up survival was 83% in the RMA group and 88% in the MVR group ($P = .54$).

Conclusions: For chronic ischemic mitral regurgitation, MVR versus RMA was associated with better postoperative exercise hemodynamic performance and long-term functional capacity. (J Thorac Cardiovasc Surg 2015;149:1595-603)



The figure shows the 6-minute walking-test distance, in the whole cohort, and according to the surgical treatment: restrictive mitral valve annuloplasty versus mitral valve replacement.

Central Message

Mitral valve replacement for ischemic regurgitation provides better hemodynamic performance and functional capacity, compared with restrictive annuloplasty.

Perspective

For treatment of ischemic mitral regurgitation, controversy persists regarding the superiority of mitral valve annuloplasty versus replacement. Procedures aiming to restore ventricular geometry or targeting subvalvular mechanisms seem promising, but they require further scientific evidence. Mitral valve replacement provides better long-term hemodynamic performance and functional capacity for patients, during exercise, compared with restrictive annuloplasty. Pending further insight from the ongoing Cardiothoracic Surgical Trials Network, valve replacement with preservation of subvalvular apparatus may be a reliable option.

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Chronic ischemic mitral regurgitation (CIMR) is a frequent complication of coronary artery disease and is independently associated with excess mortality and poor outcome.[1-3] Restrictive mitral valve annuloplasty (RMA) and mitral valve replacement (MVR) are the most common surgical options for the treatment of CIMR. However, controversy persists regarding the optimal surgical treatment.[4-8]

Recent results from the Cardiothoracic Surgical Trials Network[9] showed that patient outcomes with replacement versus repair are similar at 1 year. A previous study showed

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Abbreviations and Acronyms

CIMR = chronic ischemic mitral regurgitation
ESE = exercise stress echocardiography
MVR = mitral valve replacement
RMA = restrictive mitral valve annuloplasty
6-MWT = 6-minute walking test

that patients treated with RMA for CIMR may develop functional mitral stenosis, both at rest and during exercise, with decreasing functional capacity.[10] In line with these findings, we have reported, using exercise stress echocardiography (ESE), worse hemodynamic performance in patients treated with RMA, compared with MVR.[11]

The distance required for a 6-minute walking test (6-MWT) provides a good measure of functional capacity and is an adequate alternative to cardiopulmonary testing.[12,13] This test, coupled with ESE,[14,15] can accurately assess daily life activities and the real consequences of the underlying disease, in a large group of patients with heart failure of any etiology, and provide important diagnostic and prognostic information. The aim of the present study was to predict the determinants of long-term functional capacity, in patients with CIMR, treated with either RMA or MVR.

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METHODS

Population

We retrospectively analyzed data from 208 consecutive patients who had CIMR, and who underwent either RMA or MVR, combined with coronary bypass surgery, in our institution, between 2005 and 2011. The presence of CIMR was defined by echocardiographic and coronary angiographic findings, using the following criteria: (1) mitral regurgitation >1 week after myocardial infarction; (2) ≥1 left ventricular, segmental wall motion abnormalities; (3) significant coronary artery disease (≥75% stenosis of ≥1 coronary vessel) in the area creating the wall motion abnormality; (4) structurally normal mitral valve leaflets and chordae tendinae; and (5) type III B Carpentier classification, with or without annular dilatation.[16-19]

Exclusion criteria were the following:

- Acute ischemic mitral regurgitation;
- Ischemic isolated type I or type II dysfunction[20];
- Previous cardiac surgery or cardiac resynchronization therapy procedure;
- Other significant valve disease (aortic, pulmonary, tricuspid);
- Concomitant ventricular procedures;
- Patients unable to exercise and unwilling to cooperate;
- Severe chronic obstructive pulmonary disease;
- Persistent mitral regurgitation (defined as postoperative, residual vena contracta width >3 mm, at the echocardiographic examination, before discharge[21];
- Patients with <1 year of follow up;
- New onset of wall motion abnormalities, suggestive of myocardial ischemia, ischemic echocardiogram changes, and angina, during ESE; and
- Atrial fibrillation.

Surgical indication was given during a multidisciplinary meeting. The choice between the 2 surgical techniques (ie, RMA or MVR) was left to the surgeon. This surgical policy was systematically applied in our center, by 2 high-volume senior surgeons who had a special interest in mitral valve surgery. Given the absence of clear superiority of 1 of the 2 techniques, the decision of which to use was made in terms of risk/benefit ratio.

The 2 groups received the same preoperative, operative, and postoperative care. Six (2.8%) perioperative deaths occurred (deaths within 30 days or before discharge from the index hospitalization), with no difference between RMA and MVR. The final population of 121 patients (RMA = 62; MVR = 59) underwent a noninvasive, hemodynamic evaluation and a functional capacity assessment, using ESE and 6-MWT distance, respectively (Figure 1). The mean follow-up time (ie, time from surgery to the 2 assessments) was 41 ± 16.5 months (range, 12-65 months), without significant difference between the 2 groups (RMA: 43 ± 16 months; MVR: 38 ± 17 months, $P = .1$). Ethical approval was given by the local hospital committee, and informed consent was obtained from all patients.

Echocardiographic and Clinical Data

Coronary angiographic findings; preoperative, intraoperative, and postoperative clinical data; and Doppler echocardiographic findings were prospectively collected in our institutional, computerized database. For the eligible portion of the population, clinical information was obtained through an outpatient clinic, and was 90% complete. Postoperative cardiac events were defined as the occurrence of death or cardiac-related hospitalization, as recommended in the American College of Cardiology/American Heart Association guidelines.[22,23] Recurrent mitral regurgitation was defined as a vena contracta width of >3 mm, at follow-up appointments, in patients who had either no or trivial mitral regurgitation at discharge.[17]

Surgery

Both procedures were performed by median sternotomy. The mitral valve was approached through a conventional left atriotomy. In all patients, visual inspection by the surgeon confirmed the preoperative inclusion criteria. In the RMA group, the ring sizer was selected by measuring the intercommissural distance of the mitral valve, and positioned to cover the surface of the stretched middle scallop of the anterior leaflet. A downsizing by 2 ring sizes was performed in all patients.[24] Most (71%) of the patients who underwent RMA received a Carpentier-Edwards Physio Annuloplasty Ring I; the remaining patients (29%) received a Carpentier-Edwards Classic Annuloplasty Ring (both from Edwards LifeSciences, Irvine, Calif).

In the group who underwent MVR, biologic or mechanical prostheses were inserted with systematic preservation of the subvalvular apparatus. All the patients underwent associated coronary bypass surgery, and every vessel that could be grafted was grafted. Complete revascularization was considered to have been done when ≥1 graft was placed distal to an approximately 50% diameter narrowing in each of the 3 major vascular systems, and when this stenosis intraoperatively corresponded to a vessel of ≥1.5 mm, as previously recommended.[17] According to the given definition, complete revascularization was performed in all patients.

Transesophageal echocardiography was always performed after cardiopulmonary bypass surgery, to assess potential residual mitral regurgitation. A leaflet coaptation length of ≥5 mm (mean, 0.78 ± 0.1 mm); a mitral regurgitation grade ≤1, and a systolic mitral valve area of >2 cm^2 were considered the criteria for successful repair.[25]

Exercise Stress Echocardiography and Functional Capacity Assessment

The postoperative ESE protocol, and the echocardiographic measurement obtained at rest and during exercise, were performed as described elsewhere.[11] The mitral regurgitation severity was quantified using the