Does Mitral Valve Intervention Have an Impact on Late Survival in Ischemic Cardiomyopathy?

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Abstract

Background: Ischemic mitral regurgitation is associated with reduced survival after coronary artery bypass surgery.

Objectives: To compare long-term survival among patients undergoing coronary surgery for reduced left ventricular function and severe ischemic MR in whom the valve was repaired, replaced, or no intervention was performed.

Methods: Eighty patients with severe left ventricular dysfunction and severe MR underwent coronary bypass surgery. The mean age of the patients was 65 years (range 42–82), and 63 (79%) were male. Sixty-three (79%) were in preoperative NYHA functional class III-IV (mean NYHA 3.3), and 26 (32%) were operated on an urgent/emergent basis. Coronary artery bypass surgery was performed in all patients. The mitral valve was repaired in 38 and replaced in 14, and in 28 there was no intervention. The clinical profile was similar in the three groups, although patients undergoing repair were slightly younger.

Results: Operative mortality was 15% (8%, 14%, and 25% for the repair, replacement and no intervention respectively; not significant). Long-term follow up was 100% complete, for a mean of 38 months (range 2–92). Twenty-nine patients (57%) were in NYHA I-II (mean NYHA 2.3). Among the surgery survivors, late survival was improved in the repair group compared to the other groups ($P < 0.05$). Predictors for late mortality were non-repair of the mitral valve, residual MR, and stroke ($P = 0.005$).

Conclusions: Patients with severe ischemic cardiomyopathy and severe MR undergoing coronary bypass surgery should have a mitral procedure at the time of surgery. Mitral valve repair offers a survival advantage as compared to replacement or no intervention on the valve. Patients with residual MR had the worst results.

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Patients with mitral regurgitation secondary to ischemic cardiomyopathy pose a therapeutic challenge, and long-term prognosis is poor [1]. The presence of ischemic MR has been shown to be associated with increased mortality related directly to the degree of MR, and independent of baseline characteristics and degree of left ventricular function [2]. Increased operative risk and decreased survival have been reported in patients with coronary disease and mitral regurgitation [3]. Surgical options include replacing the mitral valve, repairing the valve, or not performing any intervention on the mitral valve, but results have been conflicting [4–6].

MR = mitral regurgitation
LV = left ventricular
NYHA = New York Heart Association

We examined the surgical as well as the long-term outcome in patients with severely decreased left ventricular function and severe ischemic MR undergoing coronary bypass surgery, and compared between those undergoing mitral valve repair, mitral valve replacement, or revascularization alone.

Materials and Methods

Patients

Between 1993 and 2002, 80 patients with severely impaired LV function (ejection fraction <25%) and severe ischemic MR underwent surgery in our department. Ischemic MR was defined as mitral incompetence secondary to ischemic heart disease and absence of structural defects of the mitral valve. LV function was assessed by echocardiography and/or left ventriculogram.

Mean patient age was 65 years (range 42–82), and 63 (79%) were male. Sixty-three patients (79%) were in New York Heart Association functional class III-IV and mean NYHA was 3.3. Twenty-six (32%) were operated on an urgent or emergency basis, and 2 cases were salvage operations. A summary of patient profile is shown in Table 1.

Operative procedures

All patients underwent complete revascularization. Bypass grafts were performed on all major coronary branches, unless these

Table 1. Clinical profile of all patients (n=80)

	MV repair (n=38)	MV replacement (n=14)	No intervention (n=28)	*P*
Age (yrs)	62 ± 10	67 ± 7	68 ± 10	0.03
Male	28 (74%)	13 (93%)	22 (79%)	NS
Hypertension	19 (50%)	8 (57%)	17 (61%)	NS
Diabetes	17 (45%)	8 (57%)	13 (46%)	NS
COPD	5 (13%)	2 (14%)	6 (21%)	NS
CRF	10 (26%)	4 (29%)	6 (21%)	NS
PVD	6 (16%)	4 (29%)	6 (21%)	NS
Prior stroke	2 (5%)	2 (14%)	3 (11%)	NS
NYHA IV	31 (82%)	6 (49%)	9 (32%)	<0.001
Reoperation	2 (5%)	0 (0%)	1 (4%)	NS
Urgent	9 (24%)	3 (21%)	14 (50%)	0.05
BPT	154 ± 44	184 ± 64	101 ± 32	<0.001
XCT	99 ± 25	111 ± 42	57 ± 23	<0.001
No. of grafts/ patient	2.7 ± 0.9	2.6 ± 1.2	2.8 ± 0.9	NS

COPD = chronic obstructive pulmonary disease, CRF = chronic renal failure, PVD = peripheral vascular disease, BPT = cardiopulmonary bypass, XCT = aortic clamp time were of very small caliber and considered to have a low potential to remain patent.

In 38 patients the mitral valve was repaired. Repair techniques included ring annuloplasty using a flexible Duran ring (Medtronic Inc, Minneapolis, MN, USA) in all cases. The size of the implanted ring was 26 ± 1.2 mm. Partial resection of the posterior leaflet was performed in one patient, and implantation of artificial chords in another. Fourteen patients underwent mitral valve replacement with a St. Jude mechanical prosthesis (St. Jude Medical Inc, St. Paul, MN). Implanted valve size was 28 ± 1.4 mm, and in all cases the entire native valve and subvalvular apparatus were preserved. In 28 patients no intervention was performed on the mitral valve. Reasons not to intervene included: underestimation of the severity of the MR in the operating room in 12, the impression that the MR is reversible and will improve with revascularization in 12, urgency (shock) in 2, and high risk for use of cardiopulmonary bypass with surgery performed "off pump" in 2.

Surgery was performed through a midline sternotomy. Connection to cardiopulmonary bypass was via the ascending aorta and right atrial or bi-caval cannulation. Cold or tepid blood cardioplegia was administered through the aortic root, vein grafts and/or via the coronary sinus.

Data analysis

Patient data were collected on the standard computerized Society of Thoracic Surgeons database and reviewed according to a predetermined protocol. This database includes demographic, preoperative, intraoperative and early postoperative data. This information was collected during hospitalization. Late follow-up was obtained from outpatient records, medical summaries, telephone interviews, or contact with the family physician. Preoperative data of surgery survivors were used in analysis of long-term outcomes [Table 2]. Operative mortality was defined as death within 30 days of surgery or within the same hospitalization.

Pearson chi-square and Likelihood Ratio chi-square were used to study the difference of operative mortality between the groups. Proportional hazard calculation was used to find variables affecting time to mortality. Long-term survival was calculated by the Kaplan-Meier survival estimates. Log-Rank chi-square and Wilcoxon chi-square were used to study the difference in the survival curves.

Table 2. Clinical profile of surgery survivors (n=68)

	MV repair (n=35)	MV replacement (n=12)	No intervention (n=21)	*P*
Age (yrs)	62 ± 1.8	66 ± 2.2	66 ± 2	NS
Male	27 (77%)	12 (100%)	17 (81%)	0.07
Hypertension	17 (49%)	8 (67%)	12 (57%)	NS
Diabetes	14 (40%)	6 (50%)	11 (52%)	NS
COPD	5 (14%)	2 (17%)	6 (29%)	NS
PVD	5 (14%)	4 (33%)	4 (19%)	NS
CRF	9 (26%)	4 (33%)	4 (19%)	NS
Prior stroke	1 (3%)	2 (17%)	2 (10%)	NS
NYHA IV	28 (80%)	6 (50%)	6 (29%)	0.0005
Reoperation	1 (3%)	0	0	NS
New stroke	4 (11%)	2 (17%)	0	0.09
Urgent	7 (20%)	3 (25%)	9 (43%)	NS

Results

In the bypass-only group, patients were slightly older than in the repair group ($P = 0.03$), and there was a higher number of urgent patients than in the other two groups ($P = 0.05$). Cardiopulmonary bypass time and aortic clamp time were shorter in the no-intervention group than in the other two groups [Table 1].

Overall operative mortality was 15% (12 patients). Mortality was lower in the repair group than in the replacement or no-intervention groups (8%, 14%, and 25% respectively), although this did not reach statistical significance. Cause of death was cardiac in seven patients, and non-cardiac in five (infection in two, stroke in three). Multivariate analysis showed stroke ($P = 0.007$) and urgency of operation ($P = 0.04$) to be predictors for operative mortality. The operative procedure per se was not predictive for early mortality.

The 68 surgery survivors were followed for a mean of 38 months (range 2–92), and follow-up was 100% complete. Twenty-nine patients (57%) were in NYHA class I–II, and the mean NYHA class was 2.3. Three patients (9%) in the repair group developed MR grade 3–4 at 8 ± 6 months (range 1–12) after surgery. Late mortality was lower for patients undergoing mitral valve repair than replacement ($P < 0.05$). Kaplan-Meier survival curves are shown in Figure 1. In the no-intervention group, the degree of MR remained severe in 13 patients. Good function of the native valve resulted in better survival than mitral valve replacement (Cox proportional hazard risk ratio 0.31, confidence interval 0.14–0.58, $P < 0.05$) and to residual MR (RR 0.33, CI 0.16–0.59, $P < 0.05$). Survival was poorest for patients with residual severe MR [Figure 2] with a mortality of 50% within 3 years. Multivariate logistic regression showed non-repair of the mitral valve, residual severe MR, and new stroke to be predictors for late mortality ($P = 0.005$), using the whole model test for significance.

Discussion

The mechanism of ischemic MR is, in effect, underlying damage to the left ventricle, and not primary pathology of the valve itself. Most ischemic mitral regurgitation is due to alteration of left ventricular geometry, including dilatation of the left ventricle and the mitral annulus, as well as displacement of the papillary muscles and tethering of the leaflets [7,8]. A smaller portion is due to ruptured papillary muscle or chordae, but these are usually acute and present a different clinical picture.

Thus, patients undergoing coronary surgery with ischemic MR often have significant damage to their left ventricle. In the presence of "hibernating" or "stunned" myocardium, some functional

RR = risk ratio
CI = confidence interval

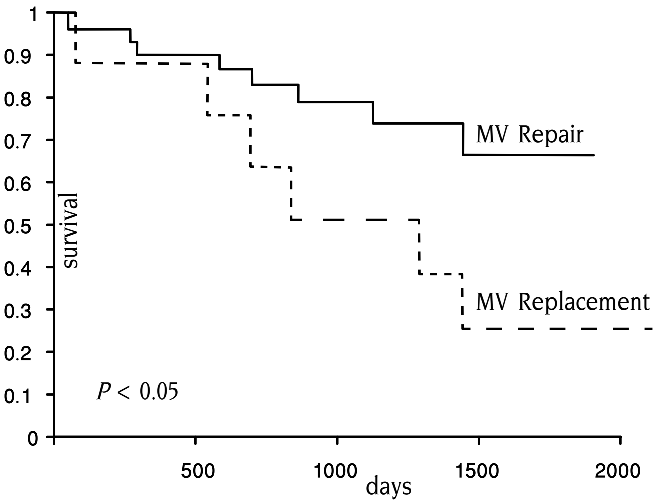

Figure 1. Kaplan-Meier curves showing predicted survival of repair and replacement groups.

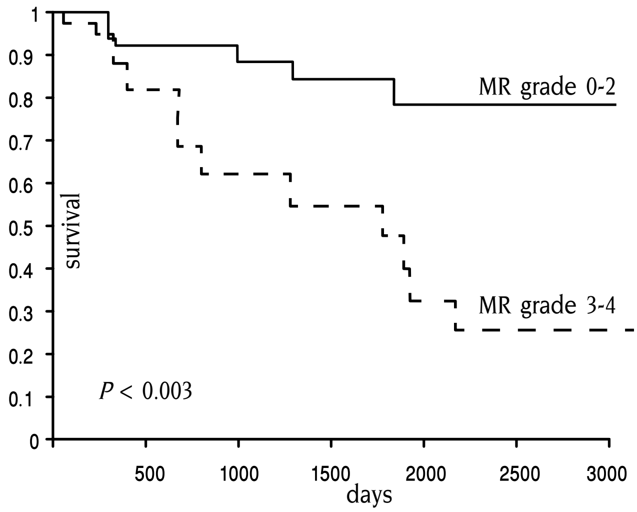

Figure 2. Kaplan-Meier curves showing predicted survival according to postoperative mitral regurgitation.

improvement may be expected following revascularization, with possible decrease in the degree of MR. However, this cannot be foreseen before surgery and, even under the best circumstances, may not occur for days or even weeks after surgery. Therefore, the decision whether to intervene on the mitral valve must be taken with these uncertainties in mind. Although in the past combined coronary and mitral valve surgery was considered to carry a higher operative risk than coronary artery bypass alone [9], evolving techniques in surgery and myocardial protection have reduced surgical mortality. Long-term survival has become the more important issue. Our results as well as others' [10] have shown that residual MR is associated with reduced survival, therefore mitral regurgitation should be addressed at the time of surgery. In retrospect, there should have been intervention in all the patients in this series.

Replacement of the mitral valve will, with great certainty, correct any MR. However, it is not well established that this is the best solution for the long-term prognosis. Gillinov and colleagues [11] have shown a survival advantage for patients with ischemic MR who have their valve repaired over those having their valve replaced. In our patients, those who had their valve replaced with preservation of the whole subvalvular apparatus, despite not having any residual MR, had poor survival compared to those who had valve repair. Although we cannot fully explain this difference in survival, it may be speculated that the presence of a rigid prosthesis in itself may have an impact on the left ventricle, thereby affecting long-term survival.

Success of repair can be assessed only after cardiopulmonary bypass is discontinued, but patients with poor LV function may not tolerate prolongation of their operation in order to replace the valve. Another point to consider is the state of the papillary muscles. If these are infarcted and calcified, it may be better to replace the valve. Therefore, although our results show an advantage of repair over replacement it would be wrong to conclude that every case of ischemic MR should be repaired.

We examined a specific subgroup of patients who had extensive myocardial damage with resultant severe LV dysfunction and severe MR. Indeed, the majority of these patients were in end-stage congestive heart failure. Operative mortality in such patients is high [12] and the expected late survival is poor [11–13]. However, the accumulating experience in recent years, including our own, has been encouraging and shows superior results of surgery over the natural history in these patients [14].

The main limitation of our study is its retrospective nature. Thus, the decision to repair or replace the mitral valve was based on accumulating evidence in favor of repair, and our own confidence in applying this procedure to patients with ischemic etiology for their mitral disease. In order to eliminate any selection bias, a prospective randomized trial is warranted. However, in light of current experience and the proven superiority of repair, such a study is difficult to initiate. In an attempt to reduce the effect of selection bias at the time of surgery on long-term outcome, we compared baseline characteristics of the surgery survivors. Aside from NYHA class, the operative groups were similar. Indeed, factors such as urgency, which was a risk factor for operative death, did not emerge as a risk factor for late mortality. It is of interest that the repair group had a higher percentage of patients in preoperative NYHA class IV, yet these had the best long-term survival and quality of life, lending further support to the benefit of repair over replacement.

Conclusions

Patients with severe ischemic cardiomyopathy and severe MR undergoing myocardial revascularization should have surgery for their mitral valve as well. Although overall survival is poor, patients having their valve repaired do better in the long run than those having valve replacement. Patients with residual MR had the worst results.

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