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CLINICAL RESEARCH
Valvular heart disease

A propensity score-adjusted retrospective comparison of early and mid-term results of mitral valve repair versus replacement in octogenarians

Joanna Chikwe[1], Andrew B. Goldstone[1], Jurgen Passage[2,3], Anelechi C. Anyanwu[1], Joerg Seeburger[2], Javier G. Castillo[1], Farzan Filsoufi[1], Friedrich W. Mohr[2], and David H. Adams[1*]

[1]Department of Cardiothoracic Surgery, Mount Sinai School of Medicine, 1190 Fifth Avenue, Box 1028, New York, NY 10029, USA; [2]Department of Cardiothoracic Surgery, Herzzentrum Universitaet, Leipzig, Germany; and [3]Department of Cardiothoracic Surgery, Sir Charles Gairdner Hospital, Perth, Australia

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Aims Feasibility and efficacy of mitral repair in the elderly remain controversial. This study aims to compare outcomes of mitral repair and replacement in octogenarians.

Methods and results We compared the outcomes of 322 consecutive octogenarian patients (mean age 82.6 ± 2.2 years) who underwent mitral repair (*n* = 227, 70%) or replacement (*n* = 95, 30%) at Mount Sinai Medical Center and Leipzig Herzzentrum between 1998 and 2008 using propensity score adjustment and univariate and multivariate analyses. Patients undergoing aortic valve replacement were excluded. Coronary bypass was performed in 47.5% (*n* = 153), and 31.1% (*n* = 100) required tricuspid repair. Propensity score adjustment yielded comparable groups. Thirty-day mortality in patients undergoing primary elective mitral repair for degenerative disease was 5.1% (2/39). Overall 90-day mortality was 18.9% (43/227) for repair compared with 31.6% (30/95) for replacement (*P* = 0.014). Pre-discharge echocardiography revealed less than moderate residual regurgitation in 99% of patients (231/232). Adjusted 1-, 3-, and 5-year survival for patients undergoing mitral repair was 71 ± 3, 61 ± 4, and 59 ± 4%, respectively, compared with 56 ± 5, 50 ± 6, and 45 ± 6% for patients undergoing mitral replacement (*P* = 0.046). Multivariate analysis demonstrated emergency surgery, previous myocardial infarction, concomitant coronary artery bypass surgery, and mitral replacement to be strong independent predictors of early mortality; mitral valve replacement was an independent predictor of reduced survival in degenerative patients.

Conclusion Elective mitral repair can be performed with low operative mortality and good long-term outcomes in selected octogenarians with degenerative mitral disease, and is associated with better long-term survival than mitral replacement. The survival benefit associated with surgery for non-degenerative disease is more questionable.

Keywords Mitral valve repair • Mitral valve replacement • Elderly • Octogenarian

Introduction

Mitral valve repair is the treatment of choice for severe mitral regurgitation in the general population,[1] as it has been demonstrated to provide a significant survival advantage over both medical treatment[2,3] and mitral valve replacement.[4] The feasibility and efficacy of mitral repair in very elderly patients, however, are more controversial.[5] Over 80% of octogenarian patients with severe mitral regurgitation and class I indications for surgery are denied surgery,[6] and of those patients who do undergo surgery over two-thirds receive a mitral valve replacement.[7,8] This reflects the perception that mitral valve surgery is associated with

* Corresponding author. Tel: +1 212 659 6820, Fax: +1 212 659 6818, Email: david.adams@mountsinai.org

prohibitively high early mortality in this age group; second, the belief that the survival benefit associated with repair may not be applicable in elderly patients; and third, concerns that fragile tissues and valvular calcification are more likely to preclude satisfactory valve repair in older patients. Consequently, current consensus guidelines recommend medical management of severe mitral regurgitation in all except very symptomatic elderly patients.[1]

Previous studies are limited by the small numbers of octogenarian patients undergoing mitral valve surgery in most institutions and consequently either include younger patients in their cohorts,[5,9–12] or combine the results of mitral repair and replacement.[13,14] This study was therefore designed to examine the feasibility and efficacy of routine mitral valve repair compared with mitral valve replacement in octogenarians, and to provide information on outcomes according to the aetiology of mitral regurgitation in this age group.

Methods

Study population

We retrospectively analysed 322 consecutive octogenarian patients who underwent mitral valve repair ($n = 227$, 70%) or replacement ($n = 95$, 30%) in two institutions [Mount Sinai Medical Center, New York ($n = 118$ patients, 97 (82%) repairs), and the Herzzentrum, Leipzig ($n = 204$ patients, 130 (64%) repairs)] between 1998 and 2008. The protocol was approved by both local institutional review boards and compliant with the HIPAA (Health Insurance Portability and Accountability Act) regulations and the ethical guidelines of the 1975 Declaration of Helsinki. The approval included a waiver of informed consent.

Patients undergoing concomitant aortic valve replacement were excluded. The mean age of patients was 83 ± 2 years, and 45.0% ($n = 132$) of patients were female. Aetiology, documented in all patients, was degenerative disease in 44% ($n = 144$); ischaemic in 24% ($n = 77$); rheumatic in 11% ($n = 34$); and endocarditis in 5% ($n = 17$). The ascribed aetiology of the mitral regurgitation in the remaining 16% ($n = 50$) was prosthetic valve failure, prosthetic valve endocarditis, failure of previous repair, mitral annular calcification, intra-cardiac mass, and dilated cardiomyopathy. Eight per cent of patients ($n = 25$) had a pre-operative left ventricular ejection fraction of $<30\%$, and 11% ($n = 36$) had undergone previous cardiac surgery. Patient demographics are summarized in *Table 1*. Propensity scores were calculated for each patient to minimize treatment allocation bias. In order to compare the results of repair and replacement in a less heterogeneous patient group, we analysed the subgroup of elective octogenarians with degenerative disease (*Table 2*).

Definitions

Pre-operative co-morbidities were defined according to the definitions used in the EuroSCORE risk stratification model.[15] Post-operative respiratory failure was defined as re-intubation or total intubation >72 h; post-operative renal failure was defined as new dialysis requirement or creatinine >2.5 mg/dL for 7 days post-operatively; post-operative stroke was defined as new, permanent neurological disability; and post-operative gastrointestinal complication was defined as upper or lower gastrointestinal bleeding or need for surgical intervention. Valve aetiology and lesions were determined by the surgeon after intra-operative inspection of the valve. Degenerative disease was defined as single- or multi-segment prolapse due to chordal elongation or rupture. Ischaemic mitral regurgitation was caused by papillary muscle displacement posteriorly as a result of asymmetrical left ventricular dilatation due to ischaemic cardiomyopathy. Rheumatic valve disease was defined as reduced leaflet motion in systole and diastole associated with leaflet thickening and commissural fusion. Endocarditis was defined by the evidence of acute or chronic vegetations or leaflet perforation, or a history of endocarditis. Emergency surgery was defined as surgery carried out within 24 h of unscheduled admission, and included patients presenting with acute decompensation of chronic mitral regurgitation and mechanical complications of acute myocardial infarction and endocarditis.

Intra-operative management

Incisions included sternotomy, lower hemisternotomy, conventional thoracotomy, and non-rib-spreading mini-thoracotomy approaches. The choice of incision was dependent on centre and surgeon preference. Patients undergoing sternotomy approaches were cannulated in the ascending aorta and in both venae cavae unless epiaortic scanning revealed significant atherosclerotic disease, in which case the right axillary artery was typically cannulated. Patients undergoing non-sternotomy approaches were usually cannulated via the right femoral artery and vein. Techniques of myocardial protection used included high-potassium antegrade and retrograde cold blood cardioplegia, high-potassium antegrade cold crystalloid cardioplegia, and fibrillatory arrest without cross-clamping, also according to surgeon or centre preference. Further myocardial protection was obtained with moderate systemic cooling (28–30°C). In re-operative cases with patent left internal mammary artery grafts, patients were cooled to a systemic temperature of 20–25°C, and cardioplegia was given in a retrograde and antegrade fashion intermittently. Decisions regarding repair or replacement as well as prosthesis choice were made according to surgeon preference. In both centres, repair was favoured wherever technically possible: relative contraindications to repair included extensive leaflet calcification or destruction, excessive leaflet tethering in severe ischaemic cardiomyopathy, and significant mitral stenosis.

The repair techniques employed have been described previously.[16–18] Two main approaches were employed in degenerative disease. The first approach used classic Carpentier technique based primarily on leaflet resection, leaflet resuspension with native chordae, and a true-sized annuloplasty using a complete semi-rigid remodelling ring. The second approach involved suturing pre-formed polytetrafluorethylene neo-chordae to the papillary muscles and all prolapsing segments, followed by a remodelling annuloplasty. The primary approach to ischaemic disease was a down-sized annuloplasty using a complete semi-rigid remodelling ring. Concomitant coronary bypass grafting was generally not performed on vessels with patent stents, where there was no evidence of reversible ischaemia, or where target vessels were occluded or too small to graft. In acute bacterial endocarditis, all infected material was debrided, and valve reconstruction performed using a lesion-specific approach, including the use of glutaraldehyde-treated autologous pericardium to reconstitute leaflet tissue and support annuloplasty where appropriate. In rheumatic disease, fused commissures and restrictive chordae were divided, and glutaraldehyde-treated autologous pericardium patch augmentation performed. All but one replacement were performed using bioprosthetic valves, using a subvalvular sparing technique wherever possible.

Adjunctive cardiac procedures (*Table 1*), including coronary artery bypass grafting (CABG) and atrial ablation procedures, were carried out in patients prior to the mitral procedure, whereas tricuspid valve repair was generally carried out after the mitral procedure. Intra-operative transoesophageal echocardiography was performed prior to the institution of, and following weaning from, cardiopulmonary bypass.

Table 1 Patient characteristics according to mitral valve repair or replacement, in all patients

Variable	Mitral valve repair (*n* = 227, 70%), *n* (%)	Mitral valve replacement (*n* = 95, 30%), *n* (%)	Unadjusted *P*-value	Adjusted *P*-value[a]
Age (years, mean ± SD)	83 ± 2	83 ± 2	0.991	0.999
Female sex	109 (48.0)	39 (41.1)	0.253	1.000
Body mass index (kg/m^2, mean ± SD)	25.1 ± 4.1	25.0 ± 3.8	0.732	0.999
Body mass index >30 kg/m^2	24 (10.6)	10 (10.5)	0.928	0.518
LVEF (%, mean ± SD)	52.2 ± 14.7	55.8 ± 13.5	0.044	0.995
LVEF ≤30%	22 (9.7)	3 (3.2)	0.052	0.997
Previous myocardial infarction	34 (15.0)	10 (10.5)	0.289	0.995
Unstable angina	9 (4.0)	5 (5.3)	0.602	0.980
Previous stroke	11 (4.8)	6 (6.3)	0.591	0.973
Diabetes	50 (22.4)	19 (20.0)	0.765	1.000
Peripheral vascular disease	28 (12.3)	12 (12.6)	0.941	0.995
Chronic obstructive airway disease	6 (2.6)	3 (3.2)	0.689	0.997
Active endocarditis	3 (1.3)	14 (14.7)	<0.001	0.457
Renal failure	26 (11.5)	18 (18.9)	0.074	0.980
Hepatic failure	5 (2.2)	1 (1.1)	0.550	0.757
Re-operation	18 (7.9)	18 (18.9)	0.004	0.959
Emergency surgery	9 (4.0)	12 (12.6)	0.004	0.946
Logistic EuroSCORE [%, median (IQR)]	15.1 (9.5–23.4)	19.0 (11.4–36.1)	0.010	0.995
Aetiology				
Degenerative	106 (46.7)	38 (40.0)	0.270	0.999
Ischaemic	73 (32.2)	4 (4.2)	<0.001	0.992
Rheumatic	8 (3.5)	26 (27.4)	<0.001	0.646
Endocarditis	4 (1.8)	13 (13.7)	<0.001	0.807
Other	36 (15.9)	14 (14.7)	0.800	0.994
Operative data				
Concomitant CABG	107 (47.1)	46 (48.4)	0.833	
Concomitant tricuspid repair	81 (35.7)	19 (20.0)	0.006	
Cardiopulmonary bypass time (min, mean ± SD)	140.3 ± 52.3	133.8 ± 57.0	0.354	
Cross-clamp time (min, mean ± SD)	97.2 ± 44.2	88.8 ± 39.9	0.144	

[a]Adjusted for propensity score by inclusion as a covariate.
LVEF, left ventricular ejection fraction.

Data collection and follow-up

Clinical variables were prospectively entered into databases including patient demographics and risk factors, operative information, and post-operative outcome data. Additional information was obtained from patient charts when necessary. Mean follow-up time was 2.4 ± 2.3 years (range 0.5–8.3 years). The main outcome of interest was 30-day mortality. Other outcomes analysed included 90-day mortality, residual mitral regurgitation, major post-operative complications, and survival. Follow-up survival information for US patients was obtained by cross-matching each patient's social security number with the web-based social security death index (http://ssdi.rootsweb.com/) in January 2009. For German patients, government death registries were examined and patients' general practitioners were contacted. *Table 1* summarizes pre-operative variables included in this study. The logistic EuroSCORE[15] was used for risk stratification.

Data analyses

Continuous variables are expressed as mean ± standard deviation. Categorical variables are presented as percentages. Differences between groups were assessed with the χ^2 or Fisher's exact test for categorical variables, the unpaired Student's *t*-test for normally distributed continuous variables, and the Mann–Whitney *U* test for non-normally distributed continuous variables. Tests were two-tailed. Logistic regression was used to evaluate correlates of replacement vs. repair. Mid-term survival was evaluated with Kaplan–Meier survival analysis and log-rank test. A Cox proportional hazard regression was performed to determine independent predictors of mortality in univariate and multivariate analyses. Additionally, univariate and multivariate logistic regression models were utilized to identify predictors of operative mortality and major post-operative morbidity. Results are demonstrated as hazard ratio (HR) or odds ratio (OR) and 95% confidence intervals (CIs). A *P*-value <0.05 was considered statistically significant.

In a separate analysis, we calculated the propensity to undergo mitral valve replacement using multivariable logistic regression to model a dichotomous outcome of replacement or repair for 263 patients in the sample. Patients undergoing re-replacement were excluded from the propensity score analysis. Sixteen fixed effect variables were included in the final model. The model fit and predictive

Table 2 Patient characteristics according to mitral valve repair or replacement

Variable	Elective degenerative patients only		
	Mitral valve repair (n = 105, 76%), n (%)	Mitral valve replacement (n = 34, 24%), n (%)	P-value
Age (years, mean ± SD)	83 ± 2	83 ± 2	0.563
Female sex	56 (53)	15 (44)	0.350
Body mass index (kg/m^2, mean ± SD)	24.6 ± 4.3	25 ± 3	0.271
Body mass index >30	7 (6.7)	3 (8.8)	0.683
LVEF (%, mean ± SD)	57.7 ± 13.1	55 ± 15	0.244
LVEF ≤30%	4 (3.8)	2 (5.9)	0.636
Previous myocardial infarction	9 (8.6)	3 (8.8)	0.964
Unstable angina	1 (1.0)	1 (2.9)	0.431
Previous stroke	1 (1.0)	1 (2.9)	0.431
Diabetes	12 (11)	8 (23.5)	0.075
Peripheral vascular disease	9 (8.6)	2 (5.9)	0.614
Chronic obstructive airway disease	1 (1.0)	0 (0)	1.000
Active endocarditis	0 (0)	0 (0)	
Renal failure	7 (6.7)	8 (23.5)	0.006
Hepatic failure	2 (1.9)	0 (0)	1.000
Re-operation	4 (3.8)	4 (11.8)	0.100
Logistic EuroSCORE [%, median (IQR)]	11.6 (9.0–16.5)	14.6 (9.4–25.4)	0.026
Operative data			
Concomitant CABG	38 (36.1)	21 (61.7)	0.009
Concomitant tricuspid repair	41 (39.0)	6 (17.6)	0.612
Cardiopulmonary bypass time (min, mean ± SD)	144.1 ± 54.0	141.0 ± 72.1	0.796
Cross-clamp time (min, mean ± SD)	100.9 ± 47.5	83.9 ± 55.7	0.085

power were validated with the Hosmer and Lemeshow goodness-of-fit test ($P = 0.97$) and c statistic (0.88), respectively. The impact of mitral valve replacement on mid-term survival and post-operative morbidity and mortality was adjusted for propensity score by inclusion in the model as a covariate. The statistical analysis was performed using SPSS for Windows, version 17.0 (SPSS, Inc., Chicago, IL, USA).

Results

Baseline patient demographics, risk variables, and co-morbidity are summarized in *Table 1*. Adjustment for propensity score yielded two treatment groups with no significant difference in baseline characteristics (*Table 1*). In the subgroup of octogenarians undergoing elective surgery for degenerative disease, pre-operative patient characteristics were not significantly different between patients undergoing repair and replacement, with the exception of a higher incidence of pre-operative renal failure in patients undergoing replacement, resulting in a higher mean logistic EuroSCORE in the replacement group (*Table 2*).

Operative procedures

Adjunctive cardiac procedures are summarized in *Table 1*. Patients undergoing replacement were significantly more likely than patients undergoing repair to undergo concomitant CABG both when the cohort was analysed as a whole [48% ($n = 36$) vs. 27% ($n = 61$), $P < 0.049$], and when only degenerative patients were analysed [59% ($n = 20$) vs. 22% ($n = 23$), $P < 0.001$]. The incidence of tricuspid valve repair was not significantly different between groups (*Table 1*). Twenty-five per cent of patients (n = 79) underwent non-rib-spreading mini-thoracotomy approaches and there was no significant difference in the rate of repair between these patients and those undergoing conventional approaches. Institution was a significant predictor of replacement in the overall patient cohort, and when only elective patients with degenerative disease were analysed (*Table 3*).

Outcomes

Overall early mortality and morbidity are shown in *Table 4*, and were not significantly different between the two institutions. Mitral valve replacement was associated with significantly higher operative mortality than mitral repair in the overall patient group as well as after adjustment for propensity score (*Table 4*). Significant predictors of early mortality identified in univariate analysis of all patients included prior myocardial infarction (HR 2.2, 95% CI 1.1–4.4, $P = 0.022$), concomitant CABG (HR 1.8, 95% CI 1.3–3.1, $P = 0.028$), ejection fraction <30% (HR 2.5, 95% CI 1.1–5.8, $P = 0.035$), mitral replacement (HR 2.0, 95% CI 1.1–3.4, $P = 0.014$), and emergency surgery (HR 5.3, 95% CI 2.1–13.2, $P < 0.001$). When only patients with degenerative disease were analysed, 30-day mortality was 5.1% ($n = 2$), and 90-day mortality was 12.8% ($n = 5$): significant predictors of 90-day mortality identified in this subgroup were concomitant CABG (HR 2.5,

Table 3 Independent predictors of replacement versus repair

	All patients			Elective, degenerative only		
	HR	95% CI	*P*-value	HR	95% CI	*P*-value
Ejection fraction ≤30%	0.4	0.1–1.4	0.138	1.4	0.1–16.4	0.804
Concomitant CABG[a]				**3.9**	**1.5–10.1**	**0.005**
Concomitant tricuspid valve repair	0.8	0.4–1.5	0.411	1.0	0.3–3.3	0.997
Active endocarditis	**10.4**	**2.5–42.2**	**0.001**			
Emergent surgery	1.5	0.5–4.7	0.478			
Institution	**3.2**	**1.6–6.4**	**0.001**	**18.3**	**2.1–159.5**	**0.008**

[a]Concomitant CABG was not a significant predictor of replacement in univariate analysis of all patients ($P = 0.833$), and was not included in the multivariable model.
HR, hazard ratio; CI, confidence interval. Boldface indicates statistically significant values ($P < 0.05$).

Table 4 Outcomes according to mitral valve repair or replacement

Variable	Mitral valve repair (*n* = 227, 70%), *n* (%)	Mitral valve replacement (*n* = 95, 30%), *n* (%)	Unadjusted *P*-value	Adjusted OR[a,b]	Adjusted *P*-value[a]
30-day mortality	25 (11.0)	18 (18.9)	0.056	3.4	0.028
90-day mortality	43 (18.9)	30 (31.6)	0.014	1.7	0.257
Stroke	7 (3.1)	1 (1.1)	0.294	—	—
Deep sternal wound infection	5 (2.2)	2 (2.1)	0.956	5.1	0.239
Bleeding	19 (8.4)	11 (11.6)	0.366	1.0	0.956
Sepsis	11 (4.8)	3 (3.2)	0.498	—	—
Gastrointestinal complications	9 (4.0)	14 (14.7)	<0.001	6.2	0.004
Renal failure	8 (3.5)	2 (2.1)	0.593	2.0	0.258
Respiratory failure	48 (21.1)	25 (26.3)	0.356	1.3	0.591
Any major morbidity or mortality	75 (32.9)	34 (42.5)	0.122	2.0	0.085

[a]Adjusted for propensity score.
[b]OR represents replacement:repair.

95% CI 1.1–5.9, $P = 0.032$) and mitral replacement (HR 2.5, 95% CI 1.0–6.0, $P = 0.045$).

Gastrointestinal complications occurred more frequently in patients undergoing replacement compared with repair both in the overall group and after propensity score adjustment. Otherwise major early post-operative morbidity did not differ between repair and replacement groups. The overall incidence of post-operative stroke was 2% ($n = 8$) (*Table 4*).

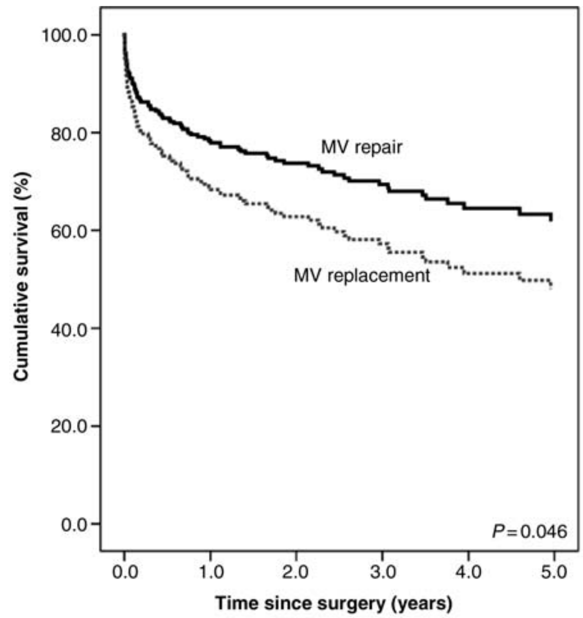
Pre-discharge trans-thoracic echocardiographic assessment was available in 264 (72%) patients. In patients who underwent repair, pre-discharge echocardiography showed no, trace, or mild mitral regurgitation in 99% ($n = 263$) patients (*Table 5*).

Adjusted survival was significantly better in patients who had undergone repair (*Figure 1*). Survival was also significantly better in elective degenerative patients undergoing mitral repair compared with replacement (*Figure 2*). Concomitant CABG was associated with greatly increased early mortality and a significant reduction in survival at 5 years (*Figure 3*), and less than half of patients with ischaemic mitral regurgitation and severe left ventricular dysfunction survived to 1 year in either group. Multivariate analysis performed on all patients identified several independent risk factors for decreased survival including an ejection fraction ≤30% (HR 1.8, 95% CI 1.0–3.3, $P = 0.047$), renal failure (HR 1.8, 95% CI 1.1–2.8, $P = 0.02$), and emergency surgery (HR 2.9, 95% CI 1.6–5.2, $P < 0.001$). When only elective patients were

Table 5 Pre-discharge echocardiographic findings

Grade of mitral regurgitation	All patients (*n* = 322), *n* (%)	Mitral valve repair (*n* = 227), *n* (%)[a]	Mitral valve replacement (*n* = 95), *n* (%)[a]
None (0)	122 (52.6)	78 (45.3)	44 (73.3)
Trace (1+)	80 (34.4)	66 (38.3)	14 (23.3)
Mild (2+)	29 (12.5)	27 (15.7)	2 (3.3)
Moderate (3+)	1 (0.4)	1 (0.6)	0 (0)
Severe (4+)	0 (0)	0 (0)	0 (0)
No pre-discharge echocardiogram	90	55	35

[a]Percentages calculated only for patients with post-operative echocardiograms.



Number of remaining cases						
Time since surgery (years)	0	1	2	3	4	5
MV repair	227	151	116	82	55	39
MV replacement	95	49	33	28	21	12

P-value in figure (0.046) is adjusted for propensity score by inclusion in the model.

MV, mitral valve.

Figure 1 Kaplan–Meier actuarial survival curve for all patients according to whether they underwent mitral valve repair or replacement.

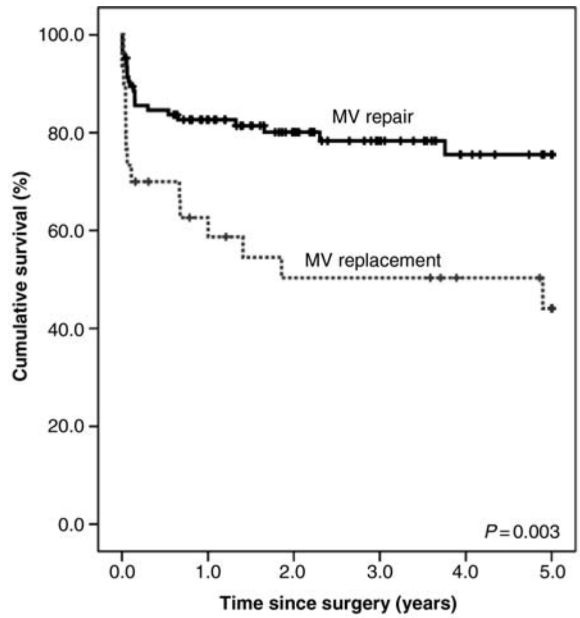
included in the multivariate analysis, age (HR 1.1, 95% CI 1.0–1.2, $P = 0.02$) and mitral valve replacement (HR 1.6, 95% CI 1.0–2.4, $P = 0.043$) were identified as the only independent predictors of worse survival. Concomitant coronary surgery was not found to be predictive of decreased survival in multivariate analysis.

Discussion

The main findings of this study are that isolated primary elective mitral valve repair can be undertaken in selected octogenarians with degenerative mitral regurgitation, low operative mortality and morbidity, and minimal residual or recurrent mitral regurgitation. Early mortality appears, however, to be relatively high in the general population of octogenarians undergoing mitral surgery, particularly those requiring concomitant CABG, mitral valve replacement, or emergency surgery. Mid-term survival in elderly patients who undergo mitral repair appears to be significantly better than that of patients undergoing replacement.

The American College of Cardiology/American Heart Association (ACC/AHA) guidelines for the management of the general populace of severe mitral regurgitation recommend medical management of all but very symptomatic mitral regurgitation in elderly patients.[1] The higher threshold for surgery, compared with younger patients where surgical referral before symptom onset is recommended for patients with left ventricular dysfunction, atrial fibrillation, or pulmonary artery hypertension, stems in part from reports of high operative mortality in elderly patients. The operative mortality, for example, in a cohort of 2700 octogenarian patients undergoing mitral valve replacement between 1997 and 2000 from the Society of Thoracic Surgeons National Cardiac Database was 16.9%.[19] In smaller single-centre studies, operative mortality has ranged from 15 to 20%,[14,19] which is similar to what we observed in our overall cohort. Much lower operative mortality, however, has been reported in elderly patients with non-ischaemic mitral regurgitation undergoing isolated mitral surgery similar to that reported here.[13]

In contrast to encouraging outcomes in elective patients with degenerative disease, we identified two main subgroups at particular risk of poor outcomes with mitral surgery. Mitral regurgitation due to ischaemic cardiomyopathy is associated with a much poorer operative outcome and long-term prognosis than degenerative mitral regurgitation,[20] and in very elderly patients with ischaemic



Number of remaining cases

Time since surgery (years)	0	1	2	3	4	5
MV repair	105	75	54	37	25	19
MV replacement	34	19	14	12	9	6

P-value is not adjusted for propensity score because the propensity score was created from the overall study population.

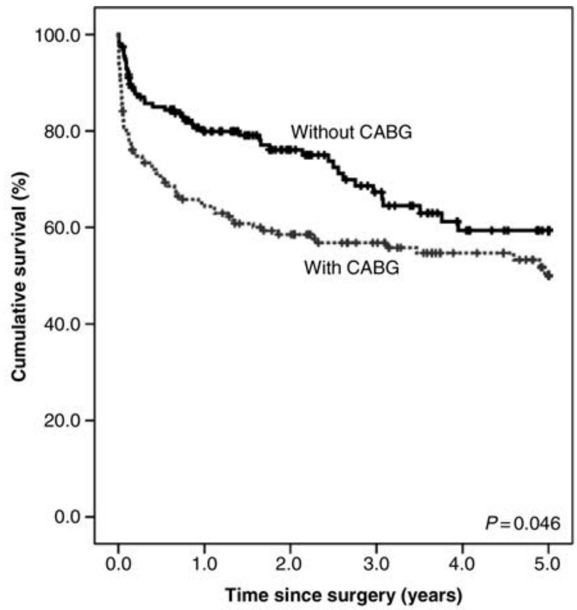
MV, mitral valve.

Figure 2 Kaplan–Meier actuarial survival curves comparing outcome of elective patients with degenerative mitral valve disease according to whether they underwent mitral valve repair or replacement.

mitral regurgitation, the operative mortality has been reported to be >15%.[19,21] In contrast with degenerative patients who required concomitant CABG (a significant proportion as might be expected in such an elderly population), patients with mitral regurgitation due to severe ischaemic cardiomyopathy faired very poorly, with less than half surviving to 1 year. Although these patients with NYHA class III/IV symptoms of heart failure and decreased left ventricular function pre-operatively represent a subgroup very likely to die in the short-term without surgery, there may be little grounds to offer surgery to improve life expectancy on the basis of the figures for survival presented here: maximal medical therapy is most probably the treatment of choice. We also found emergency presentation to be a particularly strong risk factor for early and later mortality in this patient cohort, confirming previous findings,[22] and underlining the need to follow disease progression in elderly patients particularly closely.

In contrast with younger patients in whom early mitral valve repair is advocated in order to improve life expectancy, very elderly patients are more likely to undergo surgery with the primary aim of improving quality of life, making the likelihood of major morbidity a particularly important factor in the decision whether to operate. Like other groups, we observed a low rate of major post-operative complications during the follow-up period; and low rates of thrombo-embolism, bleeding, and hospitalization for cardiac causes after hospital discharge have been reported elsewhere.[13] Emerging percutaneous techniques may offer a viable alternative to surgery in the large subgroup of elderly patients who present high risk of post-operative morbidity or mortality.

Does mitral repair confer a survival advantage over replacement in elderly patients? There is some evidence to suggest that, in contrast with young asymptomatic patients, valve replacement in patients with complex mitral disease pathology, who tend to be older with more co-morbidity and worse ventricular function, may not adversely affect survival compared with mitral valve repair.[23] This non-randomized study does not permit firm conclusions to be drawn regarding how much of the large survival difference between repair and replacement seen at 5 years may be attributed to choice of surgical technique, as factors such as



Number of remaining cases						
Time since surgery (years)	0	1	2	3	4	5
Without CABG	169	109	75	51	34	23
With CABG	153	92	74	58	42	30

Although significant in univariate analysis ($P=0.008$), concomitant coronary surgery was not found to be predictive of decreased survival in multivariate analysis ($P=0.187$).

CABG, coronary artery bypass grafting.

Figure 3 Kaplan–Meier actuarial survival curves comparing outcome of patients according to whether they underwent concomitant coronary artery bypass grafting or not.

patient frailty and complexity of valve lesion were not included in the propensity analysis. Mitral valve replacement was, however, found to be an independent predictor of mortality in octogenarian patients and associated with decreased survival after propensity score adjustment, which raises questions about the rationale of routine mitral replacement for elderly patients presenting with mitral disease amenable to repair.

Feasibility of repair remains a concern for many surgeons, who also believe that repair is associated with longer bypass and cross-clamp times, and consequently associated with much poorer outcomes in a patient group likely to be adversely affected by prolonged pump-runs. The repair rate of 70% achieved by surgeons at two centres, with very low rates of residual mitral regurgitation, suggests that these concerns should not preclude a strategy of routine mitral repair in this patient group.

Strengths and limitations

Although this is, to our knowledge, the largest analysis comparing outcomes of mitral valve repair and replacement in octogenarians, this study is a retrospective observational study, and conclusions are limited in their application. We do not have comparative data on patients with mitral valve disease who did not undergo surgery. Clinical outcomes are limited to major post-operative morbidity and mortality, and early echocardiographic results, with no late echocardiographic data or information on late complications, quality of life, or cause of death during follow-up. The repair and replacement groups are heterogeneous, which is only partly addressed by analysing the subgroup of elective patients with isolated degenerative disease, and use of propensity score adjustment.

The main advantages of combining data from two centres are two-fold. First, meaningful subgroup analysis was enhanced by an increase in patient numbers achieved without the loss of detailed data that tends to occur in retrospective registry analyses. Second, these findings may have increased applicability to other similar practices. There are several limitations associated with this approach. First, although it was possible to standardize many variables between participating centres, there are likely to have been differences in patient population and surgical practice that we were unable to account for, and which may have contributed to the fact that institution was one of the strongest independent predictors of repair. Second, there was a significant difference in routine echocardiographic follow-up between institutions, resulting in less than optimal rates of early and mid-term echocardiographic data.

Conclusion

Elective primary isolated mitral valve repair can be performed with low operative mortality and good mid-term outcomes in selected octogenarians with degenerative mitral valve disease, and appears to offer superior early and mid-term survival compared with mitral valve replacement. The survival benefit associated with surgery for mitral regurgitation due to severe ischaemic cardiomyopathy is more questionable, as less than half of these patients were alive 1 year after surgery. Emergency surgery is the strongest independent predictor of mortality in this age group, underlining the desirability of close follow-up and timely operative intervention when indicated.

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