Original Article

The Mid-term Outcome of Geometric Endoventricular Repair for the Patients with Ischemic Left Ventricular Dysfunction

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Objective: Recent studies have suggested that increased left ventricular (LV) size is a risk factor for perioperative mortality in patients with low ejection fraction (EF) undergoing coronary artery bypass surgery (CABG). We previously presented a new method of LV reconstruction, called geometric endoventricular repair (GER) as representing a physiologically effective repair. The aim of this study is to assess whether GER confers benefits compared to patients undergoing CABG alone.

Methods: Between July 1996 and July 2001, 110 patients with a low EF of less than 35% documented by radionuclide ventriculogram (RNVG) underwent CABG in Austin Hospital, Australia, and were divided into two groups. Group I consisted of 52 patients undergoing isolated CABG. Group II comprised 58 patients undergoing CABG and GER. We compared the two groups in terms of EF, NYHA class, incidence of recurrent heart failure, and mortality.

Results: Preoperative EF was 27.7±6.1% in group I and 27.4±5.7% in group II, respectively (NS), with significant improvement in both groups (33.8±13.0% in group I, 35.1±13.3% in group II). NYHA class was also significantly improved postoperatively (from 3.3 to 1.8 in group I, and 3.6 to 1.7 in group II). There were 15 patients (28.8%) hospitalized for heart failure in group I, postoperatively, compared to seven patients (10.9%) in group II (p=0.026). Cardiac event-free survival rate at 28 months (mean follow-up) was also significantly higher in group II (88.9% in group II vs. 70.6% in group I, p=0.05). The actuarial survival rate at 31 months (mean follow-up) was 88.2% in group I and 95.3% in group II, respectively (NS).

Conclusions: LV reconstruction along with CABG for ischemic ventricular dysfunction may provide symptomatic and cardiac event free survival benefits, compared to CABG alone. (Ann Thorac Cardiovasc Surg 2003; 9: 241–4)

Key words: ischemic myopathy, left ventricular reconstruction, CABG

Introduction

Recent studies have suggested that increased left ventricular (LV) size is a risk factor for perioperative mortality in patients with a low ejection fraction (EF) undergoing coronary artery bypass surgery (CABG).[1,2] Batista and colleagues reported the efficacy of partial left ventriculectomy for ischemic cardiomyopathy.[3] However, the operation was associated with a high incidence of sustained ventricular tachycardia episodes that jeopardized survival estimates.[4] We previously reported a new method of LV reconstruction, so called geometric endoventricular repair (GER) as representing a physiologically effective repair.[5] The aim of this study is to assess whether GER confers benefits compared to patients undergoing CABG alone.

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Patients and Methods

Between July 1996 and July 2001, 110 patients with a

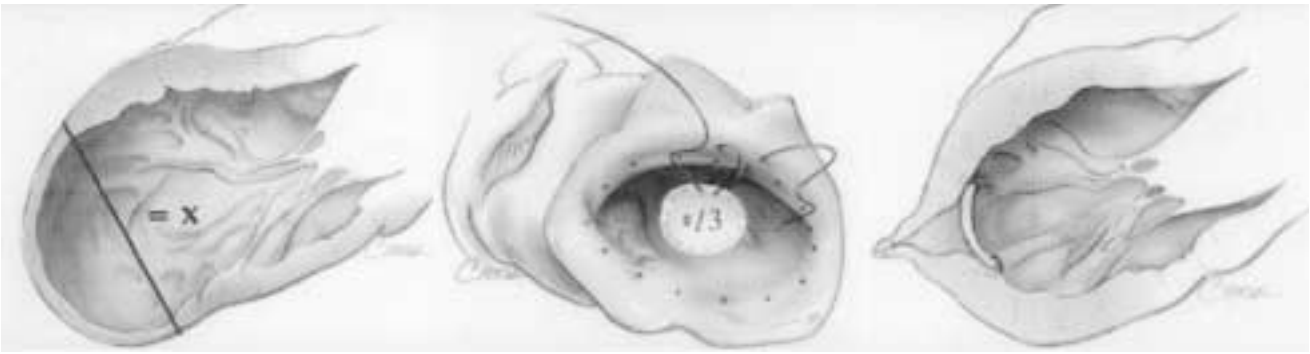

Fig. 1. Schematic drawing of geometric endoventricular repair.

low EF of less than 35% documented by radionuclide ventriculogram (RNVG) underwent CABG in our institute, and were divided into two groups. The decision to apply GER was made by one surgeon (J.R.), preoperatively. The other surgeons performed isolated CABG for the patients with a low EF during the study. Group I consisted of 52 patients undergoing isolated CABG. Group II comprised 58 patients undergoing CABG and GER. The GER was performed using normothermic cardiopulmonary bypass. Cardiac standstill was achieved by a combination of antegrade and retrograde warm blood cardioplegia. After cardiac arrest, the aneurysmal or dyskinetic segment was opened parallel to the left anterior descending coronary artery (LAD). A circular bovine pericardial patch was cut to size such that its diameter was about one-third of the diameter of the border zone. This patch was sutured to the border zone between the infarct scar and intact area with radially placed sutures. The remnant of the resected scar was then closed in a linear fashion over the patch (Fig. 1). We compared the two groups in terms of EF, left ventricular end-diastolic diameter (LVEDD), left ventricular end-systolic diameter (LVESD), NYHA class, incidence of recurrent heart failure, and mortality.

Statistical analysis

Data were tested for normal distribution. The results were expressed as means with standard deviation (SD). Statistical differences between groups were tested using Fisher's exact test for nominal values and Student's t-test for parametric numeric values. The Mann-Whitney U test was used to compare non-parametric numerical data. Cardiac event-free and actuarial survival curves were analyzed with the Kaplan-Meier method and statistical significance was tested with the log-rank test. A p value of less than 0.05 was considered statistically significant.

Results

The prevalence of hypertension, hyperglycemia, and hyperlipidemia were similar between the groups. The mean age of group I was 69.4±7.1 years and that of group II was 70.1±6.5 years. There was no difference between the groups. The average number of grafts was similar. There were no significant differences in aortic cross clamping time and cardiopulmonary bypass duration.

Postoperative early results

Preoperative EF was 27.7±6.1% in group I and 27.4±5.7% in group II, respectively (NS), with significant improvement one year after operation in both groups (33.8±13.0% in group I, 35.1±13.3% in group II). But there was no difference between the groups. In group II, both the LVEDD and LVESD were significantly improved one month postoperatively (from 61.2 to 51.6 mm, p=0.012, and from 50.2 to 40.5 mm, p=0.022, respectively). In group I, those data were also improved one month postoperatively, but there were no significant differences (from 60.5 to 56.2 mm, NS, and from 51.4 to 47.8 mm, NS, respectively). NYHA class was also significantly improved postoperatively (from 3.3 to 1.8 in group I, and 3.6 to 1.7 in group II, NS). There were no differences in the incidence of acute renal failure, atrial fibrillation, ventricular tachycardia, wound infection, and pneumonia.

Postoperative late results

There were 15 patients (28.8%) hospitalized for heart failure in group I, postoperatively, compared to seven patients (10.9%) in group II (p=0.026). Both groups had one operative death (Fig. 2). Mean follow-up duration was 28 months for cardiac event free and 31 months for actuarial survival, ranging from 1 to 62 months. Cardiac event-free survival rate at 28 months was significantly

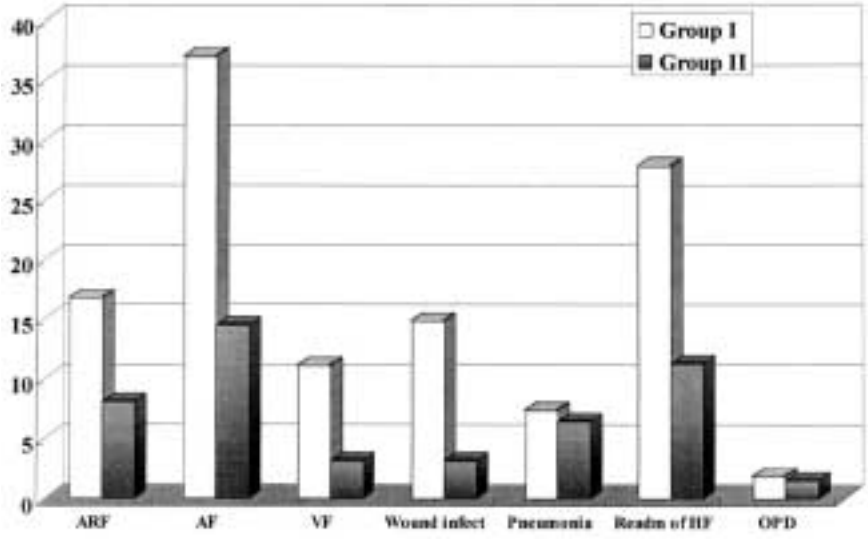

Fig. 2. Postoperative complications.
ARF, acute renal failure; AF, atrial fibrillation; VF, ventricular fibrillation; wound infect, wound infection; readm of HF, readmission for heart failure; OPD, operative death.

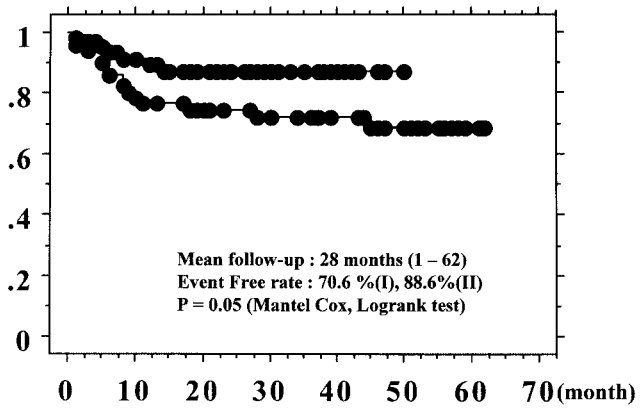

Fig. 3. Cardiac event-free survival curve.

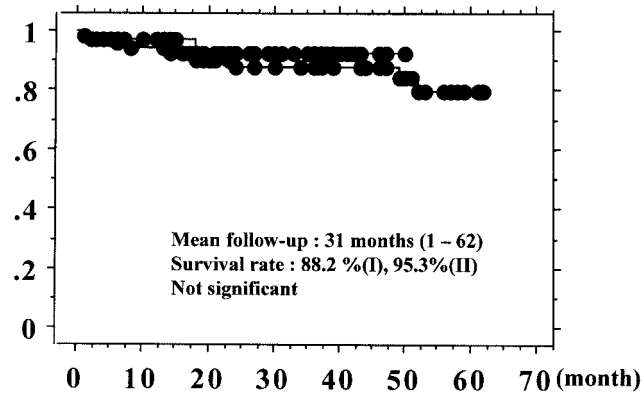

Fig. 4. Actuarial survival curve.

higher in group II (88.6% in group II vs. 70.6% in group I, p=0.05, Fig. 3). The actuarial survival rate at 31 months was 88.2% in group I and 95.3% in group II, respectively (Fig. 4). This was not significantly different.

Discussion

In patients with coronary disease and poor LV function, CABG remains a surgical challenge. Kron reported the excellent results of isolated CABG for patients with a low EF and a more aggressive approach was associated with increasing hospital mortality. Furthermore that paper described that poor vessel quality had 100% predictive value for perioperative death; therefore proper patient selection was the most important predictor of patient survival.[6] Suma et al. reported that the combination of an enlarged LV, signs of heart failure, and absence of angina pectoris were strong indicators of an unsuccessful outcome with CABG alone.[1]

Recently, surgical restoration has been suggested as an effective solution for better outcome in the CABG patient with deteriorated LV function.[1-3] Batista and colleagues reported the efficacy of partial ventriculectomy for patients with ischemic cardiomyopathy.[3] However, many patients who underwent partial left ventriculectomy required relisting for heart transplantation.[7] Surgical resection of postinfarction dyskinetic LV aneurysms has been performed for many years since the procedure was first carried out by Likoff and Bailey.[8] Standard linear repair of LV aneurysm is widely accepted.[9,10] Clinical results of this technique have been reported in many studies, but most failed to show satisfactory results in regard to early and late mortality. Linear repair may distort the shape of the LV chamber. Recently, new methods of geometric LV reconstruction have been proposed as a more physiologic repair.[5]

In the present study, EF improved significantly in both groups, with no difference between the two groups. NYHA class was also similar. However, 15 patients (28.8%) in group I returned to the hospital for recurrent heart failure. This incidence was significantly less in group II. Cardiac event-free survival rate was also significantly higher in group II. These results suggest that GER does not show any superiority compared to isolated CABG in the early postoperative period. However, in the mid- and long-term stage, outcome is definitely better in patients undergoing CABG and GER. In this study, both of LVEDD and LVESD were significantly improved postoperatively in the patients with GER. On the other hand, those data did not reach statistical significance in patients with CABG alone. We consider that the most attractive effect of GER is to reshape the LV from globular to elliptical without critically reducing cavity volume and presenting further dilation. Therefore, GER seemed to release the LV wall stress after surgery. In the other words, the most important effect of GER is prevention of further ventricular remodeling. The long-term goals of this procedure are to relieve symptoms, improve the patient's quality of life, and to reverse progressive LV dysfunction and dilatation. Besides the myocardial injury, the failing heart undergoes ventricular remodeling as a complex response to changes in loads imposed on the myocytes associated with quantitative changes in contractile proteins, and slippage between adjacent myocytes, that modify the geometry of the heart.[11] Recent studies demonstrate that chronic LV unloading of sufficient magnitude and duration can result in reversal of chamber enlargement and normalization of cardiac structure as indexed by end-diastolic pressure-volume relations, marked reduction of myocytosis, and important aspects of remodeling, even in the most advanced stages of heart failure.[12,13] We also believe that GER can reduce wall stress and myocardial oxygen demand with consequent improvement in ventricular performance and work efficiency.

Conclusions

GER along with CABG for ischemic ventricular dysfunction may provide symptomatic and cardiac event-free survival benefits, compared to CABG alone.

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