

Surgical Treatment for Heart Failure in Ischemic Cardiomyopathy

Yu-Xuan Chen, Yen Chang, Hung-Wen Tsai, Hao-Ji Wei, Shih-Rong Hsieh, Chung-Chi Wang and Yung-Kai Lin

Background: Cardiac transplantation remains the gold standard of surgical therapies for severe LV dysfunction ischemic cardiomyopathy. However, the Achilles heel of heart transplantation is the shortage of organ donors. Thus, nontransplant surgical alternatives are necessary to treat many of the patients who progress to intractable Class III, or especially Class IV, heart failure.

Methods: Two hundred and twelve consecutive patients (57 women and 155 men; average age 64 ± 12 years old) who underwent surgical revascularization with or without combined mitral repair (or replacement) and left ventricular reconstruction between 1999 and 2005 were retrospectively analyzed.

Results: The in-hospital or 30-day mortality rate was 6.60%. At a median follow-up of 32 months (range, 6-88 months), 48.7 % of the patients were alive at 5 years.

Conclusion: The results of our study confirm that surgical revascularization with or without combined mitral repair (or replacement) and left ventricular reconstruction for patients with severe LV dysfunction are presently the common and promising surgical approaches, with surprisingly low operative mortality and encouraging intermediate results.

Key Words: Heart failure • Ischemic cardiomyopathy • Coronary artery bypass grafting

INTRODUCTION

Heart failure is the third most common cause of death in Taiwan and remains the leading one in the United States. Heart failure is also the leading cause for hospitalization in elderly patients. More than 50% of patients presenting with heart failure have ischemic heart disease.¹ The significant increase in the prevalence, morbidity and mortality of ischemic cardiomyopathy has made this disease a major public health problem and economic impact. The aging of population with limited health care funds will be a challenge for the management

of this disease in Taiwan.

Multiple clinical trials of pharmacologic therapy completed during the past 15 years (the majority of patients entered into trials were middle-aged white men) have shown a substantial reduction in mortality for patients with coronary disease and severe left ventricular dysfunction.²⁻⁵ However, the results remain far from perfection. The unsatisfactory prognosis of ischemic cardiomyopathy is associated with progression of symptoms, progressive left ventricular remodeling, and unacceptably high intermediate- and long-term mortality rates. The only definitive treatment modality for ischemic cardiomyopathy remains orthotopic cardiac transplantation.⁵ Because donor supply is extremely limited, less than 100 transplants are performed in Taiwan annually. Nontransplant surgical treatment for heart failure in ischemic cardiomyopathy may play an increasingly important role and has gained growing attention.

In this article, we present our experience with surgical revascularization with or without mitral repair (or replacement) and left ventricular reconstruction for pa-

Received: June 11, 2007 Accepted: January 28, 2008
Division of Cardiovascular Surgery, Department of Surgery, Taichung Veterans General Hospital, Taichung, Taiwan.
Address correspondence and reprint requests to: Dr. Yen Chang, Division of Cardiovascular Surgery, Department of Surgery, Taichung Veterans General Hospital, No. 160 Taichung-Kan Rd., Taichung, Taiwan. Tel: 886-4-2359-2525 ext. 5061; Fax: 886-4-2461-5734; E-mail: ychang@vghtc.gov.tw

tients with severe heart failure.

METHODS

Patient population

Between January 1999 and December 2005, two hundred and twelve consecutive patients (57 women and 155 men; average age 64 ± 12 years old) with left ventricle dysfunction (ejection fraction $< 30\%$) caused by coronary artery disease underwent surgical revascularization with or without combined mitral valve repair (or replacement) and left ventricular reconstruction. Patients with acute myocardial infarction who underwent emergent surgical procedures were not included in this study.

Functional status was evaluated using the New York Heart Association (NYHA) classification. Mitral valve regurgitation was assessed semi quantitatively as grade 1+ to 4+ by means of echocardiography. Left ventricular ejection fraction (LVEF) was calculated by modified Simpson's rule. All patients underwent preoperative coronary and ventricular angiography. Regional wall motion was analyzed with centerline method and defined as dyskinetic if the absolute motion of contiguous chords was less than zero and akinetic if it was equal to zero. Early mortality (death in-hospital or within 30 days after discharge) and late mortality were recorded.

Operative technique

The aim of the operation was to complete coronary revascularization, restore mitral valve competence and exclude asynergic areas of left ventricle. All patients underwent coronary arterial bypass grafting (CABG) either through on-pump or off-pump technique. Mitral valve correction including annuloplasty, quardrectomy, neochorda reimplantation, or mitral valve replacement (all use On-X mechanical valve), and left ventricular reconstructions were carried out in 85 patients.

Statistical analysis

Data collection and statistical analysis were performed with MS Excel for Windows and SPSS for Windows, respectively. Results are presented as mean values \pm standard deviation or frequency percentages. Using the Wilcoxon signed-rank nonparametric test for continuous variables and Fisher exact test for categorical

variables, we compared baseline and follow-up findings. A p value less than 0.05 was considered as statistically significant. Kaplan-Meier survival curves were constructed for survival analysis.

RESULTS

Patient population

Two hundred and twelve patients were collected. There were 57 (26.9%) women and 155 (73.1%) men. The average age was 64 years old (45-76). The mean of LVEF was $23.84\% \pm 3.83\%$. One hundred and eighty-one (85.4%) patients were in NYHA functional class III or IV. The EuroScores ranged from 5 to 11, with median 7. The logistic mortality ranged from 4.37% to 22.48%.

One hundred and twenty-seven (59.9%) patients underwent isolated coronary bypass grafting. Eighty-five (40.1%) patients underwent concomitant procedures: mitral valve correction in 59 patients (repair in 47 and replacement in 12) and left ventricular reconstruction in 32 patients.

Clinical outcomes

Fourteen patients died in hospital or within 30 days. The early mortality rate was 6.60%. Sixteen patients were lost to follow up. The other patients were followed up for a mean of 32 months (range, 6-88 months) after being discharged. The survival rates of followed patients after 3 years and 5 years were 58/81 (71.9%) and (19/39) 48.7%, respectively.

A significant clinical improvement was observed in most survivors (182 patients had postoperative echocardiographic study), with improved LVEF and the reduction of NYHA functional class and grade of mitral regurgitation. The NYHA functional class decreased from 3.14 ± 0.66 to 1.62 ± 0.64 ($p < 0.001$). The grade of MR decreased from 2.33 ± 1.15 to 1.26 ± 0.68 ($p < 0.001$). The mean of LVEF was improved from $23.84\% \pm 3.83\%$ to 30.48% ($p < 0.001$).

DISCUSSION

Current medical therapy is successful in achieving the goal of improving quality of life by relieving symp-

toms, but one-quarter of patients with ischemic cardiomyopathy who are hospitalized experience re-hospitalization for heart failure within 6 months, with its attendant health care costs. Also, such therapy has had limited success in achieving the long-term goal of extending the lives of these patients. Almost 50% of patients with severe LV dysfunction ischemic cardiomyopathy die within 1 year.⁶ Heart transplantation is still the most effective therapy for severe LV dysfunction ischemic cardiomyopathy. But the annual number of transplants performed in Taiwan is less than 100. Because of the shortage of donors, alternative surgical options for the treatment of ischemic cardiomyopathy must be sought in Taiwan.

It is well known that revascularized patients with left ventricular dysfunction can result in upwards of a 25% improvement in long-term survival.⁷⁻⁹ But the results from the Coronary Artery Surgery Study (CASS)¹⁰ showed high operative mortality in CABG patients with severe left ventricular dysfunction. With the progress in myocardial protection, surgical technique and postoperative care, revascularization has been developed and widely accepted for these patients, with acceptable mortality risk. The in-hospital mortality rate reported in the literature is 1.7% to 11%. The long-term survival rates are between 57% and 75% after 5 years, whereas with medical therapy alone, it is less than 25%.

More than 50% of patients presenting with heart failure have underlying ischemic heart disease. In some of these patients, progression of heart failure leads to dilatation and structural changes in the left ventricle. These remodeling changes are both compensatory and progressive. Progressive ventricular dilatation leads to higher myocardial wall stress, elevated neurohormonal levels and increased inflammatory mediators, thus perpetuating the process of myocardial damage. Surgical restoration of the size and shape of the left ventricle have been developed and widely accepted.¹¹⁻¹³

It is generalized believed that viable but ischemic myocardium is a prerequisite for successful coronary revascularization. Hibernating myocardium can be identified by stress echocardiography, thallium 201 nuclear studies, MRI or positron emission tomography.^{14,15} The meta-analysis by Allman et al.¹⁵ included 3088 patients with ischemic cardiomyopathy. At a mean follow-up of 25 ± 10 months, in the presence of myocardial viability,

revascularization decreased the risk of death by approximately 80%, producing an annual mortality rate of 3.2%, compared with 16% for patients who did not undergo revascularization. When no viable myocardium could be demonstrated, bypass surgery was not beneficial and did not improve survival compared to medical treatment. On the other hand, several authors have suggested that viability studies in these patients may be of little value at all and have recommended revascularization in every patient who has target vessels.¹⁶ We don't have a standard protocol for myocardial viability evaluation before surgery; only some patients underwent thallium-201 perfusions, or positron-emission tomography for identification of myocardial viability. We also consider complete revascularization using left internal mammary artery as prognostically favorable. Our results in 212 patients showed 93.87% perioperative survival, and 48.70% of the patients were alive with improvement of life quality at 5 years, similar with results reported by different authors.¹⁸

Functional mitral regurgitation (FMR) is common in patients with ischemic cardiomyopathy. The pathophysiological components of FMR are represented by annular deformation or dilatation, alteration of left ventricular geometry with displacement of one or both papillary muscle (usually in posterior medial papillary muscle), and reduction of the closing forces of the mitral leaflets due to left ventricular dysfunction. The development of significant mitral regurgitation worsens the prognosis of patients with ischemic heart failure. Several studies¹⁸⁻²² showed the correction of FMR is intended to abolish chronic LV over loading, promote reverse remodeling, improve symptoms and increase survival. Our policy is to perform mitral valve procedure in all patients who have demonstrated worse than 3+ mitral regurgitation on preoperative echocardiography. Forty-eight repairs and 12 replacements for mitral valve were done in these patients.

The process of LV remodeling, starting in the acute phase with infarct expansion and myocardium thinning, and progressing to LV dilatation, geometric distortion, and impaired relaxation and contraction, will develop after an acute myocardial infarction. It results in complex alterations in the architecture and function of the left ventricle involving both the infarcted and the non-infarcted zone. Patients who develop LV dilatation have significantly reduced survival. Several studies²³⁻²⁵ showed LV volume is the most important predictor of survival in

patients with coronary artery disease; surgical treatment to resize and reshape the distorted LV geometry has been developed. The goal is to reduce the size of the left ventricle, restore a more normal elliptical shape to the left ventricle, reduce myocardial wall stress, and improve cardiac function. Recent studies²⁶⁻²⁸ have demonstrated excellent survival and improvements in ejection fraction, left ventricular volumes, and NYHA functional class. In our studies, 32 patients received surgical ventricular restoration, mostly by implantation of an endoventricular circular patch. The mean LV ejection fraction increased from $18.81 \pm 4.41\%$ to $33.46 \pm 5.25\%$ after repair in followed patients.

In conclusion, because the early postoperative and intermediate results are encouraging, surgical revascularization with or without combined mitral repair (or replacement) and left ventricular reconstruction is being increasingly performed for CHF patients. Certainly, a larger patient cohort and longer follow-up are necessary to determine how widely the procedures can be used as an alternative to heart transplantation, and more trials will be needed to identify patients who will gain the greatest comparative benefit from these surgical interventions to restore cardiac function. Trials like the Surgical Treatment for Ischemic Heart failure trial will be of enormous importance to clarify surgical treatment of ischemic heart failure.

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