CARDIOVASCULAR

Impact of Lateral Wall Myocardial Infarction on Outcomes After Surgical Ventricular Restoration

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Background. Surgical ventricular restoration (SVR) attempts to reverse negative ventricular remodeling after anterior myocardial infarction (MI). However, the impact of lateral wall MI (LMI) on SVR outcomes is unknown.

Methods. We retrospectively reviewed SVR patients between January 2002 and December 2005. Patients were grouped into those with and without LMI. Lateral wall myocardial infarction patients were further subdivided into those with anterior-lateral and anterior-inferior-lateral MI. Extent of LMI was assessed intraoperatively as less than 25%, 25% to 49%, 50% to 75%, and more than 75% of the lateral wall. Follow-up was 100%.

Results. Seventy-eight patients underwent SVR; all had anterior MI. Forty-one percent (32 of 78) had LMI; 19% (6 of 32) had anterior-lateral MI; and 81% (26 of 32) had anterior-inferior-lateral MI. The remaining 59% (46 of 78) comprised the no-LMI group. Among LMI patients, 6% (2 of 32) had more than 75% involvement of the lateral wall. Lateral wall myocardial infarction patients were more likely to be New York Heart Association (NYHA) class IV preoperatively. There were 2 operative deaths in the LMI group. Surgical ventricular restoration significantly improved ejection fraction and end-systolic volume index for patients with and without LMI. Sixty-three percent of patients (20 of 32) with LMI and 83% of patients (38 of 46) without LMI improved to NYHA class I/II at follow-up. Three-year Kaplan-Meier survival for LMI patients was 67%, which trended toward a decreased survival versus patients without LMI (85%; $p = 0.18$). Three-year Kaplan-Meier survival for anterior-lateral MI patients was 100%, and for anterior-inferior-lateral MI patients, it was 60%. Lateral wall myocardial infarction involving >50% of the lateral wall was a significant predictor of mortality (odds ratio = 8.3, 95% confidence interval: 1.3 to 54.1, $p = 0.03$).

Conclusions. Cardiac function is improved after SVR for patients with and without LMI. However, anterior-inferior-lateral MI and LMI involving 50% or more of the lateral wall may predict mortality. Our results should prompt further investigation to determine the role of SVR for patients with LMI.

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Congestive heart failure (CHF) remains a leading public health concern, with a prevalence of 5 million patients in the United States alone [1]. In Western society, the majority of these patients have CHF secondary to ischemic cardiomyopathy. Currently, patients with CHF have a poor 2-year survival of approximately 50% with optimal medical therapy [2, 3]. Limitations in medical therapy and the paucity of surgical alternatives have led to poor survival among CHF patients.

Surgical ventricular restoration (SVR) is an alternative therapy for some CHF patients with ischemic cardiomyopathy. Surgical ventricular restoration attempts to reverse the maladaptive morphologic changes of postinfarction ventricular remodeling by reducing the size of the left ventricle and restoring a more normal elliptical shape to the chamber, thereby reducing myocardial wall stress and improving ventricular function. Commonly accepted indications for SVR include anterior wall myocardial infarction (MI) with subsequent left ventricular dilatation, akinetic or dyskinetic segments, and reconstructable coronary artery disease [4–10]. Outcomes after SVR have been reported a number of ways. Many centers have demonstrated excellent survival for appropriate patients with improvements in ejection fraction (EF), left ventricular morphology and volumes, and New York Heart Association (NYHA) functional class after SVR [4–10]. Some have shown that SVR improves mechanical dyssynchrony [11] and reduces abnormal elevations in blood levels of neurohormones associated with CHF [12]. In one of the more elegant physiologic studies done to date, Tulner and colleagues [13] used conductance catheters to show that SVR normalized left ventricular volumes, improved measures of systolic function, reduced left ventricular wall stress, decreased mechanical dyssynchrony, and improved mechanical efficiency.

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Abbreviations and Acronyms

ANOVA	= analysis of variance
CABG	= coronary artery bypass graft surgery
CHF	= congestive heart failure
EF	= ejection fraction
LMI	= lateral wall myocardial infarction
LVEDVI	= left ventricular end-diastolic volume index
LVESVI	= left ventricular end-systolic volume index
MI	= myocardial infarction
MRI	= magnetic resonance imaging
NYHA	= New York Heart Association
SVI	= stroke volume index
SVR	= surgical ventricular restoration

Owing to the small, relatively fixed number of patients who will receive a transplant and the lack of effective alternatives for transplant candidates and noncandidates alike, we recently expanded our inclusion criteria and have offered SVR to patients with multiterritory MI [10], who were traditionally considered to be high-risk candidates. We showed that these patients could benefit from SVR and concluded that a critical amount of viable myocardium is necessary for a successful outcome regardless of the location of infarction (anterior, inferior, or lateral wall alone or in combination). Some of these patients had a lateral wall MI (LMI). No investigator to date has performed a systematic evaluation of the impact of LMI on outcomes after SVR. We hypothesized that a LMI may portend a worse outcome than an anterior wall MI, alone or in conjunction with an inferior wall MI, because of its contribution to ventricular function and mitral valve competence. Therefore, we reviewed our SVR experience to analyze the impact of LMI on cardiac function and survival after this procedure.

Material and Methods

Study Design

All patients who underwent SVR between January 2002 and December 2005 were retrospectively reviewed after Institutional Review Board approval; individual waiver for consent was granted. Patients were divided into those who had an anterior wall MI with and without LMI based on preoperative magnetic resonance imaging (MRI) studies and intraoperative findings. We further subdivided the LMI patients by those with anterior-lateral MI and those with anterior-inferior-lateral MI. Patients with an isolated inferior wall MI were excluded from analysis. Therefore, there were four different groups based on location of MI: anterior MI, anterior-inferior MI, anterior-lateral MI, and anterior-inferior-lateral MI. For the purpose of this study, we grouped patients into those with anterior MI without LMI (including isolated anterior MI and anterior-inferior MI), those with anterior-lateral MI, and those with anterior-inferior-lateral MI. These subgroups enabled us to assess the impact of different ventricular walls involved in MI on outcomes after SVR.

The extent of full-thickness LMI was estimated as involving less than 25%, 25% to 49%, 50% to 75%, or more than 75% of the lateral wall. Infarct location and the extent of lateral wall involvement was assessed preoperatively by MRI (including short and long axis, and CINE views of the heart) with gadolinium contrast to localize areas of transmural hyperenhancement on delayed sequence, when available. A single surgeon (J.V.C.) then reviewed the MRI to better identify areas of viable myocardium and guide the intraoperative observation of the opened left ventricle. During intraoperative inspection, the surgeon assessed the extent of infarction of each wall and prospectively completed a detailed map depicting the location and extent of full-thickness infarction (Fig 1). Our SVR exclusion criteria included the presence of hypokinesis without akinetic or dyskinetic segments, and poor basilar function. We did not exclude patients with preoperative pulmonary hypertension [14].

Patient Variables

Data collection included demographics, NYHA functional status, cardiac function, and postoperative complications and procedures. Magnetic resonance imaging and echocardiography were used to measure left ventricular EF, left ventricular end-systolic volume index (LVESVI), left ventricular end-diastolic volume index (LVEDVI), and stroke volume index (SVI).

Operative Technique

Our surgical technique has been previously described [9, 10, 14]. Surgical ventricular restoration was performed after coronary artery bypass grafting (CABG) and mitral valve repair/replacement, if indicated. As described in our previous work [9, 10, 14], an interventricular sizing device was used in most patients to aid in the ventricular reconstruction. The size of the device was selected based on an optimal LVEDVI of 50 to 60 mL/m^2 body surface area. When necessary, LMI was addressed with a linear plication extending from the base of the infarction to the apex, as previously illustrated [10]. The plication consists of running a continuous polypropylene suture from the base of the area of infarction to the apex, taking bites on both sides of the infarcted tissue in such a fashion to exclude the scarred area.

Statistical Analysis

Statistical analyses were performed with SPSS 12.0 software (SPSS, Chicago, Illinois). Preoperative clinical characteristics, MRI and echocardiographic data, and postoperative clinical data were compared between patients with and without LMI using Student's *t* test and Fisher's exact test, where appropriate. When comparing patients without LMI to those with LMI involving 50% or more and those with LMI involving less than 50% of the lateral wall, a Student's *t* test was used to compare the two latter groups versus the no-LMI group individually to independently assess any differences in MRI and echocardiographic data. We also conducted an analysis of variance