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Quality of Life after 114 Months of Follow-up following Geometric Reconstruction of the Left Ventricle by Endoventriculoplasty with Septal Exclusion

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ABSTRACT

Background: The purpose of this study was to present the surgical experience of the Institute of Cardiovascular Surgery of West of Paraná (ICCOP) with respect to the treatment of left ventricle aneurysms by endoventriculoplasty with septal exclusion (EVSE) and to evaluate the quality of life of these patients after a 114-month follow-up.

Methods: Between April 1999 and April 2006, 28 patients underwent EVSE. Preoperative, transoperative, and late postoperative clinical and echocardiographic variables were analyzed retrospectively. In addition, late-postoperative quality of life was evaluated with questionnaire SF-36 (Brazilian version). The mean age (±SD) of the group was 59.0 ± 9.5 years, and 23 of the patients were male. Seventeen patients were in New York Heart Association functional class IV, and the mean preoperative EuroSCORE was 8.2 ± 2.3. The mean preoperative values for the ejection fraction (EF) and the end-systolic and end-diastolic left ventricular volumes were 32.3% ± 9.2%, 113.9 ± 36.0 mL, and 179.2 ± 48.4 mL, respectively.

Results: The in-hospital mortality rate was 14.3%, with the major causes of morbidity being low cardiac output syndrome and arrhythmias. The mean follow-up period was 5.9 ± 3.4 years. The left ventricular EF and the aortic cross-clamping time were the significant factors for hospital and late mortality (P = .0222, and P = .0123, respectively). The actuarial survival curve showed survival rates of 82.1 ± 7.2%, and 54.7 ± 22.9%, before and after 107 months of follow-up. The overall score for the quality of life showed an improvement.

Conclusion: EVSE surgery is an effective option for treating this group of patients, with improvement noted in left ventricular function and in the patients' quality of life, despite the high in-hospital mortality.

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INTRODUCTION

Left ventricular aneurysm (LVAn) after myocardial infarction due to coronary artery disease is one of the causes of congestive heart failure, and its treatment remains one of the topics on which there is still no consensus regarding the surgical technique to use. Today, heart failure is the major cause of hospital admissions, according to both national and international statistics [Murali 2004; MS/SVS/DASIS 2008].

With an incidence of 10% to 30% in cases of myocardial infarction, LVAn affects up to 85% of the left ventricle (LV) anteroseptal wall, being responsible for the onset of clinical heart failure.

The method of treating these patients, when there is dilation and loss of normal LV geometry, is a reverse remodeling of the LV with preservation of the ventricular structure and function. Given the progressive deterioration of cardiac function that can occur over time, surgery is needed to correct the remodeling that occurs after infarction. Some authors have shown that despite the improvement in anginal symptoms, patients with a low ejection fraction (EF) who undergo only coronary artery bypass grafting (CABG) have survival times that are lower than otherwise expected [Shah 2003]. Several techniques have been proposed for the treatment of LVAn, such as resection of the necrotic tissue and/or ischemic areas [Cooley 1958] as represented by akinetic/dyskinetic areas, with resection with plication being the more accepted method. The area to be resected has great importance in LV function, and therefore this technique carries a risk, not only because resection decreases the LV volume but also because it modifies the shape of the remaining ventricular cavity [Parolari 2007].

In 1985, Jatene [1985] presented a novel concept for geometric LV reconstruction that involved the restoration of its elliptical shape, which is thought to be an important factor, after analysis of 508 patients who underwent their operations between 1977 and 1983. In subsequent reports, Dor et al [1989] described the use of Jatene's approach and presented their initial experience with 25 cases. After these initial results, other groups, such as Cooley [1989] and Michelborough et al [1994], published their own results.

The main consideration in all of these techniques is preserving a normal physiology by maintaining the LV anatomy

Table 1. Echocardiographic Pre- and Postoperative Data for Ejection Fraction (EF), Left Ventricular End-Systolic Volume (LVESV), and Left Ventricular End-Diastolic Volume (LVEDV)

	EF, %		LVEDV, mL		LVESV, mL	
	Pre	Post	Pre	Post	Pre	Post
Mean	32.3	46.4	179.3	129.1	113.9	79.6
SD	9.2	11.3	48.4	55.1	36.1	30.3
Maximum	46	68	285.7	277.0	194.9	173.0
Minimum	13	29	94.2	54.7	51.0	36.7

with the imperative of reconstructing its elliptical shape, rebuilding an apex, reducing the mitral annulus, and restoring the geometry of the papillary muscles. Our experience began in 1999 [Almeida 2000] after we found that repair of LVAn, with its great hemodynamic repercussions and large volumes, produced different results when the linear technique was used [Almeida 2001]. Other Brazilian authors also have described the use of that surgical technique [Prates 2002].

The main objective of this report is to describe the immediate and late results of this technique. The secondary objectives are to show (1) the survival curve of these patients, (2) the factors that contributed to a poor surgical outcome, and (3) the patients' quality of life in relation to echocardiographic parameters.

MATERIALS AND METHODS

Between April 1999 and 2006, 71 patients underwent surgery at the Institute of Cardiovascular Surgery of the West of Paraná (ICCOP) for LVAn of ischemic origin and with areas of dyskinesia and/or akinesia. Twenty-eight patients (39.4%) underwent surgery with the reverse-remodeling technique, which was performed by means of a circular endoventriculoplasty with septal exclusion (EVSE), with or without the use of a heterologous graft. All patients were evaluated with coronary angiography and/or echocardiography. Data were obtained retrospectively through a review of hospital records. The data included the following: (1) demographic data, including age, sex, weight, height, body surface area, surgical indication, date of surgery, type of surgery (elective, urgent, emergency, first surgery, or reoperation), and surgeon; (2) heart failure functional class according to the New York Heart Association (NYHA) and evaluation of surgical risk with the EuroSCORE; (3) the presence of comorbidities, such as hypertension, chronic obstructive pulmonary disease, diabetes mellitus, stroke, and renal failure; (4) echocardiographic data for mitral regurgitation, EF, LV end-systolic volume (LVESV), and LV end-diastolic volume (LVEDV); (5) surgical data, such as type of surgery, associated procedures, cardiopulmonary bypass and aortic clamping times, use of LV assist devices, and intraoperative complications; and (6) data on postoperative complications, such as bleeding with surgical indication for exploratory thoracotomy, surgical infections, use of mechanical ventilation >24 hours, low cardiac output syndrome, and use of LV assist devices.

Table 2. Concomitant Procedures and Sites of Coronary Artery Bypass Grafting (CABG)*

Concomitant Procedure	No. of Procedures
Thrombi resection	8 (28.57%)
Endarterectomy	2 (7.14%)
Surgical correction of VSD	1 (3.57%)
CABG	25 (89.29%)
Arteries revascularized, n	
LAD	23 (82.14%)
MbCx	21 (75.00%)
RDiag	10 (35.71%)
RCA	10 (35.71%)
PD	5 (17.86%)
VP	2 (7.14%)
Diagnls	1 (3.57%)

*VSD indicates ventriculoseptal defect; LAD, left anterior descending coronary artery; MbCx, marginal branch of the circumflex artery; RDiag, right diagonal branch; RCA, right coronary artery; PD, posterior descending artery; VP, ventricular posterior branch; Diagnls, diagonalis branch.

The long-term follow-up was performed prospectively via direct contact with the patients or their doctors. For these follow-ups, we used the Brazilian version of the modified SF-36 quality-of-life questionnaire and echocardiographic data (EF, LVESV, and LVEDV) obtained within 6 months preceding the assessment period. The Ethics Committee of the State University of the West of Paraná approved this research (432/2008-CEP).

The male sex was predominant (23 patients, 82.1%), and the mean age (±SD) was 59.0 ± 9.5 years (57.5 years for males and 65.8 years for females). The mean NYHA functional class was 3.6 ± 0.5, with 60.7% of the patients being in class IV. All aneurysms were anteroapical with involvement of the interventricular septum. The main clinical indication for surgical treatment was heart failure in 20 patients (71.4%), angina in 7 patients (25.0%), and arrhythmia in 1 patient (3.6%). All patients were evaluated for EF (Simpson method), LVESV, and LVEDV (Table 1); the mean values were 32.3% ± 9.2%, 113.9 ± 36.0 mL, and 179.2 ± 48.4 mL, respectively. Mitral insufficiency was moderate in 2 patients (7.1%), mild in 8 patients (28.6%), and trivial or absent in the rest. The mean time between the completion of the coronary angiography evaluation and surgery was 84.0 ± 67.5 days. The mean additive EuroSCORE was 8.2 ± 2.3, and the mean logistic EuroSCORE was 11.5 ± 9.1. Surgery was performed as an emergency (defined as any surgery performed within 24 hours after admission) in 4 cases (14.3%). All procedures were first surgery.

Surgical Technique

Surgery was performed with the patient under general anesthesia, with cardiopulmonary bypass, and with

moderate systemic hypothermia (28°C-30°C). Cold crystalloid cardioplegia and Shumway solution were used in all but 1 case. The LV cavity was opened after clamping of the aorta. Thrombi, if present, were removed, and the LV was thoroughly cleaned. In the transition zone between normal muscle and fibrosis, a 3-0 polypropylene circular suture was applied to resize the LV cavity. The fibrous portion of the interventricular septum was dissected from the rest of the septum, between the apical portion of the LV and the place of passage of the suture ring. This flap was used for closure of the LV cavity. The distal grafts were anastomosed, followed by the proximal anastomoses during the process of weaning from bypass, with partial clamping of the aorta. The mitral valve was not addressed in any of the patients in this group.

In this group, reverse-remodeling surgery without concomitant CABG was performed in only 3 patients (10.7%). The concomitant procedures performed were resection of LV thrombi in 8 patients (28.6%), coronary endarterectomy in 2 patients (7.1%), and closure of a ventricular septal defect in 1 case (3.6%). In the 25 patients (89.3%) who underwent CABG, the mean number of grafts was 2.9 (range, 1-5), with 1.96 and 0.92 venous and arterial grafts, respectively, performed per patient. For arterial grafts, the left internal thoracic artery was used in 92.0% of the cases. Table 2 lists the types of concomitant procedures and the arteries revascularized. In only 1 case (3.6%) was a heterologous bovine pericardium graft used for correction of LVAn. Four patients (14.3%) required the use of a ventricular assist device, such as an intra-aortic balloon pump; the mean time of its use in this patient was 26.3 ± 16.9 hours. One patient (3.6%) had bypass of the left atrium/aorta (mean time, 83 minutes).

The mean cardiopulmonary bypass and aortic clamping times were 113.9 ± 38.9 minutes (range, 67-234 minutes) and 49.4 ± 13.0 minutes (range, 29-80 minutes), respectively.

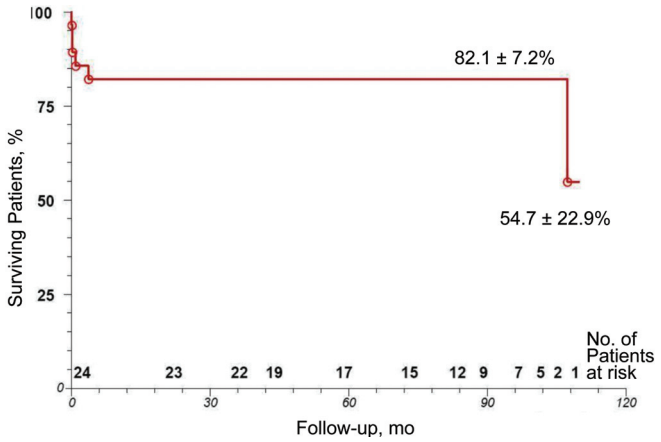
The Brazilian version of the SF-36 quality-of-life questionnaire [Ribeiro 2002] was used in the evaluation of 23 patients, either directly or through contact with their doctors, in a period not exceeding 6 months before this study. The value for each of the 8 evaluated areas is calculated on a scale of 0 to 100, with 0 being the worst state and 100 being the best.

Statistical Analysis

Data were expressed as the mean ± SD, and statistical analysis was done on these data. The variables were analyzed by relative risk (comparison of 2 linear variables), multiple linear regression (analysis of multiple linear variables), and analysis of Kaplan-Meier survival curves. The tests were performed with the statistical analysis software StatsDirect (StatsDirect, Altrincham, UK). *P* values <.05 were considered statistically significant.

RESULTS

The complications that occurred most frequently during the operative procedure were low cardiac output syndrome in 5 patients (17.9%), bleeding from the LV in 3 patients (10.7%), and arrhythmia in 2 patients (7.1%). There was a need for inotropic drugs in 33.3% of the patients. Mechanical ventilation was maintained for >24 hours in only 2 patients (7.4%). The main causes of morbidity during this period were low cardiac output syndrome (8 patients), arrhythmia (3 patients), and acute renal failure, respiratory failure, and transient ischemic stroke in 1 patient each. Eight patients (33.3%) required the use of catecholamines in high doses. The mean length of hospital stay postoperatively was 7.4 ± 4.1 days. The mean hospital stay for those patients who were discharged from the intensive care unit, after a mean of 7.50 ± 1.7 days, was 3.3 ± 4.4 days (range, 1-24 days). Four patients (14.3%) died in the transoperative or the immediate postoperative period. Of these patients, 75% had an EF <24%. The causes of mortality for these 4 patients were LV failure in 2 patients (1 death occurring intraoperatively and 1 occurring 2 days after surgery), 1 death from arrhythmia and low cardiac output syndrome occurring on the second postoperative day, and 1 death from pulmonary and neurologic complications occurring on the 24th postoperative day.



Kaplan-Meier survival curve over a 114-month follow-up for 28 patients who underwent endoventriculoplasty with septal exclusion.

The mean follow-up period was 5.6 ± 3.2 years (until July 2008). All of the survivors were followed up. Two patients died during follow-up. The cause of death was LV failure in both cases, at 4 and 107 months. The mean NYHA functional class of the 23 survivors was 1.5 ± 0.7, with 60.9% in functional class I.

Multiple linear regression was performed to assess whether the variables (age, sex, NYHA functional class, EF, LVEDV, LVESV, cardiopulmonary bypass time, aortic cross-clamping time, weight, height, and body surface area) had influenced the final outcome (mortality), both immediately and during follow-up. When the variables were analyzed with respect to immediate mortality, the EF was statistically significant (*P* = .0222). A comparison of the 3 variables with greatest tendency toward statistical significance (EF, NYHA functional class, and time of anoxic cardiac arrest), only EF was significant (*P* = .0125). With respect to overall mortality, cross-clamping time had the greatest statistical significance (*P* = .0123). The 3 most important variables were sex (*P* = .0068), aortic cross-clamping time (*P* = .0049), and EF.

The Kaplan-Meier actuarial analysis of survival of the patients who underwent geometric reconstruction showed a mean survival of 82.1% ± 7.2%, 82.1% ± 7.2%, and 54.7% ± 22.9% at the end of 50, 100, and 110 months, respectively (Figure).

Analysis of the quality-of-life questionnaires showed that the 23 patients had better outcomes, as assessed by the quality of life (2.4 ± 1.2). Evaluation at the gross scale of the 8 assessed areas showed values of 74 for pain, 65 for functional capacity, 54.7 for limitation caused by emotional aspects, 52.5 for general state of health, 49.2 for mental health, 46.5 for limitation due to physical aspects, 39.3 for the social aspects of life, and 40.1 for energy/fatigue.

In addition, the EF, LVESV, and LVEDV values improved to 46.4% ± 11.3%, 126.1 ± 55.1 mL, and 79.6 ± 30.3 mL, respectively, which represent respective improvements of 43.7%, 42.2%, and 43.1% compared with the preoperative data.

DISCUSSION

This report presents the experience of ICCOP for a consecutive series of patients who underwent geometric reconstruction of the LV by EVSE to repair aneurysms of the anterior wall. The operations were performed by a single surgeon. This investigation evaluated the study group with respect to the survival curve, the factors that contributed to mortality, and the relationship of the patients' subjective assessment of their quality of life with respect to echocardiographic parameters.

The purpose of this surgery is to reduce the volume of the LV cavity and thus restore its original shape, as well as to perform a complete revascularization. When the results in the literature prompted us to use this technique for LV repair and improving patient survival, we also inquired whether we could also improve the patients' quality of life, because survival prospects have increased over the last few decades for patients with heart failure symptoms [Levy 2006]; however, mean survival by the end of 5 years is 50%. Most patients (71.4%) in this study had heart failure as the main symptom, and its evolution can therefore be compared. More recent studies [Athanasuleas 2004; Tulner 2006] have shown that surgical restoration of the ventricular geometry improves cardiac parameters and consequently the survival of patients with LV remodeling, both for patients with an ischemic etiology and in patients with dilated cardiomyopathy.

Previous work performed in single centers [Dor 2001; Menicanti 2002] has shown excellent results in both the medium and long terms with these techniques. Multicenter studies to assess akinetic areas have also shown good results over the long term [Athanasuleas 2004].

The association of CABG with LV re-remodeling has its basis in studies that have shown that despite viable myocardium after an acute myocardial infarction, the LVESV increased because of the remodeling and that the decrease in cardiac function improved globally [Schinkel 2004].

Analysis of postoperative complications [Sartipy 2005] indicated similarities, and the durations of hospital stays (7.4 ± 4.1 days) and intensive care unit stays were similar to those of patients who only underwent coronary revascularization in ICCOP. Bockeria et al [2006] reported a mean hospital stay of 21.4 ± 6.9 days for a group of patients with a comparable functional class and a similar ventricular function (NYHA class, 3.6 ± 0.5 versus 3.5 ± 0.3; LVEF, 32.3% ± 9.2% versus 32.9% ± 5.4%); however, these investigators' use of ventricular assistance (intra-aortic balloon pump) was very different from ours (14.3% versus 58%), which may explain the difference in the immediate-mortality rate. The data differ from those presented by Gomes et al [2004] for a group of 11 patients in which there was no mortality or use of circulatory assistance.

The immediate mortality was actually a significant factor compared with results from the literature, when EuroSCOREs were evaluated, with an increase in the relative risk (odds ratio) from 0.75% to 6.1%. In an attempt to assess the reason, multiple linear regression was performed to see which factors affected the immediate mortality. The variable that stood out was an EF <32.31% (P = .0284). Multiple linear regression analysis of the 3 most important variables (NYHA functional class, LVEF, and cross-clamping time) revealed statistical significance for the last 2 variables (P = .0125 and .0713, respectively) for times >48.86 minutes. Adams et al [2006] demonstrated that the EF is a factor contributing to mortality. Athanasuleas et al [2004] in their RESTORE study also found an EF <30% to be one of the variables that influenced the immediate mortality of these patients, together with LVEDV, NYHA functional class, and age.

Despite the higher immediate mortality in this study compared with that in most studies [Sartipy 2005], we should consider the fact that the present study included all patients and made no adjustments for the learning curve. Another factor that may have contributed to a higher mortality may have been mitral valve dysfunction; some authors have recommended mitral valve repair as a concomitant treatment in such surgeries [Barletta 2006]. Suma et al [2001] studied 54 patients and reported an immediate-mortality rate and improvements in EF, LVESV, LVEDV, and survival that were similar to those described in this report.

Concomitant CABG is a key factor for obtaining good results [Schinkel 2004], especially when the left anterior descending coronary artery (LAD) is bypassed. In this group, bypass of the LAD was possible in 82.14% of the patients, and the left internal thoracic artery was the conduit of choice in 86.96%.

Mean survival at the end of 110 months of follow-up was 54.7% ± 22.9%, which was within the range of values obtained for other patient groups but with a smaller number of patients at risk. Analysis of survival to the end of 5 years yielded a survival rate (82.1% ± 7.2%) that is lower than that obtained by the majority of studies [Dor 2001; Gomes 2004; Sartipy 2005; Adams 2006]. We therefore can say that once patients survived their surgery, patients had very good outcomes.

The study showed a correlation between the improvement in echocardiographic values obtained during the last 6 months and the quality of life for the same period, as evaluated with the SF-36 questionnaire. Despite the improvements in values

for echocardiographic parameters (a mean of approximately 40%), the patients apparently did not perceive these changes as an improvement in their quality of life. Only the measures of functional capacity, pain, and limitation by emotional aspects showed marked improvement. One of the possibilities that have been suggested to explain this fact in Brazil is the irregular use of medications.

Limitations of the Study

The main limiting factor of this retrospective study was the total number of patients studied. Another limiting factor was that all tests for assessing LV parameters were performed by echocardiography; the ideal examination would have been magnetic resonance imaging. Although we assessed quality of life for all survivors, the information in some cases (34.8%) was obtained through contact with the patient's doctor, which may not have been the ideal.

CONCLUSIONS

Surgical reconstruction of LV geometry by EVSE for the treatment of remodeling after myocardial ischemia had a high immediate-mortality rate, depending on the preoperative ventricular EF remaining, but showed an excellent survival rate after 114 months of follow-up: 82.1% ± 7.2% at the end of 9 years and 54.7% ± 22.9% thereafter. The factors that contributed to an immediate adverse outcome were (1) in the short term, a LVEF <32.3% and (2) in the long term, female sex and a cross-clamping time >48.9 minutes. The improvement in the echocardiographic data postoperatively was compatible with the improvement in the quality of life, but the latter improved to a lesser degree than expected in some areas.

REFERENCES

Adams JD, Fedoruk LM, Tache-Leon CA, et al. 2006. Does preoperative ejection fraction predict operative mortality with left ventricular restoration? Ann Thorac Surg 82:1715-9.

Almeida RMS, Lima JD. 2001. Surgical correction of the left ventricular aneurysms – Which technique should be used? 2nd Virtual Congress of Cardiology. Available at: http://www.fac.org.ar/scvc/llave/tlibres/tl068/tl068i.htm. Accessed October 17, 2009.

Almeida RMS, Lima JD Jr, Bastos LC, Carvalho CT, Loures DR. 2000. Remodelamento do Ventrículo Esquerdo pela Técnica da Endoventriculoplastia - Experiência Inicial. Rev Bras Cir Cardiovasc 15:302-7.

Athanasuleas CL, Buckberg GD, Stanley AWH, et al. 2004. Surgical ventricular restoration in the treatment of congestive heart failure due to post-infarction ventricular dilation. J Am Coll Cardiol 7:1439-45.

Barletta G, Toso A, Del Bene R, Di Donato M, Sabatier M, Dor V. 2006. Preoperative and late postoperative mitral regurgitation in ventricular reconstruction: role of local left ventricular deformation. Ann Thorac Surg 82:2102-9.

Bockeria LA, Gorodkov AJ, Dorofeev AV, Alshibaya MD, the RESTORE Group. 2006. Left ventricular geometry reconstruction in ischemic cardiomyopathy patients with predominantly hypokinetic left ventricle. Eur J Cardiothorac Surg 29(suppl 1):S251-8.

Cooley DA. 1989. Ventricular endoaneurysmorrhaphy: a simplified repair for extensive postinfarction aneurysm. J Card Surg 4:200-5.

Cooley DA, Collins HA, Morris GC, Chapman DW. 1958. Ventricular aneurysm after myocardial infarction: surgical excision with use of temporary cardiopulmonary bypass. JAMA 167:557-60.

Dor V, Di Donato M, Sabatier M, Montiglio F, Civaia F. 2001. Left ventricular reconstruction by endoventricular circular patch plasty repair: a 17-year experience. Semin Thorac Cardiovasc Surg 4:435-47.

Dor V, Saab M, Kornaszewska M, Montiglio F. 1989. Left ventricular aneurysm: a new surgical approach. Thorac Cardiovasc Surg 37:11-9.

Gomes WJ, Jaramillo JI, Asanuma F, Alves FA. 2004. Reconstrução fisiológica do ventrículo esquerdo: o conceito de máxima redução ventricular e mínima resposta inflamatória. Rev Bras Cir Cardiovasc 19:353-7.

Jatene AD. 1985. Left ventricular aneurysmectomy: resection or reconstruction. J Thorac Cardiovasc Surg 89:321-31.

Levy WC, Mozaffarian D, Linker DT, et al. 2006. The Seattle Heart Failure Model: prediction of survival in heart failure. Circulation 113:1424-33.

Menicanti L, Di Donato M. 2002. The Dor procedure: what has changed after fifteen years of clinical practice? J Thorac Cardiovasc Surg 5:886-90.

Mickleborough L, Maruyama H, Liu P, et al. 1994. Results of left ventricular aneurysmectomy with a tailored scar excision and primary closure technique. J Thorac Cardiovasc Surg 107:690-8.

MS/SVS/DASIS. Sistema de Informações sobre Mortalidade – SIM. 2008. Available at: http://w3.datasus.gov.br/site/visualiza_texto.php?noticia=15980. Accessed October 16, 2009.

Murali S. 2004. Long-term circulatory support – the left ventricular assist system for advanced heart failure. US Cardiol 43:1-4.

Parolari A, Naliato M, Loardi C, et al. 2007. Surgery of left ventricular aneurysm: a meta-analysis of early outcomes following different reconstruction techniques. Ann Thorac Surg 83:2009-16.

Prates PR, Homsi Neto A, Lovato LM, et al. 2002. Late results of endoventricular patch plasty repair in akinetic and dyskinetic areas after acute myocardial infarction. Arq Bras Cardiol 79:107-16.

Ribeiro GCA, Costa CE, Lopes MM, Albuquerque APN, Silva JP. 2002. Eficiência da correção endoventricular com patch em pacientes com grande área acinética pós-infarto do miocárdio e severa disfunção ventricular. Rev Bras Cir Cardiovasc 17:13-8.

Sartipy U, Albåge A, Lindblom D. 2005. The Dor procedure for left ventricular reconstruction. Ten-year clinical experience. Eur J Cardiothorac Surg 27:1005-10.

Schinkel AFL, Poldermans D, Rizzello V, et al. 2004. Why do patients with ischemic cardiomyopathy and a substantial amount of viable myocardium not always recover in function after revascularization? J Thorac Cardiovasc Surg 2:385-90.

Shah PJ, Hare DL, Raman JS, et al. 2003. Survival after myocardial revascularization for ischemic cardiomyopathy: a prospective ten-year follow-up study. J Thorac Cardiovasc Surg 5:1320-7.

Suma H, Isomura T, Horii T, Hisatomi K. 2001. Left ventriculoplasty for ischemic cardiomyopathy. Eur J Cardiothorac Surg 20:319-23.

Tulner SA, Bax JJ, Bleeker GB, et al. 2006. Beneficial hemodynamic and clinical effects of surgical ventricular restoration in patients with ischemic dilated cardiomyopathy. Ann Thorac Surg 82:1721-7.