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Mitral valve repair by Double Teflon technique: cardiac remodeling analysis by tridimensional echocardiography

Plastia valvar mitral pela técnica do Duplo Teflon: análise do remodelamento cardíaco pela ecocardiografia tridimensional

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Abstract

Introduction: **Mitral valve repair is the treatment of choice for mitral insufficiency, although the literature is scarce regarding the behavior of the atrium and left ventricle after mitral repair without the use of prosthetic rings.**

Objective: **To analyze the morphology and cardiac function in patients undergoing mitral valvuloplasty by the Double Teflon technique, through the three-dimensional echocardiography.**

Methods: **We included 14 patients with myxomatous mitral regurgitation who underwent mitral valve repair by the Double Teflon technique. Thirteen patients were in class III / IV. Patients were evaluated at preoperative, immediate postoperative (IPO), 6 months and 1 year after mitral valve repair. We used the test for analysis of variance (ANOVA) with repeated measures for the statistical analysis, being considered statistically significant *P* <0.05.**

Results: **The analysis of systolic, atrial and ventricular volumes showed a significant reduction between the IPO and one year (*P* = 0.028 and *P* = 0.020, respectively). Between the preoperative period and 1 year, there was a mean reduction of 19.9% and 15.4% in the atrial and ventricular volumes, respectively. The diastolic, atrial and ventricular volumes showed a significant reduction in the IPO (*P* <0.001 and *P* = 0.024, respectively), remaining stable throughout the study. There was an increase in the ejection fraction of the left atrium after 6 months (*P* <0.001), although no change occurred in the left ventricular function.**

Conclusions: **Patients submitted to mitral valve repair using the Double Teflon technique showed reverse remodeling of the left atrium and left ventricle. This reduction in cavity volume was associated with improved left atrial function during the study.**

Keywords: **Mitral valve. Mitral valve insufficiency. Mitral valve prolapse. Reconstructive surgical procedures. Three-dimensional echocardiography.**

Resumo

Introdução: **A plastia valvar mitral é o tratamento de escolha para a insuficiência mitral, porém a literatura é escassa em relação ao comportamento do átrio e ventrículo esquerdos após a plastia mitral sem utilização de anéis protéticos.**

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Objetivo: **Analisar a morfologia e a função cardíaca de indivíduos submetidos à plastia valvar mitral pela técnica de Duplo Teflon, por meio da ecocardiografia tridimensional.**

Métodos: **Foram incluídos 14 pacientes com insuficiência mitral mixomatosa, submetidos à plastia mitral pela técnica de Duplo Teflon. Treze pacientes encontravam-se em classe III/IV. Os pacientes foram avaliados nos períodos pré-operatório, pós-operatório imediato (POI), 6 meses e 1 ano após a plastia mitral. Foi utilizado teste de análise de variância de medidas repetidas para o estudo estatístico, sendo considerado estatisticamente significante *P*<0,05.**

Resultados: **A análise dos volumes sistólicos, atrial e ventricular demonstrou redução volumétrica significativa entre POI e 1 ano (*P*=0,028 e *P*=0,020, respectivamente). Entre o pré-operatório e 1 ano, houve redução média de 19,9% e 15,4% nos volumes atrial e ventricular, respectivamente. Os volumes diastólicos atrial e ventricular apresentaram redução significativa no POI (*P*<0,001 e *P*=0,024, respectivamente), permanecendo estáveis ao longo do estudo. Houve aumento na fração de ejeção do átrio esquerdo após 6 meses (*P*<0,001), porém não houve variação na função ventricular esquerda.**

Conclusões: **Os pacientes submetidos à plastia valvar mitral por meio da técnica de Duplo Teflon apresentaram remodelamento reverso do átrio esquerdo e do ventrículo esquerdo. Esta redução nos volumes cavitários esteve associada à melhora da função atrial esquerda durante o estudo.**

Descritores: **Valva mitral. Insuficiência da valva mitral. Prolapso da valva mitral. Procedimentos cirúrgicos reconstrutivos. Ecocardiografia tridimensional.**

INTRODUCTION

Mitral insufficiency is defined as the presence of a retrograde systolic flow of the left ventricle into the left atrium [1]. Although mild mitral insufficiency is often found in healthy individuals [2], epidemiological data show that mitral failure secondary to the valve prolapse, whether mild or severe, it is the main valve disease in the United States [3] and the second most common form of heart valve disease surgery in Europe [4]. In Brazil, the mitral valve prolapse accounted for 25.9% of the etiology of patients undergoing mitral valve repair in 12 years of experience in the Heart Institute, Hospital das Clinicas, Faculty of Medicine, University of São Paulo [5].

The main mechanism of the reduction or failure in coaptation of the anterior and posterior mitral valve cusps is the elongation or tendon chordal rupture [6], leading to prolapse of the affected cusp during systole towards the left atrium [7,8] . In approximately 70% of the cases, the valve prolapse is related to tendon chordal rupture located in the P2 segment of the mitral valve [9] according to the segmental classification proposed by Carpentier [10-12], corresponding to 1/3 medium of the posterior cusp.

Previous studies demonstrated the superiority of valve preservation in relation to mitral valve replacement [13-16]. In the technique of quadrangular resection of the posterior cusp, with ring plication and suture edge to edge of the cusps, the use of prosthetic rings is still a subject of discussion [17]. In Brazil, Pomerantzeff et al. [18] developed a modified technique using wire with pledgets over Teflon flap for segmental plication of the posterior ring corresponding to the segment removed from the cusp without using prosthetic ring. This technique, called "Double Teflon technique 'has been showing excellent long term results, with low rates of morbidity and mortality [19,20].

Two-dimensional, transthoracic or transesophageal echocardiography, is the main tool used to obtain real-time images of cardiac structures [21,22]. Currently, three-dimensional echocardiography is emerging as a promising tool, and its clinical applicability has been demonstrated in several areas. Previous studies compared the accuracy and reproducibility of measurements of the atrial and ventricular volume between the two-dimensional and three-dimensional echocardiography. Regardless of the method of obtaining cardiac images, three-dimensional echocardiography demonstrated superiority in quantifying these volumes [23].

The aim of this study was to analyze the morphology and function of the atrium and left ventricle of patients undergoing mitral valvuloplasty by the Double Teflon technique, through the three-dimensional echocardiography in real time.

METHODS

This study was conducted at the Heart Institute, Hospital das Clinicas, Faculty of Medicine, University of São Paulo for Heart Valve Surgery Unit and the Echocardiography Unit, with support from CEPEC (Echocardiography Research Center). After the study was approved by the Ethics Committee of Hospital das Clinicas, Faculty of Medicine, University of São Paulo and obtaining a written post-informed consent, between May/2006 and August/2008 we included 14 consecutive patients with mitral insufficiency secondary to mitral valve prolapse of degenerative etiology, due to elongation or tendon chordal rupture related to the mitral valve posterior cusp, who underwent mitral valve repair with the Double Teflon technique (Figure 1). We excluded patients with associated valvular heart disease or submitted to previous heart surgery.

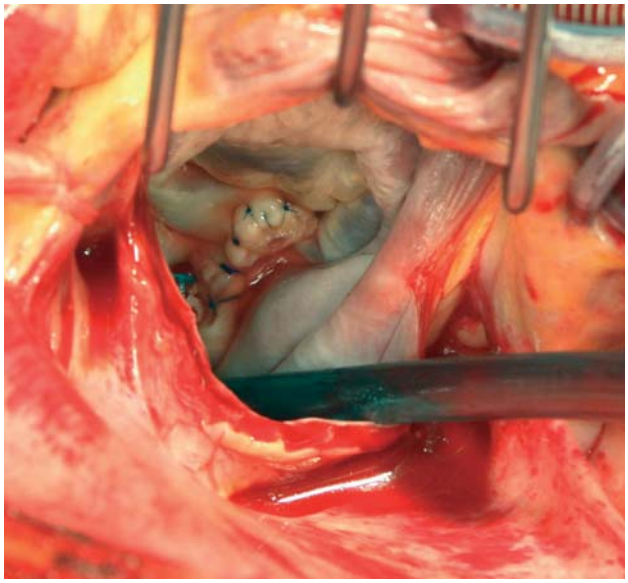

Fig. 1. Intraoperative aspect of the mitral valve after completion of mitral valve repair using the technique of Double Teflon. We can observe the pledgets grounded in strips of Teflon and the edge to edge suture of the cusps

In this population, the age ranged between 39 and 75 years, mean 61 ± 11 years. Out of the 14 patients, 10 were male and 4 were female. The average weight and height of patients was 75.6 ± 10.9 kg and 1.69 ± 0.1 m, respectively. Body surface area ranged between 1.64 and 2.10 m^2, with a mean of 1.85 ± 0.17 m^2. In the investigation of personal history, 11 patients had hypertension; two patients had diabetes mellitus, two from chronic renal failure requiring dialysis, three had dyslipidemia, and two had coronary artery disease. The additive EuroSCORE ranged between 0 and 6, being that 11 cases presented additive EuroSCORE from 0 to 3 and the other 3 cases showed additive EuroSCORE between 3 and 6. Regarding the functional class (FC) in the preoperative period, one patient was in FC II, 12 in FC III and one in FC IV. Out of the 14 patients, eight had atrial fibrillation preoperatively.

All patients were operated by the same surgical team. In one patient it was performed plication of the free edge of the anterior mitral valve cusp, as a technique associated with the repair. In this same case it was performed atrioseptoplasty with raffia of the direct atrial septal defect. In addition, in one patient it was performed decalcification of the mitral annulus. Regarding the location of mitral valve disease, 12 patients had involvement of the P2 segment, one patient had involvement of the P1 segment, and one patient had associated involvement of A2 and P2 segment. Cord rupture were found in 10 patients, in one patient it was found string stretching; stretching and cord snapping found in two patients; calcification of the ring and cord rupture found in one patient. Two patients had coronary heart disease as an associated diagnosis. Of these patients, one patient had distal coronary lesion, not treatable surgically. One patient underwent revascularization of the left marginal branch.

Patients were evaluated in the preoperative period (up to 30 days before surgery), postoperative (between 5 and 30 days postoperatively), 6 months (between 6 and 7 months postoperatively) and 1 year (between the 12th and 15th month postoperatively).

In order to perform the test, we used the IE-33 (Philips Medical Systems, Andover, MA, USA). Echocardiographic images were obtained using the matrix transducer positioned in the acoustic parasternal and apical windows. The images were optimized by changing the gain, brightness and compression. Data from the three-dimensional transthoracic echocardiography in real time were acquired using the acquisition mode with open angle, obtaining a pyramidal volume of approximately 110 º x 100 º, with the capture of seven wedge-shaped subvolumes.

This acquisition was made over four cardiac cycles during a short expiratory apnea, aiming to reduce artifacts in reconstruction. In turn, each subvolume was captured at the peak of R wave, according to electrocardiographic monitoring. It was considered the maximum systole the moment prior to the closing of the aortic valve, and the maximum diastole, the moment prior to the opening of the aortic valve.

The three-dimensional echocardiographic data were analyzed in a workstation, using specific software QLAB 5.0 and QLAB 6.0 (Philips Medical Systems, Andover, MA, USA). With the acquisition of three-dimensional data, the image was cut and reconstructed to visualize the cardiac structures within the pyramid or the whole heart block.

Measurements of end systolic volume, end diastolic volume and ejection fraction of left atrium (Figure 2) were obtained in the coronal, sagittal and transversal planes. The calculation of these parameters was performed automatically by the delineation of the endocardial phases: end diastole (time of higher atrial filling) and end systole of the left atrium (lower atrial filling time). The endocardial delineation was corrected manually from the images viewed in transverse planes. Ejection fraction of left atrium was determined using the relationship between atrial volumes, according to the formula: EF = EDV - ESV / EDV.

Measurements of end systolic volume, end diastolic volume and ejection fraction of left atrium (Figure 2) and left ventricle (Figure 3) were obtained in the coronal, sagittal and transversal planes. The calculation of these parameters was performed automatically, through the delineation of the endocardium at the end diastole and end systole phases of the cardiac cycle. The endocardial delineation was corrected manually from the images viewed in transversal planes. The categorization of the degree of mitral

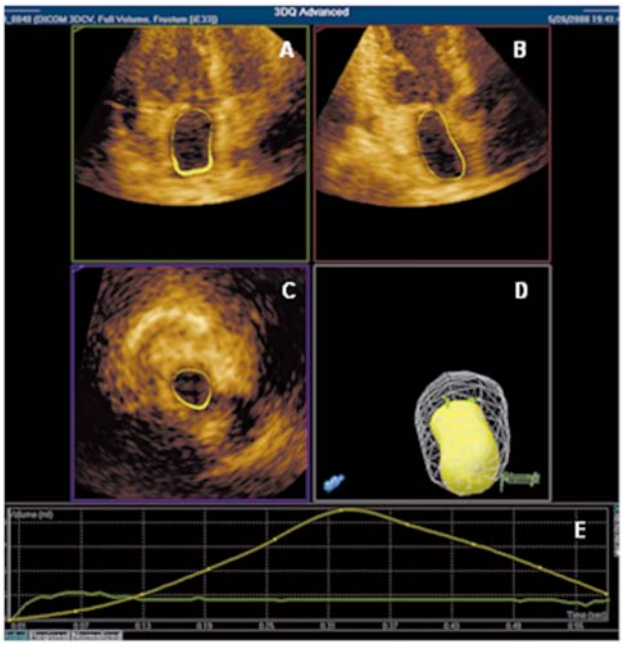

Fig. 2. Delineation of the atrial endocardium in the process of analysis of systolic and diastolic volumes (A, B and C). We can see the left atrial volume variation between times of the cardiac cycle (D and E)

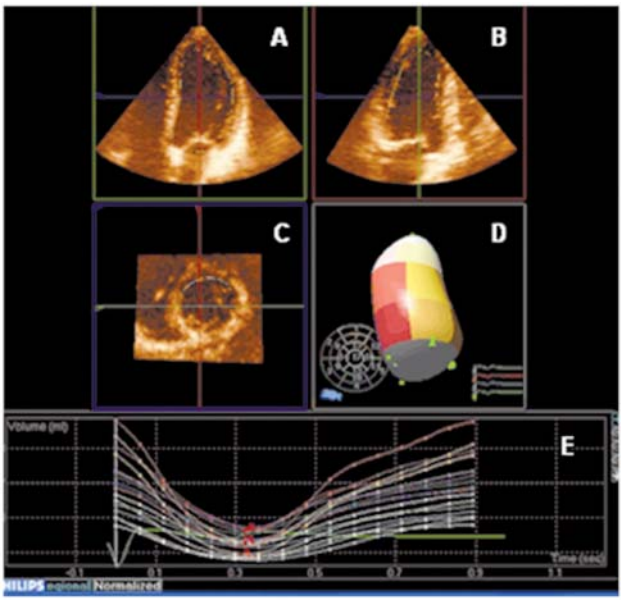

Fig. 3. Ventricular endocardial delineation in the process of analysis of systolic and diastolic volumes. We can observe the three-dimensional basic plans: mediolateral (A), of elevation or depth (B) and inferior-superior (C). Moreover, we can observe the left ventricular segmental division (D) and the behavior of each segment during the cardiac cycle (E)

insufficiency was performed by analyzing the extent of the regurgitant jet observed by color flow mapping.

Categorical variables were described by absolute and relative frequencies. The descriptive analysis of continuous variables was performed by observing the minimum and maximum values, means and standard deviations. In order to analyze the behavior of the group considering the conditions studied, we used the technique of Analysis of Variance for Repeated Measures. It was considered statistically significant $P < 0.05$. The software SPSS version 15.0. (Inc, Chicago) was used for this analysis.

RESULTS

During the study period, no death, endocarditis, reoperation for valve dysfunction or thromboembolism were observed. In terms of physical activity in the postoperative period, 12 patients were in functional class I and two in functional class II, one year after surgery. In the immediate postoperative period, 12 patients had mild mitral insufficiency and two patients had minimal mitral insufficiency. There was no significant change in the degree of mitral regurgitation after valvuloplasty during the study. Patients who had atrial fibrillation preoperatively maintained arrhythmia postoperatively, with no reversal of the rhythm during the study.

The end-systolic volumes of left atrium (LAESV), in the preoperative, postoperative, 6 months and 1 year periods were 48.86 ± 14.96 ml, 44.21 ± 12.65 ml, 40.25 ± 14 , 03ml and 39.15 ± 13.88 ml, respectively. Significant effect of condition evaluation was observed during the study period ($P < 0.001$). At the end of the study there was a decrease of 19.9% in end-systolic volume of the left atrium when comparing the averages of the preoperative and 1 year periods. Figure 4 represents the evolution of end-systolic volume of the left atrium throughout the study. A decrease in volume was

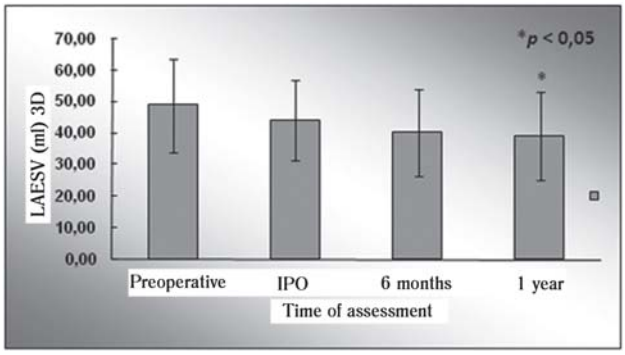

*Fig. 4. Evolution of end-systolic volume of the left atrium (LAESV) during the study. We observed significant reduction in LAESV between the time one year and IPO (immediate postoperative). Values = mean ± standard deviation. * P <0.05 compared to IPO*

observed when comparing the preoperative and immediate postoperative period, and the postoperative period and 6 months, however, the difference is not statistically significant (P = 0.117 and P = 0.08, respectively). We observed significant reduction in LAESV when comparing IPO and one year periods (P = 0.028).

The end-diastolic volumes of left atrium (LAEDV) in the preoperative, postoperative, 6 months and 1 year periods were 77.86 ± 13.94 ml, 67.00 ± 19.92 ml, 68.36 ± 13 , 08ml and 67.58 ± 13.14 ml, respectively. Significant effect of condition evaluation during the study period was observed (P <0.001). At the end of the study it was observed a decreased from 13.2% in LAEDV when comparing the means of the preoperative and 1 year periods. Figure 5 represents the evolution of LAEDV throughout the study. By comparing the preoperative and immediate postoperative period, we noted a significant reduction in mean left atrial diastolic volumes (P <0.001). This reduction remains stable throughout the study period, no significant difference was observed when comparing the periods IPO with 6 months, and IPO with 1 year (P = 0.683 and P = 0.851, respectively).

Ejection fractions of the left atrium (LAEF) in the preoperative, immediate postoperative, 6 months and 1 year periods were 39.57 ± 9.22%, 44.12 ± 12.19%, 45.64 ± 11.27% and 45.36 ± 10.72%, respectively. Significant effect of condition evaluation during the study period was observed (P <0.001). At the end of the study, there was an increase in ejection fraction compared to the pre-operative period. On average, it was observed an increase of 14.6% of atrial ejection fraction, demonstrating the optimization of the left atrium function. Figure 6 represents the evolution of the LAEF throughout the study. We observed a progressive increase in ejection fraction of the left atrium until 6 months postoperatively. By comparing the preoperative and immediate postoperative period, we observed that this

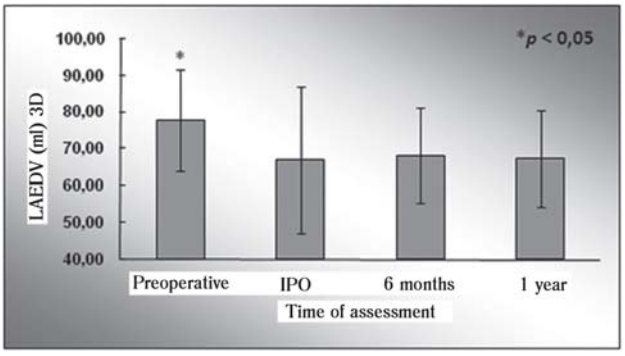

*Fig. 5. Evolution of end diastolic volume of the left atrium (LAEDV) during the study. We observed significant reduction in LAEDV between the time Pre (preoperative) and IPO (immediate postoperative). This reduction remains stable during the study. Values = mean ± standard deviation. * P <0.05 compared to IPO*

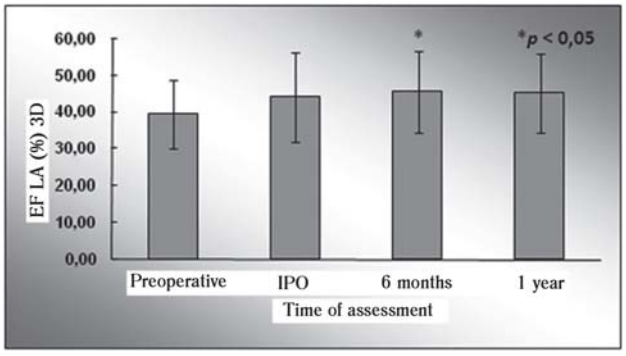

*Fig. 6. Evolution of the ejection fraction of left atrium (LAEF) during the study. We observed a significant increase in the time of LAEF between 6 months and IPO (immediate postoperative). This increase remained stable during the study. Values = mean ± standard deviation. * P <0.05 compared to IPO*

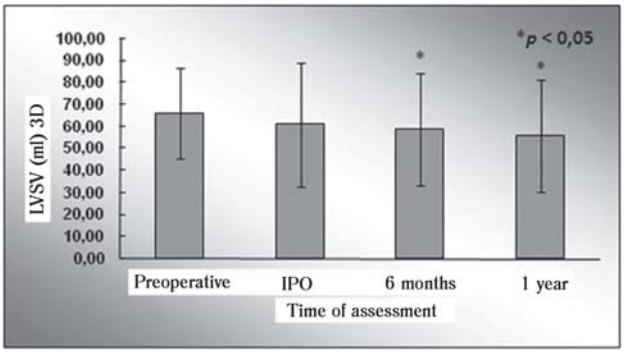

*Fig. 7. Evolution of the left ventricle end-systolic volume (LVSV)) during the study. We observed significant reduction in LVSV between the time 6 months and IPO (immediate postoperative) and 1 year and IPO. Values = mean ± standard deviation. * P <0.05 compared to IPO*

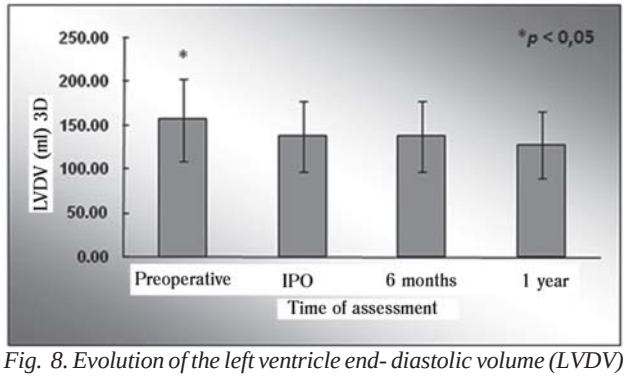

*Fig. 8. Evolution of the left ventricle end- diastolic volume (LVDV) during the study. We observed significant reduction in LVDV between the time Pre (preoperative) and IPO (immediate postoperative). This reduction remains stable during the study. Values = mean ± standard deviation. * P <0.05 compared to IPO*

difference does not reach statistical significance ($P = 0.053$), but when comparing the postoperative period and 6 months it shows a statistically significant difference ($P < 0.001$). In the period between 6 months and 1 year, there was stabilization of atrial function ($P = 0.859$).

The end-systolic volumes of the left ventricle (LVESV) in the preoperative, postoperative, 6 months and 1 year periods were 66.14 ± 20.62 ml, 61.21 ± 27.98 ml, 58.93 ± 25 , and 55.93 ± 25.36 61ml ml, respectively. Significant effect of condition evaluation during the study period was observed ($P < 0.001$). At the end of the study there was 15.4% reduction in end systolic volume of the left ventricle when compared to the means of the preoperative and 1 year periods. Figure 7 represents the evolution of the LVSV along the study. Although there is a reduction in ventricular systolic volume when comparing the preoperative and immediate postoperative period, there was no statistical significance ($P = 0.177$). During the evolution of the study, there was progressive reduction of these volumes when comparing the periods IPO and 6 months and POI with1 year, reaching statistical significance ($P = 0.011$ and $P = 0.020$, respectively).

The left ventricle end-diastolic volumes (LVDV) in the preoperative, postoperative, 6 months and 1 year periods were 156.57 ± 46.61 ml, 137.71 ± 40.12 ml, 137.21 ± 40 , 127.86 ± 37.98 and 58ml ml, respectively. Significant effect of condition evaluation during the study period was observed ($P < 0.001$). At the end of the study there was a decrease of

Table 1. Analysis of subgroup compared to the presence of atrial fibrillation.

Variable	Period	AF (n = 8)	No AF (n = 6)	*P* PA	PB
LAESV	Preoperative	53.38 ± 11.35	42.83 ± 18.04		
	IPO	48.38 ± 12.40	38.67 ± 11.67		
	6 months	45.25 ± 12.95	33.58 ± 13.57		
	1 year	44.81 ± 13.10	31.60 ± 11.86	0.582	0.116
LAEDV	Preoperative	83.25 ± 8.17	70.67 ± 17.41		
	IPO	73.25 ± 16.10	58.67 ± 22.85		
	6 months	75.38 ± 7.95	59.00 ± 13.13		
	1 year	74.20 ± 8.51	58.75 ± 13.55	0.645	0.051
LAEF	Preoperative	36.25 ± 8.88	44.00 ± 8.34		
	IPO	42.88 ± 14.88	45.78 ± 8.38		
	6 months	44.13 ± 13.92	47.67 ± 7.09		
	1 year	42.75 ± 11.90	48.83 ± 8.66	0.775	0.383
LVESV	Preoperative	70.25 ± 24.62	60.67 ± 13.95		
	IPO	66.88 ± 33.14	53.67 ± 19.46		
	6 months	64.75 ± 30.47	51.17 ± 16.71		
	1 year	60.38 ± 29.95	50.00 ± 18.50	0.530	0.394
LVEDV	Preoperative	151.75 ± 43.89	163.00 ± 53.52		
	IPO	140.38 ± 41.87	134.17 ± 41.29		
	6 months	138.63 ± 40.57	135.33 ± 44.38		
	1 year	131.13 ± 37.59	123.50 ± 41.62	0.667	0.948
LVEF	Preoperative	56.38 ± 8.48	60.00 ± 2.45		
	IPO	54.25 ± 9.87	57.67 ± 5.43		
	6 months	55.00 ± 9.43	59.00 ± 1.55		
	1 year	53.38 ± 10.08	58.33 ± 1.97	0.892	0.320

Analysis of subgroup compared to the presence of atrial fibrillation. Values = mean ± standard deviation P_A*: statistical significance of the group comparison according to the behavior along the study,* P_B*: statistical significance of the mean comparison between groups in different times of assessment. AF = atrial fibrillation, LAEF = left atrium ejection fraction, IPO = immediate postoperative, LAEDV = left atrium end-diastolic volume, LAESV = left atrium end-systolic volume*

18.3% in the end-diastolic volume of the left ventricle when compared to the means of the preoperative and 1 year periods. Figure 8 represents the evolution of LVDV throughout the study. By comparing the preoperative and immediate postoperative periods, we noted a significant reduction in the mean of diastolic left ventricular volumes ($P = 0.024$). This reduction remains stable throughout the study period, no significant difference was observed when comparing the periods IPO with 6 months and IPO with 1 year ($P = 0.698$ and $P = 0.058$, respectively).

The ejection fractions of the left ventricle (LVEF) in the preoperative, immediate postoperative, 6 months and 1 year periods were 57.93 ± 6.67%, 55.71 ± 8.18%, 56.71 ± 7.28% and 55.50 ± 7.92%, respectively. There was no effect of condition assessment in the analysis of this variable ($P = 0.260$). At the end of the study, there was a slight reduction in ejection fraction compared to the pre-operative period, although without statistical significance. On average, there was a 4.2% decrease in left ventricular ejection fraction.

We performed subgroup analysis, taking into account the presence of atrial fibrillation (Table 1). There was no statistically significant difference compared to the behavior of the study groups throughout the study and in the comparison of means at the different times evaluated compared to the variables: systolic and diastolic volume of the left atrium, ejection fraction of the left atrium, systolic volume of the left ventricle, diastolic volume of the left ventricle and ejection fraction of the left ventricle.

DISCUSSION

There are several surgical techniques that can be applied to the mitral valve system in order to preserve the valve. The authors defend that the use of a prosthetic ring in mitral valve repair stabilizes the posterior component of the mitral ring, avoiding annular redilation, a mechanism which is related to a reduction of the durability of the valve repair. However, experimental and clinical studies have identified adverse pathophysiological effects of the use of prosthetic rings. The implantation has the disadvantage of altering the physiological morphology of the mitral annulus, making the saddle shape of the mitral annulus flattened in shape, affecting transmitral blood flow. Intracardiac prosthetic materials are predisposed to the occurrence of infection, thrombosis, formation of pannus or thrombus.

The use of a prosthetic ring is associated with the anterior systolic motion of the mitral valve anterior cusp leading to obstruction of the left ventricle outlet tract and left ventricular dysfunction. Calcification and late fibrosis in the site of implantation of the prosthetic ring have been described in re-explored patients after valve repair. The techniques of mitral repair without using prosthetic rings preserve the dynamics of the mitral valve, preserving left ventricular function. Complications related to insertion of a prosthetic material are avoided, and also present a lower cost [17].

Recently, Fundarò et al. [17] published a review of major studies that analyzed the clinical results of annuloplasty techniques without a prosthetic ring. One of the most significant points of this study was to classify these techniques into two types according to the location of the procedure: Wall and commissural annuloplasty. The wall annuloplasties were subdivided into semicircular plication, when a shortening of all segments of the mitral ring is carried out, and the segmental plication, when a plication is performed in the annulus corresponding to the segment of the posterior cusp removed in the quadrangular resection.

The best early and late results were found in patients with degenerative etiology who underwent segmental plication or semicircular reduction. In the immediate evaluation, patients undergoing these techniques showed low rates of residual mitral regurgitation, between 1% and 2%, being that in most studies it was not observed early structural failure of the valve repair. The mid-term evaluation showed excellent results. Actuarial survival was 90% in 5 years. Furthermore, the best results of survival free of reoperation were found in patients undergoing segmental plication or semicircular reduction, especially in patients with degenerative mitral regurgitation. The curves of actuarial survival free of thromboembolism and endocarditis showed excellent results. The authors concluded that the techniques of segmental and semicircular plication options may be valid and reliable, especially in patients with posterior cusp prolapse associated with mild dilatation of the mitral annulus, reviving questions about the necessity of the use of prosthetic rings.

Brandão et al. [20] found excellent clinical results in mitral valve repair with the use of the Double Teflon technique for 10 years of monitoring. Actuarial survival was 94.1 ± 3.6%, survival free of thromboembolism was 97.3 ± 1.5% and survival free of reoperation was 99.2 ± 0.8%.

In this study, we evaluated 14 patients with mitral valve prolapse with involvement of the posterior cusp, submitted to the Double Teflon technique. This technique, which was classified in 2007 by Fundarò et al. [17] as segmental annuloplasty, obtained clinical results similar to those found in the literature, being this the pioneering study on three-dimensional echocardiographic analysis of postoperative remodeling of the left cavities of a homogeneous population with degenerative valve disease undergoing surgical repair using a technique of annuloplasty without prosthetic rings over a year.

Previous studies of two-dimensional echocardiography demonstrated significant reduction in the volumes of the left atrium and left ventricle after the correction of valvular insufficiency with or without the use of mitral rings [19,24].

Mor-Avi and Lang [23] showed that the three-dimensional echocardiography provides better accuracy than the two-dimensional method for the assessment of cavity volumes in compared to magnetic nuclear resonance, considered the gold standard. There is little available data on the remodeling of the left cavities after mitral valve repair using three-dimensional echocardiography. Furthermore, the populations studied are etiologically heterogeneous and, in general, underwent mitral valve repair by techniques using prosthetic rings. The present study describes the morphology and function of the left atrium and left ventricle over 1 year postoperatively, in a homogeneous population in relation to the etiology of mitral regurgitation submitted to mitral valve repair without the use of prosthetic rings.

In this study, we observed a distinct behavior of the systolic and diastolic volumes of the left chambers throughout the study. Regarding the systolic volumes, the LA and LV performed similarly, reducing their volume progressively throughout the study in 19.9% and 15.4% respectively. The pattern of progressive reduction of systolic volumes of the left chambers observed in this study may reflect the phenomenon of reverse cardiac remodeling after correction of mitral regurgitation.

We also observed that the mean of systolic volume of the LV, observed at the end of the study, returns to values considered within normal limits. Regarding the diastolic volumes, the LA and LV also exhibited similar behavior, reducing their volume in the immediate postoperative period and remained stable throughout the study. The pattern of immediate reduction of diastolic volumes in the left chambers observed in this study may be related to the discontinuation of volume overload imposed by mitral regurgitation after surgical repair.

Atrial fibrillation is an independent predictor of cardiovascular events [25]. In this series, approximately half of the patients had this arrhythmia during the study. We performed a subgroup analysis to assess whether the presence of atrial fibrillation could have an impact on the results of the trial. We found no significant changes in the behavior of variables studied during the study, showing that the mitral valve repair allowed atrial and ventricular reverse remodeling regardless of atrial fibrillation. It is possible that patients with persisting atrial fibrillation over time will not differ in behavior, but rather in the magnitude of the remodeling. We identified that the trend of reverse remodeling was higher in patients with maintenance of atrial contraction. However, the results acquired must be viewed with caution due to the small number of patients allocated to each group in this analysis.

In this study, we used three-dimensional transthoracic echocardiography, a new technology under development, which has shown better accuracy than the two-dimensional method. We believe that in the near future, the three-dimensional echocardiography will be an obligatory and indispensable tool in centers that intend to perform preserving valve surgery.

CONCLUSION

We concluded that patients undergoing mitral valve repair using the Double Teflon technique presented both reverse remodeling of the left atrium and left ventricle. This reduction in cavity volume was associated with improved left atrial function.

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