Left atrial reduction by posterior wall plication combined with mitral valve surgery in patients with a dilated left atrium

Dilate sol atriyumlu hastalarda mitral kapak cerrahisi ile birlikte posteriyor duvar plikasyonu ile sol atriyal küçültme

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Background: We aimed to reduce atrial fibrillation and thromboembolic events by reducing left atrial dilatation via posterior plication technique.

Methods: Between May 2003 and January 2009, 38 patients (17 males, 21 females; mean age 53.7±9.9 years; range 44 to 76 years) underwent mitral valve surgery with left atrial reduction by posterior wall plication. Neither bipolar nor unipolar catheter ablation therapy for chronic atrial fibrillation (AF) was performed in this study. We also did not include patients in this study who had undergone radiofrequency ablation therapy for chronic AF.

Results: At discharge, 15 patients (39%) were in sinus rhythm. During follow-up, sinus rhythm was restored in 14 patients (37%). Left atrium diameter was significantly reduced from 7.0±1.4 cm preoperatively to 4.6±0.5 cm at six months after surgery.

Conclusion: In conclusion, left atrial size reduction is simple, takes less time, and is also effective in maintaining sinus rhythm without adding any additional mortality or morbidity compared to mitral valve surgery alone.

Key words: Heart valve diseases; left atrial reduction process; mitral valve.

Amaç: Sol atrial genişlemenin posteriyor plikasyon yöntemiyle azaltılması ile atriyal fibrilasyon ve tromboembolik olayların engellenmesi amaçlandı.

Çalışma planı: Mayıs 2003 ile Ocak 2009 tarihleri arasında 38 hastaya (17 erkek, 21 kadın; ort. yaş 53.7±9.9 yıl; dağılım 44-76 yıl) posteriyor duvar plikasyonu ile sol atriyal küçültmeli mitral kapak cerrahisi ameliyatı uygulandı. Bu çalışmada kronik atriyal fibrilasyon (AF) için ne bipolar ne de unipolar kateter ablasyonu tedavisi uygulandı. Ayrıca kronik AF için radyofrekans ablasyonu uygulanan hastalar çalışmaya dahil edilmedi.

Bulgular: Taburcu olduklarında hastaların 15'i (%39) sinüs ritmindeydi. Takip sırasında sinüs ritmi 14 hastada (%37) geri döndü. Sol atriyumun ameliyat öncesi çapı, ameliyat sonrası 6. ayda 7.0±1.4 cm'den 4.6±0.5 cm'ye anlamlı ölçüde azalmıştı.

Sonuç: Sol atriyum boyut küçültülmesi basittir, az zaman alır, aynı zamanda sinüs ritminin korunmasında etkindir ve tek başına mitral kapak cerrahisi ile karşılaştırıldığında herhangi bir ek mortalite ve morbiditeye neden olmaz.

Anahtar sözcükler: Kalp kapak hastalıkları; mitral kapak; sol atriyum küçültme işlemi.

Most of the patients who undergo mitral valve (MV) surgery also have left atrial (LA) enlargement and chronic atrial fibrillation (AF). Atrial fibrillation is closely related with the LA enlargement. Atrial fibrillation and LA enlargement cause several morbidities and mortalities. Mitral valve surgery alone mostly does not restore sinus rhythm or prevent recurrence of AF after surgery. Left atrial size is critically important for the restoration of the sinus rhythm, and LA reduction alone may augment the maintenance of the sinus rhythm.[1,2] Stroke is the most feared complication of AF, and left atrial appendage (LAA) obliteration could be a potentially valuable strategy for stroke prevention.[3,4] We used LA plication to reduce the LA size and incidence of AF. It consists of MV repair or replacement combined with LA posterior wall plication. The LAA orifice is also sutured from inside. In this study, we report our experience with this surgical concept.

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PATIENTS AND METHODS

Thirty-eight patients (21 females, 17 males; mean age 53.7±9.9 years; range 44 to 76 years) who underwent elective MV replacement or MV repair along with a LA volume reduction operation in our clinic between May 2003 and January 2009 were enrolled in this study. Neither bipolar nor unipolar catheter ablation therapy for chronic AF was performed in this study. We also did not include patients who had undergone radiofrequency ablation therapy for chronic AF.

The etiology of the MV disease was rheumatic in 29 patients (76%) and degenerative in nine (24%). Eight (21%) of the patients had mitral stenosis, 16 (42%) had mitral insufficiency, and 14 (37%) had mitral insufficiency and stenosis. All the patients were in chronic AF except one who was in sinus rhythm with paroxysmal atrial tachycardia. A total of eight patients (21%) were in New York Heart Association (NYHA) class II, 19 (50%) were in class III, and 11 (29%) were in class IV.

The echocardiographic imaging was performed in each patient pre- and postoperatively at six days and six months after surgery, during which MV function and LA diameters were evaluated (Table 1). The echocardiographic data obtained in each patient was the anterior-posterior diameter in the parasternal axis view (Table 2). Preoperative transesophageal echocardiography (TEE) was done in all patients in order to assess the MV reparability, except in one patient who did not tolerate it due to orthopnea. On the other hand, all of the patients underwent intraoperative TEE. No reoperation was performed for bleeding, pericardial tamponade, or valvular issues.

Pharmacological antiarrhythmic treatment was continued until at least the sixth month in patients who were in sinus rhythm postoperatively. All the patients were on oral anticoagulant treatment before surgery because of chronic AF. Mitral valve surgery with LA reduction and internal suturing of the LAA orifice were performed in all patients.

Table 1. Preoperative echocardiographic and hemodynamic parameters

Variable	n	%	Mean±SD
Ejection fraction			
>0.50	21	55.2	
0.30-0.50	15	39.4	
<0.30	2	5.2	
Left ventricle end-diastolic dimension (mm)			56±7.9
Left ventricle end-systolic dimension (mm)			37.4±8.5
PAP (mmHg)			53.7±10.9

SD: Standard deviation; PAP: Pulmonary artery pressure.

Operation and anesthesia

Anesthesia induction was performed by fentanyl, midazolam, and pancuronium. Patients were monitored by radial artery, internal jugular vein and urinary catheter. Operations were performed by median sternotomy in 34 patients and right thoracotomy in four cases. After systemic heparinization, the ascending aortic and bicaval venous cannulations were done as usual. Cardiopulmonary bypass was initiated with crystalloid priming. Intermittent cold blood cardioplegia was used for myocardial protection during aortic cross clamping. The mean cardiopulmonary bypass and aortic clamping times were 81±24 min and 70±15 min, respectively.

Surgical technique

After the classical left atriotomy, we occluded the LAA and plicated the inferior (or posterior) wall of the left atrium. Following atriotomy along the interatrial groove, para-annular plication parallel to the posterior mitral annulus of approximately 10-20 mm was performed (Figure 1). The posteroinferior wall of the left atrium between the ostia of inferior pulmonary veins and the posterior mitral annulus were plicated in a semilunar fashion. In the first stage, the LAA was occluded with continuous 4/0 prolene sutures. In the second stage, with the same suture, the LA posterior wall was plicated with stay-sutures at a distance 20-30 mm from each other, 15-20 mm from the ostia, and 10 mm from the annulus. Then a second row of continuous sutures (over-and-over) was fashioned (Figures 2a-d).

Statistical analysis

Statistical analysis was performed using the commercially available statistics software SPSS 11.5 version for Windows, (SPSS Inc., Chicago, Illinois, USA). A p value of less than 0.05 was considered to be statistically significant. All the quantitative data was expressed as mean ± standard deviation (SD), and categorical data as n (%) unless specified otherwise. Paired samples t-tests were used to compare the pre- and postoperative six-day and six-month values.

RESULTS

Open mitral commissurotomy and mitral ring annuloplasty were performed in only one patient (3%), mitral ring annuloplasty in 13 (34%), and mitral valve replacement (MVR) in 24 (63%). Tricuspid De Vega annuloplasty was performed in six (16%) cases and

tricuspid ring annuloplasty in 13 (34%). Coronary artery bypass grafting (CABG) was performed in one case and aortic valve replacement (AVR) in three cases.

There was no operative mortality, and none of the patients required re-intervention for bleeding. Sixteen patients had sinus rhythm after their operations, and one of them developed AF in the first hour after surgery. Although medical treatment was given, this patient remained in AF at the time of discharge. Except for temporary atrial premature systoles, there were no other arrhythmic problems observed.

Table 2. Preoperative and postoperative echocardiographic results of patients

	Preop.		Postop. 6th day	Postop. 6th month
Patient	Mitral valve function	LAD (cm)	LAD (cm)	LAD (cm)
1	MS	6.9	4.5	4.8
2	MR	9.8	5.4	5.1
3	MS, MR	5.8	3.8	3.8
4	MS, MR	8.3	5.1	5.0
5	MR	5.1	4.2	4.4
6	MR	5.6	4.1	4.0
7	MS, MR	7.2	4.5	4.5
8	MS, MR	8.2	5.9	5.9
9	MS	5.3	3.9	3.8
10	MR	5.9	4.2	4.2
11	MS, MR	6.1	4.7	4.8
12	MS	6.4	3.7	3.9
13	MS	6.2	4.0	4.2
14	MS, MR	6.5	3.9	4.0
15	MS, MR	8.3	4.7	4.6
16	MS	5.8	4.1	4.1
17	MS	9.1	5.2	5.2
18	MS	5.7	3.9	4.0
19	MR	6.2	4.1	4.2
20	MS, MR	7.7	5.1	5.0
21	MS	6.8	4.5	4.5
22	MS	6.9	4.2	4.3
23	MR	5.6	3.9	3.9
24	MS, MR	5.7	4.1	4.1
25	MY	6.0	4.5	4.7
26	MR	6.9	4.8	4.8
27	MR	6.3	4.7	4.9
28	MR	6.5	4.6	4.6
29	MR	8.8	4.5	4.7
30	MR	8.3	4.7	4.9
31	MS, MR	7.0	4.9	5.0
32	MS, MR	6.1	5.0	4.9
33	MR	12.0	5.0	5.0
34	MR	7.9	5.1	5.3
35	MR	6.6	4.9	4.7
36	MR	7.3	4.8	4.8
37	MR	8.3	5.2	5.4
38	MR	6.9	4.7	4.9
Mean±SD		7.0±1.42	4.55±0.51	4.59±0.50

Preop.: Preoperative; Postop.: Postoperative; LAD: Left atrium diameter; MS: Mitral stenosis; MR: Mitral regurgitation.

All the patients received respiratory support between the fourth and 30th hours after surgery (mean 9±11). One of the patients was admitted to the intensive care unit (ICU) for 23 days due to the development of acute renal failure. For the rest of the patients, the period of stay in the postoperative ICU was two to five days (mean 2.8±1.1 days). There were no in-hospital deaths and the mean postoperative hospital stay was 9±0.9 (range 6-30) days.

A postoperative echocardiographic follow-up study was performed on the sixth day and sixth month to evaluate the size of the LA. An important, statistically-significant ($p<0.05$) reduction was observed in the LA diameters by echocardiography after surgery (7.0±1.4 versus 4.6±0.5- 4.6±0.5 cm). When the postoperative six-day and six-month measurements were compared, no significant differences were found ($p<0.05$; Table 2). Overall, 15 (39%) patients had sinus rhythm at discharge. At follow-up six to 28 months after surgery (11.1±6.8 months), 33 patients (87%) were in NYHA class I, five (13%) were in NYHA class II, and 14 (37%) patients remained in sinus rhythm. There were no patients left in NYHA class III-IV. At follow-up, only one patient had a transient ischemic attack without any neurological sequel. Antiarrhythmic treatments (amiodarone, calcium channel blocker, and beta blocker) were eliminated after six postoperative months. Oral anticoagulant treatment was continued in all the patients who had a mechanical MVR and/or had AF. Oral anticoagulant treatment of patients who had sinus rhythm and underwent mitral repair surgery was stopped at six months during the follow-up.

DISCUSSION

Giant left atrium (GLA) is closely related to rheumatic MV regurgitation or mixed mitral disease with predominant regurgitation. Giant left atrium is rare in patients with nonrheumatic MV regurgitation.[4] In 76% of our patients, rheumatic MV disease was detected. Currently, there is no consensus regarding the management of GLA during MV surgery. Most surgeons fix the MV and do little to an oversized left atrium. Others occlude the LA appendage.[5-8] According to Di Eusanio et al.[7] about 19% of patients requiring an operation for MV disease had GLA. Patients with GLA always have a long history of MV disease and

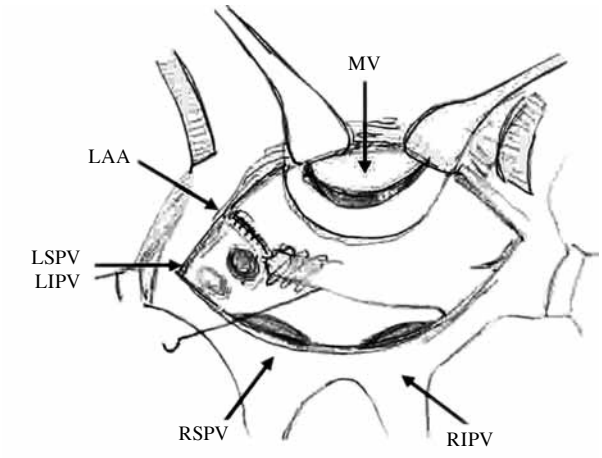

Figure 1. Schematic representation of surgical technique performed to reduce left atrial. MV: Mitral valve; LAA: Left atrial appendage; LSPV: Left superior pulmonary vein; LIPV: Left inferior pulmonary vein; RSPV: Right superior pulmonary vein; RIPV: Right inferior pulmonary vein.

atrial fibrillation, and very often they present with hemodynamic and/or respiratory complications as well as the formation of atrial thrombus.[7,9-11]

The current methods for LA volume reduction may be classified into three categories: partial plication or excision of the inferior atrial wall, partial plication or excision of both the inferior and superior atrial walls, and partial auto-transplantation of the heart. The main advantage of resection techniques is that they are not blind, and the surgeon has direct vision to free any adhesions and avoid injury behind the posterior wall.[4] Our posterior plication technique with the LAA orifice obliteration is a simple and usable method. We don't make any incision in the LA posterior wall. Because of the thinness of the LA wall in GLA, the excision technique may cause bleeding. We did not perform any excision in our technique, so we did not observe any bleeding. In this technique, we managed to have enough reduction in the LA size. In contrast, the disadvantage of plication techniques is the lack of releasing posterior wall adhesions to mediastinal organs; therefore, mediastinal structures could be injured owing to the blind nature of this process.[4] In our study, no such complications were observed.

Chronic AF usually accompanies MV disease at the time of surgery, especially when the LA is enlarged. This is the main determining factor in the occurrence and maintenance of chronic AF.[12] In many instances, MV surgery does not result in long term relief of AF. The restoration of atrial pump function and maintenance of an adequate heart rate during exercise are major advantages of treating AF in those cases with enlarged LA and MV disease. It is known that LA volume is one of the independent predictive factors for both occurrence and recurrence of AF, especially when the LA size is in excess of 45 mm.[12-14] After LA surgery, there was also a significant increase in vital capacity as well as an increased probability of regaining postoperative sinus rhythm.[4] Schrerer et al.[15] showed in a comparative study that GLA reduction after radiofrequency ablation contributes to a higher restoration of sinus rhythm (77.3% vs 61%) after one year. This was proportional to the LA size reduction (from 69±19 mm to 51±8 mm) and possible reduction of late thromboembolic complications due mainly to a significant reduction of the LA size as well as to the restoration of normal rhythm. However, this is difficult to understand when warfarin was in use.[16-18] In our follow-up, only one patient had a transient ischemic attack without any neurological sequela.

The procedure that we used in our study is a simple technique and effectively reduces the LA size. We used this technique in 38 patients and 15 of them (39%) remained in sinus rhythm at discharge. Twenty-three cases (61%) had AF postoperatively, although they were treated with pharmacological agents in the first postoperative days. Fourteen patients (37%) had sinus rhythm after six months without any antiarrhythmic medication during follow-up.

In conclusion, it is well-known that most of the patients who undergo MV surgery also have LA enlargement and chronic AF, and this is closely related with LA dilatation. Also, stroke is the most feared complication of AF, and LAA obliteration could potentially be a highly valuable strategy for stroke prevention in these patients. The procedure that we used in our study is a simple technique which effectively reduces LA. We believe that this technique is simple, time effective, and also successful in maintaining sinus rhythm without any additional mortality or morbidity compared to MV surgery alone.

Declaration of conflicting interests

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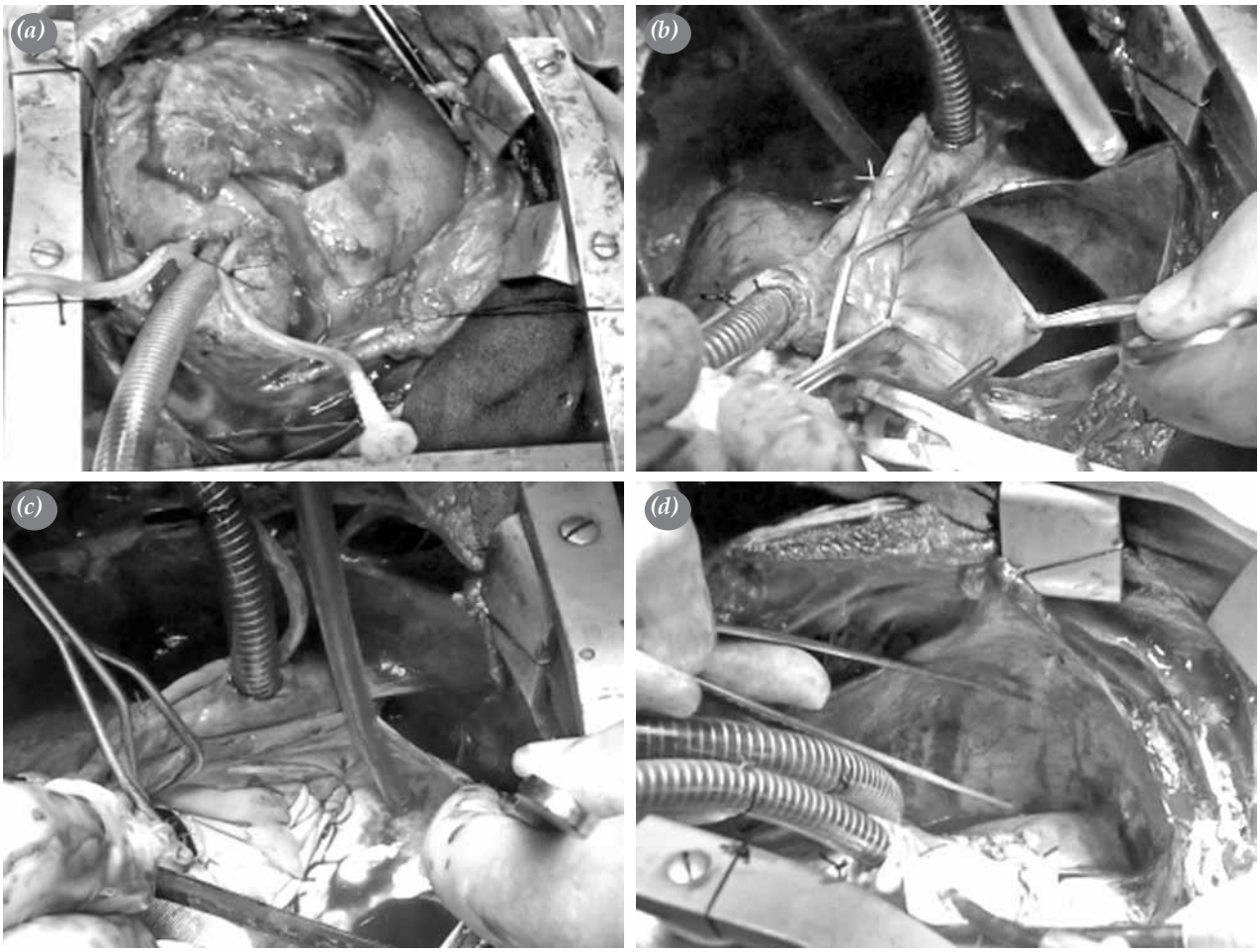

Figure 2. (a) A view of giant left atrial. **(b)** Lateral wall of giant left atrial. **(c)** The plication stitching of the posterior wall. **(d)** Post-procedural view of left atrial reduction surgery.

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