Early and long-term outcomes and quality of life after concomitant mitral valve surgery, left atrial size reduction, and radiofrequency surgical ablation of atrial fibrillation

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Abstract

Objective: Atrial fibrillation (AF) is the most formidable supraventricular tachyarrhythmia, which worsens the natural course of mitral valve disease. In this study, we evaluated early and long-term results and quality of life (QOL) after simultaneous surgical radiofrequency ablation (RFA) of AF, left atrial reduction and mitral valve repair or replacement.

Methods: Overall, 147 patients with mitral valve diseases who underwent mitral valve surgery were included in this prospective cohort study. Patients were divided into two groups according to the type of operation: the study group—patients after mitral valve surgery with concomitant radiofrequency surgical ablation and left atrial reduction procedure (54 patients), and the control group—patients undergoing only mitral valve surgery (93 cases). We assessed AF recurrence and sinus rhythm restoration rates and mortality rates, QOL measures, postoperative complications rates, and left atrial size during follow-up.

Results: In the study group, sinus rhythm restoration rate in the early postoperative period was 63%, but at the time of discharge it reduced to 29%; after 6 months, it significantly increased to 72% and after 3 years, to 81% (p=0.02). In the control group, the sinus rhythm restored only in 14% after 1 year, and at 3 years, it was 22%, although in the early postoperative period it, was 43%. Analysis of left atrial size before and after surgery showed that dimension significantly reduced in both groups (study group, p=0.013; control group, p=0.024). In addition, in patients undergoing surgical RFA procedure, there was a significant association between shorter heart disease history (p=0.02) and shorter AF history (p=0.074) with maintenance of sinus rhythm. The mortality rate in the study group was 4% (two patients) and in the control group 5% (five patients). Comparison of QOL measures between study and control groups after 1 year showed that patients undergoing concomitant atrial reduction surgery and RFA had significant improvement of QOL physical (p=0.03) and role (p=0.03) functioning, heartbeat (p=0.01), general (p=0.03) and mental health (p=0.01), vitality (p=0.007), and social role (p=0.02) functioning measures as compared to preoperative state, being higher than in patients who underwent only mitral valve surgery.

Conclusion: Application of surgical RFA using irrigated cooling electrode and atrial reduction during mitral valve surgery is associated with higher restoration and maintenance of SR as compared to patients undergoing only mitral valve surgery. We did not observe complications related to AF surgery that required permanent pacemaker implantation. Performing concomitant surgery as surgical RFA, atrial reduction along with mitral valve surgery, improves QOL in the short- and long-term and reduces the feeling of heartbeat and discomfort. *(Anatol J Cardiol 2016; 16: 797-803)*

Keywords: mitral valve disease, atrial fibrillation, surgical radiofrequency ablation, atrial reduction surgery, mitral valve repair, mitral valve replacement, quality of life, outcome

Introduction

Atrial fibrillation (AF) is the most formidable supraventricular tachyarrhythmia, which worsens the natural course of the mitral valve (MV) disease (1). In the setting of MV disease, AF mostly occurs due to an enlarged left atrium, and it is the cause of increased morbidity and mortality in consequence of progressive heart failure, stroke, and other thromboembolic complications (2). In addition, these patients are constantly worried by irregular heartbeat and discomfort, which further worsens the general health (3). Some studies have shown that patients with AF have a significantly lower quality of life (QOL) than the healthy population, general population, and other patients with cardiovascular diseases (4). Only MV surgery does not solve the problem of arrhythmia, so a combined MV and AF surgery may be beneficial for the patient.

There are a few studies dedicated to assessing QOL in patients after MV surgery (5), concomitant maze procedure with valve surgery (2) or coronary artery bypass grafting (6), catheter

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Accepted Date: 24.07.2015 **Available Online Date:** 23.03.2016

DOI:10.14744/AnatolJCardiol.2015.6960

ablation, and medical therapy (2). However, we could not find any studies devoted to the evaluation of QOL in patients after left atrial (LA) reduction procedures; and moreover, there were no studies with one-time application procedures as LA reduction, surgical ablation, and MV surgery—repair or replacement.

Therefore, in this study, we evaluated early and long-term outcomes and QOL after simultaneous surgical radiofrequency ablation (RFA) of AF, LA reduction, and MV repair or replacement.

Methods

Study design and patients

The design was a prospective cohort study. Overall, 147 patients with MV diseases who underwent MV surgery (repair or replacement) in the Clinical Research Center for Cardiac Surgery and Transplantation, Taraz, Kazakhstan in the period from October 2010 to December 2014 were included in the study. The main exclusion criteria were aortic valve diseases needing surgical correction and concomitant coronary artery bypass grafting operations.

The study protocol was approved by the Ethics Committee of the Clinical Center. Before inclusion in the study, all participants provided written informed consent to the procedure and possible complications of the treatment; they also gave consent to further assessing the QOL using the SF-36 questionnaire.

Patients were divided into two groups according to the type of operation: the study group—patients undergoing MV surgery with concomitant RFA surgical ablation and LA reduction procedure (54 patients) and the control group—patients undergoing only MV surgery (93 cases).

Baseline clinical variables

We assessed age, gender, etiology, concomitant heart diseases, AF type, and duration, preoperative cardiac rhythm on electrocardiogram (ECG), echocardiography measured LA size, and left ventricular ejection fraction (LVEF).

MV surgery, atrial reduction procedures, and surgical ablation of AF

Standard cardiopulmonary bypass was established through median sternotomy or through the anterior mini-thoracotomy in the 3rd intercostal space, cutting the 4th rib cartilage. Access to the MV was carried out through right atrium and interatrial septum or through the left atrium over the interseptal groove. We performed MV surgery: If MV leaflets were in good condition we preserved them and repaired; if they were bad, we replaced them.

For surgical ablation, we preferred radiofrequency energy because it was the first technology certified in Kazakhstan. Surgical RFA was performed by using the Medtronic Cardioblate-68000 (Medtronic BB, Minneapolis, USA) with monopolar saline irrigated cooled tips. Surgical RFA were performed by the scheme of Maze-IV (7).

LA reduction procedure was performed according to echocardiography data: if in women, LA antero-posterior dimensions were more than 4.7 cm and men, more than 5.2 cm (8). The reduction techniques were made by application of LA free walls (so-called atrioplasty) with double-row suture and without excision of atrial tissues, i.e., the integrity of LA walls was intact. We used the following reduction technologies:

- application of interatrial septum and sealing LA appendage—30 patients (55%),
- para-annular plication of LA wall among the MV—eight patients (14%), and
- application of area between the right and the left pulmonary veins—five patients (10%).

The operation ended by suturing myocardial electrodes for temporary pacemakers.

Quality of life measures

For assessing QOL, we used a modified SF-36 questionnaire, (9) replacing the 3rd section "bodily pain" to "heartbeat" because it is a typically characteristic symptom for AF. The scales ranged from 0 to 100 points. The numbers close to 100 points were the mark of improvement, but "heartbeat" was in reverse effect: the smaller number of points shown, the fewer disturbances. QOL measures were taken before operation, 6 months after operation, and 1 year after operation.

Electrocardiography

The 12-lead ECGs were recorded using Heartscreen (Inomed Medical Inc., Hungary) before operation, in early postoperative period, at discharge, after 3–6 months, after 1 year, and after 3 years. From recorded ECGs, we determined the source of heart rhythm: presence of AF or sinus rhythm (SR).

Echocardiography

Echocardiography was performed using iE33 xMATRIX Echocardiography System (Philips, USA). We assessed LA size and LVEF before operation, at discharge time, and 12 months after operation.

Postoperative rhythm and rate control medications

After concomitant MV surgery, LA reduction and RFA patients received amiodarone from early postoperative day in a maximum dose of 900 mg in 24 hours, followed by 200 mg per day until 6 months. However, if patients had contraindications, we administered β-blockers. In 75% of cases, insomnia, nightmare, and low blood pressure developed during 1 week after discharge; in these patients, amiodarone therapy was replaced by β-blocker treatment.

Follow-up

The observation period was from early postoperative until 3 years (36 months). We recorded AF recurrence and SR restoration/maintenance in early postoperative period, at discharge, after 3–6 months, after 1 year, and after 3 years. We assessed

QOL and LA size before operation and during 1-year follow-up. We also evaluated AF recurrence and SR restoration according to the type of MV surgery and AF surgery (biatrial and LA RFA), rhythm, and rate control postoperative therapy. We also analyzed postoperative need for pacemaker therapy and mortality rate.

Statistical analyses

Statistical analysis was performed using STATISTICA software (StatSoft Inc., USA). The continuous variables are presented as mean±standard deviation values and compared using unpaired test for independent samples (Student's t test). Categorical variables are presented as a number (percentage) and were compared using chi-square test. Student's t-test was also used to compare one group before and after treatment. If there were more than two groups of data, then analysis of variance (ANOVA) was used for comparison of continuous data. The repeated measurements ANOVA test was used to compare LA size, LVEF, and QOL scales before and during follow-up within groups. Spearman correlation analysis was used to determine influencing factor to variables groups. Categorical variables represent a qualitative method of scoring data (i.e., represents categories or group membership) and can be included as independent variables in a regression analysis. The $p<0.05$ was accepted as a significant value.

Results

Clinical characteristics of the patients and types of MV surgery

As can be seen from Table 1, study and control groups did not differ by age, gender, and concomitant heart diseases, though more patients in the study group had MV disease of rheumatic etiology (p=0.02), while in the control group, the etiology of MV disease was more often due to degenerative process (p=0.04). Patients undergoing AF surgery had a higher rate of longstanding persistent AF (p=0.02), longer duration of AF (p=0.05), and all of them had AF preoperatively (p=0.04) as compared to patients undergoing only MV surgery. The study group patients also had larger LA size (p=0.004) and lower LVEF (p=0.03) than the control group patients.

Analyses of the type of MV surgery (Table 2) revealed that in study and control groups, MV repair were made less than replacement (p=0.01 for the study group and p=0.04 for the control group), but there was no difference between groups in the type of surgery (p>0.05 for both).

Table 1. Clinical characteristics of the patients before operation

Parameters	Study group	Control group	*P*
Total number of patients n, (%)	54 (100)	93 (100)	0.23
Age, years, M±SD	57±8	52±9	0.65
Male n, (%)	31 (58)	50 (54)	0.25
Etiology			
Rheumatic n, (%)	38 (71)	60 (64)	0.02
Endocarditis n, (%)	6 (11)	6 (6)	0.07
Degenerative n, (%)	10 (18)	27 (30)	0.04
Concomitant heart diseases			
Tricuspid valve disease n, (%)	11 (20)	31 (33)	0.12
Aortic valve disease n, (%)	5 (9)	11 (12)	0.09
Ischemic heart disease n, (%)	7 (13)	17 (18)	0.51
Left atrial myxoma n, (%)	1 (2)	3 (3)	0.14
AF type			
Paroxysmal n, (%)	0 (0)	3 (3)	0.19
Persistent n, (%)	2 (4)	27 (29)	0.61
Longstanding Persistent n, (%)	52 (96)	63 (68)	0.02
AF duration, years M±SD	5.9±2.1	5.4±1.7	0.05
Preoperative cardiac rhythm on ECG			
Atrial fibrillation n, (%)	54 (100)	82 (88)	0.04
Sinus rhythm n, (%)	0 (0)	11 (22)	1.0
Echocardiography			
Left atrial size, cm M±SD	6.4±1.9	5.4±1.7	0.004
LVEF, % M±SD	51.0±5.0	54.0±4.5	0.03

CG - electrocardiogram; LVEF - left ventricular ejection fraction; M - mean average; SD - standard deviation

Table 2. Types of MV surgery

Parameters	Study group	Control group	*P*
MV repair n, (%)	12 (22)	24 (26)	0.12
MV replacement, n, (%)	42 (78)	69 (74)	0.25

MV - mitral valve

Outcomes of AF surgery

AF recurrence and SR restoration and maintenance rates according to AF surgery

Biatrial surgical RFA was performed in 37 (68%) patients, whereas only LA ablations were performed in 17 patients (31%). After biatrial ablation, the restoration and maintenance of SR at the time of discharge was 69%; and at 3 years, it reached 78%, while in the LA ablation subgroup SR at discharge time was restored in 61%, but at 3 years it retained only in 70%.

Table 3 shows that in the study group, SR restoration rate in the early postoperative period was 63%, but at the time of discharge it reduced to 29%, whereas after 6 months it was significantly increased up to 72%, and further after 3 years up to 81% (p=0.02). In the control group, the SR restored only in 14% of patients after 1 year, and at 3 years it was 22%, although in the early postoperative period it was 43%. Comparison of SR maintenance and AF recurrence rates between groups showed that significantly more patients who underwent surgical RFA and atrial reduction surgery were free of AF postoperatively and maintained SR at discharge from hospital and during medium (6 months) and long-term (1–3 years) follow-up periods, as compared to patients who underwent only MV surgery ($p<0.05$ for all).

Table 3. AF recurrence and SR maintenance rates

ECG	Early postop/period	At discharge	After 3 months	After 6 months	After 1 year	After 3 years	*P*
Study group							
AF, n (%)	20 (37)	38 (71)	33 (62)	15 (28)	12 (23)	10 (19)	0.04
SR, n (%)	34 (63)	16 (29)	21 (38)	39 (72)	42 (78)	44 (81)	0.02
Control group							
AF, n (%)	53 (57)	89 (96)	91 (98)	89 (96)	80 (86)	72 (78)	0.07
SR, n (%)	40 (43)	4 (4)	2 (2)	4 (4)	13 (14)	21 (22)	0.16
**P*		0.0168	0.0001	0.0001	0.0001	0.0001	0.0001

*Comparison of SR and AF rates between groups AF -atrial fibrillation; SR -Sinus rhythm

AF recurrence and SR restoration and maintenance rates according to the type of MV surgery

Analysis of arrhythmia outcome according to the type of MV surgery showed no statistically significant difference between MV repair and replacement groups. However, there was a positive trend for within subgroups of MV repair and MV replacement in patients undergoing AF surgery. In the study group after MV repair, the SR restoration at the time of discharge was 67%, at 6 months it increased to 74%, but by the time of 3 years it was 75% (p=0.09). At the same time, after MV replacement the restoration of SR at the discharge time was 61%, at 6 months it was 71%, and in 3 years it reached 81% (p=0.06). Analysis of the control group data showed that after MV repair surgery the SR restoration rate at the time of discharge was 31%, after 6 months it reduced to 22%, and at 3 years it was 41% (p=0.12). After MV replacement the restoration of SR at the time of discharge was 51%, at 6 months 30%, and at 3 years 27% (p=0.23); however, the results did not show any statistically significant effects of the type of MV surgery on restoration of SR.

Effect of AF surgery on LA size and relationship between SR restoration rate and clinical variables

Analysis of LA size (Table 4) before and after surgery showed that LA dimension significantly reduced in both groups (study group p=0.013, control group p=0.024). However, LA size at discharge and after 1 year was significantly lower in the study group than in the control group (p<0.0001 for all).

We also found that in the control group, in case of anterior–posterior LA size >6.1 cm, the SR restored only in 27% of patients, whereas in the study group, SR was restored in 64% of patients even if LA size was >6.1 cm.

Table 4. Left atrial size after atrial reduction procedures

Left atrial size parameters	Study group	Control group	*P*
At discharge time, cm M±SD	4.0±0.3	4.7±0.7	<0.0001
After 12 months, cm M±SD	4.4±0.5	5.1±1.1	<0.0001
**P* (ANOVA was made in comparing with before operative data)	0.013	0.024	

Correlation analysis showed that in patients undergoing surgical RFA procedure there was a significant association between maintenance of SR and shorter heart disease history (r=0.49; p=0.02) and shorter AF history (r=0.75; p=0.024).

Postoperative complications, arrhythmia management, and outcomes

In the study group, the temporary pacemaker was used in 9 (17%) patients, and 16 (18%) patients in the control group, among whom SR was restored independently in the early postoperative period within 2–5 days after surgery. During the observation period, there were no cases of a complete atrioventricular block requiring implantation of a permanent pacemaker.

For some patients in the study group we administered β-blockers for maintaining SR, and within the first 6 months the restoration level was 80%, whereas in patients receiving amiodarone SR was restored only in 38% (p=0.002). Mean duration of amiodarone treatment was 4.0±2.7 months, while for β-blocker treatment it was 24.0±6.9 months (p=0.017).

Mortality

The mortality rate in the study group was two (4%) patients: the cause of death was acute ventricular arrhythmia (parasystole) in a patient with temporary pacemaker (i.e., pacemaker syndrome), and the other patient had acute heart failure. In the control group, five (5%) patients died: four patients from acute heart failure and one from bleeding.

Quality of life

SF-36 questionnaire scales for assessing QOL are shown in Table 5.

As seen from Table 5, in the study group, mean "heartbeat" score was 72±23 before surgery, which decreased significantly after operation (p=0.03) and at the 6-month (p=0.02) and 1-year (p=0.01) follow-ups; this shows the effectiveness of procedures for the restoration and maintenance of SR. At the same time, in the study group, there were marked improvements in physical, role, emotional, and social functioning scores, as well as in general vitality and mental health scores at the postoperative, 6-month, and 1-year follow-ups, as compared with preoperative state (all p<0.05).

Table 5. SF-36 questionnaire scales

Sections	Groups	Before operation	After operation	*P*	**P*	After 6 months	*P*	**P*	After 1 year	*P*	**P*
Physical functioning,	Study group	20±7	56±11	0.01	<0.0001	69±19	0.01	<0.0001	84±22	0.03	<0.0001
scores M±SD	Control group	38±12	41±9	0.08		43±5	0.1		49±7	0.1	
Role functioning,	Study group	38±13	66±21	0.01	<0.0001	74±22	0.05	<0.0001	81±17	0.03	<0.0001
scores M±SD	Control group	44±9	39±4	0.2		49±11	0.5		47±9	0.2	
Heartbeat,	Study group	71±23	34±13	0.03	<0.0001	30±8	0.02	<0.0001	21±5	0.01	<0.0001
scores M±SD	Control group	47±11	41±5	0.3		42±8	0.2		49±6	0.3	
General health,	Study group	39±7	65±17	0.02	<0.0001	74±27	0.04	<0.0001	89±21	0.03	<0.0001
scores, M±SD	Control group	51±5	56±9	0.1		53±7	0.9		54±6	0.4	
Thevitality,	Study group	44±12	76±19	0.04	<0.0001	84±25	0.03	<0.0001	88±31	0.007	<0.0001
scores, M±SD	Control group	49±5	62±11	0.05		57±7	0.1		60±5	0.9	
Social role functioning,	Study group	39±7	57±10	0.03	<0.0001	66±24	0.9	<0.0001	84±21	0.02	<0.0001
scores, M±SD	Control group	33±11	41±9	0.04		43±11	0.2		51±17	0.9	
ERF,	Study group	41±23	69±12	0.03	<0.0001	74±19	0.08	<0.0001	89±22	0.04	<0.0001
scores, M±SD	Control group	61±11	54±13	0.3		63±9	0.09		50±7	0.08	
Mental health,	Study group	39±7	60±11	0.02	0.596	81±26	0.01	<0.0001	89±29	0.01	<0.0001
scores, M±SD	Control group	55±13	59±11	0.1		51±5	0.3		59±9	0.2	

*Difference between study and control groups in periods after operation and at the 6-month and 1-year follow-ups. ERF - emotional role functioning

In contrast, there were no significant changes in all QOL measures in the control group (all p>0.05). There were no changes in "heartbeat" score either (p>0.05).

Comparison of QOL measures between study and control groups after 1 year showed that patients undergoing concomitant atrial reduction surgery and RFA had significantly better QOL physical (and role functioning, heartbeat, general and mental health, vitality, and social role functioning) measures as compared to patients who underwent only MV surgery (p<0.05 for all).

Overall, 74% of patients had improved social status and QOL after concomitant surgery, whereas QOL improved only in 57% of patients undergoing MV surgery.

Discussion

Our results demonstrated that LA reduction surgery and surgical RFA in patients undergoing MV surgery is associated with higher SR restoration rate and lower AF recurrence rate, as well as higher QOL, as compared to patients with AF undergoing only MV surgery. Concomitant RFA ablation, atrial reduction and MV surgery was accompanied by smaller atrial size at discharge and during follow-up as compared to patients undergoing only MV surgery. Higher SR restoration rate was associated with shorter duration of AF and MV disease. SR restoration and maintenance rates did not depend on type of MV surgery: repair or replacement, though patients undergoing AF surgery and MV replacement attained slightly higher rates at long-term follow-up as compared to patients undergoing AF surgery and MV repair.

Several studies are dedicated to determine SR restoration after surgical RFA. One of the first researchers performing RFA was Patwardan et al. (10); they used microbipolar coagulation for AF surgery during MV surgery with resulting SR restoration approximately 80%. Sie et al. (11) described results in 122 patients with a follow-up of 3 years and noted the restoration of SR in 78%. Chiappini et al. (12) performed RFA in 40 patients with a follow-up of 1.5 years and noted the restoration of SR in 88%. On the other hand, lower rates of SR were reported by Beukema et al. (13). In their study, 285 patients were included with a follow-up of 1, 3, and 5 years and freedom from AF rates were recorded in 69%, 58%, and 55% of cases, respectively. In our study, in the early postoperative period restoration of SR was 63%, at 6 months—71%, and after 3 years—81%. Ulrich et al. (14) published results using the same Medtronic Cardioblate device with restoration of SR in 75% of cases. The higher rates of SR restoration and maintenance in our and the latter study might be explained by different devices used. Use of irrigated cooled tips (electrodes) gives more chances to increase energy with less risk of damage surrounding tissues (like esophagus), which in turn through creating a more transmural damage and might increase numbers of patients with restored SR.

In addition, different ablation techniques could have an influence on restoration and maintenance of SR. Barnett et al. (15) in a meta-analysis of 5885 patients showed better results in biatrial ablation than in only LA ablation. However, Khargui et al. (16) reviewed 48 retrospective studies including 3832 patients and found no significant differences between biatrial and LA ablation procedures in restoration of the SR.

Also Wang et al. (7) in a prospective randomized trial defined no differences in outcomes during 28 months between use of LA + cavotricuspid ablation vs biatrial ablation techniques. In our study, biatrial ablation technique was associated with SR restoration in 78% of patients, compared to 67% in the group of only LA ablation.

In our opinion, higher rate of SR restoration and maintenance might be attributed also to LA reduction procedures performed during the same session with RFA, which reduces LA enlargement and creates preconditions for recovering the atrial contraction phase. Several studies indicated the size of the left atrium as a major predictor of AF recurrence in the early and late postoperative period (13, 17–19). Chen et al. (20) showed that the sinus conversion rate was significantly lower in patients with preoperative LA diameters >56.8 mm ($p<0.001$) or AF duration >66 months ($p<0.001$). Kasemsarn et al. (21) revealed that RFA was an effective option for treatment of permanent AF concomitant with MV surgery and atrial reduction to <50 mm in improving SR restoration rates.

In our study atrial reduction procedures showed a statistically significant reduction of the LA antero-posterior sizes in the postoperative period ($p<0.01$) and smaller LA size at discharge and after 1-year as compared to control subject, which contributed to reduction of the risk of AF recurrence in patients undergoing concomitant RFA, atrial reduction and MV surgery.

Concomitant MV surgery, atrial reduction technique, and RFA did not increase the risk of postoperative complications, namely as sick sinus syndrome in our study. Several studies (18, 22, 23) indicated the presence of sick sinus after surgical ablation requiring installation of permanent pacemakers in 6–23% of cases. While in our study we did not identify any cases requiring permanent pacemaker implantation, all 17% of patients were independently resolved before discharge.

We also did not find any difference between the types of MV surgery: repair and replacement in the study group with reasonable rates for both groups, though slightly higher rates of SR restoration were obtained for MV replacement subgroup: at discharge time was 71%, and in 3 years it was 81%. Mesana et al. (24) described the results where he indicated that MV repair was associated higher rate of SR. This may be in part explained by the additional atrial reduction surgery we applied along with MV repair and replacement, and RFA.

There are several studies devoted to the assessment of QOL in patients with AF after different treatment methods, such as medical therapy, catheter ablation, rate control with AV node ablation and pacemaker therapy; however, few studies evaluated QOL after surgical RFA. Jessurun et al. (25) revealed significant impairment in QOL ($p<0.05$) in 6\8 subscales. After successful maze operation, at 3 months QOL in patients was significantly higher, except "bodily pain" ($p=0.85$) and role limitations because of emotions ($p=0.09$). In addition, there was no significant increase in QOL in patients from 3–12 months after operation ($p>0.05$). Lonnerholm et al. (26) revealed the same results as improving QOL in Swedish population at 6–12 months, but also except "bodily pain." Nielsson et al. (27) described results after pulmonary vein isolation in comparison with a healthy population of Denmark, where they revealed a statistically significant decrease in 5 of the 8 points before operation and increase after operation in 7\8 subscales. In 2003, Jessurun et al. (28) continued a prospective randomized study, where they revealed significant increase in QOL in patients after MV surgery, but there was no improvement after maze operation post-MV surgery. In our study, we observed significant improvement of all QOL measures in patients undergoing MV surgery along with RFA and atrial reduction surgery, while in patients undergoing only MV surgery no significant improvement was obtained. It should be emphasized that in the control group, there were no significant changes ($p=0.3$) in "heartbeat" measure, but in the study group, "heartbeat" scales reduced markedly ($p=0.01$) in proportion to the postoperative time, which confirms the effectiveness of procedures for the restoration and maintenance of SR. Overall, QOL indicators improved in 74% of our patients after concomitant surgery, whereas only 57% of patients undergoing only MV surgery had an increase in their QOL.

Study limitations

There are several limitations of our study. Among them the limitation inherent to the study design should be mentioned, as our study was a prospective cohort not a randomized study. In addition, because we used the monopolar AF technology, we cannot guarantee a full transmural lesion. Another potential limitation is that we did not use long-term monitoring to detect AF episodes, therefore asymptomatic and brief episodes of paroxysmal AF might have been missed.

Conclusion

Application of surgical RFA using irrigated cooling electrode and atrial reduction during MV surgery is associated with higher restoration and maintenance of SR as compared to patients undergoing only MV surgery. We did not observe complications related to AF surgery requiring permanent pacemaker implantation. Performing concomitant surgery as surgical RFA, atrial reduction along with MV surgery, improves QOL in the short- and long -term, reduces the feeling of heartbeat and discomfort.

Conflict of interest: None declared.

Peer-review: Externally peer-reviewed.

Authorship contributions: Both authors S.J. and B.B. equally contributed to the designing of the study and its protocol, patients selection, performing operations, evaluation and follow-up, statistical analyses, critical analyses of results and writing manuscript.

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