

ASSOCIATION BETWEEN THE LEFT ATRIAL DIAMETER AND RADIOFREQUENCY ABLATION PROCEDURE AT RESTORING SINUS RHYTHM (MID TERM AND LONG TERM RESULTS)

Halil Basel¹, Hakan Kutlu², Ünal Aydın³,
Aysenur Dostbil⁴, Sahin Kapan⁵, Hakan Akbayrak⁶

ABSTRACT

Objective: Atrial fibrillation (AF) is the most common arrhythmia type among other arrhythmias. In this study, we aimed to search the effect of left atrium diameter in AF treatment with radiofrequency ablation procedure.

Methodology: Preoperative left atrium diameter and postoperative sinus rhythm restoration was prospectively studied in 84 patients who had undergone valve surgery and radiofrequency (RF) ablation procedure in Department of Cardiovascular Surgery from January 2004 to March 2009. The patients were classified in two groups. Group-I consisted of the patients with left atrial diameter less than 5 cm, and Group II consisted of the ones whose left atrial size was more than 5cm. Normal sinus rhythm restoration was followed by electrocardiography (ECG). ECG monitoring was done in early postoperative period, 12th, 24th and 36th months following the operation.

Results: In early post-operative period normal sinus rhythm (NSR) was recorded in 34 patients (Group I: 20, Group II: 14) in which unipolar RFA was performed. Supraventricular tachycardia (SVT) was observed in 20 patients (Group I: 10, Group II: 10) and NSR was restored with medical treatment in these patients. AF was permanent in 26 patients (Group I: 8, Group II: 18) and nodal rhythm was observed in 4 patients (Group I: 2, Group II: 2). The ECG monitoring was done in the patients in early postoperative period at 12th, 24th and 36th months. Data were evaluated with statistical studies, too.

Conclusion: Radiofrequency (RF) ablation is a feasible, efficient and safe method for the treatment for Atrial fibrillation (AF). In our study we found that left atrial diameter is an important factor in restoring sinus rhythm. However, AF treatment with extended left atrium is more difficult.

KEY WORDS: Atrial fibrillation, left atrial diameter.

Pak J Med Sci October - December 2009 (Part-II) Vol. 25 No. 6 997-1002

How to cite this article:

Basel H, Kutlu H, Aydın U, Dostbil A, Kapan S, Akbayrak H. Association between the Left Atrial Diameter and Radiofrequency Ablation Procedure at Restoring Sinus Rhythm (Mid Term and Long Term Results). Pak J Med Sci 2009;25(6):997-1002

Correspondence

Halil Basel
E-mail: hbasel@mynet.com

- * Received for Publication: May 18, 2009
- * Revision Received: May 20, 2009
- * Second Revision: October 29, 2009
- * Final Revision Accepted: November 4, 2009

INTRODUCTION

The ratio of AF among patients undergoing mitral valve surgery would reach up to 40%-60%.¹ The purposes of the treatment are; restoring sinus rhythm, decreasing the frequency and interval of high ventricular response to AF

attacks, preventing cardiomyopathy induced by AF, decreasing the risk of thromboembolism consequently increasing the quality and duration of life. AF treatment with RF ablation should be performed only in the patients who do not respond to any antiarrhythmic medication and are suffering from severe symptoms. Previously, some surgical methods were used for the treatment of AF.² Therefore some catheter or surgical ablation methods using different energy types were developed in order to provide a sort of contact blockage with less duration and less bleeding risk than the contact blockage caused by scars of incisions and sutures while performing Maze procedure at the same locations.

These methods can be listed as Microwave Ablation, Laser Ablation, Cryoablation, Ultrasound Ablation and Radiofrequency Ablation.^{3,4} The first intra-operative RF ablation application was made in 1998 by Melo et al.⁵ Researches done about intra-operative radiofrequency ablation indicate that the short and medium term results of this method are as successful as Maze procedure. In this method, using saline irrigation with catheter can prevent the increase of heat to high degrees at the contact area of catheter head and tissue. Therefore it becomes possible to make deeper lesions on atrial tissue by applying increased amount of radiofrequency energy. Nakagawa et al. studied the performance of different RF Ablation catheters (Heat control RF, Conventional RF and Saline Irrigated RF) and reported correlation between the total RF energy applied to the tissues and, the width and depth of the lesion.⁶

The most important complication of AF, besides cardiac failure, is thromboembolism. In USA, the incidence of stroke in AF patients is 75 thousand per year.^{7,8} The possible complications are encountered with endocardial applications. Among these complications which may occur independently from the type of probe used and left atrial endocardial RFA, the most important one is assumed to be the esophageal injury.¹¹

The effect of LA dimension on the recurrence and occurrence of AF has been examined in such

studies. An association between LA dimensions and AF had been determined.¹²⁻¹⁴ However the purpose of this study was to find an association between the efficiency of unipolar RF ablation and left atrial dimension.

METHODOLOGY

The study group included 84 patients and patients were divided into two groups. Groups were classified as Group I: Patients with left atrium diameter under 5cm and Group II: Patients with left atrium diameter over 5cm. Thirty two patients were male (37.5%) and 52 were female (62.5%), and the mean age was 41.6 (14-76). Patients underwent open heart surgery with mitral valve disease - with or without an additional disease- and chronic AF for over 6 months. Ventricular functions of all patients were in good condition (mean ejection fraction 59, four (50-70) accept five patients and, there was left atrial thrombus in 6 patients (8, 3%). None of the patients had sick sinus syndrome, left atrium wall calcification or active endocarditic. Five patients were with low EF (<50%) and four patients underwent re-operation. Demographic data, risk factors and performed procedures are mentioned in Table-I.

The association between preoperative left atrial diameter size and postoperative sinus rhythm restoration rates were prospectively studied for 84 patients who had undergone radiofrequency ablation performed via Cardioblate™ Surgical Ablation System (Medtronic Inc., MN, USA) and Cardioblate™ Surgical Ablation Pen probe devoted to treat chronic atrial fibrillation combined with open heart surgery in Cardiovascular Surgery Clinic of Education and Research Hospital of Van, from January 2004 to March 2009.

Operation technique included median sternotomy, standard aortic cannulation and bicaval cannulation through the right atrium, left ventricular venting through the right superior pulmonary vein. Myocardial protection was provided with systemic cooling to 28°C, antegrade and retrograde isothermal blood cardioplegia. Pre-operative and post-operative ECG and transthoracic echocardiography

monitoring of all patients were obtained. In this prospective study ECG controls of patients were provided in the early post-operative period, 12th, 24th, 36th months. About 35 patients underwent mitral valve replacement(4 of them were re-operations), four patients underwent mitral valve repair, 9 patients underwent combined mitral valve replacement and coronary artery bypass grafting (CABG) procedure, 23 patients underwent combined mitral valve replacement and tricuspid De Vega annuloplasty procedures, 10 patients underwent combined double valve replacement and tricuspid de vega annuloplasty, two patients underwent mitral valve repair and tricuspid De Vega annuloplasty, two patients underwent combined mitral valve replacement and tricuspid valve repair , and one patient underwent combined aortic valve replacement and mitral valve repair procedure. [Table 1] Left atrial unipolar RF ablation was performed in all patients.

In the post-operative period, all the patients were treated with standard amiodarone infusion protocols (300mg/30min followed by 900mg/day amiodarone) and later on daily 2-3 x 1 times 200mg amiodarone was prescribed for per oral treatment. Warfarine was administered to all patients for the duration of the study and all patients underwent transthoracic echocardiography before hospital discharge.

RESULTS

Among all saline irrigated unipolar RFA performed patients (n:84) normal sinus rhythm was restored in 34 patients (Group I:20, Group II:14 p=0.086) in early post-operative period. Supraventricular tachycardia accompanied in 20 patients (Group I: 10, Group II: 10 p=0.807). Afterwards normal sinus rhythm was achieved by antiarrhythmic medication. Rhythm consisted on AF at 26 patients (Group I: 8, Group II: 18). High ventricular response to AF was observed in 3 patients (Group I: 1, Group II: 2 p=0.609) who were transferred to intensive care unit. Heart rate was taken under control by medication. Normal ventricle response to AF was observed in 23 patients (Group I: 7, Group II: 16 p=0.045) Nodal rhythm was observed in four

patients (Group I: 2, Group II: 2 p=0.922). [Table2] Patients with nodal rhythm were monitored in intensive care unit in order to enable temporary pacing. No amiodarone infusion treatment was administered to these patients and eventually two patients restored normal sinus rhythm at the day of operation but other two patients continued with AF rhythm. No permanent pace implantation was indicated for none of these four patients. No electrical cardioversion was performed in any of our patients during post-operative period.

Spontaneous Echo Contrast (SEC) was present in 4 of our patients in early periods which was missing in the following controls. There were four revisions for bleeding (4.7%). Total mortality was three and there was no evidence of other complications. None of the possible RFA

Table-I: Demographic datas and procedures performed

	Group1 (N=40)	Group2 (N=44)	P value
Age	48.2	50.6	P>0.05, t= 0.98
Sex (M/F)	14/26	18/26	p<0.58
Left Atrium	4.6	5.8	P<0.01, t=15.33
Diameter			
EF normal	39	41	P<0.34
EF low	1	3	P<0.27
MVRp	17	18	P<0.88
AVRp+MVRp	-	1	P<0.31
MVR+TVR	-	2	P<0.31
ACBG+MVRp	4	5	P<0.84
AVRp+	4	6	P<0.61
MVRp+TVR			
MVRepair	3	1	P<0.27
MVRp+TVR	12	11	P<0.61
Total	40	44	

EF: Ejection Fraction

MVRp: Mitral Valve Replacement

TVR: Tricuspid Valve Repair

M: Male AVRp: Aort Valve Replacement

B: Bioprosthesis ACB: Aorta Coronary Bypass

Re-do: Re-operation MVR: Mitral Valve Repair

Table-II: ECG monitoring results

		Early Post Operative Period		
		Group1	Group2	P
NSR		20	14	0.086
SVT		10	10	0.807
AF	HHP	1	2	0.609
	NHP	7	16	0.045
NR		2	2	0.922
Total		40	44	

AF= Atrial Fibrillation HHP: High Heart Pulse
 NSR: Normal Sinus Rhythm
 NHP: Normal Heart Pulse
 SVT: Supra Ventricular Tachycardia
 NR: Nodal rythm

procedure's complications (such as esophagus injury, circumflex coronary arterial injury, pulmonary vein inlet narrowness, left main bronchial injury, left atrial perforation originated bleedings, pace necessity) was observed in our study.

Two patients who were monitored in intensive care unit with normal sinus rhythm were discharged from hospital with AF rhythm. Normal sinus rhythm could not be maintained for these patients by antiarrhythmic medication. The patients representing AF rhythm at the discharge couldn't restore normal sinus rhythm later.

At 12th month follow up visit NSR was achieved in 33 patients from Group 1 and 26 patients from Group 2 (p=0.014). Patients con-

Table-IV: ECG monitoring results

		24 th Month Follow-up		
		Group1	Group2	P
NSR		34	26	0.005
SVT		—	—	
AF	HHP	—	—	
	NHP	6	18	0.005
NR		-	—	
Total		40	44	

AF= Atrial Fibrillation HHP: High Heart Pulse
 NSR: Normal Sinus Rhythm
 NHP: Normal Heart Pulse
 SVT: Supra Ventricular Tachycardia
 NR: Nodal rythm

Table-III: ECG monitoring results

		12 th Month Follow-up		
		Group1	Group2	P
NSR		33	26	0.014
SVT		—	—	
AF	HHP	—	—	
	NHP	7	18	0.014
NR		—	—	
Total		40	44	

AF= Atrial Fibrillation HHP: High Heart Pulse
 NSR: Normal Sinus Rhythm
 NHP: Normal Heart Pulse
 SVT: Supra Ventricular Tachycardia
 NR: Nodal rythm

sisting of AF was 7 in Group I and 18 in Group II (p=0.014). [Table-III] Furthermore at 24th month follow up visit 34 patients from Group I was in NSR and 26 from Group II (p=0.005). Six patients from Group I and 18 patients from Group II continued with AF (P=0.005). [Table-IV] At 36th follow up visit 34 patients from Group I and 26 patients from Group II remained in NSR(p=0.005). Nevertheless six patients from Group I and 18 patients from Group II had persistent AF (p=0.005). [Table-V]

Statistical Analysis: Continuous variables were tested by Student t test and Mann Whitney U test. Variables in categoric forms were tested with Z test. Statistical significance rate was assumed as 5 % and 1%. Statistical analyses were performed with SPSS.

Table-V: ECG monitoring results

		36 th Month Follow-up		
		Group1	Group2	P
NSR		34	26	0.005
SVT		—	—	
AF	HHP	—	—	
	NHP	6	18	0.005
NR		—	—	
Total		40	44	

AF= Atrial Fibrillation HHP: High Heart Pulse
 NSR: Normal Sinus Rhythm
 NHP: Normal Heart Pulse
 SVT: Supra Ventricular Tachycardia
 NR: Nodal rythm

DISCUSSION

The ratio of AF among the patients those underwent mitral valve surgery may reach up to 40-60%.¹ AF treatment carries several morbidity and mortality risks.¹⁵ While treating AF the main goal is not a symptomatic treatment but a complete recovery, which means to maintain a normal sinus rhythm.

Patients with AF who have undergone mitral valve disease – not chronic- the normal sinus rhythm was generally achieved when the mitral pathology is corrected properly. The complete recovery possibility decreases in case of chronic AF.¹⁶ That is the reason why we frequently attempt a further procedure for the patients with chronic AF. As a result, new techniques based on Maze procedure shortening the period and reducing the difficulty of the operation are improved; Maze procedure is a difficult and longstanding operation, despite its success over 90% in historical progress. These methods can be listed as Microwave Ablation, Laser Ablation, Cryoablation, Ultrasound Ablation and Radiofrequency Ablation.⁴ Among these methods, radiofrequency ablation is more frequently performed technique because of its applicability and effectiveness. It's reported that Radio Frequency Ablation procedure have been performed randomly to half of the patients who had undergone mitral valve operation and after one-year follow up the recovery of AF in Radio Frequency Ablation performed group have been detected as 80% versus 26,7% in patients whom this procedure had not been performed.¹⁶

The electrophysiological mapping proved that AF is originated from the margins of pulmonary veins. RF ablation procedure has been limited to left atrium and especially ablation approximate to pulmonary veins has gained importance.¹⁶ In case of atrial flutter, there is superiority of biatrial ablation^{17,18} but there is no significant difference when left atrial and biatrial procedures are compared for cases beyond.¹⁹ We preferred to use left atrial RF ablation technique in this study because there wasn't a history of atrial flutter at the patients.

The transmuralty of the lesion is the most important factor in the success of ablation. That is why we preferred to use saline irrigated method in RF ablation procedure in order to provide deeper atrial lesions. Because it is possible to apply more energy in a longer period of time on the application surface cooled by saline without carbonization.²⁰

In our study NSR was achieved in 54 patients (64 %) in early post operative period. This ratio increased during post operative follow up and reached to 71 % at the end of 36 months follow up. This result is consistent with reported studies.^{21,22} However there wasn't a significant difference between two groups at NSR restoration. In early post operative period a significant difference was found between the groups of AF rhythm with normal ventricular response ($p=0.045$). In 12th month follow up a statistical difference was established between two groups at NSR restoration ($p=0.014$). Significant difference between in AF groups with normal ventricular response. These statistical differences in two parameters continued at all follow up visits between two groups. This finding suggests that LA diameter is an important parameter at restoring NSR, and recovery period following Maze procedure supports NSR restoration. Furthermore if cardiac pathologies are corrected and sinus rhythm is restored return to AF would be too difficult at the patients with LA diameter < 5cm.

There are many studies concerning the effects of age factor on sinus rhythm restoring.²³ Age over 60 is reported to decrease success rate of Maze procedure.^{24,25} In this study age factor wasn't evaluated because mean age of the patients were 48.2/50.6 ($p>0.05$).

CONCLUSIONS

Radiofrequency ablation of the left atrium during mitral valve surgery for continuous atrial fibrillation significantly increases the rate of sinus rhythm restoration. We concluded that atrial diameter is an important factor at the restoration and permanence of NSR. The elimination of AF using radiofrequency ablation is more successful in patients undergoing isolated

mitral valve surgery with preoperative left atrial diameter less than 5cm.

REFERENCES

- Kannel WB, Abbott RD, Savage DD, McNamara PM. Epidemiologic features of chronic atrial fibrillation: the Framingham study. *N Engl J Med* 1982;306(17):1018-22.
- Duran E, Kalp Ve Damar Cerrahisi, Diametara Tip Kitabevi, Istanbul, 1. Baski; 2004 (1561-1581)
- Watanabe H., Hayashi J., Sugawara M. Experimental application of microwave tissue coagulation to ventricular myocardium. *Ann Thorac Surg* 1999;67:666-671
- Viola N., Williams MR., Oz MC. The technology in use for the surgical ablation of atrial fibrillation. *Semin Thorac Cardiovasc Surg* 2002;14:198-205
- Melo J, Adragao P, Neves J. Endocardial and epicardial radiofrequency ablation in the treatment of atrial fibrillation with a new intra-operative device. *Eur J Cardiothorac Surg* 2000;18(2):182-6.
- Nakagawa H, Yamanashi WS, Pitha JV, et al. Comparison of in vivo tissue temperature profile and lesion geometry for radiofrequency ablation with a saline-irrigated electrode versus temperature control in a canine thigh muscle preparation. *Circulation* 1995;91:2264-2273
- Wolf PA., Mitchell JB., Baker CS. D'Agostinono RB. Impact of atrial fibrillation on mortality, stroke and medical costs. *Arch Int Med* 1998;158:229-234.
- Cox JL, Ad N, Palazzo T. Impact of the maze procedure on the stroke rate in patients with atrial fibrillation. *J Thorac Cardiovasc Surg* 1999;118:833-840
- Benussi S, Pappone C, Nascimbebe S. A simple way to treat chronic atrial fibrillation during mitral valve surgery: the epicardial radiofrequency approach. *Eur J Cardiothorac Surg* 2000;17:524-9.
- Chen MC, Chang JP, Guo GB. Atrial size reduction as a predictor of the success of radiofrequency maze procedure for chronic atrial fibrillation in patients undergoing concomitant valvular surgery. *J Cardiovasc Electrophysiol* 2001;12:867-74.
- Mohr FW., Fabricus AM., Falk V. Curative treatment of atrial fibrillation with intraoperative radiofrequency ablation: short-term and midterm results. *J Thorac Cardiovasc Surg* 2002;123:919-927.
- Henry WL, Morganroth J, Perlman AS. Relation between echocardiographically determined left atrial size and atrial fibrillation. *Circulation* 1976;53:273-279.
- Ommen SR, Tsang TSM, Ammash NM. Usefulness of serial echocardiographic parameters for predicting the subsequent occurrence of atrial fibrillation. *Am J Cardiol* 2001; 87:1298-1301.
- Parkash R, Green MS, Kerr CR. The Association of Left Atrial Size and Occurrence of Atrial Fibrillation: A Prospective Cohort Study from the Canadian Registry of Atrial Fibrillation. *American Heart Journal* 2004;148(4)
- Diker E, Aydogdu S, Ozdemir M. Prevalence and predictors of the atrial fibrillation in rheumatic heart disease. *Am J Cardiol* 1996;77:96-8.
- Psaty BM, Manolio TA, Kuller LH. Incidence of the risk factors for the atrial fibrillation in older adults. *Circulation* 1997;96:2555-61.
- Chen MC, Chang JP, Guo GB. Atrial size reduction as a predictor of the success of radiofrequency maze procedure for chronic atrial fibrillation in patients undergoing concomitant valvular surgery. *J Cardiovasc Electrophysiol* 2001;12:867-74.
- Usui A, Inden Y, Mizutani S. Repetitive atrial flutter as a complication of the left-sided simple maze procedure. *Ann Thorac Surg* 2002;73:1457-9
- Guden M, Akpınar B, Caynak B. Left Versus Bi-Atrial Intraoperative Saline-Irrigated Radiofrequency Modified Maze Procedure for Atrial Fibrillation. *Cardiac Electrophysiology Review* 2004;7:252-258.
- Guden M, Akpınar B, Caynak B. Left versus bi-atrial intraoperative saline- irrigated radiofrequency modified maze procedure for atrial fibrillation. *Card Electrophysiol Rev* 2003;7:252-8.
- Guden M, Akpınar B, Sanisoglu I. Intraoperative saline-irrigated radiofrequency modified Maze procedure for atrial fibrillation. *Ann Thorac Surg* 2002;74:S1301-6.
- Vivek Srivastava, Susheel Kumar , Satish Javali et al. Efficacy of Three Different Ablative Procedures to Treat Atrial Fibrillation in Patients with Valvular Heart Disease: A Randomised Trial. *Heart, Lung and Circulation* 2008;17(3):232-240.
- Bong Gun Song, Soo Jin Cho, Sang Yeub Lee. Atrial Mechanical Function After Maze Procedure for Atrial Fibrillation Concomitant With Mitral Valve Surgery. *Korean Circ J* 2008;38:606-611
- Creswell LL, Schuessler RB, Rosenbloom M, Cox JL. Hazards of postoperative atrial arrhythmias. *Ann Thorac Surg* 1993;56:539-49.
- Incalzi RA, Pistelli R, Fuso L, Cocchi A, Bonetti MG, Giordano A. Cardiac arrhythmias and left ventricular function in respiratory failure from chronic obstructive pulmonary disease. *Chest* 1990;97:1092-7.

-
- Halil Basel, MD
 - Hakan Kutlu, MD
 - Unal Aydin, MD
 - 1-3: Cardio Vascular Surgery Clinic of Education Research Hospital of Van, Turkey
 - Aysenur Dostbil, MD
Anesthesia Clinic of Education Research Hospital of Van, Turkey
 - Sahin Kapan, MD
Cardio Vascular Surgery Clinic of Education Research Hospital of Van, Turkey
 - Hakan Akbayrak, MD
Cardio Vascular Surgery Clinic of Sevgi Hospital, Malatya, Turkey

Correspondence

Halil Basel
Cardio Vascular Surgery Clinic of Education and Research Hospital of Van,
Edremit/ VAN, Turkey.