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The Difference of Left Atrial Volume Index : Can It Predict the Occurrence of Atrial Fibrillation after Radiofrequency Ablation of Atrial Flutter?

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-Abstract-

Background : The occurrence of atrial fibrillation after ablation of atrial flutter is clinically important. We investigated variables predicting this evolution in ablated patients without a previous atrial fibrillation history.

Materials and Methods : Thirty-six patients (Male=28) who were diagnosed as atrial flutter without previous atrial fibrillation history were enrolled in this study. Group 1 (n=11) was defined as those who developed atrial fibrillation after atrial flutter ablation during 1 year follow-up. Group 2 (n=25) was defined as those who has not occurred atrial fibrillation during same follow-up term. Echocardiogram was performed to all patients. We measured left atrial size, left ventricle end diastolic and systolic dimension, ejection fraction and left atrial volume index before and after ablation of atrial flutter. The differences of each variables were compared and analyzed between two groups.

Results : The preablation left ventricular ejection fraction (preLVEF) and postablation left ventricular ejection fraction (postLVEF) are 54±14%, 56±13% in group 1 and 47±16%, 52±13% in group 2. The differences between each two groups are statistically insignificant (2.2±1.5 in group 1 vs 5.4±9.8 in group 2, p=0.53). The preablation left atrial size (preLA) and postablation left atrial size (postLA) are 40±4 mm, 41±4 mm in group1 and 44±8 mm, 41±4 mm in group 2. The atrial sizes of both groups were increased but, the differences of left atrial size between two groups before and after flutter ablation were statistically insignificant (0.6±0.9

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mm in group 1 vs -3.8±7.4 mm in group 2, p=0.149). The left atrial volume index before flutter ablation was significantly reduced in group 1 than group 2 (32±10 mm^3/m^2, 35±10 mm^3/m^2 in group 1 and 32±10 mm^3/m^2, 29±8 mm^3/m^2 in group 2, $p<0.05$).

Conclusion : The difference between left atrial volume index before and after atrial flutter ablation is the robust predictor of occurrence of atrial fibrillation after atrial flutter ablation without previous atrial fibrillation.

Key Words: Atrial flutter, Ablation, Atrial fibrillation, Left atrium, Volume

Introduction

Radiofrequency catheter ablation targeting the isthmus between the tricuspid annulus and the inferior vena cava is an established therapy for typical atrial flutter (AFL). It is successful in more than 90% of patients.[1-7] But, in the clinical setting, AFL and atrial fibrillation (AF) often coexist, and the follow up of patients successfully treated with transisthmic ablation is complicated by the occurrence of AF in 10~47% of patients.[8-17] We already have known that the presence of preablation AF is the most significant predictor of postablation AF.[18-20] However, clinical and procedural predictors of postablation AF occurrence has always been evaluated in the mixed group of AFL patients with AF[18-20] and rarely in the group of patients without history of AF. +This study aimed that better identification of patients who are at risk for the development of AF may help to optimize the antiarrhythmic stratery during or after AFL ablation. So, we investigated variables predicting this evolution with echocardiography in ablated patients without a previous AF History.

Materials and methods

1. Study population

The study group consisted of 36 consecutive patients who were diagnosed as AFL without previous history of paroxysmal AF and underwent radiofrequency catheter ablation for recurrent typical AFL from January 2000 to June 2005 at Yeungnam university hospital. Typical AFL was diagnosed when the surface ECG showed flutter waves that were predominantly negative in leads II, III, aVF and positive in lead V1 and defined as a macroreentrant atrial tachycardia that exhibited either counterclockwise or clockwise activation around the tricuspid annulus and atypical AFL was defined as an atrial flutter other than typical AFL.Previous episodes of AF were all excluded from this study. Postablation AF development during 1 year follow-up was defined as the documentation of AF during ECG or Holter ECG monitoring of at

least one episode of AF lasting more than one minute.

2. Electrophysiological study and radiofrequency catheter ablation

Written informed consent was obtained before transcatheter ablation from all patients. Four multipolar catheters were inserted from right femoral vein and left subclavian vein: One quadripolar catheter (Boston scientific, USA) positioned at the His bundle and RV; One decapolar catheter (Daig, USA) positioned in the coronary sinus with the proximal electrode pair positioned at the ostium; a 20 electrode Halo catheter (Cordis, USA) positioned around the tricuspid valve to assess annular activation; and the ablation catheter. All measurements were performed with the Cardiolab system (Prucka engineering, USA). The ablation was anatomically guided. The end-point of the procedure was the achievement of a complete bi-directional isthmus block according to the method reported in detail in the land mark study by Poty et al[21] using activation mapping.

3. Echocardiographic measurements

Transthoracic echocardiography was performed before and after 24 hour of the radiofrequency ablation procedure by one observer blinded to the patient's electrophysiological status. Ultrasound studies were performed with Acuson Sequoia C256 (SIEMENS). M-mode measurements were made according to the recommendations of the American Society of Echocardiography.[22] Left ventricular systolic function was evaluated on two-dimensional echocardiographic imaging of the left ventricle. Left ventricular volumes and ejection fraction were calculated by planimetry in the apical two and four-chamber views with the modified Simpson rule. Left atrial long axis, short axis and area were obtained by planimetry of the atrial inner borders with maximized atrial chamber size at end-systole in the four and two-chamber views. All two dimensional echocardiographic measurements were averaged over five cardiac cycles and the differences of each variable before and after AFL ablation were compared and analyzed between two groups.

4. Statistical analysis

Continuous variables are presented as mean±SD. Discrete variables are presented as percentages(%). Variables were compared by Fisher's exact test for categorical variables and independent sample t test for continuous variables. A probability value of $p<0.05$ was considered significant.

Results

Thirty-six patients (36, Male=28) were enrolled in this study. Among all patients, AFL ablation succeeded in 35 patients (35/36, 97%) and AFL recurred in four patients (4/36, 11%). During 1 year follow-up, eleven

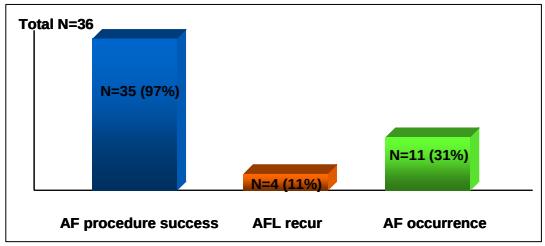

Fig. 1. One Year Follow-up Results of Patients After Ablation of Atrial Flutter.

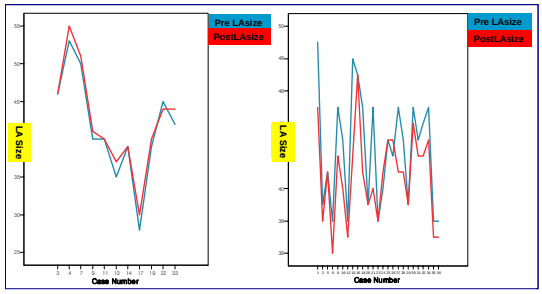

Fig. 2. Comparison of LA size between two groups.

patients developed AF (Group 1, n=11) but, eighteen patients has not occurred AF (Group 2, n=25) (Fig 1). Baseline characteristics between two groups are summarized in Table 1. No differences between two groups are existed in age, sex, DM, hypertension and organic heart disease. Table 2 showed echocardiographic differences between two groups and the result was statistically insignificant. The findings between two groups during electrophysiologic study are

Table 1. Baseline characteristics between two groups

	Group 1 (n=11)	Groups 2 (n=25)	P
Age(yr)	57±13	58±11	NS
Male	10(90%)	18(72%)	NS
Organic Ht Ds			NS
Valvular	0	3	
Ischemic	0	1	
CHF	0	2	
HCM	0	1	
DM	2(18%)	3(12%)	NS
HTN	1(9%)	5(20%)	NS

Ht: Heart, Ds: Disease, CHF: Congestive heart failure, HCM: hypertrophic cardiomyopathy

Table 2. Echocardiogrphic findings between two groups

	Group 1 (n=11)	Group 2 (n=25)	P
LVEDD	50±3	49±8	NS
LVESD	34±3	35±8	NS
LVEF	57±10	49±14	NS
LA size	41±7	43±7	NS
LA Vol Index	33±14	38±30	NS

LVEDD: Left ventricular end-diastrolic dimension, LVESD: Left ventricular end-systolic dimension, LVEF: Left ventricular ejection fraction, LA: Left atrium, Vol: Volume, NS: not significant

Table 3. Electrophisiologic findings between two groups

	Group 1 (n=11)	Group 2 (n=25)	P
AFL type			NS
Typical	10	23	
Atypical	1	2	
AFL Cycle length	237±22	238±27	NS
AFL recur	2	2	NS
Ablation failure	1	0	NS
Antiarrhythmic drug discharge	1	0	NS
AFL Success	10(91%)	25(100%)	NS

AFL: Atrial flutter

Table 4. Echocardiographic Comparison Between two group

	Group 1 (n=11)	Group 2 (n=25)	P
PreAbl-LVEF	57±10	49±14	0.138
PostAbl-LVEF	59±8	54±11	0.354
Differences	2±9	5±8	0.613
PreAbl-LA size	41±7	43±7	0.745
PostAbl-LA size	42±7	41±4	0.745
Differences	0.8±1	-2.8±6	0.009
PreAbl-LA Vol index	33±14	38±30	0.846
PostAbl-LA Vol index	35±14	29±7	0.303
Differences	2.1±2	-9±28	0.000

PreAbl: preablation, PostAbl: postablation, LVEF : Left ventricular ejection fraction, LA: Left atrium, Vol: volume

represented in Table 3. Statistical significance was not found in this examination. Table 4 showed echocardiographic differences between two groups. Differences of Left ventricular ejection fraction (LVEF) before and after AFL ablation were not statistically different between two group after 1 year follow-up (p=0.613). The atrial sizes of both groups were increased but, pre-ablational left atrium (LA) size were significantly increased in group 1 but, decreased in group 2 after AFL ablation (p=0.009) and pre-ablational LA volume index were significantly increased in group 1 but, decreased in group 2 (p=0.000) during same follow up period. In summary, Differences of LA size and LA volume index were increased or not decreased in case of patients who had development of AF after

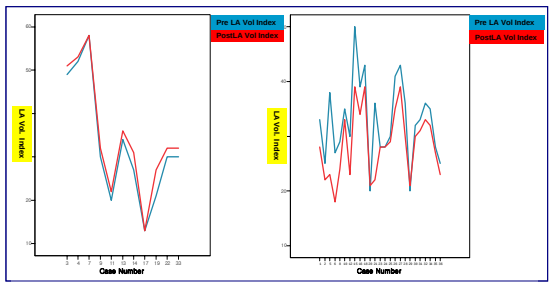

Fig. 3. Comparison of LA Vol. Index between two groups.

AFL ablation and differences of LA size and LA volume index were decreased in those who had not occurred AF after AFL ablation (Fig 2, Fig 3).

Discussion

Predictors of postablation AF occurrence have been recognized as history of preablation AF, left atrial size, inducibility of AF at the end of the ablation, the presence of structural heart disease, and a reduced left ventricular ejection fraction. Among these, history of preablation AF has emerged as the most significant predictor of postablation AF.[8, 10, 11, 13, 18–20] But, in clinical setting, we didn't recognize exactly the history of AF and it is not easy to document AF with AFL. So we started in fact that we already have known previous history of AF that is important in prediction of AF occurrence after AFL ablation but, in case we didn't have information about AF, we hypothesized that if AF coexists with AFL, AF remains and LA volume does not decreased or increased after AFL ablation. This study confirms moderately high incidence of development of symptomatic AF in patients who did not decreased or increased LA volume index by echocardiography after AFL ablation. LA volume index is calculated from LA volume by dividing by body surface area. There are now multiple peer-viewed articles that validate the progressive increase in risk of AF development associated with having LA volumes greater than these normal values.[23, 24] The left atrium is a thin-walled structure and, in the absence of obstructive mitral valve disease, is directly exposed to LV pressure; its size has been shown to reflect diastolic impairment[25] and filling pressure.[26] Diastolic dysfunction is associated with decreased passive LA emptying,[26] resulting in a larger LA volume at the onset of atrial systole, which helps to maintain LA ejection. With increase in LA filling pressures, atrial stretch and enlargement of the chamber occur, leading to remodeling of the structure, physiologic properties, and electrical milieu of the left atrium, resulting in the development of AF.

The LA size is also important predictors of occurrence of AF after AFL ablation. However, unidimensional M-mode measurement does not provide a sensitive assessment of LA size.[27] The relationship between M-mode LA dimension and LA volume is nonlinear.[28] Because of lack of constant relationship between the major axes of the left atrium

and LA volume, smaller increments of M-mode LA dimension are associated with greater changes of LA volume, especially for larger atria. This suggests that LA volume uniquely encompasses physiologic information not captured by clinical data or unidimensional M-mode assessment. The two parameters together provide a more comprehensive assessment of LA geometry. From this study, we studied group of AFL patients without AF history and the differences of LA size and volume index before and after ablation different from previous studies and recognized differences of LA volume index and LA size can be useful tool for predicting of occurrence of AF after AFL ablation.

This study had many limitations. Among them, this is retrospective study, not a prospective. And study population is relatively small, so clinical power may be weak. Study for large population and longer follow up period are needed for AF occurrence after AFL ablation. Asymptomatic atrial arrhythmia is frequent in ablated population but no attempt was made to identify these patients by use of holter monitoring.

Summary

Background : The occurrence of atrial fibrillation (AF) after ablation of atrial flutter (AFL) is clinically important. We demonstrated the gravity of left volume index (LAVi) after ablation of AFL in predicting of development of AF.

Methods : Thirty six (n=36) who were diagnosed as AFL without previous AF history were enrolled. Group 1 (n=11) defined as those who developed AF after AFL ablation and Group 2 (n=25) was who has not occurred AF. Echocardiographic parameters including left atrial size, left ventricular end diastolic and systolic dimension, ejection fraction and left atrial volume index before and after ablation of AFL were compared.

Results : Baseline characteristics between two groups were not significantly different. Pre and post-ablation left atrial size were not changed before and after AFL ablation. But, LAVi before AFL ablation was significantly reduced in Group 1 than Group 2.

Conclusions : The difference of LAVi is the robust predictor of occurrence of AF after AFL ablation without previous AF.

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