

Atrial fibrillation ablation guided with electroanatomical mapping system: A one year follow up

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Abstrak

Tujuan AF merupakan aritmia yang paling banyak ditemukan dalam praktek klinis dan berkaitan dengan peningkatan risiko stroke jangka panjang, gagal jantung dan segala sebab kematian. Ablasi kateter pada AF merupakan modalitas yang relatif baru untuk konversi AF ke irama sinus. Studi ini bertujuan untuk mengetahui efektifitas ablas kateter pada tipe AF campuran.

Metode 30 pasien (umur 52 ± 8 tahun) yang terdiri dari 19 paroksismal and 11 AF kronik dilakukan ablas kateter radiofrekuensi dipandu oleh sistem pemetaan elektroanatomikal CARTO™. Digunakan pendekatan ablas bertahap dengan isolasi vena pulmonalis (IVP) sebagai intinya. Tambahan ablas berupa garis atap, garis mitral isthmus, complex fractionated atrial electrogram (CFAE), garis septal dan sinus koronarius dilakukan secara bertahap bila diperlukan. Pengamatan terhadap rekurensi AF dilakukan selama 1 tahun.

Hasil IVP sirkumferensial berhasil dilakukan pada semua pasien kecuali 1 orang. Rata-rata masa pengamatan 11,5 bulan. Lebih dari 80% pasien masih dalam irama sinus pada akhir masa pengamatan dengan 62% di antaranya bebas dari obat anti-aritmia. Tidak terjadi komplikasi mayor pada serial pasien dalam studi ini.

Kesimpulan Ablasi radiofrekuensi kateter yang dipandu oleh sistem pemetaan elektroanatomikal efektif dan aman pada tipe AF campuran. (*Med J Indones 2010; 19:172-8*)

Abstract

Aim AF is the most common arrhythmia in clinical practice and associated with an increased long-term risk of stroke, heart failure, and all-cause mortality. Catheter ablation of AF is relatively new modality to convert AF to sinus rhythm. This study was aimed to elaborate efficacy of catheter ablation in mixed type of AF.

Methods Thirty patients (age of 52 ± 8 yo) comprised of 19 paroxysmal and 11 chronic AF underwent radiofrequency catheter ablation guided by electroanatomical CARTO™ mapping system. We used step wise ablation approach with circumferential pulmonary vein isolation (PVI) as a cornerstone. Additional ablation comprised of roof line, mitral isthmus line, complex fractionated atrial electrogram (CFAE), septal line and coronary sinus ablation was done respectively if indicated. All patients were followed up to 1 year for AF recurrence.

Results Circumferential PVI was successfully performed in all patients but one. Average follow up period was 11.5 months. More than 80% of all patients remain in sinus rhythm at the end of follow period which 62% of them were free from any anti-arrhythmic drug. No major complication in all patients series.

Conclusion Radiofrequency ablation guided with electroanatomical mapping is effective and safe in mixed type of AF. (*Med J Indones 2009; 19:172-8*)

Key words: Ablation, atrial fibrillation, electroanatomical, Indonesia

Atrial fibrillation (AF) is the most common arrhythmia in clinical practice, accounting for approximately one-third of hospitalizations for cardiac rhythm disturbances.¹ AF is associated with an increased long-term risk of stroke, heart failure, and all-cause mortality.² The mortality rate of patients with AF is about double that of patients in normal sinus rhythm and linked to the severity of underlying heart disease.³⁻⁵

Magnitude of data demonstrates increasing evidence of higher efficacy of catheter ablation to cure AF as

compared to other therapeutic modalities. Recent guideline indicates that the primary indication for catheter AF ablation is the presence of symptomatic AF refractory or intolerant to at least one Class 1 or Class 3 antiarrhythmic medication.⁶ The technique of ablation has continued to evolve from early attempts that target individual ectopic foci within the PV to circumferential electrical isolation of the entire PV musculature. Latest technology of three dimensional (3D) mapping guided ablation has been increased the success rate of maintaining sinus rhythm.

This study was aimed to report the initial results of AF ablation guided by electroanatomical CARTO mapping in our institution.

METHODS

Patients

In this prospective cohort study 30 consecutive patients (age of 52 ± 8 yo, comprised of 25 male) underwent AF ablation guided by CARTO mapping system. They comprised of 19 (63.3%) paroxysmal AF and 11 (36.7%) of chronic AF. AF has been very symptomatic despite average of 2 antiarrhythmic drugs including amiodarone. Of those patients, 25 were hypertensive and 5 had coronary artery disease (Table 1).

Table 1. Baseline Characteristics

Characteristics	Paroxysmal AF	Chronic AF
Sex (M/F)	15/4	9/2
Age (years)	51 ± 7.4	54 ± 10
LA Dimension (mm)	38 ± 8.2	44 ± 4.1
Ejection Fraction (%)	58.1 ± 8.3	63 ± 8.3
Hypertension	20	5
CAD	4	1

LA = left atrium, CAD = coronary artery disease

Electrophysiology study and Radiofrequency Ablation

Written informed consent was obtained from every patient. Patients were free from all antiarrhythmic drugs for more than 5 its half-lives. However, amiodarone and digoxin were not be stopped. A decapolar with lumen coronary sinus (CS) catheter was inserted via right jugular vein into CS until the proximal pole lies at CS ostium. Two transeptal punctures by means of Brockenbrock needle were performed guided by CS catheter position. This technique has been applied safely elsewhere.⁷ Ablation was performed during its original rhythm at the time of electrophysiology study.

Step wise radiofrequency ablation approach was chosen, that is comprised of circumferential pulmonary vein isolation (PVI), roof line ablation, mitral isthmus line ablation, complex fractionated atrial electrogram (CFAE) ablation, septal line ablation and coronary sinus ablation respectively.

Circumferential PVI is the cornerstone in AF ablation procedure. PVs. An anatomically based ablation strategy

of encircling the PVs guided by 3D electroanatomical mapping was used in our study.⁸ The endpoint of this procedure was the electrical isolation of at least three pulmonary vein (PV). Completion of isolation PVs was checked using lasso catheter inserted to the PV ostial. If needed, additional ostial PV ablation was performed segmentally to achieve complete PV isolation.

Other steps of AF ablation are performed if after complete circumferential PVI and electrical cardioversion sinus rhythm could not be achieved in PAF patients. In chronic AF patients every step of AF ablation was done.

Conversion to sinus rhythm either by radiofrequency ablation or electrical cardioversion considered as procedural success.

Electroanatomical Mapping

Electroanatomical CARTO™ mapping system has been published elsewhere.⁹ In brief, the system uses three low energy magnetic fields for placement catheter tip. The mapping catheter contain magnetic sensor (Navistar® Thermocool, Biosense Webster, Inc., USA) that is precisely located and positioned in a given electromagnetic field. Resolution is less than 1 mm for catheter positioning and less than 1° for catheter tip orientation. To avoid inaccuracies caused by patient movement, another reference sensor (patch) was placed on the patient's back within the electromagnetic field. The mapping procedure consists of systematic acquisition of points where the catheter tip touches the endocardium that creates 3D anatomical map. At each point, the exact position in space and the local electrogram are recorded. The greater the number of points acquired, the better the anatomical detail obtained. Locations with CFAE were marked for further necessity use.

Follow Up

During 1 year follow up period, all patients underwent 12-lead surface ECG recording every 1 to 3 months. Patient was classified as free from symptomatic AF if all ECG recordings during follow up period demonstrate sinus rhythm or no documented AF and no symptomatic palpitation suggested AF recurrence.

Definition

PV antrum is the transitional area between PVs and left atrium. This area was targeted during circumferential PVs isolation.¹⁰

CFAE characterized as low amplitude and fractionated atrial electrogram. CFAE represent a defined electrophysiologic substrate and are ideal target sites for ablations to eliminate AF.¹¹

Aggressive pacing was defined as burst and decremental pacing from right atrium. Burst pacing is an incremental pacing until pacing cycle length of 10 ms beyond right atrial refractory period. Burst pacing was performed several series with 8 beats in every series. Decremental pacing was done up to two extrastimulations with end point of atrial refractory or arrhythmias induction.

RESULTS

Baseline Rhythm

Radiofrequency ablation (RFA) performed during either sinus or AF. Of 19 PAF patients, 10 (52.6%) were in sinus rhythm at the time of RFA. In one patient, typical atrial flutter was documented beside the AF. Eleven patients experienced frequent hospitalization due to rapid ventricular response with or without sign of heart failure.

Radiofrequency Ablation

Circumferential PVI was successfully performed in all patients but one. Circumferential ablation was performed with point by point ablation. The end point of single point ablation was decreased of local potential to less than or same with 0.2 mV bipolar. The end point of circumferential PV ablation is complete electrical disconnection of all PV from LA. No bridging ablation performed between LSPV and LIPV. Figure 1 demonstrates circumferential ablation line of both right and left PV antrum. In three patients additional segmental ablation of PVs were necessary due to residual PV connection. The majority of additional segmental PV ablation was performed in superior PV. Of PAF patients, 3 patients need additional ablation line other than PVI in contrast to chronic AF which additional ablation line needed in all patients. CFAE ablation was performed in all chronic AF patients. In four patients, AF converted to sinus rhythm during RFA. One patient converted to typical atrial flutter which then converted to sinus rhythm after complete cavotricuspid isthmus ablation.

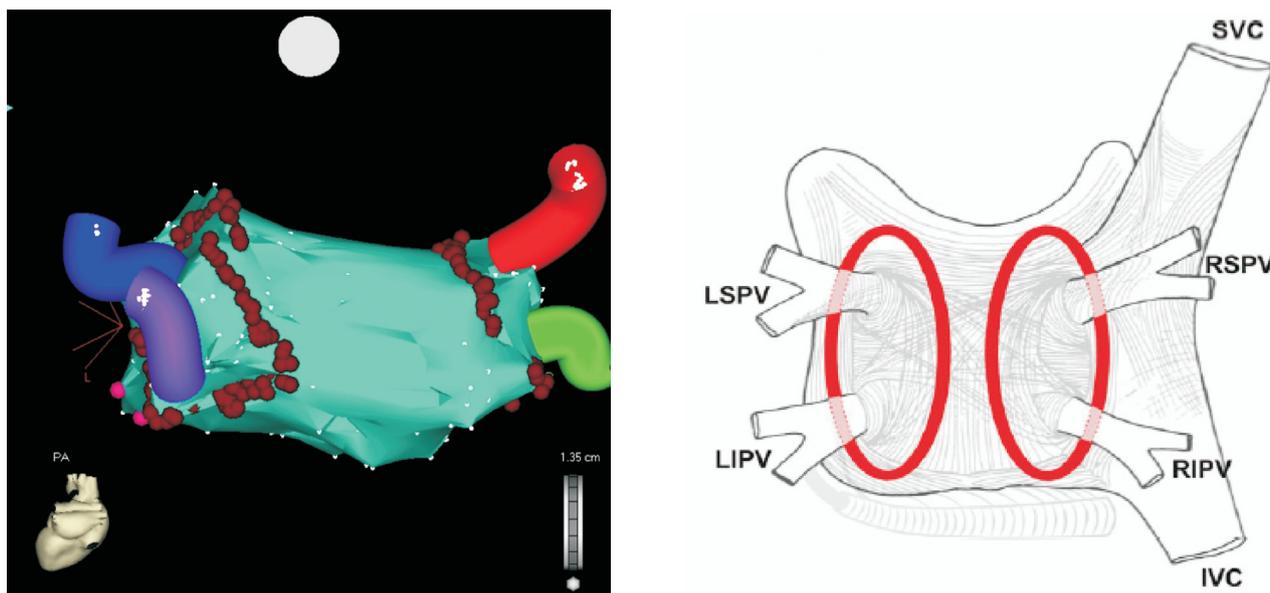


Figure 1. Left panel is postero-anterior view of left atrium virtual geometry. The red points are ablation location that formed two ablation lines along the right and left pulmonary veins antrum. Right panel is postero-anterior view of cardiac schema showing two circumferential line along the left and right antrum (red line). LSPV = left superior pulmonary vein, LIPV = left inferior PV, RSPV = right superior PV, RIPV = right inferior PV, SVC = superior vena cava, IVC = inferior vena cava.

In two patients, RFA was failed. It's comprised of one chronic and one PAF. The PAF patient failed to achieve complete PV isolation and the chronic one could not convert to sinus rhythm despite extensive RFA and electrical cardioversion.

Complications

There was no minor or major complication in all patients. However, all patients feel variable degree of pain during ablation of posterior aspect of both antrum. Three miligram of intravenous midazolam was very helpful to reduce pain.

Follow up

Five patients were loss to follow up comprised of 4 PAF and 1 chronic AF. ECG could not be recorded from those 5 patients as they were referred from remote area. Average follow up period was 11.5 months. More than eighty percent of all patients remain in sinus rhythm at the end of follow period which 62% of them were free from any anti-arrhythmic drug. Of PAF patients, 82.4% of them were sinus rhythm during 1 year follow-up. Eighty percent of chronic AF patients demonstrated sinus rhythm at the end of follow period (Figure 2). None of chronic AF patients were free from anti-arrhythmic drug and amiodarone is always given to maintain sinus rhythm in those patients.

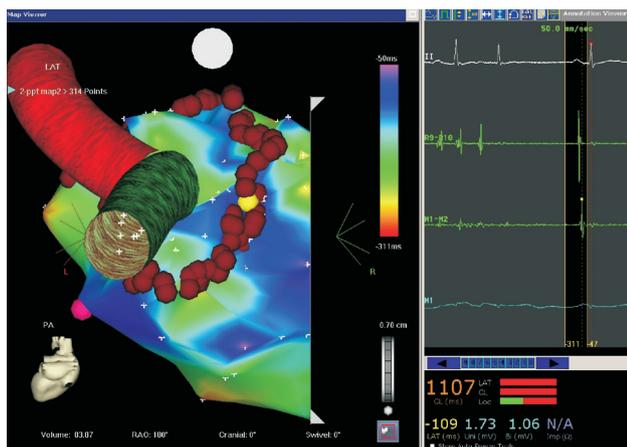


Figure 2. Left panel is RAO view of left pulmonary veins antrum showing ablation lines (red points) along the posterior aspect of the antrum. The yellow point is the point where ablation resulted in termination of atrial fibrillation. The termination of AF during RFA is demonstrated in the right panel showing conversion from AF to sinus rhythm.

DISCUSSION

This study demonstrates efficacy and safety of circumferential PVI on mixed AF patients with 86% freedom from symptomatic AF during one year follow up and without any fatal complication.

According to HRS/EHRA/ECAS expert consensus the primary indication for catheter AF ablation is the presence of symptomatic AF refractory or intolerant to at least one Class 1 or Class 3 antiarrhythmic medication. The Task Force also recognizes that, in rare clinical situations, it may be appropriate to perform catheter ablation of AF as first line therapy. Catheter ablation of AF is also appropriate in selected symptomatic patients with heart failure and/or reduced ejection fraction.⁶ All subjects in our study were symptomatic AF, either paroxysmal or persistent, that failed from optimal pharmacological therapy.

Circumferential PV isolation targeting the PV antrum has been recently demonstrated to achieve very good results. With more than 80% cured of paroxysmal AF and without significant complication after one procedure. Of 30 patients underwent AF ablation, acute results was very high (93.3%) which was decrease to about eighty percent during 1 year follow up. These results are comparable with that comes from the centers with high loaded patient and experienced operators. There was general agreement that all patients who undergo catheter ablation of AF should be seen in follow-up at a minimum of three months following the ablation procedure and then every six months for at least two years. ECGs should be obtained at all follow-up visits and patients who complain of palpitations should be evaluated with an event monitor.⁶

A recent survey on the methods, efficacy, and safety of catheter ablation of AF involving more than 180 centers reported nearly 9000 AF ablation procedures. The success rate, as defined as freedom from symptomatic AF in the absence of antiarrhythmic therapy was 52%. An additional 24% of patients were free of asymptomatic AF in the presence of a previously ineffective antiarrhythmic drug. The mean duration of follow-up of these patients was 12 ± 8 months. However, more than 27% of patients in this study underwent more than one ablation procedure.¹² As compare to that survey, we performed single procedure in our study with even higher success rate. However, method of AF observation during follow up period might cause different result, Compare to anti-arrhythmic drug alone, anti-arrhythmic drug plus RFA give better results on sinus rhythm maintenance. A randomized study investigated the adjunctive role of catheter ablation in 137 patients with paroxysmal or

persistent AF. At 12 months of follow-up, 9% of patients in the anti-arrhythmic drug arm were free of recurrent AF, as compared with 56% of patients treated with catheter ablation and anti-arrhythmic drug therapy.¹³

Only four patients (14%) converted to sinus rhythm during RFA and all of them are belong to PAF group (Figure 2). The rest of patients need electrical cardioversion to convert to sinus rhythm. Conversion to sinus rhythm during RFA is not the end point of AF ablation. As mentioned earlier, complete PV isolation is the cornerstone of AF ablation strategy.⁶ Additive ablation line and/or substrates ablation can be applied if necessary. If conversion to sinus rhythm is not achieved upon completion of RFA then electrical cardioversion must be done.

Several risk factors of AF have been identified in recent studies. Age and hypertension are two most important risk factors of AF. The estimated prevalence of AF is 0.4 to 1% in general population.¹⁴ Cross-sectional studies found a lower prevalence in those below the age of 60 yo and increasing to 8% in those older than 80 yo.¹⁵ In our study the mean age is 52±8 yo which is younger compare to previous reports. Even though not appropriate to say that incidence of AF tend to be

younger in Indonesian but this data suggest significant proportion of AF patient among younger population. It's warrant further population base study. Hypertension is the major comorbidity in our study subject. Atrial fibrillation and hypertension are 2 prevalent, and often coexistent, conditions in the North American population. Hypertension is associated with left ventricular hypertrophy, impaired ventricular filling, left atrial enlargement, and slowing of atrial conduction velocity. These changes in cardiac structure and physiology favor the development of atrial fibrillation, and they increase the risk of thromboembolic complications.¹⁶ During follow up period, subjects with hypertension did not inferior with regard to AF free survival as compared to normotensive patients (Figure 3). This result might not appropriately reflect the actual circumstances as this study was not designed to compare between hypertensive and normotensive patient. A long prospective study in hypertensive patient demonstrated that age and left ventricular mass were the sole independent predictors of atrial fibrillation.¹⁷ They reported that atrial fibrillation became chronic in 33% of subjects and showed that age, left ventricular mass, and left atrial diameter were independent predictors of chronic atrial fibrillation.

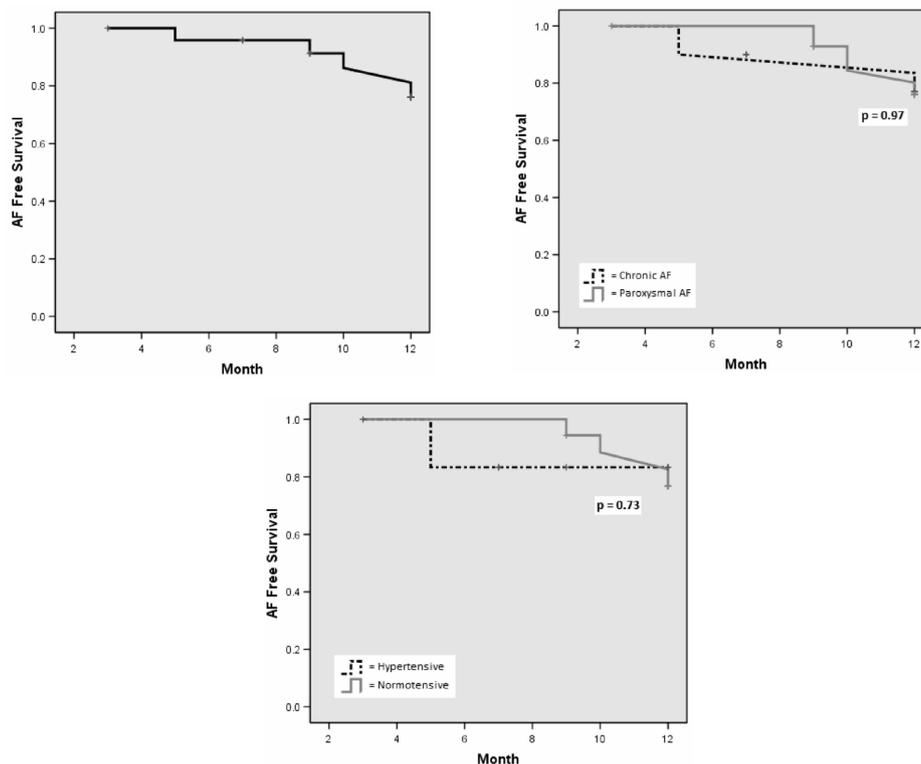


Figure 3. One year Kaplan Meier AF Free Survival. Upper panel demonstrates AF free survival of all patients. Mid panel shows survival in PAF and chronic AF groups. Lower panel shows survival in hypertensive as compare to normotensive patients.

Our study showed that either paroxysmal or chronic AF has similar result in regard to free from symptomatic during 1 year follow up. The single procedure success of catheter ablation of patients with paroxysmal AF ranged from 38% to 78%. For patients with paroxysmal AF, most series reported a single procedure efficacy of 60% or greater. In contrast, the single procedure success of catheter ablation of patients with persistent AF ranged from 22% to 45%, with most centers reporting an efficacy of 30% or less. The single procedure success of catheter ablation of patients with mixed types of AF ranged from 16% to 84%.⁶ With limited experience compare to other centers, we gain more than eighty percent success rate of mixed types AF ablation during 1 year follow up. This result is comparable with that from experienced and high patient loaded centers.

In one patient, AF converted to typical atrial flutter during RFA which then converted to sinus rhythm after cavo tricuspid isthmus ablation. Unlike left atrial flutter, the occurrence of typical atrial flutter during AF ablation is less elaborated. Recently, Luik et al¹⁸ reported 3 cases of persistent AF which converted to typical atrial flutter during CFAE ablation. The mechanism of AF conversion to typical atrial flutter has not completely understood yet.

We don't face any major complication in our patient series. However some major complication can be happen during complex AF ablation procedure. Major complications have been reported in about 6% of procedures and include PV stenosis, thromboembolism, atrioesophageal fistula, cardiac tamponade and LA flutter.¹² Current approaches avoid delivering radiofrequency energy within the PV and instead target areas outside the veins to isolate the ostia from the remainder of the LA conducting tissue has dramatically decreased PV stenosis complication.

Method of AF recurrence monitoring used in this study might not appropriately record asymptomatic AF recurrence. Implantable loop recorder will give accurate 6 to 12 months AF recurrence monitoring but it is not practical due to the need of surgical intervention. In addition, the long-term efficacy to prevent recurrent AF requires further study.

In conclusion, radiofrequency ablation guided with electroanatomical mapping is effective and safe in mixed type of AF.

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