

Principles and Techniques of the Three Dimensional Electroanatomic Cardiac Mapping Approach to the Treatment of the Intractable Atrial Macroreentrant Tachycardia Ablations

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ABSTRACT

Introduction: Challenging and intractable macroreentrant atrial tachycardias mostly occur after cardiac surgeries and the response of such arrhythmias to conventional treatments is poor. Also, arrhythmias that previously underwent unsuccessful ablations are compulsive arrhythmias. This study represents our approach for the ablation of the challenging atrial macroreentrant tachycardias.

Materials and Method: Five consecutive patients with atrial flutter and previous history of cardiac surgery and/or radiofrequency ablation were enrolled to this study. The focal of the clinical arrhythmia was defined in the CARTO® and Columbus™ map and the critical isthmus targeted for ablation. Radiofrequency ablation was performed till the arrhythmia stopped or until a change in cycle length or activation wave front were seen.

Results: All of the complex atrial macroreentrant tachycardias were arisen from the right atrium. Overall cases were successfully mapped and ablated. None of them had recurrence after 6 months of follow-up. The mean (\pm SD) procedure time was 49.0 ± 22.4 minutes. Three dimensional electroanatomic cardiac mapping technologies including CARTO and Columbus™ are the highly effective methods of the revealing atrial arrhythmias and facilitating ablation of the scar related potential circuits.

Conclusion: This study highlights success and usefulness of three dimensional electroanatomic cardiac mapping in complex atrial macroreentrant tachycardia ablations.

Keywords: Cardiac mapping, three dimensional technology, complex atrial macroreentrant tachycardias.

Üç Boyutlu Elektroanatomik Kardiyak Haritalama ile Zor ve Tedaviye Dirençli Atriyal Macroreentran Taşikardi Ablasyonlarına Yaklaşım Prensipleri ve Teknikleri

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ÖZET

Giriş: Zorlu ve dirençli makroreentran atriyal taşikardiler çoğunlukla kardiyak cerrahi sonrası oluşur ve konvansiyonel tedaviye verdikleri yanıt zayıftır. Ayrıca, daha önceden başarısız ablasyon geçiren hastaların tedaviye yanıtları daha dirençlidir. Bu çalışma ile zorlu atriyal makroreentran taşikardilere yaklaşımımızı paylaştık.

Hastalar ve Metod: Daha önceden kardiyak cerrahi geçiren ve/veya radyofrekans ablasyon geçirmiş olan 5 atrial flutter hastası çalışmaya dahil edildi. Klinik olarak izlenen aritmi odağı CARTO® ve Columbus™ haritalama yöntemi ile istmus işaretlenerek belirlendi. Aritmi sonlanana kadar veya siklus uzunluğunda veya aktivasyon dalga boyunda değişiklik elde edilene kadar radyofrekans enerji uygulandı.

Bulgular: Tüm kompleks atriyal makroreentran taşıkardiler sağ atriyumdan orjin alıyordu. Tüm olgular başarılı bir şekilde haritalandı ve ablasyon işlemi uygulandı Başarılı ablasyon uygulanan hastalarda 6 aylık takip süresince rekürrens izlenmedi. Ortalama işlem süresi (\pm SS) 49.0 \pm 22.4 dakikadır. Atriyuma CARTO ve Columbus™ üç boyutlu elektroanatomik kardiyak haritalama teknolojileri kullanılarak tüm potansiyel devrelerin başarılı ablasyonu skar ilişkili makroreentran atriyal taşıkardilerin ablasyonunda yüksek oranda etkili bir methodtur.

Sonuç: Bu çalışma, kompleks makroreentran atriyal taşıkardilerin ablasyonunda, üç boyutlu elektroanatomik kardiyak haritalamanın başarısını ve kullanılabilirliğini vurgulamaktadır.

Anahtar Kelimeler: Kardiyak haritalama, üç boyutlu teknoloji, kompleks atriyal makroreentran taşıkardiler.

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Introduction

Cardiac electrophysiology has made important progress, during recent years in treatment of complex cardiac arrhythmias. Electrophysiologic studies and radiofrequency ablations have developed for many variety of tachyarrhythmias. More complex rhythm disturbances gradually are complicating to define ablation side. The complex and challenging macroreentrant atrial tachycardias can present after cardiac surgery of atrial septal defects operation, ventricular septal defects operation, Fontan, Mustard, Senning procedures (1,2). Following to an undergone ablation procedure, secondary procedures are getting more challenging. Conventional radiofrequency catheter ablation of these intractable arrhythmias is hard to deal and related with longtime procedures, prolonged fluoroscopic times and high percentages of recurrences (3). Nowadays, advanced technology of three dimensional electroanatomic cardiac mapping, called CARTO (Biosense, Diamond Bar, CA, USA), EnSite NavX (St. Jude Medical, Saint Paul, MN, USA) and Columbus™ Three-dimensional EP Navigation System (Shanghai MicroPort EP Medtech) have ability of advanced signal recording, represent critical information simultaneously during ablation procedures and for all lessening the fluoroscopic time and reduce radiation dosage (4).. Real time view of catheters also facilitate procedure and enhance success rates. These systems reconstruct the cardiac anatomy and demonstrate the ablation territory with a low margin of error. In this study we represent our approach for the ablation of the complex atrial macroreentrant tachycardias.

Patients and Method

Five consecutive patients (3 men, 2 women) with atrial flutter and previous history of cardiac surgery and/or radiofrequency ablation were submitted to an electrophysiologic study. All patients were anticoagulated with warfarin sodium to maintain an international normalized ratio (INR) between 2 and 3 for at least 3 weeks before the procedure and received antiarrhythmic drugs to control ventricular rate. Antiarrhythmic drugs were stopped five days before the procedure. All subjects gave their consent for inclusion to the study. The investigation conforms with the principles outlined in the Declaration of Helsinki. Three femoral venous punctures were done and three sheaths were placed in the femoral vein. A decapolar catheter was placed in the coronary sinus. A quadripolar catheter was positioned in the right atrium or His, and an irrigated-tip catheter was used for mapping and ablation. Previously, a bolus of 2500 IU of heparin was administered intravenously. Firstly, assessment of the arrhythmia was started from setting the cycle length and activation wave front. Catheter was introduced to the cavo-tricuspid isthmus, proximal coronary sinus, low lateral and high lateral walls to determine the possible origin of arrhythmia. An activation/voltage map was gained and scar tissue was described with the smallest local potential which could not be differentiated from noise. The circuit of the clinical arrhythmia was defined in the CARTO® and Columbus™ map and the critical isthmus targeted for ablation (Figure 1A, 1B). Radiofrequency energy was applied until the arrhythmia stopped or until a change in cycle length or activation wave front were observed. The data of patients age, sex, processing time, echocardiographic and laboratory findings were collected. Transthoracic echocardiographic evaluation was performed before ablation procedure. Statistical Software Package of SPSS version 13.0 was used for statistics analysis. All the values were determined as mean \pm standard deviation.

Results

Five consecutive patients totally, who underwent radiofrequency ablation were fulfilled the criteria of inclusion to this study (Table 1). 5 patients (3 men, 2 women) underwent ablation at a mean age (\pm SD) of 57.4 ± 7.6 . (median: 58, range 44 to 68). Patients referred to ablation procedure had mean (\pm SD) ejection fraction of $58.40\% \pm 2.30$. Patients left atrium diameters were found 4.40 ± 0.18 . All of the patients were successfully mapped and also 5 of them (100%) were terminated during radiofrequency ablation. 5 of the 5 cases were macroreentry. The mean (\pm SD) procedure time was 49.0 ± 22.4 minutes. There was not any complication occurred during the procedure and time till discharge. During a mean 6 months follow ups, 5 of 5 patients were free of atrial flutter recurrences.

Discussion

Congenital cardiac operations augment arrhythmia rates, particularly stimulate atrial macroreentrant arrhythmias. Atrial septal defect closure operations, induced arrhythmias especially generating from atypical origins. Considering to studies, atrial arrhythmias followed up in preoperative period was nearly 20%, however the incidence of arrhythmias increased up to 60% (2). Among the electrophysiologic sequelae of corrective surgery for congenital heart disease, there are a number of delivery lines favoring reentrant arrhythmias, associated with recurrence and fibrosis. Radiofrequency catheter ablation trials, performed to patients who underwent cardiac surgery or had an unsuccessful radiofrequency ablation experience, are challenging and associated with prolonged procedure times which bring high radiation doses with longer fluoroscopy times and high rates recurrences (5). Recently used electroanatomic mapping systems provide the association of intracardiac electrical activity with established anatomic origin of arrhythmia with high accuracy (6). Three dimensional view of cardiac anatomy, certain point of ablation area, important landmarks and manipulation of catheters without necessity of fluoroscopic screen are improving procedural performances and rising success rates particularly in intractable arrhythmias with unusual anatomic varieties. Due to advanced electroanatomic mapping systems, recurrence rates and antiarrhythmic drug treatment requirements after complex and intractable arrhythmia ablations are significantly decreasing. Atypical atrial flutter, atrial fibrillation and ventricular tachycardias are mostly associated with ischemic etiology, structural heart disease related with abnormal cardiac anatomy and cardiac surgery. Electroanatomical mapping systems facilitate complete treatment of intractable rhythm disturbances and currently accomplished with successful results (7).

Conclusion

Medical management of complex atrial macroreentrant tachycardias are often unsuccessful, and require invasive procedures. Electroanatomic cardiac mapping may gain further advantageuses for complex atrial tachycardias.

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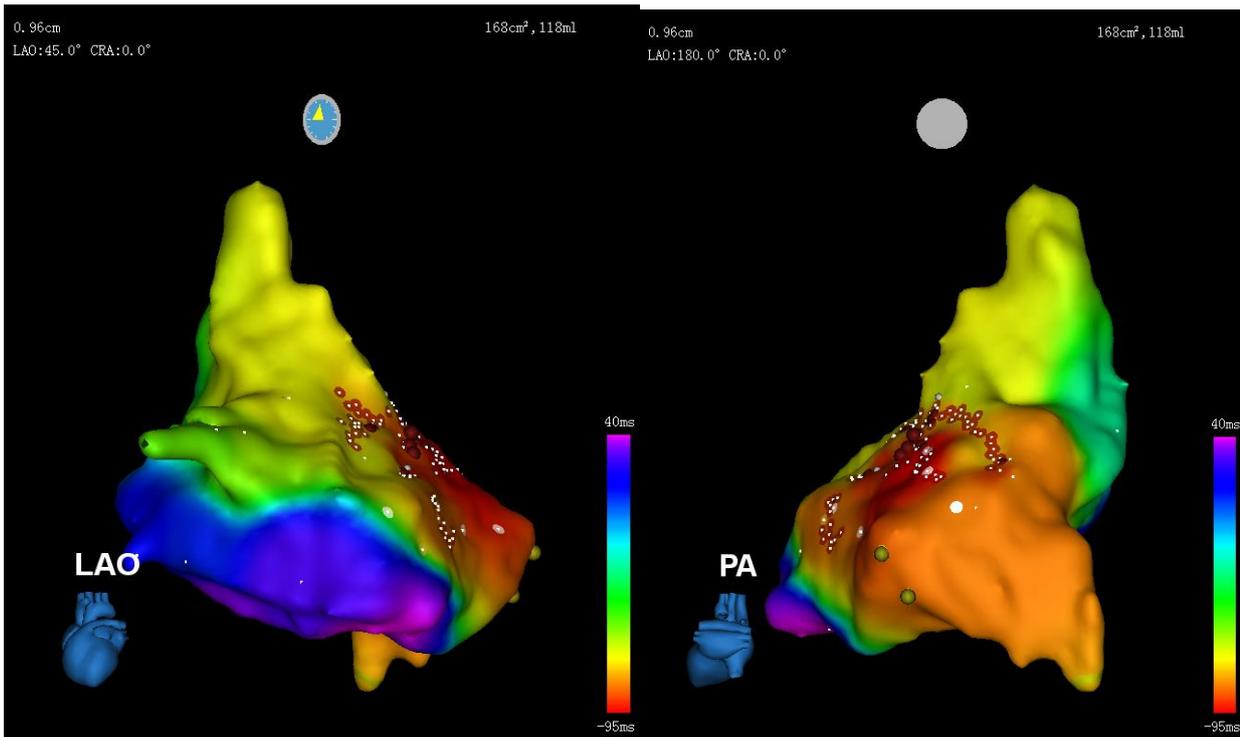


Figure IA, IB. The circuit of the clinical arrhythmia was defined in the Columbus™ map and the critical isthmus (around the atrial septal defect patch) targeted for ablation

Table I: Patients age, sex, processing time, echocardiographic and laboratory findings

Age (years)	57.4±7.6
Ejection Fraction (%)	58.40±2.30
Left Atrium Diameter (cm)	4.40±0.18
Creatinine (mg/dL)	0.86±0.15
Sodium (mmol/L)	141.80±1.30
Potassium (mmol/L)	4.55±0.38
Thyroid stimulating hormone (uIU/mL)	2.24±1.61
Hemoglobin (mg/dL)	13.70±0.88
Processing time (minute)	49.0±22.4