

Ablation of Atrial Fibrillation: First Single-Center Latin-American Consecutive Series guided by ICE and 3D Electroanatomic Mapping

William Uribe MD¹; Edgardo González MD¹; Adrian Baranchuk MD FACC²; Ana Milena Herrera MD, Ph.D³; Eduardo Medina MD¹; Jorge Marín MD¹; and Mauricio Duque MD¹

¹Servicio de Electrofisiología y Arritmias, Universidad CES, Medellín, Colombia, ²Arrhythmia Service, Kingston General Hospital, Queen's University, Kingston, Ontario, Canada, ³Coordinadora doctorado facultad de Medicina, Universidad CES, Medellín Colombia

Resumen

Las venas pulmonares fueron identificadas como los sitios que frecuentemente gatillan fibrilación auricular (FA). El objetivo de este estudio fue evaluar la reproducibilidad, seguridad, y efectividad del aislamiento eléctrico del antró de las venas pulmonares en pacientes con FA paroxística, en una serie de pacientes consecutivos de un único centro de Latinoamérica.

Métodos: Se incluyeron en el análisis pacientes con FA recurrente paroxística refractarios a por lo menos una droga antiarrítmica. Se realizó aislamiento eléctrico de las venas pulmonares a nivel del antró guiada por potenciales eléctricos, ecocardiograma intracardiaco, fluoroscopia convencional y sistema de navegación no fluoroscópica (Ensite NaVx® and CARTO®).

Resultados: Cien pacientes consecutivos fueron sometidos a ablación. Se aislaron 4 venas pulmonares en 93% de los casos. Se utilizó catéter de punta irrigada en 96% de los casos liberando una potencia máxima de 35 Watts. Se observaron complicaciones en el 7% de los casos: 3 taponamientos cardíacos, una elevación transitoria del segmento ST, un "atrapamiento del catéter circular, una pseudoaneurisma femoral, un ataque isquémico transitorio, y un caso severo, pero asintomático, de estenosis de las

venas pulmonares. No se produjeron muertes en este grupo de pacientes. En el seguimiento, 88.6% se encontraban libres de recurrencias. Se realizó un Segundo procedimiento en 5 pacientes. No se identificaron predictores de recurrencia en esta serie

Conclusiones: El aislamiento eléctrico del antró de las venas pulmonares en pacientes con FA paroxística es un método seguro, reproducible y eficaz, que puede realizarse en centros de países en vías de desarrollo.

Abstract

Pulmonary veins (PV) are well recognized triggers of atrial fibrillation (AF). The aim of this study was to evaluate the reproducibility, safety, and effectiveness of antral electric isolation of PV in patients with paroxysmal AF (PAF), in consecutive patients from a single Latin-American center.

Methods: Patients with recurrent PAF refractory to at least one antiarrhythmic drug were included in the analysis. Antral electric isolation of PV was performed guided by electric potentials, intracardiac echocardiography (ICE), conventional fluoroscopy and non fluoroscopic three-dimensional mapping (Ensite NaVx® and CARTO®).

Results: One hundred consecutive patients underwent antral electrical isolation. Four pulmonary veins were isolated in 93% of the cases. Irrigated tip catheter was used in 96% of the cases with a maximal power of 35

Correspondencia: William Uribe MD
Carrera 43 No. 36-02, torre Norte,
Consultorio 1101,
Medellín Colombia S.A.
Tel-fax: (574)444-0566
wuribe@une.net.co

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Watts. Complications were present in 7% of the patients: three cardiac tamponades, one transitory elevation of the ST-segment, one circular catheter entrapment, one femoral pseudoaneurism, one transient ischemic stroke and one significant but asymptomatic PV stenosis. No deaths occurred in this cohort. During the follow up, 88.6% were free of AF recurrences. A second procedure was performed in five patients. No predictors of recurrence were identified.

Conclusions: Antral electric isolation of the PV in patients with paroxysmal AF is a safe, reproducible and effective technique, feasible for a center located in a non-developed country.

Key words: Ablation; atrial fibrillation; antral ablation

INTRODUCTION

Atrial fibrillation (AF) is a supraventricular arrhythmia characterized by a non coordinated activation of the atria that deteriorates their contractile function.¹ Its prevalence in the general population is estimated between 0,4% and 1,0%, and increases with age reaching 8% in those older than 80 years of age.^{2,3} Pulmonary Veins (PV) are frequent triggers of paroxysmal AF (PAF). Given this fact, AF is potentially curable with electric isolation of such structures by percutaneous techniques⁴⁻⁸ that allows a sinus rhythm to be maintained in a high percentage of patients.

No studies have been published to date by a single-center Latin-American group in order to evaluate these procedures in a considerable number of patients. In the present manuscript, short and mid term follow up of patients that underwent antral PV electric isolation for the treatment of PAF will be analyzed.

METHODS

Retrospective, descriptive, observational follow up study of consecutive patients with diagnosis of recurrent symptomatic PAF that in spite of the use of at least one antiarrhythmic drug underwent antral isolation of the PV between

December 2004 and July 2008 at the electrophysiology department of a private hospital in Medellín City, Colombia.

Procedure success was determined by the absence of recurrence after a blanking period of 2 months post intervention, and the absence of complications inherent to the procedure during the follow up, including death.

Frequencies distribution were calculated for each one of the variables evaluated, such as personal and pharmacologic history, physical and cardiac structure findings, and clinical evaluation after the procedure.

ELECTRIC ISOLATION OF PV

Antral isolation of the PV was performed in all the patients. In brief, a transesophageal echocardiography and contrasted multidetection thoracic tomography with three dimensional reconstruction of the left atrium was performed 24 to 48 hours before the procedure. Under sedation, the vascular accesses were obtained. A 7F duodecapolar Daig® catheter was implanted by internal jugular access for registration and stimulation of coronary sinus and right atrium electric potentials. Two transseptal sheaths were advanced to the left atrium by right femoral access, one 7F external irrigated radiofrequency ablation 4 mm tip (Johnson®) catheter and a circular fixed or variable 6F catheter (Lasso® and Spiral®) for the PV potential recording. Before the first transseptal puncture, 5000 units of heparin were infused and activated coagulation time (ACT) was performed every 30 minutes maintaining a value between 250 and 350 milliseconds. These transseptal punctures were assisted by intracardiac echocardiography probe (Navistar®) advanced to the right atrium through the left femoral vein (Fig 1). In most cases a non fluoroscopic three-dimensional mapping of the left atrium and pulmonary veins was performed. Radiofrequency applications were

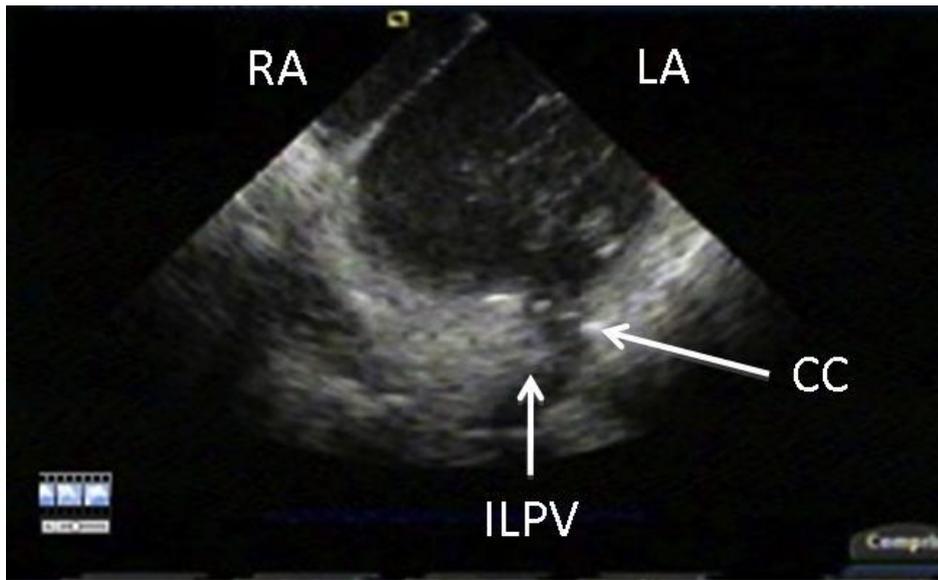


Figura 1: ICE image: Circular catheter at left inferior pulmonary vein antrum. RA: right atrium; LA: left atrium; ILPV: inferior left pulmonary vein; CC: circular catheter

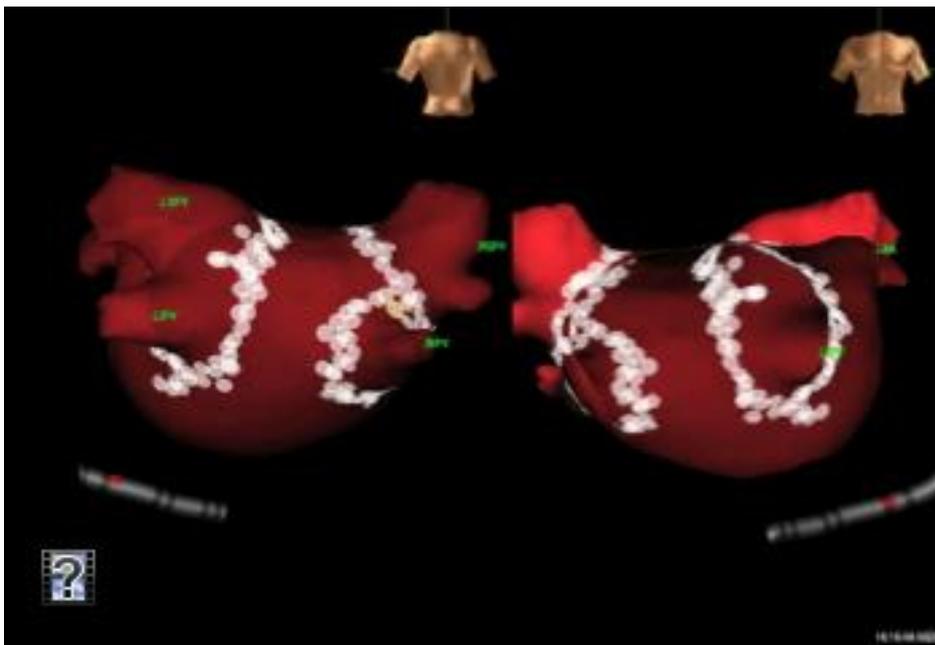


Figura 2: 3D reconstruction of the left atrium and pulmonary veins. Please note the lesion set (Ensite Navx® system).

delivered with a maximum power of 30-35 Watts in all those antral places where the circular catheter documented pulmonary vein potentials and if the patient was in AF during the procedure additional lines were performed (Fig.2). A new electrical mapping was then carried out to document the disappearance of the potentials and when necessary additional applications of radiofrequency were delivered. Before removing

the left atrium catheters, progressive doses of isoproterenol of up to 20 micrograms per minute were given as a pharmacologic challenge. If AF, atrial tachycardia or repetitive premature atrial contraction (PAC) were induced, PV potentials were re-mapped and reinforcement of the prior lines was performed. Finally, a superior vena cava (SVC) mapping and electrical isolation, if

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considered necessary, was performed due to the reported high incidence of recurrences (up to 6%) reported by others. Oral Warfarin and acetyl salicylic acid, betablockers and antiarrhythmics such as propafenone or amiodarone were started on the same day of the procedure. The patients were followed clinically and by Holter monitoring on the first, third, sixth and twelfth months. On the third month a multislice CT was performed to rule out PV stenosis in the first 50 patients.

RESULTS

Pulmonary vein isolation was performed in 100 patients with PAF, 74% were males. Only 5 patients underwent a second procedure. The median age was 56 years (21-77 years). The mean follow up was of 13.2 ± 8.6 months (1-40 months). Clinical characteristics of the patients are displayed in table 1.

Table 1: Clinical characteristics of the patients

Characteristic	Percentage %
Arterial hypertension	18
Dyslipidemia	5
Tobacco use	6
Diabetes mellitus	0
Hypothyroidism	3
Chronic renal insufficiency	1
Coronary artery disease	4
Valvular disease	2
Previous atrial flutter ablation	10
Previous ablation of other supraventricular arrhythmias	9
Previous maze surgery	1
Previous pacemaker	8
Previous automatic defibrillator (CDI)	2
Previous stroke	7
Previous peripheral thromboembolism	1
Previous episodes of congestive heart failure	4

Table 2: Echocardiographic characteristics

Characteristic	Result
Left atrium diameter cm	3.68 ± 5.91 SD
Left atrium area cm ²	19.0 RIQ (14-24)
Left ventricle ejection fraction	61.8 ± 6.0 SD
Diastolic dysfunction	11%
Spontaneous contrast	12%

Transesophageal echocardiography was performed 24-48 hours before the procedure in all patients and the anatomic characteristics are summarized in Table 2. Technical aspects of pulmonary vein electric isolation can be seen in Table 3.

COMPLICATIONS

Complications were classified in acute if presented in the first 24 hours post-procedure, sub-acute after 24 hours and within the first three months, and chronic after

Table 3: Technical aspects of pulmonary vein isolation

Characteristic	Percentage %
Initial rhythm	
Sinus	77
AF	18
AFL	5
Number of isolated pulmonary veins	
1	2
3	3
4	93
5	2
Other ablation lines	72
Superior vena cava	62
Cavotricuspid isthmus	10
Coronary sinus	5
Left interatrial septum	2
Left atrial roof	3
Mitral isthmus	1
Electric cardioversion	39
Intracardiac echocardiography	100
Non fluoroscopic three-dimensional mapping	98
Catheter type	
Non irrigated 8 mm	4
Irrigated 4 mm	96
Final rhythm	
Sinus	99
AFL	1
Isoproterenol Test	59
Post isoproterenol sinus rhythm	93.2

Table 4: Complications associated with the procedures

Complications	Percentage %
Acute	4
Cardiac tamponade	2
Transient ST-segment elevation	1
Circular catheter entrapment	1
Subacute	3
Cardiac tamponade	1
Femoral pseudoaneurysm	1
Transient ischemic stroke	1
Chronic	
Pulmonary vein stenosis	1

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three months. These complications are described in Table 4. Among the acute complications, two cardiac tamponades were present: one associated with transseptal puncture and the second probably associated with the ablation, given that it occurred at the end of the procedure. Both cases resolved with pericardiocentesis and pericardial drainage. A transient ST-segment elevation associated to air embolism resolved spontaneously. A circular catheter entrapment in the tendinous chords required surgical intervention. Other patient presented a neurological deficit that spontaneously resolved within 24 hours (with adequate anticoagulation range). The only chronic complication consisted in an asymptomatic significant stenosis of one pulmonary vein detected by CT scan on the third post-procedure month. There was no mortality associated with the procedure or during the follow up.

FOLLOW UP

In the first three months of follow up, 11% of the patients presented AF recurrence. After this period and within a year 88 patients were followed up and 10 presented AF recurrence (11.4%). In five of these patients a second pulmonary vein isolation procedure was performed. No clinical or echocardiographic predictor factors for AF recurrence were identified.

DISCUSSION

The present study demonstrated feasibility of pulmonary vein isolation performed in our center with an acceptable rate of complications (7%). This result is comparable to that reported worldwide in AF ablation in which major complications were present in 6% of the patients.⁹ The presence of complications was particularly elevated in the first procedures and has decreased at the same time as the group's learning curve has improved. This finding is probably related to the standardization of the procedure, which has had scarce modifications since the beginning, and the simultaneous use of echocardiographic images and three-dimensional mapping.¹⁰⁻¹¹ Pulmonary vein stenosis rate is also comparable to what has been reported in prior

studies^{9,12} and the low rate could be explained by the use of an antral technique instead of an ostial technique decreasing the risk for this complication.¹³ The most frequent complication in our study was cardiac tamponade, which was 3%. This is slightly higher than the previously reported in the literature, which is around 1%.⁹ However, incidences of up to 2,9% have been found when extensive ablation of the left atrium was performed¹⁴. No deaths occurred in this cohort.

The second important finding of the study was the high success rate and low recurrence rate during the follow up (11.4%), comparable to previous studies.¹⁵⁻¹⁷ This high success and low recurrence rates were probably related to the standardization of the procedure, the simultaneous use of imaging techniques, and the early use of irrigated catheters.

The authors and others agree that atrial myocardium surrounding the ostium of the veins is involved in the origin and perpetuation of AF.¹⁸ Furthermore, other sites were targeted in a high proportion of cases, especially those in the superior vena cava which are considered to be the cause of recurrence in about 6% of the cases.¹⁹

Even though no predictors of recurrence were identified, it is well known that recurrences are associated with incomplete pulmonary vein isolation²⁰⁻²² or the presence of other triggering foci located in other atrial structures (5-15%).²³ In our experience, the five patients in whom a second procedure was performed, residual pulmonary vein potentials (reconnections) were observed, suggesting incomplete isolation.

Similar to what has been reported in the literature,²⁴ early recurrences occurred in 11% of our patients. However, these early recurrences were not associated with mid term AF recurrence.

Our study demonstrates that antral isolation is a feasible, efficient and reproducible technique that can be performed in developing countries.

LIMITATIONS

Given that this is an observational retrospective study, there could be some bias in the way that the information was collected.

CONCLUSIONS

The present study shows that pulmonary vein antral electrical isolation in patients with PAF is a safe, efficient and reproducible technique.

This first reported single-center Latin-American series demonstrates that ablation for AF can be done in our region with similar results that those reported in North America and Europe.

REFERENCES

1. Fuster V, Ryden LE, Cannom DS, et al. ACC/AHA/ESC 2006 guidelines for the management of patients with atrial fibrillation: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and the European Society of Cardiology Committee for Practice Guidelines (Writing Committee to Revise the 2001 Guidelines for the management of Patients With Atrial Fibrillation): developed in collaboration with the European Heart Rhythm Association and the Heart Rhythm Society. *Circulation* 2006; 114:e257-e354.
2. Go AS, Hylek EM, Phillips KA, et al. Prevalence of diagnosed atrial fibrillation in adults: national implications for rhythm management and stroke prevention: the Anticoagulation and risk factors in atrial fibrillation (ATRIA) study. *JAMA* 2001; 285:2370-5.
3. Furberg CD, Psaty BM, Manolio TA, et al. Prevalence of atrial fibrillation in elderly subjects (the Cardiovascular Health Study). *Am J Cardiol* 1994; 74: 236 -41
4. Le Heuzey JY, Paziand O, Piot O, et al. Cost of care distribution in atrial fibrillation patients: the COCAF study. *Am Heart J* 2004; 147: 121-6.
5. Jais P, Haissaguerre M, Shah DC, et al. A focal source of atrial fibrillation treated by discrete radiofrequency ablation. *Circulation* 1997; 95: 572-6.
6. Haissaguerre M, Jais P, Shah DC, et al. Spontaneous initiation of atrial fibrillation by ectopic beats originating in the pulmonary veins. *N Engl J Med* 1998; 339: 659-66.
7. Verma A, Marrouche NF, Natale A. Pulmonary vein antrum isolation: intracardiac echocardiography-guided technique. *J Cardiovasc Electrophysiol* 2004; 15: 1335-40.
8. Pappone C, Rosanio S, Oreto G, et al. Circumferential radiofrequency ablation of pulmonary vein ostia: a new anatomic approach for curing atrial fibrillation. *Circulation* 2000; 102: 2619-28.
9. Cappato R, Calkins H, Chen S, et al. . Worldwide survey on the methods, efficacy and safety of catheter ablation for human atrial fibrillation. *Circulation* 2005; 111:1100 -1105
10. Dixit S, Marchlinsky FE. How to recognize, manage, and prevent complications during atrial fibrillation ablation. *Heart Rhythm* 2007; 4: 108-115
11. Johnson SB, Seward JB, Packer DL. Phased-array intracardiac echocardiography for guiding transseptal catheter placement: utility and learning curve. *PACE* 2002; 25: 402-407.
12. Querishi AM, Preito LR, Latson LA, et al. Transcatheter angioplasty for acquired pulmonary vein stenosis after radiofrequency ablation. *Circulation* 2003; 108: 1366 -1342.
13. Saad EB, Rossilli A, Saad CP, et al. Pulmonary vein stenosis after radiofrequency ablation of atrial fibrillation: functional characterization, evolution and influence of ablation strategy. *Circulation* 2003; 108: 3102-3107.
14. Hsu LF, Jais P, Hocini M, et al. Incidence and prevention of cardiac tamponade complicating ablation of atrial fibrillation. *PACE* 2005; 28: S106-S109.

DOI: 10.5031/v1i2.RIA10110

15. Oral H, Knight BP, Tada H, et al. Pulmonary vein isolation for paroxysmal and persistent atrial fibrillation. *Circulation* 2002; 105: 1077-1081.
16. Wazni OM, Marrouche NF, Martin DO, et al. Radiofrequency ablation vs antiarrhythmic drugs as first-line treatment of symptomatic atrial fibrillation. A Randomized Trial. *JAMA* 2005; 293: 2634-2640.
17. Pappone C, Augello G, Sala S, Gugliotta F, Vicedomini G, Gulletta S, et al. A randomized trial of circumferential pulmonary vein ablation versus antiarrhythmic drug therapy in paroxysmal atrial fibrillation: the APAF study. *J Am Coll Cardiol* 2006; 48:2340-7.
18. Arentz T, Weber R, Bürkle G, et al. Small or large isolation areas around the pulmonary veins for the treatment of atrial fibrillation?. Results from a prospective randomized trial. *Circulation* 2007; 115: 3057-3063.
19. Chin-Feng Tsai, MD; Ching-Tai Tai, MD; Ming-Hsiung Hsieh, MD et al. Initiation of atrial fibrillation by ectopic beats originating from the superior vena cava: Electrophysiological characteristics and results of radiofrequency ablation. *Circulation* 2000; 102:67-74
20. Cappato R, Negroni S, Pecora D et al. Prospective assessment of late conduction recurrence across radiofrequency lesions producing electrical disconnection at the pulmonary vein ostium in patients with atrial fibrillation. *Circulation* 2003; 108: 1599-604.
21. Nanthakumar K, Plumb VJ, Epstein AE, Veenhuyzen GD, Link D, Kay GN. Resumption of electrical conduction in previously isolated pulmonary veins: rationale for a different strategy? *Circulation* 2004; 109:1226-9.
22. Ouyang F, Antz M, Ernst S, Hachiya H, et al. Recovered pulmonary vein conduction as a dominant factor for recurrent atrial tachyarrhythmias after complete circular isolation of the pulmonary veins: lessons from double Lasso technique. *Circulation* 2005; 111:127-35.
23. Ming-hsiung hsieh MD, Ching Tai Tai MD, Shih-Huang Lee MD et al. The different mechanisms between late and very late recurrences of atrial fibrillation in patients undergoing a repeated catheter ablation. *J Cardiovasc Electrophysiol* 2006, 17: 231-235
24. Oral H, Knight BP, Özyaydin M, et al. Clinical significance of early recurrences of atrial fibrillation after pulmonary vein isolation. *J Am Coll Cardiol.* 2002; 40:100-104