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Editorial

Cardiocentro ERNESTO CHE GUEVARA SANTA CLARA CUBA

Ablación por catéter en la era intervencionista de los síndromes arritmogénicos

Catheter ablation in the interventional era of arrhythmogenic syndromes

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INFORMACIÓN DEL ARTÍCULO

Abreviaturas
ARF: ablación por radiofrecuencia
RF: radiofrecuencia

Palabras Clave: Ablación por Catéter, Radiofrecuencia, Arritmias Cardíacas
Key words: Catheter Ablation, Radiofrequency, Cardiac Arrhythmias

A finales de los años ´80, sobrevino el peor de los tiempos para los fármacos antiarrítmicos, por problemas propios y por el surgimiento de la radiofrecuencia (curativa) y del cardioversor-desfibrilador automático implantable (salvador de vidas). Existió una revolución en la terapia de las arritmias cardíacas y se desarrollaron las opciones no farmacológicas, que fueron notablemente exitosas[1-4].

Hubo y aún hay, un vertiginoso crecimiento en todo el mundo de los laboratorios que practican el intervencionismo en la Arritmología: la ablación por radiofrecuencia (ARF) y el cardioversor-desfibrilador automático implantable. Lo cual se refleja en las numerosas publicaciones sobre estos temas[1-6].

Callans ha dicho: *"Many of us began practicing electrophysiology before its interventional era, when this field was intensily intellectual but less successful at protecting patients from future harm".* Así lo vivimos en Cuba desde la creación del laboratorio de electrofisiología clínica en el Instituto de Cardiología y Cirugía Cardiovascular, en diciembre de1984, hasta que se practicó la primera ARF en enero de 1996.

Las bases del intervencionismo en la Arritmología, hasta llegar a la ARF, fueron la electrofisiología experimental, la electrocardiografía y la electrofisiología clínica; de la arritmología clásica se pasó a la intervencionista, luego la diagnóstica se transformó en terapéutica. La estimulación eléctrica programada del corazón, la cirugía y la fulguración con corriente directa, fueron los cimientos para el desarrollo del nuevo procedimiento. Todo esto sucedió también en nuestro país y cambió drásticamente la función del laboratorio clínico, de lo diagnóstico y artístico, a lo terapéutico. De 1967, año en que surgió la electrofisiología clínica en el mundo, se transitó a la electrofisiología terapéutica, en 1987, con la aparición de la radiofrecuencia (RF). Existe una absoluta conexión en ambos sentidos: el entendimiento de los sustratos

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arrítmicos y su ablación, no puede haber divorcio entre la electrofisiología clínica y la electrotecnología, que se enriquecen mutuamente[1-4,7].

En esta subespecialidad naciente, se produjeron rápidos cambios que la llevaron a convertirse en una gran subespecialidad, que también se enfrentó desde entonces y hasta hoy a grandes retos.

Dijo Zipes que: "*No other cardiovascular subspeciality has undergone a more radical transformation than the study and treatment of cardiac arrhythmias*". Y que *"...thanks to advances in radiofrequency catheter ablation it is the only subspeciality that can claim the ability to actually cure a patient of disease"*[2]. Esto da idea de la trascendencia de la RF.

El objetivo de la ablación es curar las arritmias mediante la destrucción de pequeñas áreas de tejido miocárdico o de conducción, las cuales son críticas para el inicio y el mantenimiento de una arritmia cardíaca. Este procedimiento origina lesiones bien demarcadas, progresivas, y destruye intencionalmente el tejido arritmogénico en el miocardio, las conexiones aurículo-ventriculares o ciertas partes del sistema especializado de conducción. Tiene el objetivo de curar o controlar arritmias. Es una opción terapéutica segura, altamente efectiva, no requiere de anestesia, no crea barotrauma y su lesión hística es muy focal[1-4,8].

La RF causa disipación de energía térmica a través del miocardio vecino desde el extremo del catéter, y la hipertermia producida suprime la arritmia y crea áreas de inexcitabilidad celular y de bloqueo de la conducción. Su naturaleza precisa y dirigida y el mapeo detallado, unen aspectos estructurales y funcionales de la arritmogénesis, y permiten entender mejor estos mecanismos. Se trata de crear una lesión focal con bordes discretos, suficientemente grande para incorporar el blanco pero suficientemente pequeña para minimizar el daño colateral, en eso se basó la ARF: lesiones precisas, pequeñas (de 4 a 7 mm de diámetro y 5 de profundidad), selectivas, y dirigidas, por lo que se requiere de un mapeo detallado. Sus efectos son superiores frente a los más difusos de la cirugía (a la cual virtualmente eliminó) y a los no específicos de los fármacos antiarrítmicos. La investigación y la educación no se eclipsaron, sino que fueron enriquecidas por la RF[1-4,8].

Para cualquier arritmia hay una región anatómica crítica de generación anormal del impulso o de su propagación, requeridas para que se sostenga clínicamente. Si ese sustrato se altera de manera irreversible o se destruye, la arritmia no ocurrirá espontáneamente ni se provocará.

La RF ha permitido, entre otras cosas: un mayor entendimiento de los mecanismos arritmogénicos, con los cambios progresivos que ocurren al destruir un sustrato; la elaboración de nuevas clasificaciones para localizar las vías accesorias y el reconocimiento de las vías múltiples, dormidas, arborizadas, vecinas, oblicuas, decrementales, inaccesibles, con selectividad anterógrada y retrógrada, y con mala función del sistema normal de conducción; asimismo, la presencia de varias vías rápidas y lentas en la taquicardia por reentrada intranodal[9-11].

El crecimiento fue vertiginoso en todo el mundo y los laboratorios que practican las ablaciones más complejas (fibrilación auricular y otras todavía no realizables en Cuba), se desarrollaron con rapidez. Las publicaciones igualmente se multiplicaron. Hoy se tratan por RF casi todas las arritmias: taquicardia por reentrada intranodal, vías accesorias, taquicardia y *flutter* auriculares, taquicardia ventricular (en sujetos con cardiopatía estructural o sin ella), extrasístoles, y fibrilación auricular.

La ARF puede intervenir sobre el sustrato (vía lenta de la taquicardia por reentrada intranodal, vía accesoria, entre otras), sobre el disparador (la extrasístole ventricular en la fibrilación ventricular), sobre el sustrato y el modulador (fibrilación auricular por vía accesoria). Sobre el elemento que inicia la arritmia o sobre el que la sostiene, y que no siempre es el mismo (extrasístoles de venas pulmonares, reentradas, focos de Purkinje).

Se han efectuado innovaciones en: los catéteres (irrigados, deflectables), la energía (ultrasonido, láser, crioablación), la anatomía fluoroscópica, y los mapeos refinados (fluoroscópicos y no)[1-4,7,12,13].

A veces la RF se combina con otros procedimientos intervencionistas: marcapaso y ablación, cardioversor-desfibrilador automático implantable y ablación.

Se crearon importantes registros internacionales, tales como: el *Multicentre European Radiofrequency Survey (MERFS),* el de la *Heart Rhythm Society* y el de la *NASPE (North American Society of Pacing and Electrophysiology)*[5,6].

Entonces se planteó el peligro de que la electrofisiología se transformara en electrotecnología y el electrofisiólogo en "ablacionista", pero ello en general no ha sucedido, por el contrario, la ARF ha permitido entender muchos aspectos sobre los mecanismos

fisiopatológicos de las arritmias y sus sustratos. Antes se diagnosticaban y trataban las arritmias, hoy se diagnostican y tratan los sustratos arritmogénicos.

Existen guías para orientar esta práctica pero es necesario atemperar el beneficio frente a los peligros, el juicio clínico para la decisión final y recordar que mecanismos arritmogénicos tan variados, deben tener opciones terapéuticas también variables.

Como en todos los procedimientos novedosos, al principio existió fantasía, euforia y entusiasmo, luego se tiende al equilibrio y al balance.

Se abordaron ablaciones cada vez más complejas, que requieren tiempos largos de ejecución. A veces es difícil disuadir de la práctica de la ARF a pacientes y a médicos, por los excelentes resultados del procedimiento y por lo que conocen por Internet; sin embargo, hay riesgos reales que habrá que considerar. En ocasiones la ARF no es opción de primera línea pero no siempre es la última posibilidad, habrá que tomar en cuenta de qué ablación se trata, en quién, y con qué enfermedades están asociadas. La gran lección será optimizar la selección de los pacientes; dice Klein: *"We must ask ourselves not can we apply a tehnology but should we in a given individual"*[14-16].

Si la ablación estuviera totalmente libre de riesgo, no se discutirían sus indicaciones. Algunos conflictos pueden ser: bloqueos aurículo-ventriculares de diversos grados, accidente cerebrovascular, disección de arterias coronarias, embolismo pulmonar, taponamiento cardíaco, daño valvular, infarto miocárdico, espasmo coronario, neumotórax, perforación de seno coronario, laceración de arteria femoral, derrame pericárdico, hematoma, hipotensión, derrame pleural o pericárdico, reacción vasovagal, fiebre, depresión respiratoria, arritmias incesantes, aumento de la dispersión, anormalidades de la repolarización, proarritmia, y muerte. Son infrecuentes pero existen. Por otra parte, hay ablaciones fallidas y otras con circuitos, que recuperan su capacidad arritmogénica[17,18].

Josephson comenta que debe intentarse primero *"Learning before you burn"* antes que *"Learning while burning"*, y en cuanto a la ablación de la fibrilación auricular, opina que existe pérdida del pensamiento crítico y que en ocasiones se tiene dependencia total de la tecnología sin entender sus limitaciones, se acepta lo publicado, con olvido del pro y el contra, y del peligro-costo-inefectividad de las terapias. Se viven tiempos de uso-abuso de la ARF en la fibrilación auricular, sin recordar que los resultados positivos son los más publicados, y menos las complicaciones y los fracasos. Los mecanismos de las arritmias difieren y no todas las fibrilaciones auriculares son lo mismo ni responden a iguales procedimientos: se intenta una cura universal y rápida, aunque ello no siempre es posible. Debe saberse qué y qué tanto se ablaciona en los variados tipos de fibrilación auricular; es necesario uniformar los seguimientos y los estudios estadísticos pues se obtienen buenos resultados con métodos variados. Por otra parte, recordar que esta arritmia es silente en el 75 % de los pacientes, que las lesiones de RF pueden ser excesivas y en el 20-40 % recurren en taquiarritmias auriculares. En ocasiones los sitios más tempranos de activación durante el mapeo son mal interpretados, las líneas adicionales pueden generar proarritmia y del 30-50 % de los casos deben someterse a un segundo procedimiento. Sin olvidar algunas complicaciones posibles: accidente cerebrovascular, parálisis del frénico, oclusión coronaria, perforación, fístula atrioesofágica, y muerte. Además, se trata de enfermedades progresivas. Algunas interpretaciones pueden ser erráticas en la ARF de la fibrilación: electrogramas fraccionados que pueden no requerirse para mantener la arritmia; conducción asincrónica y no por reentrada; y superposición de frentes de onda de activación en una estructura tridimensional. Es necesario saber cómo se inicia la arritmia, cómo se perpetúa, si se trata de un tipo persistente, crónico, permanente y si está indicada la ablación[13,14].

En cuanto a los síndromes arritmogénicos hereditarios, la ablación: no resulta útil en el síndrome de QT largo; no hay datos suficientes en el de QT corto; se practican algunas de arritmias asociadas y de focos disparadores de fibrilación ventricular en el síndrome de Brugada; puede disminuir la frecuencia de los eventos en la displasia arritmogénica del ventrículo derecho que continúan ocurriendo por tratarse de una enfermedad progresiva; se emplea en la destrucción de una vía accesoria en la miocardiopatía hipertrófica familiar; y no es de utilidad en la taquicardia ventricular polimórfica catecolaminérgica[19]. Habrá que esperar mejores resultados en la fibrilación auricular familiar.

Hay asuntos aun no resueltos y sujetos a grandes controversias, por ejemplo, si se realiza o no ablación en los portadores asintomáticos de vías accesorias y su real papel en la fibrilación auricular[20-23].

Epílogo: Mucho ha brindado la ARF y mucho puede esperarse aún de ella. Ha habido un tránsito de la electrofisiología diagnóstica a la terapéutica. Se apren-

de al *"quemar"* o, mejor, debe aprenderse antes de *"quemar".* La electrofisiología y la electrotecnología han de marchar aunadas. Como todo procedimiento tiene limitaciones y se impone conocer qué puede esperarse de ella y qué no, saber en quiénes sí y en quiénes no.

REFERENCIAS BIBLIOGRÁFICAS

1. Josephson ME. Catheter and surgical ablation in the teraphy of arrhythmias. En: Clinical cardiac electrophysiology: techniques and interpretations. 4th ed. Philadelphia: Lippincott Williams & Wilkins; 2008. p. 746-887.
2. Issa ZF, Miller JM, Zipes DP. Ablation energy sources. En: Clinical arrhythmology and electrophysiology. A companion to Branwald's Heart Disease. Philadelphia: Saunders Elsevier; 2009. p. 100-17.
3. Atiga WL, Calkins H. Catheter ablation of supraventricular tachycardias. En: Ganz LI. Management of cardiac arrhythmias. New Jersey: Humana Press; 2002. p. 51-73.
4. Tracy CM, Akhtar M, DiMarco JP, Packer DL, Weitz HH, Creager MA, *et al*. American College of Cardiology/American Heart Association 2006 update of the clinical competence statement on invasive electrophysiology studies, catheter ablation, and cardioversion: a report of the American College of Cardiology/American Heart Association/American College of Physicians Task Force on Clinical Competence and Training: developed in collaboration with the Heart Rhythm Society. Circulation. 2006; 114(15):1654-68.68.
5. Scheinman MM. Patterns of catheter ablation practice in the United States: results of the 1992 NASPE survey. North American Society of Pacing and Electrophysiolgy. Pacing Clin Electrophysiol. 1994;17(5 pt 1):873-5.
6. Hindricks G. The Multicentre European Radiofrequency Survey (MERFS): complications of radiofrequency catheter ablation of arrhythmias. The Multicentre European Radiofrequency Survey (MERFS) investigators of the Working Group on Arrhythmias of the European Society of Cardiology. Eur Heart J. 1993;14(12):1644-53.
7. Wellens HJ. Forty years of invasive clinical electrophysiology 1967-2007. Circ Arrhythmia Electrophysiol. 2008;1(1):49-53.
8. Haines DE. The biophysics and pathophysiology of lesion formation during radiofrequency catheter ablation. En: Zipes DP, Jalife J, editors. Cardiac electrophysiology: from cell to bedside. 4th ed, Philadelphia: WB Saunders Co; 2005. p. 1018-27.
9. Callans DJ, Schwartzman D, Gottlieb CD, Marchlinski FE. Insights into the electrophysiology of accessory pathway-mediated arrhythmias provided by the catheter ablation experience: "learning while burning, part III". J Cardiovasc Electrophysiol. 1996;7(9):877-904.
10. Callans DJ, Schwartzman D, Gottlieb CD, Marchlinski FE. Insights into the electrophysiology of atrial arrhythmias gained by the catheter ablation experience."Learning while burning, part II". J Cardiovasc Electrophysiol. 1995;6(3):229-43.
11. Callans DJ, Schwartzman D, Gottlieb CD, Marchlinski FE. Insights into the electrophysiology of ventricular tachycardia gained by the catheter ablation experience: "Learning while burning". J Cardiovasc Electrophysiol. 1994;5(10):877-94.
12. Erdogan A, Grumbrecht S, Neumann T, Neuzner J, Pitschner HF. Microwave, irrigated, pulsed, or conventional radiofrequency energy source: which energy source for which catheter ablation? Pacing Clin Electrophysiol. 2003;26(1 Pt 2):504-6.
13. Erdogan A, Walleck E, Rueckleben S, Neumann T, Tillmanns HH, Waldecker B, *et al*. Companion between pulsed and continuous radiofrequency delivery. J Interv Card Electrophysiol. 2007;20(1): 21-4.
14. Josephson ME. Electrophysiology at a crossroads. Heart Rhythm. 2007;4(5):658-61.
15. Klein GJ. Electrophysiology at crossroads: a time of great opportunity. Heart Rhythm. 2007;4(5):662-4.
16. Modi S, Skanes AC. Complex problems require complex solutions… but may result in other complex problems. Heart Rhythm. 2011;8(11):1667-8.
17. Calkins H, Yong P, Miller JM, Olshansky B, Carlson M, Saul JP, *et al*. Catheter ablation of accessory pathways, atrioventricular nodal reentrant tachycardia, and the atrioventricular junction: final results of a prospective, multicenter clinical trial. The Atakr Multicenter Investigators Group.Circulation. 1999;99(2):262-70.
18. Bohnen M, Stevenson WG, Tedrow UB, Michaud GF, John RM, Epstein LM, *et al*. Incidence and predictors of major complications from contemporary catheter ablation to treat cardiac arrhythmias. Heart Rhythm. 2011;8(11):1661-6.
19. Stephenson EA, Berul CI. Electrophysiological in-

terventions for inherited arrhythmia syndromes. Circulation. 2007;116(9):1062-80.
20. Freedberg NA. Learning while burning revisited. J Cardiovasc Electrophysiol. 2008;19(1):7-9.
21. Cohen MI, Triedman JK, Cannon BC, Davis AM, Drago F, Janousek J, *et al*. PACES/HRS expert consensus statement on the management of the asymptomatic young patient with a Wolff-Parkinson-White (WPW, ventricular preexcitation) electrocardiographic pattern: developed in partnership between the Pediatric and Congenital Electrophysiology Society (PACES) and the Heart Rhythm Society (HRS). Endorsed by the governing bodies of PACES, HRS, the American College of Cardiology Foundation (ACCF), the American Heart Association (AHA), the American Academy of Pediatrics (AAP), and the Canadian Heart Rhythm Society (CHRS).Heart Rhythm. 2012;9(6):1006-24.
22. Obeyesekere MN, Leong-Sit P, Massel D, Manlucu J, Modi S, Krahn A, *et al*. Risk of arrhythmia and sudden death in patients with asymptomatic pre-excitation: a meta-analysis. Circulation 2012; 125(19):2308-15.
23. Raviele A, Natale A, Calkins H, Camm JA, Cappato R, Ann Chen S, *et al.* Venice chart international consensus document on atrial fibrillation ablation: 2011 update. J Cardiovasc Electrophysiol. 2012; 23(8):890-923.

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Catheter ablation in the interventional era of arrhythmogenic syndromes

Ablación por catéter en la era intervencionista de los síndromes arritmogénicos

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Este artículo también está disponible en español

ARTICLE INFORMATION

Acronyms
RFA: radiofrequency ablation
RF: radiofrequency

Key words: Catheter Ablation, Radiofrequency, Cardiac Arrhythmias
Palabras Clave: Ablación por Catéter, Radiofrecuencia, Arritmias Cardíacas

The worst times for antiarrhythmic drugs came in the late '80s, as a result of their own problems and the emergence of radiofrequency (curative treatment) and the implantable cardioverter-defibrillator (life-saving treatment). There was a revolution in the treat-ment of cardiac arrhythmias and a development of nonpharmacologic options, which were remarkably successful[1-4].

There was, and still is, a rapid worldwide growth of laboratories practicing interventionism in Arrhyth-mology: radiofrequency ablation (RFA) and implan-table cardioverter-defibrillator. This is reflected in the numerous publications on these topics[1-6].

Callans said: *"Many of us began practicing elec-trophysiology before its interventional era, when this field was intensily intellectual but less successful at protecting patients from future harm".* So it was in Cuba, since the creation of the clinical electro-physiology laboratory at the Institute of Cardiology and Cardiovascular Surgery, in December de1984, until the first RFA was performed in January 1996.

The bases for interventionism in Arrhythmology, until reaching the RFA, were experimental elec-trophysiology, electrocardiography and clinical elec-trophysiology. There was a move from classical arrhythmology to the interventional one, and then diagnosis became therapeutics. Programmed electrical stimulation of the heart, surgery and fulguration with direct current, were the foundation for the develop-ment of the new procedure. All this also happened in our country, changing dramatically the role of the clinical laboratory, from a diagnostic and artistic role to a therapeutic function. Clinical electrophysiology emerged in 1967, and therapeutic electrophysiology, in 1987, with the emergence of radiofrequency (RF). There is an absolute two-way connection between them: the understanding of the arrhythmic substrate

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and its ablation; there cannot be a divorce between clinical electrophysiology and the electrotechnology, they enrich each other[1-4,7].

Rapid changes occurred in this emerging subspecialty, turning it into a major subspecialty that has faced, since then, great challenges.

Zipes said that: "No other cardiovascular subspecialty has undergone a more radical transformation than the study and treatment of cardiac arrhythmias". And that "...thanks to advances in radiofrequency catheter ablation it is the only subspecialty that can claim the ability to actually cure a patient of disease"[2]. This illustrates the importance of the RF.

The purpose of the ablation is to cure the arrhythmia by destroying small areas of myocardial or conduction tissue which are critical for the initiation and maintenance of cardiac arrhythmia. This procedure results in well-demarcated, progressive lesions, and intentionally destroys the arrhythmogenic tissue in the myocardium, the atrioventricular connections, or in certain parts of the specialized conduction system. It aims to cure or control arrhythmias, and constitutes a safe and highly effective therapeutic option that requires no anesthesia, creates no barotrauma and causes a highly localized tissue damage[1-4,8].

The RF causes heat energy dissipation through the near myocardium from the end of the catheter, and the hyperthermia produced suppresses the arrhythmia and creates areas of cell inexcitability and blocked conduction. Its precise and directed nature, and detailed mapping, combine structural and functional aspects of the arrhythmogenesis, helping to understand these mechanisms. It seeks to create a local lesion with discrete edges, large enough to include the target but small enough to minimize collateral damage. The RFA is based on that: precise, small (4-7 mm in diameter and 5 mm deep) and selective lesions, aimed to a target and therefore requiring a detailed mapping. Its effects are superior compared to the more diffuse results of surgery (which it virtually eliminated) and the nonspecific effects of the antiarrhythmic drugs. Research and education were not eclipsed, but were rather enriched by RF[1-4,8].

For any arrhythmia, there is a critical anatomic region that generates the impulse or allows its propagation, and that is required to sustain it clinically. If that substrate is irreversibly altered or destroyed, the arrhythmia will not occur, either spontaneously or caused.

The RF has allowed, among other things: a better understanding of arrhythmogenic mechanisms, with the progressive changes that occur when destroying a substrate; the development of new classifications to locate accessory pathways and the recognition of multiple pathways, dormant, arborized, neighboring, oblique, decremental, inaccessible pathways, those with anterograde and retrograde selectiveness, and those with poor function of the normal conduction system; as well as the presence of several fast and slow pathways in atrioventricular nodal reentrant tachycardia[9-11].

Growth was very fast worldwide, and laboratories conducting the most complex ablations (atrial fibrillation and others not yet performed in Cuba), developed rapidly. Publications also increased. Today, almost all arrhythmias are treated by RF: atrioventricular nodal reentrant tachycardia, accessory pathways, atrial tachycardia and flutter, ventricular tachycardia (in subjects with or without structural heart disease), extrasystoles, and atrial fibrillation.

The RFA can intervene on the substrate (slow pathway of atrioventricular nodal reentrant tachycardia, accessory pathways, among others), on the trigger (ventricular extrasystole in ventricular fibrillation), on the substrate and the modulator (atrial fibrillation through accessory pathways), and on the element that initiates the arrhythmia or on the element that sustains it, that is not always the same one (pulmonary vein extrasystoles, reentry, Purkinje foci).

Innovations have been made in catheters (irrigated, deflectable), the energy (ultrasound, laser, cryoablation), fluoroscopic anatomy and refined mappings (fluoroscopic or not)[1-4,7,12,13].

Sometimes RF combines with other interventional procedures: pacemaker and ablation, and implantable cardioverter-defibrillator and ablation.

Major international records were created, such as the Multicentre European Radiofrequency Survey (MERFS), the Heart Rhythm Society and the NASPE (North American Society of Pacing and Electrophysiology)[5,6].

Then, the danger that electrophysiology was transformed into electrotechnology and the electrophysiologist into "ablationist" emerged, but it has not happened in general; on the contrary, RFA has allowed to understand many aspects of the pathophysiological mechanisms of arrhythmias and their substrates. In the past, arrhythmias were diagnosed and treated;

today, arrhythmogenic substrates are diagnosed and treated.

There are guidelines to direct the practice, but it is necessary to consider the benefits and hazards, the clinical judgment for the final decision, and remember that such varied arrhythmogenic mechanisms must have also variable treatment options.

Initially, as with all new procedures, there was a lot of fantasy, euphoria and excitement; then, there was a tendency to equilibrium and balance.

Increasingly complex ablations were performed, requiring long execution periods. Sometimes, it is difficult to deter patients and physicians from using RFA, due to the excellent results of the procedure and the information available in Internet. However, there are real risks to be considered. Sometimes RFA is not a first-line option, but it is not always the last choice. It is necessary to take into account what type of ablation is going to be used, in whom, and with what diseases it is associated. The big lesson is to optimize the selection of patients. As Klein says: "We must ask ourselves not can we apply a technology but should we in a given individual"[14-16].

If ablation was completely free of risk, no one would discuss its indications. Some of the problems it may cause are: atrioventricular blocks of varying degrees, stroke, coronary artery dissection, pulmonary embolism, cardiac tamponade, valvular damage, myocardial infarction, coronary spasm, pneumothorax, perforation of the coronary sinus, femoral artery laceration, pericardial effusion, hematoma, hypotension, pleural or pericardial effusion, vasovagal reaction, fever, respiratory depression, incessant arrhythmias, increased dispersion, repolarization abnormalities, proarrhythmia, and death. They are rare but they exist. Moreover, there are ablations that are not successful, and others in which the circuits recover their arrhythmogenic capacity[17,18].

Josephson says that the approach "Learning before you burn" should be tried first than "Learning while burning". And, with regard to the ablation of atrial fibrillation, he believes there is loss of critical thinking and that sometimes there is a total dependence on technology without understanding its limitations. What is published is accepted, forgetting the pros and cons and the risk-cost-ineffectiveness of therapies. These are times of use and abuse of RFA in atrial fibrillation, without remembering that positive results are very much publicized, while complications and failures receive less coverage. Arrhythmia mechanisms differ, and not all atrial fibrillations are the same nor respond to similar procedures. There is an attempt to find a fast and universal cure, although this is not always possible. It must be known what is going to be ablated, and how much, in the various types of atrial fibrillation. It is necessary to standardize the monitoring and the statistical studies, because good results are obtained with varied methods. Furthermore, it must be remembered that this arrhythmia is silent in 75% of patients, that the lesions caused by RF may be excessive and that in 20-40% of them it recur in the form of atrial tachyarrhythmias. Sometimes, the earliest sites of activation during the mapping are misunderstood, additional lines can generate proarrhythmia, and 30-50% of the cases must undergo a second procedure. Not to mention some possible complications such as stroke, paralysis of the phrenic nerve, coronary occlusion, perforation, atrio-oesophageal fistula, and death. Furthermore, these are progressive diseases. Some interpretations may be erratic in the RFA of fibrillation: fractionated electrograms that may not be required to maintain the arrhythmia; asynchronous conduction and not by reentry; and overlapping of the activation wavefronts in a three dimensional structure. It is necessary to know how the arrhythmia is started, how it is perpetuated, if it is a persistent, chronic or permanent type and if ablación is indicated[13,14].

As for inherited arrhythmogenic syndromes, ablation is not useful in the long QT syndrome, and there are insufficient data on the short QT. It is performed in some associated arrhythmias and in ventricular fibrillation triggers in Brugada syndrome. It may decrease the frequency of events in arrhythmogenic right ventricular dysplasia that continues to occur because it is a progressive disease. It is used in the destruction of an accessory pathway in familial hypertrophic cardiomyopathy; and it is not useful in catecholaminergic polymorphic ventricular tachycardia[19]. Better results will have to be seen in familial atrial fibrillation.

There are unresolved and controversial issues, for example, whether ablation is performed in asymptomatic patients with accessory pathways or not, and its real role in atrial fibrillation [20-23].

Epilogue: RFA has been of much help and much can be expected of it. There has been a transition from diagnostic to therapeutic electrophysiology. You can

learn while "burning" but it is better to learn before you "burn". Electrophysiology and electrotechnology must go hand in hand. Like every procedure, it has limitations; therefore, it is necessary to know what to expect from it and what not, and in which patients it must be applied and in which it must not.

REFERENCES

1. Josephson ME. Catheter and surgical ablation in the teraphy of arrhythmias. En: Clinical cardiac electrophysiology: techniques and interpretations. 4th ed. Philadelphia: Lippincott Williams & Wilkins; 2008. p. 746-887.
2. Issa ZF, Miller JM, Zipes DP. Ablation energy sources. En: Clinical arrhythmology and electrophysiology. A companion to Branwald's Heart Disease. Philadelphia: Saunders Elsevier; 2009. p. 100-17.
3. Atiga WL, Calkins H. Catheter ablation of supraventricular tachycardias. En: Ganz LI. Management of cardiac arrhythmias. New Jersey: Humana Press; 2002. p. 51-73.
4. Tracy CM, Akhtar M, DiMarco JP, Packer DL, Weitz HH, Creager MA, *et al*. American College of Cardiology/American Heart Association 2006 update of the clinical competence statement on invasive electrophysiology studies, catheter ablation, and cardioversion: a report of the American College of Cardiology/American Heart Association/American College of Physicians Task Force on Clinical Competence and Training: developed in collaboration with the Heart Rhythm Society. Circulation. 2006; 114(15):1654-68.68.
5. Scheinman MM. Patterns of catheter ablation practice in the United States: results of the 1992 NASPE survey. North American Society of Pacing and Electrophysiolgy. Pacing Clin Electrophysiol. 1994;17(5 pt 1):873-5.
6. Hindricks G. The Multicentre European Radiofrequency Survey (MERFS): complications of radiofrequency catheter ablation of arrhythmias. The Multicentre European Radiofrequency Survey (MERFS) investigators of the Working Group on Arrhythmias of the European Society of Cardiology. Eur Heart J. 1993;14(12):1644-53.
7. Wellens HJ. Forty years of invasive clinical electrophysiology 1967-2007. Circ Arrhythmia Electrophysiol. 2008;1(1):49-53.
8. Haines DE. The biophysics and pathophysiology of lesion formation during radiofrequency catheter ablation. En: Zipes DP, Jalife J, editors. Cardiac electrophysiology: from cell to bedside. 4th ed, Philadelphia: WB Saunders Co; 2005. p. 1018-27.
9. Callans DJ, Schwartzman D, Gottlieb CD, Marchlinski FE. Insights into the electrophysiology of accessory pathway-mediated arrhythmias provided by the catheter ablation experience: "learning while burning, part III". J Cardiovasc Electrophysiol. 1996;7(9):877-904.
10. Callans DJ, Schwartzman D, Gottlieb CD, Marchlinski FE. Insights into the electrophysiology of atrial arrhythmias gained by the catheter ablation experience."Learning while burning, part II". J Cardiovasc Electrophysiol. 1995;6(3):229-43.
11. Callans DJ, Schwartzman D, Gottlieb CD, Marchlinski FE. Insights into the electrophysiology of ventricular tachycardia gained by the catheter ablation experience: "Learning while burning". J Cardiovasc Electrophysiol. 1994;5(10):877-94.
12. Erdogan A, Grumbrecht S, Neumann T, Neuzner J, Pitschner HF. Microwave, irrigated, pulsed, or conventional radiofrequency energy source: which energy source for which catheter ablation? Pacing Clin Electrophysiol. 2003;26(1 Pt 2):504-6.
13. Erdogan A, Walleck E, Rueckleben S, Neumann T, Tillmanns HH, Waldecker B, *et al*. Companion between pulsed and continuous radiofrequency delivery. J Interv Card Electrophysiol. 2007;20(1): 21-4.
14. Josephson ME. Electrophysiology at a crossroads. Heart Rhythm. 2007;4(5):658-61.
15. Klein GJ. Electrophysiology at crossroads: a time of great opportunity. Heart Rhythm. 2007;4(5):662-4.
16. Modi S, Skanes AC. Complex problems require complex solutions… but may result in other complex problems. Heart Rhythm. 2011;8(11):1667-8.
17. Calkins H, Yong P, Miller JM, Olshansky B, Carlson M, Saul JP, *et al*. Catheter ablation of accessory pathways, atrioventricular nodal reentrant tachycardia, and the atrioventricular junction: final results of a prospective, multicenter clinical trial. The Atakr Multicenter Investigators Group.Circulation. 1999;99(2):262-70.
18. Bohnen M, Stevenson WG, Tedrow UB, Michaud GF, John RM, Epstein LM, *et al*. Incidence and predictors of major complications from contemporary catheter ablation to treat cardiac arrhythmias. Heart Rhythm. 2011;8(11):1661-6.
19. Stephenson EA, Berul CI. Electrophysiological in-

terventions for inherited arrhythmia syndromes. Circulation. 2007;116(9):1062-80.
20. Freedberg NA. Learning while burning revisited. J Cardiovasc Electrophysiol. 2008;19(1):7-9.
21. Cohen MI, Triedman JK, Cannon BC, Davis AM, Drago F, Janousek J, *et al*. PACES/HRS expert consensus statement on the management of the asymptomatic young patient with a Wolff-Parkinson-White (WPW, ventricular preexcitation) electrocardiographic pattern: developed in partnership between the Pediatric and Congenital Electrophysiology Society (PACES) and the Heart Rhythm Society (HRS). Endorsed by the governing bodies of PACES, HRS, the American College of Cardiology Foundation (ACCF), the American Heart Association (AHA), the American Academy of Pediatrics (AAP), and the Canadian Heart Rhythm Society (CHRS).Heart Rhythm. 2012;9(6):1006-24.
22. Obeyesekere MN, Leong-Sit P, Massel D, Manlucu J, Modi S, Krahn A, *et al*. Risk of arrhythmia and sudden death in patients with asymptomatic pre-excitation: a meta-analysis. Circulation 2012; 125(19):2308-15.
23. Raviele A, Natale A, Calkins H, Camm JA, Cappato R, Ann Chen S, *et al.* Venice chart international consensus document on atrial fibrillation ablation: 2011 update. J Cardiovasc Electrophysiol. 2012; 23(8):890-923.