Mechanisms Of Atrial Fibrillation Terminations In Humans: Insights From Non-Invasive Cardiac Mapping

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Abstract

Introduction: Mechanisms of atrial fibrillation (Afib) termination still poorly understood. A new method - noninvasive electrocardiographic imaging (ECGI) allows panoramic mapping of Afib in humans. The goal of this study is to investigate the Afib termination processes in patients using ECGI.

Methods: Seven patients (4 male, ages 54±8) with paroxysmal Afib were involved in this study. All patients underwent ECGI procedure (Amycard 01 K System, EP Solutions, SA). In three patients we were able to capture the moment of spontaneous Afib termination in baseline conditions. In four patients we observed Afib termination under intravenous administration of propafenone (dosage 0.5 mg/kg).

Results: In all cases Afib stopped as results of collision and annihilation of phase singularity points with opposite signs of topological charges (i.e. cores of the rotors with opposite directions of rotations). In 4 cases it occurred by reduction of the unclosed wave fronts (Fig A), in 3 cases by closing of the wave fronts into the rings (fig B).

Conclusions: The observed underlying mechanisms of AFib termination in patients with paroxysmal Afib was the collision and annihilation of the counter-rotated rotors.
Abstract

Introduction: RF ablation requires a complex set of devices and profound electrophysiological experience, based on substantial knowledge of physical science basics. Besides the medical aspects, interdependent technical parameters have to be considered. Thus, RF ablation needs intensive training.

Aims: To establish RF ablation in-vitro Training-System in order to explain effects observed during clinical application.

Methods: Six workstations were equipped with computer-controlled RF ablation generators. Universal connection boxes allow ablation-essays with catheters of different make and model. Special wetlabs (Fig. 1) were developed combining a basin containing physiological saline solution with thermostat and pump to simulate blood flow. Parameters are recorded graphically and in tabular form.

Results: The Training-System was used to demonstrate differences in lesion-forming dependent on tip-electrodes, sensor technology and ablation-techniques. Influence of blood flow, electrode-angle and contact pressure could be clearly shown. It was also utilized to reproduce industrial in-vitro tests.

Conclusions: To become acquainted with the physical science basics of RF ablation the Training-System provided excellent conditions and offers unique possibilities of direct measurements. Visualization of parameters associated with direct measurement of ablation-results guarantee highest learning success.
Abstract

Radiofrequency (RF) ablation is becoming a standard of care for atrial fibrillation (AF) management. However, a relatively high incidence of recurrence after acutely successful procedures persists, a problem connected to non-transmural necrosis and gaps in linear lesions. This work reports an innovative catheter for RF ablation guided by polarization-sensitive optical coherence reflectometry, a powerful technique offering three main capabilities: (i) Feedback on contact and catheter-tissue orientation through intensity measurements. (ii) Identification of healthy or ablated tissue related to loss of birefringence caused by denaturation of oriented collagen in myocardium, as quantified by polarization sensitive detection. (iii) Real-time lesion formation monitoring through quantitative analysis of collagen fibers shrinkage during heating based on the normalized cross-correlation of intensity signals. Endocardial experiments have been carried out in-vitro and using a percutaneous femoral access in an in-vivo swine model. This novel integrated catheter design opens a new path to better clinical outcomes by providing the electrophysiologist complete control over the procedure, including local navigation between lesions to ensure continuity, information about catheter-tissue contact, safe and effective energy delivery, and real-time estimation of lesion size.
Comparison Of The Efficacy Of Pvac And NmarqtM F For Paroxysmal Atrial Fibrillation

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Abstract

Background: The purpose of this study was to compare the efficacy of a circular duty-cycled radiofrequency-based pulmonary vein ablation catheter (PVAC, Medtronic, Minneapolis USA) and a circular, irrigated multipolar ablation catheter nMARQT (Biosense Webster, CA, USA).

Methods: and results: One hundred and twenty patients (mean age 64.7±11.9; male n=67) suffering from drug-resistant paroxysmal AF referred for PVI were treated either with the PVAC ablation catheter (n=45) or the nMARQT (n=75). Fortyseven percent of the patients had a history of prior PVI ablation in the nMARQT group, but only 15 % in the PVAC group. The primary endpoint was freedom from symptomatic or documented AF>30sec. In a subset of patients the duration and number of energy applications was analyzed. Mean follow up was 8.3±11.9 months. Freedom from atrial fibrillation after one single procedure was 61.3% in the NMarque and 60% in the PVAC group (ns). Complications occurred in 5.8% of the patients and did not differ between the groups (including air embolism n=1; oesophageal ulcer n=1, inflammatory pericardial effusion n=1, TIA five days after the procedure n=1, peripheral complications n=3). The total mean number and duration of energy application was significantly higher in the PVAC group, when compared to the nMARQT group (p<0.05 and p< 0.001 respectively).

Conclusions: Both catheters are effective and safe in treating patients with AF and have comparable success rates.
Possible Clinical And Hemodynamic Predictors Of Atrial Fibrillation Recurrence After Catheter Ablation

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Abstract

Introduction: Large proportion of patients with atrial fibrillation (AF) are not arrhythmia-free after ablation and remain at risk for complications such as stroke and cardiac morbidity.

Methods: Study enrolled 148 patients (mean age 52±9.2 yrs, male 87 (59%)) with AF after radiofrequency ablation (RFA). Follow up period was 5 years.

Results: Rate of post-operative AF relapse was 52% (77 patients). There were significant predictors of AF recurrence: left atrium (LA) dilation, age, type of RFA, duration of post-operative period, in-hospital AF recurrence, number of reference points and RF applications, previous antiarrhythmic treatment, aortic and mitral regurgitation. Correlative and logistic regression analysis data can be expressed in formula for calculating the risk of AF recurrence in long-term post-operative period: -75 +0.82*age +0.99*months after RFA -1.79*in-hospital AF recurrence +2*aortic regurgitation + 1.33*LA diameter + 2.9*previous antiarrhythmic treatment + 0.04*number of RF applications + 4.8*type of RFA + 0.31*number of reference points - 0.96*mitral regurgitation.

Conclusions: This approach taking into account possible predictors of arrhythmia recurrence allows to optimize management of AF patients after catheter ablation.
Prediction Of Catheter Ablation Efficacy For Patients With Paroxysmal Or Persistent Atrial Fibrillation

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Abstract

Introduction: Catheter ablation is considered to improve symptoms and quality of life for patients with atrial fibrillation (AF) and may be regarded as first-line treatment compared with medical therapy especially in paroxysmal forms.

Methods: We enrolled 148 patients (mean age 52+9.2 years, male 87 (59%)) with paroxysmal (47%) and persistent (53%) AF which underwent radiofrequency ablation (RFA). Follow up period was 5 years.

Results: The majority of patients experienced relapse of AF during the first 6 months after RFA (54 of 77 cases). Significant correlations were obtained between recurrence of arrhythmia and dilation of the left atrium (LA) ($r = -0.58$, $p<0.001$), the patient’s age ($r = 0.66$, $p<0.001$), antiarrhythmic treatment ($r = 0.40$, $p<0.001$), aortic ($r = 0.55$, $p<0.001$) and mitral regurgitation ($r = 0.41$, $p<0.001$). Logistic regression equation takes the following form: risk of AF recurrence = -14.4 + 0.12*age + 0.21*LA diameter– 0.5*previous antiarrhythmic treatment+ 2.33*aortic regurgitation+ 0.89*mitral regurgitation.

Conclusions: This mathematical model evaluating initial risk of post-operative AF recurrence should be used before RFA to optimize screening of patients with favorable prognosis of sinus rhythm maintenance.