Parasympathetic Modulation Plays a Key Role in Initiation of Paroxysmal Atrial Fibrillation

Won Jae Lee, Dong Gu Shin, Geu Ru Hong, Jong Sun Park, Young Jo Kim

Department of Internal Medicine, College of Medicine, Yeungnam University, Daegu, Korea

Abstract

Background: An acceleration or deceleration of the heart rate (HR), which reflects autonomic effects, is observed before the onset of paroxysmal atrial fibrillation (PAF). The purpose of this study was to assess the discrepancy in the autonomic interactions before the onset of PAF for different patterns of change in the HR.

Materials and Methods: From 105 Holter tapes with the PAF recorded, 55 episodes (42 patients, 34 men, 58±12 years) of PAF (>5 min), preceded by a sinus rhythm for more than 1 hour, were selected and submitted to time-domain and frequency-domain HR variability analyses. Fifty-five episodes were divided into 2 groups: group A PAF (n=30) with acceleration of the HR during the last 2 minutes before the PAF and group B (n=25) with deceleration of the HR.

Results: A significant linear decrease in the mean R-R interval was observed in group A (924±30 to 835±28 ms, \( P = 0.001 \)) and an increase from 831±32 to 866±31 ms in group B PAF episodes (\( P = 0.046 \)). In the frequency-domain analyses, the LF/HF ratio exhibited a progressive linear increase before the PAF in group A (\( P = 0.005 \)). The HF normalized units (HFnu) and natural logarithm-transformed HF (lnHF) values decreased from 30.8±4.0 to 16.1±1.8 (\( P = 0.003 \)) and 4.49±0.25 to 4.07±0.22 (\( P = 0.001 \)), respectively. Contrary to the results in group A, a significant increase in the HF components (HFnu and lnHF) (from 22.6±3.2 to 30.2±4.0, \( P = 0.005 \), and 4.27±0.27 to 4.75 0.33, \( P = 0.001 \), respectively) and a resultant decrease in the LF/HF ratio were observed in group B PAF episodes. No significant changes were observed in the LF components in either PAF group.
Conclusion: Autonomic stimuli leading to an acceleration or deceleration of the HR before the onset of AF are due to parasympathetic modulation. Parasympathetic modulation plays a key role in the initiation of PAF.

Key Words: Atrial Fibrillation, Autonomic Nervous System, Heart Rate, Variability

Introduction

Paroxysmal atrial fibrillation (AF) is an arrhythmia commonly encountered in clinical practice. It is generally accepted that the autonomic nervous system functions to modulate the initiation of AF. The analysis of the heart rate variability (HRV), just preceding the spontaneous onset of AF, is a noninvasive method for evaluating autonomic effects and provides a way to document them. An improved understanding of the mechanism of onset of PAF may help with patient management and preventive therapy.

Several studies have demonstrated the fluctuation in the autonomic effects before the onset of AF; however, the results have been inconsistent. Coumel classified AF into vagally mediated and sympathetically mediated types, based on the clinical history. Vagally mediated AF, was preceded by progressive bradycardia, whereas adrenergically mediated AF, was accompanied by an increased sinus rate, and was opposite to the vagal type in all aspects.

In previous studies to determine the autonomic mechanism underlying AF, PAF episodes were grouped and analyzed based on the AF onset time or the presence or absence of structural heart disease in order to characterize and quantify the autonomic changes. Grouping of the PAF episodes by the timing of the AF onset or the presence of organic heart disease is too subjective. For example, daytime AF is not always sympathetically mediated AF and not always associated with organic heart disease. A more objective classification might improve the consistency of the study results. For example, the change in the heart rate, would be a more objective measure to study the autonomic effects before the onset of AF.

We hypothesized that the change in the autonomic effects before the spontaneous onset of AF would differ between AF preceded by bradycardia and AF adrenergically mediated with an increased sinus rate. No data are available regarding how the parasympathetic and sympathetic nervous system interact and cause changes in the heart rate before the spontaneous onset of AF. This study was undertaken to detect differences in the autonomic effects between the two types of AF, acceleration or deceleration of the heart rate, before the onset of AF.