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Artículo:

Validation of inter-atrial conduction time measurement by means of echo-Doppler

Validation of inter-atrial conduction time measurement by means of echo-Doppler

Abdel J Fuenmayor,* Leonardo Ramírez,* Abdel M Fuenmayor*

Summary

Background: Little is known about the correlation between the inter-atrial conduction time (IACT) measured at the electrophysiology laboratory and the interval measured from the beginning of the electrocardiographic P wave to the initiation of the A wave in the mitral Doppler signal (P-A interval). **Hypothesis:** IACT can be assessed by means of echo-Doppler. **Methods:** We studied 21 patients who were referred to our arrhythmia clinic for evaluation of supraventricular tachycardia. During the electrophysiological study, the IACT was measured from the first rapid deflection of the A wave recorded with the high right atrial catheter to the A wave recorded with the coronary sinus catheter. An independent observer measured the P-A interval. Both the electrophysiological and echo-Doppler measurements were corrected for heart rate. **Results:** P-A interval was slightly longer than IACT (83.36 ± 23.91 *vs* 80.77 ± 24.11 msec; p = 0.042), but a very good correlation was found between both measurements (r^2 = 0.94). **Conclusions:** IACT can be non-invasively assessed by measuring the P-A interval.

Resumen

Medición del tiempo de conducción inter-auricular por eco-Doppler

Antecedentes: Se conoce poco acerca de la relación que exista entre el tiempo de conducción inter-auricular (IACT) medido en el estudio electrofisiológico y el intervalo medido desde el comienzo de la onda P del EKG al inicio de la onda A mitral en el registro Doppler del ecocardiograma (intervalo P-A). **Hipótesis:** El IACT puede medirse en forma no-invasiva por medio del eco-Doppler. **Métodos:** Evaluamos 21 pacientes que nos fueron referidos por sufrir taquicardia supraventricular. Durante el estudio electrofisiológico, el IACT se midió desde el inicio de la onda A registrada con un catéter ubicado en la aurícula derecha alta, hasta la A registrada con el par de electrodos distales del catéter ubicado en el seno coronario. Un observador independiente midió el intervalo P-A. Ambas medidas fueron corregidas para la frecuencia cardíaca. **Resultados:** El intervalo P-A resultó ligeramente más prolongado que el IACT (83.36 ± 23.91 *vs* 80.77 ± 24.11 mseg; p = 0.042), pero se encontró una muy buena correlación entre ambas medidas (r^2 = 0.94). **Conclusión:** El IACT puede medirse en forma confiable y con poco margen de error por la medida del intervalo P-A.
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Key words: Inter-atrial conduction time. Echocardiography. Doppler.
Palabras clave: Conducción inter-auricular. Ecocardiografía. Doppler

* Cardiovascular Research Center and Department of Physiology. University of The Andes. Mérida, Venezuela.

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Correspondencia:
Abdel J Fuenmayor MD. Apartado Postal 154, Mérida, 5101, Venezuela. E-mail: farocha@ing.ula.ve. Tel. +58 74 447717. Fax +58 74 403230

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Introduction

Inter-atrial conduction time (IACT) is the interval elapsed between the initiation of atrial depolarization in the vicinity of the sinus node and the depolarization of the low lateral aspect of the left atrium.[1] IACT can be measured with electrodes inserted into the heart and positioned at the high right atrium near the superior vena cava (sinus node region) and the inferior and lateral aspect of the left atrium.[1] IACT has been shown to be prolonged by the action of drugs and therapeutic interventions, and in several heart diseases,[2-7] but the possible applications of this finding have not been sufficiently investigated probably because IACT recording requires an expensive and invasive electrophysiological study. Atrial depolarization produces the P wave in the ECG and is followed by mechanical activation and atrial contraction. Atrial contraction in turn induces an increase in left ventricular filling velocity. In the case of the left atrium, this increase can be detected by the appearance of the A wave in the echo-Doppler signal of the mitral valve. The interval elapsed between the beginning of the P wave in the ECG and the initiation of the A mitral wave in the echo-Doppler signal (P-A interval) could be used as an estimate of IACT. Indeed, Wang et al measured that interval in the mitral echo-Doppler signal as an estimate of IACT in normal patients and in patients who had an implanted DDD pacemaker.[8] They found significant differences in the two groups of patients, but they did not validate the echocardiographic measurement against the gold standard, i.e., the IACT measured during the electrophysiological study. This validation is the very purpose of the present research, the hypothesis of which is that there is a good correlation between IACT and the P-A interval measured in the echo-Doppler signal.

Methods

The procedures were carefully explained to all the patients. Those who accepted to participate signed a written informed consent. The study protocol was previously approved by the Human Research Committee of our Institution and was in accordance with the Declaration of Helsinki.

***Patients*:** Twenty-one patients (13 women) 33.7 ± 13.2 year-old who were referred to our Arrhythmia Clinic for evaluation and treatment of supraventricular tachycardia were enrolled in the study. All the patients were subjected to an exhaustive medical examination, a twelve-lead conventional EKG, and an echo-Doppler evaluation. The inclusion criteria were the following: the patient should 1) have normal cardiac anatomy and function, 2) be in sinus rhythm and 3) be in a drug-free state.

Echocardiographic measurements: In each patient, the mitral valve echo-Doppler signal was recorded in the left parasternal and apical views. A simultaneous ECG recording was performed with the echo-Doppler equipment. The recordings were made at a speed of 100 mm/second. The P-A interval was measured during three consecutive cardiac cycles and was corrected for the heart rate according to the following formula: **CP-A = P-A x 800/R-R**[1]. The three corrected measures were averaged for subsequent analyses.

Electrophysiological study: The electrophysiological study was performed in a fasting antiarrhythmic drug-free state under mild sedation with diazepam. Three recording multipolar catheters (USCI and Mansfield) were placed in the high right atrium near the superior cava vein orifice, in the His recording position, and in the left lateral portion of the mitral A-V ring through the coronary sinus. IACT was measured from the first rapid atrial deflection recorded at the high right atrium to the first rapid deflection of the A wave recorded with the coronary sinus catheter; it was also corrected according to the above mentioned formula and calculated as the average of three consecutive measures.

Statistical analyses: Alpha value was set at 0.05 and confidence intervals at 95%. The analyses were performed with the Excel® computer program by means of the Student t-test and regression and correlation analyses. Results were expressed as the mean ± the standard deviation.

Results

Clinical and non-invasive evaluations: No complication arose from the procedures. The clinical cardiovascular examination, chest X-ray, cardiac systolic and diastolic function, cardiac volumes, and ejection fraction were normal in all the patients.

[1] **P-A** = The interval measured from the beginning of the P wave to the beginning of the A mitral wave. **CP-A =** Corrected P-A interval. **R-R** = Interval between the 2 preceding R waves in the ECG.

Table I. P-A interval and Inter-atrial Conduction Time (milliseconds).

	P-A Interval	Inter-atrial CT
	90.70	83.38
	125.34	131.97
	88.47	90.77
	65.51	64.23
	121.39	125.41
	64.22	71.36
	89.84	92.54
	54.90	55.87
	65.73	60.06
	54.08	60.02
	83.95	83.37
	80.48	86.14
	76.82	79.65
	116.14	120.07
	70.0	63.00
	86.63	94.54
	112.79	106.22
	88.61	97.25
	56.14	65.97
	31.17	40.22
	73.32	78.60
Average	80.77	83.36
Standard Deviation	24.11	23.91

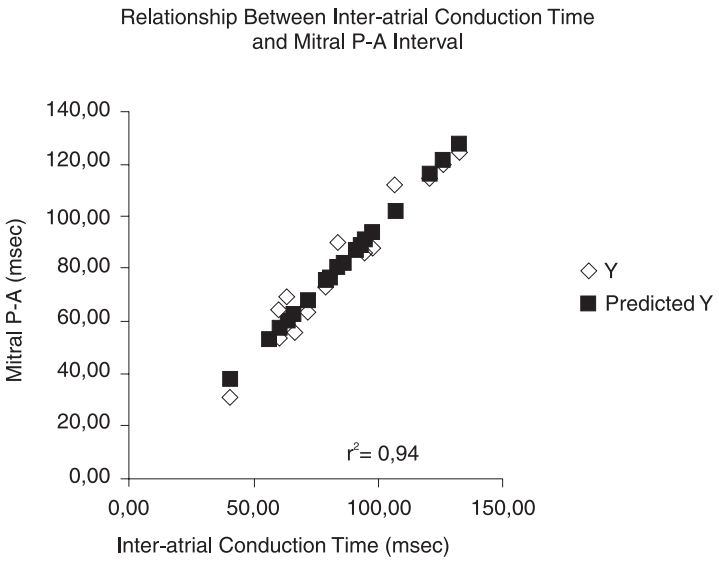

Fig. 1. Values of inter-atrial conduction time measured by means of electrophysiological studies are plotted against P-A interval measured by means of echo-Doppler. The regression line is depicted in squares and plotted values in rhombi.

Electrophysiological study: In the electrophysiological study, a sustained, reproducible, supraventricular arrhythmia could be induced in 19 of the 21 patients: supraventricular tachycardia involving accessory pathways in eigth, A-V nodal reentrant tachycardia in ten, and atrial fibrillation in one. In the remaining two patients, an idiopathic left ventricular tachycardia was induced in one, whereas no cardiac arrhythmia could be induced in the other.

IACT and P-A interval measurements: In all patients the measurements were successfully recorded. Heart rate-corrected IACT was 80.77 ± 24.11 msec and heart rate corrected P-A interval was 83.36 ± 23.91 msec. The difference between these two values was found to be significant (p = 0.042) *(Table I)*. Moreover, both measurements displayed a multiple regression coefficient of 0.94 (p = 9.95E-14) *(Fig. 1)*.

Discussion

Thus far, IACT could only be assessed by means of electrophysiological studies. The invasive nature of such studies and their increasing cost have limited the possibility of using IACT as an index of atrial electrical dysfunction. The validation of the possibility of measuring IACT by means of a non-invasive method such as echocardiography is of great importance, because it would allow the conduction of further research in this area. Indeed, since there is a growing interest in research on atrial fibrillation and other supraventricular arrhythmias, the use of the IACT could represent a useful index of conduction delay at the atrial level that, in turn, could predict the appearance of such arrhythmias. If future research proves this to be true, then the echocardiographic measurement of such an index would permit the selection of those patients that are more prone to suffer from supraventricular arrhythmias. IACT measurement could also permit the assessment of the electrophysiological effects of antiarrhythmic drugs and other interventions (such as catheter ablation) that are currently being used for the treatment of cardiac arrhythmias. In this small group of patients who did not have evidence of either left ventricular systolic, diastolic dysfunction or cardiac enlargement, a good correlation was found between the P-A interval and the electrophysiologically measured IACT. We conclude that IACT can be adequately assessed by measuring the P-A interval by means of Doppler echocardiography.

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