

P wave and the development of atrial fibrillation

Katsuya Ishida, MD,* Hideki Hayashi, MD, PhD,* Akashi Miyamoto, MD,* Yoshihisa Sugimoto, MD, PhD,* Makoto Ito, MD, PhD,* Yoshitaka Murakami, PhD,[†] Minoru Horie, MD, PhD*

From the *Department of Cardiovascular and Respiratory Medicine, Shiga University of Medical Science, Shiga, Japan, and

[†]Department of Health Science, Shiga University of Medical Science, Shiga, Japan.

BACKGROUND Terminal P-wave inversion in lead V₁ representing left atrial overload has been considered a precursor of atrial fibrillation (AF).

OBJECTIVE The purpose of this study was to determine whether this P-wave morphologic characteristic can predict the development of AF.

METHODS Digital analysis of 12-lead ECGs was performed to enroll patients with P terminal force $\geq 0.06 \text{ s} \times 2 \text{ mm}$ in lead V₁ from among a database of 308,391 ECG recordings. The prognostic value of ECG characteristics for developing AF was determined.

RESULTS A total of 78 patients (mean age 52 ± 19 years) with left atrial overload were chosen from among 102,065 patients in the database. During mean follow-up of 43 months, 15 (19%) patients developed AF (AF group) versus 63 (81%) patients who did not (non-AF group). No significant difference was noted between the AF and non-AF groups with regard to the area, duration, and amplitude of the P-wave terminal portion in lead V₁. In

contrast, the area, duration, and amplitude of the P-wave initial portion in the same lead were significantly greater in the AF group than in the non-AF group ($114.6 \pm 73.0 \mu\text{V} \times \text{ms}$ vs $73.1 \pm 59.3 \mu\text{V} \times \text{ms}$, $42.2 \pm 12.4 \text{ ms}$ vs $35.7 \pm 10.1 \text{ ms}$, and $94.0 \pm 39.9 \mu\text{V}$ vs $68.8 \pm 49.4 \mu\text{V}$, respectively; $P < .05$ for each). Multivariate analysis confirmed that the area of the P-wave initial portion was independently associated with the development of AF (hazard ratio 4.02, 95% confidence interval 1.25–17.8; $P = .018$).

CONCLUSION P-wave initial portion in lead V₁ was an independent risk stratifier of AF development in patients with marked left atrial overload.

KEYWORDS Atrium; Electrocardiography; Fibrillation; Prognosis

ABBREVIATIONS AF = atrial fibrillation; CI = confidence interval; ECG = electrocardiogram; LA = left atrium; RA = right atrium

(Heart Rhythm 2010;7:289–294) © 2010 Heart Rhythm Society. All rights reserved.

Introduction

The P wave reflects electrical depolarization of both the right atrium (RA) and the left atrium (LA). When the P wave is biphasic in lead V₁, the positive initial portion and the negative terminal portion of the P wave represent depolarization of the RA and the LA, respectively.^{1,2} Morris et al³ reported that the magnitude of the negative terminal portion of the P wave, calculated as the algebraic product of the duration and amplitude (P terminal force) in precordial lead V₁, was significantly larger in patients with various valvular heart diseases than in normal subjects. In their study, the P terminal force was associated with mitral valve area and increased LA pressure. The magnitude of the P terminal force has been shown to be associated with LA enlargement as revealed by transthoracic echocardiography.^{4,5} These findings suggest that the negative terminal portion of the P wave in lead V₁ is a sign of pressure and volume overload in the LA, which may lead to structural and functional remodeling in the LA. Because atrial fibril-

lation (AF) often occurs and/or recurs in the remodeled LA,⁶ the increased P terminal force may underlie the generation of AF. The increased P terminal force is observed not only in valvular heart diseases but also in other heart diseases, including hypertension, myocardial infarction, and cardiomyopathy.^{7,8} These disorders potentially underlie the generation of AF. However, little is known about whether P terminal force occurring in those disorders is associated with a prognostic risk for the development of AF. Prolonged P-wave duration is a useful predictor of AF development.^{9,10} The signal-averaged P-wave electrocardiogram (ECG) has a significant role in identifying patients who are susceptible to paroxysmal AF and in predicting the progression from paroxysmal to permanent AF.¹¹ Measurement of signal-averaged P-wave duration requires a dedicated system, which is not widely available in general clinical practice. In contrast, standard 12-lead ECGs can be conveniently recorded, and automatic analysis of 12-lead ECG recordings yields information to clinicians. In our university hospital, more than 300,000 ECGs obtained from more than 100,000 patients are available for digital analysis. Using this large database, we performed a retrospective cohort study to investigate whether terminal P-wave inversion in lead V₁ predicts the development of AF.

Address reprint requests and correspondence: Dr. Hideki Hayashi, Department of Cardiovascular and Respiratory Medicine, Shiga University of Medical Science, Otsu, Shiga 520-2192, Japan. E-mail address: hayashih@belle.shiga-med.ac.jp. (Received October 11, 2009; accepted November 9, 2009.)

Methods

Database

We constructed a database for analyzing resting 12-lead ECGs recorded in our hospital, which is associated with the Shiga University of Medical Science. A total of 102,065 patients (49,286 females and 52,779 males) who had undergone ECG recordings between January 1983 and October 2008 were collected in our database, and a total of 308,391 ECG recordings were performed during this period. Twelve leads were simultaneously acquired. The 12-lead ECG was recorded for 10 seconds at a sweep speed of 25 mm/s and calibrated to 1 mV/cm in the standard leads. ECG signals were recorded at an interval of 2 ms (i.e., 500 Hz). Digital data were stored on a computer server with 12-bit resolution. From the database, patients who fulfilled ECG criteria of LA overload were chosen using the analysis software MUSE7.1 (GE Marquette Medical Systems, Inc., Milwaukee, WI, USA). Computer-processed ECGs defined LA overload criteria as follows. (1) ECGs displaying biphasic P wave in lead V₁ were chosen. (2) The P wave was divided into the positively deflected portion in the initial P wave and the negatively deflected portion in the terminal P wave. (3) The terminal P wave in lead V₁ with duration ≥ 0.06 second and amplitude ≤ -0.2 mV (i.e., P terminal force ≥ 0.12) was considered as meeting LA overload criteria in this study (Figure 1).

Study participants

From our database, 78 participants who had marked LA overload were selected and assessed for the development of AF. A control group of 234 participants who did not have LA overload also was selected (1:3 matching). Individual matching was performed accounting for confounders (age, gender, date when ECG was taken), and when control candidates numbered more than three, the three controls were chosen randomly from among the candidates. The research

protocol was approved by the Ethical Committee of Shiga University of Medical Science (19–75).

Digital analysis of ECG

The MUSE7.1 software detected identical P waves using a template matching technique. A point that had an area ≥ 160 $\mu\text{V}/\text{ms}$ from the baseline level was considered to be P-wave onset, and a point that had an area ≤ 160 $\mu\text{V}/\text{ms}$ from the baseline level was considered to be P-wave offset. The duration, amplitude, and area of total P wave, initial P wave, and terminal P wave in lead V₁ were measured using matrix parameters available in MUSE7.1. P-wave area was constructed by integrating the duration and amplitude. Duration \times amplitude of P-wave initial and terminal portions in lead V₁ were calculated as force values. These variables were composed using the average value of the P wave during 10 seconds of recording time. Because all measurements of 12-lead ECGs were performed digitally using MUSE7.1, neither intraobserver nor interobserver variability occurred in this study.

Statistical analysis

The occurrence of AF was set as an endpoint, and the prognostic factors for developing AF were explored in the analysis. Patients whose ECG exhibited AF during the follow-up period (AF group) were compared with patients who did not (non-AF group). The follow-up period was defined as the interval between the first day when an ECG with LA overload was recorded and the first day when an ECG displaying AF was recorded in the AF group, or the interval between the first day when an ECG with LA overload was recorded and the latest day when an ECG was recorded in the non-AF group. The occurrence of death from any cause during the follow-up period was assessed by mail questionnaire. Written informed consent was obtained from all patients. Data are given as mean \pm SD or percentage, and group comparisons were made using t-test or Mann-Whitney test, as appropriate. Categorical variables were compared using the Fisher exact test. Comparison of AF occur-

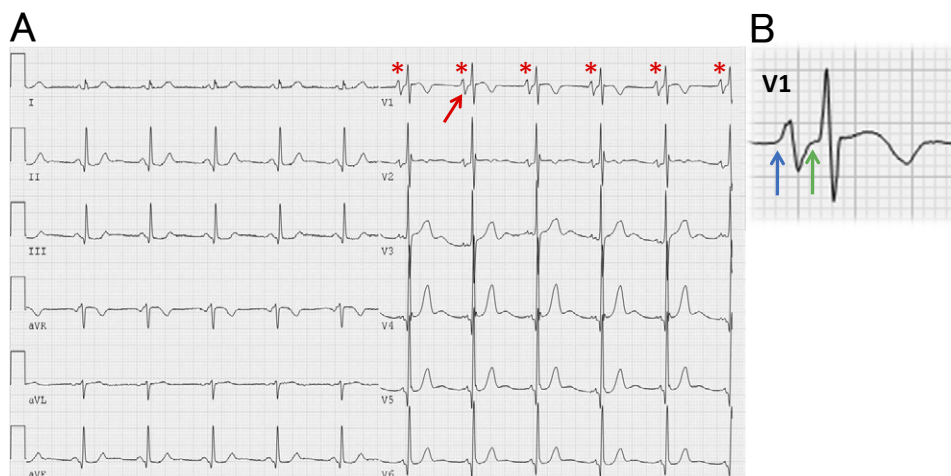


Figure 1 A: Twelve-lead ECG showing typical pattern of left atrial overload in lead V₁. Red arrow indicates P-wave negative terminal portion in lead V₁. Asterisks indicate P waves with identical morphology detected by template matching. B: Magnified ECG trace of lead V₁. Blue arrow indicates P-wave onset. Green arrow indicates P-wave offset.

Download English Version:

<https://daneshyari.com/en/article/2923897>

Download Persian Version:

<https://daneshyari.com/article/2923897>

[Daneshyari.com](https://daneshyari.com)