Original article

Inferior J waves in patients with vasospastic angina might be a risk factor for ventricular fibrillation

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ABSTRACT

Background: There is little information about the relationship between J waves and the occurrence of ventricular fibrillation (VF) in patients with vasospastic angina (VSA). The present study aimed to assess the incidence of J waves and the occurrence of VF in patients with VSA.
Methods: The subjects consisted of 62 patients with VSA diagnosed by acetylcholine provocation tests in our institution from 2002 to 2014. We investigated the VF events, prevalence of J waves, and relationship between the VF events and J waves.
Results: J waves were observed in 16 patients (26%) and VF events were documented in 11 (18%). The incidence of VF in the patients with J waves was significantly higher than that in those without J waves (38% vs 11%, p = 0.026). J waves were observed in the inferior leads in 14 patients, lateral leads in 5, and anterior leads in 3. A univariate analysis indicated that the incidence of VF in the inferior leads of J wave positive patients (46% = 6/14) was significantly (p = 0.01) higher than that in the inferior leads of J wave negative patients (10% = 5/48). The J waves in the anterior and/or lateral leads were not related to the incidence of VF. Notched type and slurred type J waves were not associated with VF. A multivariate analysis revealed that J waves in VSA patients were associated with VF [odds ratio (OR) 6.41, 95% confidence interval (CI) 1.37–29.93, p = 0.02] and organic stenosis (OR 6.98, 95% CI 1.39–35.08, p = 0.02). Further, J waves in the inferior leads were strongly correlated with VF (OR 11.85, 95% CI 2.05–68.42, p = 0.006).
Conclusions: The results suggest that the existence of J waves, especially in the inferior leads, might be a risk factor for VF in VSA patients.

Introduction

J waves are commonly found in the electrocardiograms (ECGs) of healthy individuals and have been recognized as a normal ECG subtype that has been considered to have a relatively good prognosis. However, studies have reported the relationship between J-point elevation (J wave) and idiopathic ventricular fibrillation (IVF) in patients without structural heart disease [1]. J waves have also gained attention in patients with Brugada syndrome [2] and ischemic heart disease [3,4].

Vasospastic angina (VSA) is induced by cold stimulation, smoking, and stress, and results in chest pain. The prognosis of VSA is generally good when treated with calcium-channel blockers, with or without nitrates. However, VSA may sometimes trigger lethal ventricular arrhythmias and lead to cardiopulmonary arrest [5–8], and the risk stratification of VSA would be required. A study has shown a positive association between J waves and ventricular tachyarrhythmias (VTAs) in patients with coronary artery disease, not only in the chronic phase [3], but also in the acute phase [9–11].

We hypothesized that J waves may also be associated with an increased risk of lethal arrhythmias in patients with VSA and

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assessed the incidence of J waves and the occurrence of VF in patients with VSA.

Methods

Study patients

This single-center retrospective study included a total of 166 consecutive patients that were suspected of VSA who were admitted to our institution between January 2002 and January 2014. They had syncope and a history of VF, and suffered from chest pain at rest, but no ECGs were recorded during the incidence of chest pain. All patients underwent cardiac catheterization, which included a provocation test for coronary artery spasms. A definite diagnosis was made based on the guidelines for VSA endorsed by the Japanese Circulation Society [12]. Significant coronary stenosis was defined as a >50% luminal narrowing of the major coronary arteries evaluated by coronary angiography [13]. The clinical characteristics were obtained through a chart review and the assessment of the left ventricular ejection fraction (LVEF) was evaluated by echocardiography at the cardiac ultrasound center in our institution.

Sixty-five patients were diagnosed with VSA by a provocation test for coronary artery spasms. Three patients were excluded from this study because of difficulty in diagnosing J waves due to atrial fibrillation, a paced rhythm, and intraventricular conduction block on the baseline ECGs. Of the 62 patients, 11 had documented VF and were successfully resuscitated before admission to our unit. Those patients were carefully diagnosed for other responsible cardiac diseases [14,15]. The study was approved by the Institutional Review Board at Yamaguchi University Hospital, Ube, Japan.

ECG analysis

The standard 12-lead ECGs were independently analyzed by two well-trained cardiologists, who were unaware of the clinical history of the patients, and any discordances were solved with the supervision of a third expert electrocardiologist. The ECGs recorded at rest without symptoms 5 days before the provocation test were used for the analysis. For the evaluation of the J waves, the ECGs were enlarged up to twice their size (speed 50 mm/s and amplitude 20 mm/1 mV), and analyzed. J waves were defined as notching, slurring, or a J-point elevation of 0.1 mV above the baseline in two contiguous inferior, lateral, or anterior leads [1,16]. The J wave morphology was characterized as exhibiting notching or slurring if it met the amplitude criteria. Notching was classified as a positive deflection at the terminal portion of a positive QRS complex. Slurring was defined as a smooth transition from the QRS complex to the ST segment with an upright concavity (Fig. 1). The amplitude of the notching was measured at the peak of the positive deflection relative to the QRS onset, and the amplitude of the slurring was measured at the inflection point of the QRS complex relative to the QRS onset [1,17].

Statistical analyses

Continuous variables were presented as the mean ± standard deviation (SD) and the categorical variables are presented as the number and percentage in each group. A comparison of the continuous variables between the groups was performed with a Student's t-test because all continuous variables were normally distributed. A comparison of all dichotomous variables between the two groups was done using a χ^2 contingency test and Fisher's exact probability test when the number of patients was not enough for a χ^2 contingency test. Univariate (Mantel-Haenszel method) and multivariate (Linear model method) analyses were performed to evaluate the association between the J waves and VTAs, and a logistic regression analysis was performed to detect any independent significant predictors by adjusting for multivariables [reported as odds ratios (OR) with a 95% confidence interval (CI)]. We arbitrarily defined an age less than 40 years old as a variable related to age, because, according to the previous report, the prevalence of J waves had a tendency toward being young (35 ± 13 years) [1].

The analyses were considered significant at a p-value <0.05 (2-tailed). All statistical analyses were performed using SPSS software (version 16.0 Family for Windows, Mapinfo, Troy, NY, USA).
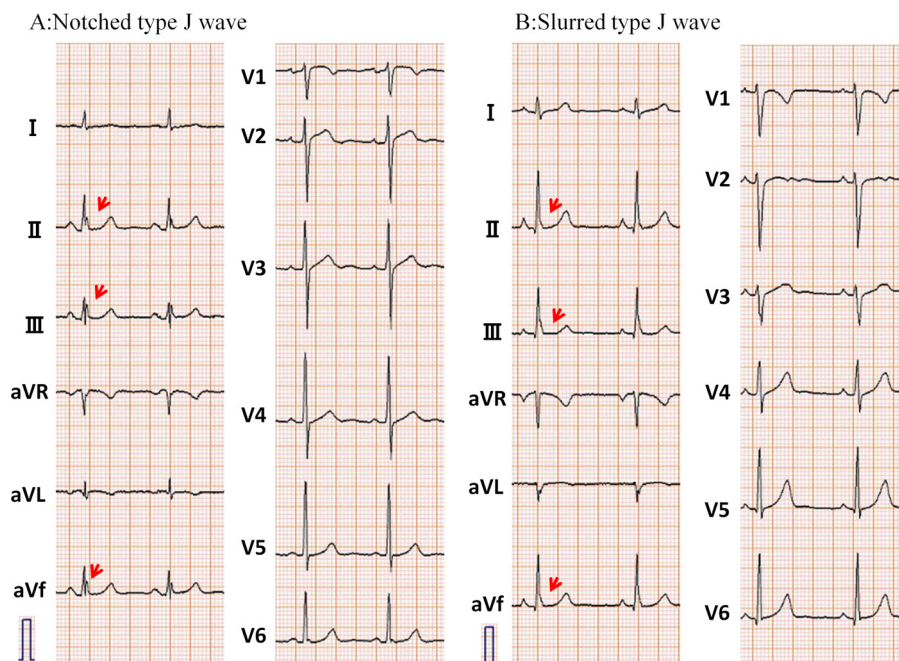

Fig. 1. Twelve-lead electrocardiograms of two representative cases with a history of ventricular fibrillation. Notched type J waves are shown in (A) and slurred type J waves in (B).