

Short-Term Reproducibility of T Wave Alternans Measurement

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T Wave Alternans Reproducibility. *Introduction:* Microvolt T wave alternans (TWA) has been proposed as a strong independent predictor of malignant ventricular tachyarrhythmias and sudden cardiac death. TWA reproducibility during bicycle stress test has not been previously investigated. We sought to assess the short-term reproducibility of TWA, as well as heart rate (HR) threshold for TWA, and its spatial distribution and magnitude.

Methods and Results: The study enrolled 42 patients who were able to complete two bicycle stress tests with HR at peak exercise >110 beats/min within 4 hours of each other and who had technically adequate recordings for TWA analysis during both tests. Concordant results for TWA determination were obtained in 39 (93%) of 42 cases. TWA was present during both tests in 23 patients and was absent during both tests in 16 patients. In the 23 patients with two positive tests, HR at the onset of TWA was not significantly different during the two tests. Further, the number of leads showing TWA and the magnitude of TWA were not significantly different between the two tests.

Conclusion: TWA is characterized by satisfactory short-term reproducibility and, when present, by high temporal and spatial stability. (*J Cardiovasc Electrophysiol*, Vol. 13, pp. 641-644, July 2002)

reproducibility, sudden cardiac death, T wave alternans, ventricular arrhythmias

Introduction

Alternans of the configuration and/or the duration of the T wave, known as T wave alternans (TWA), has been identified as a substrate for ventricular reentrant rhythms in the experimental model.^{1,2} Clinically, microvolt TWA has been proposed as a strong independent predictor of malignant ventricular tachyarrhythmias and sudden cardiac death.³⁻⁵ The reproducibility of several invasive and noninvasive risk stratifiers, such as arrhythmias on ambulatory ECG,⁶ heart rate (HR) variability,⁷ late potentials on signal-averaged ECG,⁸ and programmed ventricular stimulation,⁹ has been carefully tested. However, little data are available on the reproducibility of TWA measurements. TWA is HR dependent. Klingenhoben et al.¹⁰ recently showed that TWA could be reproducibly induced by atrial pacing in patients undergoing electrophysiologic study for documented or suspected ventricular tachyarrhythmias. In most studies, however, a bicycle or treadmill stress test has been used to increase HR.^{4,5,11} This may introduce confounding variables, such as possible effects of autonomic balance on TWA.¹² The aim of this study was to investigate the reproducibility of TWA measurements during bicycle exercise test. Additionally, we sought to test the reproducibility of HR threshold associated with the onset of TWA, as well as TWA spatial distribution and magnitude.

Methods

Patient Population

Patients in this study were selected from among those who underwent TWA and programmed ventricular stimulation for documented or suspected ventricular tachyarrhythmias. Patients had stopped taking antiarrhythmic drugs and beta-blockers for at least four half-lives at the time of TWA testing. Tests were performed in the morning hours. All patients who completed a symptom-limited bicycle exercise test with HR at peak exercise >110 beats/min and had technically adequate TWA recordings were asked to undergo a repeat test, once the vital signs had returned to baseline.

Exercise Testing

Bicycle exercise testing and TWA determination were performed with commercially available equipment (CH2000, Cambridge Heart, Bedford, MA, USA) and according to previously described techniques.^{4,11} After electrode placement to record standard 12-lead ECG leads and Frank orthogonal leads (X, Y, and Z), 5 minutes of resting ECG tracing was obtained. Then, bicycle ergometry was started with increasing workloads at 3-minute intervals, and patients were asked to pedal at one third or two thirds of their HR, in order to keep the frequency of motion artifacts distinct from the alternans frequency. Continuous ECG recordings were obtained during the exercise phase and for at least 5 minutes of the recovery phase and sampled at 1 kHz with 2.5- μ V resolution, filtered (bandwidth 0.05 to 250 Hz), and digitized (1,000 Hz with 12-bit resolution).

TWA Determination

TWA determination was performed using previously published spectral methods.^{3,4,11} The onset and end of the T

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Manuscript received 21 February 2002; Accepted for publication 7 May 2002.