

NOTE

Short-term studies of heart rate variability: comparison of two methods for recording

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Abstract

Heart rate variability (HRV) is often analysed using short-term studies. Our objective was to compare two of them in a group of diabetic patients (reduced HRV) and in a control group. From the same 10 min surface electrocardiogram (ECG) two recordings were obtained. In one of them the whole signal was acquired through an A/D converter (post-event method). In the other (real-time method), an interface between the electrocardiograph and a parallel port of a computer was used to perform real-time processing of the ECG signal. The *R–R* intervals were measured after a visual validation in the post-event method. In the real-time method, the stored *R–R* intervals were automatically filtered. For both methods HRV indexes were calculated using the same software. The values of mean *R–R* intervals for each subject were almost identical regardless of the method. Accordingly, we found a high correlation between HRV indexes obtained from both methods (all Spearman values ≥ 0.9441 and $P < 0.0001$). In addition, we found similar *P* values in the comparisons between the diabetic and control groups. We conclude that both methods are suitable for HRV analysis. Therefore, the selection of method can be based on other considerations such as the capability to store the ECG of the post-event method or the speed of analysis and lower cost of the real-time one.

Keywords: heart rate variability (HRV), short term method, real time acquisition

1. Introduction

The intervals between heartbeats normally show subtle variations in duration that are mainly related to autonomic nervous system (ANS) activity. The analysis of these variations, known as heart rate variability (HRV), is widely used for research and diagnostic or prognostic purposes in many pathologies such as: diabetes, heart failure, coronary artery disease, and arrhythmias (Akselrod *et al* 1981, Task Force of the ESC and the NASPE 1996, Malik 1999, Malpas and Maling 1990, La Rovere *et al* 2003, Bigger *et al* 1992, Huikuri *et al* 2003).

HRV can be analysed using either 24 h monitoring (Holter) or short-term recordings. In a previous work we have shown that a surface electrocardiogram (ECG) recorded over 10 min is as useful as Holter for diagnosis of reduced HRV in diabetes (Migliaro *et al* 2003), and we can speculate that this comparison could be extended to other conditions related to reduced HRV as described in many papers (La Rovere *et al* 2003, Pontet *et al* 2003).

The goal of our present work is the comparison of two different short-term methods for HRV analysis, selected among the broad spectrum of techniques used for short-term studies (Fei *et al* 1996, Radespiel-Troger *et al* 2003, Risk *et al* 2001).

One method acquires the whole ECG signal through an A/D converter (post-event method). The other method only detects the *R* wave peak that is fed into the computer (real-time method). To compare both modalities, we chose a group of patients who have suffered from diabetes for a long time; these patients are known to have reduced HRV due to diabetic neuropathy (Malpas and Maling 1990). HRV was simultaneously measured in each individual using both methodologies. The same procedure was carried out on a control group (normal HRV).

2. Methods

After a detailed explanation of the aims and methods of our research, all volunteers expressed their conformity. The diabetic group was composed of 15 insulin-dependent diabetic patients (8 women and 7 men). They were allowed to receive their usual medication. The control group was composed of 15 healthy subjects (9 women and 6 men), they were non-smokers and had a body mass index <30. They were not receiving any medication. Both groups had similar age (see table 4).

Recordings were performed in a quiet room in supine position. Three silver electrodes were placed on the chest surface in order to obtain a bipolar lead (plus ground) which was connected to an ECG recorder (Fukuda FJC 7110). The lead used was the one known as 'V5 like' (Bayés de Luna 1993).

Seeking similar conditions in all volunteers, they were instructed to avoid caffeine, alcohol and heavy exercise the day before the study. All tests started between 4 and 6 PM. The subjects were allowed to relax for 20 min in order to stabilize their heart rate before a 10 min recording period.

The collection of data was performed in two different ways:

- (a) *Post-event method.* Details of acquisition and processing have already been published (Migliaro *et al* 2003). Briefly, the ECG signal was fed into a computer (Compaq Armada) by means of an A/D converter (National Instruments DAQ Card-1200). The sampling rate was 500 Hz. After that, the *R* waves were detected as described in the appendix of Migliaro *et al* (2003). Later, they were visually inspected together with the ECG to correct either false positives or negatives. Then, intervals between successive *R* waves (*R-R* intervals) were measured and the HRV indexes were calculated. For this work we chose SDNN, rMSSD and the high- and low-frequency bands of the spectral analysis (see table 1).

