

Paper Electrocardiograph Strips May Contain Overlooked Clinical Information in Screen-Detected Type 2 Diabetes Patients

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Abstract

Background:

A large number of nondigitized electrocardiograph (ECG) strips are routinely collected in larger cohort studies such as the ADDITION study (Anglo-Danish-Dutch Study of Intensive Treatment in People with Screen-Detected Diabetes in Primary Care). These ECG strips are routinely read manually but may contain overlooked information revealing cardiac autonomic dysfunction. The aim of this study was to investigate whether clinical information may be lost using manual R wave to R wave (RR) interval measurements in the calculation of heart rate variability (HRV) in patients with type 2 diabetes mellitus (T2DM).

Method:

From the Danish part of the ADDITION study, we randomly selected 120 T2DM patients at baseline of the ADDITION study. Analysis of the ECG strips was performed using two different methods: (1) by experienced technicians using rulers and (2) by experienced technicians using a high-resolution computer-assisted method. Calculation of heart rate and time domain HRV [standard deviation of normal-to-normal RR intervals (SDNN) and root mean square of successive differences (RMSSD)] were performed with the same software.

Results:

When comparing results from the two methods, the following values of Pearson's r are obtained: 0.98 for heart rate, 0.76 for SDNN, and 0.68 for RMSSD. These results indicate that heart rate and HRV measurements by the computer-assisted and manually based methods correlate. However, Bland-Altman plots and Pitman's test of difference in variance revealed poor agreements ($p < .01$) for both HRV measurements (SDNN and RMSSD); only heart rate showed substantiated agreement ($p = .54$) between the two methods. Low HRV was statistically significantly associated to high heart rate, systolic blood pressure, and diastolic blood pressure in these screen-detected T2DM patients.

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Abbreviations: (bpm) beats per minute, (CAN) cardiac autonomic neuropathy, (CV) coefficient of variation, (ECG) electrocardiograph, (HbA1c) hemoglobin A1c, (HRV) heart rate variability, (ln) natural logarithm, (QTc) QT interval corrected for heart rate, (RC) reproducibility coefficient, (RMSSD) root mean square of successive differences, (RR) R wave to R wave, (SD) standard deviation, (SDNN) standard deviation of normal-to-normal RR intervals, (T2DM) type 2 diabetes mellitus

Keywords: autonomic dysfunction, complications, diabetes, neuropathy, risk stratification, ultra short-term HRV

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Abstract cont.

Conclusions:

Paper ECG strips may contain overlooked clinical information on the status of autonomic function in patients with T2DM. In our study, manual measurements of RR intervals were inferior to the computer-assisted method. Based on this study, we recommend cautiousness in the clinical use and interpretation of HRV based on manual or low resolution measurements of RR intervals from ECG strips. High resolution measurements of RR intervals reveal significant associations between low HRV and high heart rate, systolic blood pressure, and diastolic blood pressure among patients with screen-detected T2DM. It is feasible to use a computer-assisted method to determine RR intervals in patients with T2DM.

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