

Short-Term Measurement of the Pulse Rate Variability in Overweight Patients with 2 Type Diabetes

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Background: The problem Pulse Rate Variability (PRV) in type 2 diabetes and increased body mass index has not been studied enough. Type 2 diabetes affects the peripheral vasculature leading to coronary, cerebral and peripheral vascular disease associated with oxidative stress and inflammatory processes. Similarly increased body weight also changes oxidative stress and inflammation that may adversely affect diabetes disease progression.

Methods: The Heart Rhythm Scanner Special Edition Version 1 (Biocom Technologies, USA) was used for PPG (Photoplethysmography) recording and PRV analysis.

Results: Our study found that short-term measurement of PRV shows some statistically significant differences using multifactorial analysis of type 2 diabetes with overweight and a healthy control group with normal weight. Short-term measurements of PRV can be used as an alternative method for HRV. PPG-method can be used as preliminary screening tool for large populations with increased risk of heart problems. This is because the PPG method is simple to use and takes much less time.

Up to now there are many scientific articles dealing with the problem of Heart Rate Variability (HRV) in type 2 diabetes with increased body mass index ($18.5 < \text{BMI} < 25$). These studies showed that the HRV is decreased in type 2 diabetics with overweight compared with the healthy controls with normal weight. However, Pulse Rate Variability (PRV) in type 2 diabetes with increased BMI ($\text{BMI} > 25$) has not been studied enough that is why he is relevant and deserves to be investigated.

It has been found that type 2 diabetics with overweight suffer more often from cardiovascular diseases and the mortality in them is greater. There are several scientific

studies conducted to establish that the PRV can be an alternative to the HRV. These studies found that changes in the frequency and temporal parameters of HRV and PRV in type 2 diabetics are similar.

Photoplethysmography (PPG) enables the non-invasive measurement of the peripheral pulse wave enabling assessment of cardiac time interval. PPG-method can be used as preliminary screening tool for large populations with increased risk of heart problems. This is because PPG method is simple to use and takes much less time. It does not require any electrodes. PPG is simple and only requires on small optical probe to be applied to the skin. In contrast to conventional electrocardiography (ECG) which requires several sticky electrodes to be carefully placed on the body, PPG measurements can help reduce possible white coat' effects on subjects. It has already been demonstrated that the pulse-to-pulse intervals (PPI) derived from PPG signals can be a surrogate for RR intervals (RR!) derived from ECG recordings. In this study pulse rate variability (PRV) was used to obtain HRV information.

The study was conducted after approval by the Ethics committee of our hospital. It was conducted according to the international standards for the measurement of HRV (heart rate variability). We investigated total 28 patients. Fourteen were type 2 diabetics with increased BMI (6 male, 8 female; age 40-64; $\text{BMI} > 25$) and 14 healthy non-diabetic patients with normal weight (5 male, 9 female; age 40-59; $\text{BMI} 18,5-25$). All subjects were requested to avoid strenuous exercise, refrain from consuming hot drinks or those containing caffeine, or eating a substantial meal for 1 h prior to the study. All smokers were also asked not to smoke cigarettes for at least 1 h before their measurements, as acute smoking may be associated with hemodynamic changes in the cardiovascular system

The measurement room temperature was set to 25 ± 1 °C. All subjects rested in supine position at least 10 min

on a comfortable bed, and then the PPG signals were recorded in supine position during spontaneous breathing for 5 min. Subjects were asked to remove any earrings prior to their cording session. The left ear lobe was the measurement site for this study.

The Heart Rhythm Scanner Special Edition Version 1 (Biocom Technologies, USA) was used for PPG recording and PRV analysis. The method of PRV analysis allows for selective assessment of the function of both ANS branches: sympathetic and parasympathetic nervous systems. These systems are specifically responsible for engaging the body to cope with stress and restore the body once stress is over. They are constantly working together trying to maintain regulatory balance. Chronic stress causes this balance to shift away from its equilibrium and exhaust ANS reserves for adaptation. PRV provides means to assess how both branches work and how balanced they are.

This device records the instantaneous pulse wave using a pulse wave sensor (PPG=photoplethysmography).

We performed a time and frequency domain PRV analysis in accordance with recognized standards.

We measured the following HRV-parameters: the Spectral power indices Total power, LF, HF, LF normalized, HF normalized, LF/HF ratio, VLF and the Time-domain parameters-SDNN and RMSSD.