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Original Article

Heart rate variability in normal weight and overweight patients with controlled hypertension

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Abstract

Objective: Heart rate variability (HRV) is a noninvasive marker used to predict cardiac autonomic modulation. Obesity and hypertension are two separate clinical conditions that can affect HRV. This study examined HRV in normal weight and overweight patients with controlled hypertension.

Methods: The study included patients who had hypertension under control with medical treatment. All patients underwent ambulatory electrocardiography. It analyzed the standard deviation of all normal to normal RR intervals (SDNN), one of the HRV time domain indices. It further measured the body weight and height of each patient. The patients were divided into two groups based on their body mass index (BMI): normal weight and overweight. The patient groups were examined to determine whether there was a difference between the groups in terms of the SDNN parameter.

Results: The mean age of 54 patients participating in the study was 77.5 (51-89). The mean SDNN of the patients was 111.4±41.2. The mean SDNN of the normal BMI group was 110.7±39.1 and 112.5±44.8 in the overweight group. There was no statistically significant difference between the groups (p=0.876).

Conclusion: Hypertension and obesity together can affect HRV. Obesity does not affect HRV in the patient group with controlled hypertension. Although hypertension caused a decrease in SDNN values, obesity did not cause a further reduction in these values.

Keywords: Heart rate, hypertension, obesity.

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INTRODUCTION

Hypertension is one of the most common chronic diseases worldwide (1). It is the leading cause of cardiovascular diseases (CVD) and premature death and is among the most important modifiable risk factors together with smoking (2). Obesity is a chronic health problem whose prevalence is increasing in adults, adolescents, and children, and it is now considered a global epidemic (3). Heart rate variability (HRV) is a noninvasive marker used to predict cardiac autonomic modulation. It is useful in the analysis of cardiac autonomic status and measurement of cardiac adaptation mechanisms (4). HRV parameters vary significantly in nondiabetic hypertensive patients (5). Many studies have determined an inverse relationship between weight gain and obesity and changes in HRV parameters (6-8).

In this study, we investigated whether there was a difference in HRV between the normal weight and overweight groups in patients with controlled hypertension.

MATERIALS AND METHODS

The study included patients who applied to the Zonguldak Atatürk State Hospital Cardiology outpatient clinic between 01.09.2015-01.09.2016 and had hypertension under control with medical treatment.

The study excluded patients with chronic renal failure, diabetes mellitus, coronary artery disease, heart failure, thyroid disease, use of beta blockers, calcium channel blockers, and anxiolytic or antidepressant drugs. Patients in both groups were statistically similar in terms of age and sex. All patients employed in the study underwent ambulatory electrocardiography (ECG). A two-channel bipolar recording was performed during a single working day. Ambulatory electrocardiographs were recorded for 24 hours using a DR-512 VX3 ECG recording system (Biomedical Systems, Century series Holter analysis systems, Maryland. Heights, MO, USA). During the electrocardiographic follow-up, all patients were asked to perform their daily routine normal activities between normal sleep-wake periods. In the evaluation of heart rate variability, the study population was first asked to abstain from coffee, tea, cola drinks, smoking for 12 hours and alcoholic beverages for 24 hours. All recordings were analyzed by an experienced cardiologist. The standard deviation of all normal to normal RR intervals (SDNN), one of the HRV time domain indices, was analyzed. Body weight and height measurements of each patient were measured as per the standard protocols with calibrated devices. Body mass index (BMI) was calculated by dividing body weight (kg) by the square of height (m^2). Those with a BMI between 18.5 and 24.9 kg/m^2 were considered normal, 25-29.9 kg/m^2 were overweight, and 30 kg/m^2 and above were obese. The patients were divided into two groups based on their BMI: normal weight and overweight-obese. We examined whether there was a difference between the groups in terms of HRV.

Statistical analysis

Statistical analyses were performed using Windows SPSS 20.0 (IBM Corp., Armonk, NY, USA). The conformity of the variables to the normal distribution was examined using visual (histogram and probability graphs) and analytical (Kolmogorov–Smirnov/Shapiro–Wilk tests) tests. Descriptive analyses were performed using the median (minimum-maximum) for nonnormally distributed variables. Normally distributed variables were compared using Student's t test, while Mann–Whitney U tests were used for nonnormally distributed variables. Categorical data were given using crosstabs with frequency (n) and percentage (%). Comparisons of categorical variables between groups were conducted using the Pearson chi-square test. Statistical significance was set at $p<0.05$ for all comparisons.

RESULTS

The study included 54 patients who met the criteria. The mean age of the patients was 77.5 (51-89). Of the patients, 53.7% (29) were female, while 46.3% (25) were male. While 31 (57.4%) of the patients had a normal BMI, 18 (33.3%) were overweight, and 5 (9.3%) were obese. The mean SDNN of the patients was 111.4±41.2 (Table 1). The patients were divided into two groups: those with normal BMI and overweight-obese. While there

were 31 (57.4%) patients in the group with normal BMI, there were 23 (42.6%) patients in the other group. There was no difference between the groups in terms of sex and age. The mean SDNN of the normal BMI group was 110.7±39.1 and 112.5±44.8 in the overweight-obese group. There was no significant difference between the groups (p=0.876) (Table 2).

Table 1. Demographic and clinical characteristics of the patients

Gender	
Male	25 (46.3%)
Female	29 (53.7%)
Age (year)	77.5 (51-89)
BMI (kg/m^2)	24.5 (19.4-35.5)
SDNN (ms)	111.4±41.2
BMI Group	
Normal	31 (57.4%)
Overweight	18 (33.3%)
Obese	5 (9.3)

Abbreviations: BMI: Body mass index, SDNN: Standard deviation of all normal to normal RR-intervals, ms: milliseconds.

Table 2. Demographic and clinical characteristics of patients according to BMI groups

	BMI		**p**
	Normal	**Overweight-Obese**	
Gender			
Male	14 (45.2%)	11 (47.8%)	0.532
Female	17 (54.8%)	12 (52.2%)	
Age (year)	77 (51-89)	78 (63-88)	0.916
SDNN (ms)	110.7±39.1	112.5±44.8	0.876

Abbreviations: BMI: Body mass index, SDNN: Standard deviation of all normal to normal RR-intervals, ms: milliseconds.

DISCUSSION

In healthy individuals with normal sinus rhythm, the intervals between heartbeats are constantly changing. Changes in autonomic tone are the primary cause of changes in both baseline heart rate and heart rate variability. Parasympathetic stimulation slows the heart rate, while sympathetic stimulation accelerates the heart (9). Autonomic control of the heart is provided by the balance between the sympathetic and parasympathetic systems. In many diseases, this balance is affected, leading to cardiac autonomic dysfunctions. This can further cause fatal rhythm disturbances (10). Different HRV measurements provide complementary information on autonomic tone and cardiac innervation, as well as important information on the risk of sudden death, cardiac, and general mortality in various disease conditions (11). Decreased HRV is an indicator of increased sympathetic tone and decreased vagal tone and is associated with an increase in fatal ventricular arrhythmias (12). HRV measurements can be made over 5-minute short or 24-hour long-term ECG recordings using time-dependent and frequency-dependent methods. The basic principle in HRV measurement is the analysis of successive R

waves measured on the surface ECG. Many indices have been developed for this purpose. One of the most commonly used of these is SDNN. SDNN is the standard deviation of all NN intervals. The SDNN mean value is 141±39 ms (13). Hypertension is a very common and significant health problem. Although different results have been reported based on race and geography in various studies, it has a frequency of 25-30% in the adult population (14). HRV is suppressed in essential hypertension (15-16).

Abate et al. found that significant disruptions in the autonomic nervous system caused a decrease in parasympathetic tone and an increase in sympathetic activity in elderly hypertensive patients (17). In a study by Huikuri et al, individuals with hypertension had lower heart rate variability parameters than individuals with normal blood pressure (18). In a study conducted by Guzzetti et al, there was a strong correlation between all time-dependent HRV parameters, especially SDNN, and hypertension (19). In our study, HRV decreased in our patient group with hypertension under control, consistent with findings in the literature. While the SDNN mean value was 141±39 ms, the mean SDNN of the patients in our study was 111.4±41.2. Overweight and obesity are among the most important public health problems in developed and developing countries (20,21). Obesity affects the cardiovascular system through various mechanisms and causes cardiovascular diseases that lead to morbidity and mortality (22). One of the noninvasive techniques for assessing autonomous status is HRV, a method that can evaluate sympathovagal balance at the sinoatrial level (13). There was an increase in sympathetic activity, a decrease in parasympathetic activity, and concomitant sympathetic imbalance (SVI) in obese individuals (23-25). Chintala et al (26) stated that "The increased risk of death from CVD in overweight individuals may be due to altered sympathetic activation and decreased parasympathetic response. Therefore, regular evaluation of HRV measurements can be used as a pretest for early detection and management of CVD in overweight individuals."Poirier et al, in their study with severely overweight women, concluded that "An average of 10 percent weight loss has been shown to result in a significant decrease in mean heart rate (HR) and a remarkable increase in many parasympathetic parameters over months" (27). In our study, there was no difference in terms of HRV between normal weight and overweight-obese patients with controlled hypertension. Studies have found an inverse relationship between HRV parameters in overweight-obese patients. However, our study has already been conducted in a hypertensive patient group that affects HRV parameters. Obesity did not cause an extra change in HRV in this patient group. Obesity added to hypertension did not further affect the autonomic system of the heart. The mortality in overweight and obese patients with cardiovascular disease is lower than that in patients with a normal BMI and the prognosis of these patients is better. This has been called the "obesity paradox" (28), which may be one reason that there was no difference in HRV between the overweight-obese patient group and the normal weight patient group in our study.

Limitations:

There are some limitations in our study. Preoperative hypovolemia, oxygen capacity, pain, and emotional stress may affect autonomic tone and interact with HRV. Autonomic tone was not evaluated by pharmacological methods. Our study was conducted ata single center with a relatively small sample size. Future long-term, multicenter studies with more participation canbe beneficial.

CONCLUSION

In our study conducted in the patient group with controlled hypertension, there was no difference between the normal weight and overweight-obese patient groups in terms of HRV parameters. Hypertension is a condition that affects HRV and is affected by obesity. Although hypertension caused a decrease in SDNN values in our study, obesity did not cause a further decrease in these values. It canbe useful to conduct further studies with larger patient groups.

Conflicts of interest: The author declares no conflict of interest.
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Ethical approval: The study was conducted with the conditions recommended by the Helsinki Declaration. It was approved by the Clinical Research Ethics Committee of the Zonguldak Bülent Ecevit University Faculty of Medicine (no: 2015/06 dated: June 2015)
Peer-review: Externally peer-reviewed.
Authorship contributions: Design of the study; -Supervision; -Data collection & processing; -Performed data analysis; -Literature search; -Written by; -Critical review; M.O.Ç.

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