Original article

Effect of obesity on electrocardiographic P-wave dispersion in apparently healthy young women

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Abstract

Obesity is said to affect cardiovascular physiology. Objective**:** The present study was undertaken to assess the impact of obesity on electrocardiographic p-wave dispersion.

Methods and materials: A cross sectional study conducted among 60 apparently healthy young women, who were further divided into two groups according to their BMI. The first group consisted of non-obese subjects with BMI of 18 to 24.9 kg/m^2 and the second group consisted of obese subjects with BMI of 30 kg/m^2 and above. All the subjects underwent electrocardiogram analysis for p-wave dispersion.

Results: After analysing the data and comparing by independent sample t-test, we found significantly higher p wave dispersion in obese group in comparison to non obese group ($p<0.001$).

Conclusion: Obesity has an impact on cardiac electrophysiology of women even in younger age group, therefore they should be safeguarded against the hazards of obesity by taking corrective steps through our health programs.

Key words: Obesity, ECG, P-wave, BMI

Introduction

Obesity is an important global health hazard and has been linked to increased incidence of cardiovascular diseases, hypertension, metabolic disorders and pulmonary dysfunction [1]. Obesity is a chronic medical condition characterized by an excessive accumulation of fat on human body that causes a generalized increase in body mass. It is measured by using body mass index (BMI) which is a reflection of weight and height. BMI is calculated as the weight in kilograms divided by the square of the height in meters (BMI = weight (kg)/height (m^2)). The world Health Organization (WHO) classified obesity as follows. BMI of 18 - 24.9 kg/m^2 is considered normal weight, a BMI of 25.0-29.9 kg/m^2 is considered overweight and a BMI of 30 kg/m^2 or higher is considered obesity [2]. Obesity is often associated with many health consequences such as diabetes, hypertension, dyslipidemia, ischemic heart diseases, obstructive sleep apnoea, stroke, premature death, osteoporosis and a reduction of the overall quality of life [3]. Obesity causing changes in cardiac morphology such as LV hypertrophy and right ventricular hypertrophy are well established [4,5]. However along with the changes in cardiac anatomy, obesity may also alter the electrocardiogram (ECG) . According to Seyfeli et al., P-wave changes are highly specific in screening healthy obese individuals for the risk of cardiovascular diseases [6]. P-wave dispersion, which is the difference between maximum and minimum P-wave duration,

has been recently defined as a new electrographic marker for the prediction of atrial fibrillation (AF) [6,7]. Although, in the Framingham Heart Study [8] body mass index (BMI) was not defined as an independent risk factor for AF, according to Wang et al. obesity has proved as an important, potential risk factor for AF [9]. The association of obesity with subsequent development of AF persists even after accounting for the influence of concominant conditions such as hypertension, diabetes mellitus and myocardial infarction [10]. An electrocardiogram is a simple representation of the electrical activity of the heart muscle during the cardiac cycle. Recording of ECG is one of the easiest, cheap and reliable methods of assessing cardiovascular function. Studies have shown that obesity induces changes in the normal ECG pattern, in healthy young women but the results have been inconsistent [11,12]. Since there are very few studies on effect of obesity on the duration and dispersion of P-wave, this study was undertaken to investigate the dispersion of P-wave in apparently healthy obese young women in order to stratify them for risk of cardiovascular diseases.

Materials and methods

Sixty apparently healthy young female medical student volunteers, in the age group of 18-25 years, were enrolled for this study. The subjects were subsequently divided into two groups according to their BMI. The first group consisted of non-obese (normal body weight) subjects with BMI of 18 to 24.9 kg/m^2 and the second group consisted of obese subjects with BMI of >30 kg/$m^{2.}$ Individuals leading a sedentary life style were included. Written informed consents were obtained from all the participants after explaining the study protocol. The present study was conducted in the department of physiology, Gandhi Medical College, Hyderabad for a period of two years after obtaining the approval of institutional ethics committee. All the subjects underwent a thorough evaluation of medical history and general physical examination. The clinical details and baseline parameters were recorded on a well designed proforma. The laboratory was well ventilated throughout the recordings. All the recordings were taken between 10 AM to 1 PM at room temperature.

Methods

Waist to hip ratio (WHR):

The waist circumference (cm) was measured at a point midway between the lower rib and iliac crest, in a horizontal plane. The hip circumference was measured in centimeters at the widest girth of the hip. The measurements were recorded to the nearest 0.1 cm. and were used to WHR .

BMI:

The weight was measured with the subjects wearing light clothing and barefoot on a SECA weighting scale (Hamburg, Germany). The standing height was measured without shoes with the subject's back to a vertical backboard. Both the heels were placed together, touching the base of the vertical board. Normal weight and obesity were defined on the basis of WHO cut offs.BMI was measured by calculating the weight in kilograms divided by the square of the height in meters (BMI = weight (kg)/height (m^2))[2].

Blood pressure:

The systolic blood pressure (SBP) and diastolic blood pressure (DBP) were recorded by sphygmomanometer in the morning, prior to collection of blood sample. Mean arterial blood pressure (MABP) was calculated with the formula: Diastolic pressure+1/3rd of Pulse pressure (DBP+1/3rdPP).

Heart rate:

Recording of pulse was done by palpating the radial artery for full one minute .

ECG Recording:

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ECG recording was carried out in all the subjects after thorough clinical and systemic examinations were done. With the subjects in the resting supine position, a 12 lead electrocardiogram was recorded by using a single channel ECG cardiant (heart view 1200 ECG recorder-manufactured by Brown Dove Healthcare Pvt Ltd) at a speed of 25mm/s. The ECGs were magnified and P-wave duration was measured by manual callipers from the onset to the offset of the P-wave. The maximum (Max.) P-wave duration was taken as longest P-wave duration and minimum (Min.) P-wave duration as the shortest P-wave duration. P-wave dispersion is defined as the difference between the Maximum and Minimum duration.

Statistical analysis

The statistical analysis was performed using the SPSS 19 software (SPSS, Chicago). The variables were expressed as the means and standard deviations, and p value <0.05 was considered statistically significant. Independent sample t- test was used to compare the results of obese to non-obese subjects.

Results

The baseline characteristics of study subjects are shown in Table 1. The ECG analysis is described in table-2. While comparing baseline variables, we did not find any significant difference in age and height, where as significant difference (p<0.001) (table-1) was observed in WHR and BMI between the obese and non-obese subjects. Obese women had higher max P-wave duration (P<0.001) and P-wave dispersion (P<0.001) compared to non-obese. Although, min P-wave duration was found higher in obese compared to non-obese women, however, it was not statistical significance (Table 2).

Table 1. Baseline parameters of the obese group and non-obese group. [Data expressed as mean (SD)]

Parameters	Non-obese group (N=30)	Obese group (N=30)	p-value
Age(Yrs)	19.75 ± 0.74	19.66 ±0.61	NS
Height(m)	162.44 ± 5.13	162.53 ±4.97	NS
Weight(kg)	54.34 ± 6.08	71.66 ±8.14	<0.001
WHR	0.82 ± 0.07	0.90 ±0.06	<0.001
BMI(kg/m^2)	21.68 ±1.73	27.96 ± 2.63	<0.001

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Table-2.Comparison of ECG variables in obese and non obese group.[Data expressed as mean(SD)

Parameters	Non-obese group (N=30)	Obese group (N=30)	p-value
SBP(mm of Hg)	110±14	132±18	<0.001
DBP(mm of Hg)	78±4	84±8	<0.001
HR(beats/min)	76 ± 8	80±10	NS
Max.P-wave duration (ms)	92±14	114±12	<0.001
Min.P-wave duration (ms)	62±10	66±12	NS
P-wave dispersion	52±15	29±11	<0.001

Discussion

Obesity is a major risk factor for many acute and chronic disorders, including cardiovascular and cerebrovascular disease, and diabetes. It may worsen many chronic diseases such as hypertension, dyslipidemia, gallstone disease and osteoarthritis [13]. It is well known that obese patients are under the risk of ventricular arrhythmias and sudden death [14, 15]. However, the association between obesity and AF was not exactly clarified until recently. Wang et al. [9] previously have shown that obesity is a risk factor for AF, and they observed that obesity was associated with a 50% increase in the risk of AF. Furthermore, Frost et al. have suggested that AF and flutter should be added to the list of diseases caused by overweight and obesity [16]. In our study, obese women had higher blood pressure, max. P-wave duration, and P-wave dispersion compared with non-obese women. While the high blood pressure in obesity is well established, the left atrial enlargement, which is an important precursor of AF, may contribute to the increase in P-wave duration and P-wave dispersion associated with obesity [17]. Some studies have shown that BMI is one of the most powerful determinants of left atrial size [18, 19]. In obese patients, left atrial enlargement and electrical instability may be caused by elevated plasma volume, ventricular diastolic dysfunction and enhanced neurohormonal activity. The present study is concurrent with Cheema et al., and seyfeli et al., who have reported that changes in left atrial dimension and pressure may influence P-wave duration [20,6]. Obesity has the potential to affect the ECG in several ways such as by displacement of the heart by elevating the diaphragm in the supine position, by increasing the cardiac workload and by increasing the distance between the heart and the recording electrodes. However our study does not agree with Nomura et al., who did not find significant influence of obesity on ECG findings in young women [21]. We feel that further studies are required to figure out the relation between the P-wave dispersion and left atrial diameter in obese women.

Limitations

The present study could not quantify the effect of different patterns of fat distribution on ECG changes in obesity. Also we could not evaluate the ECG findings of atrial dilatation and ventricular hypertrophy because of lower sensitivity of ECG in obese subjects.

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