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Original Research Article

Evaluating the Impact of Obesity on Electrocardiographic P-Wave Dispersion in a Population of Healthy People

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Abstract

Aim: The aim of the present study was to investigate the dispersion of P–wave in healthy young adults.

Methods: The study was conducted in the Department of Physiology, ESIC Medical College & Hospital, Bihta, Patna. Design of the study was cross - sectional observational and a total 200 young healthy adults both male and female aged between 18 to 40 years participated voluntarily in the study. Written informed consents were taken from all the participants after explaining the study protocol.

Results: There was no significant difference in age, sex and height between obese and non –obese group but a significant difference were found in weight and BMI between groups. Obese group had higher SBP, DBP, HR, maximum P-wave duration, minimum P-wave duration and P-wave dispersion compared to non-obese and statistically significant ($p<0.001$) was found.

Conclusion: It can be concluded that apparently healthy obese individuals may have higher anthropometric values and abnormal P–wave findings. Hence the present study gives an insight on the variations in P-wave in healthy adults who are obese and thereby helps in creating awareness so that; they can change their lifestyle in order to prevent the onset of the deleterious effects of obesity on their health.

Keywords: Obesity, BMI, ECG, P-wave, P-wave dispersion, Atrial fibrillation

Introduction

Obesity is an important public health problem, especially in developed countries. [1] It is well known that obesity is an independent risk factor for cardiovascular diseases and is associated with type 2 diabetes, hypertension, dyslipidemia, coronary artery disease, and metabolic syndrome. The occurrence of sudden death has been reported in obese patients without known heart abnormalities. [2,3] Ventricular tachyarrhythmias have been shown to be associated with obesity. [2] It has also been shown by recent data that obesity is also an important potential risk factor for atrial fibrillation (AF). [4] Furthermore, Frost et al [5] have suggested that AF and flutter should be added to the list of diseases caused by overweight and obesity. A new electrocardiographic marker, P wave dispersion, has been defined recently as a predictor of AF. [6,7] P wave dispersion, which is defined as the difference between maximum (max.) and minimum (min.) P wave duration, has been associated with homogeneous and discontinuous propagation of sinus impulses. [6,8]

Although, in the Framingham Heart Study [9] 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. [4] 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]

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. [13] 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). [13,14]

The aim of the present study was to investigate the dispersion of P–wave in healthy young adults.

Materials and Methods

The study was conducted in the Department of Physiology, Employee State Insurance Medical College and Hospital, Bihta Patna, Bihar, India for one year. Design of the study was cross - sectional observational and a total 200 young healthy adults both male and female aged between 18 to 40 years participated voluntarily in the study. Written informed consents were taken from all the participants after explaining the study protocol.

Subjects were divided into two groups based on the BMI:

Group A – Normal/Non-obese (BMI: 18.5 – 24.99kg/m2) =100

Group B– Obese (BMI > 30kg/m2) =100

Subjects with history of cardiovascular disease, respiratory disease, thyroid disorder, diabetes, smoking, neuropsychiatric disorder, menstrual abnormalities etc were excluded from study.

Methods of Collection of Data:

Measurement of BMI:

Body weight was measured on portable weighing machine without shoes and lightly clothed, and height was measured in barefoot using stadiometer. The subject stood against a standard meter scale, ears and the infra– orbital margins lay in one horizontal plane. Body weight was recorded in kilograms on an empty bladder and before lunch. BMI was calculated as body weight in kilogram divided by the square of the body height in meters.

[BMI = Weight (kg) / Height (m2)]

Measurement of Blood Pressure

Blood pressure (systolic blood pressure and diastolic blood pressure) was recorded in supine position in the right upper arm after the subject had rested for at least 5 minutes with standard mercury sphygmomanometer to the nearest 2 mmHg.

Electrocardiographic Recording

The electrocardiographic recording was done by using 3– channel ECG machine by Medicaid India. To avoid from diurnal variations, we took ECG recordings of all subjects at the same time interval (10:00 am - 12 noon). [15] The speed of ECG paper was 25 mm/sec and the voltage was 1mv/cm. A resting ECG was recorded in lying posture after duly assuring them the non- invasive nature of the procedure and after resting of 10 min in a well – ventilated quiet room. The subject's chest, forearms and legs were uncovered. Objects such as electronic gadgets, metallic ornaments etc. were removed to avoid interference. Location for placing electrodes on arms and legs was selected by choosing a place where there was minimum movement. Sufficient quantity of ECG gel was applied approximately 2cm on the skin at the chosen location to ensure good electrical contacts. Limb electrodes were clipped to subject's skin to give proper contact. Chest leads were placed over six different locations. Care was taken so that gel does not smear between the chest electrode sites.

Measurement of P-wave Dispersion (Pd)

All ECG papers were scanned and digital files were created. Then after doing 200% magnification P-wave duration was measured using Adobe Photoshop-7 software. Pd was derived by subtracting the minimum P-wave duration from the maximum in any of the 12 ECG leads. P-wave onset was determined as the initial deflection from the isoelectric baseline defined by the T-P segment and the P-wave offset was defined as the junction of the end of the P wave and its return to baseline.[16]

Statistical Analysis:

The data was compiled in Microsoft excel and analysed using SPSS (Statistical Package for Social Sciences) version 20. The variables were expressed as mean and standard deviation, and P value <0.05 was considered statistically significant. Independent sample t-test was used to compare the results of obese to non- obese control group subjects.

Results

Table1: Comparison of baseline anthropometric data between non-obese and obese group

Parameters	Group A (Non-obese) (N=100)	Group B(Obese)(N=100)	p– value
Age(Years)	25.15±4.66	29.81±3.47	0.931
Weight(Kg)	60.55±7.73	84.26±7.63	<0.001
Height(meter)	1.65±0.05	1.59±0.07	0.859
BMI(Kg/m^2)	22.18±1.86	32.78±2.06	<0.001

There was no significant difference in age, sex and height between obese and non –obese group but a significant difference were found in weight and BMI between groups.

Table 2: Baseline assessment of cardiovascular parameters (Blood pressure, Heart rate and P-wave duration and dispersion)

Variables	Group A(Non-obese)	Group B(Obese)	p-value
SBP(mmofHg)	114.26±7.73	128.12±6.06	<0.001
DBP(mmofHg)	75.65±5.06	84.26±3.62	<0.001
HR(b/m)	78.52±4.18	86.54±8.90	<0.001
Pmax(ms)	88.62±14.75	116.14±6.44	<0.001
Pmin(ms)	56.74±10.54	71.13±7.48	<0.001
Pd(ms)	35.15±5.92	47.13±5.45	<0.001

Obese group had higher SBP, DBP, HR, maximum P-wave duration, minimum P-wave duration and P-wave dispersion compared to non-obese and statistical significant (p<0.001) was found.

Discussion

Obesity is defined as a disease process in which excess body fat has accumulated to an extent that health may be adversely affected. According to WHO classification of body mass index (BMI) a person whose BMI is more than or equal to 30 Kg/m2 is obese and when BMI is between 18.5 to 24.99 then the person is considered normal. [17] Obesity is the first wave of a defined cluster of non-communicable diseases called 'New World Syndrome's creating an enormoussocioeconomic and public health burden. [18] It has a strong impact on cardiovascular changes which is manifested in electrocardiogram (ECG). [19] Currently it is a serious public health problem with established cardiovascular co-morbidities and a major cause of sudden death in developed as well as developing countries. [20] According to the National Family Health Survey-4 (NFHS-4) in 2015- 16 conducted by Ministry of Health and Family Welfare (MOHFW) in India, the percentage of men and women aged 15–49 years who are obese are 19% and 21% respectively. [21] In a large prospective study 'Framingham Heart study' there is evidence for inclusion of obesity as a major modifiable cardiovascular risk factor by American Heart Association and also sudden cardiac death has been reported 40 times higher in obese men and women. [22]

There was no significant difference in age, sex and height between obese and non –obese group but a significant difference were found in weight and BMI between groups. Obese group had higher SBP, DBP, HR, maximum P-wave duration, minimum P-wave duration and P-wave dispersion compared to non-obese and statistical significant (p<0.001) was found. 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. [23] Some studies have shown that BMI is one of the most powerful determinants of left atrial size. [23,24]

Left atrial enlargement leads to atrial fibrillation which contributes to increase in the P wave duration. In obese individuals, left atrial enlargement and electrical instability may be caused by elevated plasma volume, ventricular diastolic dysfunction and enhanced neurohormonal activity. In addition, the autonomic control of the heart is abnormal in obese subjects due to prevalence of sympathetic over parasympathetic limb of the autonomic balance. This affects intraatrial and interatrial conduction times and leaves them prone to develop atrial arrhythmias, such as atrial fibrillation. Duru and his colleagues noted that P wave duration and dispersion significantly decreased after substantial (10%) weight loss and the decrease in the level of P wave dispersion clearly correlated with the percentage of weight loss. [25]

Conclusion

Obesity leads to significant increase in systolic blood pressure, diastolic blood pressure and heart rate, thus increasing the risk of coronary heart disease and hypertension in these subjects. Prolongation of the P-wave duration increases the possibility of left atrial enlargement and atrial fibrillation. Thus, it can be concluded that apparently healthy obese individuals may have higher anthropometric values and abnormal P–wave findings. Hence the present study gives an insight on the variations in P-wave in healthy adults who are obese and thereby helps in creating awareness so that; they can change their lifestyle in order to prevent the onset of the deleterious effects of obesity on their health.

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