Evaluation of E: I Ratio and Electrocardiographic Changes during Breath Holding in Overweight Young Males

Pramod Kumar Porwal[1], Shashi Pandey[2], Pradeep Kumar[3]

[1]Assistant Professor, Department of Physiology, TSM Medical College Amausi, Lucknow, India, [2]Professor, Department of Physiology, TSM Medical College Amausi, Lucknow, India, [3]Professor, Department of Physiology, King George's Medical University, Lucknow, India

Abstract

Background: It is well established fact that the obesity is one of the crucial risk factors for many diseases. The cause of obesity in Indian adolescent and young adults is intake of excessive calories and sedentary life style. The majority of studies revealed that obesity might be responsible for derangements in the balance between sympathetic and parasympathetic out flow. QT prolongation has been reported more than 28 percent of obese persons. Therefore in present study we examined the changes in QTc after stimulation of vagus nerve through breath holding.

Methods: This study was conducted on 76 volunteers including normal weight male subjects (Control group) and overweight /obese subjects (study group). . Participants were kept in lying position and ECG was recorded in three stages: (1) Rest state, (2) Breath - Holding state, (3) After breath holding state. E: I ratio was calculated as per standard protocol.

Results: During breath holding, the heart rate decreases significantly ($P < 0.01$) in both the groups, the alteration in QRS complex and QTc was also observed but difference in decrease in these parameters was not statistically significant between two groups. E: I ratio was with in normal limits.

Conclusion: Data from our study showed no significant change in parasympathetic arm of autonomic nervous system. Further studies with large sample size are needed to support this elucidation.

***Key words:** Overweight, Breath Holding, Electrocardiogram, Parasympathetic*

Introduction

Obesity, a complex physiological disorder, is result of multiple interactions of genetic and environmental factors .[1] Rapid increase in obesity prevalence among adolescent and middle age group is major societal and health problem in developed and developing countries including India .[2] It is well established that obesity is risk factor for diabetes, cardiovascular and other non communicable diseases .[3] The basic cause of obesity in Indian adolescent and young adults is intake of excessive calories in form of junk food and carbonated drinks, sedentary life style due to various factors including unlimited use of mobile and decreased interest in outdoor games resulting in less physical activity which may accompanied by neuronal and muscular disorders.[4] In general, the increasing numbers of early age obesity is alarming and concerning, as obese children are more likely to become obese adults and likely to increase their risk of developing obesity related diseases .[5] A number of studies have been carried out to evaluate the effect of obesity on autonomic and cardiovascular modulation in adolescent and children. The majority of these studies revealed that obesity might be responsible for derangements in the balance between sympathetic and parasympathetic out flow in obese children .[6-9] Basic path physiology behind the development of cardiac malfunctions in obesity is that in obesity, the amounts of adipose tissue increases and subsequently increase oxygen and blood flow demand. Therefore, the total work done per unit of time by heart increases and subsequently ventricular hypertrophy takes place which in turn leads

to difficulty in contraction and relaxation during each cardiac cycle. These alterations in the myocardial morphology due to obesity could be the triggering factor to the impairment of cardiac autonomic modulation.[10] It is now established that decrease in the parasympathetic activity responsible for the morbidity of cardiovascular diseases CVD and mortality.[11] Prolonged QT interval considered as one of the important electrocardiographic abnormality detected in obese subjects. Mild QT prolongation has been reported more than 28 percent of obese persons .[12] Rate corrected QT interval referred as QTc is more sensitive parameter for detection of myocardial repolarization state. Repolarization state of ventricle and heart rate are under the influence of parasympathetic arm of autonomic nerve supply. Early identification of impairment of autonomic function in young obese may be an important tool in the prevention of CVD. Therefore in present study we examined the changes in QTc after stimulation of vagus nerve through breath holding.

Material and Method

The present case-control study was conducted in the Department of Physiology of TS Mishra Medical College and Hospital Lucknow. India from April 2019 to June 2019. Informed consent was obtained for every participant before recruitment into the investigation. This study was conducted on 76 volunteers including 42 non obese male subjects (Control group) and 34 overweight /obese subjects (study group). Subjects of both the groups were age matched and were between ages of 19 to 24 years. The subjects with BMI less than 25 were considered as control group (n=24) and subjects with BMI[13] more than 25 were kept in study group (overweight) (n=24). Subjects with any congenital heart disease, any CNS abnormalities, or any endocrine disorder which can influence the autonomic functions were excluded from the study. The volunteers using nicotine in any form, alcohol consumer and taking any medication were also excluded from the study.

Breath-Holding:

The volunteers for the study were allowed to calm down to avoid stress effects, they were assured that the breath holding procedure is non invasive and harmless to normal physiology of human body. All the steps of the study protocol were explained briefly to each participant. Subjects were excluded who did not able to perform study protocol. The subjects with any conductive abnormality in their ECG, difficulty in breathing and breath holding were also excluded. Participants were kept in lying position and ECG was recorded in three stages: 1- Rest state, in which the subjects were advised to exhale and inhale normally; 2- Breath holding state, in which they were instructed to inhale maximally and hold the breath as long as he can; 3-After breath holding state, in this state the subjects were instructed to release breath holding and start normal inspiration and expiration. For each subject twelve lead ECG was recorded, the heart rate, RR interval, duration of the QRS complex , QT interval were recorded and the rate corrected QT interval (QTc) was calculated using Bazett's formula[14] (QTc=QT/square root of RR interval in s. The differences between the durations of the individual waves from the rest, breath holding and after breath holding ECGs were analyzed and are represented using descriptive summary statistics.

Electrocardiographic recording

Placement of electrodes: Optimum part above the umbilical was exposed to place chest electrodes. Electrolyte gel was applied on the skin (contact points). Four standard lead electrodes were placed on four limbs of subjects while V1 was placed in the fourth right intercostal space adjacent to the sternum. V2 was placed in the left fourth intercostal space next to the sternum. V3 electrode was placed between V2 and V4. V4 was placed on the mid-clavicle line in the fifth left intercostals space. V5 was placed in the anterior axillary line and V6 was placed in the mid-axillary line, left horizontal from V4. The ECG was recorded using an automated ECG recorder and analysis system (CARDIART6108 ECG Machine, BPL, India)

Measurement of various durations and interval:

QRS complex represents the depolarization of ventricle starts from beginning of Q wave to end of R wave. QT intervals represents the repolarization, were measured from the onset of the Q wave to the end of the T wave. The end of the QT interval was defined as the intersection of a tangent to the steepest down slope of the dominant repolarization wave with the isoelectric line. For measuring QTc, the QT interval was corrected for heart rate using Bazett's formula (QTc=QT/square

root of RR interval in s).

Statistical Analysis

The data are represented as mean with standard deviation; the statistical significance of various values are calculated by using online software (Quick cal Graph pad).p value less than 0.05 considered as statistically significant.

Observation and Results

The mean age of normal healthy subjects (control group) was 19.85 ± 3.21 years and of overweight (study group) was 19.96 ± 2.72 years. There was no significant difference in age was observed between the study group and control group (*P* = 0.87). In our study, it is observed that the mean BMI of the study group (27.72 ± 3.29) was significantly higher (*P* < 0.001) than the control group (22.45 ± 2.05). According to the WHO guidelines the study group was in overweight category and control group was in normal range category[13]. Baseline and anthropometric parameters including age, height and weight of study subjects (control and overweight) are shown in (Table 1). There was no significant difference (*P* >0.01) in resting HR (bpm), QRS complex duration, QT and QTc of study group and control group. The E: I ratios of overweight subjects (1.36 ± 0.15) and control subjects (1.35 ± 0.17) were within the normal range (>1.2) and the difference between the two groups was not statistically significant (*P* = 0.785) (Table 1). During breath holding, the heart rate decreases significantly (*P* < 0.01) in both the groups, the alteration in QRS complex and QTc was also observed but difference in decrease in these parameters was not statistically significant between two groups (Table-2). No significant differences in any parameters were observed in both the groups after relaxation from breath holding procedure (Table-3).

Table -1: Baseline (at rest) parameters:

Parameters	Control	Overweight	P value
Age (in years)	19.85 ±3.21	19.96 ± 2.72	0.87
Height (cm)	170.71±7.56	168.76±4.71	0.1915
Weight (kg)	65.67±8.09	79.01±11.33	0.001
BMI(kg/m^2)	22.45±2.05	27.72±3.29	0.001
Heart rate (bpm)	80.02±11.98	80.50±13.35	0.8704
RR interval (ms)	0.7760±0.138	0.765± 0.1281	0.7393
E:I ratio	1.35 ± 0.17	1.36 ± 0.15	0.785
QRS duration (ms)	82.95±11.67	79.50±7.99	0.1463
QT interval(ms)	338.24±21.32	337.03±23.05	0.8133
QTc (ms)	388.64±16.25	388.18±17.21	0.8712

Table -2: Parameters during breath holding:

Parameters	Control	Overweight	P value
Heart rate (bpm)	75.93 ± 12.15	74.74±11.58	0.665
RR interval (ms)	0.8101 ± 0.134	0.82274, 0.1344	0.865
QRS duration (ms)	82.95 ± 11.58	80.62 ± 7.45	0.3125
QT interval (ms)	346.60 ± 23.15	345.76 ± 23.83	0.8784
QTc (ms)	388.16 ± 17,16	384.41 ± 21.40	0.4076

Table -3: Parameters after breath holding:

Parameters	Control	Overweight	P value
Heart rate (bpm)	78.31 ± 10.28	77.41±10.86	0.7312
RR interval	0.7610 ± 0.1511	0.7908 ± 0.1172	0.3485
QRS duration (ms)	81.55 ± 10.60	81.29 ± 7.47	0.9066
QT interval (ms)	344.00 ± 21,81	345.32 ± 19.19	0.7823
QTc (ms)	391.40 ± 17.36	391.65 ± 14.55	0.9484

Discussion

The results of our cross sectional study revealed that there was significant difference in resting heart rate verses heart rate during breath holding state in control and study subjects, the amount in decrease in heart rate in both the group was almost identical. Previous studies showed that this decrease in heart rate is physiological. Breath holding induces an increase in arterial tension and reduction in cardiac output.[15] The increase in arterial tension stimulates the circulatory baroreceptors and provokes bradycardia. On the basis of our results it can be stated that the parasympathetic activity of overweight participants was not affected. However, decreased in sympathetic activity is likely to occur in overweight participants as reported in various studies. Çolak *et al*[16] claimed the normal activity of parasympathetic system and hypoactivity of sympathetic nervous system in obese participants. Bedi *et al*[17] and Pal *et al*[18] also have reported similar results. The sympathetic and parasympathetic arms of autonomic nervous system are responsible for changes in electrocardiographic changes including QRS, QT and QTc during cardiac cycle.[19] Our study data revealed that there were no significant changes in electrocardiographic parameters hence no alteration in autonomic activity in control as well as overweight subjects. Shkul et al[20] claimed that there are various chemical changes occur in the blood but its effects on ECG parameters are not evident in our study.

Conclusion

Current reviews of literature suggest that the childhood obesity is associated with impairment of autonomic functions including sympathetic overflow and reduced parasympathetic modulation. However, data from our study showed no significant change in parasympathetic arm of autonomic nervous system. Further studies with large sample size are needed to support this elucidation. Still it is suggest that the implementation of long-term regular programs to regulate well-balanced diet that can help obese children reduce their weight, reduce the risk

of future cardiovascular diseases in adulthood.

This study conducted after taking the informed consent from participants as per latest ethical guidelines.

In our Study the procedures were non invasive.

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Conflict of Interest - Nil

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