Original Research Article

A Hospital Based Prospective Study to Evaluate the Parasympathetic and Sympathetic Activity in Obese Patients and Compare to Age Matched Control Subjects

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Abstract

Background: Human beings have an Autonomic Nervous System (ANS) which is a system of automatic control of the body's senses and controls that perform all the backward functions that keep the body working. The present study is designed to evaluate low parasympathetic and sensitivity function in obese patients and compare age-related control subjects.**Materials & Methods:** A hospital based prospective study conducted in 100 subjects in department of physiology, LLRM Medical College, Meerut, U.P. Sixty obese subjects of both genders between age group 18-25 years with BMI >25 kg/m^2 were selected for the study. The results were compared with sixty age-matched non-obese controls with BMI <25 kg/m^2. The parasympathetic and sympathetic activity was done by various tests. The quantitative data was expressed as Mean ± S.D. and the student's paired 't' test was used to compare the differences between the respective means.**Results:** The present study showed that mean age of obese patients was 34.28±6.23 yrs and 33.52±5.37 yrs in control group. The mean value of BMI was 29.67±2.12 kg/m2 in group I and 21.45±1.66 kg/m2 in group II. The significant decrease in the Heart rate response to standing (30:15 ratio), Valsalva ratio, S:L ratio & Heart rate response to deep breathing (HRDB) in Group I individuals as compared to Group II ($p<0.05$). The significant decrease in the systolic and diastolic blood pressure in obese subjects (group I) as compared to controls (group II) during the application of isometric handgrip exercise and cold pressor tests ($p<0.05$).**Conclusion:** Obesity is associated with dysfunction of the sympathetic and parasympathetic nervous system which can lead to various heart problems. Weight loss and healthy living are recommended in the articles to prevent future problems.

Keywords: Obesity, Parasympathetic Activity, Sympathetic Activity, BMI.

Introduction

The burden of overweight and obese is one of the world's major health problems and is the 5th leading cause of death in the world. It is also estimated that by the year 2030, about 57.8% (3.3 billion) of adults worldwide will be overweight or obese with higher in developing countries than in developed countries[1].

Obesity is a common and important health risk[2]. At the individual level, excessive and insufficient energy use is used to describe many obesity conditions[3,4].Obesity is considered a risk factor for various cardiovascular conditions such as high blood pressure, coronary heart disease and stroke and is characterized by hemodynamic and metabolic changes[5].Complex communication between various factors such as endocrine, nervous, vascular features maintains consistent energy retention[6].Obesity and its early problems (i.e. insulin resistance and non-fasting glucose fasting) are associated with a dramatic increase in the sensory system sensitivity (SNS) and a decrease in the tone of the parasympathetic nervous system (PNS)[7].The autonomic nervous system is the center for the coordination of a different body system[8].Since the ANS is involved in energy efficiency and the regulation of the cardiovascular system[9-11], it is thought that one or more groups of people with idiopathic obesity may switch to their autonomic nervous system that could cause side effects in many obesity clinics[8].

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Human beings have an Autonomic Nervous System (ANS) which is a system of automatic control of the body's senses and controls that perform all the backward functions that keep the body working. The ANS consists of three different subsystems, the Parasympathetic Nervous System, the sympathetic Nervous System and the enteric nervous system[9,10].

The Parasympathetic Nervous System is responsible for many of our relaxation activities such as reducing heart rate, increasing digestive and glandular function and stimulating sex, the Sympathetic Nervous System is mainly associated with hormonal and neurotransmitters-related changes in "flight or fight" responses.

Young and Macdonald[12] found that there were several studies that suggested that the Sympathetic nervous system (SNS) in obese subjects be low, normal, or high. The variability of the results is most likely due to the imbalance of the method used (in particular, venous or urinary norepinephrine concentrations) and due to the fact that SNS activity is usually regionalized, where total discharge throughout the body is uneven. The present study is designed to evaluate low parasympathetic and sensitivity function in obese patients and compare age-related control subjects.

Materials &Methods

A hospital based prospective study conducted in 100 subjects in department of physiology, LLRM Medical College, Meerut, U.P. Sixty obese subjects of both genders between age group 18-25 years with BMI >25 kg/m^2 were selected for the study. The results were

compared with sixty age-matched non-obese controls with BMI <25 kg/m^2.

Exclusion criteria

1. Hypertensive subjects
2. Diabetic subjects
3. Any history of chronic illness

Methods

The BMI was calculated as the weight in kilograms divided by the square of the height in meters [weight (kg) /height (m^2)][13]

For Assessing Parasympathetic Activity[14]:

1. Resting heart rate was calculated from ECG by using standard limb leads.
2. Heart rate response to standing (30:15 ratio) was calculated as the ratio between the R-R interval at beats 30 and 15 of the ECG recorded immediately upon standing.
3. The S:L (standing to lying) ratio was taken as the ratio of the longest R-R interval during the 5 beats before lying down to the shortest R-R interval during the 10 beats in the ECG after lying down.
4. The Valsalva ratio. Subjects were instructed to exhale into a mouthpiece connected to a mercury manometer and to maintain the expiratory pressure of 40 mmHg for 15 Sec. ECG was recorded during the manoeuvre and 45 sec after the manoeuvre. The ratio was calculated between the maximum R-R interval (after release of strain) and the minimum R-R interval (during strain).
5. Heart rate response to deep breathing: Heart rate was recorded first during normal. Breathing (at rest), and then during deep breathing (6/min). ECG 3rd & 6th respiration, minimum R-R intervals and corresponding heart rate were calculated.

For Assessing Sympathetic Activity

1. Lying to standing test (LST)

The subjects were asked to stand upright quickly from the supine position and to remain standing free continuously for 2.5 min. During this assessment the heart rate and blood pressure were measured before standing, and within 30 sec, 1 min, and 2.5 min of standing.

2. Cold pressor test (CPT)

The subjects were directed to immerse his hand (upto the wrist) in ice cold water (water temperature 10C) for 1 min. The blood pressure and heart rate were monitored before immersion of the hand at 1 min, and 2.5 min. The cold pressor test-diastolic blood pressure is the diastolic blood pressure at the end of the 1-min immersion of hand in the 10ºC water minus the DBP just before the beginning of the cold pressor test.

3. Isometric handgrip test (HGT)

The subjects were asked to maintain handgrip at 30% of the maximum voluntary contraction (MVC) for 4 minute utilizing a handgrip dynamometer. Blood pressure and heart rate were measured before test, at 1 min, 2 min, 4 min, and 6 min during the handgrip test. The isometric handgrip Δ DBP is the maximum DBP during the 4-min handgrip test minus the DBP just before commencing the handgrip test.

Analysis of Observations

The quantitative data was expressed as Mean ± S.D. and the student's paired 't' test was used to compare the differences between the respective means. All p values were 2 tailed, p value of <0.05 was considered significant.

Results

The present study showed that mean age of obese patients was 34.28±6.23 yrs and 33.52±5.37 yrs in control group. The mean value of BMI was 29.67±2.12 kg/m^2 in group I and 21.45±1.66 kg/m^2 in group II (Table 1).

Our study showed that there was significant decrease in the Heart rate response to standing (30:15 ratio), Valsalva ratio, S:L ratio & Heart rate response to deep breathing (HRDB) in Group I individuals as compared to Group II($p<0.05$) (Table 2).

The significant decrease in the systolic and diastolic blood pressure in obese subjects (group I) as compared to controls (group II) during the application of isometric handgrip exercise and cold pressor tests ($p<0.05$) (Table 3).

Table 1: Anthropometric variables

Variables	Group-I (Obese) N=60	Group II (Control) N=60
Age (yrs)	34.28±6.23	33.52±5.37
BMI (kg/m^2)	29.67±2.12	21.45±1.66

Table 2: Parasympathetic function tests in Group I and Group II

Variables	Group-I (Obese) N=60	Group II (Control) N=60	P-value
Heart rate response to standing (30:15 ratio)	1.05±0.023	1.15±0.13	<0.05
S:L (standing to lying) ratio	1.13±0.032	1.23±0.041	<0.05
Valsalva ratio	1.49±0.13	1.66±0.27	<0.05
Heart rate response to deep breathing (HRDB)	18.23±2.19	22.58±4.17	<0.05

Table 3: Sympathetic function tests in Group I and Group II

Variables	Group-I (Obese) N=60	Group II (Control) N=60	P-value
IHG SBP	8.56±1.31	12.23±1.21	<0.05
IHG DBP	8.42±1.20	12.11±1.39	<0.05
CPT SBP	8.37±1.22	12.46±1.56	<0.05
CPT DBP	9.12±1.39	13.16±1.80	<0.05

Discussion

Obesity is characterized by excessive fat accumulation, a powerful endocrine organ and paracrine that releases excess cytokines and bioactive mediators that can affect the functioning of the sensory system[15].While there is ample evidence that sympathetic activity is seen in obesity, it is important to know that there are many factors that may be involved in the onset of obesity-related sensitivity[16].

It is well established that obesity is one of the major factors in promoting high blood pressure in the general population[17]. Methods that contribute to the development of high blood pressure in obese people include many factors such as hyperinsulinemia, renin-angiotensin-aldosterone production, abnormal levels of certain adipokines such as leptin, and altered spectrum of cytokines in blood vessels[18,19].

Our study showed that there was significant decrease in the Heart rate response to standing (30:15 ratio), Valsalva ratio, S:L ratio & Heart rate response to deep breathing (HRDB) in Group I individuals as compared to Group II($p<0.05$). Resetting baroreceptors is possible in obese people due to atherosclerosis that strengthens the walls of the cinotid sinus. This reduces compliance. The obese group is less responsive to changes in blood pressure. Similar results have been shown by other investigators.

Obese subjects show a low sensitivity response when exposed to cold. Our study results were consistent with the reported study of Monterio et al[20]. It also decreased blood pressure response in isometric exercise tests in obese individuals in contrast to the control group. It shows a decrease in the activity of the sympathetic nervous system [21] or a slight increase in border resistance to activate the sympathetic system. Baek et al[22] states that under normal conditions sensitivity activity increases during isometric handgrip exercise and cold cold machine testing. This reduction in sympathetic repetition in the formation of obesity may be responsible for the maintenance of the obesity status. Valensi et al[6] has shown a lack of empathy for obese people. It has been shown that glucose inhibition of lipid oxidation levels in obese people is greater in patients with autoimmune disorders that may be due to decreased parasympathetic activity. Decreased sensitivity to function may lead to disruption of the homeostatic system and thus promote excessive energy storage as suggested by Peterson[11].

It has been shown that increased sympathetic activity caused by cold water pressure causes the release of norepinephrine and elevated blood pressure in obese subjects.

Conclusion

Obesity is associated with dysfunction of the sympathetic and parasympathetic nervous system which can lead to various heart problems. Weight loss and healthy living are recommended in the articles to prevent future problems.

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