Article

Autonomic Neuropathy in Obesity

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Abstract:

Background: Obesity is one of the health problems and the association of autonomic nerve dysfunction with certain cardiovascular disorders may exist in obese subjects. **Objective:** To observe the status of autonomic nerve function activity in order to detect the presence of autonomic neuropathy in obese persons. **Methods:** This study was conducted in Physiology department of Bangabandhu Sheikh Mujib Medical University during July 2006-June 2007. 40 apparently healthy obese subjects of both sexes with BMI ≥25 were included. Age and sex matched 40 nonobese subjects with BMI range 18.5-22.9 were also included for comparison(control). 5 noninvasive cardiovascular reflexes tests were done and scoring of autonomic neuropathy was also detected. Unpaired Student 't' test was used for statistical analysis. **Results:** Mean values of all cardiovascular reflex tests were significantly lower in obese subjects. Autonomic neuropathy in its early involvement stage was found in 22.5% of the obese subjects. **Conclusion:** The results of this study indicate that autonomic neuropathy though in early stage may be silently present in otherwise healthy obese person.

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Introduction

Obesity is a common and significant health hazard[1]. It is a risk factor for a variety of cardiovascular conditions including hypertension, ischemic heart disease and stroke[2]. Obesity is a condition in which the body fat stores are increased to an extent which impairs health and leads to serous health consequences. Body mass index (BMI) provides the most useful measure of overweight and obesity in adult individuals. The cut off point for overweight (23 to 24.9) and for obese (e"25) are lower for Asians[3] than the WHO standards (overweight and obesity are indicated by BMI ≥25 and e"30 respectively) [3,4.]

A complex interaction among different factors like endocrine, nervous, metabolic factors maintain constant energy storage[5]. Autonomic nervous system is vital for the coordination of different factors[6]. Depression in sympathetic and parasympathetic activity was significantly associated with increasing percentage of body weight[7].

There are various controversial reports on autonomic nervous activity in obese persons. Some report showed hypoactivity of parasympathetic and associated hyperactivity of sympathetic nerve function[8]. Some showed both reduced sympathetic and parasympathetic nerve activity[7,9]. Again, an increased parasympathetic activity with a decreased sympathetic activity had also been reported by a group of investigators but in animal model[6]. Minor impairments of autonomic nervous system were found in obesity, changes in parasympathetic division of autonomic nervous system were found in most cases; which is likely to analogus to the early stages of autonomic neuropathy in diabetes mellitus[10].

Obesity is one of the health problems and is not uncommon in our community. Obesity and its related disorders like cardiovascular and metabolic diseases are gradually increasing day by day both globally and also in developing countries. The probable association of autonomic nerve dysfunction with certain cardiovascular disorders may also exist in obese subjects. To avoid the complications of obesity and also to take effective measures it is necessary to detect autonomic nerve function status.But no such data is yet available on obese people in Bangladesh. Therefore, the present study was to assess the autonomic nerve function status in obese subjects in order to detect presence of impaired autonomic nerve function.

Methods

This observational study was conducted in the department of Physiology of Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh. For this 80 apparently healthy subjects of both sexes in equal number with age range 18-40 years from the different areas of Dhaka city were included.

These subjects were divided into two groups on the basis of their body mass index. Group A consisted of 40 nonobese subjects with BMI between 18.50 - 22.90. Group B consisted of obese subjects with BMI e"25.

The subjects with age >40 years, overweight (BMI 23 - 24.9), diabetes mellitus, chronic renal failure, any obvious cardiovascular diseases, chronic obstructive lung diseases, previous history of head injury and smokers were excluded from this study.

The purpose and outcome of the study were explained to each subject. They were assessed upon their voluntary participation. Written informed consent was obtained from each subject. Detailed medical and family history was recorded in a preformed questionnaire. Thorough clinical examination was done. Height and weight of the subjects were recorded and BMI was calculated. Random blood sample was collected to determine blood glucose and serum creatinine to exclude diabetes mellitus and chronic renal failure. Blood glucose and serum creatinine level were measured by auto analyzer in the hematology laboratory of the Physiology department. Then the resting pulse rate and blood pressure was measured by sphygmomanometer.

Each of the subjects was briefed about the detail of the procedure and encouraged to obtain maximum efficient performance. The subjects were allowed to rest and relax for at least 10 minutes upon arrival. Before the performance of the tests, all the subjects were at rest in supine position for a minimum of 10 minutes. Some cardiovascular reflex tests such as heart rate response to valsalva maneuver, heart rate response to deep breathing, heart rate response to standing, blood pressure response to sustained handgrip and blood pressure response to standing were used to assess autonomic nerve function[10]. All these reflex tests are able to diagnose the autonomic nerve function damage caused by various factors**.**

Analysis of the data was done by using SPSS program version-12. All the parametric variables were expressed as mean ± SD (Standard deviation). The comparison between the groups were calculated by unpaired Student's 't' test and the relationship of BMI with the parameters were evaluated by using Pearson's correlation-coefficient test. P value <0.05 was accepted as significant.

Autonomic nerve function scoring system[10]

According to the severity of damage, autonomic neuropathy can be classified into five groups.

- **Normal:** all five tests normal or one borderline.
- **Early involvement:** one of the three heart rate tests abnormal or two border line.
- **Definite involvement:** Two or more of the heart rate tests abnormal.

- **Severe involvement:** Two or more of the heart rate tests abnormal plus one or both of the blood pressure tests abnormal or both borderlines.
- **Atypical pattern:** Any other combination of abnormal test.

Results

All the autonomic nerve function parameters were significantly lower in obese subjects (Table I).No subjects in the control group had abnormal autonomic nerve function but 22.5% obese objects had early involvement of autonomic neuropathy as they had several abnormal reflex test. No obese subjects had definitive or severe involvement (Table II).

Again, in this study, early involvement of autonomic neuropathy was found in 17% of the obese subjects within BMI range 26-28.9, in 33% within BMI range 29-31.9 and in 50% within BMI range 32-34.9. (Figure 1).

Table I: Autonomic nerve function parameters in the study groups (n=80)

Parameters	Group-A n=40	Group-B n=40
Valsalva ratio	1.67±0.31 (1.21-2.34)	1.47±0.24** (1.07-1.98)
Heart rate response to deep breathing (beats/min)	27.57±6.51 (16.18-39.83)	19.62±5.55*** (9.28-31.89)
Heart rate response to standing (30th:15th ratio)	1.13±0.08 (1.04-1.34)	1.07±0.07** (0.9-1.25)
BP response to sutained handgrip	20.7?3.58	18.60?3.17*
BP response to standing from lying	4.32±2.05 (0-8)	5.65±2.25* (2-10)

Values are expressed as mean±SD
Group A : Nonobese subjects having BMI between 18.50 to 22.90
Group B : Obese subjects having BMI: ³25
Values in parenthesis indicate range.
* = significant at <0.05 level.
**=significant at <0.01 level.
*** = significant at <0.001 level.

Table II : Distrbution of the subjects by autonomic nerve function scoring in the study groups (n=80)

Autonomic nerve function	Group-A (n=40)		Group-B (n=40)	
	No.	%	No.	%
Normal	40	(100)	31	(77.5)
Early involvement	0		9	(22.5)
Definite involvement		0	0	
Severe involvement		0	0	
Total autonomic nerve function involvement in the individual group	0	9	(22.5)	

Group A : Nonobese subjects having BMI between18.50 to 22.90
Group B : Obese subjects having BMI ≤ 25

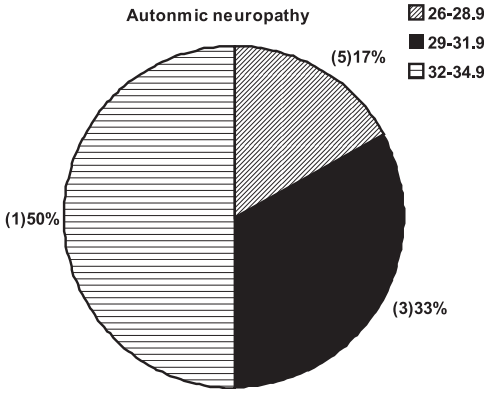

Figure 1: Distribution of the obese subjects in different ranges of BMI by early involvement of autonomic neuropathy

Discussion

In this study, significantly lower values of valsalva ratio, H.R response to deep breathing and H.R response to standing (30^{th}:15^{th} ratio) in obese subjects indicate that decrease in parasympathetic nerve function and also baroreflex sensitivity was found in obesity. Similar observation was also made by some other investigators[11-13]. On the other hand, decrease

in sympathetic nerve function as observed for lesser rise of diastolic by handgrip test with a greater fall of systolic blood pressure in response to standing in the obese subjects. These findings are consistent with some other investigators,[5,14,15]. Again, presence of autonomic nerve dysfunction at their early involvement in considerable percentage (22.5%) of obese person was detected by autonomic nerve function scoring in this study. Ewing et al. found autonomic neuropathy in 61% of diabetic patients of them 15% were in early involvement stage.[16] These results suggest that impairment of autonomic nerve may be present in otherwise healthy obese. The exact mechanism for the impairment of autonomic nerve function in obese person can not be elucidated from this type of study. According to the suggestions made by different investigators, parasympathetic damage or decreased vagal tone may occur due to hyperinsulinaemia or insulin resistance or there may be decreased baroreflex activity and decreased sympathetic activity due to defect in sympathetic nerve activation or in peripheral adrenoceptors.. However, it was not possible to comment on all these factors as none of these were studied in this work.

On the basis of autonomic nerve function scoring, presence of normal autonomic nerve function in majority (77.5%) of the obese subjects of the present study suggests that impairment of autonomic nerve function is not a constant finding in obesity. Again, there may be some other associated factors like degree and duration of obesity, eating behavior of food etc. that may have some role in occurrence of autonomic neuropathy in obese subjects. Only early involvement (22.5%) in a few but significant numbers of obese subjects and absence of definite and severe involvement may also support the association of these factors.

Conclusion

From this study, it can be concluded that autonomic neuropathy can occur in otherwise healthy obese person.

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