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Original Research Article

Effect of Posture on Heart Rate Variability in Obese Young Adults

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ABSTRACT

Background &Aims: Sudden cardiac death is a main cause of cardiovascular mortality. Obesity related impairment of the autonomic function may exist even at a young age and progress asymptomatically for decades before clinical manifestations appear. One simple non-invasive method to evaluate the cardiac autonomic status is HRV (Heart Rate Variability), which is a variation in cardiac cycle length. Low HRV is associated with an increased risk of CHD (Coronary heart Diseases). In frequency domain analysis, HF (High Frequency) component is a marker of vagal activity; LF (Low Frequency) component denotes sympathetic modulation while LF/HF ratio mirrors sympatho-vagal balance.
Change of posture is an important challenge to the ANS(Autonomic Nervous System) and studies have reported a sympathetic preponderance in standing position, but the effect of standing in obese individuals compared to normal have not been well studied.
This study was taken up to measure HRV indices in healthy obese individuals in supine and standing position and compare the values with non-obese individuals.
Materials &Methods: 33 obese (BMI≥25) and 20 non-obese subjects (BMI <25) were taken for HRV recording both in supine and standing position. Differences between HRV indices in both postures were determined by the paired "t" test. Comparison of HRV indices of both groups were done by independent sample "t" test, p Value < 0.05 was taken to be statistically significant.
Results: Highly significant changes of HRV parameters have been observed in obese subjects on standing compared to the non-obese subjects.
Conclusion: The findings of HRV suggest that in obese individuals balance between sympathetic and parasympathetic system was impaired and vagal activation was decreased in the standing position demonstrating that autonomic dysfunction is present even in asymptomatic obese individuals.

Keywords: frequency domain analysis, HRV, obesity, posture.

INTRODUCTION

Obesity as per WHO (World Health Organisation) is defined as excessive or abnormal deposition of fat in the body to the extent that health is impaired. [(1)] It is a serious health issue in developing countries like India and it is affecting all sections of the population. [(2)] Obese individuals have higher prevalence of many diseases like coronary heart disease, hypertension, hyperlipidemia and diabetes mellitus. Sudden cardiac death is a main cause of cardiovascular mortality. Obesity related impairment of the cardiovascular function

may exist even at a young age and progress asymptomatically for decades before clinical manifestations appear. Studies have proposed that obesity is related with autonomic dysfunction. [3] ANS (autonomic nervous system) maintains a delicate balance between stimulation and inhibition of the efferent control of the organ systems of the body.

One simple non-invasive method to evaluate the cardiac autonomic status is Heart Rate Variability (HRV), which is a variation in cardiac cycle length. [4] In frequency domain analysis, low HRV is associated with an increased risk of CHD (coronary heart disease). [5,6] HF (High Frequency) component at 0.15 - 0.4 Hz is a marker of vagal activity while LF (Low Frequency) component at 0.04 - 0.15 Hz denotes sympathetic modulation. [4-6] LF/HF ratio mirrors sympatho-vagal balance. [7,8] Obesity in general is more associated with reduction in HRV reflecting a higher sympathetic tone, but different studies have revealed conflicting results including high [9,10] and low sympathetic tones [11] coupled with reduction of vagal tone. The BMI (Body Mass Index) is an accepted index for human body fat based on an individual's height and weight. [12]

Change of posture is an important challenge to the ANS and studies have reported a sympathetic preponderance in standing position in healthy adults, [13] but the effect of standing in obese individuals compared to normal have not been well studied specially in the Indian population. Benefits can be gained from the position which can produce greatest vagal activity and/or least sympathetic activity. Such posture can be used as an effective physiological vagal enhancer in normal subjects.

With this background in view, this study was taken up to study the frequency domain analysis of HRV in healthy obese individuals in supine and standing position and compare the values with non obese individuals. Our aim was to detect the early changes in autonomic function in obese, which could lead to early intervention and lifestyle changes to prevent obesity related complications.

MATERIALS & METHODS

Study design and subjects: This was a cross-sectional analytical study. Cases were obese (BMI≥25) and otherwise normal individual in either sex aged between 19 to 25 years chosen randomly for HRV recording both in supine and standing position. Control group subjects were age and sex matched non-obese (BMI<25) and otherwise normal. Exclusion criteria included individuals having diabetes, hypertensive, history of coronary artery disease or any other heart disease, dyslipidemia, known chronic illness and taking any medication. There were 33 cases and 20 control subjects. All the subjects had given informed consent and the study had been approved by Institutional Ethics Committee.

HRV measurement: Subjects were asked to come in the morning at 10:00 am after proper night sleep and no hard work or exercise on the day of examination. The HRV was recorded in supine and standing position. In each posture HRV was recorded for 6 minutes with a period of rest of 10 minutes in between. HRV was measured with digital ECG machine recorder (POLYGRAPH 4 Channel) with sampling frequency of 256 Hz and all relevant parameter in the Frequency Domain obtained and tabulated.

Statistical analysis: Data analysis was done using statistical package SPSS (IBM SPS Package 20).Values were expressed in mean ±SD. All data were normally distributed (SHAPIRO-WILK TEST) and parametric analysis were done. Differences between

HRV Indices in supine and standing positions for both obese and non-obese were determined by the paired "t" test. Comparison of HRV Indices of obese and non-obese in supine as well as standing position by independent sample "t" test done, p Value < 0.05 was taken to be statistically significant.

RESULT AND ANALYSIS

Table 1: HRV parameters in different posture in obese (BMI ≥25)

HRV PARAMETERS	SUPINE POSTURE N=33	Standing Posture N=33	p-value
LF (nu)	55.91 ± 16.12	75.82 ± 53.63	0.051
HF(nu)	43.81 ± 16.10	32.45 ± 10.24	0.001
LF/HF	01.62 ± 01.03	02.33 ± 0 .91	0.002

Table 1 showed a significant (p value = 0.05) increase in LF (nu) and a highly significant (p value <0.005) decrease in the standing position when compared to supine posture in obese individuals. LF/HF was also highly significantly (p value < 0.005) increased in standing position showing a sympathetic preponderance.

Table 2 HRV parameters in different posture in non-obese (BMI<25)

HRV PARAMETERS	SUPINE POSTURE N=20	STANDING POSTURE N=20	P VALUE
LF (nu)	58.14± 18.56	61.55 ± 19.13	0.247
HF(nu)	38.25± 17.57	34.56 ± 16.98	0.209
LF/HF	01.90± 0.98	02.21 ± 1.09	0.106

In Table 2, there was an increase in LF and slight decrease in HF in standing position when compared to supine position in non-obese individuals but none were statistically significant. So, it reflects a normal autonomic response.

Table 3 HRV parameters in supine posture in obese and non-obese

HRV PARAMETERS	OBESE N=33	NON OBESE N=20	P VALUE
LF(nu)	55.91± 15.87	58.14± 18.09	0.501
HF(nu)	43.81± 15.85	38.25± 17.13	0.680
LF/HF	01.62± 1.02	01.90± 0.95	0.779

Table 3 shows that there is an increased LF and also slight decreased HF in non-obese when compared to obese in supine position. But these changes are not significant statistically.

Table 4 HRV parameters in standing posture in obese and non-obese

HRV PARAMETERS	OBESE N=33	NON OBESE N=20	P VALUE
LF(nu)	75.82± 52.81	61.55± 18.64	0.000
HF(nu)	32.45± 10.09	34.56± 16.55	0.013
LF/HF	02.33± 0.90	02.21± 01.06	0.406

Table 4 demonstrates that there is a highly significant (p value = 0.000) increase in LF (nu) component accompanied by a significant (p value <0.05) decrease in the HF (nu) component in the standing position in obese group compared to normal.

DISCUSSION

The obesity epidemic is having a negative impact by increasing the risk of developing insulin resistance, diabetes mellitus, cardiovascular diseases and other systemic diseases. Studies suggest that obesity is associated with cardiac autonomic dysfunction. [(14)] HRV is widely used as a non-invasive tool that shows the balance of the cardiovascular system controlled by the sympathetic and parasympathetic divisions of the ANS.

Our study population comprised of young adults who were not suffering from any obvious disease and they were divided into two groups according to their BMI. In this study we could not demonstrate any significant difference in the LF, HF, LF/HF components between the obese and non-obese group in the supine position. This could be due to the fact that cardiac autonomic neuropathy remains subclinical at the early stage of obesity. In the erect posture, the obese group showed a highly significant increase in LF (nu) and a significant decrease in HF (nu) components when compared to non-obese. This can be

attributed to an increased sympathetic drive along with a reduced parasympathetic activity resulting in an inability to cope up with the physiological challenge of standing. In the non obese group, on standing from the supine posture showed an increase in the LF (nu) component and a decrease in the HF (nu) component but none were statistically significant showing that a mild sympathetic preponderance occurs normally due to posture. But we found a significant increase in the LF component along with a highly significant decrease in the HF component in the standing position compared to supine in the obese group showing a sympathetic overdrive and a parasympathetic withdrawal.

Pushpa Krishna et al [(15)] in 2013 showed that overweight young adults have an increased LF but no significant decrease in HF compared to normal suggesting sympatho-vagal imbalance. A large population based study by WHO [(16)] in 2008 has revealed no difference in LF in obese but they showed a reduced HF and an increased LF/HF compared to normal. Yeragani [(17)] studied HRV in relation to postural challenge in the age group of 4-40 years and showed that children had higher supine LF and HF along with a low HF on standing compared to adults suggesting a decrease of cholinergic and an increase in adrenergic modulation of Heart Rate variability with age. Srinivasan K [(18)] in 2002 observed an attenuated response in LF and HF power to standing in elderly as compared to young adults and children. Vuksanovic [(13)] in 2005 studied the effect of posture on HRV spectral measures in children and young adults with heart disease and they have observed a decrease in HF power on standing.

Our study demonstrates that in obese individuals balance between sympathetic and parasympathetic system was impaired and vagal activation was decreased in the standing position resulting in a decreased ability to cope with the physiological challenge of standing. So it can be concluded that autonomic dysfunction is present in asymptomatic obese individuals. Cardiac Autonomic Neuropathy remains subclinical and undetected during the early stages of obesity but accounts for high rates of morbidity and mortality in the later years. As obesity predisposes to many cardiovascular diseases and metabolic diseases, so a short term HRV test could be used as a screening tool for early detection of cardiac autonomic dysfunction.

Limitation of this study is that visceral obesity has not been accounted for .There is no adequate information in the literature about the effect of posture on HRV in obese young adults and so this study could act as a torch bearer and further studies in large and overweight population are required to validate these inferences.

CONCLUSION

The findings of HRV suggest that in obese individuals balance between sympathetic and parasympathetic system was impaired and vagal activation was decreased in the standing position resulting in a decreased ability to cope with the physiological challenge of standing. So this study demonstrates that autonomic dysfunction is present in asymptomatic obese individuals. As obesity predisposes to many cardiovascular diseases and metabolic diseases, so a short term HRV test could be used as a screening tool for early detection of cardiac autonomic dysfunction.

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