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RESEARCH ARTICLE

FREQUENCY DOMAIN ANALYSIS OF HEART RATE VARIABILITY IN PREPRANDIAL AND POST PRANDIAL STATE BETWEEN OBESE AND NON OBESE YOUNG WOMEN – A COMPARATIVE STUDY.

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Key words:-
Heart rate variability, obese women.

Abstract

Background: In obesity, as excessive tissue accumulates, an altered metabolic profile occurs along with a variety of adaptations/ alterations in the cardiac structure and functions even in the absence of co morbidities. **Aim&Objectives**: To compare the Heart rate variability analysis between the pre-prandial and postprandial state in obese and non obese young healthy females. **Materials & Methodology**: 50 obese and 50 non obese young healthy females aged between 21-25 years were selected based on body mass index. Heart rate variability was recorded in both pre and postprandial state by using computer based software device, Digital finger pulse photo plethysmography (DFP) to identify separate frequency components, i.e, total power, low frequency power and high frequency power. **Results**: All the statistical methods were carried out through the SPSS for windows version 16.0 .The independent samples T test procedure was done to compare the means for the two groups. P value ≤ 0.05 was considered statistically significant. HRV analysis found significantly lower values of LF, HF in millisecond square ($ms^{2)}$ and HF in normalized unit (nu) & higher values of LF (nu) and LF/HF ratio among the obese group in both pre and post prandial state when compared to non-obese group. **Conclusion**: Our data indicate that obese subjects have decreased parasympathetic activity as evidenced by decrease in Total Power(TP)(ms^2), Low Frequency(LF)(ms^2), High Frequency(HF)(ms^2) and High Frequency(nu) and increase in sympathetic activity as evidenced by increase in HR, LF(nu) and LF/HF ratio in both pre and post prandial state.

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Introduction:-

Obesity is an emerging global health problem[1-4]. Nutritional problem in India is gradually shifting from undernourishment to obesity[5]. It is a disease, which has evolved with the advent of civilization, sedentary lifestyle and high calorie diet. Obesity is one of the causative factors for multiple co-morbid conditions leading to metabolic and cardiac disorders[6]. The incidence of overweight and obesity are increasing around the world especially in young adults and middle-aged people. There are increased chances of acquiring endocrinal diseases, genetic and metabolic disorders[7]. Obesity is one of the risk factors attributed for the development of lipid abnormalities, insulin

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resistance, hypertension etc. Growing number of evidences indicate association of obesity and sudden cardiac deaths[8-10]. Imbalance in cardiac autonomic activity might be a predisposing factor for arrhythmogenesis and subsequently sudden cardiac deaths. Obesity is accompanied with varied combinations of abnormalities in the autonomic nervous system imbalance[11].

Heart Rate Variability (HRV) is a specific and sensitive noninvasive tool to assess the Cardiac autonomic activity. HRV is the degree of variation of the heart rate during the day under the balanced influence of sympathetic and parasympathetic component of the cardiac autonomic nervous system. It expresses the total amount of variation of both instantaneous heart rate and RR intervals. HRV also indicates the extent of neuronal damage to autonomic nervous system.

This study is an effort to assess the effect of obesity on cardiac autonomic activity using Heart rate variability in young females.

Aim & objectives:-

To compare the Heart rate variability analysis between the pre-prandial and postprandial state in obese and non obese young healthy females.

Materials & methodology:-

Comparative study was conducted. There were two study groups including 100 subjects .The subjects were 50 non-obese and 50 obese females in the age group between 21 to 25 years . Subjects were examined for their general physical health. Subject's clinical history and details were taken according to the standard proforma. Subjects were recruited for the study in VMKVMC Hospital Salem. Institutional ethical committee clearance was obtained. The subjects were recruited after a detailed history and thorough physical examination.Written informed consent was taken from all the subjects.Subjects were classified into 2 groups based on BMI as follows.Normal weight – BMI – 18.5 – 24.99 kg/m^2,Obese – BMI > 30 kg/m^2 (BMI = Weight in kg/ (height in meter) ^{2} Subjects were selected for the study on 10th -12th day of their menstrual cycle.Subjects with history of Asthma, diabetes mellitus, hypertension, other cardiovascular diseases, endocrine disease or surgery, neuro-muscular disorders and subjects on chronic medication, were excluded from the study.Subjects on any drugs affecting the functioning of autonomic nervous system, adrenergic blockers, calcium channel blockers, anxiolytics, anesthetics, narcotics were also excluded.Heart rate variability was recorded in both pre and postprandial state using computer based software device Digital finger photo pulse plethysmography to identify separate frequency components.Digital finger photo pulse plethysmography (Figure-1) transmitting infra-red light will be applied to the left index finger. The amount of light transmitted through the finger varies proportionally to changes in its blood volume. The signal from the Digital finger photo pulse plethysmography was obtained over a 30 second period, to produce a single digital volume pulse wave form. Pulse wave for 5 minutes in pre and post prandial state and HRV components were recorded by computer based HRV software.The analysis of HRV[12] are the,The frequency Domain components of HRV were analyzed by using computer based HRV software. The power spectrum divided into bands of frequencies. LF ms^2: Power in low frequency range. HF ms^2: Power in high frequency range. LF nu: Low Frequency component, where nu means statistically normalized units. This mainly signify sympathetic component. HF nu: High Frequency component, where nu means statistically normalized units. This signify parasympathetic component. LF/HF: Ratio of Low Frequency component to High Frequency component, which signify the sympatho vagal balance.

Statistical analysis:-

All data were expressed as the arithmetical mean, and SD. Statistical analyses were performed using parametric methods. The upper 95% confidence limits in control subjects were used to establish abnormalities in the patients. This study was analyzed by Student unpaired t test . P value less than 0.05 was considered statistically significant.

Results:-

Table:- Measurements Of Heart Rate Variability Components Among Obese And Non Obese Group Of Population

Parameters	Non obese (N=50)			Obese (N=50)			P value (Unpaired t test)
	Mean	SD	95% CI	Mean	SD	95% CI	
LF (ms^2) - Pre-prandial	21173.4	1303.9	19559.3-23787.1	14837.7	3378.6	5473.7-24201.7	0.0141
Postprandial	21174.3	1303.9	19559.9-23788.6	7633.7	974.8	4931.7-9335.8	0.0138
HF (ms^2)- Pre-prandial	26866.2	6111.4	19927.2-33805.2	21174.3	6344.2	16746.2-28118.2	0.0231
Postprandial	11533.1	1450.7	9491.7-13533.9	9512.86	1015.8	8354.5-10986.1	0.0173
LF (nu)- Pre-prandial	10.05	3.13	9.19-10.91	24.6	17.3	19.84-29.44	<.0001
Postprandial	10.29	3.16	9.42-11.16	24.4	16.1	20 – 28.94	<.0001
HF (nu)- Pre-prandial	18.1	12.2	14.8-21.48	14.23	4.38	13.02-15.44	0.005
Postprandial	17.9	12.1	14.56-21.28	13.86	4.37	12.65-15.07	0.005
LF/HF - Pre-prandial	0.68	0.15	0.64-0.72	1.18	0.47	1.05-1.31	<.0001
Postprandial	0.94	0.25	0.87-1.01	1.47	1.43	1.08-1.86	<.0001

significantly lower values of LF,HF(ms^2) and HF(nu)& higher values of LF(nu) and LF/HF ratio among the obese group in both pre and post prandial state compared to non obese group.

Disccussion:-

Ingestion of food is a visceral stimulus that leads to metabolic and cardiovascular changes such as increased blood flow to GIT and a decreased skeletal muscle blood flow[13]. Peptides released in the GIT after food intake, produces local vasodilatation. This leads to redistribution of blood supply to GIT. The enteric nervous system, that controls the pacemaker and motor activity of GIT, communicates with the CNS & interacts with the heart through the ANS[14].The variations in heart rate are cyclic and non-cyclic. The cyclical variations are associated with various physiological functions like respiration, baroreceptor reflex activity, thermoregulatory mechanisms, and changes in peripheral chemoreceptor activity and renin-angiotensin activity. These functions exhibit cyclical oscillations. Each of these oscillations occurs at particular frequency, which gets reflected as predominant peak in frequency spectrum. Postprandial regulation of central hemodynamics is highly dependent on the autonomic nervous system[15] .The probable reason for the insignificant alteration in cardiovascular autonomic tone after food intake in young healthy subjects is because of the redistribution of blood volume does not lead to any systemic changes in blood pressure. The sympathetic activity very quickly compensates for any effects of the parasympathetic activity after food intake[16]. In obesity there was an alteration in cardio autonomic activity due to hyperinsulinemia, baroreceptor down regulation and thermoregulatory mechanisms. The major findings of this study were that the obese group showed significant reduction in LF, HF, HF nu, and significant increase in the values of LF nu and LF/HF in post prandial state when compared to non obese group. These findings indicate the presence of impaired parasympathetic activity &elevated level of sympathetic activity in obese group. Thus, it showed a definite shift in the sympatho-vagal balance towards sympathetic component.

Conclusion:-

HRV is a specific and sensitive noninvasive tool to evaluate cardiac autonomic activity. It is a helpful indicator in prevention of obesity related diseases like hypertension, coronary heart disease, stroke related events. So our results support HRV as an effective modality in the early diagnosis of obesity related diseases. Thus early interventional programs like weight reduction, lifestyle changes and physical exercises, which reduce fat content of the individual, can be advised to reduce the chances of subsequent cardiac rhythm abnormalities.

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