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RESEARCH ARTICLE

FREQUENCY DOMAIN ANALYSIS OF HEART RATE VARIABILITY BETWEEN PREMENOPAUSAL AND POSTMENOPAUSAL KNOWN DIABETICS - A COMPARATIVE STUDY.

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Abstract

Back Ground: Diabetes mellitus mainly type II is mainly due toinsulin resistance. The hyperglycemia casued by diabetes lead to micro and macrovascular complication that endangers with life. Premenopausal women with diabetes had the risk similar to that of men with diabetes. Postmenopausal diabetic women had additional risk due to estrogen hormone deficiency.

Aim And Objective: To compare the Frequency Domain Analysis of Heart Rate Variability between premenopausal and postmenopausal known diabetic females.

Materials& Methods: 100 Type II diabetic females around the age of 40-65yrs (both pre and postmenopausal) from diabetic OPD were recruited from Stanley Medical College Hospital. Institutional Ethical committee approval was obtained. After obtaining written and informed consent from the subjects. ECG(LEADII)was recorded for five mintues in supine position using RMS Digital Polyrite.HRV analysis was done using Frequency domain methods using RMS Digital Polyrite software version 2.1.

Results: Our study states that there is a lower HRV in postmenopausal known diabetic females when compared to that of premenopausal known diabetics. Further, decline in estrogen level and diabetes gives a additional risk of increased sympathovagal balance in postmenopausal diabetic women.

Conclusion: Type II postmenopausal diabetic females have increased level of autonomic dysfunction .Hence they require hormonal replacement therapy, regular periodic evaluation of cardiac autonomic status in order to prevent future cardiovascular morbidity and mortality.

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Introduction:-

Diabetes Mellitus is a group of common metabolic disorders that share the phenotype of uncontrolled blood sugar levels(hyperglycemia) The metabolic abnormalities associated with diabetes mellitus causes secondary pathological changes in multiple organ system that impose a tremendous burden on the individual with diabetes and on the health care system[1].With evolving trend across worldwide, Diabetes Mellitus will be a leading cause of mortality and morbidity. The worldwide prevalence of Diabetes Mellitus has risen drastically over past two decades, from an

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estimated 30 million cases in 1985 to 285 million in 2010.In individuals aged more than 65 years ,the prevalence was 26.9%. Worldwide estimates project that in 2030 shows that the greatest number of individuals with Diabetes will be aged 45-64 years[1]. Diabetic Autonomic Neuropathy (DAN) is among the most recognized and silent complications of diabetes, in the face of its significant harmful impact on survival and quality of life in people with diabetes[2] DAN may be either clinically evident or subclinical[3] Reduced heart rate variability is the earliest indicator of CAN[4].

Materials & Methods:-

100 Type II Diabetic females around the age of 40-65yrs(both pre and postmenopausal) from diabetic OPD with duration of diabetes of 5-15 yrs with Random Blood Sugar ≥ 200 mg/dl or Fasting Blood Sugar ≥ 126 mg/dl were recruited from Stanley Medical College Hospital. Institutional Ethical committee approval was obtained. After obtaining written and informed consent from the subjects ECG(LEADII)was recorded for five mintues in supine position using RMS Digital Polyrite. HRV analysis was done using Frequency Domain methods using RMS Digital Polyrite software version 2.1.

Exculsion Criteria:-

Subjects with a history of Asthma, Hypertension , Cardiovascular Disease and those on Chronic Medication .

Experimental Protocol:-

The short term Heart rate variability recording is usually performed for research , clinical investigations and followed the procedure given in the Task-Force report on Heart Rate Variability. Subjects were instructed to avoid heavy physical activity and also instructed to retrain from all caffeinated beverages for 12 hours prior to research activity. All the study subjects and controls have a prestructed proforma completed .Subjects were screened after measuring height,weight,blood pressure.The basal recording of blood pressure was done using sphygmomanometer by standard Riva Rocci method. Ask the subjects to liedown comfortably in the supine position in the Neurophysiology lab ,Department of Physiology,Stanley Medical Collage.(5 mints rest). Placed the ECG electrodes on the limbs of the subjects and connect the leads to the machine for lead II ECG recording. Transfer the data from RMS Polyrite to window based PC loaded with software for Heart rate variability.Removed ectopics and artifacts from the recorded ECG.Extracted the R-R tachogram from the edited 256 –second ECG using the R wave detector in the Acq Knowledge software and saved it in the ASCII format which is later used offline for short –term HRV analysis. Performed HRV analysis using the HRVanalysis software version 2.1(Biosignal Analysis group,Finland). Mean R-R is measured in second(s).Variance, defined as power in a portion of the total spectrum of frequencies, is measured n milliseconds squared(ms2).Mean R-R is measured in seconds .

Parameters Studied:-

Spectral indices (LF ms2,HF ms 2 , LF/HF ratio) are calculated.

Statistics:-

Data are expressed as mean ± SD .Data between the study groups were compared using unpaired Student t-test. Differences were considered statistically significant at ($P<0.05$). The collected data was analysed with SPSS 16.0 version.Data were normally distributed based on the Kolmogorov-Smirnov Z test for normality.To describe about the data mean and S.D was used. To find the significant difference between the Patients and controls Independent t-test was used .

Results:-

Table 1:-Subjects Characteristics,Anthropometric Measures.

PARAMETER		MEAN	SD	t-value	p-value
BMI	pre	173	35	1.02	0.315
	post	29.8	150		
SBP(mmhg)	pre	130.2	6.6	7.333	0.000
	post	141.4	6.2		
DBP(mmhg)	pre	34	6.0	7.666	0.000
	post	42.3	36		

No significant difference between pre and postmenopausal study subjects

Table:- Frequency Domain Analysis Between Pre And Postmenopasal Known Diabetic Individuals

		MEAN	SD	T-VALUE	p-value
Pm2LF	PRE	1109.6	160.2	2.999	0.001
	POST	3304.1	499.9		
Pm2HF	PRE	501.1	222.1	10.989	0.000
	POST	190.9	180.1		
LF/HF	PRE	3.8	1.2	18.989	0.000
	POST	19.9	5.9		

Compared to premenopausal diabetics,postmenopausal diabetics had lower HF,Higher LFand high LF/HF ratio.

Discussion:-

Diabetes Mellitus is characterized by hyperglycemia mainly in Type II diabetes due to reduced action of insulin (Insulin resistance)1. It is the major cause for cardiovascular morbidity and mortality. The main advantage of using frequency domain analysis of Heart rate variability is that one can study the signal's frequency-specific oscillations.Thus both the amount of variability and the oscillation frequency(number of heart rate fluctuations per second) can be obtained. Spectral analysis involves decomposing the series of sequential R-R intervals into a sum of sinusoidal functions of different amplitudies and frequencies by the FFT algorithm. . The LF fluctuations are predominantly under sympathetic control with vagal modulation, whereas the HF fluctuations are under parasympathetic control[5]. Three main spectral components are distinguished in a spectrum calculated from short-term recordings of 2 to 5 minutes[6,7,8,9,10] : VLF, LF, and HF components. Frequency domain analyses contributed to the understanding of autonomic background of RR interval fluctuations in the heart rate record.[11,12]Silent ischemic heart disease or cardiac arrhythmias have both been invoked as contributors to sudden death. In Asymptomatic Diabetics (DIAD) study of 1123 patients with type 2 diabetes, cardiac autonomic dysfunction was a strong predictor of ischemia. Results from the European Diabetes Insulin-Dependent Diabetes Mellitus (IDDM) Complications Study showed that patients with impaired HRV had a higher corrected QT prolongation than without this complication Cardiac autonomic neuropathy (CAN), which can be documented by abnormal heart rate variability (HRV), occurs commonly in patients with diabetes and is associated with silent myocardial ischemia[6] and increased mortality[7,] In a recent large meta-analysis, Maser et al. reported that the presence of cardiac autonomic neuropathy was associated with a greater than threefold increase in mortality and sudden death[7].. Autonomic imbalance between the sympathetic and parasympathetic nervous systems regulation of cardiovascular function contributes to metabolic abnormalities and significant morbidity and mortality for individuals with diabetes.[8-10]The presence of CAN was associated with a greater than threefold increase in mortality and sudden death. Silent ischemic heart disease or cardiac arrhythmias have both been invoked as contributors to sudden death. Meta-analyses of published data demonstrate that reduced cardiovascular autonomic function as measured by heart rate variability (HRV) is strongly associated with an increased risk of silent myocardial ischemia.s[9,15] Regular HRV testing provides early detection and thereby promotes timely diagnostic and therapeutic interventions. HRV was found to be an independent predictor of all-cause mortality during a period of 9 years, in a population-based study using Cox proportional hazard models. Moreover, the Hoorn study by Gerritsen et al demonstrated that impaired autonomic function is associated with increased all-cause and cardiovascular mortality and that CAN in patientsalready at risk (diabetes, hypertension, or history of CVD) may be especially hazardous Clinical manifestations of cardiovascular autonomic dysfunction (e.g., exercise intolerance, intraoperative cardiovascular liability, orthostatic tachycardia and bradycardia syndromes, silent myocardial ischemia) can result in life-threatening outcomes[10-14].

Results:-

Compared to premenopausal diabetics, postmenopausal diabetics had lower estrogen level ,lower HF and high LF/HF ratio. Further, decline in estrogen level and diabetes gives a additional risk of increased sympathovagal imbalance in postmenopausal diabetic women.

Conclusion:-

The postmenopausal women had a significantly reduced overall fluctuation in autonomic input demonstrated by lower HF, increased LF ,HF ratio in postmenopausal diabetic suggests that more sympathetic dominance.Therfore my study suggests that decline in levels of estrogen from pre to postmenopausal makes shift of autonomic balance towards the sympathetic dominence. Type II postmenopasual diabetic females have increased level of autonomic dysfunction .Hence they require hormonal replacement therapy, regular periodic evaluation of cardiac autonomic status in order to prevent future cardiovascular morbidity and mortality.

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