Study of Heart Rate Variability in Hypertensive Subjects

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Abstracts: Introduction: Hypertension represents a multifactorial disease of blood pressure (BP) regulation with persistently elevated systolic and/or diastolic BP over 140/90mmHg. 90% cases of hypertension have to be assigned as essential hypertension. Research has proven that patients with essential hypertension, especially at an early stage without any medication, display autonomic disturbance in the form of increase in sympathetic and a reduction in parasympathetic activity of the ANS. The heart rate variability analysis is a powerful tool in assessment of the cardiac autonomic nerve function. It is non-invasive, an accurate, reliable, reproducible, yet simple to measure and to process and It is indicative of neuro-cardiac fitness and overall health. Objective – The aim of the present study was to (1) measure Heart rate variability (HRV) in Essential Hypertension (2) effect of different drugs on Heart rate variability in hypertension among hypertensive subjects. **Materials and Methods:** This study was conducted On 100 Hypertension subjects & 100 Normal subjects after obtaining informed written consent by use of Heart rate variability Analysis System Variowin-HR Medical System. **Results:** The mean values of Very low frequency (VLF), Low frequency (LF), High frequency (HF), Normalized High Frequency (HF (nu) & all time domain parameters were found to be reduced significantly in hypertensive subjects as compared to control subjects. The mean values of LF (nu), LF / HF ratio were significantly high in hypertensive subjects as compared to control subjects. **Conclusion**: observations in our study demonstrate that hypertensive subjects had markedly reduced heart rate variability (HRV) in comparison with normal subjects which indicate cardiac autonomic disturbances in hypertension subjects in causation of essential hypertension. [Diwan J NJIRM 2015; 6(1):1-6]

Key Words: Heart Rate Variability, Hypertension, and Autonomic Disturbance

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Introduction: Hypertension represents a multifactorial disease of blood pressure (BP) regulation with persistently elevated systolic and/or diastolic BP over 140/90mmHg. Hypertension is an emerging health problem in India among the cardiovascular diseases[1,2]. Hypertension is a risk factor for the development of cardiovascular (myocardial infarction, heart failure) and cerebro-vascular (stroke) diseases[1,2].

90% cases of hypertension have to be assigned as essential hypertension, while particular causes for BP elevation can only be found in approximately 10% of the patients (secondary hypertension). Recent results have shown that not only the level of BP but also the variance of heart rate should be considered with respect to cardiovascular sickness[1,2]. Research has proven that patients with essential hypertension, especially at an early stage without any medication, display an increase in sympathetic and a reduction in parasympathetic activity of the ANS[3,4]. Although the pathogenesis of most hypertension is unclear, dysregulation of the autonomic nervous system has been implicated in its development. There is considerable evidence to suggest that the autonomic nervous system plays an important role in blood pressure regulation and in the development of hypertension[5,6]. The integrity of autonomic modulation of heart rate is evaluated by analyzing heart rate variability (HRV), which refers to oscillations in the intervals between consecutive heartbeats or R-R intervals. It is non-invasive, an accurate, reliable, reproducible, yet simple to measure and to process for assessment of the cardiac autonomic nerve function. Therefore, qualitative measurement of cardiac sympathetic nerve activity along with cardiovagal balance may throw some light on the role of autonomic modulation to develop hypertension and also change in the autonomic activity after treatment with antihypertensive therapy. The aim of the present study was to measure HRV in Essential Hypertension. & effect of different drugs on HRV in hypertension among hypertensive subjects.

Material and Method: This study was conducted On 100 Hypertension subjects & 100 Normal

subjects in the Autonomic Function Lab in department of physiology, Government Medical College Bhavnagar after receiving permission from Intuitional Review Board & Ethical Committee, Government Medical College, Bhavnagar taking informed written consent in prescribed format with anthrological measurement & physiological measurement.

All normal participants were age between 30 to 60 years with both sex and Systolic blood pressure (SBP) less than 140 mmHg and diastolic blood pressure less than 90 mmHg. The following exclusion criteria of all normal participants were accepted for the investigation: presence of any cardiovascular disease, Stressful and Anxious subjects even after 5 minute rest and metabolic and neurological disorders that could influence the heart rate variability.

All Hypertensive participants were age between 30 to 60 years with Both sex with Known Case of Essential Hypertension diagnosed by Physician according to classification of JNC VII criteria systolic blood pressure ≥ 140 mmHg or and diastolic blood pressure ≥ 90 mmHg & Taking regular or irregular antihypertensive treatment. The following exclusion criteria of all hypertensive participants who failed to give consent & Secondary hypertension subjects & History of Cardiovascular disease like ischemic heart disease, Peripheral arterial disease, Strokes, Diabetes, Renal failure, Endocrine disorders. Cancer, AIDS, Tuberculosis, Stressful and Anxious subjects even after 5 minute rest & Taking any drug that can cause neuropathy & Disease that can cause autonomic neuropathy like leprosy, alcoholic neuropathy.

All HRV parameters were taken between 8 am to 11 am to minimize diurnal variation. Subjects were informed to fast at least before 12 hours to abort effect of food on HRV .Subject was asked to lie down comfortably on supine position for 5 minute before recording of HRV to avoid wrong results. Subjects were instructed to breath quietly and avoid movement and not to talk while procedure as it can make artifact in recordings.

Placement of Electrodes: At the end of the 5 min,skin area cleaned with spirit at the placement of the ECG disposable electrodes, which decrease conduction resistance. Electrodes were placed as shown in figure 1

Figure 1:Placement of Electrode

Measurement of Heart Rate Variability: The HRV was analyzed both by the time domain and the frequency domain methods during normal breathing by use of Windows based Heart rate variability Analysis System Variowin-HR Medical system (Genesis Medical system PVT. Ltd.) Measured from 5 minutes continuous ECG Lead I & II. Parameters measured by frequency domain is shown in table 1 and time domain in table 2.Parameters of HRV Task Force[7]

Table 1: Frequency-Domain Measures of HRV

Parameter and Range	Normal value
High frequency(HF $ms^{2)}$-0.15-0.4Hz.-Parasympathetic influence	975±203
Low frequency(LF $ms^{2)}$- 0.04-0.15 Hz-Sympathetic and Parasympathetic influence	1170±416
Very low frequency(VLF $ms^{2)}$-0.003-0.04Hz – rennin-angiotensin system.	-
Total power(TP $ms^{2)}$	3466 ±1018
Normalized High Frequency(HF nu) -Parasympathetic influence	29±3
Normalized Low Frequency(LF nu)-Sympathetic influence	54±4
LF:HF ratio-Sympathovagal balance	1.5-2.0

Table 2: Time-Domain Measures of HRV Indicate Parasympathetic Activity

Parameter	Normal value
Standard deviation of all NN interval(SDNNms)	141±39
The square root of the mean of the sum of the squares of differences between adjacent NN intervals(RMSSD ms)	27±12
Standard deviation of differences between adjacent NN intervals(SDSD ms)	127 ±35
Number of pairs of adjacent NN intervals differing by more than 50 ms in the entire recording(NN50 count)	-
NN50 count divided by the total number of all NN Intervals.(pNN50 %)	-

SDSD Indicates HF power and reliable indicator of parasympathetic efferent activity. NN50 Indicates HF power and reliable indicator of parasympathetic efferent activity. pNN50% indicates HF power and reliable indicator of parasympathetic efferent activity

Statistical Analysis: Unpaired student T Test was used to compare overall heart rate variability between hypertensive and normal subjects and between two different drugs using subjects groups among hypertensive. Data expressed in mean ± SD. Statistical significance indicated by 'p' value < 0.05

Result: Present study was done to evaluate HRV on 100 were normal & 100 were Hypertension. Hypertension subjects further subdivided into two different drugs using subgroups ß Adrenergic Blocking drugs(n=30) & Non- ß Adrenergic Blocking drugs Users(n=70). Table 3 show the distribution of the Anthropometric Data in the Study Population.

Table 3: Distribution of the Anthropometric Data intheStudy Population.

Variables	Normal(N=100) Mean ± SD	Hypertensive (N=100) Mean ± SD	P Value
Age (in years)	44.09 ± 7.90	45.08 ± 8.08	0.3817 **
Height (in centimeter)	165.70 ± 9.56	162.77±10.64	0.0367 **
Weight (in kgs)	63.78 ± 6.97	63.13 ± 10.98	0.6178 **
BODY MASS INDEX (in Kg/m2)	23.34 ± 3.33	23.88 ± 3.88	0.2998 **
R-R WAVE interval (in ms)	963.87±261.24	774.82 ±148.21	<0.0001 *
Heart rate (Per minute)	66.26 ± 17.17	79.48 ± 14.88	<0.0001 *
Systolic Blood Pressure (in mmhg)	122.54 ± 5.12	135.40 ± 14.27	<0.0001 *
Diastolic Blood Pressure (in mmhg)	78.80 ± 4.35	84.26 ± 6.80	<0.0001 *

* Significant, ** not significant.

Table 4: Comparison of Frequency Domain Parameters of HRV among Normal and Hypertension Subjects

Variables	Normal(n=100) Mean ± SD	Hypertensive(n=100) Mean ± SD	P Value
VLF	1201.54 ± 821.46	738.01 ± 703.62	<0.0001 *
LF	1067.73 ± 617.82	563.65 ± 547.95	<0.0001 *
HF	1004.61 ± 1242.24	280.98 ± 423.54	<0.0001 *
LF (NU)	0.57 ± 0.15	0.68 ± 0.18	<0.0001 *
HF (NU)	0.43 ± 0.15	0.32 ± 0.18	<0.0001 *

Table 5: Comparison of Time Domain Parameters of HRV among Normal and Hypertensive Subjects.

Variables	Normal(n=100) Mean ± SD	Hypertensive (n=100) Mean ± SD	P Value
SDNN	56.73 ± 16.76	30.56 ± 12.70	<0.0001 *
RMSSD	48.90 ± 21.86	20.63 ± 14.01	<0.0001 *
SDSD	48.39 ± 22.11	18.57 ± 14.46	<0.0001 *
NN50	67.73 ± 40.96	8.79 ± 15.34	<0.0001 *
PNN50 %	23.83 ± 16.26	3.27 ± 6.66	<0.0001 *

* Significant, ** not significant.

Table 6: Comparison Of Frequency Domain Parameters of HRV Among ß Adrenergic Blocking Drugs Users and Non-ß Adrenergic Blocking Drugs In Hypertensive Subjects.

Variables	ß Adrenergic Blocking drugs Users (n=30) Mean ± SD	Non-ß Adrenergic Blocking drugs Users(n=70)Mean± SD	P Value
VLF	967.74 ± 851.10	639.65 ± 610.80	0.0319 *
LF	943.98 ± 507.3	507.36 ± 558.59	0.1054 **
HF	331.15± 194.58	254.48 ± 489.90	0.4409 **
LF (NU)	0.64 ± 0.14	0.69 ± 0.19	0.1765 **
HF (NU)	0.35 ± 0.14	0.30 ± 0.18	0.1882 **
LF/HF	2.16 ± 1.29	4.04 ± 3.70	0.0110 *

Table 7: Comparison of time domain parameters of HRV among ß Adrenergic Blocking drugs and non-ß Adrenergic Blocking drugs users in hypertensive subjects.

Variables	ß Adrenergic Blocking drugs Users Mean ± SD	Non-ß Adrenergic Blocking drugs Users Mean ± SD	P Value
SDNN	36.20 ± 13.20	28.15 ± 11.78	0.0032 *
RMSSD	24.73 ± 15.94	18.15 ± 13.14	0.0304 *
SDSD	23.42 ± 15.37	16.49 ± 13.64	0.0271 *
NN50	14.37± 21.83	6.40 ± 10.88	0.0166 *
PNN50 %	5.56 ± 10.12	2.28 ± 4.15	0.0207 *

* Significant, ** not significant.

The analysis of the HRV by the Frequency Domain Parameters [Table-4] & time domain Parameters [Table-5] showed statistically significant difference in any of the variables between normal & hypertension subjects. the analysis of the HRV by Frequency Domain Parameters [Table-6] showed statistically significant difference in any of the variables between among ß Adrenergic Blocking drugs & non-ß Adrenergic Blocking drugs users in hypertensive subjects' he analysis of the HRV by the time domain Parameters [Table-7] showed statistically significant difference in VLF, LF/HF Ratio between among ß Adrenergic Blocking drugs & non-ß Adrenergic Blocking drugs users in hypertensive subjects

Discussion: In present study there is significant decrease in VLF, LF, HF (ms^2), HF (nu) (Frequency Domain Parameters) in hypertensive subjects may be indicative of sympathetic over-activity, reduced parasympathetic activity and sympathovagal imbalance (SVI) in hypertension. LF (nu) and LF / HF ratio (Frequency Domain Parameters) indicating sympathetic overdrive and sympathovagal balance respectively significantly increased in hypertensive patients. VLF significant reduced in subjects using non-ß Adrenergic Blocking drugs as compared with ß Adrenergic Blocking drugs Users indicating sympathetic activity. LF/HF Ratio was significant high in subjects using non-ß Adrenergic Blocking drugs as compared with ß Adrenergic Blocking drugs Users indicating Sympathovagal balance.

All time domain parameters like SDNN, RMSSD, SDSD, NN50, Pnn50 % were reduced in hypertension patients as compare to normal subjects & hypertension using non-ß Adrenergic Blocking as compared with ß Adrenergic Blocking drugs Users this is because of markedly depressed HRV, which is an it reflects cardiac autonomic disturbances in hypertensive subjects & reflects both sympathetic and parasympathetic activity which predict increased risk for subsequent cardiac events in hypertensive patients.

Our study findings were in accordance with other mentioned studies[8,11-17] that there was autonomic imbalance in hypertensive subjects as compared to control subjects & hypertension using non-ß Adrenergic Blocking drugs as recommended that ß adrenergic mediated vasodilatation might have some contribution in the sympathetic overdrive in essential hypertension[9,10]

Conclusion: From present study it indicates that hypertensive subjects had markedly depressed HRV which reflects sympathovagal imbalance. thus

we can predict increased risk for subsequent cardiac autonomic disturbances in hypertension subjects in causation of essential hypertension. All time domain parameters were reduced in hypertensive patients. This demonstrate Observation of drug group May indicate possibility to unravel the sympathetic & parasympathetic activities of these beta blocking drugs and thus explain their protective effects in cardiac diseases and may be revert sympathovagal imbalance in hypertension.

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