ORIGINAL RESEARCH PAPER

Physiology

KEY WORDS: HRV, LF,HF, ANS,CPT, Age

Effect of age on heart rate variability in different phases (normal, deep breathing, cold pressor test)

Dr. prashanth N Dixit Associate Professor Department of Physiology KIMS Koppal

Dr. vijaynath Itagi Professor and Head Department of Physiology KIMS Koppal

ABSTRACT

Age and heart rate are main determinants of HRV. Regardless of life style HRV is reduced with increased heart rate and age. The Heart rate variability (HRV), this noninvasive methodology, which is one of the important tool in the hands of scientists to asses both cardiac and Autonomic nervous system (ANS) activity. This study was proposed to record and asses the HRV in elderly population involved to predict and prevent further deterioration and thereby help the elder to lead more normal, healthy and active life. In this study 47 persons were participated, the ECG signal is first analogally recorded & then digitally converted. Analysis of this in the time domain & frequency domain in normal breathing, deep breathing and cold pressor test(CPT). Result showed that in normal breathing, deep breathing and in cold pressor test as age increases there will be significant decrease in HRV. Where as in frequency domain there is significant decrease in HF and LF as age increases, where as cold perssor test does not showed any significant changes. Thus the result showed that as age increases sympathetic activity increases but there is a significant decrease in the parasympathetic activity.

INTRODUCTION

The Heart rate variability (HRV), this non invasive methodology, which is one of the important tool in the hands of scientists to asses both cardiac and ANS activity. This study was proposed to record and asses the HRV in elderly population involved to predict and prevent further deterioration and thereby help the elder to lead more normal, healthy and active life.

HRV is beat-to-beat fluctuation in the rhythm of the heart which is a indirect measure of heart health[1].

- HRV represents one of the most promising markers[2].

Heart -DB (Deep Breathing) in approximately double than during quiet breathing[3]. So due to larger variation in intervals, HRV –DB ins probably more precise measure and recently HRV-DB has been shown to be an independent prognostic marker after myocardial infarction [4].This method is easy method & can be carried out without much difficulty in general population.

Age and heart rate are main determinants of HRV. Regardless of life style HRV is reduced with increased heart rate and age. Aging has a profound impact on many of the interacting neural and endocrine mechanisms that regulate heart rate. Parasympathetic and sympathetic influences become attenuated, rennin and angiotensin levels fall and circadian hormonal and temperature rhythms loose amplitude [5].

Kenumetai MD et al, [6] studied age and gender effects on HRV over nine decades in healthy subjects. Results of the study showed that HRV of healthy subjects declines with age which is a measure dependent SDNN and SDANN decreases gradually reaching 60% of base line by tenth decade, PNN 50 and MSSD, HRV decreases rapidly reaching 25% and 47 % baseline by sixth decade. Using the SDNN index, RMSSD and PNN 50, HRV of subjects more than 65 years old fell below published cut points for increased risk of mortality in 25%, 12% and 4% respectively.

Decreased heart rate variation was seen with aging but the balance between parasympathetic and beta adrenergic input at rest and in response to postural changes does not appear to be influenced by age during spontaneous breathing. Metronome breathing altered spectral content within subjects and produced age related differences in response to postural maneuvers not seen during spontaneous breathing [7].

A reduction in HRV has been reported in several cardiological and non cardiological diseases[8]

This study aims to assess the degree of deterioration of cardiac function with respect to the regulatory mechanisms as the age advances.

MATEREAL AND METHODS

This study was conducted in LITTLE SISTER OLD AGE HOME. There are about 47 old aged inmates in the age group 55 to 85 years attended the study voluntarily. Among them 14 were men and 33 were women.

A detailed clinical history of these subjects was taken. Relevant past history, family history, any drug history, personal history like smoking, alcoholism occupational history etc, were also taken. General physical examination, vital signs, complete systemic examination was done.

Inclusion Criteria

1. Subjects between age group 55 to 85 years.
2. Can follow instructions.
3. Healthy, doing their routine work by themselves.

Exclusion Criteria

1 History of respiratory disease.
2 History of neurological disease.
3. Atrial fibrillation.
4. Congestive cardiac failure.
5. Acute MI or unstable angina.
6. Frequent Ectopics .
7. Inability to under go deep breathing test.
8. Inability to under go cold pressor test.

Diabetic subjects (n=8)

Subjects on anti diabetic therapy regardless of duration and Diabetes under control were included in study.

LIST OF PARAMETERS STUDIED

1) Age
2) Heart rate Variability

MEASUREMENT OF HRV

1) Material used in the study was ECG appliances with Jelly & electrode.
2) Digital data Acquisition system
3) HRV soft 1.1 VERSION, AIIMS, NEW DELHI.

A high quality ECG recording was taken under standardized condition to minimize artifacts. The ECG signal is first analogally recorded & then digitally converted. Analysis of this in the time

domain & frequency domain was done using 1.1 VERSION,AIIMS, NEW DELHI software.

Recording was done in the morning between 8.30 to 9.30am in a cool room temperature of 20 to 28 degree Celsius after breakfast. They were requested to come in a relaxed condition & quiet mood .

The room was darkened & without acoustic disturbance. They were instructed to be relaxed and to breathe spontaneously at their own rate the procedure was explained to the subject.

After a resting period, the subjects ECG was recorded in the supine position during normal breathing for 5 min . After this a break of 2min was given . Then the next ECG recording was taken during deep breathing for 1 min, the procedure as follows.

The subject was asked to inspire for the first 5 seconds from the count of 1 to 5 and expire the next 5 seconds from the count of 5 to 1. This recording was taken for 6 such cycles I.e. one min.

COLD PRESSOR TEST- The subjects were asked to keep one hand till wrist joint in an ice cold box for 1 min, during that time the ECG were recorded.

STATISTICS

The statistical analysis was done by using ANOVA (Analysis of variance), student's unpaired T test, Mannwhitney U test, Tukey's Test.

P value was taken as significant at 5 percent confidence level($p < 0.05$)

Results

In this study14 male and 33 female subjects between age group of 55 to 85 were participated, ECG of these people were taken in Normal(N), Deep breathing (DB), Cold presser test (CPT) conditions. The HRV of these people under different conditions were compared with different parameters and results were as follows.

The Study group consists of 47 volunteers in the age group of 50 to 85. They were divided in to two groups as Group I, with 29 subjects who were less than 70 yrs of age and The Group II, with 18 subjects who were more than 71 yrs of age. The association of HRV with age under different conditions was analyzed.

In time domain method, the HRV i.e., (standard deviation of adjacent normal to normal beat) SDANN, were compared. The mean value of SDANN in group1 was 14.1838±5.121 and group2 was 10.422±6.538 in Normal breathing. The Group I showed significantly higher HRV than group II ($P<0.05$).

In frequency domain analysis in normal condition, The LF component of group1 was 28.96±7.60 and group2 was 23.52±8.76. Here also the group I showing greater value than group II ($p<0.05$).

The HF component during normal breathing in group1 was 42.76±16.05 and group2 was 32.82±18.7. The Group1 showed significantly higher value than group2 ($p<0.05$). (Table I)

Table I: effect of age on HRV in normal breathing period

Age group		N	Mean	Std. deviation	Z
HRV	<70	29	14.1838	5.12168	2.49500
	>70	18	10.4228	6.53849	P=0.013 SIG
LF	<70	29	28.9676	7.60590	1.98300
	>70	18	23.5256	8.76705	P=0.049 SIG
HF	<70	29	42.7986	16.05523	2.21100
	>70	18	32.8250	18.70909	P=0.027 SIG
LFHF RATIO	<70	29	.7888	.55035	1.29100
	>70	18	.8996	.41736	P=0.197 NS

In DB condition, the mean value of HRV in the group I was 21.44±10.13 in the group II it was 18.798±8.768. In deep breathing conditions the HRV was higher in group I when compared to group II ($p<0.05$).

In the DB the LF of group I population was 76.75±13.65 and group II had 66.26±12.72. Here the LF of group I was significantly higher than group II ($p<0.05$) in DB.

The HF component during DB also showed significantly higher value in group I than group II ($p<0.05$) and the values of group I was 30.33±10.84 and group II was 22.85±9.69. Table II.

Table II: effect of age on HRV in deep breathing period

Age group		N	Mean	Std. deviation	Z
HRV	<70	29	21.4403	10.13648	2.05000
	>70	18	18.7989	08.76833	P=0.045 sig
LF	<70	29	76.7559	13.65237	2.30900
	>70	18	66.2622	12.72470	P=0.021 sig
HF	<70	29	30.3383	10.84872	2.13400
	>70	18	22.8544	9.69855	P=0.033 sig
LFHF RATIO	<70	29	2.9012	1.23277	1.06100
	>70	18	3.5191	1.80288	P=0.288 ns

In CPT condition, the mean value of HRV in the group I was 16.83±6.02 and in the group II it was 10.14±7.016 .In CPT conditions the HRV was higher in group1 when compared to group2 ($p<0.05$).

In CPT the LF of group I population was 49.98±17.45 and group II had 50.67±12.62. Here the LF of group I was significantly lower than group II ($p<0.05$) in CPT conditions.

Where as during CPT, the HF component of group I was 40.44±19 and group II was 42.83±14.83, which was not significantly different from each other.

The LF/HF ratios compared between the two groups were also not significant in normal, DB, CPT conditions. Table III.

Table III: effect of age on HRV in cold pressor period

Age group		N	Mean	Std. deviation	Z
HRV	<70	29	16.8379	6.02276	3.66400
	>70	18	10.1411	7.01678	P<0.001
LF	<70	29	49.9804	17.45006	1.98300
	>70	18	50.6763	12.62494	P=0.049 sig
HF	<70	29	44.0414	19.42046	.39000
	>70	18	42.8379	14.84883	P=0.696 ns
LFHF RATIO	<70	29	1.3192	.60997	1.33300
	>70	18	1.2771	.44013	P=0.182 ns

DISCUSSION

This study consisted of forty seven elderly in the age group of 50–85 years residing in Little sister old age home. These subjects HRV was analyzed during normal breathing condition (control state), deep breathing condition (to asses the vagal activity), and CPT (to study the sympathetic modulatory effect).

Their mean age was 67.5 years. First the effect of age on heart rate variability by time domain method was analyzed, and the result showed that there was significant decrease in the HRV as the age advances during normal, deep breathing and CPT. The previous studies also have shown that as the age advances, HRV declines [9,10,11].

Normal aging is associated with a constant decline of cardiovagal modulation due to significant decrease of parasympathetic activity, which resulted in a decrease in the HRV as the age advanced in healthy subjects [10].

The effect of age on HRV were measured by spectral analysis showed LF i,e sympathetic component of autonomic nervous system was more in younger than older in normal condition and during deep breathing which stimulates parasympathetic component of ANS.

But during CPT which is an indicator of sympathetic modulatory effect showed more sympathetic activity in older people.

Michael Reardon et al [2006] compared HRV in subjects who are below and above 70 yrs. He found out that there was a significant difference in HRV index in those above 70 yrs compared with those below 70 yrs. There was no significant difference in RMSSD between two groups. Study concludes that aging reduces the global measure of HRV and may reflect reduced responsiveness of autonomic activity to external stimuli with age[12].

HF i,e parasympathetic component of ANS was more in younger age group than older group when sympathetic and parasympathetic activity was increased during DB and CPT.

LF/HF ratio which shows the balance between sympathetic and parasympathetic component of ANS. when compared was not significant.

CONCLUSIONS

In this study,

1. HRV decreases as age advances.
2. In old age sympathetic activity is first affected as age advances than parasympathetic activity.

Overall assessment of the old age changes in the nervous cardio regulatory mechanisms as per the study indicates that, as the age advances the autonomic nervous system activity decreases, but the degree of decrease in sympathetic activity precedes the parasympathetic activity.

BIBLIOGRAPHY

Eur J Med Res.

1. 7Overweight, obesity and elevated blood pressure in children and adolescents.Schiel R, Beltschikow W, Kramer G, Stein G. 2006 Mar 27;11(3):97-101.
2. Lown B, Verrier RL. Neural activity and ventricular fibrillation. N Engl J Med. 1976; 294:1165-1170.
3. Wheeler T, Watkins PJ. Cardiac denervation in diabetes. BMJ 1973; 4 :584 – 586.
4. .Katz A, Liberty IF, Porath A, ovsyscher I, PrystowskyEN A simple bed side test of 1 minute heat rate variability during deep breathing as a prognostic index after myocardial infarction. AM Heart J 1999; 138 : 32-8.
5. Iyengar N, peng CK, Morin R, GoldbergerAL and Lipsitz LA. Age related alterations in the fractal scaling of cardiac inter beat interval dynamics. Am J physiol 1996;271:R1078-R1084.
6. Twenty-Four Hour Time Domain Heart Rate Variability and Heart Rate:Relations to Age and Gender Over Nine Decades Ken Umetani, M.D., Donald H. Singer, M.D., F.A.C.C., Rollin McCraty, Ph.D., and Mike AtkinsonJournal of the American College of Cardiology. 1998; 31(3): 593-601.
7. J Gerontol. Aging effects on heart rate variation.Schwartz JB, Gibb WJ, Tran T. 1991 May;46(3):M99-106.
8. Malliani A, Pagani M, Lombardi F, Cerutti S. Cardiovascular neural regulation explored in the frequency domain. Circulation. 1991;84:1482-1492.
9. Lipsitz LA, Goldberger AS. Loss of complexity and aging- potential applications of fractals and chaos theory to senescence. JAMA 1992; 267 : 1806–1809.
10. Bonnemier H, Richardt G, Polratz J, Weiegand UK, Brandes A et al. Circadian Profile of cardiac autonomic nervous modulation in healthy subjects, differing effects of aging and gender on heart rate variability. J Cardiovarsc Electrophysiol 2003; 14 (8): 800-2.
11. Masaoka S, Lev-Ran A, Hill LR, Vakil G, Hon EH. Heart rate variability in diabetes; relationship to age and duration of the disease. Diabetes care 1985; 8(1) 64-68.
12. Pacing and Clinical ElectrophysiologyVolume 19 Issue 11 Page 1863Issue 11 - 1866 - November 1996 Changes in Heart Rate Variability with Age. MICHAEL REARDON .Department of Cardiological Sciences, St. George's Hospital Medical School, London, United Kingdom and MAREK MALIK Department of Cardiological Sciences, St. George's Hospital Medical School, London, United Kingdom.