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Physiology

HEART RATE RESPONSE TO DEEP BREATHING (E:I RATION) WITH AGING AND ITS CORRELATION: AN PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT Aging is an natural and universal phenomenon which results in various changes in body function and most of functions either altered or they are decreased. Autonomic function are also affected with aging and results in various degree of changes that can be observed. But what is the age at which these changes starts affecting the AFT are not yet confirmed. This gives idea to take this present study and to find out what is the effect of aging on AFT and correlation of aging with E:I ratio which was studied in this present by CANWin as a emerged non-invasive tool to measure cardiac changes easily. On statistical analysis we found there was a significant decline in E/I ratio with advancing age (p value=<0.003) Thus heart rate response to deep breathing which is an indicator of parasympathetic function was reduced linearly with advancing age.

KEYWORDS :

INTRODUCTION

The Autonomic Nervous System (ANS) is the most important part of the nervous system which is responsible to achieve balance in internal environment i.e. homeostasis therefore it is has a vital importance in daily life and it perform all these regulatory action autonomously without involvement of one's conscious. Any disorder in ANS will results in various diversified autonomic function in body that may be primary or secondary to other disorders, that originates from peripheral and central nervous system directly linked from the nervous system may be from other organs where they can prompt or develop pathological symptoms.

Various chronic diseases like diabetes mellitus, hypertension and arthritis are on increasing worldwide and their association has been seen with ANS. Not only in pathological diseases, in healthy population with normal human ageing changes in the autonomic functions are also seen are different due to their divergent neural pathways i.e. sympathetic and parasympathetic. with aging. Although aging changes occur in all of the body's cells, tissues, and organs, and these changes affect the functioning of all body systems but functions mainly associated with changes is cardiovascular parameter and it has been considered as one of the important confounding variable for cardiac autonomic function. The parasympathetic division is primarily involved in relaxation, preparing the body to rest and recover. An increase in parasympathetic activity constricts the pupils, decreases the heart rate and intensifies digestion

India is considered as one of youngest country in world as in India 7.1% of the people are over 65 years in compared to 12% in U.S.A and Britain (as per 2001census).Although in India the percentage of aged persons to total population is low in comparison to developed countries, but, the absolute size of aged population is considerable increasing. In old age though both sympathetic and parasympathetic systems are affected.[1] As age advances, the parasympathetic tone and baroreflex sensitivity are gradually reduced [2].Thus blood-pressure regulations ultimately may lead to the development of many cardiovascular diseases.[3] There are many evidences indicating relationship between aging and parasympathetic functions from various parts of the world. There are few studies involving ANS testing with conventional methods for assessing the parasympathetic functions of Indian origin with the CANwin mainly in Rajasthan. Thus, the aim of the present study is to observe correlation of parasympathetic function tests with age by E:I ratio.

MATERIAL AND METHODS

The present study was carried out in the Department of Physiology in collaboration with Department of Medicine, Dr. S.N. Medical College on 125 healthy individuals of western Rajasthan between the age group of 21-50 years. A informed consent was obtained from subjects after explaining the procedure in detail. The procedure was in accordance with the ethical standards of the committee of the institute.

Subjects were checked for symptoms and signs of possible autonomic dysfunctions including orthostatic hypotension (light headedness, blurred vision, sensation of weakness and unsteadiness, fainting or syncope on standing), perspiration, palpitations.

Inclusion criteria

Only healthy subjects of age group of 21 to 50 years and average body mass index of Indian origin will be included in the study.

Exclusion criteria

- Subjects not giving consent for participation.
- History of alcohol intake.
- History of smoking, tobacco consumption.
- History of hypertension or any other clinical
- Signs of cardiovascular diseases.
- Subjects receiving drugs known to affect autonomic function, for example: Adrenergic
- drugs, Adrenergic blocking drugs, Cholinergic agents, Diuretics, Antihypertensive drugs etc.
- Females with irregular menstrual cycle.

Statistical Analytic

Numerical data was summarized as mean and standard deviation and categorical data as count and percentage. ANOVA with Post-hoc Tukey HSD test was used for pair wise comparisons and Chi-square test were used to find difference among groups to find statistical analysis for Ewing's Criteria &Bellavere's Criteria. $p<0.05$ was considered statistically significant. Pearson's Correlation was also analysed to find out any correlation between ageing and E:I ratio. All data was analysed in IBM SPSS statistic.

METHOD- For E:I Ratio By CANWin

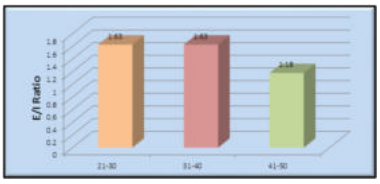
Heart Rate Variation during Deep Breathing (Expiration/Inspiration ratio) was recorded by non invasively CAN Win . It is PC Windows based Cardiac Autonomic Neuropathy (CAN) Analysis System with interpretation. While recording ECG, the subject was asked to inhale deeply for 5 seconds followed by exhalation for 5 seconds at a rate of 6 breaths per minute. The ratio between longest R-R interval during expiration and shortest R-R interval during inspiration (E/I ratio) in

each respiratory cycle is calculated for evaluation. A value of 1.20 or higher was taken as normal.[4]

Observation and Result

Table 1 Statistical analysis of E:I ratio by Analysis of Variance (ANOVA)

Age groups (Years)	N	E/I Ratio Mean ± SD
21-30	25	1.63±0.635
31-40	25	1.63±0.635
41-50	25	1.18±0.068
F Value	6.187	
Sig.	0.003 (S)	



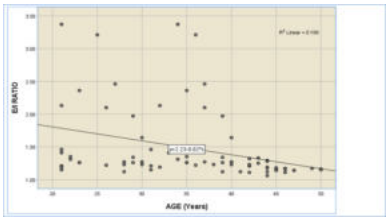
Graph 1 Comparison of E:I ratio between different age groups

Table 2 Post Hoc Tests for Multiple Comparisons in between different age groups

Post Hoc test	(I) AGE	(J) AGE	E;I Ratio
Tukey HSD	21-30	31-40	1.000
		41-50	.009
	31-40	21-30	1.000
		41-50	.009
	41-50	21-30	.009
		31-40	.009

Table:- 3 Statistical Analysis of E:I ratio by students t- test and its Correlation with aging.

No. of subjects =75	AGE (21-50 years)	E/I Ratio
Mean	35.16	1.48
Std. Deviation	8.64	0.56
Std. Error	1.021	0.064
t- Value	33.00	
Significance	0.0001	
Pearson's Correlation	-0.331	
Correlation Significane	0.004	



Graph No.2 shows Pearson's correlation between age with E:I ratio. Graph shows that there was negative correlation between age and E:I ratio. On statistical analysis result was highly significant (p-value 0.004)

DISCUSSION

In healthy young individuals breathing at a normal rate, the HR varies with the phases of respiration i.e., HR accelerates during inspiration and decelerates during expiration, this is known as sinus arrhythmia. Sinus arrhythmia is a normal phenomenon and is due to fluctuations in parasympathetic output to the heart. Baroreceptors are solely responsible for resting vagal tone in the normally breathing individuals[4].

During inspiration, neuronal activity of inspiratory neurons in the medulla besides initiating inspiration also discharge to Nucleus of tractus solitarius (NTS), Nucleus ambiguus (NA), and inhibit both the relay centers of the Baroreceptors, NTS-NA pathway. This leads to inhibition of cardiac vagal motor discharge which in turn leads to an increase in HR during inspiration and decrease in HR during expiration[5]. The difference between heart rate varies from 10-15 and a value below 10 is abnormal. Therefore the E:I ratio should be higher than 1.2 in normal healthy subjects.

In present study heart rate response to deep breathing was decreased with aging. Mean and SD of E:I ratio in group A, group B, group C, were respectively 1.63±0.63, 1.63 ± 0.63, 1.18 ± 0.003 as shown in above table no.1 and graph [1].

On statistical analysis we found there was a significant decline in E/I ratio with advancing age (p value=<0.003) Thus heart rate response to deep breathing which is an indicator of parasympathetic function was reduced linearly with advancing age in our study. On further analysis by post hoc for multiple group comparison we found the significant changes was mainly in 41-50 years of subjects which shows that with advancing age the change in heart rate response to respiration starts from the age above 40 years as shown in table no. 2. Our current study results are supported by the earlier studies done by, Vita G et al [6], Sampo J piha [7], Ewing et al.[8], Gautshy et al.[9].

Vita G et al (10) and Philip A low et al [11] observed a linear decline in heart rate response to deep breathing with advancing age as observed in our study. Vita G et al (10) attributed this decline to reduction in number of fibers in the vagus nerve, increase in empty Schwann cell bands and accumulation of pigments in neurons as the age advances.

O' Brien et al (12) observed a nonlinear decline in heart rate response to deep breathing with advancing age. They attributed this age related decline to altered vagal activity, since chronotropic response to atropine was also reduced in older subjects Kaijser & Sachs(13) found that there is decrease in E:I ratio Above age 60 years. They attributed this decline to decreased nerve function and decreased end organ sensitivity or function in older subjects. On further analysis by Pearson's correlation and scattered graph the changes was mostly fond near the age of 41-50 years subject. Maximum and significant correlation was between E/I ratio and age as shown in table no.3 and graph 2.

So we should take care of our heart and lungs after 40 years with the advancement of age so that the serious changes doesn't takes place which may be fatal for our life. Heart rate response to deep breathing is very sensitive & detects the parasympathetic dysfunction at the earliest. Different researchers suggested that the vagal tone is reduced or loss of vagal tone occurs gradually as age advances [6] and is thought to be a result deterioration of cardiovagal baroreflex sensitivity and impaired transmission of impulse through both afferent and efferent pathway as well as reduced central integration of afferent inputs may be the contributory factors for this lower baroreflex activity in elderly subjects.[6]

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