University Journal of Pre and Para Clinical Sciences

ISSN 2455–2879 2018, Vol.4(3)

HEART RATE VARIABILITY OF ONE MINUTE CONTROLLED DEEP BREATHING IN OBESE INDIVIDUALS

ARCHANA

Department of Physiology,STANLEY MEDICAL COLLEGE AND HOSPITAL

Abstract : BACKGROUND Obesity, an evolving metabolic disease, has become the most common risk factor for Non-communicable diseases. The increased morbidity and mortality in these diseases are due to autonomic imbalance1. Heart Rate Variability (HRV) analysis is a tool to assess the cardiovascular autonomic function. Although, many methods are there to study the relationship between obesity and autonomic function, HRV plays an easy, simple, noninvasive and effective method.AIMOBJECTIVE To evaluate and compare cardio-respiratory interactions using HRV in respiratory maneuvers among Obese and non-obese individuals.MATERIALS AND METHODOLOGY After twenty minutes of supine rest, ECG (Lead II) was acquired during one minute controlled deep breathing at 6 breathes per minute and instantaneous RR intervals were analysed using Finland software for HRV. Time domain measures of obese were compared with age and gender matched non-obese group. Time domain measures SDNN (Standard Deviation of NN interval in ms), RMSSD (Root Mean Square of Standard Deviation in ms), NN50, p NN50 () and Deep breathing maximum (DB max) were taken for analysis.RESULT In Obese, Mean HR increased and Mean RR decreased significantly. There is a significant decrease in SDNN , RMSSD, NN50, pNN50() in Obese compared to Non obese. Deep breathing ratio is also significantly decreased in obese.CONCLUSION Obese individuals found to have impaired cardiovagal dysfunction characterized by depressed parasympathetic activity.

Keyword : Obesity , Body Mass Index , Autonomic function, Heart Rate Variability INTRODUCTION**:**

Obesity, an excessive accumulation of adipose tissue, is an important risk factor for developing chronic disease[1]. With continued rise in standards of living, Obesity has become global epidemic [2] and “New world syndrome” .Consequently , this has lead to massive social, economic and cultural problems across developing and developed countries. This complex disease arises from multifaceted interactions of genetic and environmental factors[2,3]. Of these the prime cause for obesity has been found to be the imbalance between energy intake and energy expenditure[4].

The ANS is an Integrated Nervous System known to play a role in the interaction between circulation and respiration. Respiratory Sinus Arrythmia is a rhythmical fluctuations in RR periods (interval between successive QRS complex) at the respiratory frequency which has been characterized by the shortening and lengthening of RR interval in relationship with inspiration and expiration[5]. RSA is used as a selective non-invasive index of vagal control of heart. Respiratory mediated heart ratechanges are small during quiet breathing but more pronounced respiratory sinus arrhythmia duringdeep breathing. RSA magnitude is inversely related to respiratory rate and directly related to tidalvolume. Increase in tidal volume at slower respiration rates will cause larger RSA elevations than thesame tidal volume increase at more rapid respiration rates [6]. These respiratory maneuvers, associated with reflex cardiovascular changes, provide an important information about the appropriate function of ANS and functional capacities of effectors (heart and vessels).

It is well known that Autonomic Nervous System plays pivotal role in regulation of energy metabolism and cardiovascular System[1]. Thus, whether Obesity results from ANS dysfunction or Obesity itself a mounting factor for ANS dysfunction is unclear.We have attempted to study autonomic function in obese using Heart Rate Variability of One minute Controlled Deep Breathing as a diagnostic tool.

AIM: To test whether evaluation of the cardio- espiratory interactions using Heart Rate Variability can reveal cardiovagal dysfunction in Obese individuals.

OBJECTIVE: To compare HRV during one minute controlled deep breathing in Obese with Non obese adults.

MATERIALS AND METHODS:

The study was done in thirty age and gender matched obese and non-obese individuals (Obese: 17:13, female: male; aged 28.13 ± 5.45; non-obese aged 26.33±4.15)[7]. These participants were drawn from Master Health check-up at out-patient department. The study was conducted at the Neurophysiology Laboratory, Department of Physiology, after obtaining an informed and written consent from all the participants and was approved by the Institutional Ethics Committee.

Detailed history and clinical examination was done to exclude conditions interfering with autonomic modulation like smoking, alcohol intake, caffeine intake, meals, hypertension, diabetes mellitus and drug intake. All these examination were carried out between 8.00 AM and 1.00 PM under comparable ambient conditions, after having made the participants relaxed.

After cleaning the skin surface with the spirit, ECG electrodes were placed properly and lead II ECG was recorded for five minutes after a resting period of 15 minutes at supine rest position with normal breath rate of 12 – 16 / minute, using RMS polyrite D Hardware 2.2 (India). Then, participants were trained to breath at 6 breaths per minute, with inspiration for 5 sec and expiration for 5 seconds and ECG was recorded. The instantaneous RR intervals were plotted using Finland1.1version, University of Kuopio, and Software for HRV analysis, with the interpolation frequency of 4Hz and smoothness prior method as per recommendations of Task Force[8] (Circulation
1996).

BMI:Body weight was measured (to the nearest 0.5 kg) with the individuals in position standing motionlesson the weighing scale and with the weight distributed equally on each leg. Height was measured (tothe nearest 0.5cm) with the individual standing in an erect position against a vertical scale and with the head positioned so that top of the external auditory meatus was level with the inferiormargin of the bony orbit (Frankfurt's plane).WHO Asian Pacific Standards[7] were taken for BMI classification.

Heart Rate Variability Analysis:HRV analysis was performed with linear methods in the time domain. In the time domain, SDNN[Standard Deviation of NN interval and in the frequency domain], RMSSD [Root Mean Square ofStandard Deviation], NN50 [number of differences between adjacent NN intervals greater than 50msec] and pNN50 [the percentage of differences between adjacent normal to-normal intervalsgreater than 50 msec] were used. The HRV analysis software Finland1.1v of Kuopio Lab was used toanalyse the recording. Deep breathing maximum (DB max) , a mean ratio of maximum / minimum inRR interval during one minute of controlled deep breathing was also used.

STATISTICAL ANALYSIS:

SPSS version 15 was used for statistical analysis. The Data are expressed as mean ± Standard Deviation. The variation in parameters between the two groups was tested using student's independent t-test. P value less than 0.05 was considered significant.

RESULTS:

In Table I , there shows no significant difference in age between obese and non obese . Weight and BMI is significantly ($p<0.01$**) higher in obese compared to Non obese.

Table II shows significant increase in Mean HR and decrease in RR in obese than Non obese.SDNN decreased significantly in Obese compared to Non Obese. Also RMSSD , NN50 , p NN50significantly decreased in obese compared to Non Obese. There is also significant decrease in DBmax in Obese compared to Non obese.

DISCUSSION :

In the present study, there is an increase in mean heart rate during paced breathing in obese individuals. Normally the chronotropicity of heart is under the parasympathetic control[8]. In Hugh. Peterson et al[10] and Hirsch et al[11] it is showed that resting heart rate is increased with increase in body fat and 10 % increase in this body fat is associated with decline in parasympathetic tone. It is well documented that heart rate is inversely related to RR interval[9] (young et al). HRV shows the variations between consecutive heart beat and therefore beat to beat control mechanisms. Hence we hypothesized autonomic dysfunction in obese individuals and studied HRV in one minute controlled deep breathing in obese individuals.

It is well known that during deep breathing there is an increase in parasympathetic activity at SA node. Hence , the increase in heart rate observed in obese during deep breathing suggests that there is definite parasympathetic deactivation. Thus SDNN reflecting parasympathetic activity[8] is observed to be reduced in the obese individuals when compared to non obese. Also RMSSD , NN50 and pNN50 were also reduced in obese.

Deep breathing maximum is decreased in Obese compared to Non obese. The normal value for deep breathing for age group 18 – 25 years was 1.21 (Smith et al 1995). But in our study, DB max in obese is 1.17. This indicates a reduced respiratory sinus arrhythmia in obese which strongly reinforces decreased parasympathetic activity in obese [12]. The decrease in the DB in the study group may be due to reduced baroreflex sensitivity or impaired vagal afferents to the brain or an impaired ability of the brain stem to recognize the different signals resulting in an altered efferent signal to the heart and produce decreased cardiac parasympathetic activity [11].

This parasympathetic withdrawl explain a subclinical autonomic dysfunction in obese, which could be due to leptin resistance , inflammatory factors like TNF alpha, Interleukins and sedentary lifestyle [13,14]. This vagal restraint could be the reason for sudden death happening in the busy world.

CONCLUSION :

Our study indicates there is a reduction in the HRV. Cardiac autonomic function is impaired by decreased parasympathetic activity. The result suggest there is a need for monitoring increase in their weight and to prevent future complications.

Bibliography

1. Tonhajzerova. I et al . Cardiorespiratory interaction and Autonomic dysfunction in obese adolescents. Journal Of Physiology And Pharmacology 2008, 59, Suppl 6, 709-718

2. Simran Grewal, Vidushi Gupta et al. Effect of obesity on autonomic nervous system. Int J Cur Bio MedSci 2011; 1(2) 15 - 18.

3. Yadav K, Krishnan A (September 2008). "Changing patterns of diet, physical activity and obesity among urban, rural and slum populations in north India". Obes Rev 9 (5): 400–8.

4. Murray Esler, Nora Straznicky, Nina Eikelis, Kazuko Masuo, Gavin Lambert and Elisabeth Lambert; Mechanisms of Sympathetic Activation in Obesity-Related Hypertension. Hypertension 2006;48;787-796 originally published online Sep 25, 2006

5. Gary. G. Bernston et al . Respiratory Sinus Arrythmia : Autonomic Origins , Physiological mechanisms and psychophysiological implications . Psychophysiology 30(1993). Cambridge University Press. 180 – 193.

6. Paul Grossman et al. Toward understanding respiratory sinus arrhythmia: Relations to cardiac vagal tone, evolution and biobehavioral functions. Elsevier Biological Psychology 74 (2007) 263–285

7. WHO CRITERIA 2004; The International Classification of adult underweight, overweight and obesity according to BMI.

8. Task force of the European society of cardiology and the North American society of pacing and electrophysiology. Heart rate variability – standards of measurement, physiological interpretation, and clinical use. Circulation, 93(5):1043–1065, March 1996

9. Young FL, Leicht AS. Short-term stability of resting heart rate variability: influence of position and gender. Appl Physiol Nutr Metab. 2011 Apr;36(2):210-8.

10. Peterson HR, Rothschild M, Weinberg CR, Fell RD, Mcleish KR, Pfeifer MA. Body fat and the activity of the autonomic nervous system N Engl J Med.1988; 318:1077-1083.

11. Hirsch J, Leibel RL, Mackintosh R, Aguirre A. Heart rate variability as a measure of autonomic function during weight change in humans. Am JPhysiol. 1991 : 261; 1418- 23.

12. Peter G. Katona et al . Respiratory Sinus Arrythmia : Non invasive measure of parasympathetic cardiac control. Journal of Applied Physiology Vol 39, No: 5.
13. Christopher L. Kaufman, Daniel R. Kaiser,†JuliaSteinberger,‡ Aaron S. Kelly,‡§ and Donald R.Dengel* R. W. Lucky, Relationships of Cardiac Autonomic Function With Metabolic Abnormalities in Childhood Obesity.*
14. Gallistl S, Sudi KM, Aigner R Borkenstein M. Changes in serum interleukin-6 concentrations in obese children and Adolescents during a weight reduction program. Int J Obes Relat Metab Disord. 2001;25:1640 –3.

N= 30	OBESE		NON OBESE		p value
	Mean	Standard Deviation	Mean	Standard Deviation	
Age (years)	25.13	5.45	26.33	4.15	0.156
Weight (kilograms)	76.53	12.25	56.20	6.01	*0.01**
Height (centimetres)	155.06	6.96	160.46	4.75	0.125
BMI (Kg/ m2)	30.61	4.45	21.61	1.69	*0.01**

*p*0.05 - significant **p*0.01 - highly significant

N= 30	OBESE		NON OBESE		p value
	MEAN	STANDARD DEVIATION	MEAN	STANDARD DEVIATION	
Mean HR (beats per min)	84	6	71	12	*0.01**
Mean RR (milliseconds)	713	72	856	122	*0.01**
SDNN (milliseconds)	62.07	27.46	100.22	19.16	*0.01**
RMSSD (Milliseconds)	65.87	26.12	94.43	17.43	*0.01**
NN50	74.87	61.50	110.63	67.92	0.037*
pNN50 (%)	19.13	16.75	31.22	20.16	0.014*
DB max	1.17	0.03	1.26	0.05	*0.01**

*p*0.05 - significant , ** p*0.01 - highly significant