IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861. Volume 9, Issue 6 (Sep.- Oct. 2013), PP 01-05
www.iosrjournals.org

A Study of Heart Rate Recovery Following Exercise in Subjects with Normal Pulmonary Function Test

Dr.Jagnyaseni Panda[1], Dr.SnigdhaPrava Mishra[2], Dr.BipinBihari Pradhan[3]
[1]*Tutor, Department of physiology, M.K.C.G Medical College, Berhampur, Odisha.*
[2]*Associate Professor, Department of physiology, M.K.C.G Medical college, Berhampur, Odisha.*
[3]*Professor and Head of the department, Department of physiology, M.K.C.G Medical College,Berhampur, Odisha.*

Abstract:*Exercise is a common physiological stress which has positive chronotropic effect on heart rate and on cessation heart rate returns to pre-exercise level. A delay in heart rate recovery (HRR) (≤12beats in first minute) is considered abnormal and reflects autonomic dysfunction.Pulmonary function tests (PFT) are good indicator of autonomic function.Few studies are available on abnormal HRR (heart rate recovery) in COPDCases. Hence the present study was taken up to find out the presence of abnormal HRR in subjects with normal PFT and to establish HRR as an independent autonomic marker. For the study 150 healthy young adults (both male and female) with normal PFT were subjected to exercise by Bicycle ergometer till targeted Heart Rate (85%Maximum Heart Rate(MHR)) was achieved. HRR at the end of 1 minute followingcessation of exercise were tabulated. In our study 29 subjects (19.33%) with normal PFT show Abnormal HRR indicating HRR could be an independent autonomic marker.keyword-PFT,HRR,MHR.*

I. Introduction:

Exercise is a common physiological stress used to elicit cardiovascular abnormalities not present at rest and to determine the adequacy of cardiac function[1]. Physiologically it has positive chronotropic effect on heart rate due to sympathetic stimulation and parasympathetic (Vagal) withdrawal (Kluessetal 2000)[2]. On cessation of exercise parasympathetic reactivation and withdrawal of sympathetic activity ultimately leads to return of heart rate towards pre exercise level (Arai etal 1989)[3].Heart Rate Recovery (HRR) is defined as the change in heart rate from peak exercise to 1minute following cessation of exercise. Fall in heart rate ≤12beats after first minute following peak exercise is considered abnormal (cole.etal)[4].A delay in HRR reflects autonomic dysfunction. Role of Autonomic nervous system in regulation of cardio respiratory function is well documented. Pulmonary function tests which are good indicators of autonomic function are abnormal in patients with obstructive lung diseases[5].

There are few information regarding study on association of HRR and PFT. More ever the studies available are on subjects with lung pathology like COPD. Previousauthor have found out that patients with COPD demonstrate abnormal HRR (La Rovere MT) [6] 5,7,8,9,10,11). So the present study was taken up with the objective to find out the presence of abnormal HRR following exercise in healthy young adults with normal PFT and in such cases whether HRR by itself can be an independent autonomic marker.

II. Materials and Methods

This prospective study was conducted in the P.G Research Laboratory of Department of physiology, M.K.C.G Medical College Berhampur during the period from 2009-11 after due approval from the institutional ethics committee.

For the study healthy young adults between 17-24 years both male and female were included. From those, we selected 150 volunteers who confirmed to baseline spirometry with normal PFT. Cardiac monitor was connected to each subject and Blood pressure (B.P), Heartrate (H.R) and Oxygen saturation at rest were recorded. They were subjected to exercise by Bicycle Ergometer with digital display till targeted Heart Rate (85%MHR) was achieved or appearance of limiting symptoms like(chest discomfort,shortness of breath, dizziness) whichever was earlier. During exercise continuous recording of heart rate, Blood pressure and oxygen saturation were done by cardiac monitor.

At cessation of exercise therecording of HR, B.P and oxygen saturation were noted. HRR at the end of 1minute after cessation of exercise were tabulated and analyzed.

III. Observation and Analysis

Basal spirometry was done and subjects with normal pulmonary function test (PFT) were included in our study. The data of both dynamic lung function and flow rates are given in table 1 & 2 for male and female.

TABLE 1

OBSERVED AND PREDICTED VALUE OF DYNAMIC LUNG FUNCTION PARAMETERS MALE AND FEMALE.

Parameters	Male(n=106)		Female(n=44)	
	Observed Value (Mean ± SD)	Predicted Value (Mean ± SD)	Observed Value (Mean ± SD)	Predicted Value (Mean ±SD)
FVCex(L)	3.96±0.59	4.41±0.53	2.99±0.43	3.24±0.47
FEVI(L)	3.54±0.49	3.77±0.44	2.77±0.38	2.81±0.41
FEVI/FVC(%)	89.58±6.06	83.31±0.82	93.00±4.73	84±0.92

TABLE 2

OBSERVED AND PREDICTED VALUE OF EXPIRATORY FLOW REATES MALE & FEMALE

Parameters (L/sec)	Male(n=106)		Female(n=44)	
	Observed Value (Mean ±S.D)	Predicted Value (Mean ± S.D)	Observed Value (Mean± S.D)	Predicted Value (Mean ±S.D)
MEF_{25}	2.32±1.02	2.23±0.88	2.18±0.98	2.01±0.81
MEF_{50}	5.30±1.21	4.97±0.50	4.47±1.21	4.11±0.52
MEF_{75}	7.77±1.45	7.5±0.90	5.88±1.26	5.75±0.78
MEF_{25-75}	4.56±1.08	4.64±0.49	3.96±1.02	3.77±0.54
PEF	8.44±1.37	8.81±1.12	6.21±1.27	6.48±0.95

TABLE 3

ANTHROPOMETRIC PARAMETERS OF THE STUDY GROUP

Parameters	Male(n=106) Male (Mean ±S.D)	Female(n=44) Female (Mean ±S.D)
Age(yrs)	19.00±1.24	21.00±10.78
Height (mtr)	1.66±0.07	1.55±0.066
Weight(Kg)	62.6±12.22	56.00±12.14
B.M.I(kg/m^2)	22.75±4.04	23.50±5.35

Study includes subjects with normal B.M.I both male and female.

TABLE 4

PRE EXERCISE PARAMETERS

Parameters	Male(n=106) Male (Mean ±S.D)	Female(n=44) Female (Mean±S.D)
Heart Rate (beats/min)	77±3.86	78±5.79
Blood Pressure(mmHg)		
Systolic	119±6.34	114±6.23
Diastolic	81±3.86	79±4.35
Oxygen Saturation (%)	98±1.25	98±1.03

Mean heart rate, Blood Pressure both systolic, diastolic &oxygen saturation are within normal range in both male and female.

TABLE 5

EXERCISE PARAMETERS (Male)n=106

Parameters	Pre-Exercise (Mean±S.D)	End of Exercise (Mean ±S.D)	1 min after cessation of exercise (Mean ±S.D)
Heart Rate (Beats/Min)	77±6.34	163±9.13	140±13.58
Blood Pressure(mmHg)			
Systolic	119±6.34	142±10.54	136±8.63
Diastolic	81±3.86	89±6.32	87±5.15
Oxygen Saturation (%)	98±1.25	98±1.14	99±0.81

After exercise mean heart rate increased to 163 ± 9.13 and came down to 140 ± 13.58, 1 minute following cessation of exercise.

TABLE 6

EXERCISE PARAMETERS OF SUBJECTS WITH ABNORMAL HEART RATE RECOVERY (Male) n=23

Parameters	Pre-Exercise (Mean ±S.D)	End of Exercise (Mean ± S.D)	1 min after cessation of exercise(Mean ± S.D)
Heart Rate (Beats/Min)	78±5.75	164±6.46	155±5.79
Blood Pressure(mmHg)			
Systolic	119±8.15	144±10.45	136±9.43
Diastolic	82±4.05	92±4.80	89±3.11
Oxygen Saturation (%)	98±1.56	98±0.79	98±0.65

23 male subjects showed abnormal HRR following 1 minute after cessation of exercise, the mean heart rate came down to 155±5.79 following 1 minute after cessation of exercise from 164±6.46 at end of exercise.

TABLE 7

EXERCISE PARAMETERS (Female) n=44

Parameters	Pre-Exercise (Mean ±S.D)	End of Exercise (Mean ± S.D)	1 min after cessation of exercise(Mean ± S.D)
Heart Rate (Beats/Min)	76±5.79	161±8.19	137±13.25
Blood Pressure(mmHg)			
Systolic	114±6.23	136±7.20	130±7.53
Diastolic	79±4.35	89±5.49	87±6.51
Oxygen Saturation (%)	98±1.03	98±1.01	99±0.58

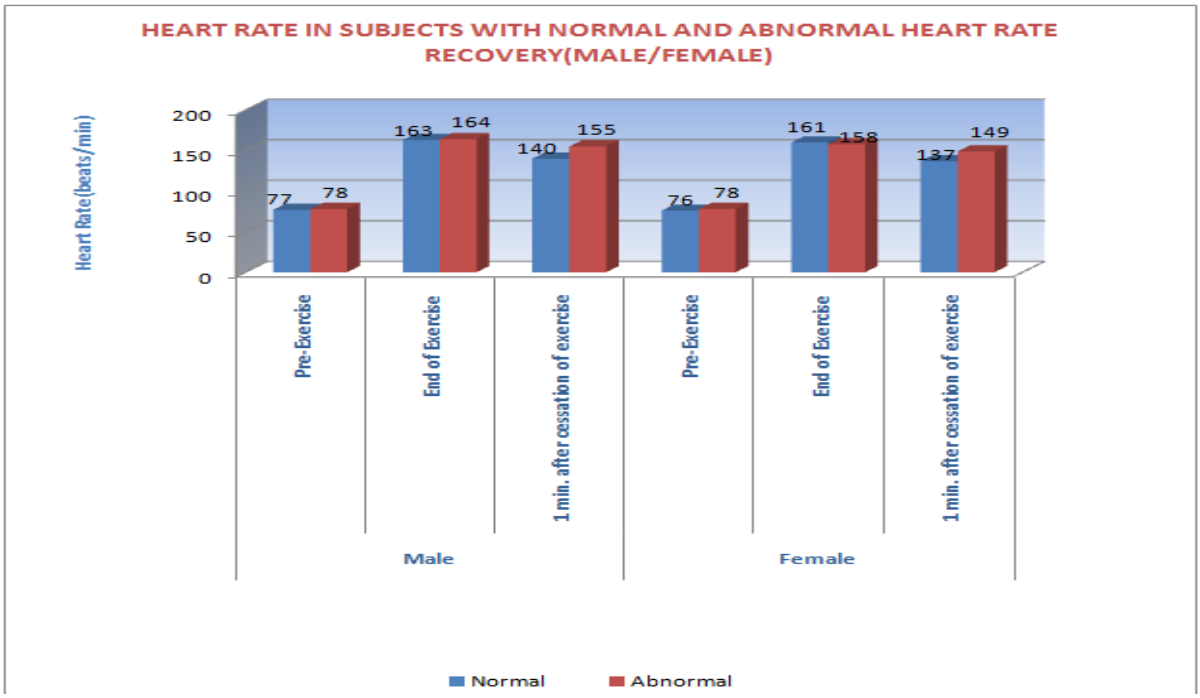
The mean heart rate in female was 76±5.79 in pre-exercise state and increased to 161±8.19 following exercise. The HRR was normal with 137±13.25 following 1 min after cessation of exercise.

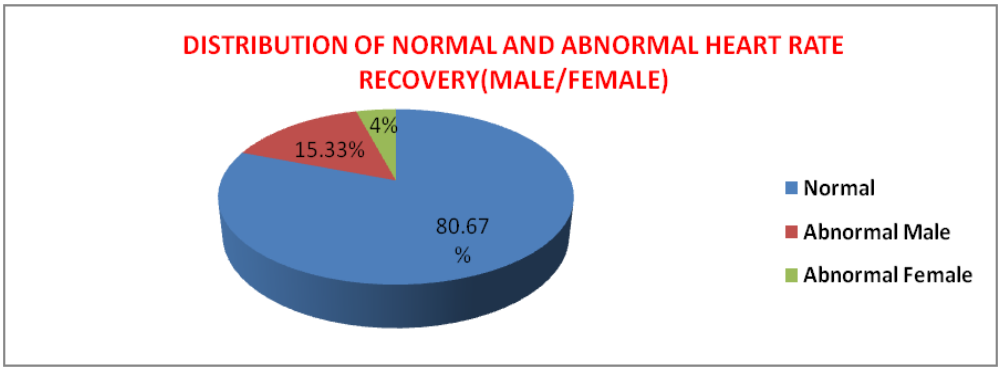
TABLE8

EXERCISE PARAMETERS OF SUBJECTS WITH ABNORMAL HEART RATE RECOVERY (Female) n=6

Parameters	Pre-Exercise (Mean ± S.D)	End of Exercise (Mean ± S.D)	1 min after cessation of exercise (Mean ± S.D)
Heart Rate (Beats/Min)	78±4.50	158±12.66	149±11.29
Blood Pressure(mmHg)			
Systolic	118±5.66	146±6.05	141±8.38
Diastolic	79±6.20	93±4.43	89±0.98
Oxygen Saturation (%)	98±1.89	99±0.49	99±0.49

Out of 44 females only 6 showed abnormal HRR with heart rate 149±11.29 following 1 min after cessation of exercise from 158±12.66 at the end of exercise.





IV. Discussion

Out of the total 150 healthy subjects of our study, only 29 showed abnormal HRR[4] .All of themhad normal PFT. Heart Rate (HR) during dynamic exercise is regulated by a combination of neural, hormonal and intrinsic mechanism. At the onset of exercise the rise in heart rate is thought to be mediated by withdrawal of inhibitory vagal tone. Central command from higher brain centre and input from mechanoreceptors in muscle contribute to this early response.[12, 13] At higher heart rate, increase sympathetic out flow to the heart, increased level of circulatory catecholamine and temperature of pacemaker tissue also play a role [14, 15, 16]. Immediately after exercise acceleratory influence from higher brain centre and peripheral nerve reflexes diminish and heart rate is thought to be primarily regulated by restoration of vagal inhibitory tone[17-20]

HRR following exercise correlates with vagal tone and a decrease of HRR in the first minute of the exercise is associated with increased mortality[7-11]. Our study therefore is suggestive of possibility that the HRR following exercise is highly sensitive enough to reflect the autonomic dysfunction due to decreased vagal tone. So, it can be an independent autonomic marker, which is easy to obtain in any clinical set up. Few studies have found out that delay in HRR following exercise, which may be a influence of decrease vagal activity is a powerful predictor of overall mortality, independent of work load, the presence or absence of myocardial perfusion defects [21]. This marker is simple to calculate from data that are already contained in the results of standard exercise tests and may be valuable for the assessment of risk in routine clinical practice.

V. Summary and Conclusion:

Our study consisting 150 healthy individuals of either sex, within age group 17-24 years, was carried out to assess the presence of abnormal HRR following dynamic exercise in subjects with pulmonary functions. Also we aimed at using HRR as an independent autonomic marker. From our study we found out that, 19.33% of total subjects with normal lung function showed abnormal HRR. Therefore we can conclude that although both pulmonary functions and HRR reflect automatic dysfunction, HRR could be an independent variable as a prognostic marker.

References:

[1]. Hurst's The Heart ValentinFuster, Richard A Walshs , Robert ,A.Harrington ,Thirteenth Edition, McGraw Hill Medical, Vol.1, P.371.
[2]. KlussH.A.Wood.R.H. andWelsch.M.A(2000) Vagal modulation of the heart and central hemodynamics during handgrip exercise.American journal of physiology 279,H1648-H1652.
[3]. Arai.Y.Saul.J.P.Albrecht,P.Hartley,L.H,Lilly,L.s,Cohen, R.J. and Colucci,W.S(1989). Modulation of Cardic autonomic activity during and immediately after exercise. American journal of physiology256,H132-H141.
[4]. Cole CR, Blackstone EH, PashkowFJ,et al. Heart-rate recovery immediately after exercise as a predictor of mortality .N Engl J Med 1999,341:1351-1357.
[5]. NiranjanSeshadri,ThomasR,Gildea,Kevin McCarthy, RCPT, Claire Pothier, Mani S .Kavure and Michael S.Lauer.Association of an abnormal exercise Heart Rate Recovery with Pulmonary Function Abnormalites. Chest/125/4/April,2004.
[6]. La RovereMT,BiggerJT,MarcusFI,et al. Baroreflex sensitivity and Heart Rate variability in prediction of total cardiac mortality after myocardial infraction . Laneet 1998;351:478-484.
[7]. Stewart AG,Waterhosue JC, HowordP.TheQTc interval, autonomic neuropathyand mortality in hypoxemic COPD,Respir Med,1995;89:79-84.
[8]. Stewart AG,Marsh F, Waterhosue JC et al. Autonomic nerve dysfunction in COPD as assed by the acetylcholine sweat spot test .EurRespir J ,1994;7:1090-1095.
[9]. Stewart AG,Waterhosue JC, HowordP.Cardiovascular autonomic nerve function in patients with hypoxemic chronic obstructive pulmonary disease. EurRespir J,1991;4:1207-1214.
[10]. SteinPK,NelsonP,Rottman JN et al.Heart rate variability reflects severity of COPD in Piz Alpha-antitryspindeficiency.Chest 1998;113,327-333.
[11]. Volterrani M,ScalvineS,Mazzuero G, et al. Deceased heart rate variability in patients with chronic obstructive pulmonary disease,Chest,1994;106:1432-1437.
[12]. MacielBC,L.Gallo,M.Neto,EC Lima Filho,and LB Martin .Autonomic nervous control of the heart rate during dynamic exercise in normal man. Clin.Sc.71:457:460,1986.

[13]. Mitchell JH, WC Redon and DI McCloskey. Reflex effect on circulation and respiration for contracting skeletal muscle.Am.J.Physiol,233(Heart Circ.Physiol 2):H374-H378,1977.
[14]. Lamb DL. The physiology of aerobic endurance.In: Physilogy of exrcise(2nd e3d),New York,Macmillan,1984,P.137-143.
[15]. Robinson BF,SE Epstin,GDBeiser and E.Braunwald. Control of Heart rate by the autonomic nerves system .Circ.Res.19:400-411,1966.
[16]. VonEuler,US.Sympatho-adrenal activity in physical exercise.Med.Sci.Sports,6:165-173,1973.
[17]. Blomqvist CG and B. Saltin. Cardiovascular adaptations to physicicaltraining.Annu Rev.Physiol.45:169-189,1983.
[18]. Savin WM,DM Davidson and Wl Haskell. Autonomic contribution to heart rate recovery from exercise in humans.J.Appl.Physiol,53:1572-1576,1982.
[19]. Savin WM,WM Haskell, JS Schroeder and EB Stinson. Cardiorespiratory responses of cardiac transplanting patients to graded ,symptom limited exercise.Circulation 64:55-60,1980.
[20]. Scheuer J. and CM Tipton. Cardiovascular adaptations to physical Training.Annu Rev Physiol,39:221-251,1976.
[21]. Christopher R,ColeMD,Eugene H, Black Stone MD,FredricJ,Pshkow MD, Claire E,Snader MA and Michael Laucher MD. Heart rate recovery immediately after exercise as a predictor of mortality,Vol.341:1351-1357,October,28,1999.