Original Article

Heart Rate Recovery and Lipid Profile in Postmenopausal Women

Sasikala.J[1], Gnanavel.P[2], Milind V.Bhutkar[3]

[1]Tutor in Physiology, Department of Physiology, Government Dharmapuri Medical College, Dharmapuri,Tamil Nadu. [2]Assistant Professor, Department of Cardiology, Govt Mohan Kumaramangalam Medical College, Salem, Tamil Nadu. [3]Professor and HOD, Department of Physiology, Vinayaka Missions Kirupananda Variyar Medical College, Salem, Tamil Nadu.

ABSTRACT

Background : The present study was undertaken because there is only limited information available regarding the effect of menopause over heart rate recovery and lipid profile.

Aim: Aim of the study was to calculate heart rate recovery and to estimate lipid profile and to compare the parameters between pre and post menopausal women.

Materials and Methods: The present cross-sectional study was conducted in 120 healthy non athletic female volunteers consisted of 60 premenopausal women between the age group of 40-45 years and 60 post-menopausal women between the age group of 45-50 years. All the 120 subjects underwent a modified Bruce exercise protocol testing on a treadmill after taking blood sample for lipid profile. Heart rate was recorded during the exercise at each stage and also during the recovery period (1 minute, 2 minute and 5 minutes after the exercise)

Result: The heart rate recovery was lower in the post-menopausal group when compared to premenopausal women and the difference was statistically significant (P<.0001). The mean of the total cholesterol, LDL, triglycerides and VLDL were comparatively higher in the post-menopausal group than that of the pre-menopausal group and the difference was statistically significant (P<.0001).

Conclusion: Our data suggested that post menopausal women had delayed heart rate recovery and increased total cholesterol, LDL, VLDL, triglycerides and reduced HDL when compared to premenopausal women.

Keywords: Heart rate recovery, lipid profile, postmenopausal women.

INTRODUCTION:

The incidence of coronary heart disease rises significantly after menopause. It has been hypothesized that cardio protective effect before menopause could be due to the effect of natural hormone oestrogen and the decreased cardiac autonomic activity among post-menopausal women might be due to depletion of oestrogen.

Clinical evaluation of heart rate recovery (HRR) is being used as a prognostic tool for diagnosing cardiovascular diseases. HRR is mainly thought to be due to parasympathetic reactivation.[1] A delayed decline of heart rate has been associated with increased risk of cardiovascular mortality. At the end of exercise a decrease of 15-20 beats per minute (bpm) in the first minute of recovery has been shown to be typical for a healthy person.[2] A first minute reduction of post-exercise heart rate less

Address for correspondence:
Dr.Gnanavel P., Department of Cardiology, Government Mohan Kumaramangalam Medical College, Salem, Tamilnadu-636 308.
Email id: drsasikalagnanavel@gmail.com

than 12 bpm if recovery is active or 18 bpm if recovery is passive in the supine position after a maximal exercise test, represents an unfavorable prognosis.[3] Serum lipid profile has now become almost a routine test in predicting cardiovascular risk.

AIM &OBJECTIVES:

The aim of the present study was to calculate heart rate recovery and estimate lipid profile and to compare the parameters between pre and post menopausal women.

MATERIALS AND METHODS:

The present cross-sectional study was conducted to assess the heart rate recovery and lipid profile in 120 healthy nonathletic female volunteers.

Group I - 60 premenopausal women between the age group of 40-45 years having regular menstrual cycle.

Group II - 60 post-menopausal women between the age group of 45-50 years who had menopause naturally at least 2 years before.

Exclusion criteria

Subjects with:

1. Diabetes Mellitus
2. Hypertension
3. Cardiovascular diseases which included valvular diseases, coronary artery diseases and atherosclerosis
4. Dyslipidemia
5. H/O taking oral contraceptive pill were excluded from the study.

Informed written consent was obtained from all the participants. Ethical clearance was obtained from the institutional ethics committee

Procedure

The subjects were made to rest for 15 minutes. Pulse and BP were recorded.

Blood samples for blood sugar estimation and lipid profile estimation were collected from group1 individuals during 6th -10th day of the menstrual cycle, as hormonal level varies with phases of the menstrual cycle. Fasting blood samples were collected in the morning between 7 a.m. and 8 a.m. Results were collected after 2 hours. After excluding Diabetes mellitus and dyslipidemia, subjects were allowed to undergo treadmill test.

Before starting the exercise, screening echocardiogram was done for all the subjects with GE-Vivid 'e' portable echocardiogram and structural cardiac abnormalities were ruled out. All the 120 subjects underwent a modified Bruce exercise protocol testing on a treadmill as shown in figure 1. The modified Bruce exercise protocol is a description for the increments in speed and gradient in the treadmill test which starts at a lower work load than the standard test and is typically used for elderly or sedentary patients.[4]

The modified Bruce exercise protocol consists of seven stages

Stages	Speed MPH	Gradient	Duration (min)	Cumulative time(min)
Stage 1	1.7	0%	3	3
Stage 2	1.7	5%	3	6
Stage 3	1.7	10%	3	9
Stage 4	2.5	12%	3	12
Stage 5	3.4	14%	3	15
Stage 6	4.2	16%	3	18
Stage 7	5.0	18%	3	21

Figure 1.Treadmill Test

Heart rate was recorded during the exercise at each stage and also during the recovery period (1 minute, 2 minute and 5 minutes after the exercise). Heart rate was shown by software system connected to treadmill. Maximal heart rate to be achieved was estimated by using a formula i.e. (220 minutes the age in years). Blood pressure was recorded at each stage of exercise and during the recovery period.

Muscle fatigue, dyspnoea and the maximum predicted heart rate were considered as normal end points. If any abnormal responses to exercise occurred which includes angina, dizziness, dyspnoea, leg cramps and declining systolic blood pressure during the exercise, the exercise was discontinued before reaching the maximum effort of the subject.

Calculation of heart rate recovery:

After the exercise, the subjects were asked to sit and rest. The heart rate was recorded after an interval of one minute, two minutes and five minutes of rest. The heart rate recovery was calculated by subtracting peak heart rate with heart rate at one minute after exercise to get heart rate recovery at one minute. Similarly, heart rate recovery at two minutes and five minutes were calculated.[5]

STATISTICALANALYSIS:

Comparison of mean of heart rate recovery and lipid profile between pre and post-menopausal group was done by applying unpaired 't' test.

Table 1. Comparison of mean of heart rate recovery between Pre and Post-menopausal group

Parameters	Pre-menopausal Mean	Post-menopausal mean	P value
Resting heart rate/Min	81.62	90.0	<.0001
Peak heart rate/Min	141.89	148.2	<.0001
Heart rate recovery@1 min	33.57	26.4	<.0001
Heart rate recovery @2 mins (Beat/Min)	45.25	36.7	<.0001
Heart rate recovery @5 mins (Beat/Min)	54.71	49.5	<.0001

As shown in table 1, the mean of the resting and peak heart rate of the post menopausal women were comparatively higher than that of the pre-menopausal women and this increase was found to be statistically significant (p<.0001). Whereas the heart rate recovery @1min, 2mins and 5mins were higher in the pre-menopausal group when compared to the post-menopausal women and this difference was also found to be statistically significant (P<.0001).

Table 2. Comparison of Lipid profile between Pre and Post-menopausal group

Parameters	Pre-menopausal (Mean)	Post-menopausal (Mean)	P value
Total cholesterol (mg/dL)	145.3	175.8	<.0001
LDL (mg/dL)	72.9	107.5	<.0001
HDL (mg/dL)	50.64	39.8	<.0001
Triglycerides (mg/dL)	108.8	141.8	<.0001
VLDL (mg/dL)	21.8	28.5	<.0001

As depicted in table 2, the mean total cholesterol, LDL, triglycerides and VLDL were comparatively higher in the post-menopausal group than that of

the pre-menopausal group and the difference was statistically significant (P<.0001). The mean of HDL was higher in the pre-menopausal group than that of the post-menopausal group and the difference was also statistically significant (p<.0001).

DISCUSSION:

The present study showed that heart rate recovery is better among the premenopausal women when compared with post-menopausal women. It denotes the decreased cardiac autonomic activity among post-menopausal women might be due to depletion of oestrogen. Oestrogen may block the release of endothelium-derived constricting factors or enhance the release or bio availability of nitric oxide from endothelial cells, resulting in increased cGMP in underlying smooth muscle and vasorelaxation. Nitric oxide stabilizes the endothelial cells, enhances antioxidant effect and alters fibrinolysis protein. All these cardio protective mechanisms are lost after menopause.[6]

Moodithaya SS et al., have shown that both ageing and declined oestrogen levels are associated with autonomic alterations seen among postmenopausal women.[7] Suchita Nadkarni et.al., study have shown that annexin-A1 (AnxA1) and oestrogen levels were strongly linked throughout the menstrual cycle. Pre menopausal women expressed higher levels of surface AnxA1 on circulating human polymorphonuclear cells (PMN). Treatment of human PMN with oestrogen (E2) inhibited cell adhesion to an endothelial cell monolayer under shear, which was absent when endogenous AnxA1 was neutralized. Thus, from the above study, it can be concluded that oestrogen activates vasculo-protective mechanisms via AnxA1 mobilization in PMN cells.[8]

Effect of oestrogen on lower density lipoprotein (LDL)

The reduction in LDL cholesterol level is probably a result of accelerated conversion of hepatic cholesterol to bile acids and increased expression of LDL receptors on cell surfaces resulting in augmented clearance of LDL from the plasma.[9] Oestrogen participates in both lipogenesis and lipolysis. At the transcriptional level they increase the hepatic expression of apoprotein genes and the LDL receptors and decrease the transcription of the lipoprotein lipase gene through oestrogen receptor alpha (ERα). Thus, when oestrogen level decreases after the menopause, an increase in the lipoprotein lipase enzyme(LPL) activity is observed and this probably contributes to the increase of free fatty acids and the accumulation of abdominal fat.[10] Another mechanism is oestrogen increases hepatic production of apolipoprotein A and decreased hepatic elimination of high density lipoprotein-C (HDL-C) by reducing activity of hepatic lipase. Since during menopausal period oestrogen level is low, all these actions are hampered resulting in increased total cholesterol (TC) and LDL-C and decreased HDL-C level.

Exercise and lipid profile

Exercise and low fat diet can help the post-menopausal women to increase HDL-C levels and reduce other lipid levels. Free fatty acids are the main source of energy during exercise. To mobilize the energy stored in adipose tissue for use during physical activity, stored triglycerides are hydrolyzed to form free fatty acids and glycerol. Adipose triglyceride lipase and hormone-sensitive lipase are the major enzymes contributing to triglyceride breakdown.[11] Thus exercise decreases serum levels of TC, TG and VLDL and reduced physical activity in the post-menopausal period elevates their levels. Sunami et al., have shown that low-intensity aerobic training may improve the profile of HDL-C and its subfractions in healthy elderly subjects.[12]

CONCLUSION:

Our data suggests that post menopausal women had delayed heart rate recovery when compared to premenopausal women. Total cholesterol, LDL, VLDL, triglycerides were increased significantly (P<.0001) in postmenopausal women. Postmenopausal women showed reduced HDL (P<.0001) when compared to premenopausal women. Loss of ovarian function after menopause results in adverse changes in glucose and insulin metabolism, body fat distribution, coagulation, fibrinolysis, vascular endothelial dysfunction and also derangement of lipoprotein profile.

REFERENCES:

1. Fletcher GF, Balady GJ, Amsterdam AE, Chaitman B, Eckel R, Fleg J, et al. Exercise standards for testing and training. A statement for health care professionals from the American heart association.Circulation. 2001 Oct 2;104(14):1694-1740.

2. Shetler S, Marcus R, Froelicher VF, Vora S, Kalisetti D, Prakash M, et al. Heart rate recovery: validation and methodological issues.J Am Coll Cardiol. 2001 Dec; 38(7):1980-1987.

3. Cole CR, Blackstone EH, Pashkow FJ, Snader CE, Lauer MS. Heart rate recovery immediately after exercise as a predictor of mortality.N Engl J Med. 1999 Oct 28;341(18):1351-1357.

4. Bruce RA. Multi-stage treadmill test of maximal and sub maximal exercise. In: Bruce RA, eds. Exercise Testing and Training of apparently Health Individuals: A handbook for physicians. USA: American Heart Assoc.; 1972: 1-40.

5. Cole CR, Foody JM, Blackstone EH, Lauer MS. Heart rate recovery after sub maximal exercise testing as a predictor of mortality in a cardiovascularly healthy cohort. Ann Intern Med. 2000 Apr 4;132(7):552-555.

6. Srinivas Reddy Kilim and Srinivasa Rao Chandala. A comparative study of lipid profile and oestradiol in pre- and post-menopausal women. J Clin Diagn Res. 2013 Aug; 7(8): 1596–1598.

7. Moodithaya SS, Avadhany ST. Comparison of cardiac autonomic activity between pre and post-menopausal women using heart rate variability. Indian J Physiol Pharmacol. 2009 Jul-Sep; 53(3):227-234.

8. Suchita Nadkarni, Dianne Cooper, Vincenzo Brancaleone, StefaniaBena, and Mauro Perretti. Activation of the annexin A1 pathway underlies the protective effects exerted by oestrogen in polymorphonuclear leukocytes. Arterioscler Thromb VascBiol, 2011 Nov;31(11):2749-2759.

9. Windler E, Kovanen PT, Chao YS, Brown MS, Havel RJ, Goldstein JL. The oestradiol-stimulated lipoprotein receptor of rat liver. J Biol Chem. 1980; 255(21):10464-10471.

10. Mayes JS, Watson GH. Direct effects of sex steroid hormones on adipose tissues and obesity. Obes Rev. 2004 Nov;5(4):197-216.

11. Martina, Schweiger, Renate Schreiber, Guenter Haemmerle, Achim Lass, Christian Fledelius, Poul Jacobsen et.al.,Adipose triglyceride lipase and hormone –sensitive lipase are the major enzymes in adipose tissue triacylglycerol catabolism. Journal of Biological Chemistry 2006 Oct 30;281(52):40236-40241.

12. Sunami Y, Motoyama M, Kinoshita F, Mizooka Y, Sueta K, Matsunaga A, Sasaki J, Tanaka Het. al., Effects of low-intensity aerobic training on the high-density lipoprotein cholesterol concentration in healthy elderly subjects. Metabolism. 1999; 48(8):984-988.

Received on 28/07/2017 **Revised** on 28/08/2017 **Accepted** on 01/09/2017