ORIGINAL ARTICLE

MAXIMAL EXERCISE TESTING –AS IT ELICITS A VARIED CARDIOVASCULAR RESPONSE IN PERIMENOPAUSAL WOMEN DURING PROLIFERATIVE PHASE OF MENSTRUAL CYCLE

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Background: The role of hormones on lung function tests was well-known in the normal course of the menstrual cycle. Significant increase in both progesterone (37%) and estradiol (13.5%), but no change in plasma follicle stimulating hormone and luteinizing hormone was observed in exercising women in previous studies. Therefore, this study was intended to see the limitations of the cardiovascular system in adaptability to exercise in proliferative phase of the menstrual cycle in perimenopausal obese woman. **Methods:** Healthy young adult females between 42 and 45 years who regularly undergo training and participate in competitive middle distance running events for at least past 3 years were considered in the control, whereas the study group, consisting of obese women did not have any such regular exercise program. The two groups were in perimenopausal age group. They were made to undergo maximal treadmill testing. **Results:** It was observed that exercise *per se* does not cause a statistically significant change in cardiovascular function parameters but Maximum oxygen pulse is an index representing both stroke and A-V oxygen difference. A higher value in those exercising regularly suggests that training increases both stroke volume and average A-V oxygen differences. **Conclusion:** This finding supports the hypothesis that the cardiovascular system is not normally the most limiting factor in the delivery of oxygen even under the predominant influence of oestrogen in proliferative phase, which is further accentuated by exercise.

Keywords: Cardiovascular adaptability, oestrogen in exercise, obese, Heart rate, Stroke volume.

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INTRODUCTION

The role of hormones on the healthy pulmonary system in delivering oxygen to meet the demands of various degrees of exercise has been a matter of difference of opinion. Genomic actions are exerted by steroids such as oestrogen, progesterone and testosterone with intracellular receptors.[1] Prevention and treatment of negative affect associated with perimenopause is becoming increasingly important. Various studies suggest that natural changes in endogenous oestrogen levels may underlie women with increased susceptibility to physiological limitations as a result of the aging process.[2] Fluctuations in ventilation and alveolar Pco_2 in various phases of the menstrual cycle have been ascribed to the action of progesterone, though this may not be the sole determinant of these changes.[3] There are conflicting reports that the respiratory system is not normally the most limiting factor in the delivery of oxygen to the muscles during maximal muscle aerobic metabolism, whereas others do not support this.[4] Within this context it is appropriate to study the effect of proliferative phase of the menstrual cycle on ventilatory functions after exercise. Mechanical constraints on exercise hyperpnoea have been studied as a factor limiting performance in endurance athletes.[5] Others have considered the absence of structural adaptability to physical training as one of the 'weaknesses' inherent in the healthy pulmonary system response to exercise.[6] Ventilatory functions are an important part of functional diagnostics[7], aiding selection and optimization of training and early diagnosis of sports pathology. Assessment of exercise response of dynamic lung functions in the healthy pulmonary system in the trained and the untrained has a role in clearing gaps in the above areas, especially a special group like menopausal women.

MATERIAL AND METHODS

The present study was conducted as a part of cardiovascular efficiency studies on two groups of the study group consisting of obese sedentary women (n=20) and control group (n=20) comparable in age and sex. Informed consent was obtained and clinical examination to rule out any underlying disease was done. Twenty healthy young adult females between 42 and 45 years who regularly undergo training and participate in competitive middle distance running events for at least past 3 years were considered in the control group, whereas the study group did not have any such regular exercise program. Smoking, clinical evidence of anaemia, disorder of the cardiovascular system was considered as exclusion criteria.[8] Menstrual history was ascertained to confirm proliferative phase of the menstrual cycle. Detailed procedure of exercise treadmill test by Bruce treadmill protocol was explained to the subjects and VO_2 max (maximum oxygen consumption) levels were measured. Before exercise, resting heart rate was noted. After maximal exercise VO_2 max was assessed indirectly by using Astrand's nomogram.

Maximal heart rate was determined by electrocardiogram. The delta heart rate was obtained by calculating the difference between the maximal heart rate and resting heart rate. The recovery heart rate was recorded after a period of 1 minute from the cessation of maximum exercise. Lead II was selected in ECG machine and ECG was recorded for 15 sec.
Recovery heart rate was obtained by using the formula:

Recovery Heart Rate (HR)= 15-s HR×4

Statistical analysis was performed using paired Student's *t*-test for comparing parameters within the group before and after exercise testing, and unpaired *t*-test for comparing the two groups of the study, and $p<0.05$ was considered statistically significant.

RESULTS

On comparing the anthropometric data of the two study groups it is clear that the age and sex matched subjects have no statistically significantly difference in height, weight and Body Mass Index, taking $p<0.05$ as significant (Table-1)

Table-1: Comparison of anthropometric data and VO_2 max of study and control groups

Parameter	Study group	Control group	*p*
Age (Year)	43.51±2.62	43.47±2.84	<0.10 (NS)
Height (Cm)	159.71±7.50	155.91±7.24	<0.10 (NS)
Weight (Kg)	72.66±5.64	55.43±6.26	<0.05*
BMI (Kg/m²)	28.99±2.47	21.60±1.75	<0.001**

*Significant, **Highly significant, BMI= Body mass index

On comparing the cardiovascular efficiency parameters, it was observed that resting HR and recovery HR was higher in study group, whereas in control group had higher delta HR. The maximum HR was numerically higher in control group, but it was not statistically significant. (Table-2)

Table-2: Comparison of cardiovascular efficiency parameters of study and control groups

Parameter	Study group	Control group	*p*
Resting HR(/min)	76.85±6.05	61.62±6.73	<0.001**
Max HR(/min)	186.25±4.50	187.00±8.00	>0.05
Delta HR(/min)	109.3±5.64	125.34±6.26	<0.001**
Recovery HR(/min)	148.83±9.06	135.92±14.14	<0.001**

**Highly significant, HR: Heart rate

DISCUSSION

Considerable information can be obtained by studying cardiovascular response to exercise in untrained and trained subjects. Intragroup comparisons are helpful in noting the exercise response and intergroup comparison in evaluating adaptations of the cardiovascular system to exercise training.[9]

On comparing the anthropometric data of the two study groups, it is clear that age and sex matched subjects have no statistically significant difference in height, weight and body mass index taking $p<0.05$ as significant.

VO_2 max values were higher in study group and was statistically highly significant ($p<0.001$). This observation is expected in view of the training stimulus and adaptability of cardiovascular system.[10] VO_2 max is an objective index of the body's ability to generate power.

The lower resting heart rate in the study group is attributable to the higher vagal tone and supports the hypothesis that endurance training modifies heart rate control through neuro-cardiac mechanism.

There is no significant difference in the maximal heart rate between the two groups; this indicates a better stroke volume in study group increasing their VO_2 max. The higher delta heart rate in the study group suggests that this group is at a lesser risk for cardiovascular mortality.

CONCLUSION

The cardiovascular system is not normally the most limiting factor in the delivery of oxygen even under the predominant influence of a sedentary and obese lifestyle of the group studied.

REFERENCES

1. Cunningham GR, Tindall DJ, Means AR. Differences in steroid specificity for rat androgen binding protein and the cytoplasmic receptor. Steroids 1979;33:261–76.
2. Pakkala A. Mid career blues in healthcare workers: A physiological approach in ethical management. J Midlife Health 2010;1(1):35–7.
3. Frye CA. Steroids, reproductive endocrine function, and affect. A review. Minerva Ginecol 2009;61:541–62.
4. Guyton AC, Hall JE, editors. Text Book of Medical Physiology. 11th ed. Missisippi: Saunders; 2006. p. 1061–2.
5. Johnson BD, Saupe KW, Dempsey JA. Mechanical constraints on exercise hyperpnea in endurance athletes. J Appl Physiol 1992;73:874–86.
6. Dempsey JA, Johnson BD, Saupe KW. Adaptations and limitations in the pulmonary system during exercise. Chest 1990;97:81S-7.
7. Andziulis A, Gocentas A, Jascaniniene N, Jaszczanin J, Juozulynas A, Radzijewska M. Respiratory function dynamics in individuals with increased motor activity during standard exercise testing. Fiziol Zh 2005;51(4):86–95.
8. Seaton A, Seaton D, Leitch AG, editors. Crofton and Douglas's Respiratory Diseases. 5th ed. Oxford: Oxford University Press; 2000. p. 43–5.
9. Bonen A, Ling WY, MacIntyre KP, Neil R, McGrail JC, Belcastro AN. Effects of exercise on the serum concentrations of FSH, LH, progesterone, and estradiol. Eur J Appl Physiol Occup Physiol 1979;42:15–23.
10. Jurkowski JE, Jones NL, Walker C, Younglai EV, Sutton JR. Ovarian hormonal responses to exercise. J Appl Physiol 1978;44:109–14.

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