Endurance Testing in A Group of Indian Athletes and Non Athletes

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ABSTRACT

Background: The role of estrogen on the heart is well known in the normal course of the menstrual cycle. Significant increase in both progesterone (37%) and estradiol (13.5%), whereas no change in plasma FSH & LH was observed in exercising women in previous studies. Therefore this study was intended to see the limitations of the pulmonary system in adaptability to exercise in proliferative phase of menstrual cycle in perimenopausal women.

Material and Methods: Healthy adult females between 42-45 years who regularly undergo training and participate in competitive middle distance running events for at least past 3 years were considered in the athlete group whereas the non-athlete group did not have any such regular exercise program. Dynamic heart functions were measured in both groups before exercise was evaluated following standard procedure of treadmill testing.

Results: It was observed that exercise per se cause a statistically significant change in dynamic heart function parameters in either of the groups.

Summary and Conclusion: This finding supports the hypothesis that the cardiovascular system is normally the most limiting factor in the delivery of oxygen even under the predominant influence of estrogen in proliferative phase which is further accentuated by exercise.

Keywords: Proliferative Phase, Estrogen in Exercise, Dynamic Heart Functions, Adaptability

Introduction

The role of hormones on the healthy cardiovascular system in delivering oxygen to meet the demands of various degrees of exercise has been a matter of differences in opinion. There are conflicting reports that the cardiovascular System is normally the most limiting factor in the delivery of oxygen to the muscles during maximal muscle aerobic metabolism whereas others do not subscribe to this³. Within this context it is appropriate to study the effect of proliferative phase of menstrual cycle on heart functions after exercise.

Mechanical constraints on exercise hyperpnoea have been studied as a factor limiting performance in endurance athletes¹. Others have considered the absence of structural adaptability to physical training as one of the “weaknesses” inherent in the healthy cardiovascular system response to exercise [³]

Heart functions are an important part of functional diagnostics [⁴], aiding selection and optimization of training and early diagnosis of sports pathology. Assessment of exercise response of dynamic lung functions in the healthy cardiovascular system in the trained and the untrained has a role in clearing gaps in the above areas especially a special group like perimenopausal women.

Material and Methods

The present study was conducted as a part of cardiopulmonary efficiency studies on two groups of non-athletes (n=10) and athletes (n=10) comparable in age & sex.

Informed consent was obtained and clinical examination to rule out any underlying disease was done. Healthy adult females between 42-45 years who regularly undergo training and participate in competitive middle distance running events for at least past 3 years were considered in the athlete group whereas the non-athlete group did not have any such regular exercise program. Smoking, clinical evidence of anemia, obesity, involvement of cardiorespiratory system was considered as exclusion criteria. Menstrual history was ascertained to confirm proliferative phase of menstrual cycle. Detailed procedure of exercise treadmill test and computerized spirometry was explained to the subjects.

Dynamic heart functions were measured in both groups before exercise was evaluated following standard procedure of treadmill testing. All subjects were made to undergo maximal exercise testing to VO2 max levels on a motorized treadmill.
After exercise, the assessment of dynamic lung functions was repeated. All these set of recordings were done on both the non-athlete as well as the athlete groups.

Statistical analysis was done using paired students t-test for comparing parameters within the group before & after exercise testing and unpaired t-test for comparing the two groups of subjects.

A p-value of < 0.01 was considered as significant.

**Results**

It is clear from table 1 that the two study groups are anthropometrically similar and comparable. The dynamic cardiopulmonary functions did not show any significant changes in the non-athlete and athlete groups as shown in table 2 & 3. It was observed that exercise per se cause a statistically significant change in dynamic heart function parameters in either of the groups.

**Discussion**

Considerable information can be obtained by studying the exercise response of dynamic lung functions in untrained and trained subjects.

Intra group comparison is helpful in noting the exercise response and inter-group comparison in evaluating adaptations of the respiratory system to training.

On comparing the anthropometric data of the two study groups it is clear that the age & sex matched subjects have no statistically significant difference in height taking a p-value of <0.05 as significant.

VO2 max values were higher in controls and was statistically significant (P< 0.001). This observation is expected in view of the training stimulus and adaptability of both the pulmonary system and the cardiovascular system. VO2 max is an objective index of the functional capacity of the body’s ability to generate power.

Forced vital capacity (FVC) is the volume expired with the greatest force and speed from TLC and FEV1 that expired in the 1st second during the same maneuver. The FEV1 was initially used as an indirect method of estimating its predecessor as the principal pulmonary function test, the maximal breathing capacity [8]. On comparing the response of exercise within the two study groups and in between them, there is no statistically significant difference in FVC & FEV1 under any condition. A normal FEV1/FVC ratio is observed always.

**Table No. 1:** Comparison of anthropometric data & VO2 max of non-athletes & athletes with statistical analysis.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Non-Athletes</th>
<th>Athletes</th>
<th>P- value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Yr)</td>
<td>43.51± 2.62</td>
<td>43.48 ± 2.84</td>
<td>&lt; 0.10</td>
<td>Not significant</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>160.71 ± 7.51</td>
<td>155.91 ± 7.25</td>
<td>&lt; 0.10</td>
<td>Not significant</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>52.65 ± 5.66</td>
<td>55.44 ± 6.26</td>
<td>&lt;0.05</td>
<td>Not significant</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>22.01 ± 2.47</td>
<td>21.61 ± 1.75</td>
<td>&lt; 0.10</td>
<td>Not significant</td>
</tr>
<tr>
<td>VO2 max (lit/min)</td>
<td>2.49±0.15</td>
<td>2.96±0.28</td>
<td>&lt; 0.001</td>
<td>Highly Significant</td>
</tr>
</tbody>
</table>

**Table No. 2:** Comparison of Dynamic cardiopulmonary Functions of Non- Athletes before exercise testing (BE) & after exercise testing (AE) with statistical analysis. **NON-ATHLETES (n=10).**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>BE</th>
<th>AE</th>
<th>P- value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart Rate bpm</td>
<td>76.09</td>
<td>86.00</td>
<td>&lt; 0.10</td>
<td>Not Significant</td>
</tr>
<tr>
<td>FEV1 (L)</td>
<td>3.10 ± 0.51</td>
<td>2.98 ± 0.05</td>
<td>&lt; 0.05</td>
<td>Not Significant</td>
</tr>
<tr>
<td>FEV1/FVC</td>
<td>0.95</td>
<td>0.962</td>
<td>&lt; 0.05</td>
<td>Not Significant</td>
</tr>
</tbody>
</table>

P< 0.01 is considered significant

**Table No. 3:** Comparison of Dynamic cardiopulmonary functions of Athletes before exercise testing (BE) & after exercise testing (AE) with statistical analysis. **ATHLETES (n=10).**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>BE</th>
<th>AE</th>
<th>P- value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart Rate bpm</td>
<td>70.10</td>
<td>78.08</td>
<td>&lt; 0.10</td>
<td>Not Significant</td>
</tr>
<tr>
<td>FEV1 (L)</td>
<td>3.11 ± 0.51</td>
<td>2.99 ± 0.04</td>
<td>&lt; 0.05</td>
<td>Not Significant</td>
</tr>
<tr>
<td>FEV1/FVC</td>
<td>0.95</td>
<td>0.97</td>
<td>&lt; 0.05</td>
<td>Not Significant</td>
</tr>
</tbody>
</table>

P< 0.01 is considered significant

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Another way of looking at forced expiration is to measure both expiratory flow and the volume expired. The maximum flow obtained can be measured from a flow–volume curve is the peak expiratory flow rate (PEFR). The peak flow occurs at high lung volumes and is effort dependent. Flow at lower lung volumes depends on the elastic recoil pressure of the lungs and the resistance of the airways upstream or distal to the point at which dynamic compression occurs. Measurements of flow at low lung volumes, mid expiratory flow [MEF 25% to 75%] are often used as indices of peripheral or small airways resistance.

On examining Table 2 & Table 3 it is clear that exercise per se does not cause a statistically significant change in dynamic lung function parameters MMEF, PEFR, MEF 25% to 75% in either of the groups. This finding supports the hypothesis that the respiratory system is not normally the most limiting factor in the delivery of oxygen. These findings are in line with other studies Bonen A et al and Jurkowski JE et al. Thirty minutes of exercise at 74% of VO2 was found to cause a significant increase in both progesterone (37%) and estradiol (13.5%), whereas no change in plasma FSH & LH was observed in exercising women; others have confirmed these findings. This finding supports the hypothesis that the respiratory system is not normally the most limiting factor in the delivery of oxygen even under the predominant influence of a sedentary and obese life style of the group studied.

References
1. Cunningham GR, Tindall DJ, Means AR. Differences in steroid specificity for rat ABP. Steroids 1979;33:261-276

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