Original article

Influence of menstrual cycle on lung functions in young healthy medical students

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ABSTRACT

Background: The dynamic changes in the level of various hormones during different phases of the menstrual cycle are known to affect various functions of the body, apart from the reproductive system. Present study was intended to demonstrate the variation in the pulmonary functions during different (menstrual, luteal and follicular) phases of the menstrual cycle in adolescent girls.

Material & Methods: This was a prospective, observational study which was performed at a referral centre in India. Regularly menstruating first year M.B.B.S. adolescent girls admitted to the course were included in the study. Their lung volumes were measured serially during various phases of the menstrual cycle. During the menstrual phases, various parameters were compared.

Results: Total 70 girls were enrolled in the study; (mean age – 19.5±8.2 years, mean height -158.1 ±6.8cm and mean weight-49±7.1 kg) The forced vital capacity (FVC), the forced expiratory volume (FEV1), the FEV1/FVC ratio were noticed to be significantly higher during the luteal phase and the lowest during the menstrual phase. The procedure will be repeated for one more cycle. the findings in both the cycle were consistent.

Conclusions: The pulmonary functions which were quantified as lung volumes and capacities were better during the luteal phase of the menstrual cycle, thus suggesting a possible beneficial role of progesterone in the management premenstrual asthma.

Key Words: Menstrual phase, Lung functions, Progesterone, Premenstrual asthma, Medical students.

Introduction

Changes in lung function have been reported in different phases of menstrual cycle owing to the action of the hormone progesterone. Progesterone has been reported to have a role in relaxation of bronchial smooth muscle which reduces the contractile response of these respiratory muscles. Studies have shown that the increase in expiratory resistance during follicular phase of the menstrual cycle may be contributing to the changes in pulmonary system of females. The increased ventilation seen in luteal phase might be related to high progesterone levels bringing about an increased inspiratory muscle endurance and bronchial smooth muscle relaxation. Studies have reported a decrease in forced expiratory volume 1 (FEV1) in Korean girls during menstruation period compared to those who were not on menstruation. The authors have not mentioned the reason for this decrease in FEV1.

In cats it has been reported that the administration of progesterone intravenously or directly in to the medulla oblongata stimulates respiratory center through a CNS steroid receptor mediated mechanism and hence induces hyperventilation and thereby
causes improvement in lung function.4 There are only few studies from India on pulmonary function tests in different phases of menstrual cycle 5-7. There are contradictory reports on pulmonary function in different phases of menstrual cycle. Some have reported changes in pulmonary function in luteal phase of menstrual cycle5,6. Significant increase in minute ventilation in luteal phase was also observed when compared to menstrual and follicular phases5. It is reported that in luteal phase an increased progesterone secretion leads to hyperventilation6. While others have failed to find any significant relationship between phases of menstruation and pulmonary function8, 9. In view of the above we planned the present study to evaluate the pulmonary function in different phases of menstrual cycle. With this background the present study was planned to assess the pulmonary function in menstrual, follicular and luteal phase of cycle.

Materials and Methods
This prospective observational study was carried out on the first year medical student of a medical college in the city of India. Regularly menstruating adolescent girls were included in the study after taking their written informed consent. Those with a history of chronic pulmonary illnesses or long term relevant medication use (bronchodilators, antitubercular drugs, etc) were excluded from the study. A detailed questionnaire was used to assess the pattern of the menstrual cycle, the premenstrual disturbances and the last menstrual period and to rule out allergic respiratory diseases and obesity. The anthropometric measurements and the vital parameters were recorded. The preliminary clinical examination of the respiratory system was carried out. Pulmonary function tests (PFTs), viz. forced vital capacity (FVC), forced expiratory volume (FEV1), the FEV1/FVC ratio were studied by using the computerized machine” BREEZESUITE” manufactured by Medgraphics Minnesota USA 55127 and standard laboratory methods, during different phases of the menstrual cycle with the girls in a sitting posture. The said apparatus is a true multi tasking software package that enables simultaneous display of pulmonary function graphics and tabular data. Before the test the subject would be familiarized with the machine and the detail instructions cum demonstration up to the satisfaction would be done. PFTs were performed after 10 minutes of non-ambulation and before having lunch during the different phases of their cycles i.e menstrual phase (1-5th day), follicular phase (6th - 13th day) and luteal phase (15th – 28th). For each subject, the procedure was repeated thrice and the maximum value was considered for the study. The respective phases of menstruation were calculated from the day of the last menstrual period and during the usual duration of the menstrual cycle. The data was entered in Microsoft Excel sheets. The continuous variables were compared by using paired T test among the groups and a ‘p’ value of < 0.05 was considered as significant. The study protocol was approved by the ethics committee of our institution.

Result and analysis
Total 70 girls were enrolled for the study. The complete details for the final assessment were available from all 70 girls (mean age – 19.5±8.2 years, mean height -158.1 ±6.8cm and mean weight-49±7.1 kg). The pulmonary function measures in the cohort over the phases of the menstrual cycle are shown in [Table/Fig-1]. The mean of the FVC was more during the luteal phase and it was statistically significant. The mean of the FEV1 was more during the luteal phase as compared to that in the follicular
and the menstrual phases and it was statistically significant. FEV1/FVC% was more in the luteal phase as compared to those in the follicular and the menstrual phases and this was statistically significant.

The comparison between FVC and FEV1 during various phases of the menstrual cycle is shown in following tables.

**Cycle I : Table- 1**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Menstrual</th>
<th>Follicular / Preovulatory</th>
<th>Luteal / postovulatory</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC (litres)</td>
<td>2.91± 0.22</td>
<td>2.97 ± 0.34</td>
<td>3.50 ± 0.32</td>
</tr>
<tr>
<td>FEV1(litres)</td>
<td>2.30 ± 0.24</td>
<td>2.36 ± 0.30</td>
<td>2.85 ± 0.26*</td>
</tr>
<tr>
<td>FEV1 / FVC</td>
<td>80.85 ± 1.12</td>
<td>81.11 ± 1.12</td>
<td>82.82 ± 0.91*</td>
</tr>
</tbody>
</table>

Pulmonary functions measures over the phases of menstrual cycle (n=70). Forced vital capacity (FVC), forced expiratory volume in one second (FEV1) and the ratio FEV1/FVC. *Significantly higher (p<0.05) in luteal phase as compared to other 2 phases in cycle I.

**Cycle II : Table-2**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Menstrual</th>
<th>Follicular/ Preovulatory</th>
<th>Luteal / postovulatory</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC (litres)</td>
<td>2.9 ± 0.32</td>
<td>3.03 ± 0.37</td>
<td>3.5± 0.38*</td>
</tr>
<tr>
<td>FEV1(litres)</td>
<td>2.3 ± 0.21</td>
<td>2.37 ± 0.35</td>
<td>2.9± 0.23*</td>
</tr>
<tr>
<td>FEV1 / FVC</td>
<td>81.31 ± 1.68</td>
<td>81.74 ± 1.36</td>
<td>82.68± 0.80*</td>
</tr>
</tbody>
</table>

Pulmonary functions measures over the phases of menstrual cycle (n=70). Forced vital capacity (FVC), forced expiratory volume in one second (FEV1) and the ratio FEV1/FVC. *Significantly higher (p<0.05) in luteal phase as compared to other 2 phases in cycle I.

**The findings of cycle (II) are consistent with those of cycle I.**

**Discussion**

The present study demonstrated better pulmonary functions which were measured as the lung volumes and capacity during the luteal phase of the menstrual cycle as compared to those in the follicular and menstrual phases in the regularly menstruating adolescent girls. Though statistically significant differences were demonstrated in our study, our results need to be interpreted in the background of certain limitations. An adequately powered study design which uses the objective measurements of the hormonal levels and the detailed pulmonary functions including diffusion studies, are expected to provide a better insight to the suggested relationship.

Our study is on par with a study which was conducted by Beynon et al 10. He reported that the administration of high doses of progesterone throughout the menstrual cycle prevented the
deterioration of premenstrual exacerbation of asthma. The withdrawal of progesterone, therefore, is expected to cause lower flow rates during the premenstrual and the menstrual phases. A study which was done by Das et al showed that the use of progesterone in the hypoventilation syndrome, obesity and emphysema has been by its virtue of increasing the sensitivity of the respiratory neurons to CO2, producing a stimulatory effect directly on the medullary receptors, thus indicating the role of progesterone on the pulmonary function. According to Brenner et al, both the pre-ovulatory and the premenstrual phases are the actual triggers of the exacerbation of asthma in some women, or maybe these two phases serve as “co-factors” that worsen other recognized triggers of acute asthma, thus indicating the role of low levels of progesterone during these two phases. This has been emphasized by Rajesh et al, where the pulmonary functions reflect better values in the luteal phase as compared to those in the follicular phase, and also by Sundar et al, where a change in the expiratory flow rates during various phases of the menstrual cycle has been demonstrated. The low peak expiratory flow and the forced expiratory flow 25-75% that were observed during the premenstrual and the menstrual phases indicated a higher bronchial tone during these phases, even in normal women. The possible reason for the changes in the bronchial tone could be the fluctuating levels of the sex hormones in the blood (or) of the mediators which circulate in the blood. In a study which was conducted by Chen et al, the pulmonary functions were measured and compared in the midfollicular phase and in the midluteal phase in 30 healthy women. They concluded that the inspiratory muscle endurance was higher in the midluteal phase and that it was lower in the midfollicular phase. This was in par with the findings of our study. According to Chong et al, the menstrual cycle appeared to have little effect on the peak expiratory flow rate in healthy, non-asthmatic, Asian women.

**Conclusion**

The pulmonary functions were better, which were measured as the lung volumes and lung capacities, during the luteal phase of the menstrual cycle as compared to those in the follicular and the menstrual phases in regularly menstruating adolescent girls. This suggests a possible role of the increased levels of progesterone during the luteal phase on the respiratory system. The use of progesterone instead of steroid can be tried in cases of asthma in young females.

**Recommendations:** The blood progesterone levels of should be measured simultaneously so that its exact correlation between improved lung functions in luteal phase will be proved.

**References**


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