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ORIGINAL RESEARCH

Study of pulmonary function test in females of reproductive age group around national capital region at a tertiary care center

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ABSTRACT

Introduction- The reproductive system as well as other systems of the body are known to be physiologically impacted by the dynamic endocrine interplay reflecting rhythmic changes in the rate of ovarian hormone secretion during different phases of the menstrual cycle. These changes in pulmonary function occur during the various menstrual cycle phases. The aim of present study is to evaluate the pulmonary function test in females of reproductive age group around national capital region at a tertiary care center. **Material & methods-** At a tertiary care center, a descriptive cross-sectional study was carried out. The study involved 100 reproductive-age female with normal menstrual cycles. Measurements of pulmonary function were taken during the pre- ovulatory and post- ovulatory of the menstrual cycle. Every detail, including height in centimeters, weight in kilograms, and age, was noted, and the BMI was computed. The purpose of data analysis was to determine the statistical significance (p value) of the menstrual cycle's pre- and post-ovulatory phases. **Results-** Our study shows a highly significant increase in FEV1 parameter during post ovulatory phase having mean values of 2.56±0.27 as compared to pre-ovulatory phase with the mean values of 2.23±0.16. We found a significant increase in FVC (L), during post ovulatory phase as compared to pre ovulatory phase of menstrual cycle. **Conclusion-** FVC and FEV1 significantly increase during the postovulatory phase of the menstrual cycle, when progesterone levels are higher. Our effort to determine the correlation between the levels of the pulmonary function test at various stages of the menstrual cycle can assist clinicians in providing progesterone hormone supplementation to women suffering from inflammatory lung conditions like COPD, asthma and other lung disorders.

Keywords – menstrual cycle, post-ovulatory phase, pre-ovulatory phase, Pulmonary function test, reproductive age

INTRODUCTION

The menstrual cycle, which is an essential component of women's lives, is part of the female reproductive phase. Estrogen and progesterone levels in the ovary fluctuate during the menstrual, proliferative, and secretory phases of the cycle, which are all necessary for a healthy menstrual cycle. The reproductive system and other organ systems both undergo equivalent modifications as a result of the distinctive rhythmic variations in the rate of ovarian hormone secretion. It is hypothesized that in addition to daily variations, lung functions also fluctuate according to the various menstrual cycle phases.[1]

After controlling for smoking, women are more likely than men to develop inflammatory lung diseases such cystic fibrosis, chronic obstructive pulmonary disease, and asthma, and they also suffer from excess morbidity and death from these conditions. The causes of this trend are mainly unknown. It is becoming more widely acknowledged that between one-third and fifty percent of women report their asthma symptoms getting worse before or during their periods.[2]

The sex variations in asthma are mediated in part by sex hormones, especially in the case of the premenstrual period asthma exacerbation that many women encounter. Although the negative consequences of menstruation on asthma have long been known, the mechanisms are not well understood. Research on the relationship between female sex hormone and asthma has looked at characteristics

related to allergic inflammation, airflow, and/or airway reactivity throughout the menstrual cycle. Despite the fact that gas transfer fluctuates in healthy women throughout the menstrual cycle, diffusing capacity has not been assessed. Numerous studies have demonstrated that when progesterone and estrogen levels change during the menstrual cycle, diverse physiological reactions are generated. Ovulation is accompanied by a minimum 0.2˚C rise in basal body temperature because of the thermogenic impact of progesterone.[3,4] It should be noted that progesterone functions as a smooth muscle relaxant to strengthen smooth muscles and lowers arterial and alveolar pCO2 during the luteal phase of the menstrual cycle.[5,6]
Hence the present study was done to study the pulmonary function test in females of reproductive age group around national capital region at tertiary center.

MATERIAL & METHODS

The present descriptive cross sectional study had been conducted at a tertiary care center for a period of one year among females of reproductive age group. Ethical permission was taken from institutional ethical committee of allied medical college and hospital before commencement of study.
Convenience sampling method was used to enroll 100 female subjects who were of reproductive age and had regular menstrual cycles lasting between 21 and 35 days, as determined by history, for at least six months.Informed consent was taken from each subject after fulfilling the inclusion and exclusion criteria. Subjects having previous history of any respiratory illness or any allergic symptoms in the recent times, having irregular cycle those on hormonal replacement therapy, females using any contraceptive pills, posthysterectomy patients, having history of chronic pulmonary obstructive disease, having any history of cardiovascular disease or having history of smoking, alcohol intake or any psychiatric illness were excluded from the study.
Pulmonary function parameters (FVC, FEV1, FVC/FEV1) were assessed during pre-ovulatory and post-ovulatory phases of menstrual cycle. For the pulmonary function and respiratory efficiency tests, each subject was required to report three times, once for each phase of their menstrual cycle. Weight and height were also recorded.The different phases of menstrual cycle were estimated as per the menstrual history related questionnaire and date of last menstrual period.
Results were analyzed using SPSS computer program for windows 25.0. Mean ± SD (Standard deviation) was calculated and paired T test was used to obtain statistical significance (p value) between pre-ovulatory and post-ovulatory phases of menstrual cycle.

RESULTS

On analysis of 100 female subjects, the average age (years) was 24.32±2.23, average height (cms) was 160.03±2.72, average weight (Kg) was 57.19±5.29 and average BMI was 23.13±1.78as shown in table 1.

Table 1 showing baseline characteristics of patients

Baseline characteristics	Mean ±SD
Age (in years)	24.32±2.23
Height (cms)	160.03±2.72
Weight (kg)	57.19±5.29
BMI (Kg/m^2)	23.13±1.78

FEV1 value in pre ovulatory phase was 2.23±0.16 and in post ovulatory phase was 2.56±0.27 and results were significant with p value 0.001. FVC showed average 2.37±0.15 in pre ovulatory phase and 2.89±0.29 in post ovulatory phase with significant results p value <0.001. Ratio of FEV1/FVC (%) was seen as 90.65±3.47 in pre phase versus 88.43±4.63 in post phase with p value 0.023 as shown in table 2.

Table 2 showing pulmonary function test at pre ovulatory and post ovulatory phase

Pulmonary function test	Pre ovulatory	Post ovuatory	P value
FEV1 (L/s)	2.23±0.16	2.56±0.27	0.001
FVC (L)	2.37±0.15	2.89±0.29	<0.001
FEV1/FVC (%)	90.65±3.47	88.43±4.63	0.023

DISCUSSION

During a woman's reproductive phase, the menstrual cycle is the periodic loss of epithelium that causes uterine bleeding. This process is caused by an intangible interaction of hormone levels. The ovarian hormones, progesterone and estrogen, fluctuate rhythmically during the menstrual, follicular, and luteal phases of the cycle, which is indicative of a regular menstrual cycle. The reproductive system and other organ systems undergo similar modifications as a result of these cyclical fluctuations in the rate of ovarian hormone output. Progesterone lowers arterial and alveolar pCO2 during the luteal phase and increases the respiratory center's ventilatory response to CO2. It also has a smooth muscle relaxant effect on bronchial smooth muscle, therefore a decrease in progesterone plasma levels in the days leading up to menstruation may cause bronchoconstriction.
Progesterone and estrogen levels fluctuate cyclically during each menstrual cycle, and this fluctuation is

linked to changes in lung function measures and other physiological changes. Both the pre-ovulatory and post-ovulatory periods of the menstrual cycle saw the assessment and correlation of basic characteristics and pulmonary function test (FVC, FEV1, and FEV1/FVC).

In our study various pulmonary function indices show significant variation during pre and post ovulatory phase. In our study we also found decrease in FEV1/FVC ratio during postovulatory phase is due to highly significant increase in FVC as compared to FEV1.These findings were consistent with the reports ofResmi et al,[7] Pai et al,[8] Dabhoiwala et al,[9] and Arora et al,[10] who found different values. The study done by Kannan et al [11] and Nandhini[12] also showed the same result that FEV1/FVC ratio was lower in post ovulatory phase.

Another study found a statistically significant rise in FVC as a result of progesterone's potentiation of prostaglandin, which causes the smooth muscles in the bronchi to relax. The impact of progesterone on respiratory centers, peripheral and central chemoreceptors, which on activation alters thecholinergic outflow of airways, is responsible for this notable rise in FEV1. Within the ventral respiratory group in the nucleus ambiguous, preganglionic cell bodies are the primary excitatory input to the airway smooth muscles that fire during inspiration.[13,14]

In our study, FVC was shown to be considerably higher in the post-ovulatory phase of the menstrual cycle than in the pre-ovulatory period. This finding is consistent with previous research, and the luteal phase of the menstrual cycle's elevated progesterone level was identified as the explanation.[15]

The higher basal metabolic rate brought on by hyperventilation may be the cause of the increased oxygen demand.[16] Additionally, progesterone receptors at the hypothalamic location that are dependent on estrogen may directly stimulate the respiratory centers through RNA and protein production pathways.[17] Based on Beynon et al's observations, this occurrence may be correlated, who investigated how progesterone administered intramuscularly affected asthmatic patients.[18] They discovered that patients on progesterone had lower bronchodilator dosages. The values of lung volumes and capacities may decrease relative to low progesterone levels during the premenstrual phase.

Because progesterone has been demonstrated to have a smooth muscle relaxant effect and may thus have a bronchodilator activity, it is well known that elevated levels of progesterone are responsible for the increase in alveolar ventilation during pregnancy and the luteal phase of the menstrual cycle. According to reports, progesterone affects central (medullary) and peripheral receptors, increasing their sensitivity and resulting in hyperventilation and hypocapnia during the luteal phase of a normal menstrual cycle and pregnancy. This increased respiratory system sensitivity to progesterone during the luteal phase has been linked to advantageous compensatory mechanisms to meet the increased demands during pregnancy. In animal studies, Foster et al. demonstrated that progesterone promoted relaxation of the bronchial smooth muscle via a betaadrenoreceptor mediated mechanism. Progesterone is frequently used exogenously to treat hypoventilation syndrome. It is also known to induce smooth muscle relaxation, particularly in the gastrointestinal and reproductive systems. In vitro, Keane et al. showed that progesterone exposure reduced both the amount of maximum contraction and spontaneous contraction in the human gall bladder. The luteal phase of the menstrual cycle is when the gall bladder muscle relaxes, according to Everson et al. Additionally, it may have a helpful effect in premenstrual asthma, where it has been claimed that asthma attacks worsen when serum progesterone levels decline.[19]

Due to practical limitations, female sex hormones were not measured during the menstrual cycle phases. All of the individuals did, however, report having regular, regular menstrual cycles. The consistency of the link may be ascertained by a well-designed study using volunteers who were healthy female participants in varying age groups and stages of reproductive life, with measurements of ovarian hormones and pulmonary function test data.

CONCLUSION

FVC and FEV1 significantly increase during the postovulatory phase of the menstrual cycle, when progesterone levels are higher. Our effort to determine the correlation between the levels of the pulmonary function test at various stages of the menstrual cycle can assist clinicians in providing progesterone hormone supplements to women suffering from inflammatory lung disorders like COPD, asthma, and other conditions. Such study is still lacking and might be strengthened by including a few more parameters that could aid in further studies and therapeutic approaches.

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