Original Article

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Variations in Pulmonary Function in Relation with the Menstrual Cycle in Healthy Adult Female

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ABSTRACT

Objective: To compare the respiratory parameters during different menstrual versus luteal phases of the menstrual cycle in healthy adult female.

Methodology: This comparative study was conducted in research lab physiology department of Liaquat University of medical and health sciences Jamshoro, from January 2018 July 2018. Adult healthy non-pregnant females aged between 18 and 24 years were Included. Each participant was advised to visit the Physiology Lab on a particular date for pulmonary function test during menstrual (1-5th day) and luteal (19-22th day) phases, based on their menstrual history. Using the Power lab AD tools 15:HT Computerized Spirometer and parameters recorded on Labtutor software, the participants were made to undertake pulmonary function testing in distinct menstrual cycle stages. All the data was collected via study proforma.

Results: Mean age of the cases was 20.03+6.30 years and mean duration of menstrual cycle was 28.62±1.35 days. Mean FVC value was significantly higher in luteal phase (2.57) as compared to menstrual phase (2.50) (p-0.016). Average FEV1 value was significantly higher in luteal phase (2.61) compared to menstrual phase (2.53) (p-0.009). Average values of PEF and FEV1/FVC were also significantly higher in luteal phase as compared to menstrual phase (p-<0.05).

Conclusion: Pulmonary functions as well as respiratory efficiency were significantly improved in luteal phase compared to menstrual phase of menstrual cycle, which were enumerated in this study thus suggesting a possible beneficial role of progesterone in improvement of respiratory parameters. The reason could be the bronchodilator effect of progesterone, its level remains higher during this phase.

Keywords: Respiratory function, menstrual phase, luteal phase,

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Introduction

The menstruation cycle, commonly known as menstrual period, is a biological regularity of natural changes in the reproductive system of female.[1] Periodic blood discharge from the uterus by the vaginal canal, which occurs more or less on a monthly basis throughout a female's active reproductive life.[2] Five significant hormones regulate it, i.e. GnRH from hypothalamus, LH and FSH from anterior pituitary, progesterone and estrogen from ovary. The menstrual cycle consists of 3 phases: luteal, follicular and menstrual that are controlled by the hormones cited above. Hormone levels vary in distinct menstrual cycle stages.[3] The duration of the menstrual cycle varies widely, but on average, it lasts 28 days from either the onset of one period to the starting of the next.[4] Duration is controlled by ovarian hormone fluctuation, i.e., progesterone and estrogen. These variations result in associated modifications within the reproductive system as well as in further organ system such as respiratory, cardiovascular and musculoskeletal systems.[5] Gonadotropin stimulation of ovarian hormones triggers

progesterone release that has been shown to be a respiratory stimulant.[6] The influenced respiratory parameters in distinct stages of the menstrual cycle are: Forced Expiratory Volume (FEV1), Forced Vital Capacity (FVC), FEV1 as a proportion of FVC (FEV1/FVC percent) and Peak Expiratory Flow rate (PEFR).[7] Elevated endurance of inspiratory muscle and relaxation of bronchial smooth muscle result in hyperventilation at luteal phase, progesterone also stimulates production of endogenous NO, resulting in high progesterone concentrations.[8,9] Progesterone is secreted by corpus luteum that increases the function of the lung.[10] Progesterone induces hyperventilation through peripheral and central medullary receptors. At secretory stage, progesterone also improves the sensitivity of the respiratory receptor. During the menstrual cycle, there is a distinction of 20 times in Progesterone concentration.[11] In menstrual phase, level of serum progesterone is nearly zero. Progesterone's low level can possibly worsen asthma in the course of menstrual and premenstrual phases among 1/3rd of females.[12,13] FEV_1, FVC, PEFR and FEV_1/FVC (%) are generally measured to assess pulmonary function. In luteal phase, a small rise has been noticed in these parameters. Hyperventilation in the course of luteal phase can possibly bring about these variations in lung function.[14-16] Progesterone receptor is found in the respiratory epithelium, and progesterone reduces the frequency with which cilia beat, potentially affecting mucociliary clearance during in the menstruation in female.[17,18] Since few research have been performed in Sindh Pakistan in seeing variation in lung functions during various menstrual cycles among healthy young women. Thus, this research was performed to figure out variability in pulmonary function test in various menstrual cycle stages, which will assist physicians to identify disease course such as bronchial asthma in the course of various menstrual cycle stages. Locally, no such investigations have been discovered. This research was performed to assess the pulmonary functional effect of the menstrual cycle.

Methodology

This cross-sectional comparative study was conducted in research lab physiology department of (LUMHS) Liaquat University of medical and health sciences Jamshoro after approval of Research Ethics Committee of LUMHS. Study duration was 6 months from January 2018 July 2018. All adult healthy non-pregnant females aged between 18 and 24 years were Included. All females with menorrhagia, dysmenorrhea, irregular menstruation, smokers, obese, anemia, individuals with RTI, drugs e.g. bronchodilators, oral contraceptive pills, anti-tuberculosis medications and individuals with history of cardiopulmonary disease were excluded. The subjects were notified regarding the purpose and methodology of current research. All the participants were examined regarding the menstrual cycle in two phases (luteal and menstrual). The preliminary clinical, respiratory system examination was performed. Each participant was advised to visit the Physiology Lab on a particular date for pulmonary function test during menstrual (1-5th day) and luteal (19-22nd day) phases of menstrual cycle, based on their menstrual history. Using the Power lab AD tools 15:HT Computerized Spirometer and parameters recorded on Labtutor software, the participants were made to undertake pulmonary function testing in distinct menstrual cycle stages (menstrual and luteal). All the data including history, test results were incorporated in specially designed proforma.

Results

Mean weight and height of females was 50.43±6.30 and1.589 ±1.201respectively. However mean BMI of female was 20.38±1.39 respectively. Mean age of women was 20.03±1.51 years. Min and max age of females was 18 and 23 years respectively. Mean age of menarche of females was 13.91±0.48 years. Mean no. of days menstrual period was 4.83±0.83 days. Mean duration of menstrual cycle was 28.62±1.35 days. Table-1

Mean FVC value was significantly higher in luteal phase as compared to menstrual phase. i.e. Luteal Phase: 2.57 vs. Menstrual Phase: 2.50, p-value=0.016. Mean FEV1 value was significantly higher in luteal phase as compared to menstrual phase. i.e. Luteal Phase: 2.61 vs. Menstrual Phase: 2.53, p-value=0.009. Mean PEF value was significantly higher in luteal phase as compared to menstrual phase. i.e. Luteal Phase: 404.09 vs. Menstrual

Table I: Descriptive statistics of demographic variables (n=255)

	Age (years)	Age of Menarche (years)	Menstrual Period	Duration of Menstrual Cycle	BMI Kg/m^2
Mean± SD	20.03±1.51	13.91±0.48	4.83±0.83	28.62±1.35	20.38±1.39
Minimum	18	13	3	26	18.10
Maximum	23	15	7	30	23.10

Phase: 399.27, p-value=0.010**.** Mean FEV1/FVC value was significantly higher in luteal phase as compared to menstrual phase. i.e. Luteal Phase: 93.74 vs. Menstrual Phase: 92.64, p-value=0.007. Table II

Table II: Comparison of FVC, FEV1, FEV1/FVC and PEFR in different phases of menstrual cycle

Variables	Phase	Mean ± SD	p-value
FVC (Liters)	Luteal phase	2.57±0.26	0.016
	Menstrual phase	2.50±0.37	
FEVI (Liters)	Luteal phase	2.61±0.33	0.009
	Menstrual phase	2.53±0.39	
FEV1/FVC (%)	Luteal phase	93.74±4.97	0.007
	Menstrual phase	92.64±4.20	
PEF(Lt/min)	Luteal phase	404.09±24.12	0.010
	Menstrual phase	399.27±17.32	

Discussion

Menstruation is regarded as an important and essential aspect of a reproductive life of women. The HPO axis is accountable for its cyclic variations of hormone concentration. Menstruation takes 28 days on average and is grouped into three stages: luteal, follicular and menstrual. The amount of progesterone serum is very small during the follicular stages; however, it becomes large in luteal phase. Fluctuations in these hormone levels during the menstrual cycle have an impact on not just the reproductive tract, but also the musculoskeletal, brain, cardiovascular and respiratory system.[17]

In our study, mean age of participants was 20.03±1.51 years. The present study showed better pulmonary operations that were measured as peak flow and lung volume in regularly menstruating teen girls during the luteal phase of menstrual cycle than those in the menstrual phase. On other hand Das et al,[19] also found comparable findings. Gavali et al. showed that coherent outcomes with our research.[20] Contrary to the research carried out by James et al., where the age of respondents was 30-45 years, our findings are not consistent with it, perhaps owing to variations in age.[21]

In this study mean FEV1/FVC value was significantly higher in luteal phase as compared to menstrual phase p-value 0.007. Consistently Dimple et al. recorded significantly greater mean value in the luteal phase of FEV1and FVC than in the menstrual stage. The correlation between progesterone and estradiol concentrations and cardiac parameters PEFR, FVE1/FVC percent and FVC has been noted by Johanesson M et al., suggesting a positive rise in luteal phase relative to menstrual stage.[22] Mannan et al. noted enhanced lung functions, i.e. FEV1, FVC, PEFR and VC may be associated with elevated progesterone levels in the luteal phase.[4] Rajesh et al and Saprova et al. discovered greater FEV1/FVC%, PEFR values in secretory stage and after that in follicular and lowest values in menstrual stage.[16] Above findings by several other studies are in line with this study. Jasrotia et al. also observed considerably higher rates of FEV1 and FVC in luteal phase than follicular and menstrual phases; though higher PEFR score were observed in luteal phase than menstrual phase.[23] Nandhini et al. also recorded greater FEV1/FVC%, FEV1, and FVC forced expiratory flow in the luteal phase around 25 to 50 percent , whereas the smallest values were recorded in the menstrual phase .[10] The above studies correlate with our research outcomes which indicated that parameters of lung function in the luteal stage have been considerably enhanced. Rao et al. highlighted a shift in menstrual cycle expiratory flow rates during different stages. During these stages, even in normal females, the low PEFR and the 25-75 % FEF found during premenstrual and menstrual stages suggested a greater bronchial tone. The potential explanation for bronchial tone modifications could be the varying levels of the sex hormones or mediators circulating in blood.[24]

The values of PEFR, FVE1 and FVC were evaluated contrasted to in healthy females in the mid-follicular stage and mid-luteal phase in research undertaken by Chen et al. They found that in the luteal phase, inspiratory muscle strength was greater and lesser in follicular phase. [15] After using Birth Control Pills for six months, Mamoona et al. noted a substantial rise in PEFR and FVC. Though, they found that the enhancement found in lung mechanics was because of progesterone and that the impact of progesterone may be intensified by estrogen.[7] Pai SR et al. discovered a greater rate of progesterone hormone and PEFR in the luteal phase compared to follicular and menstrual phases of menstrual cycle. A significantly higher PEFR in secretory phase than that of follicular phase was also demonstrated by Gokhale et al.[25] The explanation for these findings shows the hormonal differences during different menstrual cycle stages. Since it is also essential to remember that progesterone concentrations are maximum during the menstrual cycle's luteal phase, progesterone is considered to be a smooth

relaxant muscle and therefore can also trigger bronchodilation. Another research conducted by Gibbs et al. found that women with asthma observed symptoms that worsened just a few days prior menstrual bleeding and improved symptoms with menstrual abatement each time. Therefore, the premenstrual asthma diagnosis is made by demonstrating important variability in the function of the airway during the periods just before the menstrual beginning. On contrary Silva et al., observed decline in PEFR in the secretory phase, it may be because this study includes females of age group more than 35 years.[26] While Parsons et al. showed PEFR was not much affected by menstrual cycle. On the other side this study is inconsistent with current study in which Chong et al. have reported that the menstrual cycle has slight to no outcome on the "peak expiratory flow rate or PEFR" among normal, Asian females, because of postural difference.[27] During the menstrual secretory phase, hyperventilation associated with elevated progesterone levels is accountable for enhanced pulmonary function. Rajesh et al. found that through regular hyperventilation, the stability of the respiratory muscle and the lung capacity are enhanced.[16] Enhancement in pulmonary functions in regularly menstruating adolescent girls was assessed in relation to menstrual and follicular phases in lung volumes and lung capacity during the menstrual cycle's luteal phase. This indicates the potential function of enhanced progesterone concentrations in the respiratory system during the luteal phase.

Conclusion

Pulmonary functions as well as respiratory efficiency were significantly improved in the luteal phase of menstrual cycle, which were enumerated in this study thus suggesting a possible beneficial role of progesterone in improvement of respiratory parameters. The reason could be the bronchodilator effect of progesterone, its level remains higher during this phase. Clinicians treating young female patients suffering from respiratory disorders may keep this in mind about the phases of menstrual cycle while prescribing bronchodilator drugs. Also, conditions like, premenstrual asthma can be better tackled with the help of these observations.

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