Article

Relationship of Forced Vital Capacity (FVC), Forced Expiratory Volume in First Second (FEV_1)and FEV_1/FVC% with Plasma Progesterone Level during Different Phases of Normal Menstrual Cycle

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The present study was carried out to observe the correlation of some lung function parameters with the endogenous plasma progesterone level during different phases of menstrual cycle. The study was conducted on 30 healthy young female volunteers with age range of 20-25 years in the department of Physiology of BSMMU, Dhaka, during July 2005- June 2006. All the subjects were studied in 3 phases of menstrual cycle for 2 consecutive cycles. FVC, FEV_1 , FEV_1/FVC% for assessing lung function and plasma Progesterone level during each phase of menstrual cycle were measured by a portable spirometer and by ELIZA method in auto analyzer respectively. Comparison of the values between different phases were done by paired 't' test considering menstrual phase data as baseline due to negligible amount of progesterone detected in this phase. Correlation of FVC , FEV_1 and FEV_1/FVC%with Progesterone level in each 3 phases were analyzed by Pearson's correlation–coefficient test. Plasma progesterone level was much higher during luteal phase compared to those of follicular phases of both cycles (24.54ng/ml vs1.41 ng/ml; 26.56 ng/ml vs. 1.48 ng/ml). Both FVC and FEV_1 were significantly higher ($p<0.001$) during luteal phase than those of follicular phases in both the cycles. FVC, FEV_1 and FEV_1/FVC%were positively correlated with plasma progesterone level but these relationships had failed to show any statistical significance. Similar to others, this study also observed increased ventilation and high endogenous progesterone level during luteal phase. Therefore increased ventilation might be related to high progesterone level during luteal phase owing to increased inspiratory muscle endurance and bronchial relaxation effect.

Key words: Plasma Progesterone; Forced Vital Capacity; Forced Expiratory Volume; Menstrual cycle.

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Introduction

Menstrual cycle occurs in three phases: menstrual, follicular and luteal which are regulated by the sex hormones- estrogen and progesterone from the ovary and also by the gonadotropins:- leutinilizing and follicle stimulating hormone from the anterior pituitary. The levels of these hormones in three phases of the menstrual cycle are fluctuating.[1]

Variations in the functional parameters of many systems may be related to fluctuations in the hormonal levels during the different phases of menstrual cycle.[2]

For assessment of pulmonary function FVC, FEV_1, and FEV1/FVC (%) are usually measured[3]. Significant increase in FVC, FEV_1, and FEV1/FVC% were observed during the luteal phase where the progesterone level is higher in

comparison to those of menstrual and follicular phases of menstrual cycle. Hyperventilation occurring during luteal phase may lead to these changes in lung functions.[4-5]

In addition, progesterone may also has a role in relaxation of the bronchial smooth muscle which ultimately causes improvement of lung function during this phase[5]Moreover, progesterone may also reduce the contractile response of the respiratory muscles during the luteal phase of menstrual cycle[6].

All these evidences support the presence of a relationship of progesterone with changes in lung function in luteal phase of menstrual cycle[2].

Again, different observations have shown that after addition of exogenous progesterone no further increase of these lung function parameters occur during the different phases of menstrual cycle[7].

Though it is still controversial, all these changes of pulmonary function parameters also indicate existence of their relationships with progesterone level during luteal phase of menstrual cycle. It has also been shown that higher level of progesterone was positively correlated with FVC, FEV_1, FEV1/FVC(%), in luteal phase of menstrual cycle[2].

Some of the investigators also proposed to supplement progesterone hormone as one of the important regimen along with other bronchodilators and they found better results in female patients suffering from bronchial asthma with acute exacerbations[2,8] . In addition a huge number of female patients are suffering from bronchial asthma and many of them are hospitalized with acute premenstrual exacerbation (according to National Health Survey 2000). Establishment of relationship of progesterone level with improvement of lung function may be helpful to suggest the hormone therapy in treatment of the patients suffering from premenstrual exacerbation of asthma.

Therefore, the present study was attempted to observe the pulmonary function status in different phases of menstrual cycle in order to find out the correlation of progesterone level with some lung function parameters during the different phases of menstrual cycle in apparently healthy adult girls.

Methods

The present cross sectional study was carried out in the Department of Physiology, BSMMU, Dhaka, between January 2005 and December 2005. Thirty apparently healthy female volunteers with normal menstrual cycle within the age range from 20-24 years were included in this study .All the subjects were selected from a Private Medical College in Dhaka and were studied in three phases of menstrual cycle. All of them were grouped as Phase A -menstrual phases (baseline data), Phase B-follicular phase or proliferative phase and Phase C -luteal phase or secretory phase. All the parameters were studied for two consecutive cycles and were marked as cycle I and cycle II in order to get more confirmatory results.

The subjects with history of irregular menstrual cycle, use of contraceptive pills, hypertension ,cardiovascular diseases, diabetes mellitus, dysmenorrhoea, psychiatric illness, premenstrual symptoms like headache, irritability, edema insomnia were excluded from the study. After selection all the subjects were briefed about the objectives and benefits of the study to ensure their voluntary participation .Informed written consent was taken from each subject prior to the study. A thorough physical examination of each subject was done and detail socio demographic data, family and medical history, menstrual history were recorded in pre-designed questionnaire. From the date of onset of the menstrual cycle a probable date of ovulation was calculated, based upon which duration of different phases of the cycle were determined. Then all the subjects were asked to attend the Department of physiology, BSMMU, Dhaka on a given schedule, which were from the 1^{st} to 3^{rd} day of the menstrual cycle for phase A, from the 9 to 11^{th} day for phase B

and from the 19 to 23rd day of the cycle for phase C.

Plasma progesterone hormone level of each subject during three different phases of each cycle was measured by ELIZA method (Lange Microbiology,2001). To assess lung function, FVC, FEV1 and FEV1/FVC% were measured during each of these three phases by using a digital spirometer, described by Clement Clarke international .

Statistical analysis was done using SPSS windows package version 12.The comparisons between the phases were done by paired t test. Pearson's correlation coefficient test was performed to observe the relationships of lung function parameters with progesterone level during follicular and luteal phases of the menstrual cycles. The P value < 0.05 was considered as significant.

Results

Table-I shows age, height and weight of the study subjects. Mean±SD of age, height and weight were 21.27±1.41 years, 147.75±5.67 cm, and 48.67±3.1 kg, respectively.

Table – I : Mean (±SD) Age, Height and Weight of the study subjects (n=30)

Parameters	Values
Age (years)	21.27±1.41 (20-24)
Height (cm)	147.75±5.67 (138.00 – 159.40)
Weight (kg)	48.67±3.1 (44-54)

Figures in parentheses indicate ranges

In cycle I, the mean plasma progesterone levels were significantly increased (P<0.001) in phase C in comparison to those of phases A & B. Though this value was higher in phase B than that of phase A, the difference between them was not statistically significant (P>0.05). In cycle II, the mean plasma progesterone levels were significantly increased (P<0.001) in phase C in comparison to those of phases A & B and also in phase B than that of phase A (P<0.05). Plasma progesterone levels were almost similar both in cycle I and II in different phases. Therefore no statistically significant differences of this hormone level were observed between the cycles (Table- II).

Table – II : Plasma progesterone level in different phases of two consecutive menstrual cycles(n=30)

	Plasma progesterone level (ng/ml)		
Cycles	Phase A	Phase B	Phase C
I	0.01±0.02	1.41±0.21	24.54±6.27
(1st month)	(0.00-0.05)	(1.02-1.96)	(11.90-22.02)
II	0.01±0.03	1.48±0.22	26.56±4.02
(2nd month)	(0.00-0.05)	(1.11-1.94)	(18.06-32.01)
Statistical Analysis			
	P value		
	Cycle I	Cycle II	
A vs. B	0.10 ns	<0.05	
A vs. C	<0.001	<0.001	
B vs. C	<0.001	<0.001	

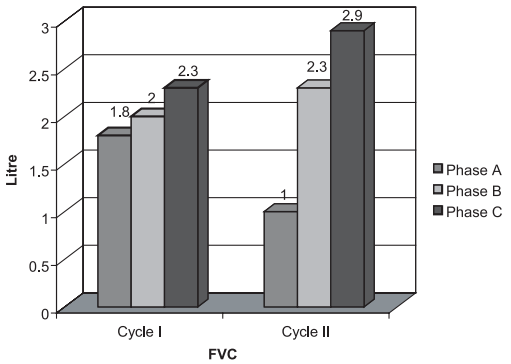
ns = not significant, n = total number of subjects.
Figures in parentheses indicate ranges.

In cycle I, the mean FVC, FEV1, FEV1/FVC (%) were significantly increased (p<0.001) in phase C in comparison to those of phases A and B. Though this value was increased in phase B than that of phase A in the same group, the difference between them was not statistically significant (p>0.05).In Cycle II, all these were significantly increased (p<0.001) in phase C in comparison to those of phases A and B. Again, all theses values were significantly increased (P<0.001) in phase B than those of phase A.

FVC,FEV1,FEV1/FVC(%) ratio were almost similar both in cycle I and II in different phases. Therefore no statistically significant differences

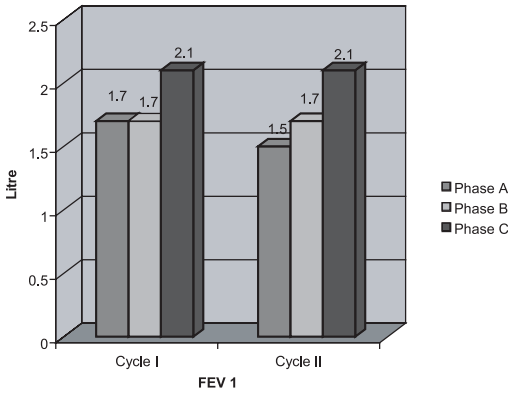
of theses values were observed in different phases between the cycles (Figure 1, 2, 3).

Correlation of FVC, FEV_1 FEV1/FVC % with plasma progesterone level in phase C (luteal phase) of the two consecutive menstrual cycles were studied. This relationship was not observed



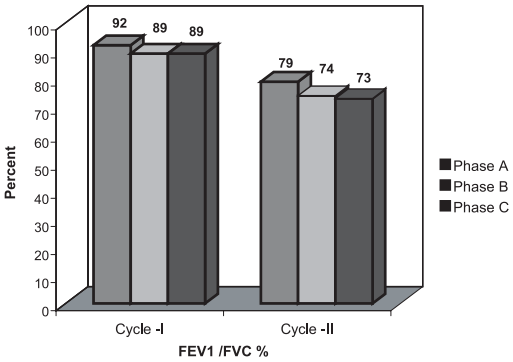
Cycles: I = 1st month; II = 2nd month; Phases: Phase A = Menstrual phase (Baseline); Phase B = Follicular phase; Phase C = Luteal phase

Figure 1: Mean FVC in different phases of two consecutive menstrual cycles (n=30)



Cycles: I = 1st month; II = 2nd month; Phases: Phase A = Menstrual phase (Baseline data); Phase B = Follicular phase; Phase C = Luteal phase

Figure 2: Mean FEV_1 in different phases of two consecutive menstrual cycles (n=30)



Cycles: I = 1st month; II = 2nd month; Phases: Phase A = Menstrual phase (Baseline data); Phase B = Follicular phase; Phase C = Luteal phase

Figure 3: Mean FEV1 /FVC % in different phases of two consecutive menstrual cycle (n = 30)

in phase A and phase B as the hormone level was almost negligible during these phases (Table- II).

Plasma progesterone level was positively correlated with the values of FVC, FEV_1 and FEV1/FVC % in phase C (luteal) in two consecutive menstrual cycles, but these relationships were not statistically significant (P>0.05).(Table-III)

Table-III : Correlations of FVC,FEV_1 and FEV_1/ FVC% with plasma progesterone levels during phase C(luteal phase) of two consecutive menstrual cycles(n=30)

	r/p values		
	FVC	FEV_1	FEV_1/ FVC%
Cycle I	+0.253	+0.202	+0.80
	0.10	0.50	0.10
Cycle II	+0.350	+0.258	+0.71
	0.10	0.10	>0.50

Cycle I = I st month, Cycle II= 2nd month

Discussion

The present study was undertaken to evaluate the correlations of plasma progesterone with some

pulmonary function parameters like FVC,FEV1, FEV1/FVC (%) during luteal and follicular phases of two consecutive menstrual cycles in apparently healthy females whose mean height and weight were within normal ranges. As the hormone level becomes almost zero during menstrual phase, it was considered as the baseline and the relationship during this phase was not studied. The plasma level of progesterone and lung function parameters were studied during all the three phases of two consecutive menstrual cycle for comparison and also to get more confirmatory result. Plasma progesterone levels were significantly higher in luteal phases in comparison to those of follicular and menstrual phases in both the menstrual cycles. These findings are consistent with those of reported by some others[2-3,5] . Again, this hormone levels were also higher in follicular phases in comparison to those of menstrual phases and the differences were statistically significant in cycle II ($P<0.05$) but not in cycle I ($P>0.05$). However, no similar data were available to compare all these findings.

In the present study, FVC was found to be gradually and significantly increased from menstrual through follicular to luteal phases in both the menstrual cycles. This is comparable to observations made by other investigators.[2,5,9]

In this study FEV_1 was significantly higher ($P<0.001$) in luteal phase than those of the menstrual and follicular phases. This findings are consistent with those of others[2].

Plasma progesterone level was positively correlated with the values of FVC, FEV_1 and FEV1/FVC % in luteal phase in the two consecutive menstrual cycles. all these relationships were statistically non significant .

These findings are consistent with those of others[5,10]. However, they did not mention about their statistical significance in their study.

Various suggestions are made by different investigators about the effect of higher progesterone level in changing lung function during different phases of menstrual cycle. In this study the observed improved pulmonary function in luteal phase might be related to high progesterone level which induces hyperventilation by direct stimulation of respiratory center[11] and increased oxygen consumption due to increased metabolic rate[5]. Experimental evidences showed that administration of progesterone, directly stimulates respiratory center through a CNS steroid receptor mediated mechanism. Thus the stimulatory effect on these receptors may induce hyperventilation and thereby causes improvement in lung function[12-14]. Moreover, progesterone may potentiate prostaglandin induced relaxation of bronchial smooth muscles. For this reason bronchial relaxation is well marked during luteal phase[15]

In the present study, the observed improvement of pulmonary functions during luteal phase of menstrual cycle is most likely due to increased level of plasma progesterone. In addition the positive correlation of plasma progesterone level with FVC, FEV1 and FEV1/FVC% were also in favor of the statement that, increased progesterone level causes improvement of lung function.

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