Pulmonary Functions in Different Phases of Menstrual Cycle and its Relation with Serum Progesterone levels.

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Abstract: *Background & objectives:* Cyclical changes in the hormonal levels determine different phases of menstrual cycle. These variations in hormonal levels are also responsible for variations in functional parameters of many systems in the body. Many studies have highlighted the changes in respiratory parameters in different phases of menstrual cycle. In this study, we have explored the factors that influence lung function in adolescent girls focusing on the hormonal factors related to the menstrual cycle. *Methods:* 36 adolescent girls with normal menstrual cycle consented for the study. Pulmonary functions and serum progesterone were measured during follicular and secretory phase of menstrual cycle after a detailed menstrual history and screening for medical illness. *Results* : show a significantly higher serum progesterone and FVC, FEV1 and PEFR during secretory phase. There was a strong positive correlation of Serum progesterone in secretory phase with FVC and negative correlation with FEV1%. *Interpretation & conclusion:* This improvement of pulmonary function during secretory phase is due to increase in serum progesterone levels which have a dual effect of overall smooth muscle relaxation and hyperventilation. Supplement of progesterone may be useful to avert premenstrual asthma and enhance the performance. [Dabhoiwala S et al NJIRM 2012; 3(1) : 39-42]
Key Words: adolescent girls, pulmonary function, menstrual cycle, serum progesterone.

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Introduction: Menstrual cycle is an integral part of life of women. The menstrual cycle is divided into two phases, follicular and luteal, typified by specific hormonal fluctuations and separated by ovulation at midcycle. The follicular phase starts with the first day of menstruation and is followed by the luteal phase from ovulation until menstruation restarts. Cyclical changes in the hormonal levels determine different phases of menstrual cycle. These variations in hormonal levels are also responsible for variations in functional parameters of many systems in the body[1]. It is known that the asthma incidence is greater in boys during childhood and in girls during adolescence[2]. Hormonal differences and their changes during adolescence have been considered to be contributing factors. It is well known that some female asthmatic patients experience aggravation of asthma symptoms during the premenstrual or menstrual phase of their cycle[3]. However, the underlying mechanisms associated with asthma exacerbation during the perimenstrual period and the related hormones have not been described.

Many studies have highlighted the changes in respiratory parameters in different phases of menstrual cycle[4]. This study attempted to observe the pulmonary functions in different phases of menstrual cycle in order to find out the correlation of progesterone level with some lung function parameters during different phases of menstrual cycle in apparently healthy adolescents girls.

Material and Methods: The study was conducted in the department of physiology, Medical College, Baroda. 36 adolescent girls with normal menstrual cycle consented for the study. Girls with history of irregular menstrual cycle, use of contraceptive pills, medical or surgical illness were excluded from the study. Informed written consent was taken from each subject. The institutional ethical committee permitted the study. Detailed medical and menstrual history was elicited. Height and weight were measured and BMI was calculated. The 1st day of menstrual cycle was determined based on menstrual history. Each subject were given two specific dates as per their menstrual cycle to report

to the department 2 times -one during follicular phase and again during luteal phase of menstrual cycle. The tests were performed in early morning between 8 to 9 am. Manoeuvre for forced vital capacity was explained and demonstrated to the subjects. Each subject was relaxed before the measurement and given a chance to rehearse the manoeuvre. Final reading was selected from three best manoeuvres after examining the flow volume curves. A blood sample was collected for measuring plasma progesterone levels. Pulmonary functions were measured using MEDI:SPIRO (Maestros mediline system Ltd.) and serum progesterone levels were measured by Radioimmunoassay (RIA) method.

Statistical analysis was done by SPSS windows package version 12. Values are expressed as mean ±SD. The comparison between phases of menstrual cycle was done by paired t test. Pearson's correlation coefficient was found to observe the relationship between pulmonary functions and serum progesterone levels. The P value of <0.05 was considered as statistical significant.

Result:
Study included 36 adolescent girls from medical college Baroda. Mean age was 18.08±0.73 years.

Table:1: Comparison of pulmonary functions in follicular and secretory phases of menstrual cycle.

	Follicular phase	Secretory phase
FVC (L)	2.36±0.15	2.49±0.15**
FEV1(L)	2.12±0.10	2.18±0.09**
FEV1 %	89.95±3.8	87.77±3.51**
FEF25-75%(L)	2.89±0.41	2.8±0.31
PEFR (L/s)	6.06±0.29	6.37±0.26**
Serum Progesterone (ng/ml)	0.18±0.06	9.89±2.39**

*P<0.05,**P<0.01 on comparing difference between means.

Anthropometric parameters showed mean height of 158.75±4.45 cm and mean weight of 48.81±6.33 kg and mean BMI as calculated from weight and height was 19.35±2.25 kg/m^2. Mean Serum progesterone level in secretory phase 9.89±2.39

ng/ml was remarkably higher in comparison with follicular phase 0.18±0.06 ng/ml.
Pulmonary function parameters show significantly higher FVC, FEV_1 and PEFR in secretory phase while FEV_1% was lower and FEF_{25-75}% was not significantly different in the two phases of menstrual cycle (table 1).

Table:2 : Correlation between serum progesterone and pulmonary functions in different phases of menstrual cycle (values = correlation coefficient r).

	Serum Progesterone in Follicular phase(ng/ml)		Serum Progesterone in Secretory phase(ng/ml)
FVC (L)	0.719**	FVC (L)	0.544**
FEV$_1$(L)	0.437**	FEV$_1$(L)	0.269
FEV$_1$ %	-0.563**	FEV$_1$ %	-0.542**
FEF$_{25-75\%}$(L)	-0.369*	FEF$_{25-75\%}$ (L)	0.212
PEFR (L/s)	0.442**	PEFR (L/s)	0.188
Serum Progesterone in secretory phase (ng/ml)	0.441**	------	------

** Correlation is significant at the 0.01 level.
* Correlation is significant at the 0.05 level.

Table 3. Change in pulmonary functions with increase in serum progesterone levels in secretory phase of menstrual cycle (all values are mean ±SD).

	Serum Progesterone (ng/ml) in secretary phase		
	<9 (n=14)	9-12 (n=12)	>12 (n=10)
Serum Progesterone in secretory phase (ng/ml)	7.47±1.15	10.31 ±0.93	12.78 ±0.76**
FVC (L)	2.41±0.16	2.48±0.10	2.6 ±0.1*
FEV$_1$(L)	2.16±0.11	2.17±0.05	2.21±0.05
FEV$_1$ %	89.82±3.7	87.38 ±2.45	85.37 ±2.76*
FEF$_{25-75\%}$(L)	2.93±0.35	2.73±0.27	2.69±0.23
PEFR(L/s)	6.35±0.27	6.24±0.19	6.52 ±0.25*
Serum Progesterone in follicular phase (ng/ml)	0.16±0.05	0.15±0.04	0.22 ±0.05*

**P<0.01,*P<0.05- on comparing with other two groups.

Studying the correlation between the pulmonary function parameters and serum progesterone levels during the follicular phase show FVC, FEV_1 and PEFR show a strong positive correlation while FEV_1% and FEF_{25-75}% were negatively correlated with serum progesterone levels during follicular phase. FVC show a strong positive correlation while FEV_1% shows a negative correlation with serum progesterone during secretory phase. Other parameters were not significantly correlated with serum progesterone in secretory phase.

As the standard deviation of plasma progesterone levels during secretory phase was on higher side we grouped plasma progesterone into 3 categories (level of serum progesterone in secretory phase) as <9ng/ml, 9-12ng/ml, >12ng/ml.

Table 3 shows comparison of pulmonary function in these 3 groups. FVC and PEFR significantly increased with serum progesterone while FEV_1 was higher but not statistically significant. FEV_1% significantly decreased with increase in serum progesterone levels.

Discussion: In our study group the mean value of serum progesterone in secretory phase was significantly higher. These findings were consistent with reports of Das T K et al[5]. Chen HI et al during a study of respiratory muscle function in menstrual cycle found a significantly higher serum progesterone levels in secretory phase[6]. While Pai RP et al also demonstrated a rise in progesterone levels in secretory phase compared to follicular phase[7]. However Mannan et al found a similar higher progesterone levels in secretory phase but mean value was much higher 24.54ng/ml, perhaps the lower levels in our study may be due to lower age group in our study[8].

Pulmonary function parameters like FVC, FEV_1 and PEFR were significantly higher in secretory phase of menstrual cycle. Mannan et al showed a similar finding of increased FVC in secretory phase[8]. Also we found significant correlation between FVC and serum progesterone in secretory phase. Rajesh CS et al found a similar finding in adolescent girls of delhi[9]. While Rao GS et al pointed out higher value of expiratory flow rates like FVC in secretory phase

compared to follicular phase[10]. The influence of progesterone may account for such a response. Progesterone has shown to have widespread smooth muscle relaxant effect and therefore may have bronchodilator action[11].

FEF_{25-75}% was not significantly different in the two phases of menstrual cycle. Correlation between plasma progesterone and FEF_{25-75}% was not statistically significant. Resmi et al demonstrated a similar finding of no significant change in FEF_{25-75}% during menstrual cycle phases[12], however Gokhale et al found increased FEF_{25-75}% during secretory phase[13]. The plasma progesterone levels in our study may not be enough to give a significant relaxant effect on bronchial smooth muscle.

PEFR was significantly higher in the secretory phase of menstrual cycle. PEFR also showed a strong correlation with serum progesterone levels in both secretory and follicular phases of menstrual cycle. Resmi et al showed a similar higher PEFR in secretory phase[12]. A significantly high PEFR in secretory phase was also demonstrated by Gokhale et al[13]. While Stephanie Megan Parsons BS showed PEFR was not much affected by menstrual cycle[14], on contrary Bruno de Silva et al noted a decrease in PEFR during secretory phase[15]. The increase in PEFR in our study indicates overall improvement in lung function during secretory phase of menstrual cycle. Higher progesterone levels during secretory phase of menstrual cycle induces hyperventilation by direct stimulation of respiratory center[11,16,17].

Conclusion: The improvement of pulmonary function during secretory phase is due to increase in serum progesterone levels which have a dual effect of overall smooth muscle relaxation and hyperventilation. Supplement of progesterone may be useful to avert premenstrual asthma and enhance the lung performance. Thus sex hormones play an important role in women's lung.

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