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STATUS OF PULMONARY FUNCTION TESTS IN ADOLESCENT FEMALES OF DELHI

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Abstract : Progesterone is known to cause hyperventilation and hypercapnia in the luteal phase of a normal menstrual cycle. Viewing this fact lung functions were measured in 71 girls with a mean age of 14.5 years during their follicular and luteal phase of menstrual cycle. Subjects were grouped into I, II and III depending on the age range. Respiratory functions comprising of FVC, FIVC, TLC, RV/TLC, FEV1, FEV1/FVC, FRC, PEFR, FEF 25%, FEF 50%, FEF 75%, PIFR, RAW and KST respectively were performed using Spiro 232 of PK Morgan under standardized laboratory settings. The anthropometric parameters such as height, weight and arm span were also recorded. The majority of pulmonary functions reflect better values in luteal phase as compared with follicular phase however, a statistically significant higher results of FVC, FIVC, FEV_1, and TLC were noticed in group I and group III. These observations suggest a possible role in increased level of progesterone in luteal phase on respiratory system.

Key words : lung functions; adolescent females; progesterone; luteal phase

INTRODUCTION

Reports suggest that the lung functions exhibit not only diurnal variation but also show changes dependent on different phases of the menstrual cycle. Increase in alveolar ventilation during pregnancy and luteal phase is also well known and has been attributed to increased levels of progesterone (1, 2, 3, 4, 5, 6, 7, 8). Exogenous administration of progesterone is often used clinically in obesity associated hypoventilation syndrome (9) and is known to cause relaxation of smooth muscles especially of the reproductive and gastrointestinal system (10, 11, 12, 13). Everson et al (11) have reported relaxation of gall bladder muscle in luteal phase of menstrual cycle due to the action of progesterone. Other studies have shown that progesterone also causes an increase in diffusion capacity (14), mouth occlusion pressures (15), and changes at central and peripheral level in the carbon

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dioxide sensitivity during the normal menstrual cycle (2, 4, 10, 16, 17, 18, 19). Further due to its beneficial role in premenstrual asthma, wherein the asthmatic attacks are increased when the serum levels fall has also been suggested (12, 20, 21, 22, 23).

Also in females the regular adult hormonal pattern is reached after few cycles following menarche, which may vary up to two years (24). During such period the cycles are anovulatory (24, 25).

Keeping all these facts in mind, the present study was planned to evaluate more precisely the possible effects of progesterone on lung function tests in initial few years after menarche in school going girls of East Delhi.

METHODS

Seventy-one healthy female subjects of 12 to 17 years age, who had achieved their menarche, were studied in follicular and luteal phase of their menstrual cycle. The subjects were grouped according to their age and categorized in 3 groups : group I of age 12 and 13 years, group II 14 and 15 and group III of 15 and 16 years respectively. An exclusion criterion was formulated in which all subjects with recurrent respiratory tract infections, congenital anomalies, obesity, smoking and irregular cycles were excluded. Anthropometrical measurements including age, height, weight, arm-span and chest circumference were recorded. Further a preliminary clinical examination was carried out on the selected subjects to rule out any medical problems. All subjects selected had not only attained their menarche but also had fairly regular cycles (~28 days with previous 3 cycles of that duration, based on subjects statement).

Pulmonary functions were performed on the computerized machine; Spiro-232 of PK Morgan with built in computer program, using the standard laboratory methods. Before each test the subject was familiarized with the machine and a detailed instructions cum demonstration up to the satisfaction was done. All the procedures were carried out in sitting position in our respiratory laboratory during morning hours between 8 am and 12 pm in a quite laboratory setup in order to alleviate the emotional and psychological stresses. During the tests the subject was adequately encouraged to perform at their optimum level and also a nose clip was applied during the entire maneuver. Test was repeated at least 3 times and the best matching results were considered for the analysis. All recordings were done at the BTPS. The timing of the lung function during the cycle was such that they were performed on the 8th to 10th day (follicular cycle) and on 20th to 22nd days of the cycle (luteal phase).

The outcome of pulmonary function tests was presented as a mean ± SD for each of the parameter. A statistical comparison was drawn between the lung functions of the two phases of the menstrual cycle for each group by applying paired 't' test model and scatterogram are plotted for selected lung tests i.e. FVC (L), TLC (L) and FRC (L) recorded during first and second phase of menstrual cycle related to age in years of all subjects.

RESULTS

The mean cycle length of all the subjects was in the range of 28 ± 2 days. Anthropometrical results of all the subjects are exhibited in Table I. The values of lung function parameters measured in each subject during follicular and luteal phase are depicted in Table II along with a statistical comparison (paired 't' test) is also given. Table III shows the lung function results of group I, II and III respectively along with the statistical comparison.

TABLE I : Shows the anthropometric parameters of all subjects (n = 71).

Parameters	*Mean±SD*
Age (years)	14.45±1.72
Arm span (cms)	157.25±6.37
Chest Circumference (cms)	80.58±7.67
Height (cms)	149.07±4.64
Weight (kgs)	45.65±6.79

TABLE II : Exhibits the results of all pulmonary function tests in all subjects (n = 71).

PFT	*Follicular Phase Mean±SD*	*Luteal Phase Mean±SD*	*P value*
FEF 25 (L/sec)	3.73±0.98	4.38±4.84	0.263
FEF 50 (L/sec)	3.28±0.77	3.34±0.78	0.544
FEF 75 (L/sec)	2.13±0.55	2.16±0.54	0.721
FEV_1 (L/sec)	1.97±0.39	2.03±0.35	0.126
FEV_1%	97.04±4.00	94.37±9.12	0.041*
FIVC (L)	2.04±0.42	2.19±0.35	0.002*
FRC (L)	1.44±0.40	2.16±0.37	0.001*
FVC (L)	2.01±0.40	2.16±0.37	0.001*
PEFR (L/sec)	3.69±1.01	4.05±0.90	0.507
PIFR (L/sec)	2.97±0.75	3.16±0.74	0.051
Raw (cmH_2O/L/sec)	2.34±0.75	2.29±1.00	0.722
RV (L)	0.75±0.17	0.78±0.19	0.149
RV/TLC Ratio	27.27±6.13	26.67±5.13	0.468
TLC (L)	2.83±0.50	2.98±0.45	0.011*

*Significance at P≤0.05

TABLE III : Shows pulmonary function tests in various age groups.

	Group I Lung functions in 12 & 13 years (n = 23)		*Group II Lung functions in 14 & 15 years (n = 26)*		*Group III Lung functions in 16 & 17 years (n = 22)*	
	Follicular Phase Mean±SD	*Luteal Phase Mean±SD*	*Follicular Phase Mean±SD*	*Luteal Phase Mean±SD*	*Follicular Phase Mean±SD*	*Luteal Phase Mean±SD*
FEF 25 (L/sec)	3.73±1.03	3.81±1.39	3.64±0.66	5.03±7.93	3.85±1.24	4.22±0.59
FEF 50 (L/sec)	3.16±0.77	3.17±1.03	3.16±0.49	3.16±0.48	3.56±0.99	3.75±0.58
FEF 75 (L/sec)	2.07±0.52	2.06±0.60	1.93±0.39	2.01±0.44	2.45±0.63	2.44±0.50
FEV (L/sec)	1.84±0.46	1.95±0.41	1.98±0.33	2.00±0.32	2.11±0.35	2.18±0.28
FEV^1%	98.74±2.23	94.98±4.61*	94.95±4.72	91.42±13.62	97.73±3.55	98.31±2.77
FIVC (L)	1.84±0.45	2.16±0.44*	2.11±0.40	2.20±0.34	2.18±0.32	0.23±0.28
FRC (L)	1.40±0.30	1.56±0.37*	1.35±0.38	1.45±0.31	1.61±0.21	1.60±0.22
FVC (L)	1.83±0.46	2.65±0.43*	2.10±0.35	2.19±0.33	2.11±0.32	2.24±0.35*
PEFR (L/sec)	3.89±1.04	3.99±1.27	3.99±0.73	3.87±0.64	4.00±1.28	3.43±0.50
PIFR (L/sec)	2.84±0.80	2.77±0.71	3.04±0.77	3.27±0.82	3.02±0.69	4.35±0.61*
Raw (cm H_2O/L/sec)	2.20±0.51	2.52±1.32	2.61±0.74	2.53±0.86	2.19±0.90	1.79±0.45*
RV (L)	0.77±0.18	0.80±0.22	0.68±0.18	0.71±0.18	0.82±0.11	0.85±0.13
RV/TLC Ratio	29.80±5.14	27.25±4.70*	25.26±7.12	25.94±5.94	27.02±5.01	26.95±4.66
TLC (L)	2.61±0.56	2.96±0.59*	2.79±0.42	2.87±0.36	3.12±0.40	3.14±0.31

*Significance at P≤0.05

Figure 1, 2 and 3 show scatterogram plotted for a few selected lung function parameters i.e. FVC (L), TLC (L) and FRC (L) between first and second test in relation with age of all subjects. As indicated P≤0.05, hence significant higher values of these parameters obtained during second test as compared with the first one.

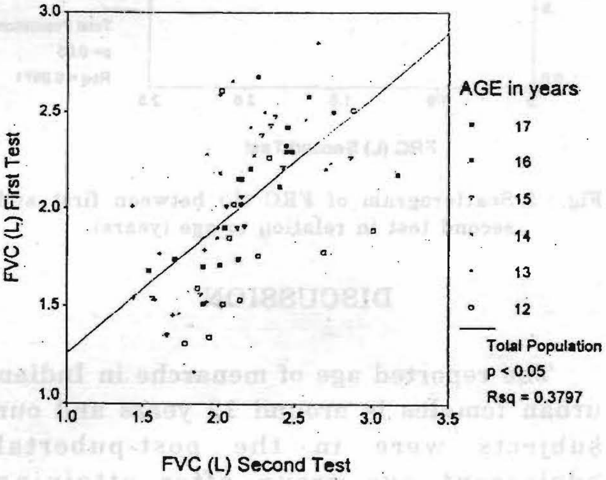

Fig. 1 : Scatterogram of FVC (L) between first and second test in relation to age (years).

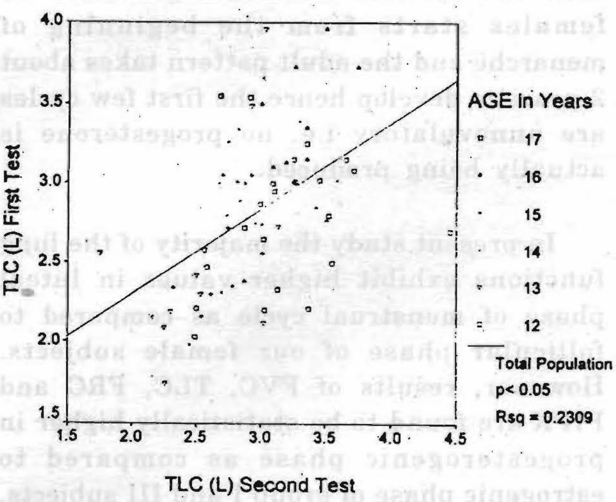

Fig. 2 : Scatterogram of TLC (L) between first and second test in relation to age (years).

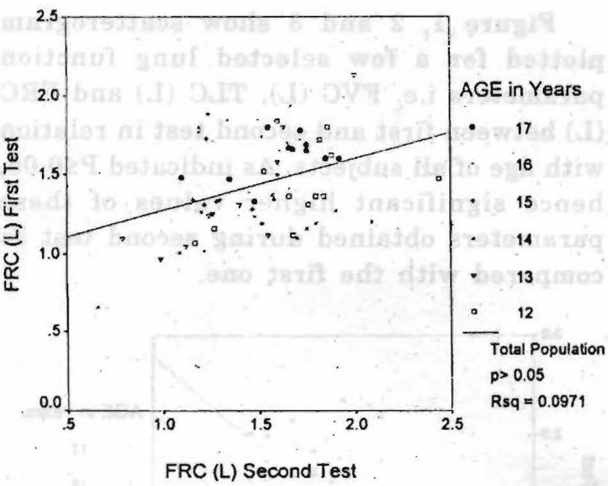

Fig. : 3 Scatterogram of FRC (L) between first and second test in relation to age (years).

DISCUSSION

The reported age of menarche in Indian urban females is around 12 years and our subjects were in the post-pubertal adolescent age group after attaining menarche and having regular cycles as per their history. Tanner et al (24) have noted that the cyclical hormonal secretion in females starts from the beginning of menarche and the adult pattern takes about 2 years to develop hence the first few cycles are annovulatory i.e. no progesterone is actually being produced.

In present study the majority of the lung functions exhibit higher values in luteal phase of menstrual cycle as compared to follicular phase of our female subjects. However, results of FVC, TLC, FRC and PIFR are found to be statistically higher in progesterogenic phase as compared to estrogenic phase of group I and III subjects, but no such significance is noticed in group II individuals.

Our results are comparable to those of Rao et al (4) who reported significantly lower values of PEFR and FEF $_{25-75\%}$ in estrogenic phase and Das et al (3) who found non significant higher values in progesterogenic phase respectively in their adult female subjects of mean age 18 years. However, Sansores et al (14) did not find changes in FEV_1, FVC and $FEF_{25-75\%}$ parameters except for higher DL_{CO} levels in the luteal phase of their subjects.

Other reports (16, 26) indicate the influence of progesterone on central (medullary) and peripheral receptors causing hyperventilation and hypo-capnia in luteal phase of the normal menstrual cycle and pregnancy by increasing the sensitivity of the receptors, and this increased sensitivity of respiratory system to progesterone in luteal phase has been attributed to cause a beneficial compensatory mechanisms to meet the increased demands during pregnancy (27, 28). Foster et al (29) showed progesterone mediated relaxation of the bronchial smooth muscle in animal models through an β adeno-receptor mediated mechanism (30). Further this model (11) was also used to study the effect of progesterone on the relaxation of gall bladder in pregnancy and in luteal phase of menstrual cycle. The use of progesterone in hypoventilation syndrome and emphysema has been by its virtue of increasing the sensitivity of the respiratory neurons to CO_2 (17), producing stimulatory effect directly on the medullary receptors (9, 31, 32). More recently the exogenous progesteronic preparations are also found to be showing to increase in resting minute volume (3), respiratory muscle endurance (15) and hypoxic drive (16, 17, 33, 34). Premenstrual asthma a newly evolving concept is due to exaggerated of the normal cyclical variation in the lung functions in patients suffering from asthma, it is postulated that it is due to decreased responsiveness of progesterone precipitating the condition (8, 20, 21, 22, 23, 33). Further Foster et al (29) have suggested that female sex steroids potentiates the broncho-relaxant effects of catecholamines and a blunted β adenoreceptor response may contribute to the development of asthma. To conclude we have found in majority better results of lung functions and few of these are statistically higher in luteal phase as compared with the follicular phase of our subjects shown in scatterogram (Fig. 1, 2 and 3), indicating a possible role of progresterone causing β adrenergic stimulation/sensitization. Also after attaining the menarche initial few cycles are irregular and anovulatory, hence causing the present pattern of pulmonary function results. Further it is suggested that more such studies must be carried out on large population along with quantitative measurements of progesterone levels to correlate with respiratory functions.

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