Section: Physiology

Original Research Article

SPIROMETRIC EVALUATION OF LUNG FUNCTION IN DIFFERENT PHASES OF MENSTRUAL CYCLE

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ABSTRACT

Background: "The reproductive changes in women exhibit cyclical changes that occur regularly over a period of about one month. This is called menstrual cycle". Women continually experience fluctuation in estrogen (being higher in follicular phase) and progesterone (being higher in luteal phase) during their menstrual cycle. The cyclic hormonal changes not only bring about changes in the reproductive system but also affects a variety of physiological processes like respiratory system, cardiovascular system and musculoskeletal system. Variation in functional parameters of respiratory system may be related to fluctuation in the hormonal levels during the different phases of menstrual cycle. **Aims and objective:** Spirometric evaluation of FVC, FEV_1, FEV_1/FVC, PEFR, $FEF_{25\%}$, $FEF_{50\%}$, $FEF_{75\%}$, $FEF_{25-75\%}$ in follicular and luteal phase. And to compare the status of lung function between follicular and luteal phase of menstrual cycle.

Material and Methods: 100 young females in age group of 18-24 years having regular menstrual cycle were selected amongst medical students, paramedical students of Gauhati medical college, Guwahati. Spirometric parameters were evaluated in follicular and luteal phase.

Results: spirometric evaluation shows FVC, FEV_1, FEV_1/FVC were significantly higher($p<0.01$) in luteal phase than in follicular phase. There was also increased PEFR and $FEF_{25-75\%}$ ($P<0.01$) in luteal phase compared to follicular phase.

Conclusion: In the present study, the observed improvement in lung function profiles in the luteal phase compared to follicular phase and with the limitation of measurement of hormonal levels, suggest that progesterone probably involved in increased ventilation during luteal phase.

Key Words: Menstrual cycle, progesterone, follicular and luteal phase

INTRODUCTION

The cyclical changes that occur regularly over a period of about one month during the woman reproductive period is called menstrual cycle. During this period there is preparation of the reproductive system for fertilization and implementation of the fertilized ovum. In human beings the reproductive cycle externally manifest by periodic vaginal bleeding called menstruation". Characteristically, "the menstrual cycle is divided into follicular phase and luteal phase, separated by ovulation that occurs between these two phases. Ovulation usually occurs on 14th day in a 28 days cycle".[3,4]

Woman continually experience a wide fluctuation in estrogen & progesterone levels during the menstrual cycle with estrogen being higher in follicular phase and progesterone higher in luteal phase and level of hormone fall to baseline in menstrual phase. The estrogen is secreted from the granulosa cells of ovarian follicles during the follicular phase and progesterone is secreted from corpus luteum during the luteal phase. This cyclic hormonal changes not only bring about changes in the reproductive system but also affects a variety of physiological processes

like in cardiovascular system, respiratory system and musculoskeletal system.

Variation in functional parameters of respiratory system may be related to fluctuation in the hormonal levels during the different phases of menstrual cycle. Reports suggest that lung function exhibit not only diurnal variation but also show changes dependent on the different phases of menstrual cycle. Studies have suggested that "respiratory function is influenced by female sexual hormones, especially progesterone, which could increase ventilatory response at rest during the luteal phase".[1,2] "It is being increasingly reported that about one third to half of the women experience worsening of asthma symptoms during the premenstrual or menstrual period".[14] It was also reported that exogenous administration of progesterone preparation found to increase the resting minute volume.[3]

Very few reports of studies of similar nature from this part of our country is available, hence with the facilities available in our department the present study "spirometric evaluation of lung function in different phases of menstrual cycle" has been undertaken in the department of physiology to observe the variation in spirometric parameters in follicular and luteal phase of menstrual cycle.

Aims and objective: The objective of the study are

1. To do spirometric evaluation of FVC, FEV1, FEV1/FVC, PEFR, FEF25%, FEF50%, FEF75%, FEF25-75% in follicular and luteal phase.
2. To compare the status of lung function between follicular and luteal phase of menstrual cycle.

MATERIALS AND METHODS

It was a cross sectional study done from a departmental based sample. It was intended to compare the dynamic pulmonary function in different phases of menstrual cycle. Ethical clearance was taken from institutional ethical committee. The study was conducted amongst medical students, paramedical students, and students of dental college during a period from July 2011 to June 2012. 100 subjects were in the age group of 18-24 years who had achieved menarche, having regular menstrual cycle (28 days with previous 3 cycles of that duration based on subjects statement). The subjects were asked to come between 8th to 10th day postmenstrual (follicular phase) and 20th to 22nd premenstrual (luteal phase) day of menstrual cycle. Anthropometric measurements like height, weight were recorded. Further a clinical examination was carried out to rule out any medical problem. After a brief period of 10-15 min rest, spirometry was performed on the digital spirometer ("MEDSPIROR- Records & medicare system ISO-9001). Before each test the subject was familiarized with the machine and a detailed instruction and demonstration upto satisfaction was done. All the tests were performed in standing position in a quiet laboratory set up between 12 O'clock to 2 pm to avoid diurnal variation. FVC, FEV1, FEV1/FVC, PEFR, FEF25%, FEF50%, FEF75%, FEF25-75% were recorded from the screen of the machine. In this way three such reading were taken at interval of 3min and best results were considered for analysis.

Exclusion criteria: subjects with respiratory diseases, congenital anomalies, irregular menstrual cycle, contraceptive pill users, obesity, smokers or suffering from any other illness which might affect lung functions.

Data Analysis: The data so collected were compiled and tabulated & expressed as mean ± SD. Statistical analysis were done using t -test (paired). This is commonly used to determine the statistical significance of difference of different spirometric parameters like FVC, FEV1, FEV1/FVC, PEFR, FEF25%, FEF50%, FEF75%, FEF25-75% etc. P value of less than 0.01 indicates a significant difference.

RESULTS

Spirometric tests were conducted on 100 healthy subjects having regular menstrual cycle in the age group of 18-25 years. The values of recordings of different parameters in each subject during follicular and luteal phase were depicted in the following table. All the data were expressed as mean ± SD. Comparison of data were done statistically using students paired t- test. P value of less than 0.01 indicates a significant difference.

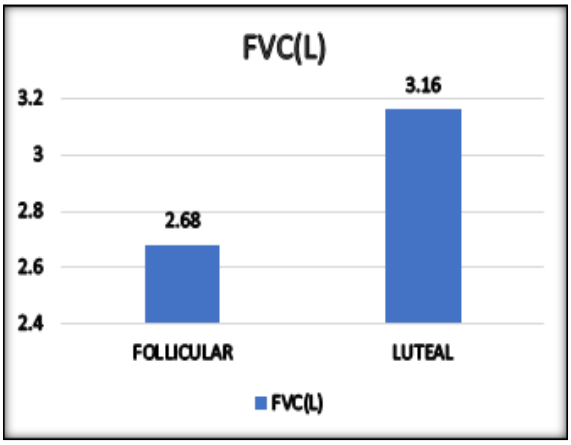

Figure 1: Bar diagram showing FVC in follicular and luteal phase

After the statistical analysis, the calculated value at 0.01 level of significance with 99 degrees of freedom was found to be greater than the tabulated value (t > 2.63). Hence FVC is significantly higher in luteal phase than in follicular phase (P< 0.01).

Table 2: Shows results of FEV1/FVC (L/sec)

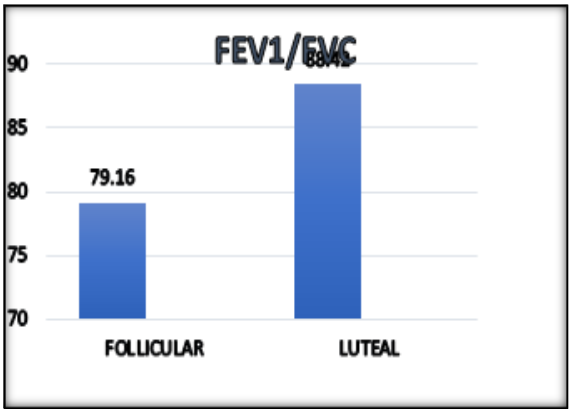

Figure 2: Bar diagram showing FEV1/FVC in follicular and luteal phase

After the statistical analysis, the calculated value at 0.01 level of significance with 99 degrees of freedom was found to be greater than the tabulated value (t > 2.36). Hence FEV1/FVC is significantly higher in luteal phase than in follicular phase (P< 0.01).

Table 3: Shows results of PEFR

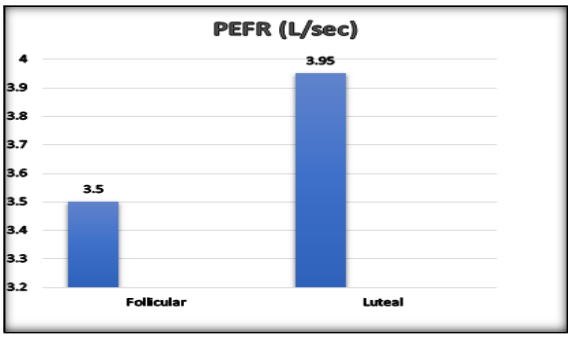

Figure 3: Bar diagram showing PEFR (L/sec) in follicular and luteal phase

The mean PEFR in luteal phase is found to be greater (3.95) than follicular phase (3.50). This was found to be significant using t test at 1% level of significance (P < 0.01) with 99 degrees of freedom.

Table 4: Shows results of Forced expiratory flow during middle of the FVC (FEF 25-75%)

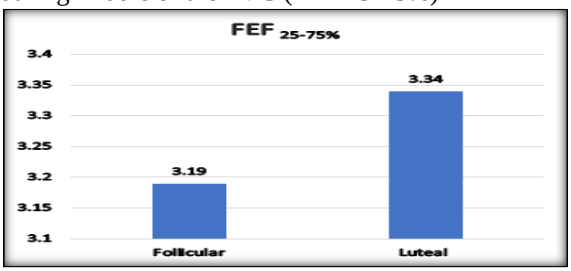

Figure 4: Bar diagram showing FEF 25-75% in follicular and luteal phase

The calculated value at 0.01 level of significance with 99 degrees of freedom was found to be greater than the tabulated value (t > 2.36). Hence FEF25-75% is significantly higher in luteal phase than in follicular phase (P< 0.01).

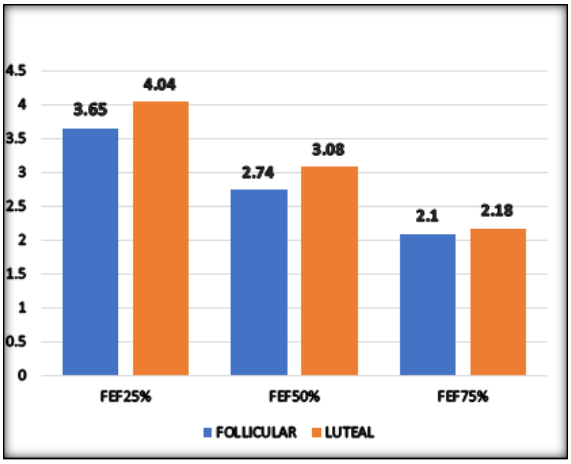

Figure 5: FEF 25%, FEF 50%, FEF 75% in follicular and luteal phase

Values of FEF25%, FEF50%, FEF75% were found to be significantly higher (P< 0.01) in luteal phase than follicular phase.

Table 1: Shows results of FVC (L)

	Follicular phase		Luteal phase		P value
	mean	SD	mean	SD	
FVC (L)	2.68	0.74	3.16	0.93	< 0.01
FEV1 (L/sec)	2.12	0.58	2.77	0.79	< 0.01
FEV1/ FVC	79.16	4.34	88.42	5.4	< 0.01
PEFR (L/sec)	3.50	0.57	3.95	0.69	< 0.01
$FEF_{25\%}$	3.65	0.59	4.04	0.79	< 0.01
$FEF_{50\%}$	2.74	0.55	3.08	0.56	< 0.01
$FEF_{75\%}$	2.10	0.32	2.18	0.50	< 0.01
FEF_{25-75}	3.19	0.46	3.34	0.61	< 0.01

DISCUSSION

The present study ‘’SPIROMETRIC EVALUATION OF LUNG FUNCTION IN DIFFERENT PHASES OF MENSTRUAL CYCLE” was carried out to compare the status of lung function in follicular phase and luteal phase of menstrual cycle in healthy females in the age group of 18-24 years.

it is observed that FVC, FEV1, FEV1/FVC, PEFR, FEF25%, FEF50%, FEF75%, FEF25-75% levels showed significant rise in luteal phase compared to follicular phase.

The result of this study is in agreement with previous studies where similar rise in lung function parameters have been reported in luteal phase. Rao

et al (1991) observed that mean of FVC, FEV1 and FEF25-75% showed higher values in progesterogenic phase as compared to estrogenic phase. Rajesh et al (2000) showed significant increase in FVC and FEV1/FVC in luteal phase compared to follicular phase. S R Mannan et al showed positive correlation of high progesterone with increased lung function in luteal phase of menstrual cycle.

It is learnt from the literature that there is hormonal fluctuation in different phases of menstrual cycle with progesterone being comparatively higher in luteal phase than in follicular phase. Since our study also shows an increase in the lung function parameters in the luteal phase as compared to follicular phase, so progesterone may have been involved in the increased ventilation during luteal phase.

Progesterone is a sex hormone secreted in significant only during the later half of each menstrual cycle. When it is secreted by corpus luteum. However, small amounts of other progestin, 17 α- hydroxyprogesterone, are also secreted along with progesterone and have essentially the same effects. Most of the effects of progesterone, however mediated through its specific binding to progesterone receptors with subsequent changes in the expression of target genes.

Studies have shown that there is increased sympathetic activity during luteal phase of menstrual cycle which may be due to upregulation of sympathetic receptors by progesterone during the luteal phase. ß-adrenergic receptors are present in the smooth muscle of airways. When ß-agonists (adrenaline, noradrenaline) binds to the ß- receptors, it cause dilatation of air passages in the lung.58 Foster et al reported that progesterone causes relaxation of bronchial smooth muscles through an ß-adrenoreceptor mediated mechanism. This relaxation is more marked in luteal phase. Harold et al showed that progesterone is an effective agent for improving ventilation in patients with obesity hypoventilation syndrome. It is reported that progesterone may potentiate the effects of prostaglandin (PGE2) induced relaxation of smooth muscle through ß-adrenergic receptor mediated mechanism.

In the present study, the observed improvement in lung function profiles in the luteal phase compared to the follicular phase and with limitation of measurements of the hormonal levels , suggests that progesterone is probably involved in increased ventilation during the luteal phase which it executes through various mechanisms as stated above.

The fluctuation in respiratory parameters during different phases of menstrual cycle in healthy young woman which is highest in luteal phase, may be an important factor to be taken into consideration in women with predisposition to respiratory allergies. They may be prone to develop symptoms of asthma during premenstrual and menstrual phases when the progesterone level fall. Taking this into consideration during the planning and management of therapeutic regimens in patients with asthma may be beneficial.

CONCLUSION

This study suggests that hormonal changes associated with the menstrual cycle phases affect spirometric variables. From the study it is concluded that the spirometric parameters were improved in luteal phase. Though statistically significant differences were demonstrated in our study, our results need to be interpreted in the background of certain limitations. Further it is suggested that more such studies must be carried out on large population with simultaneous hormonal assay to correlate with respiratory functions.

REFERENCES

1. Schoene, R.B, Robertson, H.T., Pierson, D.J., & Peterson, A.P (1981). Respiratory drives and exercise in menstrual cycles of athletic and nonathletic women. Journal of Applied Physiology, 50; 1300-1305.
2. White, Douglas, N.J., Pickett, C.K, Weil, J.V. and Zwillich C.W, (1983) Sexual influence on the control of breathing. Journal of Applied Physiology: Respiratory Environmental, Exercise Physiology 54(4), 874-879.
3. Das TK, Effects of menstrual cycle on timing and depth of breathing at rest. Indian J Physiology Pharmacol 1989;42; 498-502.
4. Bern and Levy Physiology: 6th edition p 417-426; 430-439
5. Best and Tailor's Physiological basis of Medical Practice p 547-600, 927-930.
6. G. K Pal. Textbook of Medical Physiology, 2nd edition p 724
7. Ganong WF, The female reproductive system, Review of Medical Physiology, 22nd edition, 433-450.
8. Guyton AC, Hall WD. Female physiology. Textbook of Medical Physiology, 10th edition. 2000: 436-438; 929-933.
9. Harold A. Therapeutic use of progesterone in alveolar hypoventilation associated with obesity. American J of Medicine 1968; 44.
10. Mannan SR, Begum N, Begum S, Ferdousi S, Ali T. Relationship of forced vital capacity (FVC), Forced expiratory volume in first second (FEV1) and FEV1/FVC % with plasma progesterone level during different phases of normal menstrual cycle. J of Bangladesh Society Physiol.2007; 2:7-12.
11. Rajesh CS, Gupta & Vaney. Status of pulmonary function tests in adolescent females of Delhi. Indian J of Physio and Pharma 2000; 44(4): 442-448.
12. Rao GS, Ranjan P, and Walter S. expiratory flow rate changes during the menstrual cycle. Indian J physiol Pharmacol 35; 74-76, 1991.
13. Foster PS, Goldie RG, Peterson JW, Effects of steroid on ß adrenergic receptor mediated relaxation of pig bronchus. British J of Pharmacol 1983; 52;259-264.
14. Skobeloff EM, Spivey WH, St Clair SS, Schoffstall JM. The influence of age and sex on asthma admissions. JAMA. 1992;268(24):3437–40.
15. Dorland's Oxford dictionary p127.