DOI: 10.14260/jemds/2014/3899

ORIGINAL ARTICLE

EFFECTS OF DIFFERENT PHASES OF MENSTRUAL CYCLE ON RESPIRATION

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HOW TO CITE THIS ARTICLE:
Hemalatha N. R. "Effects of Different Phases of Menstrual Cycle on Respiration". Journal of Evolution of Medical and Dental Sciences 2014; Vol. 3, Issue 65, November 27; Page: 14183-14188,
DOI: 10.14260/jemds/2014/3899

ABSTRACT: BACKGROUND: Menstrual cycle is an integral part of life in women. The characteristic rhythmic changes in the rate of secretion of ovarian hormones produce physiological changes in different organ systems, in addition to changes in the reproductive system. **AIM:** The present study is done to elucidate a possible correlative changes in respiration during the different (menstrual, luteal and follicular) phases of menstrual cycle in healthy young girls. **MATERIAL AND METHODS:** Volume and rate of resting ventilation were measured serially in 40 healthy female student's volunteers, during menstrual, follicular and luteal phases of menstrual cycle. **STATISTICAL ANALYSES:** ANOVA, 'T' test and 'P' value are applied to find out statistical significance and conclusions are drawn based on this statistical treatment. **RESULTS:** Respiratory Rate was significantly higher (P<0.006) in luteal phase than in menstrual and follicular phases. The Minute ventilation though showed slight increase in LP, was not statistically significant. The Tidal Volume showed fall during LP. **CONCLUSION:** The luteal increase in ventilation suggests a possible role for progesterone in stimulating the respiratory drive, either centrally or through the peripheral chemoreceptors or by both, thus suggesting a possible beneficial role of progesterone in the management of respiratory illnesses.

KEYWORDS: Female, Follicular phase, Luteal phase, Menstrual cycle, Progesterone, Respiration, Students.

INTRODUCTION: Menstrual cycle is an integral part of life in women. The characteristic rhythmic changes in the rate of secretion of ovarian hormones produce physiological changes in the brain, in the musculoskeletal system, cardiovascular and pulmonary functions, in addition to changes in the reproductive system. Ovulation is followed by the formation of a corpus luteum, which secretes progesterone.

Though the effect of cyclical changes in hormonal secretion on reproductive system is well-known, that on other organ systems has not been well established. The information on the variability of respiration which is relative to the menstrual phases is insufficient. The objective of the present study is to elucidate a possible correlative changes in respiration during the different (menstrual, luteal and follicular) phases of menstrual cycle in healthy young Indian girls.

MATERIALS AND METHODS: Forty healthy female student volunteers from Bangalore Medical College, Bangalore were studied throughout their menstrual cycle after taking written informed consent from them. Thorough history was taken, including menstrual history and complete clinical examination done before accepting them as subjects.

The selection of the subjects was based on fairly normal and regular menstrual history (28 ± 2 days cycle). Menstrual histories including regularity, associated dysmenorrhea, history of premenstrual symptoms like headache, irritability, edema and age of menarche were collected for screening the subjects. Female subjects with irregular menstrual cycles and/or using medications for excess bleeding of the uterus were excluded.

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The respiratory rate (RR), tidal volume (TV) and minute ventilation (MV) were recorded using Benedict – Roth apparatus (for 6 minutes) along with basal oxygen consumption during each phase of menstrual cycle–1-5th day during menstrual phase (MP), 9-12th day during follicular phase (FP) and 19–22nd day during luteal phase (LP). The phases were corroborated with the period of ovulation, as judged from daily basal oral temperature of subjects throughout cycle.

Emotional and physiological distress was avoided by allowing a few trials of breathing through the apparatus before the day of actual test. The experiment was carried out under almost similar environmental conditions at the basal state in morning hours. To minimize the effect of training, if at all, the subjects were randomly allocated to be studied first in any of the three phases 12(MP), 16(FP) and 12(FP).

The RR (breaths/min) and TV (ml) were obtained from the recording chart, the product of which was taken as MV (L/min).

The procedure repeated during next two phases of menstrual cycle in each subject.

STATISTICAL ANALYSES: ANOVA, 'T' test and 'P' value are applied to find out statistical significance and conclusions are drawn based on this statistical treatment.

RESULTS: 40 female students were selected based on purposive sampling basis for the present study. The RR (breaths/min) and TV (ml) recorded during 3 phases of Menstrual Cycle.

The descriptive statistics (table 1a) and ANOVA (Table 1 b) of RR shows 18.5±2.66, 17.85±2.55 and 19.73±2.65 in MP, FP and LP, respectively with F- ratio =5.269 and $p<0.006$ suggestive of significant increase during luteal phase.

The Tidal Volume descriptive statistics (table 2 a) and ANOVA (Table 2 b) application has showed fall during LP.

The MV (RR×TV) though showed slight increase in LP, was not statistically significant. (Table 3a and 3b).

DISCUSSION: Functional lungs are able to adapt to the metabolic need of the body and accordingly the lung function varies during different conditions. Normal ventilation is a complex process involving several interactions. Behavioural, chemical and central neuromuscular drives influence breathing profoundly. The altered state of breathing during menstrual cycle probably involves all or any such mechanisms. Since hormonal levels vary as per the metabolism, any variation in the female gonadal hormone during different phases of menstruation exerts corresponding changes in the lung functions.

Our study showed slight increase in RR, MV and fall in TV during LP which can be explained as follows:

Increased levels of both estrogen and progesterone, with predominant effect of progesterone, characterize LP. These hormones have varied physiological actions, which can influence metabolism. Progesterone increases the sensitivity of respiratory Centres to CO_2, thus causing hyperventilation, ↑ O_2 intake and ↓ alveolar and arterial CO_2.[1] Also, because of hyperventilation, breath becomes shorter, leading to decrease in tidal volume.

The increase in MV during LP has been shown in studies done by Milne et al,[2] Das and Jana.[3] Earlier studies indicate that hyperventilation during luteal phase of menstrual cycle and during pregnancy are associated with increased progesterone concentration.[3,4]

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Further, administration of progesterone to normal men and post-menopausal women produces hyperventilation.[5,6] Progesterone has also been used for treating hypoventilating patients.[7,8]

Increase in brain adrenergic receptors during pregnancy is associated with behavioural changes which can modify ventilation.[9] Recently it has been reported that luteal phase of menstrual cycle is also associated with increased adrenoreceptor density.[10]

Evidences suggest that both luteal phase of menstrual cycle and pregnancy are associated with central ventilatory drive as indicated by increase in mouth occlusion pressure.[11,12]

The physiologic changes observed during the luteal phase of menstrual cycle are known to mimic early pregnancy.[13] A significant increase in minute ventilation in the luteal phase was observed when compared to the menstrual and follicular phases.[3] This may be a result of increased oxygen consumption[12] or due to thyroid hormone over activity during the luteal phase.[14] Earlier studies indicate that an increase in progesterone secretion was a possible cause for the hyperventilation in the luteal phase.[15]

Study done by Das showed significant increase (P<0.0l) in minute ventilation was noted during luteal phase compared to both menstrual and follicular phases. Ventilation during the latter two phases was almost equal. Hyperventilation during the luteal phase was significantly high in VT only, without any appreciable change in respiratory rate.[16]

The most possible cause for an increase in lung function parameters during the luteal phase of menstruation and pregnancy is the hyperventilation associated with increased progesterone secretion.[17,18]

Periodic hyperventilation like during exercise improves respiratory muscle strength and lung capacity. Progesterone induces hyperventilation through both the central medullary and peripheral receptors and the sensitivity of respiratory receptors during the luteal phase and pregnancy.[19]

The fluctuation in respiration during different phases of menstrual cycle in healthy young women, highest in luteal phase, may be an important factor to be taken into consideration especially in women with predisposition to respiratory allergies. They may be prone to develop symptoms of asthma during premenstrual and menstrual phases when the progesterone levels fall.

CONCLUSION: In summary, the Minute Ventilation raised during Luteal Phase, along with increase in Respiratory Rate and decrease in Tidal Volume during Luteal Phase of menstrual cycle. However, this study was done in a small group of subjects and may not represent the whole Indian women. Further study needs to be performed.

REFERENCES:

1. Saul M. Genuth “The reproductive glands”, chapter 46 in Physiology. 5th ed. Beene RM, Levy MN, Koeppen BM, Stanton B. A, Mosby, 2005.
2. Milne JA, Pack AI and Coutts JR. Gas exchange and acid base status during the normal human menstrual cycle and in subjects taking oral contraceptives. (Proceedings). J Endocrinol 1977; 75: 17.
3. Das TK, Jana H. Basal oxygen consumption during different phases of menstrual cycle. Indian J Med Res 1991; 94: 16-19.
4. Milne JA. The respiratory response to pregnancy. Postgrad Med J 1979; 55: 318-324.
5. Mikami M, Tatsumi K, Kimura Honda Y, Kuriyama T. Respiration effect of synthetic progestin in small does in normal men. Chest 1989; 96: 1073-1075.

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6. Smith CA. Progesterone and control of breathing. Dissertation Abstracts International. D. The Sciences and Engineering 1978; 39: 3178-3179.
7. Lyons HA, Huang CT. Therapeutic effect of progesterone in alveolar hypoventilation associated with obesity. Am J Med 1968; 44: 881-888.
8. Sutton FD, Zwillich CW, Creagh CE, Pierson DJ. Wiel, JV. Progesterone for outpatient treatment of pick wickian syndrome. Annals Intern Med 1975; 83: 476-479.
9. Smiley RM, Finster M. Do receptors get pregnant too? Adrenergic receptors alterations in human pregnancy. J Maternal Fetal Med 1996; 5: 106-114.
10. Tan KS, Mcfarlane LC, Lipworth BJ. Beta adrenoreceptor regulation and AMP reactivity during the menstrual cycle in female asthmatics. Thorax 1995; 50 Suppl 2: 60.
11. Contreras G, Gutierrez M, Beroiza T, Fantin A, Oddo H, Villarroel L, Cruz E, Lisoba C. Ventilatory drive and respiratory muscle function in pregnancy. Am Reu Respir Dis 1991; 144: 837-841.
12. Schoene RB, Robertson HT, Pierson DJ, Peterson AP. Respiratory drives and exercise in menstrual cycles of athletic and non-athletic women. J Appl Physiol 1981; 50: 1300-1305.
13. Chapman AB, Zamudio S, Woodmansee W, et al. Systemic and renal hemodynamic changes in the luteal phase of the menstrual cycle mimic early pregnancy. Am J Physiol 1997; 273: 777-782.
14. Gulati N, Roy S, Malkani PK, and Narula RK. Plasma protein bound iodine in normal menstrual cycle and in normal and abnormal pregnancy. J Indian Med Assoc 1974; 62: 293.
15. Rajesh CS, Gupta P, and Vaney N. Status of pulmonary function tests in adolescent females of Delhi. Indian J Physiol Pharmacol 2000; 44: 442-448.
16. Tarun K. Das. Effects of the menstrual cycle on timing anddepth of breathing at rest. Indian J Physiol Pharmacol 1998; 42 (4): 498-502.
17. Goodland RL, Reynolds JG, McCord AB, and Pommerenke WT. Respiratory and electrolyte effects induced by estrogen and progesterone. Fert Steril 1953; 4: 300-317.
18. Rao GS, Ranjan P, and Walter S. Expiratory flow rate changes during the menstrual cycle. Indian J Physiol Phramacol 1991; 35: 74-76.
19. Clerici C. Modifications of respiratory function during pregnancy. Rev Pneumol Clin 1999; 55: 307-311.

	Minimum	**Maximum**	**Mean**	**Std. deviation**	**Std. error**	**95% confidence interval for Mean**	
						Lower bound	**Upper bound**
MP	15	24	18.5	2.66	.421	17.65	19.35
FP	15	24	17.85	2.558	.404	17.03	18.67
LP	15	26	19.73	2.65	.419	18.88	20.57
Total	**15**	**26**	**18.69**	**2.716**	**.248**	**18.20**	**19.18**

Table 1a: Descriptive Respiratory Rate/min

DOI: 10.14260/jemds/2014/3899

	Sum of squares	Df	Mean square	F-ratio	p-value
Between Groups	72.517	2	36.258	5.269	<0.006
Within Groups	805.075	117	6.881		
Total	**877.592**	**119**			

Table 1b: ANOVA of Respiratory Rate/min

	Minimum	Maximum	Mean	Std. deviation	Std. error	95% confidence interval for Mean	
						Lower bound	Upper bound
MP	450	750	622.5	79.219	12.526	597.16	647.84
FP	450	750	647.5	80.024	12.653	622.71	672.29
LP	400	900	615.0	92.126	14.566	585.54	644.46
Total	**400**	**900**	**620.0**	**83.112**	**7.587**	**604.98**	**635.02**

Table 2a: Descriptive statistics of tidal volume

	Sum of squares	Df	Mean square	F-ratio	p-value
Between Groups	1500	2	750	.107	>0.899
Within Groups	820500	117	7012.821		
Total	**822000**	**119**			

Table 2b: ANOVA of tidal volume

	Sum of squares	Df	Mean square	F-ratio	p-value
Between Groups	6.700	2	3.350	1.012	>0.367
Within Groups	387.277	117	3.310		
Total	**393.977**	**119**			

Table 3a: ANOVA of Minute Ventilation

Pair		Mean	Std. deviation	Std. error mean	t-value	df	p-value
1	MP	11.460	1.8842	.2979	0.171	39	>0.865
	FP	11.517	1.9964	.3157			
2	MP	11.460	1.8842	.2979	1.547	39	>0.130
	LP	11.988	1.5474	.2447			
3	FP	11.517	1.9964	.3157	1.489	39	>0.145
	LP	11.988	1.5474	.2447			

Table 3b: Statistical Inference based on paired samples student's t-test on Minute Ventilation (L/min).

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Date of Submission: 08/11/2014.
Date of Peer Review: 09/11/2014.
Date of Acceptance: 21/11/2014.
Date of Publishing: 26/11/2014.