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Pulmonary Function Tests in Different Phases of Menstrual Cycle

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ABSTRACT

Progesterone is implicated in the exacerbation of symptoms of asthma in the premenstrual period. We analyzed pulmonary function tests in 100 female volunteers within the age group of 18 to 30 years having regular menstrual cycles of 28+3 days. Pulmonary function tests comprising of FVC, FEV1, FEF25-75%, FEF200-1200%, PEFR were performed using vitalograph spirometer and mini-Wright peak-flow meter. We found all the pulmonary functions reflect better values in secretory phase and lowest values during menstrual phase. The study findings reaffirm and suggest a possible beneficial role of progesterone on respiratory system in secretory phase of menstrual cycle.

KEYWORDS: Pulmonary function tests, Progesterone, Menstrual cycle

INTRODUCTION

It has been noted that there is a pre-menstrual and menstrual exacerbation of asthma that may result from change in female hormones in the blood. Studies done earlier have documented that peak-expiratory flow rate (PEFR) decreased significantly during pre-menstrual and menstrual periods in women with asthma. The present study was undertaken to confirm the probable effects of these female hormones on the bronchial musculature that may explain exacerbation of symptoms of asthma during some phases of the menstrual cycle. The results may help to modify the treatment of asthmatic women especially in the menstruating age groups.

MATERIALS AND METHODS

Data was collected from 100 female volunteers in the age group between 18 and 30 years. All the subjects were of average weight, height and build based on accepted values for Indian females with respect to age. Detailed history for the presence of any allergy was obtained. However, allergy testing was not done and all cases of known allergy were excluded from the study (three volunteers). Females with irregular menstrual cycles, on hormonal therapy, post-hysterectomy or any respiratory illness were excluded from the study. All the volunteers were informed of the full extent of their role in the study and any further participation was by their complete informed consent. The PFT was conducted over 2 successive cycles in each volunteer in different phases of menstrual cycle as follows:

1. During the first or second day of the menstrual period henceforth referred to as the menstrual phase.
2. Middle of the proliferative or follicular phase.
3. Day of ovulation (which was assumed to be 14 to 16 days prior to the next menstrual period based on the history of past cycles).
4. Middle of secretory or luteal phase.

The PFT was recorded on a Vitalograph TM spirometer and the mini-Wright peak-flow meter. To maintain the uniformity of recording standards the data was recorded in the same room at the same time of the day. The temperature of the room where the recording was done was maintained constant by an air-conditioning unit. The following respiratory parameters were studied during different phases of menstrual cycle:

1. Forced Vital Capacity (FVC): It is the volume of gas that can be expired as forcefully and rapidly as possible after maximum inspiration.
2. Forced Expiratory Volume in the first second (FEV1): It is the volume of gas expired over the first second during the performance of a forced vital capacity.
3. Maximal Mid Expiratory Flow Rate (MMEFR or FEF25-75%): It is the average rate of flow during the middle half of a forced vital volume.
4. Maximal Expiratory Flow Rate (MEFR or FEF200-1200): It is the average flow rate for the litre of gas expired after the first 200ml during a forced expiratory volume manoeuvre.
5. Peak Expiratory Flow Rate (PEFR) – It is the maximum flow rate attainable at any time during a forced expiratory volume manoeuvre.

RESULTS

Recordings of FVC, FEV1, FEF25-75%, FEF200-1200 and PEFR were taken during the menstrual, proliferative and secretory phases of the menstrual cycle and on the expected day of ovulation. The average of each of the tests was determined for each of the volunteers separately and this mean value was taken for statistical analysis of the study.

Table I: Mean values for pulmonary function tests during different phases of menstrual cycle

Parameter	Mean Values			
	Menstruation	Proliferative phase	Day of ovulation	Secretory phase
FVC (lt.)	2.13	2.28	2.13	2.43
FEV1 (lt.)	2.01	2.16	2.04	2.29
FEF 25-75% (lt.)	179.12	204.74	188	217.24
FEF 200-1200% (lt/min)	241	265.64	236.8	316.84
PEFR (lt/min)	378.6	424.8	390.6	451.6

Similar parameters from all the different phases were compared with each other and the following results were obtained.

Table II: Statistical data for FVC

	Menstrual/ Proliferative	Proliferative/ Ovulation	Ovulation/ Secretory	Secretory/ Menstrual
Standard Deviation	0.223	0.15	0.175	0.25
Standard Error	0.022	0.015	0.017	0.02
'p' Value	<0.001	<0.01	<0.001	<0.01
Significance	Significant	Significant	Significant	Significant

Table III: Statistical data for FEV1

	Menstrual/ Proliferative	Proliferative/ Ovulation	Ovulation/ Secretory	Secretory/ Menstrual
Standard Deviation	0.212	0.161	0.19	0.251
Standard Error	0.021	0.016	0.019	0.025
'p' Value	<0.001	<0.01	<0.001	<0.001
Significance	Significant	Significant	Significant	Significant

Table IV: Statistical data for FEF25-75%

	Menstrual/ Proliferative	Proliferative/ Ovulation	Ovulation/ Secretory	Secretory/ Menstrual
Standard Deviation	67.6	50.46	51.76	63.12
Standard Error	6.76	5.05	5.18	6.31
'p' Value	<0.01	<0.01	<0.001	<0.001
Significance	Significant	Significant	Significant	Significant

Table IV: Statistical data for FEF200-1200%

	Menstrual/ Proliferative	Proliferative/ Ovulation	Ovulation/ Secretory	Secretory/ Menstrual
Standard Deviation	65.57	71.53	62.66	77.44
Standard Error	9.27	10.11	8.86	10.95
'p' Value	<0.05	<0.01	<0.001	<0.01
Significance	Significant	Significant	Significant	Significant

Table V: Statistical data for PEFR

	Menstrual/ Proliferative	Proliferative/ Ovulation	Ovulation/ Secretory	Secretory/ Menstrual
Standard Deviation	21.26	51.35	37.49	32.3
Standard Error	2.126	5.14	3.75	3.23
'p' Value	<0.001	<0.001	<0.001	<0.001
Significance	Significant	Significant	Significant	Significant

DISCUSSION

A common finding during the menstrual cycle is premenstrual tension during which there are mood swings, hot flushes, etc. The condition is thought to be due to sudden decline in the levels of progesterone. Also premenstrual exacerbation of asthma has been reported and the reason for this may be related to the level of progesterone [1, 2]. Exacerbation of symptoms seen during the premenstrual and early part of the menstrual period may require intensive care therapy in some cases [3]. Wegienka et al. recorded the peak expiratory flow rate daily in menstruating asthmatic women. They found an association between sex hormones and FEV1 that varied with asthma status and menstrual phases [4].

The present study was conducted in an attempt to determine what role the fluctuating hormonal levels of the menstrual cycle might play on the bronchomotor tone during the menstrual cycle. In this study it has been observed that there is a significant reduction in the PFT value in the menstrual and ovulatory phases while there is a significant increase in the proliferative and secretory phases. The values in the menstrual phase were generally the lowest and those in the secretory phase were usually the highest. The peak of the proliferative phase was lower than the peak of the secretory phase for all our recordings. These indicate that the latter may result from a bronchodilatory effect of an increase in progesterone level. The effect that coincides with progesterone correlates well with studies conducted by some workers [5].

It is a known fact that progesterone has some smooth muscle relaxing effects. The fact that progesterone could cause relaxation of smooth muscle with special reference to the respiratory tract maybe seen from the study conducted by Beynon et al. They studied the effects of IM injection of progesterone in patients with severe asthma. It was seen that the dose of bronchodilator drugs required was reduced in the patients who reduced in the patients who received progesterone by IM route. All these patients had suffered from asthma which was not responsive to other conventional therapies like corticosteroids [6]. All the above suggest that the bronchomotor tone maybe affected by either high or low levels of progesterone. When the levels of progesterone are low in premenstrual period and during the menstrual cycle there maybe a relative bronchoconstriction, resulting in low expiratory flow rates as correlated well in the present study.

Studies done to estimate the levels of other mediators that might affect the bronchial tone report that high level of prostaglandins are secreted into the blood stream during the premenstrual and menstrual phases [7]. Also, perimenstrual shift in type-1/type-2 cytokine balance has been implicated in premenstrual exacerbation of asthma [8]. These aspects need to be studied in further detail.

Inspite of this fact, the almost uniformly higher significant values of PFTs observed in the secretory phase and largely reduced values in the menstrual cycle suggest that even though there maybe other mediators that cause some amount of variation in the bronchial tone during the menstrual cycle, progesterone does contribute to a great extent towards this end. However, further study needs to be done to demonstrate the effects of hormones on bronchial muscles.

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