A STUDY OF FVC, PEFR AND MEP IN DIFFERENT TRIMESTERS OF PREGNANCY

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Abstract

Objective: Pregnancy is characterized by profound changes in the function of virtually every regulatory system in the human body. The events in pregnancy elicit one of the best examples of selective anatomical, physiological & biochemical adaptation that occurs during pregnancy & profound changes in respiratory physiology is a part of the same process. Thus this study was designed to evaluate the pulmonary function tests in 1st, 2nd and 3rd trimesters of pregnancy & compare them with non-pregnant control group.

Method: A cross-sectional study was carried in 200 healthy women in the age range of 19-35 years .The subjects were distributed in four groups, i.e control (non-pregnant) group and 1st , 2nd &3rd trimester pregnant groups. Number of subjects in each group is 50. We recorded respiratory parameters in control and study groups. Statistical analysis done by 'Z' test.

Result: There was significant decrease in FVC, PEFR & MEP in all trimesters of pregnancy with maximum decrease of FVC in 1st trimester & PEFR, MEP in 2nd trimester.

Conclusion: The changes in pulmonary function are attributed to major adaptations in the maternal respiratory system & are also be influenced by the mechanical pressure of enlarging gravid uterus, elevating the diaphragm & restricting the movements of lungs thus hampering the forceful expiration & decrease in 1st trimester might be due to decline in alveolar Pco_2 caused by hyperventilation which acts as bronchoconstrictor & due to sensitization of respiratory centre due to progesterone.

Keywords: Pregnancy, FVC, PEFR, MEP.

1. Introduction

Pregnancy is characterized by profound changes in the function of virtually every regulatory system in the human body. The events in pregnancy elicit one of the best examples of selective anatomical, physiological & biochemical adaptation that occur during pregnancy & profound changes in respiratory physiology is a part of the same process[1] .The changes in the respiratory physiology [2] are due to increasing size of the fetus with advancing gestation which constitutes a mechanical impediment to normal process of ventilation[3]& due to hormone Progesterone which increases ventilation by increasing respiratory centre sensitivity to carbondioxide as a result the tidal volume and minute ventilation is increased [4-6].

The physiological adaptation of the pregnant woman involves the circulatory, respiratory, digestive, renal, endocrine & metabolic systems. Their precise knowledge allows the clinician to verify the extent of the adaptation in pregnant women & helps to avoid unnecessary treatment of physiology changes misinterpreted as pathological changes in reference to pre pregnancy standards[7].

The knowledge of the expected or desired changes in pulmonary parameters is fundamental in understanding of how the disease states affect pregnancy & vice versa[8]. Also, information regarding status of pulmonary function is essential for assessment of fitness for anaesthesia[9].

The serial testing initiated early in pregnancy permits valid interpretation of pulmonary function changes with advance in gestation. The respiratory changes are adaptive in nature. In order to evaluate any respiratory ailment during pregnancy, an accurate knowledge of the physiological changes in pulmonary function during normal pregnancy is necessary. The changes in maternal pulmonary function tests during pregnancy have been reported.[10]

Aim of this study was to evaluate the changes in the pulmonary functions of women in the age group of 19-35 yrs at 1st, 2nd& 3rd trimesters of pregnancy & compare them with that of healthy non-pregnant age matched controls.

2. Material and Methods

A cross sectional study was conducted in the Department of Physiology, Shri B.M.Patil Medical College, Hospital and Research Centre, Bijapur.

The study was undertaken to determine the pulmonary function changes in 1st, 2nd & 3rd trimesters of pregnancy. The observations were compared with age matched healthy non pregnant women

2.1 Method of Collection of data:

Study Group: 150 pregnant women in the age group of 19-35yrs who were attending the OPD of OBGy of Shri B.M. Patil Medical College were included in the study group. The study group was in turn divided into 3 subgroups. Each sub group was comprised of 50 women in first, second and third trimesters of pregnancy.

Control Group: It comprised of apparently healthy age matched 50 non pregnant women.

The nature and purpose of the study were explained to the subjects who had volunteered for the study. From each participant an informed consent was obtained. A proforma was used to record the relevant information from each selected individual who had fulfilled inclusion criteria. The subjects who had exclusion criteria were dropped from the study. A thorough physical & systemic examination of each subject was done (in particular, cardiovascular and respiratory system). Recordings were taken during morning hours between 9 am to 12 Noon.

Inclusion Criteria: Apparently healthy subjects of Indian origin were included in the study. The apparent health status of the subject was determined through thorough clinical examination and history taking.

Exclusion Criteria : Subjects with acute respiratory infection in the previous three months, chronic respiratory infection including asthma, history or clinical signs of cardiovascular diseases, diabetes mellitus, hypertension , tobacco consumption in any form , alcohol intake, endocrine disorders, obesity & moderate to severe anemia were excluded from the studies.

Following parameters were recorded in each subject:

A .Record of physical Anthropometry of subjects: Height (in centimeters), Weight (in kilograms), Body surface area & Body Mass Index were measured.

B. Record of physiological parameters: Pulse Rate (beats per minute), Blood Pressure (SBP and DBP in mmhg), Respiratory Rate (cycles /minute) were recorded.

C. Record of pulmonary function parameters: The subject was informed about the procedure. Consent was taken from each subject before recording .For each test, three readings were taken. The highest reading of the three was taken for calculation. All tests were recorded in a sitting posture at room temperature, in morning hours.

The following pulmonary parameters are recorded by Computerized Spiropac (Medicad)[11]

I) 1. FVC (Forced Vital Capacity in L)

2. PEFR (Peak Expiratory Flow Rate in L/sec)

II). MEP (Maximum Expiratory Pressure in mmHg) - Recorded by using modified Black's apparatus.

2.2 Statistical analysis: The results were expressed as Mean ± SD. Z test was used for comparison between control and study groups in consultation with statistician. A 'p' value of 0.05 or less was considered as statistically significant.

3. Results

3.1 Forced Vital Capacity (FVC) in Litres: There was statistically very highly significant decrease in FVC in 1st ($p<0.001$), 2nd ($p<0.001$) & 3rd ($p<0.001$) trimesters of pregnancy when compared to control group. However, there was statistically significant increase in FVC of 3rd trimester ($p<0.01$) as compared to 2nd trimester of pregnancy.

3.2 Peak Expiratory Flow Rate (PEFR) in Liters/sec: There was statistically very highly significant decrease in PEFR in 1st ($p<0.001$), 2nd ($p<0.001$) & 3rd ($p<0.001$) trimesters of pregnancy when compared to non pregnant women. Maximum decrease was in 1st trimester.

3.3 Maximum Expiratory Pressure in mmHg: There was statistically significant decrease in MEP in 1st ($p<0.041$), 2nd ($p<0.004$) & 3rd trimesters when compared to control group. Maximum decrease in MEP was seen in 2nd trimester of pregnancy.

Table 1: Mean ± SD and level of significance of Age and Anthropometric Parameters of subjects in Control and Study Groups

Parameters	Control	1ST Trimester		2ND Trimester		3RD Trimester	
	Mean ± SD	Mean ± SD	P value	Mean± SD	P value	Mean± SD	P value
Age (yrs)	24 ± 5.8	25 ± 4.4	0.183	25±0.36	0.244	26± 3.4	0.032*
Height (cms)	159 ± 5.06	151 ± 16	0.001***	155±5.2	0.001***	155± 5.3	0.001***
Weight (kg)	59 ± 9.6	52 ± 7.1	0.001***	55±7.1	0.007**	60 ± 9.2	0.342
BMI (kg/m^2)	23.19 ± 3.5	21.93 ± 3.86	0.045*	22.4±3.79	0.139	24.73 ± 3.08	0.010**
BSA (Sq m)	1.61 ± 0.14	1.49 ± 0.13	0.001***	1.5±0.1	0.001***	1.58 ± 0.13	0.091

p>0.05: Not Significant, *p: <0.05: Significant, ** p: <0.01: Highly significant, *** p: <0.001: Very highly significant

Table 2: Mean ± SD and Range of Physiological Parameters of subjects in Control and Study groups

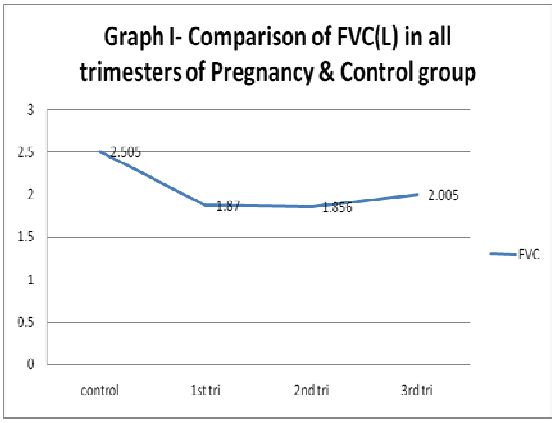
Parameters	Control	1ST Trimester	2nd Trimester	3rd Trimester
	Mean± SD	Mean ± SD	Mean ± SD	Mean ± SD
PR(beats/min)	76± 9.4	89 ± 10 (p=0.054*)	77±5.5 (p=0.167)	78 ± 7.7 (p=0.053*)
SBP (mm Hg)	118.66±4.4	115.60±7.67 (p=0.0146*)	109.56±5.68 (p=0.001***)	117.56±7.94 (p=0.17)
DBP (mm Hg)	74.32±4.75	73.36 ± 5.97 (p=0.378)	66.52± 5.68 (p=0.001***)	75.60 ± 7.41 (p=0.441)
PP (mm Hg)	44.34±5.47	42.44 ± 7.81	43.20 ± 5.33	42.44 ± 8.33
MAP (mm Hg)	88.94±5.72	88.32 ± 5.80	80.90± 4.19 (p=0.001)	89.45 ± 7.26
RR(cpm)	16±3	22±3	22±4.3	26±3.7

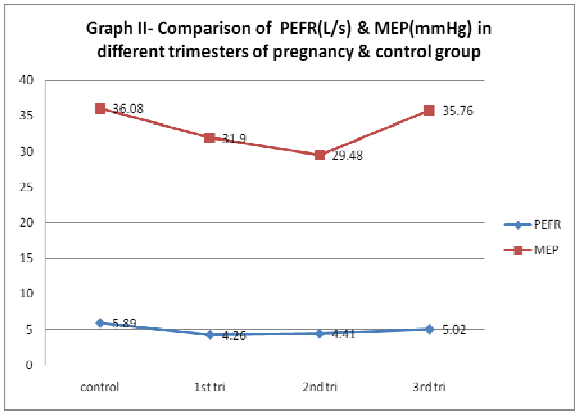
p>0.05: Not Significant, *p: <0.05: Significant, ** p: <0.01: Highly significant, *** p: <0.001: Very highly significant

Table 3: Mean ± SD of FVC, PEFR & MEP of subjects in Control and Study groups

Parameters	Control	1ST Trimester	2ND Trimester	3RD Trimester
	Mean± SD	Mean ± SD	Mean ± SD	Mean ± SD
FVC(L)	2.50± 0.39	1.87±0.37 (p=0.001***)	1.85±0.39 (p=0.001***)	2.19± 2.0(p=0.001***)
PEFR(L/s)	5.89± 1.16	4.26±1.28 (p=0.001***)	4.41±1.35 (p=0.001***)	5.02± 1.26(p=0.001***)
MEP(mmHg)	36.08± 14.13	31.9±9.35 (p=0.041*)	29.48±10.33 (p=0.004**)	35.76± 12.6(p=0.458)

p>0.05: Not Significant, *p: <0.05: Significant, ** p: <0.01: Highly significant, *** p: <0.001: Very highly significant





4. Discussion

A cross-sectional study was carried in 200 healthy women in the age range of 19-35 years. The subjects were distributed in four groups, i.e control (non-pregnant) group and 1st , 2nd &3rd trimester pregnant groups. Number of subjects in each group is 50. We have recorded various physical, physiological & respiratory parameters in control and study groups.

4.1 Forced vital capacity: Our study showed significant decrease in FVC from 1st trimester to 3rd trimester as compared to control which is in agreement with other workers. The decrease in FVC was maximum in first trimester which may be attributable to hormonal changes which requires further studies.

A study of forced vital capacity in pregnant women by Dipok Kumar Sunyal and workers showed reduced FVC in all trimesters as compared to control & maximum decrease in third trimester. The decrease in FVC is attributable to the mechanical pressure of enlarging gravid uterus, elevating the diaphragm & restricting the movements of lungs thus hampering the forceful expiration[12].

A study by Deepal & workers showed no significant changes in FVC during all trimesters of pregnancy. Hormonal alteration in pregnancy causes a reduction in the tracheo-bronchial smooth muscle tone & the increasing thoracic width may be due to enlarging uterus as a result there is no impairment in large airway function throughout pregnancy[13].

4.2 PEFR: Our study showed significant decrease in PEFR from 1st trimester to 3rd trimester as compared to control & maximum decrease was seen in 1st trimester. The maximum decrease in 1st trimester may be attributable to the hormonal levels.

As per studies on PEFR by Neeraj & workers, there was decrease in PEFR in third trimester & decrease was attributable to the decline in alveolar Pco_2 which acts as bronchoconstrictor. Also the decrease in PEFR could be due to lesser force of contraction of main expiratory muscles like the anterior abdominal wall muscles & internal intercostals muscles[14].

A work on PEFR by Sunyal DK et al there was decrease in PEFR in all trimesters of pregnancy which is significant in 2nd & 3rd trimesters of pregnancy. The cause for the decrease was more likely due to lesser force of contraction of the expiratory muscles like anterior abdominal muscles & internal intercostals muscles in this state [15,16]. Moreover, progressively reduced value of PEFR in three trimesters of pregnancy may be attributed to the mechanical effects of enlarged gravid uterus reducing vertical dimension by limiting movement of diaphragm[17]. In addition some degree of obstruction to the expiratory flow, especially late in pregnancy also contributes[18]. Some studies suggest, inadequate nutrition due to morning sickness, altered eating habits associated with advancing gestation that resulted in muscular weakness & the lesser force of contraction of main expiratory muscles[19].

A study by Leo R. Brancazio & workers showed that PEFR does not change with pregnancy. Not only are the absolute mean peak expiratory flow rates similar at all four times, but the mean normalized peak expiratory flow rates (calculated by using formula PEFR (L/min) = 198.07 + 3.07 age – 0.0477 age^2 + 3.6 height) in all groups are close to unity [19].

4.3 MEP: Our study showed significant decrease in MEP from 1st trimester to 3rd trimester as compared to control with maximum decrease in 2nd trimester.

Conclusion

The significant decrease in FVC & PEFR might be due to the mechanical pressure of enlarging gravid uterus, elevating the diaphragm & restricting the movements of lungs thus hampering the forceful expiration and maximum decrease in 1st trimester due to decline in alveolar Pco_2 caused by hyperventilation which acts as bronchoconstrictor.

The statistical significant decrease in PEFR & MEP in all trimesters might be due to decrease in expiratory muscle power.

To establish the cause of decrease in respiratory parameters more in first trimester of pregnancy than in 2nd & 3rd, further studies are to be undertaken by hormonal assay in different trimesters to know the relation between hormone and respiratory parameter

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