



Original Research Article

Assessment of FVC and PEFR and its correlation with progesterone levels in pregnancy

Archana S Pawar¹, K Senthil Kumar^{2,*}, K Madhan Srinivasan³¹Dept. of Physiology, Meenakshi Medical College Hospital and Research Institute, Tamil Nadu, India²Dept. of Physiology, Madha Medical College and Hospital, Tamil Nadu, India³Dept. of General Medicine, Madha Medical College and Hospital, Tamil Nadu, India

ARTICLE INFO

Article history:

Received 19-07-2019

Accepted 11-11-2019

Available online 31-12-2019

Keywords:

Pregnancy

Forced Vital Capacity

Peak Expiratory Flow Rate

Progesterone

ABSTRACT

In pregnancy there is change in the physiological levels of hormones. It also brings about changes in other systems like circulatory, respiratory and also leads anatomical modifications in pelvis. These changes are essential for the mother to accommodate the foetus. It is essential to know the changes in pulmonary functions that occur normally in pregnancy and to differentiate it from abnormal values. Progesterone a hormone of pregnancy is known to cause certain degree of bronchodilatation. Hence forth this study was conducted to assess FVC and PEFR and to correlate with Progesterone levels in pregnancy.

Materials and Methods: An observational and analytical study was conducted in 90 pregnant women (Primigravidae). The controls were non-pregnant women. All were in the age group between 18 and 25 years. Their pulmonary function parameters FVC and PEFR was analyzed using computerised RMS 401-Heliometer. Progesterone assay was done using CLIA. SPSS 21 version software was used for statistics. Significance was given to p value less than 0.05.

Results: FVC and PEFR decreased significantly in pregnancy irrespective of trimester in comparison to controls. FVC did not show significant variation in all trimesters of pregnancy. In the third trimester of pregnancy PEFR showed significant decrease. Between the groups there was significant increase ($p < 0.0001$) in progesterone levels. FVC and PEFR were significant, positive and was correlated with progesterone in first trimester of pregnancy. There was positive and significant correlation of FVC and Progesterone in third trimester of pregnancy. This study brings the knowledge about modifications in respiratory functional parameters and helps to identify the norms on predicted values in pregnancy.

© 2019 Published by Innovative Publication. This is an open access article under the CC BY-NC-ND license (<https://creativecommons.org/licenses/by/4.0/>)

1. Introduction

Pregnancy is an altered physiologic state of an individual. Maternal physiological changes are the normal adaptations that a woman undergoes during pregnancy to accommodate the embryo or foetus. The awareness about various physiological respiratory changes in each trimester helps us to avert complications. The body must change its physiological and homeostatic mechanisms in pregnancy to ensure the requirement of the foetus. The alterations in respiratory physiology has been attributed to Progesterone, which was thought to increase ventilation by increasing

respiratory center sensitivity to carbon dioxide as a result the tidal volume and minute ventilation is increased.^{1–3} Earlier studies have documented changes in pulmonary functions using spirometry in different trimesters of pregnancy. There is less information on standard predicted or desired values in all three trimesters of pregnancy. Correlation with progesterone and pulmonary functions was not undertaken in a large scale. This study was done to evaluate the pulmonary function parameters using spirometry in primigravidae, and to correlate with their progesterone levels.

* Corresponding author.

E-mail address: drksk.cool@gmail.com (K. S. Kumar).

2. Aim and Objectives of the Study

The aim of the study is to assess, compare and correlate the pulmonary function parameters (FVC, PEFR) in primigravidae of age group between 18 and 25 with Progesterone. To formulate norms on predicted or desired values in all trimesters of pregnancy.

3. Materials and Methods

A total of 120 subjects were taken for the study. The subjects were from the obstetrics OPD from Meenakshi medical college. Ethical committee approval was obtained. Written informed consent was taken from the subjects. These subjects were divided into four study groups. Each group containing 30 subjects.

3.1. Control group

Group 1: Non-pregnant women, Study group: Group 2: Primigravidae in 1st trimester, Group 3: Primigravidae in 2nd trimester, Group 4 – Primigravidae in 3rd trimester.

3.2. Study design

This is an observational and analytical study.

3.3. Inclusion criteria

Healthy normal Primigravidae of Kanchipuram population in the age group 18 to 25 years and nulliparous women in the same age group. All pregnant females had a haemoglobin above 10 gm%.

3.4. Exclusion criteria

Subjects with Chronic respiratory illness, Hypertension, Diabetes mellitus (Type I, II), Pregnancy induced hypertension, Endocrine disorders, Acute and chronic CVS diseases, multiple pregnancies were avoided.

3.5. Methodology

Examination proforma used for recording the clinical examination findings was clinically well designed and validated. Computerized data logging Spirometer was used for recording the pulmonary function tests and the make was (RMS- Helios spirometer). They were assessed during morning hours (9am to 12 noon). Vital parameters and anthropometric measurements were taken. FVC and PEFR was recorded using computerised spirometer. Progesterone assay was done using CLIA.

Statistical analysis: Comparisons were performed using unpaired student's t-test for 2 group comparisons and one way Anova was employed for multiple groups. Version SPSS 21 was used for analysis. The p value of 0.05 or less was depicted as significant. Pearson's correlation method was used to correlate.

4. Result

4.1. FVC

Decrease in FVC in 1st ($p < 0.000$), 2nd ($p < 0.000$) and 3rd ($p < 0.000$) trimesters of pregnancy when compared to control group was significant. In between the three trimesters there was no significant decrease ($p > 0.05$) in FVC values. There was significant and positive correlation of FVC and progesterone in the first and third trimester of pregnancy.

4.2. PEFR

Decrease in PEFR levels in 1st ($p < 0.000$), 2nd ($p < 0.000$) and 3rd ($p < 0.000$) trimesters of pregnancy was significant when compared to control group. Amongst the three trimesters there was significant decrease ($p < 0.001$) in third trimester when compared to 1st and 2nd trimester. There was significant and positive correlation with the progesterone in the first trimester of pregnancy.

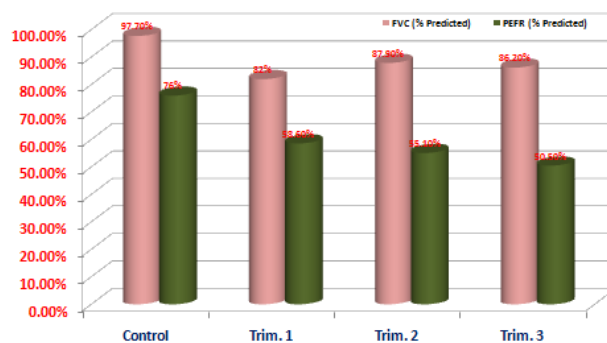


Fig. 1: Analysis of FVC and PEFR in three trimesters

There is a positive correlation in all 3 trimesters of pregnancy and significant in 1st and 3rd trimester

5. Discussion

5.1. Pulmonary function parameters

Forced vital capacity: Present study showed significant decrease in FVC in all three trimesters of pregnancy in comparison to controls. I trimester showed significant decrease, when compared to controls, which may be due to progesterone. Decrease in FVC could be due to a decrease in the negativity of the intrapleural pressure due to upward displacement of the diaphragm by the enlarging uterus.⁴ This finding concurred with the study by Anita Teli *et al.* A study by Dipok Kumar Sunyal on forced vital capacity in pregnant women showed reduced FVC in

Table 1: Comparison of anthropometric measurements

Parameters	Control Mean±S.D	1st Trimester Mean±S.D	2nd Trimester Mean±S.D	3rd Trimester Mean±S.D
Age in years	21.7 ± 1.67	22 ± 2.1	23 ± 2	23 ± 1.3
Height in cm	156 ± 4.5	156 ± 3.7	157 ± 5.9	158 ± 5.9
Weight in Kgs	51.06 ± 6.6	53.8 ± 3.8	60.9 ± 8.4**	69 ± 4**
BMI(Kg/m ²)	21.04 ± 2.8	22.2 ± 1.75	24.7 ± 3.05**	27.8 ± 2.73**

Parameters are expressed as mean ± SD; *p<0.05 significant, **p<0.001 highly significant

Table 2: Comparison of pulmonary function parameters

Parameters	Control Mean + SD	I Trimester Mean + SD	P Value	II Trimester Mean + SD	P Value	III Trimester Mean + SD	P Value
FVC (% predicted)	97.73 ± 8.02	82 ± 16**	0.000 (<0.05)	87.96 ± 6.52	0.000	86.2±14.49	0.0004
PEFR (% predicted)	76.83 ± 4.87	58.63±11.70**	0.000	55.1 ± 8.87	0.0000	50.5 ± 5.68	0.0000
Progesterone	14.19 ± 8.02	39 ± 8.08**	0.000	50.76 ± 8.92**	0.0000	70.2 ± 8.76**	0.0000

Values are expressed as mean ± SD; *p<0.05 significant

Table 3: Comparison of cardiovascular parameters

Parameters	Control (Group- I) Mean ± S.D	1st Trimester(Group - II) Mean±S.D	2nd Trimester(Group- III) Mean±S.D	3rd Trimester (Group - IV) Mean±S.D
PULSE/min	77.46 ± 2.47	81.6 ± 2.65	86.53 ± 4.8	88.5 ± 5.39**
SBP mm of Hg	122.9 ± 5.40	114.8 ± 8.57**	111.3 ± 8.84**	120.1 ± 6.4
DBP mm of Hg	81.06 ± 3.56	72.93 ± 4.46**	70.8 ± 5.55**	78.73 ± 5.42
PP mm of Hg	41.86 ± 6.90	41.86 ± 7.51	40.53 ± 9.47	41.4 ± 7.30
MAP mm of Hg	95.02 ± 2.76	86.88 ± 5.02	84.31 ± 5.16	92.53 ± 4.65
RR/min	15.2 ± 0.83	17.2 ± 1.27	21.07 ± 1.56	26.7 ± 2.9

Values are expressed as mean ± SD; *p<0.05 significant

Table 4: Comparison of pulmonary function parameters

Parameters	1st & 2nd Trimester P Value	2nd & 3rd Trimester P Value	1st & 3rd Trimester P Value
FVC (% predicted)	0.160	0.875	0.369
PEFR (% predicted)	0.022	0.000**	0.003
Progesterone	0.0001**	0.0001**	0.0001**

Values are expressed as mean ± SD; *p<0.05 significant

Table 5: Correlation of pulmonary function parameters and progesterone

Parameters	Group II(I Trimester)		Group III (II Trimester)		Group IV (III Trimester)	
	p- Value	r – Value	p- Value	r – Value	p- Value	r– Value
FVC & Progesterone	0.011	0.456	0.997	0.001	0.001	0.573
PEFR & Progesterone	0.001	0.572	0.21	0.234	0.478	0.135

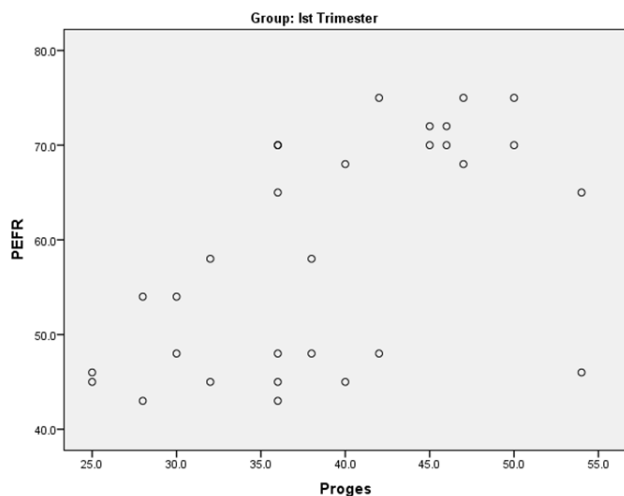


Fig. 2:

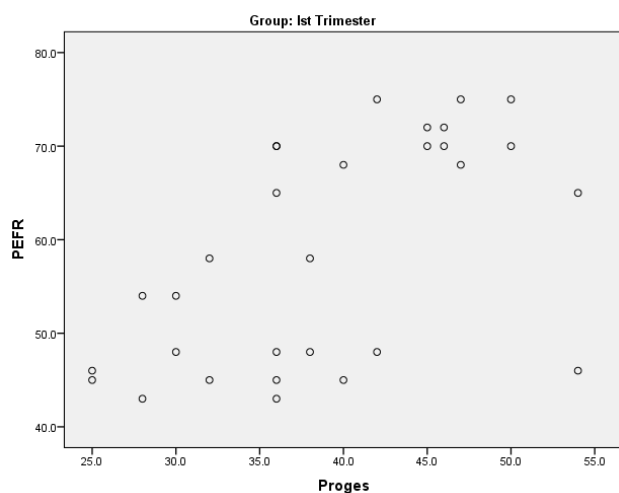


Fig. 3:

all trimesters when compared to controls and maximum decrease in third trimester. The decrease in FVC was attributed to the mechanical pressure of enlarging gravid uterus, elevating the diaphragm & restricting the movements of lungs thus hampering the forceful expiration.⁵ Deepal et al., showed no significant changes in FVC during all trimesters of pregnancy. Hormonal alteration in pregnancy could have caused a reduction in the tracheo-bronchial smooth muscle tone.⁶ The increased thoracic width could be due to enlarging uterus as a result there was no impairment in large airway function throughout pregnancy. There was significant correlation between Progesterone and FVC in first and third trimester of pregnancy. Rarthana et al from their study suggested that the improvement in pulmonary functions in luteal phase of menstrual cycle was due to increase in progesterone levels.

Peak expiratory flow rate: In our study there was a significant decrease in PEFR in all three trimesters when

compared to control group. The decrease in PEFR could be due to gravid uterus and lesser force of contraction of the expiratory muscles like anterior abdominal muscles & internal intercostals muscles.^{7,8} Neeraj et al., opined that the decrease in PEFR in third trimester was due to the decline in alveolar, pCO₂ which acts as bronchoconstrictor. Sunyal DK *et al.*, attributed that there was decrease in PEFR in all trimesters of pregnancy which was significant in second and third trimesters of pregnancy. 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.⁸ In addition some degree of obstruction to the expiratory flow, especially late in pregnancy also must have contributed.⁹ Our study concurred with his findings. There was significant correlation between PEFR and Progesterone in first trimester of pregnancy.

In this study the significant decrease in FVC and PEFR could be due to the mechanical pressure of enlarging uterus which elevates the diaphragm and thus restricting the movements of lungs during forceful expiration. Decrease in PEFR also could be due to lesser force of contraction of main expiratory muscles like the anterior abdominal wall muscles and internal intercostal muscles. There was gradual increase in progesterone levels in all three trimesters. This also indirectly stimulates the secretion of endogenous catecholamines thereby through sympathomimetic action causes bronchodilatation. Though there is enlargement of uterus, progesterone effect tries to balance the restrictive changes in pregnancy.

6. Conclusion

This study gives an information that there is a definite alteration in pulmonary parameters during different trimesters of pregnancy. The same study involving larger population would help us more in deriving the norms on predicted values on pulmonary parameters in pregnancy.

7. Source of funding

None.

8. Conflict of interest

None.

References

1. Bayliss DA, Millhorn DE. Central neural mechanics of progesterone action: application to the respiratory system. *J Appl Physiol.* 1992;73(2):393–404.
2. Skatrud JB, Dempsey A, Kaiser DG. Ventilatory response to medroxyprogesterone acetate in normal subjects: time course and mechanism. *J Appl Physiol.* 1978;44(6):939–944.
3. Lysons HA, Antonio R. The sensitivity of the respiratory centre in pregnancy and after the administration of progesterone. *Trans Assoc*

Am Phys. 1959;72:173-180.

4. Teli A. A Study of FVC, PEFr and MEP in different trimesters of pregnancy. *Int J Biomed Adv Res*;p. 648-651.
5. Sunyal DK, Amin MR, Molla MH, Ahmed A, Begum S. Abida Ahmed, Shameena Begum. Forced vital capacity in normal pregnancy. *J Med Sci Res.* 2007;09(1):21-25.
6. Deepal SW, Kusua RD, Sivayogan S. Pulmonary Functions in Pregnant Sri Lankan Women. *Sabaragauwa Univ J.* 1999;2(1):57-60.
7. Phatak MS, Kurhade GA. Longitudinal study of antenatal changes in lung function tests and importance of postpartum exercises in their recovery. *Indian J Physiol Pharmacol.* 2003;47(3):352-356.
8. Spiropoulos K, Prodromaki E, Tsapanos V. Effect of body position on PaO₂ and PaCO₂ during pregnancy. *Gynecol Obstet Invest.* 2004;58:22-25.
9. Norregaard O, Schultz P, Ostergaard A, Dahl R. Lung function & Postural changes during pregnancy. *Respir Med.* 1989;83:467-70.

Author biography

Archana S Pawar Assistant Professor

K Senthil Kumar Professor

K Madhan Srinivasan Junior Resident

<p>Cite this article: Pawar AS, Kumar KS, Srinivasan KM. Assessment of FVC and PEFr and its correlation with progesterone levels in pregnancy. <i>Indian J Clin Anat Physiol</i> 2019;6(4):442-446.</p>
--