ORIGINAL RESEARCH ARTICLE

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INTERNATIONAL JOURNAL OF ANATOMY PHYSIOLOGY AND BIOCHEMISTRY

IJAPB: Volume: 2; Issue: 1; January 2015 *ISSN(Online):2394-3440*

Effect of advanced normal pregnancy on pulmonary function tests

Published online on 14 th January 2015©www.eternalpublication.com

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Received: 6th Jan 2015; Accepted: 11th Jan 2015

How to cite this article: Patil HJ, Deokar NA. Effect of advanced normal pregnancy on pulmonary function tests. International Journal of Anatomy Physiology and Biochemistry 2015; 2(1):12-15.

Abstract:

Background: The physiological adaptations of the pregnant woman involve the circulatory, respiratory, digestive, renal, endocrine and metabolic systems. Their precise knowledge allows the clinician to verify the extent of the adaptation in pregnant women and helps to avoid unnecessary treatment of physiological changes misinterpreted as pathological changes in reference to pre-pregnancy standards. We designed the study to understand changes in pulmonary function tests during advanced pregnancy.

Results: In all subjects of the study group there was decrease in Forced Vital Capacity (FVC) and Forced Expiratory Volume (FEV1) but FVC decreases more than FEV1 so the FEV1/FVC ratio is seen to be increased as compared to the control group. The results were found to be statistically significant ($p<0.05$).

Conclusion: It is concluded that pulmonary function tests like FVC and FEV1 decreases due to gravid state in advanced pregnancy.

Keywords: forced vital capacity, FVC, forced expiratory volume, FEV1, pulmonary function test

Introduction:

The events in pregnancy elicit one of the best examples of selective anatomical, physiological and biochemical adaptations that occur during pregnancy and profound changes in respiratory physiology are a part of the same process.[1] The changes in respiratory physiology[2] are due to increasing size of the fetus with advancing gestation which constitutes a mechanical impediment to normal process of ventilation.

The physiological adaptations of the pregnant woman involve the circulatory, respiratory, digestive, renal, endocrine and metabolic systems. These adaptations are necessary to meet the increased metabolic demands of the mother and fetus. Their precise knowledge allows the clinician to verify the extent of the adaptation in pregnant women and helps to avoid unnecessary treatment of physiological changes misinterpreted as pathological changes in reference to pre-pregnancy standards[3] and in anticipating disease worsening in pregnancy and the peripartum period in those women with cardiopulmonary disorders. The knowledge of the expected or desired changes in pulmonary parameters is fundamental to understanding of how the disease states affect pregnancy and vice versa. Also, information regarding status of pulmonary function is essential for assessment of fitness for anesthesia.[4] Although there are reports of changes in pulmonary function

tests during pregnancy in the western population, not much work has been documented on similar studies in Indian subjects.

This study was undertaken to evaluate the pulmonary functions of women in the third trimester of uncomplicated pregnancy and to compare them with those of normal non-pregnant women with a view to define the standards of normalcy in pregnancy and also to document expected changes in pulmonary parameters in Indian women in the last trimester of normal gestation.

Materials and method:

The present study was conducted on 50 normal pregnant women in third trimester in the age group of 20-30 years and height of 130-160cm, Hemoglobin >10gm/dl and 50 non pregnant women of the same age and height. Written informed consent was obtained from each participant. A detailed history was recorded and complete clinical examination was done. The height and weight of the subject was noted and BMI was calculated. Pulmonary function tests were carried out in pulmonary function test laboratory using spirometer and the Forced vital capacity (FVC), Forced Expiratory Volume (FEV1) and FEV1/FVC ratio was recorded in the study and control groups. Data was analyzed with Microsoft office 2007 Excel and mean was calculated. Student't' test was applied using SPSS software version 16. There are many systems which are used to determine the severity of disease; the most commonly used system is given below[1],

Normal PFT out comes : >85% of predicted values

Mild Disease: >65% but <85% of predicted value

Moderate Disease: >50% but <65% of predicted value

Severe Disease: <50% predicted values

If both FVC and FEV_1 are normal, then patient has a normal PFT tests.

If FVC and/ or FEV_1- is 80- 90 % or higher, then patient has restrictive lung disease.

If the % predicted for FEV_1/ FVC is 69% or lower, then the patient has an obstructive lung disease.[1]

Results:

In all subjects of the study group there was decrease in Forced Vital Capacity (FVC) and Forced Expiratory Volume (FEV1) but FVC decreases more than FEV1 so the FEV1/FVC ratio is seen to be increased as compared to the control group. The results were found to be statistically significant ($p<0.05$).

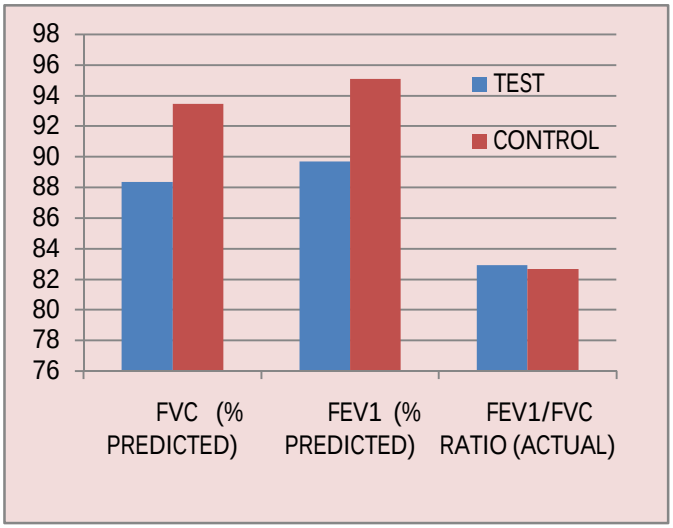
Table 1. Comparison of parameters between test and control populations

Parameters	Test	Controls
Age (years)	23.2±3.3	22±2
Height (cm)	150.52±1	152+3.2
Weight (kg)	62±4.4	53±6.0
BMI(kg/m2)	25.09+1.7	21.5±4.1
Heart Rate (beats/min)	82.73±5.3	81.09±1.1
Systolic blood pressure (mm Hg)	122±7.8	120.89±3.6
Diastolic blood pressure (mm Hg)	78.88±4.9	76.54±3.8
Haemoglobin (gm/dl)	10.9±0.8	11.3±0.7

Table 2: Comparison of Pulmonary Function Test among the test and control population

PFT	Tests	Control	'P' value
FVC (% Predicted)	88.35±8.7	93.45±4.55	p<0.05
FEV1 (% Predicted)	89.69±6.9	95.09±0.9	p<0.05
FEV1/FVC ratio (actual)	82.9±5.6	82.67±5.8	p<0.05

Graph 1. Graphical representation showing comparison of Pulmonary Function Test among the test and control populations



Discussion:

The study and control groups are matched with one another with respect to age in years *(23.16 vs22.76)*, height in centimeters *(147 vs 149.16)*, heart rate in beats/min (83.8 vs 80.58), systolic blood pressure in mm of Hg (122 vs 119.4), diastolic blood pressure in mm of Hg (78.41 vs 76.88) and hemoglobin in gm% (10.95 vs 12.94) but it was found that the difference in weight and Body Mass Index (BMI) is statistically significant ($P < 0.001$)**.** This is because of the normal weight gain, edema and uterine enlargement which occur in pregnancy. This gain in weight may be one of the reasons for the changes in PFTs.

All parameters were compared among cases and among controls themselves (Table I). It was found that the difference is not statistically significant ($P = 0.0000$), it means that the results of pulmonary function tests does not vary within themselves.

There was a significant ($p < 0.001$) decrease in mean value of FEV1 recorded as a percentage of predicted value (FEV1 %) in study group than in control group (Table II). A number of studies[4,5,6,7,8] as reviewed show decrease in FEV1. No change in FEV1seen in few studies.[9,10-13]

Between mean value of FVC of case group and control group it was found that FVC is less in case subjects than in control subjects ($P < 0.001$). When we compared actual values of FEV1/FVC of case group with that of control group, it was found that both FEV1 and FVC decreases but FVC decreases more than that of FEV1 in case group, so the ratio FEV1 /FVC appears like increased ($P < 0.001$). Decline in FVC and FEV1 was due to mechanical pressure of enlarging gravid uterus, elevating the diaphragm and restricting movements of lungs[5,6,14] and thus hampering the forceful expiration. It may also be due to broncoconstrictor effect of decreased alveolar P_{CO2} on the bronchial smooth muscles.[6,9]

The present study validates the physiological changes, adaptations and decline[15] in pulmonary function in pregnancy especially in the late third trimester. The effect of the enlarged uterus displacing the diaphragm upwards is evident in the significantly reduced forced vital capacity among the pregnant subjects compared to the controls. Apart from mechanical factors other factors such as hormonal influences also play a role, in altering the pulmonary function parameters like FEV_1, PEFR and FVC. We found that the FEV_1 /FVC ratio shows a definite increase due to less decrease in FEV_1 as compared to FVC.

Conclusion:

It is concluded from the study that pulmonary function tests like FVC and FEV1 decreases due to gravid state in advanced pregnancy. The present study concluded that pregnancy causes changes in PFTs. The mechanical and hormonal changes which take place in pregnancy leads to decrease in all parameters of PFTs except FEV1/FVC. The combination of hormonal changes and mechanical effects of the enlarging uterus result in significant changes in pulmonary physiology. These adaptations are necessary to meet the increased metabolic demands of the mother and fetus. It is important for the clinician to be familiar with the normal physiologic changes in pregnancy. Understanding these changes is critical in distinguishing the common dyspnea that occurs during normal pregnancy from pathophysiologic

states associated with cardiopulmonary diseases seen in pregnancy, and in anticipating disease worsening in pregnancy and the peripartum period in those women with cardiopulmonary diseases.

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