

COMPARISON OF LUNG FUNCTIONS OF PREGNANT WOMEN WITH NON-PREGNANT WOMEN AT SHEIKH ZAYED HOSPITAL, RAHIM YAR KHAN

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ABSTRACT

Background: Pregnancy has marked effect on pulmonary functions and capacities. The knowledge of the expected changes in pulmonary parameters is fundamental to understanding how the disease states affect pregnancy and vice versa. **Objectives:** This study was designed to determine the changes in pulmonary functions during pregnancy. **Patients and Methods:** This was prospective study, conducted from 1st January 2008 to 30th November, 2008, in the Department of Physiology, Sheikh Zayed Medical College, Rahim Yar Khan. A total of 80 study subjects were included in this study, divided into 4 groups, with each group having 20 study participants. The groups were as; 1st group having non pregnant females in their mid-luteal phase, 2nd group having females in their 1st trimester of pregnancy, 3rd group having females in 2nd trimester of pregnancy, 4th group having females in their 3rd trimester of pregnancy. A questionnaire in which data regarding name, age, parity, duration of gestation was used. **Results:** A total of 80 study subjects were included in this study. Overall mean age was 25±3.5 years. 1st group was having age of 21±2 years, 2nd group was having mean age of 26±4 years, 3rd group having mean age of 27±4 years, whereas, 4th group was having mean age of 24±3.2 years. All the females were house wives, except controls, who were students. 71% of the study subjects were uneducated. We found out significant decrease in FEV₁(P=0.000), FVC(P=0.002), and FEV₁/FVC(P=0.014) in all three groups of pregnant women as compared to non-pregnant. **Conclusion:** The respiratory system undergoes anatomical & physiological changes during pregnancy and there is a significant decrease in FEV₁, FVC and FEV₁/FVC among pregnant women.

Key words: Pregnancy, Forced Vital Capacity, Forced Expiratory Volume in one second.

INTRODUCTION

Pregnancy has marked effect on pulmonary functions and capacities.¹ In a study it was found that gradual reduction in vital capacity in the last month of pregnancy occurs, a sharp reduction follows delivery and a gradual return to normal limits by the tenth post partum day². The results of most studies done on western populations indicate that vital capacity and peak expiratory flow rate do not change significantly throughout the course of pregnancy.³ A study done on Srilankan population, comparing lung function test in pregnant women at a gestation of 36-40 weeks, with a group of non pregnant women showed that vital capacity was low in pregnant women. The events in pregnancy indicate one of the best examples of anatomical, physiological and biochemical adaptations in pregnancy, and marked changes in respiratory physiology are part of same process. Anatomical changes include pushing up of diaphragm early in pregnancy, flattening of thoracic cage, increasing size of fetus with advancing gestation which

constitutes mechanical impediment to normal process of ventilation. Early in pregnancy and not secondary to pressure from uterus, diaphragm is displaced upwards by 4cm.^{4,5}

There is a compensatory increase in the diameter of the thorax by about 2cm in pregnancy. This compensates for the rising diaphragm and the volume of thoracic cavity remains the same in pregnancy, as in normal situations. Diaphragm performs the major work of respiration. Breathing is thoracic rather than abdominal.^{3,6} In study done on maternal mortality, it was concluded that penobarbital sodium was a significant factor for respiratory depression. The dangers associated with anesthetic doses of barbiturates in depression of cardio respiratory system were emphasized in another study.⁷ Acute pulmonary edema may result from therapeutic doses in individuals with an idiosyncrasy.⁸ All narcotics and hypnotics used for obstetrical analgesia are respiratory depressants. Normal influences cause the muscles and cartilage in thoracic region to relax so the chest broadens. The knowledge of the expected changes in pulmonary parameters is fundamental to understanding of how the disease states affect pregnancy and vice versa.⁹ This information is also essential for assessment of fitness for anesthesia and dangers associated with obstetrical analgesia.⁸ We have found studies conducted on these changes in Indian and Western populations,^{8,9} however, no such work on this subject was available from Pakistan. So present study was designed to determine the changes in pulmonary

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functions during pregnancy.

PATIENTS AND METHODS

This was a prospective study conducted from 1st January to 30th November, 2008. A total of 80 study subjects were included in this study, divided into 4 groups, with each group having 20 study participants. 1st group consisted of non pregnant females in their mid-luteal phase. 2nd, 3rd and 4th groups had females in their 1st, 2nd and 3rd trimesters of pregnancy.

A generalized inclusion criteria for all groups was that there should be no history of obstructive or restrictive pulmonary disease, smoking, cardiovascular diseases and hemoglobin level should be above 10 mg/dl.

A questionnaire was used in which data regarding name, age, parity, duration of gestation was included. The study was conducted in the Department of Physiology, Sheikh Zayed Medical College, Rahim Yar Khan in collaboration with Department of Obstetrics and Gynecology over a period of eleven months after approval from institutional ethical committee. The pregnant women were included from antenatal Out Patient Department and controls non-pregnant were volunteer medical students in compatible age group. Test subjects were either primigravida or multigravida in the age group of 20-30 years. After taking informed verbal consent from each subject, a detailed history was taken and complete clinical examination was done to rule out the exclusion criteria. Hemoglobin concentration was measured. The height as well as weight of the subjects were noted. The equipment used for Pulmonary Function Test (PFT) was spirometer., Prior to performing the PFT, the procedure was explained to each subject, the queries and apprehensions of the subjects were satisfied, special emphasis was on need to maintain an effective seal with lips around the mouth piece and the use of nose clip during the procedure. Each subject was made to relax for a minimum of 5 minutes before PFT procedure. The following parameters were recorded in test and control subjects;

1. Forced vital capacity (FVC): The maximum volume of air expired after a maximum inspiration.

2. Forced expiratory volume in first second (FEV₁): The fraction of vital capacity expired

during the first second of a forced expiration.

3. FEV₁/FVC ratio

Recording of PFTs

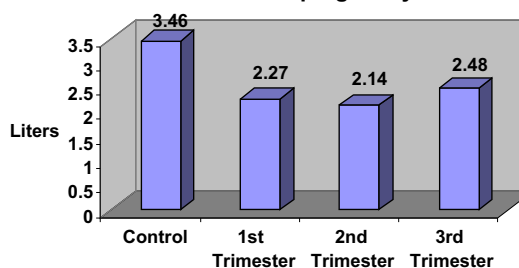
The relaxed subject, in a sitting position, was prepared to grip the sterile mouth piece as demonstrated to her prior to the recording. When the subject was confident and familiar with the procedure, she was asked first to perform maximal inspiration after a deep expiration. The subject was then instructed to expire with maximal effort (maximal expiration). The mouth piece was then removed and the actual, predicted and percentage of predicted values were printed for analysis. Each subject (Test or Control), was asked to repeat the maximum forced expiratory effort three times, each time with adequate rest in between, and the best reading of the three was considered for analysis. Data was entered in SPSS version 15 and ANOVA test was used for comparison of FEV₁ & FVC in all groups.

RESULTS

A total of 80 study subjects were included in this study. Overall mean age was 25±3.5 years. 1st group was having age of 21±2 years, 2nd group was having mean age of 26±4 years, 3rd group having mean age of 27±4 years, whereas, 4th group was having mean age of 24±3.2 years. All the females were house wives, except controls, who were medical students. 71% of the study subjects were uneducated.

The FEV₁ values in different groups were as; First group (control): 3.46±.13 litres, 2nd group (in 1st trimester of pregnancy): 2.27±.18 litres, 3rd group (in 2nd trimester of pregnancy): 2.14±.66 litres, 4th group (in 3rd trimester of pregnancy) 2.48±.1litres. (Figure:1)

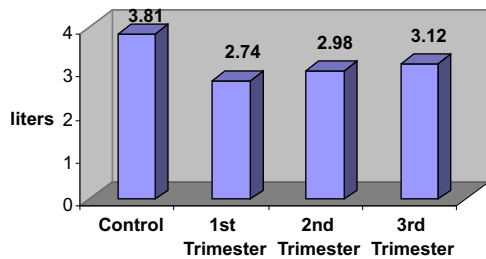
Fig 1: Comparison of FEV1 changes; control vs pregnant women in their 1st, 2nd and 3rd trimester of pregnancy



The FVC values in different groups were as; First

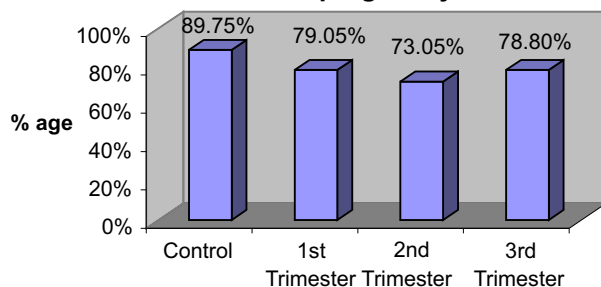
group (control): 3.81 ± 0.8 Litres, 2nd group (in 1st trimester of pregnancy): 2.74 ± 0.1 litres, 3rd group (in 2nd trimester of pregnancy): 2.98 ± 0.66 litres, 4th group (in 3rd trimester of pregnancy): 3.12 ± 0.91 litres. (Figure:II)

Fig II: Comparison of FVC changes; control vs pregnant women in their 1st, 2nd and 3rd trimester of pregnancy



FEV₁/FVC ratio values were as; First group (control): $89.75\% \pm 10.402$, 2nd group (in 1st trimester of pregnancy): $79.05\% \pm 15.72$, 3rd group (in 2nd trimester of pregnancy): $73.05\% \pm 19.84$, 4th group (in 3rd trimester of pregnancy): $78.80\% \pm 16.92$. (Figure:III)

Fig III: Comparison of FEV₁/FVC changes; control vs pregnant women in their 1st, 2nd and 3rd trimester of pregnancy



In our study, we found out significant decrease in FEV₁ (P=0.000), FVC (P=0.002), and FEV₁/FVC (P=0.014) in all the three groups of pregnant women as compared to controls.

DISCUSSION

In our study, we found out significant decrease in FEV₁ (P=0.000), FVC (P=0.002) and FEV₁/FVC (P=0.014) in all the three groups of pregnant women as compared to controls (Non-pregnant). The decrease in FEV₁ with pregnancy is relatively of greater amplitude as compared to the decrease in FVC. Decrease in FVC in our study may be due to a relative decrease in the

negativity of the intrapleural pressure brought about by an upward displacement of the diaphragm by the enlarging uterus.²

Decrease in FEV₁, PEFR may be due to a decline in alveolar pCO₂ (caused by hyperventilation) 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 and internal intercostal muscles.⁴ We found a similarity in our findings with some previous studies.^{10,11,12,13} In one study, it was reported that inspiratory reserve volume increases but vital capacity, total lung volume, and FEV₁ remained unchanged.⁶ In another study it was reported that chief forced expiratory parameters remained unchanged in pregnancy.⁸

Although none of our subjects had haemoglobin <10gm/dL, we found that even the borderline change in Hb levels makes a difference to PFT values. It is obvious that pulmonary functions would definitely be compromised in women with severe chronic anaemia. Thus, our study validates the physiological changes, adaptations and decline in pulmonary function in pregnancy especially in the last 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. The mechanical factors are not the only causative factors. Other factors, such as hormonal influences, also play a role in altering and compromising the pulmonary flow parameters like FEV₁ & PEFR. We found that the FEV₁ / FVC ratio shows a definite decrease due to relative decrease in FEV₁ as compared to FVC. In a study, it was reported that peak expiratory flow values did not change along gestation.

However, present study highlights observation that the respiratory parameters are significantly compromised due to gravid state in the last trimester of pregnancy in our subjects from rural Pakistan. We feel, to establish norms on predicted and desired PFT values in various phases of pregnancy, extensive studies on larger population need to be done and the correction factors be introduced while evaluating PFT readings in such patients. In the absence of these norms of normal deviation from non gravid states, the computerized values obtained through routine spirometry may give inaccurate information of the respiratory status of the patient to the clinicians, obstetricians and anaesthetists managing complications during last stages of pregnancy.

CONCLUSION

The respiratory system undergoes anatomical & physiological changes during pregnancy and there is a significant decrease in FEV₁, FVC and FEV₁/FVC among pregnant women. FEV₁/FVC can be used to assess lung function during pregnancy. There is almost a proportionate decrease in the individual values of FEV₁ and FVC maintaining the ratio.

REFERENCES

1. Sweeraseekarad D, Ruberu K, Sivayogan. Pulmonary functions in pregnant Srilankan women. *Sabaragamuwa University Journal*; 2(1): 57-60
2. Neeraj, Sodhi C, Joydeepsingh J, Kaur V. Effect of advanced uncomplicated pregnancy on pulmonary function parameters of north Indian subjects. *Indian j physiol pharmacol* 2010;54(1):69-72.
3. Elkus R, Popovich J. Respiratory physiology in pregnancy. *Clin Chest Med* 1992;13: 555-565.
4. Kolarzyk E, Wojciech M, Lyszczarz J. Lung function and breathing regulation parameters during pregnancy. *Archives of Gynecology and Obstetrics*; 272(1): 53-58.
5. Rebuck DA, Hanania NA, D'Urzo AD, Chapman KR. The accuracy of a handheld portable spirometer. *Chest*. 1996; 109:152-7.
6. Barreiro TJ, Perillo I. An approach to interpreting spirometry. *Am Fam Physician*. 2004; 69:1107-14.
7. Nissen K. Barbiturates in pregnancy. *Br Med J*. 1972; 4(5835): 295
8. Phatak MS, Kurhade GA. A longitudinal study of antenatal changes and lung function tests and importance of postpartum exercise on recovery. *Indian J Physiol Pharmacol*. 2003; 47: 352-356
9. Monga, Kumari. Pulmonary functions in pregnant Punjabi women. *Indian J Physiol Pharmacol* 200; 44: 115-116.
10. Harirah et al. Effects of gestational age and position on peak expiratory flow rate. A longitudinal study. *Obs Gynecol*. 2005. 105: 372-376
11. Bernhard H Heidemann, Updates in anesthesia. 2001; 13; 52-61 and (2003): 16-25
12. Sroczyński T. Evaluation of respiratory tract function in healthy women in the last month of uncomplicated pregnancy. *Ann Acad Med Stetin*. 2002;48:331-50
13. Gustavo Antonio Neppelenbroek, et al. Peak expiratory flow analysis in healthy pregnant women. *Rev. Bras. Ginecol. Obstet*. 2005; 27(1)



**The great thing, then, in all education,
is to make our nervous system our ally
instead of our enemy.**

William James