

SHORT COMMUNICATION

A LONGITUDINAL STUDY OF ANTENATAL CHANGES IN LUNG FUNCTION TESTS AND IMPORTANCE OF POSTPARTUM EXERCISES IN THEIR RECOVERY

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Abstract : A study of changes in lung function tests during pregnancy was undertaken in fifty pregnant women beginning from third month of gestation. Fifty nonpregnant age and height matched women formed the controls. Forced Vital Capacity (FVC), Timed Vital Capacity (FEV1), Inspiratory Capacity (IC), Expiratory Reserve Volume (ERV) and peak Expiratory Flow Rate (PEFR) were performed in each month of pregnancy. However ten subjects were not available for follow-up during postpartum period. Remaining forty women were divided into two groups of twenty each. Group I performed daily graded active exercises to strengthen the anterior abdominal wall muscles. Group II women did not perform any exercises.

It was observed that the antenatal changes in percent FVC and FEV1 were insignificant, but the decline in ERV and PEFR were very highly significant ($P < 0.001$) and the increment in IC was significant ($P < 0.05$). In the postpartum period the percentage variation of values in group I was less than 5% from controls ($P > 0.05$) and in group II it was 15–20% from controls ($P < 0.05$), resulting in a significant variation in group II women as compared to the controls.

It is concluded that there are adaptive changes in lung functions in the antenatal period. We stress the importance of regular graded active exercises in the postpartum period for the speedy recovery of these changes.

Key words: lung function tests FVC FEV1% IC ERV
PEFR postpartum period exercises

INTRODUCTION

Profound local and systemic changes in maternal physiology are initiated by conception and continue throughout pregnancy (1). We have reported changes in

the maternal pulmonary function tests during pregnancy (2, 3). The serial testing initiated early in pregnancy permits valid interpretation of these changes with advancing gestation. The respiratory changes are adaptive in nature. In order to evaluate

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any respiratory ailment during pregnancy an accurate knowledge of the physiological changes in the pulmonary functions during normal pregnancy is necessary.

Active cycle of breathing exercises including expiration technique is a method which is economical of time, effective and efficient for improvement of cardio respiratory fitness and morale (4).

As early as in 1948 Kegel emphasized the importance of Postpartum pelvic floor muscle exercises (5). As a result, the effect of postpartum exercises on restoring pelvic floor and cardiac function after child birth has been well documented (6,7), but surprisingly its effect on restoration of pulmonary function has not been documented. This led us to speculate if some of the postpartum exercises could prove as a means of pulmonary rehabilitation for speedy recovery of antenatal respiratory changes. We have not come across any such studies that have specifically examined the effects of postpartum exercises on recovery of the changes observed in Pulmonary Function Tests (PFTS) during pregnancy.

METHODS

A total of fifty women in their third month of gestation were selected from the antenatal clinic, Department of Obstetrics and Gynecology, Government Medical College, Nagpur after ruling out cardiopulmonary disorders based on history and clinical examination. Hemoglobin of all subjects was more than 10 gm%. All subjects were in the age group 20 to 28 years and height ranged between 130 to 160 cms.

Women who exercised during pregnancy were excluded. Informed consent was obtained from subjects.

PFTs examined included :

Forced Vital Capacity (FVC) and Timed Vital Capacity (FEV1%) using Vitalograph S model Spirometer with function analyzer (Vitalograph Limited, Buckingham); Inspiratory Capacity (IC) and Expiratory Reserve Volume (ERV) using Expirograph calibrated to read 33 ml/ division along vertical axis. (Rajdhani Scientific Instruments Company, New Delhi); Peak Expiratory Flow Rate (PEFR) using Wright's Peak Flow Meter (Airmed Limited, Harlow, England).

PFTs were done every month during pregnancy and 8 weeks after delivery in post absorptive stage between 10 a.m. to 12 noon in a standing position after allowing 30 minutes rest. Prior explanation and demonstration was given to each subject and was encouraged to perform better and best of the three trials was recorded. Control readings were obtained from a group of 50 nonpregnant women of same age group and height range selected from the staff of Government Medical College, Nagpur.

In the postpartum period out of the 50 subjects 8 were dropped due to Caesarian Section and 2 due to other complication. The remaining subjects were divided into two groups of 20 each. In group I women daily graded postpartum exercises were started under the guidance of an experienced chest physiotherapist 24 hours after delivery and included:

- 1) Relaxation in semi recumbent position.
- 2) Breathing exercises
 - Diaphragmatic and pursed lip breathing
 - Effective coughing techniques
- 3) Strength training involving
 - Seated press for strengthening pectoralis major
 - Upper extremity exercises for inspiratory muscles
 - Exercises for anterior abdominal wall muscles.

One set of 8-10 repetitions increasing gradually by one set per week were started (8).

Women forming group II did not perform any exercises. Postpartum readings were correlated with control readings. All readings were corrected to B.T.P.S. Student's 't' test and Analysis of Variance (ANOVA) were done for statistical analysis.

RESULTS

There was a significant decline in ERV and PEFR ($P < 0.001$) and a significant increase in IC ($P < 0.05$) throughout pregnancy. The changes in FVC and FEV1 were not statistically significant (Table I).

The per cent variation of group I readings from control was not statistically significant and in group II it was significant ($P < 0.05$) suggesting that the antenatal changes in PFTs recover in the Postpartum period but recovery is better in group I than in group II (Table II).

TABLE I: Pulmonary function test during pregnancy.

<i>Month of gestation</i>	<i>FVC in liters</i>	<i>FEV1%</i>	<i>IC in liters</i>	<i>ERV in liters</i>	<i>PEFR in liters/sec</i>
Control	2.25	79.1	1.61	0.64	348
3	2.25	76.6	1.61	0.64	325
4	2.25	76.36	1.73	0.52	328
5	2.2	78.06	1.67	0.53	314
6	2.16	78.63	1.68	0.48	307
7	2.15	79.32	1.74	0.41	298
8	2.1	77.51	1.76	0.34	298
9	2	77.37	1.76	0.24	286
P value	>0.5	>0.5	<0.05	<0.001	<0.001

TABLE II: Pulmonary function test in post partum period.

	<i>FVC in liters</i>	<i>FEV1%</i>	<i>IC in liters</i>	<i>ERV in liters</i>	<i>FEFR in liters/sec</i>
Control (C)	2.25	79.1	1.61	0.64	348
Group I	2.22	78.66	1.67	0.6	346
Group II	2.1	77.5	1.74	0.53	300
%variation in Group I	1.4	0.6	3.6	6.3	0.6
%variation in Group II	7	2.1	9.2*	17.2*	13.8*

* $P < 0.05$

DISCUSSION

During pregnancy there is significant decline in ERV and PEFR and a significant rise in IC whereas FVC and FEV1% show no significant change.

The preservation of FVC is associated with diminished abdominal compliance and augmentation of rib cage volume displacement. Other contributory factors are relative mobility of thoracic cage as well as unimpaired diaphragmatic movement despite progressive enlargement of gravid uterus. (9) Also the FVC is maintained as the increase in IC is compensated by decrease in ERV.

No significant change is observed in FEV1%, as during pregnancy progesterone, corticosteroids and relaxin cause certain degree of bronchodilatation due to relaxation of smooth muscles. Thus the mechanical disadvantage to the respiratory apparatus induced by advancing pregnancy is compensated by decrease in airway resistance and an improved airway conductance (9, 10, 11).

The significant increase in IC during pregnancy is due to mechanical changes in thoracic cage increasing its volume (12, 13). Another possible cause is the heightened response to nervous stimuli because intensity and duration of nervous stimuli required to produce muscular contraction are shortened during pregnancy (14).

The decline in ERV observed during pregnancy might have occurred due to decreased negativity of intrapleural pressure brought about by upward displacement of diaphragm by enlarged uterus. Another important cause for the decline is attenuation or reduction in contraction power of expiratory muscles due to the stretching of the abdominal wall with the progress of pregnancy (10, 11, 15).

The decline in PEFV during pregnancy occurs suggestively due to lesser force of contraction of main expiratory muscles like anterior abdominal muscles and internal intercostal muscles (15, 16).

From the middle of the second trimester ERV, residual volume and functional residual volume are progressively decreased by approximately 20% at term. Lung compliance is relatively unaffected, but chest wall compliance is reduced. A progressive increase in minute ventilation begins soon after conception and peaks around the second

trimester at 50% above normal. This increase is by a 40% rise in tidal volume and a 15% rise in respiratory rate. Since dead space remains unchanged, alveolar ventilation is about 70% higher at the end of gestation.

Oxygen consumption increases gradually to the needs of the growing fetus, rising by at least 20% at term. These changes in respiratory functions have clinical relevance. Increased oxygen consumption and decreased reserve leave the pregnant women with little defense against the development of hypoxia due to any pulmonary disease (17).

The postpartum exercises performed by group I women encouraged pulmonary circulation and thoracic expansion and also strengthened the anterior abdominal wall muscles thus improving their respiratory functions (7). Women who exercise in postpartum period recover almost twice as fast as matched control subjects in terms of physical ability and also emotional stability. Addition of strength training to postpartum care is associated with significantly greater increase in muscle strength and mass (18).

Improvements in physical function and quality of life are purported benefits of exercise training. Unfortunately postpartum exercises are not actively prescribed in our society. The postpartum period is an ideal time for clinicians to promote the importance of physical fitness as a means of weight control, stress reduction thus establishing healthy exercise goals for the rest of their lives (19). The postpartum exercises enhance the cardiovascular fitness and mental health of the new mother (20).

Breast feeding has little impact on postpartum weight loss, because of a compensatory increase in calorie intake and

a decrease in activity. Exercise coupled with a small reduction in calorie intake is preferable to diet alone for weight loss in lactating women. Dieting reduces more maternal lean body mass; exercise plus diet burns more fat while conserving lean body mass (21).

On the basis of this study we suggest that women during the postpartum period should be recommended a daily regimen combining exercise with physiotherapy. Each subject should be assessed individually and a safe and effective program should be advised.

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