

VENTILATORY FUNCTIONS IN PREGNANCY

RUPA MOKKAPATTI*, ESHWAR C. PRASAD*, VENKATRAMAN** AND KANEEZ FATIMA**

*A.P. Chest Hospital, Irramnuma, Hyderabad (A.P.)

**Government Maternity Hospital, Hyderabad (A.P.)

(Received on August 27, 1991)

Abstract : Ventilatory functions in 115 pregnant women and 20 control subjects were studied with a view to detecting variation with stage of pregnancy, if any.

The apparatus used was a dry bellows spirometer and a Wright's peak flow meter. Statistical analysis using the student's t test showed a significant reduction in peak expiratory flow rate, forced vital capacity and first second forced expiratory volume in the third trimester compared to controls. Besides, mid-expiratory flow rates were significantly lower in the first trimester. Spirometric performance was reduced in all three trimesters when compared to controls, although values were within physiological limits. This reduction may assume importance in patients with associated diseases or those requiring surgery.

Key words:

ventilatory functions

pregnancy

INTRODUCTION

Information regarding pulmonary functions in normal women during pregnancy is necessary for better antenatal care, and in assessment of fitness for anaesthesia and the progress of pre-existing lung disease.

Very few of the Indian studies on lung function in pregnancy have measured certain dynamic functions such as the forced expiratory volume in one second (FEV₁) forced vital capacity (FVC) and maximal midexpiratory flow (MMF) (1). There is a paucity of studies of MMF in the western literature as well (2,3). Peak flow rates during pregnancy have been studied by few Indian (4) or Western authors. As these functions may be measured using simple, inexpensive and sturdy apparatus it was considered that a study of these parameters during pregnancy would be useful.

METHODS

Pregnant women from the antenatal clinic of a Government Hospital participated in the study. None

were smokers. All subjects gave informed consent to the investigation. Criteria for inclusion in the study were:

1. Age: 18-30 years,
2. Absence of significant medical illness of any system,
3. Haemoglobin above 10 gm% and
4. Normal ECG.

The study group consisted of 119 women, of whom 25 were in the first trimester, 49 in the second and 45 in the third. Controls were 20 female subjects aged 20-30 years, drawn from the infertility clinic, and volunteers.

All subjects answered the modified British Medical Research Council questionnaire on respiratory symptoms (5). Those with no current respiratory signs or symptoms and no history of major respiratory illness participated in the study. Spirometry was performed on the Vitalograph dry bellows spirometer and the Wright's mini peak flow-meter.

*Corresponding Author and present address : Dr. Rupa Mokkalatti, 234, Melwood Avenue, Apt. 202, Pittsburgh, PA 15213, U.S.A.

Measurements of lung functions were made with the subjects seated and clothing loosened, after demonstration and explanation of the manoeuvres. Calculations were made from the best of 3 of more readings. No corrections were made for BTPS (6). Functions studied were the FEV₁, FVC, FEV₁/FVC, MMF and PFR.

Normal values were derived as under:

FVC, FEV₁ and

FEV₁/FVC : Regression analysis equations of Kamat et al (7)

MMF : Regression equation of Udawadia et al (8)

PFR : 75% of Greg's standard values (9)

RESULTS

On the 139 subjects studied, 25 were in the first

trimester, 49 in the second and 45 in the third. 20 were controls. Characteristics of each group are shown in Table I.

The mean values for FEV₁, FVC and FEV₁/FVC are shown in Table II.

The changes in MMF and PFR are shown in Table III.

TABLE I : Demographic data.

Group	Mean Age (Yrs)	Mean Height (Cm)	Mean Hb (gm%)
1st Trimester	21.6 ± 2.2	150.6 ± 6	10.8 ± 0.8
2nd Trimester	22.7 ± 2.69	152 ± 5.78	11.2 ± 0.61
3rd Trimester	23.4 ± 3.4	152.3 ± 5.4	10.9 ± 0.5
Controls	25.0 ± 3.5	152 ± 5.56	11.6 ± 0.8

TABLE II : Spirometric performance : FEV₁, FVC, FEV₁/FVC.

Group	Mean FEV ₁ (litres)	% Pred.	Mean FVC (litres)	% Pred.	Mean FEV ₁ /FVC	% Pred.
1st Trimester n = 25	1.73 ± 0.39	87.9 ± 18.9	1.91 ± 0.34	83.49 ± 18.2	91.67 ± 7.46	100.05 ± 10.6
2nd Trimester n = 49	1.79 ± 0.47	90.93 ± 22.9	1.96 ± 0.51	83.78 ± 22.5	90.23 ± 8.6	103.76 ± 8.56
3rd Trimester n = 45	1.73 ± 0.45	88.11 ± 20.58	1.84 ± 0.51	80.51 ± 20.48	93.0 ± 5.38	98.6 ± 11.27
Controls	2.21 ± 0.47	99.6 ± 21.8	2.03 ± 0.6	93.03 ± 18.8	90.23 ± 7.2	107.2 ± 8.75

Mean values are shown with SD.

FEV₁ was reduced in pregnant women in all trimesters; significantly (P 0.02) in the third trimester compared to controls. Mean FVC was reduced in all 3 trimesters, but significantly to (P 0.02) only in the third trimester compared to controls. Mean values slightly lower in pregnant women compared to controls; difference significant (P 0.01) in the third trimester.

TABLE III : Spirometric performance: MMF, PFR.

Group	Mean MMF (Litres/Sec.)	MMF % Pred.	Mean PFR (Litres/Min.)	PFR % Pred.
1st Trimester n = 25	2.2 ± 0.67	78.42 ± 25.1	335.00 ± 37.0	97.8 ± 11.3
2nd Trimester n = 49	2.3 ± 0.8	82.57 ± 29.24	320.4 ± 58.5	93.23 ± 17.22
3rd Trimester n = 45	2.4 ± 0.82	85.02 ± 28.58	312.09 ± 60.6	91.3 ± 17.69
Controls n = 20	2.55 ± 0.82	92.88 ± 29.04	350.00 ± 59.2	100.95 ± 15.58

Mean values are shown with SD.

Values significantly lower in 1st trimester (P 0.05) compared to controls; values higher in the 2nd and yet higher in the 3rd trimester. Mean flow rates were lower in pregnancy; statistically significant reduction in third trimester (P 0.05) compared to controls.

DISCUSSION

Values for pulmonary functions were found to be reduced in all three trimesters compared to controls. The reduction in FEV₁, FVC, the ratio of FEV₁ to FVC and the PFR were significant in the third trimester compared to controls.

Previous workers have differed regarding changes in the first three of the above parameters (6, 7, 10, 11, 12). It was concluded that some, but not all women increase their vital capacity (VC) during pregnancy (de Swiet et al) and the difference may be related to build as Eng et al (13) showed the VC to be reduced in late pregnancy in 12 obese women.

It is known that significant restrictive defects may reduce FEV₁, FVC and FEV₁/FVC. However, the mechanical pressure of the enlarged uterus was not found, by most previous authors, to cause significant changes in any of these tests (14, 15). On the other hand, these studies of lung mechanics were carried out on Western subjects and it is possible that mechanical factors are more important in Indian women due to racial differences in build.

We found only one reference in the Indian literature to PFR: that of Ganeriwal et al (4). As in

the present study, the PFR in the third trimester was significantly reduced compared to non-pregnant women.

The changes in MMF were intriguing. Values were significantly lower in the first trimester than in controls. The values rose in successive trimesters, though they were lower than in controls.

Few workers have measured MMF (1, 2). De et al found a progressive increase, in a pattern similar to that in the present study. The change was not statistically significant. Baldwin et al (2), too, found no change from the third trimester to the post-partum state.

Various theories have been advanced to explain the changes observed. De et al (1) hypothesized that the increase in MMF was brought about by a state of relative bronchodilatation due to the smooth muscle relaxation induced by progesterone, relaxin and corticosteroids. Milne et al proposed that the bronchoconstrictor effects of the low P_A CO₂ of pregnancy are opposed by the adrenergic stimulation caused by progesterone. Pandya (16) quoted studies that demonstrated travel of trophoblastic tissue through the uterine sinuses to reach the alveoli of the maternal lung. One of these, or inadequate matching of the control group, may have been responsible for the decreased MMF in the first trimester.

The possibility exists that observed differences were influenced by inadequate matching of the control group. The control subjects had a slightly higher mean haemoglobin level. Gupta et al (17) found that chronic severe anemia effects respiratory muscle strength. Another factor to be considered while interpreting the results is the relatively small number of women in the first trimester.

CONCLUSIONS

Measures of large airway functions such as FVC, FEV₁, FEV₁/FVC and PFR were reduced during pregnancy, and significantly so in the third trimester. It is possible that mechanical factors contribute to this reduction.

MMF, which reflects small airway functions, was

significantly lower in the first trimester compared to controls, and rose in successive trimesters. Such a pattern has been observed before (1). The possible role of hormonal changes and the question of whether this pattern is universal remain to be elucidated.

Spirometric values, though lower than those of controls, remained within physiological ranges throughout pregnancy.

ACKNOWLEDGEMENTS

We wish to express our gratitude to the Superintendents of the A.P. Chest Hospital, Government Maternity Hospital, and ESI Hospital, Hyderabad for their kind co-operation. We are grateful to the staff of the pulmonary function laboratory at the Chest Hospital for their help.

REFERENCES

- De S, Bhargava RP, Benawri S. Longitudinal ventilatory functions (static and dynamic) during different trimesters in pregnant women. *J Obstet Gynecol Ind* 1984; 812-816.
- Baldwin Gr, Moorthi DS, Welton JA, Mac Donnel KF. New lung functions and pregnancy. *Am J Obstet Gynecol* 1977; 127 : 235-239.
- Weinberger SE, Welse ST, Cohen WR, Johnson TS. (State of the Art) Pregnancy and the lung. *Am Rev Respir Dis* 1980; 121 : 559-581.
- Ganerwal SK, Deshpande DR, Reddy BV, Shaikh RM. Effect of pregnancy on pulmonary ventilation. *J Obstet Gynecol Ind* 1984; 639-641.
- Questionnaire on respiratory symptoms: Publication Group, Medical Research Council, London 1976.
- Boushey HA, Dawson A. Spirometry and flow-volume curves. In Clausen JL. Ed. Pulmonary Function Testing-Guidelines and Controversies, Grune & Stratton, Inc. 1984. p. 77.
- Kamat SR, Sarma BS, Raju VRK, Venkataraman C, Balakrishna M, Bhavsar RC et al. Indian norms for pulmonary function. *Jr Assoc Phys Ind* 1977; 25 : 531-540.
- Udwadia FE, Sunavala JD, Shetty VM. Lung function studies in healthy Indian subjects. *Jr Assoc Phys Ind* 1987; 36:491-496.
- Greg I, Nunn AJ. Peak expiratory flow in normal subjects. *Br Med J* 1973; 3:282.
- Milne JA, Mills RJ, Howie AD, Pack AI. Large airways function during normal pregnancy. *Br J Obstet & Gynecol* 1977; 84: 448-451.
- Alaily AB, Carrol KB. Pulmonary ventilation in pregnancy. *Br J Obstet Gynecol* 1978; 85:518-524.
- Sims CD, Chamberlain GVP, De Swiet M. Lung function tests in bronchial asthma during and after pregnancy. *Br J Obstet Gynecol* 1976; 84:434-437.
- de Swiet M. The respiratory system, Inc. Clinical physiology in Obstetrics. Hytten FE & Chamberlain GVP Eds Black Well Scientific Publications, Oxford, 79-100.
- Gilroy RJ Jr, Lavietes MII, Loring SH, Manguara BT, Mead J. Respiratory mechanical effects of abdominal distension. *J Appl Physiol* 1985; 58: 1997-2003.
- Gilroy RJ, Manguara BT, Lavietes MII. Rib cage and abdominal volume displacements in pregnancy. *Am Rev Respir Dis* 1988; 137:668-672.
- Pandya MR, Nishith SD, Bhatta RV. Pulmonary function in pregnancy. *J Obstet Gynecol Ind* 1972; 22:1-3.
- Gupta P, Pandya N. Pulmonary and diaphragmatic functions in chronic severe nutritional anaemia. *National Med J Ind* 1989; 2:266-268.