ISSN 0975-6299 Vol 3/Issue 1/Jan – Mar 2012

International Journal of Pharma and Bio Sciences

RESEARCH ARTICLE PHYSIOLOGY

EFFECT OF ADVANCED GESTATION ON CELLULAR ACTIVITY IN RESPIRATORY SYSTEM IN FEMALES: A STUDY OF ALVEOLAR VENTILATION PARAMETERS IN PREGNANT WOMEN OF NORTH INDIA

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ABSTRACT

This study was conducted on 100 pregnant women in third trimester of uncomplicated pregnancy (cases) and 100 non pregnant women (control). Cases were further subdivided as per the gestational age into two groups of ≤ 34 weeks and > 34 weeks gestation. Pulmonary function test (PFT) parameters FVC, FEV_1, PEFR and $FEF_{(25-75\%)}$, FEV_1/FVC. were evaluated with digital Medspiror. The aim of the study was to assess and compare the change in PFT parameters in third trimester of pregnancy vis a vis those in the non pregnant control subjects of the same age. The study revealed a decrease in PFT values in the ≤ 34 weeks group as compared to the control group which was statistically not significant. But a comparison of PFT in > 34 vs control group, showed significant decrease in all PFT,s except FEV_1 / FVC ratio. A similar decline was seen while comparing the subgroups of the study group i.e. ≤34 wks Vs > 34wks groups. This study validates the physiological changes in pulmonary functions during third trimester of pregnancy which if accentuated are likely to affect the outcome of the pregnancy.

KEY WORDS

Pulmonary Function Tests, Pregnancy, Early third trimester, Late third trimester,

INTRODUCTION

Pregnancy represents one of the best examples of selective adaptation in terms of respiratory physiology.[1] Anatomical, physiological and biochemical adaptation that occur during pregnancy and profound changes in respiratory physiology are a part of the same process.[2] The increasing size of the fetus with advancing gestation constitutes a mechanical impediment to normal process of maternal ventilation.[3] During the course of pregnancy, the fetus gradually grows and therefore, brings about generalized systemic changes in the mother to accommodate and adapt to the needs of developing fetus.[4] As the uterus expands, the diaphragm is replaced cephalad by as much as 4 cm ; the anteroposterior and transverse diameters of thorax increase which enlarges the chest wall circumference.[5] A precise knowledge of the pulmonary function tests and the gradual maternal compromises in these parameters, helps to understand and manage the course and the gestational outcome for a safe delivery. Understanding of the maternal pulmonary function adjustment also helps to avoid inappropriate diagnosis and unnecessary intervention. It also forms the essentials for administration of anaesthesia in complicated third trimester pregnancy management and caesarian sections.[6,7,8]

Although there are reports of changes in pulmonary function tests during pregnancy, not much work has been done specifically in third trimester, and also in the light of contradictory evidences given by different studies, the present study was conducted with a view to find out the changes in pulmonary function tests during early and late third trimester of uncomplicated pregnancy and to establish norms of adaptive changes in respiratory physiology.

MATERIAL AND METHODS

The study was conducted in the Department of Physiology and Department of Obstetrics and Gynaecology, Christian Medical College & Hospital, Ludhiana over a period of one year after approval from institutional research and ethical committee.

The study included one hundred pregnant women in third trimester of uncomplicated pregnancy (cases) and 100 non-pregnant women (Control). The pregnant women were included from antenatal OPD of Department of Obstetrics & Gynaecology, Christian Medical College & Hospital, Ludhiana and they were further subdivided into two groups according to gestational age. First group comprised of 46 subjects in the gestational age group ≤ 34 weeks and the other group had 54 subjects in the gestational age group > 34 weeks.

The age matched controls were volunteers from the relatives of pregnant women who were attending the OPD and from amongst the hospital staff and students. Those with known respiratory or cardiovascular diseases, anaemia, multiple pregnancy, hydramnios were excluded from the study.

After taking informed written consent from each subject, a detailed history was recorded and a thorough clinical examination was done to rule out the exclusion criteria. The age, height (in cm) and weight (in kg) of the subject and room temperature (in °C) was noted. Computerized

spirometer i.e. Medspiror was used to perform the PFT. Before performing the PFT, the procedure was thoroughly explained to each subject, stressing on the need to maintain an effective seal with lips around the mouth piece as also the use of nose clip during the procedure. Each subject was made to relax for minimum 5 minutes prior to performing the PFT procedure.

The following parameters were recorded in Test and Control subjects;

1. FVC – The maximum volume of air expired after a maximum inspiration.
2. FEV_1 – (Forced expiratory volume in first second) the fraction of vital capacity expired during the first second of a forced expiration.
3. $FEF_{25\%-75\%}$ – Forced mid expiratory flow.
4. PEFR – Peak expiratory flow rate.
5. FEV_1 / FVC ratio .

Recording of PFTs: The information regarding the age, sex, weight, height of the subject and specific room temperature was fed into the spirometer .
A nose clip was attached to the subject and a clean mouth piece was attached to the breathing tube. The subject was asked to perform maximal inspiration with maximal effort. Mouthpiece was placed in the mouth and then she was asked to perform maximum expiration into the mouthpiece with maximum effort .The mouthpiece was then removed and a print out of the actual, predicted and percentage of predicted values was taken for analysis.
Each subject (Test or Control), was asked to repeat the maximum forced expiratory effort three times, and the best reading of the three was considered for analysis.
Data was compiled using Microsoft Office 2003 Excel software. Statistical analysis was done using the student 't' test to compare between means of populations, ANOVA and the coefficient of correlation 'r'.

RESULTS

Table 1 A shows the baseline data of the control and study groups. There was no statistically significant difference of mean age in all the three groups. In the control group height was significantly higher as compared to ≤34 wks and >34 weeks gestational age groups. There was no statistically significant difference of weight in ≤34 vs Control group but it was significantly higher in >34 wks group as compared to both control and ≤34 wks groups. BMI was comparable in ≤34 wks and >34 wks gestational age groups but it was significantly lower in controls in ≤34 vs Control group and in >34 vs Control group . Basal heart rate was significantly highin controls in ≤34 vs Control group though there was no significant difference in ≤34 weeks vs >34 and >34 weeks vs Control groups. There was no statistically significant difference of SBP in ≤34 Vs >34 weeks groups and ≤34 Vs Control group but it was significantly high in >34 wks group as compared to controls. Similarly there was no statistically significant difference of DBP between ≤34 wks and >34 weeks group although it was significantly higher in control group as compared to both ≤34 wks and >34 wks groups. Table 1 B shows comparative analysis between various groups (≤34 wks Vs >34 wks, ≤34 wks Vs Control group and > 34 wks Vs Control)

Table 1 A

Parameters	Test				Control	
	≤34 wks		>34 wks			
	Mean	SD	Mean	SD	Mean	SD
Age (yrs)	25.50	3.24	25.07	2.92	25.18	3.99
Height (cm)	154.13	5.85	154.83	4.49	159.45	5.23
Weight (kg)	61.46	9.00	67.09	10.79	58.06	11.91
BMI (kg/m^2)	25.87	7.34	27.99	7.42	22.68	4.10
Heart Rate (beats/min)	80.39	3.65	81.07	3.51	81.84	2.44
Systolic BP (mm Hg)	118.43	7.58	120.67	6.87	117.50	6.58
Diastolic BP (mm Hg)	76.22	5.32	76.56	5.23	77.50	4.39

Table 1 B

Parameters	≤34 wks		>34 wks				p-value		
	Mean	SD	Mean	SD	Mean	SD	≤34 vs >34	≤34 vs C	>34 vs C
Age (yrs)	25.50	3.24	25.07	2.92	25.18	3.99	0.236446	0.346471	0.925264
Height (cm)	154.13	5.85	154.83	4.49	159.45	5.23	0.244001	0.004693	0.004701
Weight (kg)	61.46	9.00	67.09	10.79	58.06	11.91	0.009202	0.095821	0.005564
BMI (kg/m^2)	25.87	7.34	27.99	7.42	22.68	4.10	0.115299	0.007678	0.004505
Heart Rate (beats/min)	80.39	3.65	81.07	3.51	81.84	2.44	0.174049	0.009108	0.103457
Systolic BP (mm Hg)	118.43	7.58	120.67	6.87	117.50	6.58	0.106482	0.218351	0.009185
Diastolic BP (mm Hg)	76.22	5.32	76.56	5.23	77.50	4.39	0.513292	0.005808	0.005044

Table 2 shows the pulmonary function parameters of control and study groups. Subjects in the gestational age group ≤ 34 weeks although had lower values of PFTs as compared to Subjects in control group but they were not statistically significant. All the pulmonary function parameters except FEV_1/FVC ratio were found to be significantly lower in the gestational age group> 34 weeks as compared to the control group. Also Subjects in gestational age group> 34 weeks had lower mean values of pulmonary function parameters, except the FEV_1 / FVC ratio, as compared to those with gestational age ≤ 34 weeks , the differences being statistically significant ($p < 0.01$ in all cases).

Table 2

Pulmonary function parameters	Control		Study group				p-value		
			≤34 wks		>34 wks				
	Mean	SD	Mean	SD	Mean	SD	≤34 vs C	>34 vs C	≤34 vs >34
FVC (%age predicted)	95.69	5.56	95.46	5.66	86.24	10.17	0.715	0.0004	0.005
FEV_1 (%age predicted)	97.24	3.53	95.99	5.43	88.30	7.77	0.099	0.0003	0.005
FEV_1 / FVC ratio (actual)	83.15	6.28	82.60	4.12	84.20	8.14	0.304	0.1853	0.137
PEFR (%age predicted)	96.01	5.44	94.96	7.37	87.20	9.49	0.171	0.0004	0.006
$FEF_{25-75\%}$ (%age predicted)	93.00	7.08	92.12	7.45	84.30	10.45	0.240	0.0042	0.006

DISCUSSION

In our study all the pulmonary function parameters were found to be lower in the subjects in gestational age group ≤ 34 weeks as compared to those in the control group but this decrease was not statistically significant. . All parameters except FEV_1/FVC ratio were found to be significantly lower in the gestational age group> 34 weeks as compared to that in the control group. Subjects in gestational age group > 34 weeks had lower mean values of pulmonary function parameters, except the FEV_1 / FVC ratio, as compared to those in ≤ 34 weeks , the differences being statistically significant ($p < 0.01$ in all cases). The FEV_1 / FVC ratio was seen to increase because the decrease in FEV_1 in late third trimester i.e at gestational age > 34 weeks is not of such amplitude as the decrease in FVC. Decrease in FVC in our study in late pregnancy 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[9]. Decrease in FEV_1, $FEF_{(25-75\%)}$ and PEFR may be due to a decline in alveolar Pco_2 (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 intercostals muscles[6,10].caused due to increased maternal weight gain, edema and uterine enlargement which limit the maternal effort significantly especially in late third trimester[11]. We found that our findings were in agreement with those of Mokkapatti et al [8], Monga and kumari[12] , Puranik

et al (1995) [10] Phatak and Kurhade [6] and Harirah et al [11].

In our study significantly lower pulmonary function parameters in subjects in gestational age group >34 weeks as compared to those in Control group may be attributed to increase in gestational age, increasing size of the gravid uterus with advancing gestational age causing upward displacement of the diaphragm resulting in more decrease in the pulmonary function parameters in late third trimester i.e at gestational age >34 weeks .

The present study validates the physiological changes, adaptations and decline 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 $FEF_{(25-75\%)}$. We found that the FEV_1 / FVC ratio shows a definite increase due to less decrease in FEV_1 as compared to FVC.

CONCLUSION

The present study highlights observation that the respiratory parameters are significantly compromised due to gravid state in the late last trimester of pregnancy. 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 in the last trimester of pregnancy.

REFERENCES

1 Pandya KD, Chandwani S, Desai CA, Dadlani AG. Study of vital capacity and timed vital capacity in normal non-pregnant and pregnant women. J Obstet Gynecol India. 36: 1053-57 (1984).

2 Chhabra S., Nangia V., Ingley KN., Changes in respiratory function tests during pregnancy. Indian J Physiol Pharmacol. 32(1): 56-60 (1988).

3 Saxena SC., Rao VSC., Mudgal SA., Study of pulmonary function tests during pregnancy. J Obstet Gynecol. 29: 993-995 (1979).

4 De S., Bhargava P., Benawari S., Longitudinal ventilatory function (static and dynamic) studies during different trimesters of pregnant women. J Obstet Gynecol India. 34: 812-816 (1984).

5 Sharma S., Pulmonary disease and pregnancy. Available at: http://www.emedicine/com/med/byname/pulmonarydiseaseandpregnancy.htm

6 Phatak MS., Kurhade GA., A longitudinal study of antenatal changes in lung function tests and importance of post partum exercise in their recovery. Indian J Physiol Pharmacol. 47: 352-356 (2003).

7 Elkus R., Popovich J Jr., Respiratory physiology in pregnancy. Clin Chest Med. 13: 555-565 (1992).

8 Mokkapati R., Prasad EC., Venkatraman.., Fatima K., Ventilatory functions in pregnancy. IJPP. 35: 237-240 (1991).
9 . Shaikh RM., Deshpande DR., Ganeriwal SK., Reddy BV., Effect of pregnancy on vital capacity and FEV%. J Obstet Gynecol. 33: 495-499 (1983).
10 Puranik BM., Kurhade GA., Kaore SB., Patwardhan SA., Kher JR., PEFR in pregnancy: A longitudinal study. IJPP. 39 (2): 135-139 (1995).
11 Harirah HM., Donia SE., Narsallah FK., Saade GR., Belfort MA., Effect of gestational age and position on peak expiratory flow rate: A longitudinal study. Obstet Gynecol. 105: 372-376 (2005).
12 Monga U., Kumari K., Pulmonary functions in Punjabi pregnant women. Indian J Physiol Pharmacol. 44 (1): 115-116, (2000).