RESEARCH ARTICLE

EFFECT OF GESTATIONAL AGE ON PULMONARY FUNCTIONS IN PREGNANT ODIA WOMEN

Girija Priyadarshini
Department of Physiology, S.C.B Medical College, Cuttack, Odisha, India

Correspondence to: Girija Priyadarshini (girijapriyadarshini@gmail.com)

DOI: 10.5455/ijmsph.2014.150820141 **Received Date: 06.07.2013** **Accepted Date: 15.08.2014**

ABSTRACT

Background: Pregnancy is a physiological state of adaptation that results in significant hormonal, mechanical and cardiorespiratory changes. Progesterone increases minute ventilation. In Odisha, where malaria and helminthic infections are endemic, even mild anaemia during pregnancy can severely deteriorate respiratory functions.

Aims & Objectives: Aim of the study is to evaluate pulmonary functions in three trimesters of pregnancy and to compare them with those of non-pregnant women and to define standards of normalcy in pregnancy in Odia women.

Materials and Methods: The study comprised of 150 pregnant women in age group 20-60 years. 150 healthy age matched non-pregnant women served as controls. The pulmonary function was assessed in all subjects by Medspiror having Helios 401 software. The pulmonary function parameters studied were Forced vital capacity (FVC), Forced expiratory volume in 1st second (FEV_1), FEV_1/FVC ratio, Forced expiratory flow ($FEF_{25-75\%}$), Peak expiratory flow rate (PEFR) and maximum voluntary ventilation (MVV). The parameters were compared by using Student's t-test and ANOVA.

Results: A significant decline in FVC ($p=0.005$), FEV1 ($p<0.05$), PEFR and MVV ($p<0.001$) was seen in study group. However, FEV1/FVC ratio increases significantly ($p<0.05$). Further comparison of lung function parameters between three trimesters in study group shows progressive reduction in PEFR and MVV ($p<0.001$) from 1st to 3rd trimester in study group with maintained FVC and FEV_1 values.

Conclusion: Thus our study highlights the progressive decline in lung functions in pregnant Odia women. Proper interventional strategies and respiratory muscle exercise in the antenatal period may improve the respiratory functions in pregnancy.

Key Words: Pulmonary Functions; Pregnancy; Anaemia; Progesterone; Vital Capacity

Introduction

Pregnancy is a physiological state of adaptation that results in significant hormonal, mechanical and cardiorespiratory changes.[1] The increase in progesterone and estrogen associated with pregnancy contributes to vascular and central nervous system effects. Increase in peptide hormones alters connective tissue characteristics. Progesterone increases tidal volume and minute ventilation by increasing sensitivity of respiratory centre to carbon dioxide.[2]

The course of pregnancy is accompanied by structural changes to the ribcage and abdominal compartments as a consequence of the hormonal changes and the enlarged uterus.[3] Chest wall compliance is reduced and expiratory muscle strength is in the low-normal range.[4]

Information regarding status of pulmonary function is essential to understand disease states affecting pregnancy, to differentiate between physiological and pathological changes, and to avoid unnecessary treatment of physiological changes.[5]

Although there are reports of changes in pulmonary function tests during pregnancy in Indian population, none has been documented on pregnant women of eastern states like Odisha, where malaria and helminthic infestations are endemic and the incidence of anaemia rises to almost 90%.[6]

In the present study, an attempt has been made to evaluate pulmonary functions in three trimesters of pregnancy, and to compare them with those of non-pregnant women, and to define standards of normalcy in pregnancy in Odia women.

Materials and Methods

Study Period

The present cross sectional study was carried out for a period of over one year from April 2013 to May 2014.

Study Design and Participants

Experiment was performed in the Post Graduate department of Physiology, S.C.B Medical, College, Cuttack, Odisha. The study group comprised of 150 pregnant women in age group of 20- 35 years attending the obstetrics & gynaecology antenatal outdoor patient department. The control group consisted of 150 age matched non pregnant women from amongst the

medical, paramedical staff and healthy volunteers from the relatives of pregnant women. Those with known respiratory, cardiovascular, endocrine diseases, anaemia, multiple pregnancy, hydraminos, alcohol intake or chronic therapy for any other disease were excluded from the study.

After taking informed written consent from each subject, and approval of institution ethical committee, detailed history was recorded and complete clinical examination was done at the beginning of experiment. The anthropometric parameters like height and weight of subject were measured.

Experimentation and Collection of Data

1. *Haemoglobin Estimation:* It was done in the Department of Physiology, S.C.B. Medical College, Cuttack by Sahli's Method (Acid Haematin Method). First N/10 hydrochloric acid (HCl) was taken with the help of a dropper and was placed in the graduated haemoglobinometer tube up to its lowest mark (10% or 2 gm%). Finger prick blood was drawn into the haemoglobinometer pipette up to mark 20 cumm and was immediately transferred into the N/10 HCl in the graduated haemoglobinometer tube. After mixing the contents thoroughly, the solution was allowed to stand for about 10 minutes for maximum conversion of haemoglobin in blood to acid haematin. Then distilled water was added drop by drop till the colour of the solution matches with the standard coloured glass rods. Then the reading was taken.

2. *Recording of Pulmonary function test (PFT):* The equipment used for PFT was RMS medspiror. Subject was asked to relax for 5 minutes, prior to performing the test. All tests were recorded 3 times & out of them best manoeuvre was taken. *(a) FVC test:* A nose clip was attached to the subject & a clean mouth piece was attached to breathing tube. The subject was asked to take a deep maximal inspiration & exhale as rapidly & as completely as possible into the mouth piece. *(b) MVV test:* MVV was recorded by asking the patient to take deep breaths as rapidly and forcefully as possible for 15 seconds. The parameters were recorded: Forced vital capacity (FVC), Forced expiratory volume in 1st second (FEV_1), FEV_1/FVC ratio, Forced expiratory flow ($FEF_{25-75\%}$), Peak expiratory flow rate (PEFR), maximum voluntary ventilation (MVV).

Statistical Analysis

All data were expressed as Mean ± SD. Statistical analysis was done using unpaired students t test, one way analysis of variance (ANOVA). A level of p value <0.05 was used to indicate statistical significance in all analyses. Data were analysed using SPSS version 19.

Results

Table 1 expedites comparison of anthropometric parameters between study and control group. There is no significant difference in age, height and haemoglobin status. However the difference in weight and BMI is significant. Table 2 explains comparison of pulmonary function parameters between pregnant and non-pregnant women. The decline in FVC, FEV1, PEFR and MVV and increase in FEV1/FVC ratio is significant in study group.

Table 3 reveals comparison of lung function parameters between three trimesters in study group. A progressive reduction in PEFR and MVV is seen from 1st to 3rd trimester in study group. However, decline in FVC and FEV1 was not statistically significant.

Table-1: Baseline characteristics in study and control group

Characteristics	Study Group (n=150)	Control Group (n=150)	t value	p value
Age (years)	25.52 ±3.37	26.05 ± 3.096	0.581	0.562
Height (m)	1.51 ± 0.046	1.531 ± 0.038	1.812	0.078
Weight (Kg)	65.05 ± 3.5	57.17 ± 4.51	1.776	0.009
BMI (Kg/m^2)	28.88 ± 4.08	24.36 ± 4.12	0.388	0.008
Haemoglobin (g/dl)	11.05 ± 1.72	1.945 ± 0.832	6.953	0.081

Data presented are in Mean ± SD.

Table-2: Comparison of lung function parameters between study and control group

Parameters	Study Group (n=150)	Control Group (n=150)	t value	P value
FVC (L)	2.27 ± 0.34	2.54 ± 0.28	2.97	0.005**
FEV_1 (L)	1.95 ± 0.27	2.13 ± 0.26	2.26	0.028*
FEV_1/FVC (%)	85.9 ± 2.49	83.89 ± 3.28	2.25	0.029*
$FEF_{25-75\%}$ (L/Sec)	2.54 ± 0.33	2.67 ± 0.27	1.49	0.142
PEFR (L/Sec)	4.89 ± 0.61	6.67 ± 0.41	5.13	0.000**
MVV (L/min)	63.44 ± 9.24	92.91 ± 6.88	3.92	0.000**

*Data presented are in Mean ± SD. *P<0.05: Significant; **P<0.01: Highly Significant*

Table-3: Comparison of lung function parameters between three trimesters in study group (n = 150) (ANOVA)

Parameters	Trimester			F Value	P Value
	1st (n=52)	2nd (n=51)	3rd (n=47)		
FVC (L)	2.51 ± 0.25	2.46 ± 0.26	2.19 ± 0.34	0.738	0.481
FEV_1 (L)	2.12 ± 0.24	2.09 ± 0.24	1.91 ± 0.27	0.167	0.847
FEV_1/FVC (%)	84.42 ± 3.27	85.14 ± 3.13	86.69 ± 2.49	1.262	0.288
$FEF_{25-75\%}$ (L/Sec)	2.69 ± 0.25	2.70 ± 0.28	2.54 ± 0.33	0.108	0.898
PEFR (L/Sec)	5.12 ± 0.46	4.67 ± 0.54	4.13 ± 0.61	37.245	0.000**
MVV (L/min)	67.76 ± 6.21	62.71 ± 6.07	55.44 ± 9.25	21.286	0.000**

*Data presented are in Mean ± SD. *P<0.05: Significant; **P<0.01: Highly Significant*

THE ARTICLE WAS RETRACTED DUE TO AUTHORS' DISPUTE

Discussion

In the present research work, lung function parameters were recorded and compared between pregnant and non-pregnant women. Apart from that, inter trimester comparison was done in study group to obtain level of respiratory performances between each group.

Our study documents significant decline in lung function parameters except $FEF_{25-75\%}$ in pregnant women. This is in accordance with various studies that show vital capacity decline due to upward displacement of diaphragm by gravid uterus which leads to further decrease in intrapleural pressure. Chest wall compliance is slightly reduced, because of the effect of the enlarging uterus. Expiratory muscle strength is in the low-normal range.[4]

Again reduced alveolar PCO_2 has a broncho-constrictor effect, which further reduces FEV_1. Decrease in FVC more than FEV_1 documents a restrictive defect in pregnancy.[7,8] The reduction of FVC, FEV_1, PEFR and MVV may be attributed to reduced oxygen carrying capacity of blood leading to tissue hypoxia, lactate accumulation leading to exhaustion.[9]

Reduction in lung function has not been consistently documented by all investigators. Das T.K et al in a study documented no significant effect of pregnancy on FEV_1 or the FEV_1/FVC ratio. According to them, despite the significant increase in intra-abdominal pressure due to the enlarging uterus, the maximal inspiratory and expiratory pressures, as well as maximum trans-diaphragmatic pressure do not change significantly.[10]

G. Grindheim et al, in their study suggested that pulmonary functions are not compromised and do not induce any mechanical stress on the respiratory efficiency of pregnant women.[11] Our study documents maintenance of FEV_1, FVC, FEV_1/FVC with advancing pregnancy. This finding is consistent with previous studies. The plausible explanation for this is smooth muscle relaxing action of progesterone, relaxin and corticosteroids leading to state of bronchodilation.[12] The mobility of thoracic cage and diaphragmatic movement is well preserved despite progressive enlargement of gravid uterus.[13] Other investigators have documented similar findings.[14,15]

However, Anita Teli et al in their study documented progressive decline in FVC, which may be attributable to hormonal changes.[16] Our study documented a significant decline in PEFR with advancing pregnancy. This may be attributed to lesser force of contraction of anterior abdominal muscle and internal intercostal muscle and restricted diaphragmatic movement, thus affecting vertical dimension.[17]

Decreased values of MVV from 1st to 3rd trimester of pregnancy may be explained by the fact that overstretching of muscles of anterior abdominal wall lead to decreased force of contraction needed for expiration. MVV depends upon efficiency of respiratory apparatus as a pump which is at mechanical disadvantage during pregnancy, due to reduced compliance of thoracic wall, lungs and airway resistance.[12,16]

Although the mean haemoglobin level in our study group was greater than 10gm/dl, a slight decline in value can lead to significant reduction in PEFR and MVV in pregnant women residing in malaria endemic state and belonging to low income group. Anaemia, inadequate nutrition and altered eating habits lead to muscular weakness.[18,19]

Conclusion

Thus our study highlights the progressive decline in lung functions in pregnant Odia women. Interventional strategies like antenatal exercises for respiratory muscle strengthening, proper nutrition, iron and calcium supplementation should be promoted.

LIMITATIONS & FUTURE SCOPE OF THE STUDY

Sample size is less. Broad spectrum, multi-centric studies are strongly recommended.

References

1. Cunningham F, Leveno K, Bloom S, Hauth J, Rouse D, Spong C. William's Obstetrics, 23rd edition. St. Louis: McGraw-Hill Professional. 2009. p. 1079-103.
2. Pereira A, Krieger BP. Pulmonary complications of pregnancy. Clin Chest Med 2004;25:299-310.
3. McCormack MC, Wise RA. Respiratory Physiology in Pregnancy. In: Bourjeily G, Rosene-Montella K. Pulmonary Problems in Pregnancy, Respiratory Medicine; 2009. p. 419.
4. Crapo RO. Normal cardiopulmonary physiology during pregnancy. Clin Obstet Gynecol 1996;39:3– 16.
5. Foidart M. Physiology of the pregnant woman and risk factors. Contracept fertile sex 1993;21:811-5.
6. Padhi M, Padhi PK. Anaemia in Pregnancy. The Indian Scenario. Orissa Medical Journal 2012;32:3-12.
7. Mokkapati R, Prasad EC, Venkatraman, Fatima K. Ventilatory functions in pregnancy. Indian J Physiol Pharmacol 1991;35:237-40.
8. Monga U, Kumari K. Pulmonary functions in Punjabi pregnant

THE ARTICLE WAS RETRACTED DUE TO AUTHORS' DISPUTE

women. Ind J Physiol Pharmacol 2000;44:115-6.
9. Dutt SN, Yeshwanth M, Raghuveer TS. Effect of iron deficiency anaemia on pulmonary function in children. Lung India 1944:12:168-73.
10. Das TK, Jana H. Maternal airways function during normal pregnancy. Ind J Med Sci 1991;45:265-7.
11. Grindheim G, Toska K, Estensen M, Roselland L.Changes in pulmonary functions during pregnancy: a longitudinal cohort study. BJOG 2012;119:94-101.
12. Surekha DE, Bhargava RP, Benawri S. Longitudinal Ventilatory Function (Static and Dynamic) studies during different trimesters in pregnant women. J Obs Gyn (India) 1984;36:812-6.
13. Pathak MS, Kurhade GA. A longitudinal study of antenatal changes in lung function tests and importance of postpartum exercises in their recovery. Indian J Physiol Pharmacol 2003:47:352-6.
14. Singh S, Singh KC, Sircar SS, Sharma KN. Airway functions in pregnant Indian women. Indian J Physiol Pharmacol 1995:39:160-2.
15. Kolarzyk E, Szot WM, Lyszczarz J. Lung function and breathing regulation parameters during pregnancy. Arch Gynecol Obstet 2005;272:53-8.
16. Teli A, Bagali S, Aithala M. A study of FVC, PEFR and MEP in different trimesters of pregnancy. International J. of Biomedical and Advance Research 2012;3:648 – 52.
17. Bansal M, Goyal M, Dhilon JK, Kaur P. Longitudinal Study of peak expiratory Flow Rate in Pregnant women. NJIRM 2012;3:34-8.
18. Puranik BM, Kurhade GA, Kaore SB, Patwardhan SA, Kher JR. PEFR in pregnancy : A longitudinal study. Indian J Physiol Pharmacol 1995;39:135-9.
19. Neeraj, Sodhi C, Pramod J, Singh J, Kaur V. Effect of advanced uncomplicated pregnancy on pulmonary function parameters of North Indian subjects. Indian J Physiol Pharmacol 2010:54:69-72.

Cite this article as: Priyadarshini G. Effect of gestational age on pulmonary functions in pregnant Odia women. Int J Med Sci Public Health 2014;3:1364-1367.
Source of Support: Nil
Conflict of interest: None declared

THE ARTICLE WAS RETRACTED DUE TO AUTHORS' DISPUTE