EVALUATION OF PULMONARY FUNCTION TESTS IN NORMAL PREGNANT (II & III TRIMESTER) & NON PREGNANT WOMEN

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ABSTRACT
Pregnancy is principally a phenomenon of maternal adaptation to the increasing demands of the growing fetus\(^1\). Pregnancy causes many visible and invisible changes in human body and it represents one of the best example of selective adaptation in terms of respiratory physiology.

**BACKGROUND:**
To evaluate the changes in dynamic pulmonary function tests (PFTs) in IInd & II/IIIrd trimesters of pregnancy and compare the results between normal pregnant women (case group) & normal non pregnant women of IInd & II/IIIrd trimesters (control group).

**DESIGN (MATERIAL & METHOD):**
50 Subjects were divided into two groups, non pregnant women \((n = 20, \text{ mean age } = 26.5 \pm 2.69)\) and normal pregnant women’s of II & III trimesters \((n = 30, \text{ mean age } = 24.84 \pm 3.00)\). PFTs were done by medspior.

**RESULTS :**
Significant decrease in all the parameters of PFTs like Forced Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV\(_1\)), Peak Expiratory Flow Rate (PEFR), Maximum Ventilation Volume (MVV), were seen in II & III trimester of normal pregnant women as compared to normal non pregnant women.

**CONCLUSION :**
Our data suggests that there is alteration in PFTs in pregnant women. Continuous Monitoring of PFTs may prove to be of great value in maternal healthcare as cases of restriction and obstruction in lungs during pregnancy can be identified early and its deterioration can be prevented by proper management.

**KEY WORDS :**
PFTs, Pregnancy

**EVALUATION OF PULMONARY FUNCTION TESTS IN NORMAL PREGNANT (II & III TRIMESTER) & NON PREGNANT WOMEN**

**INTRODUCTION:**
Pregnancy causes many visible and invisible changes in human body. The highly efficient and sensitive respiratory system becomes vulnerable with profound changes during pregnancy where adaptability is a key feature to combat stress, anxiety and
fear resulting in altered performance of systems to need demands\textsuperscript{1}.

Pulmonary function tests (PFT\textsubscript{s}) permit an accurate and reproducible assessment of the functional state of respiratory system and allow quantification of the severity of disease.

Various investigators\textsuperscript{4,11} have studied pulmonary function tests (PFT\textsubscript{s}) during normal pregnancy but their results were conflicting. Out of various pulmonary function tests medspiiror assess FVC, FEV\textsubscript{1}, PEFR, MVV, etc.

The scanty literature on pulmonary function testing during pregnancy has prompted the present work.

MATERIAL AND METHODS :

About 50 subjects were examined for PFTs. In this linear study groups, 30 pregnant women were taken for case study and 20 normal female were examined for PFTs for control study. About 30 female pregnant patients belonging to the 20-30 yrs of age volunteered themselves for the present study belonging to middle socio economic status and come for regular check up in hospital as OPD basis. Young healthy normal non pregnant women of child bearing age (20-30 yrs) from medical faculty and also from those who accompanied the case subjects were selected for control group.

General physical examination of the subject including required anthropometric measures such, as height, weight and chest circumference was noted. Resting body temperature resting pulse rate, and Blood Pressure were taken in sitting postured after half an hour of rest for every time when they come for pulmonary function testing.

Anthropometric measures such as height, weight was noted. In standing posture, during late morning session, after taking consent and explained the procedure to the subjects and they were asked to take maximum deep inspiration then blow out with maximum effort in mouth piece of medspiiror which already apposed between the lips firmly. Nose was closed by nose clips. As two reading for PFTs were taken on instrument and the highest one selected for calculation.

The instrument was fed with the data, height in centimeters age in years, weight in Kilograms, sex and room temperature prior
to performance of a FVC maneuver. The specifications of Instrument provides flow rate L/Sec versus volume (L) plot and provides volume verses time plot recordings on thermo sensitive paper.

Results of PFTs displayed and recorded as follows:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC</td>
<td>Forced Vital</td>
</tr>
<tr>
<td>FEV1</td>
<td>Forced</td>
</tr>
<tr>
<td>Expiratory Volume in one second</td>
<td>PEFR – Peak Expiratory</td>
</tr>
<tr>
<td>MVV</td>
<td>Maximum</td>
</tr>
</tbody>
</table>

The actual values as measured during the maneuvers, predicted values for the specific patient, when compared to others of same age, height, sex or percentage predicted values, i.e. a ratio of actual value and predicted value expressed as percentage are displayed and if resources available printed records can be obtained.

The PFTs data’s are examined by medspiror and a diagnosis of obstructive or restrictive disease is made and there are a number of systems which used to determine the severity of disease. Here is just one way that is very commonly used.

Normal PFT outcomes: >85% of predicted values
Mild Disease: >65% but <85% of predicted values
Moderate Disease: >50% but <65% of predicted values
Severe Disease: <50% of predicted values

If both FVC and FEV1 are normal, then patient has a normal PFT tests. If FVC and/or FEV1, is 80-90 % or higher, then patient has restricted lung disease. If the % predicted for FEV1/FVC is 69% or lower, then the patient has an obstructed lung disease.

RESULTS AND OBSERVATION:

Statistical analysis was done for all parameters undertaken in study along with some investigative parameters. The age ranged between 20-30 yrs in both groups.

The figures of range have been rounded off, second & third trimesters are abbreviated as II, III respectively in all tables &
graphs. Percentage difference (% diff) for increase or decrease in any parameter was calculated, considering the mean values of controls (non pregnant subjects) as baseline when compared with the case group (two different trimesters).

On comparing control versus second trimester and third trimester, mean values of control were taken as baseline. Mean values of second trimesters were considered 100%, when this group was compared with third trimester group. The positive value in percent difference depicts the increase and negative value as the decrease for that parameter.

Unpaired 't' test by OS 3 programme (computer), was done to find the level of significance as number of control subjects is differ from the number of case group. That were significant when these respiratory parameters of different of pregnancy were compared trimesters with each other and with non pregnant state (Control group). The calculated 't' values and corresponding 'p' values are given for various sample groups for all the respiratory parameters.

TABLE - 1
STATISTICAL ANALYSIS FOR FORCED VITAL CAPACITY (Lt/Sec.) IN DIFFERENT CONTROL AND IN II & III TRIMESTER OF PREGNANCY

<table>
<thead>
<tr>
<th>Sample</th>
<th>Mean</th>
<th>±SD</th>
<th>Range</th>
<th>% difference</th>
<th>'t' values</th>
<th>'p' values</th>
<th>Significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control vs II</td>
<td>2.13</td>
<td>0.21</td>
<td>0.78-3.26</td>
<td>-15.9</td>
<td>-2.842</td>
<td>0.0068 (&lt;0.0)</td>
<td>NS</td>
</tr>
<tr>
<td>Control vs III</td>
<td>2.13</td>
<td>0.21</td>
<td>0.66-2.34</td>
<td>-35.6</td>
<td>-6.466</td>
<td>0.0000</td>
<td>HS</td>
</tr>
<tr>
<td>II vs III</td>
<td>1.79</td>
<td>0.50</td>
<td>0.49-1.37</td>
<td>-23.4</td>
<td>3</td>
<td>0.0043 (0.005)</td>
<td>S</td>
</tr>
</tbody>
</table>

GRAPH -1 GRAPHICAL REPRESENTATION OF FVC (Lt/Sec.) IN CONTROL AND IN II & III TRIMESTER OF PREGNANCY
Decrease in forced vital capacity from second trimester to third trimester is less significant while decrease in FVC from control to third trimester is highly significant.

**TABLE - 2**

**STATISTICAL ANALYSIS FOR FORCED EXPIRATORY VOLUME IN ONE SECOND FEV₁ (Lt/Sec.) IN CONTROL AND IN II & III TRIMESTER OF PREGNANCY**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Mean</th>
<th>±SD</th>
<th>Range</th>
<th>% difference</th>
<th>'t' values</th>
<th>'p' values</th>
<th>Significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control vs II</td>
<td>1.96</td>
<td>0.23</td>
<td>0.70-2.28</td>
<td>-19.8</td>
<td>3.797</td>
<td>0.0005 (&lt;.001)</td>
<td>S</td>
</tr>
<tr>
<td></td>
<td>1.57</td>
<td>0.41</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control vs III</td>
<td>1.96</td>
<td>0.23</td>
<td>0.52-2.24</td>
<td>-37.2</td>
<td>6.589</td>
<td>0.0001</td>
<td>HS</td>
</tr>
<tr>
<td></td>
<td>1.23</td>
<td>0.45</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II vs III</td>
<td>1.57</td>
<td>0.41</td>
<td></td>
<td>-21.6</td>
<td>2.793</td>
<td>0.0075 (&lt;0.01)</td>
<td>LS</td>
</tr>
<tr>
<td></td>
<td>1.23</td>
<td>0.45</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**GRAPH - 2** **GRAPHICAL REPRESENTATION OF FEV₁ (Lt/Sec.) IN CONTROL AND IN II & III TRIMESTER OF PREGNANCY**
Table-2 shows that forced expiratory volume in one second (FEV1) in non pregnant subjects is higher than in pregnant subjects. It also shows that FEV1 decreases upto late pregnancy. When compared with control the decrease in mid and late pregnancy i.e. second and third trimester is highly significant. The decrease from mid to late pregnancy is less significant.

**TABLE - 3**  
**STATISTICAL ANALYSIS FOR PEAK EXPIRATORY FLOW RATE (PFFR) IN CONTROL AND IN II & III TRIMESTERS OF PREGNANCY**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Mean ±SD</th>
<th>Range</th>
<th>% difference</th>
<th>'t' values</th>
<th>'p' values</th>
<th>Significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control vs II</td>
<td>5.40 ± 3.90</td>
<td>1.8-6.0</td>
<td>-27.7</td>
<td>5.601</td>
<td>0.0000</td>
<td>HS</td>
</tr>
<tr>
<td>Control vs III</td>
<td>5.40 ± 2.68</td>
<td>0.8-4.5</td>
<td>-50.3</td>
<td>10.315</td>
<td>0.0000</td>
<td>HS</td>
</tr>
<tr>
<td>II vs III</td>
<td>3.90 ± 2.68</td>
<td>1.09-1.07</td>
<td>-31.28</td>
<td>3.994</td>
<td>0.082 (&lt;0.001)</td>
<td>HS</td>
</tr>
</tbody>
</table>

**GRAPH - 3**  
**GRAPHICAL REPRESENTATION OF PEFR (Lt/Sec.) IN CONTROL AND IN II & III TRIMESTER OF PREGNANCY**

Table - 3 shows statistically decrease in PFFR from non pregnant to mid & late pregnant state i.e. when second and third trimester were compared with non pregnant state, the decrease in values were statistically highly significant. When PEFR values of second trimester & third trimester was compared, it was observed that decrease in PEFR values were insignificant.
### TABLE - 4
STATISTICAL ANALYSIS FOR MAXIMUM VENTILATION VOLUME (MVV) (Lt/sec.) IN CONTROL AND IN II & III TRIMESTERS OF PREGNANCY

<table>
<thead>
<tr>
<th>Sample</th>
<th>Mean ±SD</th>
<th>Range</th>
<th>% difference</th>
<th>'t' values</th>
<th>'p' values</th>
<th>Significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control vs II</td>
<td>70.65</td>
<td>14.81</td>
<td>39-83</td>
<td>-26.61</td>
<td>5.390</td>
<td>0.0000</td>
</tr>
<tr>
<td></td>
<td>57.72</td>
<td>11.25</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control vs III</td>
<td>78.65</td>
<td>14.01</td>
<td>34-69</td>
<td>-40.24</td>
<td>8.123</td>
<td>0.0000</td>
</tr>
<tr>
<td></td>
<td>47.00</td>
<td>11.34</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II vs III</td>
<td>57.72</td>
<td>11.25</td>
<td>39-83</td>
<td>-10.57</td>
<td>3.356</td>
<td>0.0016</td>
</tr>
<tr>
<td></td>
<td>47.00</td>
<td>11.34</td>
<td></td>
<td></td>
<td></td>
<td>(&lt;0.005)</td>
</tr>
</tbody>
</table>

GRAPH – 4 GRAPHICAL REPRESENTATION OF MVV (Lt/Sec.) IN CONTROL AND IN II & III TRIMESTER OF PREGNANCY

Table - 4 shows mean values in the table clearly depict that maximum voluntary ventilation (MVV) per minute decrease to a great extent in case groups when compared with control group. This is obvious from the high 't' values showing highly significant decrease in maximum voluntary ventilation. MVV decrease by almost half that is by 40.24% in late pregnancy as compared to non pregnant state and by one third that is 26.61% as compared to second trimester.

Respiratory parameters shows significant changes when third trimester values of case group were compared with non pregnant state (Control group). The calculated 't' values and corresponding 'p' values are given for various sample groups for all the respiratory parameters.
 DISCUSSION:

- PFTs were conducted with the help of medspiror.
- All the results were statistically analyzed.
- The results of PFTs parameters are briefly tabulated in table 1, 2, 3, 4 for inferring the changes that have occurred at glance and compared with various studies that have already published.

- Some studies\(^3\) shows significant rise in FVC. Mostly all studies\(^4,5,6\) show decrease in FVC.
- Significant reduction in FVC may be obtained due to restrictive effect of the enlarging uterus\(^4\).
- FVC is diminishing due to augmentation of rib cage volume displacement, relative mobility of thoracic cage and unimpaired diaphragmatic movements\(^4\).
FEV₁ is essential to access ventilatory capacity of the pulmonary or to access the ability to ventilate².

A number of studies⁴,⁶,⁸,⁹ as reviewed show decrease in FEV₁.

No change in FEV₁ seen in few studies³,⁵.

Decline in FVC and FEV₁ due to mechanical pressure of enlarging gravid uterus, elevating the diaphragm and restricting movements of lungs⁴,⁶,⁹ and thus hampering the forceful expiration.

It may also be due to bronchoconstrict effect of decreased aveolar PCO₂ on the bronchial smooth muscles³,⁶.
All studies\textsuperscript{5,6} show statistically significant decline in PEFR.

The restriction brought about by enlarged breast growing gravid and the fear of complications arising at term due to abdominal pressure required to forcefully inspire and expire for executing flow rates could render lowered values during pregnancy. The mechanical effects of gravid uterus cause relatively adaptive changes in pulmonary mechanics\textsuperscript{10}.

GRAPH : 8

![Comparison of MVV Values of Present Study with Other Studies](image)

All studies\textsuperscript{6,11} show significant decline in mean values of MVV.

MVV decrease during pregnancy indicating of a mechanical inhibition of chest\textsuperscript{4}.

The decrease MVV may also be attributed to an increased oxygen per unit of work done in the respiratory muscles scar.

CONCLUSION:

\* In control subjects, pulmonary function tests by medspiror were within normal range.

\* In second & third trimester of normal pregnant subjects, pulmonary function tests were seen lower as compared to normal non pregnant state.
FEV₁, FVC decrease in pregnant case group providing that pregnancy is a restrictive condition and not obstructive, the decrease in values of these parameters also suggests that dysfunction of expiratory muscle is not there though weakness may be there and mechanical properties of respiratory system are normal that are due to altered configuration affecting elastic recoil of chest and intra thoracic diameter.

Peak Expiratory Flow Rate (PEFR) decreases states that it might be caused by upward displacement of diaphragm, reduced strength of expiratory muscles and mechanical effect of growing uterus.

Other factors as morning sickness, lack of motivation and resistance to exertion contribute in decreasing Maximum Ventilation Volume (MVV).

Because of abdominal distension, there is gradually fall in all pulmonary function tests values.

The importance of continuous antenatal surveillance and therefore use of pulmonary function test by medspiror is thus evident in early identification of suspected and established cases of restriction and obstruction in lungs during pregnancy. The disease can be identified early and its deterioration can be prevented by proper management.

REFERENCE :


4. Puranik BM, Kaore SB, Korhade GA, Agrawal SD, Patwardhan SA, Kher JR. A longitudinal study of pulmonary function tests


