Evaluation of Pulmonary Functions In Third Trimester Pregnant Odia Women and Its Correlation with Severity of Anaemia

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Abstract:

Background: Anaemia has potential adverse effects on mother and fetus. Chronic severe anaemia reduces diaphragmatic strength and leads to exertional dyspnoea.

Objective: In the present study an attempt has been made to establish a correlation between pulmonary functions and severity of anaemia in third trimester pregnant Odia women.

Material and method: The study comprised of 90 anaemic third trimester pregnant women in age group 20-40 years. 100 healthy age matched third trimester pregnant women served as controls. The pulmonary function was assessed in all subjects by Medspiro having Helios 401 software and hemoglobin estimation was done in physiology department, S.C.B Medical College, Cuttack. The pulmonary function parameters studied were FVC, FEV1, FEV1/FVC ratio, FEF25-75%, PEFR, MVV. The parameters were compared by using Student’s t-test, ANOVA, Bon ferroni, Pearson correlation.

Result: With increasing severity of anaemia, a progressive decline in pulmonary functions seen in anaemic pregnant belonging to third trimester. FEV1 (p=0.003), FVC, PEFR, MVV values (p<0.001) show significant decline while FEV1/FVC (p =0.006) value increase from control to severe anaemic subjects.

Conclusion: Moderate to severe anaemia adversely affects pulmonary functions in pregnant women. Proper interventional strategies should be carried out to prevent adverse outcomes.

Key words: Anaemia, pulmonary function, dyspnoea, pregnancy

I. Introduction

Anaemia is the most common haematological disorder in pregnancy. It has been speculated that the physiologic anaemia of pregnancy serves the purpose of reducing maternal blood viscosity, thereby enhancing placental perfusion, facilitating oxygen and nutrients delivery to the fetus and anticipates the blood loss that attends normal child birth1,2. But chronic severe anaemia has potential adverse effects on the mother and the fetus. It results in impaired work capacity, hypoxemia, reduced transfer factor, lowered cognitive function and impaired immune response3,4.

India contributes to about 80% of maternal deaths due to anaemia in South Asia. The prevalence is highest in the eastern states, especially Bihar, Jharkhand, Odisha, Bengal and Assam. High parity, low socio-economic status, poor nutrition, worm infestations are common predisposing factors5,6.

During pregnancy expiratory muscle strength is in lower normal range which is further weakened by anaemia. It also reduces diaphragmatic strength, the main inspiratory muscle leading to exertional dyspnoea. Changes in pulmonary function in anaemia have been sparingly reported with conflicting results. The objective of our study was to establish a correlation between pulmonary function and different degrees of anaemia in third trimester of pregnancy.

II. Materials And Methods

Study period

The present cross sectional study was carried out for a period of 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 included 90 anaemic last trimester pregnant women within the age group of 20-40 years. It also included 100 age matched normal healthy third trimester pregnant women. The normal 100 healthy pregnant women were selected from antenatal outdoor of Obstetrics and Gynaecology department of S.C.B. Medical College and Hospital, Cuttack at random. It was believed that, in the healthy individuals, the socio economic strata of the community had been adequately represented. The healthy subjects were judged on the following criteria:
Evaluation of Pulmonary Functions In Third Trimester Pregnant Odia Women and Its Correlation

- With haemoglobin level greater than 11 g/dl.
- No history of chronic cardio-pulmonary disease during the 6 month period, preceding the testing or frequent colds. No obesity, history of smoking or tobacco chewing, evidence or history of disease, which can be expected to affect pulmonary function (such as, neuromuscular disorder or arthritis of spine). No obvious sign of malnutrition or skeletal deformities affecting normal expansion of lungs.
- Physically and mentally capable of adequate co-operation during the test.

The anaemic pregnant women were selected either from the antenatal outdoor of Obstetrics and Gynaecology department or the indoor patients, admitted into the antenatal ward of Obstetrics and Gynaecology department of S.C.B. Medical College and Hospital, Cuttack. The anaemic patients selected were, having haemoglobin level in the range of 10.9 g/dl to 4 g/dl. The subjects were further sub-divided into mild, moderate and severe anaemic groups based on WHO criteria for haemoglobin.

- Mild anaemia in pregnancy :- 10 - 10.9 g/dl
- Moderate anaemia in pregnancy :- 7 – 10 g/dl
- Severe anaemia in pregnancy :- 4 – 6.9 g/dl.

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 HCl was taken with the help of a dropper and was placed in the graduated haemoglobinometer tube upto its lowest mark (10% or 2 gm%). Finger prick blood was drawn into the haemoglobinometer pipette upto mark 20cumm 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 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 maneuver was taken.
   - **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 mouth piece.
   - **MVV test**: MVV was recorded by asking the patient to take deep breaths as rapidly and forcefully as possible for 15 seconds.
   - Following parameters were recorded:
     - Forced vital capacity(FVC), Forced expiratory volume in 1st second,(FEV₁), FEV₁/FVC ratio, Forced expiratory flow (FEF₂₅₋₇₅%), Peak expiratory flow rate (PEFR), maximum voluntary ventilation (MVV)

Statistical analysis of data
   - All data 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 analysed using SPSS version 19.

III. Results

Table I expedites comparison of anthropometric parameters between study and control group. There is no significant difference in age, height, weight and BMI but haemoglobin is significantly reduced in study group.

Table II explains comparison of pulmonary function parameters between anaemic pregnant and healthy pregnant women. The decline in FVC, FEV₁, PEFR and MVV is significant in study group however, FEV₁/FVC increase significantly in anaemic subjects.

Table IIIA explains comparison of dynamic parameters between control group and study group with different degrees of anaemia in third trimester of pregnancy using ANOVA.

There is significant reduction in FVC, FEV₁, PEFR and MVV and significant increase of FEV₁/FVC values from control to severe anaemic subjects.
Table IIIB shows comparable parameters in control and mild anaemic subjects but, significant variation in FVC, FEV\textsubscript{1}, PEFR and MVV values in severe anaemic subjects.

Figure 1 depicts positive correlation of haemoglobin with all parameters except FEV\textsubscript{1}/FVC.

IV. Discussion

Comparison of lung function parameters between anaemic pregnant and healthy pregnant females show significant reduction of FVC, FEV\textsubscript{1}, PEFR and MVV values except FEF\textsubscript{25-75\%} and FEV\textsubscript{1}/FVC in the study group in third trimester of pregnancy.

FEV\textsubscript{1}/FVC ratio increase significantly in the study group compared to control indicating restrictive defect. Similar findings were documented by other investigators.

Singhal U and Saxena K in their study, documented 4 normal (Hb >12.5 g\%) and 10 anaemic pregnant women (Hb<10 g\%) in their IIIrd trimester. The reduction of oxygen carrying capacity of blood causes tissue hypoxia and accumulation of intermediary products of metabolism like lactate in the tissue leading to exhaustion. So the respiratory effects become less powerful. This is evident from the significant lower (P <0.001) peak expiratory flow rate (PEFR) in anaemic women (251 l/min ± 12.8) as compared to normal pregnant women (352.5 l/min ± 12.5). The PEFR is more sensitive to muscular element in respiration\textsuperscript{7}.

Phatak M.S. et al conducted a longitudinal study of antenatal changes in lung function tests and importance of postpartum exercises in their recovery and documented significant decline in PEFR and ERV which may be attributed to lesser force of contraction of main expiratory muscles like anterior abdominal muscles and internal intercostals muscles\textsuperscript{8}.

Neeraj et al studied the effects of advanced uncomplicated pregnancy on pulmonary function parameters of North Indian subjects. All the parameters (FVC, FEV\textsubscript{1}, FEF\textsubscript{25-75\%}, PEFR) except FEV\textsubscript{1}/FVC ratio, were found to be lower in the third trimester of pregnancy as compared to the non-pregnants\textsuperscript{9}.

Due to mechanical effect of gravid uterus affecting vertical dimension and restriction of diaphragmatic movement, PEFR declines in advanced pregnancy\textsuperscript{10,11}.

Our study results corroborates with other workers in the same field. The reduced concentration of myoglobin and iron containing enzymes in skeletal muscle is proportional to degree of anaemia. Anaemia accentuates the decline in lung functions as pregnancy advances\textsuperscript{12,13}.

Blumgart HL et al documented a decrease in FVC in anaemic patients which may be attributed to reduced lung distensibility and congestion in anaemia\textsuperscript{14}.

Ganeriwal SK et al documented reduced MVV values in anaemic subjects. It is due to over stretching of anterior abdominal wall muscles leading to decreased force of contraction of expiratory muscles\textsuperscript{15}.

MVV is also influenced by respiratory apparatus as a pump which is at mechanical disadvantage during pregnancy\textsuperscript{16}.

Reduction in lung function has not been consistently documented by all investigators.

Gupta P et al documented normal PEFR and FEV\textsubscript{1} and reduced FEF\textsubscript{25-75\%} in their study\textsuperscript{17}.

Guleria J S et al documented no significant change in FEV\textsubscript{1} and FEF\textsubscript{25-75\%} in anaemic patients. Patients having clinical or radiological evidence of pulmonary congestion were excluded from the study. The low value of MVV in their study is comparable with present study and show similar findings\textsuperscript{18}.

The comparison between different study groups and control group in last trimester of pregnancy shows highly significant lowering of FVC, FEV\textsubscript{1}, PEFR, MVV values.

With increasing severity of anaemia, the pulmonary functions decline consistently.

FEF\textsubscript{25-75\%} is a marker of small airway obstruction and is a effort independent parameter. So doesn’t vary significantly.

Thus the present study highlights the observation that moderate to severe anaemia adversely affects pulmonary functions. Proper interventional strategies should be carried out to prevent adverse outcomes. Intake of iron supplements should be advised.

Limitations & future scope of the study

Sample size is less. Broad spectrum, multicentric studies are strongly recommended.

Abbreviations

FEV\textsubscript{1} = forced expiratory volume in first second, FVC=forced vital capacity, FEF\textsubscript{25-75\%} forced expiratory flow in 25-75\% of FVC , PEFR =peak expiratory flow rate, MVV= maximum voluntary ventilation.

Competing Interests

Authors don’t have any competing interest.
### Table I
Baseline Characteristics in 3rd Trimester of Pregnancy

<table>
<thead>
<tr>
<th></th>
<th>Study Group (n = 90)</th>
<th>Control Group (n = 100)</th>
<th>'t' value</th>
<th>'p' value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Yrs)</td>
<td>25.5263 ± 3.3725</td>
<td>26.0571 ± 3.0959</td>
<td>0.583</td>
<td>0.562</td>
</tr>
<tr>
<td>Height (mt)</td>
<td>1.5105 ± 0.0462</td>
<td>1.5317 ± 0.038</td>
<td>1.812</td>
<td>0.076</td>
</tr>
<tr>
<td>Weight (Kg)</td>
<td>60.0526 ± 3.5035</td>
<td>62.1714 ± 4.508</td>
<td>1.776</td>
<td>0.082</td>
</tr>
<tr>
<td>BMI (Kg/m²)</td>
<td>26.3242 ± 1.1525</td>
<td>26.5512 ± 2.3945</td>
<td>0.388</td>
<td>0.699</td>
</tr>
<tr>
<td>Hb (gm/dl)</td>
<td>8.4474 ± 1.6607</td>
<td>11.9457 ± 0.8325</td>
<td>2.3945</td>
<td>0.8325</td>
</tr>
</tbody>
</table>

All data presented are in Mean ± SD.

[P>0.05 – Not Significant , P <0.05 – Significant *, P <0.01 – Highly Significant **]

### Table II
Lung Function Parameters of 3rd Trimester Pregnant Females

<table>
<thead>
<tr>
<th></th>
<th>Study Group (n = 90)</th>
<th>Control Group (n = 100)</th>
<th>'t' value</th>
<th>'p' value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC (Lt)</td>
<td>2.1263 ± 0.2883</td>
<td>2.4617 ± 0.2631</td>
<td>4.325</td>
<td>0.000**</td>
</tr>
<tr>
<td>FEV₁ (Lt)</td>
<td>1.8711 ± 0.2747</td>
<td>2.097 ± 0.245</td>
<td>3.101</td>
<td>0.003**</td>
</tr>
<tr>
<td>FEV₁/FVC (%)</td>
<td>87.932 ± 3.8222</td>
<td>85.1438 ± 3.1343</td>
<td>8.888</td>
<td>0.006**</td>
</tr>
<tr>
<td>FEF₂₅₋₇₅ (L/sec)</td>
<td>2.5853 ± 0.3489</td>
<td>2.7023 ± 0.2778</td>
<td>2.588</td>
<td>0.183</td>
</tr>
<tr>
<td>PEFR (L/Sec)</td>
<td>3.049 ± 135</td>
<td>4.6714 ± 0.5458</td>
<td>4.6714</td>
<td>0.000**</td>
</tr>
<tr>
<td>MVV (L/min)</td>
<td>51.00 ± 8.6087</td>
<td>62.714 ± 6.0758</td>
<td>62.714</td>
<td>8.6078</td>
</tr>
</tbody>
</table>

All data presented are in Mean ± SD.

[P>0.05 – Not Significant , P <0.05 – Significant *, P <0.01 – Highly Significant **]

### Table IIIA
Comparison of Lung function parameters between control group and study group with different degrees of Anaemia in 3rd Trimester (ANOVA)

<table>
<thead>
<tr>
<th></th>
<th>Control (n = 100)</th>
<th>Mild Anaemia (n = 33)</th>
<th>Moderate Anaemia (n = 29)</th>
<th>Severe Anaemia (n = 28)</th>
<th>F Value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC (Lt)</td>
<td>2.46 ± 0.26</td>
<td>2.358 ± 0.30</td>
<td>2.15 ± 0.198</td>
<td>1.84 ± 0.19</td>
<td>10.750</td>
<td>0.000**</td>
</tr>
<tr>
<td>FEV₁ (Lt)</td>
<td>2.09 ± 0.245</td>
<td>2.04 ± 0.35</td>
<td>1.89 ± 0.16</td>
<td>1.65 ± 0.25</td>
<td>5.583</td>
<td>0.002**</td>
</tr>
<tr>
<td>FEV₁/FVC (%)</td>
<td>85.14 ± 3.13</td>
<td>86.23 ± 5.03</td>
<td>88.08 ± 1.69</td>
<td>89.35 ± 5.34</td>
<td>3.508</td>
<td>0.022**</td>
</tr>
<tr>
<td>FEF₂₅₋₇₅ (L/sec)</td>
<td>2.70 ± 0.27</td>
<td>2.648 ± 0.406</td>
<td>2.58 ± 0.34</td>
<td>2.52 ± 0.38</td>
<td>0.723</td>
<td>0.543</td>
</tr>
<tr>
<td>PEFR (L/Sec)</td>
<td>4.67 ± 0.54</td>
<td>4.436 ± 0.25</td>
<td>3.606 ± 0.29</td>
<td>3.09 ± 0.211</td>
<td>24.428</td>
<td>0.000**</td>
</tr>
<tr>
<td>MVV (L/min)</td>
<td>62.71 ± 6.07</td>
<td>60.80 ± 4.43</td>
<td>50.89 ± 5.79</td>
<td>41.4 ± 3.36</td>
<td>26.608</td>
<td>0.000**</td>
</tr>
</tbody>
</table>

### Table IIIB
Comparison of dynamic parameters between control and study group in 3rd trimester (Bonferroni)

<table>
<thead>
<tr>
<th></th>
<th>Control – Mild Anaemia Significance</th>
<th>Control-Moderate Anaemia Significance</th>
<th>Control – Severe Anaemia Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC (Lt)</td>
<td>1.00</td>
<td>0.012**</td>
<td>0.000**</td>
</tr>
<tr>
<td>FEV₁ (Lt)</td>
<td>1.00</td>
<td>0.197</td>
<td>0.003**</td>
</tr>
<tr>
<td>FEV₁/FVC (%)</td>
<td>1.00</td>
<td>0.145</td>
<td>0.073</td>
</tr>
<tr>
<td>FEF₂₅₋₇₅ (L/sec)</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>PEFR (L/Sec)</td>
<td>1.00</td>
<td>0.000**</td>
<td>0.000**</td>
</tr>
<tr>
<td>MVV(L/min)</td>
<td>1.00</td>
<td>0.000**</td>
<td>0.000**</td>
</tr>
</tbody>
</table>

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[P>0.05 – Not Significant , P <0.05 – Significant *, P <0.01 – Highly Significant **]
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Figure 1

Correlation of haemoglobin with pulmonary function parameters

![Graph showing correlation between hemoglobin and pulmonary function parameters]

Pearson correlation with haemoglobin

References

[12]. Dutt SN, Yeshwanth M, Raghavar Ts. Effect of iron deficiency anaemia on pulmonary function in children. Lung India. 1944:12:No:4-P.168-173
[16]. De Surekha, Bhargava RP, Benarsi S. Longitudinal Ventilatory Function (Static and Dynamic) studies during different trimesters in pregnant women. J Obs Gyn (India), 1984; 36 : 812-816.