

## **Progressive Decline of Partial Pressure of Carbon dioxide and Bicarbonate levels in Arterial Blood of Pregnant Women**

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In the present study the partial pressure of carbon dioxide (PaCO<sub>2</sub>) and bicarbonate ion (HCO<sub>3</sub><sup>-</sup>) in arterial blood was estimated in 32 women in Dhaka city. For this purpose a total 32 women subjects with age ranged from 25 years to 35 years without any recent history of respiratory diseases were selected and divided into 8 healthy non-pregnant women as control and 24 normal pregnant women as experimental group. Experimental group was further divided into 8 first trimester, 8 second trimester & 8 third trimester of pregnant women. The PaCO<sub>2</sub> and HCO<sub>3</sub><sup>-</sup> were estimated by using "Easy Blood Gas Auto Analyzer". The PaCO<sub>2</sub> and HCO<sub>3</sub><sup>-</sup> were estimated during the 1st, 2nd, 3rd trimesters of pregnant women and non-pregnant women. The mean of measured values of PaCO<sub>2</sub> and HCO<sub>3</sub><sup>-</sup> were analyzed statistically in relation to 1st, 2nd, 3rd trimesters of pregnant women & non-pregnant women.

The PaCO<sub>2</sub> and HCO<sub>3</sub><sup>-</sup> were significantly lower in 1st trimester, 2nd trimester & 3rd trimester of pregnant women than that of non-pregnant women. There were no statistically significant difference of PaCO<sub>2</sub> and HCO<sub>3</sub><sup>-</sup> between the 1st trimester and 2nd trimester ; between the 1st trimester and 3rd trimester ; and between the 2nd trimester and 3rd trimester of pregnant women.

It may be concluded that the causes of progressively decreased PaCO<sub>2</sub> and HCO<sub>3</sub><sup>-</sup> throughout the pregnancy were most likely to be due to effect of progesterone causing hyperventilation. Hyperventilation in pregnancy is due to hypersensitivity of respiratory centre. Due to hyperventilation, there is expelling out CO<sub>2</sub> & HCO<sub>3</sub><sup>-</sup> causing decreases PaCO<sub>2</sub> & HCO<sub>3</sub><sup>-</sup> during pregnancy.

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### **Introduction**

**I**n normal pregnancy, respiratory minute volume increases and hyperventilation of pregnancy occurs, which decrease in alveolar CO<sub>2</sub>. This decrease in alveolar CO<sub>2</sub> lowers the maternal blood CO<sub>2</sub> tension. Maternal hyperventilation is probably due to the action of progesterone on the respiratory center<sup>1</sup>. Metabolic changes occurring in pregnant women might modify pulmonary functions. Hypocapnia was observed during pregnancy and this was known to increase airway resistance. However, hormone-determined changes in smooth muscle tone & possibly connective tissue elastance might

occur during pregnancy & so could possibly alter the mechanical properties of the respiratory system<sup>2</sup>.

Maternal ventilation & blood gases undergo substantial change in pregnancy. There was a 40% increase in minute ventilation, resulting in a fall in PaCO<sub>2</sub> & bicarbonate ion. This increased ventilation is thought to be mediated by progesterone, which lowers the threshold of respiratory centre & increases the sensitivity of the respiratory centre. PaCO<sub>2</sub> was lower in pregnant women at sea level compared with the non-pregnant women as control.

Pregnancy was associated with an increase in ventilation ; consequently, the arterial pressure of carbon dioxide falls <sup>4</sup>. During pregnancy hyperventilation caused the arterial carbon dioxide (PaCO<sub>2</sub>) to fall, a compensatory fall in serum bicarbonate ion <sup>5</sup>.

So, it was important to observe the PaCO<sub>2</sub> & bicarbonate ion (HCO<sub>3</sub><sup>-</sup>) in pregnant women both Physiologically and clinically. Although this type of work have been done in different countries by different workers but no established data is available in our country on this aspect.

Therefore, the aim and objective of this study to observe the changes in PaCO<sub>2</sub> & bicarbonate ion (HCO<sub>3</sub><sup>-</sup>) during the different trimesters of normal pregnant women & healthy non-pregnant women

#### Methods

PaCO<sub>2</sub> and HCO<sub>3</sub><sup>-</sup> were measured in normal pregnant and healthy non-pregnant women. For this purpose, total number of 32 subjects in which 8 non-pregnant as control and 24 pregnant women as experimental group with age ranged from 25 years to 35 years were selected. Experimental group was further divided into 8 first trimester, 8 second trimester, 8 third trimester of pregnant women. All the subjects were taken from different areas of Dhaka city that belonged to lower middle and poor socioeconomic classes.

The subjects were selected by carefully history taking and physical examination which revealed no evidence of past or recent significant respiratory diseases.

The measurement of PaCO<sub>2</sub> and HCO<sub>3</sub><sup>-</sup> were done both in healthy non-pregnant women and normal pregnant women during 1st trimester, 2nd trimester, 3rd trimester.

The PaCO<sub>2</sub> and HCO<sub>3</sub><sup>-</sup> were measured by Easy Blood Gas Auto Analyzer. The mean of measured values of PaCO<sub>2</sub> and HCO<sub>3</sub><sup>-</sup> were statistical analysis by unpaired Student's "t" test between and among the study group. P value <0.05 was accepted as significance.

#### Results

The mean (±SD) of measured values of PaCO<sub>2</sub> were 36.89±3.70, 32.73±3.16, 32.46±3.61 and 31.03±3.20 in non-pregnant women (control) and in pregnant women during 1st trimester, 2nd trimester & 3rd trimester shown in table-I. The mean (±SD) of measured values of PaCO<sub>2</sub> were significantly lower in 1st trimester, 2nd trimester & 3rd trimester of pregnant women than that of non-pregnant women shown in table-II.

On the other hand, the mean (±SD) of measured values of HCO<sub>3</sub><sup>-</sup> were 23.61±2.05, 21.68±1.45, 21.53±1.80 and 21.13±1.47 in non-pregnant women and in pregnant women during 1st trimester, 2nd trimester & 3rd trimester shown in table-III. The mean (±SD) of measured values of HCO<sub>3</sub><sup>-</sup> were significantly lower in 1st trimester, 2nd trimester & 3rd trimester of pregnant women than that of non-pregnant women shown in table-IV.

The PaCO<sub>2</sub> & HCO<sub>3</sub><sup>-</sup> value were gradually decreased during pregnancy from 1st trimester to 3rd trimester than that of non-pregnant women.

There were no statistically significant difference of PaCO<sub>2</sub> & HCO<sub>3</sub><sup>-</sup> in between 1st trimester & 2nd trimester ; in between 1st trimester & 3rd trimester ; in between 2nd trimester & 3rd trimester of pregnant women.

**Table –I :** The mean (±SD) of measured values of PaCO<sub>2</sub> in different groups of subjects.

Groups	n	Measured value (mm Hg)
A	8	36.89±3.70
B-I	8	32.73±3.16
B-II	8	32.46±3.61
B-III	8	31.03±3.20

**Table-II:** The statistical analysis of mean ( $\pm$ SD) of measured values of PaCO<sub>2</sub> in different groups of subjects

Statistical Analysis (measured value)	
Groups	P value
A vs B-I	<0.05*
A vs B-II	<0.05*
A vs B-III	<0.01**
B-I vs B-I	>0.50 <sup>ns</sup>
B-I vs B-III	>0.10 <sup>ns</sup>
B-II vs B-III	>0.10 <sup>ns</sup>

**Table –III:** The mean ( $\pm$ SD) of measured values of HCO<sub>3</sub><sup>-</sup> in different groups of subjects.

Groups	N	Measured value (mm Hg)
A	8	23.61 $\pm$ 2.05
B-I	8	21.68 $\pm$ 1.45
B-II	8	21.53 $\pm$ 1.80
B-III	8	21.13 $\pm$ 1.47

**Table – IV:** The statistical analysis of mean ( $\pm$ SD) of measured values of HCO<sub>3</sub><sup>-</sup> in different groups of subjects

Statistical Analysis (measured value)	
Groups	P value
A vs B-I	<0.05*
A vs B-II	<0.05*
A vs B-III	<0.05*
B-I vs B-II	>0.50 <sup>ns</sup>
B-I vs B-III	>0.10 <sup>ns</sup>
B-II vs B-III	>0.50 <sup>ns</sup>

A : healthy non-pregnant women (control)  
 B-I : 1st trimester of pregnant women (experimental)  
 B-II : 2nd trimester of pregnant women (experimental)  
 B-III : 3rd trimester of pregnant women (experimental)  
 n : number of subjects

P values were obtained by unpaired Student’s “t” test  
 \* = significant  
 \*\*\* = highly significant  
 ns = non significant

**Discussion**

In the present study the mean ( $\pm$ SD) of measured values of PaCO<sub>2</sub> were significantly lower in group 1st trimester, 2nd trimester and 3rd trimester than that of non-pregnant (control) women. Similarly the mean ( $\pm$ SD) of measured values of bicarbonate were also significantly lower in group 1st trimester, 2nd trimester and 3rd trimester than that of non-pregnant (control) women. However, both PaCO<sub>2</sub> and HCO<sub>3</sub><sup>-</sup> were gradually decreased throughout the pregnancy from 1st to 3rd trimester of pregnant women. Our results are in agreement with other workers<sup>3-9</sup>.

It was noted that PaCO<sub>2</sub> and bicarbonate were lower in pregnant women at sea level compared with the non-pregnant (control) women due to maternal ventilation and blood gases undergo substantial changes in pregnancy. There is a 40% increased in minute ventilation in pregnant women, resulting in decrease of PaCO<sub>2</sub> and bicarbonate. This increased ventilation is thought to be mediated by progesterone, which lowers the threshold of respiratory centre and increases the sensitivity the respiratory centre<sup>3</sup>.

It opined that normal pregnancy was associated with a 20% increase in O<sub>2</sub> consumption and a 15% increase in the maternal metabolic rate. This extra demand is achieved via 40-50% increase in resting minute ventilation. This hyperventilation causes the PaCO<sub>2</sub> and bicarbonate to fall<sup>5</sup>. There is no significant changes of PaCO<sub>2</sub> and bicarbonate in pregnant women<sup>6</sup>.

During pregnancy CO<sub>2</sub> wash out increases due to hyperventilation, which results of PaCO<sub>2</sub> and bicarbonate to falls<sup>7-9</sup>. There is no statistically significant difference in PaCO<sub>2</sub> between 1st trimester and 2nd trimester; between 1st trimester and 3rd trimester; between 2nd trimester and 3rd trimester of pregnant women.

**Conclusion**

In our study, it may be concluded that PaCO<sub>2</sub> and bicarbonate were significantly lower in 1st

trimester, 2nd trimester and 3rd trimester of pregnant women than that of non-pregnant (control) women due to the effect of progesterone causing hyperventilation. Hyperventilation in pregnancy is due to hypersensitivity of respiratory centre. Hyperventilation, expel out CO<sub>2</sub> causing decreased PaCO<sub>2</sub> and bicarbonate during pregnancy.

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