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Electrocardiographic Changes in Second and Third Trimester in Bangladesh: A Comparative Study

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Abstract

Background: During pregnancy, there are notable changes in cardiovascular function to meet the increasing needs of the developing baby. The objective of this study was to compare ECG in pregnant women during their second and third trimesters with a control group of non-pregnant women in Bangladesh. This study aims to offer valuable insights into the cardiovascular changes that happen during pregnancy. This study's findings are important for maternal health research and clinical practice in Bangladesh and beyond. ***Objective:*** The purpose of this study is to analyze and compare the ECG variations in women during the second and third trimesters of pregnancy. ***Methods:*** The study took place in the gynecology Department at CMH Saidpur, Bangladesh. This study was conducted from March 2023 to August 2023. During this period, 75 pregnant patients in their 2nd trimester and 75 patients in their 3rd trimester were chosen as cases from antenatal outdoor, while 75 non-pregnant women of the same age were selected as the control group. We use the purposive sampling method. ***Results:*** During pregnancy, there were notable changes in BMI, heart rate, and PR interval. BMI decreased in the second trimester and increased in the third trimester.22.67% were nulliparous and 77.33% were multiparous in 2nd trimester. In the third trimester, 26.67% were nulliparous and 73.33% multiparous. So, no significant difference in parity. Heart rate increased in both trimesters, while the PR interval shortened in both trimesters. No significant changes were observed in the durations of the QRS complex or QT interval. In our study, the QTc interval displayed a significant rise. ST depression, which may suggest decreased blood flow, was exclusively seen in pregnant women, particularly in the third trimester. ***Conclusion:*** We found no significant changes in age, but BMI, heart rate, and PR interval were significantly different from the control group throughout pregnancy. No significant QRS complex or QT interval duration changes were identified. The QTc interval rose. ST depression, more prominent in the third trimester, only affected pregnant women. As shown by ST depression, pregnancy may change cardiac function, electrical activity, and ischemia.

Keywords: ECG, Heart rate, PR interval, QRS complex, QT interval, QTc interval, Trimester.

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INTRODUCTION

During pregnancy, a woman's body undergoes notable transformations to support the developing fetus. These modifications have an impact on the cardiovascular system, resulting in an elevated workload for the heart. Electrocardiography (ECG) is a method used to measure the electrical activity of the heart concisely and. During pregnancy, there are anticipated ECG changes that occur as a result of physiological adaptations [1].

The hemodynamic condition of pregnant women undergoes significant alterations during their pregnancy. A decrease in blood pressure, an increase in heart rate and cardiac output, and an expansion in plasma volume are some of the changes that occur as a result of these metabolic alterations [2]. The hormonal changes that occur during pregnancy, as well as the expansion of the walls of the cardiac chambers, can affect the rhythm of the heart [3].

During a typical pregnancy, various hemodynamic changes take place. These include an augmentation in blood volume and cardiac output, a reduction in systemic vascular resistance (SVR), and blood pressure fluctuations. The heart rate (HR) increases by 25% as a result of heightened adrenergic activity [4].

The preload increases when there is an increase in circulating volume, while the afterload decreases as a result of a decrease in systemic vascular resistance (SVR) [5].

During pregnancy, various physiological changes can be observed in the electrocardiogram (ECG). These changes include sinus tachycardia, a shift in the electrical axis, a small Q wave, an inverted T wave, and ST-segment depression [6-10].

During pregnancy, the heart rate increases by 15-25% due to higher metabolic needs and increased sympathetic activity. This increase begins early in pregnancy and reaches its peak in the third trimester [11].

The reduction in PR interval observed during pregnancy may be attributed to the shortening of atrioventricular (A-V) conduction and the resulting tachycardia that occurs during pregnancy [12]. The elevation in heart rate can result in a reduction in PR, QRS, and QT intervals; yet, there is typically no alteration in the magnitude of the P wave, QRS complex, or T wave [13]. Hormonal changes resulting from pregnancy may potentially impact the QT interval [14].

Earlier studies have demonstrated that the QTc increases during pregnancy even in the absence of any prior cardiac illness, while remaining within the normal range [15].

Like many other low- and middle-income nations, Bangladesh struggles to provide quality maternal healthcare. Maternal morbidity and death are burdened by socioeconomic differences, insufficient resources, and restricted access to specialized treatment. Optimizing antenatal treatment and enhancing maternal outcomes in this setting requires an understanding of the particular cardiovascular changes that Bangladeshi women experience throughout pregnancy.

OBJECTIVES

General Objective: The objective of this study conducted in CMH would likely be to examine and contrast the electrocardiographic (ECG) changes that occur in women during the second and third trimesters of pregnancy.

Specific Objective:

1. To determine the variations in ECG patterns between healthy pregnant women during their second and third trimesters.
2. To determine the statistical significance of these ECG alterations concerning a control group of non-pregnant women.

MATERIALS AND METHODS

The study was conducted in the gynecology Department at CMH Saidpur, Bangladesh. Between March 2023 and August 2023, this observational study with a cross-sectional design was conducted. Throughout this period, healthy pregnant women attending antenatal outdoors are selected as cases. The control group consisted of 75 women who were not pregnant and were the same age as the cases attended at Gynae Outdoor. The cases consisted of 75 pregnant patients who were in their second trimester and 75 patients who were in their third trimester. Our study included women who did not have any clinical or known heart illness. Those patients who had a documented history of cardiovascular diseases or those who had underlying medical conditions that had a significant impact on the cardiovascular system were not included in the study. These conditions included hypertension (HTN), pregnancy-induced hypertension (PIH), diabetes mellitus (DM), chronic anaemia, and renal disease. The number of people in the sample was 225. In this case, the method of purposive sampling is utilized.

Data Collection and Data Analysis:

The checklist is divided into four sections. The initial section included basic demographic data, including age and BMI. The second section of the text covers heart rate. The third part of the discussion covers PR interval, QRS complex, QT interval, and ST segment depression. The data was inputted into SPSS 23. A significance threshold of 0.05 was established.

RESULTS

Table 1 displays the following information: The mean age in the control group was 22.56± 3.60 years. In the second trimester, the mean age was 27.43±2.45 years, and in the third trimester, the mean age was 28.76± 3.09 years. The p-value of 0.7830 indicates that there is no statistically significant difference in the mean age between the control group and the 2nd and 3rd trimesters. The BMI of the control group was 29.3 ± 3.97. In the second trimester, the BMI was 25.0 ± 3.04, and in the third trimester, it was 28.7 ± 3.48. The p-value is below 0.001, indicating a statistically significant difference in BMI.

During the second trimester, 22.67% of the cases were nulliparous, while 77.33% were multiparous. During the third trimester, 26.67% of individuals had not given birth before (nulliparous) and 73.33% had given birth multiple times (multiparous). The calculated p-value is 0.6226. Therefore, there is no discernible disparity in parity.

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Table 1: Basic socio-demographic profile

Socio-demographic profile	Control group	Patients in 2nd trimester	Patients in 3rd trimester	P-value
Age (Mean)	28± 3.60	27.43±2.45	28.76± 3.09	0.7830
BMI(Mean)	29.3 ± 3.97	25.0 ±3.04	28.7 ± 3.48	<0.001
Parity Nulliparous Multiparous	N/A	17(22.67%) 58 (77.33%)	20(26.67%) 55(73.33%)	0.6226

The mean heart rate in the control group was 76.89±3.73/min, while in the second trimester, it was 89.54±10.07/min, and in the third trimester it was 96.43±11.72/min, as shown in Table 2. The p-value was found to be less than 0.001. There is a statistically significant difference in HR. (Table- II)

Table 2: Heart rate in our study cases

Heart rate	Control group	Patients in 2nd trimester	Patients in 3rd trimester	P-value
HR	76.89±3.73	89.54±10.07	96.43±11.72	<0.001

Table III shows that in the control group, the PR interval was measured to be 0.20 ± 0.07 seconds. In the second trimester, the PR interval was 0.12 ± 0.11 seconds, and in the third trimester, it was 0.10 ± 0.15 seconds. The PR interval is decreased during the second and third trimesters compared to the control group. The P value of 0.01 indicates that there is a statistically significant difference in the PR interval across different trimesters.

The QRS complex duration in the control group was 0.08± 0.00788 seconds. In the second trimester, it was 0.08± 0.00749 seconds, and in the third trimester, it was 0.08± 0.0094 seconds. The p-value is 0.99. There is no statistically significant relationship or correlation involving the QRS complex. The QT interval in the control group was measured to be 0.35 ± 0.0149 seconds. In the second trimester, it was 0.35 ± 0.0192 seconds, and in the third trimester, it was 0.36 ± 0.026 seconds. The p-value is 0.99. There is no statistically significant relationship or correlation involving the QRS complex. The p-value is 0.99. There is no statistically significant relationship between the QT interval. The control group had a QTc interval of 0.37 ± 0.02156 seconds. In the second trimester, the QTc interval was 0.39 ± 0.0063 seconds, and in the third trimester, it was 0.41 ± 0.10012 seconds. Our group observed a substantial rise in the QTc interval. The p-value is 0.001.

Table 3: Mean distribution of ECG features between 2nd trimester and control group

	Control group	Patients in 2nd trimester	Patients in 3rd trimester	P-value
PR interval (s)	0.15± 0.097	0.11 ±0.11	0.10±0.15	0.01
QRS complex (s)	0.08± 0.00788	0.08± 0.00749	0.08± 0.0094	0.99
QT interval (s)	0.35 ± 0.01498	0.35 ± 0.01928	0.36± 0.02628	0.99
QTc interval	0.37 ± 0.02156	0.39 ± 0.0063	0.41 ± 0.10012	0.001

Figure 1 includes the enrollment of ST segment depression in control groups during the 2nd and 3rd trimesters. Only 3cases exhibited ST depression during their second trimester, whereas seven cases displayed ST depression during their third trimester. The control group did not exhibit any ST depression.

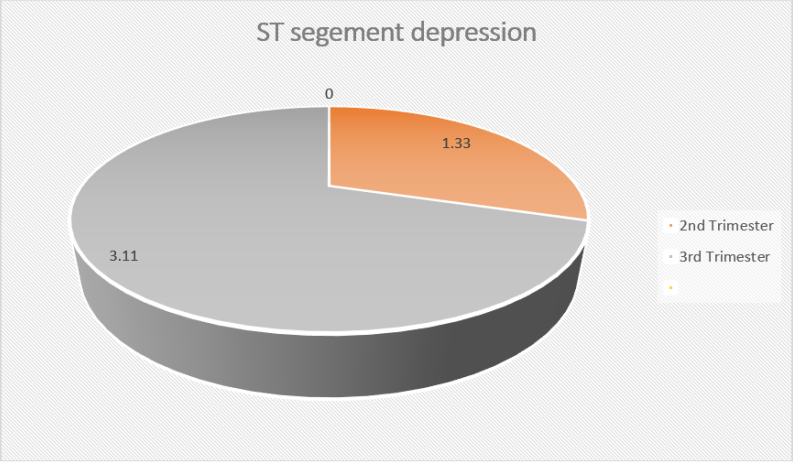

Figure 1: ST segment depression in various groups

DISCUSSION

The control group had an average age of 22.56 years, with a wide range of 3.60 years. In the second trimester, the average age was 27.43±2.45 years, but in the third trimester, it was 28.76±3.09 years compared to the average age during the second trimester. There is no statistically significant difference in the average age between the control group and the second and third trimesters, according to the p-value of 0.7830, which indicates that there is no difference between the two groups.

A mean body mass index (BMI) of 29.3 was found in the control group, with a standard deviation of 3.97. During the second trimester, the body mass index (BMI) was recorded as 25.0 ± 3.04, but during the third trimester, it was recorded as 28.7 ± 3.48. The fact that the p-value is lower than 0.001 indicates that there is a difference in BMI that is statistically significant. In a separate investigation, the average age and body mass index (BMI) were equivalent to those found in our study [16].

In the second trimester, 22.67% were nulliparous, while 77.33% were multiparous. In the third trimester, 26.67% were nulliparous while 73.33% were multiparous. P-value: 0.6226. So, there is no major difference in parity.

During the second trimester, the average heart rate in the control group was 89.54±10.07 beats per minute, and during the third trimester, it was 96.43±11.72 beats per minute, as shown in table 2. The average heart rate in the control group was 76.89±3.73 beats per minute. The p-value that was calculated was found to be lower than 0.001, which is statistically significant. This result correlates with studies by Madras and Challa [17].

In the control group, the PR interval was measured to be 0.20 seconds, with a standard deviation of 0.07 seconds. It was observed that during the second trimester, the PR interval was recorded as 0.12 ± 0.11 seconds. However, during the third trimester, the interval was recorded as 0.10 ± 0.15 seconds. Over the second and third trimesters of pregnancy, the PR interval is shorter as compared to the group that was used as the control. The P value of 0.01, which is a statistically significant. The alterations in the PR interval by Kannur at all are comparable to those that were observed in our investigation [18].

Within the control group, the duration of the QRS complex was measured to be 0.08±0.00788 seconds. It was 0.08±0.00749 seconds during the second trimester, and it was 0.08±0.0094 seconds during the third trimester. It is 0.99 for the p-value. Regarding the QRS complex, there is neither a link nor a correlation that can be considered statistically significant. A measurement of 0.35 ± 0.0149 seconds was obtained for the QT interval in the group that served as the control. It was 0.35 ± 0.0192 seconds during the second trimester, it was 0.36 ± 0.026 seconds during the third trimester, and it was approximately the same. During the first trimester, the QTc interval in the control group was 0.37 ± 0.02156 seconds, whereas during the second trimester, it was 0.39 ± 0.0063 seconds, and during the third trimester, it was 0.41 ± 0.10012 seconds. In our group, there was a noticeable increase (p-value 0.001) in the QTc interval throughout the study. Alterations in the QRS complex, QT interval, and QTc interval are consistent with that of other studies [19].

In our research, we found that only three cases of ST depression were observed during the second trimester of pregnancy, while seven cases of ST depression were observed during the third trimester of pregnancy. ST depression was not observed in the group that served as the control. A different study is comparable to the ST segment alteration findings [20].

CONCLUSION

In the end, this study examined the physiological alterations that transpire throughout pregnancy by contrasting a control group with women in their second and third trimesters. Although there were no notable variations in age among the groups, statistically significant disparities were observed in BMI, heart rate, and PR interval during pregnancy when compared to the control group. There were no noticeable variations in the duration of the QRS complex or QT interval. Furthermore, the occurrence of ST depression was exclusively detected in the pregnant groups, particularly in the third trimester, and at a higher frequency. These findings imply that pregnancy is linked to alterations in cardiac function and electrical activity, and maybe ischemia (lower blood flow) as evidenced by ST depression in certain instances.

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