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Original Research Article

Electrocardiographic Changes during the Third Trimester of Pregnancy: A Cross Sectional Study

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Abstract: This study is intended to evaluate the changes in Electrocardiogram (ECG) in the third trimester of pregnancy. The cross sectional study was conducted on two hundred subjects whose age ranged between 18 and 35 years. One hundred pregnant women and one hundred non-pregnant women attending the Government General Hospital in Kakinada, Andhra Pradesh were included. The 12 lead ECGs of the participants were taken in supine position. The ECGs were studied for different parameters like heart rate PR, QT intervals, T wave, PR, QT segments, atrial and ventricular depolarization axis. QTc interval was calculated using Bazett's formula. The results were analyzed using student's t-test and probability (p value) was calculated. The results showed increase in heart rate in pregnant women compared to the control group. The decrease in PR interval associated with pregnancy was highly significant. The analysis showed statistically significant increase in QT and QT_C interval (p value 0.003, 0.0001). The QRS frontal axis compared to control showed increased tendency to shift towards left with advancing pregnancy. QRS Frontal axis showed a statistically significant decrease in the 3rd trimester (p value 0.001). This study shows that changes in ECGs in the third trimester pregnant women do occur. Therefore interpretation and evaluation of electrocardiograms in pregnancy should be done with due caution.
Keywords: Electrocardiogram, pregnancy, third trimester, heart rate.

INTRODUCTION

The cardiovascular system undergoes significant structural and hemodynamic changes during the course of pregnancy. They are (a) major increase in cardiac output and a decrease in maternal systemic vascular resistance (b) the renin-angiotensin aldosterone system is significantly activated (c) the heart and vasculature undergo remodeling. These adaptations allow adequate fetal growth and development, and mal-adaptation has been associated with fetal morbidity. Understanding the normal cardiovascular changes in pregnancy is essential to caring for patients with cardiovascular disease[1]. Electrocardiography is one of the basic tools in the investigation of cardiovascular diseases. Electrocardiogram during normal pregnancy may show wide variation from the normal accepted. The present study aims at evaluating ECGs to detect possible abnormalities in the normal healthy pregnant women in the 3rd trimester compared to the ECGs in the non-pregnant women. Certain changes are known to occur during the 3rd trimester of pregnancy due to increased cardiac output and upward pushing of the heart produced by the enlarging uterus. This includes cardiovascular changes such as increase in heart rate, cardiac output and intravascular volume. These physiological changes facilitate the adaptation of the cardiovascular system to the increased metabolic needs of the mother enabling adequate delivery of oxygenated blood to the peripheral tissues and to the fetus. Resting pulse rate increases about 10-15 beats per minute during pregnancy. The cardiovascular changes that occur normally during pregnancy sometimes simulate heart disease[2]. In addition, many of the physiological adaptations of normal pregnancy alter the physical findings, thus misleading the diagnosis of heart disease[3]. Particularly in first two trimesters, a 30% to 50% increase in cardiac output may be observed, which begins to rise gradually at 8 to 10 weeks of gestation and peaks at approximately 25 to 30 weeks' of gestation. ECG changes observed during pregnancy include sinus tachycardia, left axis deviation, ectopic beats, inverted or flattened T waves, a Q wave in lead III and the augmented voltage unipolar left foot lead[4]. Moreover these alterations in cardiovascular parameters

during pregnancy suggest the likelihood of an altered ECG during pregnancy. In support of this view, few previous studies have also demonstrated that some electrocardiographic parameters are indeed altered by the pregnant state[5,6]. Hence it is very crucial to understand the cardiovascular alteration during normal pregnancy. This helps to establish a reference for comparison when pathological complications arise during pregnancy[7]. The fact that cardiovascular disease ranks as the prime indirect cause of maternal death as well as the most common cause of maternal death overall, further necessitates a detailed study[8]. Hence we took up the present study to assess the changes in electrical activity of heart in the third trimesters of normal pregnancy and by comparing the same in non-pregnant women, by using PR and QT intervals of ECG. Understanding of these physiological changes is important to distinguish pathological changes.

Table-1: Hemodynamic changes in pregnant women at term

S.NO	Parameter	Change %
1	Cardiac out put	+43%
2	Heart rate	+17%
3	Left ventricular stroke	+17%
4	Vascular resistance:	
	--Systemic	-21%
	--Pulmonary	-34%
5	Mean arterial pressure	+4%
6	Colloid osmotic pressure	-14%

MATERIALS AND METHODS

One hundred normal healthy non-pregnant women and one hundred healthy pregnant women in the 3rd trimester within the age group of 18 to 35 years were chosen for the study from among the antenatal women who attended the out-patient department at The Government General Hospital, Kakinada, Andhra Pradesh. Clearance from the Institutional Ethical Committee was obtained prior to taking up this study. Each participant was individually explained about the study protocol. Subjects were included in the study after obtaining their informed consent and after careful clinical examination ruling out any disease in general and cardiac abnormality in particular. A detailed physical and systemic examination was done on the subjects who were selected. Physical examination included measuring height in centimeters, weight in kilograms. Subjects were matched for age, height, and weight. Subjects were allowed to take rest for ten minutes. Recording of resting pulse rate was done by palpating the radial artery. Blood pressure was recorded with a mercury sphygmomanometer using the appropriate sized cuff. Clinical examination of the cardiovascular system and respiratory system was done in detail. The instrument used to record electrocardiogram is the twelve channel electrocardiograph Hewlett Packard page writer manufactured by Philips electronics Ltd. This high-quality cardiograph captures accurate 12-lead ECGs on full-size paper with no cutting or pasting. It records 3 or 6 channels at speeds ranging from 5mm to 50mm per second, so we cancapture multiple levels of detail. We can activate an ECG at the press of a single button. ECG of each subject was studied for rate, rhythm, axis, intervals PR, QRS, QT, time corrected QT duration (QTc). The heart rate was calculated by dividing 1500 with number of small squares between two R waves. The QTc (corrected QT interval) was calculated by using Bazett's formula (QT interval/square root of the RR interval)[9]. The PR interval, the QT interval, QRS segments were evaluated in seconds and the ST segment QT in millivolts. The results that were obtained were statistically analyzed by using the Student's t-test. The probability (p value) was calculated.

RESULTS

In the present study the mean age of control and 3rd trimester pregnant women was 23.25 ± 3.03 and 23.26 ± 3.02 years respectively. The heart rate was increased in pregnancy when compared to control group, which was highly significant (p value 0.0001). Increase in QT interval duration and decrease in QRS axis in the third trimester of pregnancy were also statistically significant.

Table-2 shows that 54% of control group showed QRS axis between 60^0 and 0^0 whereas the percentage increased 88% in women in the 3rd trimester of pregnancy.

Table-3 shows that 67% of normal subjects' electrical position of the heart in aVL and aVF were in the intermediate position. Whereas it has increased to 78% in the 3rd trimester.

Table–2: Distribution of QRS Axis

Axis	control		III trimester	
$0^0 – 30^0$	46	46%	34	34%
$30^0 – 60^0$	8	8%	14	54%
$60^0 – 90^0$	46	46%	52	12%

Table–3: Distribution of the position of Heart

Position	Control		IIIrd Trimester	
	No. of cases	%	No. of cases	%
Vertical	33	33%	22	22%
Intermediate	67	67%	78	78%

Table–4: Comparison of parameters of pregnant and control group

Variable	Control(Mean±SD)	Third Trimester(Mean±SD)	P value
Age (years	23.25±3.03	23.26±3.02	0.67
Heart rate (/min)	84.26±10.06	92.86±15.61	0.0001***
PR Interval (sec)	0.13±0.04	0.15±0.12	0.0169**
QRS complex (sec)	0.08±0.10	0.07±0.06	0.6851
QT interval (sec)	0.33±0.02	0.35±0.04	0.003*
QTc interval (sec)	0.37±0.02	0.40±0.05	0.0001***
P axis(degrees)	34.8±10.8	37.6±13.5	0.06
QRS axis (degrees)	45.64±15.51	51±17.9	0.04*

p>0.05: Not Significant,*p: <0.05: Significant,** p: <0.01: Highly significant,*** p: <0.001: Very highly significant.

DISCUSSION

The present study aims at evaluating ECGs to detect possible abnormalities in the normal healthy pregnant women in the 3rd trimester in comparison with ECGs of the non-pregnant women. In the present study, sinus tachycardia was observed in subjects in the third trimester pregnancy due to increased cardiac output, due to increased plasma volume by about 40%. The increase in heart rate was due to a decrease in vagal baroreflex as well as a decrease in parasympathetic tone. The increase in heart rate during the third trimester of pregnancy compensates for the fall in the stroke volume resulting from caval compression. This result correlates with the previous study by Voss A, *et al*[10]. The present study also showed decreased PR interval in the third trimester pregnant subjects and it was statistically significant. The decrease in PR interval observed during pregnancy is due to shortening of A-V conductance with respect to increased heart rate accompanied during pregnancy. Nandini B, Shiva M, also concluded similar results in their study[11]. In our study, there was statistically significant increase in the QT interval when compared between the control and study groups. Similar results are seen in study done by Drs. Carruth J.E., Mirris BB, Brogan *et al* [12]. In the present study, it was found that there was a statistically significant increase in QTc interval in the 3rd trimesters of pregnancy when compared to control group. Similar reports were given by Lechmanova *et al*[13], Carruth JE *et al*[12], Oram S *et al*[8] in their studies. An increase in the QTc interval may be due to tachycardia. It seemed possible that the altered circulatory dynamics during pregnancy might have some effect on its duration. It appears that the physical and emotional stress during the 9 months of pregnancy may be a factor in triggering heart rhythm disorders in some vulnerable women[14]. They must be considered as complex consequences with changes in regulatory mechanisms during normal pregnancy.

In the present study, QRS axis showed a statistically significant decrease in the 3rd trimester of pregnancy when compared to non-pregnant women. With increase in gestational age, position of heart changes from vertical to intermediate indicating that heart shifted to left with increase in gestational period. Electrical position of heart also changed from vertical to intermediate in 11% of cases involving axis deviation in pregnancy. This finding confirms the observation of Schwartz DB & Schamroth L *et al*[15].In the present study QTc interval prolonged and was statistically significant which is an indirect reflection of complete process of ventricular repolarization as established by Lecchmonova *et al* in their study on QT dispersion and 'T' loop morphology in late pregnancy and after delivery. T wave inversion was seen in 1% and partial RBBB in another 1% of cases in the present study. The T wave inversion might have occurred due to hypoxia to the myocardium--(Myocardial strain). Upward displacement of the diaphragm by the enlarging uterus causes the heart to shift to left and anteriorly. As a result the apex beat is moved upwards and outwards. Partial RBBB is seen because of conduction delay giving rise to sagging of QRS complex thus increasing the QRS duration. Partial RBBB can be considered as a bradyarrhythmia. The pregnancy state may be pro

arrhythmia[16]. It was due to the mechanisms such as hormonal, hemodynamic and autonomic changes that occur during pregnancy.

CONCLUSION

The study has proven that the ECG parameters do alter during pregnancy. Further, a significant change was noticed in the electrical activity in pregnancy in terms of PR, QT and QTc intervals. These parameters need to be considered with due caution so as not to diagnose falsely or fail to diagnose the condition. In this study the electrocardiographic parameters were studied by comparing the pregnant and non-pregnant groups. The results perhaps would have been more ideal, had the electrocardiograms in the same group of individuals been recorded before and during the pregnancy.

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