



A STUDY ON ELECTROCARDIOGRAPHIC CHANGES IN PREGNANCY

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ABSTRACT

During pregnancy, physiological adaptations occur in different systems of maternal body to cater to the needs of the growing fetus as well as to support the increasing metabolic demands of mother. The cardiovascular system also undergoes changes and these changes are reflected in the electrocardiogram. So, this study has been conducted with the aim to learn the electrocardiographic changes in pregnancy and to compare and analyze the electrocardiogram of pregnant women with the non-pregnant women. This was a comparative study of 30 pregnant women in the age group of 20-35 yrs and 30 non-pregnant women in the same age group. A 12 lead ECG of both pregnant and non-pregnant women were recorded using ECG machine and they were analyzed. RESULT- It has been observed that there was a statistically significant increase in heart rate, decrease in PR interval, decrease in QRS axis and an increase in corrected QT interval in pregnant women compared to non-pregnant women. There was presence of Q wave in inferior leads III and aVF in pregnant women. The occurrence of Q wave in lead III was more frequent in pregnant women than non-pregnant women while only pregnant women showed Q wave in lead aVF. The occurrence of T wave abnormalities like flat T waves and inverted T waves in lead III was more frequent in pregnant women than non-pregnant women. Also, there was statistically significant occurrence of inverted T wave in V2 in pregnant women. CONCLUSION- These physiological changes in the electrocardiogram of pregnant women must be taken into consideration while interpreting the ECGs for diagnosis of heart diseases in pregnancy.

Keywords: pregnancy, electrocardiographic changes, heart rate, QRS axis, PR interval, corrected QT interval, T inversion, Q wave.

INTRODUCTION

Pregnancy is a physiological state and during pregnancy, physiological adaptations occur in different systems of maternal body to cater to the needs of the growing fetus as well as to meet the increasing metabolic demands of mother. The cardiovascular system also undergoes changes. Maternal cardiac output increases due to an increase in heart rate and stroke volume. Mother's cardiac output increases to 30-40% above normal by the 27th week of pregnancy (1). An increase in cardiac output means an increased uterine blood flow and an increased uterine blood flow leads to increased placental blood flow. Increased placental blood flow ensures better nutrition and oxygen for the growing fetus. As the pregnancy advances and uterus becomes an abdominal organ, the gravid uterus compresses inferior vena cava which reduces venous return and therefore the stroke volume(2,3). But this fall in stroke volume is compensated by the increase in heart rate and maternal cardiac output is maintained(4). In the later half of pregnancy maternal blood volume also increases. This also contributes to increase in cardiac output. Maternal blood volume increases due to increased levels of aldosterone and oestrogens and due to increased fluid retention by the kidneys. The maternal blood volume shortly before term is 30% above normal (1). This increase in blood volume will lead to increased venous return and as a result of this volume overload left ventricular size and mass increases(5,6). Therefore, in pregnancy there is physiological eccentric hypertrophy of heart(6). This shifts the apical impulse to the left causing a leftward deviation of cardiac axis. Also the gravid uterus causes elevation of diaphragm which leads to transverse displacement and clockwise rotation of heart, which in turn leads to leftward deviation of cardiac axis(7,8). With the leftward deviation of cardiac axis the heart assumes a more horizontal position (8) and the plane of septum is such that the septal electrical activity is directed inferoposteriorly(9). All these changes are reflected in the electrocardiogram. So, this study has been conducted with the aim to learn the electrocardiographic changes in pregnancy and to compare and analyze the electrocardiogram of pregnant women with the non-pregnant women.

MATERIALS AND METHODS

This was a comparative study in 30 apparently healthy pregnant women in the age group of 20-35 yrs and 30 apparently healthy non-pregnant women in the same age group, conducted in Civil hospital, Asarwa, Ahmedabad, Gujarat. Subjects included the inpatients of obstetric wards, pregnant women attending antenatal clinics and non-pregnant women attending gynaecology OP department. Informed consent was taken from all the subjects. Then a detailed history was taken. All apparently healthy pregnant & non-pregnant women in the age group of 20-35 yrs were included in the study while women with history of cardiorespiratory diseases, anaemia, hypertension, thyroid disorders, renal disease and preeclampsia/eclampsia were exempted.

- INCLUSION CRITERIA

Apparently healthy pregnant & non-pregnant women in the age group of 20-35 yrs.

- EXCLUSION CRITERIA

Women with history of cardiorespiratory diseases, anaemia, hypertension, thyroid disorders renal disease, preeclampsia/ eclampsia

After giving a rest of 5 minutes, a 12 lead ECG was taken in supine position using BPL CARDIART 6108T ECG machine. The ECGs were analyzed and data were entered in excel sheet. Data analysis was done using student t test and chi square test, and p values were derived to ascertain the statistical significance of ECG changes.

RESULTS

Out of 30 pregnant women five each belonged to 1ST and 2ND trimesters of pregnancy while 20 of them were in their 3RD trimester of pregnancy (table 1). In non pregnant women the mean heart rate was found to be 77.4 bpm with a standard deviation of 7.224 while in pregnant women the mean heart rate was found to be 94.37 bpm with a standard deviation of 8.938. On statistical analysis by comparison of means by t test the p value was found to be less than 0.0001. This proves that there was statistically highly significant increase in heart rate in pregnant women compared to nonpregnant women (table 2). The mean QRS axis in non-pregnant women was 60.56° (≈61°) with a standard deviation of 15.402 and in pregnant women it was 48° with a standard deviation of 17.256. There was a leftward deviation of 13° in the mean QRS axis among pregnant women compared to non-pregnant women. On t test there was found to be statistically significant decrease in QRS axis or leftward deviation of cardiac axis in pregnant women compared to non-pregnant women (table 3). The mean PR interval in non-pregnant women was found to be 150 msec with a standard deviation of 10.148 while in pregnant women it was 130 msec with a standard deviation of 19.475. With a p value of less than 0.0001, there was found to be statistically highly significant decrease in PR interval in pregnant women compared to non-pregnant women (table 4). The mean corrected QT interval (QTc) in non pregnant women was 384 msec and in pregnant women it was 431 msec. There was statistically highly significant increase in QTc in pregnant women compared to non pregnant women (table 5). 53% of pregnant women showed Q wave in lead III while only 17% of the non-pregnant women showed Q wave. Therefore, the occurrence of Q wave in lead III was more frequent in pregnant women than non pregnant women. It was found to be statistically significant. When none of the non pregnant women showed Q wave in aVF, 23% of pregnant women showed Q wave in aVF. There was a statistically significant occurrence of Q wave in aVF in pregnant women (table 6). The occurrence of T wave abnormalities like flat T wave or inverted T wave in lead III was more frequent in pregnant women

than non-pregnant women (table 7). Also T inversion was observed in V2 in pregnant women (table 8). These findings were found to be statistically significant

Table1: Characteristic of study group

NO.OF SUBJECTS	PREGNANT			NON-PREGNANT
	1 ST TM	2 ND TM	3 RD TM	
	5	5	20	30
TOTAL	30			30

Table 2: Comparison of heart rate

GROUP	NO.OF SUBJECTS	MEAN±SD (bpm)	STATISTICAL SIGNIFICANCE (t test)
NON-PREGNANT	30	77.4±7.224	p<0.0001 HS 95% CI -21.17 to -12.77
PREGNANT	30	94.37± 8.938	

Table 3: Comparison of QRS axis

GROUP	MEAN±SD (degrees)	STATISTICAL SIGNIFICANCE (t test)
NON- PREGNANT	60.56±15.402	P=0.0043 S 95% CI 4.1069 to 21.013
PREGNANT	48±17.256	

Table 4: Comparison of PR interval

GROUP	MEAN±SD (msec)	STATISTICAL SIGNIFICANCE (t test)
NON- PREGNANT	150±10.148	p<0.0001 HS 95% CI 11.974 to 28.025
PREGNANT	130±19.475	

Table5: Comparison of QTc

GROUP	MEAN±SD (msec)	STATISTICAL SIGNIFICANCE (t test)
NON-PREGNANT	384.25±46.92	P<0.0001 HS 95% CI -67.89 TO -27.12
PREGNANT	431.67±30.175	

Table 6: Occurrence of Q wave

LEAD	GROUP	Q WAVE		STATISTICAL SIGNIFICANCE (Chi square vaue)
		YES(%)	NO(%)	
III	NON-PREGNANT	5(17)	25(83)	7.326 P=0.0068 S
	PREGNANT	16(53)	14(47)	
aVF	NON-PREGNANT	0	30(100)	5.822 P=0.0158 S
	PREGNANT	7 (23)	23 (77)	

Table 7: Comparison of Twave abnormalities like flat T waves /inverted T waves in lead III

GROUP	T WAVE ABNORMALITIES IN LEAD III		STATISTICAL SIGNIFICANCE (Chi square value)
	YES(%)	NO(%)	
NON-PREGNANT	14(47)	16(53)	9.075 P=0.0026 S
PREGNANT	26(86.66)	4(13)	

Table 8 : T inversion in V2

GROUP	T INVERSION IN V2		STATISTICAL SIGNIFICANCE (Chi square value)
	YES (%)	NO(%)	
NON-PREGNANT	0	30(100)	5.822 P=0.0158 S
PREGNANT	7(23.33)	23(76.66)	

DISCUSSION

In pregnancy cardiac output increases to meet the increasing metabolic demands of mother and fetus. Increased blood volume, increased heart rate, together with reduced systemic vascular resistance all lead to increased cardiac output(6).

In this study there was statistically highly significant increase in heart rate in pregnant women compared to nonpregnant women. The increase in heart rate in early pregnancy is linked to the production of pregnancy hormone, human chorionic gonadotropin(10). The increase in heart rate is also attributed to the decrease in vagal parasympathetic tone(11). There was statistically highly significant decrease in PR interval in pregnant women compared to non-pregnant women. The decrease in PR interval is due to shortening of A-V conductance with respect to increased heart rate associated with pregnancy(12). This shows that there is fast conduction of electrical impulses from atria to ventricles during pregnancy. The corrected QT interval was found to be increased in pregnant women compared to non pregnant women due to increase in heart rate(3). In individual cases QTc was found to be prolonged, more than 450 msec but it was less than 500 msec also. A corrected QT interval of 500 msec or longer may predispose to paroxysmal ventricular tachycardia of particular type called “torsade de pointes”(13). Lechmanova et al in their study found an increase in QT interval as well as prolongation of QTc interval during late pregnancy.(14)

There was also statistically significant decrease in QRS axis or leftward deviation of cardiac axis in pregnant women compared to non- pregnant women. A mean QRS axis deviation of 13° was observed in pregnant women. The studies of Carruth et al. ,Singh AD et al and Sunitha et al. also showed leftward axis deviation in pregnancy(7,15,16). The QRS axis is a measure of overall direction of depolarization of the ventricles. In pregnancy, increase in blood volume leads to left ventricular volume overload and eccentric hypertrophy of heart which shifts the apical impulse to left causing leftward axis deviation. Also as the pregnancy advances ,the gravid uterus causes elevation of diaphragm. This leads to transverse displacement and clockwise rotation of heart contributing to leftward axis deviation. It was observed in our study that QRS axis lies well within the physiological limits and it has to be emphasized that there was only leftward deviation of cardiac axis in pregnancy and it was not a left axis deviation.

There was occurrence of Q wave in leads III and aVF. This is because with the leftward deviation of cardiac axis the heart assumes a more horizontal position in pregnancy. As a result the septal

depolarization is directed inferoposteriorly leading to formation of Q waves in inferior leads III and aVF(9). T wave inversion was observed in lead III and V2 .It may be attributed to the increased workload on heart due to temporary increased blood volume during pregnancy which may cause a temporary ischemia represented by T wave inversion(17).

CONCLUSION

So ,in this study there was a statistically significant increase in heart rate, decrease in PR interval, decrease in QRS axis/left ward deviation of the cardiac axis and an increase in QTc interval in pregnant women compared to non-pregnant women. There was presence of Q wave in inferior leads III and aVF in pregnant women. The occurrence of Q wave in lead III was more frequent in pregnant women than non-pregnant women while only pregnant women showed Q wave in lead aVF. The occurrence of T wave abnormalities like flat T waves and inverted T waves in lead III was more frequent in pregnant women than non-pregnant women. Also, there was statistically significant occurrence of inverted T wave in V2 in pregnant women. These physiological changes in the electrocardiogram of pregnant women must be taken into consideration while interpreting the ECGs for diagnosis of heart diseases during pregnancy. A knowledge of physiological variations in ECG during pregnancy is essential and will provide a standard reference for the analysis of ECGs of patients with heart diseases complicating pregnancy as well as to diagnose heart diseases in pregnancy.

REFERENCES

1. *Guyton and Hall textbook of medical physiology*, twelfth edition, unit XIV, chapter 82, page no.1010
2. Julian DG ,WegnerNK.Heart disease and heart surgery during pregnancy. *In women and heart disease*. United Kingdom: Martin Dunitz ;2000s
3. Venkatachalam Madras, Nagasireeshachalla, Sri Venkateshwara medical college Electrocardiographic variations during three trimesters of pregnancy-*International Journal of research in Medical Sciences*
4. PriyaSoma-Pillay, Catherine Nelson Piercy, HeliTolppanen ,AlexandreMebbaza-Physiological changes in pregnancy.*Cardiovascularjournalof Africa* vol27,No2,mar/apr2016-
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4928162>
5. *Robbins and Cotran pathologic basis of disease*-8th edition, chapter 12,page533.
6. Jingyuan Li, SobanUmar ,MarjanAmjedi ,Andrea Iorga, Salil Sharma ,RangarajanNadadur, VeraRegitz, MansourehEghbali -New frontiers in heart hypertrophy during pregnancy.*Am J Cardivasc Dis* 2012;2(3):192-207
7. Sunitha, Chandrasekharappa.S, S.V BridElectrocardiographic QRS axis ,Q wave and T wave changes in 2nd and 3rd trimesters of normal pregnancy. *Journal of Clinical & Diagnostic Research*.2014 sep,Vol-8(9)BC17-BC21
8. Chia P, Chia H, Subramanian R. A clinical approach to heart disease in pregnancy part 1General considerations in management.*The Obstetrician & Gynaecologist*.2002;4(3):162-68.
9. Dr.S.Venkatesan M.D, expressions in cardiology. Inferior MI by ECG....anterior MI by echocardiography.jan 14,2013 .
10. Clap JF. Maternal heart rate in pregnancy .*American Journal of Obstetrics and Gynaecology*,1985;152(6):659-60.[http://dx.doi.org/10.1016/S0002-9378\(85\)80040-5](http://dx.doi.org/10.1016/S0002-9378(85)80040-5).
11. Voss A, Malberg H ,Schumann A, Wessel N, Walther T ,StepanH,Faber R. Baroreflex sensitivity ,heart rate and blood pressure variability in normal pregnancy. *Am J Hypertension*.2000;13(11):1218-25.
12. SharadKole, JnaneshwraShenoy ,ShivakumarJ,Suvarna P ,Prasannakumar J. variations in electrical activity of heart as the pregnancy progresses .*National journal of Physiology ,Pharmacy and Pharmacology*.2014;4(3):187-90.
13. *THE ECG MADE EASY*-John R.Hampton
14. Lechmanova M, Kittnar O, Mleck M, Slavicek J, DohnalovaA,Havranek S et al.changes of the electrical heart field and hemodynamic parameters in 34th to 40th weeks of pregnancy and after delivery.*ArchGyneol Obstet*.2002;266:145-51
15. Singh AD, Devi L, Singh L, Singh J. Electrocardiographic findings at term labour and immediate postpartum.*J. Obstet&gynaecol.of India*.1986;36:316-19.



16. Carruth JE, Mirvis SB, Brogan DR, Wenger NK. The electrocardiogram in normal pregnancy. *Am heart j.* 1981;102:1075-78.
17. Misra J, Dutta B, Ganguly D. Electrocardiographic study in pregnant women in normal & toxemia of pregnancy. *J. Obstet Gynaecol.* 1986;36:635-38.
18. Niraj Yanamandra, Edwin Chandraran - Anatomical and physiological changes in pregnancy and their implications in clinical practice. *Obstetrics and Intrapartum Emergencies : A practical guide to management*
19. Cardiopulmonary and hematological parameters in pregnancy - Nagadeep Wulsa, Geeta Soren, Rama Mohan Pathapati, Madhavulu Buchineni - *International archives of integrated medicine*, vol2, issue12
20. Chaudhary S., Saha C.G and Sarkar D. (2015) Alterations in heart rate and atria to ventricular conductivity in third trimester pregnancy : A comparative study. *Advances in reproductive sciences* ,3,75-80. <http://dx.doi.org/10.4236/arsci.2015.34009>