QRS Axis deviation in Nigerian women during normal pregnancy

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Summary

The effect of pregnancy on the heart rate, respiratory rate, QRS axis and QRS complex duration of the ECG was investigated in 41 pregnant compared to 39 non pregnant age and height matched Nigerian subjects.

Results obtained show that pregnancy had no significant effect ($p>0.05$) on heart rate, respiratory rate and QRS complex duration of the ECG. However, the QRS axis showed significant ($p<0.05$) left ward deviation in pregnant subjects compared to non-pregnant subjects. The magnitude of the deviation apparently increases as pregnancy progresses. In addition, chi-squared analysis revealed significant association ($p<0.001$) between the incidence of left axis deviation in pregnant subjects compared to non-pregnant subjects.

Our findings highlight the need for caution in the interpretation of the ECG during the antenatal period.

Keywords: ***ECG, QRS axis, Pregnancy.***

Résumé

Les effet de la grossesse sur le rythme du cœur, rythme de respiration, axe QRS et le QRS durée compliquée de ECG ont été étudiés chez 41 femmes enceintes en comparaison de 38 femmes non enceintes sujets nigériane mais avec l'âge et la taille normale.

D'après le résultat, la grossesse n'avait pas un effet remarquable (P>O,O5) sur le rythme du cœur, le rythme de respiration et QRS durée compliquée de ECG. Cependant, l'axe QRS avait indiqué la direction gauche déviation remarquable (p>O,O5) chez les sujets, femmes enceintes, en comparaison de femmes non enceintes. Apparemment, la valeur de la déviation augmente autant que la grossesse développe.

En outre, l'analyse chi-carré a indiqué une association remarquable (p<O,OOl) entre la fréquence de la déviation axe gauche chez les sujets enceintes en comparaison des sujets non enceintes.

Nous sommes arrivé à la conclusion que c'est nécessaire d'avoir la prudence dans l'interprétation du ECG pendant la période anténatale.

Introduction

The Electrocardiogram (ECG) a graphical record of the electrical potential caused by the excitation of the cardiac muscle has been shown to be affected by several physiologic factors. These factors include, race, age, sex, height, weight, nutritional status and chest circumference [1,2,3,] amongst several others.

Expectedly, the ECG like other cardiovascular parameters could be affected by the physiological changes induced by pregnancy. Amongst pregnant Caucasian women, a left ward deviation of the QRS axis was initially reported by Carr and Palmer in 1932 [4] as a normal characteristic occuring especially in the third trimester. Similar studies amongst pregnant Caucasian women by Hollander and Crawford in 1942 [5] gave a mean left ward deviation of 15°, with some individual subjects showing deviations of as much as 28°. This deviation they attributed to the transverse displacement of the heart and also to its clockwise rotation around its long axis due to the effect of the gravid uterus. Later, reports by Zatuchni (1951) [6], Wanger et al (1964) [7], Carruth et al (1981) [8] and Wenger (1982) [9] and several other workers confirmed the left ward deviation of the QRS axis, especially in the third trimester of pregnancy. Carruth et al in 1981[8] reported a mean QRS axis of 49°, 46°, 40° and 44° in the first, second, third trimesters of pregnancy and immediate post-natal period respectively. In addition, increases in heart rate [8] and cardiac output [10] have been reported as accompanying pregnancy.

Clearly changes in the QRS axis of the ECG have been confirmed in normal pregnant Caucasian women. Similar studies on pregnant women of Negro origin are relatively scarce. In this study, we describe changes in the QRS axis of the ECG in Nigerian women during the course of normal pregnancy. This we hope would provide insight into the electrocardiographic changes during the course of normal pregnancy in Nigerian women and assist in the interpretation of the ECG in the antenatal period.

Materials and methods

Forty one apparently healthy pregnant subjects from several states of southeastern Nigeria were selected for the study. A group of 39 healthy non-pregnant female subjects served as control. The control subjects were matched age, weight and height with the study group. Subjects with antecedent history of cardiovascular, endocrine, metabolic, neurologic or nutritional disease were excluded from the study. Each subject gave informed consent before recruitment into the study.

The study was conducted at the antenatal clinics of selected government hospitals in several states of south eastern Nigeria. Traditional birth attendants were also used to obtain subjects from rural areas. All the pregnant subjects had at least three ECG records taken at the first, second and the third trimesters of pregnancy. For the study, the first trimester was considered to end at the thirteenth week, the second trimester to end at the twenty-sixth week and the third trimester to end at forty weeks. All ECG records were taken during routine antenatal visits between 9 a.m. and 1 noon each day. On arrival the height and weight of each subject were determined using the SECA scale. The subject was subsequently allowed to rest comfortably for at least 30 minutes supine on an examination couch before blood pressure, respiratory and pulse rates were determined by standard clinical procedures. The ECG leads were then fastened and secured. All ECG records were obtained using a portable ink-writing single channel ECG machine (MEDICOR ELECTROCARDIOGRAPH MODEL MR-11, MEDICOR WORKS HUNGARY). A recording speed of 25 mm/second was used with a recorder calibration of 10 mm/mV stylus deflection. For subjects with high precordial QRS voltages, the recorder calibration was readjusted to 5mm/mV stylus deflection, to ensure the QRS voltage was well recorded. The standard 12 lead ECG was recorded in all subjects. The electrical axis of the heart was determined as described by Gazes 1990[11]. Routine haemoglobin concentration and urinalysis for protein and sugar were determined using the cyanomethaemoglobin method[12] and clinical urinalysis strips respectively. Heart rate was determined from the interval between two QRS complexes.

The results obtained are as presented in Tables and Figures. Statistical analysis was determined using the chi-squared test and the Z-test.

Results

Table 1 shows results of age, height, blood pressure, heart rate, respiratory rate, QRS axis and QRS complex duration obtained

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for both non-pregnant and pregnant subjects. Values for all the parameters determined, were within normal physiological limits.

There were no significant differences ($p>0.05$) in the age, height, systolic blood pressure, diastolic blood pressure, heart rate and respiratory rate between the two groups under study, though pregnant subjects had lower systolic and diastolic blood pressure and a higher heart and respiratory rate compared to non pregnant subjects. However, the QRS axis showed significant differences ($p<0.05$) between the two groups. The mean QRS axis among pregnant subjects of $44.00 \pm 23.0°$ was significantly lower ($p<0.05$) than the value obtained for non pregnant subjects which was $56.00 \pm 11.00°$; implying a left ward deviation of $12.0°$ in the mean QRS axis among pregnant subjects compared to non pregnant subjects. The duration of the QRS complex was not significantly different ($p>0.05$) amongst the two groups, though pregnant subjects had a shorter QRS complex duration.

Table 1 Age, Height, Blood pressure, Heart rate, Respiratory rate, QRS axis and duration in pregnant compared to non pregnant subjects

	Non-Pregnant Subjects (N=39)	Pregnant subjects (N=41)	Significant difference
Age (years)	24.12 ± 5.0 (20 - 32)	26.71 + 6.92 (20 - 31)	No (P > 0.05)
Height (cm)	161.6 ± 4.61 (152 - 168)	159.0 ± 9.57 (150 - 168)	No (P > 0.05)
Systolic Blood Pressure (mmHg)	117.5 ± 9.71 (90-120)	103.16 ± 10.79 (90 - 110)	No (P>0.05)
Diastolic Blood Pressure (mmHg)	71.6 ± 7.16 (60 - 80)	62.3 ± 8.86 (55 - 70)	No (P>0.05)
Heart rate (Per minute)	70.0 ± 10.0 (62 - 82)	74.0 ± 10.5 (53 - 107)	No (P>0.05)
Respiratory rate (Per minute)	20.0 ± 4.0 (18 - 22)	25.0 ± 4.0 (18 - 28)	No (P>0.05)
QRS axis (degrees)	56.0 ± 11.0 (30 - 90)	44.0 ± 23.0 (0 - 90)	Yes (P<0.05)
QRS Complex duration (seconds)	0.064 ± 0.02 (0.043 - 0.106)	0.053 ± 0.07 0.015 - 0.120)	No (P>0.05)

All values Mean ± SD, range in parenthesis

Table 2 Changes in QRS axis, Heart rate and Respiratory rate during the trimesters of pregnancy and in non pregnant subjects

		Pregnant Subjects		
	Non-Pregnant Subjects (N=39)	First Trimester (N=41)	Second Trimester (N=41)	Third Trimester (N=41)
QRS axis (degrees)	56.000 ± 11.00 (30 - 90)	54.00 ± 16.19 (30 - 90)	41.00 ± 23.82 (0 - 60)	28.00 ± 24.16 (0 - 60)
Heart rate (/min)	70.00 ± 10.00 (62 - 82)	74.81 ± 12.34 (53 - 107)	73.21 ± 10.47 (60 - 94)	73.67 ± 6.6 (63 - 83)
Respiratory rate (/min)	20.00 ± 4.00 (18 - 22)	24.64 ± 4.15 (18 - 38)	25.50 ± 3.23 (20 - 32)	24.57 ± 4.26 (24.28)

All values mean ± SD; range in parenthesis.

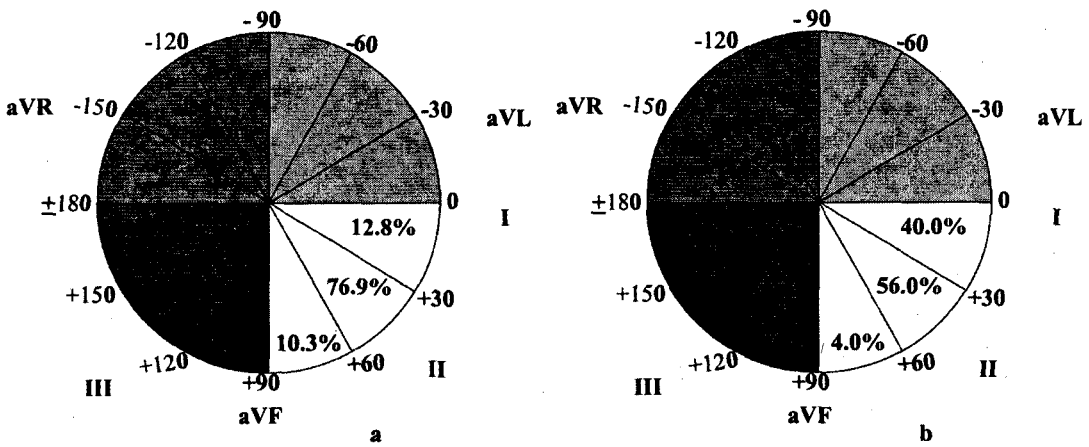

Fig.1 ***Percentage distribution of QRS axis in non-pregnant (a) and pregnant (b) subjects.***

Table 2 shows the values of the QRS axis, heart rate, and respiratory rate, in all pregnant subjects during the trimesters of prenancy and in non-pregnant subjects. Analysis of variance showed statistically significant ($p < 0.05$) reduction of the mean QRS axis during the course of pregnancy. However, there were no significant changes ($p>0.05$) in both heart rate and respiratory rate during the course of pregnancy. Thirty eight (92.7%) pregnant and 33(84.6%) non-pregnant subject had normal sinus rhythm. Sinus bradycardia was observed in 1 (2.4%) pregnant and 6 (15.4%) non-pregnant subjects. Only 2 (4.85%) pregnant subjects had sinus tachycardia. Ectopic beats and incidences of cardiac arrhythmia were absent in our pregnant subjects.

As shown in Figure 1, all subjects had QRS axis within normal of the Hexiaxial reference system [11]. However, a greater percentage i.e. 40% of pregnant subjects had a mean QRS axis deviated leftward i.e. between 0° and +30° compared to 12.8% of non pregnant subjects. The percentage distribution of the mean QRS axis for both non-pregnant and pregnant subjects is as shown in the Figure. Chi-squared analysis revealed significant association between pregnancy and the percentage distribution of the mean QRS axis ($p<0.001$).

All non pregnant subjects had haemoglobin concentrations of within normal ranges [13] and no pregnant subject had a haemoglobin concentration less than 10.0g/dl. Urine analysis for protein and sugar was negative for all non pregnant subjects, an occassional trace of protein was however detected in some pregnant subjects.

Discussion

The present study presents data of a left ward deviation of the QRS axis in Nigerian women during the course of normal pregnancy. To the best of our knowledge previous reports in this regard are relatively scarce, most reports have focused on ECG changes in young [2] healthy adult[1,14] Nigerians.

The magnitude of the left ward deviation of the QRS axis observed in our subjects and its progressive increase with pregnancy is in agreement with the pattern previously reported in pregnant Caucasian women [4-9]. Reasons for this left ward deviation of the QRS axis have been earlier advanced in this communication[5]. Though ventricular hypertrophy and dilatation have been reported to occur in pregnant Negro women [13] and this could contribute to a left ward QRS axis deviation [11] no significant ECG signs suggestive of ventricular hypertrophy or dilation was detected in our subjects. The QRS complex duration was also not significantly affected by pregnancy.

Unlike previous studies on pregnant Caucasian women [8,15] significant increases in heart rate could not be demonstrated in the present study. In addition, ectopic beats and incidences of cardiac arrhythmia were surprisingly absent in our pregnant subjects compared to previous reports on Caucasians [7,9] and in Africans.[13] Results of the present study would therefore, suggest minimal impairment of sinus rhythm during pregnancy in Nigerian women. We were also unable to demonstrate significant increase in respiratory rate in pregnant compared to non pregnant subjets. This is consistent with previous reports in African [13].

From the results of our study, we advise caution in the interpretation of ECG findings in Nigerian women during the antenatal period and suggest routine ECG before and during the antenatal period, especially in subjects with pre-existing cardiovascular disease.

In conclusion, we report significant ($p<0.05$) left ward deviation of the QRS axis of the ECG in Nigerian women during the course of normal pregnancy. No changes were observed in respiratory rate, heart rate, blood pressure and QRS complex duration. We advise caution in the interpretation of ECG results during the ante natal period.

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