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An Observational Study Of Electrocardiographic Findings In Second Trimester Of Pregnancy With And Without Anaemia, In A Tertiary Care Centre Of North East India

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Abstract:
Introduction*: Anaemia in pregnancy is a very common complication in a developing country like India. It can affect the heart by compromising the oxygen supply of myocardium. One of the important and simplest tools for the evaluation of heart diseases is electrocardiography (ECG). Hence this study is taken up to assess the electrocardiographic findings in second trimester of pregnancy with anaemia.*
Objectives:
1. *To assess the changes in ECG parameters in pregnant women with anaemia in second trimester.*
2. *To compare ECG changes in pregnant women with anaemia and normal pregnant women in their second trimester of pregnancy.*

Materials and method*: A hospital based cross sectional study was taken up among pregnant women in their second trimester with or without anaemia. Twenty five (25) normal pregnant women in 2nd trimester and Twenty five (25) pregnant women with anaemia in 2nd trimester participated in the study. Hb% and RBC count were recorded from current medical documents. 12 – lead standard, resting ECG was recorded from the study participants. The data were analyzed using SPSS 21.*
Results: *mean hb% among the controls was (11.95±0.51) gm%, in cases (8.82±0.42) gm% and the difference was statistically significant. Mean QT interval among the healthy pregnant women and the pregnant women with anaemia were (0.3792±0.03) sec and (0.4046±0.02) sec respectively. The difference between the groups were statistically significant (p=0.001). QTc intervals were significantly higher among the pregnant women with anaemia in 2nd trimester compared to the healthy pregnant women in 2nd trimester (p=0.005). ST segment was normal in 23.1%, elevated in 46.2% and depressed in 30.7% of the pregnant women with anaemia. Among the pregnant women with anaemia 69.2% had T wave inversion, 15.4% had biphasic T wave and 15.4% had flat T wave.*
Conclusion: *prolongation of qt interval and presence of st-t changes in ecg among the pregnant women with anaemia is associated with increased risk of coronary heart disease. Therefore pregnant women with anemia should be closely monitored for development of any cardiovascular abnormalities to prevent any complications.*
Keywords: *Anaemia, Pregnancy, 2nd Trimester, Electrocardiography (ECG)*

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I. Introduction

Motherhood is a wonderful experience; still the difficulties related with pregnancy are significant[1]. Pregnancy usually causes reversible changes in a women's cardiovascular system[2]. These salient changes begin soon after fertilization and continue throughout gestation to maintain healthy environment for the fetus and mother. Due to the changes in haemodynamics of pregnancy, cardiovascular system is influenced both anatomically and physiologically by conception[3]. Regarding anatomical alteration, enlarged uterus produces a more horizontal heart that mimics cardiac enlargement. The most important physiological changes in cardiovascular system include rising cardiac output, rise in blood volume, and red cell mass. The heart rate increases by 10 to 15 beats/min, and it can be noted in the first trimester.

Anaemia during pregnancy is a public health problem, especially in developing countries and is associated with adverse outcomes in pregnancy. Global data shows that 56% of pregnant women in low and middle income countries are anaemic. The negative health effects for the mother include fatigue, poor work

capacity, impaired immune function, increased risk of cardiac diseases and mortality. Some studies have shown that anaemia during pregnancy contributes to 23% of the indirect causes of maternal deaths in developing countries. India has the highest prevalence of anaemia in pregnancy and is the home to the largest number of anaemic pregnant women in the world. According to National Family Health Survey-4, the prevalence of anaemia among pregnant women in Tripura was 54.4%.[4]

Anaemia is a condition in which the number & size of red blood cells or the hemoglobin concentration falls below an established cut-off value, consequently impairing the capacity of the blood to transport oxygen around the body[5,6]. In anaemia, the oxygen carrying capacity of blood decreases, thereby it can affect heart by impairing the oxygen supply of myocardium. During pregnancy cardiac output increases putting extra load on the heart. Iron requirement also increases during pregnancy for fetal blood formation and iron is required for mothers own blood and cell mass. If anaemia persists during pregnancy, it may lead to serious cardiovascular consequences.

Adaptation of the CVS to the increased metabolic needs of the mother, thus enabling adequate delivery of oxygenated blood to the peripheral tissues and to the fetus normally brings about various changes in ECG[7]. Presence of anaemia in pregnant women increases the workload on the heart and thereby increases the oxygen demand leading to demand and supply mismatch for oxygen[8]. All these can contribute to the abnormality in cardiac performance. Cardiovascular abnormality in pregnant women with anaemia further increases the complication leading to increased morbidity and mortality.

Very few studies had been conducted in North eastern part of India to assess the cardiac performance in pregnant women with anaemia. Hence, the present study is taken up to assess the changes in electrocardiographic parameters in pregnant women with and without anaemia in their second trimester of pregnancy and to compare the ECG changes.

II. Materials And Method

Study design: Hospital based Cross-sectional study

Type of study: Observational study

Study duration: 6 months; August 2023 to January 2024

Study area/location: Department of Physiology in collaboration with Department of Obstetrics & Gynaecology, Agartala Govt. Medical College (AGMC), Agartala.

Study population: Twenty five (25) pregnant women with anaemia (study group) in their 2nd trimester and twenty five (25) normal pregnant women (control group) in 2nd trimester of pregnancy attending the antenatal clinic of Agartala Govt. Medical College (AGMC), Agartala were included in the study.

Sampling procedure: convenient sampling convenience type of sampling (non-probability) was used to select the participants for the study among the study population who suitably fulfill the selection criteria. Written informed consent was obtained from all the participants.

Inclusion criteria:

1. Pregnant women in 2nd trimester of gestation with and without anaemia. [WHO classification of anaemia for pregnant women i.e. Hb% below 11gm/dl. Mild anaemia was classified as hemoglobin concentration of 9.0 to 10.9gm/dl, moderate anaemia as 7 to 8.9 gm/dl and severe anaemia as hemoglobin below 7 gm/dl.]
2. Co-operative and willing to participate in the study.

Exclusion criteria:

All pregnant women with the following characteristics

1. Any known cardiac diseases or hypertensive disorders of pregnancy.
2. Diagnosed renal disease.
3. Uncontrolled thyroid disorders.
4. Altered lipid profile.
5. Those who are not willing to participate in the study.

Study tools:

- Electrocardiograph (Model No. CARDIART 6108T) available in the department of Physiology, AGMC and GBP Hospital.
- Sphygmomanometer – Mercury Deluxe BP apparatus (diamond allied products)

- Stethoscope
- Height measuring stand – Bioplus; height 200cm
- Weighing machine – Victoria Dx
- Case study format

Data collection:

All the participants were selected consecutively during the study period following the inclusion and exclusion criteria. Participants were personally subjected to detailed history regarding name, age, sex, occupation, socioeconomic status, educational status, medical history and clinical features etc. These findings were recorded in a predesigned and pretested standard questionnaire. Hb% and RBC count were recorded from current medical documents. Written informed consent was obtained from all the participants. Complete physical and obstetric examination was performed. Gestation was confirmed by last menstrual period and ultra sound measurement of the fetal crown-rump-length in selected pregnant women.

Measurement of height and weight:

Height of the subjects was measured barefooted in centimeters to the nearest 0.1cm. The subjects were asked to stand straight with the head in the Frankfurt horizontal plane. Two readings were taken. The average of both was recorded as the height of the subject. Weight of the subject was recorded to the nearest 0.1kg. The subjects were asked to stand on the weighing machine without shoes and while wearing only light clothes. Two readings were taken and their mean were recorded as the weight of subject.

Measurement of Blood Pressure:

BP (mmHg) was recorded as per the guidelines of the American Heart Association (2009) with the participant in a seated position and at least two measurements made with cuff at the level of the heart, 2 minutes apart and their average value recorded as the BP of the participant.

Recording of ECG:

A 12-lead standard, resulting ECG was recorded from the study participants. The recording, measurements and interpretations was done as per the standard guidelines [9].

The following ECG parameters were assessed by using Standardization (Calibration): 10mm=1mv, ECG paper speed 25mm/sec.

- P-wave duration (0.08-0.10sec)
- PR interval (0.12-0.2sec)
- QRS duration (0.05-0.11sec)
- QT interval (0.26-0.45sec)
- QTC interval (0.39±0.04sec): Bazett's formula: $QT/\sqrt{(RR)}$
- Mean QRS electrical axis (-30° to +110°)
- Heart Rate (60-100/min): 1500 divided by the no. of small boxes between two successive 'R' waves.

Data analysis:

The data were analyzed using SPSS 21. All the quantitative variables in the present study such as age, height, weight, Hb%, and ECG parameters was analyzed and expressed in terms of descriptive statistics such as mean and standard deviation. A probability value less than 0.05 was considered as statistically significant.

III. Ressults

The study included 25 pregnant women with anaemia and 25 healthy pregnant women in their 2nd trimester. Table 1 shows demographic variables among the study populations. The mean age of the healthy pregnant women was (24.69±5.58) years and among the pregnant women with anaemia (23.23± 4.95) years. The difference in age group was not significant. The difference in mean height and weight of the control group and cases were also statistically not significant. Mean BP of the control group was 115/74 mmHg and in cases 113/74 mmHg. The differences in BP among these two groups were not statistically significant. Mean Hb% among the controls were (11.95±0.51) gm% in cases (8.82± 0.42)gm% and the difference between the groups were statistically significant.

VARIABLES	Cases (Mean ±STD. deviation)	Controls (Mean ±STD. deviation)	P value
Age	23.23± 4.95	24.69±5.58	0.32
Height(cm)	150.35± 7.13	151.14±4.04	0.63
Weight(kg)	48.76± 9.99	50.57±9.84	0.51

Hb%	8.82± 0.42	11.95±0.51	0.000*
SBP(mmHg)	113± 10.08	114.62±9.84	0.56
DBP(mmHg)	74.07± 7.51	73.62±6.81	0.82

Table 1: Demographic variables among cases and controls

Table 2 shows the mean and standard deviation of ECG parameters among the controls and study population. Mean QT interval among the healthy pregnant women and the pregnant women with anaemia were (0.3792±0.03) sec and (0.4046±0.02) sec respectively. The difference between the groups were statistically significant (p=0.001). QTc intervals were significantly higher among the pregnant women with anaemia in 2nd trimester compared to the healthy pregnant women in 2nd trimester (p=0.005). Figure 1 shows the ECG parameters among 2nd trimester pregnant women with anaemia .

ECG PARAMETERS	Cases (Mean ±STD. deviation)	Controls (Mean ±STD. deviation)	P value
PR interval (sec)	0.1238±0.01	0.1277±0.02	0.39
RR interval (sec)	0.6477±0.08	0.6323±0.09	0.54
QRS duration (sec)	0.0892±0.01	0.0938±0.02	0.30
QT interval (sec)	0.4046±0.02	0.3792±0.03	0.001*
QTc interval (sec)	0.5058±0.04	0.4781±0.03	0.005*
Cardiac axis (degrees)	57.61±24.19	53.23±21.50	0.49
Heart rate (beats/min)	94.52±11.98	96.96±14.76	0.43

Table 2: ECG parameters among cases and controls

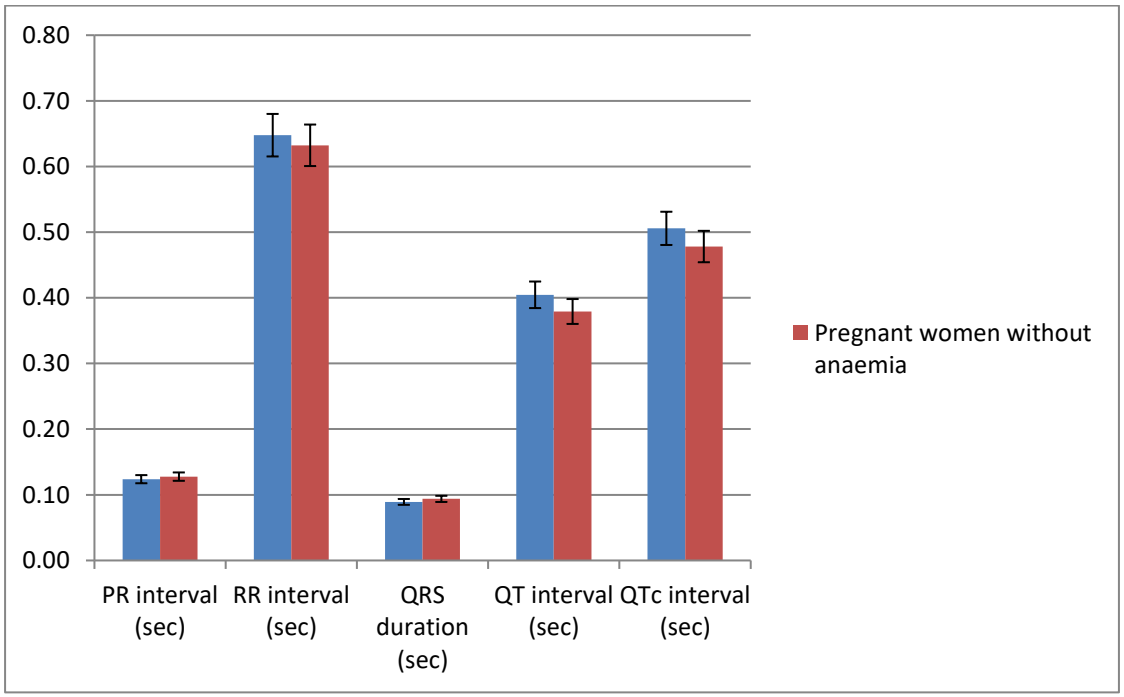

Figure1: ECG parameters among 2nd trimester pregnant women with and without anaemia

ST segment was normal in 23.1% of the pregnant women with anaemia. ST segment was elevated 46.2% and depressed in 30.7% of the study population. 73.1% of the healthy pregnant women had normal ST segment, 23.1% had elevated and 3.8% had depressed ST segment. ST segment changes are shown in Figure 2. Among the pregnant women with anaemia 69.2% had T wave inversion, 15.4% had biphasic T wave and 15.4% had flat T wave as shown in Figure 3..

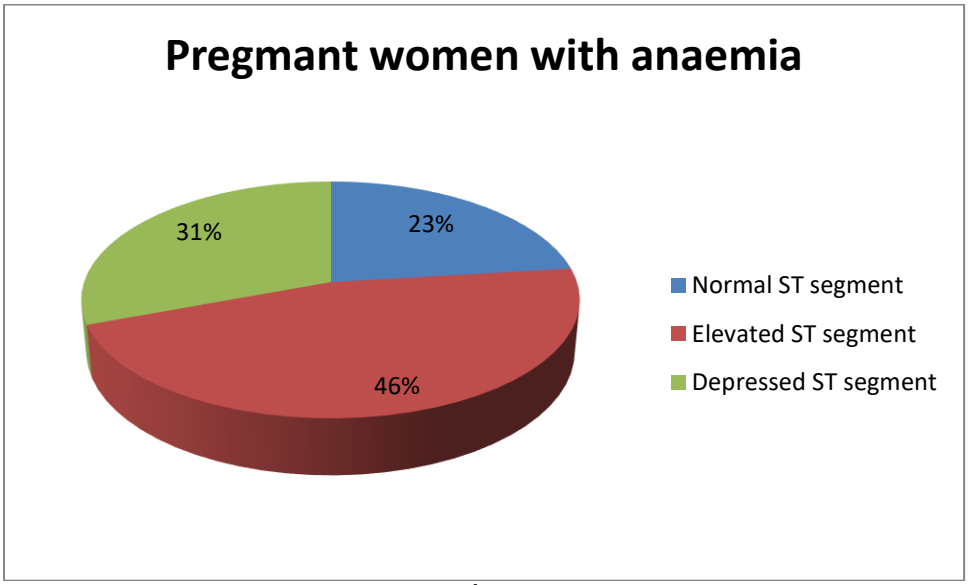

Figure2: ST segment changes among 2nd trimester pregnant women with anaemia

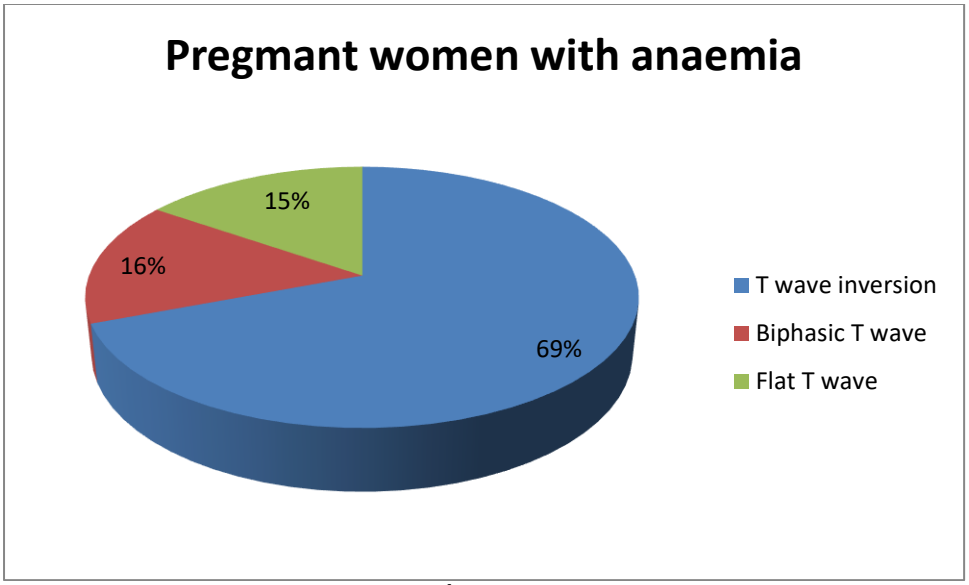

Figure3: T wave changes among 2nd trimester pregnant women with anaemia

IV. Discussion

In the present study was conducted to assess the ECG parameters among pregnant women with anaemia in their 2nd trimester. There was no statistically significant difference in the demographic variables (age, height, weight, BP) among cases and controls. But there was statistically significant difference in mean Hb% between the groups. The mean QT interval and QTc intervals were significantly higher among the cases compared to the controls (p=0.005). QTc interval in ECG reflects the time taken for depolarization and repolarization in the ventricular myocardium. Prolongation of QT and QTc interval indicates towards the abnormality in ventricular myometrium.

T wave abnormalities were also present among the pregnant women with anaemia. Presence of T wave abnormalities (T wave flattening and invertion along with biphasic T wave) among the cases may be due to disturbances in myocardium, resulting from oxygen deficiency caused by diminution of oxygen carrying power of the blood.

Padmaja R. T et al. showed in their study that pregnant women in 2nd trimester of gestation with anaemia had sinus tachycardia and and an increase in QTc interval may be due to tachycardia and complex consequences with changes in regulatory mechanisms during pregnancy. They also showed that incidence of T wave abnormalities like flat and negative or inverted T waves were statistically more in study group when compared to control group. These findings are consistent with our study.

In the present study 77% of the pregnant women with anaemia had ST segment changes. These findings are supported by the study, conducted by Vimlesh P et al. in their study there was significant ST depression (80.2%) and T wave inversion (94.1%) among the patients with iron deficiency anaemia[10].

Renuka B. G et al concluded in their study that anaemic patients are at risk of developing cardiac function abnormality as indicated by ST depression, T inversion and attenuation of QRS complex, and ECG changes seemed to be closely related to the severity of anaemia[11].

Naito Y et al concluded in their study that in ongoing IDA, the patient develops cardiac hypertrophy and cardiac chamber enlargement, eventually leading to heart failure[12].

Decrease in oxygen carrying capacity of blood in anaemia along with increase workload on the heart during pregnancy leads to mismatch between demand and supply of oxygen to the heart muscles. These factors might be responsible for abnormality in the heart muscle reflected in the ECG.

V. Conclusion

Prolongation of QTc interval among the pregnant women with anaemia indicates towards the abnormality in the ventricular myometrium. ST changes and T wave inversion in ECG in most of the anaemic pregnant women is associated with increased risk of coronary heart disease. Therefore pregnant women with anemia should be closely monitored for development of cardiovascular diseases to prevent any future complications.

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