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

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Abstract:
Introduction: *Anaemia is a major public health problem affecting both the developed as well as the developing countries. Anaemia in pregnancy is an important contributor to maternal mortality/morbidity as well as contributes to increased percentage for infant mortality. The major physiological consequence of anaemia is the reduced oxygen carrying capacity of the blood. The sensitivity of the myocardium to chronic hypoxia in pregnant women with anaemia may lead to various changes in the electrocardiographic recording. Hence this study is taken up to know the effect of anaemia on electrocardiogram during first trimester of pregnancy & to compare the ECG changes with healthy pregnant women in first trimester.*
Objectives:
1. *To assess the changes in ECG in pregnant women with anaemia in first trimester.*
2. *To compare ECG findings of anaemic pregnant women with healthy pregnant women in first trimester of pregnancy.*

Materials and method: *A hospital based cross sectional study was taken up among pregnant women in their first trimester with or without anaemia. A total of 25 healthy pregnant women in 1st trimester (controls) were compared with equal number of pregnant women with anaemia in 1st trimester (cases). All the study participants were personally subjected to detailed history and clinical examination. Hb% and RBC count were recorded from current medical documents. 12-lead standard, resting ECG were recorded from the study participants. The data were analyzed using SPSS 21.*
Results: *Mean Hb% among the controls were (11.96±0.62) gm%, in cases (8.41±0.65) gm% and the difference between the groups were statistically significant. Mean PR interval among the healthy pregnant women and the pregnant women with anaemia were (0.1254±0.01) sec and (0.1346±0.02) sec respectively. The difference between the groups were statistically significant (p=0.001). ST segment was normal in 3.8% of the pregnant women with anaemia. ST segment was elevated in 73.1% and depressed in 23.1% of the study population. Among the pregnant women with anaemia 61.5% had T wave inversion, 3.8% had biphasic T wave and 34.6% had flat T wave.*
Conclusion: *Anaemia and volume overload in pregnancy is a risk factor that may lead to cardiac abnormality that brings about various changes in ECG. If anaemia persists for longer time it may lead to cardiac complications. The pregnant women with anaemia should be regularly screened for cardiac abnormalities for early diagnosis and to prevent any future complications.*
Keywords: *Anaemia, pregnancy, 1st Trimester, Electrocardiography (ECG)*

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I. Introduction

Anaemia is a major public health problem affecting both the developed as well as the developing countries. According to World Health Organization, prevalence of anaemia among pregnant women in developed countries is about 14%, whereas it is still as high as 51% in the developing world. About half of all global maternal deaths due to anaemia occur in South Asian countries, out of which India contributes to 80%. In India the prevalence of anaemia among pregnant women is about 65-75%[1]. According to National Family Health Survey-4, the prevalence of anaemia among pregnant women in Tripura was 54.4%[2].

During pregnancy, numerous changes to all maternal body systems (anatomic, physiologic and biochemical) allow for fetal development and protection, prepare for labor and compensate for new demands[3]. Dramatic changes take place in the cardiovascular physiology leading to gradual adaptation of these changes by the body of the pregnant women[4]. The maternal blood volume increases progressively from 6-8 weeks of gestation & the increase in plasma volume is relatively greater than that of RBC mass resulting in hemodilution & decrease in haemoglobin concentration. There is steady reduction in systemic vascular resistance which contributes towards hyperdynamic circulation. A significant increase in heart rate can be demonstrated as early as 5th week of pregnancy and this contributes to an increase in cardiac output[5].

Cardiac output increases during pregnancy to 30-50% above the prepregnant levels. The increase in cardiac output occurs due to increase in stroke volume initially during gestation and later by increase in heart rate. Variables such as maternal age, multiple gestations, existing health conditions and genetic factors can affect the mother's ability to adapt to the demands of pregnancy.

Anaemia is a condition in which the number and size of red blood cells, or the haemoglobin concentration, falls below an established cut-off value, consequently impairing the capacity of the blood to transport oxygen around the body. It is an indicator of both poor nutrition and poor health[6]. In anaemia decrease in the amount of oxygen transported by each unit volume of blood tends to produce tissue hypoxia and a decrease in blood viscosity is associated with reduction in red cell mass. Most of the clinical features of anaemia are due to consequences of diminished oxygen carrying power of the blood to the tissues and cardiovascular and ventilatory adjustments to compensate the decrease in red cell mass[7].

Workload on the heart increases during pregnancy. Presence of anaemia during pregnancy leads to increased oxygen demand to myocardium and subsequently supply-demand mismatch resulting in increased risk of myocardial ischaemia or infraction. Hence this study makes an attempt to assess the changes in electrocardiographic parameters in pregnant women with anaemia during their first trimester of pregnancy and to compare the changes with healthy pregnant women in same trimester.

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: Fifty (50) pregnant women were selected and divided into two (2) groups. A total of twenty five (25) number of healthy pregnant women (control group) in 1st trimester were compared with equal number of pregnant women with anaemia (study group) in their 1st trimester 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:

Pregnant women in 1st trimester of gestation with and without anaemia.

[WHO classification of anaemia[6] for pregnant women i.e. Hb% below 11gm/dl. Mild anaemia was classified as hemoglobin concentration of 9.0 to 10.9 gm/dl, moderate anaemia as 7 to 8.9 gm/dl and severe anaemia as hemoglobin below 7 gm/dl.]

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 disorder of pregnancy.
2. Deranged liver function.
3. Diagnosed renal disease.
4. Uncontrolled thyroid disorders.
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 200 cm
- Weighing machine-Victoria Dx
- Case study format

Data collection:

All the study subjects were selected consecutively during the study period following the inclusion and exclusion criteria.

All the 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 [8].

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. Results

The study included 25 pregnant women with anaemia and 25 healthy pregnant women in their 1st trimester. Table 1 shows demographic variables among the study populations. The mean age of the healthy pregnant women was (24.34±6.49) years and among the pregnant women with anaemia (24±5.94) 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 112/71 mmHg and in cases 113/72 mmHg. The differences in BP among these two groups were not statistically significant. Mean Hb% among the controls were (11.96±0.62) gm%, in cases (8.41± 0.65)gm% and the difference was statistically significant.

Table 1: Demographic variables among cases and controls

VARIABLES	Cases (Mean ±STD. deviation)	Controls (Mean ±STD. deviation)	P value
Age	24± 5.94	24.34±6.49	0.82
Height(cm)	153.15± 5.46	153.45±6.07	0.85
Weight(kg)	51.96± 11.97	50.27±10.62	0.59
Hb%	8.41± 0.65	11.96±0.62	0.000*
SBP(mmHg)	113.19± 8.65	112.31±7.58	0.69

Table 2 shows the mean and standard deviation of ECG parameters among the controls and study population. Mean PR interval was significantly higher among pregnant women with anaemia. Mean PR interval among the healthy pregnant women and the pregnant women with anaemia were (0.1254±0.01) sec and (0.1346±0.02) sec respectively. The difference between the groups were statistically significant (p=0.001). Figure 1 shows the ECG parameters among 1st trimester pregnant women with and without anaemia .

ECG PARAMETERS	Cases (Mean ±STD. deviation)	Controls (Mean ±STD. deviation)	P value
PR interval (sec)	0.1346±0.02	0.1254±0.01	0.04*
RR interval (sec)	0.6492±0.11	0.6477±0.09	0.95
QRS duration (sec)	0.0815±0.01	0.0777±0.01	0.23
QT interval (sec)	0.3892±0.04	0.4015±0.03	0.21
QTc interval (sec)	0.4850±0.04	0.5012±0.04	0.16
Heart rate (beats/min)	94.92±16.10	94.23±13.14	0.86

Table 2: ECG parameters among cases and controls

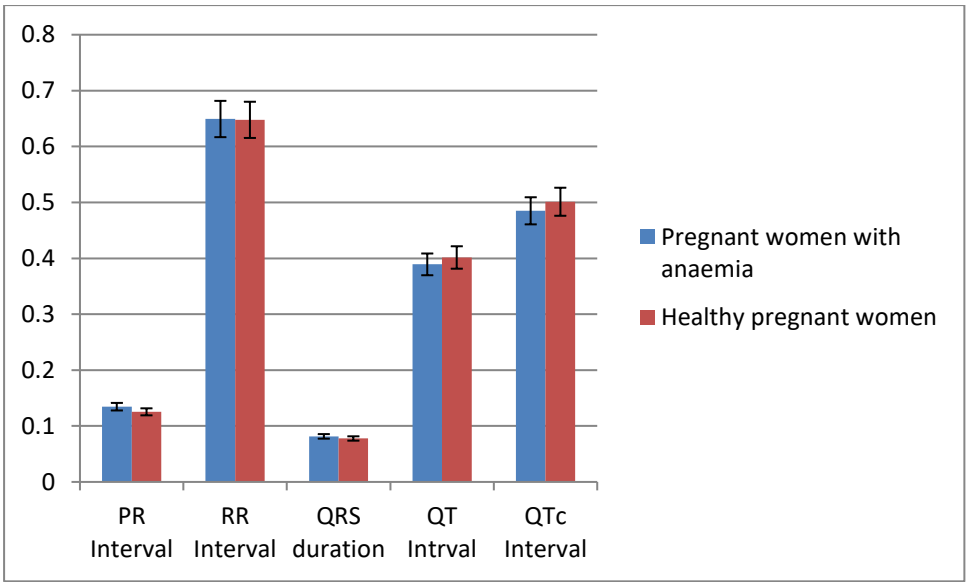

Figure1: ECG parameters among pregnant women with anaemia and healthy pregnant women in their 1st trimester

ST segment was normal in 3.8% of the pregnant women with anaemia. ST segment was elevated 73.1% and depressed in 23.1% of the study population. Figure 2 shows the ST segment changes among pregnant women with anaemia. Among the pregnant women with anaemia 61.5% had T wave inversion, 3.8% had biphasic T wave and 34.6% had flat T wave as shown in figure 3.

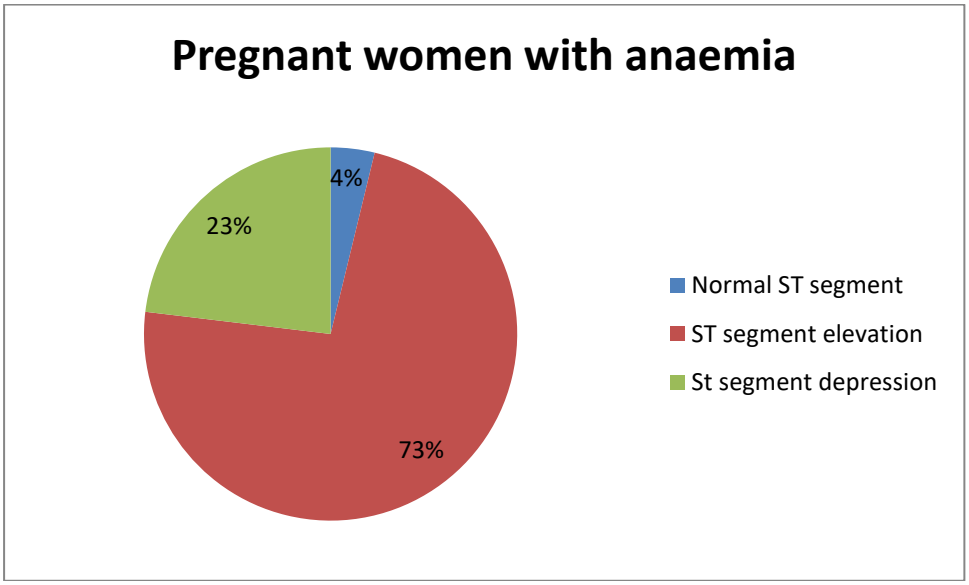

Figure2: ST segment changes among 1st trimester pregnant women with anaemia

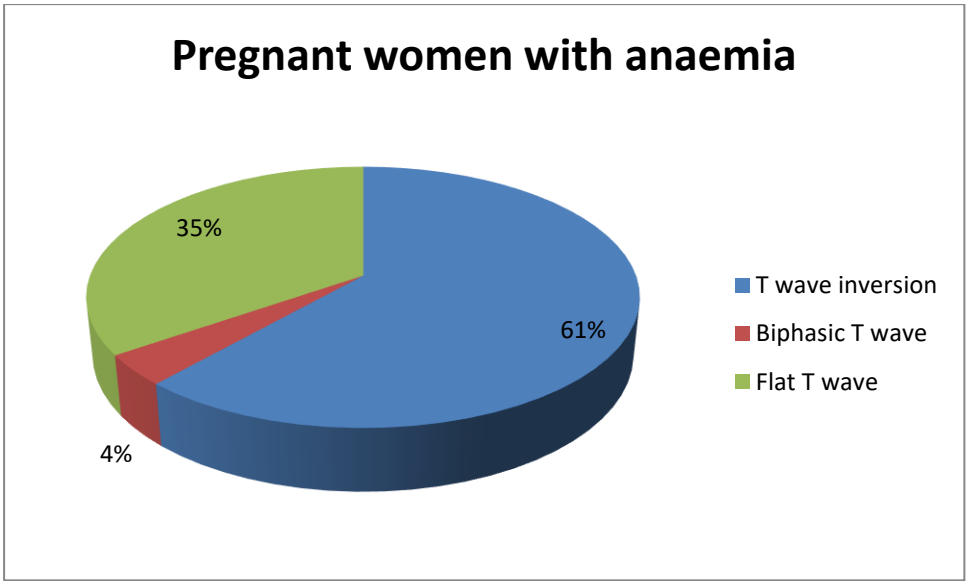

Figure3: T wave changes among 1st trimester pregnant women with anaemia

IV. Discussion

In the present study there was no statistically significant difference in the demograghic variables (age, height, weight, BP) among cases and controls. There was statistically significant difference in mean Hb% between the groups.

PR interval was found to be significantly prolonged in pregnant women with anaemia in our study. In our study there was significant changes in ST segment (depression or elevation) among the cases. These findings were supported by the study, conducted by Vimlesh P et al, where they found significant ST depression (80.2%) and T-wave inversion (94.1%) among the patients with iron deficiency anaemia[9].

Our study showed ST segment depression in 23% of cases and T wave inversion in 61% of cases. These findings are supported by the study conducted by Renuka B.G. and Samual Jebavaram D[10]. ST depression may be due to myocardial hypoxia consequent to anaemia, cardiac dilatation and stretching of myocardial fibres and temporary coronary insufficiency etc. The mechanisms of production of T wave abnormality may be same as that of ST segment change.

ST-T wave changes were also noted by the study conducted by Manjiri P. Dhamangaonkar and Deepali Deshmukh and the changes in ECG may be proportional to severity of anaemia[11].

Padmaja R T et al showed in their study that incidence of T-wave abnormalities like flat T-waves and negative or inverted T-waves were statistically more in pregnant women with anaemia when compared to healthy pregnant women. These findings are consistent with our study[12].

Anaemia during pregnancy is a global public health challenge facing the world today, especially in the developing countries. Plasma volume expansion and decreased haemoglobin concentration occur during pregnancy, the developing fetus puts the mother to greater risk of nutritional anaemia[13]. Chronic anaemia is associated with increased cardiac output, there will be circulatory congestion and angina pectoris may occur thus emphasizing the sensitivity of the myocardium to chronic hypoxia leading to various changes in the electrocardiographic recording.

V. Conclusion

Anaemia and volume overload in pregnancy is a risk factor that may lead to cardiac abnormality that brings about various changes in ECG. If anaemia persists for longer time it may lead to cardiac complications. The pregnant women with anaemia should be regularly screened for development of any cardiac abnormalities to reduce maternal morbidity and mortality.

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