

Glimpse into the electrocardiographic changes in patients of anemia at a younger age: A hospital-based observational study

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ABSTRACT

Introduction: Anemia is a major health problem in developing countries and even the developed countries are also not spared from its effect. The heart is one of the main organs affected by ill effects of anemia. Due to decreased O₂ carrying capacity in anemia, myocardium suffers from supply-demand mismatch, leading to myocardial ischemia or infarction. In view of cardiac involvement in anemia, studies have been done to evaluate electrocardiographic (ECG) changes in anemia. The ECG changes commonly seen are sinus tachycardia, ST segment depression, T wave inversion, and left ventricular hypertrophy (LVH), but there are various discrepancies in the findings of different studies. It is observed that ECG changes are also correlated to the severity of anemia.

Aims and Objective: To study the ECG of the patients presenting with anemia and to correlate same with severity of anemia.

Materials and Methods: This hospital-based prospective observational study conducted on 80 patients at the Department of Medicine, Silchar Medical College and Hospital, Silchar, after applying inclusion and exclusion criteria. Resting ECG and other routine investigations were done in all cases.

Results: In patients with severe anemia, 89.4% of patients had tachycardia, 36.8% had ST segment depression, 31.6% had T wave inversion, and 15.7% had LVH. In patients with moderate anemia, 86.9% of patients had tachycardia, 43.5% had ST segment depression, 17.4% had t wave inversion, and 34.8% had LVH. In patients with mild anemia, 26.3% of patients had tachycardia, none had ST segment depression or t wave inversion, whereas 7.9% of patients presented with LVH.

Key words: Anemia, electrocardiographic, heart, hemoglobin, left ventricular hypertrophy, myocardium, sinus tachycardia, ST segment depression

INTRODUCTION

Anemia is a global manifestation and is a major health problem affecting both the developed and the developing countries of the world even though its ill effects are more pronounced in the developing countries. Anemia is defined as a “condition of low circulating hemoglobin (Hb) in which concentration has fallen below a threshold lying at two standard deviations below the median of a healthy population of the same age, sex, and stage of pregnancy.”^[1] According to the World Health Organization (WHO), anemia is defined as Hb levels <12.0 g/dL in women and <13.0 g/dL in men.^[2] According to National Family Health Survey-4, 53% of all women of age 15–49 years and 22.7% of all men of same age group are anemic in India.^[3] Non-pregnant females of age >15 years can be categorized on the basis of severity of anemia as mild (11–11.9 g/dl), moderate (8–10.9 g/dl), and severe (<8 g/dl) while male >15 years can also be categorized in similar fashion with only difference in mild category (here, it is 11–12.9 g/dl).^[4]

The heart is one of the major organs which bear the burns of ill effects of anemia. As anemia progresses, there is resultant

decreased O₂ carrying capacity of Hb which, in turn, lead to myocardial insult as a result of supply-demand mismatch, thereby contributing to myocardial ischemia or infarction.^[5,6] Multiple physiological mechanisms are unleashed by the heart to compensate this mismatch like - increase in cardiac output (CO) and decreasing circulation time.^[7] Most of these changes are reversible and attempt to restore the cardiac physiology with the treatment of anemia. However, if left untreated for longer duration, the ill effects like hyperdynamic circulation occur which may lead to dilation and hypertrophy of the heart, but fortunately, the same is also reversible with treatment.^[8,9]

In view of the above background of the cardiac tissues in anemia, a number of studies have been undertaken to evaluate the electrocardiographic (ECG) changes in anemia. There are various discrepancies in the findings of different studies such as earlier studies showed decrease in QRS amplitude, T wave flattening, and minor degrees of atrioventricular conduction disturbances,^[10] but recent studies observed non-specific ST-T changes in ECG.^[11] It is also observed that ECG changes are correlated to severity of anemia.^[12] The ECG changes commonly seen are sinus tachycardia,

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ST segment depression, T wave inversion, and left ventricular hypertrophy (LVH).^[13]

Aims and Objective

- To study the ECG of the patients presenting with anemia.
- To correlate same with severity of anemia.

MATERIALS AND METHODS

Study Setting

The present study was conducted in the Department of Medicine, Silchar Medical College and Hospital, Silchar, Assam. It is a tertiary referral center for patients of the different districts of the Barak Valley of Assam and the neighboring states such as Tripura, Mizoram, Manipur, Meghalaya, and Nagaland.

Period of Study

The present study was conducted from July 2017 to February 2018.

Sample Size

A total of 80 patients attending the medicine outpatient department or those admitted for severe manifestations in the medicine ward at Silchar Medical College and Hospital, Silchar, were included in the study after fulfillment of the inclusion and exclusion criteria.

Study Design

The study was a hospital-based prospective observational study.

Methodology

All patients attending Outpatients Department and Inpatient Department of Medicine, Silchar Medical College, with anemia were evaluated after applying inclusion and exclusion criteria. Resting ECG was taken in those patients who were included in the study. Unstable patients were stabilized before taking the resting ECG. Routine blood investigations such as complete blood count, urine examination, renal profile, random blood sugar, and thyroid function test were also done in all patients.

Inclusion Criteria

- Patients with age between 15 and 40 years.
- Patients diagnosed anemic as per the WHO criterion (male <13 g/dl, female <12 g/dl).

Exclusion Criteria

- Age above 40 or less than 15 years.
- Pregnancy.
- Thyroid disorders.
- Other comorbid conditions such as diabetes mellitus, hypertension, chronic renal or hepatic diseases, acute medical emergency, malignancy, and debilitating disease such as tuberculosis and malnutrition.
- Patients with diagnosed heart diseases with or without treatment.
- Patients with known or preexisting ECG abnormalities due to any reason.
- Mentally ill patients.
- Unwilling patients.

Statistical Analysis

The data collected were compiled, tabulated, and analyzed in terms of descriptive statistics using SPSS version 17.0 software. Categorical data between the groups were compared using Chi-square test. $P < 0.05$ was considered as statistically significant.

RESULTS AND OBSERVATION

Of all patients, majority were females (65%), whereas males were 35% [Figure 1].

ECG changes noted in our study are tabulated in Table 1 as per category of anemia.

- In patients with severe anemia, 89.4% had tachycardia, 36.8% had ST segment depression, 31.6% had T wave inversion, and 15.7% had LVH.
- In patients with moderate anemia, 86.9% had tachycardia, 43.5% had ST segment depression, 17.4% had T wave inversion, and 34.8% had LVH.
- In patients with mild anemia, 26.3% had tachycardia, none featured with ST segment depression or T wave inversion while 7.9% of the cases presented with LVH.

DISCUSSION

Tachycardia seen in anemia may be due to physiological changes in response to the increase CO, but there are studies suggesting that stroke volume is more responsible for increase in CO, as CO depends on heart rate and stroke volume.^[14,15] In one study, it was observed that low basal parasympathetic outflow is responsible for tachycardia in anemic patients.^[16]

In the present study, 89.4% of patients with severe anemia have sinus tachycardia which matches with the findings of Shashikala *et al.*^[13] showing tachycardia in 75–100% cases. Sinus tachycardia was observed in 86.9% of patients with moderate anemia, and among mild anemic group, 26.3% of patients had sinus tachycardia.

Studies in the animals do postulate that ischemic changes in anemia are related to the metabolic alteration in myocardium rather than myocardial necrosis^[17] and may be the probable cause for the absence of typical ischemic pattern of ECG in patients with anemia.^[13]

In the present study, 36.4% of patients with severe anemia showed ST segment depression which is <50–75% as shown in the studies by Shashikala *et al.*^[13] and slightly higher than the studies by Neha *et al.*^[18] (24%) but much higher than those observed by Lee *et al.*^[19] who documented ST depression in 8.6% of cases.

In the present study, 43.5% of patients with moderate anemia had ST segment depression which is similar to the findings of Lee *et al.*^[19] (39.3%), whereas much lower values of 20% were observed by Neha *et al.*^[18]

In the present study, 31.6% of patients with severe anemia had T wave inversion which match with the results of Shashikala *et al.*^[13] showing T wave inversion in 25–50% cases and with the study of

Table 1: ECG changes as per severity of anemia

Groups	N	Tachycardia	ST depression	T wave inversion	LVH
Severe anemia	19	17 (n) 89.4%	7 (n) 36.8%	6 (n) 31.6%	3 (n) 15.7%
Moderate Anemia	23	20 (n) 86.9%	10 (n) 43.5%	4 (n) 17.4%	8 (n) 34.8%
Mild anemia	38	10 (n) 26.3%	0 (n) 0	0 (n) 0	3 (n) 7.9%
Chi-square Test		8.6639	0.081	0.705	4.796
P		0.013	0.775	0.401	0.090

N-total patient in a subgroup, n-no of patient showing positive result. ECG: electrocardiographic, LVH: Left ventricular hypertrophy

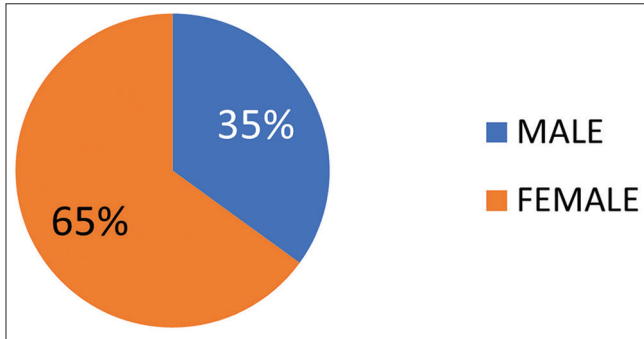


Figure 1: Pie diagram showing sex distribution

Lee et al.^[19] showing in 40% cases but differ from 4% as shown in the studies of Neha et al.^[18]

The present study showed 17.4% of patients with moderate anemia presenting with t wave inversion which is similar to the study of Neha et al.^[18] (16%) while in contrast to the study of Lee et al. (42.9%).^[19]

In the present study, 15.7% of patients with severe anemia had LVH which is similar to the observation of Lee et al. (20%)^[19] but dissimilar to the findings of Shashikala et al. (25–30%).^[13]

In the present study, 34.8% of patients with moderate anemia had LVH which is comparable to the results of Lee et al. showing in 39.3% cases.^[19]

In patients with mild anemia, 7.9% of patients had LVH in contrast to 32.6% observed by Lee et al.^[19]

The present study revealed that no patients with mild anemia associated with ST segment depression or T wave inversion as compared to 12% and 8%, respectively, as shown in the studies of Neha et al.^[18] showing complete discordance with the present series.

CONCLUSION

Anemia is a public health burden and is an important contributor of various comorbid conditions in this part of the country. Cardiovascular changes in anemia are reversible and amenable to treatment. ECG is a very important diagnostic tool for the evaluation of cardiovascular dysfunction in anemia.

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